



# INTERNATIONAL INSTITUTE OF REFRIGERATION

## SUMMARY SHEET | Montreal Protocol

### INTRODUCTION

The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty that was adopted in 1987. It was initially designed to reduce the production and consumption of ozone depleting substances (ODS) in order to reduce their abundance in the atmosphere, and thereby protect the Earth's ozone layer. Chlorofluorocarbons and halons were the first chemicals to be regulated.

Nevertheless, the Protocol has been amended several times:

- Chlorofluorocarbons (CFCs) and halons' production and consumption are to be completely phased out.
- Hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbon (HFCs), chemicals often used as refrigerants, were added to the initial list.

The latter were used to replace CFCs, because they do not deplete the ozone layer. But as they contribute to global warming, they became a target of the Montreal Protocol in 2016, with the [Kigali Amendment](#).

Initially signed by 46 countries, the Montreal protocol has nearly 200 signatories in 2017. It schedules some actions until the middle 21<sup>th</sup> century, since the HCFCs phaseout in developing countries is programmed in 2040.

See also the [UNEP webpage](#) on the Montreal Protocol

[Montreal Protocol - Full text amended \(2016\)](#)



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#### CHRONOLOGY

The [Vienna Convention for the Protection of the Ozone Layer](#), adopted in 1985, entered into force in 1985. It is the first Convention of any kind to achieve universal ratification. Its main purpose was to act as a framework on stratospheric ozone protection, and did not require any concrete actions.

Two years after the adoption of the Vienna Convention, the Montreal Protocol on Substances that Deplete the Ozone Layer was agreed upon to take concrete measures to control ozone-depleting substances. It was agreed by 189 Parties on September 16, 1987.

Over the years, several amendments have been made to the Protocol after ratification by the various Parties of the Vienna Convention. The original Protocol of 1987 and its amendments are listed below, with a link to the United Nation Treaty Collection giving information on the status of ratification of the agreements.

**Table 1: Chronology of the successive agreements**

Agreement	Date of signature	Date of entry into force
<a href="#">Montreal Protocol - Full text (1987)</a>	September 16, 1987	January 1, 1989
<a href="#">London Amendment - Full text</a>	June 29, 1990	August 10, 1992.
<a href="#">Copenhagen Amendment - Full text</a>	November 25, 1992	June 14, 1994
<a href="#">Montreal Amendment - Full text</a>	September 17, 1997	November 10, 1999
<a href="#">Beijing Amendment - Full text</a>	December 3, 1999	February 25, 2002
<a href="#">Beijing Adjustment - Full text</a>	October 16, 2007	November 14, 2007
<a href="#">Kigali Amendment - Full text</a>	October 15, 2016	January 1, 2019

#### MEASURES FORESEEN BY THE MONTREAL PROTOCOL

- The Protocol divides countries into two categories:
  - **Developing countries** (operating under **Article 5** of the Montreal Protocol): Parties whose annual calculated level of consumption of the [controlled substances](#) in Annex A is less than 0.3 kilograms per capita on the date of the entry into force of the Protocol for it, or any time thereafter until January 1, 1999. The calculated level is obtained by multiplying the amount of consumed substances by the ODP of these substances (example: 1 ton of HCFC 22 has a calculated level of 0.055 t since the ODP of HCFC22 is 0.055). The list of the developing countries is available [here](#).



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- **Developed countries** (operating under **Article 2** of the Montreal Protocol): Andorra, Australia, Azerbaijan, Belarus, Canada, Holy See, Iceland, Israel, Japan, Kazakhstan, Liechtenstein, Monaco, New Zealand, Norway, Russian Federation, San Marino, Switzerland, Tajikistan, Ukraine, United States of America, Uzbekistan and each country of the European Union.

The Montreal Protocol forecasts different schedules for developed and developing countries.

- The measures contained in the initial Montreal Protocol and its amendments aim to achieve a **gradual ban** on production and consumption of ozone-depleting substances (ODS) such as **CFCs**. To achieve this goal, they have been gradually replaced in many applications (including refrigeration) by **HCFCs** first and then by **HFCs**. Since 1997, those chemicals were gradually added to the list of the substances controlled by the Protocol:

- The Copenhagen Amendment (1992) incorporated a **phaseout of HCFCs** beginning in 2004 for developed countries.

- The Montreal Amendment (1997) added the **phaseout of HCFCs** for developing countries.

- Finally, the Kigali amendment (2016) added schedules to **phase down** the production and consumption of **HFCs**, which are not ODS but are greenhouse gases, in both developed and developing countries.

- The terms “production” and “consumption” are defined as follows:

- **Production:** amount of controlled substances produced, minus the amount destroyed by technologies to be approved by the Parties and minus the amount entirely used as feedstock in the manufacture of other chemicals. The amount recycled and reused is not to be considered as “production”.

- **Consumption:** production plus imports minus exports of controlled substances.  
Consumption = production + imports - export

### PHASE-OUT AND PHASE-DOWN SCHEDULES

The original Montreal Protocol of 1987 only concerned the phase down of CFCs production and consumption in developing countries. The London Amendment (1990) required the complete phaseout of **CFCs** between 1996 and 2000 in developed countries, and by 2010 in developing countries.

**HCFCs** were added to the list of controlled substances to be phased out by 2030 in the Copenhagen Amendment for developed countries, and in the Montreal Amendment for developing countries which schedules the total phase-out by 2040.

Finally, the Kigali amendment (2016) added schedules to phase-down the production and consumption of **HFCs** in both developed and developing countries.

The different schedules are listed below.



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**Table 1: CFC phaseout schedules (production and consumption)**

Article 2 countries	Article 5 countries
<p><b>CFCs</b></p> <p>Phase-out by January 1, 1996 with possible exemptions for essential uses.</p>	<p><b>CFC Annex A</b></p> <ul style="list-style-type: none"> <li>• Reference level: average of years 1995-1997</li> <li>• Freeze from January 1, 1999</li> <li>• Minus 50% January 1, 2005</li> <li>• Minus 85% January 1, 2007</li> <li>• Phase-out by January 1, 2010 with possible exemptions for essential uses.</li> </ul>
	<p><b>CFC Annex B</b></p> <ul style="list-style-type: none"> <li>• Reference level: average of years 1998-2000</li> <li>• Minus 20% by January 1, 2003</li> <li>• Minus 85% by January 1, 2007</li> <li>• Phaseout by January 1, 2010</li> </ul>

**Table 2: HCFC phaseout schedule (consumption)**

Article 2 countries	Article 5 countries
<ul style="list-style-type: none"> <li>• Reference level: average of year 1989: 2.8% of CFCs + 100% of HCFCs consumed</li> <li>• Freeze from January 1, 1996</li> <li>• Minus 35% by January 1, 2004</li> <li>• Minus 65% by January 1, 2010</li> <li>• Minus 90% by January 1, 2015</li> <li>• Minus 99.5% by January 1, 2020</li> <li>• Phaseout by January 1, 2030</li> </ul>	<ul style="list-style-type: none"> <li>• Reference level: average of year 2015</li> <li>• Freeze from January 1, 2016</li> <li>• Phaseout by January 1, 2040</li> </ul>

**Table 3: HCFC phaseout schedule (production)**

Limit of HCFC production	Developed countries	Developing countries
Deadline	2004	2016
Reference year	1982	2015
Limit of production	<p>Average of the following 2 values:</p> <ul style="list-style-type: none"> <li>• Production of HCFCs* + 2.8% production of CFCs*</li> <li>• Consumption of HCFCs* + 2.8% consumption of CFCs*</li> </ul>	

\* Production and consumption values for the reference year



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**Table 4: HFC phase down schedule (consumption)**

	Article 5: Group 1		Article 5 : Group 2		Non article 5 (Main group)		Non article 5 (exceptions )	
<b>Baseline formula</b>	Average HFC consumption levels for 2020, 2021 & 2022 + 65% of HCFC baseline		Average HFC consumption levels for 2024, 2025 & 2026 + 65% of HCFC baseline		Average HFC consumption levels for 2011, 2012 & 2013 + 15% of HCFC baseline		Average HFC consumption levels for 2011, 2012 & 2013 + 25% of HCFC baseline	
Freeze	2024		2028					
Step 1	2029	-10%	2032	-10%	2019	-10%	2020	-5%
Step 2	2035	-30%	2037	-20%	2024	-40%	2025	-35%
Step 3	2040	-50%	2042	-30%	2029	-70%	2029	-70%
Step 4	2045	-80%	2047	-85%	2034	-80%	2034	-80%
Plateau					2036	-85%	2036	-85%

(For further information, see also the [IIR summary sheet on the Kigali Amendment](#))

### STUDIES ON THE IMPACT OF THE MONTREAL PROTOCOL ON THE OZONE LAYER

According to a study<sup>1</sup> published in 2012 in the *Journal of Geophysical Research*, modelling shows that the growth of ozone depleting substances would have led to a global collapse of the ozone layer in the mid-21<sup>st</sup> century. The researchers studied the reversibility of these impacts following complete cessations of ODS emissions in the mid-2050s. They found that impacts are reversed on various time scale, in particular in the polar caps. Nevertheless, the authors showed that ozone in the lower stratosphere recovers very quickly.

Another study<sup>2</sup> published in *Nature Communications* in 2015 shows that by 2013 the Montreal Protocol had already achieved significant benefits for the ozone layer, since the Antarctic ozone hole is expected to disappear by 2050. Thanks to a modelling, it was estimated that without the Montreal Protocol, this hole would have grown in size by 40% in 2013, and other holes would have appeared.

A 2016 study<sup>3</sup> published in *Science* showed that for the first time in 30 years, the gaping hole in the ozone layer above Antarctica actually appears to be healing, since the size of the ozone hole has shrunk by approximately 1.5 million square miles in 15 years. According to the researchers, the phaseout of CFCs has led to a slow recovery of the ozone layer.

<sup>1</sup> Garcia, Rolando R. Kinnison, Douglas E. Marsh, Daniel R. ““World avoided” simulations with the Whole Atmosphere Community Climate Model” *Journal of Geophysical Research* /Vol. 117 (2012). DOI: [10.1029/2012JD018430](https://doi.org/10.1029/2012JD018430)

<sup>2</sup> Chipperfield, M. P. “Quantifying the ozone and ultraviolet benefits already achieved by the Montreal Protocol.” *Nature Communication*/ Article number: 7233 (2015). DOI: [10.1038/ncomms8233](https://doi.org/10.1038/ncomms8233).

<sup>3</sup> Salomon, Susan. Ivy, Diane J. Kinnison D, et al. “Emergence of healing in the Antarctic ozone layer”. *Science*. (2016). DOI: [10.1126/science.aae0061](https://doi.org/10.1126/science.aae0061)



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#### ADDITIONAL DETAILS

##### 1. List of the 147 Parties categorized as operating under Article 5 of the Montreal Protocol

Afghanistan	Djibouti	Malaysia	
Albania	Dominica	Maldives	
Algeria	Dominican Republic	Mali	Saudi Arabia
Angola	Ecuador	Marshall Islands	Senegal
Antigua and Barbuda	Egypt	Mauritania	Serbia
Argentina	El Salvador	Mauritius	Seychelles Sierra Leone
Armenia	Equatorial Guinea	Mexico	Singapore
Bahamas	Eritrea	Micronesia (Federated States of)	Solomon Islands
Bahrain	Ethiopia	Mongolia	Somalia
Bangladesh	Fiji	Montenegro	South Africa
Barbados	Gabon	Morocco	South Sudan
	Gambia	Mozambique	Sri Lanka
Belize	Georgia	Myanmar	Sudan
Benin	Ghana	Namibia	Suriname
Bhutan	Grenada	Nauru	Swaziland
Bolivia	Guatemala	Nepal	Syrian Arab Republic
Bosnia and Herzegovina	Guinea	Nicaragua	Thailand
Botswana	Guinea Bissau	Niger	Republic of Macedonia
Brazil	Guyana	Nigeria	Timor-Leste
Brunei Darussalam	Haiti	Niue	Togo
Burkina Faso	Honduras	Oman	Tonga
Burundi	India	Pakistan	Trinidad and Tobago
Côte d'Ivoire	Indonesia	Palau	Tunisia
Cabo Verde	Iran (Islamic Republic of)	Panama	Turkey
Cambodia	Iraq	Papua New Guinea	Turkmenistan
Cameroon	Jamaica	Paraguay	Tuvalu
Central African Republic	Jordan	Peru	Uganda
Chad	Kenya	Philippines	United Arab Emirates
Chile	Kiribati	Qatar	United Republic of Tanzania
China	Kuwait	Republic of Korea	Uruguay
Colombia	Kyrgyzstan	Republic of Moldova	Vanuatu
Comoros	Lao People's Democratic Republic	Rwanda	Venezuela
Congo	Lebanon	Saint Kitts and Nevis	Viet Nam
Cook Islands	Lesotho	Saint Lucia	Yemen
Costa Rica	Liberia	Saint Vincent and the Grenadines	Zambia
Cuba	Libya	Samoa	Zimbabwe
Democratic People's Republic of Korea	Madagascar	Sao Tome and Principe	
Democratic Republic of the Congo	Malawi		



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#### 2. List of controlled substances

The substances controlled by the Montreal Protocol are listed in the annexes, as follows:

- **Annex A:** Chlorofluorocarbons and halons.
- **Annex B:** Chlorofluorocarbons, carbon tetrachloride and methyl chloroform
- **Annex C:** HCFCs, HBFCs and bromochloromethane
- **Annex E:** Methyl bromide
- **Annex F:** HFCs

To consult the complete list of the controlled substances, please follow this [link](#).