



## INFORMATION BOOKLET ON MONTREAL PROTOCOL

# ACREX INDIA 2018

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22-24 FEBRUARY 2018

**BANGALORE INTERNATIONAL  
EXHIBITION CENTRE**

BENGALURU

**30<sup>th</sup> Anniversary of the Montreal Protocol**  
(1987-2017)



# **MONTREAL PROTOCOL**

caring for all life under the sun

# Contents

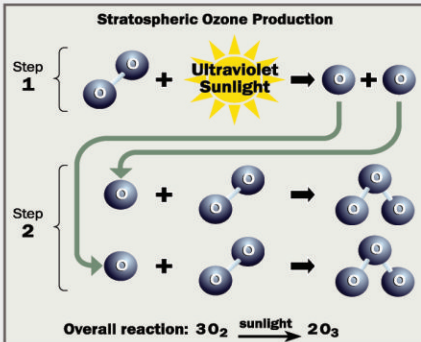
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1. Stratospheric Ozone Layer
2. Science of Ozone Layer Depletion
3. Antarctic Ozone Hole
4. Major Uses of Ozone Depleting Substances
5. Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol
6. Amendments to the Montreal Protocol
7. Achievements of Montreal Protocol
8. Collective Global Action has Led to Recovery of Ozone Layer
9. Implementation of Montreal Protocol: India's Achievements
10. Salient Features of Ozone Depleting Substances Rules (ODS Rules)
11. Ozone Depleting Substances phaseout in India
12. Regulation on the Consumption of Ozone Depleting Substances as per ODS Rules
13. Hydrochlorofluorocarbons (HCFCs) Phaseout Management Plan (HPMP)
14. Hydrochlorofluorocarbons (HCFCs) Phaseout Management Plan (HPMP) Stage II
15. Kigali Amendment to Montreal Protocol - FAQ
16. Kigali Amendment to the Montreal Protocol for phasedown of Hydrofluorocarbons (HFCs)
17. Kigali Amendment to the Montreal Protocol: India's contribution
18. How can you Help Protect the Ozone Layer
19. Climate Efficient Green Buildings can help Protect Ozone Layer
20. Refrigeration and Air-conditioning Industry can help Protect Ozone Layer and Climate
21. O2C Technology Roadshow
22. Code of Practices for RAC System Servicing
23. A way towards Climate Friendly Cooling in India – HPMP Stage I, and  
A way towards Climate Friendly Cooling in India – HPMP Stage II
24. Ozone Award for Political Leadership – India

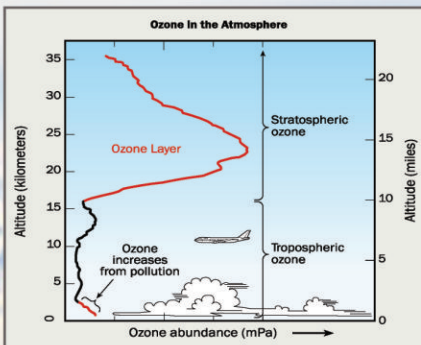




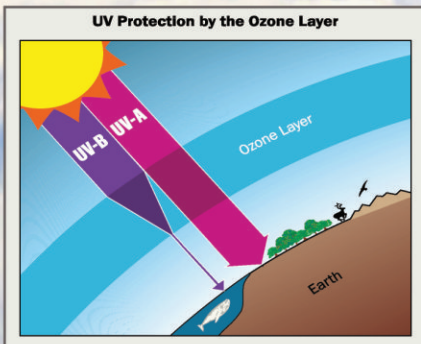
# Stratospheric Ozone Layer



- Ozone is a tri-atomic molecule of oxygen
- Formed naturally in the upper level of the Earth's atmosphere
- Three molecules of oxygen in the presence of sunlight form two molecules of Ozone in the stratosphere



- Stratosphere extends between 10-50 kilometres above the earth surface
- 90% of ozone formed in the atmosphere is present in the Stratosphere, hence called Stratosphere Ozone Layer



- Stratospheric Ozone Layer absorbs a large part of the Sun's biologically harmful UV-B ultraviolet radiation

# Science of Ozone Layer Depletion

## Principal Steps in the Depletion of Stratospheric Ozone

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 Ozone Depleting Substances (**ODSs**). Human activities generate major proportion of **ODSs** as compared to natural sources.



2

### Accumulation

**ODSs** accumulate in the atmosphere and are globally distributed throughout the lower atmosphere by winds and other air motions.



3

### Transport

**ODSs** are transported to the stratosphere by air motions.



4

### Conversion

Most **ODSs** are converted in the stratosphere to reactive halogen gases in chemical reactions involving ultraviolet radiation from the sun.



5

### Chemical reaction

**Reactive halogen gases** cause chemical depletion of stratospheric ozone over the globe.



6

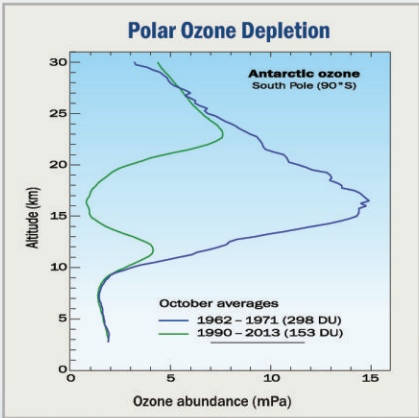
### Removal

Air containing **reactive halogen gases** returns to the troposphere where the gases are removed by moisture in clouds and rain.

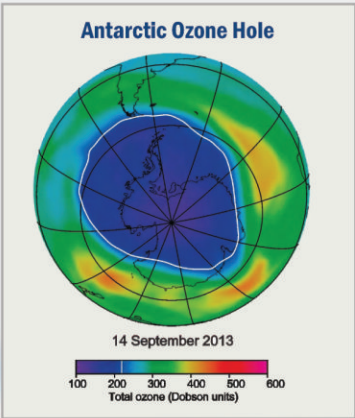
Source:

Michaela I. Hegglin (Lead Author), David W. Fahey, Mack McFarland, Stephen A. Montzka, and Eric R. Nash, Twenty Questions and Answers About the Ozone Layer: 2014 Update, Scientific Assessment of Ozone Depletion: 2014, 84 pp., World Meteorological Organization, Geneva, Switzerland, 2015.

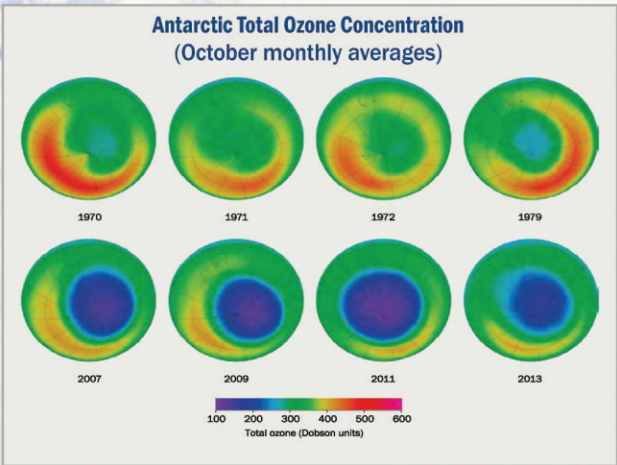
# Antarctic Ozone Hole



Vertical distribution of Ozone in Stratosphere over Antarctica



Antarctica Ozone Hole in 2013  
(Blue region depicts extremely low concentration of ozone over Antarctica)

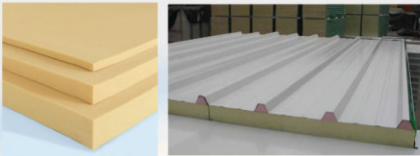


Changes in Ozone concentrations over Antarctica  
(1970-2013)

Source:  
Michaela I. Hegglin (Lead Author), David W. Fahey, Mack McFarland, Stephen A. Montzka, and Eric R. Nash, Twenty Questions and Answers About the Ozone Layer: 2014 Update, Scientific Assessment of Ozone Depletion: 2014, 84 pp., World Meteorological Organization, Geneva, Switzerland, 2015.

# Major uses of Ozone Depleting Substances

As a refrigerant in air conditioning equipment



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



As a fire extinguishing agent in fire extinguishing equipment.

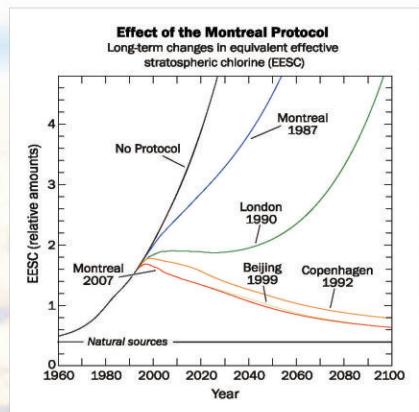


Uses of Chlorofluorocarbons (CFCs), Carbontetrachloride (CTC), halons and methyl bromide have been phased out globally



## VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER AND ITS MONTREAL PROTOCOL

- Vienna Convention for the Protection of Ozone Layer - 22nd March, 1985
- Montreal Protocol on Substances that Deplete the Ozone Layer - 16th September, 1987
- Amendments to the Montreal Protocol
  - Montreal - 1987
  - London - 1990
  - Copenhagen 1992
  - Beijing-1999
  - Kigali - 2016
- Implementation of the Montreal Protocol has led to phase-out of major Ozone Depleting Substances such as chlorofluorocarbons (CFCs), Halons, carbon tetrachloride (CTC) and methyl bromide globally. Hydrochlorofluorocarbons (HCFCs) are still being phased-out.
- Montreal Protocol is the only environment treaty having universal ratification of 197 UN member countries.



Source (graph):

Michaela I. Hegglin (Lead Author), David W. Fahey, Mack McFarland, Stephen A. Montzka, and Eric R. Nash, Twenty Questions and Answers About the Ozone Layer: 2014 Update, Scientific Assessment of Ozone Depletion: 2014, 84 pp., World Meteorological Organization, Geneva, Switzerland, 2015.

# Amendments to the Montreal protocol

## Montreal Protocol

Signature: 16th September, 1987  
India became Party: 19th June, 1992  
Number of parties ratified: 197

### LONDON AMENDMENT

Date of Amendment: 27th – 29th June, 1990  
Date of ratification by India: 17th September, 1992  
Number of parties Ratified: 197

### COPENHAGEN AMENDMENT

Date of Amendment: 23rd – 25th November, 1992  
Date of ratification by India: 3rd March, 2003  
Number of parties Ratified: 197

### MONTREAL AMENDMENT

Date of Amendment: 15th – 17th September, 1997  
Date of ratification by India: 3rd March, 2003  
Number of parties Ratified: 197

### BEIJING AMENDMENT

Date of Amendment: 29th November – 3rd December, 1999  
Date of ratification by India: 3rd March, 2003  
Number of parties Ratified: 197

### KIGALI AMENDMENT

Date of Amendment: 10th - 15th October, 2016  
Date of ratification by India: Yet to ratify  
Number of parties Ratified: Nil

Inclusion of additional controlled substances (Chlorofluorocarbons (CFCs), Methyl Chloroform, Carbon tetrachloride (CTC), etc.)

Inclusion of Hydrofluorocarbons (HCFCs) as transitional substances

Establishment of Financial Mechanism-Multilateral Fund

Ten year Grace Period for Article 5 Parties

Inclusion of HCFCs, HBFCs and Methyl Bromide as controlled substances

Licensing system put in place

Bromo-Chloromethane added as controlled substance for immediate phase-out

Production Control of HCFCs

Inclusion of Hydrofluorocarbons (HFCs) within the ambit of Montreal Protocol



# Achievements of Montreal Protocol



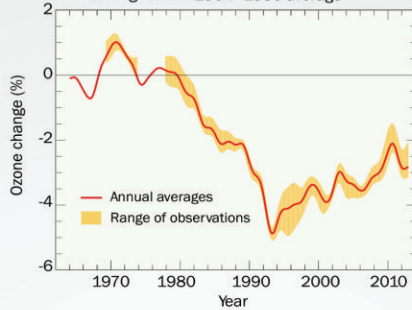
India has met its compliance targets under ongoing HCFC phase out. Chlorofluorocarbons (CFCs), Carbontetrachloride (CTC), Halon and Methyl Bromide completely phased out from India.

# Collective global action has led to the signs of recovery of Ozone Layer

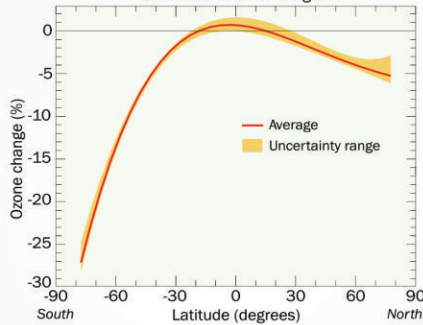
Simulation results showing trend towards recovery of Ozone Layer

## Global Total Ozone Changes

Changes from 1964–1980 average

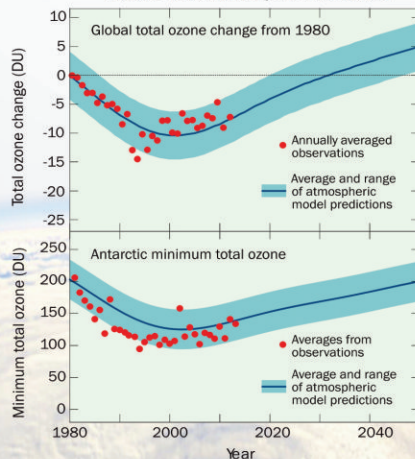


Changes between 1964–1980 and 2008–2012 averages



## Simulations of Stratospheric Ozone Depletion

Results from chemistry-climate models



Source:

Michaela I. Hegglin (Lead Author), David W. Fahey, Mack McFarland, Stephen A. Montzka, and Eric R. Nash, *Twenty Questions and Answers About the Ozone Layer: 2014 Update, Scientific Assessment of Ozone Depletion: 2014*, 84 pp., World Meteorological Organization, Geneva, Switzerland, 2015.

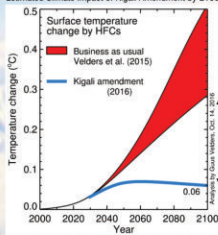
# IMPLEMENTATION OF MONTREAL PROTOCOL: INDIA'S ACHIEVEMENT



2017

INDIA PLAYED A CRITICAL ROLE IN THE ADOPTION OF THE KIGALI AMENDMENT FOR PHASE DOWN OF HYDROFLUOROCARBONS (HFCs)

Estimated Climate Impact of Kigali Amendment by 2100



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

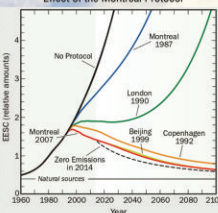
AROUND 46,924 ODP TONS OF OZONE DEPLETING SUBSTANCES PHASED OUT IN INDIA.

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

CHLOROFLUOROCARBONS (CFCs), CARBON TETRACHLORIDE (CTC), HALON AND METHYL BROMIDE COMPLETELY PHASED OUT FROM INDIA

OZONE DEPLETING SUBSTANCES (REGULATION AND CONTROL) RULES, 2000.

Effect of the Montreal Protocol



1987

INDIA'S COUNTRY PROGRAMME PREPARED IN 1993.

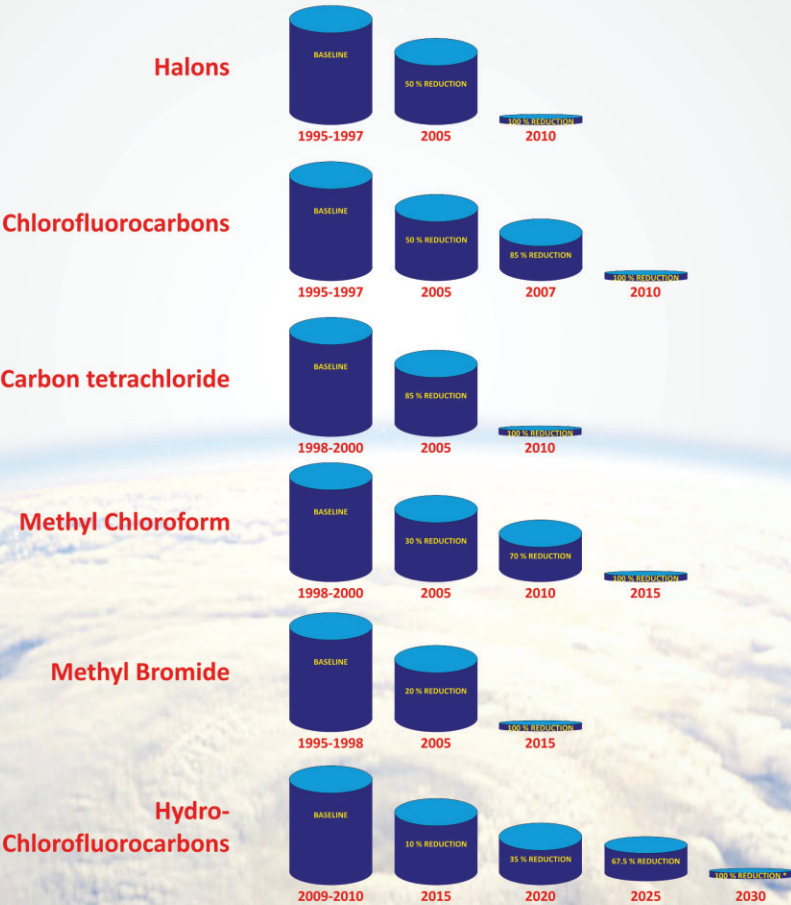
INDIA BECAME A PARTY TO THE MONTREAL PROTOCOL ON SUBSTANCES IN 1992.

## **SALIENT FEATURES OF OZONE DEPLETING SUBSTANCES (REGULATION AND CONTROL) RULES, 2000 AND ITS AMENDMENTS**

- Production and consumption control of Ozone Depleting Substances (ODSs)
- Ban on trade with non-Parties
- Ban on creation of new capacity/ expansion of ODS based industry
- Mandatory registration for producers, importers / exporters, manufacturer, sellers, reclamations / destructions enterprises, manufacturer / importer / exporter of compressors, dealing with ODSs
- Import and Export of ODS are subject to Licence issued by the Directorate General of Foreign Trade (DGFT) based on recommendations obtained from Ozone Cell, Ministry of Environment, Forest and Climate Change (MoEF&CC)
- Introduction of quota system for production of HCFC-22 for non-feedstock applications
- Prohibition on import of pre-blended polyols containing HCFCs
- Prohibition on import of blends containing ODSs including Group VI Substances



# Ozone Depleting Substances Phase out in India



\* Allowing for servicing tail at an annual average of 2.5% during the period 2030 - 2040

## **Regulation on consumption of Ozone Depleting Substances on end use basis as per Ozone Depleting Substances (Regulation and Control) Rules, 2000 and its amendments**

Phase out date

Activities

1  
January  
2001

→ Manufacture of Fire extinguishers and fire extinguishing systems containing halon

1  
January  
2003

→ Manufacture of Aerosol products or pressurised dispensers (excluding metered dose inhalers for medicinal purpose) using CFCs.  
Manufacture of Polyol for foam products using CFCs.  
Manufacture of foam products including foam part of domestic refrigerator using CFCs  
Manufacture of Mobile Air Conditioners and charging at Automobile industry using CFCs  
Manufacture of other Refrigeration and Air-conditioning products using CFCs

1  
January  
2010

→ Manufacture of Metered Dose inhalers for medicinal purposes using CFCs  
Servicing of fire extinguishers and fire extinguishing systems using Halon

1  
January  
2015

→ Use of Methyl Bromide except pre-shipment and quarantine  
Manufacture of domestic refrigerators using HCFCs  
Manufacture of continuous sandwich panel using HCFCs

1  
January  
2020

→ Manufacture of all other foam products including discontinuous sandwich panel using HCFCs

1  
January  
2025

→ Manufacture of air-conditioners containing HCFCs  
Manufacture of other refrigeration and air-conditioning products (excluding compressors) using HCFCs  
Manufacture of fire extinguishers or fire extinguishing systems using HCFCs  
Manufacture of all other equipments or products using HCFCs

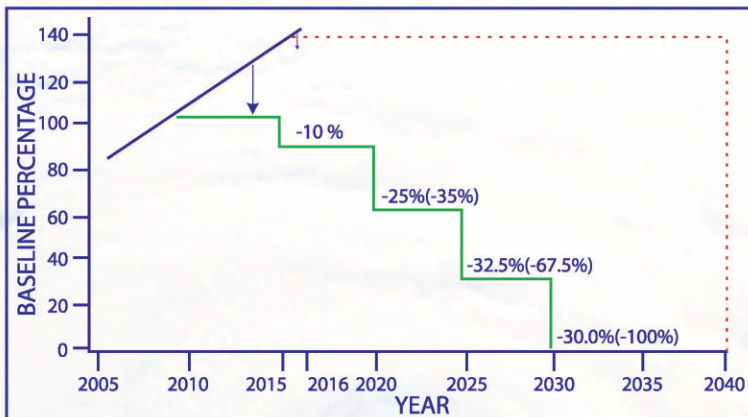
1  
January  
2040

→ Servicing of refrigeration and air-conditioning equipment or products using HCFCs.  
Servicing of fire extinguishers and fire extinguishing systems using HCFCs



## HYDROCHLOROFLUOROCARBONS (HCFCs) PHASE OUT MANAGEMENT PLAN (HPMP)

- 19th Meeting of Parties to the Montreal Protocol in September, 2007, accelerated the phase out of HCFCs by 10 years
- Roadmap for phase out of HCFCs in the country brought out in 2009
- HPMP developed by the country to phase out HCFCs with UNDP as lead implementing agency, and UNEP and GIZ as cooperating agencies for implementation of HPMP.



Accelerated phase-out schedule of HCFCs for Article 5 parties

## **HCFC PHASE OUT MANAGEMENT PLAN (HPMP) STAGE-II KEY HIGHLIGHTS**

- HPMP Stage-I implemented for achieving 2013 and 2015 compliance targets of the Montreal Protocol
- HPMP Stage-II is under implementation from 2017 till 2023
- 400+ participating enterprises in HPMP Stage-II including 300+ MSMEs to be addressed in the polyurethane foam sector.
- 6 large enterprises to be addressed in the air conditioning manufacturing sector
- Technical Assistance activities for MSMEs in the polyurethane foam sector to facilitate phase out
- Focus on promoting energy efficiency, development of building codes integrating HCFC phase out issues, cold chain development with non-HCFC alternatives and development of standards for new non-ODS and low GNP alternatives in HPMP
- Linkage with Skill India Mission for Capacity Building in the RAC servicing sector.
- Net direct CO<sub>2</sub>-equivalent emission reductions of about 8.5 million metric tonne annually from 2023.

## KIGALI AMENDMENT TO THE MONTREAL: PROTOCOL - FAQ

### ■ What is the Kigali Amendment?

The Kigali Amendment is an amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer. It was adopted by the 28th Meeting of Parties to the Montreal Protocol (MOP28) on 15 October 2016 in Kigali, Rwanda. The Amendment adds powerful greenhouse gases hydrofluorocarbons (HFCs) to the list of substances controlled under the Protocol to be phased down.

### ■ What is the expected impact of the Kigali Amendment?

The Amendment will phase-down HFCs under the Montreal Protocol.

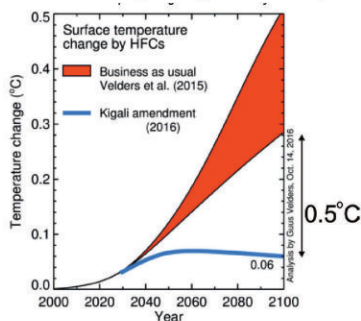
### ■ How will the Kigali Amendment work?

Under the Amendment, Montreal Protocol parties are required to gradually reduce HFC use by 80-85 per cent by the late 2040s. First reductions by most developed countries are expected in 2019. Most developing countries will follow with a freeze of HFCs consumption levels in 2024, and in 2028 for some developing countries.

### ■ What is required for the Kigali Amendment to enter into force?

The Kigali Amendment will enter into force on 1 January 2019, provided that it is ratified by at least 20 parties to the Montreal Protocol. If that condition is not met by that date, the Amendment will become effective on the 90th day following the date of ratification by the 20th party.

Estimated Climate impact of Kigali Amendment by 2100



# KIGALI AMENDMENT TO THE MONTREAL PROTOCOL FOR PHASE-DOWN OF HYDROFLUOROCARBONS (HFCs)

**A5 Countries**  
(Developing Countries)

**Group 2: India and other countries**



**Group 1 : China and other countries**

2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
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**Non A5 Countries**  
(Developed Countries)



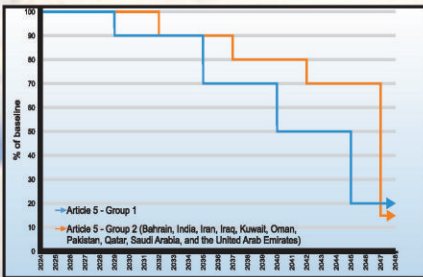
\* Compliance deferral of 2 years from the freeze year of 2028 after technology Review

\*\* 10% Reduction from the baseline year level

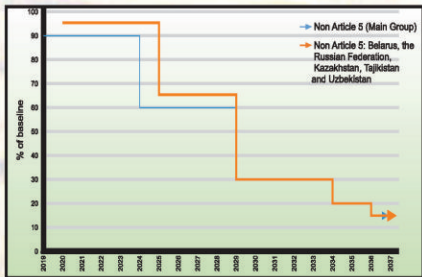
\*\*\* Group 1 Article 5 Countries :- Article 5 parties not part of Group 2

Group 2 Article 5 Countries:- GCC, India, Iran, Iraq, Pakistan

**Phase Down Schedule A5 Countries**



**Phase Down Schedule Non A5 Countries**



Source: UNEP OzonAction FACTSHEET-  
The Kigali Amendment to the Montreal Protocol : HFC Phase Down



## **KIGALI AMENDMENT TO THE MONTREAL PROTOCOL: INDIA'S CONTRIBUTION**

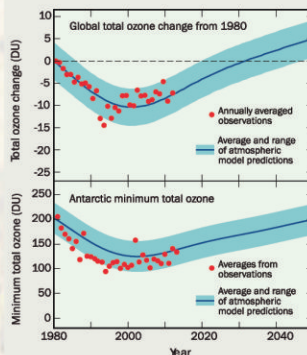
- The freeze year for India will be 2028, with a condition that there will be a technology review in 2024/2025 and, if the growth in the sectors using refrigerants is above certain agreed threshold, India can defer its freeze up to 2030.
- Multilateral Fund under the Montreal Protocol to incentivise for maintain or increase the energy efficiency with new technology while transitioning away from Hydrofluorocarbons (HFCs).
- Funding for Research and Development and servicing sector in developing countries.
- An agreement that provides adequate space for growth of Indian economy, while providing adequate time for industry to shift to sustainable alternatives in the interest of environment.
- Minimize the cost to consumers in transitioning away from HFCs and provide for domestic innovation to develop in the sector of new generation refrigerants and related technologies.
- The Kigali amendment reflects the global ambition and at the same time allows us to take necessary steps for protection of environment and our domestic economy in a longer time frame.

# How can you help protect the Ozone layer

- Dispose of old air conditioners and refrigerators containing Ozone Depleting Substances (ODSs) responsibly. Refrigerants should be removed from an appliance before it is discarded.
- Old portable Halon fire extinguisher should be returned for cycling
- Use ozone friendly products. Replace old ODS based equipment with non-ODS equipment
- Buy products (refrigerators, air-conditioners, fire extinguishers, etc.) that do not have ODSs
- Spread awareness about protection of Ozone Layer, and ozone depleting substances

Collective global action has led to the signs of recovery of ozone layer

Simulation results showing trend towards recovery of ozone layer



Source (graph):  
Michael J. Hegglin (Lead Author), David W. Fahey, Mark McFarland, Stephen A. Montzka, and Eric R. Nash, Twenty  
Questions and Answers About the Ozone Layer 2014 Update, Scientific Assessment of Ozone Depletion: 2014, 84 pp.,  
World Meteorological Organization, Geneva, Switzerland, 2015.



## CLIMATE EFFICIENT GREEN BUILDINGS CAN HELP PROTECT THE OZONE LAYER

### *Hydrochlorofluorocarbons Phase Out Management Plan and Buildings*



- The building sector as many others, can help India fulfil her commitments to protect the Ozone layer
- Good building design and efficient equipment will

- Reduce
  - Heating and cooling loads by 30% - 50%
  - Size of the HVAC equipment & quantity of refrigerant required
- Meet residual heating and cooling loads through alternative refrigerants
- Use non ozone depleting foam blowing agents and firefighting equipment

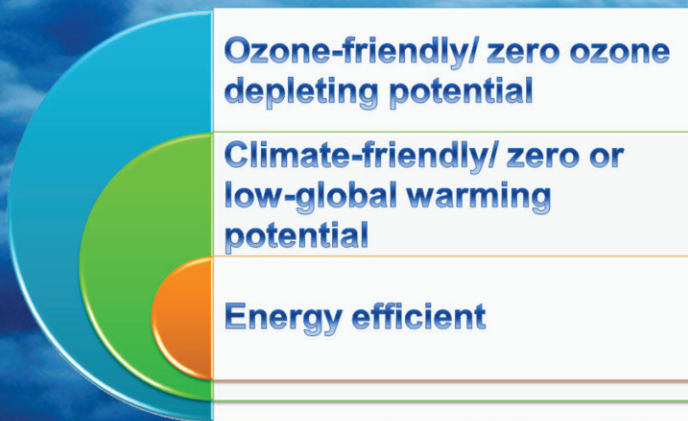
#### ● Reduce HCFCs and HFCs through Green Building Codes

- Increase energy efficiency of appliances and equipment: Adopt
  - Standards and Labeling
  - Building Energy Codes that cover refrigerant require
    - Insulation
    - HVAC
    - Refrigeration &
    - Fire suppression systems
- Abide by Regulatory measures



**Refrigeration and air-conditioning  
industry can do a lot to protect  
the ozone layer and climate  
by**

***Phasing out HCFCs,  
phasing down HFCs and choosing  
Alternative Technologies that are:***





## Technology Roadshow

O2C or Ozone2Climate technologies are energy efficient technologies with zero ozone depleting potential (ODP) and zero to low global warming potential (GWP) alternatives, which are used to replace HCFCs/HFCs (Hydrochlorofluorocarbons /Hydrofluorocarbons) that are being phased out under the Montreal Protocol On Substances That Deplete the Ozone Layer.

The O2C alternatives include :

### Domestic Refrigeration

- R-600a (Isobutane)
- HFO-1234yf

### Commercial Refrigeration

- Hydrocarbons—Isobutane (R-600a), propane (R-290) and propylene (R-1270)
- Ammonia (R-717)
- Carbon dioxide (R-744)
- Lower-GWP HFC refrigerants (HFC-32, HFC-152a, HFC-161, HFO-1234yf, other unsaturated fluorochemicals, as well as blends of them)

### Foam Blowing Agents

- Cyclopentane Blends
- HFO-1234ze
- Methylal
- Methyl Formate

### Building / Construction foam applications

- Hydrocarbons (cyclopentane, cyclopentane blends isobutane and n-pentane)
- CO<sub>2</sub> (Carbon Dioxide)
- Di-Methyl Ether
- Methyl Formate
- Methylal
- HFOs (HFO-1234ze and others)



## Technology Roadshow

O2C or Ozone2Climate technologies are energy efficient technologies with zero ozone depleting potential (ODP) and zero to low global warming potential (GWP) alternatives, which are used to replace HCFCs/HFCs (Hydrochlorofluorocarbons /Hydrofluorocarbons) that are being phased out under the Montreal Protocol On Substances That Deplete the Ozone Layer.

The O2C alternatives include :

Window/ Split AC <3TR	Ducted & Packaged AC
<ul style="list-style-type: none"><li>- HFC-32 : A2L</li><li>- R-290 (A3)</li><li>- Blends of HFC/HFO</li><li>- R452B, R444B (A2L)</li></ul>	<ul style="list-style-type: none"><li>- HFC-32(675) ; A2L</li><li>- R-452B(680) ; A2L</li><li>- R-444B (300) ; A2L</li></ul>
Scroll Chiller	Screw Chiller
<ul style="list-style-type: none"><li>- HFC-32 ; A2L</li><li>- R-452B ; A2L</li></ul>	<ul style="list-style-type: none"><li>- HFO-1234yf (&lt;1); A2L</li><li>- HFO-1234ze (&lt;1) A2L</li><li>- R-513A (600) ; A1</li></ul>
Centrifugal Chiller	
<ul style="list-style-type: none"><li>- HFO-1233zd (1) , A1</li><li>- HFO-1336mzz (2); A1</li><li>- HFO -1234yf (&lt;1); A2L</li><li>- HFO- 1234ze (&lt;1; A2L</li></ul>	





# Code of Practices for RAC\* System Servicing

## Dos

- Always apply best practices within a safe working environment;
- Always recover refrigerants before servicing or scrapping a system;
- Recycle refrigerants for reuse whenever possible;
- Contaminated refrigerants must be stored safely prior to destruction;
- Leaks must be identified and repaired before the system is recharged with refrigerants. Never assume that only one leak is possible!
- Improve your handling of refrigerants, e.g. minimize purging refrigerant hoses;
- Completely empty disposable refrigerant cylinders before scrapping;
- Maintain the best possible and energy-efficient operational conditions of the RAC system;
- Keep record of service and maintenance and manage the RAC systems logbook;
- Maintain good relations with equipment operators and inform them about important, general system features.

## Don'ts

- If you can't work safe, don't do it;
- A well operating and leakproof system should not be subjected to retrofit or conversion;
- Never vent ODS\*\* or refrigerants with high GWP\*\*\* into the atmosphere;
- Never use ODS or refrigerants with high GWP as a cleaning solvent for the system (except secured in a closed loop), or blowing-out the heat exchanger's surface;
- Do not break vacuum with refrigerant for multiple evacuation process, always use OFDN (Oxygen Free and Dry Nitrogen);
- Do not top-up the refrigerant charge of a RAC system without knowing the correct actual filling amount;
- Never use a recovery cylinder (or any other cylinder) which is not designed, certified or clearly labeled for the intended purpose;
- Never mix different types of refrigerants in one recovery cylinder;
- A RAC system designed for the use of low GWP refrigerants (such as HCs) should never be reverse-retrofitted to the use with HFCs/HCF-Cs/CFCs;
- Never attempt to work with damaged or defective tools or equipment, do not use longer refrigerant transfer hoses than necessary.





## A way towards climate-friendly cooling HPMP in India – Stage I

Highlights from the HCFC Phase-out Management Plan for Refrigeration & Air Conditioning (HPMP) – completed activities

### RAC Technicians Training:

- Training provided through a network of training partners across all the states in the country;
- More than 11'000 technicians trained through over 400 programs in installation & servicing room air conditioners up to 2 ton;
- Training included good servicing practices, leak prevention and introduction to alternative refrigerants.



## A way towards climate-friendly cooling HPMP in India – Stage II

Highlights from the HCFC Phase-out Management Plan for Refrigeration & Air Conditioning (HPMP) – proposed activities

- **Technicians training** in consultation with **National Skill Development Corporation (NSDC)** propose to complement the National Skill Development Mission launched by the Hon'ble Prime Minister of India. The aim is to create convergence across sectors and States within the country;
- **Certification:** Technicians must be certified or qualified for installation, servicing, maintenance, repair, decommissioning, leakage checking and recovery;
- **State of the art training centre** equipped with the latest equipment and tools for the RAC trade: Training provided in AC and Refrigeration equipment; support for design of servicing tools and products. Industry, RAC experts and technicians can avail of these facilities for developing synergies between manufacturing and servicing.



## OZONE AWARD FOR POLITICAL LEADERSHIP - INDIA

Ozone Award for Political Leadership  
during the Kigali Amendment Negotiations  
to Late Shri Anil Madhav Dave, the then  
Hon'ble Minister of State (Independent Charge)  
Environment, Forest and Climate Change,  
Government of India.





## NOTES

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## Implementing Partners



*Empowered lives.  
Resilient nations.*



## Partner Industry Association



Refrigeration and Air-conditioning Manufacturers Association  
(RAMA)



Indian Polyurethane Association  
(IPUA)



Refrigerant Gas Manufacturers Association  
(REGMA)



Refrigeration and Air-conditioning Servicing Sector Society  
(RASSS)

For further information

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