

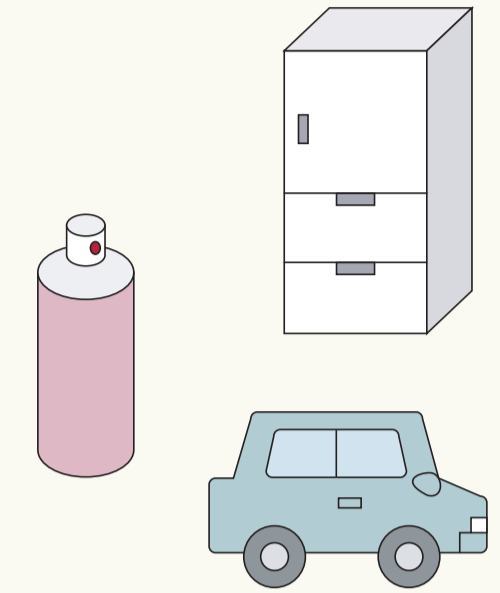
History of Chlorofluorocarbons

1928 : Chlorofluorocarbons (CFCs) were invented.

CFCs were developed as ideal gases used as refrigerants for refrigerators. Because of their special characteristics, inflammability and non-toxicity to human beings, CFCs were massively produced and consumed, particularly in developed countries, after the 1960's.

Uses of Chlorofluorocarbons

- Refrigerants for refrigerators, automobiles and air-conditioners
- Cleaning agents for semi-conductors and precision parts
- Foaming agents for insulating materials and packing cushions
- Propellants for aerosol sprays



1974 : ⚠ The mechanism of the ozone layer depleted by CFCs was identified.

In 1985, the observation of an ozone hole in the Antarctic Pole provided proof that the ozone layer was depleting.



1987 : The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted.

The Montreal Protocol was adopted as a framework for international cooperation regarding CFC control on the basis of the Vienna Convention for the Protection of the Ozone Layer.



Alternatives to CFCs, which do not deplete the ozone layer, were developed.



⚠ Three CFC alternatives: HFCs, PFCs and SF₆, influence global warming.

HFCs, PFCs and SF₆ are not ozone depleting substances, however, compared to CO₂, they have a greater influence on global warming.



1997 : The Kyoto Protocol was adopted.

Under the United Nations Framework Convention on Climate Change in 1994, the Kyoto Protocol was adopted as a concrete implement to control greenhouse gas emissions.

2005 : The Achievement Plan of the Targets Set by the Kyoto Protocol was decided at a Cabinet meeting in Japan.

Currently, control measures are implemented under the Montreal Protocol and the Kyoto Protocol.

© Environmental influences caused by ozone depleting CFCs and CFC alternatives

Ozone depleting CFCs

· CFCs
· HCFCs

Depletion of the ozone layer
Global warming

CFC alternatives

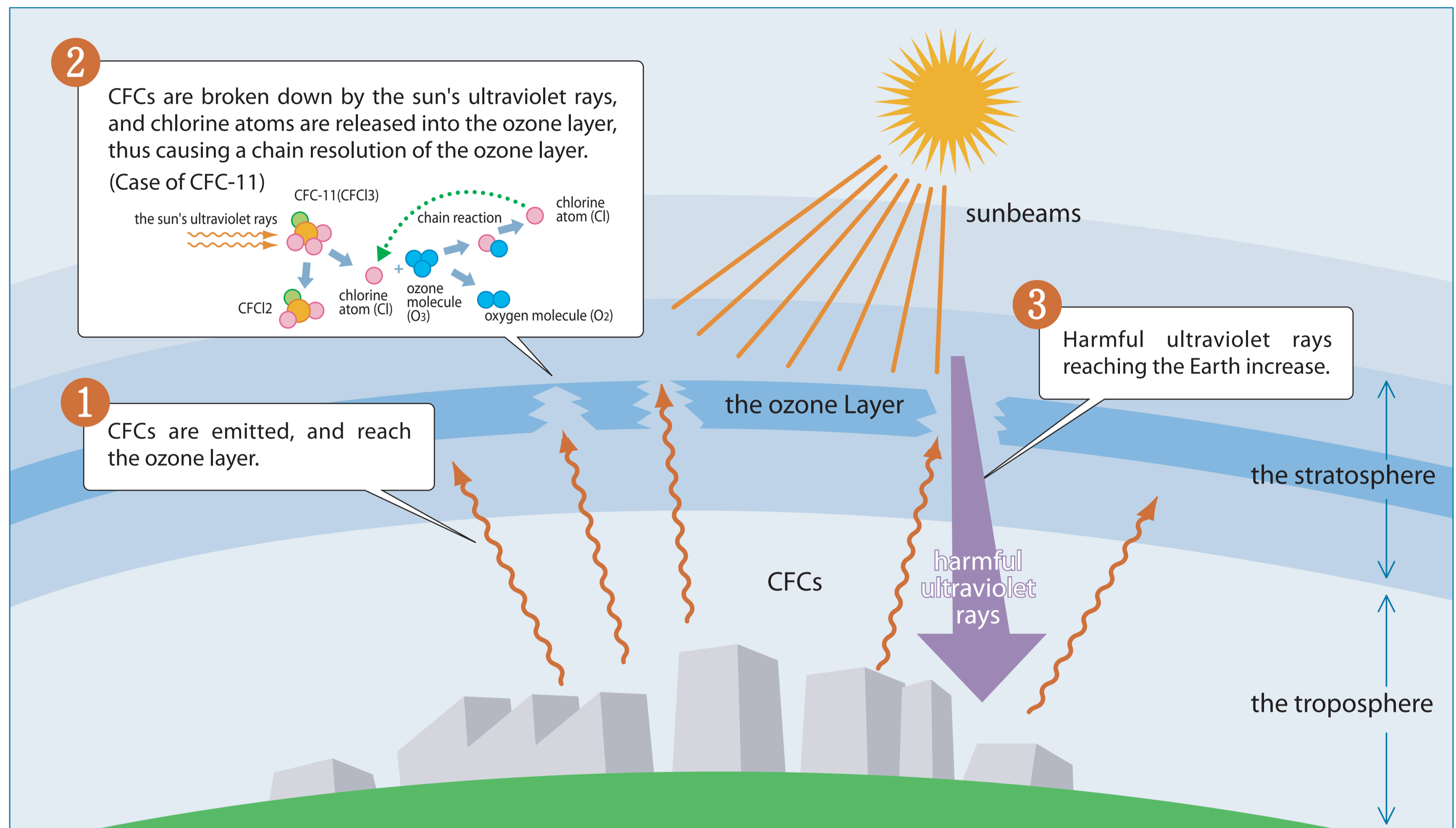
· HFCs
· PFCs · SF₆

Global warming

Influence on Depletion of the Ozone Layer and Global Warming

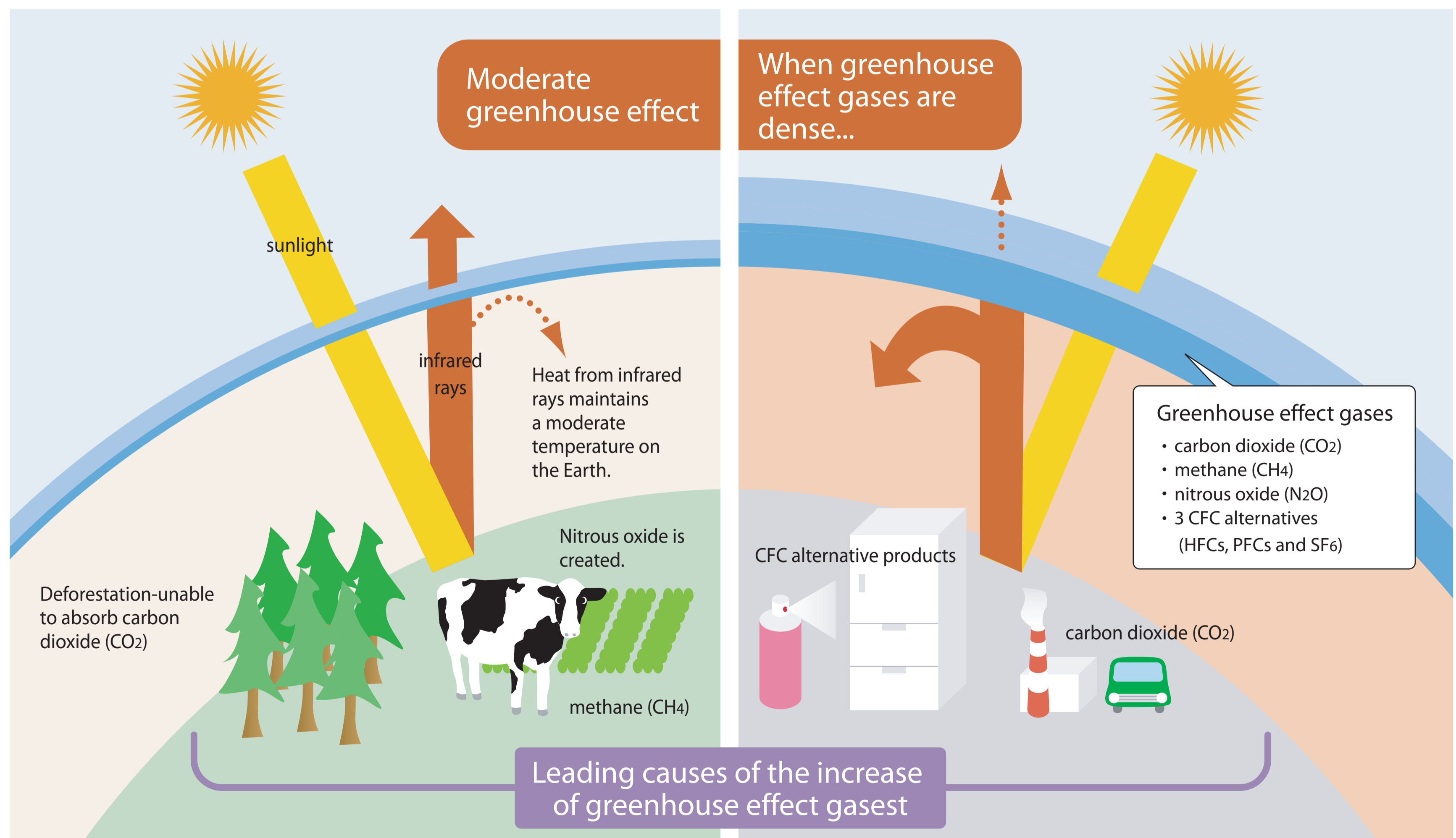
■ The Mechanism of the Ozone Layer Depleted by Ozone Depleting Substances

Substances such as CFCs and HCFCs deplete the ozone layer, which results in an increase in the number of ultraviolet rays which reach the earth.



■ The Mechanism of Global Warming Caused by Three CFC Alternatives

Dense greenhouse effect gases including three CFC alternatives have a significant effect on global warming.



The Provisions and Results of the Montreal Protocol

■ The Phase-out Schedule of Ozone Depleting Substances

Both developed and developing countries are making effort to reduce ozone depleting substances by strengthening controls outlined by the Protocol.

© The change of controls by the Montreal Protocol for developed counties

Controlled substances (standard year)	Start of control	When the Protocol was adopted (1987)	London Meeting (1990)	Copenhagen Meeting (1992)	Vienna Meeting (1995)	Montreal Meeting (1997)	Beijing Meeting (1999)
CFC-11 (1986)	July, 1989	from 1998: below 50%	from 2000: complete phasing-out	from 1996: complete phasing-out			
Halon (1986)	January, 1992	from 1992: below 100%	from 2000: complete phasing-out				
Other CFCs (1989)	January, 1993	—	from 2000: complete phasing-out	from 1996: complete phasing-out			
Carbon Tetrachloride (1989)	January, 1995	—	from 2000: complete phasing-out				
1,1,1-trichloroethane (1989)	January, 1993	—	from 2005: complete phasing-out				
HCFC (1989)	January, 1996	—	—	from 2030: complete phasing-out	from 2000: complete phasing-out (consumption)		from 2004: below 100% (production)
HBFC (-)	January, 1996	—	—			from 2005: complete phasing-out	
Methyl Bromide (1991)	January, 1995	—	—		from 2010: complete phasing-out		
Bromochloromethane (-)	January, 2002						from 2002: complete phasing-out

Note: Except for HCFC control, which has a different phase-out schedule for consumption and for production, the Protocol controls production and consumption (= production + import - export) based on the results in the standard year.

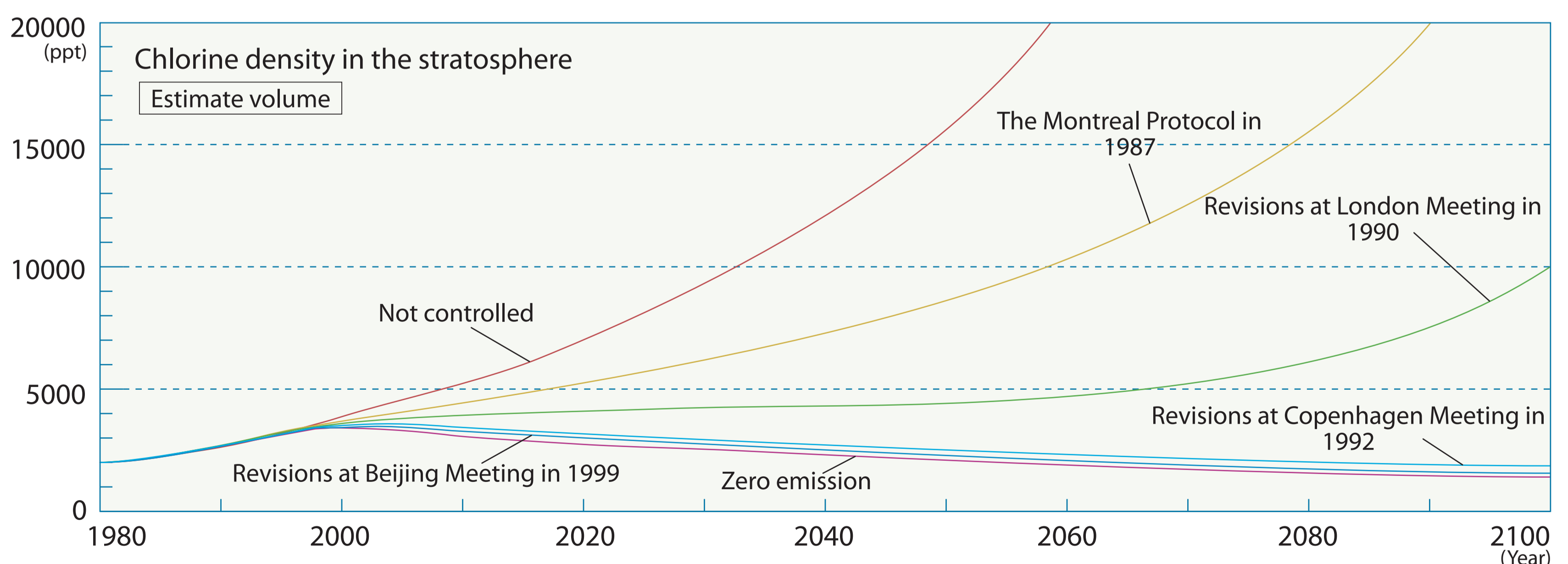
© The change of controls by the Montreal Protocol for developing counties

Controlled substances	Start of control (year)	Complete phasing-out (year)
CFC-11	1999	2010
Halon	2002	2010
Other CFCs	2003	2010
Carbon Tetrachloride	2005	2010
111-trichloroethane	2003	2015
HCFC	2013	2030
Methyl Bromide	2002	2015

■ Achievements of Controls on Production of Ozone Depleting Substances

When comparing chlorine conversion density in the stratosphere before and after the controls were implemented, a great difference in the chlorine conversion density in the stratosphere is evident. Thus, it can be expected that through the continued use of such controls, ozone holes will disappear in the future.

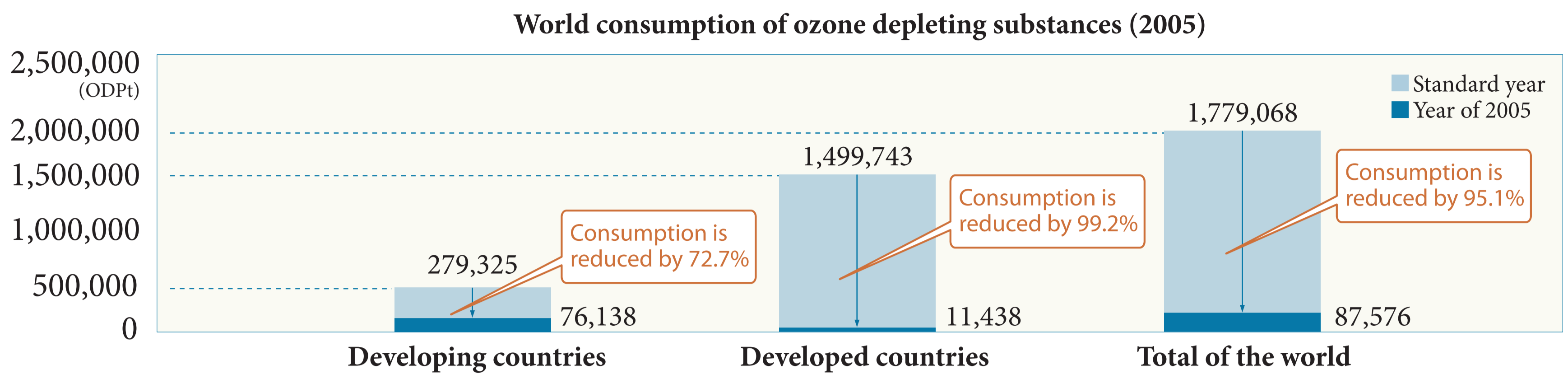
Chlorine conversion density in the stratosphere



The Present Situation of Ozone Layer Protection

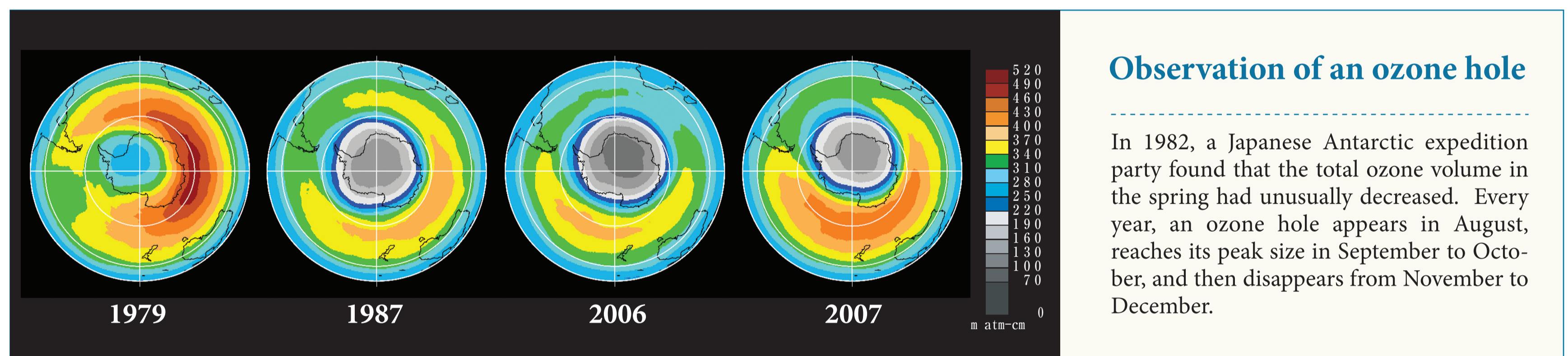
Consumption of Ozone Depleting Substances in the World

According to the phase-out schedule set by the Montreal Protocol, both developed and developing countries are proceeding to change from using ozone depleting substances to using alternative substances.



The Present Ozone Hole Situation

The size of the hole in the ozone had gradually expanded since 1997 to 2000, and since then it has remained relatively the same size.

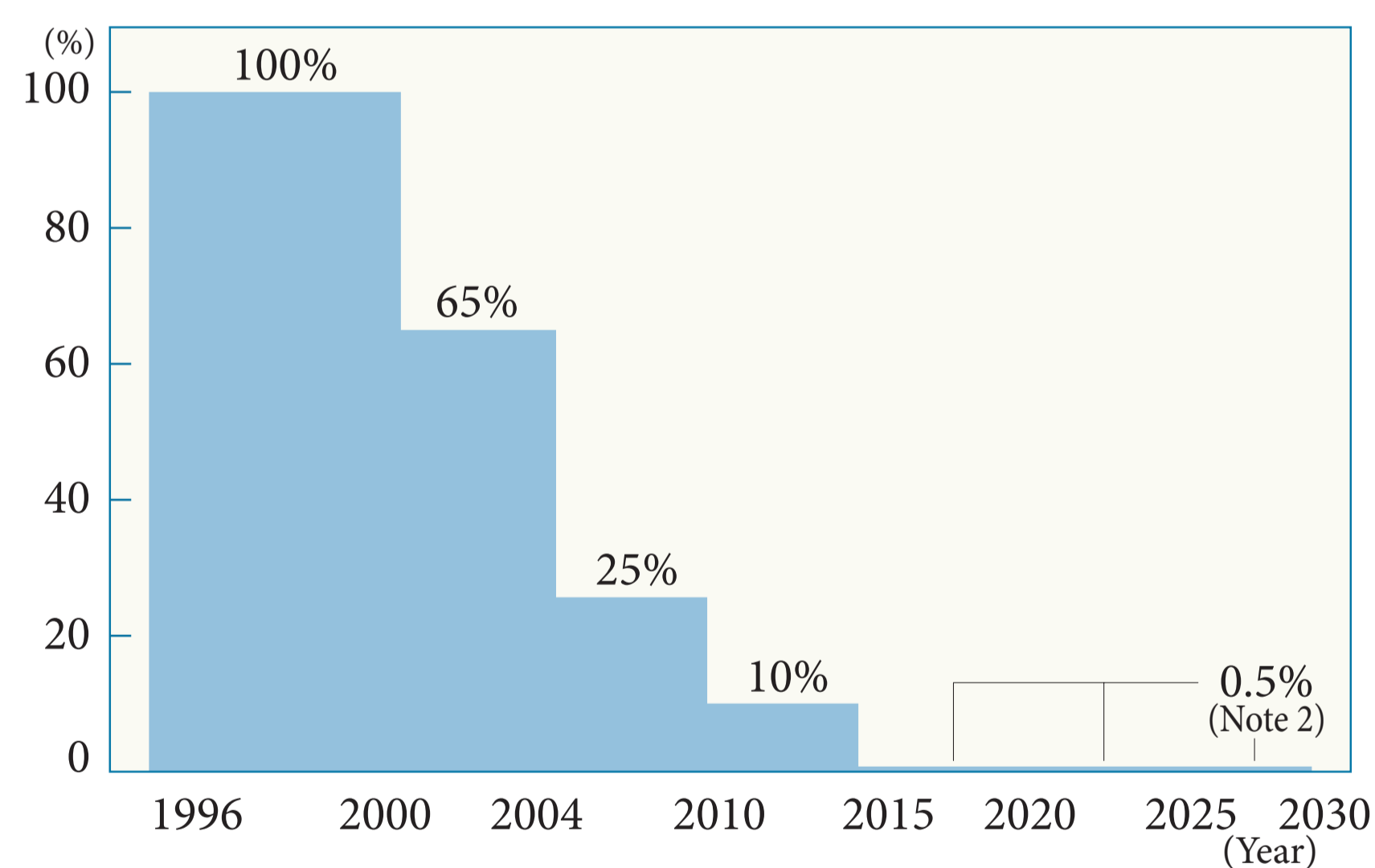


Note: Distribution of the average ozone volume in October

Made by the Japanese Meteorological Agency, with the data provided by NASA

The HCFC Phase-out Schedule

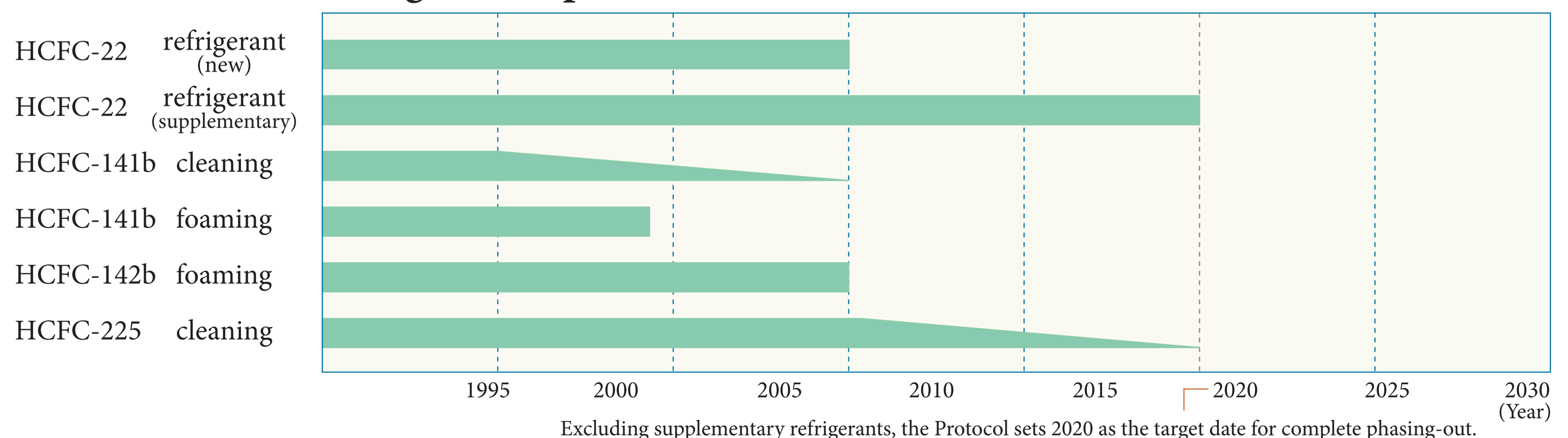
Japan implements control measures to reduce ozone depleting substances on the basis of the Montreal Protocol.



Phase-out Schedule	
Using the consumption (=production + import - export) in 1989 as a standard.	
After January 1, 1996	up to 100% consumption level
After January 1, 2004	up to 65% consumption level
After January 1, 2010	up to 25% consumption level
After January 1, 2015	up to 10% consumption level
After January 1, 2020	up to 0% consumption level

Note 1: Production should not exceed the average of the production and consumption standards.
 Note 2: Only up to 0.5% of the standard consumption of supplementary refrigerants for refrigeration and air-conditioning equipment are allowed to be produced until 2029.
 © Standard volume = (HCFC consumption & production in 1989) + (CFC consumption & production in 1989) × 2.8%

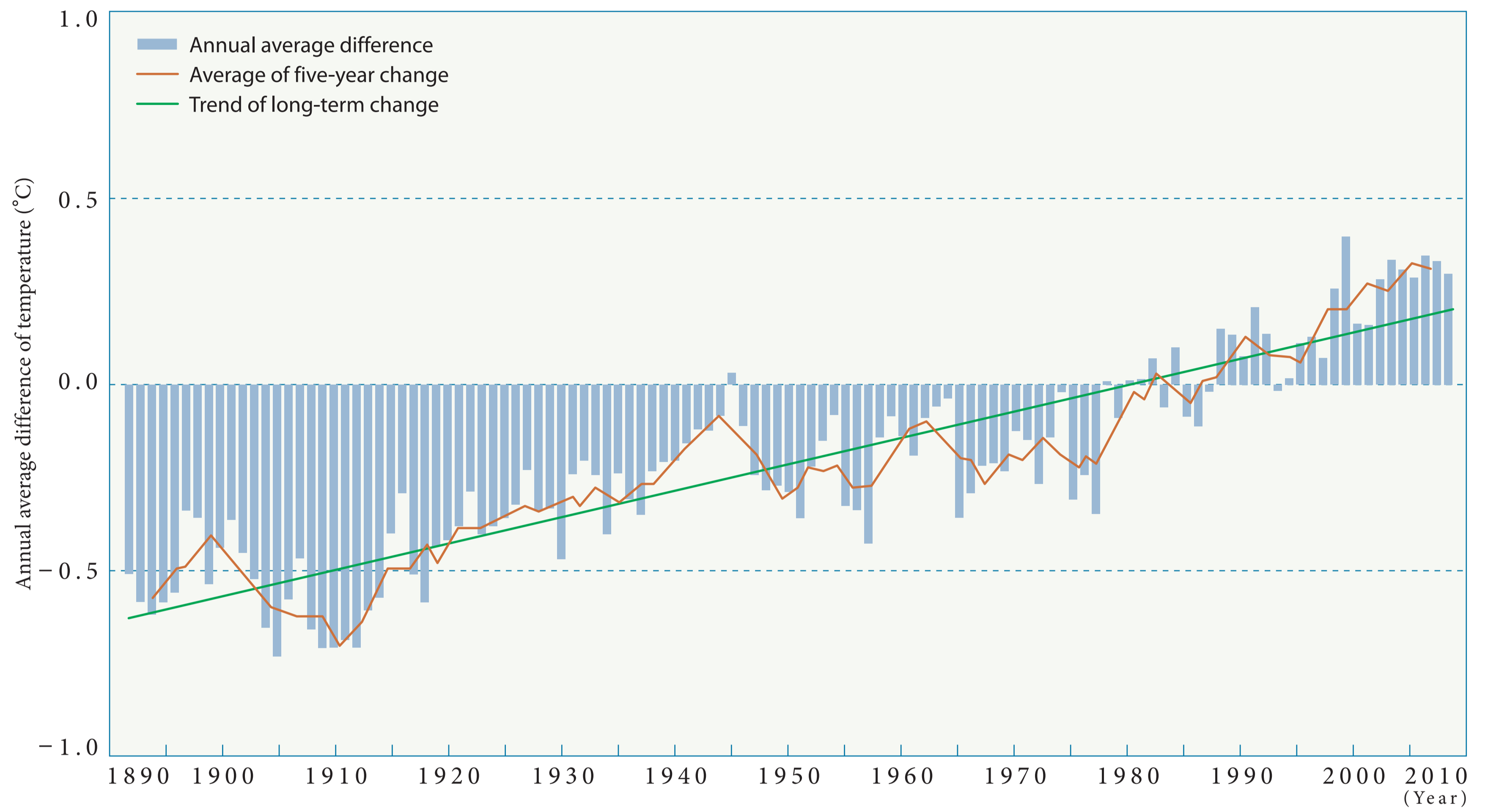
HCFC reduction targets in Japan



Secular Change of the Earth's Temperature and Greenhouse Effect Gases

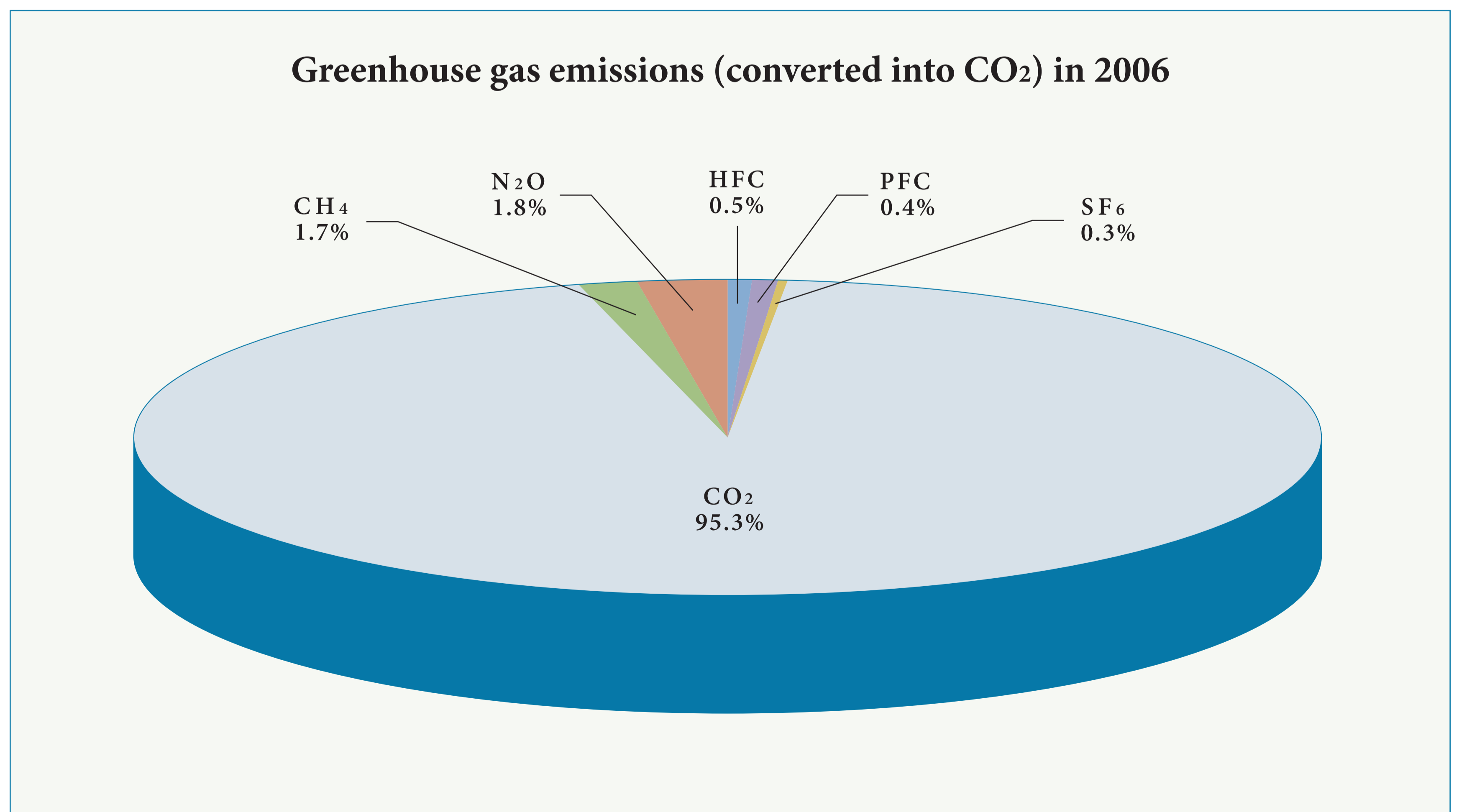
■ Secular Change of Annual Averages of the Earth's Temperature

The Earth's average temperature is expected to rise by 1.4 to 5.8 °C during the period of 1990-2100. There is a major concern that this temperature rise (global warming) will cause the ice in the Poles to melt away, thus resulting in a significant rise in the sea level.



■ Emission Ratio of Greenhouse Effect Gases

Compared to CO₂, the three CFC alternatives have a greater greenhouse effect. The effect of these three CFC alternatives on the greenhouse effect is several hundred to tens of thousands of times larger than that of CO₂. However, they do not deplete the ozone layer. Controls on greenhouse gas emissions are necessary.



Systematic Control Measures Promoted by the Japanese Industry

Industry Groups that Create Voluntary Action Plans

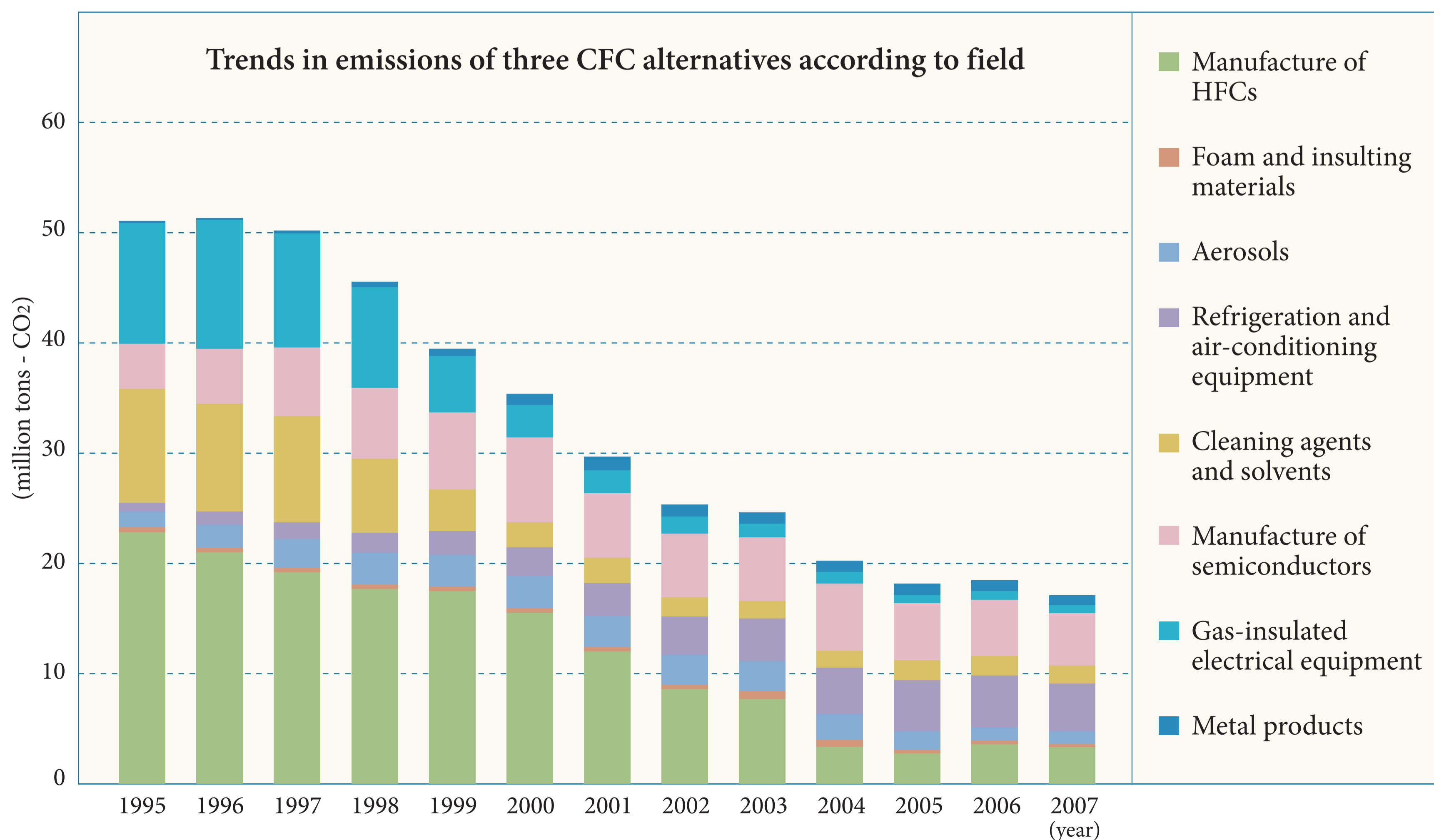
Currently, twenty-two business organizations in eight different fields have created and effectively implemented voluntary action plans to control emissions of three CFC alternatives in development, utilization, leakage prevention, and thorough management of gases.

Field	Target gases	Business organizations
Manufacture of HFCs	HFC	Japan Fluorocarbon Manufacturers Association
	PFC, SF ₆	Japan Chemical Industry Association
Foam and insulating materials	HFC	Japan Urethane Manufacturers Association Japan Urethane Raw Materials Association
		Highly Expanded Polyethylene Manufacturers Association
		Extruded Polystyrene Foam Industry association
		Japan Phenolic Foam Association
Aerosol	HFC	Aerosol Industry Association of Japan
		Federation of Pharmaceutical Manufacturers' Association of Japan
		Japan Air Gun Cooperative Association
Gas-insulated electrical equipment	SF ₆	Japan Electrical Manufacturers' Association
		Federation of Electric Power Companies of Japan
Metal products	SF ₆	Japan Magnesium Association

Field	Target gases	Business organizations
Refrigeration and air-conditioning equipment	HFC	Japan Automobile Manufacturers Association, Inc.
		Japan Automobile Dealers Association
		Japan Auto Parts Industries Association
		Japan Used Car Dealers Association
		Japan Automobile Importers Association
		Japan Refrigeration and Air Conditioning Industry Association
		Japan Association of Refrigeration and Air-conditioning contractors
		Japan Vending Machine Manufacturers Association
Cleaning agents and solvents	PFC	Japan Electrical Manufacturers' Association
		Japan Electronics and Information Technology Industries Association
Manufacture of semiconductors	HFC, PFC, SF ₆	Japan Electronics and Information Technology Industries Association

Controls in Three CFC Alternatives According to Field

In 2005, due to the industry's controls in three CFC alternatives, emissions had been drastically reduced by over 50% compared to in 1995.



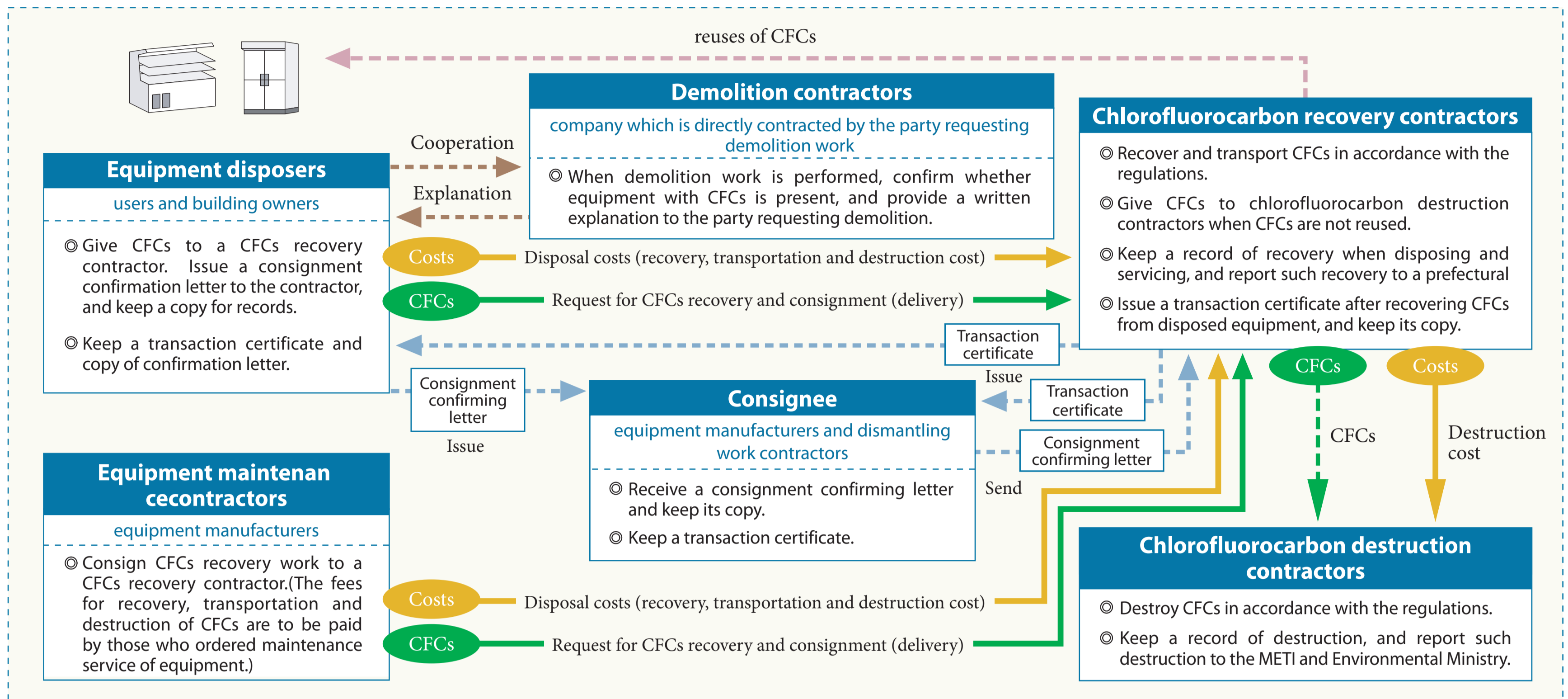
Legislative Control Measures for Chlorofluorocarbons

Following certain legislation, Chlorofluorocarbons (CFC, HCFC and HFC) used in products are recovered.

The Fluorocarbon Recovery and Destruction Law

(Law on Ensuring the Implementation of Recovery and Destruction of Fluorocarbons Concerning Designated Products)

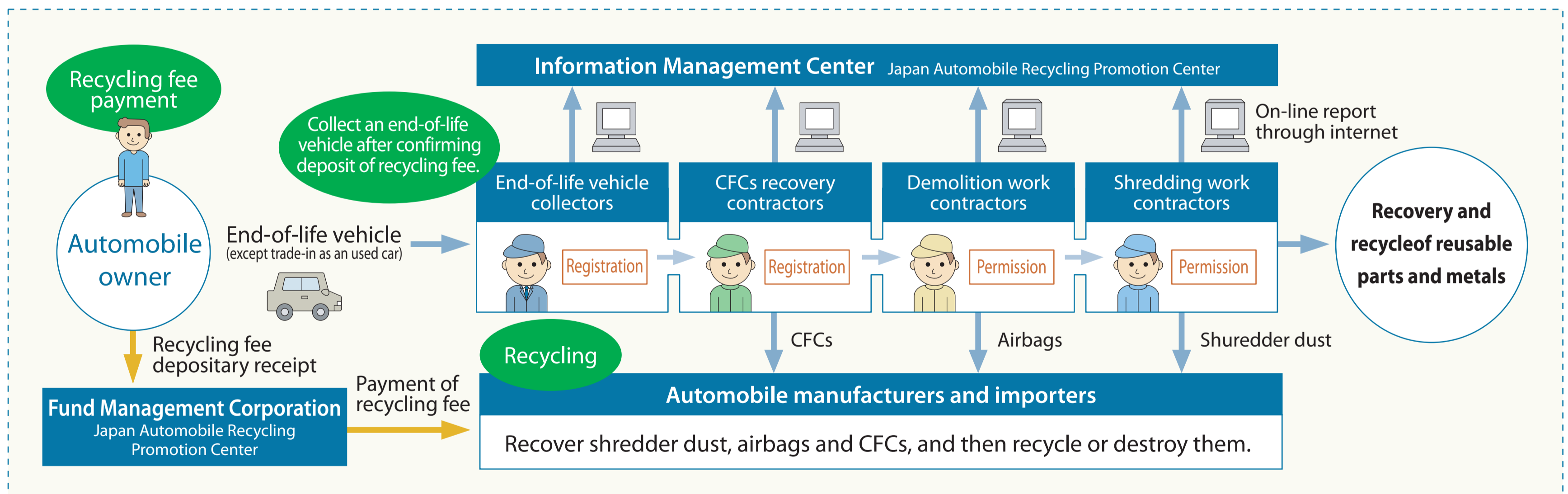
When industrial refrigeration and air-conditioning equipment is disposed of, chlorofluorocarbons (CFCs) used in the equipment are required to be recovered by chlorofluorocarbon recovery contractors. (This new system was introduced and implemented in October, 2007)



End-of-life Vehicle Recycling Law

(The Law provides that all end-of-life, or scrapped, vehicles be recycled.)

When an automobile is disposed of, an end-of-life vehicle collector, which is registered with the local government, first gets the disposed automobile, and then hands it over to a chlorofluorocarbon recovery contractor.



Home Appliance Recycling Law (Law of Recycling Specified Home Appliances)

When home appliances such as air-conditioners and refrigerators are disposed of, a home appliance retailer removes CFCs from appliances and transports them to a recycling facility.

