ENABLING ACTIVITIES FOR THE IMPLEMENTATION OF KIGALI AMENDMENT IN BANGLADESH

Ozone Cell, Department of Environment
Ministry of Environment Forest and Climate Change

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TABLE OF CONTENTS

SECTION B: EVALUATION OF DATA REPORTING SYSTEM

SECTION C: NEEDS ASSESSMENT FOR REFRIGERATION AND AIR–CONDITIONING SERVICING SECTOR IN BANGLADESH

SECTION D: LEGISLATION AND POLICY FRAMEWORK FOR HFC MANAGEMENT

SECTION E: NATIONAL STRATEGY AND COUNTRY ASSESSMENT FOR THE IMPLEMENTATION OF KIGALI

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

AC	Air-conditioning
AirC	Air Cooled
ANSI	American National Standards Institute
ASHRAE	American Society for Heating Refrigeration and Air-conditioning Engineers
ASVs	Abroad Shipping Vessels
BAU	Business-as-usual
BCFC-12B_1	Halon 1211($CBrClF_2$)
BMET	Bureau Of Manpower, Employer & Training
BRAMA	Bangladesh Refrigeration and Air-conditioning Merchant Association
BSTI	Bangladesh Standard and Testing Institute
BSTI	Bangladesh Institute of Standard and Testing
BTEB	Bangladesh Technical Education Board
CCAC	Climate and Clean Air Coalition to Reduce Short-lived Climate Pollutants
CCl_4	Carbon Tetrachloride
CEN	The European Committee for Standardization
CENELEC	The European Committee for Electrotechnical Standardization
CFC	Chlorofluorocarbon
CFC-11	Trichlorofluoromethane (CCl_3F)
CFC-12	Dichlorotrifluoromethane (CCl_2F_2)
COP	Coefficient of Performance
COPD	Chronic Obstructive Pulmonary Disease
CP	Country Programme
CTC	Carbon tetrachlorided ( )
DME	Dimethyl Ether
DOE	Department of Environment
DPI	Dry Powder Inhaler
DTE	Department of Technical Education
DUET	Dhaka University of Engineering and Technology
ECA	Environment Conservation Act
EEC	Energy Efficiency and Conservation
EN	European Standards
Ex.Com	Executive Committee of the Multilateral Fund
FC-14	Carbon tetrafluoride (CF_4)
FY	Fiscal Year
GDP	Gross Domestic Products
GHG	Green House Gas
GoB	Government of Bangladesh
GWP	Global Warming Potential
HBFC	Hydrobromofluorocarbon
HC	Hydrocarbon
HC blowing agent	pentane, cyclopentane, butane
HC-290	Propane (C_3H_8)
HC-600	Butane (C_4H_{10})

HC-600a	Iso-butane ($CH(CH_3)2CH_3$
HC-blend	Hydrocarbon blend [50% HC-600a & 50% HC-290]
HCFC	Hydro-chlorofluorocarbon
HCFC -124	1,chloro 1,2, 2, 2, tetrafluoro ethane ($CHClFCF_3$)
HCFC- 142b	2 chloro 2, 2 difluoro ethane (CH_3CClF_2)
HCFC-123	1,1 dichloro 2, 2, 2 trifluoro ethane ($CHC_2l_2F_3$)
HCFC-141b	1, 1, dichloro 1 fluoro ethane (CCl_2FCH_3)
HCFC-22	Difluoro chloromethane ($CHClF_2$)
HFA	Hydrofluoroalkane
HFC	Hydrofluorocarbon
HFC-125	Pentafluoroethane (CHF_2CF_3)
HFC-23	Trifluoromethane [CHF_3]
HFO	Hydrofluoroolefin
HPMP	Hydro chlorofluorocarbon Phase out Management Plan
HS	Harmonized System
HS Code	Harmonized System of Coding
HSC	Higher Secondary School Certificate
HVACR	Heating, Ventilation, Air-conditioning and Refrigeration
IEC	The International Electrotechnical Commission
IFVs	Inland Fishing Vessels
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IS	Institutional Strengthening
ISO	International Organization for Standardization
ISVs	Inland Shipping Vessels
KA	Kigali Amendment
KII	Key Informant Interview
KW	Kilowatt
LPG	Low Pressure Gas
MAC	Mobile Air-conditioning
MAWTS	Mirpur Agricultural Workshop and Training School
MBr	Methyl Bromide
MCF	Methyl Chloroform
MDI	Metered Dose Inhaler
MEWOE	Ministry of Expatriates' Welfare and Overseas Employment
MFVs	Marine Fishing Vessels
MLF	Multilateral Fund
MLF	Montreal Protocol Multilateral Fund
MOC	Ministry of Commerce
MOE	Ministry of Education
MOEFCC	Ministry of Environment, Forest and Climate Change
MOFA	Ministry of Foreign Affairs
MOP	Meeting of the Parties
MP	Montreal Protocol
MPG	Montreal Protocol Guideline
MPO	Monthly Payment Order

MSVs	Marine Shipping Vessels
MT	Metric Tones
MW	Mega Watt
NBR	National Board of Revenue
NDC	Nationally Determined Contribution
NGO	Non-government Organization
NOPP	National ODS Phase-out Plan
NOU	National Ozone Unit
NSDC	National Skills Development Council
NSDP	National Skills Development Policy
NSS	National Skill Standards
NTCODS	National Technical Committee on Ozone Depleting Substances
NTVQF	National Training and Vocational Qualifications Framework
ODP	Ozone Depletion Potential
ODS	Ozone Depleting Substances
PPP	Public Private Partnership
R- 1234ze	1, 2, 2, 2 tetra fluoro ethylene ($CHF=CHCF_3$)
R- 1270	Propylene (C_3H_6)
R- 134a	1,1,1,2-Tetra fluoroethane (CH_2CF_4)
R- 32	Difluoromethane (Methylene fluoride) (CH_2F_2)
R-143a	1,1,1-trifluoroethane (CH_3CF_3)
R-170	Ethane (C_2H_8)
R-404A	Blend [44% R-125; 52% R-143; 4% R-134a]
R-406A	Blend [55% R-22; 4% HC-600A; 41% R-142b]
R-407A	Blend [55% R-22; 4% HC-600A; 41% R-142b]
R-407C	Blend [10% R-32; 70% R-125; 20% R-134a]
R-410A	Blend [23% R-32; 25% R-125; 52% R-134a]
R-410A	Blend [50% R-32; 50% R-125]
R-611	Methyl formate ($HCOOCH_3$)
R-702	Normal hydrogen (H_2)
R-704	Helium (He)
R-717	Ammonia (NH_3)
R-718	Water (H_2O)
R-729	Air [78% N_2, 21% O_2, 1% Air, +]
R-764	Suphur dioxide (SO_2)
R-774	Carbon dioxide (CO_2)
RAC	Refrigeration and Air-conditioning
RMP	Refrigerant Management Plan
RR	Refrigerator Retrofit
SDG	Sustainable Development Goals
SLCP	Short-lived Climate Pollutants
SRS	Simple Random Sampling
SSC	Secondary School Certificate
TOR	Terms of Reference
ToT	Training of Trainers
TPMP	Terminal Phase-out Management Plan

TSC	Technical Secondary School
TTC	Technical Training Centre
TVET	Technical and Vocational Education and Training
UAC	Unitary Air-conditioner
UCEP	Underprivileged Children's Educational Programmes
UL	Underwriters Laboratories
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UV Ray	Ultra Violet Ray
VAT	Value Added Tax
VOCP	Volatile Organic Compounds Control
VRF	Variable Refrigerant Flow System
VTI	Vocational Training Institutions
WC	Water cooled
WCO	World Customs Organization
XPS	Extruded Polystyrene

SECTION A

ODS AND ODS ALTERNATIVES SURVEY

SUMMARY

ODS AND ODS ALTERNATIVES SURVEY

Montreal Protocol has come into light in 1987 and it is ratified by 197 countries. Bangladesh has ratified the Montreal Protocol and subsequently ratified all its amendments such as Vienna Convention in 1990, London Amendment in 1994, Copenhagen Amendment in 2000, Montreal Amendment in 2001, and Beijing Amendment in 2010 and the Kigali Amendment is signed in 2016 and the ratification is under process. Bangladesh approved its country program on Ozone Depleting Substances (ODS) phase-out in 1994. In connection with the phase out schedule from the beginning, Bangladesh phased out Halon from Service & Civil Defense in 1995, Methyl bromide (MB) from Agriculture in 1996, Methyl chloroform (MCL) from Agriculture in 2001, Chlorofluorocarbon (CFC) from Aerosol in 2003 and CFC from RAC in 2010, Carbon tetrachloride (CTC) from Solvent in 2010 and HCFC-141b from Foam in 2013.

Bangladesh already implemented HCFC phase out Management Plan (HPMP) stage I in March 2019 as per schedule of Montreal Protocol. In 2019, Bangladesh also prepared project document for HPMP Stage II and submitted to the ministry for final evaluation. It is expected that this project will be stated from March 2020 and continue up to 2024.

Rules of ODS promulgated in 2004 and was amended in September 2014 by the Government of Bangladesh. As a control substance, a license is required for import and export of HCFCs. There is an annual quota fixed for HCFC consumption specified in the amended rules. Bangladesh has an operational licensing and quota system for import and export of Ozone Depleting Substances since October 2005.

In this survey, both quantitative (top-down) and qualitative (bottom-up) data of ODS and ODS alternatives were collected through relevant questionnaires from end-users, associations, importers, various Government and non-Government agencies including National Ozone Unit (NOU), Department of Environment, National Board of Revenue (NBR) etc. Collected data were assessed and cross checked for validation. Data from importers were cross checked with NBR data for accuracy. Field data and import data were cross examined to ensure the quality of data. A double data entry method is employed for the purpose of quality assurance. Collected ODS data during 2014 to 2019 are shown below:

Consumption of ODSs during 2014 to 2019 (MT)

Name of ODS	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
R-22	1,020.00	1148.15	1141.81	1132.88	852.90	808.123
R-123	3.00	7.00	11.00	7.00	3.01	2.500
R-406a	25.75	15.64	15.64	15.64	7.75	23.86
Total	1048.75	1170.79	1232.63	1155.52	863.66	834.483
Total ODP (Tons)	**56.626**	**64.18**	**63.91**	**63.34**	**47.41**	**45.822**

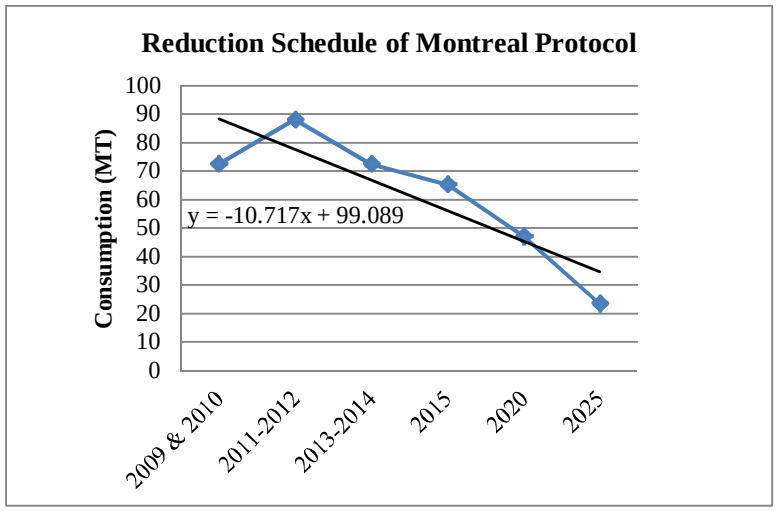
**Mixed polyol containing R-141b not considered as consumption of the country after 2013 as per Montreal Protocol*.

Bangladesh is already implemented a project to convert HCFC-141b to Cyclopentane and phased out 20.20 Ozone Depleting Potential (ODP) tons of HCFC 141b. The total established baseline consumption of HCFC-141b (pure) was 21.23 ODP tons, out of which 20.20 ODP tons of consumption was by Walton Hi-Tech Industries Limited. As per Montreal Protocol Schedule, the baseline consumption of ODS in Bangladesh was 72.6 MT on an average of 2009 and 2010, no control in consumption during 2011 to 2012, and freeze in 2013 to 2014, 10% reduction in the year 2015, 30% in 2020 and 67.5% reduction in 2025. Bangladesh agreed to follow the Montreal Protocol schedule and is committed to achieve 67.5% reduction target of the baseline HCFCs consumption by 2025. Montreal Protocol Schedule of reduction of 67.5% ODS is shown below:

Montreal Protocol baseline, freeze, 10% reduction, 35% reduction and 67.5% reduction schedule

ODS	Baseline data on an average of	No control in	Freeze In	10% reduction	35% reduction	67.5% reduction
	2009 & 2010	2011-2012	2013-2014	2015	2020	2025
HCFCs	72.60	88.14	72.60	65.34	47.19	23.60

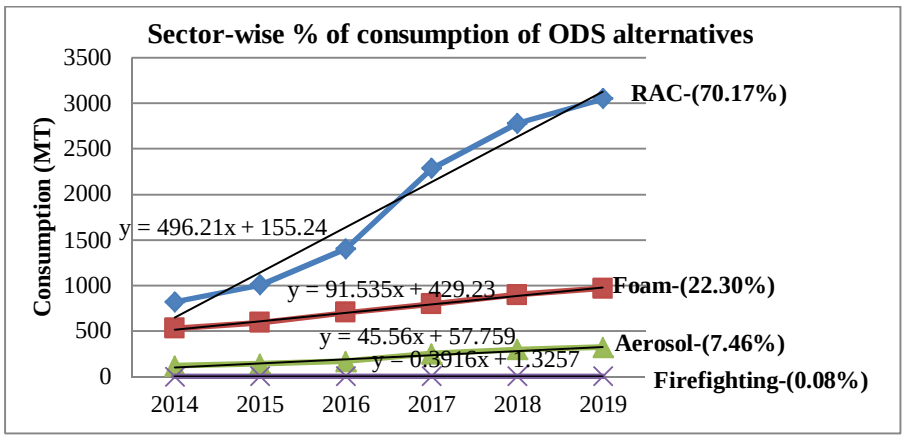
The graphical representation of Montreal Protocol Phase-out schedule is shown below:



Sector-wise totals consumption of ODS alternatives are shown below:

	2014	2015	2016	2017	2018	2019	%
RAC	820.62	1006.61	1403.65	2286.23	2,782.86	3,051.92	70.17%
Foam	530	595	705.5	797.89	899.94	969.3	22.29%
Aerosol	117.7	140.09	169.16	252.58	299.48	324.3	7.46%
Firefighting	1.20	2.538	2.80	2.96	3.12	3.56	0.08%

Survey indicated that graphically the growth of ODS alternatives In RAC sector about 70.17%, Foam sector 22.29%, Aerosol sector 7.46% and 0.08% in Fire extinguisher sector in the Year 2019.



Based on the CAGR values of Fresh Survey data during 2014-2019 the next 5 years consumption data will be calculated which are shown below:

Next 5 year from 2020 to 2024 consumption (MT)

	2019	CAGR %	2020	2021	2022	2023	2024
HFC-134a	1723.02	21.95%	2,101.22	2,562.43	3,124.88	3,810.79	4,647.26
HFC -410A	822.48	100.94	1,652.71	3,321.01	6,673.34	6,736.07	13,535.46
HFC -404A	27.18	37.93%	33.86	42.17	52.52	72.44	99.92
HFC -407C	21.26	24.55%	29.32	40.44	55.78	69.47	86.53
HFC-32	11.41	55.97%	17.80	27.76	43.29	67.52	105.31
HFC-227ea	3.56	24.30%	4.42	5.50	6.83	8.49	10.55

Prediction for the Projection of HFC consumption for the next 05 years:

The estimation of HFC consumption during 2020 to 2024 will be in a business-as-usual (BAU) scenario. The projection was calculated assuming the historical growth rate of R-134a was (22%). In according with historical data the products will grow at differentiated rates following in magnitude the same historical order (R-410A>R-134a>R-404A> R-407C). In Air-conditioning systems main used R-410A showed a compounded growth rate of 100.94% and followed by R-32 (55.97%), R-227ea (24.30%). In RAC sector utilized R-134a (22%), R-404A (24.55%) and R-407C (37.93%). (i) The RAC sector grew with an average compounded growth of around 48%. (ii) 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 service sector consumption. The consumption in service sector is anticipated to maintain a steady growth. (iii) Accelerated phase-out schedule of HCFCs in foam sector and the foam industries may switch over to HFCs and other HC based alternatives. (iv) In the Aerosol sector, it is experiencing a steady increasing growth in terms of production and exports of MDI. This growth rate would increase in future. (v) In the firefighting sector growth of HFC-227ea likely to increase. (vi) All these factors will have a cumulative affect on the rise of import and consumption of HFCs. Considering all the above, more than 3000MT yearly likely to increase of HFCs consumption is projected.

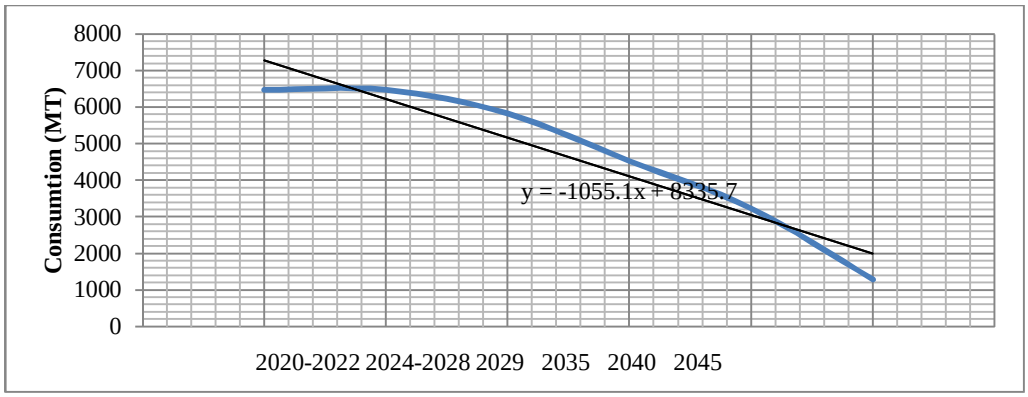
As per the Schedule of Kigali Amendment, Group 1, Article 5 Parties, baseline consumption, freeze and % of reduction is forecasted below:

Forecast baseline consumption of HFCs, freeze and % of reduction

Substances	Current year data	CAGR (%)	Baseline average of 2020-2022	Freeze	10%	30%	50%	80%
	2019		2020-2022	2024-2028	2029	2035	2040	2045
HFC-134a	1723.023	21.95%	2596.180	2596.180	2336.562	1817.326	1298.090	519.236
R-410A	822.479	100.94	3882.358	3882.358	3494.122	2717.650	1941.179	776.472
R-404A	27.184	24.55%	42.847	42.847	38.563	29.993	21.424	8.569
R-407C	21.258	37.93%	41.850	41.850	37.665	29.295	20.925	8.370
HFC-227ea	3.560	55.97%	5.587	5.587	5.028	3.911	2.793	1.117
R-32	11.409	21.95%	29.613	29.613	26.652	20.729	14.807	5.923

As per HFCs phase-down schedule of Kigali Amendment up to 2045, the growth pattern of the graph shows a drastically decreasing trend of HFCs consumption.

Bangladesh signed the Kigali Amendment and the ratification is under process. After ratification Government will adopt policy and take regulatory measures for control use of HFCs. Making rules for HFCs as control substances, adopting licensing, quota and enforcement framework which will be the crucial for achieving HFCs phased-down schedule in time. After successful implementation of MP the significantly decrease the rate of anthropogenic global warming, over time a steady decrease in their use could decrease the danger that human activity will change the climate.



Sefety Standards: Bangladesh established the safety standards cover the areas of refrigeration, air-conditioning and heat pump (RACHP) equipment. The Bangladesh Standards and Testing Institute (BSTI) are responsible for developing standards and testing protocols for RAC systems. Currently, Bangladesh has adopted a number ISO and IEC Standards related to the safety and energy efficiency in RAC sector namely:

- BDS-ISO-817 (2018), directly adopted from ISO-817 for refrigerant safety classification.
- ISO 5149 (2014) on safety requirements for mechanical refrigerating systems.
- BDS 1849 (2012) performance standards including those for testing protocols to determine the performance of different refrigerators and BDS 1850 (2012) on Minimum Energy Efficiency rating of household refrigerator and freezers, and
- BDS 1852 (2012) on the performance of AC and BDS 1853 (2012) for their minimum energy performance standards (MEPS) requirements.
- BDS 1853 (2012) for closed control air conditioner performance & their minimum energy performance standards (MEPS) requirements.

Barriers: There are some barriers, adopting low-GWP alternatives (LGAs) technologies in the systems such as technical, supply and availability, commercial, market, information resources, regulations and standards and psychological and sociological aspects.

Overcome barriers: The majority of the barriers can be overcome by determination in implementing a number of measures relating to the areas of awareness-raising within the industry, training that is focused on low-GWP alternatives (LGAs), appropriate technical and other guidance, technical developments in the areas of system efficiency (for R744) and safety, local market development for LGAs, financial incentives to favor LGA technologies, improvements and changes to regulatory infrastructure, addressing Montreal Protocol issues and activities of environmental non-governmental organizations. Other precaution measures are better leak prevention (tightness), improving recovery and reuse practices and application of alternative refrigerants.

Concluding remarks of this survey is as due to steady economic growth in the range of around 7.5% (GDP growth) in the last decade, buying capacity of the middle income and lower middle income group had substantially increased. The purchasing capacity of RAC commodities is increased. The import and consumption of ODSs were gradually decreasing and ODS alternatives were rapidly increasing.

The RAC sector is dominated by HFCs and R-600a replacing the HCFCs. About 40% of the total demand met through R-600a and 60% through the HFCs and HFC blends mainly R-404A. For PU foam, considering the ban on import of HCFC-141b pre-blended polyol under HPMP Stage-11, is anticipated to be completely transformed to HFCs ,C-Pentane, water-based technologies. In MAC, the major share is R-134a. There is no suitable freely available alternative in this sector. It is expected to stay with R-134a in the next decade. In Aerosol for the preparation of MDI is met the increasing need by R-134a as propellant. HC-based solvents used alternative to ODS, such as naphtha, toluene, benzene, while petrol etc. In firefighting system, Bangladesh has introduced several alternatives such as water based system, foam, CO_2, HFC-227ea and dry powder to Halon based suppression materials.

Recommendations: Based on the above, the following actions could be taken for reducing the country's dependence on high-GWP ODSs alternatives (mainly HFCs) and to facilitate a fast adoption of low-GWP ODS alternatives:

Prepare a national strategy for the phase-down of HFCs that include the actions to undertake, the time spam and the associated cost for the complete phase-out. Certification of service technicians may be established during implementation of HPMP Stage-II. A course curriculum related to the ozone issue may be introduced for regular students of technical institutes. Safety measures should be ensured for servicing workshop and production level during use of flammable refrigerants and safety monitoring and audition system should be introduced. Create awareness programs on new alternative technologies which are safe and energy efficient. Awareness rising will be required for end users and also for general public. Recovery and recycling project could be planned for ship breaking industries & RAC Servicing. A reclaiming project can be undertaken for recovered contaminated refrigerants.

1. INTRODUCTION

1.1 General Information

Montreal Protocol has come into light in 1987 and the protocol was ratified by 197 countries. Bangladesh ratified the Montreal protocol on 2 August 1990 and approved the country program on ODS in 1994 and all its amendments viz., London, Copenhagen, Montreal and Beijing amendment in 1994, 2000, 2001 and 2010 respectively except the Kigali Amendment. To fulfill the objectives of the protocol, each and every ratified country tries to protect ozone layer by phasing out the ozone depleting substances as per phase-out schedule. In connection with the phase-out schedule from the beginning, Bangladesh phased-out Halons, CFCs, CTC, MCF and MBr from all sectors. The country has finished implementation of HPMP Stage-1 to reach 30% reduction target in 2018. Subsequent control steps are 35% reduction by 2020, 67.5% by 2025, 97.5% by 2030 and complete phase-out from 1 January 2040.

Hydro fluorocarbons (HFCs) are used as alternative to CFCs and HCFCs. HFCs are not ozone depleting substances; however these are greenhouse gases, with a high GWP, comparable to that of CFCs and HCFCs.

The Parties to the Montreal Protocol (MP) reached an agreement at their 28th Meeting on 15 October 2016 in Kigali, Rwanda to reduce the manufacture and use of Hydro-fluorocarbons (HFCs) by 80% and 85% from their respective baselines in 2045 and 2047 respectively. The government of Bangladesh is in group 1 of article 5 countries and has to phase-down HFCs by 2045. In Kigali conference, Bangladesh agreed to phase-down HFC starting from 2024.

In Bangladesh, HFCs have been largely used as alternatives to ODS in both manufacturing and servicing sectors, and these are also imported in finished products. HFCs are expected to be found primarily in the domestic and commercial refrigeration sector, commercial/ industrial air-conditioning, and mobile air-conditioning and transport sectors. HFCs have no ozone layer depleting potential but have very high global warming potential (GWP), ranging from about 53 to 14,800.

In case of HCFCs alternatives natural refrigerant may also be considered. Ammonia is often used in the food industry and large cool storages due to its high energy efficiency. Carbon dioxide (CO_2) is now commonly being used in what are referred to as cascade or secondary loop systems. In these systems CO_2 can be used as the primary or secondary refrigerant. Hydrocarbon refrigerant has been used widely in petrochemical industries, particularly very large refrigeration systems. But in case of Hydro fluorocarbons (HFCs), which are classified as synthetic greenhouse gases, these gases generally, have a high GWP, some in the range of 140 to 3260 times that of carbon dioxide. The R-134a is the most common refrigerant used in Bangladesh and it has a GWP of 1430.

HFCs are used in Bangladesh both in manufacturing and in servicing; these are also imported in finished products. HFCs are expected to be found primarily in the domestic and commercial refrigeration sector, commercial/industrial air-conditioning, and mobile air-conditioning and transport sector. Currently HFCs are not controlled and bulk import is not tracked.

Bangladesh is concerned about its technology choices and technology future in the context of MP implementation. It would like to better understand the current and future role of HFCs as well as other HCFC alternatives in its economy, it will address HCFC phase-down and the technology choices for the sectors to meet its Stage II compliance targets (2020-2024), which might have to address HCFC phase-out in: (1) AC manufacturing, (2) commercial, (3) industrial refrigeration and (4) servicing where flammable HCFC/HFC alternatives could be possibly introduced, presenting regulatory and safety risks. Because HFC use is not regulated and is expected to grow in conjunction with HCFC phase-out and due to normal economic development, an inventory of current HFC use will be of little purpose unless it is part of a national level approach to document and monitor HFC flows and use. In addition, some of the sub-sectors that will be surveyed and analyzed for HCFC use under stage II HPMP preparation are the same as those using HFCs. An AC enterprise for example may introduce equipment with both chemicals and some types of foam applications already utilizing HFCs or HFC blends.

1.2 Existing policy regulation frameworks and controls of ODS in Bangladesh

Ozone Depleting Substances (ODSs) (Control) Rules was set up in 2004 and was amended in September 2014. As a control substance a license is required for import and export of ODSs. There is an annual quota fixed for ODS consumption specified in the rules. The Government of Bangladesh has ratified all the amendments to the Montreal Protocol ODS consumption and distribution.

Bangladesh has an operational licensing and quota system for import and export of ozone depleting substances since 2 October 2005 and these systems are also applicable to ODSs. It uses the issuance of licenses as a way to monitor ODSs imports. This will continue until the point in time when the country fixes the ODS quota levels after the baseline/national consumption target is established.

HFCs are yet-not a controlled substance in Bangladesh and yet there are no restriction on import, export, production and uses. Government of Bangladesh will ratify the Kigali Amendment to the Montreal Protocol first and then prepare strategy for the preparation of Rules and Regulation to control HFCs.

For other alternatives, there is no Rules and Regulation for use. During the preparation of HPMP Stage II, NOU will take opinon or advice from stakeholders regarding the preparation of Rules and Regulaton for natural refrigerants.

1.3. Objectives of Survey

The objectives:

- To better understand the historical and predicted consumption trend in Bangladesh including low, medium and high Global Warming Potential (GWP) refrigerants and their distribution by sector and subsector;
- To provide the country with a comprehensive overview of their national market where HFCs have been and will be used, while taking into consideration other existing technologies;
- To collect and analyse data for establishing baseline in the country and forecast growth for HFC phase-down strategy; and
- To develop methodologies for collecting, assessing and analyzing the use of ODS nd ODS alternatives and to prepare report and submit to relevant agencies.

1.4. Scope of survey

The scope of works includes

- Establish current consumption of HFCs by substnce wise, year wise, sector and subsector wise;
- Establish estimated growth patterns in HFC consumption by substace and sector-subsector wise;
- Review and forecast growth of these substance from fresh survey data;
- Estimate consumption for the next 5 years based on the assessmet of sector level consumption and growth, ODS phase-out in RAC and Foam application;
- HFCs consumption for the last 5 years and forecast the future consumption up to 2045;
- National regulation and domestic standards related to HFCs use and Identify probable barriers and how these could be addressed; and
- Institutional, regulatory and policy framework controlling ODS, GHGs and othe policy framework.

1.4.1. Sector and sub-sector population

(a) Analysis of the scope of work reveals that the survey had to cover all sector and sub-sectors using ODS alternatives. An exercise has been done, based on the review of potential information available at ozone unit of Department of Environment, to categorically identify all the sectors and sub-sectors with estimated approximate population.

1.4.2 Strategy for estimation of sample size of the population

The representative sample size of the population in various applications is shown in **Table 1.** The survey has to cover the entire sector and sub-sectors using ODS alternatives. In Bangladesh there is a huge population in service workshop sector. It was not possible to cover each unit in the survey. Statistical

method was employed to determine the sample size and their distribution. Data collection from the chiller, air conditioning and refrigeration sectors was also very complex as they had sub-sectors varying in numbers. Attempts have been made to cover each sub-sector with proportional representation under these broad categories and then extrapolations were made.

For all other sectors such as chemical importers, manufacturer/enterprises, equipment importers, fire-fighting, It can be seen that to satisfy the required level of precision, the sample size increases at a diminishing rate as the size of the population increases. Although the statistical agency would require a sample size of 44 completed questionnaires for a population of 50, it does not need to double the sample size to 88 for a survey population of twice the size. The required sample size quickly approaches n=400 for survey population of N= 5,000 and more. Therefore, for the simple random sampling (SRS), 400 completed questionnaires would be enough to satisfy the given precision requirements for populations larger than 5,000, when the true population proportion is p=0.5. Population of the sectors was identified and sample size of the each sector was determined according to standard statistical procedure.

Table A1: Strategy for estimated sample size

Sl	Sector	Sample Size
1	Chemical Importers	All
2	Equipment Importers	All
3	Manufacturers & essemblers/ Enterprise	All
4	RAC Assembling Industry	All
5	Chiller	400
6	Air-Conditioning	400
7	Refrigeration	400
8	Fire fighting	Secondary source
9	Ship-building	All
10	Ship-breaking	Secondary source
11	Service-workshops	400
12	Transport refrigeration	Secondary source

1.4.3 Geographical distribution of sample size in service workshops

There are 724, 6,278, 1,578, 4,011, 690, 1,835, 2,110, 996 service workshops in Mymensingh, Dhaka, Sylhet, Chittagong, Barisal, Khulna, Rajshahi and Rangpur division respectively in Bangladesh. Proportionally samples were collected from service workshops. Geographical distribution of sample service workshops is provided in **Figure 1**.

Figure 1: Geographical distribution of sample size in service workshops

1.5. Methodology and Approach

This includes the three main activities undertaken such as (1) methodology for data collection, (2) data assessment/validation and (3) data compilation and analysis; and methodology for questionnaire development, special investigation and stakeholder discussion, including the institutions involved and the sources from which data were collected.

1.5.1 Main activities undertaken

Activity 1: Data collection

(A) The methodologies for data collection was designed to allow for a top-down and bottom-up comparison of data that was collected from various sources in order to estimate the current use of ODS alternatives by substance and sector. As the first step, this was complied through a desk study using information available from institutional sources *inter alias*, previous ODS survey reports, 2016 & 2017, Bangladesh HCFCs & HFCs Survey Report of 2011 & 2014, ODS related GoB Gazettes, Montreal Protocol amendment reports and other important documents collected from NOU, data from importers, National Board of Revenue (NBR), Distributions, Dealers, Bangladesh Refrigeration and Air-Conditioning Merchants Association (BRAMA), Bangladesh Cold Storage Association, Bangladesh Marine Fisheries Association, Bangladesh Road Transport Authority, Bangladesh Frozen Foods Exporters Association, Fire Service and Civil Defense, Bangladesh Railways, Banks, Hospitals, hotels, Office building etc., which constituted the top-down (qualitative/ secondary) data sources.

(B) Quantitative/ primary field survey data were collected through questionnaire from servicing refrigeration and air-conditioning systems, and other end-users that provided information from bottom-up sources; Various types of questionnaires have been developed for collecting data from different sectors and sub-sectors, such as ODS alternatives in importers, ODS alternatives based equipment, industry and trade associations, manufacturers of refrigeration and air-conditioning equipment, refrigeration and mobile and stationary air-conditioning servicing companies; and others end-users.

(C) Identified existing and planned policy, legislative and regulatory framework supporting the use of ODS alternatives, including those related to energy efficiency of ODS and ODS alternative-based refrigeration and air-conditioning equipment.

(D) Estimated current use of ODS alternatives by substance through chemical and equipment suppliers/ importers, use of ODS alternatives by sector and sub-sector especially in refrigeration and air-conditioning servicing sectors, and other relevant energy information.

Activity 2: Data assessment/validation

Selected sites were visited and interviews were conducted to collect additional data and corroborate survey data, as well as extrapolated data from statistical sources, in each sector and sub-sector with ODS and ODS alternatives use. ODSs imported data were cross checked with data available from National Ozone Unit. Field data and import data were cross examined to ensure the quality of data. Collected ODSs consumption data through primary survey were cross checked with the import data. This data had been cross confirmed from quantitative estimates of consumption by different end-user category by substances. Then data were coded for computer input. Excel software was used for data entry and analysis. A double data entry method was employed for the purpose of quality assurance.

Activity 3: Data compilation and analysis

Microsoft Excel software was used for data analysis. Data and information from various sources were compiled for analysis and reporting. Based on the data collected through the questionnaires and field surveys, the following assessment was undertaken: (i) Growth patterns in consumption of ODSs alternatives by substance: (a) Estimate growth patterns in HFCs consumption by substances, sector and subsector; (b) Forecast growth of these substances from fresh survey data; (c) HFCs consumption for the last 5 years (2014-2019) and forecast the future consumption up to 2045 and (d) Establish consumption for the next 5 years (2020-2024) based on the assessment of sector/application level consumption and growth,

in the context of ODSs phase-out in RAC and foam application. (ii) National regulations and standards related to the HFCs use were reviewed and barriers were identified that limit the introduction of low-GWP technologies and how these were then addressed. (iii) National regulations and standards related to the HFCs uses, and other available low-GWP alternatives, identify barriers that limit the introduction of low-GWP technologies and how these could be addressed (e.g., safety concerns related to flammable alternatives**)** and (iv) Institutional, regulatory and policy framework controlling ODS, GHGs and other policy network.

1.5.2 Methodology for questionnaire development

A set of questionnaire for each sector was developed to cover various sectoral uses of ODS alternative pertaining to availability and use of alternatives. Field testing of the questionnaires was done in limited scale before applying for full scale data collection. Sector and subsector-wise various types of questionnaires were developed for collecting data which are as follows**:** (i) AC manufacturing/ assembling industries, (ii) Refrigeration manufacturing/ assembling industries, (iii) Air-conditioning sub-sector (iv) Refrigeration and air-conditioning service sector, (v) Aerosol sector, (vi) Solvent sector, (vii) ODS alternatives chemicals Importers, (viii) ODS alternative in Foam sector, (ix) Chiller sector and (x) Supermarkets, Hospitals, Hotels, Railway etc.

The methodologies for data collection were designed to allow for a top-down and bottom-up comparison of data were collected from various sources in order to estimate the current use of ODS alternatives by substance, subsector and sector. Quantitative/ primary field survey data were collected through questionnaire from servicing refrigeration and air-conditioning systems, and other end-users that provided information from bottom-up sources. Collected data were cross-checked with the import data.

1.5.3 Special investigation

Special investigations were carried out in a few sectors. Selected sites were visited and interviews were conducted to collect additional data and corroborate survey data, as well as extrapolated data from statistical sources/ market study, in each sector and subsectors with the use of ODS alternatives.

Special investigations were carried out in a few sectors. These include: Imported ODS and ODS alternatives and blends; and manufacturing/ assembling sectors for obtaining baseline data/information.

1.5.4 Facilitation of the data sharing workshop with relevant stakeholders and implementation modalities

Discussion meetings with stakeholders have been done. Stakeholders were covering all the sectors and sub-sectors users and manufacturers, distributors and dealers of ODS and ODS alternatives, government agencies etc. Other stakeholders include: Foam manufacturers, RAC assembler/manufacturers, Chiller assemblers/ manufacturers, Cold storage association, BRAMA, Fire fighting agencies, MDI Sector, Ship breaking and ship building associations and BSTI.

2. DATA COLLECTION ON THE USE OF ODS AND ODS ALTERNATIVES

In this survey both primary and secondary data were collected. Primary/qualitative data were collected in the field survey through specific questionnaire in specific sector. Secondary/quantitative data were also collected from various relevant organizations and agencies throughout the country. Consumption data were cross examined with import data obtained from National Board of Revenue. Collected data were scrutinized to maintain quality and accuracy. Imported data were used in refrigeration and air-conditioning equipment manufacturing, foam, aerosol, solvent, fire-fighting and servicing sectors. Country data through survey were collected on the use of ODS alternatives.

2.1 Applications of ODS and ODS alternatives in different sectors and sub-sectors

In Bangladesh, the ODS alternatives, such as R-134a and blends, such as R-404A, R-410A, R-407C and R-32 and hydrocarbons blends (R-600a & R-290) and natural refrigerants (R-717, R-718 & R-744) were widely used in different sectors and sub-sectors and especially in refrigeration and air-conditioning systems. Besides, the ODS alternatives HFC-227ea were used in fire protection systems.

2.2 Production, Export and Import of ODSs and ODS alternatives during 2014-2019

Production: There was no production of ODS and ODS alternatives except ammonia (R-717).

Export: Bangladesh did not export any virgin HFCs. There are a few refrigerator manufacturing companies who are trying to expoet refrigerators in the foreign market using HC-600a in the system. Only Walton Hi-tech Industries Ltd. has so far been successful. The volume of export of this company in 2019 was around half a millions units.

Imports: Experience from the previous survey conducted by DoE revealed that the collection of import data on ODSs from importers is reliable and accurate as they maintain good record keeping. Data collected from (NBR) were cross checked with the data collected from importers as customs department records this information under HS Codes. It was observed that record keeping system of customs is yet to be integrated. The main ODS that were consumed in the country were R-22, R-123 and R-142b. These were imported primarily from China, UAE, India, Singapore and Thailand. ODSs alternatives mainly HFCs were being imported primarily from USA, Japan, China, Singapore, Thailand etc. The main imported and consumed ODSs during 2014-2019 were HCFC-22, HCFC-123 and blend R-406a etc. is shown in **Table 2**.

Table A2: Consumption of imported ODSs during 2014 to 2019 (MT)

Name of ODS	2014 (MT)	2015 (MT)	2016 (MT)	2017 (MT)	2018 (MT)	2019 (MT)
R-22	1,020.00	1148.15	1141.81	1132.88	**852.90**	808.123
R-123	3.00	7.00	11.00	7.00	3.01	2.500
R-406a	25.75	15.64	15.64	15.64	7.75	23.86
Total	**1048.75**	**1170.79**	**1232.63**	**1155.52**	**863.66**	**834.483**
Total ODP (Tons)	**56.626**	**64.18**	**63.91**	**63.34**	**47.41**	**45.822**

Data source: NOU & NBR

Note: *[ODP of R-22 = 0.055, R-142b = 0.065, R-123 = 0.020; the composition of R-406a consists of 55% R-22, 41% R142b and 4%R-600a]* *Mixed polyol containing R-141b not considered as consumption after 2013 as per MP.

The main ODS alternatives consumed in Bangladesh during 2014-2019 were HFC-134a, HFC-blends and hydrocarbon which are shown in **Table 3**.

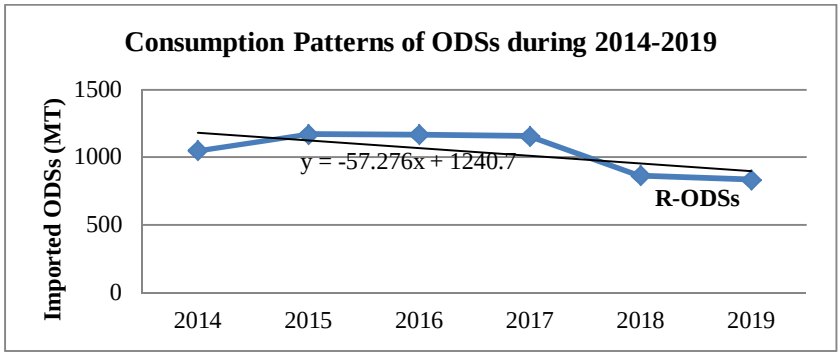
Table A3: Consumption of ODS alternatives during 2014 to 2019 (MT)

Sl. No.	Refrigerants	2014 (MT)	2015 (MT)	2016 (MT)	2017 (MT)	2018 (MT)	2019 (MT)
1	R-134a	638.8	766.5	1012.1	1497.6	1677	1755.542
2	R -32	1.5	1.9	0.8	0.0.550	1.750	2.540
3	R- 227ea	1.2	2.5	2.8	3.0	3.1	3.56
4	R-404A	14.7	16.5	16.9	12.3	12.0	27.213
5	R-410A	20.	21.3	100.6	221.3	307.1	822.542
6	R-407C	2.8	3.9	27.3	32.2	44.3	21.3523
7	HC-600a	34.6	43.8	118.8	201.8	280.3	285.23
8	HC-290		2.0	1.5	-	-	-
9	Cyclopentane	550.0	600.0	700.2	786.584	885.2	953.543

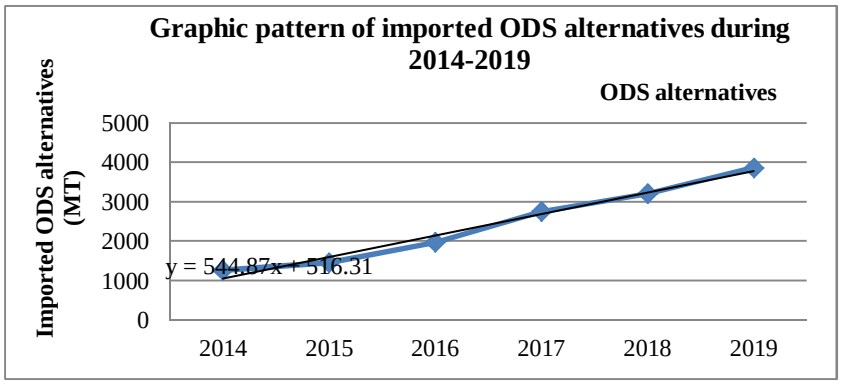
Source: NBR & Chittagong Port, 2019

Note: [*R-404A(44% HFC-125; 52% HFC-143a; 4% HFC-134) ;R-407C (25% HFC-125; 52% HFC-134a; 23% HFC-31); R-410A(50% HFC-125; 50% HFC-32); HC-600a (azaarne); HC-blend (C-30): 50% HC-600a; 50% HC-290 & HC-290 (propane); Cyclopentane: HC blowing agent]*.

2.2 Graphical representation of consumed imported of ODSs and ODS alternatives are shown as below:



2.2(a) Graphical representation of ODSs during 2014-2019 showed a gradual decreasing trend.



2.2 (b) Graphical representation of ODS alternatives during 2014-2019 was rapidly increasing.

3. CONSUMPTION OF ODS AND ODS ALTERNATIVES IN RAC SECTOR

Refrigerants: There is no "single ideal" refrigerant use in RAC sector. Refrigerant selection is a balanced result of several factors which include, suitability for the targeted use, availability, cost of the refrigerant and associated equipment and service, energy efficiency rating, safety, ease to use, and environmental issues. Due to the phase-down schedule under the Kigali Amendment, the target refrigerants for main applications will include low-GWP refrigerants such as R-717, R-744, hydrocarbons (HCs), unsaturated halo-chemicals such as hydrofluoroolefins (unsaturated HFCs sometimes referred to as HFOs) and blends of these refrigerants, some even with traditional refrigerant fluids. Many of the proposed alternatives are seen as intermediate solutions in the HFC phase-down.

3.1 Refrigeration assembling/manufacturing sector

Consumption of ODSa nd ODS alternatives in refrigeration sector was divided into two broad categories such as manufacturining and servicing. Refrigeration sector consists of domestic, commercial, industrial and transport refrigeration systems fell under manufacturing categories.

(A) Domestic refrigeration

Domestic refrigeration: This is the major component and comprises appliances that are broadly used domestically, such as refrigerators, freezers and combined refrigerator/freezer products. Small beverage dispensing machines are similar products and are commonly included in domestic refrigeration, but represent a small fraction of total units.

(B) Commercial refrigeration

Commercial refrigeration: Commercial refrigeration can be broadly classified as three different groups of systems: (a) centralized systems installed in supermarkets, (b) condensing units installed mainly in small shops and restaurants, and (c) self-contained or stand-alone units. In commercial refrigeration equipment, such as plug-in display cabinets, ice cream freezers and glass-door bottle coolers mainly used R-134a. The consumption of refrigerants in domestic and commercial refrigerators manufacturing industries during 2014-2019 is shown in **Table 4**.

Table A4: Consumption of refrigerants in domestic and commercial refrigerators manufacturing industries (MT)

Years	R-134a (MT)	HC-600a (MT)	R-404A (MT)	R-22 (MT)
2014	290.385	18.821	3.298	9.680
2015	320.850	26.082	3.809	11.178
2016	362.796	42.562	1.554	3.040
2017	359.251	60.624	0	0
2018	359.586	79.291	0	0
9019	336.197	104.976	0	0

Survey 2019

(C) Industrial refrigeration

Survey indicated that the following categories of which were expected to be using industrial refrigeration equipment: meat processing and storage, fruits and vegetables processing and storage, milk processing and storage, ice-cream manufacturing and storage, pharmaceutical including vaccination, chemicals manufacturing and storage and fish processing and storage. This survey also includes hatchery, cold storage, fish freezers etc. in industrial refrigeration systems.

(i) Chillers: A chiller is a machine that removes heat from a liquid via a vapor-compression or absorption refrigeration cycle. There are three different types of chillers: (i) air, (ii) water, and (iii) evaporative condensed chiller. There are four subcategories in each of the above categories for industrial chillers: (1) reciprocating, (2) centrifugal, (3) screw driven (4) and absorption chiller. The size, numbers, charging capacities, % of consumption in servicing sector and number of new assembled small chillers in Bangladesh were considered. The consumption of refrigerants in chillers during 2014 to 2019 is shown in the **Table 5.**

Table A5: Consumption of refrigerants in Chillers assembling industries during 2014 to 2019 (MT)

Cold storage and Fish Freezers	2014 (MT)	2015 (MT)	2016 (MT)	2017 (MT)	2018 (MT)	2019 (MT)
Manufacturing						
R-22	2.70	3.15	3.40	3.60	3.70	4.13
R-410A	0.18	0.21	0.48	0.81	1.20	1.32
R-404A	0.14	0.17	0.19	0.25	0.24	0.29
R407C	0.04	0.05	0.05	0.06	0.07	0.07
Servicing						
R-22	2.70	3.15	3.40	3.60	3.70	4.13
R-410A	0.18	0.21	0.48	0.81	1.20	1.32
R-404A	0.14	0.17	0.19	0.25	0.24	0.29
R407C	0.04	0.05	0.05	0.06	0.07	0.07

(ii) Cold Storages and Fish Freezers

In Bangladesh the majority of large industrial systems, such as cold storage, fish freezers, textiles, pharmaceutical etc. ammonia (R-717) were used as the cheaper option which was accepted as the preferred refrigerant. In future R-717 would be the best choice in industrial systems. The size, range of cold storage % fish freezers, filling capacities of refrigerants and % of consumption in servicing sector were considered. The consumption of refrigerants in cold storage and fish freezers are shown in **Table 6**.

Table A6: Consumption of refrigerants in Cold Storages and Fish Freezer during 2014 to 2019 (MT)

Cold storage and Fish Freezers	2014 (MT)	2015 (MT)	2016 (MT)	2017 (MT)	2018 (MT)	2019 (MT)
Manufacturing						
R-717	35.00	38.00	46.00	49.25	58.75	61.45
R-22	6.38	6.82	8.14	7.26	9.02	8.58
Servicing						
R-717	78.63	82.68	92.95	106.38	121.17	126.30
R-22	6.40	6.82	8.69	10.94	12.80	15.18

(D) Transport refrigeration

(i) Transport refrigeration is mainly focused on the delivery of chilled or frozen products. The refrigerant selection may be substantially different from other segments. The shipping refrigeration systems have made design changes to incorporate new refrigerants. Shipping vessels continue to operate using HCFC-22. Almost all transport refrigeration systems continue to utilize HFCs, with a prevalence of HFC-134a, R-404A and low-GWP refrigerants. Transport refrigeration systems consist of (i) ship building, (ii) abroad shipping vessels (iii) marine fishing vessels, (iv) inland fishing vessels and (v) reefer containers. Consumption in servicing sector of ship breaking and others shipping refrigeration systems were also considered. Consumption of refrigerants in shipping transport refrigerantion systems is shown in the **Table 7a-d.**

Table A7a: Consumption of refrigerants in Ship Building during 2014-2019 (MT)

(i) Ship Building	2014	2015	2016	2017	2018	2019
Manufacturing						
R-22	1.020	1.260	1.720	2.165	2.560	2.040
R-410A	0.120	0.150	0.522	0.924	1.140	1.684
R-404A	0.060	0.090	0.298	0.476	0.700	0.976

Table A7b: Consumption of refrigerants in Abroad Shipping Vessels during 2014 to 2019 (MT)

(ii) Abroad Shipping Vesels	2014	2015	2016	2017	2018	2019
Servicing						
R-22	24.700	25.600	26.600	27.500	28.500	30.400
R-134a	0.800	0.800	0.800	0.900	0.900	1.000
R-410A	0.500	0.500	0.600	0.600	0.600	0.600

Table 7c: Consumption of refrigerants in Mstomr Fishing Vessels during 2014-2019 (MT)

(iii) Marine Fishing Vessels (MFVs)	2014	2015	2016	2017	2018	2019
Manufacturing						
R-22	0.160	0.184	0.184	0.192	0.192	0.210
R-134a	0.088	0.008	0.024	0.024	0.024	0.024
R-410A	0.088	0.088	0.088	0.088	0.024	0.024
Servicing						
R-22	0.32	0.36	0.36	0.39	0.38	0.41
R-134a	0.02	0.02	0.04	0.05	0.05	0.05
R-410A	0.02	0.02	0.02	0.02	0.05	0.05

Table A7d: Consumption of refrigerants in Inland Fishing Vessels during 2014-2019 (MT)

(iv) Inland Fishing Vessels (IFVs)	2014	2015	2016	2017	2018	2019
Manufacturing						
R-134a	0.225	0.225	0.832	0.896	0.720	0.800
R-410A	0.00	0.00	0.306	0.323	0.765	0.850
Servicing						
R-134a	2.34	2.43	0.90	1.20	1.81	2.20
R-410A	0.00	0.00	0.14	0.20	0.30	0.30

Table A7e: Consumption of refrigerants in Reefer Containers during 2014-2019 (MT)

(v) Reefer Containers	2014	2015	2016	2017	2018	2019
Manufacturing						
R-134a	2.472	2.949	5.015	6.077	7.820	9.940
R-410A	0.294	0.350	0.590	0.715	0.920	1.170
R-404A	0.145	0.171	0.295	0.357	0.460	0.585
Servicing						
R-134a	4.95	5.897	9.435	11.794	14.152	16.511
R-410A	0.58	0.693	1.11	1.387	1.665	1.942
R-404A	0.29	0.346	0.555	0.69	0.832	0.971

Survey 2019

(ii) Consumption of ODS and ODS alternatives in Supermarkets, Hospitals, Hotels, Banks, Railway, Office Building, etc.

The number, size, capacities, type refrigerants, types of AC, chillers such as Scroll, rotary, packaged AC, screw, reciprocal, centrifugal etc of Surpermarkets, Hospital, Hotels, Banks, Railway and Office Building were considered. Consumption of refrigerants in srvicing sector of Supermarkets, Hospitals, Hotels Banks, Railway and Office Building are shown in the **8a-b.**

Table A8a: Consumption of HFC-134a & R-22 in servicing Supermarkets, Hotels and Hospitals during 2014-2019 (MT)

Name	Refrigerants	2014	2015	2016	2017	2018	2019
Supermarkets	R-134a	4.215	2.805	4.560	3.830	3.970	5.280
Hotels	R-134a	10.245	6.613	5.848	5.979	9.672	8.477
Hospitals	R-134a	3.580	4.105	5.100	4.568	5.188	5.434
	Total	**18.040**	**13.523**	**15.508**	**14.377**	**18.830**	**19.191**
Supermarkets	R-22	7.140	6.119	6.253	6.157	3.917	5.977
Hotels	R-22	7.606	4.796	4.578	4.277	3.981	4.351
Hospitals	R-22	19.672	17.146	18.656	20.320	20.252	14.900
	Total	**34.418**	**28.061**	**29.487**	**30.754**	**28.150**	**25.228**

Table A8b: Consumption of R-134a & R-22 in servicing Railway, Banks an Office buildings during 2014-2019 (MT)

Name	Refrigerants	2014	2015	2016	2017	2018	2019
Railway	R-134a	0.500	0.880	0.890	0.710	1.470	1.450
Banks	R-134a	5.123	5.421	6.321	6.841	5.987	6.345
Office buildings	R-134a	3.357	3.647	3.861	4.015	4.285	3.982
	Total	**8.98**	**9.948**	**11.072**	**11.566**	**11.742**	**11.777**
Railway	R-22	0.320	0.458	0.514	0.497	0. 751	0.924
Banks	R-22	8.320	9.325	7.321	10.741	9.987	10.345
Office buildings	R-22	6.552	6.617	6.761	7.915	8.285	7.982
	Total	**15.192**	**16.4**	**14.596**	**19.153**	**18.272**	**19.251**

3.2 Consumption of ODS and ODS alternatives in air-conditioning manufacturing/assembling

This sector refers to air-conditioning systems that cool and/or heat enclosed spaces ranging from single rooms to large commercial buildings, and vehicles. These include small self-contained air-conditioning, split air-conditioning, ducted and packed rooftops, water chillers, and heat pumps for heating and mobile air-conditioning systems. Air-conditioning system consists of residential, commercial and mobile air conditioning (MAC) equipment was being assembled in Bangladesh.

(A-B) Residential and commercial air conditioning

Consumption of the total number of refrigerants in residential and commercial AC assembling during 2014-2019 is shown in the **Table 9a**.

Table A9a: Consumption of refrigerants in AC during 2014 to 2019

Years	R-22 (MT)	R-410A (MT)	R-134a (MT)	R-407C (MT)
2014	381.187	9.628	11.033	1.003
2015	399.711	10.097	11.571	1.051
2016	474.524	63.270	-	-
2017	521.452	208.575	-	-
2018	510.887	330.113	-	-
2019	505.440	404.316	-	-

(C) Mobile air conditioning (MAC)

A portable air conditioner is an air-conditioner that is mobile. Unlike window, through-the-wall, or central air conditioning units, portable units do not require permanent installation. The overwhelming majority of the newly sold small and large passenger cars, buses and vans worldwide were equipped with air conditioning systems, which used HFC-134a as refrigerant. HFC-134a was largely adopted world-wide in MAC and some R-407C use in buses. The size, numbers, capacities and types of refrigerants of vehiclses and inland fishing vessels were considered.

(i) Vehicles and inland fishing vessels (IFVs)

As per the information of the transport authority, it was indicated that except a few large vehicles, air conditioning systems in all vehicles used HFC-134a and about 2% large vehicals used R-22, the consumption of refrigerants in vehicles is shown in **Table 9b**.

Table A9b: Consumption of refrigerants in Vehicles and IFVs during 2014-2019 (MT)

Name and refrigerants	2014	2015	2016	2017	2018	2019
Vehicles	**Manufacturing**					
R-134a	0.200	0.210	0.310	0.390	0.490	0.589
R-22	0.010	0.010	0.010	0.010	0.012	0.012
IFVs –(R-134a)	1.020	1.020	1.020	1.020	1.020	1.020
R-410A	0.06	0.06	0.06	0.06	0.06	0.06
R-404A	0.06	0.06	0.06	0.06	0.06	0.06
R-22	0.06	0.06	0.06	0.06	0.06	0.06
Vehicles	**Servicing**					
R-134a	3.10	3.34	4.22	5.00	6.26	7.47
R-22	0.02	0.02	0.02	0.03	0.04	0.05
IFVs (R-134a)	1.02	1.23	1.25	1.34	1.44	1.48
R-410A	0.06	0.07	0.156	0.168	0.180	0.192
R-404A	0.06	0.07	0.08	0.08	0.09	0.096
R-22	0.06	0.072	0.079	0.084	0.091	0.096

Source: Survey 2019

4. SECTOR AND SUBSECTOR-WISE ODS CONSUMPTION DURING 2014 TO 2019

As per survey, ODS used in residential, commercial and industrial air-conditioning systems including chillers, foam insulation, fire extinguishers and other servicing sectors from 2014 to 2019 are shown in the **Tables 10a-f**.

Table A10a: Sector and Subsector-wise ODS consumption in 2014 (MT)

Sector and subsector	R-22	R-142b	R-123
Residential air-conditioning	140.000	-	-
Commercial air-conditioning	90.000	-	-
Industrial air-conditioning including chillers	80.000	-	0.700
Mobile air-conditioning including ship refrigeration system	70.000	-	-
Commercial refrigeration	9.928	-	-
Industrial refrigeration	16.585	-	-
Transport refrigeration	6.330	-	-
Fire Extinguishers servicing		-	1.000
Service sector	607.157	22.500	1.200
Grand total	**1,020.000**	**22.500**	**2.900**

Table A10b: Sector and Subsector-wise ODS consumption in 2015 (MT)

Sector and subsector	R-22	R-142b	R-123
Residential air-conditioning	132	-	-
Commercial air-conditioning	86	-	
Industrial air-conditioning including chillers	104	-	2.200
Mobile air-conditioning including ship refrigeration system	85.7	-	-
Commercial refrigeration	54.1	-	-
Industrial refrigeration	8.2	-	-
Fire Extinguishers servicing		-	1.000
Service sector	686.000	6.200	2.400
Grand total	**1,116.000**	**6.200**	**5.600**

Table A10c: Sector and Subsector-wise ODS consumption in 2016 (MT)

Sector and subsector	R-22	R-142b	R-123
Residential air-conditioning	52		
Commercial air-conditioning	55		
Industrial air-conditioning including chillers	63		3
Mobile air-conditioning including ship refrigeration system	45		
Commercial refrigeration	50		
Industrial refrigeration	5		
Fire Extinguishers servicing			2
Service sector	878	6.36	6
Grand total	**1148**	**6.36**	**11**

Table A10d: Sector and Subsector-wise ODS consumption in 2017 (MT)

Sector and Subsector	R-22	R-142b	R-123
Residential air-conditioning	134.1		
Commercial air-conditioning	86.2		
Industrial air-conditioning including chillers	109.2		1.00
Mobile air-conditioning including ship refrigeration system	85.7		
Commercial refrigeration	54.1		
Industrial refrigeration	8.7		
Fire Extinguishers servicing			1.7
Service sector	657	6.00	4.1
Grand total	**1135**	**6.00**	**6.80**

Table A10e: Sector and Subsector-wise ODS consumption in 2018 (MT)

Sector and Subsector	R-22	R-142b	R-123
Residential air-conditioning	104.92		
Commercial air-conditioning	68.27		
Industrial air-conditioning including chillers	83.34		0.50
Mobile air-conditioning including ship refrigeration system	56.47		
Commercial refrigeration	34.30		
Industrial refrigeration	8.70		
Fire Extinguishers servicing			1.00
Service sector	490.00	3.00	1.50
Grand total	**846.00**	**3.00**	**3.00**

Table A10f: Consumption of ODS in different sectors in 2019 (MT)

Sector and Subsector	R-22	R-142b	R-123
Residential air-conditioning	102.92		
Commercial air-conditioning	66.27		
Industrial air-conditioning including chillers	81.34		0.50
Mobile air-conditioning including ship refrigeration system	53.47		
Commercial refrigeration	33.3		
Industrial refrigeration	7.823		
Fire Extinguishers servicing			1.00
Service sector	473	9.55	1.00
Grand total	**818.123**	**9.55**	**2.50**

Source: Survey 2019

5. CONSUMPTION OF ODS ALTERNATIVES IN DIFFERENT SECTORS DURING 2014 TO 2019

Refrigeration manufacturing and servicing are two broad categories for consumption of ODS alternatives. Domestic, commercial, industrial and transport refrigeration systems fall under manufacturing categories but yet there are no good facilities to manufacture transport refrigeration system in Bangladesh. Survey indicated that ODS alternative refrigerants were used in refrigerators and air-conditioners manufacturing including chillers and other sectors that are shown in the **Tables 11a-f**.

Table A11a: Sector and subsector wise consumption of ODS alternatives in 2014 (MT)

Sector and Subsector	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	HC-blend	R-717	Cyclo-pentane
Manufacturing sector										
Domestic Refrigerator	189.00	-	-	-	-	-	9.00	-	-	150.00
Commercial Refrigerator	113.30	3.57	-	-	-	-	9.00	-	-	150.00
Industrial Refrigerator	-	-	2.00	1.06			8.00		35.00	-
Transport refrigeration	2.31		1.00	-	-	-	-	-	-	-
Residential AC	1.33		2.01	-	-	-	-	-	-	-
Commercial AC	2.00		5.00	-	-	-	-	-	-	-
Industrial AC including chiller	-	-	-	-	-	-	-	-	-	-
MAC manufacturing	9.49		0.70	-	-	-	-	-	-	-
Eire Extinguishers	-	-	-	-		-	-	-	-	-
Aerosol: Pharmaceutical products	117.82	-	-	-	-	-	-	-	-	
Service sector										
Servicing	203.55	5.50	14.41	3.20	1.20	1.24	9.65	1.11	78.623	230.00
Total	**638.80**	**9.07**	**25.11**	**4.26**	**1.20**	**1.24**	**35.65**	**1.11**	**113.63**	**530.00**

Table A11b: Sector and subsector wise consumption of ODS alternatives in 2015 (MT)

Sector and Subsector	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	HC-blend	R-717	Cyclo-pentane
Manufacturing sector										
Domestic Refrigerator	200.45	-	-	-	-	-	9.00	-	-	250.00
Commercial Refrigerator	135.6	4.12	-	-	-	-	8.00	-	-	280.00
Industrial Refrigerator	-	-	2.00	0.50			9.00		38.00	
Transport refrigeration	2.215	-	2.00	-	-	-	-	-	-	-
Residential AC	1.38	-	2.00	-	-	1.00	-	-	-	-
Commercial AC	2.00	-	4.00	-	-	-	-	-	-	-
Industrial AC with chiller			1.00	0.55	-	-	-	-	-	-
MAC manufacturing	9.00		0.53		-	-	-	-	-	-
Eire Extinguishers	-	-	-	-		-	-	-	-	-
Aerosol: Medical products	140	-	-	-	-	-	-	-	-	
Servic sector										
Servicing	275.82	8.39	42.84	5.56	1.54	1.54	17.65	1.11	82.68	65.00
Total	**766.48**	**12.51**	**54.56**	**6.61**	**1.54**	**2.54**	**43.65**	**1.11**	**120.68**	**595.00**

Table A11c: Sector and subsector wise consumption of ODS alternatives in 2016 (MT)

Sector and Subsector	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717	Cyclo-pentane
Manufacturing sector									
Domestic Refrigerator	180.79	-	-	-	-	-	46.24	-	250.00
Commercial Refrigerator	93.21	0.20	-	-	-	-	-		300.25
Industrial Refrigerator	-	0.21	2.41	-	-	-	-	46.00	
Transport refrigeration	17.45	0.70	2.01	-	-		-	-	-
Residential AC	50.22	0.50	6.21	0.03	-		-	-	-
Commercial AC	9.47		32.2	-	-		-	-	-
Industrial AC with chiller	-	0.10	22.52	0.02	-		-	-	-
MAC manufacturing	24.12	0.50	-	-	-	-	-	-	-
Eire Extinguishers	-	-	-	-	2.80		-	-	-
Aerosol: Pharmaceutical products	169.16	-	-	-	-	-	-	-	-
Foam	5.05	-	-	-	-	-	-		
Service sector									
Servicing	462.65	9.42	69.70	4.07	-	3.12	56.10	94.34	150.00
Total	**1012.12**	**11.63**	**135.05**	**4.12**	**2.80**	**3.12**	**102.34**	**140.34**	**700.25**

Table A11d: Sector and subsector wise consumption of ODS alternatives in 2017 (MT)

Sector and Subsector	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717	Cyclo-pentane
Manufacturing sector									
Domestic Refrigerator									
Commercial Refrigerator	87.32	-	-	-	-	-	-	-	250.58
Industrial Refrigerator	-	0.22	6.47					49.25	
Transport refrigeration	33.80	0.20	4.08			-	-	-	-
Residential AC	19.45	0.30	-	0.02	-	0.50	-	-	-
Commercial AC	5.12		132.08	-	-	-	-	-	-
Industrial AC with chiller	-	0.10	68.58	0.03	-	-	-	-	-
MAC manufacturing	55.40	0.10	-	-	-	-	-	-	-
Eire Extinguishers			-	-		-	-	-	-
Aerosol: Pharmaceutical products	252.58		-	-	-	-	-	-	-
Foam	11.31	-		-	-	-	-		-
Service sector									
Servicing	863.09	11.87	221.08	10.83	2.96	5.87	110.00	106.38	182.00
Total	**1497.59**	**12.79**	**432.29**	**10.88**	**2.96**	**6.37**	**170.62**	**155.63**	**786.58**

Table A11e: Sector and subsector wise consumption of ODS alternatives in 2018 (MT)

Sector and Subsector	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717	Cyclo-pentane
Manufacturing sector	238.00	-	-	-	-	-	40.00	-	385.00
Domestic Refrigerator									
Commercial Refrigerator	121.52	0.73	-	-	-	-	39.29	-	250.23
Industrial Refrigerator		-	11.17	0.07-	-		-	58.75	
Transport refrigeration	2.71	-	9.50		-		-	-	-
Residential AC	1.53	-	65.51		-	1.50	-	-	-
Commercial AC	-	-	240.10		-		-	-	-

Sector and Subsector	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717	Cyclo-pentane
Industrial AC with chiller	-	0.47	7.34		-	-	-	-	-
MAC manufacturing	9.00	-	-	-	-	-	-	-	-
Eire Extinguishers		-	-	-		-	-	-	-
Aerosol: Medicall products	299.50	-	-	-	-	-	-	-	-
Foam	14.94	-	-	-	-	-	-	-	-
Service sector									
Servicing	989.66	13.50	357.18	15.00	-	7.76	115.05	121.12	250.00
Total	**1676.86**	**14.70**	**690.80**	**15.07**	**3.12**	**9.26**	**194.34**	**179.87**	**885.23**

Table A11f: Sector and subsector wise consumption of ODS alternatives in 2019 (MT)

Sector and Subsector	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717	Cyclo-pentane
Manufacturing sector									
Domestic Refrigerator	191.00	-	-	-	-	-	71.34	-	65.32
Commercial Refrigerator	149.12	1. 62	-	-	-	-	33.64	-	92.00
Industrial Refrigerator		-	16.50		-	-		61.45	35.25
Transport refrigeration	2.61	-	18.50		-	-	-	-	-
Residential AC	1.10	-	114.15	-	-	2.24	-	-	244.85
Commercial AC	-	-	162.00	-	-	-	-	-	62.51
Industrial AC with chiller	-	-	98.00	0.071	0.51	-	-	-	-
MAC manufacturing	9.00	-	-	-		-	-	-	-
Eire Extinguishers	-	-	-	-	1.00	-	-	-	-
Aerosol: Medical products	324.30	-	-	-	-	-	-	-	-
Foam	19.17	-	-	-		-	-	-	-
Service sector									
Servicing	1026.72	25.56	412.32	21.19	2.05	9.17	153.85	126.30	450.20
Total	**1723.02**	**27.18**	**822.47**	**21.26**	**3.56**	**11.40**	**258.83**	**191.75**	**950.13**

Source: Survey 2019

5.1. Consumption of ODS alternatives in Service sector

Survey 2019 indicated that the estimated servicing workshops in different divisions in Bangladesh were about more than 18,000. There were about more than 50,000 thousand technicians working in servicing sectors. A majority of technicians have no technical academic qualification. At the preliminary stage they received training from senior technicians during job period while working in the service workshops. Most of them repaired refrigerators and window and split air-conditioning units. Some of them engaged in other machines, such as water pump motor etc. and some of them are also repairing car air-conditioners.

Servicing technicians basically were engaged with domestic refrigeration and window air-conditioning system repair and maintenance. They seldom used to repair the commercial RAC system. Servicing workshops generally received R-134a systems for domestic refrigeration and R-22 system for window air-conditioning system. The technicians usually used R-600a and R-404A systems in domestic refrigerator and R-410A for air-conditioning as alternative to R-22. Charge of R-600a, R-404A and R-410A systems are usually low compared to R-134a and R-22 systems. HC alternatives are used as alternatives which are now available in the market. The consumption of ODS alternatives in servicing sector during 2014 to 2019 are shown in **Tables 12a to 12f**.

Table A12a: Consumption of ODS alternatives in Service sector in 2014

Application	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	HC-blends	R-717
Domestic Refrigerator	120.45	-	-	-	-	-	9.65	0.7	-
Commercial Refrigerator	58.30	3.54	-	-	-	-	-	-	-
Industrial Refrigeration	-	-	-	0.50					78.65
Transport Refrigeration	6.50	-	-	-	-	-	-	0.41	
Domestic Air-conditioner	4.00			1.25		9.17			
Commercial Air-conditioning	5.00	2.01	10.41	-	-	-	-	-	-
Industrial Air-conditioner	-	-	-	1.50	-	-	-	-	-
Mobile Air-conditioner	20.25	-	4.00	-	-	-	-	-	-
Fire Extinguisher	-	-	-	-	1.200	-	-	-	-
Total	**214.49**	**5.50**	**14.41**	**3.25**	**1.20**	**9.17**	**9.65**	**1.11**	**78.65**

Table A12b: Consumption of ODS alternatives in Service sector in 2015

Application	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	HC-blends	R-717
Domestic Refrigerator	172.23	-	-	-	-	-	17.65	0.62	-
Commercial Refrigerator	82.00	5.22	-	-	-	-	-	-	-
Industrial Refrigeration		1.17	1.00	-	-	-	-	-	82.68
Transport Refrigeration	6.00	1.00	1.84	-	-	-	-	0.80	-
Domestic Air-conditioner	5.00	0.50	20.00	1.60		1.70	-	-	-
Commercial Air-conditioning	7.00	-	20.00	4.00	-	0.84	-	-	-
Industrial Air-conditioner	-	-	-	-	-	-	-	-	-
Mobile Air-conditioner	15.00	0.50	-	-	-	-	-	-	-
Fire Extinguisher	-	-	-	-	2.54	-	-	-	
Total	**287.23**	**8.39**	**42.84**	**5.60**	**2.54**	**2.54**	**17.65**	**1.42**	**82.68**

Table A12c: Consumption of ODS alternatives in Service sector in 2016

Application	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717
Domestic Refrigerator	204.00	-	-	-	-	-	46.00	-
Commercial Refrigerator	161.68	4.63	-	-	-	-	10.10	-
Industrial Refrigeration		2.20	2.80	-	-	-	-	92.95
Transport Refrigeration	24.45	1.49	2.12	-	-	-	-	
Domestic Air-conditioner	23.60	0.50	-	2.84		1.12		
Commercial Air-conditioning	11.80		52.33	-	-	2.00	-	-
Industrial Air-conditioner		0.10	12.45	1.23	-	-	-	-
Mobile Air-conditioner	37.12	0.50	-	-	-	-	-	-
Fire Extinguisher	-	-	-	-	2.80			
Total	**462.65**	**9.42**	**69.70**	**4.07**	**2.80**	**3.12**	**56.10**	**92.95**

Table A12d: Consumption of ODS alternatives in Service Sector in 2017

Application	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717
Domestic Refrigerator	301.13						60.00	
Commercial Refrigerator	372.32	2.77	-	-	-	-	50.00	
Industrial Refrigeration	-	1.61	7.11	-	-	-	-	106.38
Transport Refrigeration	33.53	4.53	3.82	-	-	-	-	-
Domestic Air-conditioner	17.55	2.37	14.15	6.90	-	3.38	-	-
Commercial Air-conditioning	52.66		144.00	-	-	1.49	-	-
Industrial Air-conditioner	-	0.10	52.00	3.93	-	-	-	-
Mobile Air-conditioner	85.90	0.50	-	-	-	-	-	-
Fire extinguishing					2.96			
Total	**863.09**	**11.88**	**221.08**	**10.83**	**2.96**	**4.87**	**110.00**	**106.38**

Table A12e: Consumption of ODS alternatives in Service Sector in 2018

Application	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717
Domestic Refrigerator	392.52	-	-	-	-	-	65.00	-
Commercial Refrigerator	398.682	7.17	-	-	-	-	50.00	-
Industrial Refrigeration	-	1.17	11.50	-	-	-		121.17
Transport Refrigeration	79.81	4.34	8.50	-	-	-	-	-
Domestic Air-conditioner	69.31	0.20	50.85	10.70		5.24	-	-
Commercial Air-conditioning	49.34		240.00	-	-	2.52	-	-
Industrial Air-conditioner	392.52	0.10	46.33	4.31	-	-	-	-
Mobile Air-conditioner	398.682	0.50	-	-	-	-	-	-
Fire Extinguisher	-	-	-	-	3.12	-	-	-
Total	**989.66**	**13.48**	**357.18**	**15.01**	**3.12**	**7.76**	**115.00**	**121.17**

Table A12f: Consumption of ODS alternatives in Service Sector in 2019

Application	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717
Domestic Refrigerator	421.52	-	-	-	-	-	81.29	-
Commercial Refrigerator	388.78	10.17	-	-	-	-	72.56	-
Industrial Refrigeration	-	4.47	11.50	-	-	-		126.30
Transport Refrigeration	59.81	9.12	9.50	6.25	-	-	-	-
Domestic Air-conditioner	49.37	0.20	59.40	10.70		7.04	-	-
Commercial Air-conditioning	29.34		286.33	-	-	2.13	-	-
Industrial Air-conditioner	-	0.10	46.53	4.24	-	-	-	-
Mobile Air-conditioner	77.9	1.50	-	-	-	-	-	-
Fire Extinguisher	-	-	-	-	3.56	-	-	-
Total	**1026.72**	**25.56**	**413.32**	**21.19**	**3.56**	**9.17**	**153.85**	**126.30**

Source: Survey 2019

5.2 Consumption of ODS and ODS alternatives in Foam sector

Foams are of three general types, such as Polyurethane (PU), Expanded Polystyrene (EPS) and Extruded Polystyrene (XPS). There were four companies produced polyurethane (PU) foam, and the rest of all produced Expanded Polystyrene (EPS). There was no industry producing Extruded Polystyrene (XPS) in Bangladesh. EPS is manufactured by expanding spherical beads in a mold, using heat and pressure to fuse the beads together, no isocyate and prebended polyol is used. Polyurethane (PU) is a polymer commonly

formed by reacting di- or poly-isocyanate with a polyol. Both the isocyanates and polyols used to make PU foam. There were four types of products such as (i) Discontinuous panel, (ii) Commercial Refrigeration Appliances, (iii) Spray polyurethane foam and (iv) General Insulation manufactured in Bangladesh using prebended polyol. Data were collected from four PU foam industries. Consumption of ODS and ODS alternatives in foam, a polyol, blowing agents, blowing agent evolution, physical and chemical properties of blowing agent, HFCs, HFOs, HC and water based blowing agents and characteristics of pre blended polyol etc.. Consumption of HFC blowing agent used in PU Spray Foam is showen in **Table 13a** and utilized blowing agent R-141b in foam products is shown in **Tables 13b**.

Table A13a: Consumption of HFC in Spray Foam during 2016 to 2019 (MT)

Name of industries	Consumption of HFCs during 2016-2019 (MT)			
	2016	2017	2018	2019
Wattson Euro Panel industries Ltd.	5.50	7.80	10.20	13.12
Star PU Products		2.51	3.24	4.25
Radian Technology		0.5	1.0	1.25
SS Corporation		0.50	0.50	0.55
Total	**5.500**	**11.31**	**14.94**	**19.17**

Table A13b Consumption of R-141b in Foam products during 2016 to 2019 (MT)

Name of industris	Consumption of R-141b in Foam during 2014-2019 (MT)					
	2014	2015	2016	2017	2018	2019
Wattson Euro Panel industries Ltd.	248.81	263.69	282.38	285.12	295.24	307.14
Star PU Products	4.59	12.33	13.45	13.51	13.74	13.69
Radian Technology	2.00	4.43	5.87	6.70	7.27	7.64
SS Corporation	1.33	5.71	5.97	6.37	6.73	6.96
Total	**256.73**	**286.16**	**307.67**	**311.70**	**322.98**	**335.43**

5.3. Consumption of HFCs in Aerosol sector

The term aerosol product describes a product pressurized with a propellant that expels its content from a canister through a nozzle. Propellants can be compressed gases (nitrogen, nitrous oxide, carbon dioxide), or can be liquefied gases that are a liquid inside the pressurized container. Aerosol found in pharmaceutical and veterinarian products, glues, lubricant oils etc. For clear understanding, aerosol may be defined as (i) Medical Aerosol and (ii) Technical/ Consumer Aerosol

(i) Medical Aerosol

Asthma and chronic obstructive pulmonary disease (COPD) are the most common chronic diseases of the respiratory tract. Inhalation therapy is the mainstay of treatment for asthma and COPD. There are two common types of inhalation devices for the delivery of respiratory drugs: (pressurised) Metered Dose Inhaler (MDI) and the Dry Powder Inhaler (DPI) in single or multi-dose. In different markets, the proportion of MDIs to DPIs differs. Medical aerosols are used to deliver topical medication mostly onto the skin, but also to the mouth, and other body cavities. Medical aerosols are not only (MDI), cover a wide range of uses from simple numbing of pain, nasal inhalation, to the dosage of corticosteroids for the treatment of colitis.

Asthma and COPD are increasing in prevalence worldwide; the acceptance and use of inhalers are also increasing, especially in Article 5 Parties. The conversion to CFC-free inhalers has not had any adverse impact on patients. The demand of such inhaler will be high in the near future. Consumption of HFC-134a in MDI during 2014-2019 is shown in **Table 14**.

Table A14: Consumption of HFC-134a in MDI during 2014 to 2019 (MT)

Sl. No.	Name of companies	2014	2015	2016	2017	2018	2019
1	Beximco	60	718	97	152	192	210
2	Square	32	38	33	57	60	65
3	ACME	4.6	5.43	7.34	7.62	8.85	9
4	GlaxoSmithKline (GSK)	8.62	10.18	12	13.4	14.3	14.5
5	ACI Ltd	9.43	11.13	13.38	14.86	15.4	15.8
6	Health Care Pharmaceutical Ltd	1.15	1.4	1.44	1.8	2	2
7	Aristopharma	1.9	2.24	2.54	3	3.5	4
8	Drug International	-	1	1.5	1.89	2	2.501
9	Bangladesh Pharma	-	-	0.962	1.008	1.426	1.502
	Total	**117.70**	**787.38**	**169.16**	**252.58**	**299.48**	**324.30**

(ii) Technical/Consumer Aerosols

This includes a large number of applications such as insecticides, cosmetics, paints, cleaners, glues and lubricant oils. The most commonly used alternatives in technical /consumer aerosols are hydrocarbons, CO_2/ N_2/ Air, N_2O, prallethrin, d-phenothrin, Chesterton sp 296, formaldehyde, zylem, other volatile organice compounds etc. The WHO publised in 2004 that "Prallethrin is of low mammalian toxicity, with no evidence of carcinogenicity" and "is very toxic to bees and fish but of low toxicity to birds". Consumer aerosol manufactured in Bangladesh using LPG, prallethrin, d-phenothrin, manufactured aerosol with hydrocarbons (LPG). In foam goods including shaving and mousse used ethanolamines, ammonium hydroxide; as propellants used hydrocarbons, fluorocarbons, carbon dioxide and nitrogen; in fresheners aerosol spray contain like formaldehyde and zylen and other volitile organic compounds; Deep hidden-cockroach spray contains benzyn salicylate, benzyl benzoalipropallant, LGP, solvent like isopropyl alcohol C_9 to C_{20} aliphatic; air freshener 'Waue' contains butane, propane, solven fragrance etc., in freshener 'lemon' use alcohol denat, butane, propane perfume. In this survey, no use of HFCs was found in consumer aerosols.

Sterilants

Sterilization is an important process in the provision of good quality healthcare services. It is also a process that requires strict application of the principles of quality management, reliability and long-term materials compatibility. Therefore, any alternative to the use of ODSs needs to be well proven and tested to avoid putting the health of patients unnecessarily at risk. It is legal requirement in pharmaceutical and medical devices industries that any change in manufacturing processes, including sterilization, must be validated using appropriate guidelines before implementation.

5.4 Consumption of ODS alternatives in Solvent sector

Solvents are widely used as process agents in a variety of industrial manufacturing processes although these are not contained in the final products to consumers. The main applications of solvents are spot cleaning of cloths, metal cleaning, electronics cleaning and precision cleaning. In Bangladesh, solvent contribution to the ODS is relatively small with respect to the other applications, the transition to the alternative technologies can be undertaken as the alternatives are already available. Many alternative solvents and technologies include not in-kind technology such as aqueous and semi-aqueous cleaning, hydrocarbon and alcohol-base solvents; and in kind solvents such as chlorinated and fluorinated solvents which include HFCs with various levels of acceptance. The common spot cleaning of cloths solvents such as acetone, benzene, hexane, toluene, white petrol, xylene etc. used as alternative to CTC from 2010.

5.5 Consumption of ODS and ODS alternatives in Fire-fighting sector

Ozone depleting substances (ODS) used as fire extinguishants possess unique efficacy and safety properties that serve as a basis of fire protection systems where the application of water, dry chemical agents, or aqueous salt solutions in problematic.

Commercially available, technically proven alternatives to ODS for Fire Protection have been developed and include: halocarbon agents, e.g., HFCs, inert gases, e.g., nitrogen and argon and their blends; carbon dioxide; water mist technologies, inert gas generators; fine solid particles (powders); dry chemicals; and aqueous film-forming foam. Several environmentally sound 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. HFC-227ea consumption in Fire extinguishing sector during 2014 to 2019 are shown in **Table 15**.

Table A15: Consumption of HFC-227ea in Fire extinguishing during 2014-2019 (MT)

Application	Consumption of HFC-227ea in Fire-extinguishing during 2014-2019 (MT)					
	2014	2015	2016	2017	2018	2019
HFC-227ea	1.2	2.538	2.8	2.96	3.12	3.56

6. ESTIMATION OF HFC CONSUMPTION IN DIFFERENT SECTORS DURING 2014-2019

6(a) Year-wise HFCs consumption during 2014 to 2019 is shown in Table 16a.

Table A16a: Year-wise HFCs consumption during 2014-2019

Years	Year-wise HFCs consumption in (MT)					
	HFC-134a	R-410A	R-404A	R-407C	R-32	R-227ea
2014	638.83	25.11	9.07	4.26	1.24	1.20
2015	766.48	54.01	12.51	6.65	2.54	2.54
2016	1012.12	135.05	11.63	4.12	3.12	2.80
2017	1497.59	432.29	12.79	10.88	6.37	2.96
2018	1676.86	690.80	14.72	15.07	9.26	3.12
2019	1723.02	822.48	27.18	21.26	11.42	3.56

Source: Survey 2019

6(b) Substance-wise HFCs consumption during 2014 to 2019 is shown in the Table 16b.

Table A16b: Substance-wise HFCs consumption during 2014 to 2019

Substances	Substance-wise HFCs consumption (in MT)					
	2014	2015	2016	2017	2018	2019
HFC-134a	638.83	766.48	1012.12	1497.59	1676.86	1723.02
R-410A	25.11	54.01	135.05	432.29	690.87	822.48
R-404A	9.07	12.51	11.63	12.79	14.72	27.18
R-407C	4.26	6.65	4.12	10.88	15.07	21.26
R-32	1.24	2.54	3.12	6.37	9.26	11.41
HFC-227ea	1.20	2.54	2.80	2.96	3.12	3.56

Source: Survey 2019

6(c) Sector and subsectors-wise HFCs consumption during 2014 to 2019

(i) Consumption in Refrigeration manufacturing

The most commonly used HFCs are R-134a, R-404A, R-410A and R-407C. Sub-sector wise consumption of HFCs in refrigeration manufacturing sector is shown in the **Table 16c**.

Table A16c: Consumption of HFCs in refrigeration sector and subsector during 2014-2019

Sub-sector	Refrigerant charge (kg)	HFCs	Consumption (MT)					
			2014	2015	2016	2017	2018	2019
(A) Domestic	0.1-0.3	HFC-134a	188.21	202.86	263.48	246.98	264.30	233.98
(B) Commercial	0.1-200	HFC-134a	102.17	117.99	101.34	112.27	93.28	102.91
(C) Industrial	100-5,000	R-404A	0.15	0.17	0.19	0.22	0.24	0.26
		R-410A	0.18	0.21	0.48	0.81	1.20	1.65
		R-407C	0.04	0.05	0.05	0.06	0.07	0.07
(D) Transport	1-1,000	R-404A	0.22	0.26	0.59	0.84	1.16	1.56
		R-410A	1.07	1.21	1.87	2.21	2.61	2.89
		HFC-134a	3.58	3.98	6.67	7.90	9.46	11.76

Total consumption in Refrigeration sector	HFC-134a	293.97	324.83	371.49	367.15	367.05	348.65
	R-404A	0.36	0.43	0.78	1.05	1.40	1.82
	R-410A	1.25	1.42	2.35	3.02	3.81	4.54
	R-407C	0.04	0.05	0.05	0.06	0.06	0.07

(ii) Air-condition manufacturing sector

Consumption of HFCs in AC sector and subsector during 2014-2019 is shown in **Table 16d.**

Table A16d: Consumption of HFCs in AC sector and subsector during 2014-2019

Sub-Sector	**Refrigerants charge (kg)**	**HFCs**	**Consumption (MT)**					
			2014	**2015**	**2016**	**2017**	**2018**	**2019**
(A) Residential AC	0.20 -03.00	R-410A	6.74	7.068	44.29	146.01	231.08	283.05
		R-134a	7.72	8.1	0	0	0	0
		R-407C	0.70	0.736	0	0	0	0
		R-32	0	0	0	0.50	1.5	2.34
(B) Commercial AC	3.00 -100.00	R-410A	2.89	3.03	18.98	62.57	99.03	121.27
		R-134a	3.31	3.47	0	0	0	0
		R-407C	0.30	0.32	0	0	0	0
(D) MAC:	2.00-10.00	HFC-134a	0.20	0.21	0.31	0.39	0.49	0.59
(i) Large vehicles	8.00-15.oo	HFC-134a	1.02	1.02	1.02	1.02	1.02	1.02
(ii) ISVs		R-404A	0.06	0.06	0.06	0.06	0.06	0.06
		R-410A	0.06	0.06	0.06	0.06	0.06	0.06
Total consumption in AC sector		HFC-134a	12.25	12.80	1.33	1.41	1.51	1.61
		R-404A	0.06	0.06	0.06	0.06	0.06	0.06
		R-410A	9.69	10.16	63.33	208.64	330.17	404.38
		R-407C	1.01	1.05	0	0	0	0
		R-32	0	0	0	0.50	1.50	2.40

Consumption of HFCs in RAC Servicing including firefighting during 2014-2019 is shown in **Table 16e**.

Table A16e: Consumption of HFCs in RAC servicing equipment

Substance	**Use (MT)**					
	2014	**2015**	**2016**	**2017**	**2018**	**2019**
HFC-134a	203.55	275.83	450.83	845.76	968.17	1002.27
R-404A	5.36	8.22	9.24	11.66	13.24	25.32
R-410A	14.23	42.63	69.21	220.27	355.98	412.13
R-407C	3.21	5.56	4.07	10.83	15.01	21.19
R-32	1.24	2.54	3.12	6.37	9.26	11.41
HFC-227ea	1.20	2.54	2.80	2.96	3.12	3.56

Source: Survey 2019

(iii) The consumption of HFCs in Spray Foams during 2014-2019 is shown in the **Table 13a**; **(iv)** Consumption of HFCs in Aerosol during 2014-2019 is shown in the **Table 14** and (v) Consumption of HFC in Fire-fighting sector is shown in the **Table 15**.

7. SUBSTANCE-WISE GROWTH PATTERNS OF HFCS CONSUMPTION

7(a) Substance-wise growth pattern of HFCs is shown in the Figure 2.

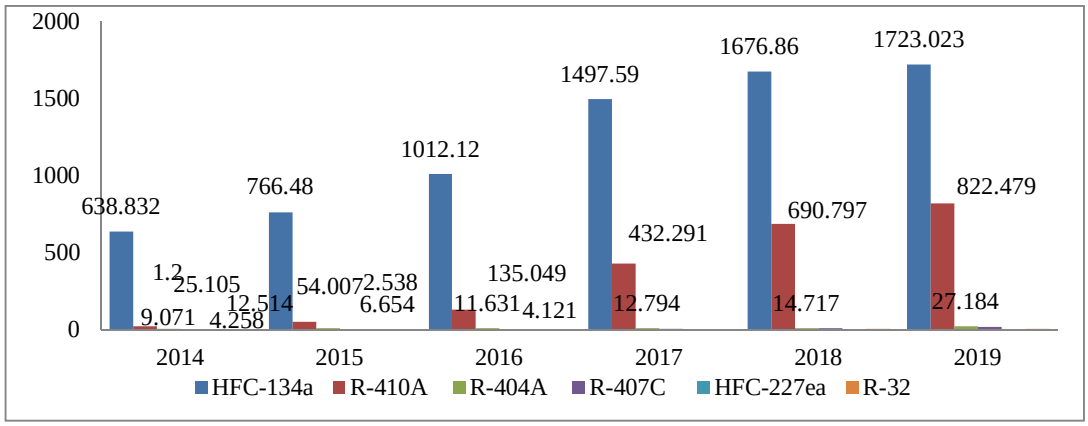


Figure 2: Substance wise growth patterns during 2014-2019

8. REVIEW HFCS CONSUMPTION TREND AND FORECAST

8(a) Review HFCs consumption from fresh survey data

Bangladesh GDP: "Bangladesh's GDP growth rate is going to reach 8.13%, against 7.86% recorded in the last fiscal year," said the finance minister referring to the provisional estimation of the Bangladesh Bureau of Statistics (BBS) data. The government also forecast that the investment to GDP ratio will stand at 31.57%—of which 8.17% will come from public investment and 23.40% from private sector investment. In FY 2017-18, investment to GDP ratio was 31.23%—of which 7.97% was from public investment and 23.26% from private sector investment. Bangladesh **GDP Growth** from 2014-2019 fiscal years is shown in **Table 17a**:

Table 17a: Bangladesh GDP Growth from 2014-2015 to 2018-2019 fiscal years

No.	Fiscal years	GDP growth
1	2014-2015	6.55%
2	2015-2016	7.10%
3	2016-2017	7.30%
4	2017-2018	7.90%
5	2018-2019	8.13%

Bangladesh Gross Domestic Products (GDP) growth is increasing, which is shown in **Figure 3.**

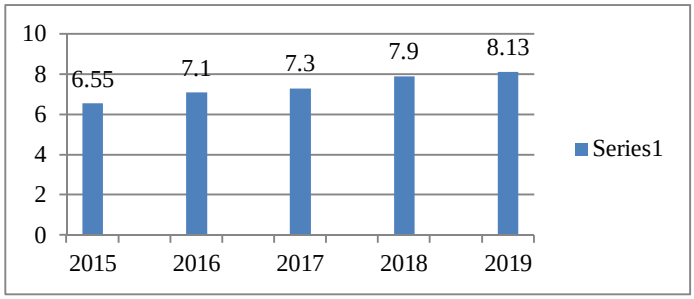
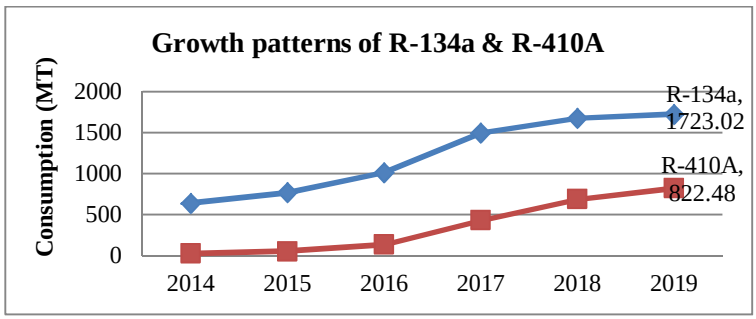


Figure 3: Graphical presentation of GDP growth from economic years 2015-2019

It is assumed that the purchasing capabilities of the people of Bangladesh are increasing day by day. Due to climate change, the temperature is also gradually increasing. In the hot climate, people never take sound sleep. People are engaged in various economic activities from morning to evening. After work everybody wants to take rest and sleep. They never regularly purchased their essential foods. For preservation of foods, refrigerator is essential and for rest and sound sleep, air-conditioning is absolutely needed. They purchased these essential things as per their ability. So, demand of these RAC commodities is increasing.

Reviewed HFCs consumption: Graphical representation of HFCs consumption is separately stated bellows:

(i) HFC-134a (GWP: 1,430)



HFC-134a has zero ODP and a GWP of 1430. Inflammable, non-poisonous, and odorless HFC-134a is safe to use in products such as refrigerators, freezers, and large screw chillers. The physical and thermodynamic properties of HFC-134a are significantly different from those of R-22. This is easy to use in different lubricant. It has a higher flow pressure drop and poorer heat transfer coefficient and the unit refrigeration value is 35% lower than that of R-22.

During 2014 to 2019, among HFCs consumption in the country, HFC-134a was the highest and this was followed by R-410A, R-404A and R-407C. HFC-134a alone accounts for 66% of the total HFCs product consumed. Consumption in the Refrigerator sector will continue to rise. The country is experiencing a wave of shopping malls being constructed in the major cities nationwide. In addition, modern supermarkets keep springing up in residential communities to ease shopping needs of residents which will also contribute to drive up the consumption of HFC-134a for servicing display cabinet, etc. In addition, domestic refrigerator import continues to grow as a consequence of rising household income, GDP growth, rapid urbanization and sustained rural electrification program which will push up the demand for HFC-134a. On the MACs side, the record of the Driver, Vehicle and Licensing Authority (DVLA) shows a steady stream of newly private motor vehicles, buses and coaches which are all fitted with air conditioners which will also push up the demand for HFC-134a.

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 in newly built hospitals, hotels and supermarkets, office buildings, banks, airports, community centers etc. and mobile air-conditioning applications with HFC-134a. Moreover, the technology is well proven and mature, cost effective, available in the market.

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 HFC-134a for servicing would continue to increase.

(ii) R-410A (GWP: 2,088)

R-410A is a zoetrope mixture composed of 50% R-32 and 50% R-125. It has zero ODP and a GWP of 2100. It has a large unit refrigeration volume, good heat transfer performance, and fluidity. R-410A is a popular substitute mainly used in small-sized or medium–sized Air Conditioning equipment and some small type of refrigeration equipment. Its working pressure is 60% higher than that of R-22, which leads to higher demand for system design, manufacture and quality control. The price of R-410A is higher when compared with that of R-22.

HCFC-22 offers stiff competition to R-410A in the window unit and single split unit air conditioners, but R-410A has the sole monopoly in the Variable Refrigerant Flow (VRF) air conditioners which is very popular in air conditioning of commercial and upscale residential buildings. Air conditioning of residential homes and work places has become a standard feature of modern lifestyle and with the increasing estate development going on in the country; this will push up demand for R-410A as HCFC-22 volumes diminish in the market as a result of Montreal Protocol phase-out measures. However, its use in air conditioners especially split and window types could be replaced by hydrocarbon HC-290 or other low GWP HFOs as the high-GWP HFC refrigerants come under when HPMP Stage II implementation will be started.

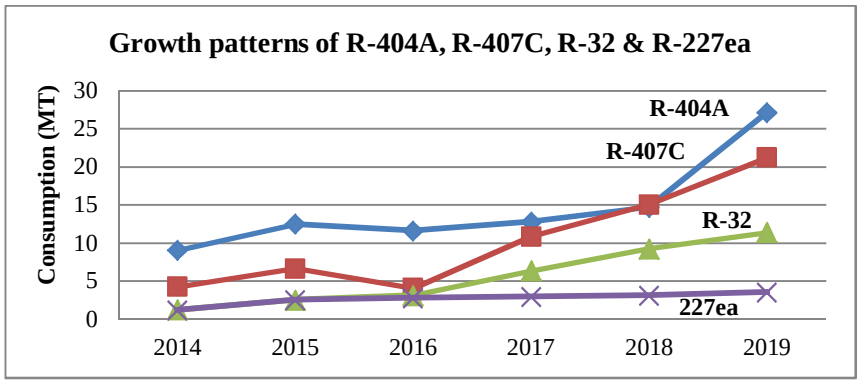
(iii) R-404A (GWP: 3,922)

R404A is a blend of (44% R-125 + 52% R-143a + 4% R-134a). R404A is used as a replacement for R-22 in low and medium temperature refrigeration applications. Although it is a popular refrigerant, it is the HFC

blend with the highest GWP in use in commercial stand-alone equipment and could meet competition from HC refrigerants in application in this equipment. The use of R-404a is decreasing due to its high GWP.

(iv) R-407C (GWP: 1,774)

R407C is a HFC blend of 23% R-32, 25% R-125 and 52% R-134a designed to have similar properties to R-22 in air conditioning systems. *R407C* is suitable for residential & light air conditioning and direct expansion air conditioning systems. It is also used in medium temperature refrigeration systems. It has not caught up as a popular refrigerant as the R-410A has among air conditioning service providers. This refrigerant is intended as a replacement of R-22. R-22 production will be phased-out by 2025 as per the Montreal Protocol. It is recommended to drop R-407C into R-22 systems on top of the existing charge in cases of low refrigerant levels. Preventive maintenance programs should include strong suggestions to replace ozone-depleting refrigerants such as R-22 with environmentally friendly refrigerants and R-407C is not recommended to become the front runner. So, its demand is gradually decreasing.



(v) R-32 (GWP: 675)

R-32 has zero ODP and a GWP of 675. It has good thermal conductivity, a large refrigeration capacity, and high theoretical efficiency. Under the condition of equal refrigeration volume, the recharge volume of R-32 is 20% less that of R-22. R-32 is a mixture and stable refrigerant which is easy and cheap to obtain. The exhaust temperature of R-32 System is relatively high ad needs to be reduced by technological measures. R-32 is moderately flammable and requires a micro-combustion destructive test, risk evaluation, and measures to be taken to reduce the leak rate before being adopted for practical applications. As the greenhouse effect has become an issue of global concern, R-32 has received worldwide attention, given its lower GWP and sound refrigerating performance. It enjoys a promising future in terms of its possible applications. The Substitute Technology expert Committee of India have conducted a comprehensive evaluation of various refrigerants taking into consideration various aspects, such as thermo-dynamic and physical properties, energy saving potential, environmental protection, safety and economy. R-32 has received common attention and appreciation in the process. From available analysis of R-32 applications, the results within a certain range of charge amount and certain product categories product to considerable potential and a promising future prospect.

(vi) HFC-227ea (GWP: 3,220)

HFC-227ea is an environmentally acceptable alternative to ODS. It does not contribute to the destruction of stratospheric ozone. It has zero ODP. It is a suitable fire extinguishing agent for total flooding, portable, and local application systems. It is noncorrosive, electrically nonconductive, free of residue, and characterized by low toxicity. It is ideally suited for protection of high-value assets such as those found in computer rooms, data control centres, telecommunication facilities and museums.

The fire extinguishing concentrations of FM-200 HFC-227ea allow it to be used as a total flooding agent in normally occupied spaces for the protection of solid, liquid and gas and electrically energised hazards. HFC-227ea is also suitable for use as an inert ion agent in explosion suppression applications.

It has inhalation toxicity and cardiac sensitization. At room temperature, R-227ea vapors have little or no effect on the skin or eyes. Always, wears protective clothing when there is a risk of exposure to liquid R-227ea. Where splashing of R-227ea may occur, always wear eye protection and face shield.

8 (b) Forecast growth trend of HFCs baseline and freeze from fresh survey data

The trend is predicted based on the assumption that the RAC industry will, in most cases, continue with a Business-As-Usual (BAU) approach and market dynamics evolving in the country. With the consultations with stakeholders and RAC industry drivers the following growth trend by substance is projected:

Baseline data: As per the Kigali Amendment Schedule the baseline consumption will be on an average of HFCs consumption from 2020 to 2022 and freeze consumption is in the year 2024 and continues up to 2028 which is shown in **Table 17b**. As per the Schedule of the Kigali Amendment, Group 1, Article 5 Parties, the % of reduction steps from baseline data would be started from 2029.

Table A17b: Forecast baseline and freeze data

Substances	2019	CAGR %	2020	2021	2022	Baseline data average of 2020-2022	Freeze 2024-2028
HFC-134a	1723.02	21.95%	2101.22	2562.43	3124.88	2596.180	2596.180
R-410A	822.48	100.94%	1652.71	3321.01	6673.34	3882.358	3882.358
R-404A	27.18	24.55%	33.86	42.17	52.52	42.847	42.847
R-407C	21.26	37.93%	29.32	40.44	55.78	41.850	41.850
HFC-227ea	3.56	24.30%	4.42	5.50	6.84	5.587	5.587
R-32	11.41	55.97%	17.79	27.75	43.29	29.613	29.613

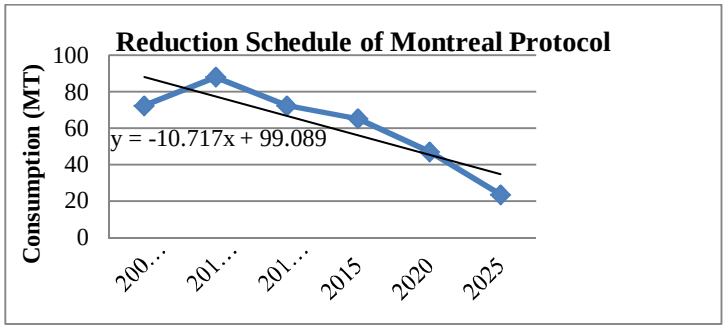
8(c) Establish consumption for the next 5 years based on the assessment of (i) ODS phase-out in RAC and (ii) Foam application

8(c) (i) : As per the Montreal Protocol Schedule, the baseline consumption of ODS in Bangladesh was 72.6 MT on an average of 2009 and 2010, no control in consumption during 2011 to 2012, and freeze in 2013 to 2014, 10% reduction in the year 2015, 30% in 2020 and 67.5% in 2025. The Montreal Protocol Schedule of 67.5% reduction of ODS is shown in **Table 17c.**

Table A17c: Montreal Protocol baseline, freeze, 10%, 35% and 67.5% reduction schedule

ODS	Baseline data on an average of	No control in	Freeze In	10% reduction	35% reduction	67.5% reduction
	2009 & 2010	2011-2012	2013-2014	2015	2020	2025
HCFCs	72.60	88.14	72.60	65.34	47.19	23.60

The graphical representation of the Montreal Protocol Schedule is shown below:



Bangladesh Government is agreed to achieve the target of ODS phased-out schedule of M. Protocol.

Government should be more careful about both HFCs and ODs consumption especially in RAC sector. Based on the CAGR values of Fresh Survey data during 2014-2019 the next 5 years HFCs consumption will be calculated which is shown in **Table 17d.**

Table A17d: Prediction of next 5 years from (2020 -2024) HFCs consumption (MT)

Substance	2019	CAGR %	2020	2021	2022	2023	2024
HFC-134a	1723.023	21.95%	2,101.22	2,562.43	3,124.88	3,810.791	4,647.259
R- 410A	822.479	100.94	1,652.71	3,321.01	6,673.34	6,736.069	13,535.457
R- 404A	21.258	24.55%	29.32	40.44	55.78	69.474	86.530
R- 407C	27.184	37.93%	33.86	42.17	52.52	72.440	99.917
R- 32	11.409	55.97%	4.42	5.5	6.84	10.668	16.639
			3,821.53	5,971.55	9,913.36	10,832.33	18,385.80

8(c) (ii) Prediction of HFCs consumption for the next 5 years based on the assessment of foam application

Prediction consumption in foam application is shown in the **Table 17e:**

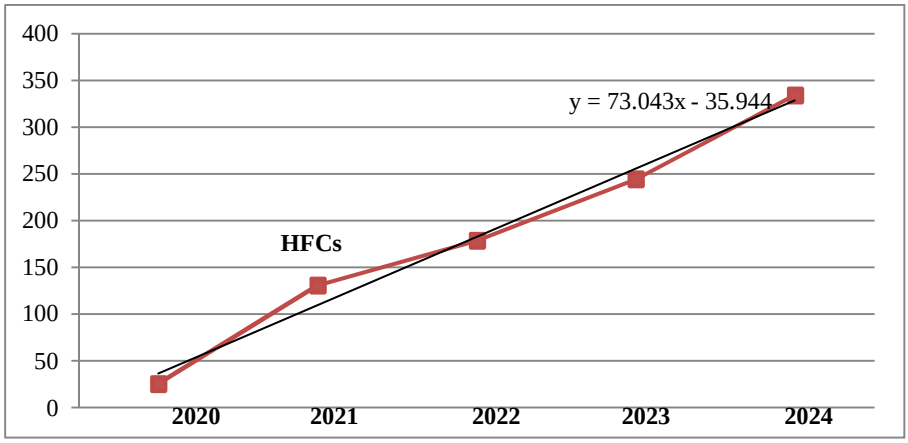
Table A17e: Prediction of next 5 years HFCs consumption in Foam (MT)

Substance	2019	CAGR %	2020	2021	2022	2023	2024
R-134a	19.17	36.6%	26.194	131.14	179.19	244.845	334.556

Prediction for the projection of all HFC consumption for the next 05 years

The projection of HFCs consumption has been calculated from CAGR value assuming the following considerations:

(i) Bangladesh has successfully implemented HPMP Stage 1 and going to implemented HPMP Stage II shortly under the umbrella of the Montreal Protocol along with other policy and regulatory measures. These have already caused an 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 will experience increased growth and consumption, if low GWP options are not made available.



(ii) Accelerated phase-out schedule of HCFCs may increase consumption of HFCs in foam sector due to imposed control on imports and use of pre-blended polyol with HCFC-141b. The foam sector (SMEs) and firefighting secotor may switch over to HFCs.

(iii) The RAC sector grew in the years 2014-2019 with an average compounded growth of around 48.3%. 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.

(iv) In the Aerosol sector, Bangladesh is experiencing a steady growth in terms of production and exports of MDI. The production and exports gradually increased. This scenario would increase in future, because the viable alternatives to HFCs are still at a research stage.

(v) The growth of HFC-227ea is 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 service sector consumption. The consumption in service 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 above, during 2020-2024, on an avearage yearly more than 3,000MT likely increase in HFC consumption is projected.

9. HFCs CONSUMPTION FORECAST UP TO 2040

Last five years survey data is shown in **Table 17d.** The baseline and freeze are shown in **Table 17b**. As per the Schedule of Kigali Amendment, Group 1, Article 5 Parties, 10% of baseline consumption would be reduced from 2029 and 30% from 2035 and 50% from 2040 and 80% from 2045. The % of reduction steps of HFCs up to 2045 are shown in the **Table 18.**

Table A18: % of Reduction steps of HFCs up to 2045

Substances	Current year data	CAGR (%)	Baseline data average of 2020-2022	Freeze Point	10%	30%	50%	80%
	2019		2020-2022	2024-2028	2029	2035	2040	2045
HFC-134a	1723.023	21.95%	2596.180	2596.180	2336.562	1817.326	1298.090	519.236
R-410A	822.479	100.94	3882.358	3882.358	3494.122	2717.650	1941.179	776.472
R-404A	27.184	24.55%	42.847	42.847	38.563	29.993	21.424	8.569
R-407C	21.258	37.93%	41.850	41.850	37.665	29.295	20.925	8.370
HFC-227ea	3.560	55.97%	5.587	5.587	5.028	3.911	2.793	1.117
R-32	11.409	21.95%	29.613	29.613	26.652	20.729	14.807	5.923

As per HFCs phase-down schedule of the Kigali Amentment up to 2045, the growth pattern of the **Figure 4** below showed the drastical decreasing trend of HFCs consumption.

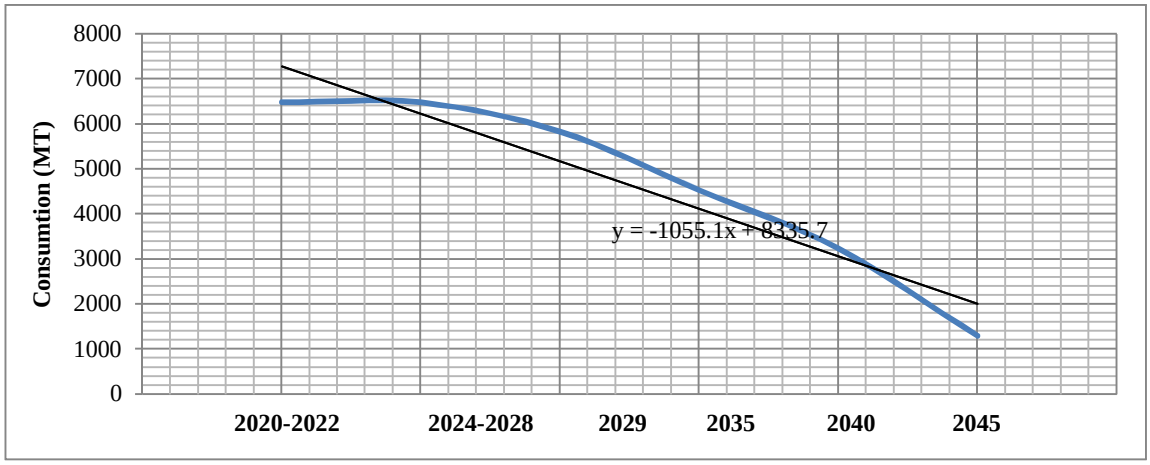


Figure 4: Graphicl representation of HFCs phase-down schedule of the Kigali Amendment up to 2045

10. DOMESTIC RAC EQUIPMENT SAFETY AND BARRIERS FOR ALTERNATIVES

10(i) Nation Regulation and domestic standards for RAC equipment

The safety standards cover the areas of refrigeration, air-conditioning and heat pump (RACHP) equipment. There are many safety standards bodies which operate at international, regional and national levels. The main international bodies are the International Organization for Standardization (ISO) and International Electro technical Commission (IEC). ISO and IEC publish RACHP safety standards. Almost all countries, at the national level, follow these standards.

Bangladesh is facing growing demands to introduce and implement mechanisms to ensure that a range of refrigerant types are fully supported at the national level. There are several alternatives to HCFCs such as HFCs, HCs, $C0_2$ and NH_3. Some if the HCFC alternatives such as HCs and NH_3 have excellent environment and energy benefits but these are flammable and toxic. Therefore, for moving towards non HCFC alternatives it is important that national level standards for installation, transportation, storage, operation and maintenance of such refrigerants in RAC system are placed well before the expected transition.

The Bangladesh Standards and Testing Institute (BSTI) are responsible for developing standards and testing protocols for RAC systems. Currently, Bangladesh has adopted a number ISO and IEC Standards related to the safety and energy efficiency in RAC sector namely:

- BDS-ISO-817 (2018), directly adopted from ISO-817 for refrigerant safety classification.
- ISO 5149 (2014) on safety requirements for mechanical refrigerating systems.
- BDS 1849 (2012) performance standards including those for testing protocols to determine the performance of different refrigerators and BDS 1850 (2012) on Minimum Energy Efficiency rating of household refrigerator and freezers, and
- BDS 1852 (2012) on the performance of AC and BDS 1853 (2012) for their minimum energy performance standards (MEPS) requirements.
- BDS 1853 (2012) for closed control air conditioner performance & their minimum energy performance standards (MEPS) requirements.

The Energy Efficiency Standards & Labeling program is being developed by Sustainable Renewable Energy Development Authority (SREDA). SREDA is at present also developing Green Building Code which would be part of the National Building Code, and also Green Building Rating systems, which are under drafting stage.

10(ii) Barriers to the use of low-GWP refrigerants and how these could be to overcome

10(ii) (a) Barriers

HFCs used in most RAC equipment alternative to HCFCs. HFCs are zero ODP but on average a higher global warming potential (GWP) than HCFCs. Alternative options include refrigerants with low-GWP, which include hydrocarbons (e.g. R-290, R-600a), ammonia (R-717), carbon dioxide (R-744) and new unsaturated HFCs (such as R-1234yf). However, whilst these low-GWP alternatives (LGA) to R-22 can be used across a wide range of RAC equipment, they are not generally applied.

There are different types of barriers, such as technical, supply and availability, commercial, market, information resources, regulations and standards and psychological and sociological aspects. Some significant barriers are: (A) no systems using LGA refrigerants available to buy, (B) no incentive for enterprises to invest in LGA technology, (C) no one is willing to invest in production of systems, parts, components and refrigerants, (D) the present rules for using LGA refrigerants are too restrictive to allow their use and (E) there is a general fear of the safety risks.

10(ii) (b) Overcome barriers

It is possible that the majority of the barriers can be overcome by determination in implementing a number of measures relating to the areas of awareness-raising within the industry, training that is focused on LGAs, appropriate technical and other guidance, technical developments in the areas of system efficiency and safety, local market development for LGAs, financial incentives to favor LGA technologies, improvements and changes to regulatory infrastructure, addressing Montreal Protocol issues and activities of environmental non-governmental organizations. Other precaution measures are **(a)** better leak prevention (tightness), **(b)** improving recovery and reuse practices and **(c)** application of alternative refrigerants. To overcome these identified barriers new technologies would be adopted and appropriate steps would be taken which are shown in **Table 19**.

Table A19: Appropriate steps to be taken to overcome these barriers

Sectors	Barriers	Appropriate steps
RAC	Flammable refrigerants	Training for safety and protection flammability and by adopting technologies
Marketing	Not available in market, High prices	Dissemination information about new technologies ensuring availability in the markets with reasonable prices.
Knowledge	Illiteracy and shortage of institutional skills of the technicians	Training for technicians and vocational trainings for institutions needed
Recovery, recycling & reuse	Want of recovery machines and special containers for storing recovered ODSs safely	Needed training for technicians for handling recovery, recycling and reclamation machines for safely recovered and reused ODSs
Equipment	ODS equipment	Training needed for conversion of ODS equipment into suitable ODS-free alternatives
Technology	Absence of technical knowledge about new technology	Availability of technology needed and disseminated information about alternatives
Rules, regulations and standards	No specific role for use, reuse & safely collection of ODSs refrigerants	Government can adopt roles for ensuring proper standards
Psychological and sociological aspects	Lobbying activities in favour of the use of LGA refrigerants in insufficient to influence decision-makers	Motivate stakeholders to use LGA refrigerants to consider gloval warming reality Informtion dissemination needed Cordinaion between the government of other training institution needed

10(iii) Safety concerns related to flammable alternatives

Fire can occur when flammable material, oxygen and sufficient ignition energy are available. Explosion depends on an atmosphere of a mixture of flammable material with oxygen. The best approach to prevent fires and explosions is to substitute or minimize the use of flammable material. If that is not possible it is important to avoid effective sources of ignition. Small service workshops have a high risk of fires and explosions because they use highly volatile hydrocarbons for spray and cleaning purposes.

Almost everyone works with or around chemicals and chemical products every day. Many chemicals have properties that make them hazardous: health hazards.Followings are the basic safe practices those will help to protect from flammable and combustible liquids: (1) beware of all of the hazards of the materials in working place; (2) eliminate ignition sources (sparks, smoking, flames, hot surfaces) when working with flammable and combustible liquids; (3) use the smallest amount of flammable liquid necessary in the work area; (4) keep storage areas cool and dry; (5) store flammable and combustible liquids away from incompatible materials; (6) store, handle and use flammable and combustible liquids in well-ventilated areas; (7) practice good housekeeping and equipment maintenance. Keep area clear of burnable materials; (8) wear the proper personal protective equipment for each of the jobs; (9) know how to handle emergencies (fires, spills, personal injury) involving the flammable and combustible liquids you work with; (10) follow the health and safety rules that apply to respectible job.

11. INSTITUTIONAL AND REGULATORY FRAMEWORK

11(i) Institutional framework

The Ozone Cell of Bangladesh acts as a National Ozone Unit (NOU), and its overall responsibility is to implement the Montreal Protocol targets. The Ozone Cell plans and coordinates all activities related to fulfilling Bangladesh's obligations under the Montreal Protocol. This unit housed by the Department of Environment (DoE), in the Ministry of Environment and Forest, and has been operational since 1995. The Director General of the DoE is the chairman of the Ozone Cell.

The National Technical Committee on Ozone Depleting Substances (NTCODS) is Steering Committee constituted under the Chairmanship of the Secretary of the Ministry of Environment, Forest and Climate Change to supervise the Ozone Cell. The NTCODS is composed of 17 members: the Secretary of the Ministry of Environment Forest and Climate Change; the Director General of DoE; a representative from each of the Ministry of Industry, the Ministry of Commerce, the Ministry of Home, the Ministry of Agriculture, and the Ministry of Fisheries and Livestock; the NBR; the Fire Service and Civil Defense; the Bangladesh Federation of Chambers of Commerce and Industry; the Bangladesh Cold Storage Association, BRAMA; the Bangladesh Institute of Law and International Affairs, the Bangladesh Association of Pharmaceutical Industries; the Project Director of Ozone Cell; and the Deputy Secretary (Environment) of the Ministry of Environment, Forest and Climate Change.

11(ii) ODS Policy/legislative/regulatory framework controlling ODS, GHGs and other policy network

(a) Ban on the production of HCFCs

The production of HCFCs is banned in Bangladesh, and there are no producers of HCFCs in the country. In a similar manner, imports of bulk HCFC-141b are also prohibited.

(b) Control in the supply and demand of HCFCs

Amended ODS rule: The Ozone Depleting Substances (Control) Rules (2004) were amended in September 2014. The quotas are issued based on an annual maximum allowed consumption which is included in the Schedule II of the amended Rules. Imports of HCFCs are in the form of pure substances, commercial blends containing HCFCs and pre-blended polyols containing HCFCs.

Licensing system: A license is required to import HCFCs. The Director-General, DoE issues licenses after the importer fulfills the stipulated conditions in a satisfactory manner. Importers are required to report the utilization of their respective licenses by the end of the calendar year. The exports of recovered and/or recycled ODS are subject to a Permit issued by the Director-General, DoE. Only licensed organizations can store and distribute ODSs in Bangladesh.

Quota system: The NOU has established a quota system which has been operational since 2013. The quota system includes all HCFCs indicated in the Annex C-Group I of the Montreal Protocol. The quota cycle runs in Bangladesh from January to December each year. The import quotas are distributed based on the importers' previous imports along with their current demands. Importers apply through a dedicated form for the quota to the DoE. There is a six-member ODS Licensing Committee headed by the Deputy Director General (DoE). This committee evaluates applications and recommends the issuance of quotas to the Director-General (DoE). The Director- General is the only responsible to issue such quotas. The DoE retains 30% of the total quotas at this time, which along with unutilized quotas, are re-distributed in the month of July by evaluating the actual utilization of the importers licenses issued for imports. 2-3% of the quotas are retained by the DoE as a buffer in case of emergencies/ unexpected events.

Harmonized System (HS) Customs Codes: Updated HS codes concerning all ODSs including HCFCs are included in the 2014 amended Rules. The current coding system used is based on WCO (World

Customs Organization) prescribed codes (i.e., HS Codes) and with national sub-codes. The HS code is mentioned in the HCFCs licenses that have been issued.

(c) Customs & Enforcement of Licensing and Quota Systems

- The Bangladesh Customs under the umbrella of National Board of Revenue (NBR) is ready to start controlling HCFC trade as soon as a quota can be set, and the Customs is informed of new ICFC regulations. There are four ports that are important for HCFC trade control, namely: Chittagong Warehouse (sea port); Dhaka TCD (inland container depot); Khulna Mongra (railway), and Benapole (land port
- Customs core training curriculum is delivered at the training academy in Chittagong, which is the only one for the Bangladesh Customs. There is an ODS database system at the Ministry of Environment and it is made compatible with the Customs ASYCUDA World import/export registry system to achieve more timely and precise tracking of the trade.
- Bangladesh Customs receive services from pre-shipment inspection companies, located in countries of origin. When shipments arrive in ports in Bangladesh, around 10% are subjected to physical inspection.

(d) Other ODS phase-out sectors

The licensing, quota and enforcement framework has been crucial for achieving compliance in Bangladesh. It is important that the NOU is supported for developing institutional partnerships and policy development leadership in: ODS trade control, ODS equipment ban, promotion of non-ODS technologies, and Climate & Energy-Use linkages of HCFC phase-out.

(e) Policies and Regulations

Policies and targeted regulations that are enforceable without distorting the markets will be instrumental in controlling the consumption of HCFCs, for meeting the phase-out targets till 2025. The ODS Regulation and Control Rules will be amended in the due course of time to align with the accelerated phase-out schedule of HCFCs. During HPMP Stage-11, a more stringent action plan will be worked out for effective enforcement of this regulation to ensure that the import of HCFC-based equipment will be prohibited as soon as possible.

11(iii) Impact of ODSs and these alternatives on the environment

HCFCs are Ozone Depleting Substances.These detroyed Ozone layer. Ozone layer thinning is most pronounced in the Polar Regions, especially over Antarctica. Ozone depletion is a major environmental problem because it increases the amount of ultraviolet (UV) radiation that reaches Earth's surface, which increases the rate of skin cancer, eye cataracts, and genetic and immune system damage. The Montreal Protocol is also expected to have effects on human health. The protection of the ozone layer under the Montreal Protocol treaty would prevent over 280 million cases of skin cancer, 1.5 million skin cancer deaths, and 45 million cataracts in the United States only (U.S. EPA, 2015).

HFCs have been used in various sectors as alternatives to HCFCs. The effect of these alternatives is clearly showed that a decrease in the atmospheric burden of ozone-depleting substances and some early signs of stratospheric ozone recovery. However, the HCFCs and HFCs are now thought to contribute to anthropogenic global warming. On a molecule-for-molecule basis, these compounds are up to 10,000 times more potent greenhouse gases (GHGs) than carbon dioxide. The Montreal Protocol currently calls for a complete phase-out of HCFCs by 2030. For the first step of the Kigali Amendment, 10% will be reduced in 2029, 30% in 2035, 50% in 2040 and, 80% reduced in 2045. Policy experts have advocated for increased efforts to link ozone protection efforts to climate protection efforts.

12. CONCLUSIONS AND RECOMMENDATIONS

12.1 Conclusions

1. As GDP growth of Bangladesh is increasing the purchasing capacity of RAC commodities is increasing
2. The consumption of ODSs were gradually decreasing and ODS alternatives were rapidly increasing.
3. The RAC sector dominated by HFCs and R-600a replacing the HCFCs. About 40% of the total demand met through R-600a and 60% through the HFCs and HFC blends.
4. In PU foam, it is anticipated to be completely converted to HFCs, HC and water-based technologies.
5. In MAC, the major share is R-134a. There is no suitable/ freely available alternative in this sector. It is expected to stay with R-134a in the next decade.
6. In Aerosol, for the preparation of MDI met the increasing need by R-134a as propellant.
7. HC-based solvents used alternative to ODS, such as toluene, benzene, thinner, while petrol etc.
8. In firefighting system, there are water based system, foam, CO_2, HFC-227ea and dry powder.
9. As per Kigali Amendment, a strategic roadmap along with action plan could be developed for compliance with the HCFC phase-out and HFC phase-down schedule.

12.2 Recommendations

Based on the above, the following actions could be taken for reducing the country's dependence on high GWP ODS alternatives (mainly HFCs) and to facilitate a fast adoption of low GWP ODS alternatives:

- Prepare a national strategy for the phase-down of HFCs that include the actions to undertake, the time spam and the associated cost for the complete phase-out.
- Provide demonstration project with alternative technologies.
- Provide training programs to the formal and informal sector technicians on safe use of alternatives through practical demonstrations.
- Certification of service technicians may be established during implementation of HPMP Stage-II.
- A course curriculum related to the ozone issue may be introduced for regular students of technical institutes.
- Strengthen industrial associations with information through continuous discussions and training programs on environmental issues.
- Set the necessary regulations to support phase-out of HFCs, adopt new local standards and codes to encourage the use of safe and energy efficient alternatives to HFCs.
- To undertake conversion project is very much important to reduce the use of HCFCs and HFCs. Energy efficiency may be considered during conversion.
- Safety measures should be ensured for servicing workshop and production level during use of flammable refrigerants and safety monitoring and audition system should be introduced.
- RAC training should be continued and to provide necessary equipment to RAC technicians.
- Create awareness programs on new alternative technologies which are safe and energy efficient.
- Awareness rising will be required for end users and also for general public.
- Recovery and recycling project could be planned for ship breaking industries & RAC Servicing.
- A reclaiming project can be undertaken for recovered contaminated refrigerants.

SECTION B

EVALUATION OF DATA REPORTING SYSTEM

1. INTRODUCTION

The Montreal Protocol on Substances that Deplete the Ozone Layer establishes the phase-out schedules for production and consumption of the most harmful ozone depleting substances (ODS). Different phase-out schedules applied to the industrialized and developing countries. Now, ODS phase-out is in different stages of implementation across the globe. Eventually, production and consumption of ODS need to be phased out globally.

At the 28th Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer in October 2016 in Kigali, Rwanda, agreement was reached to add the phase-down of hydro fluorocarbons (HFCs) to the substances controlled by the Protocol. The Kigali Amendment to the Montreal Protocol entered into force on 1 January 2019, following ratification of 65 countries. This historic amendment commits countries to phase-down the production and consumption of HFCs according to agreed schedules. While not ozone depleting, HFCs have high global warming potentials, of up to almost 15,000 times more powerful at warming the atmosphere than carbon dioxide. So, the Montreal Protocol is set to achieve a significant contribution in combating climate change, avoiding up to 0.5°C of global temperature rise by the end of the century, thus contributing to the climate protection aspirations of the Paris Agreement. One of the important commitments of the Protocol is that of reporting the consumption and production of substances controlled under the Montreal Protocol. Following ratification of the Kigali Amendment, this commitment is now extended to HFCs.

During amendment, it also decided regarding data reporting that each Party shall provide the ozone secretariat with statistical data on controlled substances: *"in Annex F for the year 2011 to 2013 except that Parties operating under paragraph 1 of Article 5 shall provide such data for the year 2020 to 2022, but those Parties operating under paragraph 1 of Article 5 to which subparagraphs (d) and (f) of paragraph 8 qua of Article 5 applies shall provide such data for the years 2024 to 2026 ….or the best possible estimates of such data where actual data are not available, not later than three months after the date when the provisions set out in the Protocol with regard to the substances in Annexes B, C, E and F respectively enter into force for that Party"*

This new sub-paragraph provides the detail of the national requirements for data reporting for HFC consumption and production which will be used to establish the HFC baselines for both groups of Article 5 countries. The following paragraph includes another small but very important addition, that is the addition of Annex "F" to the list of Annexes referred to. Therefore, countries that have ratified the Kigali Amendment are committed to provide to the Secretariat statistical data separately for substances in Annexes A, B, C, E and F on annual production, and on: *"imports from and exports to Parties and non-Parties respectively, for the year during which provisions concerning the substances in Annexes A, B, C, E and F respectively entered into force for that Party and for each year thereafter."*

The important consequence of this text is that 90 days after the date of ratification of the Kigali Amendment, the Amendment will enter into force for that Party and it is required to report HFC production and consumption data for that year. For example, if a country ratified the Kigali Amendment on 25 September 2019, the country's ratification will enter into force on 24 December 2019. As per Article 7 paragraph 3 of the Montreal Protocol, the country is required to report HFC data starting from the year during which the Kigali Amendment entered into force for that country (i.e. 2019), and for each year thereafter. Data shall be forwarded no later than nine months after the end of the year to which the data relate.

Bangladesh ratified Kigali Amendment to the Montreal protocol on 8 June 2020. So, as per Article 7 paragraph 3 of the Montreal Protocol, Bangladesh has to submit HFC consumption data for the year 2020 by September 2021 to the Ozone Secretariat and by 1 may 2021 to the Fund Secretariat.

Table: Schedule of data reporting for Bangladesh

Ratification Date	Date of Entry into force	First year for which data to be reported	Date by which data should be reported
8 June 2020	6 September 2020*	2020	30 September 2021

*90 days after Ratification date; *Entry into force of Kigali Amendment

2. THE IMPORTANCE OF DATA REPORTING

Monitoring Implementation of ODS phase-out as well as HFCs phase down relies on data reporting to the Ozone Secretariat in Nairobi and to the Montreal Protocol Multilateral Fund Secretariat in Montreal. Data reporting is also a legal obligation to the Parties under the Protocol. The Ozone Secretariat uses the data submitted by the Parties to assess compliance of the Parties. The data also serve as the basis for monitoring the progress of the global efforts to protect the ozone layer as well as climate change and to identifying any problems with reaching a timely transition to environment friendly alternatives. This enables the Parties to the Montreal Protocol to take timely action, if needed, so as to protect the ozone layer and climate effectively. Data reporting by developing countries to the Fund Secretariat enables the Executive committee to assess the present success and future need to be supported for smooth ODS phase-out and HFC phase-down. It also provides the basis of future planning activities of the Multilateral Fund including the efficient allocation of resources among the Parties.

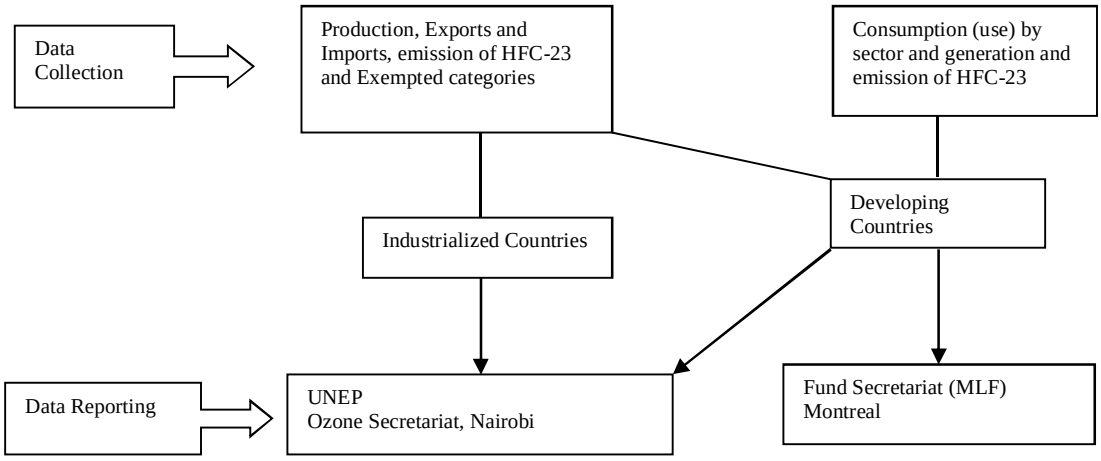
For the Parties, collecting the necessary data not only serves the purpose of fulfilling the reporting requirements under the Protocol but also essential for a sound basis for monitoring the national phase-out of ODS and phase-down of HFCs, planning further measures and developing national phase-out and phase-down strategies.

3. THE SYSTEM OF DATA REPORTING

It is important to be aware of the process of data collection and data reporting for the concerned authority. Usually the government's National Ozone Unit (NOU) collects the necessary information from various sources and reports it to the Ozone or the Fund Secretariat annually. The Ozone Secretariat and the Fund Secretariat receive the data from the NOUs. The Secretariats assess fulfillment of reporting requirements, and analyze the information contained in the country data reports submitted by the Parties.

As the NOUs have to report data to the individual Secretariats, each with differing data requirements, the two streams of data reporting have to be distinguished:

1. All Parties have to collect and submit calendar year data on production, imports, exports of ODS , HFCs and emission of HFC-23 in accordance with Article 7 of the Protocol to the Ozone Secretariat located in Nairobi.
2. Developing country Parties operating under Article 5 of the Protocol and receiving assistance from the Montreal Protocol Multilateral Fund are required to submit data to the Fund Secretariat in Montreal. Data on production, imports, exports and consumption (use) by sector and generation and emission of HFC-23 need to be reported in the course of preparing Country Programmes (CP) as well as annually thereafter.



Upon receiving data by the Parties, the Ozone Secretariat will calculate production and consumption of the different groups of controlled substances and report these data to the Meeting of the Parties. On the basis of these data, Implementation Committee under the Non-Compliance Procedure to the Montreal Protocol asses compliance status of the countries and report to the Meeting of the Parties (MOP) for further action, If necessary.

The Fund Secretariat asses the received data in elaborate way (including conversion of metric tons to ODP tons) and report to the Executive Committee of the Multilateral Fund. The Ex Com. will then use the data to assess how the ODS phase-out and HFC Phase- down are progressing as per Country Programme as well as agreement between the Ex. Com. And the relevant government, If any.

Under the Protocol, Consumption = production + imports – exports. This consumption should not be mistaken for actual consumption (use) by sector to be reported to the Fund Secretariat. Sometime, Consumption (use) by sector refers to ODS and/or HFC use in individual sectors. Production is defined as gross production minus amounts destroyed minus amounts used as feedstock. Under the Kigali Amendment data on HFC will calculated in similar fashion along with HFC -23 emissions. It should be assured that the same government office reports data to both Secretariats. Ideally, this should be the NOU. Timeline for data reporting to the Ozone Secretariat is 30 September and to the Fund Secretariat by 1 May each year. But it is better to collect and report data to both the Secretariats at the same time, if possible, to reduce any discrepancies.

4. DATA REPORTING OBLIGATION TO THE OZONE SECRETARIAT

All Parties to the Montreal Protocol are obliged to report data annually to the Ozone Secretariat in Nairobi. Developing country Parties operating under Article 5 of the Protocol (Article 5 Parties) and receiving assistance from the Multilateral Fund also have to submit data annually to the Fund Secretariat in Montreal.

According to Article 7 of the Montreal Protocol, all Parties have to report data to the Ozone Secretariat in Nairobi, using the approved data formats. Country's reporting obligations can refer to ODS contained in different groups in the Annexes A, B, C, E and HFCs listed in the Annex F of the Protocol.

According to Article 7 of the Montreal Protocol, each Party is required to report on three main categories of data: imports, exports and production for each of the controlled ODSs and HFCs. Data on these main categories have to be reported in specific forms (Data Form 1-3). Additional data forms exist for amounts destroyed (Data Form 4), imports from and exports to Non-Parties (Data Form 5), quantity of Emissions of HFC 23 from Facilities Manufacturing Annex C Group I or Annex F Substances (Data Form 6), imports of Annex F Substances for Exempted Subsectors (Data Form 7), and production of Annex F Substances for Exempted Subsectors (Data Form 8). The specific data categories to be reported in the data forms are the following:

- Data Form 1 on Imports: Parties need to report data on all bulk ODSs and HFCs imported, irrespective from where and for what purposes, using this data form. The total imports to be reported are divided into imports of new (virgin) substances and imports of recovered or reclaimed substances. Imports of some exempted categories (feedstock, essential uses and methyl bromide for quarantine and pre-shipment applications, and exemption for high-ambient-temperature Parties), which form part of the total imports of new (virgin) substances, have to be reported separately in the same data form.
- Data Form 2 on Exports: Parties are required to report data on all bulk ODS and HFCs exported, irrespective to where and for what purposes, using this data form. The total exports to be reported are divided into exports of new (virgin) substances and exports of recovered or reclaimed substances. Exports of some exempted categories (feedstock, essential uses and methyl bromide for quarantine and pre-shipment applications, and exemption for high-ambient-temperature Parties), which form part of the total exports of new (virgin) substances, have to be reported separately in the same data form.
- Data Form 3 on Production: Parties that produce ODS and HFCs have to report data on total production of ODS and HFCs, irrespective of what purpose the ODS and HFCs are finally put to. Production of some exempted categories (feedstock, essential uses and methyl bromide for quarantine and pre-shipment applications, and exemption for high-ambient-temperature Parties), which form part of the total production, has to be reported separately in the same data form.
- Data Form 4 on Amounts destroyed: Parties that have destroyed ODS and HFCs using approved technology can claim credit for this destruction by reporting the amounts destroyed.
- Data Form 5 on Import from and Export to Non-Parties: Parties need to report data on ODS and HFCs imported from and exported to Non-Parties using this data form. The amount reported in this data form should be part of the total imports and exports reported in the Data Forms 1 and 2. A Non-Party is defined by its status vis-à-vis the Montreal Protocol of 1987, the London Amendment, the Copenhagen Amendment, Beijing Amendment and Kigali Amendment respectively. Exports of HFCs should not be reported under data form 5 but should be reported under data form 2. Any export of HFCs that is nonetheless reported on Data Form 5 shall not be treated as export to non-Parties for the purpose of calculating the consumption levels as specified in paragraph 1 (c) of Article 3 of the Montreal Protocol.
- Data Form 6 on Quantity of Emissions of HFC 23 from Facilities Manufacturing Annex C Group I or Annex F Substances: Few countries will have manufacturing facilities for Annex C Group I or Annex F substances that generate HFC-23. If a Party has such facilities that were operational in the reporting period, Data Form 6 is to be used to report emissions of HFC-23 from each facility. If there were no

emissions from a manufacturing facility, it us to be included the facility in the data form and enter a zero in the emissions column.

- Data Form 7 on Imports of Annex F Substances for Exempted Subsectors: If a country formally notified the Secretariat, as specified under paragraph 29 of decision XXVIII/2, of its intention to use the exemption for high-ambient-temperature parties and is listed in appendix II of decision XXVIII/2, data form 7 is to used to report quantities of new HFCs imported for use in approved subsectors as listed in appendix I to the decision. Those imports must be for use within the country and not for export. In case other subsectors are approved after the assessments under paragraphs 32 and 33 of decision XXVIII/2, please use the additional columns in the data form to specify the approved subsectors and the amounts imported for use in those subsectors. Only bulk gases for servicing of equipment in the exempted subsectors should be reported here, not gases imported inside pre-charged equipment. Bangladesh is not eligible for this exemption.
- Data Form 8 on Production of Annex F Substances for Exempted Subsectors: Very few countries listed in Appendix II of decision XXVIII/2 have production facilities for Annex F substances (HFCs). If a country formally notified the Secretariat, as specified under paragraph 29 of decision XXVIII/2, of its intention to use the exemption for high-ambient-temperature parties and is listed in Appendix II of decision XXVIII/2, data form 8 is to be used to report quantities of HFC produced for use in approved subsectors as listed in appendix I to the decision. That production must be used within the country and not for export. Bangladesh will not be belonging to this kind.
- Exempted Categories: Countries may need to report data on a number of categories that are exempted from controls (exempted categories). Whether it is required to submit data on these exempted categories in the Data Forms 1-4 depends on the specifications (applicable) of the country. The following explanations might assist you in assessing whether your country has to report on exempted categories:

    - Feedstock.
    - Quarantine and pre-shipment applications (QPS).
    - Amounts destroyed.
    - Used substances (recovered and reclaimed).
    - Essential uses
    - Critical Uses
    - Analytical uses, and
    - Exemption for high-ambient-temperature parties (not applicable for Bangladesh)

- Increased production: Producer countries are allowed to increase production, above control levels, to meet the basic domestic needs of Article 5 Parties

All Parties have to submit data reports for all years beginning with the year in which the Protocol entered into force for the reporting country (90 days after ratification). If no data are available, best estimates should be reported. Annual data reports to the Ozone Secretariat are due by 30 September of each year and contain data related to the previous year.

If developing countries want to seek the assistance of the Multilateral Fund and the Implementation Committee, this period may be extended for another two years. Within one year of the approval of the Country Programme and the institutional strengthening by the Executive Committee of the Multilateral Fund, the data must be submitted (Decision VI/5). In general, countries not submitting data or submitting inconsistent data will be requested by the Ozone Secretariat to comply with the data reporting requirements. Such cases can also be put on the agenda of the Implementation Committee of the Montreal Protocol, which may ask Parties concerned for explanations and could recommend suitable action to the Meeting of the Parties.

5. DATA REPORTING OBLIGATION TO THE MULTILATERAL FUND SECRETARIAT

Only developing countries accessing the resources of the Multilateral Fund need to report data (and other information) to the Fund Secretariat. The Fund Secretariat on its data forms reproduced in Annex II requires data reporting on all controlled substances. Country Programme (CP) data reports represent the sole source of information on the sector distribution of the use of these controlled substances in Article 5 countries. Based on the CP data reports, the Secretariat prepares a document on CP data and prospects for compliance, which the Executive Committee considers at each meeting.

Article 5 countries are required to submit annual reports on the progress in the implementation of the CP for the previous calendar year to the Fund Secretariat, eight weeks prior to the Executive Committee's first meeting of the year, if possible, and no later than 1 May, in line with decision 74/9(b)(iv). The CP data report format contains six separate sections as described below:

	Section	**Description**
A.	Annex A - Groups I and II Annex B – Groups I, II &III Annex C - Group I Annex E	Data reporting of controlled substances of: Annex A - Group I (CFCs) and Group II (halons); Annex B – Group I (CFC-13), Group II (CTC) and Group III (TCA); Annex C - Group I (HCFCs); Annex E (MB)
B.	Annex F - Consumption	Data reporting for HFCs (including HFC-23 use) and HFCs contained in imported pre-blended polyols
C.	Price of HCFCs, HFCs and alternatives	Average estimated freight on board (FOB) or retail price of controlled substances. Prices could be obtained from importers and/or suppliers. Retailer price data can include taxes and transportation costs.
D.	Annex F, Group II (HFC-23 generation)	Quantification of HFC-23 by-product generation, only related to countries with manufacturing facilities for Annex C Group I or Annex F substances that generate HFC-23. The amounts of production or generated HFC-23 that is captured for use, feedstock, destruction or storage.
E.	Annex F, Group II (HFC-23 emissions)	Emissions of HFC-23, only related to countries with manufacturing facilities for Annex C Group I or Annex F substances that generate HFC-23. Emissions of HFC-23 should be reported separately for each manufacturing facility.
F.	Comments by bilateral/IA	Narrative comments

For countries that have ratified the Kigali Amendment, CP data reporting for Annex F substances is mandatory. Countries that have not ratified the Kigali Amendment are encouraged to submit data on Annex F substances on a voluntary basis. Data forms D and E are only relevant to countries with production facilities of controlled substances.

Discrepancies in Data Reporting: Article 5 countries are required to submit data on imports, exports and production of controlled substances under Article 7 of the Montreal Protocol to the Ozone Secretariat. The columns for import, export and production in the CP data report format should be consistent with the data reported under Article 7. Where there is a discrepancy, the country should provide an explanation for the difference in the "Remarks" column in Sections A, B and E.

However, sectorial consumption (use) data required by the Fund Secretariat reflects actual "use," since it is this use of ODS that needs to be phased out in specific sectors. Consequently, discrepancies might occur between consumption data calculated by the Ozone Secretariat and the consumption (use) reported to the Fund Secretariat. These inconsistencies might occur due to the application of different data collection techniques. The reasons for this can be;

- Stockpiling might lead to lower or higher consumption (use) of controlled substances as compared to consumption calculated by the Ozone Secretariat (production + imports – exports) depending on whether stocks are increased or reduced in any one year. Increases and reductions in stocks should balance in the longer term. It might, however, lead to considerable discrepancies in a given year.
- Imports of used substances (recovered and reclaimed) are not included in the consumption as calculated by the Ozone Secretariat, but are part of the total consumption (use) reported to the Fund Secretariat. As there are only very limited imports of such used ODS in developing countries, this has not yet been a serious problem.
- According to Article 3 (c) of the Protocol, (re-)exports to Non-Parties are not deducted by the Ozone Secretariat when calculating consumption. Thus, the consumption figure of the Ozone Secretariat might be higher than the actual ODS consumption (use) reported to the Fund Secretariat.
- Some re-exports from Article 5 Parties to other Parties may not be reported. In this case, consumption (use) reported to the Fund Secretariat by the re-exporting country might be lower than the consumption calculated by the Ozone Secretariat for the same country.

The Multilateral Fund and its Implementing Agencies (UNDP, UNEP, UNIDO and the World Bank) need to have information on the state phase-out activities as an input for their planning processes. In the case of non-reporting, the Fund Secretariat will initially request you to report. Resource flows from the Multilateral Fund might be delayed or temporarily halted. It is therefore in each country's interest to provide complete data on time to the Fund Secretariat.

6. DATA COLLECTION

For country's reporting obligations, we need to collect the necessary data. Article 5 Parties reporting to both Secretariats should make sure that data collection for this is done in one effort keeping in mind that collection of data on the substances depends on reporting obligations and categories of data need to be collected depends on the characteristics of the country. All Parties to the Protocol have to collect import data.

All Parties to the Montreal Protocol have to report on imports of ODS and HFCs. Therefore, a Party might have to collect import data on the following data categories:

1. New substances
2. Used substances
3. QPS
4. Feed stocks
5. Essential uses
6. Critical Uses
7. Import from nonparties

The following techniques may be taken for data collection regarding import of ODS in the country:

1. A properly designed licensing and monitoring system may be the best way to collect import data.
2. Yearly data update survey by the National Ozone Unit will be required for sector wise consumption.
3. Customs data is easily accessible and might help to generate approximate import figures but will not suffice to meet the specific data requirements. And not fully dependable for compliance issue but of course helpful for cross check.
4. Direct information from importers can also be used, but may not be helpful to collect total information.
5. Data Estimates or statistical data will only deliver crude results and may only be used for double-checking with other data sources and as a last resort.

Import and Export of bulk substances can be in the form of pure substances or in a mixture containing one or more controlled substances. In particular, a large number of mixtures used as refrigerants and solvents exist. Mixtures are, however, also in use in other sectors. Only those parts of mixtures that consist of the specific substance to be reported on should be included in the substance-specific data to be reported to the Ozone Secretariat and also to the Multilateral Fund Secretariat.

In 1997, the Meeting of the Parties to the Montreal Protocol agreed that each Party should adopt a licensing system for the import and export of new, used, recycled and reclaimed controlled ODS by 1 January 2000. This will help control trade in ODS and ensure compliance with the phase-out schedules under the Montreal Protocol. Bangladesh has ODS licensing system under "Ozone Depleting Substances (Control) Rules, 2004" amended in 2014. The basic principle of import, export licensing system is that designated authorities in a country are made responsible for granting licenses for import and export of substances. A license would be required for both pure and mixtures. All importers (and exporters) are then expected to have such a license or permit prior to undertaking trade in bulk ODS. This is the major source of data for reporting purpose. The licensing system for HFCs has yet to be established.

For cross checking imports and Exports of control substances (ODS and HFCs), customs statistics are an obvious source of data. The customs authorities of most of the countries use common customs codes in their customs statistics. These are laid down in the framework of an international customs agreement: the Harmonised Commodity Description and Coding System (in short, the **Harmonised System** or **H.S**) under the H.S Convention of 1988. As of March 1998, 91 countries were Party to the Harmonised System Convention. The HS can be reviewed and adapted. This is generally done once every four years. Developing countries are allowed to delay the application of certain parts of the HS. The HS has been

adapted to take into account the concerns of the Parties to the Montreal Protocol and might be changed further in this respect in the future.

The Harmonized System is organized in 96 Chapters. These are subdivided into different Headings and Subheadings. A traded product or a class of traded products is subsumed under a specific Subheading. It may be identified by a number containing up to 6 digits, where:

1. the first two digits indicate the HS **Chapter** under which the product is categorized,
2. the next two digits indicate the relevant **Heading**, and
3. the last two digits indicate the **Subheading** under which the product is subsumed.

While each Party to the HS Convention has to use the agreed HS number of up to 6 digits, countries may decide to further subdivide the international nomenclature by adding more national digits. The Parties to the HS Convention cooperating in the framework of the World Customs Organisation (WCO) can recommend assigning of such national digits to specific goods. All **pure ODS** are contained in different Subheadings of Chapter 29 "Organic Chemicals", Heading 03 "Halogenated Derivatives of Hydrocarbons." The 6-digit number of any controlled substance thus usually takes the following form:

HS 6-digit code of the controlled substance	29	03.	XX	YY
Representing the numbers indicating	Chapter	Heading	Subheading	National extension
For pure ODS	Organic Chemicals	Halogenated Derivatives of Hydrocarbons	Depending on subheading	Depending on national code system

One of the important requirements of the Kigali Amendment to the Montreal Protocol is that from 1 January 2019 (or two years later if required) an import and export licensing system for hydrofluorocarbons (HFCs) needs to be in place in each country that is Party to the Kigali Amendment. This applies to both Article 5 and non-Article 5 countries. To enable a licensing system to function effectively it is important that the government is able to monitor and record imports and exports of each specific HFC individually. Import and export statistics are normally collected by customs officers using the international product nomenclature system - the Harmonized Commodity Description and Coding System, or Harmonized System (HS). However, until the HS is revised in 2022, all HFCs are contained in a single HS code which does not allow differentiation of the individual chemicals or of mixtures (also referred to as 'blends'). In advance of the release of the new version of the HS, there are actions which countries can take in the interim. The suggested approach is to establish additional digits in the national HS codes to identify specific HFCs.

To facilitate monitoring and control over imports and exports using the HS, a country has the option to add additional subdivisions, at the national level, under the six digit HS code. Section 4 of Article 3 of The International Convention on the Harmonized Commodity Description and Coding System allows for further national subdivisions below the six digit level. It is thus recommended that countries use national subdivisions at the seven or more digit levels under the existing headings and subheadings to account for specific HFC and HFC-containing mixtures under HS 2017. Where appropriate a regional approach could be adopted. Therefore, as an interim measure, the WCO approved at its Council Session in June 2019 a new Recommendation that HS Contracting Parties insert as soon as possible the relevant new additional subheadings in their statistical nomenclatures. Countries are therefore recommended to expeditiously insert additional subdivisions for the HFCs and HFC-containing mixtures controlled under the Montreal Protocol by virtue of the Kigali Amendment.

To collect information on controlled substances imported (and exported) based on customs codes, it is a must to work together with the customs authority. Customs should be informed about the relevant customs codes and to ask for information on amounts and country of origin (or destination). The latter will enable to check which amounts of ODS might have been traded with Non-Parties. The customs authority should then be able to provide data on imports (and exports) that have occurred under each code within a specified period of time (e.g. the calendar year). This should enable to add up the total imports of substances for which there are specific codes and obtain maximum quantities for codes which have more than one substance or mixture included in them.

Customs codes can be used to generate import (and export) data in particular for the pure substances for which unique customs codes exist. It will not be possible to identify whether and to which extent the imported amounts belonged to an exempted category (used controlled substances, feedstock, and essential uses). Furthermore, customs data will hardly allow generating substance-by substance data for other pure controlled substances, since all HCFCs and HFCs are each subsumed under one common customs code. In the case of mixtures, the inadequacy of customs codes is even greater. The indicated customs codes do not exclusively cover mixtures.

In the absence of legal requirements (e.g. under a licensing system), a voluntary submission of data on imported quantities by importers has been widely used as a source of data. In order to collect complete data, all relevant importers need to be covered by the reporting scheme. In this respect, it is important to note that some user industries might import directly for their own use. Also, wholesalers that import need to be covered. In identifying the importers, it might be useful to refer to the inventory of trade names available since many of the relevant companies will know the traded products by trade name rather than substance.

In Bangladesh, data is collected from the importers under licensing system. Again no data collection mechanism has yet to be established on HFCs. All relevant categories of import data can, in general, be collected through this voluntary system. To what extent all needed data are supplied by the importers depends, however, on the negotiations with them. In addition, it is very difficult and often impossible to determine whether the information is complete and accurate, as it is collected on a voluntary basis. Data can easily be double-counted or omitted. Some importers might be overlooked. No legal action can be taken to force an importer to provide (accurate) data. Because of these limitations, it is advisable not to rely exclusively on the voluntary approach for generating import data but to consult additional data sources.

A particular problem is posed by the requirement of the Montreal Protocol to report import, export and production data for past years irrespective of when a country became a Party to the Protocol. In these cases, it might be necessary to report on years for which actual data are not available. If so, the Protocol requires Parties to submit estimates.

For production, it should not be necessary to estimate past data; for exports, it will hardly be possible. Several surveys suggested that Bangladesh neither exports nor produce substances controlled under Montreal Protocol. In the case of imports, existing data can be used to extrapolate estimates for past years. For example, a nonproducing non-exporting country may have imported and consumed 12 tons of substances in 2016 and 24 tons in 2020. Under the assumption of constant annual growth rates, one might estimate imports of 6 tons for 2012. Such extrapolation will only yield very crude results. Better results will be achieved if one takes into account any change that might have occurred in the factors influencing imports (economic growth, consuming industries, etc.). In particular, there is a correlation between the growth of Gross National Product (GNP) and consumption. Estimating import data of countries producing and/or exporting substances will be more difficult. Imports have to be estimated not only on the basis of past import data, but estimation has to take into account available production/export data. Thus, imports may decrease if a country increases its production. In contrast, imports may increase if exports grow.

The same techniques may be applied for estimating past and present import data. However, estimates generate only crude results. Data should therefore be estimated only as a last resort. Estimation is especially useful, and might be needed, for generating data for past years (including baseline years) when other data sources are unavailable. In addition, estimates can be done to check the accuracy and consistency of data collected from other sources.

Article 5 Parties accessing resources of the Multilateral Fund have to report data on consumption (use) by sector to the Fund Secretariat. Therefore, sector-specific consumption (use) data have to be collected by these Parties. For this purpose, identification of the main chemicals using sectors is an important first step.

Collecting data on consumption (use) by sector is a complicated task. Generally, three different techniques can be used for collecting data on consumption (use) by sector: use of a licensing system, surveys of user companies, and estimation. Use of these techniques for this purpose is described in the following.

In the framework of an import/export licensing system, importers can be required to provide data on the intended use/application for which the chemicals is imported (or exported). In such a system, importers would

have to keep records of their chemicals sales and the intended uses. The information can then either be inspected by the designated authority operating the licensing system or reported by the importers on a regular (e.g. annual) basis. This enables the designated authority to collect data on consumption (use) by sector. A well designed licensing system can generate all data that need to be reported. The NOU, if not operating the licensing system itself, needs to acquire this information from the designated authority.

For conducting regular surveys, inventory of relevant companies should be done. This inventory needs to include companies using substances in a production process (e.g. production of refrigerators and foams), servicing equipment (e.g. re-filling refrigerators and fire extinguishers) and applying them (e.g. for cleaning and, in the case of methyl bromide, fumigation). Wholesalers that might sell to small end-users also need to be covered, since importers will only have limited knowledge of the final use of imported substances. Such an inventory can be created based on knowledge about the main user sectors and sub-sectors.

The consumption (use) by companies and sectors can also be estimated. For example, a producer of refrigerators may be known to use HFC and to produce "x" number of household refrigerators per year. In this case, it might be multiplied the number of refrigerators produced "x" with the average HCF use per unit. The average HFC use per unit could be derived from past experience. Such use per unit depends on the applied technology. In this way, it will arrive at the estimated annual consumption of HFC by the manufacturer in question. The consumption (use) of sectors may be estimated on the basis of the known net imports of controlled substances (import – export + production). However, the possibility of discrepancies between net imports and consumption (use), in particular because of stockpiling and unrecorded exports needs to be taken into account.

There are specific limitations to each of the techniques that can be used for collecting data on consumption (use) by sector. We should thus be aware that:

1. The substance may have been used for a different use from that reported under a licensing system. This is because importers cannot guarantee the final use of the substance.
2. Surveyed user companies might not necessarily supply correct or complete information. Companies, especially small and medium-sized enterprises, might be overlooked or missed within a sector. On the other side, the amounts can easily be double-counted. This can occur because importers, end-users and wholesalers might report on the same quantities which they traded among themselves.
3. If net imports are based on accurate data, estimates of consumption (use) by sector can be quite reliable predominantly used in one sector.

Estimates of consumption (use) by single companies might only be applied if no other data sources are available and for cross-checking the results of other data collection techniques. The limitations of the individual techniques for collecting consumption (use) data might be overcome by applying as many of the techniques as you can. Data on (net) imports and a rough sectoral distribution may be collected using a licensing system. Surveys can provide more detailed information on the sectoral distribution of consumption (use). Such surveys can most easily be applied to generate information from the major consuming companies. Furthermore, it can be allocated any unaccounted amounts to specific sectors using the outlined estimation technique. Combining the collection techniques also implies plausible explanations for any differences in the collected data. Survey data, data collected in the framework of a licensing system and estimates of consumption (use) data may diverge because of some limitations.

Bangladesh is not a exporting or producing country as previous survey indicates. So data on export and production need not to be collected. Again, it is also reported in the survey (2020) that there are no potential use of exempted categories of substances used except potential aerosol used in pharmaceutical sector can be taken care of and reported to the Fund Secretariat.

Proper reporting of data is essential. If inaccurate or inconsistent data are reported to the Ozone Secretariat, country might be questioned about its fulfillment of the Protocol's provisions. Good data are also important as a basis for your government's monitoring of, and planning for, the national plan. In order to secure high data quality, it is advisable to check the accuracy of the data before submitting them. To do so, we should first add up all the collected data so that we arrive at aggregate figures for the data categories to be reported on for each individual controlled substance. Several methods can be used for checking the accuracy and consistency of the data:

- Checking Time Series: One of the easily available indicators of the accuracy and consistency of data reporting are reports. These records, before submitting of country's annual data report, we should compare the data of several past years with the current data. By doing such a check of the time series, we may be able to identify any unusual changes in the current year. If it detects such changes – e.g. if the current figures are much higher or lower than the numbers of previous years –plausible explanation might be checked.
- Comparing Results of Different Data Sources: For import, consumption (use) and export data, we can and should draw on different data sources and data collection techniques. By cross-checking the overall results of the different data sources, we might detect discrepancies. If so, we should look for plausible explanations.
- Checking Consumption per Capita/per Unit GNP: Other factors being equal, consumption of HFCs per capita usually increases along with GNP. We may thus calculate per-capita consumption of certain groups of substances and compare them with values of countries which have a similar GNP per capita.

7. COMMUNICATING THE DATA TO THE OZONE AND FUND SECRETARIATS

After having collected the necessary data and having checked its accuracy and consistency data needs to be submitted in a proper format to the Fund and Ozone Secretariats. The due date for submitting annual data reports of the year to which they relate is 1 May of the following year for the Fund Secretariat and 30 September of the following year for the Ozone Secretariat. To avoid inconsistencies and duplication of work, it is encouraged to submit annual data to the Ozone Secretariat at the time of reporting to the Fund Secretariat.

8. CHECKING COMPLIANCE

Calculation of production and consumption also allows you to check the processing of your data by the Ozone Secretariat, which publishes them in an aggregate form in its annual report on data reporting to the Meeting of the Parties. Different phase-out/ phase-down schedules and baselines from which to calculate reduction steps for controlled ODS and HFCs apply to Article 5 Parties and Non-Article 5 Parties. The following are for HCFC phase-out and HFC phase-down schedule for Article 5 Parties.

For Article 5 Parties of the Protocol, the baseline of HCFCs is the average of the 2009 and 2010 levels of, respectively, consumption and production and freeze, at that baseline level, consumption and production in 2013. Article 5 Parties have the accelerated phase out of production and consumption in 2030, on the basis of the following reduction steps:

(a) by 2015 of 10 per cent;
(b) by 2020 of 35 per cent;
(c) by 2025 of 67.5 per cent;

(d) Allowing for servicing an annual average of 2.5 per cent of baseline during the period 2030–2040;

Table: HFC Phase-down Schedule for Article 5 Parties:

	Article 5 Parties: Group 1 including Bangladesh		Artcile 5 Parties: Group 2	
Baseline	2020, 2021 & 2022		2024, 2025 & 2026	
Baseline Calculation	Average production/ consumption of HFCs in 2020, 2021 & 2022 plus 65% of HCFC baseline production/ consumption		Average production/ consumption of HFCs in 2024, 2025 & 2026 plus 65% of HCFC baseline production/ consumption	
Reduction Steps				
Freeze	2024		2028	
Step 1	2029	10%	2032	10%
Step 2	2035	30%	2037	20%
Step 3	2040	50%	2042	30%
Step 4	2045	80%	2047	85%

9. CONCLUSION AND RECOMMENDATION

Bangladesh has well established data reporting system for ODSs since 1996. Every year NOU update inventory before reporting to the Ozone and Fund Secretariat. But the reporting of the previous years had been for the reporting of HCFCs only. After Kigali Amendment to the Montreal Protocol in 2016, both the secretariats have changed reporting format that includes the reporting of HFCs.

Bangladesh has ratified the Kigali Amendment on 8 June 2020. It will enter into force for Bangladesh on 6 September 2020. So, reporting has to be done for year the 2000 in 2021 onward as per new reporting format. It is one of the main obligations to the Parties after ratification.

Bangladesh has long experience to conduct HFC survey. First HFC survey was conducted in 2014 for the year 2011, 2012 and 2013 under CCAC assistance administered by UNDP to facilitate negotiation on HFC. After that first ODS and ODS alternative survey was conducted by UNDP in 2016 for the preparation of 'HCFC Phase-out Management Plan Stage-II'. Second ODS and ODS alternatives survey has recently been completed and relevant information up to 2019 is available. It would help the government to update inventory for the year 2020 and to report as per obligation to the Protocol in 2021 in the new format.

Yet there is no licensing system introduced for HFCs and no specific HS codes for different HFCs and HFC containing mixtures are introduced in the First Schedule of customs. So it is utmost important to amend the existing ODS Rules and introduce licensing system by anyway not later than 2 January 2021. Again as a Article 5 Group I country, base year for HFC consumption will be determined on the basis of average consumption of 2020, 2021 and 2022. Already we are in the middle of 2020.

Owing to the above mentioned situation, the following activities need to be done on priority basis.

1. National HS codes for HFCs has to be introduced immediately for keeping track on import and export of HFCs and their mixtures for a good base line and for collecting data and reporting purposes.
2. Existing 'Ozone Depleting Substances (Control) Rules, 2004' amended in 2014 has to be amended to include HFCs in order impose control over HFCs to implement Kigali Amendment to the Montreal Protocol.
3. Data update survey for each year should be continued as earlier
4. Introduce licensing system for import and export of HFCs along with HCFCs not later than 1 January 2021. It is one the immediate obligation to the Parties ratified Kigali amendment to the Montreal Protocol.
5. Yearly data update, reporting and preservation has to be continued under National Ozone Unit of DOE as earlier in order to obtain benefit of the long experience and institutional memory of the NOU.
6. Capacity building of NOU and Customs, and
7. Supply new generation ODS Identifier to the customs entry point capable to identify mixtures of HFCs, etc

ANNEX B1

CONTROLLED SUBSTANCES UNDER KIGALI AMENDMENT TO THE MONTREAL PROTOCOL

Group		100-year Global Warming Potential
Group I		
CHF_2CHF_2	HFC-134	1,100
CH_2FCF_3	HFC-134a	1,430
CH_2FCHF_2	HFC-143	353
$CHF_2CH_2CF_3$	HFC-245fa	1,030
$CF_3CH_2CF_2CH_3$	HFC-365mfc	794
CF_3CHFCF_3	HFC-227ea	3,220
$CH_2FCF_2CF_3$	HFC-236cb	1,340
CHF_2CHFCF_3	HFC-236ea	1,370
$CF_3CH_2CF_3$	HFC-236fa	9,810
$CH_2FCF_2CHF_2$	HFC-245ca	693
$CF_3CHFCHFCF_2CF_3$	HFC-43-10mee	1,640
CH_2F_2	HFC-32	675
CHF_2CF_3	HFC-125	3,500
CH_3CF_3	HFC-143a	4,470
CH_3F	HFC-41	92
CH_2FCH_2F	HFC-152	53
CH_3CHF_2	HFC-152a	124
CH_3CH_2F	HFC-161	12
Group II		
CHF3	HFC-23	14,800

ANNEX B2

DATA FORMS FOR REPORTING TO THE OZONE SECRETARIAT

Article 7 data reporting forms

Questionnaire			
Party:		Reporting Year:	
Before beginning the questionnaire, respondents are requested to read the following sections of the data reporting instructions and guidelines document carefully: (a) Section 1: Introduction; (b) Section 3: General instructions; and (c) Section 4: Definitions. Respondents are encouraged to refer to the data reporting instructions and guidelines as necessary when completing the data forms.			
Questionnaire			
1.1. Did your country **import** CFCs, halons, carbon tetrachloride, methyl chloroform, HCFCs, HBFCs, bromochloromethane, methyl bromide or HFCs in the reporting year? ☐ **YES** ☐ **NO**			
If No, ignore data form 1 and go to question 1.2. If Yes, please complete data form 1. Please read **instruction I** (on data on imports of controlled substances) of the data reporting instructions and guidelines document carefully before filling in the form.			
1.2. Did your country export or re-export CFCs, halons, carbon tetrachloride, methyl chloroform, HCFCs, HBFCs, bromochloromethane, methyl bromide or HFCs in the reporting year? ☐ **YES** ☐ **NO**			
If No, ignore data form 2 and go to question 1.3. If Yes, please complete data form 2. Please read **instruction II** (on data on exports of controlled substances) of the data reporting instructions and guidelines document carefully before filling in the form.			
1.3. Did your country produce CFCs, halons, carbon tetrachloride, methyl chloroform, HCFCs, HBFCs, bromochloromethane, methyl bromide or HFCs in the reporting year? ☐ **YES** ☐ **NO**			
If No, ignore data form 3 and go to question 1.4. If Yes, please complete data form 3. Please read **instruction III** (on data on production of controlled substances) of the data reporting instructions and guidelines document carefully before filling in the form.			
1.4. Did your country destroy any ozone-depleting substances or HFCs in the reporting year? ☐ **YES** ☐ **NO**			
If No, ignore data form 4 and go to question 1.5. If Yes, please complete data form 4. Please read **instruction IV** (on data on destruction of controlled substances) of the data reporting instructions and guidelines document carefully before filling in the form.			
1.5. Did your country import from or export or re-export to non-parties in the reporting year ☐ **YES** ☐ **NO**			
If No, ignore data form 5 and go to question 1.6. If Yes, please complete data form 5. Please read **instruction V** (on data on imports from and exports to non-parties) of the data reporting instructions and guidelines document carefully, particularly the definition of non-parties, before filling in the form.			
1.6. Did your country generate the substance HFC-23 in the reporting year from any facility that produces (manufactures) Annex C Group I or Annex F substances? ☐ **YES** ☐ **NO**			
If No, ignore data form 6. If Yes, please complete data form 6. Please read **instruction VI** (on data on emissions of Annex F Group II substance – HFC-23) of the data reporting instructions and guidelines document carefully before filling in the form.			
Name of reporting officer:			
Signature:			
Designation:			
Organization:			
Postal address:			
Country:			
Phone:			
Email:			
Date:			

1. Fill in this form only if your country imported CFCs, halons, carbon tetrachloride, methyl chloroform, HCFCs, HBFCs, bromochloromethane, methyl bromide or HFCs.
2. Please read instruction I carefully before filling in this form.

DATA FORM 1
DATA ON IMPORTS
in tonnes[1] (not ODP or CO_2-equivalent tonnes)
Annex A, B, C, E and F substances

A7_Dataform/2018

Party: Period: January - December 20

(1) Annex/group	(2) Substance	Total quantity imported for all uses		(5) Quantity of new substance imported for feedstock uses	Quantity of new substance imported for exempted essential, critical, high-ambient-temperature or other uses*	
		(3) New	(4) Recovered and reclaimed		(6) Quantity	(7) Decision / type of use* or remarks
A-Group I	CFC-11 ($CFCl_3$)					
	CFC-12 (CF_2Cl_2)					
	CFC-113 ($C_2F_3Cl_3$)					
	CFC-114 ($C_2F_4Cl_2$)					
	CFC-115 (C_2F_5Cl)					
A-Group II	Halon-1211 (CF_2BrCl)					
	Halon-1301 (CF_3Br)					
	Halon-2402 ($C_2F_4Br_2$)					
B-Group I	CFC-13 (CF_3Cl)					
B-Group II	Carbon tetrachloride (CCl_4)					
B-Group III	Methyl chloroform, i.e., 1,1,1-trichloroethane ($C_2H_3Cl_3$)					
Comments:						

[1] Tonne = Metric ton.

* Against each substance imported for exempted essential, critical or other uses, please specify the meeting of the parties decision that approved the use. Should the column space be insufficient, further information can be provided in the "comments" box above.

Data Form 1 (continued) **A7_Dataform/2018**

(1) Annex/group	(2) Substance	Total quantity imported for all uses		(5) Quantity of new substance imported for feedstock uses	Quantity of new substance imported for exempted essential, critical, high-ambient-temperature or other uses*	
		(3) New	(4) Recovered and reclaimed		(6) Quantity	(7) Decision / type of use* or remarks
C-Group I	HCFC-21** ($CHFCl_2$)					
	HCFC-22** (CHF_2Cl)					
	HCFC-31 (CH_2FCl)					
	HCFC-123** ($CHCl_2CF_3$)					
	HCFC-124** ($CHFClCF_3$)					
	HCFC-133 ($C_2H_2F_3Cl$)					
	HCFC-141b** (CH_3CFCl_2)					
	HCFC-142b** (CH_3CF_2Cl)					
	HCFC-225 ($C_3HF_5Cl_2$)					
	HCFC-225ca ($CF_3CF_2CHCl_2$)					
	HCFC-225cb (CF_2ClCF_2CHClF)					
C-Group II	HBFCs					
C-Group III	Bromochloromethane (CH_2BrCl)					
E-Group I	Methyl bromide (CH_3Br)					
					Quantity of new methyl bromide imported to be used for quarantine and pre-shipment applications within your country	
Comments:						

Note: As per paragraph 5 bis of Article 2 of the Protocol, any transfer of HCFC consumption by parties not operating under paragraph 1 of Article 5 shall be notified to the Secretariat, no later than the time of the transfer, by each of the parties concerned, stating the terms of such transfer and the period for which it is to apply.

* Against each substance imported for exempted essential, critical or other uses, please specify the meeting of the parties decision that approved the use. Should the column space be insufficient, further information can be provided in the "comments" box above.

** Identifies the most commercially viable substances with ozone-depleting-potential (ODP) values listed against them to be used for the purposes of the Protocol.

Data Form 1 (continued) **A7_Dataform/2018**

(1) Annex/group	(2) Substance	Total quantity imported for all uses		(5) Quantity of new substance imported for feedstock uses	Quantity of new substance imported for exempted essential, critical, high-ambient-temperature or other uses*	
		(3) New	(4) Recovered and reclaimed		(6) Quantity	(7) Decision / type of use* or remarks
F-Group I	HFC-32 (CH_2F_2)					
	HFC-41 (CH_3F)					
	HFC-125 (CHF_2CF_3)					
	HFC-134 (CHF_2CHF_2)					
	HFC-134a (CH_2FCF_3)					
	HFC-143 (CH_2FCHF_2)					
	HFC-143a (CH_3CF_3)					
	HFC-152 (CH_2FCH_2F)					
	HFC-152a (CH_3CHF_2)					
	HFC-227ea (CF_3CHFCF_3)					
	HFC-236cb ($CH_2FCF_2CF_3$)					
	HFC-236ea (CHF_2CHFCF_3)					
	HFC-236fa ($CF_3CH_2CF_3$)					
	HFC-245ca ($CH_2FCF_2CHF_2$)					
	HFC-245fa ($CHF_2CH_2CF_3$)					
	HFC-365mfc ($CF_3CH_2CF_2CH_3$)					
	HFC-43-10mee ($CF_3CHFCHFCF_2CF_3$)					
F-Group II	HFC-23 (CHF_3)					
Mixtures containing controlled substance(s) – applicable to all substances, not just HFCs (add additional rows or pages as required for mixtures not listed below)						
R-404A (HFC-125 = 44%, HFC-134a = 4%, HFC-143a = 52%)						
R-407A (HFC-32 = 20%, HFC-125 = 40%, HFC-134a = 40%)						
R-407C (HFC-32 = 23%, HFC-125 = 25%, HFC-134a = 52%)						
R-410A (HFC-32 = 50%, HFC-125 = 50%)						
R-507A (HFC-125 = 50%, HFC-143a = 50%)						
R-508B (HFC-23 = 46%, PFC-116 = 54%)						
Comments:						

Note: When reporting mixtures, reporting of controlled substances should not be duplicated. Parties may choose to report imports of individual controlled substances, total quantities of mixtures imported, or a combination of both, provided that the amounts of imported controlled substances are not reported more than once. If a non-standard mixture not listed in section 11 of the data reporting instructions and guidelines is to be reported, please indicate the percentage by weight of each constituent controlled substance of the mixture being reported in the "remark" column or in the "comments" box above.

* Against each substance imported for exempted essential, critical, high-ambient-temperature or other uses, please specify the meeting of the parties decision that approved the use. Should the column space be insufficient, further information can be provided in the "comments" box above. In case of multiple exemptions per substance for some of the controlled substances, multiple entries may be used for those substances to report on those exemptions.

Annex to DATA FORM 1 - Exporting parties for quantities reported as imports **A7_Dataform/2018**

Note: This annex is excluded from the reporting requirements under Article 7 of the Protocol, and the information in the annex is to be provided on a voluntary basis (decision XXIV/12)

(1) Substance or Mixture	(2) Exporting party for quantities reported as imports	Total quantity imported for all uses		(5) Quantity of new substance imported for feedstock uses	Quantity of new substance imported for exempted essential, critical, high-ambient-temperature or other uses*	
		(3) New	(4) Recovered and reclaimed		(6) Quantity	(7) Decision / type of use* or remarks
Methyl bromide (CH_3Br)						
					Quantity of new methyl bromide imported to be used for quarantine and pre-shipment applications within your country	
Comments:						

* Against each substance imported for exempted essential, critical, high-ambient-temperature or other uses, please specify the meeting of the parties decision that approved the use. Should the column space be insufficient, further information can be provided in the "comments" box above.

1. Fill in this form only if your country exported or re exported CFCs, halons, carbon tetrachloride, methyl chloroform, HCFCs, HBFCs, bromochloromethane, methyl bromide or HFCs.

2. Please read instruction II carefully before filling in this form.

DATA FORM 2
DATA ON EXPORTS*
in tonnes[1] (not ODP or CO_2-equivalent tonnes)
Annex A, B, C, E and F substances

A7_Dataform/2018

Party: Period: January - December 20

(1) Substance or Mixture	(2) Country of destination of exports**	Total quantity exported for all uses		(5) Quantity of new substance exported for feedstock uses***	Quantity of new substance exported for exempted essential, critical, high-ambient-temperature or other uses****	
		(3) New	(4) Recovered and reclaimed		(6) Quantity	(7) Decision/type of use**** or remarks
Methyl bromide (CH_3Br)						
					Quantity of new methyl bromide exported to be used for quarantine and pre-shipment applications	
Comments:						

[1] Tonne = Metric ton.

Note: If a non-standard mixture not listed in section 11 of the data reporting instructions and guidelines is to be reported, please indicate the percentage by weight of each constituent controlled substance of the mixture being reported in the "remark" column or in the "comments" box above.

* Includes re-exports. Ref. decisions IV/14 and XVII/16, paragraph 4.

** Reporting of countries of destination is not a requirement under Article 7. In paragraph 4 of decision VII/9, it was decided that parties should report on the destination of Annex A and Annex B substances (new, recovered or reclaimed) that are exported. Paragraph 4 of decision XVII/16 requested a revision of the reporting formats to cover the export of all controlled substances contained in the annexes of the Protocol, and urged the Parties to implement the revised reporting format expeditiously.

*** Do not deduct from total production in column 3 of data form 3 (data on production).

**** Against each substance exported for exempted essential, critical, high-ambient-temperature or other uses, please specify the meeting of the parties decision that approved the use. Should the column space be insufficient, further information can be provided in the "comments" box above.

1. **Fill in this form only if your country produced CFCs, halons, carbon tetrachloride, methyl chloroform, HCFCs, HBFCs, bromochloromethane, methyl bromide or HFCs or generated HFC-23,**
2. **Please read instruction III carefully before filling in this form.**

DATA FORM 3
DATA ON PRODUCTION AND HFC-23 GENERATION
in tonnes[1] (not ODP or CO_2-equivalent tonnes)
Annex A, B, C, E and F substances

A7_Dataform/2018

Party: Period: January - December 20

(1) Annex/group	(2) Substance	(3) Total production for all uses	(4) Production for feedstock uses within your country	Production for exempted essential, critical, high-ambient-temperature or other uses within your country*		(7) Production for supply to Article 5 countries in accordance with Articles 2A-2H and 5
				(5) Quantity	(6) Decision / type of use* or remarks	
A-Group I	CFC-11 ($CFCl_3$)					This column is no longer applicable to Annex A and B substances (CFCs, halons, CCl_4 and methyl chloroform)
	CFC-12 (CF_2Cl_2)					
	CFC-113 ($C_2F_3Cl_3$)					
	CFC-114 ($C_2F_4Cl_2$)					
	CFC-115 (C_2F_5Cl)					
A-Group II	Halon-1211 (CF_2BrCl)					
	Halon-1301 (CF_3Br)					
	Halon-2402 ($C_2F_4Br_2$)					
B-Group I	CFC-13 (CF_3Cl)					
B-Group II	Carbon tetrachloride (CCl_4)					
B-Group III	Methyl chloroform, i.e., 1,1,1-trichloroethane ($C_2H_3Cl_3$)					
Comments:						

[1] Tonne = Metric ton.

Note: As per paragraph 5 of Article 2 of the Protocol, any transfer of production shall be notified to the Secretariat, no later than the time of the transfer, by each of the parties concerned, stating the terms of such transfer and the period for which it is to apply.

* Against each substance produced for exempted essential, critical or other uses, please specify the meeting of the parties decision that approved the use. Should the column space be insufficient, further information can be provided in the "comments" box above.

Data Form 3 (continued) **A7_Dataform/2018**

(1) Annex/group	(2) Substance	(3) Total production for all uses	(4) Production for feedstock uses within your country	Production for exempted essential, critical, high-ambient-temperature or other uses within your country*		(7) Production for supply to Article 5 countries in accordance with Articles 2A-2H and 5
				(5) Quantity	(6) Decision / type of use* or remarks	
C-Group I	HCFC-21** ($CHFCl_2$)					
	HCFC-22** (CHF_2Cl)					
	HCFC-31 (CH_2FCl)					
	HCFC-123** ($CHCl_2CF_3$)					
	HCFC-124** ($CHFClCF_3$)					
	HCFC-133 ($C_2H_2F_3Cl$)					
	HCFC-141b** (CH_3CFCl_2)					
	HCFC-142b** (CH_3CF_2Cl)					
	HCFC-225 ($C_3HF_5Cl_2$)					
	HCFC-225ca ($CF_3CF_2CHCl_2$)					
	HCFC-225cb (CF_2ClCF_2CHClF)					
C-Group II	HBFCs					This column is no longer applicable to Annex/group C/II, C/III and E/I substances (HBFCs, BCM and methyl bromide)
C-Group III	Bromochloromethane (CH_2BrCl)					
E-Group I	Methyl bromide (CH_3Br)					
				Total quantity of new methyl bromide produced for quarantine and pre-shipment applications within your country and for export		
Comments:						

Note: As per paragraph 5 of Article 2 of the Protocol, any transfer of production shall be notified to the Secretariat, no later than the time of the transfer, by each of the parties concerned, stating the terms of such transfer and the period for which it is to apply.

* Against each substance produced for exempted essential, critical or other uses, please specify the meeting of the parties decision that approved the use. Should the column space be insufficient, further information can be provided in the "comments" box above.

** Identifies the most commercially viable substances with ozone-depleting-potential (ODP) values listed against them to be used for the purposes of the Protocol.

Data Form 3 (continued) **A7_Dataform/2018**

(1) Annex/group	(2) Substance	(3) Total production for all uses	(4) Production for feedstock uses within your country		Production for exempted essential, critical, high-ambient-temperature or other uses within your country*		(7) Production for supply to Article 5 countries in accordance with Articles 2A-2H and 5
					(5) Quantity	(6) Decision / type of use* or remarks	
F-Group I	HFC-32 (CH_2F_2)						This column is not applicable to Annex F substances (HFCs)
	HFC-41 (CH_3F)						
	HFC-125 (CHF_2CF_3)						
	HFC-134 (CHF_2CHF_2)						
	HFC-134a (CH_2FCF_3)						
	HFC-143 (CH_2FCHF_2)						
	HFC-143a (CH_3CF_3)						
	HFC-152 (CH_2FCH_2F)						
	HFC-152a (CH_3CHF_2)						
	HFC-227ea (CF_3CHFCF_3)						
	HFC-236cb ($CH_2FCF_2CF_3$)						
	HFC-236ea (CHF_2CHFCF_3)						
	HFC-236fa ($CF_3CH_2CF_3$)						
	HFC-245ca ($CH_2FCF_2CHF_2$)						
	HFC-245fa ($CHF_2CH_2CF_3$)						
	HFC-365mfc ($CF_3CH_2CF_2CH_3$)						
	HFC-43-10mee ($CF_3CHFCHFCF_2CF_3$)						
		(3) Captured for all uses**	(4a) Captured for feedstock uses within your country***	(4b) Captured for destruction***			
F-Group II	HFC-23 (CHF3)**						
Comments:							

Note: As per paragraph 5 of Article 2 of the Protocol, any transfer of production shall be notified to the Secretariat, no later than the time of the transfer, by each of the parties concerned, stating the terms of such transfer and the period for which it is to apply.

* Against each substance produced for exempted essential, critical, high-ambient-temperature or other uses, please specify the meeting of the parties decision that approved the use. Should the column space be insufficient, further information can be provided in the "comments" box above.

** HFC-23 generation that is captured, whether for destruction, feedstock or any other use, shall be reported in this form.

***Amounts of HFC-23 captured for destruction or feedstock use will not be counted as production as per Article 1.

1. **Fill in this form only if your country destroyed CFCs, halons, carbon tetrachloride, methyl chloroform, HCFCs, HBFCs, bromochloromethane, methyl bromide or HFCs.** 2. **Please read instruction IV carefully before filling in this form.**	**DATA FORM 4** **DATA ON QUANTITY OF SUBSTANCES DESTROYED** in tonnes[1] (not ODP or CO_2-equivalent tonnes) **Annex A, B, C, E and F substances**	**A7_Dataform/2018**
Party:	Period: January - December 20	

(1) Substance or Mixture	(2) Quantity destroyed	(3) Remarks

Comments:	

[1] Tonne = Metric ton.

Note: If the composition of a destroyed mixture is known, please indicate the percentage by weight of each constituent controlled substance of the mixture being reported in the remarks or comments section of the form or indicate a standard mixture as listed in section 11 of the data reporting instructions and guidelines.

1. Fill in this form only if your country imported or exported CFCs, halons, carbon tetrachloride, methyl chloroform, HCFCs, HBFCs, bromochloromethane or methyl bromide from or to non-parties.
2. Please read instruction V carefully before filling in this form.

DATA FORM 5
DATA ON IMPORTS FROM AND/OR EXPORTS TO NON-PARTIES*
in tonnes[1] (not ODP or CO_2-equivalent tonnes)
Annex A, B, C and E substances

A7_Dataform/2018

Party:

Period: January - December 20

(1) Substance or Mixture	(2) Exporting party for quantities reported as imports OR Country of destination of exports**	Quantity of imports from non-parties*		Quantity of exports to non-parties*		(7) Remarks
		(3) New imports	(4) Recovered and reclaimed imports	(5) New exports	(6) Recovered and reclaimed exports	
Comments:						

[1] Tonne = Metric ton.

Note: If a non-standard mixture not listed in section 11 of the data reporting instructions and guidelines is to be reported, please indicate the percentage by weight of each constituent controlled substance of the mixture being reported in the "remark" column or in the "comments" box above.
* See definition of "non-parties" in Instruction V.
** Reporting of information on "exporting parties for quantities reported as imports" and "countries of destination of exports" is not a requirement under Article 7 of the Protocol, and the information is to be provided on a voluntary basis.

1. Fill in this form only if your country generated HFC-23 from any facility that produced (manufactured) Annex C Group I or Annex F substances.

2. Please read instruction VI carefully before filling in this form.

DATA FORM 6 **A7_Dataform/2018**

DATA ON QUANTITY OF EMISSIONS OF HFC 23 FROM FACILITIES MANUFACTURING ANNEX C GROUP I OR ANNEX F SUBSTANCES

in tonnes[1] (not ODP or CO_2-equivalent tonnes)

Party: Period: January - December 20

Note: Information in columns 2 to 5 is excluded from the reporting requirements under Article 7 of the Protocol and is provided on a voluntary basis.

(1) Facility name or identifier	(2) Total amount generated* (tonnes)	(3) Amount generated and captured** (tonnes)			(4) Amount used for feedstock without prior capture*** (tonnes)	(5) Amount destroyed without prior capture **** (tonnes)	(6) Amount of generated emissions (tonnes)	(7) Remarks
		(3a) For all uses	(3b) For feedstock use in your country	(3c) For destruction				
Comments:								

[1] Tonne = Metric ton.

* "Total amount generated" refers to the total amount whether captured or not. The sum of these amounts is not to be reported under data form 3.

** The sums of these amounts are to be reported under data form 3.

*** Amount converted to other substances in the facility. The sum of these amounts is not to be reported under data form 3.

**** Amount destroyed in the facility.

1. Fill in this form only if your country is listed in Appendix II to decision XXVIII/2, has formally notified the Secretariat of its intention to use the high-ambient-temperature exemption, and imported HFCs for its own use in the subsectors contained in Appendix I to decision XXVIII/2.

2. Please read instruction VII carefully before filling in this form.

DATA FORM 7 **HAT_Dataform/2018**

DATA ON IMPORTS OF ANNEX F SUBSTANCES FOR EXEMPTED SUBSECTORS

in tonnes[1] (not ODP or CO_2-equivalent tonnes)

Party: Period: January - December 20

(1) Annex/ group	(2) Substance	Quantity of new substances imported for approved subsectors to which the high-ambient-temperature exemption applies (columns to be added as required for other subsectors that may be approved after the assessments under paragraphs 32 and 33 of decision XXVIII/2)*				
		(3) New imports for use in multi-split air conditioners	(4) New imports for use in split ducted air conditioners	(5) New imports for use in ducted commercial packaged (self-contained) air conditioners	(6) New imports for use in subsector**	(7) New imports for use in subsector**
F-Group I	HFC-32 (CH_2F_2)					
	HFC-41 (CH_3F)					
	HFC-125 (CHF_2CF_3)					
	HFC-134 (CHF_2CHF_2)					
	HFC-134a (CH_2FCF_3)					
	HFC-143 (CH_2FCHF_2)					
	HFC-143a (CH_3CF_3)					
	HFC-152 (CH_2FCH_2F)					
	HFC-152a (CH_3CHF_2)					
	HFC-227ea (CF_3CHFCF_3)					
	HFC-236cb ($CH_2FCF_2CF_3$)					
	HFC-236ea (CHF_2CHFCF_3)					
	HFC-236fa ($CF_3CH_2CF_3$)					
	HFC-245ca ($CH_2FCF_2CHF_2$)					
	HFC-245fa ($CHF_2CH_2CF_3$)					
	HFC-365mfc ($CF_3CH_2CF_2CH_3$)					
	HFC-43-10mee ($CF_3CHFCHFCF_2CF_3$)					
F-Group II	HFC-23 (CHF_3)					
Mixtures containing controlled substance(s) – applicable to all substances, not just HFCs (add additional rows or pages as required for mixtures not listed below)						
R-404A (HFC-125 = 44%, HFC-134a = 4%, HFC-143a = 52%)						
R-407A (HFC-32 = 20%, HFC-125 = 40%, HFC-134a = 40%)						
R-407C (HFC-32 = 23%, HFC-125 = 25%, HFC-134a = 52%)						
R-410A (HFC-32 = 50%, HFC-125 = 50%)						
R-507A (HFC-125 = 50%, HFC-143a = 50%)						
R-508B (HFC-23 = 46%, PFC-116 = 54%)						
Comments:						

[1] Tonne = Metric ton.

Note: If a non-standard mixture not listed in section 11 of the data reporting instructions and guidelines is to be reported, please indicate the percentage by weight of each constituent controlled substance of the mixture being reported in the "comments" box above.

* Only bulk gases for servicing of exempted equipment should be reported here, not gases imported inside pre-charged equipment.

** For each substance imported for use in subsectors that may be approved after the assessments under paragraphs 32 and 33 of decision XXVIII/2, please specify the approved subsector. Should the column space be insufficient, further information can be provided in the "comments" box above.

1. Fill in this form only if your country is listed in appendix II to decision XXVIII/2, has formally notified the Secretariat of its intention to use the high-ambient-temperature exemption, and produced HFCs for its own use in the subsectors contained in appendix I to decision XXVIII/2.

2. Please read instruction VIII carefully before filling in this form.

DATA FORM 8 **HAT_Dataform/2018**

DATA ON PRODUCTION OF ANNEX F SUBSTANCES FOR EXEMPTED SUBSECTORS

in tonnes[1] (not ODP or CO_2-equivalent tonnes)

Party: Period: January - December 20

(1) Annex/ group	(2) Substance	Quantity of new substances produced for approved subsectors to which the high-ambient-temperature exemption applies (production should be for use within the producing country) (columns to be added as required for other subsectors that may be approved after the assessments under paragraphs 32 and 33 of decision XXVIII/2)*				
		(3) New production for use in multi-split air conditioners	(4) New production for use in split ducted air conditioners	(5) New production for use in ducted commercial packaged (self-contained) air conditioners	(6) New production for use in subsector*	(7) New production for use in subsector*
F-Group I	HFC-32 (CH_2F_2)					
	HFC-41 (CH_3F)					
	HFC-125 (CHF_2CF_3)					
	HFC-134 (CHF_2CHF_2)					
	HFC-134a (CH_2FCF_3)					
	HFC-143 (CH_2FCHF_2)					
	HFC-143a (CH_3CF_3)					
	HFC-152 (CH_2FCH_2F)					
	HFC-152a (CH_3CHF_2)					
	HFC-227ea (CF_3CHFCF_3)					
	HFC-236cb ($CH_2FCF_2CF_3$)					
	HFC-236ea (CHF_2CHFCF_3)					
	HFC-236fa ($CF_3CH_2CF_3$)					
	HFC-245ca ($CH_2FCF_2CHF_2$)					
	HFC-245fa ($CHF_2CH_2CF_3$)					
	HFC-365mfc ($CF_3CH_2CF_2CH_3$)					
	HFC-43-10mee ($CF_3CHFCHFCF_2CF_3$)					
F-Group II	HFC-23 (CHF_3)					
Comments:						

[1] Tonne = Metric ton.

* For each substance produced for use in subsectors that may be approved after the assessments under paragraphs 32 and 33 of decision XXVIII/2, please specify the approved subsector. Should the column space be insufficient, further information can be provided in the “comments” box above.

ANNEX B3

DATA FORMS FOR REPORTING TO THE FUND SECRETARIAT

REVISED COUNTRY PROGRAMME REPORT FORMAT (2019 DATA AND BEYOND)

COUNTRY: XXXX

SECTION A. ANNEX A, ANNEX B, ANNEX C - GROUP I AND ANNEX E - DATA ON CONTROLLED SUBSTANCES (METRIC TONNES)

NOTE: Data entry is required in UNSHADED cells only

Substance[1]	Use by Sector											Import	Export	Production	Import quotas	If imports are banned, indicate date ban commenced (DD/MM/YYYY)	Remarks[3]
	Aerosol	Foam	Fire Fighting	Refrigeration		Solvent	Process agent	Lab Use	Methy Bromide		TOTAL						
				Manufacturing	Servicing				QPS	Non-QPS							
Annex A, Group I																	
CFC-11	0.00	0.00		0.00	0.00						0.00	0.00	0.00	0.00	0.00		
CFC-12	0.00	0.00		0.00	0.00						0.00	0.00	0.00	0.00	0.00		
CFC-113	0.00					0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
CFC-114				0.00	0.00						0.00	0.00	0.00	0.00	0.00		
CFC-115				0.00	0.00						0.00	0.00	0.00	0.00	0.00		
Sub-Total	**0.00**	**0.00**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
Annex A, Group II																	
Halon-1211			0.00								0.00	0.00	0.00	0.00	0.00		
Halon-1301			0.00								0.00	0.00	0.00	0.00	0.00		
Halon-2402			0.00								0.00	0.00	0.00	0.00	0.00		
Sub-Total			**0.00**								**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
Annex B, Group I																	
CFC-13					0.00						0.00	0.00	0.00	0.00	0.00		
Sub-Total					**0.00**						**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
Annex B, Group II																	
Carbon tetrachloride						0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
Sub-Total						**0.00**	**0.00**	**0.00**			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
Annex B, Group III																	
Methyl chloroform						0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
Sub-Total						**0.00**	**0.00**	**0.00**			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
Annex C, Group I																	
HCFC-22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
HCFC-141b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
HCFC-141b in imported pre-blended polyol		0.00									0.00	0.00	0.00	0.00	0.00		
HCFC-142b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
HCFC-123	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
HCFC-124	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
HCFC-133	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
HCFC-225	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
HCFC-225ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
HCFC-225cb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
Other[2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
Other[2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00		
Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**			**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
Annex E																	
Methyl Bromide									0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Subtotal									**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
TOTAL	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		

1 Where the data involves a blend of two or more substances, the quantities of individual components of controlled substances must be indicated separately.

2 Indicate relevant controlled substances.

3 Provide explanation if total sector use and consumption (import-export+production) is different (e.g, stockpiling).

REVISED COUNTRY PROGRAMME REPORT FORMAT (2019 DATA AND BEYOND)

COUNTRY: **YEAR: January to December of the year** YYYY

SECTION B. ANNEX F - DATA ON CONTROLLED SUBSTANCES (METRIC TONNES)

NOTE: Data entry is required in UNSHADED cells only

Substance	Use by Sector										Import	Export	Production	Import quotas	If imports are banned, indicate date ban commenced (DD/MM/YYYY)	Remarks[4]
	Aerosol	Foam	Fire Fighting	Refrigeration				Solvent	Other[3]	TOTAL						
				Manufacturing			Servicing									
				Other	AC	Total[5]										
Annex F																
Controlled Substances																
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-134a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-143	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-143a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-152	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-236cb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-236ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-245ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-245fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-365mfc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-43-10mee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-23 (use)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Sub-Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
Blends (Mixtured of Controlled Substances)[1]																
R-404A (HFC-125=44%, HFC-134a=4%, HFC-143a=52%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
R-407A (HFC-32=20%,HFC-125=40%,HFC-134a=40%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
R-407C (HFC-32=23%,HFC-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		

Substance	Use by Sector										Import	Export	Production	Import quotas	If imports are banned, indicate date ban commenced (DD/MM/YYYY)	Remarks[4]
	Aerosol	Foam	Fire Fighting	Refrigeration				Solvent	Other[3]	TOTAL						
				Manufacturing			Servicing									
				Other	AC	Total[5]										
125=25%, HFC-134a=52%)																
R-410A (HFC-32=50%, HFC-125=50%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
R-507A (HFC-125=50%, HFC-143a=50%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
R-508B (HFC-23=46%, PFC-116=54%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
Others:[2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
Others:[2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
Sub-Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		**0.00**		
Others																
HFC-245fa in imported pre-blended polyol	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-365mfc in imported pre-blended polyol	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Sub-Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
TOTAL	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		

1 When reporting blends/mixtures, reporting of controlled substances should not be duplicated. For the CP report, countries should report use of individual controlled substances and quantities of blends/mixtures used, separately, while ensuring that the amounts of controlled substances are not reported more than once.

2 If a non-standard blend not listed in the above table is used, please indicate the percentage of each constituent controlled substance of the blend being reported in the remarks column.

3 Uses in other sectors that do not fall specifically within the listed sectors in the table.

4 Provide explanation if total sector use and consumption (import-export+production) is different (e.g, stockpiling).

5 If break-down of consumption in manufacturing is not available, information in total can be provided.

REVISED COUNTRY PROGRAMME REPORT FORMAT (2019 DATA AND BEYOND)

COUNTRY: **YEAR: January to December of the year** YYYY

SECTION B. ANNEX F - DATA ON CONTROLLED SUBSTANCES (METRIC TONNES)

NOTE: Data entry is required in UNSHADED cells only

Substance	Use by Sector										Import	Export	Production	Import quotas	If imports are banned, indicate date ban commenced (DD/MM/YYYY)	Remarks[4]
	Aerosol	Foam	Fire Fighting	Refrigeration				Solvent	Other[3]	TOTAL						
				Manufacturing			Servicing									
				Other	AC	Total[5]										
Annex F																
Controlled Substances																
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-125	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-134a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-143	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-143a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-152	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-236cb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-236ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-245ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-245fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-365mfc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-43-10mee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-23 (use)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Sub-Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
Blends (Mixtured of Controlled Substances)[1]																
R-404A (HFC-125=44%, HFC-134a=4%, HFC-143a=52%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
R-407A (HFC-32=20%,HFC-125=40%,HFC-134a=40%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
R-407C (HFC-32=23%,HFC-125=25%, HFC-134a=52%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		

Substance	Use by Sector										Import	Export	Production	Import quotas	If imports are banned, indicate date ban commenced (DD/MM/YYYY)	Remarks[4]
	Aerosol	Foam	Fire Fighting	Refrigeration				Solvent	Other[3]	TOTAL						
				Manufacturing			Servicing									
				Other	AC	Total[5]										
R-410A (HFC-32=50%, HFC-125=50%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
R-507A (HFC-125=50%, HFC-143a=50%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
R-508B (HFC-23=46%, PFC-116=54%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
Others:[2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
Others:[2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		
Sub-Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		**0.00**		
Others																
HFC-245fa in imported pre-blended polyol	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
HFC-365mfc in imported pre-blended polyol	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Sub-Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		
TOTAL	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		

1 When reporting blends/mixtures, reporting of controlled substances should not be duplicated. For the CP report, countries should report use of individual controlled substances and quantities of blends/mixtures used, separately, while ensuring that the amounts of controlled substances are not reported more than once.

2 If a non-standard blend not listed in the above table is used, please indicate the percentage of each constituent controlled substance of the blend being reported in the remarks column.

3 Uses in other sectors that do not fall specifically within the listed sectors in the table.

4 Provide explanation if total sector use and consumption (import-export+production) is different (e.g, stockpiling).

5 If break-down of consumption in manufacturing is not available, information in total can be provided.

COUNTRY: XXXX

SECTION C. AVERAGE ESTIMATED PRICE OF HCFCs, HFCs AND ALTERNATIVES (US $/kg)

Description	Previous year price (prefilled - online submission, if available)	Current prices	Remarks[1]
HCFCs			
HCFC-22	0.00	0.00	
HCFC-141b	0.00	0.00	
HCFC-142b	0.00	0.00	
HCFC-123	0.00	0.00	
HCFC-124	0.00	0.00	
HCFC-133	0.00	0.00	
HCFC-225	0.00	0.00	
HCFC-225ca	0.00	0.00	
HCFC-225cb	0.00	0.00	
HCFC-141b in imported pre-blended polyol	0.00	0.00	
HFCs			
HFC-23 (use)	0.00	0.00	
HFC-32	0.00	0.00	
HFC-41	0.00	0.00	
HFC-125	0.00	0.00	
HFC-134	0.00	0.00	
HFC-134a	0.00	0.00	
HFC-143	0.00	0.00	
HFC-143a	0.00	0.00	
HFC-152	0.00	0.00	
HFC-152a	0.00	0.00	
HFC-227ea	0.00	0.00	
HFC-236cb	0.00	0.00	
HFC-236ea	0.00	0.00	
HFC-236fa	0.00	0.00	
HFC-245ca	0.00	0.00	
HFC-245fa	0.00	0.00	
HFC-365mfc	0.00	0.00	
HFC-43-10mee	0.00	0.00	
HFC-245fa in imported pre-blended polyol	0.00	0.00	
HFC-365mfc in imported pre-blended polyol	0.00	0.00	
R-404A	0.00	0.00	
R-407A	0.00	0.00	
R-407C	0.00	0.00	
R-410A	0.00	0.00	
R-507A	0.00	0.00	
R-508B	0.00	0.00	
Alternatives			
Isobutane (HC-600a)	0.00	0.00	
Propane (HC-290)	0.00	0.00	
Pentane	0.00	0.00	
Cyclopentane	0.00	0.00	
Methyl formate	0.00	0.00	
Other alternatives (Optional):	0.00	0.00	
	0.00	0.00	

1 Indicate whether the prices are FOB or retail prices.

REVISED COUNTRY PROGRAMME REPORT FORMAT (2019 DATA AND BEYOND)			
COUNTRY:	**YEAR: January to December of the year**	YYYY	
SECTION D. ANNEX F, GROUP II - DATA ON HFC-23 GENERATION (METRIC TONNES)			
NOTE: Fill in this form only if your country generated HFC-23 from any facility that produced (manufactured) Annex C Group I or Annex F substances			

	Captured for all uses[1]	**Captured for feedstock uses within your country[2]**	**Captured for destruction[2]**
HFC-23[1]			

1 HFC-23 generation that is captured, whether for destruction, feedstock or any other use, shall be reported in this form
2 Amounts of HFC-23 captured for destruction or feedstock use will not be counted as production as per Article 1 of the Montreal Protocol.

REVISED COUNTRY PROGRAMME REPORT FORMAT (2019 DATA AND BEYOND)

COUNTRY: **YEAR: January to December of the year** YYYY

SECTION E. ANNEX F, GROUP II - DATA ON HFC-23 EMISSIONS (METRIC TONNES)

NOTE: Fill in this form only if your country generated HFC-23 from any facility that produced (manufactured) Annex C Group I or Annex F substances

	Columns shaded in grey are voluntary							
Facility name or identifier	**Total amount generated[1]**	**Amount generated and captured[2]**			**Amount used for feedstock without prior capture[3]**	**Amount destroyed without prior capture[4]**	**Amount of generated emissions**	**Remarks**
		For all uses	**For feedstock use in your country**	**For destruction**				
Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**		

1 "Total amount generated" refers to the total amount whether captured or not. The sum of these amounts is not to be reported under Section D.
2 The sums of these amounts are to be reported under Section D.
3 Amount converted to other substances in the facility. The sum of these amounts is not to be reported under Section D.
4 Amount destroyed in the facility.

COUNTRY: XXXX

SECTION F. COMMENTS BY BILATERAL/IMPLEMENTING AGENCIES

ANNEX B4

ODP VALUES OF THE MOST COMMON AND IMPORTANT HCFCS

Common HCFCs	ODP
R-22	0.055
R-123	0.020
R-124	0.022
R-141b	0.110
R-142	0.065
R-225	0.070

ANNEX B5

EXISTING LICENSING INSTRUMENT OF BANGLADESH TO IMPORT OD

License No: [redacted]

Government of the People's Republic of Bangladesh
Department of Environment
Paribesh Bhaban
E-16 Agargaon, Sher-e-Bangla Nagar
Dhaka-1207

No-Environment/ODS (License)/915/2005/ 70(16) Date 15/09/2019

Import License

This is to certify that M/S. [redacted]
has been authorized to import the following ozone depliting substance (ODS)/ equipment containing ODSs.

1. Description of ODS/ equipment containing ODS : R-22
2. H.S Code : 2903.21.00
3. Authorized quantity : 7.752 Metric tones
4. Validity of this license : 31 December 2019
5. Place of issuance : Department of Environment Head Office, Dhaka
6. Date of issuance : 15 September 2019

Director General
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SECTION C

NEEDS ASSESSMENT FOR REFRIGERATION AND AIR–CONDITIONING SERVICING SECTOR IN BANGLADESH

SUMMARY

NEEDS ASSESSMENT FOR REFRIGERATION AND AIR-CONDITIONING SERVICING SECTOR IN BANGLADESH

In Bangladesh, the refrigeration servicing sector is the major user of both ODS and HFCs. In view of the entrance of Kigali Amendment in force on 1 January 2019 which will drive the HFC phase-down in many countries and ongoing concurrent phase-out of HCFCs. The RAC sector will become complex to manage with multiple refrigerants available and suitable only for selected applications and with many alternatives presenting operational challenges due to their toxicity, high pressure and flammability. Kigali Amendment brings to the forefront the importance of climate impacts of refrigerants and cooling technologies. Energy efficiency is another key consideration for RAC servicing sector. In this context, the competence of servicing sector in installation, maintenance, repair, and disposal becomes critical. The focus on future HFC phase down related projects should be building sustainable system to support refrigeration servicing sector, which will in turn be able to support the safe and fast adoption of alternatives.

Bangladesh has ratified Kigali Amendment on 08 June 2020 and will start phase-down activity of non-ODS but high GWP HFCs. The provisions of KA include specific targets and timetables to replace HFCs with lower GWP alternatives. KA also mentions the importance of energy efficiency of RAC appliances and management of refrigerants throughout their lifecycle. About 40% of total refrigerant are used by the servicing sector in Bangladesh. It is important for Bangladesh to set the right policy conditions to address the RAC servicing sector thus effectively implement the Kigali Amendment. The complexity of the RAC sector is the multiple refrigerants, each suitable only for certain applications. The technology adoption might not be easier task for our marginal service sector personnel.

Objectives: The objective of needs assessment report is to conduct an assessment to the needs of the refrigeration servicing sector to determine the training, capacity-building, standards and regulatory support required for technicians and end users to safely use the range of alternative refrigerants, with an overview of Bangladesh market readiness and to develop a plan of actions to be included into the HFC phase-down in Bangladesh.

Methodology and Limitations: This assessment report was prepared following desk review of the existing literature as well as the key informant interview (KII).

The objectives of this assessment report covers numbers of issues that could be done in separate assessment or surveys. Due to COVID situation it was not always possible to get the stakeholders for the assessment. Number of stakeholder consultation could not possible due to the pandemic situation. Moreover, there are little access to data and literature in regards with Bangladesh for the proper analysis and assessment.

Need Assessment: A gap analysis is made for policy and regulatory framework. Challenges are identified to the new technology trend in RAC market. Strength, weakness and opportunities are determined for training of RAC technicians. Barriers are identified for the market readiness to adopt the low GWP alternatives. Need analysis for tools and equipment for training and education in RAC sector. Gap analysis is done for the standards to adopt low GWP alternatives. Opportunities are identified to utilize the current professional structure.

Recommendations: The right government policies and collaboration of RAC associations & stakeholders along with development/exploration funding mechanism can be helpful to guide RAC servicing sector. Despite many challenges, we should take this as an opportunity for our manpower development and to meet SDG no 1 to 5, 7 to 13 and 17 in RAC sector. Following recommendations might be adopted for RAC servicing sector:

1. Update national regulatory framework concomitant to the KA
2. Develop national strategy and integrated national action plan for RAC skill development and training
3. Develop national code of practice for the RAC servicing technicians and establishment of workshop.
4. Develop national safety and standard to handle and safe use of flammable refrigerants.
5. Incorporate Montreal Protocol and Kigali Amendment issues along with safety standards to handle flammable refrigerants in national TVET curricula.
6. Mass awareness campaign for safe and efficient use of RAC home appliances.
7. Awareness campaign targeting appliance users during off-peak demand season so that during the off-peak season the technicians will be involved in economic activities.
8. Awareness for RAC service technicians about occupational and personal safety.
9. To support the government in this regard, bilateral or multilateral funding opportunities other than MLF might be explored.
10. Aiding the RAC servicing workshop with necessary tools and equipment which they do not afford to obtain.
11. For life cycle management of refrigerants and equipment, recovery, recycling and or destruction policy and process might be introduced.
12. Special programme/policy might be undertaken to attract female professionals in to the RAC servicing sector.

1. BACKGROUND

After ratification of Montreal Protocol (MP) on 2nd August 1990, Government of Bangladesh (GoB) implemented series of projects of phase-out of ozone depleting substances (ODS) and other harmful chemical that is used mostly in refrigeration and air condition (RAC), pharmaceuticals and foam sectors. Bangladesh government established Ozone Cell in 1996 at the Department of Environment to implement Montreal Protocol (MP) related activities with financial support from Montreal Protocol Multilateral Funds (MLF). Montreal Protocol achieved its 93% phase-out of ozone depleting substance in Bangladesh. The country is now phasing out hydro chlorofluorocarbons (HCFCs). In October 2016, 197 parties to Montreal Protocol agreed on the Kigali Amendment (KA) to gradually reduce high global warming potential (GWP) hydro fluorocarbon (HFC) production and consumption. Bangladesh also became party to KA to phase-down high GWP HFCs on 08 June 2020. The Kigali Amendment entered into force on 1 January 2019.

Kigali Amendment proposes to phase down the production and consumption of HFCs by mid-2040 and offers an opportunity to countries for flexibility in doing so. HFCs are man-made chemicals widely used in air-conditioning, refrigeration and foam insulation. HFC are powerful greenhouse gases (GHG), more potent than carbon dioxide and contribute significantly to climate change. The refrigeration and air conditioning sectors are responsible for just over 7% of global greenhouse gas (GHG) emissions, equivalent to 3.7 GT CO_2 per annum (2014) going up to 8.1 GT CO_2 (2030) when they are estimated to contribute around 13% to global emissions. Emissions are growing at a rate which is at least three times faster than the global average increase of GHG emissions. Emissions in the RAC sectors originate from the use of high GWP refrigerants and energy consumption of RAC systems. About 40% of the emissions can be avoided globally by 2030 against the business-as-usual (BAU) by leapfrogging from high GWP refrigerants to low GWP natural refrigerants and applying best in class, highly energy efficient appliances. KA is a significant milestone in the international environmental protection as its achievement could help to reduce the global temperature rise by about 0.5 degree Celsius by the year 2100.

The provisions of KA include specific targets and timetables to replace HFCs with lower GWP alternatives, and restriction from trading in controlled substances with countries that have not ratified it. KA also mentions the importance of energy efficiency of cooling technologies and proper management of chemicals throughout their lifecycle including at the end phase for safe disposal and destruction of refrigerant gases. Bangladesh has ratified Kigali Amendment on 08 June 2020 and will start phase-down activity of non-ODS but high GWP HFCs.

It is important for Bangladesh to consider and set the right policy conditions for the effective implementation of Kigali Amendment. Understanding current market situation is essential in view of the complexity of the RAC sector with multiple refrigerants each suitable only for certain applications. The right government policies will help to guide the market and its key players for the smooth, safe and accelerated adoption of preferred alternatives and contribute to the sustainable development objectives.

Article 5 countries under Montreal Protocol on Substances that Deplete the Ozone Layer are implementing the HCFC Phase-out Management Plans (HPMP) and moving towards alternative technologies. The most commonly used HCFC alternatives are those with high GWP HFCs such as HFC-134a, R-410A, R-404A, R-407C etc. used in RAC sector, particularly the servicing sector.

In Bangladesh, the refrigeration servicing sector is the major user of both ODS and HFCs. In view of the entrance of Kigali Amendment in force on 1 January 2019 which will drive the HFC phase-down in many countries and ongoing concurrent phase-out of HCFCs, it is expected that between 2020-2040 most of A5 countries' markets will have units running with R22, R134a, R410a, R32, R290, HFO and variety of blends. The RAC sector will become more complex to manage with multiple refrigerants available and suitable only for selected applications and with many alternatives presenting operational challenges due to their toxicity, high pressure and flammability. Kigali Amendment brings to the forefront the importance of

climate impacts of refrigerants and cooling technologies. Energy efficiency is another key consideration for RAC servicing sector. In this context, the competence of servicing sector in installation, maintenance, repair, and disposal becomes critical. The focus on the HPMP and future HFC phase down related projects should be on building sustainable system to support refrigeration servicing sector, which will in turn be able to support the safe and fast adoption of alternatives.

In this regard, the Enabling Activity which have the objective of assisting the countries with the ratification and meeting initial obligations of Kigali Amendment, has key components focusing on capacity building and needs assessment of the refrigeration servicing sector including situational analysis with mapping of present practices, end-use trend analysis, and conducting awareness and consultations workshops with the refrigeration servicing sector's stakeholders. This should help the National Ozone Unit (NOU), implementing agencies and public and private sector stakeholders to develop sound strategies and programmes to support the servicing sector.

2. SCOPE, OBJECTIVES, METHODOLOGY AND LIMITATIONS OF THE STUDY

2.1 Scope

The assessment includes of the market readiness, training needs in the servicing sector, identification of barriers for introducing low-GDP alternatives on the servicing sector side, availability of tools and equipment, availability of standards etc. The assessment also includes the situational analysis of current practices, challenges and opportunity related to the servicing sector system, qualification process, current practices, the sector's professional institutional structure (RAC associations, unions), policy framework for regulating the sector, technology trends, gaps and needs assessment.

To conduct this assessment, four levels of stakeholders i.e,. RAC Training institutions, RAC Service Sector, workshops/ technicians, RAC Sector and Sub-sector governing bodies, and RAC associations would be consulted.

2.2 Objectives

The objective of this assignment is to conduct an assessment to the needs of the refrigeration servicing sector to determine the training, capacity-building, standards and regulatory support required for technicians and end users to safely use the range of alternative refrigerants, with an overview of Bangladesh market readiness and to develop a plan of actions to be included into the HFC phase-down in Bangladesh.

2.3 Methodology

This assessment report was prepared following desk review of the existing literature as well as the key informant interview (KII) with the following sector:

- RAC Training institutions;
- RAC Service Sector workshops/technicians;
- RAC Sector and Sub-sector governing bodies; and
- RAC associations;
- Ozone Cell/ National Ozone Unit

2.4 Limitations

The objectives of this assessment report covers numbers of issues that could be done in separate assessment or surveys. Due to COVID situation it was not always possible to get the stakeholders for the assessment. Number of stakeholder consultation could not possible due to the pandemic situation. Moreover, there are little access to data and literature in regards with Bangladesh for the proper analysis and assessment.

3. SITUATION ANALYSIS

3.1 Policy and Regulatory Framework

The Montreal Protocol on Substances that Deplete the Ozone Layer is the landmark multilateral environmental agreement that regulates the production and consumption of nearly 100 man-made chemicals referred to as ozone depleting substances (ODS) adopted on 15 September 1987.

The Montreal Protocol phases down the consumption and production of the different ODS in a step-wise manner, with different timetables for developed and developing countries (Article 5 countries). Under this treaty, all parties have specific responsibilities related to the phase out of the different groups of ODS, control of ODS trade, annual reporting of data, national licensing systems to control ODS imports and exports, and other matters. Developing and developed countries have equal but differentiated responsibilities, but most importantly, both groups of countries have binding, time-targeted and measurable commitments.

The Protocol includes provisions related to Control Measures (Article 2), Calculation of control levels (Article 3), Control of trade with non-Parties (Article 4), Special situation of developing countries (Article 5), Reporting of data (Article 7), Non-compliance (Article 8), Technical assistance (Article 10), as well as other topics. The substances controlled by the treaty are listed in Annexes A (CFCs, halons), B (other fully halogenated CFCs, carbon tetrachloride, methyl chloroform), C (HCFCs), E (methyl bromide) and F (HFCs).

The treaty evolves over time in light of new scientific, technical and economic developments, and it continues to be amended and adjusted. The Meeting of the Parties is the governance body for the treaty, with technical support provided by an Open-ended Working Group, both of which meet on an annual basis. The Parties are assisted by the Ozone Secretariat, which is based at UN Environment Programme headquarters in Nairobi, Kenya.

The Multilateral Fund for the Implementation of the Montreal Protocol was established in 1991 under Article 10 of the treaty. The Fund's objective is to provide financial and technical assistance to developing country parties to the Montreal Protocol whose annual per capita consumption and production of ODS is less than 0.3 kg to comply with the control measures of the Protocol.

The Multilateral Fund’s activities are implemented by four international agencies - UN Environment Programme (UNEP), UN Development Programme (UNDP), UN Industrial Development Organization (UNIDO) and the World Bank - as well as bilateral agencies of non-Article 5 countries.

Responsibility for overseeing the operation of the Fund rests with the Executive Committee, which comprises seven members each from Article 5 countries and non-Article 5 countries. The Committee is assisted by the Multilateral Fund Secretariat, which is based in Montreal. Since inception, the Multilateral Fund has supported projects including industrial conversion, technical assistance, training and capacity building.

Throughout the implementation of the Montreal Protocol, developing countries have demonstrated that, with the right kind of assistance, they are willing, ready and able to be full partners in global efforts to protect the environment. In fact, many developing countries have exceeded the reduction targets for phasing out ODS, with the support of the Multilateral Fund.

HCFCs are gases used worldwide in refrigeration, air-conditioning and foam applications, but they are being phased out under the Montreal Protocol. HCFCs are both ODS and powerful greenhouse gases. The most commonly used HCFC is nearly 2,000 times more potent than carbon dioxide in terms of its GWP. Recognizing the potential benefits to the Earth’s climate, in September 2007 the Parties decided to accelerate their schedule to phase out HCFCs. Developed countries have been reducing their consumption of HCFCs and will completely phase them out by 2020. Developing countries agreed to start their phase

out process in 2013 and are now following a stepwise reduction until the complete phase-out of HCFCs by 2030 with 2.5% servicing tail up to 2040.

In Article 5 countries, this HCFC phase out is in full swing, with support from the Multilateral Fund for the implementation of multi-stage HCFC Phase out Management Plans (HPMPs), investment projects and capacity building activities. Throughout this process, the Parties are encouraging all countries to promote the selection of alternatives to HCFCs that minimize environmental impacts, in particular impacts on climate, as well as meeting other health, safety and economic considerations. For the climate consideration, this means taking global-warming potential, energy use and other relevant factors into account. For refrigeration and air conditioning, this means optimizing refrigerants, equipment, servicing practices, recovery, recycling and disposal at end of life.

HFCs were introduced as non-ozone depleting alternatives to support the timely phase out of CFCs and HCFCs. HFCs are now widespread in air conditioners, refrigerators, aerosols, foams and other products. While these chemicals do not deplete the stratospheric ozone layer, some of them have high GWPs ranging from 12 to 14,000. Overall HFC emissions are growing at a rate of 8% per year and annual emissions are projected to rise to 7-19% of global CO2 emissions by 2050. Uncontrolled growth in HFC emissions therefore challenges efforts to keep global temperature rise at or below 2°C this century. Urgent action on HFCs is needed to protect the climate system.

The Parties to the Montreal Protocol reached agreement at their 28th Meeting of the Parties on 15 October 2016 in Kigali, Rwanda to phase-down HFCs. Countries agreed to add HFCs to the list of controlled substances, and approved a timeline for their gradual reduction by 80-85 per cent by the late 2040s. The first reductions by developed countries are expected in 2019. Developing countries will follow with a freeze of HFCs consumption levels in 2024 and in 2028 for some nations. The Kigali Amendment entered into force on 1 January 2019 for those countries that have ratified the amendment.

Bangladesh accessed the Montreal Protocol on 2nd August 1990 and ratified its London, Copenhagen, Montreal, Beijing and Kigali Amendments in 1994, 2000, 2001, 2010 and 2020 respectively. As a signatory to the protocol, control measures have been imposed on the import and consumption of ODSs in Bangladesh from 1st July 1999. The first step toward achieving the objectives of the Montreal Protocol, a preliminary survey on ODS use and import in Bangladesh was carried out in 1993 followed by a Country Programme undertaken in 1994 towards the phasing-out the use of ODS. The government set up Ozone Cell in 1995 within the Department of Environment which undertook various activities towards achieving target under Montreal Protocol. In 2004 Bangladesh's response to ODS control was reinforced when the government enacted the Ozone Depleting Substances (Control) Rules, 2004 (ODS Rules) under the Bangladesh Environment Conservation Act, 1995 (ECA). This rule empowered the government with a legal instrument to control ODS in the country and phase-out ODS as per Montreal Protocol schedule. After the Montreal Amendment in 2007, phase-out of HCFCs was shifted from 2040 to 2030. To keep pace with the Montreal Adjustment, government has amended the ODS Rules in September 2014.

The licensing, quota and enforcement framework have been key to the achievement of compliance in Bangladesh. As a control substance a license is required for import and export of ODSs. There is an annual quota fixed for ODS consumption specified in the rules. Bangladesh has an operational licensing and quota system for import and export of ODSs since 2 October 2005 and these systems are also applicable to ODSs. It uses the issuance of licenses as a way to monitor ODSs imports. The licensing system, which is issued on a yearly basis, only permits licensed organizations to import and distribute ODSs in Bangladesh. The quota system, which runs from January to December of each year, has been in place since 2013 and includes all HCFCs indicated in the Annex C-Group 1 of the Montreal Protocol. Importers apply through a prescribed form for a quota to the DoE. There is a five-member evaluation committee headed by the Additional Director General, DoE. This committee evaluates applications and recommends quotas to the Director General, DoE for the issuance of licenses. DoE retains 30% of the total quota at this time, which along with unutilized quota, is re-distributed in July based on the actual utilization of licenses issued for imports of the importers. 2-3% of quota is retained by DoE as a buffer for emergencies/unexpected events. There are provisions of punishment for violators in ODS (Control) rules.

HFCs are yet-not a controlled substance in Bangladesh and yet there are no restriction on import, export, production and uses. Bangladesh has just ratified the Kigali Amendment to the Montreal Protocol and is preparing its strategy for the preparation of Rules and Regulation to control HFCs. For natural refrigerants, there is no Rules and Regulation for use. It is expected that the amended rules will be drafted soon with the assistance of UNDP.

3.2 Refrigeration and Air-conditioning Market Analysis and Technology Trend

Refrigeration and air-conditioning market can be categorized as the following

1. Domestic refrigeration
2. Commercial Refrigeration
3. Industrial Refrigeration
4. Transport Refrigeration
5. Unitary Air-conditioning
6. Mobile Air-conditioning
7. Chillers

3.2.1 Domestic Refrigeration

The domestic refrigeration sub-sector is the major component and includes appliances that are broadly used domestically, such as refrigerators, freezers and combined refrigerator/freezer products. Small beverage dispensing machines are also included in domestic refrigeration, but represent only a small fraction of total units. HC-600a (predominantly) or HFC-134a continues to be the refrigerant options for new production and currently, more than millions of domestic refrigerators use HC- 600a in Bangladesh. Around 90% of the domestic refrigerator's demand is met by local manufacturers and assemblers. R-134A and R-600a is the preferred refrigerant.

With the market introduction of freezers and small refrigerators in Bangladesh, service infrastructure is being developed. It is expected that by more than 90% of new refrigerator production will use HC-600a and the rest will use HFC-134a as Bangladesh has recently took a demonstration conversion project completed at the largest refrigerator manufacturing industry by HC-600a refrigerant.

Walton is the leading brand that produces refrigerators in the country and holds the domestic market share of almost 70%. Jamuna, Marcel, Butterfly, Singer etc. are producing refrigerators for domestic market and few international brands like Sharp, Samsung, Hitachi, Vestfrost, Kalvinator etc are imported and has limited market share.

3.2.2 Commercial refrigeration

Commercial refrigeration is used for storing and displaying food and beverages at different temperature levels within commercial stores. Two main levels of temperatures are generated by refrigeration systems from around 0 °C to 8 °C for the conservation of fresh food and beverages, and around -18 °C for frozen food and ice cream. HCFC-22, and more recently, R-404A are the commonly used refrigerants in these applications. Traditionally, commercial refrigeration applications are prone to significant refrigerant leakage due to the fact that most large systems are field installed.

Equipment can be classified as direct or indirect systems, or as stand-alone, condensing unit, centralized and distributed systems. The choice of a lower GWP alternate refrigerant depends greatly upon the type of equipment. In addition, since the equipment operates year-round and the condensing coils are typically located outdoors, the ambient temperature also plays a major role in equipment selection. Efficiency considerations are also a major factor due to the life cycle climate performance of such equipment tends to be dominated by the power consumed and the source of that energy. Commercial equipment typically has a life span of fifteen years or greater and retrofit (changing refrigerant) is a common occurrence. Therefore, both new and existing equipment have to be considered when reviewing the refrigerant candidates for lower GWP. Several lower GWP refrigerant options have been identified for commercial

refrigeration and more options are being announced as research and development continues. As the use of alternates increases globally, their availability, knowledge of use criteria, and the cost of the equipment can be expected to improve.

According to ASHRAE, the market size of commercial refrigeration combining deep freezers, visi-coolers, remote condensing units and water coolers in the base year 2018 including the historically installed base, sourced from importers and various market intelligence reports across different types of technologies has been estimated to be around 0.8 to 1.0 million TR. Market experts believe that different kinds of commercial refrigeration units shall witness a steady growth of around CAGR 10% increase over 10 to 15 years. The main factors for growth in the commercial refrigeration sector will be commercial space growth, cold chain, GDP growth and lowering of prices in the future.

All types of refrigeration equipments in this category are manufactured/ assembled in Bangladesh. Necessary spare parts such as, indoor body cover, outdoor body cover, evaporator coil, condenser coil, plastic cabinet, copper tube, binding belt, electric box etc. are imported for manufacturing/ assembling the refrigeration equipments. R-22 is still used in condensing units.

3.2.3 Industrial refrigeration systems

Industrial refrigeration is an integrated part of the global food chain from harvest to table. Industrial refrigeration is used for cooling a variety of food from ambient temperature to just above the freezing point of water or well below. Food and beverage (F&B) are important markets for industrial refrigeration, but industrial refrigeration is also used in a range of other industries such as fishing ships, pharmaceuticals, petrochemicals, airport cooling, and heating systems. The majority of the industrial systems use R-717 refrigerant. Where R-717 is not acceptable for direct systems, options include R-744 or glycol and brine in secondary systems, or HCFCs, or HFCs in direct systems. Due to accumulation of the separate components of a refrigerant blend in different parts of the system, blends form a challenge in industrial pumped and two stage systems. The process of moving from HCFCs to zero ODP, low GWP alternatives would be accelerated by a concerted education and training program for operators and service technicians including operational experience and lessons learned from existing systems. Employee training on the higher standards is a key to ensure safety of the systems in use.

Industrial refrigeration equipment are milk, meat & fish processing and storage; fruits and vegetables processing and storage; ice-cream manufacturing and storage, pharmaceutical including vaccination, chemicals manufacturing and storage etc. In large industrial systems, such as cold storage, fish freezers, textiles, pharmaceutical etc. mainly uses ammonia (R-717) which are accepted as the preferred refrigerant. For pre-cooling system only R-22 are used in small cold storage and fish freezing.

3.2.4 Transport refrigeration

Transport refrigeration is a small segment, mainly focused on the delivery of chilled or frozen products. This segment has specific challenges such as; shock, vibration, corrosion and broad operating conditions. Because of this, the refrigerant selection may be substantially different from other segments. In truck and trailer refrigeration R-404A and HFC-134a is used in Bangladesh. The shipping industry is now using R-717 either alone or in cascade and the majority of the global fleet (other than those trading in Europe) are likely to continue to operate using HCFC-22. Although railway air conditioning applications continue to relying heavily on HFC-134a and R- 407C.

3.2.5 Unitary Air-conditioning (UAC)

The subsector UAC contains ductless split, ducted split and rooftop ACs as well as VRF systems and self-contained units, which are movable ACs and window/through-the-wall units. Split residential ACs make up 80% of the UAC market (in terms of numbers of units) and are therefore by far the most important appliance system of UAC. Split residential ACs consists of two modules; one of which contains the compressor, outdoor heat exchanger and expansion device and is installed outside. The other module with the indoor heat exchanger is placed inside in the room. The refrigerants in split AC are mainly HCFC-22

in Bangladesh or R410A (an HFC mixture). Inverter technology is used in many new units as they can help with improving the energy efficiency during part load operation. Inverters enable the control of the compressor speed according to the cooling demand, thereby reducing the so-called cycling losses that are present with on-off control.

Use of room air conditioners was very few in early 2000. A market survey indicates that in 2005 the number of air conditioners in use was only 50,000 units (Source: Air conditioners marketing survey by Unitech, 2006). Owing to rapid increase of demand, a good number of manufacturing facilities gradually developed. Production of room air conditioners including assembling over these years up to 2018 have been around 3.6million units (Source: collection of data from manufacturing units)which are assumedly have been installed. Local manufacturers claim that Local production including assembling currently can cater 80% of the market demand. The market is still in development and consumers are very price sensitive (i.e. small changes will have a high impact on demand). Currently almost all locally manufactured and sold room air conditioners are equipped with HCFC-22, although importers have turned to R-410A and R-32.

3.2.6 Mobile Air Conditioning (MAC)

Vehicles can heat up significantly in hot weather or under direct influence from sunlight. MAC systems are installed in cars to keep drivers comfortable and safe. For conventional cars, the compressor in MACs is connected to the car engine via a belt and there is direct transfer of mechanical power. Fans and controls are powered by electricity.

After the phase-out of CFCs and HCFCs under the Montreal Protocol, the refrigerant used in MAC is predominantly HFC-134a. However, due to its high GWP of 1,430, the use of HFC-134a increasingly faces restrictions around the world. Few car manufacturers have started to use u-HFC-1234yf in Europe and only in new car models since it became commercially available since late 2012. The charge size is usually smaller than 1 kg with an average of 600 g. End-users of MAC systems are almost exclusively car original equipment manufacturers (OEMs). Contrary to the other subsectors, the MAC subsector is usually uniform with one refrigerant solution for all MAC units.

3.2.7 Chillers

Chillers are used for cooling in industrial, commercial as well as residential applications and therefore come with a whole range of different cooling capacities. The cooling capacity of chillers usually depends on the compressor type, but there is some overlapping between them. Chillers can be categorized intro three classes according to the type of compressor they use:

- positive-displacement (reciprocating, scroll, screw)
- centrifugal
- absorption chillers

Among the three chiller classes, absorption chillers have the lowest market share. Absorption chillers do not use electrical compressors but heat as energy source. They use natural refrigerants, have extremely low COPs and are normally only used when waste heat is available. They represent an extremely small fraction of the market.

The smallest power classes of chillers are chillers with reciprocating and scroll compressors, the latter with a typical cooling capacity of up to 280 kW. Reciprocating chillers are now rarely used for air conditioning but mostly for refrigeration. Modular chillers with scroll compressors are cost-effective. They become an alternative to screw chillers in some applications.

Screw chillers occupy medium cooling capacity ranges (from around 18 to 1400 kW). In the upper cooling power classes modular set-ups compete with centrifugal chillers (from around 1050 kW) and are becoming an interesting option since they are cheaper. Centrifugal chillers are used for the highest cooling capacity classes.

In chillers water is cooled by the evaporator. Cooled water is then distributed over longer distances and used to cool whole buildings (air-conditioning chillers) or industrial processes such as plastics and rubber manufacturing and food processing (process chillers). There are few technical differences between AC

chillers and process chillers. The cold water from AC chillers usually has higher temperatures than in process chillers where medium and low temperatures are more common. Even though every chiller, by definition, cools water; there are water-cooled (WC) and air-cooled (AirC) chillers. This refers to the method used to remove heat from the condenser. Chillers vary in their cooling capacity, which can range from as little as 1.75 kW for AirC chillers and up to several MW for WC chillers. Different capacity chillers are equipped with different compressors. Typically process chillers have a lower COP because these chillers need to generate lower temperatures.

The main conventional HFC or HCFC refrigerants used are HFC-134a, R-410A, R-407C and HCFC-22. The natural refrigerants ammonia (R-717) is regularly used in commercially available chillers.

The use of ammonia is a more cost-efficient solution for chillers with high cooling capacity (>500-700kW). Because of the high amount of refrigerant and their respective flammability and toxicity, safety measures have to be taken. This usually includes installation of the majority of the refrigerant cycle outside of buildings or in a special machinery room. The water that is then transported to cool occupied spaces poses no risk in itself.

For AC chillers, the same considerations as for UAC apply. Even more cooling needs can be reduced by planning and designing office buildings and hospitals with the minimisation of the cooling load in mind. It is also important to choose the chillers according to the needed capacity. The location where a chiller is installed and general considerations about its operation and maintenance can lead to very high savings in electricity consumption.

The chiller market is relatively small compared to the UAC subsector, but demand is also rising and as more and more building projects include central air conditioning in the planning stage instead of having occupants buy their own UAC at a later stage, it will grow considerably in the future.

As the chiller systems are 100% import based, data on estimated market size of different types of chillers in 2018 was including the historical installed base is estimated to be around.65 to .70 million TR. As per ASHRE, commercial buildings consume approximately 80%of all chillers sold in the country and the remaining 20% goes into industrial air conditioning applications. It is also observed that roughly one-sixth of the total annual chiller sales go into replacing existing chillers.

Table C3.2 1 Refrigerants and average lifetime of RAC equipment

Equipment Type	Main Refrigerant	Lifetime
Self contained AC	R-410A, R-22	10
Split Residential AC	R-410A, R-22	15
Split Commercial AC	R-22	15
Duct Split Residential AC	R-410A, R-22	15
Multi Splits	R-410A, R-134a	15
AC Chillers	R-410A, R-134a	25
Process Chillers	R-22, R-404A, R-417	25
Car AC	R-134a	13
Large Vehicle AC	R-134a	14
Domestic Refrigeration	R-134a, R-600a	11
Stand-alone Equipment	R-134a, R-22	10
Condensing Unit	R-22	15
Centralized Supermarket Systems	R-22, R-404A	20
Integral	R-22, R-134a, R-404A	10
Industrial Condensing Unit	R-22, R-404A, R 717, R600a	20
Centralized Systems	R-22, R-404A, R 717	25
Refrigerated Trucks/ Trailers	R-134a	15

Table C3.2 2: Available brands of different refrigeration system in Bangladesh

Refrigeration system	Brands
Domestic Refrigeration	Panasonic, Midea, Sharp, Samsung, Toshiba, LG, Walton, Minister, Singer, Marcel, etc.
Commercial Refrigeration	Nakagawa, Midea, etc.
Industrial Refrigeration	Kingsun, Vestfrost, Panasonic, Haier, etc.
Transport Refrigeration	Isuzu, Truong, Suzuki, Hyundai, Hino Motors

Table C3.2 3: Types and brands of different AC systems available in Bangladesh

Item	Types	Brands
UAC	Window Ton to 2.5 Ton (Portable 1.0 Ton)	LG, Daikin, Panasonic, Walton, Hitachi, Samsung, Singer, Toshin, Whirlpool, Haier, Gree, Carrier, Unitech, General, Transtec, Kent, Emerland, Mitsumaru.
Domestic AC	Split – Wall Inverter & Non Inverter type 1.0 Ton to 2.5 Ton	Media, LG, Daikin, Panasonic, Hitachi, Haier, Gree, Carrier, General, Unitech, Transtec, Kent, Dunhumbush, Haiko, Emerland, Mitsumaru, American Aire,
Commercial AC	Split – Ceiling, Cassette, Ducted, Floor Stand,	Media, LG, Daikin, Panasonic, Hitachi, Haier, Gree, Carrier, General, Transtec, Dunhumbush, Emerland, Mitsumaru, American Aire, Unitech,
Commercial AC	VRF, VFD, VRV Multi Split Unit (Combined of Ceiling, Cassette, Ducted, Wall) 8.0 Ton to 30.0 Ton	LG, Daikin, Panasonic, Hitachi, Samsung, Gree, Carrier, Dunhumbush, Mitsubishi, York,
Commercial AC	Central HVAC (AHU with Ducted)	Carrier, Daikin, Dunhunbush, Trane, Hitachi, Gree, Wilson, York, Mitsubishi, Amana, Wilson
Industrial AC	Central HVAC (FCU with Ducted)	York, Trane, Hitachi, Dunhumbush Carrier, Wilson, Mitsubishi
Commercial MAC	Refer container, Bus, Ship	Carrier, York, Danfoss, Bitzer, Pioneer, Bock, Thermoking, Kingfisher.

3.3 Training for Servicing Technicians

The Refrigeration sector has been the second largest sector in Bangladesh consuming around 40% of total ODSs consumption in the country. Since the establishment of the Ozone Cell under the Department of Environment refrigeration servicing sector has been accounted most of its efforts to phase-out ODS from the servicing sector.

The first training programme under Montreal Protocol Activities was undertaken by a project called Refrigerant Management Plan (RMP). “Training Workshop on Good Practices in Refrigeration” along with three other activities included in RMP was accorded by the Multilateral Fund through its 29th Executive Meeting held in 1999. The aforesaid projects had found their implementation completed by December, 2004. The Implementation of a National Programme for Recovery and Recycling of Refrigerants was initiated in January 2001 and its implementation was completed in December 2004. A total number of 240 technicians from the service centres belonging to the Project’s focus sector in the cities of Dhaka, Chittagong, Khulna, Rajshahi, Sylhet and Barisal representing the six respective Administrative Divisions and in the cities of Narayanganj and Mymensingh were trained and distribution was made of 8 mobile recovery and recycling machines to service centres for AC cars, AC buses and mobile refrigeration vans and 62 electric and manual recovery units together with 8 recycling machines for R-12 for remaining centres.

The project on Training programme on Good Practices in Refrigeration had found its initiation in December 2002 and completion in December 2004. Activities of the programme had been in two phases - Training of the Trainers and Training of Trainees. A total number of 39 trainers were trained in June 2003 who trained 1000 trainees in six Administrative Divisions during January - December 2004.

National ODS Phase-out Plan (NOPP) has been approved by the 42nd meeting of the Executive Committee (ExCom) of the Multilateral Fund for the Implementation of the Montreal Protocol in April 2004. UNDP and

UNEP will jointly implement the NOPP. Under UNEP component focuses were given on capacity building of RAC servicing technicians on good servicing practices. Under Stage I, the Ozone Cell conducted 71 two-day training workshops throughout the country trained 3,944 technicians. Many of these technicians are from informal sector. These training were organized by Ozone Cell of DoE with help from the Bangladesh Refrigeration and Air-conditioning Merchants Association (BRAMA). Under UNDP component, training programme on retrofit of refrigerator (RR) has been organized. About 2000 technicians were trained under RR training programme. About 800 shops had been provided with retrofitting tools and equipment. The above mentioned training programme were meant to phase-out CFCs.

The HCFC Phase-out Management Plan (HPMP) for Bangladesh proposes a systematic HCFC phase-out approach through the conversion of those manufacturing enterprises in the foam and refrigeration sectors with the highest consumption of HCFCs, where alternative technologies are technically proven and cost-effective, taking into account global warming potential (GWP). It also proposed a phased approach in adopting alternatives where low-GWP technology availability is limited. Stage I of the HPMP focused on the expeditious implementation of the conversion project in the foam manufacturing sector for Walton to phase out HCFC-141b and undertake capacity building measures to limit demand for HCFCs in servicing and manufacturing and installation of new equipment.

To meet the 2013 and 2015 phase-out targets, 20.20 ODP tonnes of HCFC-141b used in the foam sector was phased out and several activities in the refrigeration servicing sector (i.e., training of customs officers and refrigeration service technicians, policy formulation and coordination with the other Government departments and stakeholders) was implemented during stage I of the HPMP. Under HPMP Stage-I, three train the trainers (ToT) and 70 Good Service Practices training has been organized in all over Bangladesh. Government has taken projects under HPMP Stage-II to meet 2025 target of MP and there is also provisions to organize technicians training.

UNDP has assisted during a demonstration project to phase-out HFC from refrigerator manufacturing and enabling activities to conduct train-the-trainers and train the technicians' workshop is to reduce the HCFC-22 and HFCs consumption in the refrigeration and air-conditioning sector in Bangladesh, adopt safety parameters related to A2L and A3 refrigerants, Approximately 27 senior refrigeration and air-conditioning engineers, lecturers and technicians with at least 5 years of working experience from RAC service sector industry, Engineering Colleges/Training Institute, RAC Manufacturing companies, well-established service workshops, participated in the train-the-trainers workshop.

Services sector enterprises are spread throughout the country and there are about 16000 servicing shops in Bangladesh. As the demand of air-conditioners, refrigerators and cars are growing fast in the country. Servicing workshops are still growing. These service centres are at large not controlled by any government agencies. They start their business obtaining the trade license only. There are three other channels through which room air-conditioners or fridge servicing is offered in the country. They include manufacturing companies, third party servicing company and non-authorized service shops/ individual servicing technicians.

The manufacturing companies have a formal servicing setup and a pool of trained service personnel. These companies largely operate through franchised service network i.e. third-party sales and service dealers or authorized service providers, though they may have a few engineers/technicians on payroll, at supervisory/ managerial levels. The company routes the service calls/requests for both installation and repairs to these franchisees. Actual service delivery is completed by these franchisees using their service technicians. Most of the products under the category of air-conditioners are warranted for a period of one year. During the warranty period apart from assuring satisfactory performance of the product, a few proactive services are provided by almost all OEMs at site. It is also a prevalent practice that the installations are often done by a technician employed by the sales distributor/dealer of the OEM. These technicians have been trained only for installation and a certain few routine checks of the product to commission the unit after installation at the customer premises. These technicians do not have thorough diagnostic skills on the product. This practice has become popular to cater the demand for speedy installation after the air conditioner has been purchased by the customer. After the warranty period has expired, customers generally go to non-authorized service enterprise or freelance technicians due to the relative expense of authorized servicing.

The second channel consists of third-party servicing companies. These could be either formally registered or unregistered, but they do not have any franchisee relationship with the OEM. In the MAC sector, many such enterprises offer specialized services and may even be preferred by customers.

The third channel is that of the services from non authorized service shops or freelance servicing technicians available in the country. Servicing air-conditioners is a growing opportunity, especially in the urban Bangladesh. Technicians who already have a knowhow of servicing air-conditioning systems or fridges hire people interested in the trade and train them on the job. Given the informal nature of this set-up, it is difficult to estimate the number of technicians operating in this manner and their level of training. Moreover, many people employed in the sector for servicing electronic appliances, enter into the air-conditioning servicing sector during peak season. Even technicians employed at enterprises often freelance during their free time. This sector is populous &large in numbers.

Given the above context, training cannot be only theoretical, practical training should be a critical aspect of the training process. Experience of NoU from previous servicing sector projects funded by Multilateral Fund (MLF) for the implementation of the Montreal Protocol in the country reveals that technicians who have undergone training significantly improve servicing practices. It altogether has imparted training to around 10,000 technicians both from formal and informal under Good services Practices Project in RAC, about 2000 technicians were trained on Refrigerator Retrofit and 800 RAC service shop owners were provided with the retrofit kits and essential tools for retrofitting refrigerators. The training curricula included:

- Environmental impact and human health Impacts of ODS refrigerants;
- Alternatives to HCFCs and their characteristics;
- Handling of HFCs refrigerants;
- Servicing of HCFC and HFC based air-conditioners;
- Tools & equipment for servicing;
- Dos and Don'ts in refrigeration & air-conditioning servicing;
- Handling and Safety issues of HC refrigerants;
- Servicing of hydrocarbon (HC) based air-conditioners;
- Installation procedure of split air conditioners;
- Refrigerant recovery, recycling & reclamation;
- Economics of refrigerant reclamation & best Service;
- Contaminated refrigerants and refrigerant identifier;
- Selection & safe usage of cleaning solvents;
- Maximizing climate benefits through servicing sector;
- Recovery machine – maintenance;
- Single Stage vs. double stage nitrogen regulator.

There is a pool of trainers registered with the NoU from government Polytechnic Institutes as well as qualified trainers generated from ToT training programs to act as Trainers for all such programs.

3.4 TVET System: Professional Institutional Structure and Qualification Process

The Technical and Vocational Education and Training (TVET) system comprises short courses (360 hours) plus three levels of formal TVET:

- 2 years for a secondary school certificate (vocational) (SSC Voc),
- 2 years for a higher secondary certificate vocational) (HSC Voc), and
- 4 years for a diploma.

Students can enter the diploma level in monotechnics and polytechnics after completing a general or vocational SSC or its equivalent. The main public providers of TVET are the Department of Technical Education under the Ministry of Education; the Bureau of Manpower, Education and Training (BMET) under the Ministry of Expatriate Welfare and Overseas Employment; and the Ministry of Youth and Sports. In total, about 20 ministries and departments deliver some type of skills training. Under the

Ministry of Education, the Bangladesh Technical Education Board (BTEB) is the apex body responsible for quality assurance through accreditation of training providers, curriculum development, examinations, and certification.

Private providers account for about 95% of all TVET institutions and about three-fourths of all enrollments. Compared with general secondary education, only about 3% of students enroll in secondary-level vocational programs (both SSC Voc and the National Skills Standard (Basic)). Bangladesh has a well-developed system of examinations for formal TVET qualifications, particularly regarding theoretical coverage. There are several excellent private providers, including nongovernment organizations (NGOs), and many focus on disadvantaged youth and adults. Among these are the Underprivileged Children's Educational Programs (UCEP), Dhaka Ahsania Mission, Center for Mass Education in Science, and Mirpur Agricultural Workshop and Training School. There are also excellent examples of industry initiatives for skills provision under public–private partnerships (PPPs) such as Bangladesh Garments Manufacturers and Exporters Association through technical training centers and Bangladesh Textile Mills Association with the National Institute of Textile Training, Research and Design. Other good practices include the establishment of the National Skills Development Policy and the industry skills councils and the initiatives for devolution of authority and flexibility in raising revenues among technical training centers.

3.4.1 Plans and Policies

Bangladesh has at least five plans and policies with prescriptions and implications for TVET:

(i) Vision 2021,
(ii) the Poverty Reduction Strategy Program II,
(iii) Education Policy 2010,
(iv) the National Skills Development Policy (NSDP) 2011,
(v) National Basic Skill Education Policy 2016
(vi) Diploma in Engineering Education Policy 2018
(vii) SSC (Voc) Education Policy 2018 and
(viii) the Seventh Five Year Plan (FY 2016 – FY 2020)

Most important are the TVET strategies in the Education Policy 2010 and NSDP 2011. The TVET section of the Education Policy 2010 focuses largely on massive expansion, ensuring both vertical mobility from one level to another and access for the underprivileged and marginalized segments of the population. Approved by the cabinet in January 2012, the NSDP advocates a flexible demand orientation for skills development and spells out the role of industries as well as training in the workplace. It also calls for the imposition of standards and structures for skills development through a qualifications framework and competency-based training rooted in workplace skill requirements.

The technical and vocational education and training (TVET) system in Bangladesh is comprised of formal and nonformal TVET. In a formal TVET system, students gain entrance to the diploma level in monotechnics and polytechnics after completing a secondary school certificate (SSC), both general and vocational. The minimum educational requirement for entry to the higher secondary certificate (vocational) (HSC Voc) is SSC Voc, and the requirement for entrance to SSC Voc is completion of grade 8. On the other hand, nonformal TVET is comprised of certificate courses with duration ranging from 1 month to 12 months designed by the nonformal TVET providers and the courses they offer are not affiliated with Bangladesh Technical Education Board (BTEB). All TVET programme has RAC courses in their curriculum.

3.4.2 Structure of Technical and Vocational Education and Training

3.4.2.1 Formal

Formal training is regulated and administered by the relevant ministries, directorates, or other public bodies. Those who successfully complete a formal training receive a national certificate. Formal TVET programs are affiliated with BTEB.

The formal TVET system comprises three levels of skills development programs: basic, certificate, and diploma. Each of these program levels corresponds to training that meets various certification standards.

Basic Training Program is also known as basic trade. The basic training program is a 360- hour skills training course that focuses on the development of practical skills and includes some theory. Courses last from 3 to 6 months. The minimum educational requirement for entry is completion of grade 8, but 1 year of trade-specific work experience qualifies students for the basic trade test even when they did not pass grade 8. Basic trade is offered mainly by technical training centers (TTCs), technical school and colleges (TCS), polytechnic institutes, private institutions, and some nongovernment organizations (NGOs). The training program covers 61 trade areas, and aims to meet the needs of both domestic and overseas job markets.

TVET Certificate Training Program: Certificate-level training largely pertains to SSC Voc and HSC Voc courses at the secondary level. The entry qualification for SSC Voc is grade passed. SSC Voc attracts students of vocational courses because of its equivalency to the general SSC, which provides entry to higher education and complies with National Skills Standard II after completion of the 2-year secondary education program for entry into work world. Students who complete 1 year of SSC Voc (grade 9) already have a National Skills Standard III certificate. After completing the SSC Voc program (grade 10), students may enter the 2-year HSC Voc program, after which they receive two qualifications: (i) entry to higher education, and (ii) a National Skills Standard I certification if they wish to seek work. After introducing SSC Voc and HSC Voc in 1995, the National Skills Standard became widely diversified and expanded to secondary-level education and training institutes.

Diploma Courses: More than 384 public and private polytechnic institutes offer 4-year postsecondary diploma courses in engineering, covering 42 technological areas. Students enter polytechnic institutes from SSC general, Dakhil General, Dakhil Voc and SSC Voc. The courses at polytechnic institutes are designed by the BTEB, which also administers final semestral examinations. However, the institutions conduct half of all final practical examinations, involving experts from relevant industries and departments (e.g., the Power Development Board, the Roads and Highways Department, and the Public Works Department). To enhance students' knowledge and skills, and to develop industry linkages, polytechnic institutes also arrange 3-month industrial attachment training. Public polytechnic institutes operate programs in two shifts to cover more students.

Students can achieve the entry qualification for a diploma in engineering in any of the SSC streams. The TVET system prepares students who intend to pursue postgraduate and PhD education in engineering, and also provides a clear assessment of the amount of education required for further education in the diploma in an engineering/technology program. Presently, diploma graduates can gain admission to only one publicly operated engineering university, located in Gazipur, Dhaka, which was established exclusively for diploma graduates. However, diploma graduates can pursue higher-degree engineering programs at private universities.

Qualifications: Initiated in the early 1980s, the National Vocational Qualifications Framework was designed to reflect the five levels of National Skill Standards (NSS): Basic, NSS III, NSS II, NSS I, and Master Craftsman. About 750 institutes offer basic courses (NSS), and 92% are privately operated. Most institutes (e.g., TSCs, TTCs, and privately owned training institutions) offer SSC Voc and HSC Voc courses. In 2011, as many as 5,149 BTEB-affiliated institutes, both public and private, offered these courses and HSC (business management). BTEB has initiated the process to replace this current qualification framework with National Technical and Vocational Qualification Framework (NTVQF) as prescribed in NSDP 2011.

Types of Institutions in Formal TVET: TVET institutions in Bangladesh are funded and operated by the government or managed by NGOs or private entities. Both public and private polytechnic and monotechnic institutes offer a 4-year diploma in postsecondary engineering, which is accredited by BTEB. The Ministry of Education (MOE) operates all public institutes, administered through Directorate fo Technical Education (DTE), except the Bangladesh Institute of Marine Technology in Narayanganj, Dhaka, which is operated by BMET, and the Agriculture Training Institutes, located at different districts, which are administered by the Department of Agriculture Extension.

Bangladesh has 64 Technical Schools and Colleges (TSCs), found in all districts. Operated as vocational training institutions (VTIs) until the introduction of the SSC Voc and HSC Voc certificate training programs in 1995, TSCs currently operate certificate programs through DTE. TSCs also offer short courses.

BMET operates 38 Technical Training Centers (TTCs), which offer SSC Voc and short training courses. These institutes offer diversified training courses that cater to the needs of industries within Bangladesh and abroad. Customized courses address the organizational needs (e.g., the Bangladesh Garment Manufacturers and Exporters Association and the Bangladesh police force), particularly those selected for peacekeeping missions. TTCs also have a contract with Apex Leather Industry to train manpower for leather industry. Moreover, TTCs also offer nonformal customized courses for people who have been selected for work abroad.

3.4.2.2 Nonformal

Nonformal trainings are also structured, have organized learning objectives and duration, and are provided with learning supports, but they are not affiliated/ accredited by BTEB. These programs offer flexibility and cater to the capacity-building needs of target groups. Many organizations and public and private institutes develop their own curricula and keep linkages with the prospective employers to make their training programs responsive to the job market. The nonformal TVET or short skills training courses lasts 1–12 months. Diploma institutes and TTCs also offer 360-hour courses for students who wish to start their careers either at home or abroad.

Private institutions are actively involved in providing nonformal training to specific target groups who are selected by overseas employment agencies for jobs abroad. These training institutions have linkages with overseas employment agencies but not affiliated with BTEB. They develop their own course curricula. The Mirpur Agricultural Workshop and Training School (MAWTS), for example, also offer various modular courses for people who intend to go abroad. Other government agencies also provide nonformal training services. The Ministry of Women's and Children's Affairs operates short courses (e.g., poultry, dairy, livestock, food processing, plumbing, and electronics) for women in areas with local demand. In the Ministry of Youth and Sports, the Department of Youth Development operates 1–6 month training programs in various trades, aiming to help trainees engage in self- and wage employment; they also offer a 3-month residential course on livestock, poultry, and fish culture. Other providers include the Ministry of Social Welfare and the Directorate of Ansar and the Village Defense Party under the Ministry of Home Affairs.

Table C3.4 1: Overview of the Technical and Vocational Education and Training System

Level	Qualification	Duration
Postsecondary	Diploma	4 years
HSC	Certificate	2 years
SSC	Certificate	2 years
Basic (NSS)	Certificate	3-6 months (360 hrs0

3.4.3 Organization and Management

The government provides skills development and technical training through 20 ministries and their various departments. These agencies provide formal training in all levels of TVET through government-operated technical schools, colleges, and polytechnic and monotechnic institutes. The National Skills Development Council (NSDC) is the main Directorate of Technical Education (DTE) and Bureau of Manpower, Employment and Training (BMET). Other departments under different ministries involved in TVET are the Department of Agriculture Extension, Department of Textile, Department of Women Affairs, Department of Social Services, and Department of Youth Development. BTEB, the chief quality control agency, is responsible for developing formal TVET programs, certifying private trainers, and conducting examinations for TVET qualifications. BTEB and DTE are under the Ministry of Education (MOE), while BMET is under the Ministry of Expatriate Welfare and Overseas Employment (MEWOE).

National Skills Development Council Formed in September 2011, NSDC has been a positive development

for Bangladesh. The Council can address key issues related to the structure, policy, procedures, delivery, finance, and coordination of skills development programs. Its major functions include

- monitoring the implementation of the skills development action plan,
- initiating and coordinating various agencies,
- monitoring new agency initiatives for skills development,
- managing the national skills data system,
- developing an NSDC work plan, and
- administering duties associated with council meetings.

NSDC is an important tripartite forum comprised of 36 representatives from government, employers, workers, and civil society. Headed by the Prime Minister, it is the apex body for skills development and training. Government accounts for 64% of NSDC members, compared with 30% from private industry and associations, and 6% from civil society. Located in Dhaka, the NSDC secretariat provides secretarial services to the executive committee of NSDC. The major functions of the secretariat include implementing the decisions of the executive committee and coordinating among various TVET providers and ministries involved in program delivery. Lodged in the Sheikh Fazilatunnesa Technical Training Center, the secretariat is headed by a joint secretary who functions as the chief executive officer. It has created opportunities for stakeholders to contribute to and support the development of TVET in Bangladesh. The immediate priorities of the secretariat are to

- develop a skills data system,
- form sector-specific industry skills councils and make them operational,
- prepare a draft NSDC Act, and
- implement NSDP through an action plan.

Ministry of Education: As the government's apex policy-formulating institution for the administration and development of post-primary education, MOE formulates policies, procedures, rules, and regulations for post-primary to higher education, including technical Training System in Bangladesh and vocational education and *madrasahs*. Several MOE departments manage, supervise, and control the secondary schools, colleges, *madrasahs*, TSCs, polytechnic institutes, engineering universities, and other universities. Established in 1972 as the Ministry of Education, Religion, Sports and Cultural Affairs, MOE assumed its current form in 1993. BTEB and DTE are under MOE.

Bangladesh Technical Education Board (BTEB) was established as a statutory body under the East Pakistan Technical Education Act of 1967. BTEB board comprises 15 members from Bangladesh University of Engineering and Technology (BUET), Dhaka University of Engineering and Technology (DUET), and heads of training institutions. The directors general of DTE and BMET are also important members of BTEB board, having direct involvement in policy formulation. BTEB board has no industry representatives. In addition to developing and regulating formal TVET programs, BTEB has wide powers to effect change. Although under MOE, BTEB has academic control over institutions operated by various ministries. Essentially self-financed, BTEB generates its own funds, mainly from examination fees, affiliation and registration fees from private providers, and printing revenue. The major functions of BTEB include

- inspection, monitoring, and evaluation of educational institutions;
- development of demand-led technical and vocational training programs that meet international standards and fulfill domestic and international requirements;
- development of teaching/learning materials; and
- registration of institutions and accreditation of courses.

The BTEB's priorities include

- introducing the new National Technical and Vocational Quality Framework and Competency-Based Training and Assessment (CBT & A);
- introducing a National Skills Quality Assurance System;

- assessing and determining demand for skills in both the domestic and international job markets; and
- revising and updating curricula, and introducing emerging trends and technology to ensure relevance to the job market.

In addition to curriculum responsibilities, the director of curriculum manages the inspection, registration, and affiliation of training providers. With implementation of the National Technical and Vocational Qualifications Framework, BTEB's Computer Cell gathers data on all registered training institutions and maintains enrollment and graduation data on public and private institutes that offer basic, SSC Voc, and diploma courses. Currently, seven curriculum specialists report to the Director (Curriculum), compared with the large number of trades developed and operated by BTEB. Consequently, reviewing and updating the curricula on a regular basis is difficult. BTEB submitted a proposal for additional posts, but it has not yet gained approval.

Directorate for Technical Education (DTE):. With a network that includes 49 polytechnic and monotechnic institutes, 64 TSCs, 1 TTTC, and 1 VTTI, DTE is the largest TVET provider. Established in 1960, DTE initially oversaw five technical education institutions. At present, this number has reached 117. DTE manages and administers TVET institutions, develops TVET programs, and implements quality control mechanisms, and processes and proposes approval of eligible institutions to MOE for monthly payment orders (MPOs) of private training providers. It also initiates the process of creating new projects relating to the reformation, reorganization, and overhaul of TVET systems, and the establishment of new TSCs and diploma institutes that offer diploma-level courses. The scope of DTE's work includes

- technical education;
- distance education including educational media and technology;
- educational research and training;
- educational policy and reforms;
- curriculum development;
- policy directives on public examinations above primary school;
- external examinations, equivalence of degrees, diplomas, and certificates; and
- exchanges of degrees, diplomas, and certificates with foreign countries.

Ministry of Expatriate Welfare and Overseas Employment (MEWOE) was established in 2001 to ensure the welfare of expatriate workers and enhance overseas employment. Since then, the MEWOE has worked to increase the flow of remittances and provide equal opportunity for all Bangladeshis. The major functions of MEWOE include

- contributing to the socioeconomic development of the country through overseas employment;
- ensuring the overall welfare of expatriates and protect their rights;
- expanding existing and explore new labor markets;
- assessing the demand of overseas labor markets and accordingly implement training schemes to create a skilled labor force;
- issuing/renewing recruiting agency licenses and conducting all activities related to overseas employment;
- providing financial and administrative assistance from the Wage Earner's Welfare Fund to deceased and endangered expatriates; and
- signing contracts and memorandums of understanding on training and employment with international organizations concerned with migration, governments of other countries, and other organizations.

Bureau of Manpower, Employment and Training (BMET) Established in 1976 as an agency of the Ministry of Manpower Development and Social Welfare, BMET focused on complying with domestic and export human resources requirements. Currently operating under MEWOE, BMET participates in overall planning and implementation strategies for the proper utilization of human resources. At present, BMET

operates 37 TTCs and 1 marine institute, 42 district employment and manpower offices, and 3 apprenticeship offices. The major functions of BMET include

- processing foreign demand for Bangladeshi workers,
- control and regulation of recruiting agents and the legal process of manpower export,
- overseeing the welfare of migrant workers,
- providing institution-based TVET in different trades,
- planning and implementing development programs for training activities,
- conducting informal and special training courses,
- registering job seekers for the overseas market in the Computer Database Network, and
- collecting and disseminating labor market information.

BMET offers institutional diploma-level courses, SSC Voc courses, NSS II and NSS III trades, special courses designed by BMET, and tailor-made short courses, as well as industry-based training. Experts from Japan Overseas Cooperation Volunteers, Japan International Cooperation Agency, and Korea International Cooperation Agency (KOICA) are helping improve BMET's training standards. KOICA, for example, helped modernize the Bangladesh– Korea Technical Training Centre, which offers high-quality training programs. Most of its instructors trained in the Republic of Korea, with financial assistance from KOICA. BMET institutes offer SSC (voc), NSS II, and NSS III courses that adhere to the BMET curricula. It has designed 44 certificate courses that range from 21 days to 6 months, depending on the nature of the particular course.

Private Providers constituted 95% of institutions and about 75% of total enrollment. Private providers continue their vibrant involvement and they sustain their operations through student fees. On the other hand, NGOs rely on financial assistance from development partners. NGOs provide free training, and most offer training for the underprivileged. Estimates suggest that a huge number of private institutes not affiliated with BTEB operate TVET programs, many of them targeting the information technology (IT) industry.

Private for-profit (commercial) providers: Insufficient data make it difficult to determine how commercial TVET institutions structure their programs. Currently, 309 commercial polytechnic and monotechnic institutes charge students substantial amounts. Many offer short training courses for students who intend to go abroad, but courses and duration vary from institute to institute. Many commercial institutions are affiliated with BTEB and other government agencies.

Nongovernment organizations (NGOs) offer a variety of training courses to poor and underprivileged people. NGO-managed TVET programs mostly focus on creating opportunities for income generation and self-employment. Some major NGOs focus exclusively on nonformal TVET that aims to provide skilled manpower to industry. However, insufficient data make it impossible to determine the exact number and size of NGOs and their programs. Among the leading NGOs providing innovative and quality TVET, the Underprivileged Children's Educational Programs (UCEP), the Dhaka Ahsania Mission, and MAWTS maintain uniquely designed and delivered programs.

Industry training institutions: *S*everal industry based organizations have established their own training centers, including the Chittagong Skills Development Center, a model of industry-government cooperation, and the Dhaka Chamber of Commerce and Industry (DCCI) Business Institute, established by DCCI, a leading trade body.

Enterprise-based training: The private sector dominates Bangladesh's economy, and it ultimately demands a huge supply of trained and skilled workers to maintain high productivity and accelerated growth. Because training providers cannot fulfill industry's growing demand for skilled workers, many enterprises and corporations operate their own training programs. Informal and traditional apprenticeships and on-the-job experience likely are the principal means for creating most of the skills that keep the bulk of the economy and production running. A master craftsperson who inherits skills from another master can train assistants in exchange for food or low wages. The skills apprentices acquire are often in the fields of welding, motor mechanics, carpentry, furniture making, plumbing, electrical, bicycle repair, motorcycle

repair, etc. There is no written contract between master craftspersons and apprentices regarding salary and benefits, only informal agreement on the training period. However, the government and the private sector could develop a system to introduce more formal training programs to complement and supplement the informal system. According to the Sixth Five-Year Plan (SFYP), 2011–2015, introduction of a formal system could enhance the effectiveness of the country's total skills-generation capacity.

Table C3.4 2: National Vocational Qualification Framework

Certificate Received	Entry Requirement	Duration of Schooling	Institutions
Vocational Education			
NSS (Basic)	Grade 8	3-6 months (360hrs)	TSCs. TTCs, NGOs, private institutes
NSS III	Grade 8	1 year	General schools, TSCs, TTCs, and private institutes
NSS II	Grade 8	2 years	General schools, TSCs, TTCs, and private institutes
SSC Voc	Grade 8	2 years	General schools, TSCs, TTCs, and private institutes, NGOs
NSS I/ HSC Voc/ HSC BM	SSC General/SSC Voc	2 years	General schools, TSCs, TTCs, and private institutes, NGOs
Diploma level programs			
Diploma in Engineering	SSC general/ SSC Voc/ SSC Dakhil	4 years	Polytechnics and monotechnics (public and private)
Instructor and teachers training			
Certificate in vocational Training	SSC pass with 2 years vocational training	1 year	VTTI
Diploma in Vocational Teaching	Certificate in vocational teaching/ diploma in engineering	1 year	VTTI
Diploma in Technical Education	Diploma in engineering	1 year	TTTC
BSc in Technical Education	Diploma in technical education	2 year	TTTC

Ministry of Education:

Bangladesh Technical Education Board (BTEB) has numerous programmes for skill development and competencies for the students.

BTEB carries out several education programme under the following

1. General Technical and Vocational Education SSC Voc and HSC Voc
2. Diploma in Engineering
3. National Technical and Vocational Quality Framework (NTVQF)
4. Recognition of Prior Learning (RPL) under NTVQF
5. National Competency Standards for Refrigeration and Air-conditioning
6. National Certificate in Consumer Electronics under NTVQF
7. Basic Trade Course
8. Competency Based Training (CBT)

3.5 Low GWP Alternatives

To avoid the use and emissions of HCFCs and HFCs, a variety of climate-friendly, energy-efficient, safe and proven alternatives are available. Due to different thermodynamic and safety properties of the alternatives, there is no 'one size fits all' solution. The suitability of a certain alternative must be

considered separately for each category of product and equipment and in some cases also take into account the geographical location where the product and equipment is being used.

The climate impact of a substance is commonly expressed as the global warming potential (GWP). The lower the GWP, the more climate-friendly is the substance. HFCs have a very high GWP and are hence potent greenhouse gases. Most of the HFCs are used as refrigerants in RAC equipment, but also as blowing agents, aerosol propellants and solvents. To mitigate emissions of substances with a high GWP each sector needs to find solutions to quickly switch to low GWP refrigerants.

Most of the HFCs are used as refrigerants in refrigeration and air conditioning (RAC) equipment, but also as blowing agents, aerosol propellants and solvents. In the following, alternatives to commonly used HFCs are listed for different sectors. The alternatives include

- Natural refrigerants
- HFCs with lower GWP, such as R-32
- Hydrofluoroolefins (HFOs)
- HFC-HFO blends.

Each substance is assigned to a safety group specified as follows:

	Lower toxicity	**Higher toxicity**
No flame propagation	A1	B1
Lower flammability	A2	B2
	A2L*	B2L*
Higher flammability	A3	B3
*A2L and B2L are lower flammability refrigerants with a maximum burning velocity of ≤ 10 cm/s		

3.5.1 Commercial Refrigeration:

Commercial refrigeration applications include stand-alone equipment, condensing units and centralized systems. Plug-in equipment used in small stores and supermarkets, such as vending machines relying on hydrocarbons, has become available in recent years throughout the world. CO_2-based systems have also been introduced. In large refrigeration systems for supermarkets ('centralized systems'), CO_2 cascade systems are an alternative to commonly used HFC systems in many climates. Hydrocarbons have also proven to be highly efficient alternatives in most applications under high ambient temperatures, except for larger condensing units.

Table C3.5 1: Alternative for Centralized refrigeration systems

	Substance	**GWP**	**Composition**	**Safety group**	**Replacement for**
Natural refrigerants	R-290 (propane)	3	-	A3	R134a, R404A, R407A
	R-717 (ammonia)	-	-	B2L	R134a, R404A, R407A
	R-744 (CO_2)	1	-	A1	R134a, R404A, R407A

Table C3.5 2: Alternative for condensing units

	Substance	**GWP**	**Composition**	**Safety group**	**Replacement for**
Natural refrigerants	R-290	3	-	A3	R134a, R404A, R407A
	R-744 (CO_2)	1	-	A1	R134a, R404A, R407A
	R-717	-	-	B2L	R134a, R404A, R407A

3.5.2 Industrial refrigeration

In industrial refrigeration, such as large cooling facilities for food processing or process cooling in the chemical industry, ammonia systems have been used for many years. Ammonia has been the most popular replacement option to R404A and its use is already widespread. In Europe, but also in other parts of the

world such as North America, an increasing number of cascade systems with ammonia and CO_2 have been installed in the food and beverage industry.

Table C3.5 3: Alternatives for Industrial refrigeration

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R-290	3	-	A3	R134a, R404A, R407A
	R-717	-	-	B2L	R134a, R404A, R407A
	R-744	1	-	A1	R134a, R404A, R407A
	R-1270 (propene)	2	-	A3	R134a, R404A, R407A
HFOs	R-1233zd	4,5	-	A1	R134a, R404A
	R-1234ze	7		A2L	R134a, R404A

3.5.3 Domestic Air-conditioning:

Stationary air conditioning (AC) is designed to control the thermal comfort of living and working rooms. The stationary AC sector can be broken down into several sub-categories:

Moveable room AC: Devices that are hermetically sealed and can be moved between rooms by the user. These are used in mostly private households.

Table C3.5 4: Alternatives for moveable room AC

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R-290	3	-	A3	R-407A, R-410A, R-22
HFCs	R-32	675	-	A2L	R-407A, R-410A, R-22

Single split AC: System that consists of one outdoor and one indoor unit linked by refrigerant piping, needing installation at the site of storage predominantly used in private households.

Table C3.5 5: Alternatives for Single split AC

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R-290	3	-	A3	R-407A, R-410A, R-22
HFCs	R-32	675	-	A2L	R-407A, R-410A, R-22

Multi split AC/VRF: System that consists of one outdoor unit and multiple indoor units. Further developed systems enable a variable refrigerant flow (VRF) towards every indoor unit. Used in

Table C3.5 6: Alternatives for Multi split/Variable refrigerant flow (VRF)

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R-290	3	-	A3	R-407A, R-410A, R-22
HFOs	R-1234yf	4	-	A2L	R407A, R410A
	R-1234ze	7	-	A2L	R407A, R410A, R-22
HFCs	R-32	675	-	A2L	R407A, R410A, R-22

3.5.4 Commercial Air-conditioning:

Chiller: System in which the refrigerant cools down a liquid (normally water) that is then circulated to cool air in commercial or industrial facilities. In room air conditioning systems, hydrocarbons are safely used as alternative refrigerants in several countries such as India and China, but they are not yet common in the EU. In chillers, hydrocarbons and ammonia are safe and energy-efficient alternatives, both under moderate and high ambient temperature conditions.

Table C3.5 7: Alternatives for chiller

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R-290	3	-	A3	R134a, R407A, R410A
	R-717	-	-	2BL	R134a, R407A, R410A
	R-718(H_20)	-	-	A1	R134a, R407A, R410A
	R-744	1	-	A1	R134a, R407A, R410A
	R-1270	2	-	A3	R134a, R404A, R407A
HFOs	R-1233zd	4,5	-	A1	R134a, R410A
	R-1234ze	7	-	A2L	R134a, R407A, R410A
HFCs	R-32	675	-	A2L	R134a, R407A, R410A

3.5.5 Domestic refrigeration

Hydrocarbon refrigerants mostly have replaced the use of HFCs in Bangladesh.

Table C3.5 8: Alternatives for Domestic refrigeration

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R-600a	3	-	A3	R-134a

3.5.6 Mobile air conditioning

The refrigerant R134a used in air conditioning of cars is now becoming prohibited in new cars in many developed country on mobile air-conditioning systems. The main substitute is the R1234yf, which is almost exclusively used. The only alternative to this is CO_2, which is currently used by some car manufacturers and expected to become more widespread in the future. CO_2 is also expected to become available as an alternative in the future for duty vehicles, busses and trains.

Table C3.5 9: Alternatives for Mobile air conditioning for cars

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R-744 (CO_2)	1	-	A1	R-134a
HFOs	R-1234yf	4	-	A2L	R134a

Table C3.5 10: Alternatives for Mobile air conditioning for buses

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R744 (CO_2)	1	-	A1	R134a, R-22
HFC-HFO blends	R450A	605	R1234ze(E)/134a	A1	R134a
	R513A	631	R1234yf/134a	A1	R134a

Table C3.5 11: Alternatives for Mobile air conditioning for trains

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R729 (air)	-	-	A1	R134a,
	R744 (CO_2)	1	-	A1	R134a

3.5.7 Transport refrigeration

Lately, R-448A, R-449A and R-452A have become quite common to replace R-404A in road transport refrigerated vehicles. R-452A has a very high GWP of 2140 and hence will not be suitable for future use. For refrigerated containers, CO_2 can be used as a long-term alternative.

Table C3.5 12: Alternatives for Refrigerated vehicles and containers

	Substance	GWP	Composition	Safety group	Replacement for
Natural refrigerants	R744 (CO_2)	1	-	A1	R134a, R404A, R410A

3.6 Tools and Equipment

Refrigeration and air-conditioning service technicians work mainly with hand tools and equipment. To be successful, the technicians must select quality tools, take good care of them and be skilled in their use. The technicians should always use the right hand tools and equipment for the right job and as recommended by the manufacturer of the air-conditioner. Using improper equipment and tools for a specific job may be unsafe. For example, using a flat screwdriver instead of a Phillips screwdriver - the flat screwdriver tip may slip and result in personal injury. Use of appropriate equipment and tools helps in improving the quality of installation as also repairs and servicing.

3.6.1 Spanners and Screwdrivers

The use of box-end and socket spanner-cum-screwdriver (set of 41pieces) is the best choice when there is adequate space around the nutand bolt. The plastic handle with assorted drive socket of six points, can be used or effective and speedy work. The size marked on the socket must be checked while selecting the screwdriver bit. The various types of screwdriver bits e. g. flat-bladed key stone/ cabinet, Phillips type, Allen type, Bristol, etc. can be used as per the requirement. A sturdy screwdriver of No. 8 with a firmly-bonded plastic handle can be used to remove or fit screws while servicing and installing systems. The screwdriver should not be pounded with a hammer.

Figure 3.6 1: Spanner and Screwdriver

3.6.2 Allen Keys, Wrenches and Pliers

Allen keys are made up of a hexagonal metal bar and can be used to tighten nuts having hexagonal recess on the head. The Allen key set comes with various sizes and it is useful for new air-conditioners. Ratchet wrench/service valve wrench [Sockets 6.35 x 4.76 mm (1/4” Figure 4.1 Spanners and Screwdrivers x 3/16”) square & 14.28 x 12.7 mm (9/16” x 1/2”) hexagonal]. (are usually constructed with a square end ratchet that is reversible. This helps for easy and quick work without change of tool/bit. The adjustable spanner 150 mm (6”) is a popular type of adjustable wrench (spanner) necessary for opening / fixing odd-sized nuts and bolts. Crimping pliers are necessary for crimping closed end-splices and fixing fastener clips to the ends of wires. These can be used to cut and strip wire. These can be also used for crimping solder-less connectors onto wires. They can be used to cut small bolts too.

Figure 3.6 2: Allen Keys, Wrenches and Pliers

3.6.3 Pliers and Spanners

Different pliers/wrenches need to be used as per the requirement. Insulated combination pliers 150 mm (6”) size] help to grip objects and to strip or cut wires. This is a handy tool for general use. For safety, it is not advisable to use this on nuts, bolts or fittings. To grip a small hardware or to strip or cut wires, insulated nose pliers are recommended. This helps to work in a narrow work space. To grip big objects like tubes, nuts or bolts, monkey pliers 100 mm (4”) size can be used. Spanners: Common types of spanners include open-end spanner, the box spanner and combination spanners. There are also tube-type spanners and adjustable spanners.

Figure 3.6 3: Pliers

3.6.4 Files and Cutters

Depending on the requirement, various types of files can be used to remove unwanted burrs while doing operations on tubes or other metal surfaces. A Flat Rough File 200 mm (8”) with a safe handle is recommended when metal is to be removed at a faster rate from a flat surface. A Round File 150 mm (6”) can be used for cleaning metal surfaces and shaping metal parts in a circular shape. For cutting copper tubes used in the installation and maintenance work of air-conditioners, a hacksaw (blade with frame size 300 mm (12”) is ideal. Hammer and mallet (400/500 g) are useful hand tools for accurate blows onto metal for bending or shaping as required, during the servicing or installation of air-conditioners. Chisels and knives are used for cutting metals or metallic wires. A flat cold chisel 20 mm (0.78”) size is needed for cutting metals, where as a knife can be used for cutting/shredding small size wires.

Figure 3.6 4: Files

3.6.5 Sealants and Sealing Valve

Adhesives are recommended for bonding plastic parts together. Some common adhesives are: Colloidal solution: It sets to a hard film, bonding materials together. Insulation tape roll: This is used to cover exposed electrical contacts for safety purposes. This tape is a plastic film, covered with an adhesive material to insulate live electrical wires. Teflon tape: This prevents leakages when applied on a threaded part. However, Teflon tape should not be used to cover flared connections of air-conditioners. Fuse wire: This is a low melting point wire which protects appliances from any damage due to voltage fluctuation. Hence, it should be appropriately rated, standard electric protective device.

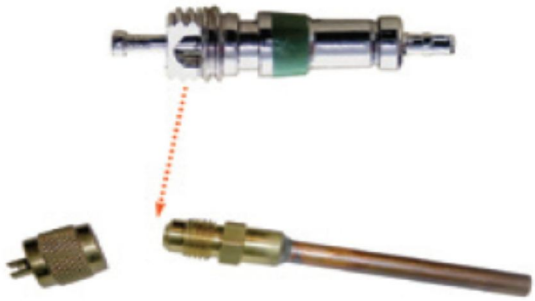

Figure 3.6 5: Sealing Valve

3.6.6 Multi-meter and Digital Thermometer

Before starting any electrical work, an insulated electric tester (500 V) should be used to test live electric supply in wires and sockets. The electric tester also helps to check polarity in the electric socket. The multifunctional digital clamp meter aids to check resistance, AC/ DC voltage and current. It measures resistance in the range 0-200kΩ, DC voltage up to 1000V, AC voltage up to 750V and AC current 0-300 A. It can be used as continuity/diode tester with an audible beep. The technician can record measured value from the display. It has peak hold/data hold buttons. Teardrop jaw design provides maximum accessibility for measurement. A digital thermometer with a puncture probe is an instrument to measure the temperature and humidity. This has an accurate electronic signal with indoor and outdoor temperature display. The indicator displays the temperature between -50°C to 100°C with Fahrenheit/ Centigrade conversion switch.

Figure 3.6 6: Multi-meter and Digital Thermometer

3.6.7 Charging Kit and Leak Detector

The portable gas charging station has hoses with female quick couplers, refrigerant measuring cylinder/weighing balance, manifold, high vacuum pump, vacuum gauge and pressure gauges. This helps to charge the air-conditioners with the exact amount of refrigerant. Small disposable cans and cylinders containing 1 to 2.5 kg refrigerant are available in the market. The empty cylinders should be carefully disposed off. The system must be checked for leakages after charging it with the refrigerant. An electronic leak detector must be used to check for leakages through joints. It rapidly pinpoints the source of the leak. By eliminating contamination with selected filters, false alarms can be avoided. Audio/visual indication helps with leak detection. A leak detector (<5 g / year) with high sensitivity must be used.

Figure 3.6 7: Charging kit and Gas leak director

3.6.8 Tube Cutter

Tube bender, cutter and flare tools are the important devices required for the installation or servicing of air-conditioners. A tube cutter designed to cut annealed /soft copper tubes up to 20 mm (0.78”) diameter must be used for installation and servicing of air-conditioners. Normally, a tube cutter has reamers attached. The reamer is used to remove burrs at the edges of the cut tube. For speedy work, as far as possible avoid the use of a tube cutter to cut the tube into small pieces. Instead, use readily available tubes cut into 120 mm (4.72”) and 150 mm (6”) pieces. While carrying out maintenance of the system at the place of the customer, use a floor protector to prevent damaging and dirtying of the floor. To avoid any damage while cutting a capillary tube, a compact tube cutter instead of a large tube cutter, must be used at work. Spring-type and lever-type tube benders are available. For the tube not to get damaged or pinched while bending, it is recommended to use a spring-type tube bender.

Figure 3.6 8: Tube Cutter

3.6.9 Pliers

Finally, while servicing or installing air-conditioners, all tubes require to be pinched-off by pinch-off pliers/self-locking pliers. These are ideal tools for this purpose. These pliers can also be used for clamping jaws in any position. For piercing tubes, quick-piercing pliers/valves can be applied, e.g. quick-tube-piercing valve fits 6.35 mm (1/4”) tube fitted with 6.35 mm (1/4”) SAE threads. Use connectors to control the flow of fluid by raising and lowering a needle that fits into a matching set. To avoid leakage of refrigerant, male and female quick couplers are suitable for quick and instant fitment with valve. This will save time as well as save the material. Apply this for 6.35 mm (1/4”) copper tubes.

Figure 3.6 9: Pliers

3.6.10 Brazing Kit

To make a closed refrigerant circuit, brazing at joints is required. Brazing is a process of joining metals together by melting at high temperature through a burner, using LPG. An LPG brazing kit is suitable for this purpose. A portable brazing kit consists of a brazing torch, nozzle, hose, regulator, spanner and lighter. Before brazing, joints must be properly prepared to make a stronger joint. It is advised to use emery cloth/paper for polishing all joints for better brazing results, through capillary action. Use a scrubber / wire brush to clean the metal joints after brazing. During brazing, much heat is generated. An asbestos-lined heat deflector must be used to reflect the heat on to the joints while brazing. This also saves plastic or similar materials, from getting burnt. After brazing, use a telescopic mirror to inspect brazed joints for leaks.

Figure 3.6 10: Brazing Kit

3.6.11: Tongs and Fire Extinguisher

Tongs are used to lift hot objects. Fire Extinguisher (ABC powder type 2 kg or 5 kg) must be kept handy for safety.

Figure 3.6 11: Tongs and Fire Extinguisher

3.6.12: Pressure Gauges and Torque Wrenches

A compound gauge is useful to measure pressure at the low and high sides of a running system. A thermo-couple vacuum gauge is useful for measuring the fine vacuum which is difficult to measure using a compound gauge. This gauge measures the vacuum in microns. (1 micron = 0.001mm i.e. 1/1000mm Hg). This can be also used to check leakage by the Pressure Rise Test. A set of torque wrenches (several heads) for up to 200 Nm (2039 kgfcm) and hardware (springs, screws, washers, nuts, bolts, bearings, rivets etc.) are required for the servicing of air-conditioners.

Figure 3.6 12: Pressure Gauge

3.6.13: 4-way Manifold

A 4-way gauge manifold is an essential tool for air-conditioning and refrigeration technicians. This reads pressures on both high and low sides of the system. This can also be applied to read vacuum on the low-pressure side of the system.

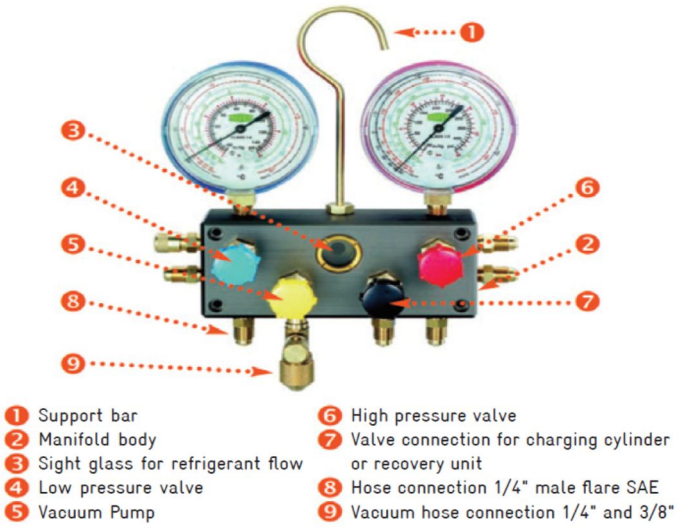

Figure 3.6 13: Four Way Manifold

3.6.14: Refrigerant Hoses

The various types of hoses are refrigerant standard hose, vacuum hose, refrigerant hose with end-mounted ball valve and specially designed HC refrigerant venting hose. Refrigerant standard hose is with 50.8 mm x 6.35 mm (2” x 1/4”) SAE Support bar Manifold body Sight glass for refrigerant flow Low pressure valve Vacuum Pump High pressure valve Valve connection for charging cylinder or recovery unit Hose connection 1/4" male flare SAE Vacuum hose connection 1/4" and 3/8" size with female flare connections of 900 mm (35.43”) length. It can withstand working pressure up to 52 bar (754 psi). Vacuum hose is with 50.8 mm x 9.5 mm (2” x 3/8”) female flare SAE connection. For minimal refrigerant emission while charging, the refrigerant hose with end-mounted ball valve must be used. The specially designed HC refrigerant venting hose, of minimum 10 m (32.8 ft) length is with 12.7 mm (1/2”) ID, vacuum pump connector and dilutor.

Figure 3.6 14: Refrigerant Hoses

3.6.15: Flaring and Swaging Tool

Flaring and swaging of copper tubes during servicing should be done with the aid of flaring and swaging tools. Levers or mechanical benders should be used for the installation of room air-conditioners.

Figure 3.6 15: Flaring and Swaging Tool

3.6.16: Soldering Iron (230 volt, 25 watt*)*

A soldering iron is used for soldering and disconnecting electronics or electrical components, wires etc. Soldering wire with flux can be used for soldering and cleaning electronic components, electrical components, wires etc.

Figure 3.6 16: Soldering Iron

3.6.17: Measuring Tape, Spirit Level, Reamer and Torch

Reamer / Burr remover removes the burr of cut copper tubes from the inner edge as well as from the outer edge. When the intensity of light is too low, the handy torch can be used. While installing, a spirit level 150 mm (6”) size will help to measure the inclination of the air-conditioner. At the time of installation of window air-conditioners (WAC) and split air-conditioners (SAC), measuring tape is required to measure the room size to calculate heat load. This also helps to cut the tubes of the required size.

Figure 3.6 17: Measuring Tape, Spirit Level and Reamer

3.6.18: Recovery Unit

The residual refrigerant from the system to be serviced should not be vented into the atmosphere when fresh refrigerant is required to be charged. Always collect this in a refrigerant recovery cylinder. This cylinder is equipped with a double valve for liquid and vapour refrigerant transfer. As HC is flammable, a separate recovery unit must be used while recovering HC refrigerant.

Figure 3.6 18: Recovery Cylinder and Recovery Unit

3.6.19 Nitrogen Cylinder and Regulator

For pressure testing, a nitrogen cylinder is required. This is fitted with a pressure regulator. Always check this cylinder for DIN EN ISO 2503. The usual nitrogen pressure is 300 bar (4351 psi). A heavy duty pressure regulator comes with 315/200 bar (4568.7 / 2900.7 psi). Working pressure is 0 -100 bar (0 -1450 psi). A nitrogen hose with a ball valve is used along with the nitrogen cylinder.

Figure 3.6 19: Pressure Regulator

3.6.20 Brush, Oil Can and Allen Keys

To remove dust from the grill, motor, etc. of an air-conditioner, a 50 mm (2”) paint brush is required. During servicing of air-conditioners, oiling of the fan motor is required to be done. An oil can is required for the purpose of better lubrication. ‘T’ Allen key is required to open the Allen screw of the fan blade and fan blower. ‘T’ box spanner is required to dismantle compressor mounting nuts.

Figure 3.6 20: Brush and Allen Keys

3.6.21 Fin Comb and Velocity Meter

Fin tool/comb is a special tool that is designed to straighten/clean the condenser and evaporator fins. For maximum efficiency of the system, regular maintenance of the system is required. Air velocity meter (vane type anemometer) measures the air velocity for balancing the air-conditioning ventilation system.

Figure 3.6 21: Fin Comb and Velocity Meter

3.6.22 Light Weight Air Blower, Hand Drill Machine and Noise Tester

A light weight air blower is used to remove dust particles from the evaporator and condenser coil of air-conditioners. Its high velocity air jet blows dust and other contaminants from the coils. A hand drill machine is used to drill holes in the sheet metal spare for fitting of screws also to drill holes at the time of installation. A corded or battery operated dB meter or noise tester is required to measure the noise level of the blower in the air-conditioner.

Figure 3.6 22: Light Weight Air Blower, Hand Drill Machine and Noise Tester

3.6.23 Lokring

Lokring tube connections can be made without a great deal of force being necessary, using simple hand assembly tools. lokring ensures an absolutely clean, permanent and purely mechanical tube connection with long-term hermetic air-tightness. All this makes LOKRING tube connections one of the most economical and reliable methods of connecting refrigerant tubes Approx. It saves 40% time. It is absolutely clean, efficient and reliable Installation work during business hours and public access Installation work in situations where there is a fire hazard. It is a light hand assembly tool without energy exertion Installation. It can also be carried out by non-skilled workers. It requires no nitrogen as purge gas, no braze-related quality problems for AC systems (split, multi-split, VRV, HVAC) and refrigeration systems.

Figure 3.6 23: Lokring assemble tool box, assemble jaws, anaerobic sealant & connectors

3.7 RAC Standards

A standard or “norm” is developed to ensure a certain uniform level of goods, products, and service quality. It is a formal document which requires certain characteristics or behavior of goods, persons, situations, etc. representing the consensus view of participants in the standards development process. Standards are developed to ensure a certain uniform level of goods, products and service quality. International standards are based on a consensual mechanism with a wide network of national members and stakeholders. In practice, however, many developing countries have limited engagement in the standardization process and consequently cannot review, vote and contribute to standards and the process of developing these. Smaller enterprises or non-industry participants can be deterred due to the often high level of fees charged for participation. Standards can be supported by supplementary information and interpretation of requirements, which can be covered by industry guidelines or codes of practice.

Main benefits of standards:

- Ensure safety considerations (of products, people, production, use, etc.).
- Enable dissemination and harmonization of best practices.
- Present a harmonized, stable and globally recognized framework.
- Can support economic growth.
- Can minimize technical barriers for trade.

In the RAC sector, technical standards are becoming increasingly recognized as a key component in successfully transitioning away from reliance on ozone-depleting and powerful global warming gases. The adoption and utilization of appropriate technical standards can establish uniform definitions, guidelines, rules, criteria, methods, processes, practices or characteristics for activities and their results. Many industries, trade associations and governments require products and services to conform to a standard or a regulation prior to being placed on the market to ensure a certain level of quality and safety. An international standard does not have any legal force and it cannot supersede national regulations. An international standard is not a mandatory regulation. A national regulation may refer to a standard or a part of a standard. Standards can be used as a technical reference when developing regulations.

Standards are developed at the international, regional, national and other levels by a variety of organizations. These organizations are independent of governments, industry, associations and the private sector. At the national level, many countries have their own national standardization bodies. Usually these national standardization bodies are the contact points for the regional and international organizations developing standards. The main role of the national standardizations bodies is to produce or review their own standards. Bodies can be independent or linked to the national government. Standards issued at the national level generally have priority over the regional or international standards. It is a common practice

that international and regional standards are adopted at the regional and national levels. During this procedure, standards can be modified to suit the best local demands and conditions. In some cases contrary approach can be applied and the standard from the national or regional level may be adopted for the regional or international level.

There are several principal organizations developing standards related to the refrigeration and air-conditioning sector. The two main bodies which are principally involved into the development of standards related to the RAC sector are the ISO (International Organization for Standardization) and the IEC (International Electro technical Commission). A formal agreement between these organisations aims to prevent overlap and potentially contradictory standards.

The International Organization for Standardization (ISO) is the largest standardization organization in the world with 162 member countries and with more than 19,500 standards issued which were developed by some 300 technical committees. The Technical Committee TC 86 on Refrigeration and Air-conditioning is crucial for the RAC sector.

Table C3.7 1: Example of ISO Standard

The International Organization for Standardization (ISO)	ISO Number	14001
ISO standard nomenclature ISO 140001:2004 Environmental management systems	Year	2004
	Name	Environmental management systems

International Electro technical Commission (IEC) IEC is primarily focused on safety issues of electrical and electronic technologies, devices containing electronics, using or producing electricity. IEC has 82 member countries (national committees). Standards related to the RAC sector are developed by experts of the technical committees- TC 59 on Performance of household and similar electrical appliances - TC 61 on Safety of household and similar electrical appliances.

Table C3.7 2: Example of IEC Standard

International Electro-technical Commission (IEC)	IEC Number	60335
IEC standard nomenclature IEC 60335-1:2012 Household refrigerating systems used for cooling and heating- Safety requirements	Number	1
	Year	2015
	Name	Household refrigerating systems used for cooling and heating- Safety requirements Environmental Management systems

Bangladesh Standards and Testing Institution (BSTI) is a government agency under the Ministry of Industries constituted for the purpose of controlling the standard of service and quality of the goods. These institutions can produce national standards or adopt international/regional standards. BSTI is the member of both ISO and IEC.

In general the standards related to the ozone depleting substances and their uses are concerned with four major areas:

1. Standards for the substances themselves such as specifications for refrigerant gas and refrigerant designation (e.g ISO 817).
2. Standards for systems, equipment and components including, for example, safety requirements for refrigerating equipment, codes/ guides for refrigeration & air-conditioning systems (e.g. ISO 5149), and refrigerant recovery/ recycling equipment (e.g., IEC 60335-2-104), and equipment charge size.

3. Standards for refrigerant containers including content of recovery cylinders (AHRI), color codes, and pressurized cylinders standards.
4. Other related standards such as foam final products, content and fire retardant requirements, buildings codes (which for example could prohibit the use of flammable refrigerants), energy efficiency labeling programmes, installations, and practice.

Safety issues, such as safety in construction and installation, use, service, maintenance, leak prevention, dismantling and recycling of technologies and substances are of particular importance, and in general standards aim to maximize operational safety and minimize hazard and risk. There are several technical international ISO and IEC standards as well as several regional and national standards (e.g. CEN, CENELC) and the United States (e.g. ANSI/ASHRAE, UL) relevant and applicable to ozone-depleting substances and technologies relying on them. In the context of the HCFC phase-out and requirement for non-ozone depleting, low-GWP alternatives, there is a requirement that existing standards are updated and/or new standards created to cover the use of these substances. Some important relevant standards, published several years ago have recently been revised and updated (e.g ISO 5149, ISO 817) or are currently under the process of revision (e.g EN 378). The previous version of standard ISO 5149 on 'Mechanical refrigerating systems used for cooling and heating – Safety requirements' which was issued in 1993 essentially prohibited the use of flammable refrigerants which are now widely applied in many sectors. Because many of the lower-GWP refrigerants are flammable, RAC equipment must conform to the requirements of any standards for *flammable atmospheres*. In most countries these standards have a higher status than the general refrigeration standards. For example, the UN has "*A Common Regulatory Framework for Equipment Used in Environments with an Explosive Atmosphere*", to which a large number of developed and developing countries are signatories. Although the general refrigeration standards include provisions for flammable refrigerants, they are not considered to provide adequate guidance for how to safely apply them. In this regard, the design, construction and evaluation requirements for achieving safety of equipment using flammable refrigerants must be sought in the relevant standards (such as EN 1127-1 and the IEC 60079-series).

The most important standards which have a role in supporting the HCFC phase-out and standards related to the low-GWP alternatives and alternative technologies are listed below. Full details of all the related standards can be found in the catalogues of standardization organizations and bodies.

3.7.1 Main technical standards relevant to the HCFC phase-out and low-GWP alternatives

3.7.1.1 International Organization for Standardization

ISO 5149:2014 Mechanical refrigerating systems used for cooling and heating – Safety requirements. This International Standard specifies the standard conditions for capacity and efficiency ratings of non-ducted air-cooled air conditioners and non-ducted air to air heat pumps. This International Standard is applicable to ducted units rated at less than 8 kW and intended to operate at an external static pressure of less than 25 Pa.

- Recently revised from 1993 version Includes requirements for new classification on low flammability (2L) for refrigerants
- Specifies the requirements relating to the safety of persons and property for the design, construction, installation and operation of refrigerating systems and puts an emphasis on minimizing the leakage of refrigerant to the atmosphere
- Specifies classification of the refrigeration systems
- Specifies monitoring of leakage; i.e., refrigeration concentration in the machine room - a special requirement for ammonia
- Applicable to all types of refrigerating systems in which the refrigerant is evaporated and condensed in a closed circuit

BSTI has adopted this standard to BDS ISO 5149:2004 in Mechanical refrigerating systems used for cooling and heating- Safety- Safety requirements & BDS ISO 5151:2011 Non-ducted air conditioners and heat pumps- Testing and rating for performance.

ISO 817:2014 Refrigerants – Designation and Safety Classification Standard specifies the requirements relating to the safety of persons and property for the design, construction, installation and operation of refrigerating systems. BSTI has not similar types of national standards.

- Provides a clear system for numbering and assigning composition-designating prefixes to refrigerants (e.g. for chlorofluorocarbons the prefix CFC is used)
- Refrigerant safety classification (flammability, toxicity)
- Refrigerant concentration limits
- Is intended to be used with other relevant safety standards such as ISO 5149,

ISO 17584:2005 Refrigerant properties specifies the refrigerant properties. BSTI has no national standards for refrigerants properties.

- Specifies thermo-physical properties of several commonly used refrigerants and refrigerant blends
- Applicable to the refrigerants R-12, R-22, R-32, R-123, R-125, R-134a, R-143a, R-152a, R-717 (ammonia), and R-744 (carbon dioxide) and to the refrigerant blends R-404A, R-407C, R-410A, and R-507
- Includes specifications of several properties, including the following: density, pressure, internal energy (total energy contained by a thermodynamic system), enthalpy, entropy, heat capacity at constant pressure, heat capacity at constant volume, speed of sound and the Joule-Thomson coefficient

ISO 11650:1999 Performance of refrigerant recovery and/or recycling equipment. Bangladesh has no such national standard.

- Specification of the test apparatus, test gas mixtures, sampling procedures and analytical techniques used to determine the performance of refrigerant recovery and/or recycling equipment
- Specification of the refrigerants to be used for the evaluation of equipment

3.7.1.2 International Electro-technical Commission

IEC 60335-1:2012 Household and similar electrical appliances – Safety, general requirements.

The most relevant are:

- IEC 60335-2-24 Particular requirements for refrigerating appliances, ice cream appliances and ice makers
- IEC 60335-2-40 Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers (currently prohibits HC use)
- IEC 60335-2-75 Particular requirements for commercial dispensing appliances and vending machines
- IEC 60335-2-89 Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant unit or compressor
- IEC 60335-2-104 ed1.0 Particular requirements for appliances to recover and/or recycle refrigerant from air conditioning and refrigeration equipment incorporating open drive or motor-compressors.

3.7.2 Safety

The safety characteristics of refrigerants are classified according to their flammability and toxicity as defined by international and regional standards (ISO 817:2014 and EN3 378-1:20084). The letters ‘A’ and ‘B’ are used to classify toxicity. Flammability is classified by the categories: ‘1’, ‘2’, ‘2L’ and ‘3’. The category ‘2L’ is a specific class for ‘lower-flammability refrigerant with low flame speed which was added in the latest update of the ISO standard in 2014 (ISO 817:2014) and is being considered in the revision of EN 378.

3.8 Sector's professional institutional structure (RAC associations, unions)

During the implementation of HPMP Stage-I, NOU of the Department of Environment has interacted with different professional association and institutions. From the previous experience government has engage more stakeholders as the phase-out process is multifaceted. During the preparation of HPMP Stage-II more stake-holders has been consulted as the phase-out comes to closing end more specific needs for the different association and organization needs to be addressed. During the alternative survey and other survey, the stakeholder consultation even becomes more important. NOU experience shows that during the HFC phase-down the more stakeholder and association will be imparted. Because of the refrigeration and air-conditioning system covers almost all sectors of infrastructure and industry from domestic to commercial to industrial to transport sector, it will become more important that not a single sector must not be neglected or omitted from the account.

For RAC servicing, NOU worked closely with the Bangladesh Refrigeration and Air-conditioning Merchant Association along with district level workshop/ technicians/ owners association. Collaboration between the government and the association was very crucial in organizing workshops, conducting survey, drafting policies and plans. Bangladesh has the successful stories in Phasing-out CFCs and meeting 2015 HCFC phase-out Target. This all became possible by identifying stakeholders, collaboration with the association and implementing agencies. For future plan for the HFC phase-down and implementing Kigali Amendment the following professional association and organization are of importance.

- Bangladesh Refrigeration and Air-conditioning Merchant Association
- Bangladesh Refrigeration Technicians Association
- Bangladesh Cold Storage Association
- Bangladesh Refrigerator Manufacturers Association
- Bangladesh Ship Breakers' Association
- Bangladesh Ship Builders Association
- Bangladesh Automobiles Assemblers' & Manufacturers Association
- Bangladesh Auto Spare Parts Merchants & Manufacturers Association
- Bangladesh Automobiles Workshop Malik Samity
- Bangladesh Cargo Vessel Owners' Association
- Bangladesh Frozen Foods Exporters Association
- Bangladesh Fruits Vegetables & Allied Products Exporters' Association
- Bangladesh Marine Fisheries Association
- Bangladesh Poultry Industries Association
- Bangladesh Railway Spares & Accessories Suppliers Association
- Bangladesh Reconditioned Vehicles Importers & Dealers Association
- Bangladesh River Transport Agent Owners Association
- ASHRAE Bangladesh Chapter
- Diploma Engineers Institution (RAC Sub-division)
- Local RAC association

4. GAPS AND NEEDS ASSESSMENT

In this chapter different models are used to assess the gaps and needs for RAC servicing sector. A gap analysis is made for policy and regulatory framework. Challenges are identified to the new technology trend in RAC market. Strength, weakness and opportunities are determined for training of RAC technicians. Barriers are identified for the market readiness to adopt the low GWP alternatives. Need analysis for tools and equipment for training and education in RAC sector. Gap analysis is done for the standards to adopt low GWP alternatives. Opportunities are identified to utilize the current professional structure.

4.1 Policy and Regulatory Framework

Bangladesh enacted the Ozone Depleting Substances (Control) Rules, 2004 in 2004. After the Montreal Amendment in 2007, the rules needed to be amended once as the phase-out schedule for HCFCs has been advanced 10 years than the previous phase-out schedule. To achieve the compliance, DoE has developed its own quota systems and license allocation system. For the phase-out CFCs, DoE took the initiatives on fiscal measurements. It was encouraged to import non-ODS alternatives. Excise, duties and tax was increased for CFCs. Besides, ODS rules was included in the import policy for proper monitoring of the customs authority.

From the previous experiences, it is obvious that the government need to again amend the rules to control HFCs. Fiscal incentives and disincentives might be imposed for the sake of environment friendly alternatives and technologies. It was learnt from the NOU that government does not impose control restrictions on equipments and banks. It should be kept in mind that HPMP is still on-going and parallel restriction of HFCs will be critical for government if the rules and existing policies are not revisited. Again, there is only one or two HS codes (harmonised system) for customs to monitor import of HFCs. HS code should be revised and harmonized for all possible HFCs and its blend for effective monitoring of the government. Import of equipment or bank containing HFCs might be included in the rules and import policy. Government might take initiatives to monitor leakage and strategy for the leak prevention might be important.

The HFC phase-down is a cross-cutting issue. It involves energy efficiency, GWP, occupational and equipment safety. So synergies with other government agencies to address HFCs in energy sector policy, export import policy, government intended nationally determined contribution (INDC), safety standard, national building codes, technical and vocational education and training, national procurement policy might be intervened. Moreover National Code of Practice should be developed for the servicing workshops, technicians and stakeholders involved marketing, transporting and storing flammable refrigerants.

4.2 Challenges in Technology Trend

HFCs are potent greenhouse gases used as alternatives to ozone depleting substances (ODS) being phased out under the Montreal Protocol. Atmospheric observations show that the volume of HFCs in the atmosphere is increasing rapidly, about 10-15% per year. Significant growth in HFC use is expected in developing countries because of population growth, rapid urbanization, electrification and changing consumer patterns. The increased use of refrigerants will also result in increased energy consumption and greenhouse gas emissions. From the market analysis it was found that new replacement options are very limited in many applications. Refrigerants are the essential working fluids in a vapour compression refrigeration cycle. A low-GWP fluid must possess many other properties. These can include zero (or very low) ozone-depletion potential, chemical stability, thermodynamic properties relative to the application, low toxicity, non-flammable and materialistic compatibility with the unit construction and last but not the least is the economical feasibility.

4.3 Strength and weakness for Training for Servicing Technicians

Strength, weakness and opportunities are determined for training of RAC technicians. NOU has created strong network with the national and local level RAC association. The association assist the NOU to organize training programme and information outreach to the grass root level. These associations can play vital role in future HFC phase-out activities.

NOU had limitation in their training programme in addressing larger cooling unit. Previously it only covers the domestic appliances. It is now time to address the larger unit specially commercial and industrial RAC units. It has been known from the stakeholder consultation that Bangladesh is lacking the technicians for larger unit. Among the few technicians, they depend on the experience to trouble shoot the larger unit. Limited formal education offers the technical knowhow for the larger units. Again, the regular domestic technicians are not very educated in terms of their level of formal education. Institutionalization of IPL will be difficult to develop skilled work force especially when it is the question of high pressure system, flammability of the refrigerant and occupational safety. So, major portion of the technicians would not reach above the certain level of certification when certification will be mandatory. One of the major sectors that should be revived after the RMP is MAC servicing sector. This will be more critical as the alternatives of HFCs in MAC are very expensive or high pressure compared to HFC. Hence more skilled and qualified technicians will be needed for MAC servicing. The association for mobile refrigeration and air-conditioning are not very much in touch with NOU. Development the partnership with MAC association and institutional will be additional task for the NOU. Government has not developed any certification scheme during HPMP implementation for technicians. Besides government is yet to develop and standardize the code of practice for the technicians. It was known from the KPI that woman are still not encouraged to enter this job market. Entire trade is controlled by the male technicians and entrepreneurs.

Another barrier for skilled technicians in our country is that they cannot communicate very in proper professional and technical terminologies and they only know the local languages. So language skill development should also be emphasised. Besides, personal and occupational safety education must be incorporated in the training or skill development courses.

The NOU can utilize its previous network and experience to cater the training needs for RAC and MAC technicians. HPMP Stage-II is the opportunity for the government to develop its certification scheme and this model can also be utilized for HFC phase-down. If the government could introduce certification scheme and enforce code of practice for more qualified and skilled technicians will be available in the local and overseas job market.

4.4 Barriers for the adoption of low GWP Alternatives

There might be a number of barriers to the adoption of low-GWP alternatives may exist at the national level. To identify the barriers technical (refrigeration and safety), supply and availability, commercial, market, information resources, regulations and standards, psychological and sociological issues were discussed with the relevant professionals. From the discussion, it was revealed that barriers naturally differ according to the country context, as well as the specific details of the facility, equipment and type of refrigerant. From the discussion the following issues were identified:

- Many systems specially unitary AC and MAC has limited or expensive alternative refrigerants available
- Low GWP alternatives are now expensive, so enterprises are reluctant to invest in low-GWP alternative technology
- Alternative refrigerants are too restrictive to allow their uses
- There is a general fear of the safety risks
- There are no suitable rules to direct users how to use the low-GWP alternatives properly
- Some stakeholders are unaware of the existence of cutting edge technologies

4.5 Tools and Equipment

From the previous experience of NOU it was known that general service shops and technicians use most essential RAC hand tools. Still they are not comfort with using tube bender, simple capillary cutter, two stage high vacuum pump and nitrogen. They still lag either these types of equipment or not comfort with. They are very reluctant to use safety gears. Again training institution has also lag laboratory RAC equipments. So it is necessary to address both service shop and institutional laboratories to equipped with the proper tools and equipment and make the technicians make comfortable to use these tools and equipment. Most importantly, technician and technical workshops are unaware or reluctant to use personal safety gazettes and safety equipment. Following matrix is the analysis needs assessment of tools and equipment.

Table C4. 1: Need assessment of RAC tools and equipment

S.no	Item	NOU	Government Institution	Private Institution	General Service Shop
1.	Refrigerant identifier	Yes	No	No	No
2	Two Stage Vacuum Pump	Yes	They use vacuum pumps	Most of them do not have	Becoming popular with the servicing technicians, but still most of the service shop do not use vacuum pumps
3	General hand tools including swaging, flaring, tube benders tube cutter, gauge manifold etc	Yes	Yes	Yes	Yes, but technicians need to know proper use of each hand tools
4	Portable recovery Machine	Yes	Yes	No	No
5	Refrigerant Recovery Cylinder(13.6 Kg)	Yes	Yes	Yes	Not used
6	Nitrogen system with pressure regulator	Yes	Yes	Mostly yes	There is need but supply of nitrogen cylinder is not available all over the country. Technicians generally use trivial method of air/ refrigerant flushing, and leak testing
7	Lokring	Yes	No	No	No. New and expensive tools to use. But it is essential for flammable refrigerant for safety issues
8	Recovery and Recycling Machine	No	No	No	No
9.	Brazing system	Yes	Yes	Yes	Yes
10.	Personal Safety gazettes	Yes	Yes	Yes	Mostly No
11.	Safety equipment	Yes	Yes	Yes	Mostly No

4.6 Assessment of Safety Standards

The phase-down of HFCs will require end users in the RAC markets to use alternative fluids with lower GWPs. In many cases this necessitates a switch from a non-flammable / non-toxic fluid to a fluid that will require some technical adaptations of the equipment. In particular, many of the low GWP alternatives being proposed might be flammable, toxic or operate at high pressure.

Various standards and pieces of legislation that affect the use of lower GWP alternatives were written at a time when there was no restriction on the GWP or ODP of the fluids available. This often led to a conservative approach being adopted by standards committees; for example, in certain specific applications the conservative approach to ban the use of any flammable fluid was adopted because a non-flammable option was widely available.

It is widely recognized that many current safety standards will restrict the use of low GWP alternatives. At the 28th Meeting of the Parties of the Montreal Protocol in Kigali, it was agreed that this is a priority issue and there are significant international efforts underway to try and revise relevant standards to help maximize the uptake of low GWP alternatives. In relation to implementation of the Kigali Amendment in an individual

country, it is important to recognize that there might be two different “levels” of safety standards to take into account:

1. At international level, there are various safety standards that relate to the use of RAC equipment.
2. At national level there are two different possibilities:
   a) The international safety standards are used directly, without any national-level changes
   b) National safety standards, national safety legislation or more localized rules are in place, which take precedence over the international standards.

During the development of the national HFC phase-down strategy it will be important to understand how RAC safety standards are defined. If international standards are used directly the situation is relatively simple. The situation can be more difficult if national or local legislation applies. In many cases, national legislation will make reference to relevant international standards, but may be more restrictive because:

1. National legislation is harmonized with an out-of-date version of an international standard. It is common for national legislation to lag several years behind changes to international standards.
2. National legislation includes extra restrictions and bans which are not in the international standards.

It must be stressed that maintaining high standards of safety remains a priority. Safety standards will not be revised to allow significantly higher levels of risk. The proposed revisions ensure a suitable level of safety.

4.7 Utilization of sector’s professional institutional structure

NOU has effective collaboration with different associations to conduct training programme and phase-out planning processes during ODS phase-out. HFCs phase-down will require wide range of stakeholders to be engaged. Sectoral strategy could be widen for the development of RAC servicing sector and engagement of RAC association and institution for qualification process of technicians as well as the development of skills. Institutionalization of these associations in terms of education, planning, training, participation in policy making process will be milestone approach for sectoral sustainable development.

5. CONCLUSION AND RECOMMENDATIONS

Bangladesh has ratified Kigali Amendment on 08 June 2020 and will start phase-down activity of non-ODS but high GWP HFCs. The provisions of KA include specific targets and timetables to replace HFCs with lower GWP alternatives. KA also mentions the importance of energy efficiency of RAC appliances and management of refrigerants throughout their lifecycle. About 40% of total refrigerant are used by the servicing sector. It is important for Bangladesh to set the right policy conditions to address the RAC servicing sector thus effectively implement the Kigali Amendment. The complexity of the RAC sector is the multiple refrigerants, each suitable only for certain applications. The technology adoption might not be easier task for our marginal service sector personnel. The right government policies and collaboration of RAC associations & stakeholders along with development/ exploration funding mechanism can be helpful to guide RAC servicing sector. Despite many challenges, we should take this as an opportunity for our manpower development and to meet SDG no 1 to 5, 7 to 13 and 17 in RAC sector.

Following recommendations might be adopted for RAC servicing sector:

1. Update national regulatory framework concomitant to the KA
2. Develop national strategy and integrated national action plan for RAC skill development and training
3. Develop national code of practice for the RAC servicing technicians and establishment of workshop.
4. Develop national safety and standard to handle and safe use of flammable refrigerants.
5. Incorporate Montreal Protocol and Kigali Amendment issues along with safety standards to handle flammable refrigerants in national TVET curricula.
6. Mass awareness campaign for safe and efficient use of RAC home appliances.
7. Awareness campaign targeting appliance users during off-peak demand season so that during the off-peak season the technicians will be involved in economic activities.
8. Awareness for RAC service technicians about occupational and personal safety.
9. To support the government in this regard, bilateral or multilateral funding opportunities other than MLF might be explored.
10. Aiding the RAC servicing workshop with necessary tools and equipment which they do not afford to obtain.
11. For life cycle management of refrigerants and equipment, recovery, recycling and or destruction policy and process might be introduced.
12. Special programme/policy might be undertaken to attract female professionals in to the RAC servicing sector.

SECTION D

LEGISLATION AND POLICY FRAMEWORK FOR HFC MANAGEMENT

Introduction

The Parties to the Montreal Protocol (MP) on Substances that Deplete the Ozone Layer reached an agreement at their 28th Meeting of the Parties on 15 October 2016 in Kigali, Rwanda to phase-down hydro fluorocarbons (HFCs).

HFCs are commonly used alternatives to ozone depleting substances (ODS). While not ODS themselves, HFCs are greenhouse gases which can have high global warming potentials (GWPs). The phase-down of HFCs under the Montreal Protocol has been under negotiation by the Parties and the successful agreement on the Kigali Amendment continues the historic legacy of the Montreal Protocol.

Background

The Parties to the Montreal Protocol reached an agreement at their 28th Meeting on 15 October 2016 in Kigali, Rwanda to reduce the manufacture and use of Hydro fluorocarbons (HFCs) by roughly 80-85% from their respective baselines, till 2045.

Technologically, HFCs were introduced in Refrigeration and Air Conditioning System (RAC sector) to phase out the Chlorofluorocarbons (CFCs) in the ninety's period. HFCs have less ozone layer depleting power but have very high global warming potential (GWP), ranging from about 121 to 14,800.

After ratification of Montreal Protocol on 2nd August 1990, the Government of Bangladesh implemented series of projects to phase out of Ozone Depleting Substances (ODS) and other harmful chemical that is used mostly in refrigeration and air-condition sector, pharmaceuticals and foam sectors. Bangladesh is one of the Parties to the Protocol and has been implementing series of program to protect the precious ozone layer. The Government of Bangladesh established Ozone Cell/Unit in 1996 at the Department of Environment to implement the MP related activities with financial support from Montreal Protocol Multilateral Funds (MLF).

Since July 1995 till date 28 projects have so far been approved with a resource of US$13,154,737 apart from PRP funds for 10 projects amounting US$458,750. Montreal Protocol achieved so far its 93% phase-out of ozone depleting substance in Bangladesh. The country is now at the stage of phasing out HCFCs. Recently MP adopted Kigali Amendment (*Annex 1*) to phase-down high GWP HFCs.

Bangladesh opted option 1 of the Article V and ratified the Kigali Amendment on 8 June 2020 after consultation and discussion process with the stakeholders.

Soon after adaption of Kigali, Montreal Protocol Multilateral Fund approved a standalone project in 2017 for the conversion of HFC-134a based refrigerator production facilities in Walton Hi-tech Industries Ltd. and was able to phase out about 170 Metric tons of yearly consumption of HFCs.

The Executive Committee of MP-MLF decided, inter alia, to approve enabling activities on the basis that countries would allow the flexibility to undertake a range of activities to fulfil their initial obligations in line with the Kigali Amendment. Enabling activities consist of, but not limited to,-

- activities to facilitate and support the early ratification of the Kigali Amendment,
- initiating supporting institutional arrangements,
- draft the national strategy for implementation of Kigali Amendment,
- evaluate the data reporting on system,
- to develop a baseline scenario for HFCs, and
- demonstration of non-investment activities.

About the Montreal Protocol

The Montreal Protocol on Substances that Deplete the Ozone Layer is a protocol to the Vienna Convention for the Protection of the Ozone Layer to monitor and report on global ozone depletion and to reverse the rapid depletion of the ozone layer. On 15 October 2016, an amendment to the Montreal Protocol was agreed and adopted in Kigali. Bangladesh is now in process of ratification of the Kigali Amendment.

Purpose of the Kigali Amendment

The purpose of the Kigali Amendment is to phase down HFCs which is used as an alternative to other ozone-depleting substances. It is mainly used in refrigeration and air conditioning. Although HFCs only have an effect on the ozone layer, some HFCs have been identified as having high global warming potential (GWP) and as potent greenhouse gases.

Phasing down the use of this substance will have important environmental benefits. In particular, if the Kigali Amendment is successfully implemented worldwide, it would prevent 0.5 degrees Celsius of global warming.

Features of the Kigali Amendment

The Kigali Amendment adds to the Montreal Protocol the phase-down of the production and consumption of HFCs. The Kigali Amendment requires the parties to meet a number of following legal obligations:

- The Kigali Amendment will enter into force on 1 January 2019, provided that it is ratified by at least 20 Parties to the Montreal Protocol (or 90 days after ratification by the 20th Party, whichever is later).
- Gradually phase down consumption and production of HFCs.
- Ensure that HFCs or emissions of HFCs from manufacturing facilities are destroyed (Bangladesh does not manufacture HFCs).
- Ban import and export of HFCs to non-parties from 1 January 2033.
- Establish a licensing/permitting system for imports and exports of HFCs.
- Introduction of reporting system on the production, use, destruction, import, and export of HFCs.
- There are two groups of Article 5 Parties with different baseline years and phase-down schedules.
- Some non-Article 5 Parties has different baseline calculations and different initial phase- down steps from the main group of non- Article 5 Parties. A new Annex F has been added to the Protocol. This lists the HFCs, separated into two groups, namely, **Group I:** all HFCs (except HFC-23, and HFOs[1]) and **Group II**: HFC-23.
- Global warming potential values have been added to the Protocol text for HFCs.
- Production, consumption, imports, exports and emissions as well as consumption baselines of HFCs shall be expressed in carbon dioxide (CO2) equivalents.
- Baselines are to be calculated from both HFC and HCFC production and consumption.
- There is an exemption for high ambient temperature countries.
- Develop guidelines for financing the phase-down of HFCs.

Article 5 Parties: Group 1

Baseline Years: 2020, 2021 & 2022

Baseline Calculation: Average production/consumption of **HFCs** in 2020, 2021 and 2022 *plus* 65% of **HCFC** baseline production/consumption 2024

Reduction steps

Freeze: 2024 (baseline level)
Step 1: 2029 --- 10 %
Step 2: 2035 --- 30%
Step 3: 2040 --- 50%
Step 4: 2045 --- 80%.

Outline of the Assignment

The current assignment was to find knowledge and capacity gaps with needs assessment to the relevant legislation. The legislation and policies is needed to fulfil the initial obligation of the Kigali Amendment will be assessed and identified to fulfil the initial obligation of the Kigali Amendment and to provide suggestions or recommendations making appropriate legislation and policy framework for HFC management.

The overall objective of this assignment is to develop a draft new legislation or draft an amending legislation complying with the existing legislation and policy.

Objective of the Assignment

The main objective of the assignment is to conduct a desk study and consultation to the relevant stakeholders to find knowledge and capacity gaps with needs assessment to the relevant legislation to fulfill the Kigali Amendment obligations.

This assignment is assessed and identifies the legislation and policies needed to fulfill the initial obligation of the Kigali Amendment and give advice for the development of technical papers for ratification, and thereafter provide suggestions or recommendations making appropriate legislation and policy framework for HFC management.

The overall objective of this assignment is to develop a draft new legislation or an amending legislation complying with the existing legislation and policy.

Methodology

The objectives is achieved by conducting thorough review of existing legislation and policies and prepare a draft legislation for amendment of the existing legislation or enacting a new legislation for the purpose of implementation of the Kigali Amendment. This will also include finding the gaps which needs amendment of the existing legislation or enacting new legislation to fulfil the purpose of implementation of the Kigali Amendment and organisation a preparation of consultation.

For the purpose of reviewing existing legislation and policies, following the issues issued by UN Environment, may be taken into account respecting Legislative and Policy Options to Control Hydro fluorocarbons (HFC) issued by UN environment:

- Monitoring and control measures
- Restriction on use
- Record keeping
- Emission prevention
- Capacity and awareness rising.

Measures taken

Upon examination of the Bangladesh Environmental Conservation Act, 1995 and the Ozone Depleting Substances (Control) Rules, 2004, it appears that there is no new primary legislation required to implement the Kigali Amendment.

Amendment of the Ozone Depleting Substances (Control) Rules, 2004 to implement the Kigali Amendment and this is achieved through amendments to the Amendment of the Ozone Depleting Substances (Control) Rules, 2004. The Rules was enacted under the Bangladesh Environmental Conservation Act, 1995. It is to be mentioned here that, the same approach was taken at the time of implementation of the phase-out of CFCs and HCFCs under the Montreal Protocol. Through consultation with the relevant officials of the Department of Environment and the officials of Ozone Cell/Unit it is decided that the Ozone Depleting Substances (Control) Rules, 2004 need to be amended.

The amendments to the Ozone Depleting Substances (Control) Rules, 2004 under the Bangladesh Environmental Conservation Act, 1995would:

- Adding 18 HFCs listed in the Montreal Protocol to the list of controlled substances.
- Licensing/permitting system is necessary to be introduced like ODS control for imports and exports of new, used, recycled and reclaimed HFCs.
- Provisions of prohibition may be incorporate for the manufacture of HFCs listed in Kigali Amendment.
- Imports and exports regulation of HFCs listed to non-Parties to the Kigali Amendment from 2033.

HFC Baseline

Baselines will be calculated from past HCFC consumption or production baselines plus the HFC consumption or production in 2020-2022 or 2024-2026 for Article 5 Parties. The basis for including both HFCs and a percentage of HCFCs is because, while HCFCs are being phased-out through already-approved HCFC Phase-out Management Plans (HPMPs), HFCs may be used as alternatives for some portion of HCFCs. The HCFC component is intended to account for this portion in the baseline.

When calculating levels of production, consumption, imports, exports and emissions of HFCs and HCFCs these will be expressed in CO2 equivalents and each Party shall use the GWP values specified in the Protocol to calculate these.

According to the Montreal Protocol for country like Bangladesh the cut-off date for eligible capacity is 1 January 2020 for those Parties with baseline years from 2020 to 2022.

GWP Values

Following the Kigali Amendment, the Montreal Protocol has adopted standard ‘reporting values’ for GWPs of HFCs and selected HCFCs and CFCs which have been incorporated into the text of the Protocol. When calculating a country’s annual levels of production, consumption, imports, exports and emissions of HFCs and HCFCs (and CFCs) these will be expressed in CO2 equivalents (GWP- weighted tones) and each Party will need to use the GWP values to calculate these.

HFCs

Substance	Group	GWP value (100 year)
HFC-134	Group I	1100
HFC-134a	Group I	1430
HFC-143	Group I	353
HFC-245fa	Group I	1030
HFC-365 mfc	Group I	794
HFC-227ea	Group I	3220
HFC-236cb	Group I	1340
HFC-236ea	Group I	1370
HFC-236fa	Group I	9810
HFC-245ca	Group I	693
HFC-43-10mee	Group I	1640
HFC-32	Group I	675
HFC-125	Group I	3500
HFC-143a	Group I	4470
HFC-41	Group I	92
HFC-152	Group I	53
HFC-152a	Group I	124
HFC-161	Group I	12
HFC -23	Group II	14 800.

Customs requirements to support the phase-down and Import-export control

Customs will be the border enforcement agency for imports and exports of HFCs. To facilitate the effective implementation of the Kigali Amendment, Customs will be updated the Tariff Document of Bangladesh to ensure unique classification codes are available to assist in the operationalization of the permitting system. Further, it is necessary make specific regulation in the existing Import and export Policy Order.

Economic, social, cultural and environmental costs and effects of the treaty action

HFCs in Bangladesh are generally imported and used by domestic manufacturers in refrigeration and air-conditioning equipment in homes and in commercial and industrial facilities, as well as for air-conditioning in vehicles. Smaller quantities are used in foam products, aerosols, fire protection systems and solvents. While the costs and effects of a phase-down of HFCs will vary from user to user, the transition could present challenges for businesses.

The Government has been proactively engaging and working with industry likely to be impacted by the HFC phase-down under the Kigali Amendment to ensure a smooth and effective transition away from HFCs. This has included informational roadshows, presentations and workshops.

Economic effects

As Bangladesh does not manufacture HFCs and is dependent on the global market for access to HFCs and alternatives, the economic effects for industry will likely be the same overall, regardless of whether Bangladesh ratifies the Kigali Amendment or not. Ratifying allows for a controlled phase-down and improved business certainty for importers and users of HFCs.

Social effects

Ratifying the Kigali Amendment is important for Bangladesh in terms of making a contribution toward addressing global climate change, and for continuing Bangladesh’s role as a good international citizen by contributing to the aims of the Montreal Protocol.

The HFC phase-down is also in line with the Government’s aims of improving environmental outcomes

for Bangladesh in the climate change space. If Bangladesh do not ratify the Kigali Amendment and enact legislation, it may lose credibility as a good international citizen playing its part in a successful environmental agreement and tackling climate change.

Environmental effects

Enacting legislation for the purpose of implementation of the Kigali Amendment has significant climate benefits for Bangladesh. If Bangladesh do not comply the obligation of Kigali Amendment, it will miss the opportunity to make a domestic contribution to global environmental outcomes. As already noted, the implementation of the Kigali Amendment is expected to prevent global warming of 0.5 degrees Celsius, a significant contribution towards the Paris Agreement's long-term temperature goal.

The costs to Bangladesh of compliance with the Kigali Amendment

The costs to the Bangladesh Government of domestic measures to implement the Kigali Amendment are likely to be low, and would be absorbed into existing baselines.

Action needs to be undertaken

Action needs to be undertaken by Bangladesh by following the recommendation of UN environment:

Recommended schedule of implementation of policy and legislative options

Kigali Amendment (KA) HFC consumption and production phase-down regime:

HFC consumption and production phase-down schedule and other important dates	**Recommended action to be undertaken by A5 country**
15 Oct 2016: KA is agreed upon.	2016/2017 all A5 awareness raising of all stakeholder groups (e.g. importers, exporters, end users) of the need of HFC phase-down
	2017 all A5 start of drafting the HFC legislation that will include all measures deemed necessary to follow HFC phase-down schedules
	2018: all A5 completion of HFC inventories, establishment of mandatory reporting and emission control measures and ratification of KA
1 Jan 2019: KA enters into force	1 Jan 2019 all A5 --- establishment of HFC import/export licensing system è mandatory based on KA
	2020: all A5 --- establishment of mandatory labeling of HFC containers (and equipment)
2022: technology review	2021 all A5 --- completion of customs training and establishment of refrigeration technicians certification system for HFC management
	2022: A5 Group 1 --- establishment of restrictions on placing on the market of products and equipment containing or relying on HFCs
	2023: A5 Group 1 --- establishment of country's baseline and setting up country's annual HFC consumption quota
1 Jan 2024: freeze date for A5 Group 1	2024 A5 Group 1 --- establishment of ban on new HFC installations and setting up HFC logbooks and HFC equipment logbooks
2025: technology review – compliance deferral of 2 years for A5 Group 2 (?)	

	2026: A5 Group 2 --- establishment of restrictions on placing on the market of products and equipment containing or relying on HFCs
2027: technology review	2027 A5 Group 2 --- establishment of country's baseline and setting up HFC consumption quotas; HAT countries è identification of exemptions
1 Jan 2028: freeze date for A5 Group 2 (possible compliance deferral of two years)	2028: A5 Group 2 --- establishment of ban on new HFC installations and of HFC logbooks and HFC equipment logbooks
1 Jan 2029: 10% reduction for A5 Group 1 and in 2029: possible agreement on exemptions	2029: A5 Group 1 --- establishment of permits for each HFC shipment, proof of origin for HFC shipments and permits for HFC transit
	2030: all A5 countries --- establishment of non-HAT exemptions – if agreed upon in 2029
1 Jan 2032: 10% reduction for A5 Group 2 and 2032: technology review	2032: A5 Group 2 --- establishment of permits for each HFC shipment, proof of origin for HFC shipments and permits for HFC transit
	1 Jan 2033: all A5 --- establishment of ban on trade with non-Parties to the Kigali Amendment --- resulting from the Kigali Amendment
	2034: A5 Group 1 --- establishment of ban on non-refillable HFC containers, HFC use bans and fees for HFC imports/placing on the market
1 Jan 2035: 30% reduction for A5 Group I	
	2036: A5 Group 2 --- establishment of ban on non-refillable HFC containers, HFC use bans and fees for HFC imports/placing on the market
1 Jan 2037: 20% reduction for A5 Group II and 2037: technology review	
1 Jan 2040: 50% reduction for A5 Group I	2040: all A5 --- establishment of electronically operated licensing system for HFCs
1 Jan 2042: 30% reduction for A5 Group II and 2042: technology review	
1 Jan 2045: 80% reduction for A5 Group I	
1 Jan 2047: 85% reduction for A5 Group II and 2047: technology review	

Legal Framework for Implementation of the Kigali Amendment Obligations

HFC phase down regulation may considerably vary from country to country both in structure and content. It depends on the country's prevailing administrative, legal and legislative structure.

The Kigali Amendment amends the Montreal Protocol to bring HFCs into the control. The legal obligation of Bangladesh under Kigali Amendment can be summarized below:

In the twelve-month period commencing 1 January 2019, and in each twelve-month period thereafter, phase down the consumption (production plus imports minus exports) of the 18 HFCs listed Montreal Protocol.

- Phase down the production of HFCs to a certain percentage of their baseline. (*This will not applicable for Bangladesh as Bangladesh do not produce HFCs*).
- Ensure that HFCs or emissions of HFCs from manufacturing facilities are destroyed using technology approved by the Parties. (*This will not applicable for Bangladesh as Bangladesh do not produce HFCs*).
- Ban the import and export of HFCs from/to any State not Party to the Kigali Amendment from 1 January 2033.
- Establish a system for licensing the import and export of new, used, recycled and reclaimed HFCs.
- Report on statistical data related to the production, use, destruction, import and export of HFCs.

The phase down of HFC can be regulated through amendment of the existing Ozone Depleting Substances (Control) Rules, 2004 (*Annex 2*) by providing for the above aspects, and upon examination of the Bangladesh Environmental Conservation Act, 1995, it appears that there is no new primary legislation is required to implement the Kigali Amendment, and an amendment proposal to the said Rules is proposed accordingly (*Annex 4*). It is mentioned that Ozone Depleting Substances (Control) Rules, 2004 was made for the purpose of phase out of ODS.
The proposed amendment (*Annex 4*) contains the following issues:

- Monitoring and control measures
- Restriction on use
- Record keeping.

For Bangladesh, the proposed amendment may achieve these without any difficulty since the country do not manufacture or produce the HFC. Therefore, the use or consumption can be regulated and phase down through establishment of control mechanism in import and export of HFC according to the obligation set in the Kigali Amendment.

Monitoring and reporting

Kigali Amendment imposes reporting and monitoring requirement regarding production/manufacture and use/consumption of the control substance *i.e*. HFC, in addition to the initial requirement for data on import-export, production/manufacture and use/consumption of all control substance. In rule 11 of the Ozone Depleting Substances (Control) Rules, 2004 there is an adequate and binding provision regarding reporting mechanism of ODS. Hence, necessary provisions are provided in the proposed amendment for collecting the relevant information from the importers, exporters, etc. and authority of the proposed National Ozone Unit (existing Ozone Cell) to require submission to it of the relevant information.

In addition to fulfilling the reporting and monitoring requirement, the collected data would be essential for ensuring compliance with the gradual phase down of HFC. Therefore, an important step is to establish a system to control monitoring and controlling import and export of HFC on a regular basis. This information is obviously collected through customs and import-export licensing. Thus, compatible with the principles of the international coding system of Harmonized System (HS Code) is needs to be

introduced. To make customs information a reliable source on HFC import-export it would be necessary to introduce separate HS Codes for all HFC.

Import-export Licensing System

The introduction of binding licensing system for import-export of HFC is most effective way to collect data and control mechanism of HFC. Proposed amendment to the Ozone Depleting Substances (Control) Rules, 2004 should be based on an import-export licensing system. Thus, licensing system is introduced in the proposed amendment like ODS import-export. The licensing system is introduced/proposed authorising the Director General of the Department of Environment to impose conditions regarding maximum quantity or license approvals in each year as may be determined, who should be allowed to import-export of HFC and imports and exports in proportion to the market share in the base year.

Exemptions

Exemptions can be approved by the countries for use/consumption which is needed to cover certain essential use and critical uses for production or consumption that is necessary to satisfy uses agreed by the Parties to be exempted use. For that purpose necessary amendment of the provisions relating to the exemptions of the Ozone Depleting Substances (Control) Rules, 2004 is proposed.

Labeling of HFC container

Specific labeling of containers of HFCs and HFC-containing mixtures is a measure that allows customs, environmental inspectors or HFC dealers and users to make a quick, preliminary identification of the contents of HFC shipments. The careful selection of information to be included on the label is, therefore, a very important element of any HFC legislation.

To that end, necessary amendment of the provisions relating to the labeling of the Ozone Depleting Substances (Control) Rules, 2004 is proposed. The proposed amendment refers the Information that should be placed on HFC containers should include at least the following elements: chemical name, chemical formula and trade name of the substance, ASHRAE designation (for refrigerants), CAS number or UN number, producer's name and address and batch number. For mixtures, the composition by percentage weight should also be specified on the label.

HPMP Stage II

For the Phase out of HCFCs in 35% in 2020 and 67.5% in 2025 as per Montreal Protocol obligation, Executive Committee of the Montreal Protocol Multilateral Fund in its 81st Meeting in June 2018 approved HCFC Phase-out Management Plan Stage-II. During approval of HPMP Stage-II, an Agreement between the Government of Bangladesh and the Executive Committee was signed regarding the yearly consumption of ODS upto 2025. These are as follows.

Particulars	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Maximum allowable consumption of ODS in ODP Tons	50.86	50.86	47.22	47.22	47.22	30.50	26.50	23.61

In this context, the proposed amendment of the existing ODS Rules are required to execute the maximum allowable limit of ODSs in ODP. For that reason the amendment of the schedule 1 and 2 of the ODS Rules are proposed by incorporating the maximum allowable limit of ODSs in ODP in ODP tons.

Limitations and Challenges

- HS codes cannot be provided as there are no specific HS codes for all HFC listed in the Protocol.
- The base year for Bangladesh will be 2020, 2021 and 2022. The quantity of allowable quota will be introduced after baseline determination. So, at this moment the proposed amendment to the rules cannot provide the yearly quantified quota.
- For future funds for phase-down, the quota allocation based on the baseline amount will reduce so the reduction percentage provided by the protocol will not be the same for specific country.
- The baseline survey is not yet finalized and it is under ongoing process. Before the baseline survey, it is not possible to predict the controllable machineries/chemicals. So, at this point in time the data cannot be provided, in particular in the HFC schedule of the proposed amendment to the existing ODS rules.
- To control of HFCs as per its end uses the baseline survey is necessary.
- To determine the exemptions of the uses of HFCs the baseline survey also necessary.
- The provisions of the proposed amendment will be implemented along with ODS control and there should be harmony about controlling and monitoring of both ODS and HFCs.
- For the purpose of implementation of Kigali Amendment there should be introduced the policy of the government about quota allocations of HFCs and ODSs at the same time.

Conclusion

Following the ratification to the Kigali Amendment the present effort to make legislation to implement the obligations under the Kigali Amendment is an effort by Bangladesh. The effort to make legislation in response to the obligation of the Kigali Amendment is a welcoming effort.

It is necessary to mention here that the proposed amendment to the ODS Rules may take some time to finalize. In the meantime, for the purpose of implementation of the Kigali Amendment the Department of Environment may take some emergent measure to issue notification under section 6A of the Environment Conservation Act, 1995. In the meantime, Ministry of Environment, Forest and Climate Change has issued a statutory Notification bearing Number SRO 40- Law/2021, dated 15 February, 2021 to meet the obligations under the Kigali Amendment on an urgent basis (*Annex 3*).

The base year for the HFC substances and the production or manufacture and use or consumption will have to be frozen at the base year. Moreover, there are some areas that need to formulate legislation in future. UN environment has already issued recommended schedule of implementation of policy and legislative options (*mentioned in the report*) for Kigali Amendment HFC consumption and production phase-down regime. Considering the schedule, presently there is no need to take immediate action in such areas which are not proposed in the proposed amendment to the Ozone Depleting Substances (Control) Rules, 2004.

The ODS Rules may be amended after the baseline survey with the support from the fund secretariat.

The Schedules of the proposed amendment to the ODS Rules are filled up appropriately through in-depth consultations with the relevant officials of the Ozone Cell/Unit of the Department of Environment. Noted that, before finalization of the proposed amendment the contents of the schedules are required to be checked again with the result of baseline survey. Moreover, the quantity of allowable quota will be introduced after baseline determination

Finally, it is expected that the proposed amendment to the Ozone Depleting Substances (Control) Rules, 2004, after finalization through consultation, discussion and legislative action, should enable the Government to fulfill its obligations under the Kigali Amendment.

Annex D1

United Nations
Environment
Programme

UNEP/OzL.Pro.28/CRP/10
14 October 2016
English only

Twenty-Eighth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer
Kigali, 10–14 October 2016
Item 6 of the agenda for the preparatory segment
Dubai pathway on hydrofluorocarbons (decision XXVII/1)

Further Amendment of the Montreal Protocol

Submitted by the Contact group on HFCs

The Twenty-Eighth Meeting of the Parties,

Decision XXVIII/--- Further Amendment of the Montreal Protocol

To adopt, in accordance with the procedure laid down in paragraph 4 of Article 9 of the Vienna Convention for the Protection of the Ozone Layer, the Amendment to the Montreal Protocol as set out in Annex ------ to the report of the Twenty-Eighth Meeting of the Parties;

Annex: Amendment of the Montreal Protocol

Article I: Amendment

Article 1, paragraph 4

In paragraph 4 of Article 1 of the Protocol, for the words:
"Annex C or Annex E"
there shall be substituted:
"Annex C, Annex E or Annex F"

Article 2, paragraph 5

In paragraph 5 of Article 2 of the Protocol, for the words:
"and Article 2H"
there shall be substituted:
"Articles 2H and 2J"

Article 2, paragraphs 8(a), 9(a) and 11

In paragraphs 8(a) and 11 of Article 2 of the Protocol, for the words:

"Articles 2A to 2I"

there shall be substituted:

"Articles 2A to 2J."

The following words shall be added at the end of subparagraph (a) of paragraph 8 of Article 2 of the Protocol:

"Any such agreement may be extended to include obligations respecting consumption or production under Article 2J provided that the total combined calculated level of consumption or production of the Parties concerned does not exceed the levels required by Article 2J."

In subparagraph 9(a)(i) of Article 2 of the Protocol, after the second use of the words:

"should be;"

there shall be deleted:

"and".

Subparagraph (a)(ii) of paragraph 9 of Article 2 of the Protocol shall be renumbered as subparagraph (a)(iii).

The following shall be added after subparagraph (a)(i) of paragraph 9 of Article 2 of the Protocol:

"Adjustments to the global warming potentials specified in Annexes C and F should be made and, if so, what the adjustments should be; and"

Article 2J

The following Article shall be inserted after Article 2I of the Protocol:

"Article 2J: Hydrofluorocarbons

1. Each Party shall ensure that for the twelve-month period commencing on 1 January 2019, and in each twelve-month period thereafter, its calculated level of consumption of the controlled substances in Annex F, expressed in CO2 equivalents, does not exceed the percentage, set out for the respective range of years as specified in subparagraphs (a) to (e) below, of the annual average of its calculated levels of consumption of Annex F controlled substances for the years 2011, 2012, and 2013, plus fifteen per cent of its baseline consumption of Annex C, Group I controlled substances as set out in Article 2F, expressed in CO2 equivalents:

   (a) 2019 to 2023: 90%
   (b) 2024 to 2028: 60%
   (c) 2029 to 2033: 30%
   (d) 2034 to 2035: 20%
   (e) 2036 and thereafter: 15%

2. Notwithstanding paragraph 1 of this Article, the Parties may decide that a Party shall ensure that, for the twelve-month period commencing on 1 January 2020, and in each twelve-month period thereafter, its calculated level of consumption of the controlled substances in Annex F, expressed in CO2 equivalents, does not exceed the percentage, set out for the respective range of years as specified in subparagraphs (a) to (e) below, of the annual average of its calculated levels of consumption of Annex F controlled substances for the years 2011, 2012, and 2013, plus twenty-five per cent of its baseline consumption of Annex C, Group I controlled substances as set out in Article 2F, expressed in CO2 equivalents:

(a) 2020 to 2024: 95%
(b) 2025 to 2028: 65%
(c) 2029 to 2033: 30%
(d) 2034 to 2035: 20%
(e) 2036 and thereafter: 15%

3. Each Party producing the controlled substances in Annex F shall ensure that for the twelve-month period commencing on 1 January 2019, and in each twelve-month period thereafter, its calculated level of production of the controlled substances in Annex F, expressed in CO2 equivalents, does not exceed the percentage, set out for the respective range of years as specified in subparagraphs (a) to (e) below, of the annual average of its calculated levels of production of Annex F controlled substances for the years 2011, 2012, and 2013, plus fifteen per cent of its baseline production of Annex C, Group I controlled substances as set out in Article 2F, expressed in CO2 equivalents:

   (a) 2019 to 2023: 90%
   (b) 2024 to 2028: 60%
   (c) 2029 to 2033: 30%
   (d) 2034 to 2035: 20%
   (e) 2036 and thereafter: 15%

   [However, in order to satisfy the basic domestic needs of the Parties operating under paragraph 1 of Article 5, its calculated level of production may exceed that limit by up to [ten] per cent of its calculated level of production of the controlled substances in Annex F.]

4. Notwithstanding paragraph 3 of this Article, the Parties may decide that a Party producing the controlled substances in Annex F shall ensure that for the twelve-month period commencing on 1 January 2020, and in each twelve-month period thereafter, its calculated level of production of the controlled substances in Annex F, expressed in CO2 equivalents, does not exceed the percentage, set out for the respective range of years as specified in subparagraphs (a) to (e) below, of the annual average of its calculated levels of production of Annex F controlled substances for the years 2011, 2012, and 2013, plus twenty-five per cent of its baseline production of Annex C, Group I controlled substances as set out in Article 2F, expressed in CO2 equivalents:

   (a) 2020 to 2024: 95%
   (b) 2025 to 2028: 65%
   (c) 2029 to 2033: 30%
   (d) 2034 to 2035: 20%
   (e) 2036 and thereafter: 15%

   [However, in order to satisfy the basic domestic needs of the Parties operating under paragraph 1 of Article 5, its calculated level of production may exceed that limit by up to [ten] per cent of its calculated level of production of the controlled substances in Annex F.]

5. Paragraphs 1 to 4 of this Article will apply save to the extent that the Parties decide to permit the level of production or consumption that is necessary to satisfy uses agreed by the Parties to be exempted uses.

6. Each party manufacturing Annex C Group I or Annex F substances shall ensure that for the twelve-month period commencing on 1 January 2020, and in each twelve-month period thereafter, its calculated level of emissions of Annex F, Group II substances generated as a byproduct in each production line that manufactures Annex C, Group I or Annex F substances does not exceed 0.1 per cent of the mass of Annex C, Group I or

Annex F substances manufactured in that production line the same twelve-month period. [Each party manufacturing Annex C Group I or Annex F substances shall ensure that for the twelve-month period commencing on 1 January 2020, and in each twelve-month period thereafter, its calculated level of emissions of Annex F, Group II substances generated as a byproduct in each production line that manufactures Annex C, Group I or Annex F substances does not exceed 0.1 per cent of the mass of Annex C, Group I or Annex F substances manufactured in that production line the same twelve-month period.]"

Article 3

The preamble to Article 3 of the Protocol should be replaced with the following:

1. "For the purposes of Articles 2, 2A to 2J and 5, each Party shall, for each group of substances in Annex A, Annex B, Annex C, Annex E or Annex F determine its calculated levels of:"

For the final semi-colon of subparagraph (a)(i) of Article 3 of the Protocol there shall be substituted:

"except as otherwise specified in paragraph 2;"

The following text shall be added to the end of Article 3 of the Protocol:

"and"

(d) Emissions of Annex F, Group II substances generated as in each facility that generates Annex C, Group I or Annex F substances by including, among other things, amounts emitted from equipment leaks, process vents, and destruction devices, but excluding amounts captured for use, destruction, or storage. (DN)

2. When calculating levels, expressed in CO2 equivalents, of production, consumption, imports, exports and emissions of Annex F and Annex C Group I substances for purposes of Article 2J, paragraph 5ter of Article 2, and paragraph 1(d) of Article 3, each Party shall use the global warming potentials of these substances as specified in Annexes C and F."

Article 4, paragraph 1 sept

The following paragraph shall be inserted after paragraph 1 sex of Article 4 of the Protocol:

"1 sept. Within one year of the date of entry into force of this paragraph, each Party shall ban the import of the controlled substances in Annex F from any State not Party to this Protocol."

Article 4, paragraph 2 sept

The following paragraph shall be inserted after paragraph 2 sex of Article 4 of the Protocol:

"2 sept. Within one year of the date of entry into force of this paragraph, each Party shall ban the export of the controlled substances in Annex F to any State not Party to this Protocol."

Article 4, paragraphs 5, 6 and 7

In paragraphs 5, 6 and 7 of Article 4 of the Protocol, for the words:
"Annexes A, B, C and E".
there shall be substituted:
"Annexes A, B, C, E and F"

Article 4, paragraphs 8

In paragraph 8 of Article 4 of the Protocol, for the words:
"Articles 2A to 2I"
there shall be substituted:
"Articles 2A to 2J".

Article 4B

The following paragraph shall be inserted after paragraph 2 of Article 4B of the Protocol:

"2 bis. Each Party shall, by 1 January 2019 or within three months of the date of entry into force of this paragraph for it, whichever is later, establish and implement a system for licensing the import and export of new, used, recycled and reclaimed controlled substances in Annex F. Any Party operating under paragraph 1 of Article 5 that decides it is not in a position to establish and implement such a system by 1 January 2019 may delay taking those actions until 1 January 2021."

Article 5

In paragraph 4 of Article 5 of the Protocol, for the word:

"2I"

there shall be substituted:

"2J".

In paragraphs 5 and 6 of Article 5 of the Protocol, for the words:

"Article 2I"

there shall be substituted:

"Articles 2I and 2J"

In paragraph 5 of Article 5 of the Protocol, before the words:

"any control measures"

there shall be inserted:

"with"

The following paragraph shall be inserted after paragraph 8 ter of Article 5 of the Protocol:

"8qua

(a) Each Party operating under paragraph 1 of this Article, in order to meet its basic domestic needs, and subject to any adjustments made to the control measures in Article 2J in accordance with paragraph 9 of Article 2, shall be entitled to delay its compliance with the control measures set out in subparagraphs (a) – (e) of paragraph 1 of Article 2J and subparagraphs (a) – (e) of paragraph 3 of Article 2J and modify those measures as follows:

i. 2024 to 2028: 100%
ii. 2029 to 2034: 90%
iii. 2035 to 2039: 70%
iv. 2040 to 2044: 50%
v. 2045 and thereafter: 20%

(b) Notwithstanding paragraph (a) above, the Parties may decide that a Party operating under paragraph 1 of this Article, in order to meet its basic domestic needs, and subject to any adjustments made to the control measures in Article 2J in accordance with paragraph 9 of Article 2, shall be entitled to delay its compliance with the control measures set out in subparagraphs (a) – (e) of paragraph 1 of Article 2J and subparagraphs (a) – (e) of paragraph 3 of Article 2J and modify those measures as follows:

i. 2028 to 2031: 100%
ii. 2032 to 2036: 90%
iii. 2037 to 2041: 80%
iv. 2042 to 2046: 70%
v. 2047 and thereafter: 15%

(c) Each Party operating under paragraph 1 of this Article, for the purposes of calculating its consumption baseline under Article 2J, shall be entitled to use the average of its calculated levels of consumption of Annex F controlled substances for the years 2020, 2021, and 2022, plus sixty-five per cent of its baseline consumption of Annex C, Group I controlled substances as set out in paragraph 8 ter of this Article.

(d) Notwithstanding paragraph (c) above, the Parties may decide that a Party operating under paragraph 1 of this Article, for the purposes of calculating its consumption baseline under Article 2J, shall be entitled to use the average of its calculated levels of consumption of Annex F controlled substances for the years 2024, 2025, and 2026, plus sixty-five per cent of its baseline consumption of Annex C, Group I controlled substances as set out in paragraph 8 ter of this Article.

(e) Each Party operating under paragraph 1 of this Article and producing the controlled substances in Annex F, for the purposes of calculating its production baseline under Article 2J, shall be entitled to use the average of its calculated levels of production of Annex F controlled substances for the years 2020, 2021, and 2022, plus sixty-five per cent of its baseline production of Annex C, Group I controlled substances as set out in paragraph 8 ter of this Article.

(f) Notwithstanding paragraph (e) above, the Parties may decide that a Party operating under paragraph 1 of this Article and producing the controlled substances in Annex F, for the purposes of calculating its production baseline under Article 2J, shall be entitled to use the average of its calculated levels of production of Annex F controlled substances for the years 2024, 2025, and 2026, plus sixty-five per cent of its baseline consumption of Annex C, Group I controlled substances as set out in paragraph 8 ter of this Article.

(g) Paragraphs (a) to (f) of this Article will apply to calculated levels of production and consumption save to the extent that a high ambient temperature exemption applies based on criteria decided by the Parties."

Article 6

In Article 6 of the Protocol, for the words:

"Articles 2A to 2I"

there shall be substituted:

"Articles 2A to 2J".

Article 7, paragraphs 2, 3 and 3 ter

The following line shall be inserted after the line that reads "– in Annex E, for the year

1991," in paragraph 2 of Article 7 of the Protocol:

– in Annex F, for the years 2011 to 2013, except that Parties operating under paragraph 1 of Article 5 shall provide such data for 2020 to 2022, but those Parties operating under paragraph 1 of Article 5 using to which subparagraphs b and d of paragraph 8qua of Article 5 applies shall provide such data for 2024 to 2026; ".

In paragraphs 2 and 3 of Article 7 of the Protocol, for the words:
"C and E"

there shall be substituted:

"C, E and F".

The following paragraph shall be added to Article 7 of the Protocol after paragraph 3 bis:

"3 ter. Each Party shall provide to the Secretariat statistical data of its annual emissions of Annex F, Group II controlled substances per facility in accordance with Article 3(d) of the Protocol."(DN)

Article 10

In paragraph 1 of Article 10 of the Protocol, for the words:

" and Article 2I"

There shall be substituted:

", Article 2I and Article 2J".

The following shall be inserted at the end of Article 10, paragraph 1 of the Protocol:

"Where a Party operating under paragraph 1 of Article 5 chooses to avail itself of funding from any other financial mechanism that could result in meeting any part of its agreed incremental costs, that part shall not be met by the financial mechanism under Article 10 of this Protocol."

Article 17

In Article 17 of the Protocol, for the words:

"Articles 2A to 2I"

there shall be substituted:

"Articles 2A to 2J".

Annex C and Annex F

The following table shall replace the table for Group I in Annex C to the Protocol:

Group	Substance	Number of isomers	Ozone-Depleting Potential*	100-Year Global Warming Potential***
Group I				
$CHFCl_2$	(HCFC-21)**	1	0.04	151
CHF_2Cl	(HCFC-22)**	1	0.055	1810
CH_2FCl	(HCFC-31)	1	0.02	
C_2HFCl_4	(HCFC-121)	2	0.01–0.04	
$C_2HF_2Cl_3$	(HCFC-122)	3	0.02–0.08	
$C_2HF_3Cl_2$	(HCFC-123)	3	0.02–0.06	77
$CHCl_2CF_3$	(HCFC-123)**	–	0.02	
C_2HF_4Cl	(HCFC-124)	2	0.02–0.04	609
$CHFClCF_3$	(HCFC-124)**	–	0.022	
$C_2H_2FCl_3$	(HCFC-131)	3	0.007–0.05	
$C_2H_2F_2Cl_2$	(HCFC-132)	4	0.008–0.05	
$C_2H_2F_3Cl$	(HCFC-133)	3	0.02–0.06	
$C_2H_3FCl_2$	(HCFC-141)	3	0.005–0.07	
CH_3CFCl_2	(HCFC-141b)**	–	0.11	725
$C_2H_3F_2Cl$	(HCFC-142)	3	0.008–0.07	
CH_3CF_2Cl	(HCFC-142b)**	–	0.065	2310
C_2H_4FCl	(HCFC-151)	2	0.003–0.005	
C_3HFCl_6	(HCFC-221)	5	0.015–0.07	
$C_3HF_2Cl_5$	(HCFC-222)	9	0.01–0.09	
$C_3HF_3Cl_4$	(HCFC-223)	12	0.01–0.08	
$C_3HF_4Cl_3$	(HCFC-224)	12	0.01–0.09	
$C_3HF_5Cl_2$	(HCFC-225)	9	0.02–0.07	
$CF_3CF_2CHCl_2$	(HCFC-225ca)**	–	0.025	122
CF_2ClCF_2CHClF	(HCFC-225cb)**	–	0.033	595
C_3HF_6Cl	(HCFC-226)	5	0.02–0.10	
$C_3H_2FCl_5$	(HCFC-231)	9	0.05–0.09	
$C_3H_2F_2Cl_4$	(HCFC-232)	16	0.008–0.10	
$C_3H_2F_3Cl_3$	(HCFC-233)	18	0.007–0.23	
$C_3H_2F_4Cl_2$	(HCFC-234)	16	0.01–0.28	
$C_3H_2F_5Cl$	(HCFC-235)	9	0.03–0.52	
$C_3H_3FCl_4$	(HCFC-241)	12	0.004–0.09	
$C_3H_3F_2Cl_3$	(HCFC-242)	18	0.005–0.13	
$C_3H_3F_3Cl_2$	(HCFC-243)	18	0.007–0.12	
$C_3H_3F_4Cl$	(HCFC-244)	12	0.009–0.14	
$C_3H_4FCl_3$	(HCFC-251)	12	0.001–0.01	
$C_3H_4F_2Cl_2$	(HCFC-252)	16	0.005–0.04	
$C_3H_4F_3Cl$	(HCFC-253)	12	0.003–0.03	
$C_3H_5FCl_2$	(HCFC-261)	9	0.002–0.02	
$C_3H_5F_2Cl$	(HCFC-262)	9	0.002–0.02	
C_3H_6FCl	(HCFC-271)	5	0.001–0.03	

* Where a range of ODPs is indicated, the highest value in that range shall be used for the purposes of the Protocol. The ODPs listed as a single value have been determined from calculations based on laboratory measurements. Those listed as a range are based on estimates and are less certain. The range pertains to an isomeric group. The upper value is the estimate of the ODP of the isomer with the highest ODP, and the lower value is the estimate of the ODP of the isomer with the lowest ODP.

** Identifies the most commercially viable substances with ODP values listed against them to be used for the purposes of the Protocol.

*** For substances for which no GWP is indicated, the default value 0 applies.

The following annex shall be added to the Protocol after Annex E:

"***Annex F:*** ***Controlled substances***

Group		**100-year Global Warming Potential**	
Group I			
CHF_2CHF_2	HFC-134	1,100	
CH_2FCF_3	HFC-134a	1,430	
CH_2FCHF_2	HFC-143	353	
$CHF_2CH_2CF_3$	HFC-245fa	1,030	
$CF_3CH_2CF_2CH_3$	HFC-365mfc	794	
CF_3CHFCF_3	HFC-227ea	3,220	
$CH_2FCF_2CF_3$	HFC-236cb	1,340	
CHF_2CHFCF_3	HFC-236ea	1,370	
$CF_3CH_2CF_3$	HFC-236fa	9,810	
$CH_2FCF_2CHF_2$	HFC-245ca	693	
$CF_3CHFCHFCF_2CF_3$	HFC-43-10mee	1,640	
CH_2F_2	HFC-32	675	
CHF_2CF_3	HFC-125	3,500	
CH_3CF_3	HFC-143a	4,470	
CH_3F	HFC-41	92	
CH_2FCH_2F	HFC-152	53	
CH_3CHF_2	HFC-152a	124	
CH_3CH_2F	HFC-161	12	
Group II			
[CHF3	HFC-23	14,800]"	

Article II: Relationship to the 1999 Amendment

No State or regional economic integration organization may deposit an instrument of ratification, acceptance or approval of or accession to this Amendment unless it has previously, or simultaneously, deposited such an instrument to the Amendment adopted at the Eleventh Meeting of the Parties in Beijing, 3 December 1999.

Article III: Relationship to the United Nations Framework Convention on Climate Change and its Kyoto Protocol

This Amendment is not intended to have the effect of excepting hydroflourocarbons from the scope of the commitments contained in Articles 4 and 12 of the United Nations Framework Convention on Climate Change or in Articles 2, 5, 7 and 10 of its Kyoto Protocol.

Article IV: Entry into force

1. Except as noted in paragraph 2, below, this Amendment shall enter into force on 1 January 2019, provided that at least twenty instruments of ratification, acceptance or approval of the Amendment have been deposited by States or regional economic integration organizations that are Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer. In the event that this condition has not been fulfilled by that date, the Amendment shall enter into force on the ninetieth day following the date on which it has been fulfilled.
2. The changes to Article 4 of the Protocol, control of trade with non-Parties, set out in Article I of this Amendment shall enter into force on 1 January 2029, provided that at least seventy instruments of ratification, acceptance or approval of the Amendment have been deposited by States or regional economic integration organizations that are Parties to the Montreal Protocol on

Substances that Deplete the Ozone Layer. In the event that this condition has not been fulfilled by that date, the Amendment shall enter into force on the ninetieth day following the date on which it has been fulfilled.

3. For purposes of paragraphs 1 and 2, any such instrument deposited by a regional economic integration organization shall not be counted as additional to those deposited by member States of such organization.
4. After the entry into force of this Amendment, as provided under paragraphs 1 and 2, it shall enter into force for any other Party to the Protocol on the ninetieth day following the date of deposit of its instrument of ratification, acceptance or approval.

Article V: Provisional Application

Any Party may, at any time before this Amendment enters into force for it, declare that it will apply provisionally any of the control measures set out in Article 2J, and the corresponding reporting obligations in Article 7, pending such entry into force.

Annex D2

MYcRvZš¿x evsjv‡`k miKvi
cwi‡ek I eb gš¿Yvjq

cÁvcb

Zwi L, 5 Gwcj 2004/22 ˆPÎ 1410

Gm, Avi, I bs 92-AvBb/2004|- *evsjv‡`k cwi‡ek msi¶Y AvBb, 1995 (1995 m‡bi 1 bs AvBb) Gi avivi 20 G c`Ë ¶gZve‡j miKvi wb¤i¡c wewagvjv cYqb Kwij, h_v t-*

1| msw¶ß wk‡ivbvg I ceZb|- (1) GB wewagvjv I‡Rvb¯i ¶qKvix `e¨ (wbqšY) wewagvjv, 2004 bv‡g Awfwn Z nB‡e|

(2) GB wewagvjv 19 ˆekvL 1411 e½vã †gvZv‡eK 2 †g 2004 wLóvã Zwi‡L ejer nB‡e|

2| msÁv|- welq ev cm‡½i cwicš¿x ‡Kvb wKQybv _wK‡j, GB wewagvjvq -

(K) ÒAvBbÓ A_ evsjv‡`k cwi‡ek msi¶Y AvBb, 1995 (1995 m‡bi 1bs AvBb);

(L) ÒI‡Rvb¯i ¶qKvix `e¨Ó A_ I‡Rvb¯i ¶qKvix `e¨ ev D³ `e¨ wgwkZ †Kvb `e¨ wbwe‡k‡l Zdwmj 1 Gi Kjvg (2) G DwjwLZ I‡Rvb¯i ¶qKvix `e¨, Z‡e cwienb ev msi¶‡Yi Rb¨ e¨eüZ aviK e¨ZxZ c¯ZKZ.c‡Y¨i AvKv‡i D³ `e¨ ev Dnvi wgkY Aš¿fy³ nB‡e bv;

(M) ÒK‡¤cmiÓ A_ I‡Rvb¯i ¶qKvix `e¨ e¨envi‡i gva¨‡g c¯ZKZ.K‡¤cmi;

(N) ÒZdwmjÓ A_ GB wewagvjvi †Kvb Zdwmj;
(O) Òcwi‡ek Awa`ßiÓ A_ AvB‡bi avivi 3 Gi Aaxb ¯wcZ cwi‡ek Awa`ßi;
(P) Òe¨w³Ó k‡ãi AvIZvq wbewÜZ nDK ev bv nDK GBi¡c †Kvb †Kv¤úvbx ev msN ev e¨w³ msNI Aš¿fy³;
(Q) ÒwfwË¯iÓ (base level) A_ Zdwmj 2 Gi Kjvg (3) G DwjwLZ ermi ev Mo erm‡i I‡Rvb¯i ¶qKvix `‡e¨i Drcv`b ev, †¶ÎgZ, e¨envi‡i cwigvY;
(R) Ògnvcwi Pvjvi K Ó A_ cwi‡ek Awa`ß‡ii gnvcwiPvjvK;
[1][(S) ÒwiKfvixÓ A_ ‡h †Kvb wkí-KviLvbv, hš¿cwZ A_ev RvnvR fv½v wkí nB‡Z I‡Rvb¯i ¶qKvix `e¨ wiKfvix;
(T) Òwi‡KBwgsÓ A_ wiKfviKZ.I‡Rvb¯i ¶qKvix `e¨ cwµqvRvZKiYcwK cwi‡kvab cwµqv;
(U) ÒwimvBwKsÓ A_ wiKfviKZ.I‡Rvb¯i ¶qKvix `e¨ cÖvte¨envi Dc‡hvMxKiY;
(V) ÒjvB‡mÝÓ A_ GB wewagvjvi Aaxb c`Ë jvB‡mÝ|]

3| I‡Rvb¯i ¶qKvix `e¨ cwi‡e‡ki Rb¨ ¶wZKi mvgMx|- AvB‡bi avivi 6K Gi D‡Ïk¨ c‡YK‡í, mgM evsjv‡`‡k cwi‡e‡ki Rb¨ ¶wZKi mvgMx wnmve I‡Rvb¯i ¶qKvix `‡e¨i Drcv`b, Avg`wb, ißvbx, evRviRvZKiY, weµq, weµ‡qi Rb¨ c`kb, gRÝ, weZiY ev ewYR¨K D‡Ï‡k¨ e¨envi msµvš KgKvÛ cwiPvjbv ev e¨e¯vcbvi †¶‡Î GB wewagvjvi weavbvejx c‡hvR¨ nB‡e|

[2][4| I‡Rvb¯i ¶qKvix `‡e¨i Drcv`‡b evav-wb‡la| —†Kvb e¨w³ Zdwmj 1 Gi Kjvg (2) G DwjwLZ I‡Rvb¯i ¶qKvix `e¨ Drcv`b Kwi‡Z cwi‡eb bv|]

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[1] `dv (S), (T), (U) I (V) Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|
[2] wewa 4 Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|

*5| **I‡Rvb¯i ¶qKvix `e¨ Avg`vbx ev ißvbx msµvš wea vb|** - (1) ‡Kvb e¨w³ Zdwmj 4 G ZwjKv fy³ ivó ewnfz-*[3]*[(L) ivó nB‡Z †Kvb I‡Rvb¯i ÿqKvix `e¨ evsjv‡`‡k Avg`vbx Kwi‡Z cwi‡eb bv; ev*

(L) iv‡ó evsjv‡`k nB‡Z †Kvb I‡Rvb¯i ÿqKvix `e¨ ißwb Kwi‡Z cwi‡eb bv [4][***]]

[5][Z‡e kZ _v‡K †h, GB `dvi Aaxb, jvB‡mÝ MnY mv‡c‡ÿ, †Kej wiKfvix, wi‡KBwgs ev wimvBwKsKZ. I‡Rvb¯i ÿqKvix `e¨ ißvbx Kiv hvB‡e t

Avi I kZ _v‡K †h, †Kvb iv‡ói Avg`vbxKviK cwZôvb mswkó iv‡ói miKvix KZc‡ÿi Abyhvqx MnYceK D³ I‡Rvb¯i ÿqKvix `e¨ evsjv‡`k nB‡Z Avg`vbx Kwi‡Z cwi‡e|]

(2) †Kvb e¨w³ GB wewagvjvi Aaxb c`Ë jvB‡mÝ e¨wZ‡i‡K Zdwmj 4 G ZwjKvfy³-

(K) ivó nB‡Z evsjv‡`k †Kvb I‡Rvb¯i ¶qKvix `e¨ Avg`vbx Kwi‡Z cwi‡eb bv; ev

(L) iv‡ó evsjv‡`k nB‡Z †Kvb I‡Rvb¯i ¶qKvix `e¨ ißvbx Kwi‡Z cwi‡eb bv|

(3) Dc-wewa (2) Gi Aaxb †Kvb jvB‡mÝ c`vb Kiv hvB‡e bv, hw` bv gnvcwiPvjK GB g‡g mšó nb †h, Zdwmj 1 Gi Kjvg (5) G DwjwLZ M‡elYv I‡Rvb¯i ¶qKvix `‡e¨i Abyhvqx jvB‡mÝ c`vb Kiv nB‡j D³ M‡elYv Rb¨ wbawiZ wfwË¯‡ii wfwË‡Z e¨envi cwigvY wfwË ermi (base year) mswkó Zdwmj 2 Gi Kjvg (5) G wb‡`wkZ [6][e¨envi cwigvb] AwZµg Kwi‡e bv|

(4) miKvi, [7][c‡qvR‡b,] miKvix †M‡R‡U cÁvcb Øviv, mgM evsjv‡`‡ki Rb¨ Dc-wewa (3) G DwjwLZ c‡Z¨K M‡elYv Rb¨ I‡Rvb¯i ¶qKvix `‡e¨i e¨envi I Drcv`b ev Avg`vbxi wbYqKZ.wfwËmxgv (base limit) c„Kfv‡e Rvix Kwi‡e|

(5) Dc-wewa (4) Gi Aaxb cÁvcb Rvixi c‡e Dc-wewa (3) G DwjwLZ I‡Rvb¯i ¶qKvix `e¨ †Kvb wbw`ó erm‡i Avg`vbxi D‡Ï‡k¨ †Kvb FYcÎ †Lvjv nBqv _wK‡j D³ erm‡ii Rb¨ Zdwmj 2 Gi Kjvg (4) G DwjwLZ M‡elYv I‡Rvb¯i ¶qKvix `e¨ Avg`vbxi MnY‡hvM¨ cwigv‡Yi mv‡_ mgšq Kiv hvB‡e|

*6| **I‡Rvb¯i ¶qKvix `‡e¨i wewµ‡qi Dci evav wb‡la|** - ‡Kvb e¨w³ ev Zvnvi c‡¶ Ab¨ †Kvb e¨w³ [8][cwi‡ek Awa`ßi KZK.AbvcwË MnY e¨wZ‡i‡K] I‡Rvb¯i ¶qKvix `e¨ gRy` ev wewµ‡qi D‡Ï‡k¨ ev Ab¨ †Kvb fv‡e weZiY (distribute) Kwi‡Z cwi‡eb bv|*

*7| **I‡Rvb¯i ¶qKvix `e¨ µq BZ¨vw`i Dci evav wb‡la|** - ‡Kvb e¨w³ ev Zvnvi c‡¶ Ab¨ †Kvb e¨w³ Zdwmj 3 Gi Kjvg (2) G DwjwLZ KgKv‡Ûi D‡Ïk¨ e¨ZxZ Ab¨ †Kvb D‡Ï‡k¨ I‡Rvb¯i ¶qKvix `e¨ gRy` ev e¨envi‡ii D‡Ï‡k¨ µq ev msMn Kwi‡Z cwi‡eb bv|*

*8| **I‡Rvb¯i ¶qKvix `e¨ Drcv`‡b bZzb wewb‡qv‡M wb‡lavÁv, BZ¨vw`|-** (1) †Kvb e¨w³ Zdwmj 2 Gi-*

(K) Kjvg (7) G wb`ókZ.Zwi‡Li ci I‡Rvb¯i ¶qKvix `e¨ c¯‡Zi j‡¶¨ †Kvb wkíKviLvbv cwZôv ev m¤cmviY ev cwZôvi ev m¤cmvi‡Yi D‡`¨vM MnY Kwi‡Z cwi‡eb bv;

(L) Kjvg (8) G wb`ókZ.Zwi‡Li ci I‡Rvb¯i ¶qKvix `e¨ m¤wjZ ev I‡Rvb¯i ¶qKvix `e¨ Øviv c¯Z‡hvM¨ †Kvb cY¨ Drcv`‡bi j‡¶¨ wkíKviLvbv cwZôv ev m¤cmviY ev cwZôvi ev m¤cmvi‡Yi D‡`¨vM MnY Kwi‡Z cwi‡eb bv|

(2) 16 †m‡Þ¤i, 1987 Zwi‡L MÖnxZ I‡Rvb¯i ¶qKvix `e¨ m¤úwKZ gv»Uj c‡UvKj Gi m`m¨ wnmv‡e evsjv‡`‡ki †Kvb e¨w³ gv»Uj c‡UvK‡ji Abyhvqx Q` 10 I 10K Gi Aaxb eûcw¶K Znwej (Multilateral

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[3] `dv (K) I (L) Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|

[4] `dv (L) Gi †kl cvšt¯Z `wo (|) Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv wejßx|

[5] kZvsk Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv ms‡hvwRZ|

[6] Òe¨envi‡ii cwigvbÓ kã¸wji Óe¨envi‡ii msL¨vÓ kã¸wji cwie‡Z Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|

[7] Òc‡qvR‡b,Ó kã I KgwU ÒmiKvi,Ó kã I KgwUi ci Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv ms‡hvwRZ|

[8] Òcwi‡ek Awa`ßi KZK.AbvcwË MnY e¨wZ‡i‡KÓ kã¸wji ÒjvB‡mÝ e¨wZ‡i‡KÓ kã¸wji cwie‡Z Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|

Fund) nB‡Z I‡Rvb¯i ¶qKvix `e¨ Drcv`b chy³i cwie‡Z I‡Rvb¯i ¶qKvix `e¨ ewRZ chy³ ¯vc‡bi Rb¨ Aw_K I KwiMix mnvqZv MnY K‡i, Zvnv nB‡j D³ e¨w³ i¦cvši cKí Abyôv`b Ges i¦cvši cwµqv mgvß nBevi ci Zdwmj 3 Gi Kjvg (2) G DwjwLZ KgKv‡Ûi Rb¨ Zdwmj 2 Gi Kjvg (2) G DwjwLZ M«cfy³ I‡Rvb¯i ¶qKvix `e¨ ev I‡Rvb¯i ¶qKvix `e¨ m¤wjZ †Kvb cY¨ ev I‡Rvb¯i ¶qKvix `e¨ mgš‡q c¯ZKZ.†Kvb cY¨ Drcv`‡bi j‡¶¨ wkí KviLvbv ¯vcb ev m¤cmvi‡Yi †Kvb D‡`¨vM MnY Kwi‡Z cwi‡eb bv|

9| **I‡Rvb¯i ¶qKvix `e¨ Øviv c¯ZKZ.ev D³ `e¨ m¤wjZ cY¨ Avg`vbx, ißvbx ev weµ‡qi Dci evav-wb‡la|**- (1) †Kvb e¨w³ jvB‡mÝ e¨wZ‡i‡K Zdwmj 5 Gi Kjvg (2) G wbw`óKZ.†Kvb cY¨ D³ Zdwm‡ji Kjvg (3) G ewYZ M«‡ci I‡Rvb¯i ¶qKvix `e¨ mgš‡q c¯ZKZ.ev I‡Rvb¯i ¶qKvix `e¨ m¤wjZ cY¨ D³ Zdwm‡ji Kjvg (4) G wbw`óKZ.Zwi‡Li ci Avg`vbx Kwi‡Z cwi‡eb bv t

Z‡e kZ _v‡K †h, D³ Zdwm‡ji Kjvg (4) G wbw`óKZ.Zwi‡Li ci I‡Rvb¯i ¶qKvix `e¨ mgš‡q c¯ZKZ.b‡n GBi¦c cY¨ Avg`vbxi †¶‡Î D³ cY¨ I‡Rvb¯i ¶qKvix `e¨ m¤wjZ b‡n g‡g D³ c‡Y¨i ‡gvo‡K mn‡R `wóMvn¨ nq Ggb ¯v‡b †j‡ej mshy³ _wK‡Z nB‡e|

(2) Zdwmj 5 Gi Kjvg (5) G wbw`óKZ.Zwi‡Li ci D³ Zdwm‡ji Kjvg (2) G wbw`óKZ.cY¨ I‡Rvb¯i ¶qKvix `e¨ mgš‡q c¯ZKZ.nB‡j ev I‡Rvb¯i ¶qKvix `e¨ m¤wjZ cY¨ nB‡j †Kvb e¨w³ D³ c‡Y¨i ‡gvo‡K Zrg‡g †j‡ej mshy³ bv Kwiqv D³ cY¨ ißvbx Kwi‡Z cwi‡eb bv|

(3) †Kvb e¨w³ Zdwmj 3 Gi Kjvg (4) G wbw`óKZ.Zwi‡Li ci D³ Zdwm‡ji Kjvg (2) G DwjwLZ KgKvÛ ev †mevc`v‡bi D‡Ï‡k¨ D³ Zdwm‡ji Kjvg (3) DwjwLZ M«cfy³ I‡Rvb¯i ¶qKvix `e¨ e¨envi Drcw`Z †Kvb cY¨ weµq, gRy`, weµ‡qi D‡Ï‡k¨ c`kb ev weZiY Kwi‡Z cwi‡eb bv|

10| **K‡¤cmi c¯‡Zi Dci evav wb‡la|** - (1) ‡Kvb e¨w³ gnvcwiPvj‡Ki cevbygwZ MnY e¨wZ‡i‡K I‡Rvb¯i ¶qKvix `e¨ e¨eüZ nq Ggb ai‡Yi †Kvb K‡¤cmi c¯Z ev Dnv Avg`vbx ev ißvbx Kwi‡Z cwi‡eb bv (2) gnvcwiPvjK, mvavi Y Av‡`k Øviv, Abyôv`b c`vb c×wZ wbavi Y Kwi‡eb|

11| **cwiex¶Y I cwZ‡e`b `wLj, BZ¨w`|**- (1) I‡Rvb¯i ¶qKvix `e¨ Drcv`bKvix, Avg`vbx-KviK, ißvbxKviK ev weµqKvix c‡Z¨K e¨w³‡K I‡Rvb¯i ¶qKvix `e¨ Drcv`b, Avg`vbx, ißvbx ev weµ‡qi h_vh_ wnmve ev †iKW msi¶Y Kwi‡eb Ges Zdwmj 7 Gi LÛ-1 G wea¸Z c×wZ‡Z GZ`msµvš cwZ‡e`b `wLj Kwi‡Z nB‡e|

(2) K‡¤cmi c¯ZKvix, Avg`vbxKviK, ißvbxKviK ev weµqKvix c‡Z¨K e¨w³‡K Dnvi c¯Z, Avg`vbx, ißvbx ev weµ‡qi h_vh_ Z_¨ I †iKWcÎ msi¶Y ceK Zdwmj 7 Gi LÛ-2 G wea¸Z c×wZ‡Z GZ`msµvš cwZ‡e`b `wLj Kwi‡Z nB‡e|

(3) Dc-wewa (1) I (2) Gi Aaxb msiw¶Z Z_¨w` m¤úwKZ cwZ‡e`b h_vµ‡g Zdwmj 8 I 9 G wea¸Z dig ci-YceK gnvcwiPvj‡Ki wbKU `wLj Kwi‡Z nB‡e|

12| **Ae¨vnwZ|**- GB wewagvjvi †Kvb wKQy Zdwmj 6 G DwjwLZ Ae¨vnwZi †¶Îmg‡n c‡hvR¨ nB‡e bv|

13| **jvB‡mÝ|**- (1) GB wewagvjvi Aaxb jvB‡mÝ cwßi Rb¨ jvB‡m†Ýi `iLv¯ gnvcwiPvjK KZK.wbawiZ dig ci-Yµ‡g Zvnvi wbKU `wLj Kwi‡Z nB‡e|

(2) D³ dig I‡Rvb †m‡ji Kvhvjq nB‡Z webvg‡j¨ msMn Kiv hvB‡e|
(3) h_vh_ fv‡e ci-YKZ.dig gnvcwiPvj‡Ki wbKU `wLj nBevi ci AvBb I GB wewagvjv Abyôv‡i D³ di‡g DwjwLZ welq¸‡jvi mZ¨Zv hvPvB ev, †¶ÎgZ, Z`š Kwiqv gnvcwiPvjK `iLv¯ gÄyix ev bvgÄyix Kwi‡Z cwi‡eb|
(4) Dc-wewa (1) Aaxb `wLjKZ.†Kvb `iLv¯ we‡ePbvi c‡qvR‡b gnvcwiPvjK `iLv¯Kvix‡K mswkó †h †Kvb Z_¨ mieivn Kwievi Rb¨ wb‡`k w`‡Z cwi‡eb|

(5) Dc-wewa (3) Gi Aaxb †Kvb jvB‡mÝ gÄyix bv Kwievi wm×vš MnY Kiv nB‡j gnvcwiPvjK Dnvi hyM© msMZ Kviv wjwce× Kwiqv D³ wm×vš Mn‡Yi 7(mvZ) Kvhw`e‡mi g‡a¨ `iLv¯Kvix‡K AewnZ Kwi‡eb|

(6) Dc-wewa (3) Gi Aaxb †Kvb jvB‡mÝ gÄyix Kwievi wm×vš MnY Kiv nB‡j gnvcwiPvjK D³ wm×vš `ªZ `iLv¯Kvix‡K AewnZ Kwi‡eb Ges gnvcwiPvjK KZK.wbawiZ c×wZ‡Z `iLv¯Kvix‡K jvB‡mÝ wdR evwe` cwZwU AvB‡Ug-Gi Rb¨ UvKv 500/- (cuPkZ) cwi‡ek Awa`ß‡ii Abyôv‡j wm×vš AewnZ nBevi 7(mvZ) Kvhw`e‡mi g‡a¨ `iLv¯Kvix‡K Rgv Kwievi wb‡`k c`vb Kwi‡eb|

(7) `iLv¯Kvix KZK.Dc-wewa (6) G DwjwLZ c×wZ‡Z jvB‡mÝ wdR c`Ë nB‡j gnvcwiPvjK ZrKZK.wbawiZ dig, kZ I †gqv‡` jvB‡mÝ c`vb Kwi‡eb|

(8) gnvcwiPvjK AvBb I GB wewagvjvi D‡Ïk¨ci¬YK‡í, Z`ax‡b Bm¨vkKZ.jvB‡m‡Ýi †h †Kvb kZ ms‡kvab Kwi‡Z cwi‡eb, Z‡e jvB‡mÝ MnxZv‡K 2(`yB) mßv‡ni †bwUk c`vb bv Kwiqv GB wewai Aaxb jvB‡m‡Ýi †Kvb kZ ms‡kvab Kiv hvB‡e bv|

(9) gnvcwiPvjK jvB‡mÝ MnxZvi `iLv‡¯i †cw¶‡Z hyM©m½Z g‡b Kwi‡j jvB‡m‡Ýi †h †Kvb kZ ms‡kvab Kwi‡Z cwi‡eb|

14| **jvB‡mÝ ewZj, BZ¨w`|**- (1) gnvcwiPvjK GB wewagvjvi Aaxb c`Ë †h †Kvb jvB‡mÝ ZrKZK.wbawiZ c×wZ‡Z ewZj Kwi‡Z cwi‡eb|

(2) GB wewai Aaxb jvB‡mÝ ewZ‡ji c‡e mswkó e¨w³‡K e¨w³MZ ïbvbxi mÿvhvM c`vb Kwi‡Z nB‡e: Z‡e kZ _v‡K †h, e¨w³MZ ïbvbxi Rb¨ wbawiZ mg‡q D³ e¨w³ nwRi bv nB‡j ev cieZx mg‡q nwRi nIqvi Av‡e`b bv Kwi‡j gnvcwiPvjK D³ jvB‡mÝ mivmwi ewZj Kwi‡Z cwi‡eb|

(3) GB wewai Aaxb jvB‡mÝ ewZj ev Ab¨ †Kvb Kvi‡Y †Kvb e¨w³ ms¶z nB‡j wZwb mswkó Av‡`k cwßi ZwiL nB‡Z 30 (wÎk) w`‡bi g‡a¨ miKv‡ii wbKU Avcxj Kwi‡Z cwi‡eb|

(4) Dc-wewa (3) Gi Aaxb †Kvb Avcxj `v‡qi nB‡j D³ Avcx‡j miKv‡ii wm×vš Pevš nB‡e Ges Dnvi wei‡× †Kvb Av`vj‡Z †Kvb gvgjv `v‡qi Kiv hvB‡e bv|

15| **I‡Rvb †mj|**- (1) GB wewagvjvi Aaxb Kvhvejx m¤úv`‡bi D‡Ï‡k¨ cwi‡ek Awa`ß‡ii Aaxb I‡Rvb †mj bv‡g GKwU †mj _vwK‡e, hvnvi cavb wbevnx nB‡eb gnvcwiPvjK KZK wb`ókZ.cwi‡ek Awa`ß‡ii cwiPvjK c`ghv`vi GKRb KgKZv|

(2) gnvcwiPvjK KZK.cwi‡ek Awa`ß‡ii wbawiZ KgKZv-KgPvix mgš‡q I‡Rvb †mj MwVZ nB‡e|

16| **`Û|**- GB wewagvjvi †Kvb weavb jsN‡bi †¶‡Î AvB‡bi avivi 15 (1) Gi †Uwe‡ji 4 bs µwg‡Ki weavbvejx c‡hvR¨ nB‡e|

17| **ewIK cwZ‡e`b|**- (1) cwZ Aw_K ermi †kl nBevi m‡½ m‡½ gnvcwiPvjK D³ erm‡i GB wewagvjvi Aaxb m¤úw`Z Kvhvejxi weeiY m¤wjZ GKwU ewIK cwZ‡e`b miKv‡ii wbKU †ck Kwi‡eb|

(2) miKvi, c‡qvR‡b, gnvcwiPvj‡Ki wbKU nB‡Z †h †Kvb mgq GB wewagvjvi Aaxb m¤úw`Z Kvhvejx ev welqvejxi Dci cwZ‡e`b AvnŸvb Kwi‡Z cwi‡e Ges gnvcwiPvjK Dnv miKv‡ii wbKU c`vb Kwi‡Z eva¨ _wK‡eb|

18| **RwUjZv wbim‡b miKv‡ii ¶gZv|**- miKvi, GB wewagvjvi weav‡bi A¯úóZvi Kvi‡Y wewagvjvi Aaxb ¶gZv c‡qv‡Mi †¶‡Î †Kvb Amyeav †`Lv w`‡j, mvaviY ev we‡kl Av‡`k Rvixi gva¨‡g, D³ weav‡bi ¯úóxKiY ev e¨vL¨v c`vb KiZt D³ wel‡q c‡qvRbxq w`K wb‡`kbv w`‡Z cwi‡e|

[9] Zdwmj - 1

[wewa 2(L), 4 I 5(3) `óe¨]

I‡Rvb¯i ¶qKvix `‡e¨i weeiY

µwgK bs	I‡Rvb¯i ¶qKvix `‡e¨i bvg	I‡Rvb¯i ¶qKvix `‡e¨i ivmvqwbK MVb	GBP. Gm †KvW*	M¤c	IwWct I‡Rvb¶q wefe (Ozone Depleting Potential)
(1)	(2)	(3)	(4)	(5)	(6)
1.	CFC-11	Trichlorofluoromethane ($CFCl_3$)	2903.77.10	I	1.0
2.	CFC-12	Dichlorodifluoromethane (CF_2Cl_2)	2903.77.20	I	1.0
3.	CFC-113	Trichlorotrifluoroethane ($C_2F_3Cl_3$)	2903.77.30	I	0.8
4.	CFC-114	Dichlorotetrafluoroethane ($C_2F_4Cl_2$)	2903.77.40	I	1.0
5.	CFC-115	Chloropentafluoroethane (C_2F_5Cl)	2903.77.40	I	0.6
6.	Halon-1211	Bromochlorodifluoromethane (CF_2BrCl)	2903.76.00	II	3.0
7.	Halon-1301	Bromotrifluoromethane (CF_3Br)	2903.76.00	II	10.0
8.	Halon-2402	Dibromotetrafluoroethane ($C_2F_4Br_2$)	2903.76.00	II	6.0
9.	CFC-13	Chlorotrifluoromethane (CF_3Cl)	2903.77.50	III	1.0
10.	CFC-111	Pentachlorofluoroethane (C_2FCl_5)	2903.77.50	III	1.0
11.	CFC-112	Tetrachlorodifluoroethane ($C_2F_2Cl_4$)	2903.77.50	III	1.0
12.	CFC-211	Heptachlorofludiropropane (C_3FCl_7)	2903.77.50	III	1.0
13.	CFC-212	Hexachlorodifluoropropane ($C_3F_2Cl_6$)	2903.77.50	III	1.0
14.	CFC-213	Pentachlorotrifluoropropane ($C_3F_3Cl_5$)	2903.77.50	III	1.0
15.	CFC-214	Tetrachlorotetrafluoropropane ($C_3F_4Cl_4$)	2903.77.50	III	1.0
16.	CFC-215	Trichloropentafluoropropane ($C_3F_5Cl_3$)	2903.77.50	III	1.0
17.	CFC-216	Dichlorohexafluoropropane ($C_3F_6Cl_2$)	2903.77.50	III	1.0
18.	CFC-217	Chloroheptafluoropropane (C_3F_7Cl)	2903.77.50	III	1.0
19.	Carbon tetrachloride	Tetrachloromethane (CCl_4)	2903.14.00	IV	1.1
20.	Methyl chloroform	1,1,1- Trichloroethane ($C_2H_3Cl_3$)	2903.19.00	V	0.1
21.	HCFC-21	Dichlorofluoromethane ($CHFCl_2$)	2903.77.50	VI	0.04
22.	HCFC-22	Chlorodifluoromethane ($CHClF_2$)	2903.79.10	VI	0.055

[9] Zdwmj-1 Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|

µwgK bs	I‡Rvb¯i ¶qKvix `‡e¨i bvg	I‡Rvb¯i ¶qKvix `‡e¨i ivmvqwbK MVb	GBP. Gm †KvW*	M¤c	IwWct I‡Rvb¶q wefe (Ozone Depleting Potential)
(1)	(2)	(3)	(4)	(5)	(6)
23.	HCFC-31	Chlorofluoromethane (CH_2FCl)	2903.77.50	VI	0.02
24.	HCFC-121	Tetrachlorodifluoroethane ($C_2HF_2Cl_4$)	2903.77.50	VI	0.04
25.	HCFC-122	Trichlorodifluoroethane ($C_2HF_2Cl_3$)	2903.77.50	VI	0.08
26.	HCFC-123	2,2-dichloro-1,1,1-trifluoroethane ($C_2HF_3Cl_2$)	2903.77.50	VI	0.06
27.	HCFC-123a	1,2-dichloro-1,1,2-trifluoroethane ($CHCl_2CF_3$)	2903.77.50	VI	0.02
28.	HCFC-124	2-chloro-1,1,1,2-tetrafluoroethane (C_2HF_4Cl)	2903.77.50	VI	0.04
29.	HCFC-124a	2-chloro-1,1,2,2-tetrafluoroethane ($CHFClCF_3$)	2903.77.50	VI	0.022
30.	HCFC-131	Trichlorofluoroethane ($C_2H_2FCl_3$)	2903.77.50	VI	0.05
31.	HCFC-132	Dichlorodifluoroethane ($C_2H_2F_2Cl_2$)	2903.77.50	VI	0.05
32.	HCFC-133	Chlorotrifluoroethane ($C_2H_3F_3Cl$)	2903.77.50	VI	0.06
33.	HCFC-141	Dichlorofluoroethane ($C_2H_3FCl_2$)	2903.77.50	VI	0.07
34.	HCFC-141b	1,1-dichloro-1-fluoroethane (CH_3CFCl_2)	2903.77.50	VI	0.11
35.	HCFC-142	Chlorodifluoroethane ($C_2H_3F_2Cl$)	2903.77.50	VI	0.07
36.	HCFC-142b	1-chloro-1, 1-difluoroethane (CH_3CF_2Cl)	2903.77.50	VI	0.065
37.	HCFC-151	Chlorofluoroethane (C_2H_4FCI)	2903.77.50	VI	0.005
38.	HCFC-221	Hexachlorofluoropropane (C_3HFCI_6)	2903.77.50	VI	0.07
39.	HCFC-222	Pentachlorodifluoropropane ($C_3HF_2CI_5$)	2903.77.50	VI	0.09
40.	HCFC-223	Tetrachlorotrifluoropropane ($C_3HF_3CI_4$)	2903.77.50	VI	0.08
41.	HCFC-224	Trichlorotetrafluoropropane ($C_3HF_4CI_3$)	2903.77.50	VI	0.09
42.	HCFC-225	Dichloropentafluoropropane ($C_3HF_5CI_2$)	2903.77.50	VI	0.07
43.	HCFC-225ca	1,3-dichloro-1,2,2,3,3-pentafluoropropane ($CF_3CF_2CHCl_2$)	2903.77.50	VI	0.025
44.	HCFC-225cb	1-3-dichloro-1,2,2,3,3-pentafluoropropane (CF_2ClCF_2CHClF)	2903.77.50	VI	0.033
45.	HCFC-226	Chlorohexafluoropropane (C_3HF_6Cl)	2903.77.50	VI	0.10
46.	HCFC-231	Pentachlorofluoropropane ($C_3H_2FCl_5$)	2903.77.50	VI	0.09
47.	HCFC-232	Tetrachlorodifluoropropane ($C_3H_2F_2Cl_4$)	2903.77.50	VI	0.10
48.	HCFC-233	Trichlorotrifluoropropane ($C_3H_2F_3Cl_3$)	2903.77.50	VI	0.23
49.	HCFC-234	Dichlorotetrafluoropropane ($C_3H_2F_4Cl_2$)	2903.77.50	VI	0.28
50.	HCFC-235	Chloropentafluoropropane	2903.77.50	VI	0.52

µwgK bs	I‡Rvb¯i ¶qKvix `‡e¨i bvg	I‡Rvb¯i ¶qKvix `‡e¨i ivmvqwbK MVb	GBP. Gm †KvW*	M¤c	IwWct I‡Rvb¶q wefe (Ozone Depleting Potential)
(1)	(2)	(3)	(4)	(5)	(6)
		($C_3H_2F_5Cl$)			
51.	HCFC-241	Tetrachlorofluoropropane ($C_3H_3FCl_4$)	2903.77.50	VI	0.09
52.	HCFC-242	Trichlorodifluoropropane ($C_3H_3F_2Cl_3$)	2903.77.50	VI	0.13
53.	HCFC-243	Dichlorotrifluoropropane ($C_3H_3F_3Cl_2$)	2903.77.50	VI	0.12
54.	HCFC-244	Chlorotetrafluoropropane ($C_3H_3F_4Cl$)	2903.77.50	VI	0.14
55.	HCFC-251	Trichlorofluoropropane ($C_3H_4FCl_3$)	2903.77.50	VI	0.01
56.	HCFC-252	Dichlorodifluoropropane ($C_3H_4F_2Cl_2$)	2903.77.50	VI	0.04
57.	HCFC-253	Chlorotrifluoropropane ($C_3H_4F_3Cl$)	2903.77.50	VI	0.03
58.	HCFC-261	Dichlorofluoropropane ($C_3H_5FCl_2$)	2903.77.50	VI	0.02
59.	HCFC-262	Chlorodifluoropropane ($C_3H_5F_2Cl$)	2903.77.50	VI	0.02
60.	HCFC-271	Chlorofluoropropane (C_3H_6FCl)	2903.77.50	VI	0.03
61.	HBFC-21B2	Dibromofluoromethane ($CHFBr_2$)	2903.78.00	VII	1.00
62.	HBFC-22B1	Bromodifluoromethane (CHF_2Br)	2903.78.00	VII	0.74
63.		Bromofluoromethane (CH_2FBr)	2903.78.00	VII	0.73
64.		Tetrabromofluoroethane (C_2HFBr_4)	2903.78.00	VII	0.8
65.		Tribromodifluoroethane ($C_2HF_2Br_3$)	2903.78.00	VII	1.8
66.	HBFC-123B2 HBFC-123aB2	Dibromotrifluoroethane ($C_2HF_3Br_2$)	2903.78.00	VII	1.6
67.	HBFC-124B1	Bromotetrafluoroethane (C_2HF_4Br)	2903.78.00	VII	1.2
68.		Tribromofluoroethane ($C_2H_2FBr_3$)	2903.78.00	VII	1.1
69.		Dibromodifluoroethane ($C_2H_2F_2Br_2$)	2903.78.00	VII	1.5
70.		Bromotrifluoroethane ($C_2H_2F_3Br$)	2903.78.00	VII	1.6
71.		Dibromofluoroethane ($C_2H_3FBr_2$)	2903.78.00	VII	1.7
72.	HBFC-124B1	Bromodifluoroethane ($C_2H_3F_2Br$)	2903.78.00	VII	1.1
73.	HBFC-124B1	Bromofluoroethane (C_2H_4FBr)	2903.78.00	VII	0.1
74.		Haxabromofluoropropane (C_3HFBr_6)	2903.78.00	VII	1.5
75.		Pentabromodifluoropropane ($C_3HF_2Br_5$)	2903.78.00	VII	1.9
76.		Tetrabromofluoropropane ($C_3HF_3Br_4$)	2903.78.00	VII	1.8
77.		Tribromotetrafluoropropane ($C_3HF_4Br_3$)	2903.78.00	VII	2.2
78.		Dibromopentafluoropropane ($C_3HF_5Br_2$)	2903.78.00	VII	2.0

µwgK bs	I‡Rvb¯i ¶qKvix `‡e¨i bvg	I‡Rvb¯i ¶qKvix `‡e¨i ivmvqwbK MVb	GBP. Gm †KvW*	M¤c	IwWwct I‡Rvb¶q wefe (Ozone Depleting Potential)
(1)	(2)	(3)	(4)	(5)	(6)
79.		Bromohaxafluoropropane (C_3HF_6Br)	2903.78.00	VII	3.3
80.		Pentabromofluoropropane ($C_3H_2FBr_5$)	2903.78.00	VII	1.9
81.		Tetrabromodifluoropropane ($C_3H_2F_2Br_4$)	2903.78.00	VII	2.1
82.		Tribromotrifluoropropane ($C_3H_2F_3Br_3$)	2903.78.00	VII	5.6
83.		Dibromotetrafluoropropane ($C_3H_2F_4Br_2$)	2903.78.00	VII	7.5
84.		Bromopentafluoropropane ($C_3H_2F_5Br$)	2903.78.00	VII	1.4
85.		Tetrabromofluoropropane ($C_3H_3FBr_4$)	2903.78.00	VII	1.9
86.		Tribromodifluoropropane ($C_3H_3F_2Br_3$)	2903.78.00	VII	3.1
87.		Dibromotrifluoropropane ($C_3H_3F_3Br_2$)	2903.78.00	VII	2.5
88.		Bromotetrafluoropropane ($C_3H_3F_4Br$)	2903.78.00	VII	4.4
89.		Tribromofluoropropane ($C_3H_4FBr_3$)	2903.78.00	VII	0.3
90.		Dibromodifluoropropane ($C_3H_4F_2Br_2$)	2903.78.00	VII	1.0
91.		Bromotrifluoropropane ($C_3H_4F_3Br$)	2903.78.00	VII	0.8
92.		Dibromofluoropropane ($C_3H_5FBr_2$)	2903.78.00	VII	0.4
93.		Bromodifluoropropane ($C_3H_5F_2Br$)	2903.78.00	VII	0.8
94.		Bromofluoropropane (C_3H_6FBr)	2903.78.00	VII	0.7
95.		Bromochloromethane (CH_2BrCl)	2903.78.00	VII	0.12
96.	Methyl bromide	(CH_3Br)	2903.79.90	VIII	0.6

* Customs Act, 1969 Gi Schedule -1 G DwjwLZ msNkó GBP.Gm. †KvW Gi, mgq mgq, cwieZb c‡hvR¨ nB‡e|

[10][Zdwmj - 2

[we‡a 2(Q), 4, 5(3), 5(5), 8(1) I 8(2) `óe¨]

Zdwmj-1 Gi Kjvg (4) G wb‡`kZ Mœc-I, III, IV, V, VI, VII-Gi Aš—f©³ I‡Rvb¯i ¶qKvix `‡e¨i Drcv`b, Avg`vbx, iß wb I e¨envi wbqšY

µwgK bs	I‡Rvb¯i ¶qKvix `‡e¨i Mœc	wfwË¯‡ii msµvš ermi	Mœc we‡k‡l wbYqKZ wfwË¯‡ii wfwË‡Z 12 (evi) gvmKvj Avg`vwbi m‡ev"P MnY‡hvM¨ cwigvY (IwWc Ub)*	Mœc we‡k‡l wbYqKZ wfwË¯‡ii wfwË‡Z e¨envi‡ii m‡ev"P cwigvY (IwWc Ub)	Kjvg (4) I (5) msµvš ZwiL	I‡Rvb¯i ¶qKvix `e¨ Drcv`b mye©avi mµó Dci wb‡lavÁv	I‡Rvb¯i ¶qKvix `e¨ mseivjZ ev e¨envi‡i cY¨ Drcv`‡bi j‡¶¨ eae mye©avi mµó Dci wb‡lavÁv
(1)	**(2)**	**(3)**	*(4)*	**(5)**	**(6)**	**(7)**	**(8)**
1.	I	*1995-1997*	*300*	*300*	*31.12.2004*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
	III	*1998-2000*	*-*				
2.	I	*1995-1997*	*290*	*290*	*31.12.2005*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
	III	*1998-2000*	*-*				
3.	I	*1995-1997*	*250*	*250*	*31.12.2006*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
	III	*1998-2000*	*-*				
4.	I	*1995-1997*	*85*	*85*	*31.12.2007*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
	III	*1998-2000*	*-*				
5.	I	*1995-1997*	*75*	*75*	*31.12.2008*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
	III	*1998-2000*	*-*				
6.	I	*1995-1997*	*50*	*50*	*31.12.2009*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
	III	*1998-2000*	*-*				
7.	I	*1995-1997*	****	****	*01.01.2010*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
	III	*1998-2000*	*-*				
8.	IV	*1998-2000*	*5.5*	*5.5*	*1-1-2005*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
9.	IV	*1998-2000*	*0*	*0*	*1-1-2010*	--	--
10.	V	*1998-2000*	*1.0*	*1.0*	*1-1-2003*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
11.	V	*1998-2000*	*0.7*	*0.7*	*1-1-2005*	--	--
12.	V	*1998-2000*	*0.4*	*0.4*	*1-1-2010*	--	--
13.	V	*1998-2000*	*0*	*0*	*1-1-2015*	--	--
14.	VI	*2009-2010*	*72.65*	*72.65*	*1-1-2013*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
15.	VI	*2009-2010*	*72.65*	*72.65*	*1-1-2014*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
16.	VI	*2009-2010*	*65.30*	*65.30*	*1-1-2015*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
17.	VI	*2009-2010*	*65.30*	*65.30*	*1-1-2016*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL
18.	VI	*2009-2010*	*65.30*	*65.30*	*1-1-2017*	we‡klgvjv ejer nBevi ZwiL	we‡klgvjv ejer nBevi ZwiL

[10] *Zdwmj-2 Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|*

µwgK bs	I‡Rvb¯i ¶qKvix `‡e¨i Mœc	wfwË¯i msµvš ermi	Mœc we‡k‡l wbYqKZ wfwË¯‡ii wfwË‡Z 12 (evi) gvmKvj Avg`vwbi m‡ev"P MnY‡hvM¨ cwigvY (IwWc Ub)*	Mœc we‡k‡l wbYqKZ wfwË¯‡ii wfwË‡Z e¨envi‡ii m‡ev"P cwigvY (IwWc Ub)	Kjvg (4) I (5) msµvš ZwiL	I‡Rvb¯i ¶qKvix `e¨ Drcv`b mÿeav mµói Dci wb‡lavÁv	I‡Rvb¯i ¶qKvix `e¨ msevwjZ ev e¨envi‡i cY¨ Drcv`‡bi j‡¶¨ eae mÿeav mµói Dci wb‡lavÁv
(1)	**(2)**	**(3)**	*(4)*	**(5)**	**(6)**	**(7)**	**(8)**
19.	VI	*2009-2010*	*48.12*	*48.12*	*1-1-2018*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
20.	VI	*2009-2010*	*48.12*	*48.12*	*1-1-2019*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
21.	VI	*2009-2010*	*47.20*	*47.20*	*1-1-2020*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
22.	VI	*2009-2010*	*47.20*	*47.20*	*1-1-2021*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
23.	VI	*2009-2010*	*47.20*	*47.20*	*1-1-2022*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
24.	VI	*2009-2010*	*47.20*	*47.20*	*1-1-2023*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
25.	VI	*2009-2010*	*47.20*	*47.20*	*1-1-2024*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
26.	VI	*2009-2010*	*23.60*	*23.60*	*1-1-2025*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
27.	VI	*2009-2010*	*23.60*	*23.60*	*1-1-2026*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
28.	VI	*2009-2010*	*23.60*	*23.60*	*1-1-2027*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
29.	VI	*2009-2010*	*23.60*	*23.60*	*1-1-2028*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
30.	VI	*2009-2010*	*23.60*	*23.60*	*1-1-2029*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
31.	VI	*2009-2010*	*23.60*	*23.60*	*1-1-2030*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
32.	VI	*2009-2010*	*****	*****	*1-1-2031*	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
33.	VII	*---*	*0*	*0*		--	--

* *1995-97 mgqKv‡j i Mœc-*I *Gi wbYqKZ wfwË¯ i 580.4 IwWc Ub Ges 2009-2010 mgqKv‡j i Mœc-*VI *Gi †¶‡Î wbYqKZ wfwË¯i 72.65 IwWc Ub|*

** *m`m¨ †`kmg‡ni m¤ve¨ Abyl‡Z evsjv‡`‡k Acwinvh e¨envi‡i Pwn`vc~i‡Y †Kvb †Kv‡i vdzi vKveb Avg`vbx ev e¨envi e¨ZxZ|*

*** *m`m¨ †`kmg‡ni Pwn`vc~i‡Y- ïaygvÎ 1-12-2030 mvj chš e¨eüZ wi dRv‡ikb I GqviKwÛkwbs 1-1-2031 n‡Z 31-12-2040 chš cwZ cwÄKv eQ‡i 1.82 IwWc Ub Mœc-*VI*-`e¨w` Avg`vwb I e¨envi e¨ZxZ| 1995-97 mgqKv‡j Mœc-I I I 1995-98 mgqKv‡j Mœc-*VIII *-Gi Aš fy³ I‡Rvb¯i ¶qKvixÓ*

[11][Zdwmj - 3

[wewa 7, 8(2) I 9(3) `óe¨]

I‡Rvb¯i ¶qKvix `‡e¨i cvš e¨envi wbqšY

µwgK bs	KgKvÛ	I‡Rvb¯i ¶qKvix `‡e¨i Mœc	chvqµg nv‡mi ZwiL*
(1)	(2)	(3)	(4)
1|	G‡ivmj ev †ckvivBRW wWm‡cÝvi Drcv`b (Jla wnmv‡e e¨envh wgUvi W †WvR Bb‡njvi e¨ZxZ)	Mœc I	1-1-2004
2|	cwjlj nB‡Z †dvgcY¨ Drcv`b	Mœc I	1-1-2004
3|	Mn¯vjx †iwdRv‡iU‡i †dvg Askmn †dvg cY¨ Drcv`b	Mœc I	1-1-2004
4|	AwMwbevcK hš ev AwMwbevcb e¨e¯v Drcv`b	Mœc II	1-1-2001
5|	†gvevBj GqviKwÛkbvi Drcv`b Ges A‡Uv‡gvevBj wk‡í PwRs	Mœc I	1-1-2004
6|	†iwdRv‡ikb I GqviKwÛkwbs msµvš Ab¨vb¨ cY¨ Drcv`b (Kg‡cmi e¨ZxZ)	Mœc I	1-1-2010
7|	wewea cY¨ Drcv`b	Mœc I, III, IV I V	1-1-2010
8|	AwMwbevcK I AwMwbevcb e¨e¯vi mwfwms	Mœc II	1-1-2010
9|	Jla wnmv‡e e¨envh wgUv‡iW †WvR Bb‡njvi Drcv`b	Mœc III	1-1-2010
10|	wewea cY¨ Drcv`b	Mœc VI	1-1-2030
11|	wcwkc‡g›U I †Kv‡i›UvBb e¨ZxZ Ab¨vb¨ †¶‡Î wg_vBj †evgvBW e¨envi	Mœc VIII	1-1-2003
12|	Jla wnmv‡e e¨envh wgUv‡iW †WvR Bb‡njvi Drcv`b	Mœc I	1-1-2013
13|	cwjlj nB‡Z †dvgcY¨ Drcv`b	Mœc VI	1-1-2013
14|	Mn¯vjx †iwdRv‡iU‡i †dvg Askmn †dvg cY¨ Drcv`b	Mœc VI	1-1-2013
15|	Acwinvh e¨envh cb¨ Drcv`‡bi	Mœc VI	1-1-2031
16|	AwMwbevcK I AwMwbevcb e¨e¯vi mwfwms	Mœc VI	1-1-2031
17|	†gvevBj GqviKwÛkbvi Drcv`b Ges A‡Uv‡gvevBj wk‡í PwRs	Mœc VI	1-1-2031
18|	†iwdRv‡ikb I GqviKwÛkwbs msµvš Ab¨vb¨ cY¨ Drcv`b (Kg‡cmi e¨ZxZ)	Mœc VI	1-1-2031
19|	†iwdRv‡ikb I GqviKwÛkwbs msµvš mwfwms	Mœc VI	1-1-2041

* i¡cvši cKí m¤cY¨ nBevi ZwiL A_ev Zdwmj-3-Gi Kjvg (4)-G c`Ë ZwiL (†h ZwiL c‡e Awm‡e) I‡Rvb¯i ¶qKvix `e¨ ewRZ chy³‡Z Drµvš nIqv ev I‡Rvb¯i ¶qKvix `e¨ ewRZ chy³ msewjZ bZb mycav m¤úmvi‡Yi j‡¶¨ Aw_K mnvqZv cvß e¨w³ ev cwZôv‡bi †¶‡Î chvqµg nv‡mi ZwiL eSvB‡e|Ó]

[11] Zdwmj-3 Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|

[12][Zdwmj - 4

[weavb 5(1) I 5(2) `óe¨]
gw›Uj c‡UvK‡ji m`m¨ †`kmg‡ni Zwj Kv
(Rby 2012 chš)

µwgK bs	†`‡ki bvg
(1)	(2)
2.	Avdmwb¯vb
3.	Avj‡ewbqv
4.	Avj‡Rwiqv
5.	Gb‡Wvi v
6.	G‡½vj v
7.	Gw›U‡Mvqv Ges evi‡evWv
8.	Av‡Rw›Ubv
9.	Avi‡gwbqv
10.	A‡÷wjqv
11.	Aw÷qv
12.	AvRvievBRvb
13.	evnvgvm
14.	evnivBb
15.	evsjv‡`k
16.	evievi‡Wvm
17.	†ejvixm
18.	†ejwRqvg
19.	†ewjR
20.	†ewbb
21.	fÞvb
22.	ewjwfqv
23.	emwbqv I nvi‡R‡Mwfbv
24.	eZ‡mvqvbv
25.	ewRj
26.	e¤‡bB `vixmmvjvg
27.	eý‡Mwiqv
28.	eyKbvdv‡mv
29.	eýxwÛ
30.	K‡¤vwWqv
31.	K¨v‡gixb
32.	KvbvWv

[12] Zdwmj-4 Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|

33.	†Kc fv`
34.	ga¨ AvwdKvb cRvZš
35.	Pv`
36.	wPwj
37.	Pxb
38.	Kj wq¤qv
39.	K‡gv‡ivm
40.	K‡½v, †W‡gv‡µwUK cRvZš
41.	K‡½v
42.	†Kv÷wiKv
43.	†KvU AvB‡fwi
44.	†µv‡qwkqv
45.	wKDev
46.	mvBcvm
47.	†PK cRvZš
48.	†WbgvK
49.	wRexZx
50.	†WvwgwbKv
51.	†WvwgwbKvb cRvZš
52.	BK‡qqWi
53.	wgki
54.	Gj mvjfv`i
55.	BK‡qq‡Uwiqvj wMwb
56.	GwiwUqv
57.	B‡¯wbqv
58.	Bw_ IwcQv
59.	wdwR
60.	wdbj¨vÛ
61.	dvÝ
62.	M¨veb
63.	Rww¤qv
64.	RwRqv
65.	RvgvbX
66.	Nvbv
67.	wMm
68.	MvbvWv
69.	¸‡q‡Zgvjv
70.	wMwb
71.	wMwb-we‡mŠ
72.	Mv‡qbv
73.	nvBwZ
74.	û‡Ûvivm

75.	nv‡½ix
76.	AvBj¨vÛ
77.	fviZ
78.	B‡›`v‡bwkqv
79.	Bivb, Bmjvwg K cRvZš
80.	BivK
81.	Avqvij¨vÛ
82.	BmivBj
83.	BUvjx
84.	RvgvBKv
85.	Rvcvb
86.	RWvb
87.	KvRvwK¯vb
88.	†Kwbqv
89.	wKwiewU
90.	†Kwiqv, wccjm †W‡gv‡µwUK wicvewjK Ae
91.	†Kwiqv, wicvewjK Ae
92.	K‡qZ
93.	wKiwN¯vb
94.	jvI, wccjm ‡W‡gv‡µwUK wicvewjK Ae
95.	jvUwfqv
96.	†jevbb
97.	†j‡mv‡_v
98.	jvB‡ewiqv
99.	wjweqv
100.	wjP‡Ub‡÷Bb
101.	wj_ybqv
102.	j‡•gevM
103.	`¨ digvi h‡MvúvewicvewjK Ae †g‡mv‡Wwbqv
104.	gv`vMv¯vi
105.	gvjvlwq
106.	gvj‡qwkqv
107.	gvjØxc
108.	gwj
109.	gvëv
110.	gvkvj AvB‡jÛ
111.	†gŠwiZwbqv
112.	†gŠwikvm
113.	†gw·‡Kv
114.	gvB‡µv‡bwkqv, †dWv‡ij †÷U Ae
115.	gj‡Wvfv
116.	†gvbv‡Kv

117.	g‡½vwjqv
118.	g‡›UwbMv
119.	gi‡°v
120.	†gvRww¤K
121.	gvqvbgvi
122.	bwggweqv
123.	bvDi‡
124.	†bcvj
125.	†b`vijvÛm
126.	wbDwRjvÛ
127.	wbKvivqv
128.	bvBRvi
129.	bvB‡RwiqvI
130.	biI‡q
131.	Igvb
132.	cwK¯vb
133.	cvjvD
134.	cvbvgv
135.	cvcqvI wbDwMwb
136.	cvivq‡q
137.	†ci‡
138.	wdwjcvBbm
139.	‡cvjvÛ
140.	cZbvj
141.	KvZvi
142.	†ivgwbqv
143.	iwkqvb †dWv‡ikb
144.	ivDÛv
145.	†m›U †KUm GÛ †bwfm
146.	†m›U jyqv
147.	†m›U wfb‡m›U GÛ `¨ †MbvWvBbm
148.	†mvgv
149.	m¨vb †gwi‡bv
150.	mvI †Uvg GÛ wcwÝc
151.	mvDw` Avie
152.	†m‡bMvj
153.	mweqv
154.	mvq‡Pjvm
155.	wm‡qivwjIb
156.	wm½vcy
157.	†¯vfwKqv
158.	†¯v‡fbqv

159.	†mv‡j vgb AvBj ¨vÛm
160.	†mvgwmjqv
161.	mvD_ AvmdKv
162.	†¯úb
163.	kxj¼v
164.	mÿvb
165.	mÿibvg
166.	mÿRj ¨vÛ
167.	mÿB‡Wb
168.	mÿBRvij ¨vÛ
169.	wmwiqvb Avie cRvZš
170.	ZvRvwK¯vb
171.	ZvbRvwbqv, BDbvB‡UW wicvewjK Ae
172.	_vBj ¨vÛ
173.	wZgÿ †j ÷
174.	†Uv‡Mv
175.	†UvsMv
176.	wÎwb`v` GÛ †Uvev‡Mv
177.	wZDwbwmqv
178.	ZœK
179.	Zœ‡gwb¯vb
180.	†Zvfvjy
181.	DMvÛv
182.	BD‡µb
183.	mshÿ Avie Awgivz
184.	hÿ ivR¨ Ges `w¶Y Avqvij ¨vÛ
185.	hÿ ivó
186.	Di‡¸‡q
187.	DR‡eK¯vb
188.	fvbqwZz
189.	†nwmjmx
190.	†fwbR‡qjv
191.	wf‡qZbvg
192.	B‡q‡gb
193.	Rww¤qv
194.	wR¤vej‡q
195.	Kœ AvBj ¨vÛm
196.	wbD
197.	BD‡iwc I BDwbqb
198.	`w¶Y mÿvb

[13][Zdwmj - 5

[wewa 9(1) I (2) `óe¨]

I‡Rvb¯i ¶qKvix `e¨ msewjZ c‡Y¨i Avg`wb I ißvwb wbqšY

µwgK bs	c‡Y¨i bvg	I‡Rv¯i ¶qKvix `‡e¨i †kYx	Avg`wbi Dci wbqšY ejer nBevi ZwiL	ißvwbi Dci wbqšY ejer nBevi ZwiL
(1)	(2)	(3)	(4)	(5)
1|	hvbevnb I UvK GqviKwÛkwbs BDwbU (mshy³ _vKv ev bv _vKv Ae¯vq)	Mœc- I Mœc - VI	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci
2|	Mn¯vjx I ewYwR¨K †iwdRv‡ikb I GqviKwÛkwbs/nxU cv¤ú hš , h_v,- - †iwdRv‡iUi - wdRvi - wWwnDwgwWdvqvi - Iqvi Uvi Kvjvi - AvBb †gwkb - GqviKwÛkwbs Ges nxU cv¤ú BDwbU - Kg‡cmi	Mœc - I Mœc - VI	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci
3|	G‡ivmj cY¨	Mœc - I	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci
4|	enb‡hvM¨ AwMwbevcK/AwMwbevcb e¨e¯v/ wmwjÛvi	Mœc - II Mœc - VI	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci
5|	Bbmy¨‡jkb †evW, c¨v‡bj I cvBc Kfvi	Mœc - I Mœc - VI	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci
6|	wc-cwjgvi	Mœc - I Mœc - VI	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci	GB wewagvjv ejer nBevi Zwi‡Li Qq gvm ci

†bvUt *1| µwgK bs 2 Gi Kjvg (2) G DwjwLZ c‡Y¨ c‡Y¨i Bbmy¨jwUs e¯ Aš—f©³ |*
2| e¨w³MZ ev Mn¯vjx e¯ ev Z`œc AewYwR¨K cwiw¯wZ‡Z KbmvBb‡g‡›U cwienbKZ.nBqv _wK‡j Ges mvaviYfv‡e Kvógm KZc‡¶i Ae¨vnwZ jvf Kwiqv _wK‡j Dc‡iwjwLZ cY¨ GB Zdwm‡ji AvIZv ewnfy³ nB‡e|]

[13] *Zdwmj-5 Gm. Avi. I. bs 226-AvBb/2014 Gi Øviv cwZ¯wcZ|*

Zdwmj - 6

Zdwmj - 1-Gi M¤c-8 D‡jwLZ I‡Rvb¯i ¶qKvix `e¨ wnmv‡e wg_vBj †evgvB‡Wi †Kvqv‡i›UvBb I wc-wkc‡g›U chv‡q e¨envi|

(1) wb¤wjwLZ kZmv‡c‡¶ M‡elYvMvi A_ev we‡klYagx KgKv‡Û e¨eüZ I‡Rvb¯i ¶qKvix `e:

(K) M‡elYvMvi MZ e¨env‡i hšcwZi µgv¼b Aš—f³ _wK‡e; ivmvqwbK we‡klY‡Yi Rb¨ e¨envh G·UvKkb mj‡f›U, WvBjÿ¨q›U, ev K¨wiqvi; cvYimvqb msµvš M‡elYv; ivmvqwbK wewµqvq K¨wiqvi, ev M‡elYvMvi ivmvqwbK `e¨ Ges we‡klY I M‡elYv msµvš Ab¨vb¨ m¶¥ cwµqvq e¨envh ivmvqwbK `e¨ wnmv‡e wbw®‹q `veK (inert solvents)|

(L) I‡Rvb¯i ¶qKvix `e¨mg n wb‡æv³ wei×Zvgvb Abÿwqx Drcw`Z nB‡e t

CTC	99.5
1, 1, 1- trichloroethane	99.0
CFC-11	99.5
CFC-13	99.5
CFC-12	99.5
CFC-113	99.5
CFC-114	99.5
Ab¨vb¨ I‡Rvb¯i ¶qKvix `e¨ hvnv‡`i ùzbv¼ 200C- Gi E‡aŸ	99.5
Ab¨vb¨ I‡Rvb¯ i ¶qKvix `e¨ hvnv‡`i ùzbv¼ 200C- Gi wb‡¤	99.5

(M) M‡elYvMvi I we‡klYMZ e¨env‡i cPwjZ e¨¯vbÿwqx Drcv`bKvix, G‡R›U ev weZiYKvixMY GBmKj wei× I‡Rvb¯i ¶qKvix `e¨ ciezx chv‡q Ab¨vb¨ ivmvqwbK `‡e¨i mwnZ wgwkZ Kwi‡eb|

(N) †Kej cÿvivq Ave× Kiv hvq GBi¦c K‡›UBbvi A_ev wZb wjUv‡ii ¶gZvm¤úb D”PPvc wmwjÛvi A_ev 10 wgwjwjUvi ev Dnvi ¶gZvm¤úb G¤•ÿyj D”P wei×Zvgvbm¤úb GB mKj I‡Rvb¯i ¶qKvix `e¨ Ges I‡Rvb¯i ¶qKvix `e¨ mse wjZ wgkY mieivn Kiv hvB‡e| mieiv‡ni j‡¶¨ GBmKj K‡›UBbvi ev wmwjÛvi ev G¤•ÿyj cwi®vifv‡e Ô I‡Rvb¯i ¶qKvix `‡e¨i †Kej M‡elYvMvi I we‡klY D‡Ï‡k¨ e¨envh t e¨eüZ ev e¨env‡ii ci Ae¨eüZ AwZwi³ I‡Rvb¯i ¶qKvix `e¨ msMn, msi¶Y I m¤e nB‡j, wimvBwKs Kwi‡Z nB‡eÕ wjwLZ _wK‡e| wimvBwKs m¤e bv nB‡j I‡Rvb¯i ¶qKvix `e¨ aŸsm Kwi‡Z nB‡e|

Zdwmj-1-Gi M¤c- I- G wb‡`wkZ I‡Rvb¯i ¶qKvix `‡e¨i Drcv`‡bi mwnZ mswkó nB‡j D³ Zdwmj-1-Gi M¤c-IV-Gi I‡Rvb¯ i ¶qKvix `‡e¨i Avg`vbx, ißvbx I Drcv`b Ôe¨envi Õ-Gi msÁvi ewnfÿZ nB‡e|

cÿvi¤×viKZ.ev wimvBKjKZ.†Kvb I‡Rvb¯i ¶qKvix `‡e¨i Avg`vbx I ißvbx Ôe¨envi Õ- Gi msÁvi ewnf Z nB‡e|

bÿbc‡¶ GK ermi e¨eüZ nBqv‡Q GBi¦c †Kvb c‡Y¨i A-ewYR¨K we µ‡qi †¶‡Î we¤a-10-Gi Dcwe¤a (1) c‡hvR¨ nB‡e bv|

ewsjv‡`k miKv‡ii Abÿgv`bµ‡g Rb¯v‡_ cYxZ †h †Kvb we¤a|

msKUKvjxb Acwinvh e¨env‡i, h_v: cwZi¶v wegvb, hÿ×‡¶‡Î e¨envh U¨vsK I Acwinvh e¨envi msµvš c¨v‡bj KZK.cZ¨qbKZ.wegvb wk‡í Zdwmj-1-Gi M¤c-II-G Aš—f³ `e¨w`|

Zdwmj - 7
[wewa - 11

LÛ - 1

1. bw_ msi¶Y

I‡Rvb¯i ¶qKvix `e¨vwgMx Avg`vbxi I wecY‡bi †¶‡Î t Zdwmj - 8 G DwjwLZ dig G ci‡YKZ.ZwiL m¤wjZ Z_¨ msi¶Y Kwi‡Z nB‡e|

2. cwZ‡e`b `wLj cm‡½|

(K) Zdwmj -8 Abyhvqx I‡Rvb¯i ¶qKvix `e¨vwgMxi Avg`vbx I wecYb msµvš cwZ‡e`b|
(L) Dc‡iv³ cwZ‡e`b jvB‡mÝ c`vbKvix KZ©‡¶i wbKU 15 Rvbyqvix Gi g‡a¨ `wLj Kwi‡Z nB‡e|

LÛ - 2

1. bw_ msi¶Y

K‡¤úmi Drcv`b, Avg`vbx, ißvbx I wecYb msµvš Z_¨ t Zdwmj-9-G DwjwLZ dig Abyhvqx c iYKZ.ZwiL m¤wjZ Z_¨ msi¶Y Kwi‡Z nB‡e|

2. cwZ‡e`b `wLj cm‡½

K‡¤úmi Drcv`b, Avg`vbx, ißvbx I wecYb msµvš Z_¨ Zdwmj-9 Abyhvqx c¯Z Kwiqv gnvcwiPvj‡Ki wbKU 15 Rvbyqvix g‡a¨ `wLj Kwi‡Z nB‡e|

Zdwmj -8

[wewa-11(3) `óe¨]

dig - 1

I‡Rvb¯i ¶qKvix `e¨vwgMx Avg`vbx I wecYb msµvš cwZ‡e`b

ewIK cwZ‡e`b

cwZ‡e`b `wLj Kivi †kl Zwi‡L t cwZ eQi Rvbgqvix gv‡mi 15 Zwi‡Li g‡a¨|

cwZôv‡bi bvg t ..... cwZ‡e`b `wL‡ji mgq t .....
wVKvbv t .....
†dvb t ..... d¨v· t .....

I‡Rvb ¶qKvix `e¨ vwgMxi bvg *1 ..... GBPGm †KvW .....

Avg`vbx msµvš cwZ‡e`b
(†gt Ub wnmv‡e)

µwgK bs	cwi‡ek Awa`ß‡ii Qvocî bs	Bbf‡qm bs Ges Zwi‡L	wej Ae †jvWs bs Ges Zwi‡L	me ai‡Yi e¨envi‡ii Rb¨ Avg`vbxKZ we‡× I‡Rvb¯i ¶qKvix `e¨i cwigvb *2	Avg`vbx we‡× I‡Rvb¯i ¶qKvix `e¨vwgMxi cwigvY	
					wdW ÷K wnmv‡e	Ae¨vnwZ cvß e¨envi‡ii †¶‡Î
1	2	3	4	5	6	7
†gvU						

AvBAviwm bs I Zwi‡L	†h †`k nB‡Z Avg`vbx Kiv nBqv‡Q	†h e›`i n‡Z Lvjvm Kiv n‡q‡Q
10	11	12
‡gvU		

mxjmn ¯v¶i *3

wecYb msµvš cwZ‡e`b

µwgK bs	µqKvix cwZôv‡bi bvg I wVKvbv	µ‡qi D‡Ïk¨*2	cwigvY*3
†gvU			

mxjmn ¯v¶i *4

cZ¨qbcÎ

Awg ..... wcZv .....

..... GB g‡g cZ¨qb Kwi‡ZwQ †h, Dc‡iv³ c`Ë Z_¨ Ges Avbyw½K mshy³ I e³e¨mgn¨ Avgvi Rvbvg‡Z mwVK I m¤úª|

Awg Avevi I †NvlYv Kwi‡ZwQ †h, ... wnmv‡e Awg GB †NvlYvcÎ cYqb I cZ¨qb Kwi‡ZwQ Ges GB Kv‡R Awg weavam¤§Zfv‡e †hvM¨Zvm¤úb|

mxj I ¯v¶i*3

ZwiL .....

†bvUt

*1 1wU I‡Rvb ¶qKvix `‡e¨i †¶‡Î ïaygvÎ 1wU dig e¨envi Kwi‡Z nB‡e| I‡Rvb ¶qKvix `‡e¨i cª½ ZwjKv Zdwmj-1 G †`qv n‡jv|

*2 D‡Ïk¨mgn¨t

- G†ivmj Drcv`b (Jla wnmv‡e e¨envh wgUvi W‡WvR Bb‡njvi e¨ZxZ)
- †dvg RvZxq cY¨ Drcv`b
- AwMwbevcK I AwMwbevcb e¨e¯vi Drcv`b
- åvg¨gvY GqviKwÛkbvi Drcv`b
- Ab¨vb¨ †iwdRv‡ikb I GqviKwÛkwbs cY¨ Drcv`b
- `veK wnmv‡e e¨envi
- Ae¨vnwZ wnmv‡e e¨envi
- weµq
- AwMwbevcKmg ‡ni AwMwbevcb e¨e¯vi mwfwms (†Kej MÆc II fy³ I‡Rvb ¶qKvix `‡e¨i †¶‡Î c‡hvR¨)
- Jla wnmv‡e e¨envh wgUvi W †WvR Bb‡njvi Drcv`b
- Kg‡cmvi Drcv`b
- wWwnDwgwWdvqvi Drcv`b
- mwfwms
- Ab¨vb¨

*3. wecYbKvjxb NvUwZ m‡ev”P 3% chš MnY‡hvM¨|

*4 cZ¨qb Askmn Dc‡iv³ Kg mswkó e¨w³ ¯qs, ev, Zvnvi Øviv ¶gZvcvß GKRb e¨w³, ev †Kvb †Kv¤úvbxi †evW Ae WvB‡i±im KZK. ¶gZv cvß GKRb e¨w³, ev Ab¨vb¨ †h †Kvb †¶‡Î e¨emv cwiPvjbv `wqZcvß GKRb e¨w³ Øviv Aek¨B ¯v¶wiZ nB‡e|

Zdwmj -9

[we‡a-11(3) `óe¨]

dig - 2

..... mv‡ji Rb¨ I‡Rvb¯i ¶qKvix `e¨ e¨eüZ nq Ggb ai‡bi Kg‡cmi Drcv`b, Avg`vbx, ißvbx I wecYb msµvš cwZ‡e`b dig

cwZ‡e`b `wLj Kivi †kl Zwi‡L t ewIK cwZ‡e`b cwZ eQi Rvbvgvix gv‡mi 15 Zwi‡Li g‡a¨|
cwZ‡e`b `wL‡ji mgq t .....
cwZôv‡bi bvg t .....
wVKvbv t .....
†dvb t ..... d¨v· t .....

Drcv`b msµvš Z_¨ t

µwgK bs	Kg‡cmi Drcv`bKvix cwZôv‡bi bvg I wVKvbv	Kg‡cm‡ii ¶gZv (H.P)	e¨eüZ I‡Rvb¯ i ¶qKvix `‡e¨i bvg	Drcv`‡bi cwigvY
			†gvU cwigvY	

Avg`vbx msµvš Z_¨ t

µwgK bs	Kg‡cmi Drcv`bKvix cwZôv‡bi bvg I wVKvbv	Kg‡cm‡ii ¶gZv (H.P)	e¨eüZ I‡Rvb¯i ¶qKvix `‡e¨i bvg	Avg`vbxi cwigvY
			†gvU cwigvY	

ißvbx msµvš Z_¨ t

µwgK bs	Kg‡cmi Avg`vbxKviK cwZôv‡bi bvg I wVKvbv	Kg‡cm‡ii ¶gZv (H.P)	e¨eüZ I‡Rvb¯ i ¶qKvix `‡e¨i bvg	ißvbxi cwigvY
			†gvU cwigvY	

wewµq msµvš Z_¨ t

µwgK bs	Kg‡cmi ‡µZv/cwZôv‡bi bvg I wVKvbv	Kg‡cm‡ii ¶gZv (H.P)	e¨eüZ I‡Rvb¯i ¶qKvix `‡e¨i bvg	wewµ‡qi cwigvY
			†gvU cwigvY	

mxjmn ¯v¶i

cZ¨qbc Î

Awg ..... wcZv .....

..... GB g‡g cZ¨qb Kwi‡ZwQ †h, Dc‡iv³ c`Ë Z_¨ Ges Avbyw½K mshy³ I e³e¨mgn¨ Avgvi Rvbvg‡Z mwVK I m¤úª|

Awg Avevi I †NvlYv Kwi‡ZwQ †h, ... wnmv‡e Awg GB †NvlYvc Î cYqb I cZ¨qb Kwi‡ZwQ Ges GB Kv‡R Awg we‡am¤§Zf~v‡e †hvM¨Zvm¤úb|

mxj I ¯v¶i *1

ZwiL .....

†bvU t

*1 cZ¨qb Askmn Dc‡iv³ Kg msMÖnkó e¨w³ ¯qs, ev, Zvnvi Øviv ¶gZvcvß GKRb e¨w³, ev, †Kvb †Kv¤úvbxi †evW Ae WvB‡i±im KZK.¶gZv cvß GKRb e¨w³, ev Ab¨vb¨ †h †Kvb †¶‡Î e¨emv cwiPvjbv `vqZcvß GKRb e¨w³Øviv Aek¨B ¯v¶iZ nB‡e|

ivócwZi Av‡`k µ‡g,
%mq` Zvbfxi †nv‡mb
mwPe|

Annex D3

রেজিস্টার্ড নং ডি এ-১ "জাতির পিতা বঙ্গবন্ধু শেখ মুজিবুর রহমানের
জন্মশতবার্ষিকী উদ্‌যাপন সফল হোক"

বাংলাদেশ গেজেট

অতিরিক্ত সংখ্যা
কর্তৃপক্ষ কর্তৃক প্রকাশিত

সোমবার, ফেব্রুয়ারি ১৫, ২০২১

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিবেশ, বন ও জলবায়ু পরিবর্তন মন্ত্রণালয়

প্রজ্ঞাপন

তারিখ : ২৮ মাঘ, ১৪২৭ বঙ্গাব্দ/১১ ফেব্রুয়ারি, ২০২১ খ্রিষ্টাব্দ

এস. আর. ও. নং-৪০-আইন/২০২১।—বাংলাদেশ পরিবেশ সংরক্ষণ আইন, ১৯৯৫ (১৯৯৫ সনের ১ নং আইন) এর ধারা ৬ক তে প্রদত্ত ক্ষমতাবলে সরকার, মহা-পরিচালকের সহিত পরামর্শক্রমে, নিম্নরূপ শর্তাধীন নির্দেশ জারি করিল, যথা :—

(১) মন্ট্রিল প্রটোকলের Anex-F এ উল্লিখিত Hydrofluoro Carbon (HFC) বা তফসিলে উল্লিখিত HFC সম্বলিত রাসায়নিক বা রাসায়নিকের মিশ্রণ উৎপাদন, আমদানি, বাজারজাতকরণ, বিক্রয়, মজুদ বা বিতরণের নিমিত্ত অধিদপ্তরের মহা-পরিচালকের নিকট হইতে লাইসেন্স গ্রহণ করিতে হইবে;

(২) শর্ত (১) এর অধীন লাইসেন্স প্রাপ্তির নিমিত্ত দরখাস্ত মহা-পরিচালকের নিকট তৎকর্তৃক নির্ধারিত ফরমে দাখিল করিতে হইবে;

(৩) শর্ত (২) এর অধীন যথাযথভাবে পূরণকৃত ফরম দাখিল হইবার পর উক্ত ফরমে উল্লিখিত বিষয়গুলোর সত্যতা যাচাই বা, ক্ষেত্রমত, তদন্ত করিয়া মহা-পরিচালক দরখাস্ত মঞ্জুর বা নামঞ্জুর করিবেন বা দরখাস্ত বিবেচনার প্রয়োজনে মহা-পরিচালক দরখাস্তকারীকে সংশ্লিষ্ট যেকোনো তথ্য সরবরাহ করিবার জন্য নির্দেশ প্রদান করিতে পারিবেন;

মূল্য : টাকা ৪.০০

(৪) দরখাস্তকারীকে লাইসেন্স ফি বাবদ প্রতিটি আইটেম এর জন্য টাকা ৫০০/- (পাঁচশত) মহা-পরিচালক বরাবর কোড নং : ১-৪৫৪১-০০০০-২৬৮১ তে ট্রেজারী চালানের মাধ্যমে জমা প্রদান করিতে হইবে;

(৫) মহা-পরিচালক তদ্‌কর্তৃক লাইসেন্সের কোনো শর্ত, প্রয়োজনে, সংশোধন বা পরিমার্জন করিতে পারিবেন এবং শর্ত ভঙ্গের জন্য শুনানী গ্রহণপূর্বক লাইসেন্স বাতিল করিতে পারিবেন;

(৬) তফসিলে উল্লিখিত রাসায়নিকসমূহের অনুকূলে লাইসেন্স প্রদানের বিধান ও অন্যান্য শর্ত মন্ট্রিল প্রটোকল ও সংশ্লিষ্ট কিগালী সংশোধনীর বাধ্যবাধকতা অনুযায়ী পরিবর্তন ও পরিবর্ধন করা যাইবে;

(৭) পরিবেশ সংরক্ষণের উদ্দেশ্যে উপরি-উল্লিখিত শর্তাবলীর এক বা একাধিক নির্দেশ লঙ্ঘনের ক্ষেত্রে বাংলাদেশ পরিবেশ সংরক্ষণ আইন, ১৯৯৫ (১৯৯৫ সনের ১ নং আইন) এর ধারা ১৫ এর উপ-ধারা (১) এর টেবিলের ৪ নং ক্রমিকের বিধান প্রযোজ্য হইবে।

তফসিল

[শর্ত (১) দ্রষ্টব্য]

মন্ট্রিল প্রটোকল নির্ধারিত HFC সম্বলিত দ্রব্যের বিবরণ

ক্রমিক নং	HFC দ্রব্যের নাম	HFC দ্রব্যের রাসায়নিক গঠন	জিডব্লিউপি (100 Year Global Warming Potential)
(১)	(২)	(৩)	(৪)
1.	HFC-134	1,1 2,2 tetrafluoro ethane (CHF_2CHF_2)	1100
2.	HFC-134a	1,2,2,2 tetrafluoro ethane (CH_2FCF_3)	1430
3.	HFC-143	1,2,2 Trifluoro ethane (CH_2FCHF_2)	353
4.	HFC-245fa	1,1,3,3,3 pentafluoro propane (CHF_2CH2CF_3)	1030
5.	HFC-365mfc	1,1,1,3,3 pentafluoro butane ($CF_3CH_2CF_2CH_3$)	794
6.	HFC-227ea	1,1,1,2,3,3,3 heptafluoro propane (CF_3CHFCF_3)	3220
7.	HFC-236eb	1,2,2,3,3,3 hexafluoro propane ($CH_2FCF_2CF_3$)	1340

(১)	(২)	(৩)	(৪)
8.	HFC-236ea	1,1,2,3,3,3 hexafluoro propane (CHF_2CHFCF_3)	1370
9.	HFC-236fa	1,1,1,3,3,3 hexafluoro propane ($CF_3CH_2CF_3$)	9810
10.	HFC-245ca	1,2,2,3,3 pentafluoro propane ($CH_2FCF_2CHF_2$)	693
11.	HFC-43-10mee	1,1,1,2,3,4,4,5,5,5 decafluoro ($CF_3CHFCHFCF_2CF_3$)	1640
12.	HFC-32	difluoromethane (CH_2F_2)	675
13.	HFC-125	1,1,2,2,2 pentafluoro ethane (CHF_2CF_3)	3500
14.	HFC-143a	1,1,1 trifluoro ethane (CH_3CF_3)	4470
15.	HFC-41	monofluoro methane (CH_3F)	92
16.	HFC-152	1,2 difluoro ethane (CH_2FCH_2F)	53
17.	HFC-152a	1,1 difluoro ethane (CH_3CHF_2)	124
18.	HFC-23	trifluoro methane (CHF_3)	14,800

রাষ্ট্রপতির আদেশক্রমে

জিয়াউল হাসান এনডিসি
সচিব।

মোহাম্মদ ইসমাইল হোসেন (উপসচিব), উপপরিচালক, বাংলাদেশ সরকারী মুদ্রণালয়, তেজগাঁও, ঢাকা কর্তৃক মুদ্রিত।
মাকসুদা বেগম সিদ্দীকা, উপপরিচালক (উপসচিব), বাংলাদেশ ফরম ও প্রকাশনা অফিস, তেজগাঁও, ঢাকা কর্তৃক প্রকাশিত। web site: www. bgpress. gov. bd

Annex D4

MYcRvZš¿x evsjv‡`k miKvi
cwi‡ek, eb I Rjevqycwi eZb gš¿Yvjq
cÁvcb

ZwiL: ....., 1428 e½vã/ ....., 2021 wL÷vã

Gm.Avi.I. bs- ..... AvBb, 2021| evsjv‡`k cwi‡ek msi¶Y AvBb, 1995 (1995 m‡bi 1 bs AvBb) Gi av‡iv 20 G c`Ë ¶gZve‡j miKvi I‡Rvb¯‹i ¶qKvix `e¨ (wbqšÍ) wewagvjv, 2004 Gi wbgi¡c AwaKZi ms‡kvab Kwij, h_v:-

Dcwi-D³ wewagvjvi-
(K) wewa 1 Gi Dc-wewa (1) Gi Ò I‡Rvb¯‹i ¶qKvix `e¨Ó kã¸wji ci ÒnvB‡Wv‡dv‡ivKvebÓ kã mwb‡ewkZ nB‡e;
(L) wewa 2 Gi `dv (K) Gi ci wbgi¡c `dv (KK) mwb‡ewkZ nB‡e, h_v:-
(KK) ÒnvB‡Wv‡dv‡ivKveb (GBPGdwm)Ó A_ Zdwmj 1K Gi Kjvg (2) G DwjwLZ †Kvb `e¨;Ó
(M) wewa 4 Gi-
(A) DcvšÍxKvi Ò`‡e¨iÓ k‡ãi cwie‡Z Ò`e¨ I GBPGdwmÓ kã¸wj cwZ¯‹wcZ nB‡e; Ges
(Av) Ò`e¨Ó k‡ãi ci ÒGes Zdwmj 1K Gi Kjvg (2) G DwjwLZ GBPGdwmÓ kã¸wj mwb‡ewkZ nB‡e;
(N) wewa 5 Gi ci wbgi¡c bZzb wewa 5K I 5L mwb‡ewkZ nB‡e, h_v:-

Ò5K| GBPGdwm Avg`vbx I ißvbx msµvš weavb| (1) †Kvb e¨w³ jvB‡mÝ e¨ZxZ-
(K) evsjv‡`‡k †Kvb GBPGdwm ev wimvB‡KjKZ.GBPGdwm Avg`vbx, ev
(L) evsjv‡`k nB‡Z †Kvb GBPGdwm ev wimvB‡KjKZ.GBPGdwm ißvbx, Kwi‡Z cwi‡eb bv|

5L| GBPGdwm ei¥‡Ïi m‡ev"P cwigvY wbavi Y| gnvcwiPvjK jvB‡m‡Ýi Aaxb †Kvb wbw`ó erm‡i jvB‡mÝ MnxZv KZK.GBPGdwm Avg`vbx I ißvbxi †¶‡Î hvnv‡Z Zdwmj 2K Ô‡Z DwjwLZ mswkó erm‡ii Rb¨ wbawiZ GBPGdwm Gi Kveb WvB A·vBW BK¨vj¤^‡f‡j›U U‡bR Gi mxgvi AwZwi³ eivÏ c`vb bv Kiv nq Dnv wbwðZ Kwi‡eb|Ó;

(0) wewa 11 Gi Dc-wewa (1) Gi, `vwqZ¡evi DwjwLZ, ÒI‡Rvb¯‹i ¶qKvix `e¨Ó kã¸wji cwie‡Z, Dfq ¯v‡b, ÒI‡Rvb¯‹i ¶qKvix `e¨ I GBPGdwm GiÓ kã¸wj cwZ¯‹wcZ nB‡e;

(P) wewa 12 Gi cwie‡Z wbgi¡c wewa 12 cwZ¯‹wcZ nB‡e, h_v:-

Ò12| Ae¨vnwZ I‡Rvb¯‹i ¶qKvix `‡e¨i Rb¨ GB wewagvjvi †Kvb wKQzB Zdwmj 6 G DwjwLZ Ae¨vnwZi †¶‡Î, Ges GBPGdwm Gi Rb¨ gnvcwiPvjK KZK„ mgq mgq, wbawiZ Ae¨vnwZi †¶‡Î, c‡hvR¨ nB‡e bv|Ó;

(Q) wewa 13 Gi-

(A) Dc-wewa (1) Gi ci wbgi¡c Dc-wewa (1K) mwb‡ewkZ nB‡e, h_v:-

Ò(1K) gnvcwiPvjK, c‡qvR‡b, GB wewagvjvi Aaxb GBPGdwm Avg`vbxi Rb¨ jvB‡mÝ cwßi `iLv¯‹ `wL‡ji †¶‡Î, mswkó e¨w³i `iLv¯‹ `wL‡ji †hvM¨Zv (eligibiligy) wbavi Y Kwi‡Z cwi‡ebÓ;

(Av) Dc-wewa (2) Gi ÒI‡Rvb †m‡jiÓ kã¸wji cwie‡Z ÒRvZxq I‡Rvb BDwb‡UiÓ kã¸wj cwZ¯‹wcZ nB‡e;

(B) Dc-wewa (7) Gi ci wbgi¡c bZzb Dc-wewa (7K) mwb‡ewkZ nB‡e, h_v:-

Ò(7K) gnvcwiPvjK, Dc-wewa (7) Gi Aaxb GBPGdwm Avg`vbx ev ißvbxi kZ Av‡iv‡ci †¶‡Î, Ab¨vb¨ wel‡qi g‡a¨, GB wewagvjvi Aaxb jvB‡mÝ Gi gva¨g KZ…K cwigvY GBPGdwm Avg`vbx ev ißvbx Kiv hvB‡e Dnvi cwigvY wbw`ó Kwiqv w`‡Z cwi‡eb Ges, we‡kl c‡qvR‡b, D³ cwigvY nvm-ewnmn Ab¨ †Kvb jvB‡mÝ MnxZvi Abyf¤^‡j ¯vbvši Kwi‡Z cwi‡eb|Ó;

(R) wewa 14 Gi ci wbgi¡c bZb wewa 14K mwb‡ewkZ nB‡e, h_v:-

Ò14K| GBPGdwm I GBPGdwm mv¤wjZ wg·vi Gi avivK †j‡ewjs| (1) mvavi Yfv‡e wPwýZKi‡Yi D‡Ïk¨ GBPGdwm ev GBPGdwm mv¤wjZ wg·vi Gi c‡Z¨K avivK Dc-wewa (2) G wewa‡Z Z_¨ mn‡hv‡M mn‡R `wóMvn¨fv‡e †j‡ej mshy³ Kwi‡Z nB‡e|

(2) D³ avi‡K Ab¨vb¨ we‡l‡qi g‡a¨, wbgewYZ Z_¨w` wjwce× Kwi‡Z nB‡e, h_v:-

(K) ivmvqwb‡Ki bvg;

(L) ivmvqwbK dgyjvi;

*(M) `‡e¨i ivmvqwmK bvg (*trade name of the substance*);*

(N) ASHRAE *†WwRM‡bkb (wiwdRv‡iUi Gi Rb¨);*

(0) CAS *b¤i ev* UN *b¤i;*

(P) Drcv`bKvixi bvg I wVKvbv;

(Q) e¨vP b¤i;

(R) wg·vi Gi †¶‡Î, ivmvqwbK mg‡ni Avbqgvwb ZK I‡Rvb|Ó;

(S) wewa 15 Gi-

(A) DcvšÍxKvmn wZbevi DwjwLZ ÒI‡Rvb †mjÓ kã¸wji cwie‡Z mKj ¯v‡b ÒRvZxq I‡Rvb BDwbUÓ kã¸wj cwZ¯wcZ nB‡e;

(Av) Dc-wewa (1) Gi ÒGKwU †mjÓ kã¸wji cwie‡Z ÒGKwU BDwbUÓ kã¸wj cwZ¯wcZ nB‡e;

(T) Zdwmj 1 Gi cwie‡Z, h_vµ‡g, wbgi¡c bZb Zdwmj 1 I 1K cwZ¯wcZ nB‡e, h_v:-

Zdwmj - 1

[wewa 2(L), 4 I 5(3) `óe¨]

I ‡Rvb¯i ¶qKvix `†e¨i weeiY

µwgK bs	I ‡Rvb¯i ¶qKvix `‡e¨i bvg	I ‡Rvb¯i ¶qKvix `‡e¨i ivmvqwbK MVb	GBP. Gm †KvW*	Mªc	I wWwct I ‡Rvb¶q wefe (Ozone Depleting Potential)	wRWweDwc (100 Year Global Warming Potential)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	CFC-11	Trichlorofluoromethane ($CFCl_3$)	2903.77.10	I	1.0	
2.	CFC-12	Dichlorodifluoromethane (CF_2Cl_2)	2903.77.20	I	1.0	
3.	CFC-113	Trichlorotrifluoroethane ($C_2F_3Cl_3$)	2903.77.30	I	0.8	
4.	CFC-114	Dichlorotetrafluoroethane ($C_2F_4Cl_2$)	2903.77.40	I	1.0	
5.	CFC-115	Chloropentafluoroethane (C_2F_5Cl)	2903.77.40	I	0.6	
6.	Halon-1211	Bromochlorodifluoromethane (CF_2BrCl)	2903.76.00	II	3.0	
7.	Halon-1301	Bromotrifluoromethane (CF_3Br)	2903.76.00	II	10.0	
8.	Halon-2402	Dibromotetrafluoroethane ($C_2F_4Br_2$)	2903.76.00	II	6.0	
9.	CFC-13	Chlorotrifluoromethane (CF_3Cl)	2903.77.50	III	1.0	
10.	CFC-111	Pentachlorofluoroethane (C_2FCl_5)	2903.77.50	III	1.0	
11.	CFC-112	Tetrachlorodifluoroethane ($C_2F_2Cl_4$)	2903.77.50	III	1.0	
12.	CFC-211	Heptachlorofludiropropane (C_3FCl_7)	2903.77.50	III	1.0	
13.	CFC-212	Hexachlorodifluoropropane ($C_3F_2Cl_6$)	2903.77.50	III	1.0	
14.	CFC-213	Pentachlorotrifluoropropane ($C_3F_3Cl_5$)	2903.77.50	III	1.0	
15.	CFC-214	Tetrachlorotetrafluoropropane ($C_3F_4Cl_4$)	2903.77.50	III	1.0	
16.	CFC-215	Trichloropentafluoropropane ($C_3F_5Cl_3$)	2903.77.50	III	1.0	
17.	CFC-216	Dichlorohexafluoropropane ($C_3F_6Cl_2$)	2903.77.50	III	1.0	
18.	CFC-217	Chloroheptafluoropropane (C_3F_7Cl)	2903.77.50	III	1.0	
19.	Carbon tetrachloride	Tetrachloromethane (CCl_4)	2903.14.00	IV	1.1	
20.	Methyl chloroform	1,1,1- Trichloroethane ($C_2H_3Cl_3$)	2903.19.00	V	0.1	
21.	HCFC-21	Dichlorofluoromethane ($CHFCl_2$)	2903.77.50	VI	0.04	151
22.	HCFC-22	Chlorodifluoromethane ($CHClF_2$)	2903.79.10	VI	0.055	1810
23.	HCFC-31	Chlorofluoromethane (CH_2FCl)	2903.77.50	VI	0.02	
24.	HCFC-121	Tetrachlorodifluoroethane ($C_2HF_2Cl_4$)	2903.77.50	VI	0.04	
25.	HCFC-122	Trichlorodifluoroethane ($C_2HF_2Cl_3$)	2903.77.50	VI	0.08	
26.	HCFC-123	2,2-dichloro-1,1,1-trifluoroethane	2903.77.50	VI	0.06	

µvgK bs	I ‡Rvb¯i ¶qKvix `‡e¨i bvg	I ‡Rvb¯i ¶qKvix `‡e¨i ivmvqwbK MVb	GBP. Gm †KvW*	M¤c	I vWvi ct I ‡Rvb¶q vefe (Ozone Depleting Potential)	vRvWveDvc (100 Year Global Warming Potential)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		($C_2HF_3Cl_2$)				
27.	HCFC-123a	1,2-dichloro-1,1,2-trifluoroethane ($CHCl_2CF_3$)	2903.77.50	VI	0.02	77
28.	HCFC-124	2-chloro-1,1,1,2-tetrafluoroethane (C_2HF_4Cl)	2903.77.50	VI	0.04	609
29.	HCFC-124a	2-chloro-1,1,2,2-tetrafluoroethane ($CHFClCF_3$)	2903.77.50	VI	0.022	
30.	HCFC-131	Trichlorofluoroethane ($C_2H_2FCl_3$)	2903.77.50	VI	0.05	
31.	HCFC-132	Dichlorodifluoroethane ($C_2H_2F_2Cl_2$)	2903.77.50	VI	0.05	
32.	HCFC-133	Chlorotrifluoroethane ($C_2H_3F_3Cl$)	2903.77.50	VI	0.06	
33.	HCFC-141	Dichlorofluoroethane ($C_2H_3FCl_2$)	2903.77.50	VI	0.07	
34.	HCFC-141b	1,1-dichloro-1-fluoroethane (CH_3CFCl_2)	2903.77.50	VI	0.11	725
35.	HCFC-142	Chlorodifluoroethane ($C_2H_3F_2Cl$)	2903.77.50	VI	0.07	
36.	HCFC-142b	1-chloro-1, 1-difluoroethane (CH_3CF_2Cl)	2903.77.50	VI	0.065	2310
37.	HCFC-151	Chlorofluoroethane (C_2H_4FCI)	2903.77.50	VI	0.005	
38.	HCFC-221	Hexachlorofluoropropane (C_3HFCI_6)	2903.77.50	VI	0.07	
39.	HCFC-222	Pentachlorodifluoropropane ($C_3HF_2CI_5$)	2903.77.50	VI	0.09	
40.	HCFC-223	Tetrachlorotrifluoropropane ($C_3HF_3CI_4$)	2903.77.50	VI	0.08	
41.	HCFC-224	Trichlorotetrafluoropropane ($C_3HF_4CI_3$)	2903.77.50	VI	0.09	
42.	HCFC-225	Dichloropentafluoropropane ($C_3HF_5CI_2$)	2903.77.50	VI	0.07	
43.	HCFC-225ca	1,3-dichloro-1,2,2,3,3-pentafluoropropane ($CF_3CF_2CHCl_2$)	2903.77.50	VI	0.025	122
44.	HCFC-225cb	1-3-dichloro-1,2,2,3,3-pentafluoropropane (CF_2ClCF_2CHClF)	2903.77.50	VI	0.033	595
45.	HCFC-226	Chlorohexafluoropropane (C_3HF_6Cl)	2903.77.50	VI	0.10	
46.	HCFC-231	Pentachlorofluoropropane ($C_3H_2FCl_5$)	2903.77.50	VI	0.09	
47.	HCFC-232	Tetrachlorodifluoropropane ($C_3H_2F_2Cl_4$)	2903.77.50	VI	0.10	
48.	HCFC-233	Trichlorotrifluoropropane ($C_3H_2F_3Cl_3$)	2903.77.50	VI	0.23	
49.	HCFC-234	Dichlorotetrafluoropropane ($C_3H_2F_4Cl_2$)	2903.77.50	VI	0.28	
50.	HCFC-235	Chloropentafluoropropane ($C_3H_2F_5Cl$)	2903.77.50	VI	0.52	
51.	HCFC-241	Tetrachlorofluoropropane ($C_3H_3FCl_4$)	2903.77.50	VI	0.09	
52.	HCFC-242	Trichlorodifluoropropane ($C_3H_3F_2Cl_3$)	2903.77.50	VI	0.13	
53.	HCFC-243	Dichlorotrifluoropropane ($C_3H_3F_3Cl_2$)	2903.77.50	VI	0.12	

µvgK bs	I ‡Rvb¯i ¶qKvix `‡e¨i bvg	I ‡Rvb¯i ¶qKvix `‡e¨i ivmvqwbK MVb	GBP. Gm †KvW*	Mœc	I wWwct I ‡Rvb¶q wefe (Ozone Depleting Potential)	wRWwe Dwc (100 Year Global Warming Potential)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
54.	HCFC-244	Chlorotetrafluoropropane ($C_3H_3F_4Cl$)	2903.77.50	VI	0.14	
55.	HCFC-251	Trichlorofluoropropane ($C_3H_4FCl_3$)	2903.77.50	VI	0.01	
56.	HCFC-252	Dichlorodifluoropropane ($C_3H_4F_2Cl_2$)	2903.77.50	VI	0.04	
57.	HCFC-253	Chlorotrifluoropropane ($C_3H_4F_3Cl$)	2903.77.50	VI	0.03	
58.	HCFC-261	Dichlorofluoropropane ($C_3H_5FCl_2$)	2903.77.50	VI	0.02	
59.	HCFC-262	Chlorodifluoropropane ($C_3H_5F_2Cl$)	2903.77.50	VI	0.02	
60.	HCFC-271	Chlorofluoropropane (C_3H_6FCl)	2903.77.50	VI	0.03	
61.	HBFC-21B2	Dibromofluoromethane ($CHFBr_2$)	2903.78.00	VII	1.00	
62.	HBFC-22B1	Bromodifluoromethane (CHF_2Br)	2903.78.00	VII	0.74	
63.		Bromofluoromethane (CH_2FBr)	2903.78.00	VII	0.73	
64.		Tetrabromofluoroethane (C_2HFBr_4)	2903.78.00	VII	0.8	
65.		Tribromodifluoroethane ($C_2HF_2Br_3$)	2903.78.00	VII	1.8	
66.	HBFC-123B2 HBFC-123aB2	Dibromotrifluoroethane ($C_2HF_3Br_2$)	2903.78.00	VII	1.6	
67.	HBFC-124B1	Bromotetrafluoroethane (C_2HF_4Br)	2903.78.00	VII	1.2	
68.		Tribromofluoroethane ($C_2H_2FBr_3$)	2903.78.00	VII	1.1	
69.		Dibromodifluoroethane ($C_2H_2F_2Br_2$)	2903.78.00	VII	1.5	
70.		Bromotrifluoroethane ($C_2H_2F_3Br$)	2903.78.00	VII	1.6	
71.		Dibromofluoroethane ($C_2H_3FBr_2$)	2903.78.00	VII	1.7	
72.	HBFC-124B1	Bromodifluoroethane ($C_2H_3F_2Br$)	2903.78.00	VII	1.1	
73.	HBFC-124B1	Bromofluoroethane (C_2H_4FBr)	2903.78.00	VII	0.1	
74.		Haxabromofluoropropane (C_3HFBr_6)	2903.78.00	VII	1.5	
75.		Pentabromodifluoropropane ($C_3HF_2Br_5$)	2903.78.00	VII	1.9	
76.		Tetrabromofluoropropane ($C_3HF_3Br_4$)	2903.78.00	VII	1.8	
77.		Tribromotetrafluoropropane ($C_3HF_4Br_3$)	2903.78.00	VII	2.2	
78.		Dibromopentafluoropropane ($C_3HF_5Br_2$)	2903.78.00	VII	2.0	
79.		Bromohaxafluoropropane (C_3HF_6Br)	2903.78.00	VII	3.3	
80.		Pentabromofluoropropane ($C_3H_2FBr_5$)	2903.78.00	VII	1.9	
81.		Tetrabromodifluoropropane ($C_3H_2F_2Br_4$)	2903.78.00	VII	2.1	

µwgK bs	I‡Rvb¯i ¶qKvix `‡e¨i bvg	I‡Rvb¯i ¶qKvix `‡e¨i ivmvqwbK MVb	GBP. Gm †KvW*	M‡c	I wWwct I‡Rvb¶q we fe (Ozone Depleting Potential)	wRWweDwc (100 Year Global Warming Potential)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
82.		Tribromotrifluoropropane ($C_3H_2F_3Br_3$)	2903.78.00	VII	5.6	
83.		Dibromotetrafluoropropane ($C_3H_2F_4Br_2$)	2903.78.00	VII	7.5	
84.		Bromopentafluoropropane ($C_3H_2F_5Br$)	2903.78.00	VII	1.4	
85.		Tetrabromofluoropropane ($C_3H_3FBr_4$)	2903.78.00	VII	1.9	
86.		Tribromodifluoropropane ($C_3H_3F_2Br_3$)	2903.78.00	VII	3.1	
87.		Dibromotrifluoropropane ($C_3H_3F_3Br_2$)	2903.78.00	VII	2.5	
88.		Bromotetrafluoropropane ($C_3H_3F_4Br$)	2903.78.00	VII	4.4	
89.		Tribromofluoropropane ($C_3H_4FBr_3$)	2903.78.00	VII	0.3	
90.		Dibromodifluoropropane ($C_3H_4F_2Br_2$)	2903.78.00	VII	1.0	
91.		Bromotrifluoropropane ($C_3H_4F_3Br$)	2903.78.00	VII	0.8	
92.		Dibromofluoropropane ($C_3H_5FBr_2$)	2903.78.00	VII	0.4	
93.		Bromodifluoropropane ($C_3H_5F_2Br$)	2903.78.00	VII	0.8	
94.		Bromofluoropropane (C_3H_6FBr)	2903.78.00	VII	0.7	
95.		Bromochloromethane (CH_2BrCl)	2903.78.00	VII	0.12	
96.	Methyl bromide	(CH_3Br)	2903.79.90	VIII	0.6	

* Customs Act, 1969 Gi Schedule -1 G DwjwLZ mswkó GBP.Gm. †KvW Gi, mgq mgq, cwieZb wieZbU c‡hvR¨ nB‡e|

Zdwmj-1K

[we‡a 2(KK), 2(N) I 5K `óe¨]

g»Uj c‡UvKj wbawiZ GBPGdwm এর *weeiY*

µwgK bs	*GBPGdwm* এর *bvg*	*GBPGdwm* এর *ivmvqwbK MVb*	*GBP. Gm †KvW**	*M‡c*	*wRWweDwc* (100 Year Global Warming Potential)
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
1.	HFC-134	1,1 2,2 tetrafluoro ethane (CHF_2CHF_2)		IX	1100
2.	HFC-134a	1,2,2,2 tetrafluoro ethane (CH_2FCF_3)	2903.39.10	IX	1430
3.	HFC-143	1,2,2 trifluoro ethane (CH_2FCHF_2)		IX	353
4.	HFC-245fa	1,1,3,3,3 penta fluoro propane (CHF_2CH2CF_3)		IX	1030
5.	HFC-365mfc	1,1,1,3,3 pentafluoro butane ($CF_3CH_2CF_2CH_3$)		IX	794
6.	HFC-227ea	1,1,1,2,3,3,3 heptafluoro propane (CF_3CHFCF_3)	2903.39.30	IX	3220
7.	HFC-236cb	1,2,2,3,3,3 hexafluoro propane ($CH_2FCF_2CF_3$)		IX	1340
8.	HFC-236ea	1,1,2,3,3,3 hexafluoro propane (CHF_2CHFCF_3)		IX	1370
9.	HFC-236fa	1,1,1,3,3,3 hexafluoro propane ($CF_3CH_2CF_3$)		IX	9 810
10.	HFC-245ca	1,2,2,3,3 pentafluoro propane ($CH_2FCF_2CHF_2$)		IX	693
11.	HFC-43-10mee	1,1,1,2,3,4,4,5,5,5 decafluoro $CF_3CHFCHFCF_2CF_3$		IX	1 640
12.	HFC-32	difluoromethane (CH_2F_2)	2903.39.20	IX	675
13.	HFC-125	1,1,2,2,2 pentafluoro ethane (CHF_2CF_3)		IX	3500
14.	HFC-143a	1,1,1 trifluoro ethane (CH_3CF_3)		IX	4 470
15.	HFC-41	monofluoro methane (CH_3F)		IX	92
16.	HFC-152	1,2 difluoro ethane (CH_2FCH_2F)		IX	53
17.	HFC-152a	1,1 difluoro ethane (CH_3CHF_2)		IX	124
18.	HFC-23	trifluoro methane (CHF_3)		X	14800

* Chemicals containing Perfluorocarbons (PFCs)or Hydrofluorocarbons (HFCs) but not containing Chlorofluorocarbons (CFCs) or Hydrochlorofluorocarbons (HCFCs) *Gi eZgwb GBP.Gm †KvW* 3824.78.00;

(U) Zdwmj 2 Gi cwie‡Z, h_vµ‡g, wbgi¡c bZzb Zdwmj 2 I 2K cwZ¯wcZ nB‡e, h_v:-

Zdwmj - 2

[we‡a 2(Q), 4, 5(3), 5(5), 8(1) I 8(2) `óe¨]

Zdwmj-1 Gi Kjvg (4) G wb‡`kZ M‡c- I, III, IV, V, VI, VII-Gi Ašfy³ I‡Rvb¯i ¶qKvix `‡e¨i Drcv`b, Avg`vbx, ißvwb I e¨envi wbqšY

µwgK bs	I‡Rvb¯i ¶qKvix `‡e¨i M‡c	wfwË¯i msµvš ermi	M‡c we‡k‡l wbYqKZ. wfwË¯‡ii wfwË‡Z 12 (evi) gvmKvj Avg`wbi m‡ev"P MnY‡hvM¨ cwigvY (I wWc Ub)*	M‡c we‡k‡l wbYqKZ. wfwË¯‡ii wfwË‡Z e¨envi‡ii m‡ev"P cwigvY	µwgK bs	I‡Rvb¯i ¶qKvix `‡e¨i M‡c	wfwË¯i msµvš ermi
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
34.	I	1995-1997	300	300	31.12.2004	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
	III	1998-2000	-				
35.	I	1995-1997	290	290	31.12.2005	H	H
	III	1998-2000	-				
36.	I	1995-1997	250	250	31.12.2006	H	H
	III	1998-2000	-				
37.	I	1995-1997	85	85	31.12.2007	H	H
	III	1998-2000	-				
38.	I	1995-1997	75	75	31.12.2008	H	H
	III	1998-2000	-				
39.	I	1995-1997	50	50	31.12.2009	H	H
	III	1998-2000	-				
40.	I	1995-1997	**	**	01.01.2010	H	H
	III	1998-2000	-				
41.	IV	1998-2000	5.5	5.5	1-1-2005	H	H
42.	IV	1998-2000	0	0	1-1-2010	--	--
43.	V	1998-2000	1.0	1.0	1-1-2003	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
44.	V	1998-2000	0.7	0.7	1-1-2005	--	--
45.	V	1998-2000	0.4	0.4	1-1-2010	--	--
46.	V	1998-2000	0	0	1-1-2015	--	--
47.	VI	2009-2010	72.65	72.65	1-1-2013	wewagvjv ejer nBevi ZwiL	wewagvjv ejer nBevi ZwiL
48.	VI	2009-2010	72.65	72.65	1-1-2014	H	H
49.	VI	2009-2010	65.30	65.30	1-1-2015	H	H
50.	VI	2009-2010	65.30	65.30	1-1-2016	H	H
51.	VI	2009-2010	65.30	65.30	1-1-2017	H	H
52.	VI	2009-2010	50.86	50.86	1-1-2018	H	H
53.	VI	2009-2010	50.86	50.86	1-1-2019	H	H
54.	VI	2009-2010	47.22	47.22	1-1-2020	H	H
55.	VI	2009-2010	47.22	47.22	1-1-2021	H	H
56.	VI	2009-2010	47.22	47.22	1-1-2022	H	H
57.	VI	2009-2010	30.50	30.50	1-1-2023	H	H
58.	VI	2009-2010	26.50	26.50	1-1-2024	H	H
59.	VI	2009-2010	23.61	23.61	1-1-2025	H	H
60.	VI	2009-2010	23.61	23.61	1-1-2026	H	H
61.	VI	2009-2010	23.61	23.61	1-1-2027	H	H
62.	VI	2009-2010	23.61	23.61	1-1-2028	H	H
63.	VI	2009-2010	23.61	23.61	1-1-2029	H	H
64.	VI	2009-2010	23.61	23.61	1-1-2030	H	H
65.	VI	2009-2010	***	***	1-1-2031	H	H
66.	VII	---	0	0		--	--

* 1995-97 mgqKv‡j i M¨c-I Gi wbYqKZ.wfwË¯ i 580.4 IwWc Ub Ges 2009-2010 mgqKv‡j i M¨c-VI Gi †¶‡Î wbYqKZ.wfwË¯ i 72.65 IwWc Ub|

** m`m¨ †`kmg‡ni m¤ve¨ Abyg~Z‡Z evsjv‡`‡k Acwinvh e¨envi Pwn`vcwi‡Y †Kvb †Kv‡ivdvjvKveb Avg`vbx ev e¨envi e¨ZxZ|

*** m`m¨ †`kmg‡ni m¤ve¨ Abyg~Z‡Z evsjv‡`‡k Acwinvh e¨envi Pwn`vcwi‡Y †Kvb nvB‡Wv-†Kv‡ivdvjvKveb Avg`vbx ev e¨envi e¨ZxZ| ïaygvÎ 1-12-2030 mvj chš e¨eüZ wiwdRv‡ikb I GqviKwÛkwbs `e¨w`i mvwfwms Kivi wbwg‡Ë 1-1-2031 n‡Z 31-12-2040 chš cwZ cwÄKv eQ‡i 1.816 IwWc Ub M¨c- VI - `e¨w` Avg`wb I e¨envi e¨ZxZ|

wet`t 1995-97 mgqKv‡j M¨c-II I 1995-98 mgqKv‡j M¨c-VIII-Gi Aš—f© I‡Rvb¯ i ¶qKvix `e¨ evsjv‡`‡k Avg`vbx I e¨envi Kiv nq bvB| c‡UvK‡ji kZvbyhvqx 2003 mv‡ji 1 Rvbyqvix nB‡Z GB mKj `e¨ Avg`vbx I e¨envi Kiv hvB‡e bv|ôô;

Zdwmj-2K
[wewa 5L `óe¨]

Zdwmj-1K Gi Aš—y³ gw›Uj c‡UvKj wbawiZ GBPGdwm m¤wjZ `‡e¨i Drcv`b, Avg`vbx, ißwb I e¨envi wbqšb Ges Dnvi eivÏ mxgv

µwgK bs	*GBPGdwm m¤wjZ `te¨i Mœc*	*wfwË¯i msµvš ermi*	*Mœc we†k†l wbYqKZ. wfwË¯ †ii wfwË†Z 12 (evi) gvmKvj Avg`wbi m†ev©P MnY†hvM¨ cwigvY (wRWweDwc)**	*Mœc we†k†l wbYqKZ. wfwË¯ †ii wfwË†Z e¨envi†ii m†ev©P cwigvY (wRWweDwc)*	*Kjvg (4) I (5) msµvš ZwiL*	*GBPGdwm Drcv`b mÿeav mµói Dci wb†lavÁv*	*GBPGdwm msewjZ ev e¨envi†i cY¨ Drcv`†bi j†¶¨ bœe mÿeav mµói Dci wb†lavÁv*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
1.	IX	*2020-2022*	*100%*	*100%*	*1-1-2023*	*GB wewagvjvi wewa 5L Ges Zdwmj 1K I 2K ejer nBevi ZwiL*	*GB wewagvjvi wewa 5L Ges Zdwmj 1K I 2K ejer nBevi ZwiL*
2.	IX	*2020-2022*	*100%*	*100%*	*1-1-2024*	*H*	*H*
3.	IX	*2020-2022*	*100%*	*100%*	*1-1-2025*	*H*	*H*
4.	IX	*2020-2022*	*100%*	*100%*	*1-1-2026*	*H*	*H*
5.	IX	*2020-2022*	*100%*	*100%*	*1-1-2027*	*H*	*H*
6.	IX	*2020-2022*	*100%*	*100%*	*1-1-2028*	*H*	*H*
7.	IX	*2020-2022*	*90%*	*90%*	*1-1-2029*	*H*	*H*
8.	IX	*2020-2022*	*90%*	*90%*	*1-1-2030*	*H*	*H*
9.	IX	*2020-2022*	*90%*	*90%*	*1-1-2031*	*H*	*H*
10.	IX	*2020-2022*	*90%*	*90%*	*1-1-2032*	*H*	*H*
11.	IX	*2020-2022*	*90%*	*90%*	*1-1-2033*	*H*	*H*
12.	IX	*2020-2022*	*90%*	*90%*	*1-1-2034*	*H*	*H*
13.	IX	*2020-2022*	*70%*	*70%*	*1-1-2035*	*H*	*H*
14.	IX	*2020-2022*	*70%*	*70%*	*1-1-2036*	*H*	*H*
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17.	IX	*2020-2022*	*70%*	*70%*	*1-1-2039*	*H*	*H*
18.	IX	*2020-2022*	*50%*	*50%*	*1-1-2040*	*H*	*H*
19.	IX	*2020-2022*	*50%*	*50%*	*1-1-2041*	*H*	*H*
20.	IX	*2020-2022*	*50%*	*50%*	*1-1-2042*	*H*	*H*
21.	IX	*2020-2022*	*50%*	*50%*	*1-1-2043*	*H*	*H*
22.	IX	*2020-2022*	*50%*	*50%*	*1-1-2044*	*H*	*H*
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SECTION E

NATIONAL STRATEGY AND COUNTRY ASSESSMENT FOR THE IMPLEMENTATION OF KIGALI AMENDMENT TO THE MONTREAL PROTOCOL

SUMMARY

NATIONAL STRATEGY AND COUNTRY ASSESSMENT FOR THE IMPLEMENTATION OF KIGALI AMENDMENT TO THE MONTREAL PROTOCOL

In October 2016, during 28th Meeting of the Parties, Montreal Protocol which was adopted in 1987 for the protection of Ozone Layer was amended in Kigali, Rwanda to control production and consumption of Hydrofluorocarbons (HFCs). HFCs are not ozone depleting substances (ODS) but have very high global warming potentials (GWP), ranging from 53 to 14,800.

Under the Kigali amendment, the phase-down schedule varies between 4 different groups. Bangladesh belongs to Article 5, group I. The baseline of the consumption of HFCs of Article 5 Group I will be established on the average consumption of the years 2020, 2021 and 2022.The country will freeze its consumption determined by the baseline during 2024. HFCs are promoted by the Parties to the Montreal Protocol during the phase-out of CFCs and Hydrochlorofluorocarbons (HCFCs) as there was no viable alternatives. Recent scientific innovation inspired Parties to take challenges to phase-down HFCs under the Montreal Protocol when developing countries are phasing-out HCFCs.

Aiming HCFC phase-out by 2030 and allowing 2.5% servicing tail during 2030 to 2040 Bangladesh has adopted policy of low GWP, zero ozone depleting potential (ODP) and energy efficient technology in selecting the alternatives of HCFCs during implementation of HCFC Phase-out Management Plan (HPMP). The phase-out schedule much aligns with the phase-down schedule of HFCs i.e, the 10% reduction by 2029 to 80% reduction by 2045 with different reduction target in between these years. Thus the adoption of the Kigali Amendment brings the opportunity to strengthen the momentum towards low GWP chemicals applications. This opens the doors of innovations to accelerate sustainable development of the country.

The 79th Ex.Com meeting of Montreal Protocol Multilateral Fund (MLF) decided to assist Article 5 countries with enabling activities which would help early ratification of the Kigali Amendment. These included developing institutional arrangements, review of licensing system, data reporting systems, National Strategies, National Cooling Plan etc. Ex.Com also decided to assist Article 5 countries with stand along conversion project for HFCs from 79th Ex.Com onward. As a response to the decisions of 79th ExCom, government developed a conversion project for phase-out of HFC-134a with a environment friendly and energy efficient alternative for the production of domestic refrigerators at Walton Hi-tech Industries Ltd including conversion of compatible compressors. The project was implemented in 2019 and facilitated the reduction of 197.30 MT of HFC-134a consumption, equivalent to 282,000 tons of CO_2. Walton also developed 24 energy efficient models of refrigerators which were certified by BSTI in 2019. It paved to start certification in the refrigerators manufacturing process in the country. MLF also approved funds for enabling activities to help initiate ratification of the Kigali amendment and for the preparation of National Cooling Plan, National Strategy, introduce licensing system to control HFCs. On 8 June 2020 Bangladesh ratified Kigali Amendment which lead the country to fulfill the following obligations

1. Establishing and implementing an effective licensing system to control import and export of HFCs (Virgin and recycled) and HFCs used in mixtures as per Article 4B of the Montreal Protocol;
2. Reporting consumption of HFCs along with HCFCs consumption data to the ozone Secretariat and country programme implementation (CP) data to the MLF Secretariat from 2020;
3. Freezing the baseline consumption of HFCs and HFCs blends from January 2024;
4. Banning import and export of HFCs and HFCs containing blend (Both virgin & recycled) with non parties to the Kigali Amendment to the Montreal Protocol;
5. Reducing the consumption of HFCs and HFCs blends as per phase-down schedule of group I of the Article 5 countries to the Montreal Protocol.

Government took initiatives to conduct ODS alternative survey in 2018 for the preparation of National Cooling Plan, Plan and formulate strategy, assess need for RAC service sector, evaluate data reporting system, update licensing system and ODS regulation to comply with obligations to the Protocol. The first HFC survey was conducted in 2014 for the year 2011, 2012 and 2013 and ODS alternatives survey was carried out in 2016 during the preparation of HPMP Stage II.

Towards the preparation of the Country Programme and National Strategy

The Country Programme and National Strategy which is prepared under this assignment is a part of Bangladesh enabling activities for HFC Phase-down. It covers all possible relevant information and aspects that will be required to execute the challenges during implementation of Kigali Amendment of the Montreal Protocol.

National Cooling Plan, updating Rules and Regulation, Need assessment for RAC servicing sector, evaluation of data reporting systems are yet to be finalized. The HFC baseline data will be available not before 2023. Owing to these constraints, this country programme and National Strategy requires an update in 2023. Guidelines of MLF regarding technical and financial assistance and the role of other international donor/organization, such as, Kigali Cooling Efficiency Programme (KCEP), Cool Coalition, GIZ, GEF, CCAC etc. will hopefully be available by 2023. In particular, willingness to finance to energy efficiency issues during phase down of HFCs by the national /international agencies need to be affirmed to get double benefit from the HFC phase down.

The following issues were considered during the preparation of National Strategy:

- Ongoing HCFC Phase-out Management Plan.
- Import and consumption scenario of HFCs since 2014
- Prioritize activities into immediate, short term, and long term based on available cost effective, environment friendly and energy efficient technology.
- Analysis of possible growth of the sector considering national and international perspectives.
- Identify probable source of funding during implementation
- Rapid growth of HFC consumption in the MDIs production in the coming years
- Energy management in the RAC sector.
- Market analysis.
- Safety issue and institutionalizing the capacity building of RAC production and servicing technicians.
- Consider other policy issues, i.e, climate policy of the country, INDC of Bangladesh, Paris agreement, Policy regarding short lived carbon pollutants etc.
- Institutional and regulatory framework and requirement to necessary adjustment.
- Capacity building of Customs and low enforcement officials to combat possible illegal trade of HFCs
- Management of high GWP end of life equipment.
- Strength, weakness, opportunities and threat (SWOT) analysis of the whole scenario.

Conclusion and Recommended Actions

The obligations under KA will be effective on 6 September 2020 for Bangladesh. Government is committed to comply with the Protocol's legal obligations. To achieve the compliance target to the protocol, this country programme and national strategy suggests the following

Immediate Actions (2020 to 2022)	Focal Point/Relevant Stakeholder
• Update National Ozone Unit (NoU) and National Technical Committee on ODS (NTCODS) with TOR	DoE/MOEFCC
• Amend existing Rules and Regulation	DoE/MOEFCC
• Develop National System for HS Codes for HFCs (including blends and pre-blended polyols)	NoU/DoE/ MOEFCC/NBR

• Include HFCs into the existing licensing system from 1 January 2021.	NoU/DoE
• Evaluate Data collection system and reporting system for HFCs and report to the Ozone Secretariat by 30 September 2021 latest and CP Data to MLF by 1 May 2021	NoU/DoE
• Mandatory (Star Rating) certification on energy efficiency of imported domestic refrigerators & ACs.	RAC Manactured/BSTI
• To facilitate energy saving in the RAC sector, a project for producing inverter type compressor in the country	NoU
• Establish the baseline by average consumption data of HFCs for the year 2020, 2021 and 2022	NoU/Ozone Secretariat

Short Term Actions (2023-2030)	
• Update National Strategy	NoU/UNDP
• Conduct HFC alternative survey in 2023 and Prepare Sector wise phase-down project	NoU/UNDP/UNEP
• Leaf Frog to introduce low GWP alternatives (where possible) during implementation of HPMP Stage II	NoU/DoE
• Update training curriculum for RAC technician	NoU/UNEP
• Develop National Standard for using flammable refrigerants for RAC sector	UNDP/DoE
• Develop code of Practice for RAC service workshop/technicians	UNEP/DoE
• Update curriculum of Diploma Engineers and TVET with Bangladesh Technical Education Board	NoU/UNEP
• Update training curriculum for Customs officers and training for law enforcement body to prevent illegal trade of HFCs	NoU/UNEP
• Update regular curriculum of Customs training Academy	NoU/UNEP
• Reduce 10% consumption of HFCs from the baseline from 1 January 2029	NoU/DoE

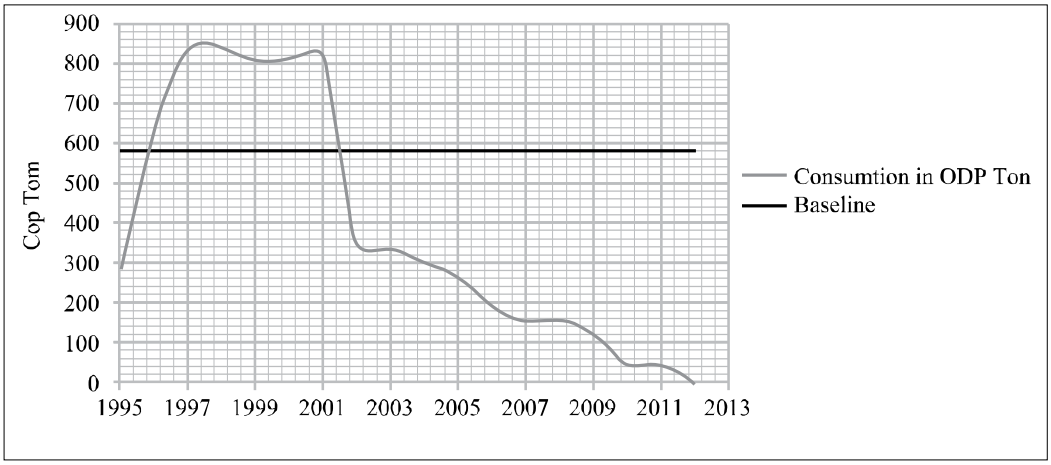
Long Term Plan (2031-2045)	
• To conduct HFC alternative survey in 2031 and update National Strategy, National Cooling plan, Rules and Regulation and other policy related to KA implementation	NoU/UNDP
• Evaluate status of MDI production in Bangladesh, estimate future need of HFC for MDI production and prepare HFC phase-out project (if alternatives are available) for MDI sector	NoU/UNDP
• Prepare projects for sectors other than RAC	UNDP/UNEP
• Continue capacity building of RAC technicians	NoU
• Continue replacement progamme for RAC equipment and continue fiscal measures to accelerate/encourage the programme	DoE/MoEFCC
• Continue disposal programme of obsolete /equipment after end of life.	DoE
• Ban import and export of HFCs containing blend (both virgin & recycled) with non parties to the Kigali Amendment to the Montreal Protocol.	DoE
• Ban of equipment containing HFCs and their blends	DoE/ NBR
• Reduce consumption of HFCs as per Montreal Protocol Phase-down schedule	DoE
• Introduce mandatory star rating system	DoE/ BSTI

1. BACKGROUND

1.1 General Information

Bangladesh accessed the Montreal Protocol on 2nd August 1990 and ratified London, Copenhagen, Montreal and Beijing amendments in 1994, 2000, 2001 and 2010 respectively. As a signatory to the protocol, control measures have to be imposed on the import and consumption of ODSs in Bangladesh from 1st July 1999. The first step toward achieving the objectives of the Montreal Protocol, a reconnaissance survey on ODS use and import in Bangladesh was carried out in 1993 followed by a Country Programme prepared in 1994 towards phasing-out the use of ODS. The government also set up Ozone Cell (National Ozone Unit) in 1995 within the Department of Environment which undertook various activities towards achieving target under Montreal Protocol.

The baseline data for controlling the ODSs, viz, CFCs, Halons, CCl_4, Methyl Chloroform and Methyl Bromide were the average consumption for the years 1995, 1996 and 1997. According to the survey in Bangladesh, the baseline consumption was 581.6 ODP tons. "Institutional Strengthening for the Phase-out of ODS" Project was undertaken for establishment and to carry day to day activities of National Ozone Unit, called Ozone Cell in the Department of Environment and a conversion project for the ACI Ltd to phase-out CFCs in the production of Aerosol. ACI conversion project was accomplished in 2002 and was able to reduce about 50% of the consumption of CFCs calculated at that time.



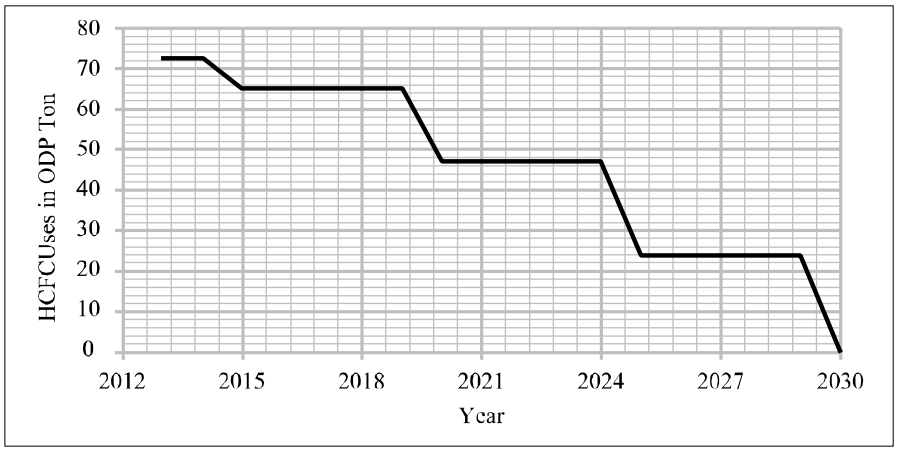
In 2004 Bangladesh's response to ODS control measures was further reinforced when the government enacted Ozone Depleting Substances (Control) Rules, 2004. This rule empowered the government with a legal instrument to control ODS in the country and phase-out ODS as per Montreal Protocol schedule. After RMP, remaining ODS was phased-out by National ODS Phase-out Plan (NOPP). The NOPP again had investment and non-investment components. Under NOPP about 3000 refrigeration and air-conditioning (RAC) technicians were trained under "Good Service Practices in RAC". About 2000 technicians were trained on Refrigerator Retrofit and 800 RAC service shop-owners were provided with the retrofit kits and essential tools for retrofitting CFC based refrigerators. To build capacity of the policy-makers and decision-makers on ODS issues, 300 officers of the various Ministries and Department were trained under training programmes on 'Promotion of Ozone Layer Protection in Bangladesh'. Besides, solvent sector was also phased-out under NOPP. Bangladesh successfully phased-out CFCs, CTC, MCF and MB from commercial sector use in January 2010.

While the government was updating the Country Programme in 2004, it was revealed that, Bangladesh has increasing demand of CFCs in the manufacturing of metered dose inhalers (MDIs) which was not included in the base-line survey earlier. Bangladesh then proposed essential use nomination (EUN) for medical use and received funding from MLF for phasing-out CFCs in the manufacturing of metered dose inhalers. For

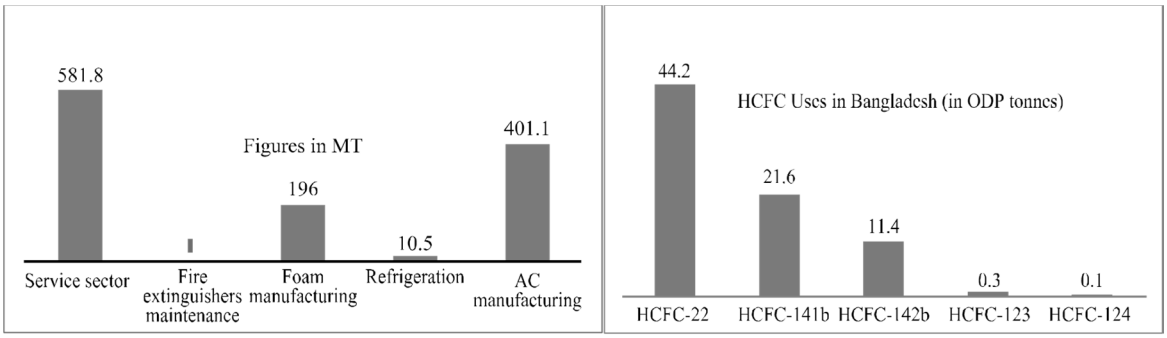
its implementation Bangladesh took investment project activities for retrofitting the manufacturing facilities at the MDI producing companies while non-investment activities were taken up to sensitize doctors and users. The transition was seamless to retrofit CFC based inhalers to HFA based inhalers. Bangladesh successfully phased out CFCs in the medical application in the year 2012. This was a great challenge to overcome the situation.

The main challenges faced during the CFC phase-out in the country were from the bulk users like aerosol sector and medical sector. The single aerosol producing sector was consuming over 50% of CFCs in the country. The second largest industrial consumption was Metered Dose Inhalers. Undertaking investment projects for aerosol producing factory or MDI producing pharmaceuticals under public-private partnership was also a challenge. But government has so far successfully overcome all the barriers faced. Bangladesh received appreciation from UNEP in 2012 for her achievement in Montreal Protocol compliance.

After CFC phase-out it was considered that major activities were done. But while phasing out CFCs, it was substituted globally by another ODS called hydrochlorofluorocarbon (HCFC). HCFCs are low potent ODS but still it is controlled under Montreal Protocol and it has also high global warming potential. In view of the new development, Montreal Protocol Meeting of the Parties in 2007 accelerated the phase-out date for HCFCs to 2030 from 2040. To keep pace with the Montreal adjustment, government has amended the Ozone Depleting Substance (Control) Rules, 2004 in September 2014.



A baseline survey was undertaken for HCFC uses in Bangladesh in 2011 for the year 2009 and 2010. According to HCFC survey it was found that HCFCs are not produced in the country. Bangladesh only imports HCFCs. The consumption of HCFCs was found in RAC servicing, fire fighting, foam manufacturing, and RAC manufacturing sectors. The baseline was estimated at 72.6 ODP ton of HCFC consumption in the country.



Following the survey, HCFC Phase-out Management Plan (HPMP)- Stage-I was prepared which was approved by the 65th Executive Committee Meeting of Montreal Protocol Multilateral Fund. Under HPMP an investment project to phase-out HCFC-141b use in the insulator foam blowing sector was undertaken.

Bangladesh is the pioneer among the developing countries of the world to phase-out HCFC-141b in the manufacturing of foam as blowing agent in January 2013. Now cyclopentane is being used as alternatives of HCFC-141b in the country for insulation foam production.

Besides investment project, under HPMP, non-investment project is also being implemented. Bangladesh is now implementing HPMP-Stage I to phase-out remaining ODSs in the country. Under the HPMP non-investment activities, about 1800 RAC service technicians were trained on 'Good Practices in RAC'; 100 teachers/ instructors were trained from polytechnic and technical institutions under 'ToT on Good Service Practices in RAC'; about 80 customs and law enforcing officers were trained to combat illegal trade of ODSs under 'Green Trade for the Protection of Ozone Layer'. Besides, four ODS identifiers were distributed to customs entry point in the country to detect ODS. A set of five books was prepared and printed on refrigeration and air-conditioning servicing and the government has received fund to prepare HPMP Stage-II. Being a compliant country to the Montreal Protocol, Bangladesh hopes to phase-out remaining ODSs before the stipulated schedule of the protocol.

1.2 Challenges and opportunities to the Kigali Amendment

Over the last 30 years, we have worked to phase-out ozone depleting substances (ODS) under the Montreal Protocol, contributing ozone layer protection and climate change mitigation. The Kigali Amendment (KA) adds hydroflurocarbons (HFCs) to the list of controlled substances which are to be phase-down. Its ratification, implementation, and enforcement pose challenges but also great opportunities.

If fully supported by respective governments, the private sector, and society, KA will reduce the projected production and consumption of powerful greenhouse gases, HFCs by more than 80 percent over the next 30 years. KA is expected to avoid upto 0.5ºC of global warming by the end of this century while continuing to protect the ozone layer.

HFCs are organic compounds frequently used as refrigerants in the RAC Sector; propellants in aerosol include Metered Dose Inhalers; blowing agents during foam production; fire supresents etc. They are not depleting the ozone but are extremely potent greenhouse gases with high global warming potentials ranging 53 to 14,800.

The Parties to the Montreal Protocol have put in place practical arrangements for its implementation. According to the Executive Committee of the Montreal Protocol Multilateral Fund at its July 2017 meeting, decided to assist Article 5 countries with enabling activities to support early ratification. These include developing institutional arrangements, review of licensing system, data reporting on HFC consumption and production, and National Strategies, finance stand alone investment projects. Phasing down HFCs under the Kigali Amendment may also open a window to redesign cooling appliances that is more energy efficient, further increasing the climate gains.

Implementation of Kigali Amendment to the Montreal Protocol will be initiated in 3(three) phases. Developed countries will start activities by 2019 and developing will follow with a freeze of HFCs consumption in 2024 at the base level. A few high ambient countries will start freezing consumption in 2028.

1.3 Human activities cause ozone depletion and global warming

Ozone (O_3) depletion does not cause global warming, but both of these environmental problems have a common cause which is human activity that release pollutants into the atmosphere.

Global warming is caused primarily by putting too much carbon dioxide in to the atmosphere when coal, oil, and natural gas are burned to generate electricity or to run our cars.

Carbon dioxide spreads around the planet like a blanket and is one of the main gases responsible for the absorption of infrared radiation (felt as heat), which comprises the bulk of solar energy.

Ozone Depletion occurs when chlorofluorocarbons (CFCs) were as refrigerants in RAC equipment; propellants in aerosol & MDIs; blowing agents in foam preparation, halons were used as fire suppressants. These gases are depleting ozone in the stratosphere.

Ozone sits in the upper atmosphere and absorbs ultraviolet radiation, another type of solar energy that's harmful to humans, animals and plants, CFCs and halons cause chemical reactions that breakdown ozone molecules, reducing ozone's ultraviolet radiation absorbing capacity in the stratosphere.

1.4 Does global warming have an impact on the stratospheric ozone layer?

Increased emission of green house gases make a blanket prevent heat, increase temperature in the lower atmosphere and cooling in the upper atmosphere. This warming-cooling dynamic creates conditions that lead to ozone loss in the stratosphere. Again depletion of ozone in the stratosphere increase ozone in the troposphere where ozone is a GHG and increase global warming. Ozone in troposphere is also a strong pollutants. According to the IPCC 1996, tropospheric ozone (O_3) is the third most important green house gas after carbon dioxide (CO_2) and Methane (CH_4).

1.5 Scope, Methodology and Objectives of the Assignment

The MLF Executive Committee, at its July 2017 meeting, decided that enabling activities will support early ratification of the Kigali Amendment. These could include developing institutional arrangement, review of existing licensing systems, data reporting on HFC consumption and production, and National Strategies, stand along investment projects are invited for submission to the 79th Ex-Com Meeting onwards. The Ex.Com is developing the cost guideline for funding HFC phase down activities. But yet not complete. The preparation of National Implementation Plan could start as early as possible before the Kigali Amendment baseline numbers are set (average 2020-2022 for Group I countries).

On request of the Government of Bangladesh, 81st Ex.Com of approved US$150,000 and Government of Canada approved US$ 75,000 for the Enabling Activities for Phase-down HFCs.

Again as per decision of 79/45 of 79th Ex.Com of MLF that Article 5 countries could submit stand alone investment project to phase-out HFCs from 79th onward, Bangladesh submitted a HFC phase-out project for the refrigerator manufacturing sector at the 80th Ex.Com.

80th Ex.Com approved US$ 3,131,610 plus agency support cost of US$ 219,213 for UNDP on understanding that:

(i) 230.63 Metric Tons of HFC-134a would be reduced from the countries starting point for sustained aggregate reduction of HFCs to be established at a future meeting; (ii) That funding for any downstream users that sought compensation for incremental operating costs associated with compressor in subsequent HFC conversion projects would be determined in accordance with decision 26/36.

To approve the stand along HFC investment project for the conversion of a domestic refrigerator manufacturing facility from HFC-134a to isobutene (R-600a) as a refrigerant and conversion of a compressor manufacturing facility from HFC-134a based compressor to isobutene based compressor at Walton Hi-tech Industries Ltd. In Bangladesh, Implementing Agency was UNDP.

This country programme and strategy is prepared as a part of Bangladesh Enabling Activities for HFC phase-down. It covers all relevant information and aspects that will be required to execute the Challenges during implementation of Kigali Amendment to the country. These are institutional arrangement and partnership policy and regulations, assessment of sector wise consumption of HFCs; understanding market development in a business-as-usual (BAU) scenario taking into account of factors such as plans and programme of HCFC phase out as per country programme and economic growth of the country will require about one year to accomplish. Again baseline of HFC consumption of Bangladesh will be determined in 2023 when we get consumption for the year 2020 to 2022. Again due to COVID 19 pandemic, detailed stakeholder consultation and organization of consultative workshop on draft was not possible.

Owing to the above mentioned circumstances and situation National Ozone Unit propose activities related to immediately after Ratification; During baseline years and during Phase-down period upto 2030. NoU also suggest to revise this country programme in 2023/24 in line with advice and suggestions provided in the National Cooling Plan, RAC need assessment for capacity building; Amended Rules and Regulations, WCO guidelines for HS Code, evaluation of data reporting system and suggestions and advice provided by the stakeholders and expects; plan for reduction of future HFC consumption; Assessment of current and future refrigerants and technologies; identify major stakeholders; and to prioritize actions in terms of immediate, short term and long term actions to be undertaken to accomplish the phase-down target as per protocol.

To develop the report National Ozone Unit of Bangladesh identified stakeholders; Reviewed data collected during ODS Alternative survey conducted by individual consultant of UNDP for the year 2014 to 2019; earlier surveys conducted by UNDP in 2014; conducted virtual stakeholders discussions; visited relevant Department, Ministries and companies wave sites due to lockdown for COVID 19 pandemic; consult various books and information, documents and guidelines of UNDP, UNIDO, UNEP, GIZ and individual experts, etc.

It is to be mentioned here that National Cooling Plan; need assessments for RAC service technician; review and revision of Rules and Regulations, review of data reporting system, introduction of HS Code for HFCs etc. is underway.

2. KIGALI AMENDMENT AND ITS IMPLICATION TO BANGLADESH

2.1 Kigali Amendment

In October 2016, during the 28th Montreal Protocol Meeting of the Parties in Kigali, Rwanda, 197 countries adopted the "Kigali Amendment" on HFCs. The Kigali Amendment establishes specific target and time tables to phase-down production and consumption of HFCs. Developed countries agreeing to help finance the transition of developing countries to help meet the global commitment to avoid over 80 billion metric tons of CO2 eq. emissions by 2050.

Under the Kigali Amendment, the phase-down timetable varies between 4 different country group. Most non-article 5 (developed) countries begin their phase-down by 2019 and must achieve an 85% cut from their baseline by 2036. Article 5 countries are split into 2 groups and will follow a slower timetable starting with a freeze in either 2024 or 2028. The final phase-down steps in Article 5 countries are in 2045 or 2047.

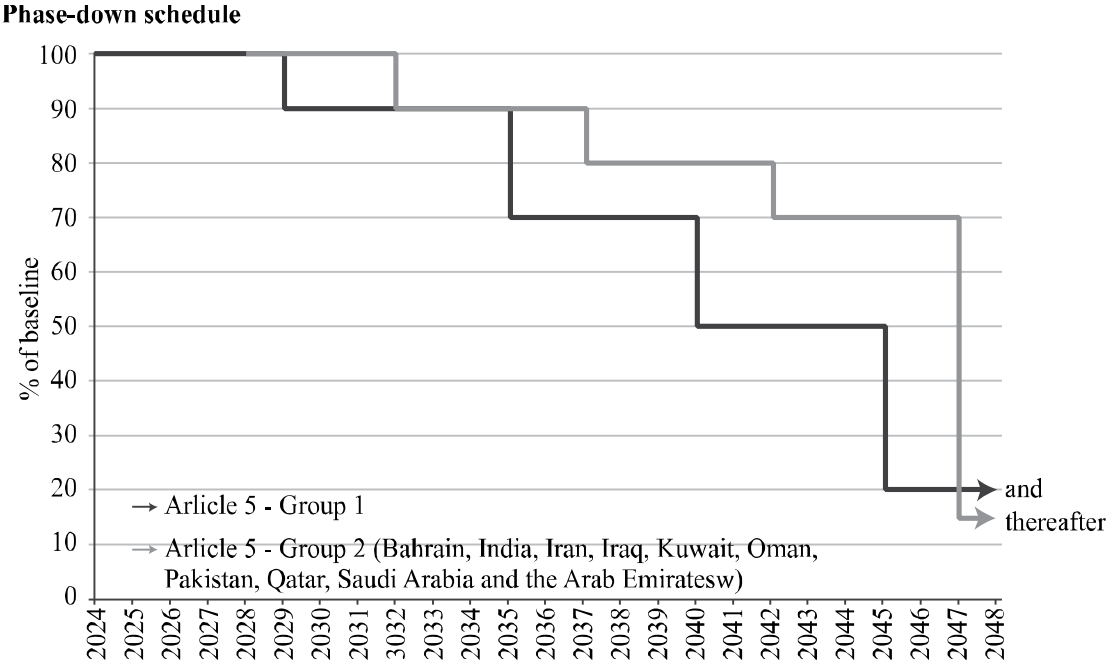
Countries ratifying the Kigali Amendment commit to cut their production and consumption of HFCs by over 80% over the next 30 years. Most developed countries started reducing HFCs by 2019, while developing countries (group I) will freeze their HFC production and consumption in 2024.

In addition, countries are encouraged to begin examining opportunities to increase the energy efficiency of appliances and equipment to achieve additional GHG mitigation, while also delivering sustainable development benefits such as better air quality, improved public health, improved energy access and energy security. Efforts made by countries to phase down HFCs can be part of their Nationally Determined Contributions (NDCs) under the Paris Agreement of the UNFCCC. To encourage developing countries towards more energy efficiency, a group of 19 philanthropic contributed US$ 52 million in the transition in the name of Kigali Cooling Efficiency Programme (K-CEP) with the goal to "significantly increase and accelerate climate and development benefits of the Montreal Protocol refrigerant transition by maximizing a simultaneous improvement in the energy efficiency of cooling".

2.2 Implication to Ratifying Kigali Amendment to Bangladesh

Bangladesh is one of the article 5 Group I country was involved throughout the international negotiations regarding the Kigali Amendment and strongly supported phase-down of HFCs under Montreal Protocol and has agreed to the final text of the amendment. Baseline will be establish as per average consumption of 2020 to 2022 and consumption will be freeze at 2024. The detailed HFC Phase-down schedule applicable for Bangladesh is shown below:

	Article 5 Prties: Group 1		Article 5 Prties: Group 2	
Baseline Years	2020, 2021 & 2022		2024, 2025 & 2026	
Baseline Calculation	Average production/consumption of HFCs in 2020, 2021 and 2022 plus 65% of HCFC baseline production/consumption		Average production/consumption of HFCs in 2024, 2025 and 2026 plus 65% of HCFC baseline production/consumption	
Reduction steps Freezw	2024		2028	
Step 1	2029	10%	2032	10%
Step 2	2035	30%	2037	20%
Step 3	2040	50%	2042	30%
Step 4	2045	80%	2047	85%



As a vulnerable country to the climate change, Bangladesh conducted an initial survey in 2014 for the year 2011, 2012 and 2013 under a financial assistance of Climate and Clean Air Coalition (CCAC) to reduce short-lived climate pollutants, administered by UNDP. Based on those information Government took part confidently into the HFC phase down negotiations held during Meeting of the Parties to the Montreal Protocol and also initiated primary activities long before Kigali Amendment adopted in Rwanda in 2016.

First demonstration project to introduce low GWP alternatives to the manufacturing of Refrigerator was implemented in Bangladesh in 2014 under financial assistance of the US Department of State, administered by UNDP. Low GWP and Energy Efficient HC-600a was introduced by replacing high GWP, HFC-134a, during manufacture of refrigerator at Walton Hi-tech Industries Ltd.

In July 2017, 79th Ex.Com of MLF decided to assist developing countries with Enabling Activities which will help assist early ratification of the Kigali Amendment. These include developing institutional arrangements, preparation of National Cooling Plan review of licensing system, data reporting of HFC consumption and preparation of national strategies etc. Ex.Com also decided to assist stand alone conversion project since 79th Ex.Com onward.

As a quick start actions in response to the Ex.Com decisions, Bangladesh developed a full size complementary stand alone conversion project from HFC-134a to HC-600a in domestic refrigerator manufacturing enterprise, Walton Hi-tech Industries Ltd. situated at Chandra, Gazipur. Bangladesh also submitted a complementary project for the conversion of HFC-134a based compressor to HC-600a for the same enterprise. UNDP as a developing partner provided technical support and accomplished all the activities of the project in record time, one year 2019 and able to 282,000 tonnes of CO_2 eq. emission reduction. Due to reduction of 197.3 MT of HFC-134a, UNDP advocates to employ female technician into the converted plant at Walton. With completion of this first ever stand alone conversion project, Bangladesh could phased out 100% use of HFC-134a in the domestic refrigerator manufacturing process. Additional emphasis was given to newly converted refrigerator for energy efficient, Walton developed 24 energy efficient model of domestic refrigerator and took certificate from Bangladesh Standard and Testing Institute (BSTI) first time in the history of refrigerator manufacturing process of Bangladesh. Capacity building of all the service and production technician were build through hands on training under this project could save 47,662 metric tones of CO_2 eq. by emission reduction of 33.33 Metric Tonnes of HFC-134a during production and servicing.

By this dress rehearsal, National Ozone Unit of Bangladesh gathered experience to mitigate consumption of HFCs and in the same time gather experience to work for energy efficiency of the RAC product.

At the same time Government of Bangladesh took initiatives to ratify the KA. A series of stakeholder meeting were organized during 2019 and all the sector associations, government, semi-government, private enterprise, NGOs and ellites were participated during the negotiations and discussions. Also a number of awareness building seminar organized by the National Ozone Unit and UNDP during the period. Ultimately government agreed and signed the ratification instrument on 24th March 2020 which was submitted to the UN depository on 6 June 2020 due to COVID-19 pandemic.

After ratification, the initial obligation of Bangladesh are:

1. Establishing and implementing an effective licensing system to control import and export of HFCs (Virgin and recycled) and HFCs used in mixtures as per Article 4B of the Montreal Protocol form 01 January 2021;
2. Reporting consumption of HFCs along with HCFCs consumption data in the prescribed form to the ozone Secretariat (Article 7 data) and country programme implementation data (CP data) to the MLF Secretariat from 2020 every year;
3. Freezing the consumption of HFCs and HFCs blends from January 2024 at the baseline level.
4. Ban import and export of HFCs and HFCs containing blend (Both virgin & recycled) with non parties to the Kigali Amendment to the Montreal Protocol.
5. Reduce consumption of HFCs and HFCs blends as per phase-out schedule of group I of the Article 5 countries to the Montreal Protocol. That is 10% reduction in January 2029; 30% reduction in January 2035; 50% reduction in January 2040 and 80% reduction in January 2045.

As government ratified the Amendment on 8 June 2020, it is pragmatic to evaluate and consider major advantages and disadvantages to implement the Protocol and to take necessary actions as per country prospect.

2.3 The Benefits of Becoming a Party to the KA

While Kigali Amendment has implications to Bangladesh as mentioned above, the Kigali Amendment also brings benefits to the Bangladesh (if ratifying) as follows:

1. Demonstrate country commitment toward global environment.
2. Contribute to INDC
3. Access to MLF funding for implementation of the KA.
4. Obtained Climate benefit by reducing use of HFCs in the country.
5. Obtained double benefit if initiatives to be taken to produce energy efficient RAC equipment
6. Boost export of RAC equipment by implementing conversion project as soon as possible.
7. Reduce/save energy by introducing environment friendly and energy efficient technology in the RAC sector.
8. Avoid implication from trade sanction with other parties.

3. SUBSTANCES CONTROLLED AND UNCONTROLLED UNDER MONTREAL PROTOCOL

The Montreal Protocol controls the production and consumption of a range of chemicals that damages the ozone layer. These are called ozone depleting substances (ODS). In the Kigali amendment, the Protocol extended to control the production and consumption of HFCs. These are not ODS, but they are very powerful Green House Gases (GHGs).

In the Montreal Protocol, controlled substances are categorized and listed as Annex A, Annex B, Annex C, Annex E and Annex F whether they exists alone or as mixture. Montreal Protocol started with provision of 50% control on production and consumption of 5 CFCs listed in Annex A, Substances in Annex B,C,C, E and F put under control subsequently through amending Protocol in the Kigali in 2016.

Table E1 : Number of Controlled Substances in Montreal Protocol.

Families of Substances	Annex A	AB	Annex C	AC	AF
Chlorofluorocarbons (CFCs)	5	10			
Bromochlorofluorocarbons (Halons)	3				
Hydrochlorofluorocarbons (HCFCs)			40		
Hydrobromofluorocarbons (HBFCs)			34		
Hydrofluorocarbons (HFCs)					18
Single Substances					
Carbon Tetrachloride					
1,1,1-trichloroethane					
Methylbromide					
Bromochloromethane					

Note : The substances listed in the above mentioned Annexes not included mixtures of ODS and all the chemicals are not using. Most commonly used controlled substances listed in the table below. These are about 95% of total controlled substances quantitatively .

Table E2 : Most commonly used control substances

Chlorofluorocarbons (CFCs)	CFC-11, CFC-12, CFC-113, CFC-114, CFC-115
Bromochlorofluorocarbons (Halons)	Halon-1211, Halon -1301
Hydrochlorofluorocarbons (HCFCs)	HCFC-22, HCFC-123, HCFC-124, HCFC-141b, HCFC-142b
Hydrofluorocarbons (HFCs)	HFC-134a, HFC-125, HFC-143a, HFC-23, HFC-32, HFC-152a, HFC-227ea, HFC-245fa, HFC-365 etc.

Note : Mixture are not mentioned in above table.

Substances not controlled under the Montreal Protocol : All the ODSs and HFCs are not controlled under Montreal Protocol and not mentioned in the Annexed in the list above. These chemicals can be identified into two categories:

1. Annual use is negligible and/or the ozone depleting potential (ODP) or global warming potential (GWP) is extremely low. These are :

    - Hydrofluoroolefines (HFOs) are unsaturated fluorocarbons have a very short atmospheric life and a very low GWPs in the range of 4 to 9 and not included in the list of controlled substances. For example, HFO-1234yf, increasingly used in mobile air conditioning has a GWP 4. Some HFOs are unsaturated fluorocarbons with very low GWPs and ODPs, not taken under control of the Protocol.

- Low GWP HFCs are not taken into control. For example HFC-161 (GWP=12) is not included in the list of control substances.
- Dichloromethane which has ODP of 0.4% of CFC-11 using increasingly in the manufacture of point stripper solvents not taken under control to the Protocol.
- 1,2 Dichlorethane with an ODP of 0.001 using in the manufacture of vinyl chloride (priniepally for PVC pipe) and also as an additive in the motor vehicle fuels.

2. The families of chemicals are very different in terms of source and usage to those controlled by the Montreal Protocol.

    - Nitrous Oxide (N_2O) is a significant ozone depleting substances with ODP computed under normal atmospheric condition is 0.017 and GWP 265-298 not included in the Montreal Protocol. Major source of N2O is agriculture as well as from industry and the barring of fossil fuels and biomass.

4. DIRECT AND INDIRECT EMISSION OF GHG

In all countries including Bangladesh, the successful implementation of the Kigali Amendment requires addressing two types of emissions from refrigeration and air-conditioning (RAC) equipment.

Direct emission from refrigerant gases, foams, solvents contribute to climate change when fluids with Global Warning Potential (GWP) are released into the atmosphere. The higher the GWP (reference CO_2=1), the stronger the negative climate impact.

Indirect emissions are produced when RAC equipment consumes energy, resulting in the emission of greenhouse gases (GHG) from power plants. As energy production is the primary factor in the emission of GHG in the atmosphere, reduction of energy use is a key consideration.

|In fact, direct emission only make up 10 to 40 percent of total climate impact, while the remaining 60 to 90 percent are indirect emission occur during various stages of production, operation, maintenance and end of the treatment. Therefore, the effectiveness of the Kigali Amendment in driving down GHG emission hinges on a nations ability to effectively address direct and indirect emissions in national strategies.

5. ODS AND ODS ALTERNATIVES SURVEY

5.1 Reconnaissance Study on HFC (2014)

Kigali Amendment adopted in 2016. But the negotiations started since 2009. To take initial stock and for the understanding HFC consumption situation, Government conducted a reconnaissance study in 2014 on HFC import and sector-wise consumption for the year 2011, 2012 and 2013. That study was funded by "Climate and Clean Air Coalition (CCAC)" administered by UNDP, Bangladesh which was very much helpful during negotiations of HFC Phase-down.

5.2 ODS and ODS Alternative Survey (2016)

First ODS and ODS Alternative survey was carried out in 2016 during preparation of "HCFC Phase-out Management Plan (Stage-II)". Primary aim was to prepare a comprehensive programme for the phase-out of HCFCs which was helpful to gather information regarding uses of alternatives of ODS in the country.

5.3 ODS and ODS alternative Survey (2020)

A detail survey was carried out during 2019-20 on import and sector-wise consumption of ODS and alternatives in 2019-20 by UNDP (funded by MLF) to assist government to initiate activities regarding implementation of Kigali Amendment to the Montreal Protocol. Government ratified Kigali amendment on 08 June, 2020 and now preparing National Cooling Plan, assessing need for service sector, evaluating need for service sector, evaluating data collection mechanism, data reporting and also preparing work plan and strategy for the implementation of Montreal Protocol by utilizing data and information of this ODS and ODS alternative survey.

5.4 Import of ODS and ODS Alternatives during 2014 – 2019.

Production: There was no production of ODS and ODS alternatives except ammonia (R-717) during the survey period.

Export: Bangladesh did not export any virgin HFCs. Walton Hi-tech Industries Ltd. exported their domestic refrigerator since 2015 and HC-600a based compressor was only exported to the European market in 2020 soon after conversion projects accomplished.

Imports: The main importing ODSs are R-22, R-123 and R-142b. ODS alternatives are mainly HFCs and HC600a were being imported primarily from USA, Japan, China, Singapore, Thailand etc. The consumption of imported ODSs during 2014-2019 is shown in the **Table 3**.

Table E3: Consumption of imported ODSs during 2014 to 2019 (MT)

Name of ODS	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
R-22	1,020.00	1148.15	1141.81	1132.88	852.90	862.716
R-123	3.00	7.00	11.00	7.00	3.01	2.50
R-406a	25.75	15.64	15.64	15.64	7.75	23.256
Total	**1048.75**	**1170.79**	**1232.63**	**1155.52**	**863.66**	**888.472**
Total ODP (Tons)	**56.626**	**64.18**	**63.91**	**63.34**	**47.41**	**48.838**

Source: NOU & NBR

Note: [*ODP of R-22 = 0.055, R-142b = 0.065, R-123 = 0.020; the composition of R-406a consists of 55% R-22, 41% R142b and 4%R-600a* ***]*** *Mixed polyol containing R-141b not considered as consumption after 2013 as per MP.

The consumption of ODS alternatives during 2014-2019 is shown in the **Table 4**.

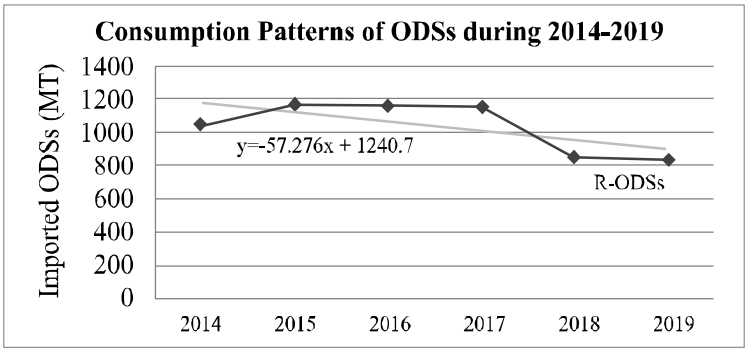
Table E4: Consumption of ODS alternatives during 2014 to 2019 (MT)

Sl. No.	Refrigerants	2014 (MT)	2015 (MT)	2016 (MT)	2017 (MT)	2018 (MT)	2019 (MT)
1	R-134a	638.8	766.5	1012.1	1497.6	1677	1755.542
2	R -32	1.5	1.9	0.8	0.0.550	1.750	2.540
3	R- 227ea	1.2	2.5	2.8	3.0	3.1	3.56
4	R-404A	14.7	16.5	16.9	12.3	12.0	27.213
5	R-410A	20.	21.3	100.6	221.3	307.1	822.542
6	R-407C	2.8	3.9	27.3	32.2	44.3	21.3523
7	HC-600a	34.6	43.8	118.8	201.8	280.3	285.23
8	HC-290		2.0	1.5	-	-	-
9	Cyclopentane	550.0	600.0	700.2	786.584	885.2	953.543

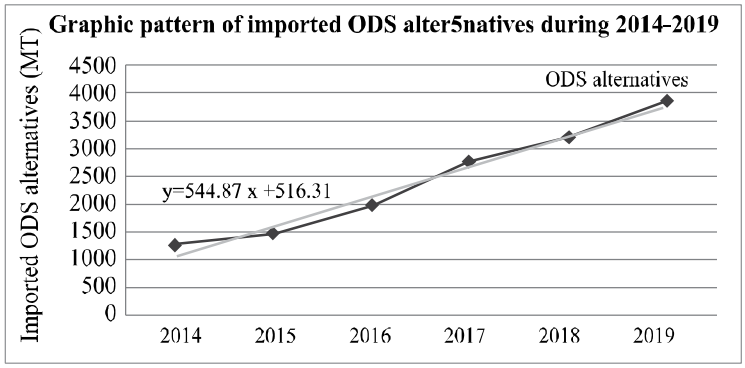
Source: NBR & Chittagong Port, 2019

Note: [*R-404A (44% HFC-125, 52% HFC-143a, 4% HFC-134) ; R-407C (25% HFC-125, 52% HFC-134a, 23% HFC-31); R-410A (50% HFC-125 & 50% HFC-32); HC-600a (iso-butane); HC-blend (C-30): {50% HC-600a & 50% HC-290}; Cyclopentane: HC blowing agent]*.

Graphical representation of consumed ODSs and ODS alternatives are shown as below:



Graphical representation of ODSs during 2014-2019 showed a gradual decreasing trend



5.5 Technology trends in RAC Sector

Refrigeration and Air-conditioning (RAC) sector require zero ODP, low or negligible GWP and energy efficient refrigerant. Refrigerant is chosen on the basis of its physical properties and its thermodynamic ability to perform the task assigned to the specific application. Unfortunately, no single refrigerant or refrigerant type fits all possible applications and therefore the industry has to cope with a number of them, with different properties and characteristics.

Some of the refrigerants that emerged during implementation of Montreal Protocol have high global warming potential (GWP) and contribute to climate change. From a technology point of view this poses a real challenge, because such high GWP fluids, most of which are hydrofluorocarbons or HFCs have become the backbone of many RAC sectors in the past two decades. So, it is better to discuss technology trends by sub-sector.

5.5.1 Domestic Refrigeration

Under the domestic appliance category, the domestic refrigeration sub-sector is the major component and comprises appliances that are broadly used domestically, such as refrigerators, freezers and combined refrigerator/freezers products. Small beverage dispensing machines are similar products and are commonly included in domestic refrigeration, but represent a small fraction of total units.

All types of refrigeration equipment have been manufactured/ assembled in Bangladesh. In 2019, about 4.5 million different types of refrigeration equipment were manufactured and assembled in the country. It is to be mentioned here that about 80% of the total refrigerator appliances are manufactured in the country.

According to the ODS alternative survey carried out by UNDP Bangladesh, about 12 companies were engaged to manufacture and assemble around 4.5 million appliances. Out of which about 3.88 million were domestic and 0.68 million were commercial.

Following a bilateral project with the US Department of State assisted through UNDP to convert one production line using HFC-134a in 2015 in the Walton Hi-tech Industries Ltd. for their refrigerator manufacturing plant. The project was successfully completed and in 2017 again Montreal Protocol Multilateral Fund assisted to convert the remaining three lines with R-600a and the project was successfully completed at the end of 2019. Now all the domestic refrigerator manufacturing with HC-600a and commercials refrigeration are still remain in HFC-134a, need intervention during phase-down of HFCs in the coming years.

Table E5: Consumption of refrigerants in domestic and commercial refrigerators manufacturing industries (MT)

Years	R-134a (MT)	HC-600a (MT)	R-404A (MT)	R-22 (MT)
2014	290.385	18.821	3.298	9.680
2015	320.850	26.082	3.809	11.178
2016	362.796	42.562	1.554	3.040
2017	359.251	60.624	0	0
2018	359.586	79.291	0	0
9019	336.197	104.976	0	0

5.5.2 Industrial Refrigeration

1. **Chillers:** A chiller is a machine that removes heat from a liquid via vapor compressor or absorption refrigeration cycle. This chilled liquid then circulate through a heat exchanger to cool equipment, or another process stream (such as air or process water). Heat generated as byproduct can be utilized in industrial purposes. There one many types of chillers.

   In the small industrial chillers mainly R-22, R-134a, R-404a, R-407C and R-410a are using in Bangladesh. According to the ODS alternative survey carried out in 2019, it is revealed that about 1100 chillers were installed in Bangladesh in 2019. Percentage share of refrigerants were R-22 (75%), R-410a (20%), R-404a (4%) and R-407C (1%). As ODS is under controlled and import is going down, it is obvious that use of alternative to R-22 will be increasing in the coming years. That is use of HFCs will be increased day by day.

Table E6: Consumption of refrigerants in chillers assembling industries during 2014 to 2019 (MT)

Cold storage and Fish Freezers	2014	2015	2016	2017	2018	2019
Manufacturing						
R-22	2.70	3.15	3.40	3.60	3.70	4.13
R-410A	0.18	0.21	0.48	0.81	1.20	1.32
R-404A	0.14	0.17	0.19	0.25	0.24	0.29
R407C	0.04	0.05	0.05	0.06	0.07	0.07
Servicing						
R-22	2.70	3.15	3.40	3.60	3.70	4.13
R-410A	0.18	0.21	0.48	0.81	1.20	1.32
R-404A	0.14	0.17	0.19	0.25	0.24	0.29
R407C	0.04	0.05	0.05	0.06	0.07	0.07

Survey 2019

2. **Cold Storage :** In Bangladesh, the majority of large industrial system, such as cold storage, fish freezing, textiles, pharmaceuticals etc. are using Ammonia (R-717) which is locally manufactured and cheaper.

   In industrial refrigeration such as industrial heat pumps and heat recovery using R-134a, R-404a and R-407c and in data server center using R-410A and R-407c and industrial chillers using R-134a. Refrigeration fishing vessels are using R-134a and R-404a.

   Cold storages are using mainly R-717. They are also using R-22 for their pre-cooling room. As per ODS alternative survey, 40 cold storages were installed those required 47.2 MT and 4.4 MT of R-717 and R-22 respectively. In the servicing about 439 cold storages went for servicing and those required 66.30 MT and 4.18 MT of R-717 and R-22 respectively.

3. **Fish Freezing Industries :** Same as cold storages, fish freezing industries are using mainly R-717 and R-22 for pre-cooling. According to the ODS alternative survey, in 2019, about 19 freeze freezing industries were installed those required 14.25 MT of R-717 and 4.18 MT of R-22 for pre-cooling room. About 800 fish freezing industries consumes 60 MT of R-717 and 11.00 MT of R-22 for servicing purposes in 2019.

Table E7: Consumption of refrigerants in Cold Storages and Fish Freezer during 2014 to 2019 (MT)

Cold storage and Fish Freezers	2014	2015	2016	2017	2018	2019
Manufacturing						
R-717	35.00	38.00	46.00	49.25	58.75	61.45
R-22	6.38	6.82	8.14	7.26	9.02	8.58
Servicing						
R-717	78.63	82.68	92.95	106.38	121.17	126.30
R-22	6.40	6.82	8.69	10.94	12.80	15.18

Survey 2019

5.6 Transport Refrigeration

Transport refrigeration is quite a big area and have specific challenges such as shock, vibration, corrosion and broad operating conditions. So selection of refrigerant and refrigerating systems are substantially different one form another.

This system comprises of delivery of frozen products by means of frozen trucks, trailers, van, refer container etc. Ship breaking, ship building, inland & outgoing shipping vessels, fishing vessels etc. are included in this segment.

i) **Ship Breaking:** During ODS alternative survey, it was revealed that there are about 200 ship breaking yard working in Bangladesh. They are mostly collected virgin refrigerants from the ships that comes for braking purposes. Refrigerants are R-22, R-134a, R-404a, R-410a etc. It is to be mentioned here that machines do not contain any refrigerant when they comes in the country territory. Because ship operators vacated refrigerant during entering into the country territory for breaking purpose. So practically no refrigerant recovered during ship breaking. Only virgin refrigerants are collected from ship during breaking.

ii) **Ship Building:** There are about 130 companies/organization engaged in Bangladesh for ship building. In 2019, 70 small and 50 medium sized ships were build required 2.04 MT R-22, 1.68 MT R-410a and 0.976MT or R-404a.

Table E8: Consumption of refrigerants in Ship Building during 2014-2019 (MT)

(i) Ship Building	2014	2015	2016	2017	2018	2019
Manufacturing						
R-22	1.020	1.260	1.720	2.165	2.560	2.040
R-410A	0.120	0.150	0.522	0.924	1.140	1.684
R-404A	0.060	0.090	0.298	0.476	0.700	0.976

iii) **Abroad Shipping Vessels:** According to the Mercantile Marine Office of Chittagong, about 3000 foreign vessels entered into the country in 2019 and collected about 30.4 MT of R-22, 1.0 MT of R-134a and 0.60 MT of R-410a.

Table E9: Consumption of refrigerants in Abroad Shipping Vessels during 2014 to 2019 (MT)

(ii) Abroad Shipping Vesels	2014	2015	2016	2017	2018	2019
Servicing						
R-22	24.700	25.600	26.600	27.500	28.500	30.400
R-134a	0.800	0.800	0.800	0.900	0.900	1.000
R-410A	0.500	0.500	0.600	0.600	0.600	0.600

iv) **Marine Fishing Vessels**: According to the Marine Fisheries Office of Chittagong, about 320 marine fishing vessels were engaged in Bangladesh territory in 2019 and recharged about 0.41 MT of R-22 0.05 MT HFC-134a and 0.5 MT R-410a in 2019.

During building marine fishing vessels in 2019, about 0.210 MT R-22, 0.024 MT of R-134a and 0.024 R-410a were used.

Table E10: Consumption of refrigerants in Mstomr Fishing Vessels during 2014-2019 (MT)

(iii) Marine Fishing Vessels (MFVs)	2014	2015	2016	2017	2018	2019
Manufacturing						
R-22	0.160	0.184	0.184	0.192	0.192	0.210
R-134a	0.088	0.008	0.024	0.024	0.024	0.024
R-410A	0.088	0.088	0.088	0.088	0.024	0.024
Servicing						
R-22	0.32	0.36	0.36	0.39	0.38	0.41
R-134a	0.02	0.02	0.04	0.05	0.05	0.05
R-410A	0.02	0.02	0.02	0.02	0.05	0.05

v) **Inland Fishing Vessels :** About 200 inland fishing vessels were manufactured in the country and those consumes about 0.8 MT HFC-134a and 0.850 R-410a. For recharge purpose of existing 2020 inland fishing vessels, about 2.20 MT of HFC-134a and 0.30 MT of R-410a was consumed in 2019.

Table E11: Consumption of refrigerants in Inland Fishing Vessels during 2014-2019 (MT)

(iv) Inland Fishing Vessels (IFVs)	2014	2015	2016	2017	2018	2019
Manufacturing						
R-134a	0.225	0.225	0.832	0.896	0.720	0.800
R-410A	0.00	0.00	0.306	0.323	0.765	0.850
Servicing						
R-134a	2.34	2.43	0.90	1.20	1.81	2.20
R-410A	0.00	0.00	0.14	0.20	0.30	0.30

vi) **Reefer Containers :** According to the survey report 35000 reefer container were entered into Bangladesh in 2019 and 30% require full/partial charging refrigerants. Mainly HFC-134a are using. Others are R-410a and R-404a. About 1900 reefer container were build in Bangladesh in 2019 and consumption of refrigerants were 9.94 MT HFC 134a, 1.17 MT R-410a and 0.585 MT of R-404a.

Table E12: Consumption of refrigerants in Reefer Containers during 2014-2019 (MT)

(v) Reefer Containers	2014	2015	2016	2017	2018	2019
Manufacturing						
R-134a	2.472	2.949	5.015	6.077	7.820	9.940
R-410A	0.294	0.350	0.590	0.715	0.920	1.170
R-404A	0.145	0.171	0.295	0.357	0.460	0.585
Servicing						
R-134a	4.95	5.897	9.435	11.794	14.152	16.511
R-410A	0.58	0.693	1.11	1.387	1.665	1.942
R-404A	0.29	0.346	0.555	0.69	0.832	0.971

Survey 2019

5.7 Supermarkets, Hospitals, Hotels, Railway and Office building

Supermarkets : According to the recent survey, new supermarkets are using in the chillers and old super markets and using R-22 based split type ACs.

Hospitals : Big hospitals have chillers mainly using R-134a and small has split type ACs.

Hotels : Big hotels are using chillers using mostly R-134a and split ACs R-22 and R-410a. Population of R-22 based split ACs decreasing and R-410a is increasing as per report.

Table E13: Consumption of HFC-134a & R-22 in servicing Supermarkets, Hotels and Hospitals during 2014-2019(MT)

Name	Refrigerants	2014	2015	2016	2017	2018	2019
Supermarkets	R-134a	4.215	2.805	4.560	3.830	3.970	5.280
Hotels	R-134a	10.245	6.613	5.848	5.979	9.672	8.477
Hospitals	R-134a	3.580	4.105	5.100	4.568	5.188	5.434
Total		18.040	13.523	15.508	14.377	18.830	19.191
Supermarkets	R-22	7.140	6.119	6.253	6.157	3.917	5.977
Hotels	R-22	7.606	4.796	4.578	4.277	3.981	4.351
Hospitals	R-22	19.672	17.146	18.656	20.320	20.252	14.900
Total		34.418	28.061	29.487	30.754	28.150	25.228

Railway : There are 5 Railway routs in Bangladesh. Each rout contains 2-3 trains having 4-6 AC compartments. Now almost all AC compartments are R-134a & R-22 based machines and 30% of them need yearly recharge. Consumption of 2019 was 0.924 MT R-22 and 1.45 MT of R-134a.

Banks : There are 48 and 9 private and public banks in the country. As per Bangladesh Bank, about

10,114 no of branches operating in 2019. All have ACs based on R-22 (70%) and R-410a (30%). Consumption in 2019 were 10.345 MT R-22 and 6.345 MT of R-410a.

Office Building : During ODS alternative survey, data for office building were collected reveals that consumption of bothR-22 and R-134a increasing upto 2018. Consumption of both the chemicals were decreased in 2019.

Table E14: Consumption of R-134a & R-22 in servicing Railway, Banks an Office buildings during 2014-2019

Name	Refrigerants	2014	2015	2016	2017	2018	2019
Railway	R-134a	0.500	0.880	0.890	0.710	1.470	1.450
Banks	R-134a	5.123	5.421	6.321	6.841	5.987	6.345
Office buildings	R-134a	3.357	3.647	3.861	4.015	4.285	3.982
Total		8.98	9.948	11.072	11.566	11.742	11.777
Railway	R-22	0.320	0.458	0.514	0.497	0. 751	0.924
Banks	R-22	8.320	9.325	7.321	10.741	9.987	10.345
Office buildings	R-22	6.552	6.617	6.761	7.915	8.285	7.982
Total		15.192	16.4	14.596	19.153	18.272	19.251

5.8 Air-conditioning Manufacture Assembly

It was understood from the ODS alternative survey that residential, commercial, industrial and mobile air-conditioning equipment was being assembled in Bangladesh. The trend of production assembling of ACs and trend of consumption of refrigerants are given below.

Table E15: Consumption of refrigerants in AC during 2014 to 2019

Years	R-22 (MT)	R-410A (MT)	R-134a (MT)	R-407C (MT)
2014	381.187	9.628	11.033	1.003
2015	399.711	10.097	11.571	1.051
2016	474.524	63.270	-	-
2017	521.452	208.575	-	-
2018	510.887	330.113	-	-
2019	505.440	404.316	-	-

5.9 Technology Trends in Foam Sector

During adjustment of Montreal Protocol to accelerate phase-out of HCFCs in Montreal in 2007, there was only one refrigerator manufacturing company of Bangladesh. Walton Hi-tech Industries Ltd. was producing Polyurethane (PU) foam for the production of their refrigerator and their consumption of HCFC-141b was significant. A stand alone project was undertaken and completed in 2014. About 183.6 MT of HCFC-141b was replaced by energy efficient, low cost and environment friendly cyclopentane (C5).

During the survey conducted in 2011 for the preparation of HMMP Stage-I, a few very small foam manufacturing companies were identified other than Walton but they were not assisted by MLF as they started their production after 2007.

During ODS alternative survey it is identified that 4 (four) companies are using mixed polyol containing HCFC-141b and HFC-134a during production of spray foam, and their consumption is continuously increasing.

Table E16: Consumption of HFC in Spray Foam during 2016 to 2019 (MT)

Name of industries	Consumption of HFCs during 2016-2019 (MT)			
	2016	2017	2018	2019
Wattson Euro Panel industries Ltd.	5.50	7.80	10.20	13.12
Star PU Products		2.51	3.24	4.25
Radian Technology		0.5	1.0	1.25
SS Corporation		0.50	0.50	0.55
Total	**5.500**	**11.31**	**14.94**	**19.17**

Table E17: Consumption of R-141b in Foam products during 2016 to 2019 (MT)

Name of industris	Consumption of R-141b in Foam during 2014-2019 (MT)					
	2014	2015	2016	2017	2018	2019
Wattson Euro Panel industries Ltd.	248.81	263.69	282.38	285.12	295.24	307.14
Star PU Products	4.59	12.33	13.45	13.51	13.74	13.69
Radian Technology	2.00	4.43	5.87	6.70	7.27	7.64
SS Corporation	1.33	5.71	5.97	6.37	6.73	6.96
Total	**256.73**	**286.16**	**307.67**	**311.70**	**322.98**	**335.43**

5.10 Technology Trends in Fire Fighting

First generation fire fighting components was halon and it was phased-out in1995 by HCFC-123 in portable fire extinguishers now gradually decreasing. Now use of HFC-227ea is increasing as substitute of halons.

Other conventional systems are water, water mist, CO_2, inert gases, fine solid particles (powders), dry chemicals, aqueous film forming foam successfully contributing in the firefighting in Bangladesh.

Table E18: Consumption of HFC-227ea in Fire extinguishing during 2014-2019 (MT)

application	Consumption of HFC-227ea in Fire extinguishing during 2014-2019 (MT)					
	2014	2015	2016	2017	2018	2019
HFC-227ea	1.2	2.538	2.8	2.96	3.12	3.56

5.11 Technology in Aerosol Sector

Non-medical Aerosol : During 1998 to 2020, a stand alone conversion project was implemented in ACI Ltd. to convert CFC based aerosol production to Hydrocarbon. Hydrocarbon is low cost that HFCs and also environment friendly and physical properties are similar to CFCs.

Medical Aerosol : One of the taught challenge was to convert CFC based Metered Dose Inhalers (MDIs) in the last decades. HFCs are the only proven available alternative propellant for MDIs. It is safe, no flammable and virtually non-toxic.

Over 500 million people suffer from asthma and chronic obstructive pulmonary disease (COPD) and 1/125 deaths can be attributed to asthma. DPIs and Nebulizer are normally used along the MDIs for the treatment of Asthma and COPD. Propellant used must be safe for human used and to be meet several criteria relating to safety and efficacy. These are mainly i) liquefied gas , ii) low toxicity, iii) non flammable, iv) chemically inactive and stable, v) acceptable to patients in terms of taste and flavour vi) appropriate solvency characteristics and vii) appropriate density. It is however extremely difficult to identify chemicals fulfilling all these criteria and to be environmentally acceptable.

Three low GWP chemicals were under study as potential propellants for MDIs. These are isobutane, HFC-152a and HFO-1234ze as per Medical Technical Option Committee (MTOC) report of 2018.

Respiratory devices and treatment methods	Carbon footprint per dose (Grams CO_2 eq.)
CFC MDIs	1500-2000
HFC-134a MDIs	200-300
HFC-227ea MDIs	600-800
Dry Powder Inhalers	<20
Tablet	<20
HFC-152a MDI	About 20

According to MTOC report 2018, about 800 million MDIs were produced (average fill weight 13/14.5 gm/MDI) worldwide using approximately 11,500 MT HFC-134a (92%) and the rest HFC-227ea was used (8%). This corresponds to direct emissions with a climate impact of approximately 18000 ktCO_2 eq which is about 2% of the global HFC emission.

During 90's only three pharmaceuticals were produced CFC based inhalers and they started their CFC based inhalers product after cut of date of the MLF fixed for getting technical and financial assistance, Government had taken initiatives to find technical support for the mentioned three pharmaceuticals and ultimately got support abut 3.0 million US$ and successfully phase-out CFCs by 2012 introduced only trusted available alternative HFC-134a.

Now about 9 (Nine) pharmaceutical manufacturers are producing MDIs and their annual consumption is increasing.

Table E19: Consumption of HFC-134a in MDI during 2014 to 2019 (MT)

Name of companies	2014	2015	2016	2017	2018	2019
Beximco	60	718	97	152	192	210
Square	32	38	33	57	60	65
ACME	4.6	5.43	7.34	7.62	8.85	9
GlaxoSmithKline (GSK)	8.62	10.18	12	13.4	14.3	14.5
ACI Ltd	9.43	11.13	13.38	14.86	15.4	15.8
Health Care Pharmaceutical Ltd	1.15	1.4	1.44	1.8	2	2
Aristopharma	1.9	2.24	2.54	3	3.5	4
Drug International	-	1	1.5	1.89	2	2.501
Bangladesh Pharma	-	-	0.962	1.008	1.426	1.502
Total	117.70	787.38	169.16	252.58	299.48	324.30

During ODS alternative survey there were no industrial medical aerosol produced by any of the manufactures of Bangladesh.

5.12 Technology trends in solvent sector

In 90's Methyl Chloroform and Carbon Tetrachloride were used for cleaning and as solvent. These were phased-out in 1 January 2010 as per Montreal Protocol obligation.

Many alternatives such as aqueous and semi-aqueous cleaning, hydrocarbons and alcohols based solvents; and in-kind solvents such as chlorinated and fluorinated solvents include HFCs with various levels are using.

The common spot cleaning agents in the readymade garments industries are acetone, benzene, chloroform, cyclohexane, dichloroethane, ethyl acetate, isopropylalchol etc have been used as alternatives.

Comparison with HFCs consumption is other sector, use of HFCs in these sector is quate negligible and need not intervene in this moment.

Table E20: Consumption of ODS alternatives in service Sector in 2019

Application	R-134a	R-404A	R-410A	R-407C	R-227ea	R-32	HC-600a	R-717
Domestic Refrigerator	421.52	-	-	-	-	-	81.29	-
Commercial Refrigerator	388.78	10.17	-	-	-	-	72.56	-
Industrial Refrigeration	-	4.47	11.50	-	-	-		126.30
Transport Refrigeration	59.81	9.12	9.50	6.25	-	-	-	-
Domestic Air-conditioner	49.37	0.20	59.40	10.70		7.04	-	-
Commercial Air-conditioning	29.34		286.33	-	-	2.13	-	-
Industrial Air-conditioner	-	0.10	46.53	4.24	-	-	-	-
Mobile Air-conditioner	77.9	1.50	-	-	-	-	-	-
Fire Extinguisher	-	-	-	-	3.56	-	-	-
Total	**1026.72**	**25.56**	**413.32**	**21.19**	**3.56**	**9.17**	**153.85**	**126.30**

Source: Survey 2019

6. RAC SERVICING SECTOR

6.1 Introduction

As per ODS Alternative Survey, there are about 16000 service shops on RAC in the country Division wise distribution are Dhaka (6050), Mymensing (600), Chittagong (3560), Khulna (2000), Rajshahi (1500), Sylhet (1400), Barisal (610) and Rangpur (440).

As population of Refrigerator, Freezer, ACs, Air-conditioner and Mobile AC Car/Van are increasing. Accordingly number of servicing sector are increasing. These service centers are at large, not controlled by any government agencies.

Manufacturing /assembly companies also have their own servicing arrangement as they providing warranty. They have formal setup and pool of trained service personnel.

The second channel consist of third party servicing companies. These could be either formally registered or unregistered, but they do not have any franchise with the OEM. In the MAC sector, many such enterprises offer specialized services and may even be preferred by an customers.

There are other types of non authorized service shops and they are some time called freelance technicians. They have no service shops and they are not related with any organization /companies. They have only a tool box and few knowledge on repairing RAC equipment.

Owing to the above mentioned situation, it is difficult to estimate the number of technicians operating in this sector. Even technicians engaged at enterprises often freelance during their free time.

6.2 Role of Service Technician

Role of service technician is crucial in the RAC sector. It relates with refrigerants emission during leak testing, refrigerant top-up, performance of the machine and energy efficiency. Poor servicing practices can lead to decrease in the energy efficiency of in-use air conditioners that also caused corrosion of tube, actual consumption of refrigerant during operation of equipment and also servicing.

Impact of proper installation, maintenance and servicing will increase energy efficiency of the equipment. It also prolongs life of equipment.

6.3 Training for RAC Technicians

More than 50000 RAC technicians are working in the country. Majority of them have no formal education or training. Concerned persons of the sector and association informed regarding the shortage of trained and skilled technicians in the sector.

During CFC phase out programme and also during implementation of HMPM stage-I, about 10,000 technicians were trained and awarded regarding the ozone layer depletion, its consequences and also on good service practices.

Again there are huge opportunities of expert killed RAC technician in abroad. Experts in this field informed us that about 1.0 million vacancies exists in the Middle East and in other countries. Most of the vacancies are filled up by Sri-Lanka, India an Philippines. Due to lack of skill and poor language proficiency our technicians working their as an unskilled technicians, ie, as helper.

Again during implementation of HPMP Stage II and during phase-down of HFCs under Montreal Protocol, government decided to introduce environment friendly and energy efficient alternatives. But almost all of the environment friendly and energy efficient alternatives are flammable need proper training for both manufacturing and service sectors. Training are also required for the training institutes and required to update curriculum of technical Board.

6.4 Training Module

RAC sector training under ODS Phase-out programme and assistance of MLF is not enough. These can handly meet requirement of the implementation of the Protocol. So government should take responsibilities to build capacity of this sector with additional funding will benefit unanimous.

Government should consider capacity building and to educate RAC technician as an opportunity and to prepare programme and module of the training that is to fulfill local demand and, export. Also need to prepare a code of Practice like other countries and to provide required tools for efficient servicing. Also assist to upgrade levelihoods and Social Security of the technician for sustainable development of the sector.

7. OVERVIEW OF EXISTING POLICIES

7.1 Introduction

This chapter provides a review of existing international and national policies/plans/agreements that may be relevant interfare with implementation of Kigali amendment to the Montreal Protocol.

7.2 Ongoing ODS Phase-out Plan/Programme

Bangladesh has been one of the Article 5 countries which have contribute a lot during phase-out of ODSs and earned remarkable appreciation in every phase of its implementation. It has established a comprehensive legal framework for the control of ODSs, including an enforceable national licensing system to control import and export of CFCs, Halons, Methylchloroform, CCl4, Methylbromide and HCFCs. The ozone depleting substances (Control) Rules was enacted in 2004 and amended in 2014 and these were aligned with the HCFCs phase-out schedule.

Ozone Cell was created in the Department of Environment (DoE) under the Ministry of Environment, Forest and Climate Change (MOEFCC) and has been operational since 1995. The Director General of the Department of Environment is the Chairman of the Ozone Cell and empowered by the ODS control rules to control over import/export of ODSs and to implement country programme in Bangladesh.

Bangladesh has phase out CFCs, Halons, CCl4, Methyl bromide and Methyl chloroform on 1 January 2010 as per Montreal Protocol. It only uses a few CFCs for the production of Metered Dose Inhalers (MDI)s till 2012 under Essential Use Nomination (EUN).

The main challenges faced during the CFC phase-out in the country were from the bulk uses, like, aerosol sector and medical sector. The single aerosol producing company ACI Ltd. Was consuming about 50% of CFCs in the country. The second largest industrial consumption was Metered Dose Inhalers (MDIs). But the government has so far successfully overcome all the barriers by undertaking two investment projects. One for aerosol in 1998 and another for 3 (three) renowned pharmaceuticals viz, Beximco Pharmaceuticals, ACME Laboratories and Square Pharmaceuticals in 2007 under private-public partnership. For that Bangladesh received appreciation from UNEP in 2012 for her achievement in Montreal Protocol compliance.

During urgent need of protecting ozone layer and to phase-out CFCs as per obligation of implementation of Montreal Protocol, two new group of chemicals introduced. One is HFCs which has zero ODP but high GWP and another is HCFCs which has low ODP but high GWP.

Montreal Protocol Parties in 2007 adjusted Protocol to accelerate the phase-out schedule of HCFCs in 2007 in Montreal and amended Protocol in 2016 in Kigali to phase down HFCs . Phase-down of HFCs was due to non availability of alternatives in all the sectors.

HCFCs phase-out Management Plan (Stage I) was undertaken in 2011. During survey it was identified that Bangladesh only imports HCFCs for her consumption in the RAC production & servicing, foam manufacturing, fire fighting etc. Main HCFCs using are HCFC-22, HCFC-123, HCFC-141b and HCFC-142b. Baseline established as per average consumption of the year 2009 and 2010. Baseline is 72.60 ODP tones.

Under HPMP Stage I, an investment project to phase-out HCFC 141b use in the insulin foam blowing sector was undertaken by the government as stand along project. Bangladesh is the pioneer among the developing countries of the world to phase-out HCFC 141b in the manufacturing of foam as blowing agent in 1 January 2013. Now Cyclopentane are using in foam manufacturing process which is environment friendly and energy efficient.

An non-investment project was also implemented under HPMP stage I targeting 30% reduction target by 2018. About 4000 RAC technician were trained on “Good Practices in Refrigeration and Air-

conditioning"; 100 Teachers/Instructors were trained from polytechnic and technical institutions through "ToT on good Serviced Practices in RAC"; about 300 customs officers and law enforcing officers were trained to combat illegal trade of ODSs under "Green Trade for the Protection of Ozone Layer". Besides, four ODS Identifier were distributed to the customs entry point to detect ODS. A set of five books and some essential equipments for servicing were also distributed to the technicians working in the RAC sectors.

Executive Committee of the Montreal Protocol Multilateral Fund in its 81st meeting approved "HCFC Phase-out Management Plan (HPMP) Stage-II" for the period 2018 to 2025 to reduce HCFC consumption by 67.5% of the baseline by 2025. Under HPMP stage II an investment project was undertaken to convert HCFC-22 based air-conditioners to HC-290 based energy efficient and environment friendly air-conditioners in 5 (five) manufacturing companies and one chillers manufacturing company.

Under non-investment component of HPMP Stage II 3000 RAC technicians to be trained during 2021 -2023.

Due to non-availability of environment friendly and cost effective alternatives of CFCs and due to urgent need to protect ozone layer, parties promote HCFCs and HFCs, HCFCs are low ozone depleting but high global warming ranging from 1000 to 3000 HFCs are not ozone depleting but high global warming ranging from 57 to 14800.

Table E21: GWPs and ODPs some Common Refrigerants

Type	Gas	GWPs	ODS
ODS	CFC-12	10,900	1.0
	HCFC-22	1810	0.005
HFC	HFC-404a	3922	0
	HFC-410a	2088	0
	HFC-134a	1430	0
	HFC-32	675	0
HFO	HFO-1234yf	4	0
Natural	Propane	3	0
	Isobutane		0
	CO_2	1	0

It is worth noting that CFCs had even higher GWPs than HFCs. The phase-out of CFCs was carried out to protect the ozone layer, but it had a very positive secondary benefit in terms of reducing climate impacts. After Kigali amendment, the Montreal Protocol will be a more powerful instrument against global warming.

7.3 National Level Climate Policy Context

The two key national plans to address climate change in Bangladesh are the National Adaptation Programme of Action (NAPA), developed in 2005 and subsequently revised in 2009, and the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2009 which is now the main national planning documents. Bangladesh also prepared its three National Communication Plans in 2002, 2012 and in 2018. Bangladesh released its intended National Determined Contribution in April 2015, Showing clear leadership as one of the first least developed countries to submit its document to the UNFCCC.

7.4 INDC of Bangladesh

The INDC of Bangladesh consists of the following elements in Mitigation contribution.

An unconditional contribution to reduce GHG emissions by 5% from "Business as usual (BAU)" level by 2030 in the power, transport and industry sector, based on existing resources.

A conditional 15% reduction in GHG emissions from BAU level by 2030 in the Power, transport, and industry sectors subject to appropriate international support in the form of finance, investment, technology development and transfer, and capacity building.

A number of further mitigation actions in other sectors which it intends to achieve subject to the provision of additional international resources.

It is observed that RAC and transport sector have not been accounted for the INDC Bangladesh though RAC and Transportation sector are responsible for an increasingly significant share of emission, which, at the same time can be mitigated effectively at a low cost.

7.5 Paris Agreement

The twenty first conference of Parties of COP 21 of the United Nations Framework Convention on Climate Change (UNFCCC) came to an end with all the 195 member countries of the planet agreeing to the "Paris Agreement" after a long session from November 29 to December 11, 2015 al La Bourget of Paris aiming to keep global warming below 2ºC, in accordance with the recommendations of the Intergovernmental Panel on climate change by the end of the country.

Bangladesh ratified Paris Agreement and submitted her INDC to UNFCCC in 2015. In the INDC, Bangladesh put emphasis on "Adaptation" than "Mitigation".

7.6 Climate and Clean Air Coalition

Bangladesh is one of the six founder member of the "Climate and Clean Air Coalition" to reduce short lived climate pollutants, an initiatives 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, methane and some hydrocarbon.

Since inception CCAC was patronized and cooperating parties to take decision regarding amendment to Montreal Protocol to take control over HFCs. They approved several project in various countries include Bangladesh for primary survey on import/export/production and sectorwise consumption of HFCs which helps countries during negotiation and implement demonstration projects.

Bangladesh got fund from CCAC for the primary survey on HFCs in 2013 and UNDP implement the project. A demonstration project was approved by US Department of State for one line conversion of HFC-134a based refrigerator production with environment friendly and energy efficient HC-600a refrigerant. Project was implemented by UNDP and based on that Montreal Protocol Multilateral Fund approved its first ever conversion project for the 3(three) remaining line of production with HC-600a and also conversion of compressor manufacturing process.

8. OBLIGATION UNDER KIGALI AMENDMENT TO THE MONTREAL PROTOCOL

8.1 Phase-down Schedule for Bangladesh

Table E22: Reduction step for HFC Phase-down for Bangladesh

Steps	1 January of the year
Freeze	2024
10% Reduction	2029
30% Reduction	2035
50% Reduction	2040
80% Reduction	2045

The above mentioned steps are as per Montreal Protocol schedule. But the real available quota will be ascertained during preparation country programme implementation plan and also as per agreement between Executive Committee of the Montreal Protocol Multilateral Fund and GOB. It always accelerated than the Montreal Protocol schedule.

8.2 Data Reporting

8.2.1 Article 7 Data Reporting for Ozone Secretariat

The Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer entered into force on 1 January 2019, following ratification of 65 countries. This historic amendment commits countries to phase down the production and consumption of HFCs according to agreed schedule.

During amendment, it also decided regarding data reporting that each party shall provide the Ozone Secretariat with statistical data on controlled substances : "in Annex F for the years 2011 to 2013 except that Parties operating under paragraph 1 of Article 5 shall provide such data for the year 2020-2022, but those Parties operating under paragraph 1 of Article 5 with sub paragraphs (d) and)f) of paragraph 8 qua of Article 5 applies shall provide such data for the year 2024 to 2026 .... or the best possible estimates of such data where actual data are not available, not later than three months after date when the provisions set out in the Protocol with regard to the substances in Annex B, C, E and F respectively enter into force for the Party."

Bangladesh ratified the Kigali amendment to the Montreal Protocol on 8 June 2020. So after 90 days, that is on 6 September 2020, the amendment will enter into force for Bangladesh.

As per Article 7 paragraph 3 of the Montreal Protocol, Bangladesh required to report HFC data starting the year during which the Kigali Amendment entered into force for Bangladesh (ie, 2020), and for each year thereafter.

For Bangladesh:

Ratification Date	Date of Entry in force	First year for which data to be reported	Data by which data should be reported
8 June 2020	6 September 2020	2020	30 September 2021

Data Reporting obligation to the Ozone Secretariat

According to Article 7 of the Montreal Protocol, all Parties have to report data to the Ozone Secretariat in Nairobi using the appropriate data form approved by the Parties Each Party required to report on three main categories of data : Imports (data form 1), exports (Data Form 2); and Production (Data form 3) in specific form. Additional data have to be provided by the relevant countries are Amount destroyed (Data Form 4); Import from and Export to Non Parties (Data Form 5); Quantity of Emissions of HFC 23 from Facilities Manufacturing Annex C Group or Annex F Substances (Data Form 6) to the Protocol; Imports of

Annex F Substances for Exempted Subsectors (Data Form 7); and production of Annex F Substances for Exempted Subsectors (Data Form 8).

In addition to that countries to provide data regarding Exemted Categories in the Data Form 1-4 if applicable for the country. Exempted categories are :

- Feedstock
- Quarantine and pre-shipment application (QPS)
- Amount destroyed
- Used substances (recovered and reclaimed
- Critical Uses
- Analytical Uses
- Analytical Uses and
- Exemption for high-ambient temperature Parties

Bangladesh should report Article 7 data for HFCs by 30 September 2021 for the first time and to continue afterwards. If no data are available best estimates should be reported.

8.2.2 Data Reporting Obligation to the Multilateral Fund Secretariat

Article 5 Parties that have access to the resources of Montreal Protocol Multilateral Fund need to report implementation of Country Programme Data (CP Data) along with other information listed below every year for the previous calendar year to the fund secretariat, eight weeks prior to the Executive Committee's first meeting of the year. If possible, no later than 1 May in line with decision 74/9(b) (iv).

Bangladesh ratified Kigali Amendment on 8 June 2020. So it has to report Annex F Substances by 1 May 2021 to the MLF secretariat of data for the calendar year 2020.

8.2.3 Discrepancies in Data Reporting

Bangladesh are not producing any ODSs. It only import for her domestic consumption. Export is permitted only for recovered ODSs, not virgin. So National Ozone Unit should carefully filled up both Article 7 and CP data format in order to avoid any discrepancies. Where there is a discrepancy, the country should provide an explanation for the difference in the "Remarks" column in Sections A,B and E.

Again as per Ozone Secretariat, Consumption =production +Import-Exports. But in CP report, consumption means sectorwise use of particular chemicals need to fill up in the format. In the CP format, import, production, export to be mentioned separately. Also need to report information on exempted categories in the appropriate boxes.

8.2.4 Compliance Assistance Progarmme of UNEP

UNEP has a compliance assistance programme to assist Article 5 countries from their regional office. UNEP are also cooperating Implementing Agency to the Montreal Protocol for Bangladesh. So, NOU can take technical assistance regarding data collection, compilation and also during preparation of reporting form and/or verification before sending to the ozone secretariat and to the fund secretariat.

8.3 HFC Baseline Determination and Phase-down Timetable for Bangladesh

8.3.1 Background

During Kigali Amendment to the Montreal Protocol in October 2016, Parties specified how to calculate the baseline of HFC consumption and production and also clearly mentioned the phase-down timetable.

These are four different country group, each with a different baseline and phase down time table.

8.3.2 Country Groups

The Montreal Protocol Parties are split into four following Kigali Amendment groups.

1.	Not-A5, earlier start	Most Non-Article 5 Countries
2.	No-A5, Later start	Russia, Belarus, Kazakhstan, Tajikistan, Uzbekistan
3.	A5, Group I	Most Non-Article 5 Countries include Bangladesh
4.	A5, Group II	Bahrain, India, Iran, Iraq Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, UAE.

Bangladesh belongs to Article-5, Group I, where most of the Article 5 countries opted during amendment.

8.3.3 HFC Baseline for Bangladesh

Bangladesh HFC baseline data will be available in 2023. It will be calculated based on average consumption of HFCs for the year 2020, 2021 and 2022 plus 65% consumption of HCFCs prior determined average consumption of HCFC in 2009 and 2010. Both the consumption will be calculated in GWP and will be expressed in Thousand tones of CO_2 equivalent.

Definition of consumption will be remain same as earlier, ie, Production +Import – Export – Destruction of controlled substances calculated in GWP.

8.3.4 HFC Phase-down timetable for Bangladesh

Bangladesh belongs to the Article 5 Group I countries and have to follow the following steps to phase-down HFCs during 2024 to 2040.

8.4 Establishment of licensing system for HFCs

As per decision of the Parties to the Montreal Protocol, all the Parties to the Montreal Protocol should establish licensing system to control import export of HFCs by 1 January 2021. Bangladesh has a comprehensive system to distribute quota system since 2005. So it may extend for HFCs if ODS control Rules could be amended.

9. NEED ASSESSMENT FOR THE IMPLEMENTATION OF KIGALI AMENDMENT

This section will assess the gap between the need and present infrastructure, regulation, available technology, finance, stakeholder participation etc. required for implementation of Kigali Amendment in Bangladesh as elaborated in previous sections of the report. It will also provide necessary actions and options to fill the gaps.

9.1 SWOT Analysis

Based on the earlier assessment and ODS and ODS alternative survey (2020) which was discussed in the earlier sections, key findings will be processed and summarized in a self explanatory and synthetic strength, weakness, opportunity & threats (SWOT) analysis. The SWOT table below presents the "strength and weakness" as internal factors in relation to internal capacity of NoU, available technology, local stake holders, domestic market, capacity of local industries to implement Kigali Amendment while "opportunities and threats" as external exogenous factors which are beyond the control of local stakeholders while implementing Kigali Amendment in Bangladesh.

Strengths	Weakness
• Well established and experienced National Ozone Unit to take responsibilities to implement Kigali Amendment to the Montreal Protocol. • Willingness of the government to phase-down HFCs under Montreal Protocol as a climate vulnerable country • First survey conducted in 2014 long before Kigali Amendment adopted (2016) and decided to support HFC phase-down during negotiation after analysis of import and consumption scenario. Two following ODS alternative survey were conducted by the government in 2016 and 2020 to gather full scenario. • During implementation of "HCFC Phase-out Management Plan, Stage-I" in 2011, government decided to introduce zero ODS, low or negligible GWP and Energy Efficient alternatives to build RAC sector environment friendly and energy efficient. • Introduced zero ODS, low GWP and Energy efficient alternatives since 2009 and trained about 1000 technician on retrofit CFC-12 based refrigerator with a mixture of HC-600a (50%) and HC-290 (50%) which is also flammable. • Introduced zero ODP, low GWP and Energy Efficient Cyclopentane (C5) during implementation of Foam project in 2013. • Implement first demonstration project in the refrigerator manufacturing process based on 1st HFC survey in 2014 and reduced consumption of HFC-134a from one line of refrigerator production at Walton Hi-tech Industries Ltd. • Implement conversion of remaining 3(three) lines of the above mentioned project in 2019 soon after adoption of Kigali Amendment from HFC-134a to HC-600a in refrigerator manufacturing process at Walton Hi-tech Industries. • Implement first ever Compressor conversion project at Walton Hi-tech Industries with HC-600a in 2019. • 100% phase-out of HFC-134a in the domestic refrigerator manufacturing process 2019 and also accomplish compressor conversion project with HC-600a which is zero ODP, low GWP and Energy Efficient (9-16%). • Capacity building of Technician since 1999 during CFC phase-out process and trained on handling flammable refrigerants since 2009 during implementation of CFC-12 based refrigerator retrofit activities. • Continue training of RAC technicians on good service practices and about 5000 technicians were trained by these time. • Government ratified Kigali Amendment to the Montreal Protocol on 8	• Low GWP and cost effective alternatives are not available in all the sectors. • Available low GWP and cost effective refrigerants are flammable in nature and sufficient safety measures and training for manufacturer and service providers are necessary to avoid any mishap. • There is no alternative, even in research, for the manufacture of Metered Dose Inhalers with low GWP alternatives • Rules and regulation yet to be amended to incorporate HFCs as control substances. • New HS Code yet to be introduced as per WCO recommendation for better control on HFCs during import and export. • Consumption of HFCs increases due to increased demand of ACs and quota of HCFCs going down. • Risk of obsolete technology dumping • Lack of sustainable waste management for RAC equipment • Licensing system yet to be for HFCs. • Limitation of ODS identifier for identifying all HFC blends. • Lack of awareness among manufacturer, service provider and end users. • Polity makers are not fully awarded regarding potentiality of the phase-down of HFCs.

June 2020. • Comprehensive Rules and Regulation on ODS control enable government to easily include HFCs toEstablished licensing and quota system for HFCs from 1 January 2021. • Established H.S Code for ODSs as per WHO recommendation and training provided to the customs officer since 2003. • Provided ODS Identifier to all of the customs entry point since 2003 which is capable to identify HFCs also. • Effective stakeholder collaboration established with almost all relevant Government organizations and with private associations. • Training provided for government, non-government, NGOs, Elite regarding ozone layer depletion and its consequences and also regarding the implementation of Montreal Protocol in Bangladesh. • Started updating curriculum of Customs Training Academy for their regular training activities on ozone issue. • Initiated updating curriculam with Technical Education Board. For Polytechnic and Technical students. • Capacity building on handling low GWP and Energy Efficient but flammable refrigerant for RAC technicians, superviser and Instructor of Polytechnic and Technical Institutions will be conducted during implementation of HPMP Stage II which will be helpful during implementation of HFC reduction process. • Low GWP, Energy Efficient and cost effective alternatives is available in the manufacture and servicing of Domestic refrigerator and ACs upto 1.5 R ton. • Low GWP, Energy efficient and cost effective alternative is available for conversion of large foam industries those have sufficient land area into their factory premises. • Technical and financial assistance of MLF will be available for phase-down of HFCs under Kigali Amendment. • Other philanthropic organization, such as “Kigali Cooling Efficiency Programme K-CEP)” Cool coalition, CCAC are assisting since adoption of the Amendment. • Implementation of enabling activities, such as preparation of National Cooling Plan, Need Assessment for servicing, conduct ODS alternative survey, preparation and evaluation of data reporting and licensing system, National Strategy and Country Programme etc. since adoption of Amendment. • Two implementing Agencies, UNDP and UNEP are assisting Government during ODS Phase-out programme. • Phase-down will be upto 80% for Article 5 (Group I) Parties. Remaining 20% can be used for Pharmaceuticals and other small consumption sectors where there are no viable alternatives.	

The above mentioned findings are taken into drawing key conclusions and recommendations.

9.2 Policy and Regulatory Measures

9.2.1 Ratification of Kigali Amendment

As a first step to implement the Kigali Amendment to the Montreal Protocol, government has ratified Kigali Amendment on 8 June 2020. It will be effective for Bangladesh on 6 September 2020. Now government have to establish an effective control over HFCs along with ODSs.

a. Ozone Depleting Substances (Control) Rules, 2004

Ozone Depleting Substances (Control) Rules, 2004 was enacted in April, 2004 and amended in September 2014 due to accelerated schedule of HFCs approved by Parties to the Montreal Protocol in September 2007 in Montreal, Canada. The existing rules to be amended again and to include HFCs to impose control over HFCs import adn consumption for which UNDP recruited one national consultant in January 2020.

b. HS Code for HFCs

First step to impose control and to monitor import and export HFCs, it is required to update HS code of the First Schedule of the National Board of Revenue as per WCO recommendation.

c. Introduce Licensing System

Existing licensing system for ODSs which was established in 2005 to be updated to include HFCs and their blends by 1 January 2021 as per decision of the Parties to the Montreal Protocol. It is related with compliance of the country. It is one of the KA obligation for the country.

d. Data Reporting

As a party to the Kigali Amendment to the Montreal Protocol, Government has to report Article 7 data to the ozone secretariat by latest 30 September 2021 and every year onward. Also to report Country Programme Implementation Data by 1st May 2021 to the Montreal Protocol Multilateral Fund. Best estimated data may be acceptable if actual data is not available. It is related with compliance of the country.

e. Capacity Building of Customs Officer

Customs officers to be trained on HFCs and HFC blends and also on the upcoming Rules and REgulations for effective control on import and export of HFCs.

f. Inclusion into Export Import Policy of the Government

After amendment of "Ozone Depleting Substances (Control) Rules" of the Government, it is required to incorporate provisions of import and export of HFCs into the Export Import Policy of the Government. Otherwise customs will not take any measures to control import and export of HFCs.

g. Monitoring System

Existing Monitoring system of HCFCs to be reviewed and updated to monitor import and export of HFCs. Customs officials to be provided more and updated ODS identifier to the customs entry point which can identify HFCs and HFC containing blends. Training is also necessary as customs officers are transfer in every six month.

h) Awareness

Awareness to be raise among importers regarding requirement of import and export licenses from 1 January 2021 to during import and export of HFCs like ODSs. Again consequences of the uses of HFCs and its impacts on overall climate and health, regarding updated rules and regulation on HFCs and possible illegal trade to be informed among law enforcement agencies like earlier. Print and Electronic media may be utilized in this regard.

Government officials, ellites, NGOs, relevant industries to be awarded regarding the consequesces of the uses of HFCs and benefit/potential to phase-down HFCs.

9.3 RAC Sector

National Cooling Plan for RAC sector is under preparation. It was scheduled to be completed by the end of 1999. But unfortunately the consultant died immediately after producing his first draft report. UNDP recruited new consultant to accomplish the task.

Before preparing strategy to phase-down HFCs in the RAC sector, it is pragmatic to have final report of the National Cooling Plan. However, due to unavoidable circumstances, the present author tried to recommend a few proposals on the basis of information and data provided during ODS alternative survey for the year 2014-2019.

9.3.1 Domestic Refrigerator

According to the ODS alternative survey of UNDP, about 12 companies are producing domestic refrigerator and all of them except Walton were using R-600a. At the end of 2019 the last company, but biggest producer Walton Hi-Tech Industries went to conversion under MLF assistance. At the same time HFC-134a based compressor production of Walton also converted to HFC-600a. Now manufacturing sector of domestic refrigerator and compressor production are HFC free.

But yet we have to work on energy efficiency. During Walton HFC phase-out project implementation, 24 model of Walton refrigerator were got BSTI certification on energy efficiency. Other model of walton and all other models of other 11 (eleven) companies have to modify their model and to take BSTI certification of energy efficiency.

For taking double benefit on energy efficiency, Inverter Compressor for domestic refrigerator to be produced in the country immediately in a cost effective manar.

In this case domestic refrigerator will be about 40% more energy efficient and indirect emission will be reduced significantly.

9.3.2 Industrial Refrigeration

a) Chillers : Trend of HFC use increasing in this sector. Environment Friendly and energy efficient alternatives are yet not started using in this sector. Conversion cost is comparatively high compare with other sectors. So, better to wait for cost effective and energy efficient HFO based technology to be available in the country.

b) Cold Storage and Fish Freezing Industries : Most of the cold storages of Bangladesh are using Ammonia (R-717) as refrigerant which is environment friendly and also cost effective. But they are also using HCFC-22 for their pre-cooling room where quick refrigeration is necessary.

   Traditionally, cold storages of Bangladesh are of 2000-5000 tons of potato storage capacity with huge investment, high electricity bills, and also unpredictable profit or loss due to unreliable power supply, frequent load shedding. Primary producers suffer huge loss and damage upto 60 percent of seasonal fruit, vegetables, fish, milk and meat items which is accounted for Tk. 3442 crore (BBS 2011). To minimize loss and to maximize profits, both the existing and future cold storage owners are actively seeking “mini solar cold storage” of average 8-10 tons capacity will be the best option. Fortunately GoB encourages and SREDA and Palli Karma Shehayak Foundation (PKSF) are assisting entrepreneurs in this regard.

9.3.3 Transport Refrigeration

A considerable amount of HFC-134a is consumed for servicing car air-conditioner. Car market is dominating by Japanese reconditioned cars, normally 4-5 years old. Car manufacturers were used HFC-134a upto 2017. Now they started using HFO-1234yf which is low GWP (GWP-4). A few car manufacturer are considering CO_2 as HFO are also flammable. HFC-1234yf and CO_2 based technology are costly in comparison with HFC-134a. Again retrofit with HFO/CO_2 and drop in option with other refrigerant is dangerous and impossible due to flammability and technical aspect.

Road transport and container refrigeration units, containing 3 to 10 Kg of refrigerant are mainly used for transporting chilled and frozen food. No good option available in this field.

9.3.4 Supermarkets, Hospitals, Hotels, Railway and office building

A few big and new super market are found using HFC-134a based chillers. Some others are using VRF system using R-410a and large number of old supermarkets depends on split ACs. HPMP Stage II project to be utilized to reduce both HCFC-22. Another project under HFC Phase-out programme may be undertaken to phase-out use of HFC-410a and tehnology is redy in this field.

Big hospitals and hotels are using R-134a bases chillers need huge investment and are not cost effective in respect to the reduction of HFC-134a.

Most of the Bank headquarters are using central air-conditioners need huge investment for changes but hundreds of branches and ATM booths are using R-22 and R-410a based split ACs.

Railway AC coaches are importing form abroad and AC systems are inbuilt. Intervention required during procurement.

Retrofit in any of the above-mentioned sector is not feasible and dangerous due to safety issue.

9.3.5 Air-conditioner manufacture/ assembly

It is understood from the ODS alternative survey that new installation in this sector is based on R-134a. MLF may be requested to provide assistances for HFO based demonstration project in this sector.

9.4 Foam producers

Big industries in Bangladesh are using environment friendly and energy efficient Cyclopentane (C5) for producing their polyurethane (PU) type insulation foam for the manufacture of their refrigerator. Others are small and still using pre-blended polyol mixed with HCFC-141b. Some of them are using HFC-134a which is high GWP. Out of 4 PU foam producer identified during survey using other then cyclopentane have no required space (land) to use cyclopentane. So for them lower GWP fluorocarbon, viz, HFO-1233zd (4) or HFO-1336m22 (6) may be consider for conversion. But all are costly in comparism with Cyclopentane. We have to wait for beter and cost effectie technology in this sector.

9.5 Fire Fighting

Bangladesh Fire Service and Civil Defense authority was well awared regarding environmental impact of ODS and had taken right decision in 1995 to phased out most powerful ODS and GWP chemical, halons, and introduced and encouraged conventional and less harmful chemicals, viz, HCFC-123 and HFC-227ea in Bangladesh.

Use of HCFC-123 and HFC-227ea is very low and need not any intervention until environment friendly alternatives are available. They are also using other conventional materals and systems as described in Chapter-5.

9.6 Aerosol Sector

a) Non-Medical Aerosol : Cost effective and environment friendly alternatives are available in this sector and all of the producers in Bangladesh are utilizing Hydrocarbon for their insecticide production need not any intervention.

b) Medical Aerosol: Conversion of HFC based Meter Dose Inhaler is extremely difficult due to non availability of alternative propellants. Vigorus research going on but yet not a single chemical meet the requirement considering high consumption in MDIs.

   During Kigali Amendment, Bangladesh had opted no 1 as there are 20% HFCs taken out from the reduction schedule.

   Bangladesh pharmaceutical industries are growing and both local and export demand of MDIs are increasing. So, after 2030, quota allocation for pharmaceuticals will be difficult we presumed.

9.7 Energy Efficiency

Energy efficiency is a key component of the Kigali Amendment, to select technology solutions that not only have low global warming potential, but also a low over all environmental impact. The RAC sector as a major energy consumer, plays a strong role to enable combat climate change, integrate renewable energy and save money.

Energy Efficiency a the main pillar of Kigali Amendment

Selecting technologies that are more efficient than the technologies they replace is a key success factor for the given that energy efficiency accounts for 60 to 90 percent of GHG emission, only 20 percent of total costs normally relates to equipment investment cost, whereas the remaining 80 percent of operating costs hold the true potential for cost saving. A decision for or against a widespread RAC solution should therefore always be guided by the total cost of ownership (TCO) principle, and ideally the life cycle climate performance (LCCP) model. Please see tech specs for a more detailed explanation of these concepts.

From an economic and social perspective, energy efficiency is also at the heart of three sustainable development goals: SDG7 dealing with affordable and clean energy; SDG9 on industry, innovation and infrastructure; and SDG 13 on climate action. The technology and economic assessment panel (TEAP) advising a Montreal Protocol related matters has established a working group to deal with and report on the request in Decision XXVIII/3 on energy efficiency.

9.8 Economic incentives and HFC control are most effective in driving technology change.

Domestic RAC manufacturing companies are overall ready and willing to implement the Kigali Amendment, but that additional incentives and support measures from governments and the international community would be needed. Initiatives like MLF funded and UNDP administered Walton HFC based refrigerator and compressor conversion project in Bangladesh sited a best example where GHG emission reduced in both direct and indirect ways.

9.9 Replacement schemes

Replacement schemes to exchange obsolete technology with state of art product seem to be popular among selected RAC equipment. Some of the domestic companies started these type of initiative may extend during the KA implementation.

Replacement incentive schemes for consumers (eg. Change of old refrigerator or AC to new one); minimum energy performance standards (MEPs) to phase in more efficient technology with lower GWP emission and or tax incentives for industries may be helpful to address both KA and energy efficiency issues.

10. CONCLUSION AND RECOMMENDATION

10.1 Way Forward

- Bangladesh ratified Kigali amendment to the Montreal Protocol on 8 June 2020. It will enter into force on 6 September 2020 and government has to comply with all its obligations along with other obligations regarding ODS phase-out activities as per Montreal Protocol.
- Administrative process, such as, amendment of existing Rules &Regulations; introduce HS Code to the First schedule of Customs; inclusion of HFCs into the licensing system and data collection and data reporting system to be updated to include HFCs along with HFCs.
- Complete preparation of National Cooling Plan; Need Assessment for RAC Servicing; Country Assessment etc. to way forward implementation of KA in the country.
- Accurate data collection and reporting to be ensured during baseline determination years.
- Update National Cooling Plan, Need assessment for RAC servicing sector, National Strategy and amendment to the Rules and Regulation to be done as soon as baseline established in 2023.
- Leaf frog to introduce low GWP alternatives (where possible) during implementation of HPMP Stage II and explore resources for energy efficiency of the product to get double benefit.
- Ratification, Implementation and enforcement of KA is no doubt a Challenge but of course consider it a great opportunity.
- Explore resources not only from MLF but also from other sources, such as, GEE, K-CEP through bilateral or from government trust fund.
- Prepare project for RAC sector where low GWP and energy efficient alternatives are available. As for example, commercial refrigeration, domestic ACs upto 1.5 R Ton etc.
- As production and export of MDIs are increasing, a considerable amounts of HFC-134a to be reserved for the Pharmaceuticals uses.
- Local production of inverter type compressor to be encouragedand compulsory use may be consider in the RAC sector in order to get double benefit from the HFC Phase-down under KA.
- Fiscal measures to be consider as earlier regarding tax adjustment and encourage replacement programme with manufacturers.

10.2 Actions Recommended

Owing to the above mentioned facts and situations recommended actions are prioritized as follows :

Accomplished Activities	Focal Point/Relevant Stakeholder
• Stakeholder Sensitization, Organized meeting and obtained favorable opinions for the ratification of KA	NOU/ DoE
• Organized Interministrial meeting and obtained fabourable opinion of stakeholders, vetting from Law Ministry, assist cabinet with relevant information and documents for approval	MOEFCC
• Issued Instrument of Ratification and submitted to the Depository of the UN Secretary General.	MOFA

Immediate Actions (2020 to 2022)	Focal Point/Relevant Stakeholder
• Update National Ozone Unit (NoU) and National Technical Committee on ODS (NTCODS) with TOR	DoE/ MOEFCC
• Amend existing Rules and Regulation	DoE/ MOEFCC
• Developing National System for HS Codes for HFCs (including blends and pre-blended polyols)	NoU/DoE/ MOEFCC/ NBR
• Include HFCs into the existing licensing system from 1 January 2021.	NoU/ DoE

• Evaluate Data collection system and reporting system for HFCs and report to the Ozone Secretariat by 30 September 2021 latest and CP Data to MLF by 1 May 2021	NoU/ DoE
• Mandatory (Star Rating) on certification on energy efficiency of Domestic Imported Refrigerator & ACs.	RAC Manufacturer /BSTI
• To facilitate energy saving in the RAC sector, a project for producing inverter type compressor in the country to be explore.	DoE
• Establish baseline by average consumption data of HFCs for the year 2020, 2021 and 2022	NoU/Ozone Secretariat

Short Term Actions (2023-2030)	
• Update National Strategy as per recommendation of National Cooling Plan, Need Assessment for RAC technicians, baseline data and trend of HFC consumption and as per available alternatives and technology and also as per government policy of that time.	NoU/UNDP
• To conduct HFC alternative survey in 2023 and Prepare sectorwise phase-down project as per available alternatives/Technology	NoU/UNDP/UNEP
• Leaf Frog to introduce low GWP alternatives (where possible) during implementation of HPMP Stage II	NoU/DoE
• Update training curriculum for RAC technician	NoU/UNEP
• Develop National Standard for using flammable refrigerants for RAC sector	UNDP/DoE
• Develop code of Practice for RAC service workshop/technicians	UNEP/DoE
• Update curriculum of Diploma Engineers with Bangladesh Technical Education Board	NoU/UNEP
• Update training curriculam for Customs officers and training for law enforcement body to prevent illegal trade of HFCs	NoU/UNEP
• Update regular curriculam of Customs training Academy	NoU/UNEP
• Reduce 10% consumption of HFCs from the baseline from 1 January 2029	NoU/DoE
• Strengthen the TVET in line with the technology trends	BTEB/ DoE

Long Term Plan (2031-2045)	
• To conduct HFC alternative survey in 2031 and update National Strategy, National Cooling plan, Rules and Regulation and other policy related to KA implementation	NoU/UNDP
• Evaluate status of MDI production in Bangladesh, estimate future need of HFC for MDI production and prepare HFC phase-out project (if alternatives are available) for MDI sector	NoU/UNDP
• Prepare projects for sectors other than RAC	UNDP/UNEP
• Continue capacity building of RAC technicians	NoU
• Continue replacement progamme for RAC equipment and continue fiscal measures to accelerate/encourage the programme	DoE/MoEFCC
• Continue disposal programme of obsolete /equipment after end of life.	DoE
• Ban import and export of HFCs containing blend (both virgin & recycled) with non parties to the Kigali Amendment to the Montreal Protocol.	DoE
• Ban of equipment containing HFCs and their blends	DoE/ NBR
• Reduce consumption of HFCs as per Montreal Protocol Phase-down schedule	DoE
• Introduce mandatory star rating system	DoE/ BSTI


Canada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DP