TRAINING MANUAL ON KIGALI AMENDMENT TO MONTREAL PROTOCOL AND ASSOCIATED NEW TECHNOLOGIES FOR THE OFFICIALS RESPONSIBLE FOR THE IMPLEMENTATION OF KIGALI AMENDMENT IN BANGLADESH

Enabling Activities of Bangladesh for HFC Phase down (UNEP Component) Project

Department of Environment

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ACRONYM/ABBREVIATIONS

AC	Air-conditioning
ASHRAE	American Society of Heating, Refrigerating and Air -Conditioning Engineers
ASVs	Abroad Shipping Vessels
BAU	Business-as-usual BBS Bangladesh Bureau of Statistics
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BCFC-12B1	Halon 1211(CBrClF2)
BIRD	Bangladesh Institute of Development Studies
BMD	Bangladesh Meteorological Department
BNBC	Bangladesh National Building Code
BNCP	Bangladesh National Cooling Plan
BRAMA	Bangladesh Refrigeration and Air -conditioning Merchant Association BRTA Bangladesh Road Transport Authority
BSTI	Bangladesh Standard and Testing Institute
BUET	Bangladesh University of Engineering and Technology
C5	Cycloopentane
CAC	Commercial Air-Conditioning
CCAC	Climate and Clean Air Coalition
CAGR	Combined Annual Growth Rate
CFC	Chlorofluorocarbons
COP	Conference of Parties
COPD	Chronic Obstructive Pulmonary Disease
CPD	Centre for Policy Dialogue
CTC	Carbon-tetrachloride
DC	Direct-Cool
DME	Dimethyl ether
DoE	Department of Environment
DPI	Dry Powder Inhaler
EE&C	Energy Efficiency & Conservation
EE&CMP	Energy Efficiency &Conservation Master Plan
FF	Frost-Free (FF)
GWP	Global Warming Potential
HC	Hydrocarbon
HC-blend	Hydrocarbon blend [50% HC-600a & 50% HC-290]
HC-290	Propane (C3H8)
HC-600	Butane (C4H10)
HC-600a	Iso-butane (CH(CH3) 2CH3
HCFC	Hydro Chlorofluoro Carbon
HCFC-124	1- Chloro-1,2, 2, 2-tetrafluoroethane (C 2 H Cl F 4)
HCFC-142b	1-Chloro 1, 1- difluoroethane (**CH3CClF2**)
HCFC-123	**2,2-Dichloro-1,1,1-trifluoroethane (C2HCl2F3)**
HCFC-141b	1, 1, dichloro 1 fluoro ethane (CCl2FCH3)
HCFC-22	Difluorochloromethane (CHClF2)
HFC	Hydro Fluoro Carbon
HFC-23	Trifluoromethane [CHF3]
HFC-125	Pentafluoroethane (CHF2CF3)
HFO	Hydrofluoroolefin
HPMP	HCFC Phase-out Management Plan
HVAC	Heating, Ventilation and Air Conditioning
INDC	Indented Nationally Determined Contributions
IFVs	Inland Fishing Vessels

IPCC	Intergovernmental Panel on Climate Change
ISVs	Inland Shipping Vessels
KA	Kigali Amendment
KCEP	Kigali Cooling Efficiency Program
LCCP	Life Cycle Climate Performance
LDC	Least Developed Countries
LGED	Local Government Engineering Department
LPG	Low Pressure Gas
MAC	Mobile Air-conditioning
MBr	Methyl Bromide
MCF	Methyl Chloroform
MDI	Metered Dose Inhaler
MEPS	Minimum Energy Performance Standards
MFVs	Marine Fishing Vessels
MLF	Multilateral Fund
MMLF	Montreal Multilateral Fund
MOEFCC	Ministry of Environment, Forest and Climate Change
MP	Montreal Protocol
MPEMR	Ministry of Power & Energy and Mineral Resources
MSVs	Marine Shipping Vessels
MPG	Montreal Protocol Guideline
MT	Metric Ton
MTOC	Medical Technical Option Committee
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Program of Action
NBR	National Board of Revenue
NCP	National Cooling Plan
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
NHI	National Housing Institute
NOU	National Ozone Unit
NOS	National Occupational Standards
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substance
OEM	Original Equipment Manufacturer
PKSF	Palli Karma-Sahayak Foundation
PPE	Personal Protective Equipment
PSF	Private Sector Facility
PWD	Public Works Department
RAC	Refrigeration & Air-conditioning
RAC&F	Refrigeration and Air-conditioning and Foam
RAJUK	RajdhaniUnnayanKattripakka
REHAB	Real Estate and Housing Association of Bangladesh
R&D	Research and Development
RHD	Roads and Highways Department
R- 1234ze	Tetrafluoroethylene (C2F4)
R- 1270	Propylene (C3H6)
R- 134a	1,1,1,2-Tetrafluoroethane (C2H2F4)
R- 32	Difluoromethane (Methylene fluoride) (CH2F2)
R-170	Ethane (C2H8)
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 (HCOOCH3)
R-702	Normal hydrogen (H2)
R-704	Helium (He)
R-717	Ammonia (NH3)
R-718	Water (H2O)
R-729	Air [78% N2, 21% O2, 1% Air, +]
R-764	Sulphur-dioxide (SO2)
R-774	Carbon dioxide (CO2)
SDG	Sustainable Development Goals
SIDS	Small Island Developing States
S&L	Standard & Labeling
SLCP	Short-lived Climate Pollutants
SME	Small and Medium Enterprise
SREDA	Sustainable and Renewable Energy Development Authority
SRS	Simple Random Sampling
TEAP	Technology and Economic Assessment Panel
Toe	Ton of Oil Equivalent
ToT	Training of Trainers
TCO	Total Cost of Ownership
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	The United Nations Industrial Development Organization
VOCP	Volatile Organic Compounds Control
VRF	Variable Refrigerant Flow
WCO	World Custom Recommendation

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CHAPTER 1

PROTECTION OF THE OZONE LAYER

i. The Vienna Convention for the Protection of the Ozone Layer (1985)

The Vienna Convention for the Protection of the Ozone Layer adopted in 1985 aimed to protect human health and the environment against adverse effects resulting from the depletion of the Earth's protective ozone layer. The Parties that agreed the Convention were aware that measures to protect the ozone layer from modifications due to human activities required international cooperation and action, and needed to be based on comprehensive scientific and technical considerations. The Parties were also aware of the need for further research and systematic observations to develop scientific knowledge of the ozone layer and the possible adverse impacts of its depletion. Since the Vienna Convention came into force, they have been carrying out research and scientific assessments of the physical and chemical processes that may affect the ozone layer and the impacts on human health and other biological processes of ozone depletion and changes in ultra-violet solar radiation (UV-B).

In the mid-1970s, a research was carried out by scientist Sherry Rowland and his doctoral student Mario Molina, which built on the work of fellow-scientist Paul Cruzan, was published in the journal, Nature, warning that CFCs could deplete the ozone layer. Widespread use of chemicals for refrigeration, air conditioning, hair spray propellants, metered dose inhalers, insulation foams for buildings and equipment, and pesticides, to name a few, called chlorofluorocarbons (CFCs), these man-made chemicals had been hailed as miracle substances that would revolutionize many aspects of our daily life. In 1985 their findings were published in Brian Gardiner and in Nature.

The atmospheric abundances of ozone-depleting substances, which peaked in 1992–1994, are now showing a downward trend. The latest scientific findings also show that the decline in stratospheric ozone seen in the 1990s outside the Polar Regions has not continued. It is predicted that the stratospheric ozone layer that protects life on earth from excessive solar radiation will recover to its pre-industrial state by 2065.

ii. The Montreal Protocol on Substances that Deplete the Ozone Layer

The Montreal Protocol on Substances that Deplete the Ozone Layer adopted in 1987 which is the most successful global environmental agreement in history. Along with the Vienna Convention for the Protection of the Ozone Layer, it is the most universally ratified multilateral environmental agreement.

The valuable historical information on the original 1987 Montreal Protocol and the separate adjustments and amendments to the Protocol that were adopted by the Meetings of the Parties in 1990, 1992, 1995, 1997, 1999, 2007, 2016 and 2018 is of interest in demonstrating how the ozone regime has evolved over time in line with evolving scientific knowledge and technological developments.

The Montreal Protocol has been updated to include the Kigali Amendment adopted in 2016 agreed by the Twenty-Eighth Meeting of the Parties [Kigali, 10–15 October 2016] to the Protocol, according to which a new group of chemicals, the hydro-fluorocarbons (HFCs) which have been used as replacements for many ozone depleting substances that threaten to derail the gains of the Montreal Protocol, are to be phased down under the Kigali Amendment.

The Montreal Protocol has been successful because of the many efforts. The heroic efforts of nations and scientists have been complemented by the determined action of companies and citizens. Science has identified the problem and governments have stepped up regulations. Companies and citizens have played their part, changing products, and becoming more conscious of buying habits.

In 2018, NASA scientists provided direct proof that the ozone layer is healing. More than 99 percent of ozone-depleting substances have been phased-out world-wide. As UN Secretary-General António Guterres has noted, these efforts have saved millions of people from skin cancer and cataracts each year. The global economy will save US$2 trillion by 2050.

iii. Earth's Atmospheric Layers

Earth's atmosphere can be divided (called atmospheric stratification) into five main layers that differ in properties such as composition, temperature and pressure. These are:

(A) Troposphere: Earth's surface to 12km (0 to 7 miles),

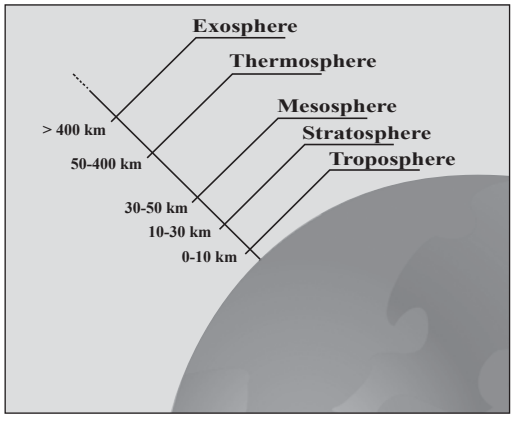
(B) Stratosphere: 12 to 50km (7 to 31 miles),

(C) Mesosphere: 50 to 80km (31 to 50 miles),

(D) Thermosphere: 80 to 70 km (50 to 440 miles) and

(E) Exosphere: 700 to 10,000km (440 to 6,200 miles).

Earth's atmospheric layers are shown in figure 1.



Source: Internet

Figure 1: Earth's Atmospheric Layers.

iv Ozone in the Atmosphere

Ozone is a gas that is naturally present in our atmosphere. Ozone is formed throughout the atmosphere in multistep chemical process that requires sunlight. In the stratosphere, the process begins with an oxygen molecule (O2) being broken apart by ultraviolet radiation from the Sun. Ozone is created when ultraviolet radiation of sunlight strikes the stratosphere, dissociating oxygen molecules into atomic oxygen. The atomic oxygen quickly combines with oxygen molecules to form ozone (Fig.1). The amount of ozone above a point on the earth surface is measured in Dobson Unit (DU). It is typically around 260 DU near the tropic and higher elsewhere, though there are large seasonal fluctuations.

Ozone is found primarily in two regions of the atmosphere. About 10% of atmospheric ozone is in the troposphere, and the remaining 90% resides in the stratosphere between the top of the troposphere and about 50 kilometers altitude. The layer amount of ozone in stratosphere is often referred to as the "Ozone Layer" (Fig.2(a-d)). Total ozone is generally lowest at the Equator and highest in the Polar Regions.

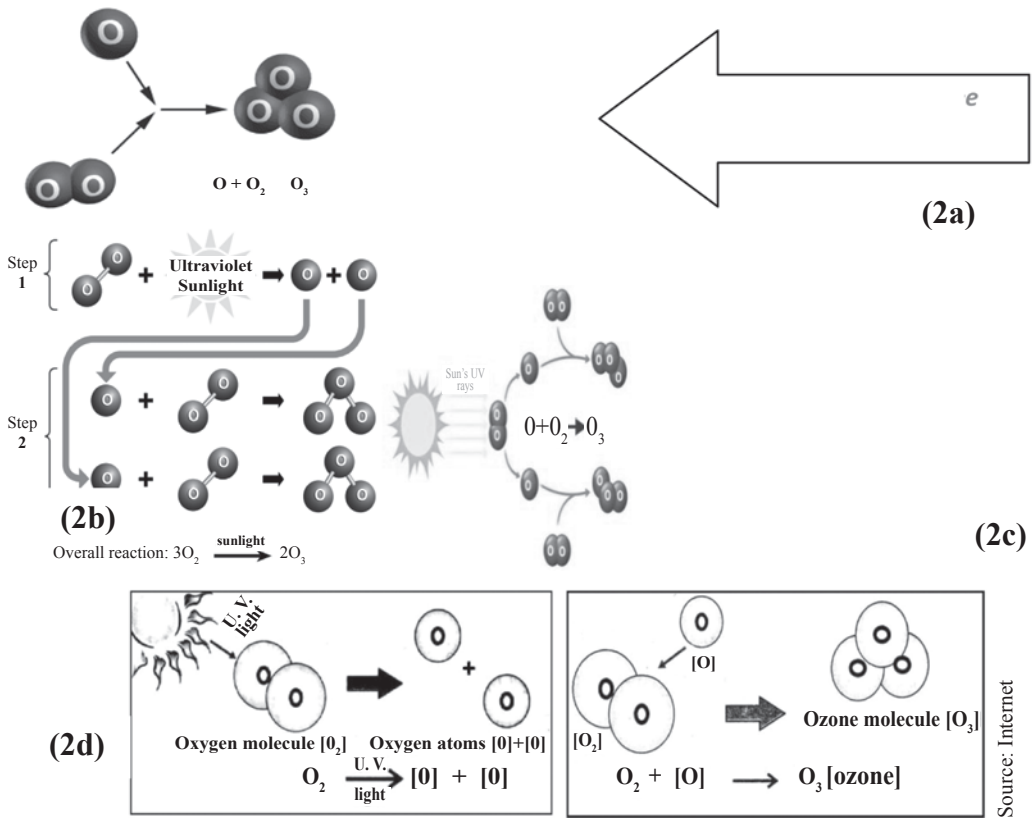


Figure 2 (a-d): Formation of ozone in the Atmosphere.

Ozone in the stratosphere absorbs a large part of the sun's biologically harmful ultraviolet radiation; stratospheric ozone is considered "good" ozone because of the beneficial role. In contrast, ozone formed at Earth's surface in excess of natural amount is considered "bad" ozone because it is harmful to humans, plants and animals.

v. Ozone Layer

The ozone layer is a deep layer in the stratosphere, encircling the Earth that has large amounts of ozone in it (Fig. 3). This layer is also called ozonosphere, region of the upper atmosphere, between roughly 15 and 35km (9 and 22 miles) above Earth's surface. The layer shields the entire Earth from much of the harmful ultraviolet radiation that comes from the sun. This layer absorbs most of the ultraviolet radiation reaching the earth from the sun.The ozone layer was discovered in 1913 by the French physicists Charles Fabry and Henri Buisson. Ozone is measured by a unit is called `Dobson unit'.

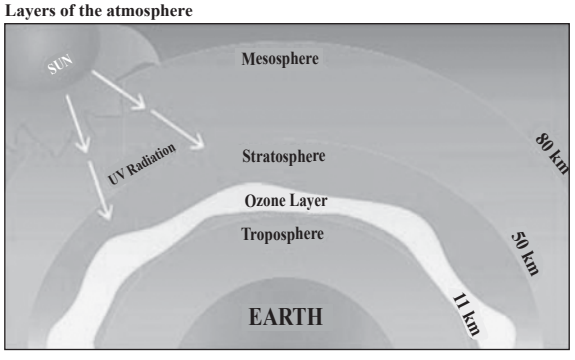


Figure 3: Stratospheric Ozone Layer.

Ozone Layer

vi. Ozone Layer Depletion and Ozone Hole

Ozone Layer Depletion: A scientific research led by Professor F.S. Rowland and M. Molina (1974) suggests that the continued emission of chlorofluorocarbons (CFCs) depletes the stratospheric ozone layer (Fig. 4). Because of their stability, CFCs do not break down in the lower atmosphere but are transported into the stratosphere where they are eventually broken down by ultraviolet radiation, releasing free chlorine radicals. These chlorine radicals act as catalysts in the destruction of ozone. The net result is that two molecules of ozone are replaced by three of molecular oxygen leaving the chlorine free to repeat the process. For a single stable CFC molecule, this can continue for over a century.

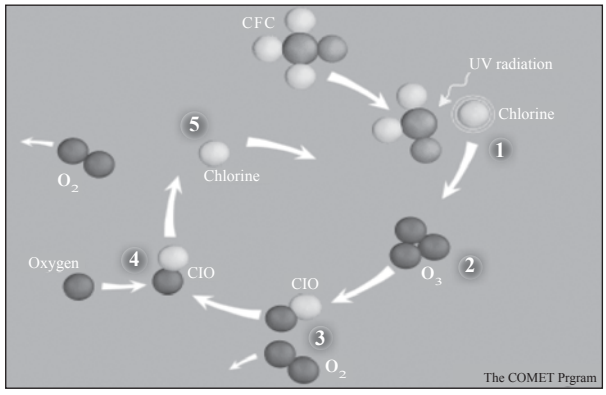


Figure 4: CFCs destroy ozone (O3) when a chlorine atom breaks loose from the CFC and interacts with the oxygen atoms in the ozone molecule[The chlorine catalytic cycle that destroys ozone].

Ozone Hole: The ozone "hole" is really a reduction in concentrations of ozone high above the earth in the stratosphere. The ozone hole is not technically a “hole” where no ozone is present, but is actually a region of exceptionally depleted ozone in the stratosphere over the Antarctic that happens at the beginning of Southern Hemisphere spring (August–October). Excessive thinning of ozone layer when more than half of the ozone gas in a particular area is depleted. The ozone hole is defined as the surface of the earth covered by the area in which the ozone concentration is less than 220 DU (Dobson Unit) (Fig.5).

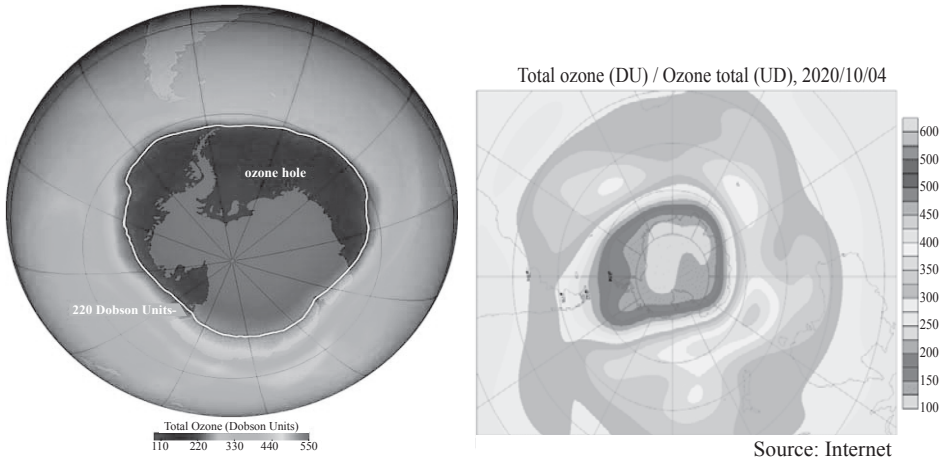
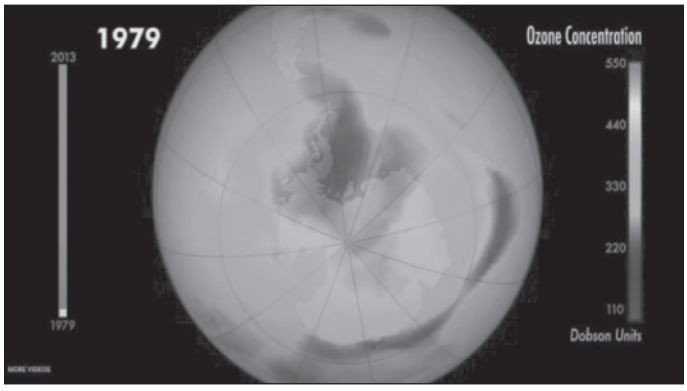


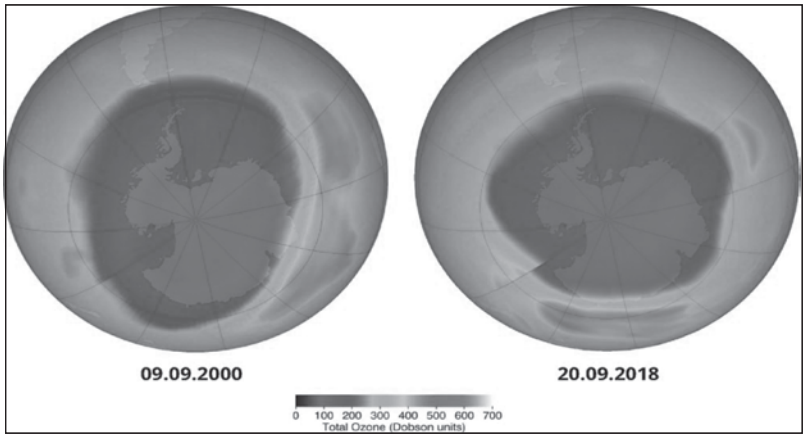
Figure 5 (a-b): 2020 Antarctic ozone hole.

Depletionof Ozone Layerin 1979 is shown inFigure 6,depletion from 2020-2018is shown in figures 7(a-b), depletion from 2020-2018 is shown in figure 8,and depletion is to be predicted from 2041 to 2065is shownin figure 9.



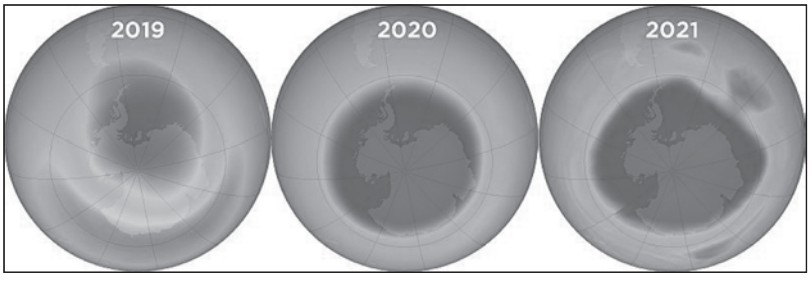
Source: Internet

Figure 6: Depletion of Ozone Layer in 1979.



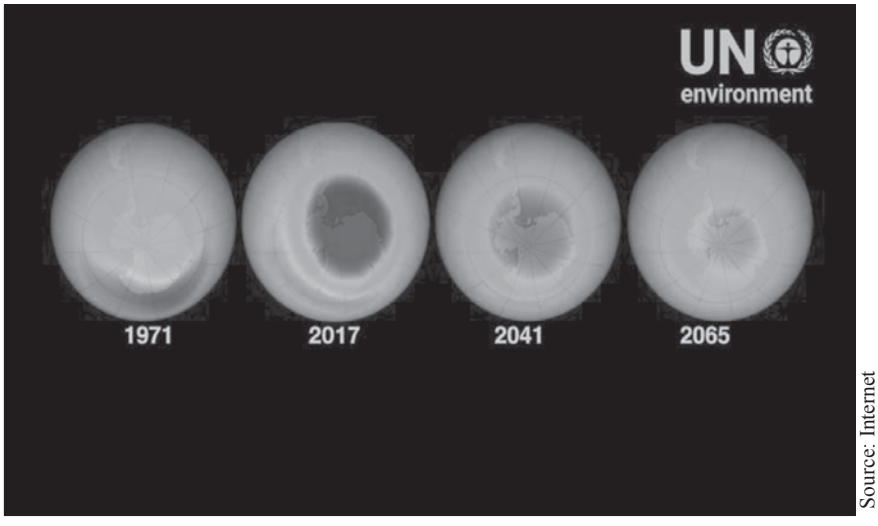
Source: Internet

Figure 7 (a-b): Depletion of Ozone Layer in 2000 and 2018.



Source: Internet

Figure 8: Depletion of Ozone Layer in 2019, 2020 and 2021.

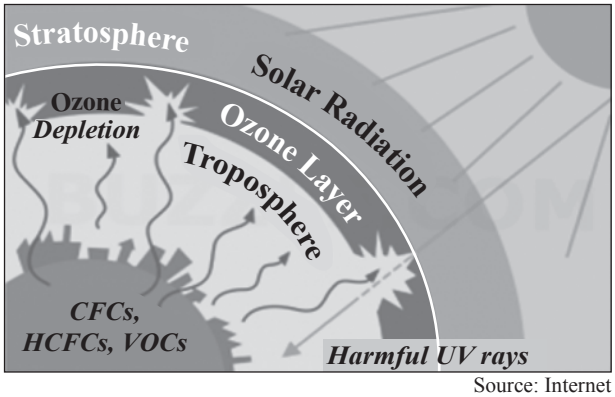


Source: Internet

Figure 9: Depletion of Ozone Layer is to be predicted from 2041 to 2065.

vii. Ozone Depleting Substances (ODSs)

The most commonly used ozone depleting substances (ODSs) are Chloro-fluorocarbons (CFCs) which were mainly used in refrigeration and air-conditioning appliances, foam production, cleaning solvents, process agents, propellants etc. Halons, methyl bromide (MBr), carbon tetrachloride (CTC), methyl-chloroform (MCF), hydro-chlorofluorocarbons (HCFCs), hydro-bromo-fluorocarbons (HBFCs) etc. are also ozone depleting substances. Ozone Layer Depletion occurs due to increase emissions of ODSs (CFCs, HCFCs etc.) and Volatile Organic Compounds (VOCs) (Fig. 10).



Source: Internet

Figure 10: Ozone Layer Depletion occurs due to increase emissions of ODSs & VOCs.

However, CFCs, MBr, CTC, MCF, halons are already phased-out under Montreal Protocol. HCFCs are under phasing-out process.

Summary of ODS and uses include,

CFCs and HCFCs in refrigerators and air conditioners,

HCFCs and halons in fire extinguishers,

CFCs and HCFCs in foam,

CFCs and HCFCs as aerosol propellants,

CTC, Methyl-chloroform and HCFCs for solvents

CFCs and HCFCs for process use and

Methyl-bromide is for fumigation of soil, and goods to be imported or exported.

viii. Ozone Depletion and Climate Change

Many of the man-made ozone depleting chemicals (viz. CFCs) and replacement of these (viz. HCFCs and HFCs) are potent greenhouse gases (GHGs). The build-up of GHGs, including ODSs and replacement of these, is known to enhance warming of the troposphere (where weather systems occur). And to balance the warming at troposphere, cooling of the stratosphere is also expected.

Stratospheric cooling creates a more favorable environment for the formation of polar stratospheric clouds, which are a key factor in the development of polar ozone holes. Thus cooling of the stratosphere due to the build-up of GHGs and associated climate change are likely to exacerbate destruction of the ozone layer.

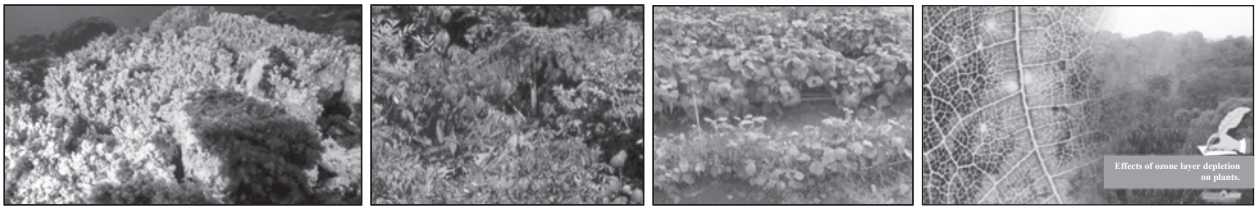
The troposphere and stratosphere are not independent of each other. Changes in the circulation and chemistry of one, can affect the other. Thus changes in the troposphere associated with climate change can affect functions in the stratosphere. In the same way, changes in the stratosphere due to ozone depletion can affect functions in the troposphere.

ix. Harmful Consequences of Ozone layer Depletion

Any rise in the amount of UV-B reaching the Earth's surface has Potential harmful effects on human health, animals, plants (Fig. 11), micro-organisms, materials and air quality. In human, long-term exposure to UV-B is associated with the risk of eye damage, suppression of immune systems, etc. In light-skinned

more serious melanoma, skin cancer also may increase with prolonged UV-B exposures, particularly during childhood. Melanoma is now one of the most common cancers among white-skinned people. Animals are subject to similar effects of increased UV-B. Marine life is particularly vulnerable to UV-B as more that 30% of the worlds' animal protein for human consumption comes from the sea. UV-B damages the early development stages of fish, shrimp, crab and other aquatic lives and reduces the productivity of Phytoplankton.

Plant-growth may also be directly reduced by UV-B radiation, harming crop yields and quality, and damaging forest. Reduction in the productivity of marine and terrestrial ecosystems could, in turn, reduce the uptake of carbon dioxide (CO2) thus contributing to global warming.



Source: Internet

Figure 11: Harmful effects of ozone layer depletion on plants.

Finally, reductions in stratospheric ozone and the accompanying increase in UV-B radiation have important effects on the troposphere. The change in chemical reactivity increases both production and destruction of ozone. Ozone at lower atmosphere is a pollutant, causing irritation to eye, lung and damage crops and structures.

x. Human Activities Cause Ozone Depletion and Global Warming

Ozone depletion occurs when ODSs are released into the atmosphere and global warming is caused when Carbon-dioxide from coal, oil, cars and natural gas burning, spreads around the planet, but both of these environmental problems have a common cause which is human activity that release pollutants into the atmosphere.

xi. International Response to Protect Ozone Layer

While the Montreal Protocol has made great efforts for the protection of the ozone layer, the task is far from over. All scientific analysis predicting the healing of the ozone layer around the middle of this century is premised on full compliance with the phase-out required by the Protocol. Over the next several years, the parties must therefore facilitate the complete elimination of the remaining substances listed under the protocol. While support for related activities is being the use of HCFCs in air conditioning and refrigeration equipment, will not be easy and will require a long-term commitment from developed and developing countries alike.

HCFCs and some related by-products are global warming gases and continued production and consumption of these contributes to climate change as well as to ozone layer depletion. Furthermore, some alternatives to HCFCs, such as HFCs, do not harm the ozone layer but are potent global warming gases.

The completion of the phase-out in both developed and developing counties will require a commitment to both a continued high level of attention to the issue and continued funding.

Recent findings on the interaction between climate change and ozone depletion have led scientists to push back the date that they believe the ozone layer will be healed. The world community is left with the challenging task to continue to monitor the state of the ozone layer and the nexus between ozone depletion and climate change so that the relate risks are understood and are adequately addressed.

Implementation of Kigali Amendment will be another challenge as there is no viable alternative to HFCs for some technologies. Consequently, Article 5 Parties will face difficulties to adopt alternative sustainable technology. But the journey shout never be stopped.

xii. National Response to Protect Ozone Layer

Government of Bangladesh has successfully implemented 21 ODSs related projects to protect the ozone layer. International Ozone Day is observed on 16 September every year to create mass awareness about the importance of ozone layer protection. In January 2010, CFCs from the commercial and servicing sector, carbon tetrachloride and methyl chloroform from solvent sector etc. were phased-out. CFCs use in the manufacturing of MDIs in the country and HCFC-141b in the production of insulation foam in refrigerator sector were phased-out in January 2013. Besides, methyl bromide was phased-out earlier in 1995. Bangladesh has been appreciated by UN Environment for her success in implementing Montreal Protocol in 2012 and 2017. For combating illegal trade Department of Environment has been appreciated by WCO, Ozone Secretariat and UN Environment in 2019.

xiii. Global Warming has an Impact on the Stratospheric Ozone Layer

Increased emission of greenhouse gases makes a blanket preventing heat increase temperature in the lower atmosphere and cooling 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 increases global warming Potential. Ozone in troposphere is also a strong pollutant. According to the IPCC 1996, tropospheric ozone (O3) is the third most important greenhouse gas after carbon dioxide (CO2) and Methane (CH4).

xvi. The Achivement of Paris Agriment of Climate Change

Although climate change action needs to be massively increased to achieve the goals of the Paris Agreement. Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016.

The years since its entry into force have already sparked low-carbon solutions and new markets. More and more countries, regions, cities and companies are establishing carbon neutrality targets. Zero-carbon solutions are becoming competitive across economic sectors representing 25% of emissions. This trend is most noticeable in the power and transport sectors and has created many new business opportunities for early movers.

The Paris Agreement speaks of the vision of fully realizing technology development and transfer for both improving resilience to climate change and reducing GHG emissions. It establishes a technology framework to provide overarching guidance to the well-functioning Technology Mechanism. The mechanism is accelerating technology development and transfer through its policy and implementation arms.

The Paris Agreement reaffirms that developed countries should take the lead in providing financial assistance to countries that are less endowed and more vulnerable, while for the first time also encouraging voluntary contributions by other Parties. Climate finance is needed for mitigation, because large-scale investments are required to significantly reduce emissions. Climate finance is equally important for adaptation, as significant financial resources are needed to adapt to the adverse effects and reduce the impacts of a changing climate.

By 2030, zero-carbon solutions could be competitive in sectors representing over 70% of global emissions

Bangladesh ratified Paris Agreement and submitted her INDC to UNFCCC in 2015. In the INDC, Bangladesh put emphasis on “Adaptation” than “Mitigation”.

Implementation of the Paris Agreement requires economic and social transformation, based on the best available science. The Paris Agreement works on a 5- year cycle of increasingly ambitious climate action carried out by countries. By 2020, countries submit their plans for climate action known as nationally determined contributions (NDCs).

In their NDCs, countries communicate actions they will take to reduce their Greenhouse Gas emissions in order to reach the goals of the Paris Agreement. Countries also communicate in the NDCs actions they will take to build resilience to adapt to the impacts of rising temperatures.

The Paris Agreement reaffirms that developed countries should take the lead in providing financial assistance to countries that are less endowed and more vulnerable, while for the first time also encouraging voluntary contributions by other Parties. Climate finance is needed for mitigation, because large-scale investments are required to significantly reduce emissions. Climate finance is equally important for adaptation, as significant financial resources are needed to adapt to the adverse effects and reduce the impacts of a changing climate.

CHAPTER 2

GLOBAL WARMING

Global warming is the long-term heating of Earth's climate system observed since the pre-industrial period (between 1850 and 1900) due to human activities, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth's atmosphere.

Global warming occurs when carbon dioxide (CO2) and other air pollutants collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. Normally this radiation would escape into space, but these pollutants, which can last for years to centuries in the atmosphere, trap the heat and cause the planet to get hotter. These heat-trapping pollutants—specifically carbon dioxide, methane, nitrous oxide, water vapor, and synthetic fluorinated gases—are known as greenhouse gases, and their impact is called the greenhouse effect

Gradual increase in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect caused by increased levels of carbon-dioxide, CFCs, and other pollutants.

Since the Industrial Revolution, the global annual temperature has increased in total by a little more than 1 degree Celsius, or about 2 degrees Fahrenheit. Between 1880—the year that accurate recordkeeping began—and 1980, it rose on average by 0.07 degrees Celsius (0.13 degrees Fahrenheit) every 10 years. Since 1981, however, the rate of increase has more than doubled: For the last 40 years, we've seen the global annual temperature rise by 0.18 degrees Celsius, or 0.32 degrees Fahrenheit, per decade.The goal of Paris Agreement is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.To achieve this long-term temperature goal of Paris Agreement, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate neutral world by mid-century.

This Agreement is a landmark in the multilateral climate change process because, for the first time, a binding agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects.

i. Substances Controlled and Uncontrolled under MP

(a) Controlled Substances: The Montreal Protocol controls the production and consumption of a range of chemicals that damages the ozone layer that is called (ODS). In the Kigali amendment, the Protocol was 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 is shown in table1.

Table 1: Number of Controlled Substances in MP

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					

Families of Substances	Annex A	AB	Annex C	AC	AF
1,1,1 -trichloroethane					
Methylbromide					
Bromochloromethane					

The substances listed in the above mentioned Annexes do not include mixtures of ODS and all the chemicals are not using. Most commonly used controlled substances listed shown in table 2. These are about 95% of total controlled substances quantitatively.

Table 2: 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: Mixtures are not mentioned in above table.

(b) Uncontrolled Substances: Substances not controlled under the MP: All the ODSs and HFCs are not controlled under MP and not mentioned in the Annexed in the list above. These chemicals can be identified into two categories: Annual use in negligible and/or the ozone depleting potential (ODP) or global warming potential (GWP) is extremely low. These are: Hydro-fluoroolefines (HFOs) are unsaturated fluorocarbons having a very short atmospheric life and 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 has ODP of 0.4% of CFC-11 used for increasing in the manufacture of point stripper solvents not taken under control to the Protocol. 1,2 Di-chlor-ethane with an ODP of 0.001 using in the manufacture of vinyl chloride (principally for PVC pipe) and also as an additive in motor vehicle fuels. The families of chemicals are very different in terms of source and usage to those controlled by the Montreal Protocol. Nitrous Oxide (N2O) is a significant ozone depleting substances with ODP… and GWP… not included in the MP. Major source of N2O is agriculture as well as from industry and the burning of fossil fuels and biomass.

ii. Direct and Indirect Emission of GHG

(a) Direct emission: In all countries include Bangladesh the successful implementation of the KA requires addressing two types of emissions that emits from refrigeration and air-conditioning (RAC) equipment. Direct emission from refrigerant gases, foams or solvents; contribute to climate change when fluids with Global Warning Potential (GWP) are released into the atmosphere. The higher the GWP (reference CO2=1), the stronger the negative climate impact.

(b) Indirect Emission: 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 makes up 10 to 40 percent of total climate impact, while the remaining 60 to 90 percent are indirect emission which occurs during various stages of production, operation, maintenance and end of the treatment. Therefore, the effectiveness of the KA is driving down GHG emission hinges on a nation's ability to effectively address direct and indirect emissions in national strategies.

iii. Greenhouse Gases and Climate Change

Earth's greenhouse gases trap heat in the atmosphere and warm the planet (Figure 12). The main gases responsible for the greenhouse effect include carbon-dioxide, methane, nitrous oxide, and water vapor, and fluorinated gases. Greenhouse gases have different chemical properties and are removed from the atmosphere, over time, by different processes. Carbon-dioxide, for example, is absorbed by so-called carbon sinks such as plants, soil, and the ocean. Fluorinated gases are destroyed only by sunlight in the far upper atmosphere.

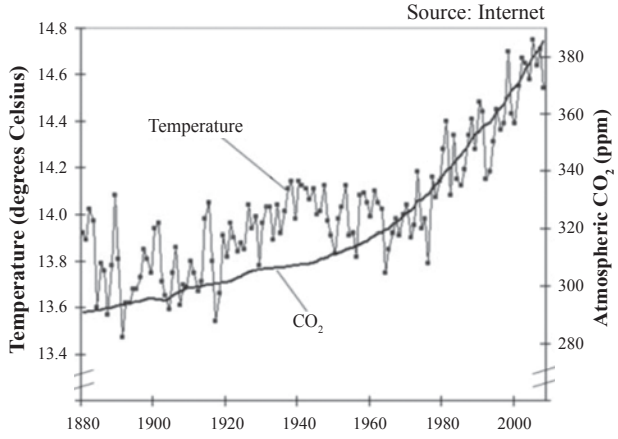


Figure 12: Greenhouse gasesinfluence global warming.

How much any one greenhouse gas influences global warming depends on three key factors. The first is how much of it exists in the atmosphere. Concentrations are measured in parts per million (ppm), parts per billion (ppb), or parts per trillion (ppt); 1 ppm for a given gas means, for example, that there is one molecule of that gas in every 1 million molecules of air. The second is its lifetime—how long it remains in the atmosphere. The third is how effective it is at trapping heat. This is referred to as its global warming potential (GWP), and is a measure of the total energy that a gas absorbs over a given period of time (usually 100 years) relative to the emissions of 1 ton of carbon dioxide.

Radioactive forcing (RF) is another way to measure greenhouse gases (and other climate drivers, such as the sun's brightness and large volcanic eruptions). Also known as climate forcing, RF quantifies the difference between how much of the sun's energy gets absorbed by the earth and how much is released into space as a result of any one climate driver. A climate driver with a positive RF value indicates that it has a warming effect on the planet; a negative value represents cooling.

The greenhouse effect is the way in which heat is trapped close to the surface of the Earth by "greenhouse gases." These heat-trapping gases can be thought of as a blanket wrapped around the Earth, which keeps it toastier than it would be without them. The Average Global Temperature Rise is shown in Figure 13.

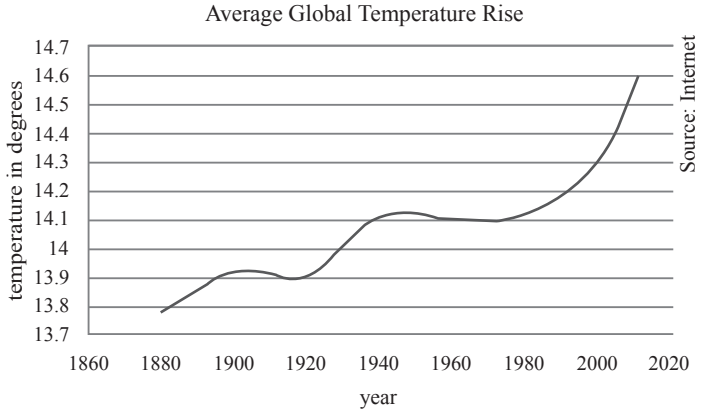


Figure 13: Global temperature rise.

Greenhouse gases arise naturally, and are part of the make-up of our atmosphere. Earth is sometimes called the "Goldilocks" planet – it's not too hot, not too cold, and the conditions are just right to allow life, including us, to flourish. Part of what makes Earth so amenable is the naturally-arising greenhouse effect, which keeps the planet at a friendly 15 °C (59 °F) on average. But in the last century or so, humans have been interfering with the energy balance of the planet, mainly through the burning of fossil fuels that give off additional carbon dioxide into the air. The level of carbon dioxide in Earth's atmosphere has been rising consistently for decades and traps extra heat near the surface of the Earth, causing temperatures to rise. On average, Earth will become warmer. Some regions may welcome warmer temperatures, but others may not. Warmer conditions will probably lead to more evaporation and precipitation overall, but individual regions will vary, some becoming wetter and others dryer.

A stronger greenhouse effect will warm the ocean and partially melt glaciers and ice sheets, increasing sea level. Ocean water also will expand if it warms, contributing further to sea level rise.

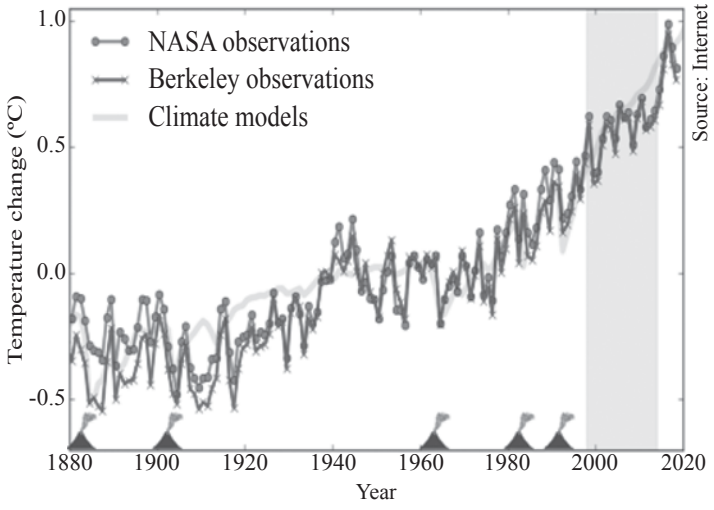
Climate extremes, such as droughts, floods and extreme temperatures, can lead to crop losses and threaten the livelihoods of agricultural producers and the food security of communities worldwide. Depending on the crop and ecosystem, weeds, pests, and fungi can also thrive under warmer temperatures, wetter climates, and increased CO2 levels, and climate change will likely increase weeds and pests.

Finally, although rising CO2 can stimulate plant growth, research has shown that it can also reduce the nutritional value of most food crops by reducing the concentrations of protein and essential minerals in most plant species.

Climate change can cause new patterns of pests and diseases to emerge, affecting plants, animals and humans, and posing new risks for food security, food safety and human health.

iv. Global Warming Potential Substances under Kigali Amendment

The global warming potential substances are hydro-fluorocarbons (HFCs) under KA to the MP is an international agreement to gradually reduce the consumption and production of hydro fluorocarbons (HFCs).HFCs were used to replace the substances banned in that agreement because they have zero impact on the ozone. However, HFCs are powerful greenhouse gases that contribute to climate change (Figure 14), so this amendment adds HFCs to the list of chemicals that countries promise to phase out. These reductions will help to "avoid up to 0.5 degree Celsius of global temperature rise by 2100--- the single largest contribution the world has made towards keeping the global temperature rise 'well below' 2 degrees Celsius, a target agreed at the Paris climate conference."



v. Response to protect Climate Change

According to NASA, the oceans have warmed by about .3 degrees F in 40 years. El Nino and La Nina, a Pacific current phenomenon, affect the surface temperatures of the oceans, with warmer water rising to the surface during the El Nino phase. In 1998, El Nino changed to La Nina and, as usual, the shift caused cooler

water to rise to the surface and allowed the oceans to hold heat – like a terrarium. However, even though the ocean's temperature has risen, the scientific studies of the air temperature rise have found that that temp has plateaued. Many scientists have then believed that global warming has essentially stopped. It has slowed recently BUT El Nino and La Nina oscillate so it can be argued too that eventually the oceans will switch back to the El Nino pattern, where warmer water will rise again to the surface forcing more heat back into the atmosphere. In summary, climate change has always been a part of our earth but it is becoming more extreme.

Mitigation – reducing climate change – involves reducing the flow of heat-trapping greenhouse gases into the atmosphere, either by reducing sources of these gases or enhancing the "sinks" that accumulate and store these gases. The goal of mitigation is to avoid significant human interference with the climate system, and "stabilize greenhouse gas levels in a timeframe sufficient to allow ecosystems to adapt naturally to climate change, ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner".

Adaptation – adapting to life in a changing climate – involves adjusting to actual or expected future climate. The goal is to reduce our vulnerability to the harmful effects of climate change. It also encompasses making the most of any potential beneficial opportunities associated with climate change.

Throughout history, people and societies have adjusted to and coped with changes in climate and extremes with varying degrees of success. Climate change (drought in particular) has been at least partly responsible for the rise and fall of civilizations. Earth's climate has been relatively stable for the past 12,000 years and this stability has been crucial for the development of our modern civilization and life as we know it. Modern life is tailored to the stable climate we have become accustomed to. As our climate changes, we will have to learn to adapt. The faster the climate changes, the harder it could be.

While climate change is a global issue, it is felt on a local scale. Cities and municipalities are therefore at the frontline of adaptation. In the absence of national or international climate policy direction, cities and local communities around the world have been focusing on solving their own climate problems. They are working to build flood defenses, plan for heat waves and higher temperatures, install water-permeable pavements to better deal with floods and storm water and improve water storage and use.

According to the 2014 report on Climate Change Impacts, Adaptation and Vulnerabilityfrom the United Nations Intergovernmental Panel on Climate Change, governments at various levels are also getting better at adaptation. Climate change is starting to be factored into a variety of development plans: how to manage the increasingly extreme disasters we are seeing and their associated risks, how to protect coastlines and deal with sea-level encroachment, how to best manage land and forests, how to deal with and plan for reduced water availability, how to develop resilient crop varieties and how to protect energy and public infrastructure.

vi. Climate and Clean Air Coalition (CCAC)

Bangladesh is one of the six founder member of the "Climate and Clean Air Coalition" to reduce short lived climate pollutants, an initiative of the United Nations Environment Program 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 sector-wise 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.

CHAPTER 3

LEGISLATIVE AND EXISTING POLICY OPTIONS TO CONTROL HFCs

It. is obligated under Kigali Amendment to the Montreal Protocol to phased-down a limit of HFCs consumption. HFCs are most commonly used alternatives to HCFCs. These substances belong to the so-called "Kyoto Protocol basket of greenhouse gases". They have a high GWP, but do not deplete the ozone layer, so they are commonly used as substitutes for ODS, especially for HCFCs. Since based on the provisions of the MP, the global consumption and production of the HCFCs is currently being phased out - the HFCs are being phased in. It is estimated that in 2015 a minimum 525,000 metric tons of these substances were produced and consumed globally. If this trend is not stopped the HFCs will become major (6-9 %) contributors to climate change by 2050. Taking this threat into account the Parties to the MP endorsed in October 2016 the "Kigali Amendment" which introduced to the MP the controls on consumption and production of HFCs.

In order to follow and facilitate the HFC phase-down schedules contained in the KA, the Parties, including both developed and developing countries, will have to implement certain measures. This booklet contains a recommended set of legislative and policy options which the developing (Article 5) countries may wish to consider for implementation. It is intended to be a guide/tool for countries.

i. HCFC phase-out and HFC phase-down Interlink-ages and Relationship

Both production and consumption of HCFCs are to be phased out by 1 January 2020 in developed countries and by 1 January 2030 in developing countries following the specified reduction schedules. Additionally, 0.5 % and 2.5 % of base year's consumption is allowed for servicing the refrigeration and air-conditioning equipment existing at the phase-out date in developed and developing countries, respectively, until 31 December 2030 and 31 December 2040. Based on Article 7 data reported to the Ozone Secretariat, an estimated 26,000 ODP tons of HCFCs were consumed in 2015 in 156 countries out of 167 countries that supplied data, which corresponds to approximately 433,000 metric tons. The reason for such a sharp decline in the global HCFCs consumption over the last 5 years is that, in spite of the long time remaining until the 100% phase out deadline, many countries decided to accelerate the process of reducing HCFCs consumption significantly and some have already completed the HCFCs phase-out process.

While the global HCFCs phase-out process is progressing, the most common alternatives to HCFCs that have zero ODP values of HFCs, unsaturated HFCs (HFOs), hydrocarbons (HCs), ammonia (R-17) or CO2- are gradually being phased in. Due to their specific features like non-flammability, chemical inertness, relatively low cost and excellent performance as refrigerants, foam blowing agents, aerosol propellants or solvents, HFCs have become the major replacements for HCFCs over the last decade. The great disadvantage of HFCs is that the most commonly-used HFCs and blends are powerful greenhouse gases which have very high GWPs, several thousand times greater than the GWP of CO2.

ii. Options related to Monitoring and Controlling Trades in HFCs

Options related to monitoring and controlling the trade in HFCs such as import quotas and exemption from quotas, mandatory reporting by HFC importers and exporters as well as different types of bans and restrictions concerning HFCs and products and equipment containing or relying on HFCs. The maximum quantity of HFCs that may be imported each year is based on the consumption limits set by the KA to the MP or by the country's policy on HFC phase-down, if more ambitious.

To achieve the goal the following facts included for monitoring and controlling trade of HFCs. (a)Import quotas for HFCs; (b) Exemptions from HFC import quotas; (c) Mandatory reporting by HFC importers and exporters; (d) Labeling of HFC containers, (e) Ban on non-refillable HFC containers; (f) Restrictions on placing on the market of products / equipment containing or relying on HFC; (g) Permits for HFC transit; (h) Permits for each HFC shipment (i) Requirement for proof of origin for HFC shipment; (j) Fees for HFC imports / placing on the market; and (k) Electronically operated licensing system for HFCs.

iii. Options related to Restrictions on HFC use

Specific phase-down schedules and use bans for HFCs

(a). An ambitious revised phase-down schedule for all HFCs that would allow the reduction of HFC consumption ahead of the schedule set up in the KA, or

(b). Specific phase-down schedules for selected HFCs or selected groups of HFCs. The first option, which treats all HFCs as a single basket of substances, is a simple approach that requires specific provision in HFC legislation and may be combined with use bans that help achieve the new consumption targets. The second option is a more complex exercise requiring certain preliminary steps, but which may have some advantages. If this option is selected, the choice of order by which particular HFCs or particular groups of HFCs would be banned; phased-out or phased-down may be based on the one of the following principles:

(c). Their GWP value - phasing out higher GWP HFCs first, e.g. establishing the agreed phase-down date or earlier phase-down date for HFCs or HFC-containing mixtures with very high GWPs. The very first HFC to be banned would naturally be HFC-23 as it has extremely high GWP (14,800), followed by other HFCs e.g. HFC-236fa (GWP of 9,810), HFC-143a (GWP of 4,470), HFC-125 (GWP of 3,500), HFC-227ea (GWP of 3,220), or as well as HFC containing mixtures like e.g. R-507 (GWP of 3,985) or R-404A (GWP of 3,922) can be subject to a faster phase-down than the others. Alternatively, all HFCs or mixtures that have GWP of "X" or more can be subject to faster phase-down or ban.

(d). Their share in the country's total HFC consumption expressed in CO2-eq, i.e. their actual impact on country's compliance with the MP phase-down schedules. That would be a challenge because in great majority of countries the most common HFC which has the greatest impact on country's HFC consumption is HFC-134a. This substance is used in so many applications that it would probably be impossible to ban it totally. However, designing a specific phase-down schedule for HFC-134a or specific phase-out schedule for HFC-134a in certain applications may be an option.

Establishing "use bans" means in practical terms establishing deadlines after which the use of HFCs in selected applications will not be allowed. If this option is selected, there are certain approaches that may be undertaken, including inter alia starting with the uses: (a) which are very large in terms of quantities expressed in CO2-eq. (b) where HFCs could be replaced most easily, faster or at a lower cost. (c) which are most emissive (solvents, aerosol propellants, fire extinguishing agents)?

It is important to decide whether or not: (i) the ban would apply to the whole sector (e.g. foam blowing) in which case there would be just one deadline for using HFCs in all applications in that sector or (ii) there would be different deadlines for different sub-sectors e.g. rigid polyurethane (PUR) foams and flexible PUR foams or expanded polystyrene (XPS) foams. Certain exemptions (e.g. military uses) may also be considered. A useful combination of the GWP-based option and the use-based option is establishing bans on certain applications, but specifying the upper GWP limit. For example, if the use of HFCs (or mixtures) with GWP of 2,500 or higher for servicing stationary refrigeration equipment is banned it would mean in practice banning the use of not only R-404A and R-507, but also R-410A.

Ban on new HFC installations

Banning new HFC installations would reduce dependency on and demand for HFCs, especially if there's no ban on manufacturing and importing products and equipment containing or relying on HFCs. This definition meets the objective of introducing such a ban since the major use of HFCs is in this type of equipment.

iv. Options related to Record Keeping

Options related to record keeping on HFCs and HFC-containing products and equipment, namely the establishment of HFC substance logbooks and HFC equipment logbooks.

(a). Mandatory HFC logbooks

Best practices in logbook keeping include the following:

1. The entities covered should include HFC importers and exporters, HFC users, those entities who place HFCs on the market and those entities who recover, recycle or reclaim HFCs. If there are destruction facilities in the country, the entities that destroy HFCs should also be included. It is recommended that producers, importers and exporters of products and equipment containing HFCs are also required to keep HFC logbooks. It is also recommended that maintaining the substance logbooks is mandatory not just for HFCs but also their alternatives.
2. One logbook is kept for each type of HFC or HFC-containing mixture.
3. The data to be placed in the logbook should include at a minimum: the name and address of the entity and name of the person who made the note, date of the note, category of transaction undertaken with HFC (importing, exporting, selling, buying, using – specifying for what purpose, recovering, recycling, reclaiming) and the quantity of HFCs involved.
4. The requirement for keeping logbooks is supplemented with the mandatory annual reporting of data contained in the logbook to the competent authority, although certain countries require registration and recording data only without the reporting obligations.
5. The logbooks can be maintained either in a paper form or in an electronic form. The latter is much easier for daily operation, but requires software development and appropriate computer equipment.

(b). Mandatory HFC equipment logbooks

The main role of HFC logbooks described in "Mandatory HFC logbooks" option on is capturing data on the flow of HFCs in the country starting from the moment they are produced or cross the country borders, until the moment they are used, exported or destroyed. The main purpose of equipment logbooks, however, is to provide data on HFC emissions that can help to verify the compliance with obligations related to HFC recovery from larger equipment and to leak checking of such equipment. If the equipment logbooks are also mandatory for equipment containing HFC substitutes then additional information can be acquired on the local market penetration of new alternative technologies. There are also other important advantages of keeping equipment logbooks.

v. Options related to Preventing HFC Emissions

HFC emission control measures are not included in the MP, but it is obvious that the climate will benefit from the control of HFC emissions from products and equipment. The substantial approach would be:

1. Establish penalties for intentional venting of HFCs to the atmosphere
2. Make leak checking mandatory for larger equipment containing HFCs, establish a leakage checking schedule depending on equipment capacity and requiring installation of leak detectors for very large capacity equipment.
3. Make the recovery of HFCs from containers, from equipment and from products mandatory. The question arises as which sectors should be covered by mandatory leak checking and mandatory HFC recovery. General emission restrictions can be applied to all sectors where HFCs are used. Some measures like leak checking requirements may only be applicable to specific sectors such as refrigeration and air conditioning. Another important question to be answered is who would be responsible for an emission if it occurs. Specifying that responsibility precisely in the country's legislation is absolutely necessary. Another approach to limit HFC emissions may be imposing bans or restrictions on the most emissive uses (solvents, aerosols, fire protection).

vi .Options related to Capacity Building and Awareness Raising

So far training programs for customs and environmental officers conducted in Article 5 countries have focused mainly on the monitoring and control of ODS (specifically HCFCs) since, until recently, no control measures related to HFCs were internationally accepted. Once the phase-down schedule for HFCs in Article 5 countries was agreed upon in 2016 through the KA, situation changed and those countries are now not

allowed to exceed their HFC baseline consumption from 2024 (Group 1) and from 2028 (Group 2) and are obliged to establish HFC import/export licensing system by 1 January 2019. Even in the absence of mandatory monitoring of HFC imports and exports the current training programs, which are focusing mainly on HCFCs, usually contain also some information on HFCs because HFCs are major HCFCs replacements and HCFCs are frequently shipped under the name of HFCs in order to avoid licenses and stricter controls by the customs. Nevertheless, in view of the provisions concerning HFC licensing contained in the KA, new training programs need to be designed in order to train new customs and environment officers on monitoring and control of HFCs including detection of HFC consignments at the border check-points. Customs officers need to be aware of the new HFC-related requirements under the MP as well as national legislation, licensing system, quotas and bans related to HFCs and HFC-containing equipment/products. At present only few Article 5 countries started the process of adjusting national legislation according to the new.

However, that process will soon be undertaken in the other Article 5 countries and all those countries which applied quotas and licenses to HFCs need appropriate training of customs and environmental officers that will ensure effective trade and border controls and prevent illegal trade of HFC and HFC-containing equipment/products, and thus facilitate compliance with the MP. Similar to previous training programs, the HFC-related training may consist of a train-the-customs-trainer program and a subsequent train-the-customs-officers program. The training sessions should include interactive discussions and working groups as well as practical exercises and case studies. Only those trained customs and environment officers who successfully passed the examination/test should be registered and receive the relevant certificates. The frequent practice of handing out participation certificates without checking the knowledge and practical skills of the participants is not recommended. Attempts on illegal trade of HFCs can be anticipated once legal trade of HFCs is restricted. Lessons learned from CFC and HCFC smuggling operations should provide much assistance. Second hand equipment may be exported ("dumped") from countries which no longer allow the use of HFCs (virgin, reclaimed or recycled) or which are replacing HFC-based manufacturing equipment, building chillers, etc. As HFOs and hydrocarbons (HCs) seem to become commonly-used alternatives to HFCs and HCFCs, the relevant information may be included in customs training manuals and be delivered during customs trainings so the customs will be aware of the possibility that HFCs, HCFCs and HFC-containing or HCFC-containing blends may be shipped under the names of HFOs and HFO-containing blends as well as under the names of HCs. The following instruments could be considered:

Media release: Press release, TV spots, radio broadcasts, distribution of leaflets, posters and films, importers, exporters and dealers, servicing companies operating in refrigeration sector, HFC end users in each sector.

vii. Existing ODSs Phase-out Plan

This ODS phase-out plan provides a review of existing international and national policies/ plans/ agreements that may be relevant interfere with implementation of Kigali amendment to the Montreal Protocol.

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, Methyl chloroform, CCl4, Methyl bromide 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 program 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) still 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) renown pharmaceuticals via, 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 groups 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.

A 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 equipment 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 would 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 14,800. The GWPs and ODPs of some common refrigerants are shown in Table 3.

Type	Gas	GWPs	ODP
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
	Iso -butane		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.

viii. National Level Climate Policy Context

The two key national plans to address climate change in Bangladesh are the National Adaptation Program 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.

ix. Intended National Determination Contributions (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.

x. Operational Issues of National Ozone Unit (NOU)

For maintaining the countries compliance status with Montreal Protocol target, the operational activities of NOU are as follows:

- Maintain communication with Ozone Secretariat, implementing agencies (UNDP, UNEP), administrative Ministries, Govt. officials, Stakeholders and project beneficiaries,
- Assist govt. for the International negotiation meeting,
- Assist govt. for control and monitoring ODSs,
- Assist govt. to develop policies/rules related to Montreal protocol,
- Assist govt. for updating maintains and reporting data,
- Assist govt. for the preparation and implementation of Montreal protocol related project,
- Any activities related to protocol and control chemicals deem benefited for the country and for the protocol, and Mass awareness activities as well as sensitization program.

CHAPTER 4

OBLIGATION UNDER KIGALI AMENDMENT TO THE MP

The purpose of the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer is to phase down the use of hydro-fluorocarbons (HFCs) worldwide.

First reductions by most developed countries began in 2019. Most developing countries will follow with a freeze of HFCs consumption levels in 2024-2028. Developed countries are required to phase down HFC production and use by 85 per cent by 2036, with developing countries achieving this reduction by 2045.

The Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer reached 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). HFCs are not ozone depleting substances, but HFCs are greenhouse gases which can have high or very high global warming potentials (GWPs), ranging from about 121 to 14,800. The phase-down of HFCs under the Montreal Protocol has been under negotiation by the Parties since 2009 and the successful agreement on the Kigali Amendment (Decision XXVIII/1 and accompanying Decision XXVIII/2) continues the historic legacy of the Montreal Protocol. This fact sheet summarizes and highlights the main elements of the Amendment of particular interest to countries operating under Article 5 of the Protocol.

i. HFC phase-down schedule for Bangladesh

A reduction step for HFC phase-down Schedule under KA to the MP for Bangladesh is shown in Table 4.

Table 4: Reduction steps for HFC Phase-down for Bangladesh

Steps	year
Baseline	2023
Freeze	2024 -28
10% Reduction	2029
30% Reduction	2035
50% Reduction	2040
80% Reduction	2045

The above mentioned steps are as per Montreal Protocol. But the real available quota will be ascertained country program implementation plan and also as per agreement between Executive Committee of the Montreal Protocol Multilateral Fund. It always accelerated than the Montreal Protocol schedule.

ii. Baseline Determination and Phase-down Timetable for Bangladesh

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 groups, each with a different baseline and phase down time table is shown in Table 5.

Table 5: The MP Parties are split into four following KA 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.

iii. 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 tons of CO2 equivalents.

Definition of consumption will remain same as earlier, i.e., Production + Import – Export – Destruction of controlled substances calculated in GWP.

iv. 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.

v. Article 7 Data Reporting to 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.

Bangladesh ratified the Kigali amendment to the Montreal Protocol on 8 June 2020. So after 90 days, 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 (i.e., 2020), and for each year thereafter. For Bangladesh it is shown in Table 6.

Table 6: Article 7 paragraph 3 data reporting schedule

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

vi. Data reporting obligation to the Multilateral Fund Secretarial

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). Exempted categories (Data Form 1-4) are: 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 data should be reported.

vii. Discrepancies in Data Reporting

Bangladesh is not producing any ODSs. It only imports for her domestic consumption. So National Ozone Unit should carefully fill 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.

In CP report, consumption means sector-wise use of particular chemicals, need to fill up in the format. In the CP format, import, production, export would be mentioned separately. Also need to report information on exempted categories in the appropriate boxes.

viii. Compliance Assistance Program of UNEP

UNEP has a compliance assistance program 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

CHAPTER 5

ENABLING ACTIVITIES TO IMPLEMENT KA TO THE MP

The Kigali Amendment aims for the phase-down of hydro-fluorocarbons (HFCs) by cutting their production and consumption. Hydro-fluorocarbons (HFCs) are manmade chemicals, which are widely used as alternatives to ODSs Although HFCs are not ODSs; they are very powerful greenhouse gases the most with high Global Warming Potential (GWP). Bangladesh reached an agreement to control a group of HFCs and adopted an amendment to the MP (the Kigali Amendment).HFC phase-down is expected to avoid up to 0.4 degree Celsius of global temperature rise by 2100.

While Bangladesh recognize the importance of HFC phase down to achieve climate benefits, the government of Bangladesh decided to take measures to address these issues with the implementation of Enabling Activities for HFC Phase-down. Specially, licensing and reporting system, as well as initial capacity building related to promote the adoption of low GWP alternatives to HFCs.

i. Ratification of the KA and Implementation

On 15 October 2016, in Kigali, the parties to the Montreal Protocol on Substances that Deplete the Ozone Layer (the Montreal Protocol) reached agreement at their 28th Meeting to phase down consumption and production of hydro-fluorocarbons (HFCs). At the same time government took initiatives to ratify Kigali Amendment. A series of stakeholder meeting and inter-ministerial meeting was organized during 2019 and took favorable opinion of stakeholders to ratify the amendment. Finally, Bangladesh ratified KA to the MP on 8 June 2020. After 90 days of ratification, it entered into force on 6 September 2020. Now, Government has to establish an effective control over HFCs along with ODSs. Immediate after the ratification of KA, it is necessary to update and modify necessary rules and regulations, selection of technology, stakeholder collaboration and training, capacity building of NOU, capacity building of technicians etc. to implement the KA in Bangladesh. The existing rules and Regulations on ODSs are to be amended for inclusion of HFCs into the list of control substances.

ii. Preparation of National Cooling Plan (NCP)

The cooling demand will grow in the future due to global warming, rapid pace of economic growth of the country, increasing per capita income, population growth and also for rapid urbanization. Bangladesh prepared the National Cooling Plan which consists of 6 different thematic areas: (a) Space cooling in buildings, (b) Cold-chain and refrigeration, (c) Transport air-conditioning, (d) Air-conditioning and refrigeration servicing sector, (e) Refrigerant demand and alternative refrigerants, and (f) Energy efficiency.

For the implementation of KA Government would be given step-wise priority on HFCs consumption reduction and enhanced the establishment of energy efficient technology transfer to the various sectors properly. A special attention would be given in the field of GHG, especially reduction of the use of HFCs in different fields.

iii. National Strategy

National Strategy is prepared under the assignment of Bangladesh enabling activities for HFC Phase-down which covers all possible relevant information and aspects that will be required to execute the challenges during implementation of Kigali Amendment of the Montreal Protocol.

Again baseline data will be available on 2023. Owing to the above mentioned situation, National Strategy to be updated in 2023.

Guideline of MLF regarding technical and financial assistance and role of other international donor/organization, such as, Kigali Cooling Efficiency Program (KCEP), Cool Coalition, GIZ, GEF, and CCAC etc. will be included. Particularly willingness of national /international agencies required to be clear whether energy efficiency to be financed during phase down of HFCs to have double benefit from the HFC phase down. The following points should be addressed during the preparation of National Strategy: (i) Ongoing HCFC Phase-out Management Plan, (ii) Import scenario of HFCs since 2014, (iii) Sector-wise

consumption of HFCs and prioritize activities depending on available cost effective, environment friendly and energy efficient technology, (iv) Prioritize activities, i.e., select immediate, short term and long term activities, (v) Analysis possible growth of the sector and consider national and international prospective of the sector, (vi) Identify probable source of funding during implementation, (vii) Exponential growth of HFC consumption in the MDIs production in the coming years, (viii) Conservation of energy in the RAC sector, (ix) Safety issue and capacity building of RAC production and service technicians, (x) Consider other policy issues, i.e., climate policy of the country, INDC of Bangladesh, Paris agreement, Policy regarding and short lived carbon pollutants etc., (xi) Existing institutional and regulatory arrangement and requirement to necessary update of these, (xii) Capacity building of Customs and low enforcement officials to combat possible illegal trade of HFCs, (xiii)Retrofit/Replacement of high GWP after end of life obsolete equipment and fiscal measures, ((xiv) Disposal of obsolete equipment, and (xv) Strength, weakness, opportunities and threat (SWOT) analysis of the whole scenario.

iv. Control Use of HFCs under Licensing System

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 MP. As per decision of the Parties to the MP, all the Parties to the MP should establish licensing system to control import export of HFCs by 1 January 2021. Existing licensing system of Bangladesh for ODSs was established in 2005 which is to be reviewed to incorporate HFCs conjointly.

Date of licensing system implementation: While the date for HFC licensing systems to be in place was 1st January 2019 for Parties to the Kigali Amendment, the text of the Amendment allows Article 5 countries a two –year delay in the establishment of the licensing system if required: "Any Party operating under paragraph 1 of Article 5 that decides it is not in a positing to establish and implement such a system by 1 January 2019 may delay taking those actions until 1 January 2021."

It is recommended that if any country which is Party to the Kigali Amendment decides it is not yet a position to implement the licensing system for HFCs, the government should formally notify the Ozone Secretariat as soon as possible. Ozone-Action can provide assistance as required.

While this provision may give some additional time to countries to establish the licensing system, it does not solve the problem of the availability of specific HS codes as the official release of the next version of the HS is 2022, a full year after the extension period. It is therefore recommended that countries take proactive and early actions to enable them to effectively monitor and control the import and export of HFCs.

Use of the HFC quotas by importers may be accomplished by either allowing the importers to use their quotas throughout the year within the license valid for one year.

Companies are required to obtain a License from Government prior to the import and export any of the 18 controlled HFCs (inclusive of blends/mixtures) which are shown in Table 7.

Table 7: List of 18 Controlled HFCs

S/N	Chemical Name	Trade Name	S/N	Chemical Name	Trade Name
1	Difluoromethane	HFC-32*	10	Pentafluoroethane	HFC-125
2	Fluoromethane (Methyl Fluoride)	HFC-41*	11	1,1,1,2 -Tetrafluoroethane	HFC-134a
3	1,1,1 -Trifluoroethane	HFC - 143a*	12	1,1,1,2,3,3,3 - Heptafluoropropane	HFC-227ea
4	1,1 -Difluoroethane	HFC - 152a*	13	1,1,1,2,2,3 - Hexafluoropropane	HFC - 236cb
5	1,1,1,3,3 - Pentafluorobutane	HFC-365mfc*	14	1,1,1,2,3,3 - Hexafluoropropane	HFC-236ea
6	Trifluoromethane	HFC-23	15	1,1,1,3,3,3 - Hexafluoropropane	HFC-236fa

S/N	Chemical Name	Trade Name	S/N	Chemical Name	Trade Name
7	1,1,2,2 - Tetrafluoroethane	HFC-134	16	1,1,2,2,3 - pentafluoropropane	HFC-245ca
8	1,1,2 -Trifluoroethan	HFC-143	17	1,1,1,3,3 - Pentafluoropropane	HFC-245fa
9	1,2 -Difluoroethane	HFC-152	18	1,1,1,2,2,3,4,5,5,5 - decafluoropentane	HFC-4310mee
	* Flammable HFCs (jointly controlled by NEA and SCDF)				
	Reference: NEA's Licensing Controls on Hydro-fluorocarbons (HFCs}				
	Singapore Civil Defense Force (SCDF) and the National Environment Agency (NEA).				

v. HS codes

The Harmonized System (HS) is a multipurpose international product nomenclature development by the WCO. It forms the basis for Customs tariffs and for the collection of international trade statistics, with each commodity group identified by a six-digit code arranged in a legal and logical structure. Over 98% of merchandise in international trade is classified in terms of the HS Codes. WCO issues Amendments every five to six years to update the HS codes.

Implementing import and export licensing systems for HFCs from January 2019 may present a challenge for countries, as the most recent HS Nomenclature 2017 edition did not include individual codes for HFCs and the next HS edition which will include specific HS codes for the most commonly traded HFCs and mixtures, will only enter into force in 2022. Prior to the official entry into force and for those countries that do not promptly adopt the 2022 HS Amendments, it is important for governments, particularly customs and enforcement officers, to be able to identify, monitor and control imports and exports of HFCs. It will not be possible, based on customs data that relies only on existing HS codes, for customs to differentiate between imported/exported HFCs and other fluorinated, brominated or iodinated substances. A special approach is therefore needed.

The national system will need to be adjusted when the 2022 HS is implemented; the additional national codes will need to be removed from the time that HS 2022 is implemented.

Can the 2022 HS codes for HFCs be used in advance of their official entry into force?

No! The provisionally adopted codes are prohibited from being used ahead of their official entry into force. The WCO has strict rules about contracting parties adopting/using amendments prior to their schedule publication date. Before their official entry into force the codes are not considered to be legal or to be enforceable.

WCO Recommendation that HS contracting Parties establish additional digits in the current national HS to identify specific HFCs

To facilitate a country's monitoring and control over imports -exports using the Harmonized System, it has the option to add additional subdivisions, at the national level, under the six digit HS code.

Paragraph 3 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.

Current HS codes for HFCs: All HFCs are covered by the single HS code: 2909.39. Mixtures containing HFCs are currently covered by the following HS code: 3824.78

Differentiation of specific HFCs in the 2017 HS

The WCO recommends that countries insert additional subdivisions as soon as possible for the following substances to facilitate the collection and comparison of data on the international movement of HFCs and

HFC-containing mixtures controlled under the Montreal protocol by virtue of the Kigali Amendment.

Pure Substances

Under subheading 2903.39 (Halogenated derivatives of hydrocarbons, other)

Saturated fluorinated derivatives of acyclic hydrocarbons (HFCs)

HFC-23

HFC-32

HFC-41, HFC-132, HFC-152a

HFC-125, HFC-143a, HFC-143,

HFC-134a, HFC-134,

HFC-227ea, HFC-236cb, HFC-236ea, HFC-236fa,

HFC-245fa, HFC-245ca,

HFC-365mfc, HFC-43-10mee

Unsaturated fluorinated derivatives of acyclic hydrocarbons (HFOs)

HFO-1234yf, HFO-1234ze (E), HFO-1336mzz (Z)

Mixtures

Under subheading 3824.74 [Mixtures containing HCFCs, whether or not containing per-fluorocarbon*s & or HFCs, but not containing CFCs]

Other, containing substances of subheadings 2903.71 to 2903.75

Under subheading 3824.78 [Mixture containing Per-fluorocarbons* or Hydro-fluorocarbons, but not CFCs or HCFCs]

Containing trifluoromethane (HFC-23) or per-fluorocarbon (PFCs), but not containing chlorofluorocarbons (CFCs) or hydro fluorocarbons (HCFCs)

Mixture containing HFC-23

Other

Containing other hydro fluorocarbons (HFCs) but not containing chlorofluorocarbons (CFCs) or hydro fluorocarbons (HCFCs)

Mixture containing 15% or more by mass of HFC-134a

Others, not included in the subheading above, containing 55% or more by mass of HFC-125 but not containing HFCs

Others, not included in the subheadings above, containing 40% or ore by mass of HFC-125

Others, not included in the subheadings above, containing 30% or ore by mass of HFC-134a, but not containing HFOs

Others, not included in the subheadings above, containing 20% or ore by mass of HFC-32 and 20% or more by mass of HFC-125

Others, not included in the subheadings above, containing saturated fluorinated derivative of methane, ethane and propane, HFC-365mfc, HFC-43-10mee

***HFC**= not controlled under the Montreal Protocol

The 2022 HS codes for HFCs [For information only: These codes are not effective until 2022, cannot be used ahead of their entry into force.]

The 2022 HS codes for HFCs: To ensure uniform interpretation of the HS and its regular updating in response to developments in technology and changes in trade patterns, the WCO priorities the maintenance of the HS codes. The WCO manages this process through the Harmonized System Committee which, inter

alia, prepares amendments updating the HS every five to six years.

In terms of advances resulting from the KA and controls required in the near future for HFCs, the HS committee has approved a proposal to update the HS codes to create HS codes for commonly traded HFCs. This also includes HS codes for HFCs contained in mixtures.

The proposal was adopted by the Council Session in June 2019. The tables below and at right provide the specific new HS codes that will be included in the 2022 HS. For mixtures containing HFCs, some example refrigerant mixtures have been included in the table, indication how they are classified by the specific HS codes. The tables are not intended to be comprehensive, rather to provide an overview and examples.

This information is provided to explain the amendments which will be included in the 2022 HS and to assist countries to understand and prepare for the implementation of the codes in 2022. It is not intended to encourage or endorse their advance use prior to entry into force-this is prohibited under the obligations of the HS Convention. HS codes for individual HFCs are shown in Table 8 and HS codes for mixtures containing HFCs are shown in Table 9.

Table 8: HC codes for individual HFCs

2022 HS Code	**Substance**
2903.4	Saturated fluorinated derivatives of acyclic hydrocarbons
2903.41	HFC-23
2903.42	HFC-32
2903.43	HFC-41, HFC-152 and HFC-152a
2903.44	HFC-125, HFC-143a and HFC-143
2903.45	HFC-143a and HFC-434
2903.46	HFC-227ea, HFC-236cb, HFC-236ea and HFC-236fa
2903.47	HFC-245fa and HFC-245ca
2903.48	HFC-365mfc and HFC-43-10mee
2903.49	Other
2903.5	Saturated fluorinated derivatives of acyclic hydrocarbons (HFOs)
2903.51	HFO-1234yf, HFO-1234ze(E) and HFO-1336mzz(Z)
2903.59	Other

Table 9: HS codes for mixtures containing HFCs

2022 HS Code	**Substances**	Examples
Containing trifluoromethane (HFC-23) or perfluorocarbons (PFCs) but not containing chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs)		
3827.51	Mixtures containing HFC-23	R-508A R-5088
3827.59	Other (i.e. contoining PFCs, but not HFC-23, CFCs or HCFCs)	R-413A

2022 HS Code	Substances	Examples
Containing other hydrofluorocarbons (HFCs) but not containing chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs)		
3827.61	Containing 15% or more by mass of HFC-143a (1,1,1-trifluoroethane)	R-404A R-428A R-434A R-507A
3827.62	Others, not included in the subheading above, containing 55% or more by mass of HFC-125 (pentafluoroethane) but not containing unsaturated fluorinated derivatives of acyclic hydrocarbons (HFOs)	R-407B R-421A R-422C R-410B R-421B R-422D R-417B R-422A R-422E R-419A R-422B
3827.63	Others, not included in the subheadings above, containing 40% or more by mass of HFC-125 (pentafluoroethane)	R-407A R-424A R-452C R-410A R-438A R-460A R-417A R-439a R-419B R-452A
3827.64	Others, not included in the subheadings above, containing 30% or more by mass of HFC-134a (1,1,1,2 tetrafluoroethane) but not containing HFOs (unsaturated) fluorinated derivatives of acyclic hydrocarbons)	R-407C R-407H R-427A R-407D R-417C R-437A R-407E R-423A R-442A R-407F R-425A R-453A R-407G R-426A R-458A
3827.65	Others, not included in the subheadings above, containing 20 % or more by mass of HFC-32 (difluoromethane) and 20% or more by mass of HFC-125 (pentafluoroethane)	R-448A R-449C R-449A R-460B R-449B
3827.68	Others, not included in the subheadings above, containing substances of subheadings 2903.41 to 2903.48 (i.e. contianing HFC-23, HFC-32, HFC-41, HFC-152, HFC-152a, HFC-125 HFC-143a, HFC-143, HFC-134a and HFC-134, HFC-227ea HFC-236cb, HFC-236ea, HFC-236fa, HFC-245fa, HFC-245ca HFC-365mfc and/or HFC-43-10mee)	R-429A R-447A R-455A R-430A R-447B R-456A R-431A R-450A R-457A R-435A R-451A R-459A R-440A R-451B R-459B R-444A R-452B R-512A R-444B R-454A R-513A R-445A R-454B R-513B R-446A R-454C R-515A
3827.69	Others (i.e. contianing other HFCs not listed to subheadings 3827 61 to 3827 68 - can also contain HFOs)	R-514A

The KA has entered into force and each country that is Party to the Amendment is required have in place an import and export licensing system for HFCs. To enable countries to effectively monitor, control and report data on imports and exports of specific HFCs and HFC-containing mixtures, the creation of specific individual HS codes for HFCs at the national level is therefore very much required. The 2022 HS, which will include specific codes for HFCs and HFC-containing mixtures, will officially enter into force on 1 January 2022. Before that date 2022 HS codes are prohibited from being used ahead of their official entry into force. The national system will then need to be adjusted when the 2022 HS enters into force. In countries where this takes some time, the 2017 HS (or previous version) can continue to be used with the additional subheadings.

UN Environment Ozone-Action can provide assistance as required to National Ozone officers and other stakeholders.

vi. Amendment of Existing Rules and Regulation

Bangladesh Government now has to establish an effective control over HFCs along with existing ODSs (Control) Rules, 2004 was enacted in April, 2004 and amended in September 2014 due to accelerated

schedule of HCFCs approved by Parties to the MP in September 2007 in Montreal. The existing rules and regulations are to be amended for inclusion of HFCs into the list of control substances. The dumping of obsolete technology would be established and enhanced sustainable waste management for RAC equipment.

Bangladesh Gazette on HFCs as control Substances is published on Monday the 15th February 2021 which is shown in Table 10.

Table 10: Bangladesh Gazette on HFCs as control Substances published on 15th February 2021.

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 Potental)
(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-236cb	1,2,2,3,3,3 hexafluoro propane ($CH_2FCF_2CF_3$)	1340
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 ($CF_3CHFCHFCF_3CF_3$)	1640
12.	HFC-32	difluoro methane (CH_2F_2)	675
13.	HFC-125	1,1,2,2,2 pentafluoro ethane (CHF_2CF_3)	3500
14 .	HFC-143a	1,1,1 trfiluoro ethane (CH_3CF_3)	4470
15.	HFC-41	monofluoto 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।

vii. Capacity Building of Stakeholders and Offices for adopting New Technology

Effective stakeholder collaboration is to be re-established with almost all relevant Government and private agencies, NGOs, Elite persons etc. Training to be provided for government agencies, non-government organizations, NGOs, Elite person's etc. about phase-out of ODSs and Phase-down of HFCs as per schedules, ozone layer depletion and its consequences, greenhouse gas emission and control, global warming causes and impacts, climate changes, reduction procedures of HFC, strategy for implementation of KA, alternative technology of HFCs, legislative and policy options to control HFCs, protection of illegal trade of HFCs, capacity building of stakeholders and officers for adopting new technology, obligation under KA to the MP, enabling activities to implement KA , etc. and their consequences regarding the implementation of KA to the MP in Bangladesh

viii. Capacity building of RAC technicians providing updated curriculum

(a) Role of Service Technicians

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. So, technicians should properly be trained.

(b) Training Module of RAC Technicians

RAC sector training under ODS Phase-out program with the assistance of MLF is not enough. So government should take responsibilities to build capacity of this sector and to educate RAC technician as an opportunity and to prepare program 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 livelihoods and social security of the technicians for sustainable development of the sector.

(c) Training of RAC Service Technicians

Around 50,000 thousand technicians are working in servicing sectors [Survey 2019]. 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.

A majority of technicians have no technical academic qualification. Experts working in this sector, say, there are acute shortages of trained service technicians in the commercial and industrial chiller sector [Survey 2019]. There is a wide variation in failure rates depending on knowledge and skill levels of technicians. The servicing needed for larger and more complex systems is significant.

Skilled personnel are needed for installation and servicing RAC equipment and thus training of RAC service technicians are so important. The new alternative refrigerants while phasing out HCFCs are either mildly flammable or flammable. The technicians need to be trained on their safe handling. Besides most of the service technicians are in informal sector than in the formal one. The servicing sector technician training activities in the country have been primarily organized by national ozone unit (NOU) of DoE and focuses on reaching technicians that generally are not covered under the formal training systems in the country. There are technical training institutes, vocational training centers, public and private spread across the country that provide formal training.

Current Status of Training for Servicing Technicians Imparted by NOU: Given the context, training cannot be only a theoretical training; the 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 also altogether has imparted training to around 10,000 technicians both from formal and informal sectors

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. It is a continuous program of the NOU under institutional strengthening project funded by MLF. It provides "Certificate" to all the participants after each training program.

(d) Updated Training Curricula for RAC Service Technicians

HFC is to be included in the course curriculum along with ODS in various sectors. Technicians also take training about HFCs use, reduction, disposal, alteration, charging etc. using personal protection equipment.

As for training to the service technicians, given importance of good service practices (GSPs) to the reduction of refrigerant consumption and maintenance of rated energy efficiency of in-use equipment, it is important to understand what the current level of adherence to GSPs are in the field, and what factors can improve them. There is no study available in this regard. Testing of leaks, calibrated charging, flushing without refrigerant and recovery of refrigerant are needed for the system.

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In general, the training course curricula for servicing technicians of good service practice (GSP) include:

- Recovering refrigerant from the sealed refrigeration system or venting and removal of leftover refrigerant like HC-290, which has insignificant impact on environment;
- Environmental impact and human health Impacts of ODS and HFC refrigerants;
- Repairing/replacing inoperative spare parts;
- Cleaning/polishing and flushing the system;
- Careful brazing and /or flaring of tubes;
- Leak and pressure testing;
- Evacuation and vacuum holding;
- Refrigerant charging;
- Sealing the process tube and /or closing the valve;
- Routine checking for proper operation;
- Recording the detail of work done;
- Alternatives to HCFCs and their characteristics;
- Handling of HFCs refrigerants;
- Servicing of HCFC and HFC based air-conditioners;
- Tools and equipment for servicing;
- Handling and Safety issues of HC refrigerants;
- Servicing of hydrocarbon (HC) based air-conditioners;
- Installation procedure of split air conditioners;
- Refrigerant recovery, recycling and reclamation;
- Economics of refrigerant reclamation and best Service;
- Contaminated refrigerants and refrigerant identifier;

- Selection and safe usage of cleaning solvents;
- Maximizing climate benefits through servicing sector;
- Recovery machine – maintenance; and
- Single stage vs. double stage regulator.

(e) Workplace Safeties for Good Service Practices (GSP)

GSPs are essential steps in refrigerant handling and AC servicing/repair that must be followed to minimize environmental impact of the AC and also to maintain their energy efficiency. MP stipulated phasing out ODS-based refrigerants, and therefore the training curriculum for HPMP II laid a special emphasis on GSPs to handle the existing ODS-based equipment. For the implementation of KA, flammable refrigerant is to be charged in the refrigerator instead of HFC. Occupational hazards and safety system include in the training curricula which are as follows:

- Personal safety and personal protective equipment (PPE);
- Electrical safety;
- Fire safety;
- Safety while using tools and equipment;
- Safe handling and storage of refrigerants;
- Guidelines for safety while following GSPs and handling flammable refrigerants;
- Safe venting of HC 290;
- General safety for installation;
- Safety precaution for brazing; and
- First aid.

(f) Livelihoods and Social Security of the Technicians

Stable and secure livelihoods and long-term social security are important from the perspective of social welfare. In large unorganized sectors in developing economies, livelihoods are vulnerable to unexpected shocks. This is also true for service technicians in the RAC industry. For example, a prolonged illness could lead to a significant impact on the income of a technician, as well as eat away a large part of financial savings, pushing them harder into the unorganized sector.

As the economy of the country is growing, it is imperative that the larger service sector, which includes the air-conditioning and refrigeration servicing sector, needs to strengthen its quality of delivery. This in turn implies that the mean performance of technicians ought to grow to deliver higher quality service. An understanding of current status is useful for better planning for the future.

Firstly, there is some disparity in the annual earning of service technicians in the room air- conditioners, commercial air conditioning (CAC) and mobile air conditioning (MAC) sector. There is also a distinct seasonal pattern to this work, with busy season lasting for six to nine months, depending on the location. During the off-seasons, many technicians provide service to other electronic equipment or do installation works.

Secondly, there is marked difference between average earnings for technicians working for authorized / specialized service centers, and the average earnings of technicians working with other enterprises or freelancing, with the former earning higher than their counterparts.

Thirdly, access to social security schemes is not prevalent in this service sector in the country. The primary reason for this is that most technicians are either self-employed or informally / casually employed by authorized service centers / registered enterprises. Only a small percentage of technicians who are employed at managerial / supervisory level, have access to the benefits associated with formal employment.

ix. Institutional Strengthening for the Implementation of Enabling Activities

Implementation of the enabling activities would be accomplished using the existing national infrastructure

and institutional setting that is already established for ODS phase-out activities. Institutional arrangement in Bangladesh is such that management of ozone depleting substances and all ODSs projects of MLF, UNDP and UNEP are executed by the same office, which facilitated the streamlining of activities. Bangladesh Government established National Ozone Unit (NOU) in 1996 at the Department of Environment, Ministry of Environment, Forests and Climate Change, Agargaon, Dhaka to implement MP related activities with the financial support from Montreal Multilateral Fund (MMLF). Protocol achieved its 93% phased-

x. Alternative Survey for Baseline Determination

First HFC alternative survey is to be conducted in the early 2023 for the preparation of sector-wise phase-down projects as per available alternatives/Technology. To conduct HFC alternative survey in early 2031 and update National Strategy, National Cooling plan, Rules and Regulation and other policy related to KA implementation.

xi. Verification for authentication of National ODSs Consumption

For authentication, National ODSs Consumption Verification Survey is urgently needed in the early of 2021 and 2023 respectively.

CHAPTER 6

DISCUSSION OF ALTERNATIVE TECHNOLOGY OF HFCS

Hydro-fluorocarbons (HFCs) are potent greenhouse gases used as alternatives to ozone-depleting substances (ODS) being phased out under the Montreal Protocol. Most of the HFCs are used as refrigerants in refrigeration and air conditioning (RAC) equipment, but also as blowing agents, aerosol propellants and solvents. To avoid the use and emissions of hydro-fluorocarbons (HFCs), a variety of climate-friendly, energy-efficient, safe and proven alternatives are available. Some of the commonly used alternatives to HFCs in different sectors are propane (R290), iso-butane (R600a), HFCs with lower GWP, such as R-32, hydro-fluoro-olefine (HFOs) and HFC-HFO blends, natural refrigerants, ammonia (R717) and carbon dioxide (R744). These refrigerants offer lower cost, have low GWP and high energy efficiency compared to their fluorinated counterparts.

i. Sector-wise use of HCFCs

Different types of HCFCs are using in Refrigeration and Air-Conditioning, Foam, Aerosol, Fire protection and Solvents sectors which are as follows:

(A) Refrigeration sub-sector:

Domestic Refrigeration: Limited use of service drop-in blends (never used in equipment production) (HCFC-141b in appliance insulation foam).

Commercial Refrigeration: HCFC-22 in service; and HCFC-141b in foam.

Industrial Refrigeration: HCFC-22, R-502 (a blend of CFC/HCFC), HFCS blends (HCFCs-141b in foam).

Transport Refrigeration: HCFC-22, R-502 (HCFC-blends), HCFC blends (HCFC-141b in foam)

(B) Air-Conditioning sector:

Residential and commercial Air-Conditioning: HCFC-22

Chiller: HCFC-22 & HCFC-123

Mobile Air-Conditioning: None or minimal (poor compatibility with hoses)

(C) Foam sector: HCFC-141b, HCFC-142b, and HCFC-22

(D) Aerosol sector: In Medical aerosol no use of HCFC but in non-medical: HCFC-2, HCFC-141b, and HCFC-142b

(E) Fire Protection sector: HCFC-123, HCFC-124, HCFC-22 (blends)

(F) Solvent sector: HCFC-141b, HCFC-225ea, HCFC-225cb

ii. Important Consideration for the Section of future Technology

The considering categories of selecting technology must be energy efficient and less emissions which depends on the following factors:

(A) Environmental: Technology must be zero GWP and short atmospheric life

(B) Cost and availability: Economically viable & Availability in local market

(C) Performance: High efficiency and Lubricants oil miscibility

(D) Capability: Thermal, Chemical & other material

(E) Toxicity: Non-corrosive and No residue

iii. Discussion of Alternatives HFCs Technology Trends in RAC

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 these, with different properties and characteristics.

Some of the refrigerants that emerged during ozone implementation of MP have high global warming potential (GWP) and contribute to climate change. From a technology point of view this poses a real change, because such high GWP fluids, most of which are HFCs have become the backbone of many RAC sectors in the past two decades. So, it is better to discuss technology trends sector by sector.

There are four main routes to replace HCFCs in the RAC sector includes:

(a) Ammonia: NH3; (R-17); (b) Hydrocarbons:Iso-butane (R-600a), Propane (R-290), Propylene (R-1270), and blends etc.; (c)Carbon-dioxide: CO2, (R-744) and (d) Hydro fluorocarbons: HFCs (i.e. R-134a & blends such as R-407C, R-410A, R-404A)

(a) Ammonia: Ammonia is a well-established refrigerant requiring special personnel competencies and system design; an increased use of ammonia will depend on more technicians and engineers receiving training in this sector; there are environmental benefits from the use of ammonia because it has zero ODP and negligible GWP; technically it is a good refrigerant, but it has some safety drawbacks and technical challenges associated with material compatibility and high temperatures occurring during compression; the investment cost is typically higher than for conventional systems, at least in lower capacities; and well-designed systems can have very good energy efficiency.

(b) Hydrocarbons: Hydrocarbons are good refrigerants with zero ODP and negligible GWP; their flammability requires specific competencies in design, manufacturing and service; iso-butane (R-600a) has become the standard refrigerant in new domestic appliances in many markets; propane (R-290) and Propylene (R-1270) have more appropriate properties to replace R-22; and safe use of hydrocarbons requires training of those involved in the design, installation and servicing the equipment.

(c) Carbon dioxide: Carbon dioxide technology is currently the most innovative area in refrigeration; easier and lower cost competing technologies; non-flammable, non-toxic refrigerants; two main challenges involved are the high system pressure at normal operating temperatures and the low energy efficiency (COP) for a standard refrigeration cycle; CO2 is introduced in different applications both as single stage "supercritical" refrigerant; and part of a cascade with a second refrigerant.

(d) Hydro-fluorocarbons: HFCs are by far the most common replacement of HCFCs in new equipment and a wide range of such equipment has been available on the market for the past 15 years; the relatively high GWP of HFCs have increased the pressure on finding alternatives with lower impact on climate and the development efforts have increased as climate change has become the number one environmental challenge; they can be used safely and cost effectively in all applications where CFCs and HCFCs have been used with minimal technical changes; and will be controlled under Montreal Protocol (Kigali amendment).

Domestic Refrigerator: According to the ODS alternative survey 2019, 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. Now almost all domestic refrigerators built in Bangladesh are HFC free.

Commercial Refrigeration System: Commercial refrigeration in general is applied through 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.

All types of this refrigeration equipment 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 equipment. R-22 is still used in condensing units. HCFC-22 continues to represent a large refrigerant bank in commercial refrigeration.

Air-cooled water and water-cooled water chiller systems have been observed to be in supermarkets. Many old supermarkets have a split AC system. Newly built supermarkets have VRF central AC system. Maximum chillers are charged with refrigerant R-22. However, in newly built supermarkets refrigerant of HFC-134a is also in used.

As the chiller systems are 100% import based, the existing stock information has been arrived at by gathering two key pieces of information - chiller sales data of 2018 and the estimate of the historical installed base. The data on estimated market size of different types of chillers in 2018 was also gathered from the above mentioned sources. The stock of the chillers in 2018 including the historical installed base is estimated to be around 0.65 to 0.70 million TR.

Industrial Refrigeration System: Industrial refrigeration equipment are milk, meat and 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.

Trends of HFC use increasing in this sector. Environment friendly and energy efficient alternatives are yet not used. Conversion cost of non-HFC is comparatively high compared to other. So, better to wait for cost effective and energy efficient HFO based technology to be available in the country.

Fish freezing sector has also come of age. There are around 280 to 300 fish freezers now in operation (Source: Bangladesh fish freezers association). All these are medium in size and have a capacity of refrigerant range from 0.75 to 1.0 TR. Ammonia (R-717) is used as refrigerant. For pre-cooling, R-22 is used in the fish freezing sector.

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 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 increased in the coming years. That is use of HFCs will be increased day by day.

Cold Storage: In Bangladesh, the majority of large industrial system, such as cold storage, fish freezing, textiles, pharmaceuticals etc. is 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, 2019, 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.

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 or R-22 for pre-cooling room. About 800 fish freezing industries consume 60 MT of R-717 and 11.00 MT of R-22 for servicing purposes in 2019.

(f) Transport Refrigeration and Mobile Air-Conditioning

This sector includes transport/mobile air-conditioning (MAC) systems used to cool the driver and passengers in land transport including cars, vans, lorries, buses, agricultural vehicles and trains. all car air conditioning used the refrigerant CFC-12. This was completely phased-out during the 1990s in developed countries and around a decade later in developing countries and the global car market switched to HFC-134a, a refrigerant with a GWP of 1430. Larger vehicles such as buses and trains also use other HFC refrigerants such as R-407C (GWP 1774) and R-410A (GWP 2088).

Passenger cars and other small vehicles such as Vans and the cabs of Lorries almost all use a very similar design of air-conditioning system. This utilizes a compressor powered via a belt drive from the main engine, connected to an evaporator in the ventilation air inlet duct and a condenser located at the front of the car near the radiator. The main components are connected by flexible hoses. The system is assembled and charged on the main vehicle production line. Some recent MAC designs use electrically driven compressors – these are a new requirement to ensure the function when the main engine is off (e.g. in hybrid vehicles) and for fully electric vehicles.

Car MAC systems contain between 0.4 kg and 0.8 kg of refrigerant. The annual demand for refrigerant in the MAC sector is split between refrigerant used in new cars and refrigerant used in the service sector to top-up systems that have leaked. Historically car MAC systems suffered from high levels of leakage – it was common to recharge the system with refrigerant on an annual basis. During the last 10 years there has been major design improvements, especially to the compressor shaft seal and to the materials used for flexible hoses. Modern MAC systems experience relatively low levels of leakage in normal use (although may suffer total refrigerant loss following a major car accident).

A considerable amount of HFC-134a is consumed for servicing car air-conditioner. Now, costly HFO-1234yf as low GWP technology is started to be used. Now, cost-effective good option technology is not available in this field.

(g) Transport Refrigeration / Shipping Refrigeration

Transport refrigeration is quite a big area and has specific challenges such as shock, vibration, corrosion and broad operating conditions. So selection of refrigerant and refrigerating system is substantially different from one form to 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.

Ship Breaking: There are about 200 ship breaking yards working in Bangladesh [ODS and ODS alternative survey, 2019]. They are mostly collected virgin refrigerants from the ships that come 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 come in the country territory. During the entering into the country territory for breaking purpose, the ship operators vacated refrigerants. Only virgin refrigerants are collected from ship during breaking.

Ship Building: There are about 130 companies/organizations engaged in Bangladesh for ship building. In 2019, 70 small and 50 medium sized ships were built which required 2.04 MT R-22, 1.68 MT R-410a and 0.976MT or R-404a.

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.

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 of marine fishing vessels in 2019, about 0.210 MT R-22, 0.024 MT of R-134a and 0.024 R-410a were used.

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 were consumed in 2019.

Reefer Containers: According to the survey report 2019, 35000 reefer containers entered into Bangladesh in 2019 and 30% required full/partial charging refrigerants which were HFC-134a and 70% of which used R-410a and R-404a. About 1900 reefer containers were built 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.

(h) Demand of Refrigerants: The combined consumption of ODS alternative-134a in MAC and MAC Service sector is increasing. The service sector of MAC always consumes more than the manufacturing sector. This increasing trend of ODS alternative is going with the Article 5 of the MP. The contribution of other ODS alternatives in this sector is still not significant.

(i) Refrigerants in Supermarkets, Hospitals, Hotels, Railways and Office Buildings

As per survey 2019, all supermarkets, hospitals, hotels, railways and commercial office buildings used HFC-134a-based chillers. Some others are using VRF system using R-410a, and large number of old supermarkets depends on R-22 and R-410 based split ACs.

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 is decreasing and R-410a is increasing as per report.

Railways: 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 nos. of branches were operating in 2019. All have ACs based on R-22 (70%) and R-410a (30%). Consumption in 2019 was 10.345 MT R-22 and 6.345 MT of R-410a.

Office Building: During ODS alternative survey, data for office buildings were collected reveals that consumption of both R-22 and R-134a is increasing up to 2018. Consumption of both the chemicals decreased in 2019.

(j) Air-Conditioning Manufacturing /Assembling

As per ODS alternative survey 2019 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

Bangladesh has a relevant national industry that produces window units, splits (medium to large sized) and chillers for domestic use only. In this scenario, six companies have the largest share of HCFC-22 consumption, while few other medium to small-sized companies have negligible consumption of HCFC-22 and the portion R-22 consumed in AC Assembling / Manufacturing sector with respect to total ODS consumed in the country.

The average consumption of ODS in Residential and Commercial AC Assembling / Manufacturing sector is close to 40% of the total ODS (R-22) consumption in the country. The demand for R-22 in Residential and Commercial AC Assembling / Manufacturing sector has recently starts decreasing. The consumption of R-22 is also decreasing recently in industrial air-conditioning including chillers.

iv. Technology Trends in Foam Sector

During adjustment of MP 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 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. Lower GWP fluorocarbon, viz., HFO-1233zd or HFO-1336m22 may be considered for conversion.

v. TechnologyTrends in Aerosol Sector

(a) 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.

(b) Medical Aerosol: One of the taught challenges 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, not flammable and virtually non-toxic.

Over 500 million people suffer from asthma and chloric 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 use and 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 flavor, 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 iso-butane, HFC-152a and HFO-1234ze as per Medical Technical Option Committee (MTOC) report of 2018.

According to MTOC report 2018, about 800 million MDIs were produced (average fill weight 13/14.5 mg/MDI) world-wide using approximately 11,500 MT HFC-134a (92%). MT of HFC-227ea was used (8%). This corresponds to direct emissions with a climate impact of approximately 18000 ktCO2 eq. which is about 2% of the global HFC emission.

During 90's only three pharmaceuticals companies in Bangladesh 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 of 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.

During ODS alternative survey there was no industrial medical aerosol produced by any of the manufactures of Bangladesh.

vi. 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 used.

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 sectors; use of HFCs in this sector is quite negligible and there is no need to intervene in this moment.

vii. Technology Trends in Fire-fighting

First generation fire-fighting components were halons and it was phased-out in 1995 by HCFC-123 in portable fire extinguishers now gradually decreasing. Now use of HFC-227ea is increasing as substitute for halons. Other conventional systems are water, water mist, CO2, inert gases, fine solid particles (powders), dry chemicals, aqueous film forming foam successfully contributing in the firefighting in Bangladesh.

CHAPTER 7

PROTECTION OF ILLEGAL TRADE OF HFCS

The illegal trade in ozone-depleting substances and greenhouse gases used in the cooling sector remains a significant obstacle to international efforts seeking to limit the worst impacts of climate change. After a long time investigation in Europe, it is found that this criminal trade and, with a steady increase in hydro fluorocarbon (HFC) smuggling as a result of an EU phase-down of these chemicals, will continue monitoring and investigating this illegal trade, pushing for strengthened enforcement, working for better engagement on the issue from customs and campaigning for an effective licensing system for HFCs.

i. Training for Customs and law enforcement Officers

Customs officers and law enforcement body would be trained on HFCs and also on the upcoming Rules and Regulations for effective control on import and export of HFCs. The updated curricula of Customs Training Academy is included for their regular training activities on ODSs and HFCs. Updated training curricula for Customs officers, and training for law enforcement body to prevent illegal trade of HFCs to be imposed.

Overview:

- Introducing the different types of HFCs and being used;
- Provisions & phase-down schedules of the MP & KA & their amendments;
- Established HFCs licensing system & its implications for Customs officers and other stakeholder agencies;
- Customs regulations & HFCs monitoring & control systems;
- Revised customs codes for HFCs & HFCs containing equipment refine & optimize the monitoring & control system for HFCs;
- Customs regulations & HFCs monitoring & control systems;
- Training on HFCs & products/ equipment containing HFCs;
- Design training strategy & time schedule for customs officers; and
- Awareness is to be rising on HFC regulations among importers & exporters.

The updated training curriculum includes:

(a) HFC Chemical Structure: such as HFC-134a, HFC-410A etc.

(b) Uses of HFCs Refrigerants: such as HFC-134a, HFC-410A, HFC-404A etc.; blends– in domestic, commercial, & transport refrigerators; air-conditioning & heat pump systems; motor vehicle air-conditioners; Blowing agents: HFC-134a foam blowing agent for the manufacture of polyurethane, phenolic, polystyrene & polyolefin foam plastics; Fire extinguishers: HFC-227ea.

(c) Phase-out schedule for HFCs: For Article 5, group 1 country the baseline schedule:Baseline: On an average consumption and production of 2020, 2021 and 2022; Freeze: 2024-2028; Phase-down(2029-2045): 10% reduction by 2029, 30% by 3035, 50% by 2040 and 80% by 2045.

(d) Key enforcement players in the HFC licensing system: Customs officers, NOU, Licensing agencies, Ministry of Trade, Industry or Commerce, Food & Drug Administration, Pesticide board, Attorney General, Ministry of Justice, Police & Coast Guard, Bureau of Standards, Industry & trade representatives & associations, General Public , Government laboratories, Climate committees and Other law enforcement agencies.

(e) Role of Customs Officers in enforcing HFC regulations : Enforcement of HFC licensing system, training of customs officers in identification of HFC & HFC based products, awareness raising on HFC regulations among importers & exporters, checking and inspecting shipments, trucks & vessels, detecting illegal trade with HFC & HFC-based products, using refrigerant identifiers & analyzers, cooperating with other stakeholders involved in monitoring HFC trade, reporting legal & illegal trade as well as seizures to the NOU, seizing illegal imports including storage & disposal, supporting other

enforcement agencies, e.g. in providing evidence for court cases refer to customs checklist for identification of HFC & HFC-based products.

(f) Customs Checklist: Compare the packing list, bill of entry, & the country of origin to ensure they match. Ensure the customs code on the entry matches the description on the invoice. Compare the invoice & the bill of lading to the outward bound ships manifest. Verify the country of origin. Is the country a party to the MP & its amendments? Verify that the importer & place of business actually exist. Contact the licensing agency to verify that the importer is licensed to import that specific material. Note the quantity, source, & destination of the HFC. These will serve as important clues that may provide indicators to prohibit illegal importations. Verify that the container number actually exists. Discovery of fictitious container numbers have led to the disclosure of illegal trade. Review all the necessary documents, if there is something that doesn't match, it may be an illegal shipment. Inspect the merchandise. Check packaging, size, & shape and label on container. Identify the name & description of the chemical, which should match (All paper work). Seize the material if the importer does not have the import/export license. Coordinate this seizure with the customs officer, environment agency, & the prosecution agency. Anyone involved with the seizure may be called to testify in court, so take good notes.

(g) Safety checklist for customs officers: Dos (Disk Operating System) do observe local regulations & industry recommended procedures for the handling, transport & storage of virgin, recovered, recycled or contaminated refrigerants. Do use protective clothing, including safety goggles & cold-insulating gloves when handling refrigerants. Refrigerants can cause frostbite & other damaging effects to the skin & eyes. Do equip storage areas with appropriate fire extinguishing systems to reduce the risk of a fire. HFCs refrigerants are not combustible, but produce low irritating or low toxic fumes in a fire. But Liquid contact can cause severe irritation and frostbite. Do use electronic leak detectors to inspect storage areas & access valves for leakage. Do check the contents of refrigerant cylinders using the temperature/pressure method or electronic refrigerant identifiers, but only if you are trained & authorized to do so under local regulations.

(h) Safety checklist:Do inspect access valves for leaking glands & effective gaskets. Protective caps should prevent valve damage. Do secure storage areas for HFC & ensure that they are only accessible by authorized personnel & that they are protected against theft. Do properly label HFC & storage areas & show appropriate warnings if necessary. Do store seized ODS until further legal action determines what will be done with the substances. They should be clearly labeled & stored. The Country Handbook on HFC Regulations should detail storage requirements for seized HFC. Do disconnect the power supply when inspecting or testing equipment, e.g. refrigerators should be unplugged & vehicle motors turned off. Do respect local requirements & standards for pressure vessels with low & high pressure refrigerants. In many countries, safety inspections are mandatory. Do store & transport HFC cylinders carefully in an upright position & prevent dropping them.

(i) Safety checklist don'ts: Do not eat, drink, or smoke in storage areas or near HFCs or HFC products/ equipment. Do not vent HFC into the atmosphere knowingly. Do not dispose of any HFC by using methods other than R &R, reclaim, reuse, adequate storage or approved destruction methods. Do not handle or store HFC in confined spaces which lack ventilation since some HFC can accumulate in confined spaces. This increases the risk of inhalation & may cause unconsciousness or suffocation resulting in death. Use breathing protection if appropriate. Do not store HFC cylinders in direct sun light or near hot surfaces. A rise in temperature will cause an increased pressure with the risk of bursting. Do not take samples of HFCs; this should be done by trained & authorized technicians or personnel of accredited Government laboratories. Do not use open flames in storage areas or near any refrigeration & air-conditioning system to reduce the risk of fire yet these are not flammable. Do not use the "halide torch method" for leak testing. Do not handle chemicals open hand if you are not trained & familiar with the necessary safety precautions.

(j) HS (Harmonized System) tariff classification: Structure of the HS codes (based on chemical contents or application), HS codes for HFC HS codes for HFC-containing products, New HS codes (2017) for

HFC and HFC-containing mixtures.

(k) ASHRAE & UN numbers: American Society of Heating, Refrigerating, & Air-conditioning Engineers (ASHRAE) Letter R (for refrigerant) + Number designation for refrigerants based on their chemical structure, e.g. R-134a UN number, United Nations Substance Identification Number (UNSIN or UN number), A four digit international standard number which identifies a particular chemical or group of chemicals, e.g. HFC-134a's UN number is 3159.

(l) CAS (Chemical Abstract Service) numbers:CAS number to identify a chemical. The CAS number contains from 5 to 9 digits separated into three groups by hyphens. The first group, staring from the left, has up to 6 digits; the second group always has 2 digits; the third group always has 1 digit. The CAS number is specific for single chemicals and for some mixtures, e.g. HFC-134a; the CAS number is 811-97-2.

(m) ASHRAE designations for single components: One less than the number of carbon atoms (i.e., there are 1+1 = 2 carbon atoms), One more than the number of hydrogen atoms (i.e., there are 3-1 = 2 hydrogen atoms), Number of fluorine atoms (i.e., there are 4 fluorine atoms). The "a" indicates an isomer (i.e., a different arrangement of the same atoms) of R-134, R-134a, *R-134a is an ODS alternative

(n) Portable refrigerant identifiers/analyzers: Some identifiers may: Detect R-134a (non-ODS), R-500, R-502, hydrocarbons & air; Detect composition of certain mixtures; Detect purity & water content; Be connected to a computer or printer; Saves several test results; Uses infrared optical technology to identify refrigerant type; and Costs US$ 900-3,000

(o) Temperature/pressure method: Be-careful when testing, frostbite & other injury could occur. Safety gloves & masks should be worn. Place thermometer with cylinder & wait until the cylinder contents have reached the approximate temperature of the warehouse. For cylinders which are in direct sunlight, allow to cool in shaded area for 1-2 hours. Take temperature reading. Attach hose to container & open valve to get true reading (PSI)* on gauge. After obtaining reading, close valve & remove hose. Compare temperature & PSI readings to PSI chart. Refer to temperature/pressure chart in Annex B e.g. for a temperature of 23.550F, the PSI should be 21 for HFC-134a. Smugglers can change the pressure of the container by adding other gases, like nitrogen. If you suspect something, send the cylinder for laboratory analysis.* [PSI=pounds per square inch]

(p) Trade & chemical names: The names companies give their products, different names and formulas can be used. Chemical's names, e.g. hydro fluorocarbon (HFC) that is in case of HFC-134a or 1,1,1,2 tetra-fluoro-ethane (CH2FCF3). ASHRAE designated Names of HFCs chemicals are shown on Table 11.

(q) Laboratory analysis: Laboratories use more extensive techniques for testing (gas chromatography, infrared analysis) than field equipment. Laboratory testing can identify specific compounds. What size containers can be sent directly to the laboratory? Check with the lab to see who can take samples. Should be conducted by a professional

(r) Motives for HFC smuggling: Existing stock of HFC in global market are often more expensive, Conversion or modification of equipment, e.g. refrigerators, for HFC can be costly

(s) HFC producing countries: Argentina, China, Taiwan, EU-25 countries, Korea, Germany, Greece, Italy, Japan, Mexico, Korea, Russian 1, Spain, Canada, USA, UK etc.

(t) Smuggling Schemes Front Door Smuggling: Mislabeling of HFCs, Mislabeling as recovered/ used/ recycled HFC Concealment & double layering of HFC, Diverting HFC from transshipment harbors or HFC produced for export—free trade zones; Declared as equipment

(u) Screening methods Risk Profiling- e GRID Intelligence Reports: [Emissions and Generation Resource Integrated Database (e GRID) is a comprehensive inventory of environmental attributes of electric power systems]. Screening Documents for Inspection of Goods:.: Screening for importers which are not licensed to import or export HFC; screening documentation for consistency of codes & names, screening by quantity of import/export, screening by country of origin, screening by transshipment harbor, Screening by recovered or recycled HFC shipments; screening by countries with recycling capacity.

Table 11:ASHRAE designated Names of HFCs chemicals.

ASHRAE designations and chemical names

Table of ASHRAE designations ('R' numbers), for HFCs and HFOs used in this policy, brief, with their chemical names. *ASHRAE designations are often presented with the prefix 'R', for example: R-134a for HFC-134o*

ASHRAE designation	Chemical Name
HFC-14	Tetrafluoromethane
HFC-23	Trifluotomethane
HFC-32	Difluoromethane
HFC-41	Fluoromethane
HFC-152	1,2-difluoroethane
HFC-152a	1,1-difluoroethane
HFC-125	Pentafluoroethane
HFC-143a	1,1,1-trifluoroethane
HFC-143	1,1,2-trifluoroethane
HFC-134a	1,1,1,2-tetrafluoroethane
HFC-134	1,1,2,2-tetrafluotoethane
HFC-227ea	1,1,1,2,3,3,3-heptafluoropropane
HFC-236cb	1,1,1,2,2,3-hexafluoropropane
HFC-236ea	1,1,1,2,3,3-hexafluoropropane
HFC-236fa	1,1,1,3,3,3- hexafluoropropane
HFC-245fa	1,1,1,3,3-pentafluoropropane
HFC-245ca	1,1,2,2,3-pentafluoropropame
HFC-365mfc	1,1,1,3,3-pentafluorobutane
HFC-43-10mee	1,1,1,2,2,3,4,5,5,5-decafluoropentane
HFC-1234yf	2,3,3,3-tetrafluoropropene
HFC-1234ze(E)	1,3,3,3-terafluoropropene
HFC-1336mzz(Z)	1,1,1,4,4,4-hexafluoro-2-butene

(v) Inspection of Goods Physical Examination of Containers & Packaging: Screening containers & packaging for consistency of codes & names, check consistency of ISO container, consistency check of container type & labeling, consistency check on flammability of refrigerants, check cylinder valves, direct identification & analysis.

(w) List of HFC products:Automobile & truck air-conditioning units (whether incorporated in vehicles or not), domestic & commercial refrigeration & air-conditioning / heat pump equipment, e.g.: refrigerators, freezers, dehumidifiers, water coolers, Ice machines, and air-conditioning & heat pump units, aerosol products, except medical aerosols, portable fire extinguisher, Insulation boards, panels and pipe covers, pre-polymers (i.e. polyol blends used to produce polyurethane foam) etc.

(x) Examples of smuggling schemes: United Arab Emirates: Trans-shipment harbors Nepal: Letters of credit issued for 368 tons despite the ceiling of 26 tons per year under the licensing system; Bangladesh: Imports rose from 181 tons in 1994 to 832 tons in 1997 resulting in artificially high base line level.

ii. Identifiers for Customs Entry Points

Identifiers for ODSs are distributed in every custom entry Point for identifying ODSs. New identifiers to be placed each and every entry points for identifying HFCs and mixture to prevent illegal trade.

iii. Enforcement

Enforcement is the process of ensuring compliance with laws, regulations, rules, standards, and social norms. Governments attempt to effectuate successful implementation of policies by enforcing laws and regulations. Enforcement officers need to be trained to prevent illegal trade of HFCs.

CHAPTER 8

SOURCING, NEGOTIATION AND STRATEGY FOR IMPLEMENTATION OF KA

The Montreal Protocol Multilateral Fund is one of the basic sources of funding for implementing the Kigali Amendment to the MP. All parties can prepare projects proposal for negotiating fund for implementation. Under the Kigali Amendment, the negotiation with the party is as a process of communication with an objective of reaching an agreement, where appropriate project proposal prepared for funding for the implementation of Kigali to the MP.Other UN sources will provide fund to the parties for the Implementation of Kigali Amendment to the Montreal Protocol.

Under the Kigali Amendment; Parties to the Montreal Protocol will phase down production and consumption of Hydro-fluorocarbons, commonly known as HFCs..

Bangladesh used environmental friendly alternatives to HFCs in insulating foams, a major use of fluorinated gases, has avoided uptake of HFCs almost entirely. Bangladesh's room air conditioning market has the largest segment used climate-friendly R-290-based models.

The HFC production and consumption (which means imports and destruction) will be capped in 2028 and phase down gradually from there. It will follow a reduction schedule of 10% in 2029, 30% in 2035, 50% in 2040 and 80% in 2045.

During the phase down of HFCs, Article 5 Parties will have the flexibility to individually select HFC sectors and replacement technologies, and adapt their strategies to their needs and national circumstances.

Energy efficiency incentives are evaluated in the context of incremental costs resulting from HFC conversions, giving consideration to limited upgrades of components and parts of alternative technologies, where it is cost effective and represents only a smaller percentage of the total conversion costs.

i. Financing for Implementation

Key actors in developing countries often require additional financial assistance to initiate the transition to a more climate-friendly RAC market. GHG mitigation in the RAC sector belongs to the most cost effective mitigation actions. However, often barriers such as lack of capital, lack of information and high risk perceptions prevent end-users from purchasing more climate-friendly and efficient RAC products.

An effective mitigation framework for the RAC sector must be based on an integrated approach, covering financing for mitigation of both direct and indirect emissions, within the NDC framework. Thereby both the climate and socio-economic benefits can be maximized.

ii. Financing of HFC Reductions under the MP

The financing of activities to reduce HFC emissions will be funded under the MP in the future. Developing countries (Article 5 of the MP) are supported through the MLF with finance for technology transfer to enable their compliance with the Protocol's control measures. The eligible funding is provided on the basis of the total baseline consumption and in view of subsector specific incremental cost guidelines.

Developing countries have agreed on a baseline approach which sets the level of allowable HFCs for consumption and production. Under this approach, developing countries responsible for approx. 87% of the HFC consumption (in developing countries) apply a baseline based on the years 2020 to 2022, while a remaining number of countries with specific difficulties take the years 2024 to 2026 as a basis for their baseline. In both cases, two years after the last baseline year the consumption will be capped at 100% of the baseline, the so called "freeze". In the following years the consumption will be gradually reduced to a final plateau of 20% or respectively 15% of the baseline in the years 2045 and 2047.

Funding the phase down of HFC may include incentives for energy efficiency improvements when appropriate and cost effective. Since the MLF has no capacity to control the impact of energy efficiency measures, it is likely that funding for energy efficiency will depend on a supporting framework in the beneficiary country. In addition, it is expected that MLF support for capacity building in the servicing and repair sector will substantively improve the energy efficiency of installations and equipment. Funding may

include the following elements: (I) Costs for setting up inventories, reporting and ratification processes; (II) Demonstration projects and regulative action; (III) Institutional strengthening; and (iv) Incremental costs necessary to achieve the first control step (freeze) and the individual phase down steps until the final plateau is achieved. Incremental costs are provided for the close down of HFC production capacities and for reducing consumption in the manufacturing sector, including costs for building capacity in the servicing sector.

End-user funding is not obligatory under the MLF and only demonstration projects are financed in exceptional cases.

It is not planned to fund an exhaustive and ambitious range of energy efficiency measures. Thus, ambitious energy efficiency will typically depend on additional measures such as NAMAs, which can provide additional funding from outside the MLF.

iii. Kigali Cooling Efficiency Program (K-CEP)

K-CEP is supporting countries, companies and communities to achieve energy efficiency objectives related to the Kigali Amendment. Launched in 2017, K-CEP is deploying US$ 52 million of philanthropic funds to strengthen institutions, support adoption of model policies, scale-up technology deployment, leverage finance and help make cooling more affordable and sustainable. UN Environment is one of K-CEP's implementing partners.

iv. Climate Finance under the United Nation Framework Convention on Climate Change (UNFCCC)

The provision of financial support for mitigation activities in developing countries is a cornerstone of the international climate policy process and the Paris Agreement. Developed countries committed to jointly mobilize US$100 billion per annum until 2020 to support climate action in developing countries. This commitment was reiterated in the Paris Agreement and extended through to 2025. Before 2025, a new collective finance goal is to be defined with the US$100 billion constituting the minimum. The HFC phase down is expected to significantly contribute to global mitigation targets with an expected reduction of 0.5°C by the year 2100. This is without reductions that could be achieved through energy efficiency and a replacement of fossil energy by renewable energy.

In developing countries, the aggregated reductions until 2050 achieved by HFC reduction and the combined introduction of EE measures and renewable energy production are projected to be equally high. In the energy sector, absolute reductions are difficult to achieve under steady high economic growth as seen in developing countries. Because of the outstanding importance of cooling in developing countries, the massive replacement of fossil energy production with renewable energy in combination with high energy-efficient cooling systems is the only option for achieving the 2050 targets. Therefore, the major part of funding for energy related mitigation in the RAC&F sector will need to come from climate finance sources.

v. Green Climate Fund

One of the main sources of support is the Green Climate Fund (GCF) which was adopted as the financial mechanism of the UNFCCC at the end of 2011. The initial resource mobilization rose over US$ 10 billion and is expected to increase substantially in future. The GCF has a goal to fund climate action equally across mitigation and adaptation sectors with at least half of available resources to be made available to the Least Developed Countries (LDC), Small Island Developing States (SIDS), and African States.

The funding framework is continuously evolving and funding for several projects has already been agreed. A Private Sector Facility (PSF) is also being established to allow direct engagement of the private sector.

The GCF will operate a variety of financial instruments including grants, concessional loans, subordinate debt, and equity and guarantees depending on specific project and funding needs. A higher risk bearing capacity is expected to support innovative approaches and crowd in finance from other, in particular private, sources.

vi. Short and Long Term strategiesfor implementation to KA

Short Term Activities (2023-2030)

- Update National Strategy, National Cooling Plan, National Assessment, and Training Curriculum and develop National Standard and Code of Practice for RAC service technicians.
- Update training curriculum of Diploma Engineers with Bangladesh Technical Education Board, Customs training Academy and Customs officers & law enforcement body to prevent illegal trade of HFCs.
- HFC alternative survey in 2023, verification of ODSs data authentication survey and prepare sector-wise phase-down project as per available alternatives/Technology.
- Reduce 10% consumption of HFCs from the baseline from 1 January 2029.

Long Term:

- HFC alternative survey in 2031, and update NS, NCP, Rules and Regulation and other policy related to KA, evaluate status of MDI production(if alternatives are available)
- Capacity building of RAC technicians, replacement program for RAC equipment and continue fiscal measures to accelerate the program.
- Disposal program of obsolete /equipment after end of life.
- Ban import and export of HFCs containing blends.
- Reduce consumption of HFCs as per schedule.

CHAPTER 9

MULTIPLE BENEFITS OF ENERGY EFFICIENCY

Energy efficiency is a key component of the KA, 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. The energy efficient targets, supply and demand, consumption and production and benefits are shown in below:

i. Bangladesh Energy Efficiency Targets

The total installed electricity generation capacity of Bangladesh (including captive and renewable energy) was 23,548 Megawatts (MW) as of August 2020. As of August 2020, 97% of the population has had access to electricity. The largest energy consuming sectors in Bangladesh are industries and the residential sector, followed by the commercial and agricultural sectors. Bangladesh will need an estimated generation capacity around 40,000 MW of power by 2030 to meet the real demand around 34,000 MW to 36,000 MW in order to sustain its economic growth over 7%.

(a) Energy Supply: Bangladesh has been able to exploit its natural gas reserves. Around one fourth of its energy supply depends on natural gas. It is anticipated, however, that the gas supply has reached its peak in 2018 and gradually decrease thereafter. Therefore, the country cannot build another gas fired power plants, but instead resort to other natural resources for power generation, such as oil, liquefied natural gas (LNG) and coal.

The Government plans to develop the Matarbari Island area to build ports and facilities which shall allow imports of coals and liquefied natural gas (LNG) for power generations after 2021 and 2022, respectively. The development of nuclear power generation in collaboration with Russia is also in progress.

(b) Demand: Bangladesh is a densely populated country with around 180 million people living in 147,570 square kilometers of land as of date. In order to maintain a sustainable GDP growth of 7% and above up to 2020 and beyond, it requires meeting the essential energy needs. Primary energy consumption has been increasing steadily at around 8% per year. 70% of total consumption is still dependent on domestic gas, excluding biomass.

The Government has formed Sustainable and Renewable Energy Development Authority (SREDA) on 24th May, 2014 under the Sustainable and Renewable Energy Development Authority Act, 2012 as a modal agency to promote, facilitate and disseminate sustainable energy (SE), i.e. covering both the areas of Renewable Energy (RE) and Energy Efficiency (EE) to ensure the energy security of the country.

A rapidly growing country like Bangladesh needs a huge amount of energy to feed its large growth appetite. In 2030, the total primary energy consumption of Bangladesh, excluding transportation and biomass, is estimated to reach over 72 Mtoe, triple the size of 2013.

ii. Sector-wise Energy Consumption in Bangladesh

In terms of direct electricity consumption, the share of industrial sector is about 33% and that of domestic sector is about 53% and the rest is followed by commercial, agricultural and others. The concept of energy intensity is an indicator to comprehensively capture energy efficiency of production in factories, buildings and nationwide economic activities, which can be described as the unit energy consumption per production, floor areas and GDP, respectively. EE&C potential can be calculated by comparing the actual energy intensity of a product / building / economy with the best-case energy intensity in the most advanced factory in Bangladesh or in other countries.

Under the EE&CMP, three EE&C programs have been promoted, namely, Energy Management Program, EE Labeling Program and EE Buildings Program, which are targeted at large energy consuming entities and equipment in the industrial, residential and commercial sectors. These programs touch all related possibilities for achieving energy efficiency in the RAC sector.

The direct economic benefit of EE&C implementation is energy consumption reduction (toe). Without proactively implementing EE&C programs, the total energy consumption of this country may expand three folds from 25 million toes (Mtoes) in 2013 to 72 Mtoes by 2030. In order to fulfill the growing appetite of the economy, it is important for the government to minimize the energy wastes and maximize the use of available energy. According to the EE&C target of EE&CMP, the Government aims to improve energy intensity (i.e., national primary energy consumption per gross domestic product/GDP) by 15% by 2020 and by 20% in 2030 compared to the 2013 level. This goal is considered attainable based on the estimation that the industrial, commercial and residential sectors currently have the potential to save energy by 21%, 10% and 28.8% respectively. The following are the two scenarios for the calculation of the economic benefits of energy savings expected to be generated through EE&C implementation in the period between 2015 and 2030: In Target Scenario (Moderate Case), the energy saving potential realization rate in 2030 will be 80% (i.e., 80% of expected energy savings by 2030 will be accomplished), whereas in Stretch Scenario (Ambitious Case), the potential realization rate will be 100% (or expected energy savings by 2030 will be fully accomplished).

iii. GHG Reduction in the Energy Sector

The Intended Nationally Determined Contributions (INDC) of Bangladesh consists of the following elements in mitigation contribution: (i) An unconditional contribution to reduce GHG emissions by 5% (12 MtCO2e) from Business as Usual (BAU) levels by 2030 in the power, transport and industry sectors, based on existing resources; (ii) A conditional 15% (36 MtCO2e) reduction in GHG emissions from BAU levels 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, and (iii) A number of further mitigation actions in other sectors which it intends to achieve subject to the provision of additional international resources.

The RAC sector has not been accounted for in the INDC Bangladesh though the RAC sector is responsible for an increasingly significant share of emissions, which, at the same time can be mitigated effectively at a low cost. This makes the sector highly appealing for early mitigation within Nationally Determined Contributions (NDC) implementation.

iv. Energy efficiency technology in RAC

RAC sector consists of the following sub-sectors:

(a) Residential sub-sector

During 2018-19 there has been around 12,000 to 13,000 MW demand of electricity in the peak hours of the summer months. In terms of sectorial consumption, share of residential sector has been around 53%, which accounts for 6,500 to 7,000 MW. If all the existing home appliances in residences are to be replaced by the highest efficiency products (as of today), huge scale of energy consumption reduction can be achieved. It is calculated that a maximum potential is 28.8% meaning 1800 to 2000 MW reduction in energy consumption is possible as a whole in the residential sector. In the RAC sector including the electric fan for cooling consume about 60% of total residential energy. Therefore, finally it would be possible to reduce around 1100 to 1200 MW electric energy reduction from RAC and electric fan sector in residence. Electric fan has 25% energy saving potential with respect to today's technology (by using high efficiency motor), that of refrigerator / freezer has 55% (by using variable speed compressor, high performance heat insulation) and air-conditioner has 50% (by using high COP with large heat exchanging coil and variable speed compressor). It may be noted that the electricity consumption is much higher in summer months than in winter months and the consumption by the room air-conditioners makes the difference. The energy efficiency rate and EE&C potential of home appliances, which are actually represent the gain of using energy efficiency equipment in terms of GWH/year (i.e. in terms of electricity consumption / cost).

(b) Industrial Building sub-sector

The manufacturing industries in our country are not efficient in energy use due to old and poorly-maintained machines and poor energy management. The EE&C potential is estimated to be around

21% of the entire sector consumption, excluding non-feasible EE&C potential. Considering that about 50% of the national primary energy is consumed in industrial sector, the potential impact of EE&C measures on the economy is massive and it is expected that the national primary energy consumption can be reduced by almost 10%.

(c) Commercial Building sub-sector

Electricity consumption in the commercial sector has been around 1100 to 1200 MW in the peak hours of summer months. Electricity is the main mode of energy in commercial buildings. In the commercial buildings also, like in residential sector, the room air conditioners makes a lot of increase in electricity consumption in the summer months,

Electricity is the main source of energy consumed within buildings. Around 50% of the total energy is consumed in air-conditioning and from 10 to 30% is consumed in lighting. The expected energy-saving potentials under these two categories are as follows: (i) Air-conditioning: 50% by applying high efficient air-conditioners (ACs) with inverter technology and (ii) Lighting: 50% by applying high efficient lighting system, such as LED lamp, T5 fluorescent lamp with electronic ballast or utilizing sun light.

It is expected that a simple replacement of ACs and lighting systems with high energy efficient ones can save about 50% (meaning 550 to 600 MW) of total electricity consumptions in the commercial sector. However, it is not easy to introduce EE&C measures for all the buildings. Thus as a realistic value, EE&C potential for buildings was estimated about 10%.

v. Energy Efficiency Option for Double Climate Benefit

The phase-down of HFC refrigerants under the Kigali Amendment has the potential to avoid up to 0.1˚C of warming by 2050 and up to 0.4 by 2100. The economic, environmental, and health benefits of catalyzing simultaneous energy efficiency improvements, in concert with the HFC phase-down, supports reduced energy consumption and avoided emissions of CO2 and black carbon, which can potentially double the climate benefit of the phase-down alone.

vi. Cooling Demand in the Building Sector

Growth in space cooling demand has been rising steadily over the last decade due to a combination of factors, such as rising population living largely in urban areas with growing aspiration needs fuelled by a steady economic growth. The following growth drivers will have a significant bearing on the sales of new comfort cooling equipment in the following decades: (i) Growth in per-capita income, (ii) Aspiration needs, (iii) Purchasing power of urban and as well as rural population and (iv) Rate of Urbanization Bangladesh is in the midst of fast construction growth. In view of the rapid increase in building stock and the associated air-conditioned area, it becomes increasingly important to reinforce the need to build in strategies and interventions to reduce the need for active cooling of buildings. By incorporating energy efficient design and construction strategies, buildings can have inherently reduced energy consumption footprints over its operating lifetime. High-performance buildings in an average reduce the energy consumption substantially than that of conventional conditioned buildings.

This section provides cooling equipment of residential and commercial building sectors current stock and its growth trajectory over the next decade to comprehend the upcoming cooling demand from these sectors. The cooling demand approximate numbers have been presented here to provide trends and are based upon industry information, surveys and research conducted by various organizations.

vii. Owner and Occupant Perspective

Owner and occupant perspective includes comfort, health, operations and maintenance, safety and property value.The multiple benefits of energy efficiency: owner and occupant perspective are shown in table 12.

Table 12: Multiple Benefits of Energy Efficiency: owner and occupant perspective.

Agents	Benefits
Comfort	Improved lighting comfort, thermal comfort and noise comfort
Health	Improved physical and mental health from indoor air quality and comfort.
Operations &maintenance	Improved building and systems durability with reduced need for maintenance.
Safety	Improved safety through lighting, controls and reduced chance of fire from gas leaks
Property Value	Increased rental income, reduced tenant turnover, increased habitable floor area.

Benefits for owners: increased quality & property value.

Benefits for occupants: increased health, comfort, safety and affordability.

viii. Social Perspective

Multiple Benefits of Energy Efficiency on Societal perspective is shown in Table 13.

Table 13:Multiple Benefits of Energy Efficiency: societal perspective

Agents	Benefits
Jobs	Shifting from global to local jobs and from polluting to green jobs
Economic	Investment that provides economic benefit for many years.
Emissions	Reduced direct and indirect emissions from efficiency, refrigerants and reduced product size / quantity.
Energy	Energy use benefit from improved efficiency and reduced embodied energy from increased durability
Environmental	Air pollution, solid waste, wastewater, and reduced input materials

Benefits: Benefits that last for many years.

ix. Industry Perspective

Multiple Benefits of Energy Efficiency on industry perspective is shown in Table 14.

Table 14: Multiple Benefits of Energy Efficiency: industry perspective

Agents	Benefits
Competitiveness	Ability to enter new markets, reduced production costs, etc.
Production	Capacity utilization, improved product quality, etc.
Operations and maintenance	Improved industrial and commercial operation; reduced need for maintenance, etc.
Working environment	Site environmental quality, worker health and safety, etc.
Environmental	Air pollution, solid waste, wastewater, and reduced input materials

Benefits for industry: increased productivity & value creation.

Benefits for consumers/indirect benefits for industry: increased affordability and access to products and services.

x. National Perspective

Multiple Benefits of Energy Efficiency on cities and national perspective is shown in Table 15.

Table 15: Multiple Benefits of Energy Efficiency: cities and national perspective

Agents	Benefits
Energy access	Expand access to supply power to more people through the existing energy infrastructure
Economic development	Supporting economic growth including through industrial productivity and reducing fuel import bills.
Poverty alleviation	Increasing the affordability by reducing the per -unit cost of lighting, heating, refrigeration, etc.
Combatting local pollution	Reducing direct and indirect emissions through energy efficiency on supply side and demand side.
Climate change resilience	Reducing vulnerable energy infrastructure and improving the durability of buildings

Benefits for cities and nations: supporting key government goals.

xi. Safety and Security

At the building level, lighting and lighting controls can improve safety, increase security, improve the value of the building and reduce light pollution. Energy efficient equipment and system that comply with modern standards have reduced risk of fire and leaks. Increase the reliability of electrical systems, reducing outages frequency and improving living conditions. The existing electricity, water and gas connections will be set to standard, reducing the possibility of accidents such as electrical fires or gas leakages. Substitution of older is for more energy-efficient appliances.

xii. Multiple sectorial benefits

(a) International: Energy price reduction & greenhouse gas emissions reduction.

(b) National: Reduced energy demand and local price reduction, reduced public health spending, energy security and potential net increase in employment.

(c) Sectorial: Increase in resale value of home, improved bill payments for energy providers and jobs in installation and production of insulation materials.

(d) individual: Lower energy bills (discretionary), increased disposable income, warmer, drier, more comfortable home, improve health and well-being potential, significantly reduce utility bills, increase property value, enhance quality of life, a great return on investment, energy savings tips help cut-costs easily and Overall 50% reduction is in electricity consumption and a more comfortable place to live.

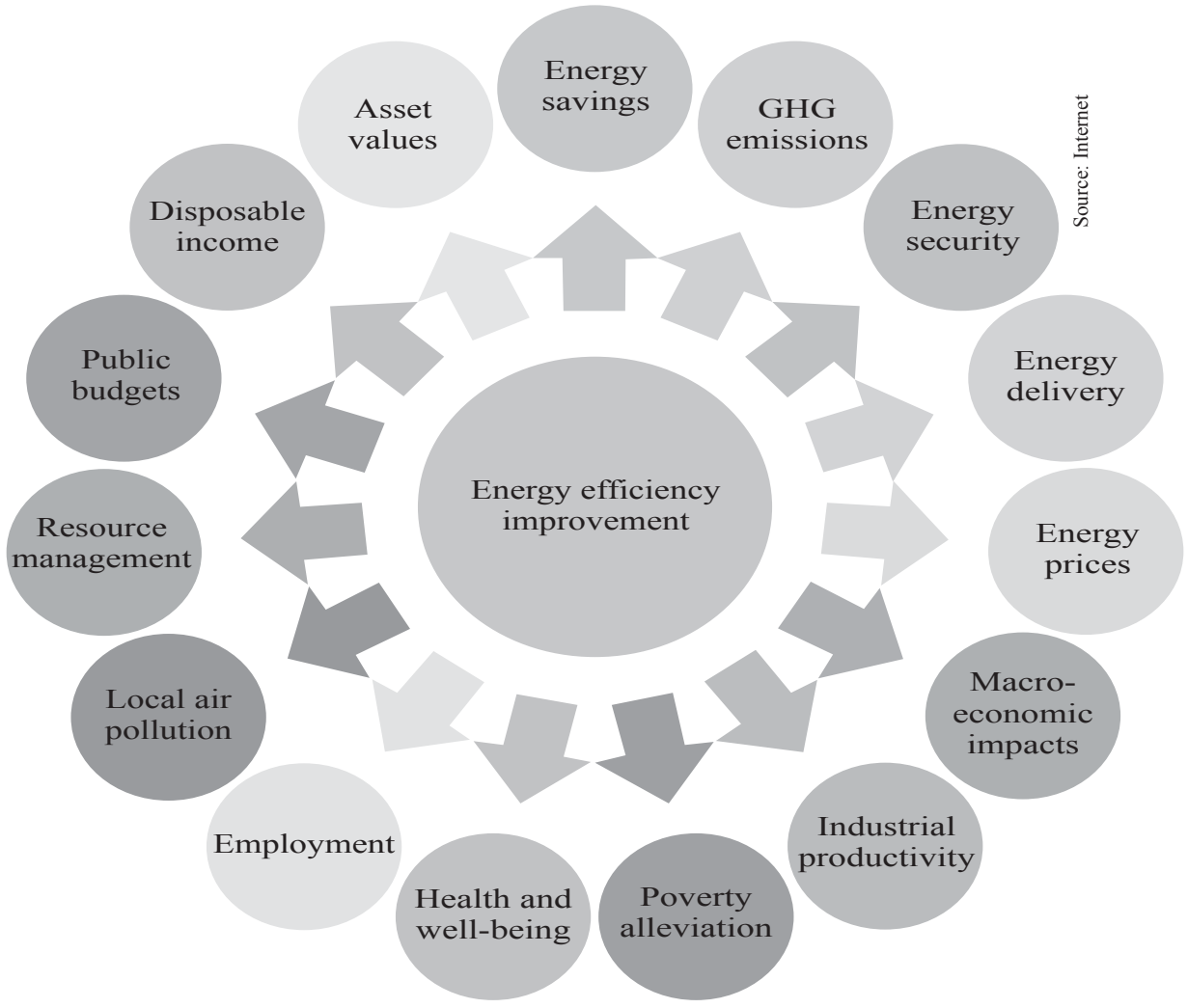

Figure 15: Multiple Benefits of Energy Efficiency.

xiii. Operational Improvement

Energy efficient clothes and dishwashers can be better than hand washing, reduction of electricity and water consumption, reduction in energy and time required for drying, extending clothes lifetime and higher capacity saves times, earn incremental returns on energy efficiency investments, insulate from rising electricity prices and also protect the environment.

CHAPTER 10

CONCLUSIONS

Standardizing training curricula is a complex task requiring considerations for the many types of refrigerants and equipment available currently and in the future. Given that the technology evolves continuously, curricula development is a continuous process of revision.

Training enhanced managerial, supervision and controlling skills and career development which are essential to empower stakeholders and national officers and relevant experts associated with implementation of KA and, in turn necessary for the overall development of the participant's management efficiency.

Training program for technicians for both industries and servicing forms one component of the overall transition roadmap for the RAC sector. However, it plays a critical role in the reduction of emissions. The priority areas were identified based on Bangladesh mandated transition under the KA to the MP, as well as domestic skill development agenda. The NOU promotes the need for adherence to GSPs and safety and is also aimed at creating sufficient awareness on alternative refrigerants.

The participants for the training of Officers include DoE, related Govt. & non-Govt. agencies, delegates from related associations, customs and enforcement officers, ODSs and HFCs importers, distributers, dealers, and national and international experts related to ODSs and HFCs etc.

Study material: Videos, slides presentation etc.

Media release: (i) Press releases - in different newspapers highlighting on the links between ozone layer and climate protection, HFC phase-down challenge and the opportunity to change over to the alternatives at the earliest; (ii) TV spots – brief announcements could be considered in order to raise general public awareness or to change consumer behavior; (iii) radio broadcasts – expert discussion could be considered in order to address particular stakeholder groups and (iv) Distribution of leaflets, posters and films – different leaflets could be designed separately for: (x1) importers and dealers, and (x2) servicing companies operating in refrigeration sector.

Time Schedule of the Training: Minimum 2 days.

References

1.Ozone Cell, Department of Environment, Ministry of Environment , Forest, and Climate Change, Government of the People's Republic of Bangladesh, www.ozonecellbd.org.

2. Amendment to the Montreal Protocol on substances that deplete the ozone layer, Kigali, October 2016.

3.Sustainable Development Goals: Bangladesh First Progress Report 2018, Government of the People's Republic of Bangladesh.

4. Energy Efficiency and Conservation Master Plan up to 2030, 2016, SREDA, Government of the People's Republic of Bangladesh.

5. Bangladesh Climate Change Strategy and Action Plan 2009, Government of the People's Republic of Bangladesh.

6. HCFC phase-out management plan (stage I, first tranche) for Bangladesh, 2018, UNEP, United Nations.

7. HFC Emissions Report for Bangladesh, 2020, Climate and Clean Air Coalition, UNDP.

8. Survey on 'AC Assembling Industries in Bangladesh', 2016, UNDP, Dhaka, Bangladesh.

9 Survey on 'ODS Alternatives' 2017, UNDP, Dhaka, Bangladesh.

10. Survey on 'Foams, SMEs in RAC and Supermarkets in Bangladesh', 2018, UNDP, Dhaka. Bangladesh

11. Survey on 'ODSs and ODSs Alternatives in Bangladesh', 2019, UNDP, Dhaka, Bangladesh.

12. The Technology & Economic Assessment Panel (TEAP, 2016).

13. Hand Book for the Vienna Convention for the protection of Ozone Layer,

Twelfth edition (2019).

14. Handbook for the Montreal Protocol on Substances that Deplete the

Ozone Layer, Thirteenth edition (2019)

15. Kigali Amendment to the Montreal Protocol on Substance that Deplete the Ozone Layer, United Nation, 2021.

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