UN environment
United Nations Environment Programme

OZONE SECRETARIAT

MONTREAL PROTOCOL
caring for all life under the sun

The latest developments under the Montreal Protocol and the Kigali Amendment

Symposium to Commemorate the 30th Anniversary of the Montreal Protocol and the Adoption of the Kigali Amendment

17 July 2017, Tokyo

Megumi Seki
Ozone Secretariat

The Ozone Layer – at the beginning

The Cosmic Calendar

1 January
The Big Bang

11 May - The Milky Way Galaxy was formed

21 September
appearance of first life on earth 'prokaryotes'

1 September The sun was formed and soon after formation of planets and moon

29 October
Oxygenation of the atmosphere

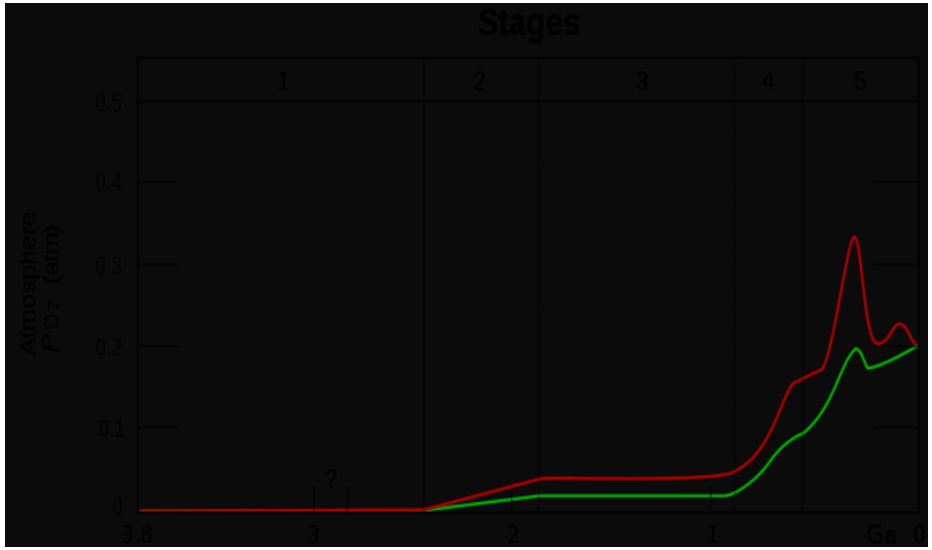
12 October
Photosynthesis began

5 December
Appearance of first multi-cellular life

14-31 December
Ozone layer was formed. Plants, animals including humans came to life

The Great Oxygenation Event (GOE)

(29 October, i.e. about 2.4 billion years ago)



Estimated evolution of atmospheric O_2 The red and green lines represent the range of estimates.

The stages are:

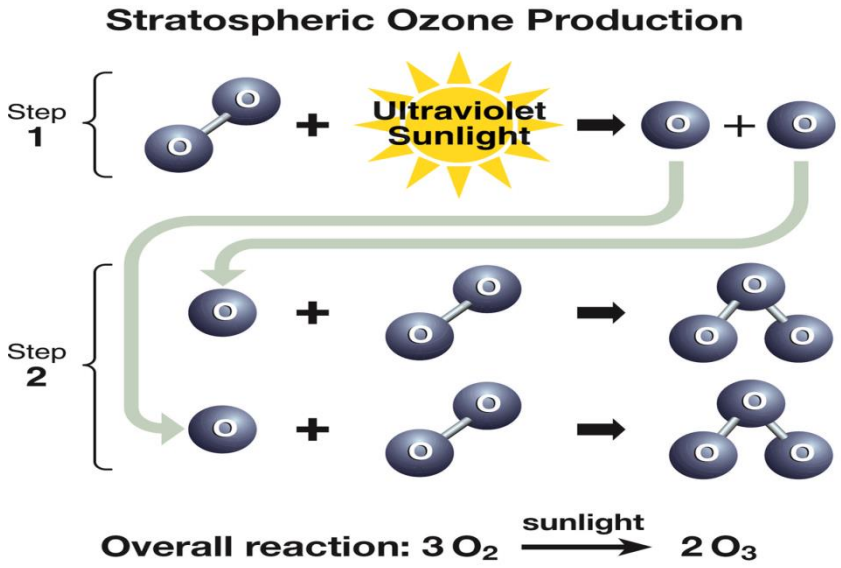
stage 1 (3.85–2.45Gyr ago (Ga)),

stage 2 (2.45–1.85Ga),

stage 3 (1.85–0.85Ga),

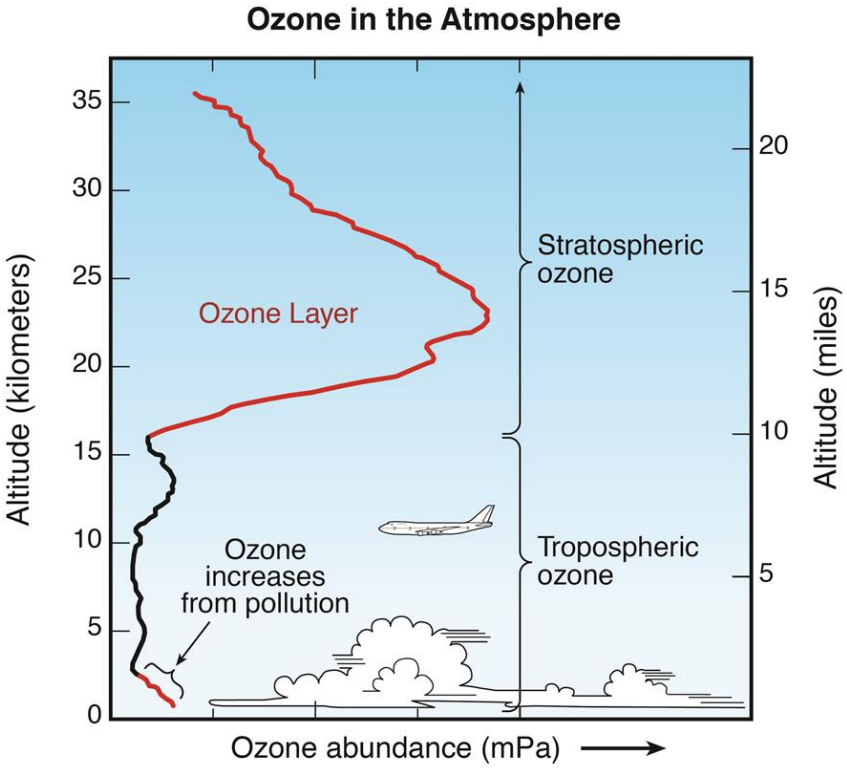
stage 4 (0.85–0.54Ga),

stage 5 (0.54Ga–present)



2-Step Production of Ozone

The Ozone Layer



The original Dobson Spectrometer

Ozone Concentrations are highest between about 15 to 35km altitude.

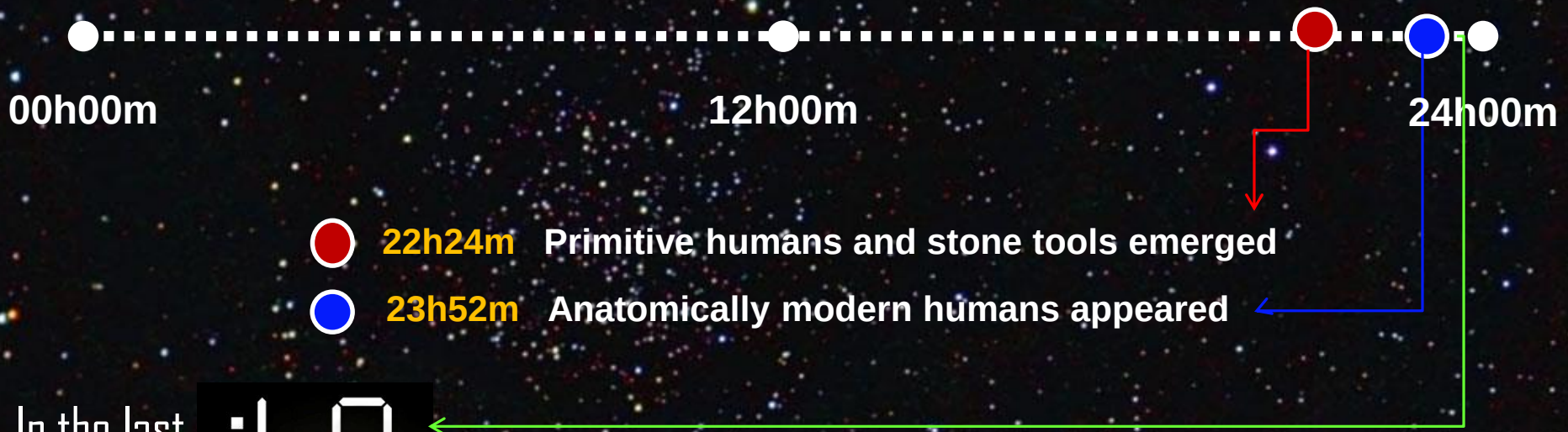
At sea-level pressure, ozone would be 3mm thick

December

31

Human History on the Last Day of the Cosmic Calendar

UNEP



In the last :60

00:32 secs Agriculture

00:47 secs First writings

00:48 secs First Dinasty of Egypt and Astronomy

00:49 secs Alphabet and wheel

00:53 secs Ancient olympics

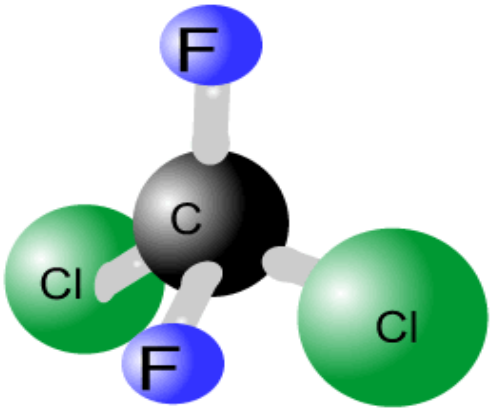
00:55 secs Roman Empire and Jesus Christ

00:59 secs Modern science and tech, American & French Revolution, WWI & II, Apolo moon landing internet

CFCs – invented!

- **1890s** – Frederic Swarts synthesized CFCs
- **1920s** – Charles Kettering and team including Thomas Midgley Jr developed first refrigerants with CFCs
- **1930** - Midgley publicly demonstrated ‘miracle’ properties

A technological revolution started,
CFC use increased rapidly



The Chemistry of Ozone Depletion

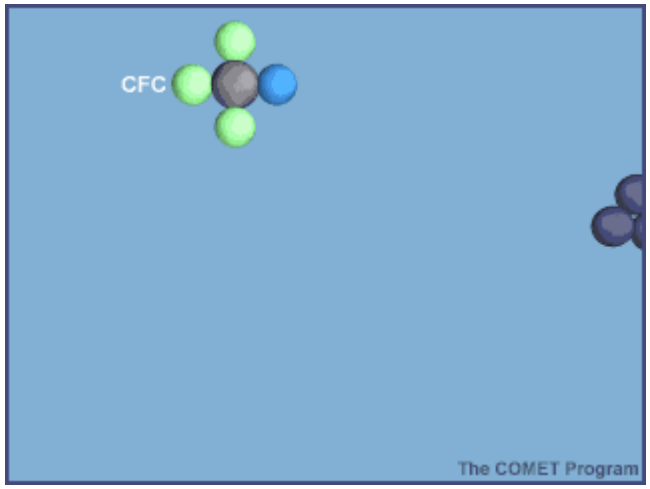
- 1970, 1972: Paul J. Crutzen demonstrated ozone loss from nitrogen oxides including from supersonic aircrafts.
- 1974: F. Sherwood Rowland and Mario J. Molina hypothesized that active chlorine from CFCs destroy ozone.

$$NO + O_3 \longrightarrow NO_2 + O_2$$

$$O_3 + \text{sunlight} \longrightarrow O_2 + O \text{ (oxygen free radical)}$$

$$NO_2 + O \longrightarrow NO + O_2$$

$$\text{Net: } 2O_3 \longrightarrow 3O_2$$



The Nobel Prize in Chemistry 1995 was awarded jointly to Crutzen, Molina and Rowland "for their work in atmospheric chemistry, particularly concerning the formation and decomposition of ozone"

International Negotiations

- **1975**: UNEP GC endorsed the UNEP proposed programme on risks to the ozone layer
- **1976**: UNEP GC requested UNEP to convene an international meeting to address the ozone layer issue
- **1977**: World Plan of Action was adopted, Coordinating Committee on the Ozone Layer was established

More research and harmonizing national policies

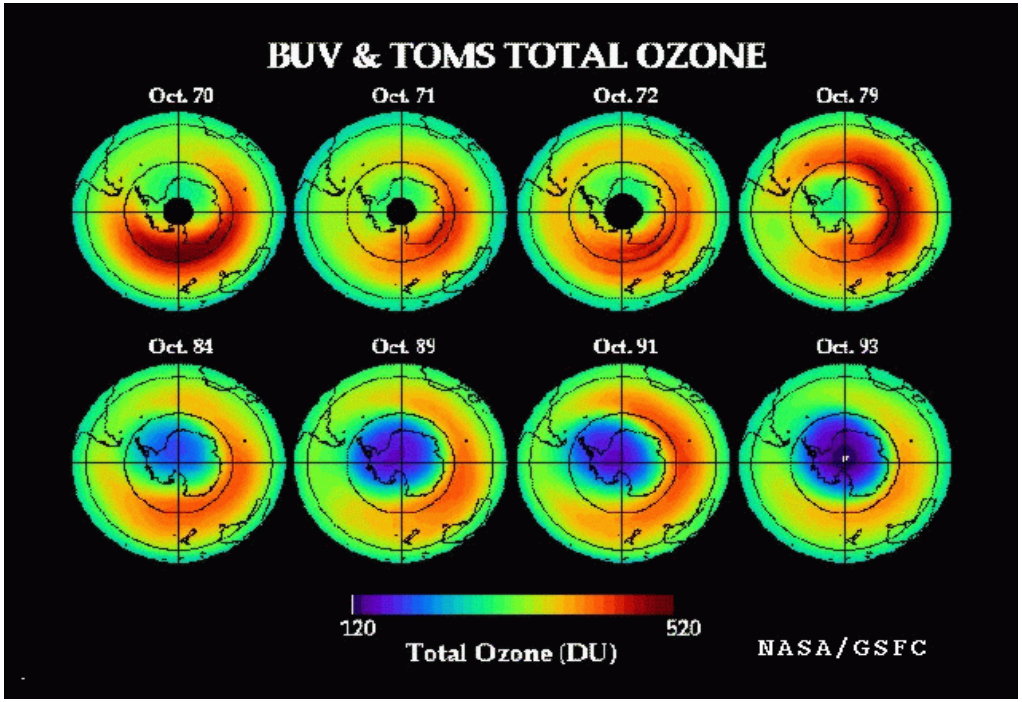
- **1981:** UNEP GC requested UNEP to start work on negotiating a global framework convention
- **1985**: Adoption of the Vienna Convention for the Protection of the Ozone Layer

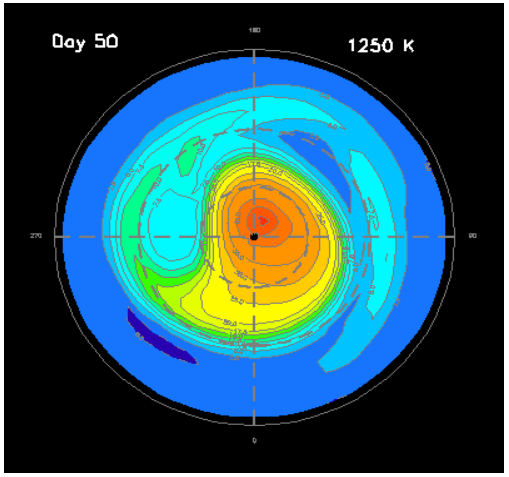
Precautionary Principle

Dr Mustafa TOLBA, Executive Director of UNEP, 1975-1992

Discovery of the Ozone Hole

- **1984**: Chubachi published results of research on ozone depletion over Antarctic, reporting that very low ozone concentrations were observed from Sept to Oct in the early 1980s
- **1985**: British Antarctic Survey (Farman, Gardiner and Shanklin) published a paper confirming that ozone levels over the Antarctic had been significantly depleted in the spring time, at least since 1981





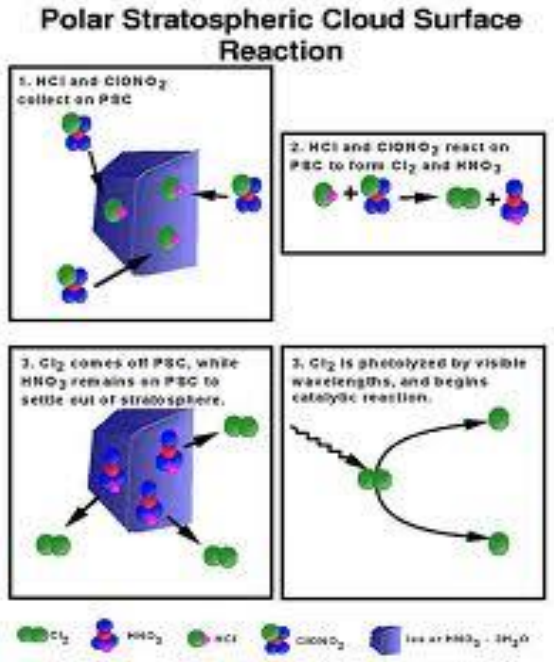
Ozone Hole

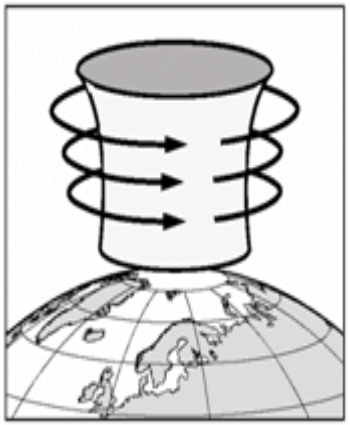
Ozone Hole Formation Process

1986: Susan Solomon proposed that chemical reactions on ice crystals of the polar stratospheric clouds (PSCs) caused a massive increase in active chlorine amounts.

The polar vortex formed over Antarctica is very tight and stays isolated from the surrounding air, thus led to formation of ozone hole.

This hypothesis was decisively confirmed.

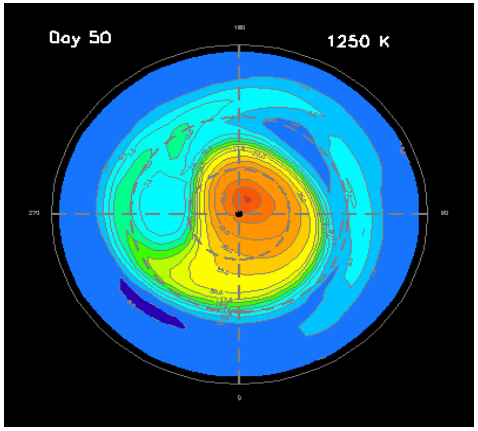




The polar stratospheric clouds contain ice particles that catalyze the formation of Cl atoms and lead to the destruction of ozone

The Montreal Protocol on Substances that Deplete the Ozone Layer 1987

Protects the ozone layer that shields the earth from harmful ultraviolet rays of the sun by phasing out ODSs such as CFCs and halons



It is widely recognized as a most successful MEA

The Montreal Protocol on Substances that Deplete the Ozone Layer

Main Achievements of the Montreal Protocol

- ✓ **Achieved universal ratification**
- ✓ **99% of ODSs phased out**
- ✓ **All uses of CFCs phased out globally,** with the phase-out of the essential use of CFCs in metered-dose inhalers (MDIs) in 2016
- ✓ **The ozone layer is expected to recover** around the middle of this century
- ✓ The Montreal Protocol has **contributed significantly to climate change mitigation** (avoided 135 gigatonnes CO2-eq between 1990 and 2010)

And…

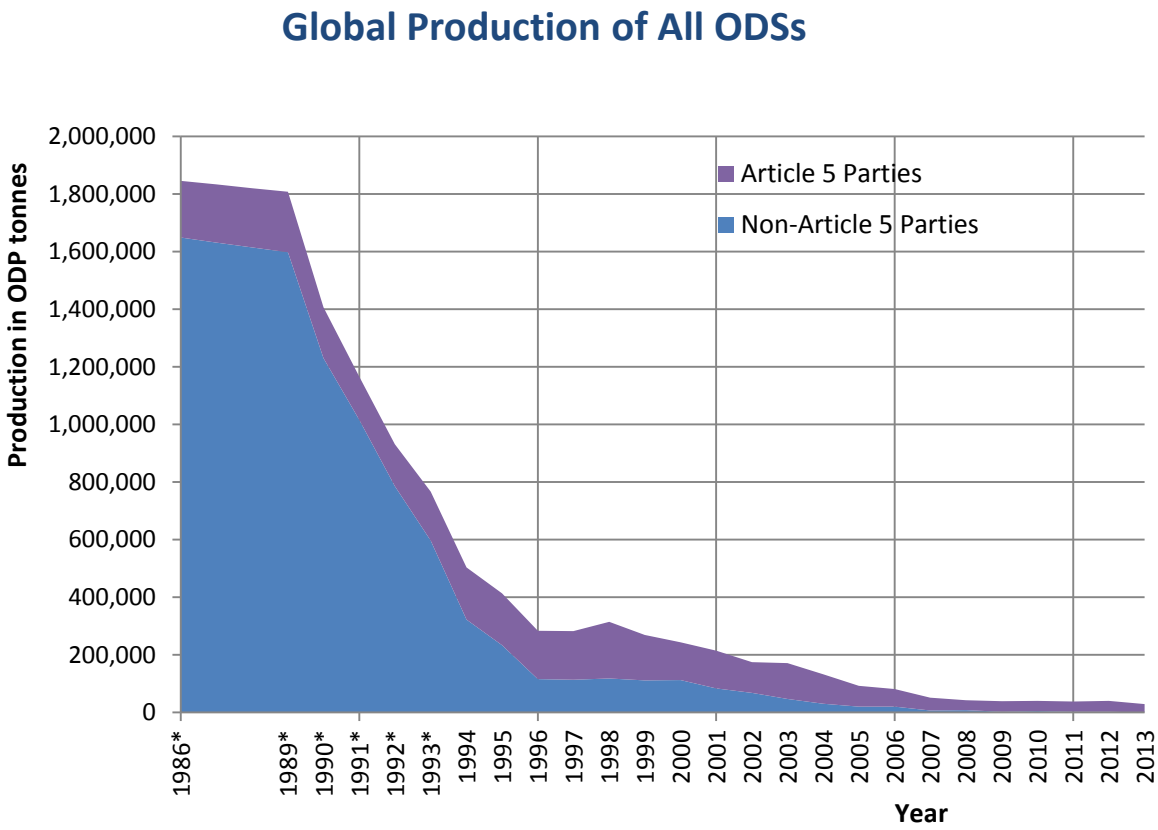
- ✓ **The Kigali Amendment adopted!** After 6 years of discussions and 1 year of formal negotiations

Status of Ratification

On **16th September 2009**, the Vienna Convention and the Montreal Protocol became the **first treaties in the history** of the United Nations to **achieve universal ratification** including the amendments to the Protocol.

Ratification of	Countries
Vienna Convention	197
Montreal Protocol	197
London Amendment	197
Copenhagen Amendment	197
Montreal Amendment	197
Beijing Amendment	197
Kigali Amendment	4

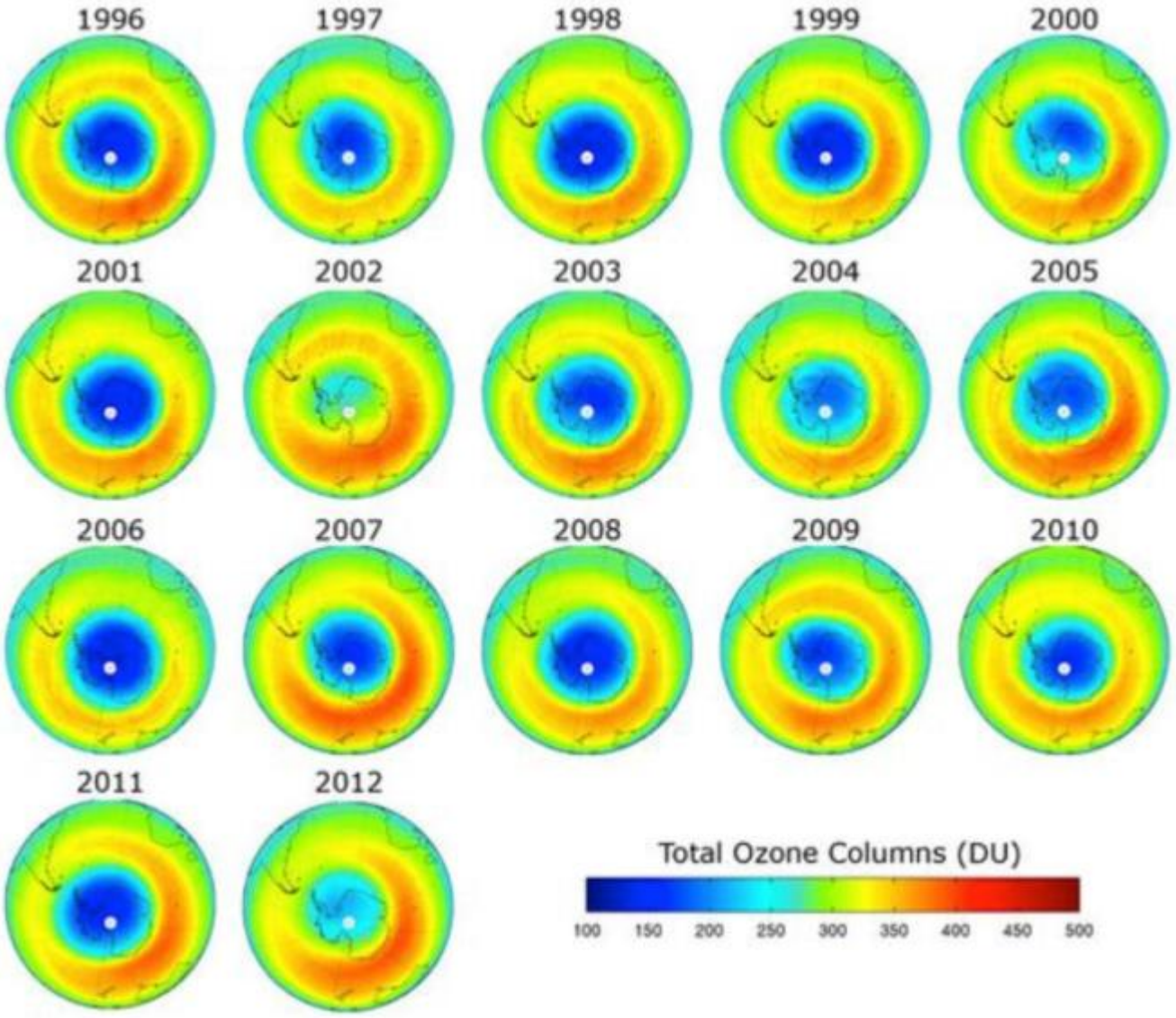
Progress in phasing out all controlled ODSs



* Missing Production for years prior to entry into force has been estimated at the base year levels

Phased out 99 per cent of the historic levels of production and consumption of ozone depleting substances (ODSs) globally.

The ozone hole is healing



Averted the adverse impacts of ozone depletion

Damages to:

Human health

Terrestrial ecosystems

Aquatic ecosystems

Biogeochemical cycles

Air quality

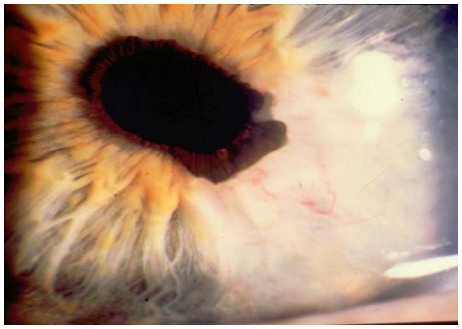
Materials

from the effects of increased harmful UV radiation were prevented

Human Health

Averted millions of cases of cancer and eye cataracts

Globally, up to 2 million cases of skin cancer may be prevented each year by 2030.



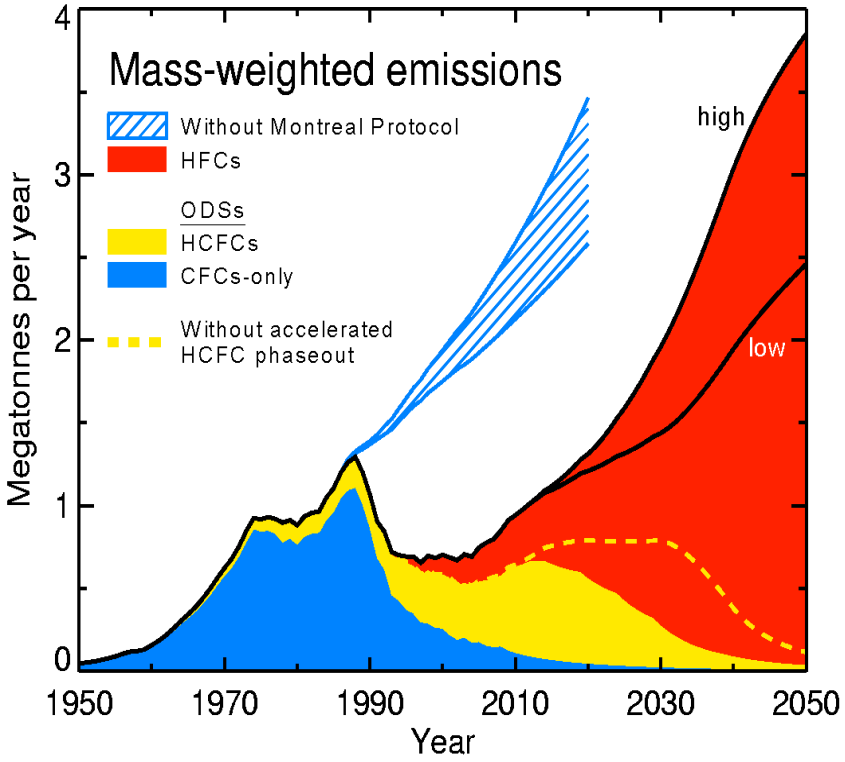
Estimates in the USA

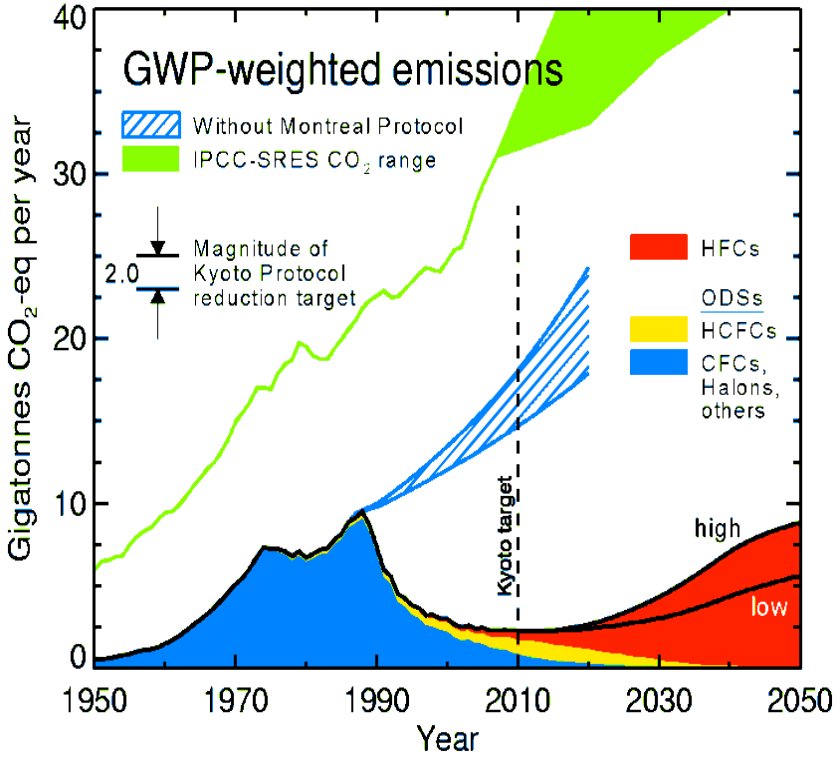
- ✓ **283 million cases of skin cancer (including 8.3 cases of melanoma) avoided by 2100;**
- ✓ **1.6 million deaths from skin cancer prevented;**
- ✓ **46 million cases of cataracts prevented.**


Ozone protection efforts are expected to result in economic benefits worth more than US$460 billion by 2060 due to avoided damages to agriculture, fisheries, and materials.

Climate Protection

ODSs are also powerful greenhouse gases.
Co-benefits of Montreal Protocol for climate has been estimated to be about 5 times that CO_2-equivalent reduction of the first commitment period of the Kyoto Protocol.





Scenarios of ODSs and ODS substitutes | Velders G., et al, 2007: The importance of the Montreal Protocol

Green economy and GDP

- Greener alternatives;
- Efficiency including energy efficiency;
- Greener global value chains;
- Support through Financial Mechanism: USD3.5 billion;
- GDP maintained by avoiding loss to agriculture, fishery and human health impacts.

What is behind those achievements?

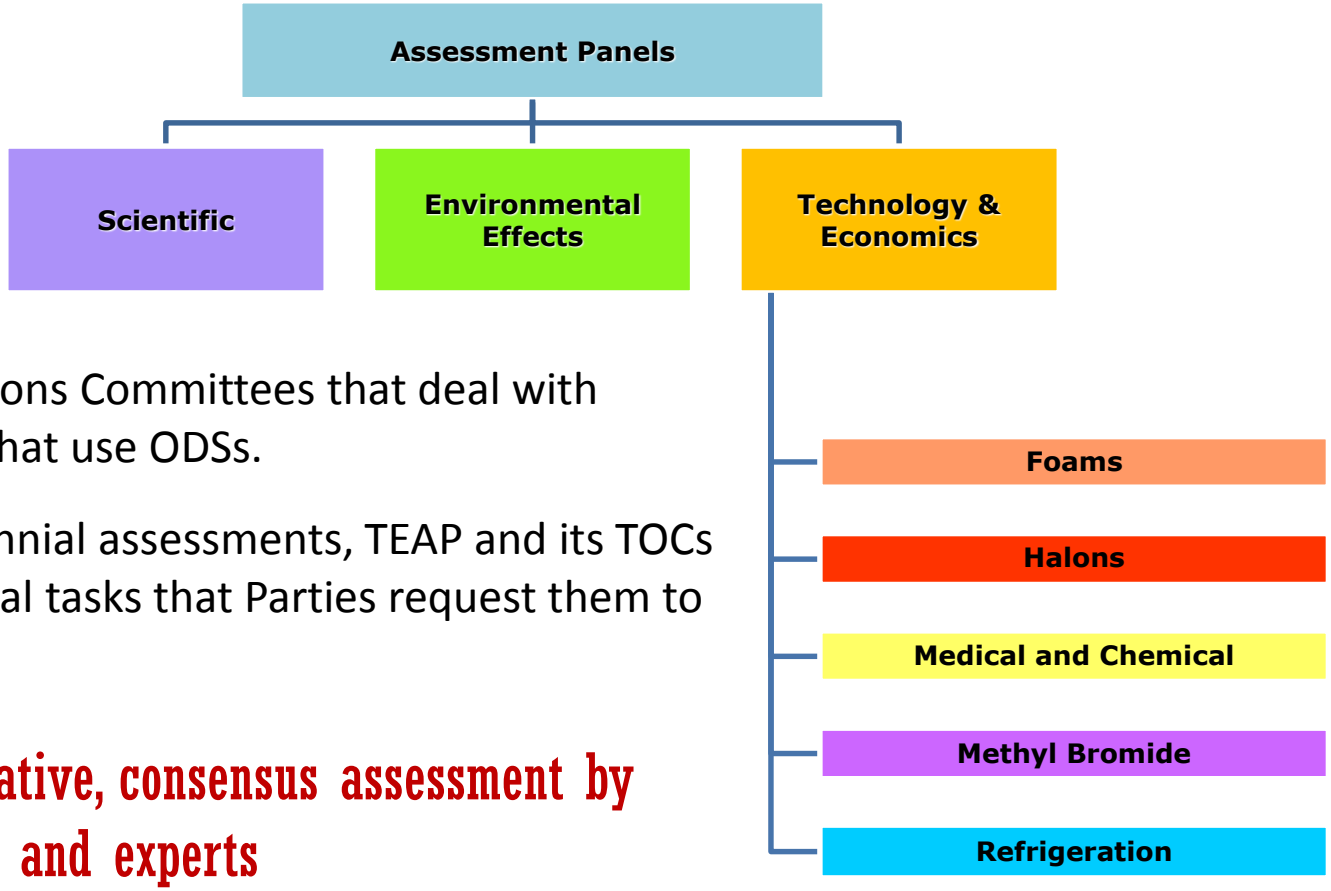
What makes the Montreal Protocol work so well?

There are many special features embedded in the Montreal Protocol…..

- ✓ **Sound science (Assessment Panels) as basis for policy and decision making**
- ✓ **Start small and strengthen**
- ✓ **Financial mechanism**
- ✓ **Non-compliance regime**
- ✓ **Fair principles and other special features**

Assessment Panels provide the basis for informed decision making

Parties' decisions on strengthening of the Protocol are based on the periodic (at least every 4 yrs) assessment of latest information on scientific, environmental, technological and economic aspects – carried out by the 3 Assessment Panels.



TEAP has 5 Technical Options Committees that deal with specific industry sectors that use ODSs.

In addition to the quadrennial assessments, TEAP and its TOCs carry out several additional tasks that Parties request them to do annually.

Independent, authoritative, consensus assessment by world's top scientists and experts

Start and Strengthen

- The original Montreal Protocol (MP):
  - **Controlled 8 chemicals (5 CFCs and 3 halons)**
  - **50% reduction in CFCs**
  - **Freeze halons**
- The MP has been strengthened through 6 sets of adjustments and 5 Amendments including Kigali.
  - **Controls 96 chemicals (15 CFCs, 3 halons, CCl_4, methyl chl, methyl br, 40 HCFCs, 34 HBFCs, BCM) and 19 HFCs**
  - **100% phaseout of consumption and production over time**

Adjustments

- London, Copenhagen, Vienna, Montreal, Beijing, Montreal

Amendments

- **London 1990:** included more CFCs, CCl_4, MCl and financial mechanism
- **Copenhagen 1992:** included HCFCs and their consumption control, MB and its freeze, HBFCs and their phaseout
- **Montreal 1997:** introduced trade bans and licensing systems
- **Beijing 1999:** HCFC production controls, BCM and its phaseout
- **Kigali 2016:** HFC production and consumption phasedown

An Innovative Financial Mechanism: Multilateral Fund - 1991

Replenishment of the Multilateral Fund

The Fund has been replenished nine times:

1991-1993 :	US $240 million
1994-1996:	US $455 million
1997-1999:	US $466 million
2000-2002:	US $440 million
2003-2005 :	US $474 million
2006-2008:	US $400.4 million
2009-2011:	US $400 million
2012-2014:	US $400 million
2015-2017 :	US $507.5 million (including interest and other accruals)

TOTAL CONTRIBUTIONS (as at end 2016): US $3.6 billion

2018-2020: ???
(decision expected at MOP29 this year)

Achievements of the Multilateral Fund

Characteristics

- It pays for the incremental costs incurred by developing countries to comply with the Montreal Protocol obligations
- It is managed by an Executive Committee made up of 7 developed and 7 developing countries
- Projects and activities are supported by Implementing Agencies
- It has an independent Secretariat within UNEP

Achievements

- Over 6000 projects and activities have been were carried out in all the developing countries
- Technology Transfer: Old technologies totally replaced through industrial projects and technical assistance
- Capacity building and institutional strengthening
  - Establishment of over 145 National Ozone Units
  - Regulations and Legislation in over 100 Parties
  - System of Regional Networks of Ozone Officers

Non-Compliance Procedure

The non-compliance system of the Montreal Protocol is built on trust and assistance rather than punishment and embarrassment.

- **Parties self report non-compliance and work cooperatively to address the underlying issues.**
- **The process involves an Implementation Committee which looks for amicable solutions.**

- **Support is provided through the Multilateral Fund to enable the developing countries to achieve compliance with the Protocol obligations. The Parties also recognize the ability for the developing countries to comply depends on the effectiveness of the Fund.**

Other Special Features

Principle of common but differentiated responsibilities

Equitable and fair

- The special situation of developing-country Parties
- Equal voting rights
- The control measures that focus on production and consumption and allow stockpiling for future use
- Trading of production rights
- The trade measures
- The essential and critical use exemptions
- The concept of basic domestic needs

Different needs of different countries

Avoids disruption to society

The Kigali Amendment

Kigali Amendment: Decision XXVIII/1

- **Big Achievement**!
- HFCs added as controlled substances, in Annex F to the Protocol, to be phased down
- Long journey:
  - First proposal tabled in 2009, 6 years of discussion, then Dubai pathway in 2015 was the start of formal negotiations


April 2016
Solutions to challenges
GENEVA
VIENNA
July 2016
Negotiations on elements of an amendment
DUBAI TO KIGALI
October 2016
Kigali Amendment adopted
KIGALI
DUBAI
November 2015
Dubai Pathway on HFCs

Decision related to the Amendment: Decision XXVIII/2

- Solutions to challenges identified by the parties in phasing down HFCs are dealt with in Decision XXVIII/2
- The issues include:
  - Funding issues – principles and guidelines
  - HAT exemption
  - Technology reviews
  - Linkages with ongoing HCFC phase-out

Energy efficiency: Decision XXVIII/3

- Requests TEAP to review energy efficiency opportunities in the refrigeration and air-conditioning (RAC) sectors related to a transition to climate-friendly alternatives
- Invites parties to provide relevant information on energy efficiency innovations in the RAC sectors by May 2017 on a voluntary basis
- Ozone Sec sent a communication (17 March) to parties inviting submissions (a set of questions was included to assist parties)
- TEAP to assess the information submitted by the parties
- TEAP to report to MOP29 in November

Establishment of regular consultations on safety standards: Decision XXVIII/4

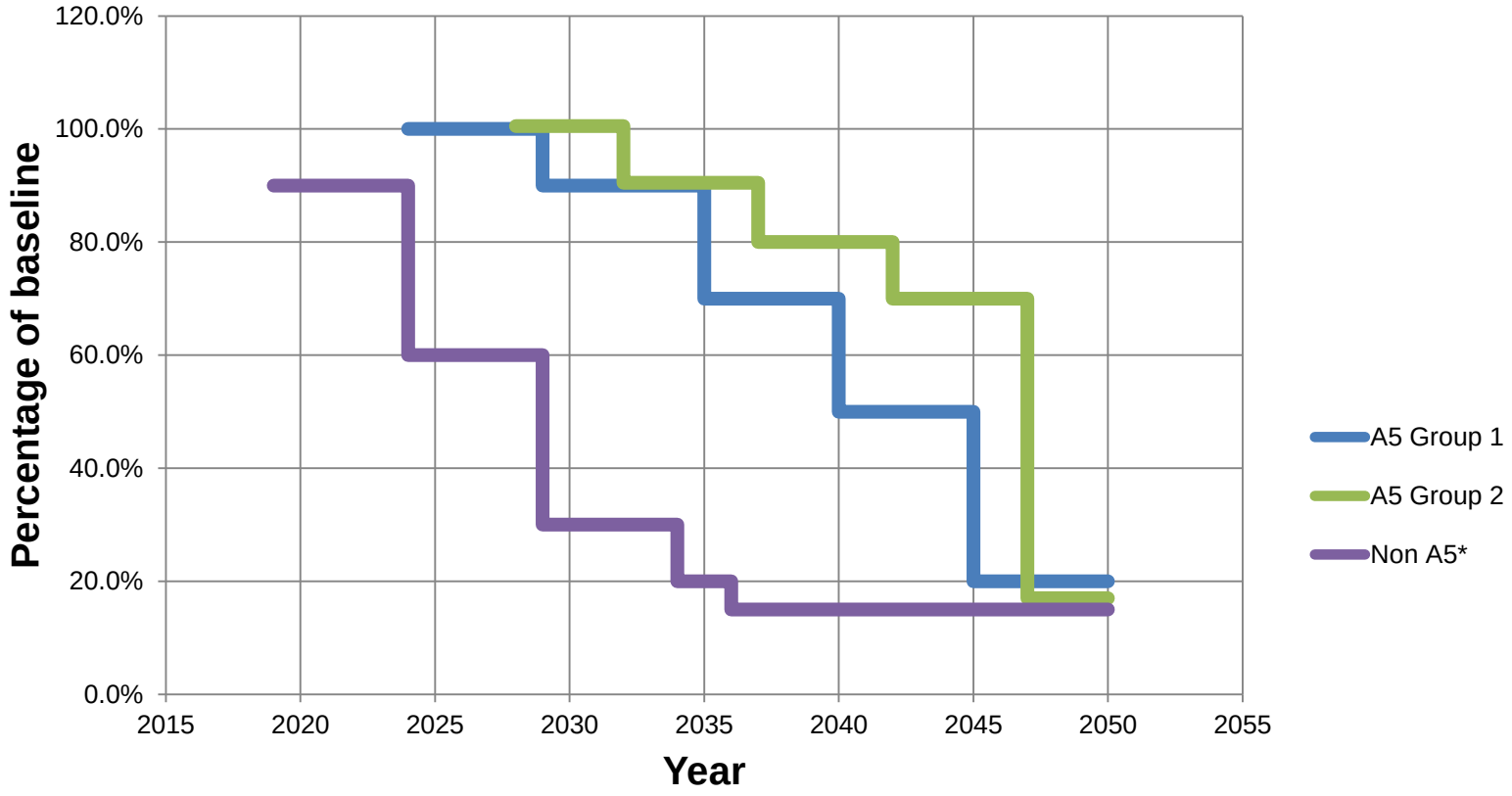
- **Requests TEAP** to establish a **task force** to:
  - liaise with stds organizations to support timely revision of stds
  - report to 39OEWG on stds issues
- **Parties are:**
  - urged to work with industries and stds bodies to support developing, harmonizing and revising stds to facilitate adoption of environmentally friendly alternatives to HFCs and HCFCs
  - invited to submit info on relevant domestic safety stds by Dec 2016

    (Oz Sec sent reminders with a set of questions to assist parties in making the submissions)
  - encouraged to strengthen cooperation between national and regional committees and national ozone units
- **Requests ExCom** to consider maintaining or increasing technical assistance and capacity building, to improve cooperation between national authorities dealing with MP and national and regional stds committees
- Parties are to consider holding regular consultations on international safety standards with Oz Sec and international stds bodies

How the Amendment will work

- Parties will reduce HFC production and consumption according to the schedules specified in **Article 2J** and **Article 5 paragraph 8 qua** and also reduce HFC-23 emissions
- HFCs are listed as controlled substances in Annex F
- There are **groupings** of parties within non-Article 5 and Article 5 with different phasedown schedules
- Consumption, production, imports and exports will be measured in **CO_2 equivalents using the global warming potential (GWP)** listed in Annex F
- Funding and exemptions are dealt with in Decision XXVIII/2

Agreed HFC phasedown schedule



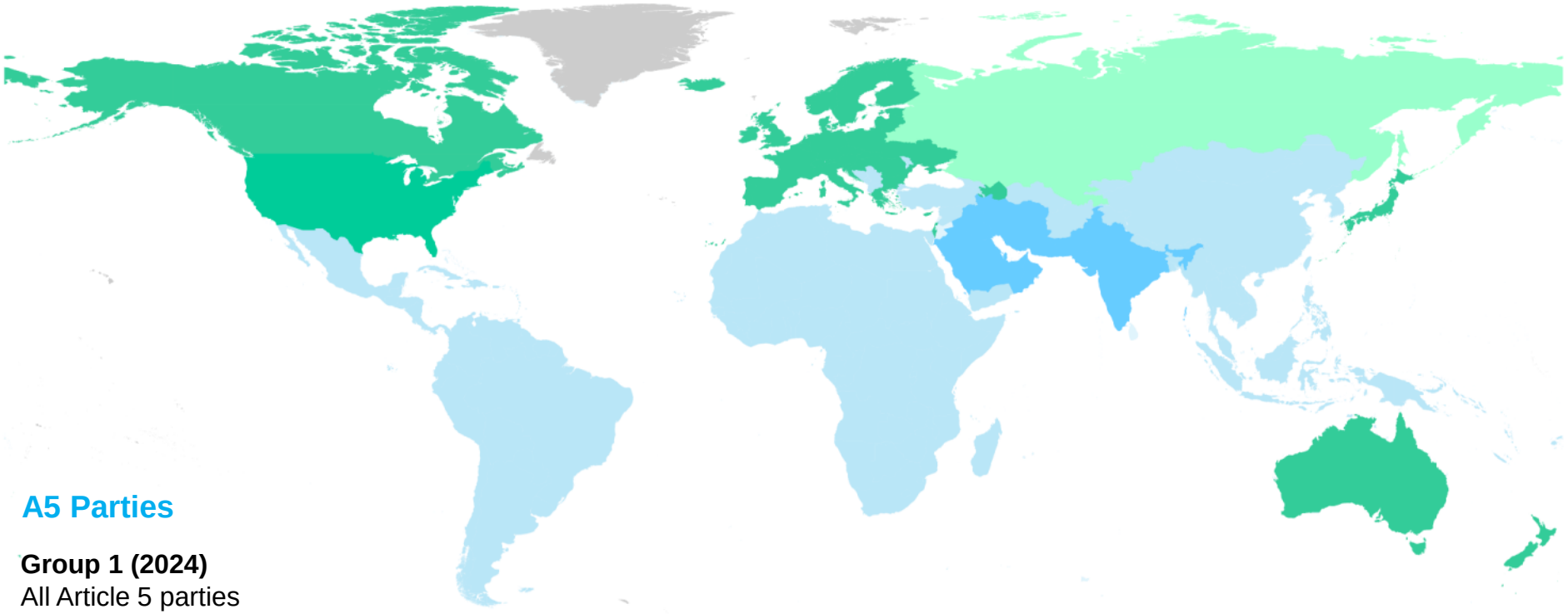
- **Baseline for Non A5** = Average HFC consumption for 2011-2013 + 15% of HCFC baseline*

  *For Belarus, Kazakhstan, Russian Federation, Tajikistan, Uzbekistan, 25% HCFC component of baseline and different initial two steps (1) 5% reduction in 2020 and (2) 35% reduction in 2025

- **Baseline for A5 Group 1** = Average HFC consumption levels for 2020-2022 + 65% of HCFC baseline
- **Baseline for A5 Group 2** = Average HFC consumption levels for 2024-2026 + 65% of HCFC baseline

NOTE: The same timeframes and baseline formula apply to production and consumption

Groupings as specified in decision XXVIII/2



A5 Parties

Group 1 (2024)
All Article 5 parties except for those parties falling under “Group 2”

Group 2 (2028)
Bahrain, India, Islamic Republic of Iran, Iraq, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, United Arab Emirates

Non A5 Parties

Earlier start (2019)
All Article 2 parties except for those parties falling under ‘later start’

Later start (2020)
Belarus, Kazakhstan, Russian Federation, Tajikistan, Uzbekistan

A5 Group 1
A5 Group 2
Non A5: Earlier start
Non A5: Later start

How the Amendment will work

- Article 4 control of **trade with non-parties** applies from 2033
- **Licensing** of HFCs applies from 1 January 2019 or within 3 months of entry into force for a party, whichever is later. Article 5 parties may delay until 2021
- **Article 7 Data reporting and Article 8 compliance mechanism** to follow existing procedure; Ozone Secretariat is updating the data reporting forms for approval by the parties and will assist parties with all enquiries
- **Exemptions** are anticipated, to be agreed by the parties

Entry into force: Requirements

(See Annex 1 to Report of MOP28)

- 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. (Article IV paragraph 1)
- 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. (Article IV paragraph 1)
- For parties ratifying after that date, the Amendment enters into force on the 90th day after deposit of their instrument of ratification, acceptance or approval. (Article IV paragraph 4)
- **Except:** Provision on trade (Article 4) enters into force on 1 January 2033 if ratified by 70 parties; otherwise on the 90th day following the date of ratification by the 70th party. (Article IV paragraph 2)

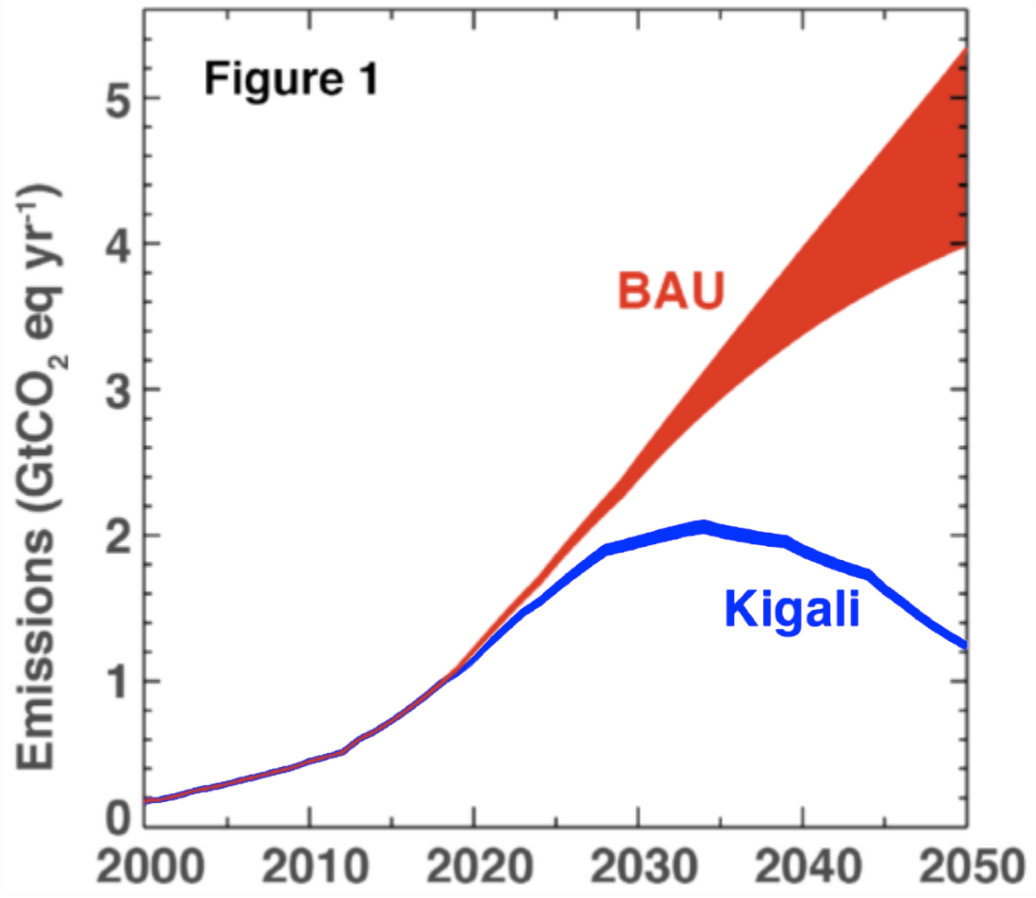
Next steps towards ratification

- Depositary (UN Secretary-General) circulated the Kigali Amendment to all Parties in November 2016
- Each party will take the necessary steps at the national level, as specified in their constitutional arrangements, to allow it to move ahead with ratification of the amendment at the international level
- The Ozone Secretariat has produced a **Briefing Note on Ratification** to assist the parties with information
- Ozone Secretariat and Compliance Assistance Team are ready to assist the parties upon request

Reasons to ratify

- Ratification of the Kigali Amendment will contribute to the protection of the global climate – avoiding up to 0.5 degree Celsius of global temperature rise by 2100
- "**Leaving no one behind**" in following the 2030 Agenda for Sustainable Development
- All amendments and adjustments to the Montreal Protocol **have universal support**; states ratifying early play a leading role in a trend the rest of the world is likely to follow
- Parties gain a **competitive advantage** in the world market: alternative technologies are often cost effective and lead to an improvement in the quality of end products
- Article 5 parties to the Kigali Amendment will have access to **financial and technical support** provided under the Protocol

Expected impact on climate



Source: Guus Velders, RIVM

Business as usual (BAU) emissions: 4-5 gt of CO_2 equivalent in 2050 with continuing increase;

Temperatures to increase slightly, but **with Kigali Amendment** peak mid-century at about 0.07°C;

Without Kigali Amendment, HFCs add up to 0.5°C temperature increase on top of other climate forcings by 2100.

Key happenings in 2017

Key meetings

- **Special Executive Committee Meeting** 4-7 April, Montreal
  - Discussed funding issues related to the Kigali Amendment
- **10th Ozone Research Managers Meeting** 28-30 March, Geneva
  - Discussed national and international research and monitoring activities including progress in the implementation of recommendations of the 9th ORM
  - Recommendations are available (Oz Sec website, “In focus”) and will be presented to COP11 for consideration

- **58th meeting of the Implementation Committee,** 9 July, Bangkok
- **Workshop on Safety Standards,** 10 July, Bangkok
- **39th meeting of the OEWG,** 11-14 July, Bangkok

- **58th meeting of the Implementation Committee,** 18 November, Montreal
- **Joint Bureaux meeting** 19 November, Montreal
- **Joint 11COP/29MOP,** 20-24 November, Montreal

Safety Standards: Decision XXVIII/4

- **Decision XXVIII/4 requests Ozone Secretariat** to organize a workshop on safety standards relevant to the safe use of low-GWP alternatives

The Secretariat has:

- ✓ Contacted several international standards bodies for the workshop and to discuss further cooperation
- ✓ Finalized the agenda for the workshop
- ✓ Prepared briefing notes – to be posted soon

Workshop on safety standards

10 July 2017, Bangkok

Agenda available:

http://conf.montreal-protocol.org/meeting/workshops/safety-and-standards/presession/SitePages/Home.aspx

Celebrations!

- This year marks the **30th anniversary of the Montreal Protocol**!
- Commemoration plans include:
  - ✓ National Ozone Day celebrations on 16 September
  - ✓ An information materials package will be distributed in June
  - ✓ An international campaign to be announced in September
  - ✓ Ozone Awards Ceremony, organized in cooperation with Canada

Ozone Awards!

- Call for nominations sent out
- 8 award categories:
  - **Political leadership**
  - **Policy and implementation leadership**
  - **Scientific leadership**
  - **Technical leadership**
  - **Partnership**
  - **Exemplary project**
  - **Youth creativity**
  - **Best media coverage**
- Oz Secretariat website – online nomination by **20 July**

  http://ozone.unep.org/en/ozone-awards-2017
- Selection: Technical Screening Committee/International Jury

Awards Ceremony: 23 November

Joint 11th meeting of the Conference of the Parties to the VC and 29th Meeting of the Parties to the MP (COP11/MOP29), 20-24 November 2017

UN environment
United Nations Environment Programme

OZONE SECRETARIAT

MONTREAL PROTOCOL
caring for all life under the sun

Thank you

Symposium to Commemorate the 30th Anniversary of the Montreal Protocol and the Adoption of the Kigali Amendment

17 July 2017, Tokyo

ozone.unep.org