Ministry of Environment,
Forest,and Climate Change

सत्यमेव जयते

CPCB

Training Manual

for

Capacity Building of Officials of Pollution Control Boards with respect to Montreal Protocol Implementation

Prepared by

National Productivity Council

National Productivity Council
Lodhi Road, New Delhi

In collaboration with Ozone Cell, MoEFCC

SAVE OUR ZONE LAYER

December 2025

NATIONAL PRODUCTIVITY COUNCIL

सत्यमेव जयते

राष्ट्रीय उत्पादकता परिषद्
(उद्योग संवर्धन और आंतरिक व्यापार विभाग,
वाणिज्य एवं उद्योग मंत्रालय, भारत सरकार)
उत्पादकता भवन 5–6, इन्स्टीट्यूशनल एरिया
लोदी रोड, नई दिल्ली–110 003

नीरजा शेखर, आई. ए. एस.
महानिदेशक

NEERJA SEKHAR, IAS
DIRECTOR GENERAL

NATIONAL PRODUCTIVITY COUNCIL
(Department for Promotion of Industry and Internal Trade,
Ministry of Commerce & Industry, Govt. of India)
Utpadakta Bhavan, 5-6, Institutional Area
Lodhi Road, New Delhi - 110 003

Foreword

The transition away from Ozone-Depleting Substances (ODS) and high-GWP refrigerants is an essential element of India's broader environmental and climate commitments. In line with our obligations under the Montreal Protocol and the ODS Rules, 2000, it is important that the regulatory bodies are equipped with a strong understanding of the legal provisions, monitoring mechanisms, and emerging technology pathways.

This Training Manual has been developed by the NPC along with the Ozone Cell, MoEF&CC, and CPCB with the objective of strengthening institutional capacity and enhancing the enforcement capabilities of pollution control authorities. It provides a comprehensive overview of the scientific, regulatory, and operational aspects essential for implementing the Montreal Protocol in India, including ozone science, global agreements, and enforcement mechanisms under the ODS Rules, 2000. The Manual also offers practical guidance on sectoral transition challenges, safety considerations, and future strategies for HCFC phase-out and HFC phase-down.

Looking ahead, NPC remains committed to supporting the Pollution Control Boards in building technical capacities, undertaking sector-specific studies, developing standard operating procedures, and strengthening monitoring frameworks for ODS and HFC management. As the knowledge partner to the regulators and the industries, NPC facilitates technology upgradation, best-practice dissemination, and smoother transitions toward non-ODS, low-GWP, and energy-efficient solutions. Through sustained collaboration, we can collectively strengthen India's environmental governance and contribute meaningfully to global climate protection efforts.

I am confident that this Training Manual will serve as a practical and timely resource for officials across India, empowering them to discharge their responsibilities with clarity, competence, and confidence.

Dated: December 4, 2025

(Neerja Sekhar)

रजत अग्रवाल, आईएएस
RAJAT AGARWAL, IAS
संयुक्त सचिव
Joint Secretary

सत्यमेव जयते

भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT FOREST AND CLIMATE CHANGE

Foreword

The Montreal Protocol is an international environmental treaty for protection of the Stratospheric Ozone Layer. India as Party since 1992, has been implementing the Montreal Protocol through setting up well established regulatory and policy measures in the country. The Ozone Depleting Substances (Regulation and Control) Rules, 2000, and their subsequent amendments, provide the national regulatory framework for ensuring compliance with these international obligations. Effective implementation of these rules requires pollution control authorities to have a clear understanding of regulatory provisions, monitoring mechanisms and the evolving technological landscape across the manufacturing and production sectors.

This Training Manual on **"Capacity Building of Officials of Pollution Control Boards with respect to Montreal Protocol Implementation"** has been developed to strengthen the enforcement capacity of State Pollution Control Boards (SPCBs), Pollution Control Committees (PCCs), and the Central Pollution Control Board (CPCB). The manual emphasizes uniform interpretation of rules, reporting practices, and constructive engagement with industries undergoing technological transition.

The Ozone Cell of the Ministry of Environment, Forest and Climate Change, in collaboration with the Central Pollution Control Board and the National Productivity Council, has developed a training manual. This manual serves as a practical guide for pollution control officials across India, enabling them to strengthen the national compliance with the Montreal Protocol and its Amendments.

I commend the efforts of Ozone Cell, CPCB and NPC for bringing out this training manual.

Dated: December 4, 2025

(Rajat Agarwal)

पहला तल, पृथ्वी विंग, इंदिरा पर्यावरण भवन, जोर बाग रोड, नई दिल्ली-110 003, फोन. : +91-11-20819340, 20819398, ई-मेल : js.ia-moefcc@gov.in
1st Floor, Prithvi Wing, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi-110003, Tel.: +91-11-20819340, 20819398, Email: js.ia-moefcc@gov.in

TABLE OF CONTENTS

Module 5: Kigali Amendment to the Montreal Protocol

Module 6: ODS Rules 2000 and Amendments

Module 7: Roles and Functions of Ozone Cell

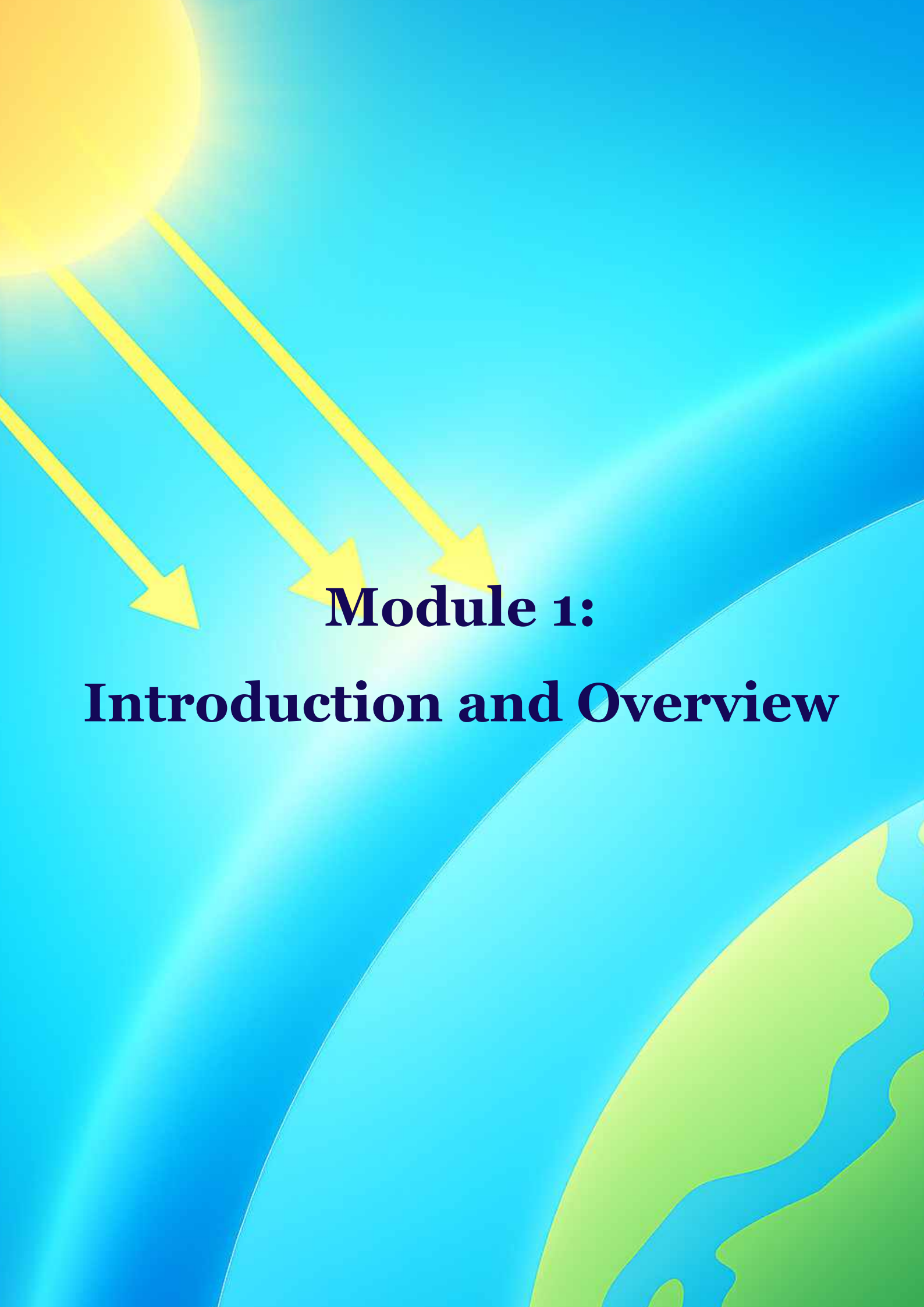
Module 8: Case Studies of Successful Phase out of ODS in the Country

Annexures

Bibliography

LIST OF ABBREVIATION

ODS	:	Ozone-Depleting Substances
ODP	:	Ozone-Depleting Potential
HCFC	:	Hydrochlorofluorocarbon
CFC	:	Chlorofluorocarbon
CTC	:	Carbon Tetrachloride
HFC	:	Hydrofluorocarbon
GWP	:	Global Warming Potential
MP	:	Montreal Protocol
UNDP	:	United Nations Development Programme
UNEP	:	United Nations Environment Programme
MoEF&CC	:	Ministry of Environment, Forest, and Climate Change
ESC	:	Empowered Steering Committee
HPMP	:	HCFC Phase-out Management Plan
MT CO2-eq	:	Metric Tonnes Carbon Dioxide Equivalent
RAC	:	Refrigeration and Air Conditioning
MDI	:	Metered-Dose Inhaler
GWP 1 (Ar4)	:	Global Warming Potential with a 1-year time horizon based on the IPCC's Fourth Assessment Report
EUN	:	Essential Use Nomination
DGFT	:	Directorate General of Foreign Trade

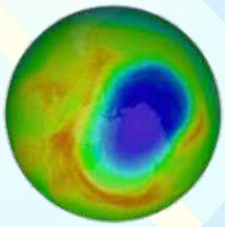


Module 1:

Introduction and Overview

1.1 Objectives of The Training

BACKGROUND



Threat of Ozone-Depleting Substances (ODS): ODS endanger the stratospheric ozone layer, exposing life to harmful UV radiation.

India's Commitment: As a Montreal Protocol signatory, India enforces ODS phase-out under the ODS Rules, 2000

Challenges: Gaps in capacity, awareness, and enforcement among SPCBs hinder effective regulation

OBJECTIVES

Capacity Building: Training of SPCBs and PCCs officers on implementing ODS regulations, inspecting converted projects, and promoting compliance, enabling SPCBs and PCCs to enforce ODS rules and support India's Hydrochlorofluorocarbon (HCFC) phase-out and Hydrofluorocarbon (HFC) phase-down plans.Training SPCBs & CPCB officials on HCFC & HFC phase-out.

Training Manual: Developing a comprehensive guidebook for mainstreaming ODS enforcement.

Goal: Strengthen SPCBs' enforcement capabilities for effective ODS regulation compliance. The training will be coordinated by NPC on behalf of CPCB, in collaboration with Ozone Cell.

Source: Ozone Cell Ministry of Environment, Forest and Climate Change Government of India, 2024

LEARNING AGENDA

- Montreal Protocol provisions on ODS phase-out including Kigali Amendment for HFCs phase-down.
- Awareness on phase-out and phase-down of controlled substances as per the schedule of the Montreal Protocol.
- Salient features of the ODS Rules.
- Mandatory requirements for registration of ODS producers, suppliers, traders, and consumers.
- Regulations for import/export of controlled substances.
- Monitoring and verification systems for ODS.

1.2 Importance of CPCB/SPCB's Role in implementing ODS Rules and ODS phase-out & HFC phase-down

CPCB shall act as a body in verifying the ODS related data received by SPCB.
SPCB has a role in issuing, CTE and CTO, once the enterprise has received environmental clearance.
During issuance of CTE/CTO, SPCB official shall check following:

1 Check for usage of banned ODS.
2 If allowed ODS is being used, verify whether it is for controlled use or as feedstock.
3 Check the status of registration with the Ozone Cell.
4 Verify the status of annual reporting to the Ozone Cell by enterprises.
5 Maintain a checklist (mentioned in the table below).
6 ODS users for feedstock application:
    - o Confirm whether Environmental Clearance (EC) has been obtained for the manufacturing of new chemicals from ODS.
    - o Check emission management of ODS, if generated.
    - o Verify the existence and adequacy of HFC-23 incineration facilities.
    - o Check Fugitive emission, leakage of ODS (if any).
    - o Check record-keeping practices of quantity procured, generated, used and stored of ODS.
    - o Check whether the leftover or waste stock containing ODS disposed scientifically i.e. incinerated.
    - o Ensure that best practices for incineration are followed as per CPCB guidelines.
    - o Data maintenance and reporting of import, export, production and consumption of ODS and HFCs.
7 For producers:
    - o Confirm whether Environmental Clearance (EC) from MoEFCC has been obtained.
    - o Verify whether production is for controlled use or feedstock purposes.
    - o If for controlled use, ensure that phased out ODS is not produced.
    - o If production for controlled use is allowed, verify whether it is within the licensed quota.
8 Check data reporting:
    - o Opening stock, production, consumption, import/export, and closing stock of ODS.
    - o Ensure data is maintained in the format prescribed as per the ODS Rules 2000 and its amendments.
    - o In cases where ODS is used as a feedstock, verify the following:
        - o Whether the entity holds a valid registration with the Ozone Cell.

Checklist 1: General ODS Consumer Compliance

Checkpoint	Follow-Up Question	Answer Format	Answer
ODS Usage	Are you using any ODS ?	Yes / No	
ODS Identification	If yes, mention the type of ODS used.	Name of ODS	
Banned Substance	Is the ODS being used listed as banned?	Yes / No	
Ozone Cell Registration	Is your enterprise registered with the Ozone Cell?	Yes / No	
Annual Reporting	Have you submitted annual data to the Ozone Cell?	Yes / No	
Leakage Check	Are regular checks done for ODS or HFC leakages?	Yes / No	
Stock Maintenance	Are stock details of ODS and HFCs maintained properly?	Yes / No	
Data Format	Is the data maintained as per the ODS Rules	Yes / No	
Usage Type	Are you using the ODS for controlled use or as feedstock?	Controlled / Feedstock	

Checklist 2: For Controlled Use Consumer

Checkpoint	Follow-Up Question	Answer Format	Answer
Purpose	Specify the purpose of controlled use (e.g. refrigeration, foam).	Mention	
ODS Status	Is the ODS being used phased out or banned for this use?	Yes / No	
Legal Procurement	Are you sourcing the ODS from licensed suppliers only?	Yes / No	
Consumption Records	Are detailed usage records maintained?	Yes / No	
Stock Details	Are stock details of ODS/HFCs maintained and updated?	Yes / No	
Leakage Checks	Are regular ODS and HFC leakage checks conducted?	Yes / No	
Safe Disposal	Is leftover or expired ODS properly disposed of?	Yes / No	
Training	Are staff trained in handling ODS safely?	Yes / No	
Alternatives	Have alternatives to ODS been considered?	Yes / No	

Checklist 3: Feedstock Use Consumer Checklist

Checkpoint	Follow-Up Question	Answer Format	Answer
Environmental Clearance	Do you have EC for feedstock use of ODS?	Yes / No	
ODS Approval	Is the ODS being used legally approved for feedstock use?	Yes / No	
HFC-23 Generation	Does your process generate HFC-23?	Yes / No	
Emission Management	Are HFC-23 emissions controlled effectively?	Yes / No	
Incineration Facility	Is there a working HFC-23 incineration facility on-site?	Yes / No	
CPCB Guidelines	Are CPCB incineration guidelines being followed?	Yes / No	
Record Keeping	Are detailed records kept for feedstock usage and emissions?	Yes / No	
Stock Maintenance	Are stock details of ODS and HFCs properly maintained?	Yes / No	
Leakage Checks	Are regular leakage inspections conducted for ODS/HFCs?	Yes / No	
Reporting Compliance	Is annual data submitted to the Ozone Cell?	Yes / No	

Checklist 4: ODS Compliance Checklist for Producers

Checkpoint	Follow-Up Question	Answer Format	Answer
ODS Production	Are you producing any ODS?	Yes/No	
ODS Type	Mention the ODS produced.	Name of ODS	
Registration	Are you registered with the Ozone Cell?	Yes/No	
EC Clearance	Have you obtained EC from MoEFCC?	Yes/No	
Production Purpose	Is the production for controlled use or feedstock?	Controlled/ Feedstock	
Phased-Out Check	If for controlled use, is the ODS phased out?	Yes/No	
Licensed Quota	Are you producing within the licensed quota?	Yes/No	
Quota Certificate	Is your HCFC-22 quota approved by Ozone Cell?	Yes/No	
Annual Reporting	Is data reported to the Ozone Cell annually?	Yes/No	
Data Details	Is data on opening stock, production, consumption, etc. maintained?	Yes/No	
Data Format	Is the data format as per CPCB/Ozone Cell norms?	Yes/No	
Leak Checks	Are ODS leakages regularly monitored?	Yes/No	
Stock Records	Are detailed stock records of ODS/HFCs maintained?	Yes/No	

1.3 About ozone layer

What is Atmosphere?

The atmosphere is a mixture of gases and particles that surround our planet. The atmosphere is divided into five main layers based on temperature variations with altitude

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Thermosphere
5. Ionosphere

The stratosphere is the second layer of the Earth's atmosphere. The ozone layer is found in the stratosphere. The ultravoilet rays coming from the sun is filtered by the ozone layer

What is the ozone layer?

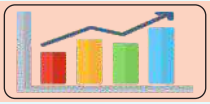
Ozone layer is a part of the Earth's atmosphere that contains a high amount of ozone gas (O_3). It absorbs most of the Sun's harmful ultraviolet rays

1.4 Formation and Importance of the Stratospheric Ozone Layer

1. Ozone is a tri-atomic molecule of oxygen formed naturally in the upper level of the Earth's atmosphere
2. Three molecules of oxygen in the presence of sunlight form two molecules of Ozone in the stratosphere
3. Stratosphere extends between 10-50 kilometeres above the earth surface
4. 90% of ozone formed in the atmosphere is present in the Stratosphere, hence called Stratosphere Ozone Layer
5. Stratospheric Ozone Layer absorbs a large part of the Sun's biologically harmful UV-B ultraviolet radiation

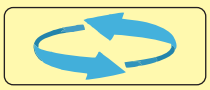
1.5 Mechanism of Ozone Layer Depletion by ODS

1) **Emissions:** Human and natural processes emit Halogen source gases, which contain chlorine and/or bromine, at earth's surface. Halogen source gases are often referred to as ODS. Human activities generate major proportion of ODS as compared to natural sources.

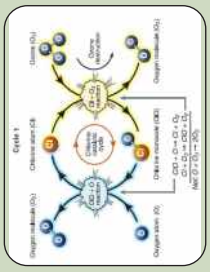


2) **Accumulation**: ODS accumulate in the atmosphere and are globally distributed throughout the lower atmosphere by winds and other air motions.

3) **Transport**: ODS are transported to the stratosphere by air motions.



4) **Conversion:** Most ODS are converted in the stratosphere to reactive halogen gases in chemical reactions involving ultraviolet radiation from the sun.



5) **Chemical reaction:** UV radiation breaks down ODS, releasing chlorine atoms. A chlorine atom reacts with an ozone molecule (O_3) to form chlorine monoxide (ClO) and oxygen (O_2). Then, the chlorine monoxide reacts with a free oxygen atom (O), regenerating the chlorine atom and releasing another oxygen molecule. This regenerates the chlorine atom, allowing it to repeat the cycle and destroy more ozone molecules. This cycle highlights how a single chlorine atom can catalytically destroy thousands of ozone molecules in the stratosphere.

1.6 Impact of Ozone Layer Depletion

Human and Animal Health:

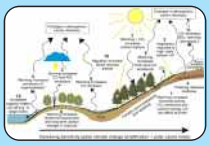
- Increased UV-B exposure can lead to eye disorders such as cataracts.
- Raises risk of skin cancers, especially non-melanoma types in light-skinned populations.
- Weakens the immune system, increasing susceptibility to infectious diseases.
- In animals, UV exposure reduces immunity to skin cancers and other diseases.

Terrestrial Plants:

- Affects physiological and developmental processes of plants.
- May require UV-B tolerant crops and new cultivars in agriculture.
- Alters species composition in forests and grasslands, affecting biodiversity.
- Impacts plant form, metabolism, disease resistance, and ecosystem functions.

Aquatic Ecosystems:

- Disrupts phytoplankton productivity—the base of aquatic food chains.
- Affects early development of fish, shrimp, crabs, and amphibians.
- Leads to reduced reproductive capacity and impaired larval growth.

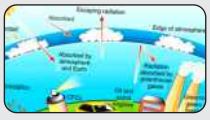


Bio-geochemical Cycles:

- Alters carbon, nitrogen, and sulfur cycles by affecting gas exchange and decomposition.
- Impacts microbial activity, such as nitrifying bacteria and bacterioplankton.
- Increases degradation of dissolved organic matter in water bodies.

Air Quality:

- Enhances photodissociation, affecting tropospheric ozone and oxidants.
- Alters atmospheric lifetimes of methane and Chlorofluorocarbon (CFC) alternatives.
- May lead to increased particulate formation.



Materials:

- UV-B accelerates degradation of polymers and natural materials.
- Results in discoloration, brittleness, and reduced durability.

Source: Ozone Cell Ministry of Environment, Forest and Climate Change Government of India, 2024

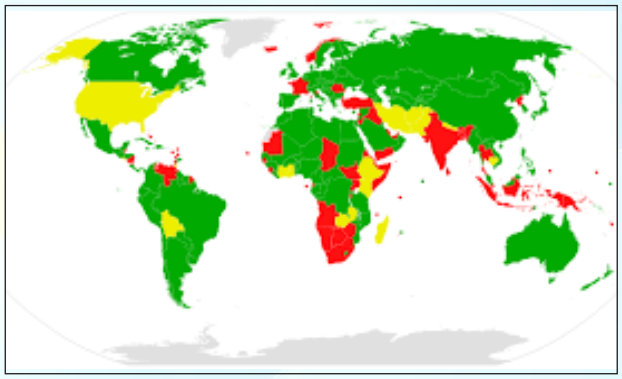
Module 2:

Vienna Convention, Montreal Protocol

2.1 The Vienna Convention for the protection of the Ozone Layer

- In 1974, scientists discovered that CFCs, found globally in the atmosphere, could reach the stratosphere and break down under UV rays, releasing chlorine atoms.
- The first global effort to address ozone depletion began in 1977, when 32 countries, coordinated by UNEP, launched a work plan for ozone protection.
- A framework for actions was designed and agreed in an international convention held in Vienna on 22 March 1985.
- The Vienna Convention for the Protection of the Ozone Layer, signed in March 1985, came into force on 22 September 1988 with 198 parties. The Convention serves as a framework agreement that laid the foundation for international cooperation on ozone layer protection, paving the way for the binding commitments under the Montreal Protocol.

Vienna Convention held on 22 March 1985



Map showing the widespread ratification of the Vienna Convention

2.2 Overview of Montreal Protocol

The Montreal Protocol on Substances that Deplete the Ozone Layer is a landmark multilateral environmental agreement that regulates the production and consumption of 96 ODS. The Protocol was adopted on 16 September 1987 and came into force on 1 January 1989. It is the only agreement that every country in the world has ratified. World Ozone Day is observed each year on 16 September to commemorate its adoption.

The Montreal Protocol is legally binding and includes scheduled targets and timelines for ODS phase-out for developed and developing countries (referred to as Article 5 countries).

Under this treaty, all parties have specific responsibilities related to the phase out of the different groups of ODS, control of ODS trade, annual reporting of data, national licensing systems to control ODS imports and exports, and other matters. Developing and developed countries have equal but differentiated responsibilities, but most importantly, both groups of countries have binding, time-targeted, and measurable commitments

2.3 Evolution of the Vienna Convention, Montreal Protocol

The Vienna Convention was enforced on 22 September 1988 and has 198 parties.

↓

The Montreal Protocol, enforced on 01 January 1989 with 198 parties, was an agreement to control ozone-depleting substances.

↓

The London Amendment (enforced 08 October 1992, 197 parties) mandated phasing out major CFCs and halons by 2000 and established the Multilateral Fund for developing countries.

↓

The Copenhagen Amendment, enforced on 14 June 1994 with 197 parties, added controls for HCFCs and methyl bromide to combat ozone depletion..

↓

The Montreal Amendment to the Montreal Protocol, which entered into force on 10 November 1999 and has 197 parties, introduced a licensing system for the import and export of ODS.

↓

The Beijing Amendment, enforced on 25 February 2002 with 197 parties, defined the phase-out schedule for HCFCs to protect the ozone layer.

↓

The adjustment made to the Montreal Protocol in 2007 introduced the HCFC phase-out and accelerated the timeline, with developed countries beginning their phase-out by 2013 and developing countries by 2015.

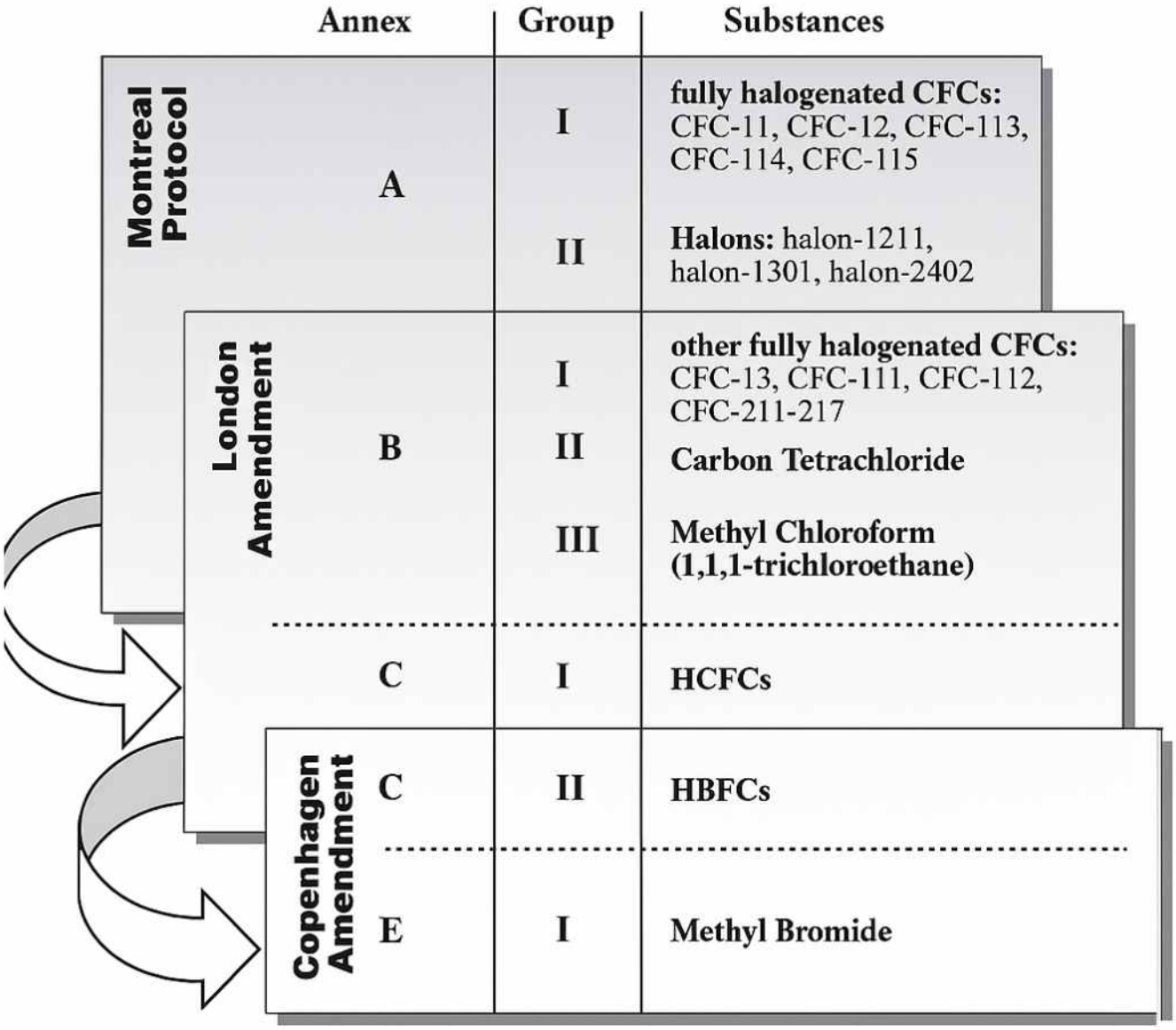
↓

The Kigali Amendment to the Montreal Protocol was decided in October 2016 for the phase-down of HFCs, which have a high global warming potential ranging from 12 to 14,000. The Kigali Amendment came into force in 2019, with 163 parties as of November 2024. The Government of India ratified the Kigali Amendment in September 2021 after approval by the Union Cabinet.

↓

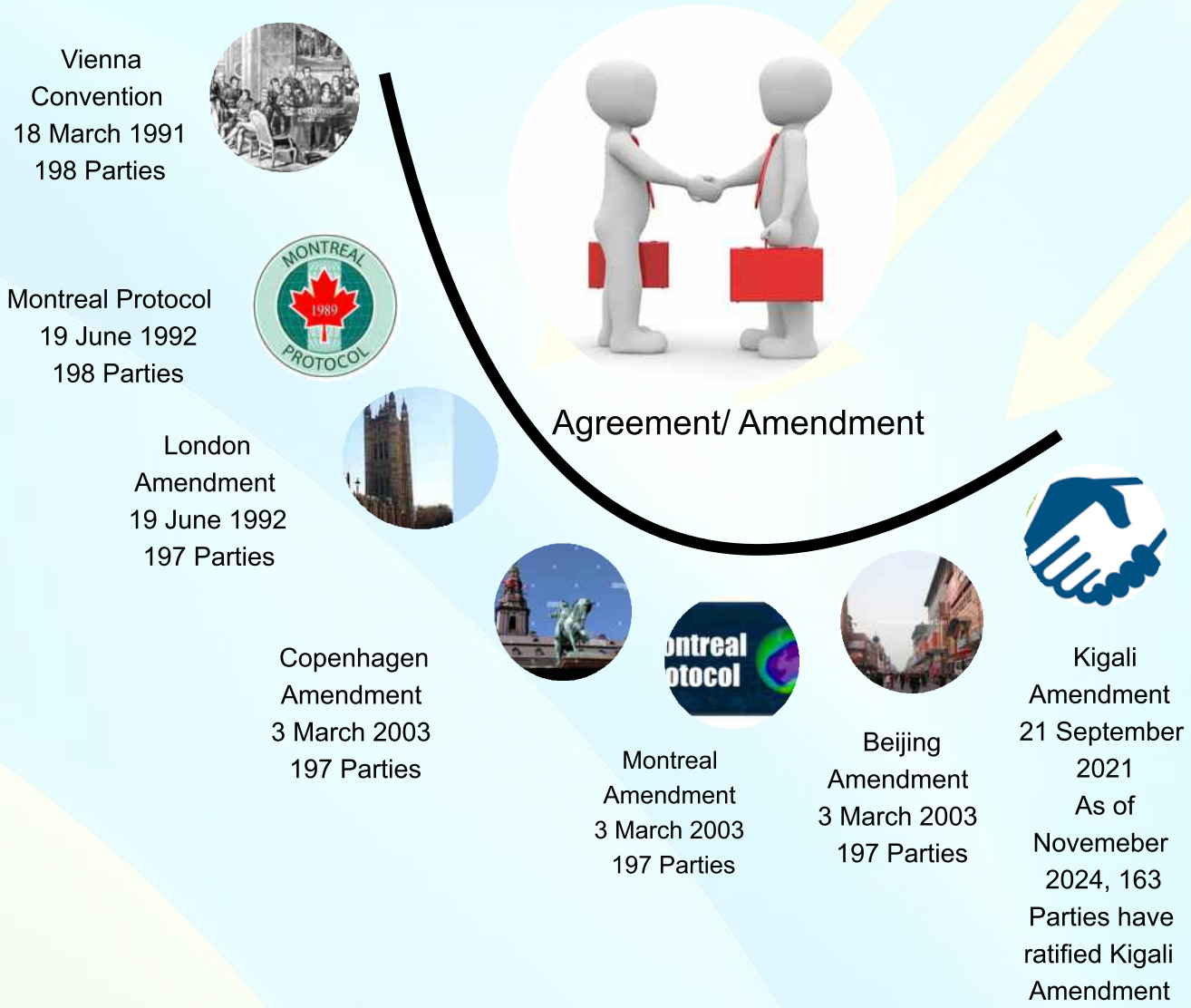
Full Ozone Layer Recovery is expected by mid-21st century if current efforts continue.

Groups of ODS Controlled by the Montreal Protocol



Dates of Accession to Montreal Protocol and its Amendments by India

India is the second largest producer and consumer of ODS after China amongst the Article-5 countries (developing countries). India ratified the Vienna Convention for the Protection of Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer as early as in 1991 and 1992, respectively. The dates of accession by India of the Montreal Protocol and its amendments are as follows:



Source: Ozone Cell Ministry of Environment, Forest and Climate Change Government of India, 2024

Module 3:

About Ozone Depleting Substances

3.1 Definition of ODS

Ozone-depleting substances (ODS) are man-made chemicals that, when released into the atmosphere, can damage the Earth's protective ozone layer. The Montreal Protocol on ODS that deplete the Ozone Layer is the landmark multilateral environmental agreement that regulates the production and consumption of 96 man-made ODS.

'Controlled substance' means a substance listed in Annex A, B, C, and E to the Montreal Protocol, whether existing alone or in a mixture. It excludes, however, any such substance or mixture that is in a manufactured product, other than a container used for the transportation or storage of the listed substance.

- Annex A (Controlled Substances): Group I (CFCs) and Group II (Halons)
- Annex B (Additional Controlled Substances): Group I (Other CFCs), Group II (Other Halons), Group III (Carbon Tetrachloride)
- Annex C (Additional Controlled Substances): Group I (HCFCs), Group II (HBFCs), and Group III (Bromochloromethane)
- Annex E (Additional Controlled Substances): Methyl Bromide

India was self-sufficient in production of chemicals like CFCs, Carbon Tetrachloride (CTC), halons and HCFCs. India was mainly producing and using 9 of the 96 substances controlled under the Montreal Protocol. These are CFC-11, CFC-12, CFC-113, HCFC-22, halon-1211, halon-1301, CTC, Methyl Chloroform and Methyl Bromide.

Feedstock refers to raw materials used in chemical manufacturing, where a controlled substance is chemically transformed into another product, and not released into the atmosphere. Under the Montreal Protocol, feedstock uses of controlled substances are exempt from control measures—meaning they are not counted as "consumption"—provided that emissions are negligible. The Protocol encourages the monitoring and reporting of such uses, and the exemption is periodically reviewed to prevent misuse.

List of ODS produced in India for feedstock applications
CTC
HCFC-22
HCFC-142 b
Bromofluoromethane (BFM)
Bromotrifluoromethane / Halon 1301
Chloro Fluro Propane (Mixture of HCFC 241, 242, 243 and 244)
HCFC-225

List of ODS used in India as feedstock for manufacturing of different products
CTC
HCFC-22
HCFC-142 b
Bromofluoromethane (BFM)
Bromotrifluoromethane / Halon 1301
CFC -113

Source:
- *Ozone Cell Ministry of Environment, Forest and Climate Change Government of India, 2024*
- *"Handbook for the Montreal Protocol on Substances That Deplete the Ozone Layer," 2018*
- *UN environment Programme Ozone secretariat, n.d.*

Each controlled substance is assigned a value indicating its impact on the stratospheric ozone layer per unit mass of a gas, as compared to the same mass of CFC 11. This value is called *Ozone depleting potential (ODP).*

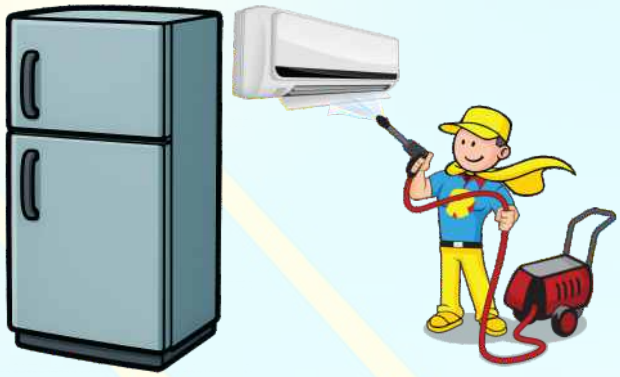
In the case of HCFC 141b, for example, 10 metric tons would equal 1.1 ODP tons, as HCFC-141b has an ODP value of 0.11 (10 * 0.11 = 1.1). In contrast, 10 metric tons of halon 1211 would equal 30 ODP tons, as halon-1211 has an ODP value of 3.0 (10 * 3.0 = 30.0).

All substances having an ODP above zero are, in principle, ODS. These are generally chemicals containing chlorine or/and bromine. The most important ODS are controlled substances under the Montreal Protocol.

For example, CTC has an ODP of 1.2, while methyl chloroform has an ODP of 0.11.

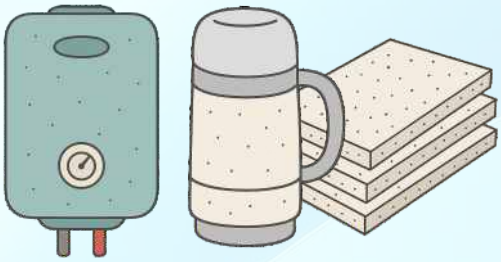
Higher ODP means more ozone depletion

3.2 Major uses of ODS (Controlled purpose)



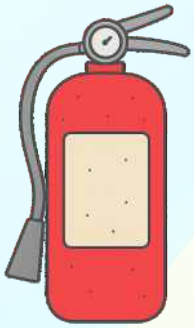
ODS used as refrigerants in refrigeration systems, cold storage facilities, and mobile air conditioning (transport sector).

As a foam blowing agent in foam manufacturing sector including foam insulation panels, thermoware, insulation for commercial refrigeration products, water heaters, etc.



ODS were used as propellants in MDIs. They helped push the medicine out of the inhaler in aerosol form so it could be easily inhaled.

As a fire extinguishing agent in fire extinguishing equipment.



Uses of CFCs, CTC, halons and methyl bromide have been phased out globally

Module 4:

ODS Phase out in India

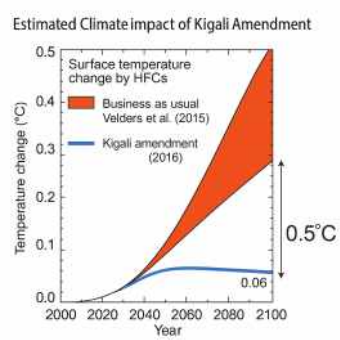
4.1 Status of ODS Phase out in India

1987

INDIA BECAME A PARTY TO THE MONTREAL PROTOCOL ON SUBSTANCES IN 1992.

INDIA'S COUNTRY PROGRAMME PREPARED IN 1993.

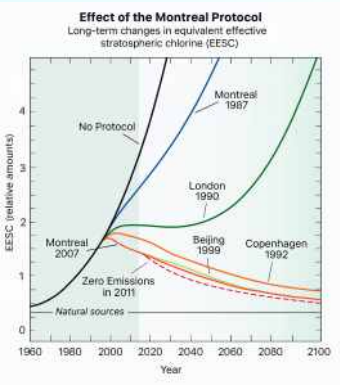
ODS (REGULATION AND CONTROL) RULES, 2000.



CFCS, CTC AND HALON COMPLETELY PHASED OUT FROM INDIA IN 2010

METHYL BROMIDE COMPLETELY PHASED OUT FROM INDIA IN 2013

HYDROCHLOROFLUOROCARBON (HCFC) PHASE-OUT MANAGEMENT PLAN (HPMP) STAGE-I, LEAD TO REDUCTION OF 341.77 ODP TONS BY 2017



AROUND 48,242 ODP TONS OF ODS PHASED OUT IN INDIA TILL 2024.

INDIA HAS RATIFIED THE KIGALI AMENDMENT TO THE MONTREAL PROTOCOL DURING SEPTEMBER 2021

HCFC PHASE-OUT MANAGEMENT PLAN (HPMP) STAGE-II LEAD TO REDUCTION OF 769.49 ODP TONS BY 2023.

HCFC PHASE-OUT MANAGEMENT PLAN (HPMP) STAGE-III WILL LEAD TO REDUCTION OF 579.99 ODP TONS BY 2030.

2030

Source: Ozone cell Ministry of Environment, Forest & Climate change, Government of India, 2023

Phase-out of ODS led to saving of 135 billion tonne of CO, equivalent of atmospheric emission

Antarctic ozone hole is no longer increasing in size

ODS phase-out avoided damages to agriculture and fisheries of around US$ 460 billion*

ODS phase-out has resulted in global health benefits of US$ 1.8 trillion

ODS Phase-out has significantly contributed in reducing greenhouse gas emission

Around 98% of ODS phased out globally

India has met it compliance targets under ongoing HCFC phase out. CFCs, CTC, Halon and Methyl Bromide have been completely phased out from India

*Facts and figures on ozone protection | Ozone Secretariat. (n.d.). https://ozone.unep.org/facts-and-figures-ozone-protection

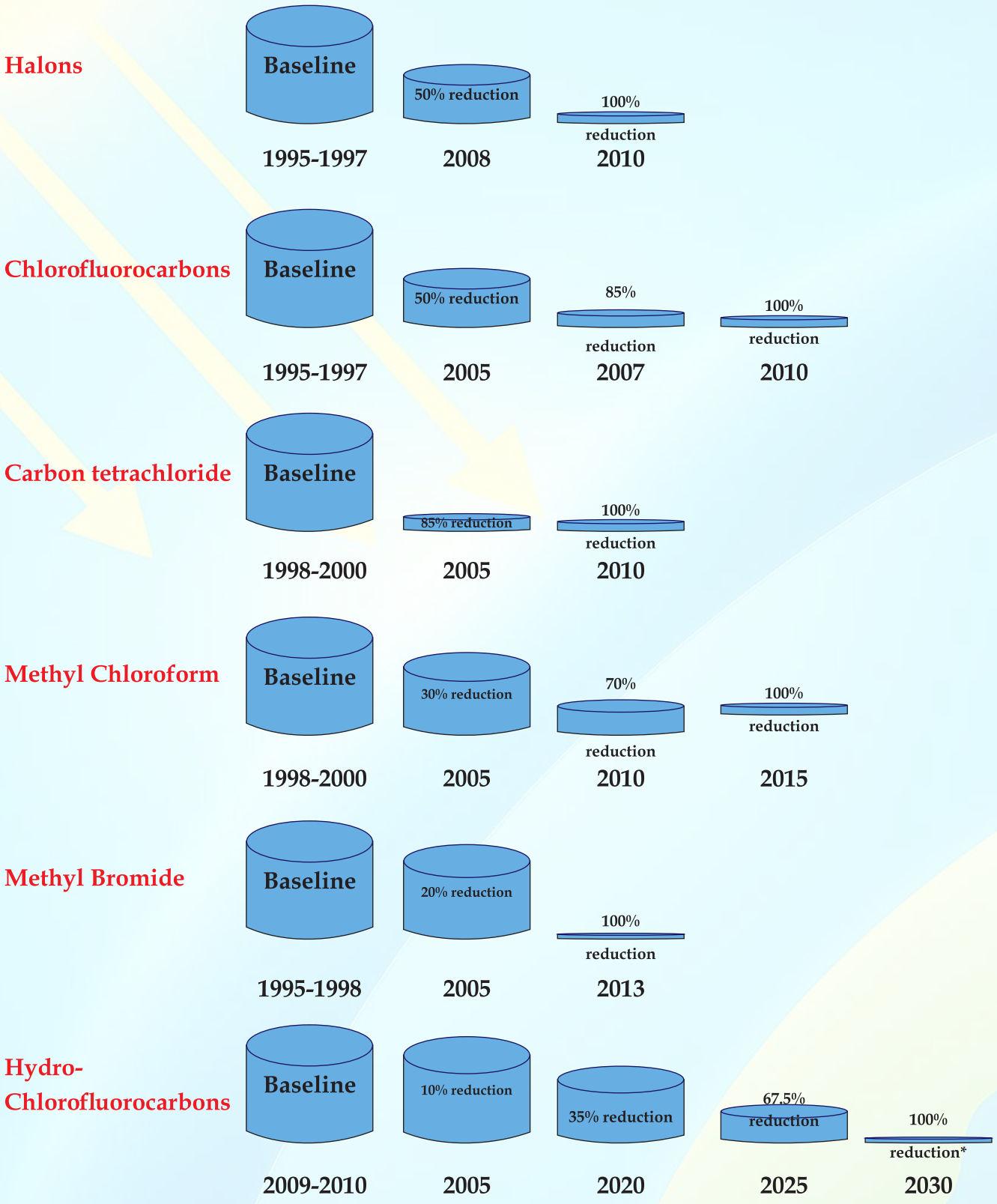
4.2 ODS Phase Out in India

ODS	Baseline year	Baseline Production (ODP tonne)	Baseline Consumption (ODP tonne)
CFC	1995-97	22,632.40	6,681.00
Halon	1995-97	288.80	1,249.40
CTC	1998-2000	11,552.90	11505.3
MCF	1998-2000	0	122.2
MeBr	1995-1998	0	0
HCFC s	2009-2010	2,399.50	1608.2

Source:

- *https://ozonecell.nic.in/home-page/montreal-protocol-implementation-in-india/production-consumption-control-schedule-as-per-montreal-protocol/*
- *https://ozonecell.nic.in/home-page/montreal-protocol-implementation-in-india/ods-phaseout-in-the-country/page-indias-country-programme/*

Ozone Depleting Substances Phase out in India



* Allowing for a service tail of 2.5% annual average during the period 2030-2040.

4.3 Accelerated Phase out of CFC

India phased out CFC production and consumption by 1st August 2008, 17 months ahead of schedule, except for pharmaceutical-grade CFCs in MDIs.The transition to non-CFC MDIs was led by UNDP, with support from UNEP, Italy, and Ozone Cell MoEF&CC), in collaboration with the MDI industry in 2011.

Phase-out Schedule :CFC Production

Year	CFC Production (MT)	Phase-out Quantity (MT)
1999	22,588	-
2000	20,706	1,882
2001	18,824	1,882
2002	16,941	1,883
2003	15,058	1,883
2004	13,176	1,882
2005	11,294	1,882
2006	7,342	3,952
2007	3,389	3,953
2008	2,259	1,130
2009	1,130	1,129
2010	0	1,130

4.4 Best technologies used during Phase out of CFC

RAC Sector

In 1991, the total ODS consumption in the RAC sector in India was 1,990 MT. This constituted about 39% of India's total consumption of CFCs.

Sub-sector	ODS Used	Preferred Alternatives/ Substitutes
Domestic Refrigerators	Refrigerant: CFC-12	Refrigerant: HFC-134a, HC-600a, isobutane, HC blend, HFC-1234yf
	Foam: CFC-11, HCFC-141b	Foam Blowing Agents: Cyclopentane, HFC-245fa, HFC-365mfc, HFC-1234ze, Methyl Formate, Methylal, Solstice-LBA, FEA-1100

Sub-sector	ODS Used	Preferred Alternatives/ Substitutes
Refrigerated Cabinets (Display freezers, ice-cream, bottle coolers)	Refrigerant: CFC-12	Refrigerant: HFC-134a, HC-600a, HC-blend, CO_2 (Foam)
	Foam: HCFC-141b, CFC-11	Blowing Agents: Cyclopentane, HFC-245fa, HFC-365mfc, HFC-1234ze, Methyl Formate, Methylal, Solstice-LBA, FEA-1100
Mobile (Car, Bus, Van, Refrigerated Trucks, Train)	Refrigerant: CFC-12	HFC-134a, HFC-152a, CO_2(R-744), HFC-143a, blends of HFCs and Hcs
	Refrigerant: HCFC-22 (Train)	HFC-134a, HFC-1234yf, R-407C, blend of HFCs and Hcs
Central Air Conditioning	CFC-11, CFC-12, HCFC-22	HFC-134a, R-410A, R-407C, HFC-1234ze, HC-290, Ammonia
Process Chillers	CFC-12, HCFC-22	HFC-134a, R-404A, R-407C
Ice Cream Machines	CFC-12, HCFC-22	HFC-134a, R-407F, HC-290, R-404A
Walk-in Coolers	CFC-12, HCFC-22	HFC-134a, R-407F, R-404A
Room Air Conditioners	HCFC-22	R-410A, HC-290, HFC-32, blends of HFCs and Hcs
Packaged Air Conditioning	HCFC-22	R-410A, R-407C, HFC-32, HC-290, HC-1270
Shipping Refrigeration	CFC-12, HCFC-22	HFC-134a, R-404A, CO_2

Foam Sector

The Foam Manufacturing sector was one of the major ODS- consuming sectors in India predominantly using CFC-11 as blowing agent.

In 1991, the consumption of CFCs in Foam Manufacturing sector was 1,580 MT, predominantly CFC-11, which amounted to about 31% of India's total CFC consumption in the country.

Sub-sector	ODS Used	Preferred Alternatives / Substitutes
Flexible Polyurethane Foam (PUF)	CFC-11	Methylene Chloride
Flexible Moulded PUF	CFC-11	Water blown technology
Rigid PUF General Insulation	CFC-11, HCFC-14b	Cyclopentane, HFC-245fa, HFC-365mfc, HFO-1234ze, HFO-1233zd(E), Methyl Formate, Methylal-Solstice-LBA, FEA-1100
Thermoware	CFC-11, HCFC-22B	HFC-245fa, HFC-365mfc, Water, Methyl Formate, Solstice-LBA, FEA-1100
Integral Skin PUF	CFC-11, HCFC-14B	HFC- 245fa, Water, Hydrocarbons, Solstice-LBA, FEA-1100
Thermoplastic Foams - EPE/ EPPN Foams - Phenolic Foams	CFC-11, CFC-12, CFC-11	Hydrocarbons, CO_2
Phenolic Foams	CFC-11	Hydrocarbons

Aerosol Sector

Sub-sector	ODS Used	Preferred Alternatives / Substitutes
Perfumes, having Foams, Insecticides, Paints, etc.	CFC-11, CFC-12	Hydrocarbon Aerosol Propellant (HAP), Deodorized LPG, Dimethyl Ether
Metered Dose Inhalers	CFC-11, CFC-12	Hydrofluoroalkanes (HFAs)

4.5 Phase out of Halons

Halons, which are potent ODS, were used only in about 5% of the fire extinguishing applications

The MoEF&CC has established National Halon Banking Facility at the Centre for Fire, Explosive and Environment Safety (CFEES), Defence Research and Development Organization (DRDO), Ministry of Defence, New Delhi to recover, recycle and store halons in existing equipment for future use

In 1991, the total consumption of halons in India was 750 MT, equivalent to 3,650 ODP tonne. This constituted 7.2% of India's total ODS consumption and almost 28% of the total consumption in ODP tonne.

India has phased out the production and consumption of halons as of 1st January 2010

Alternative Technologies

There were no drop-in replacement technologies identified. However, a wide variety of fire-extinguishing technologies were identified at the time of preparation of the CP, viz., ABC powder, carbon di-oxide (CO2)-based systems, foam-based systems, inert gases, HFC-based systems,fast response sprinklers, etc

4.6 CTC Phase out

CTC was used as solvent in metal cleaning sub-sectors

The production of CTC in the country was successfully phased out as of 1 January 2010, except co- production of CTC during the production of chloromethane. The co- produced CTC is being used only for feedstock applications.

CTC was used as feedstock primarily in the production of CFCs and DV Acid chloride. It was also used in India as a process agent and a solvent. For process agents, CTC was used in sectors such as chlorinated rubber, chlorinated paraffin, pharmaceutical, and agro-industries. It was used as a solvent in the textile, garment industries, metal cleaning etc.

In 2006, a total of 103 CTC projects, covering both process agent and solvent applications were identified and the phase out of CTC in these applications was taken up

The CTC consumption phase-out projects were successfully implemented and resulted in phase out of 2,080 ODP tonne of CTC. The consumption of CTC was phased out completely in the country since 1st January 2010, for controlled applications as per the Montreal Protocol schedule

Technical assistance was provided to replace CTC used in stain removal work for small garment manufacturers and metal cleaning. The fast reduction in the supply of CTC increased price of the CTC significantly in the country and that motivated the MSMEs to move away from CTC.

Source: https://ozonecell.nic.in/home-page/montreal-protocol-implementation-in-india/ods-phaseout-in-the-country/page-indias-country-programme/

4.7 HCFCs Phase-Out

HCFCs were adopted as alternative technologies during the accelerated phase-out of CFCs in India

2007

- Montreal Protocol (19th Meeting of Parties) accelerated HCFC phase-out by 10 years.

2009

- India released a national roadmap for HCFC phase-out.

HCFC Consumption Baseline in India

Substance	Consumption Baseline (ODP tonnes)
Annex-C Group-I substances (HCFCs)	1,608.23

4.8 HCFC Uses and Application

HCFCs and their blends are used as refrigerants, blowing agents, industrial propellants, solvents and cleaning agents and as fire suppressants. HCFC-22 is exported to 19 countries, while an other **HCFC (HCFC-123)** is imported primarily from 3 countries and is used for servicing

Substance	Uses/Applications
HCFC-123	As a refrigerant in centrifugal chillers in new installations and servicing. Also used as a component of blends used in portable fire extinguishers
HCFC-124	As a component of refrigerant blends for industrial refrigeration applications (R-401A, R-409A) and also as component of blends used in flooded fire extinguishing systems

Source: Ozone cell Ministry of Environment, Forest & Climate change, Government of India, 2023

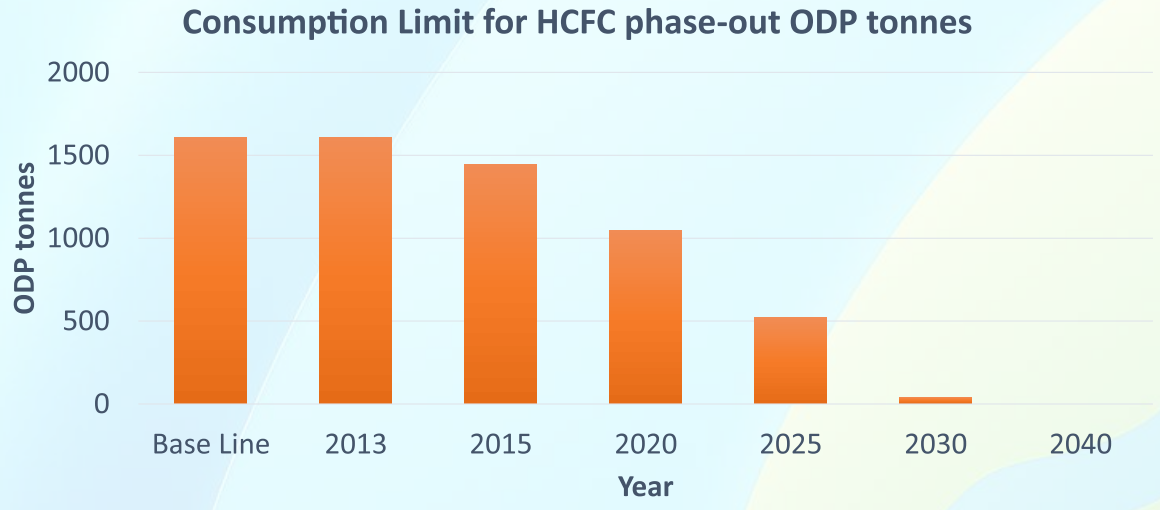
Substance	Uses/Applications
HCFC-141b	Mainly as a blowing agent in the manufacture of polyurethane and polyisocyanurate foams. Also used as a propellant in industrial aerosols and as a solvent and cleaning agent in specialized cleaning operations for precision metal, optical and electronic equipment
HCFC-142b	As a physical blowing agent in the manufacture of extruded polystyrene foams. Also used as a component of refrigerant blends (R-406A, R-409A) for industrial refrigeration applicationsHCFC-22Widely used a standalone refrigerant in air conditioning and medium-temperature refrigeration systems. Also used as a component of refrigerant blends (R-401A, R-406A, R-409A and R-415B)

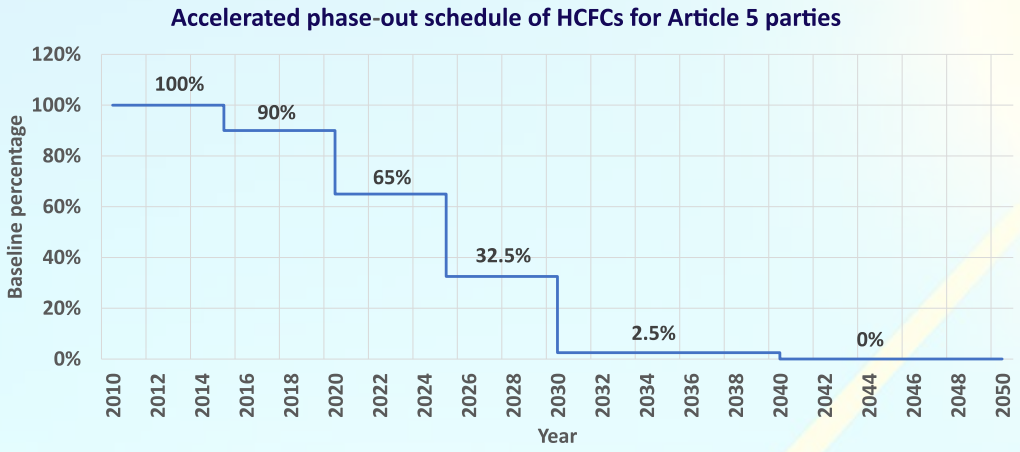
HCFC use in Foam Manufacturing Sub sectors

HCFC-141b is the widely used foam blowing agent in India. The various sub sectors of the polyurethane foam which use HCFC-141b in the country are as follows:

- Commercial refrigeration
- Continuous panels
- Discontinuous panels
- Thermo ware
- Integral skins
- Spray foam
- General insulation

4.9 HCFCs Phase-Out





Implementation of HCFC Phase out Management Plan (HPMP):

a) Adoption of a staged approach for HPMPs within the context of an overarching strategy for HCFC reductions and phase-out as per the adjusted schedule. HCFC Phase out was planned in three Stages

- HPMP I
- HPMP II
- HPMP III

The HPMP (stage I) focused on compliance with the 2013 freeze and 2015 reduction targets.

b) Prioritization of HCFCs for phase-out by ODP, like HCFC-141b, which has highest ODP among HCFCs is to be phased out first and subsequently other HCFCs with lower ODP.

c) Commitments to achieve the 2013, 2015, 2020, 2025 and 2030 control milestones through performance-based agreements.

d) HPMP Implementing Agencies:

- Lead: UNDP
- Cooperating: UNEP & GIZ

4.10 Regulatory action taken for Phase out of HCFC

4.10.1 HPMP - 1

Maximum Allowable Consumption for Stage-I

Target	Maximum Consumption Level (ODP tonnes)
From 01 January 2013	1,608.23
From 01 January 2015	1,447.41

Key Planned Regulatory Actions

Year	Key Planned Regulatory Actions
2013	Amend existing rules for controlling use, manufacturing, assembly and installation of products as applicable to HCFCs
	Restrict the amount of HCFCs that can be sold in the domestic market with effect from 01 January 2013
	Prohibition of establishment new capacities or expansion of existing capacities for manufacturing HCFC-based products with effect from 01 January 2013
	Prohibition imports of polyols pre-blended with HCFCs with effect from 01 January 2013
2015	Prohibition of manufacturing domestic refrigerators and continuous sandwich panels with HCFCs as blowing agents with effect from 01 January 2015
	Prohibition on imports of HCFC-based air-conditioning and refrigeration equipment from 01 July 2015

The starting point of 1,691.25 ODP tonnes for the HPMPs was determined by adding India's consumption baseline of 1,608.2 ODP tonnes (average consumption for 2009 and 2010) and 83.05 ODP tonnes from imports of pre-blended polyol containing HCFC-141b during the baseline years.

The enterprises participating in the HPMP stage-I were the large consumer of HCFC-141b which were capable of handling the alternative technology based on cyclopentane as cyclopentane is a flammable blowing agent so due safety measures for storage, handling and use during manufacturing of foam needs to be put in place.

These enterprises were from 3 subsectors, viz., domestic refrigeration (8 enterprises), Continuous Sandwich Panel (2 enterprises) and Discontinuous Sandwich Panel (5 enterprises) manufacturers.

The HPMP Stage-I, has successfully phased-out a total of 341.77 ODP tons of HCFCs including 310.53 OPD tons of HCFC 141b in foam manufacturing and 31.24 ODP tons of HCFC-22 in RAC servicing sector respectively.

4.10.2 HPMP -II

Successful implementation of the HPMP-Stage-II resulted in sustainable reductions of 8,190 MT or 769.49 ODP tons of HCFC consumption from the starting point of 1691.25 ODP tons in 2023.

Sector	Actual phase-out Consumption	
	MT	ODP
Polyurethane Foam Sector Plan	5,800	638.02
Air-conditioning Manufacturing Sector	1,140	62.72
Servicing Sector Plan	1,250	68.75
Total	8,190	769.499

Sectoral Participation:

400+ Enterprises, including 300+ MSMEs in polyurethane foam6 Large Enterprises in air-conditioning manufacturing

Strategic Focus Areas:

- Promote energy efficiency
- Develop building codes integrating HCFC phase-out
- Cold chain development using non-HCFC alternatives
- Develop standards for non-ODS & low-GWP alternatives

Key Planned Regulatory Actions

- Prohibition of use of HCFC - 141b in manufacturing of foam products by 1.1.2020
- Prohibition of issuance of import license for HCFC - 141b by 1.1.2020

4.10.3 HPMP -III

The HPMP Stage-III was being planned as the last of the HPMPs for India, to be implemented from 2023 to 2030, during which India was working toward achieving the 2025 and 2030 compliance targets in the consumption sector as per the accelerated phase-out schedule of the Montreal Protocol for HCFCs.

Accordingly, HPMP Stage-III is addressing the complete phase-out of HCFCs in all manufacturing sectors by 31.12.2024. In turn, the activities in the RAC servicing sector are continuing until 2030.

Key Planned Regulatory Action

Prohibition of use of HCFCs in manufacturing of new Refrigeration and Air-conditioning (RAC) equipment and Fire Extinguishers from 1.1.2025 except the servicing sector.

Impact

Implementation of HPMP-Stage-III will result in sustainable reductions of 10678.87 MT or 579.99 ODP tonne of HCFCs consumption from the starting point, contributing to India's compliance with the 2025 and 2030 control targets for Annex C-Group I substances (HCFCs) under the Montreal Protocol. In addition, the project will result in net direct CO2- equivalent emission reductions of 19,239,929 tonnes CO2-eq. from 2030 onwards.

4.11 HCFC phase out in production sector - Quota management

In order to comply with the phase out targets of production and consumption of ODS as per the Montreal Protocol Schedule , the Central Government introduced implementation modalities, such as quota system for production of Group VI (HCFCs) substances for non-feedstock applications.

The producers of Group VI substances shall not supply to the domestic market quantities in excess of the quota orders issued by the Ozone cell, Ministry of Environment and Forests to cover the entire domestic requirement of HCFC-22 for non-feedstock application.

HCFC-22 Production Quota Application Process

Any enterprise wishing to apply for the enterprise production quota, for the next calendar year, must submit 4 copies of the required application form to the Ozone Cell within the first week of January of the current year.

The Ozone Cell will:

- Assess applications,
- Apportion next year's country-level eligible quota,
- Consider any quota trading, and
- Evaluate the implementation status of the prior year's quota license.

Quota licenses will be issued to qualified enterprises within 5 working days of receiving applications.

Source: Ozone cell ministry of environment, forest and climate change Government of India, 2024

4.12 Best technologies used during Phase out of HCFC

Sector	Subsector	ODS being used	Alternative Technology
Refrigeration and Air Conditioning	Room Air Conditioners	HCFC 22	R 410 A, HFC 32, R 290A
	Light Commercial AC & Chillers	HCFC 22	R-410A, HFC-134a, R-407C, R-404A
	Commercial Refrigeration & Process Chillers	HCFC 22	HFC 32, HC 290
	Industrial AC/ Process Chillers (Market)	HCFC 22	R-717 (Ammonia), HFC-134a, R-404A
Foam Manufacturing Sector (polyurethane)		HCFC 141b, HCFC-142b and HCFC-22 as Foam blowing Agent	Cyclopentane (C5), Methyl Formate (Ecomate) water, and Hydrofluoroolefins (HFOs) as foam blowing agent

Module 5:
Kigali Amendment to the Montreal Protocol

5.1 Kigali Amendment to the Montreal Protocol and Its Implications

The Kigali Amendment is an important addition to the Montreal Protocol, adopted on 15 October 2016 in Kigali, Rwanda. While the original Montreal Protocol focused on phasing out substances that deplete the ozone layer (like CFCs and HCFCs), the Kigali Amendment targets another group of chemicals i.e. Hydroflorocarbon (HFCs).

What are HFCs?

HFCs are man-made chemicals used mainly in refrigeration, air-conditioning, and aerosols.

HFCs were used as replacements for ODS, although they do not deplete the ozone layer, they are known to be potent greenhouse gases — some are thousands times more powerful than carbon dioxide (CO_2) in terms of their global warming potential (GWP).

GWP is a measure of how much energy the emission of 1 ton of a gas will absorb over a given period of time, relative to the emission of 1 ton of carbon dioxide (CO_2). The larger the GWP, the more the given gas warms the Earth compared to CO_2 over that time period. The time period usually used for GWPs is 100 years.

After Kigali Amendments Annex F comprising of HFCs was introduced in the controlled substance list of Montreal Protocol

Annex F: Controlled Substances

Group	Common Name	100-Year GWP
Group I		
CHF_2CHF_2	HFC-134	1,100
CH_2FCF_3	HFC-134a	1,430
CH_2FCHF_2	HFC-143	353
$CHF_2CH_2CF_3$	HFC-245fa	1,030
$CF_3CH_2CF_2CH_3$	HFC-365mfc	794
CF_3CHFCF_3	HFC-227ea	3,220
$CH_2FCF_2CF_3$	HFC-236cb	1,340
CHF_2CHFCF_3	HFC-236ea	1,370
$CF_3CH_2CF_3$	HFC-236fa	9,810
$CH_2FCF_2CHF_2$	HFC-245ca	693
$CF_3CHFCHFCF_2CF_3$	HFC-43-10mee	1,640
CH_2F_2	HFC-32	675
CHF_2CF_3	HFC-125	3,500
CH_3CF_3	HFC-143a	4,470
CH_3F	HFC-41	92
CH_2FCH_2F	HFC-152	53
CH_3CHF_2	HFC-152a	124
Group II		
CHF_3	HFC-23	14,800

What does the Kigali Amendment do?

It sets a timeline for countries to phase down HFCs. Different countries have different schedules, based on their economic development:

Developed countries (like the U.S. and EU) started phasing down in 2019.

Developing countries are divided into 2 groups : Group 1 (most developing countries like China): Freeze in 2024, earlier reduction.Group 2 (India, Gulf countries): Freeze in 2028, later reduction.

Source: Ozone Cell Ministry of Environment, Forest and Climate Change Government of India, 2024

5.2 Kigali Amendment to the Montreal Protocol – At a Glance

What is the Kigali Amendment?

- Adopted on 15 October 2016 during MOP28 in Kigali, Rwanda
- Amends the Montreal Protocol to include HFCs — potent greenhouse gases
- Adds HFCs to the list of substances to be phased down

Expected Impact

- Phasedown of HFCs globally
- Major step toward limiting global warming

How Will It Work?

- HFC usage to be reduced by 80–85% by late 2040s
- Developed countries began reductions in 2019
- Developing countries:
  - 2024: Freeze in HFC consumption
  - 2028: Freeze for some other developing countries

When Did It Enter Into Force?

Effective from 1 January 2019, upon ratification by 20+ parties

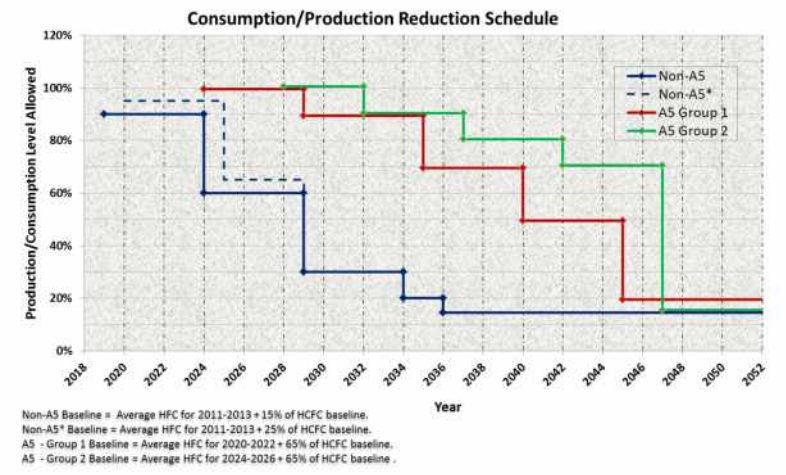
Climate Impact by 2100

- Without Kigali: +0.5°C rise due to HFCs
- With Kigali: Significant reduction in temperature increase

HFC Phase Down schedule for Developed Countries

Group 1	Baseline (Production & Consumption)	2019	2024	2029	2034	2036
Non-Article 5 parties which are not part of Group 2	HFC (Avg. 2011-2013) + 15% of HCFC baseline*	90%	60%	30%	20%	15%
Group 2	**Baseline (Production & Consumption)**	**2020**	**2025**	**2029**	**2034**	**2036**
Belarus, the Russian Federation Kazakhstan, Tajikistan, and Uzbekistan	HFC (Avg 2011-2013) + 25% of HCFC baseline*	95%	65%	30%	20%	15%

*HCFC baseline for non-A5 Parties is equal to HCFC (1989) + 2.8% CFC (1989)



HFC Phase Down schedule for Developing Countries

Group 1	Baseline (Production & Consumption)	2024	2029	2035	2040	2045
Article 5 parties which are not part of Group 2	HFC (Avg. 2020-2022) + 65% of HCFC baseline*	100%	90%	70%	50%	20%
Group 2	**Baseline (Production & Consumption)**	**2028**	**2032**	**2037**	**2042**	**2047**
Bahrain, India, Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, and UAE	HFC (Avg 2024-2026) + 65% of HCFC baseline*	100%	90%	80%	70%	15%

*HCFC baseline for A5 Parties is equal to average of 2009-2010

Source: https://ozone.unep.org/treaties/montreal-protocol/annex-f-hydrofluorocarbons

5.3 Ratification of the Kigali Amendment by India

In September 2021, the Government of India has ratified the Kigali Amendment

The Kigali Amendment came into force for India on 26th December 2021. Thereafter, framework for licensing system and reporting obligations has been put in place and data reporting for HFCs has commenced from 2022 along with other ODS as per provisions of Article 7 of the Montreal Protocol.

National Strategy for HFC phase down

The development of the national strategy for HFC phase down comprises the following:

(i) Outreach and awareness raising.

(ii) Development of a National Strategy including policy framework for the implementation of the Kigali Amendment.

(iii) Establishing a framework for implementing licensing, quota system, and reporting obligations related to HFCs.

HFC Phase Down schedule (agreed) for India

Baseline for Production /Consumption	=	Average HFC Production/Consumption during 2024–2026 + 65% of the average HCFC Production/Consumption during 2009–2010

2028: **Production freeze**
2032: 10% reduction
2037: 20% reduction
2042: 30% reduction
2047: 85% reduction

2028: **Consumption freeze**
2032: 10% reduction.
2037: 20% reduction.
2042: 30% reduction.
2047 : 85% reduction.

5.4 List of HFCs produced and consumed in the country

HFCs produced in India
HFC- 32 (GWP: 675)
HFC -125 (GWP: 3500)
HFC- 134a (GWP: 1430)

HFCs blend produced in India
R-407C (GWP: 1774)
R-410A (GWP: 2088)

HFCs consumed in India
HFC- 32 (GWP: 675)
HFC -125 (GWP: 3500)
HFC- 43-10mee (GWP: 1640)
HFC- 152a (GWP:124)
HFC- 227ea (GWP: 3220)
HFC- 236fa (GWP: 9810)
HFC- 245fa (GWP: 1030)

HFCs blend consumed in India	Blend Composition
R-404A (GWP: 3922)	HFC-125 (44%), HFC-134a (4%), HFC-143a (52%)
R-407C (GWP: 1774)	R 32 (23%), R125 (25%), R 134 A (52%)
R-410A (GWP: 2088)	R 32 (50%), R 125 (50%)

5.5 Uses of HFCs for controlled purpose in India

Name of HFC	GWP	Uses
HFC 134a	1430	Refrigeration and Air conditioning sector (RAC) , Mobile Air conditioning sector , Medical device inhaler and Blend (R 407C) production.
HFC 32	675	Refrigeration and Air conditioning Servicing and manufacturing, Blend (namely, R 407C, R 410 A) production
HFC 125	3500	Blend production namely R 410 A, R 407 C
HFC 227ea	3200	Metered dose Inhalers and Firefighting sector
HFC 245fa	1030	Foam manufacturing sector
HFC 236fa	9810	Firefighting sector
HFC 43-10mee	1640	Used as a solvent in the aviation sector

Source: Stakeholders Consultation Meet 2025

5.6 Requirements for Incineration and Management of HFC-23

- Mandatory Destruction of HFC-23
- All HCFC-22 production plants must destroy HFC-23, which is generated as a by-product, through incineration using an efficient and proven technology, such as thermal oxidation.
- Proper Upkeep and Minimum Downtime of Incineration Systems
- Plants must ensure regular maintenance and proper functioning of HFC-23 incineration units.
- The downtime of incineration facilities should be kept below 10% at all times.
- Adequate Storage to Prevent Atmospheric Release.
- Facilities must create and maintain sufficient storage capacity for HFC-23 to ensure safe containment during any authorized shutdowns of the incineration system.
- No venting of HFC-23 to the atmosphere is permitted under any circumstances.
- Annual Reporting and Certification.
- HCFC-22 producers are required to certify the status of HFC-23 produced in various categories—incinerated, used as feedstock, or used for any other purpose—while submitting annual reports under the Ozone Depleting Substances Rules, 2000 and its amendments.
- Permissible Use as Feedstock.
- HFC-23 may be used as feedstock for producing other chemicals, where applicable."

Source: MoEFCC Office Order dated 13 October 2016

Module 6:
ODS Rules 2000
and Amendments

6.1 Overview & Background

The Ministry of Environment, Forest & Climate Change, Government of India, notified the ODS (Regulation & Control) Rules, 2000 on July 19, 2000. These comprehensive rules cover production, consumption, export, and import of ODS.These rules align with India's National Strategy for ODS phase-out and have been amended multiple times, with the most recent amendment in 2019.

Important provisions of the ODS Rules, 2000

Mandatory Registration, Record Maintenance, and Reporting Requirements for Monitoring ODS Production and Consumption

ODS Producers
Companies manufacturing ODS substances

Importers
Bringing ODS & ODS-based products into country

Stockists
Storing ODS & ODS-based products for distribution

Sellers
Retail/wholesale of ODS & ODS-based products

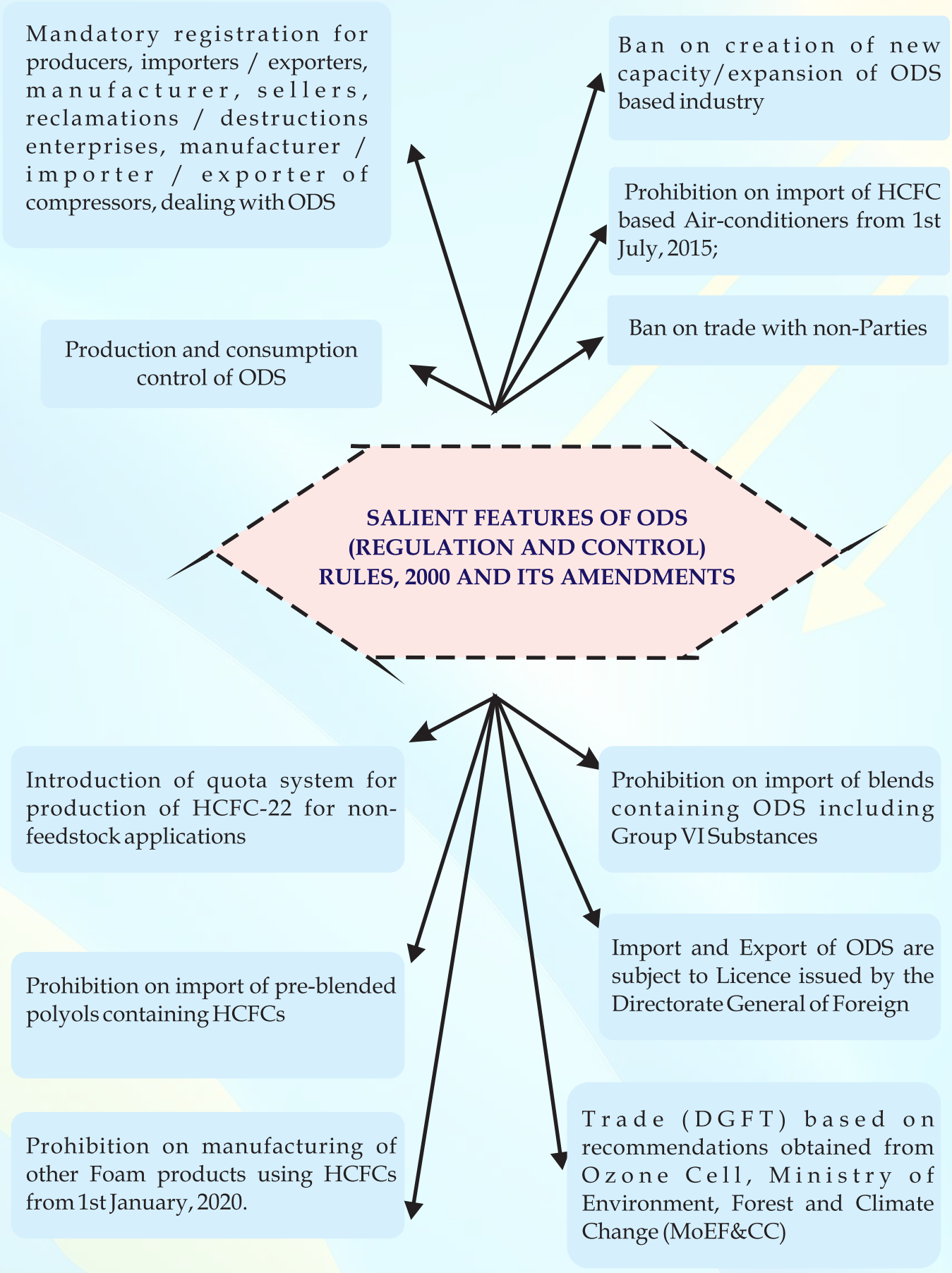
Product Manufacturers
Makers of ODS-based products & equipment

Exporters
Sending ODS & ODS-based products abroad

Special Requirement for MLF Recipients
Enterprises that have received financial assistance from the Multilateral Fund (MLF) for implementing the Montreal Protocol and switching to non-ODS technology must register the date of project completion and declare that the equipment used for ODS has been destroyed.

Regulatory Provisions for Import, Export, Use, and Manufacturing of ODS and ODS-Based Products

- All imports and exports of ODS and products containing ODS require a license.
- The recommendation of the MoEF&CC is essential before the DGFT, Ministry of Commerce and Industry, issues any license for import or export of ODS and products containing ODS.
- Purchasers of ODS for manufacturing products containing ODS are required to declare the purpose for which ODS are purchased.
- Creation of new capacity or expansion of existing capacity for manufacturing ODS and ODS-based equipment is prohibited.
- These rules also specify phase-out dates for different ODS used in the manufacturing of products.
- Additionally, the rules ban trade in ODS with non-Parties.



Source: The Gazette of India Notification (ODS Rules, 2000) & Its Amendments, n.d.

6.2 Amendments to the ODS (Regulation & Control) Rules

2001
Registration Extension

Extended the last date of registrations from one year to two years after the commencement of the Rules

2003
Technical Correction

Correction of typographic error in the original rules

2004
Registration Deadlines

It specified the date of registration for substances listed in Group IV of Schedule I (CTC) and for substances listed in Group VI of Schedule I (HCFCs) on or before 31 December 2004 and on or before 19 July 2007 respectively.

2005
Registration Deadline Extension

Registration date for substances listed in Group IV of Schedule I (CTC) was extended upto 31 December 2005

2007
Comprehensive Registration Deadline Update

Registration has been extended for substances listed under Group I, Group II, Group III and Group IV upto 31 December 2009, in case of substances in Group VI upto 31 December 2030 and in case of substances in Group VIII upto 31 December 2014 and the existing registered enterprises need not apply for renewal.

2014
1. Production Control
Accelerated Phase-out

Production and consumption of Group VI substances (HCFCs) is now controlled according to an accelerated phase-out schedule, ensuring faster elimination of these ozone-depleting substances.

Quota System Introduction

Government has introduced a quota system for production and consumption of HCFCs for non-feedstock applications, along with comprehensive monitoring and reporting systems for all feedstock applications including CTC use.

2. License Ban

Import/Export License Ban

Prohibition of license issuance for import and export of Groups I-IV, VI and ODS blends, except for recovered, recycled, reclaimed ODS, EUN applications, destruction purposes and feedstock applications.

3. Manufacturing Capacity Ban

Strict ban on creating new manufacturing capacities for products made with or containing Group VI substances (HCFCs) for controlled application except feedstock applications.

4. Equipment Import Prohibition

From July 1, 2015, import of air-conditioning and refrigeration equipment and other products using HCFCs is prohibited to control inventory and reduce future HCFC consumption in servicing.

5. Feedstock Exemption

Exemption provided for all Groups of ODSs production for Protocol-approved feedstock uses in manufacturing other chemicals, provided emissions are negligible.

6.3 Banned Activities as per ODS Rules, 2000 and its subsequent Amendments

1 January 2001

Ban on:

- Manufacture of fire extinguishers and systems using virgin Halon.

1 January 2003

Ban on:

CFC-based manufacture of:

- Aerosol/pressurised dispensers (except medicinal inhalers)
- Polyol for foam products
- Foam products (e.g., refrigerator foam)
- Mobile ACs (charging at automobile industry)
- Refrigeration and air-conditioning products

1 January 2010

Ban on:

- Medicinal metered dose inhalers using CFCs
- Fire extinguishers/systems using virgin Halon (servicing too)

1 January 2015

Ban on:

- Methyl Bromide (except pre-shipment/quarantine)
- Manufacturing of domestic refrigerators using HCFCs
- Manufacturing of continuous sandwich panels using HCFCs

1 January 2020

Ban on:

- Manufacturing of all foam products (including discontinuous sandwich panels) using HCFCs
- Manufacturing of pre-blended polyols

1 January 2025

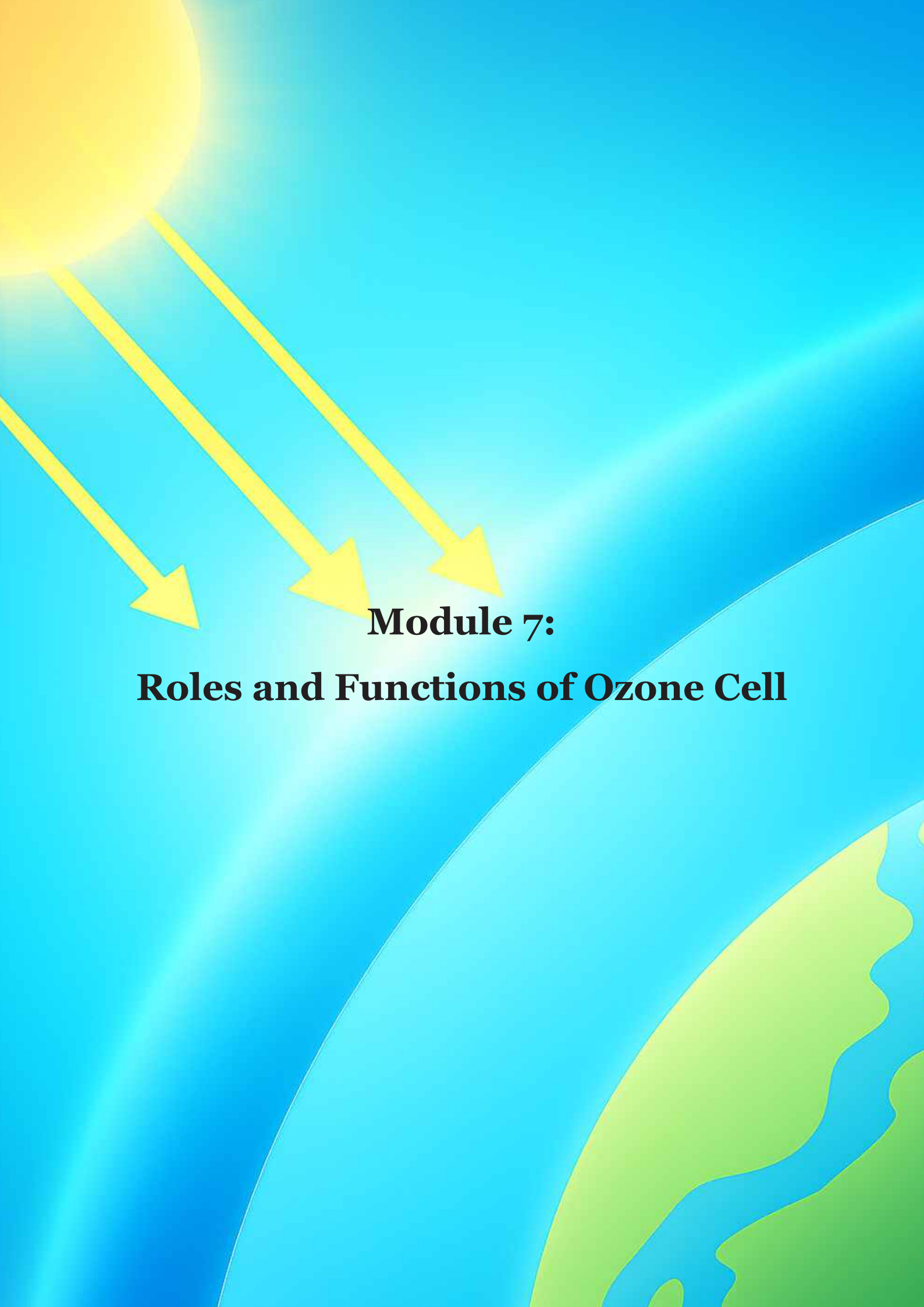
Ban on:

- Manufacturing of new Refrigeration and Air-conditioning (RAC) equipment and Fire-extinguishers using HCFCs
- Other refrigeration & air-conditioning products (except compressors)
- Fire extinguishers/systems using HCFCs
- All other new equipment using HCFCs

1 January 2040

Ban on:

- Servicing of refrigeration and AC equipment using HCFCs
- Servicing of fire extinguishers/systems using HCFCs



Module 7:

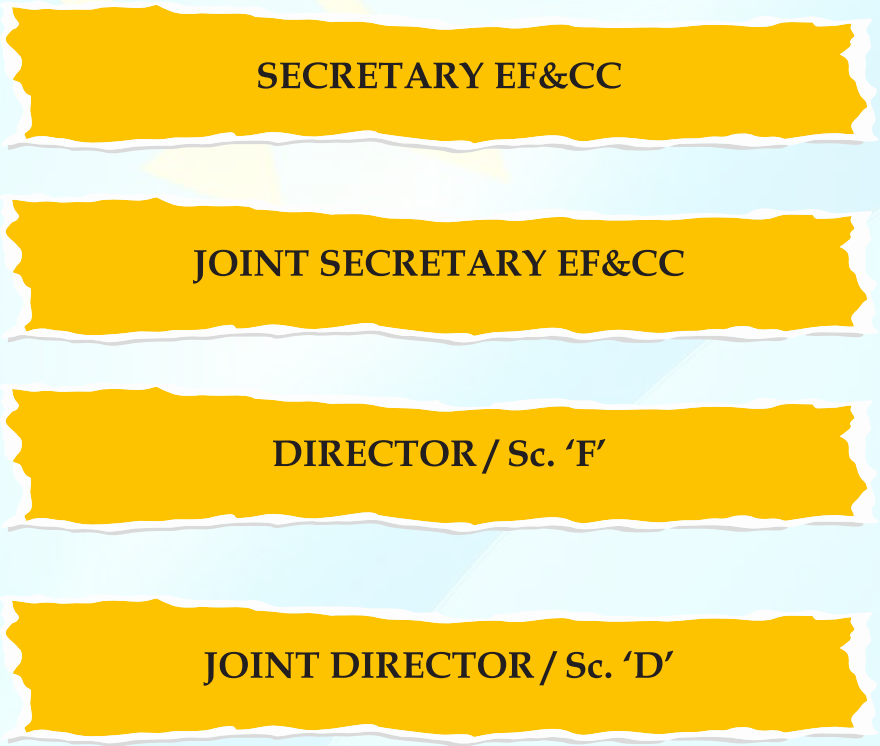
Roles and Functions of Ozone Cell

7.1 Ozone Cell, MoEF&CC

The Government of India has entrusted the work relating to ozone layer protection and implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer, to the Ministry of Environment, Forest and Climate Change (MoEF&CC).

The MoEF&CC has set up the Ozone Cell as a National Ozone Unit (NOU) to render necessary services for effective and timely implementation of the Protocol and its ODS phase- out activities in India.

Organisational Structure of Ozone cell-MoEFCC



Source: https://ozonecell.nic.in/home-page/about-us/organizational-structure

7.2 Functions of the Ozone Cell

1. Formulation of policies and regulations for implemention of provisions of the Montreal Protocol. The Ozone Depleting Substances (Regulation and Control) Rules, 2000, amended from time to time, is the regulatory framework for implemention.

2. Implemention of ODS (Regulation and Control) Rules and its amendments including:

   a. Registration of enterprises dealing with ODS.

   b. Recommendation to (Directorate General of Foreign Trade (DGFT) for import/export of ODS and HFCs.

   c. Monitoring of production, export and consumtion of ODS and HFCs.

3. Implementation of Ozone Depletion Substances phase out/HFC phase down projects.

4. Data Reporting on Production, consumption, import, export of ODS & HFCs as per Article 7 of the Montreal Protocol

7.3 Monitoring Mechanism: MIS Portal

- The MIS portal was officially launched on World Ozone Day 2018.
- The MIS Portal has been developed to facilitate the online submission (Note: Manual submission is not permitted) of registration applications and data by ODS stakeholders (ODS producers, ODS users, Importers, Exporters, Sellers) to the Ozone Cell, MoEF&CC.
- Data submitted through the MIS portal is examined by the Ozone Cell.
- If any anomaly is detected, an Electronic Deficiency Slip (EDS) is raised.
- The applicant must then resubmit the corrected and completed form through the portal.
- The portal is designed to support the monitoring and compliance of ODS phase-out activities, covering both the production and consumption sectors.

Functions Accessible to Users via the MIS Portal

I. Registration as per ODS rules.

II. Apply for Production Quota for HCFC-22 for non feedstock uses.

III. Recommendation for import/export licence.

IV. Seek fiscal incentives scheme.

V. Manage implementation projects funded by the Multi-lateral Fund(MLF)

VI. Information on RAC service technicians.

VII. Reporting requirements as per the ODS rules 2000 & its amendments and the Montreal Protocol.

VIII. Knowledge dissemination on ODS.

7.4 Registration Procedure

Registration is mandatory for all ODS producers, traders (Importer/Exporter), comsumers, those reclaiming or reprocessing or destroying used ODS substances.

Registration has to be done online through MIS portal of Ozone cell, MoEF&CC (https://ozonecell-mis.nic.in/public/login/loginPage)

First time applicant has to first create a login account.

Source: https://ozonecell-mis.nic.in/public/aboutUsForLoginPage/aboutUsForLoginPage

MoEF&CC is developing a module under Parivesh 2.0 for registration under ODS Rule & Regulations 2000, and issuance of recommendations to DGFT for Import & Export of ODS and HFCs.

For registration, relevant form pertaining to the category has to be filled and submitted online alongwith the relevant documents as depicted in figure below:

Form	Types of Enterprises	Documents
9	Producers	Annual Report, Audited Balance Sheet, and Profit & Loss Account of the enterprise for the last three years.
10	Sellers	Income Tax Assessment Order
10A	Importers/exporters	Income Tax Assessment Order
11	Users of ODS as per activities in Column 2 of Schedule IV	Annual Report, Audited Balance Sheet, and Profit & Loss Account of the enterprise
13	Manufacturers and importers/exporters of compressors	Annual Report, Audited Balance Sheet, and Profit & Loss Account or Income Tax Assessment Order of the enterprise.
14	Reclaimers and destroyers of ozone-depleting substances	Annual Report, Audited Balance Sheet, and Profit & Loss Account of the enterprise.

The Registration Authority, as outlined below, shall verify the documents submitted by the applicant. Upon successful verification, a unique registration number shall be issued.

Registration of traders (dealers/wholesalers/sellers of ODS 6(1)

Registration of producers of ODS 3(1)

Registration of manufacturers, importers & exporters of compressors (Capital investment > Rs. 1 crore (12)

Registration of persons engaged in activities in Schedule IV (Capital investment > Rs.1 crore)8(1)

Registration Authority: An officer not below the rank of Deputy Secretary in the Ministry of Environment and Forests

Officer-in-Charge of the Small Industries Service Institute under the Small Industries Development Organization, Ministry of Micro, Small and Medium Enterprises (formerly Ministry of Small Scale, Agro and Rural Industries)

Registration of manufacturers, importers & exporters of compressors (Capital investment < Rs. 1 crore)

Registration of persons/enterprises engaged in activities specified in Schedule-IV (Capital investment < Rs. 1 crore

Registration of persons having facilities to destroy ODS

Registration of persons having facilities to reclaim ODS

The Certificate of Registration shall contain the following information:

a. Name of registering authority.
b. Registration number.
c. Information contained in application for registration (excluding enclosures).
d. Signature and seal of registering authority.

- The Certificate of Registration should be kept at the company's Registered Office and shown if asked by an officer who is at least of the rank of Section Officer in the Government of India.
- Registration will not be granted or will be cancelled if the required conditions are not met, necessary documents are not submitted.
- The registration will be valid for 18 months from the date it is issued. It can be renewed any time after 12 months from the date of issue or the last renewal. Each renewal will also be valid for 18 months.

7.5 Data Reporting to Ozone Cell

Once registered, the applicant can submit data online through the MIS portal using the relevant form listed below.

An alert system is integrated into the MIS portal. If a registered applicant—such as a producer, trader, or consumer—fails to submit the required data within the stipulated time period (as shown in the figure below), an email notice shall be sent to the applicant.

Stakeholders	Form	Type of Data	Frequency	Last Date of Submission:
Producer	1	Production of ODS	Annually	Within 60 days of the calendar year
Importer	2	Import of ODS	Quarterly	Within 30 days of the quarter
Exporter	3	Export of ODS	Quarterly	Within 30 days of the quarter
Seller	4	Sale of ODS	Quarterly	Within 30 days of the quarter
Consumer	5	Purchase of ODS on end use basis	Annually	Within 30 days of the calendar year
Reclaimer	7	Reclamation of ODS	Annually	Within 60 days of the calendar year
Destroyer	8	Quantity of ODS destroyed	Annually	Within 30 days of the calendar year
Manufacturer, Importer, Exporter and Seller	12	Manufacture, import/export and sale of compressors	Quarterly	Within 30 days of the quarter

All data collected and compiled by the Ozone Cell, MoEF&CC shall be submitted to the Monitoring Committee.

Source:
- https://ozonecell-mis.nic.in/public/aboutUsForLoginPage/aboutUsForLoginPage
- https://ozonecell.nic.in/wp-content/themes/twentyseventeen-child/Documentation/assets/pdf/Schedule11.pdf

7.6 Data Reporting to Ozone Secretariat

- All Parties (countries) to the Montreal Protocol are required to report annual data.
- The report must be submitted to the Ozone Secretariat, based in Nairobi, by 30 September each year.
- The data submitted must relate to the previous calendar year.
- Reporting obligations depend on the country's ratification of the Montreal Protocol and its Amendments.
- Data must be reported for the following groups of controlled substances listed in the Annexes of the Protocol:
  - Annex A:
    - Group I – CFCs
    - Group II – Halons
  - Annex B:
    - Group I – Other fully halogenated CFCs
    - Group II – CTC
    - Group III – Methyl chloroform
  - Annex C:
    - Group I – HCFCs
    - Group II – HBFCs
  - Annex E:
    - Methyl bromide
  - Annex F:
    - HFCs
- Countries are generally required to report data on the following categories:
  - Imports
  - Exports
  - Production
  - Amounts destroyed
  - Certain exempted categories
  - Trade with Non-Parties
- The Ozone Secretariat provides five data forms for annual reporting (Annex I):
  - Data Form 1 – Imports
  - Data Form 2 – Exports
  - Data Form 3 – Production
  - Data Form 4 – Amounts Destroyed
  - Data Form 5 – Imports from and/or Exports to Non-Parties
- As per the Protocol, consumption is calculated using the formula:
  - Consumption = Production + Imports − Exports

In India, Data reporting for HFCs commenced from 2022 along with other ODS as per provisions of Article 7 of the Montreal Protocol.

Source: "Handbook for the Montreal Protocol on Substances That Deplete the Ozone Layer," 2018

Data on production, export and import of ODS and HFCs under Article-7 of the Montreal Protocol for the year 2022 was submitted to the Ozone Secretariat and data on production, consumption, export and import of ODS and HFCs data under Country Programme Progress Report (CPPR) for the year 2022 was submitted to the Multilateral Fund Secretariat respectively.

The Standing Committee on Monitoring of the Empowered Steering Committee of the Montreal Protocol, chaired by the Ex-Officio, Chairman, Central Pollution Control Board (CPCB) and comprising representatives from concerned line Ministries involved in maintaining data on substances controlled under the Montreal Protocol, reviews the data compiled by the Ozone Cell and recommends the same for consideration and approval of the ESC, for submission to the Ozone Secretariat and MLF Secretariat respectively.

7.7 Licensing System for Import/Exports

As per Article 4B: Licensing, Section 1 of the Montreal Protocol, the following requirements apply to all member countries ("Parties"):

1. By 1 January 2000 (or within three months after this rule takes effect for a country, whichever is later), each Party must set up and enforce a licensing system for the import and export of new, used, recycled, and reclaimed substances listed in Annexes A, B, C, and E of the Protocol.

2. A licensing system for substances listed in Annex F must be in place by 1 January 2019, or within three months of the rule coming into effect, whichever is later. Countries classified under Article 5(1) (developing countries) are allowed to delay this requirement until 1 January 2021, if necessary.

3. Each Party must report to the Secretariat about the establishment and functioning of its licensing system within three months of putting the system in place.

Annex A: CFCs (CFC-11, CFC-12), Halons (Halon-1211, halon-1301 and halon-2402)
Annex B: Other fully halogenated CFCs, CTC, Methyl Chloroform
Annex C: HCFCs, HBFCs, Bromochloromethane
Annex E: Methyl bromide
Annex F: HFCs

Source: "Handbook for the Montreal Protocol on Substances That Deplete the Ozone Layer," 2018

Licensing System for Import/Exports as per Indian Regulations

India introduced a licensing system for ODS in 1996, following the recommendation made at the Meeting of the Parties (MOP) held in Vienna in 1995. As part of this system, trade in ODS with countries that are not parties to the Montreal Protocol has been banned.

A harmonized system of commodity classification codes, aligned with international standards, has been developed and implemented.

HCFCs are included under the import licensing system. The ODS Rules specify 38 HCFCs for which importers must apply for an import license. Import of these substances is allowed only if a valid import license is obtained.

The import/export license is issued by the Directorate General of Foreign Trade (DGFT), Ministry of Commerce and Industry, Government of India, based upon the recommendations of the Ozone Cell, MoEF&CC.

Source: https://ozonecell.nic.in/home-page/montreal-protocol-implementation-in-india/regulatory-framework/

7.8 Institutional Framework for Implementation of Montreal Protocol (MP) in India

The MoEF&CC also constituted an Empowered Steering Committee (ESC), which is supported by two Standing Committees, namely the Technology and Finance Standing Committee (not active at present) and the Standing Committee on Monitoring.

Empowered Steering Committee

Chaired By: Secretary, MoEF&CC
Members: Line Ministries, Sectoral Experts from Industries and Industrial Associations
Mandate: Policy Actions Pertaining to the Montreal Protocol

Ministry of Environment, Forest & Climate Change (MoEF&CC)

OZONE CELLMandate: Management / Coordination of all MP Activities

Standing Committee for Monitoring & Evaluation

Members: Experts / Officials from Government & Industry
Mandate:

- To analyze, compile, and recommend national data on the production, import, and export of each controlled substance, in accordance with Article 7 of the Montreal Protocol, for submission to the Ozone Secretariat.
- To analyze, compile, and recommend data for the Country Programme Progress Report, to be submitted to the Multilateral Fund Secretariat.
- To examine the use and manufacture of ODS for both controlled and feedstock purposes, including processes related to feedstock qualification, monitoring, and data reporting.
- To consider and act upon any other matter referred by the Ministry concerning the implementation of the Montreal Protocol.

Working Group
Members: Experts from Government Institutions
Mandate:
To examine and address issues related to the use and manufacture of controlled substances for feedstock applications, particularly where the processes are not specified by the Technology and Economic Assessment Panel (TEAP) of the Montreal Protocol.
To provide recommendations on qualifying process for feedstock use, monitoring and data reporting of ODS etc.
The recommendation of the working group, shall be forwarded to the Ozone Cell, MoEF&CC for further necessary action. The proposals recommended by the Working Group for registration under ODS (Regulation and Control) Rules, 2000 as amended from time to time, shall be apprised to the Standing Committee on Monitoring.

Source: https://ozonecell.nic.in/home-page/montreal-protocol-implementation-in-india/india-institutional-framework/

Members of Empowered Steering Committee

- Secretary (Environment, Forest and Climate Change - Chairperson
- Secretary (Department of Economic Affairs) - Member
- Secretary (Department Chemicals & Petrochemicals) - Member
- Secretary (Department for Promotion of Industry and Internal Trade) - Member
- Secretary (Department of Commerce) - Member
- Secretary (Ministry of Petroleum & Natural Gas) - Member
- Secretary (Department of Science & Technology) - Member
- Secretary (Ministry of Food Processing Industry) - Member
- Secretary (Ministry of Fisheries, Animal Husbandry and Dairying) - Member
- Director General, Council of Scientific and Industrial Research - Member
- Secretary (Ministry of Skill Development and Entrepreneurship) - Member
- Director General, Directorate General of Training (DGT) - Member
- Additional Secretary (Climate Change) - Member
- Chairman, Central Pollution Control Board - Member
- Development Commissioner, Ministry of Micro, Small & Medium Enterprises - Member

Members (from outside Government representing Environment, Technology & Finance) nominated by Ministry of Environment, Forest and Climate Change

- Dr. Vibha Dhawan, Director General, The Energy and Resources Institute (TERI)
- Prof. A. B. Pandit, Vice-chancellor of the Institute of Chemical Technology
- Dr. G. Venkatarathnam, Professor, Department of Mechanical Engineering, IIT Madras
- Dr. Krishnaiah Atmakur, Chief Scientist & Head, CSIR-IICT

Industry representatives (not having direct interest) nominated by Ministry of Environment, Forest and Climate Change

- Dr. Seema Arora, Sustainability and Environment Division, Confederation of Indian Industry (CII)
- Director General, Federation of Indian Chambers of Commerce and Industry (FICCI)
- President Society of Indian Automobile Manufacturers (SIAM)
- National President, Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE)
- President, PHD Chamber of Commerce and Industry (PHDCCI)

Members of Standing Committee on Monitoring

- Central Pollution Control Board (CPCB) - Chairperson
- Representative of Department of Chemicals & Petrochemicals, Government of India - Member
- Representative of Ministry of Micro, Small and Medium Enterprises (MSME), Government of India - Member
- Representative of Department for Promotion of Industry and Internal Trade, Government of - Member
- Representative of Directorate General of Commercial Intelligence and Statistics (DGCIS) - Member
- Representative of Directorate General of Foreign Trade (DGFT) - Member
- Representative of Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture & Framer's Welfare, Government of India - Member
- Representative of Director, Institute of Pesticide Formulation Technology, Department of Chemical and Petrochemicals, Government of India - Member
- Representative of Director, National Institute of Pharmaceutical Education and Research, Mohali, Department of Pharmaceutical, Government of India - Member
- Representative of Director, Indian Institute of Chemical Technology (IICT), Hyderabad - Member
- Officer-in-charge (Ozone Cell) - Member

Members of Working Group Standing Committee on Monitoring

- Representative of director, Institute of Pesticide Formulation Technology, Department of chemical and petrochemicals, Government of India
- Representative of Director, national Institute of Pharmaceutical Education and Research, Mohali, Department of Pharmaceutical, Government of India
- Representative of Director, Indian Institute of Chemical Technology (IICT), Hyderabad
- Member Secretary, Central Pollution Control board
- Officer-in-charge (Ozone Cell)- Convener

Module 8:
Case Studies of Successful Phase out of ODS in the Country

8.1 CFC Phase out in RAC sector

The phase-out of use of CFCs in Refrigeration and Air Conditioning (RAC) Servicing sector was an extremely challenging task because it involved the informal sector that comprissed a large number of very tiny enterprises. These enterprises were located throughout the country, including in small towns and rural areas.

National CFC Consumption Phase-out Plan (NCCoPP) and its forerunning projects (Indo- Swiss-German Project "Ecological Refrigeration (ECOFRIG) and Human and Institutional Development in Ecological Refrigeration (HIDECOR) not only addressed this sector in a very effective manner by training more than 20,000 servicing technicians but also provided equipment support to a large number of enterprises. This was one of the significant achievements addressing the informal sector in the country.

8.2 HCFC Phase out in Foam Sector

HCFCs are used in the foam manufacturing, refrigeration and air conditioning industry. During the implementation of the CFC phase-out under the Montreal Protocol, HCFCs were introduced as transitional substitutes for ODS wherever other non-ODS technologies were not available

HPMP-I

The HPMP is implemented with UNDP as the lead agency, in cooperation with UNEP and GIZ.

PU Foam Sector: 15 large-sized enterprises in the foam manufacturing sector were assisted to phase-out their use of HCFC-141b, including eight (8) domestic refrigeration manufacturing enterprises; two (2) continuous sandwich panel manufacturers; and five (5) enterprises in discontinuous (sandwich) panels. In addition, 15 system houses were also assisted in developing HCFC-free polyol formulations with low GWP blowing agents

Source: Ozone Cell Ministry of Environment, Forest and Climate Change Government of India, 2024

HPMP II

PU Foam Manufacturing Sector

- The polyurethane foam sector was prioritized for complete phase-out of HCFC-141b by 1.1.2020, as per ODS (Regulation and Control) Rules 2000 (amended 2014). Alternative blowing agents included Cyclopentane (C5), Methyl Formate (Ecomate), water, and HFOs.

- 160 enterprises (verified) participated in HPMP Stage-II, consuming 2,630.11 MT of HCFC-141b.

- Memoranda of Agreement (MOA) with Ozone Cell, MoEF&CC outlined legal obligations and milestones.

- The technical institute along with Ozone Cell, MoEF&CC provided technical support to enterprises under a competency enhancement framework, which included training workshops, trials, on- site demonstrations and support, practical hands-on-training and product validation. The technical institute also provided the testing facilities for non-HCFC and low GWP formulations and foam products certification. It also addressed issues related to physical technology conversion of the enterprises. The technical assistance support of CIPET to the enterprises proved to be the key for successful sustainable implementation of complete phase-out of HCFC-141b in foam manufacturing sector.

- M/s Mott MacDonald (third-party) verified compliance, confirming no HCFC-141b stocks remained at manufacturing sites.

- The initiative successfully achieved complete phase-out through structured agreements, expert assistance, and independent verification.

Annexure - 1

List of ozone depleting substances

S.No.	Name of Ozone Depleting Substance	Chemical Composition of Ozone Depleting Substance	Group	Ozone Depleting Potential
(1)	(2)	(3)	(4)	(5)
1.	CFC-11	Trichlorofluoromethane ($CFCl_3$)	I	1.0
2.	CFC-12	Dichlorodifluoromethane (CF_2Cl_2)	I	1.0
3.	CFC-113	Trichlorotrifluoroethane ($C_2F_3Cl_3$)	I	0.8
4.	CFC-114	Dichlorotetrafluoroethane ($C_2F_4Cl_2$)	I	1.0
5.	CFC-115	Chloropentafluoroethane (C_2F_5Cl)	I	0.6
6.	Halon-1211	Bromochlorodifluoromethane (CF_2BrCl)	II	3.0
7.	Halon-1301	Bromotrifluoromethane (CF_3Br)	II	10.0
8.	Halon-2402	Dibromotetrafluoroethane ($C_2F_4Br_2$)	II	6.0
9.	CFC-13	Chlorotrifluoromethane (CF_3Cl)	III	1.0
10.	CFC-111	Pentachlorofluoroethane (C_2FCl_5)	III	1.0
11.	CFC-112	Tetrachlordifluoroethane ($C_2F_2Cl_4$)	III	1.0
12.	CFC-211	Heptachlorofluoropropane (C_3FCl_7)	III	1.0
13.	CFC-212	Hexachlorodifluoropropane ($C_3F_2Cl_6$)	III	1.0
14.	CFC-213	Pentachlorotrifluoropropane ($C_3F_3C_5$)	III	1.0
15.	CFC-214	Tetrachlorotetrafluoropropane ($C_3F_4Cl_4$)	III	1.0
16.	CFC-215	Trichloropentafluoropropane ($C_3F_5Cl_3$)	III	1.0
17.	CFC-216	Dichlorophexafluoropropane ($C_3F_6Cl_2$)	III	1.0
18.	CFC-217	Chloroheptafluoropropane (C_3F_7Cl)	III	1.0
19.	Carbon tetrachloride	Tetrachloromethane (CCl_4)	IV	1.1
20.	Methyl chloroform	1, 1, 1-Trichloroethane ($C_2H_3Cl_3$)	V	0.1

21.	HCFC-21	Dichlorofluoromethane ($CHFCl_2$)	VI	0.04
22.	HCFC-22	Dichlorodifluoromethane (CHF_2Cl)	VI	0.055
23.	HCFC-31	Chlorofluoromethane (CH_2FCl)	VI	0.02
24.	HCFC-121	Tetrachlorodifluoroethane ($C_2HF_2Cl_4$)	VI	0.04
25.	HCFC-122	Trichlorodifluoroethane ($C_2HF_2Cl_3$)	VI	0.08
26.	HCFC-123	2, 2-dichloro-1, 1, 1-trifluoroethane ($C_2HF_3Cl_2$)	VI	0.06
27.	HCFC-123a	1.2-dichloro-1, 1, 2-trifluoroethane ($CHCl_2CF_3$)	VI	0.02
28.	HCFC-124	2-chloro-1, 1, 1, 2-trifluoroethane (C_2HF_4Cl)	VI	0.04
29.	HCFC-124a	2-chloro-1, 1, 2, 2-trifluoroethane ($CHFClCF_3$)	VI	0.022
30.	HCFC-131	Trichlorofluoroethane ($C_2H_2FCl_3$)	VI	0.05
31.	HCFC-132	Dichlorodifluoroethane ($C_2H_2F_2Cl_2$)	VI	0.05
32.	HCFC-133	Chlorotrifluoroethane ($C_2H_3F_3Cl$)	VI	0.06
33.	HCFC-141	Dichlorofluoroethane ($C_2H_3FCl_2$)	VI	0.07
34.	HCFC-141b	1, 1-dichloro-1-fluoroethane (CH_3CFCl_2)	VI	0.11
35.	HCFC-142	Chlorodifluoroethane ($C_2H_3F_2Cl$)	VI	0.07
36.	HCFC-142b	1-chloro-1, 1-difluoroethane (CH_3CF_2Cl)	VI	0.065
37.	HCFC-151	Chlorofluoroethane ($C_2F_54l_3$)	VI	0.005
38.	HCFC-221	Hexachlorofluoropropane (C_3HFCl_6)	VI	0.07
39.	HCFC-222	Pentachlorodifluoropropane ($C_3HF_2Cl_5$)	VI	0.09
40.	HCFC-223	Tetrachlorotrifluoropropane ($C_3HF_3Cl_4$)	VI	0.08
41.	HCFC-224	Trichlorotetrafluoropropane ($C_3HF_4Cl_3$)	VI	0.09
42.	HCFC-225	Dichloropentafluoropropane ($C_3HF_5Cl_2$)	VI	0.07

43.	HCFC-225ca	1, 3-dichloro-1,2, 2,3,3-pentafluoropropane ($CF_3CF_2CHCl_2$)	VI	0.025
44.	HCFC-225cb	1-3-dichloro-1,2,2,3,3-pentafluoropropane (CF_2ClCF_2CHClF)	VI	0.033
45.	HCFC-226	Chlorohexafluoropropane (C_3HF_6Cl)	VI	0.10
46.	HCFC-231	Pentachlorofluoropropane ($C_3H_2FCl_5$)	VI	0.09
47.	HCFC-232	Tetrachlorodifluoropropane ($C_3H_2F_2Cl_4$)	VI	0.10
48.	HCFC-233	Trichlorotrifluoropropane ($C_3H_2F_3Cl_3$)	VI	0.23
49.	HCFC-234	Dichlorotetrafluoropropane ($C_3H_2F_4Cl_2$)	VI	0.28
50.	HCFC-235	Chloropentafluoropropane ($C_3H_2F_5Cl$)	VI	0.52
51.	HCFC-241	Tetrachlorofluoropropane ($C_3H_3FCl_4$)	VI	0.09
52.	HCFC-242	Trichlorodifluoropropane ($C_3H_3F_2Cl_3$)	VI	0.13
53.	HCFC-243	Dichlorotrifluoropropane ($C_3H_3F_3Cl_2$)	VI	0.12
54.	HCFC-244	Chlorotetrafluoropropane ($C_3H_3F_4Cl$)	VI	0.14
55.	HCFC-251	Trichlorofluoropropane ($C_3H_4FCl_3$)	VI	0.01
56.	HCFC-252	Dichlorodifluoropropane ($C_3H_4F_2Cl_2$)	VI	0.04
57.	HCFC-253	Chlorotrifluropropane ($C_3H_4F_3Cl$)	VI	0.03
58.	HCFC-261	Dichlorofluoropropane ($C_3H_5FCl_2$)	VI	0.02
59.	HCFC-262	Chlorodifluoropropane ($C_3H_5F_2Cl$)	VI	0.02
60.	HCFC-271	Chlorofluoropropane (C_3H_6FCl)	VI	0.03
61.	BFC-21B2	Dibromofluoromethane ($CHFBr_2$)	VII	1.00
62.	HBFC-22B1	Bromodifluoromethane (CHF_2Br)	VII	0.74
63.		Bromofluoromethane (CH_2FBr)	VII	0.73
64.		Tetrabromofluoroethane (C_2HFBr_4)	VII	0.8
65.		Tribromodifluoroethane ($C_2HF_2Br_3$)	VII	1.8
66.	HBFC-123B2 HBFC-123aB2	Dibromotrifluoroethane ($C_2HF_3Br_2$)	VII	1.6

67.	HBFC-124B1	Bromotetrafluoroethane (C_2HF_4Br)	VII	1.2
68.		Tribromofluoroethane ($C_2H_2FBr_3$)	VII	1.1
69.		Dibromodifluoroethane ($C_2H_2F_2Br_2$)	VII	1.5
70		Bromotrifluoroethane ($C_2H_2F_3Br$)	VII	1.6
71.		Dibromofluoroethane ($C_2H_3FBr_2$)	VII	1.7
72.	HBFC-124B1	Bromodifluoroethane ($C_2H_3F_2Br$)	VII	1.1
73.	HBFC-124B1	Bromofluoroethane (C_2H_4FBr)	VII	0.1
74.		Haxabromofluoropropane (C_3HFB_6)	VII	1.5
75.		Pentabromodifluoropropane ($C_3HF_2Br_5$)	VII	1.9
76.		Tetrabromofluoropropane ($C_3HF_3Br_4$)	VII	1.8
77.		Tribromotetrafluoropropane ($C_3HF_4Br_3$)	VII	2.2
78.		Dibromopentafluoropropane ($C_3HF_5Br_2$)	VII	2.0
79.		Bromohaxafluoropropane (C_3HF_6Br)	VII	3.3
80.		Pentabromofluoropropane ($C_3H_2FBr_5$)	VII	1.9
81.		Tetrabromodifluoropropane ($C_3H_2F_2Br_4$)	VII	2.1
82.		Tribromotrifluoropropane ($C_3H_2F_3Br_3$)	VII	5.6
83.		Dibromotetrafluoropropane ($C_3H_2F_4Br_2$)	VII	7.5
84.		Bromopentafluoropropane ($C_3H_2F_5Br$)	VII	1.4
85.		Tetrabromofluoropropane ($C_3H_3FBr_4$)	VII	1.9
86.		Tribromodifluoropropane ($C_3H_3F_2Br_3$)	VII	3.1
87.		Dibromotriflvoropropane ($C_3H_3F_3Br_2$)	VII	2.5
88.		Bromotetrafluoropropane ($C_3H_3F_4Br$)	VII	4.4
89.		Tribromofluoropropane ($C_3H_4FBr_3$)	VII	0.3

90.		Dibromodifluoropropane ($C_3H_4F_2Br_2$)	VII	1.0
91.		Bromotrifluoropropane ($C_3H_4F_3Br$)	VII	0.8
92.		Dibromofluoropropane ($C_3H_5FBr_2$)	VII	0.4
93.		Bromodifluoropropane ($C_3H_5F_2Br$)	VII	0.8
94.		Bromofluoropropane (C_3H_6FBr)	VII	0.7
95.	Methyl bromide	(CH_3Br)	VIII	0.6
96.	Bromochloromethane	(CH_2BrCl)	IX	0.12

List of ODSs used in India as feedstock for manufacturing of different products

1. **Carbon Tetrachloride (CTC)- Used in manufacturing of following:**
   - 3-chloro-5-Trichloromethyl Chloropent-1-ene (CTCM - CP)
   - 3,4-Dichloro-6-(Trifluoromethyl) Toluene
   - Cypermethric Acid Chloride (CMAC)
   - Cypermethric Acid Chloride (D V Acid Chloride)
   - DV Acid Chloride (DVAC)
   - Chlorotrichloromethyl Cyclopentene (CTCM-CP)
   - HFC-245fa, HFO-1233zd, HFO-1234yf and HFO – 1336mzz
   - 1-Chloro 3,3,3 Trifluoro Propene (i.e. HCFO-1233zd) and 1,3,3,3 Tetrafluoro Propene (i.e.HFO-1234ze)
   - 1-Chloro 3,3,3 Trifluoro Propene and 1,3,3,3 Tetrafluoro Propene

2. **HCFC-22 (Hydrochlorofluorocarbon)- Used in manufacturing of following:**
   - Sulfentrazone (N-2,4-Dichloro-5-4-(difluoromethyl)-3-methyl-5-oxo-4,5-dihydro-1H-1,2,4-triazol-1-yl phenyl methane sulfonamide)
   - Tetrafluoroethylene (TFE)
   - Pyroxasulfone (Octopussy)

3. **Hydrochlorofluorocarbon (HCFC)-142 b- Used in manufacturing of following:**
   - Vinylidene Fluoride (VDF) as intermediate to manufacture Polyvinylidene Fluoride (PVDF)
   - Fluoro Elastomer (FKM only)

4. **CFC -113 - Used in manufacturing of following:**
   - Lambda Cyhalothric Acid

5. **Bromofluoromethane (BFM) - Used in manufacturing of following:**
   - Fluticasone propionate/furoate

6. **Bromotrifluoromethane/Halon 1301 - Used in manufacturing of following:**
   - Manufacture of Fipronil

BIBLIOGRAPHY

1. Handbook for the Montreal Protocol on Substances that Deplete the ozone Layer. (2018). In https://ozonecell.nic.in/wp-content/themes/twentyseventeen-child/Documentation/assets/pdf/MP_handbook-english-2018.pdf. https://ozonecell.nic.in/wp-content/themes/twentyseventeen-child/Documentation/assets/pdf/MP_handbook-english-2018.pdf
2. https://ozonecell.nic.in/home-page/montreal-protocol-implementation-in-india/ods-phaseout-in-the-country/page-indias-country-programme/
3. Ministry of Environment, Forest and Climate Change, government of India. (2023, September 16). Montreal Protocol: Fixing the ozone layer and reducing climate change [Press release]. https://www.pib.gov.in/PressReleasePage.aspx?PRID=1957968#:~:text=India%20has%20ratified%20the%20Kigali,shall%20be%20developed%20by%202023. https://www.pib.gov.in/PressReleasePage.aspx?PRID=1957968#:~:text=India%20has%20ratified%20the%20Kigali,shall%20be%20developed%20by%202023
4. Ozone cell Ministry of Environment, Forest & Climate change, Government of India. (2023). HCFC PHASE-OUT MANAGEMENT PLAN (HPMP). In https://ozonecell.nic.in/wp-content/uploads/2023/09/2-HPMP-Stage-III.pdf. https://ozonecell.nic.in/wp-content/uploads/2023/09/2-HPMP-Stage-III.pdf
5. Ozone cell Ministry of environment, Forest and climate change Government of India. (2023). Order, Reconstitution of Standing Committee on Monitoring. In https://ozonecell.nic.in/wp-content/uploads/2023/05/Reconstitution-of-Standing-Committe-on-Monitoring-Order-dated-16th-May-2023.pdf. https://ozonecell.nic.in/wp-content/uploads/2023/05/Reconstitution-of-Standing-Committe-on-Monitoring-Order-dated-16th-May-2023.pdf
6. Ozone cell ministry of environment, forest and climate change Government of India. (2024). Office Order: Implementation of quota system for hydrochorofluorocarbon-22 production for non-feedstock applications in INDIA for the calendar year 2024. In https://ozonecell.nic.in/wp-content/uploads/2024/05/Quota-Order-2024.pdf. https://ozonecell.nic.in/wp-content/uploads/2024/05/Quota-Order-2024.pdf
7. Ozone Cell Ministry of Environment, Forest and Climate Change Government of India. (2024). The Montreal Protocol India's success story. https://ozonecell.nic.in/wp-content/uploads/2025/03/1-26th-edition-of-The-Montreal-Protocol-India%E2%80%99s-Success-Story.pdf
8. The Gazette of India Notification (ODS Rules, 2000) & its amendments. (n.d.). https://ozonecell.nic.in/home-page/montreal-protocol-implementation-in-india/regulatory-framework/the-gazette-of-india-notification-ods-rules-2000-its-amendments/
9. UN environment Programme Ozone secretariat. (n.d.). Facts and figures on ozone protection. https://ozone.unep.org/facts-and-figures-ozone-protection. https://ozone.unep.org/facts-and-figures-ozone-protection
10. Ministry of Environment, Forest and Climate Change. (2016, October 13). Order: Control of emission/venting of Hydrofluorocarbon HFC-23, produced as byproduct while manufacturing of Hydrochlorofluorocarbon HCFC-22, in the atmosphere. Government of India, Ozone Cell.
11. Ozone Cell, Ministry of Environment, Forest and Climate Change (MoEF&CC). The Ozone Depleting Substances (Regulation and Control) Rules, 2000 and its Amendments. Government of India. Available at: https://ozonecell.nic.in/wp-content/uploads/2022/08/The-Gazette-of-India-Rule-2000-2019.pdf

National Productivity Council

ABOUT NPC

NATIONAL PRODUCTIVITY COUNCIL

NPC is a national level organization to promote productivity culture in India. Established as a registered society in 1958 by Government of India, it is an autonomous, tripartite, not for profit organization with equal representation from the Government, Employers and Employees' organizations, apart from technical & professional institution on its governing council. Besides providing training, consultancy and undertaking research in the area of productivity, NPC also implements the productivity promotion plans and programmes of the Tokyo based Asian Productivity Organization (APO), an inter-governmental body of which the Government of India is a founder member.

MISSION of NPC is Development, Dissemination and Application of knowledge and experience in productivity, for promoting consciousness and improvement in productivity, with the objective of strengthening the performance and competitiveness of the economy as well as of improving the working conditions and quality of working life.

The Union Minister for Industry is the President of NPC, and the Secretary (Industrial Development) is its Chairman. Director General is the Chief Executive Officer, and is a government appointee. NPC has 13 Regional Directorates in the country with its Head Quarters at New Delhi and strength of over 170 full time consultants.

CORE COMPETENCIES:

NPC offers TOTAL SOLUTIONS, as also specific services in management as well as technological areas. These include:

- **Industrial Engineering:** Workload assessment, Organization Redesign, Systems & Procedures redesign, Material requirement planning, MIS, Project Management, Cost reduction. Total Quality Management, ISO 9000, Certification, Business Process engineering, KAIZEN, Benchmarking etc.
- **Human Resource Development:** Work culture, Participative group activities, Productivity Linked reward Scheme, Training needs assessment, Wage structure, Competency Matrix.
- **Information Technology:** Management Information system, E – Governance, IT Infrastructure Planning.
- **Energy Management:** Energy Audits, Co-generation, Demand side management, Renewable & Green energy sources, Process Optimization & energy Conservation.
- **Environment Management:** Integrated environment planning, Environmental Audit, Cleaner Production Techniques, Hazardous Waste Management, Waste Minimization & Utilization, Green Productivity, ISO 14000 & OHSAS 18000.
- **Productivity Implementation:** Policy Research & Techno-economic Consultancy, Productivity Audit.
- **Technology Management:** Condition Monitoring, Safety audit, Risk assessment, Total Productive Maintenance.
- **World Class Manufacturing:** Flexible/ cellular manufacturing, JIT, Cycle time reduction, Six Sigma.
- **Agribusiness:** Food Processing, Warehousing Logistics, Evaluation Studies, Soil & Water conservation.
- NPC brings out literature suitable to Indian situation on current and emerging subjects relating to productivity and quality. It also brings out following periodicals, viz. PRODUCTIVITY, PRODUCTIVITY NEWS AND UTPADAKTA (Hindi).

Visit us on: http://www.npcindia.gov.in

प्रकृतिः रक्षति रक्षितः
Nature Protects if She is Protected

स्वर्ण जयंती वर्ष
स्वच्छ पर्यावरण के लिए प्रतिबद्ध
IN PURSUIT OF CLEAN ENVIRONMENT
1974-2024
CPCB

राष्ट्रीय उत्पादकता परिषद
योग कर्मसु कौशलम्
NPC
National Productivity Council