Humans are
not so bad
after all.

Protect the ozone layer; Prevent global warming

Ministry of Economy, Trade and Industry

From Protecting the Ozone Layer to Preventing Global Warming

(1) Advent of the Ozone Layer Depletion Issue

Chlorofluorocarbons (CFCs) do not exist in nature; they are artificial substances invented by human beings in the 20th century.

In 1928, CFCs were developed as ideal gases to be used as refrigerants. CFCs are incombustible, chemically stable, and easily liquefied, so they are gases ideal for refrigerants.

Moreover, CFCs are oil solvent, easily evaporable, and not toxic to the human body. They are thus used for various purposes, such as heat insulating materials, foaming agents for cushions, cleaning agents for semiconductors and precision components, and propellants for aerosol sprays. In particular, CFC consumption exploded from the 1960s onward mainly in developed countries.

But in 1974 Professor F.S. Roland (who won the Nobel Prize in chemistry in 1995) of the United States discovered that once CFCs are emitted into the atmosphere they rise into the stratosphere and deplete the ozone layer. P.2

The increase of ultraviolet light due to depletion of the ozone layer will not only have adverse health effects, such as causing skin cancer and cataracts, but also damage the genes of plants and animals and thus endanger their survival. Once the ozone hole was discovered in Antarctica in 1985 and the evidence of actual ozone layer depletion was confirmed, it became a serious concern throughout the world.

In accordance with the "Vienna Convention for the Protection of the Ozone Layer" (1985), the "Montreal Protocol" was adopted in 1987 as an international framework for regulating CFCs, which marked the start of international regulations on ozone depleting substances (ODS).

For the past dozen years or so, regulations on producing, importing, and exporting ODS (Specified fluorinated gases: CFCs, HCFCs, etc.) have been steadily strengthened, and a shift to alternative substances is now in progress. P.3

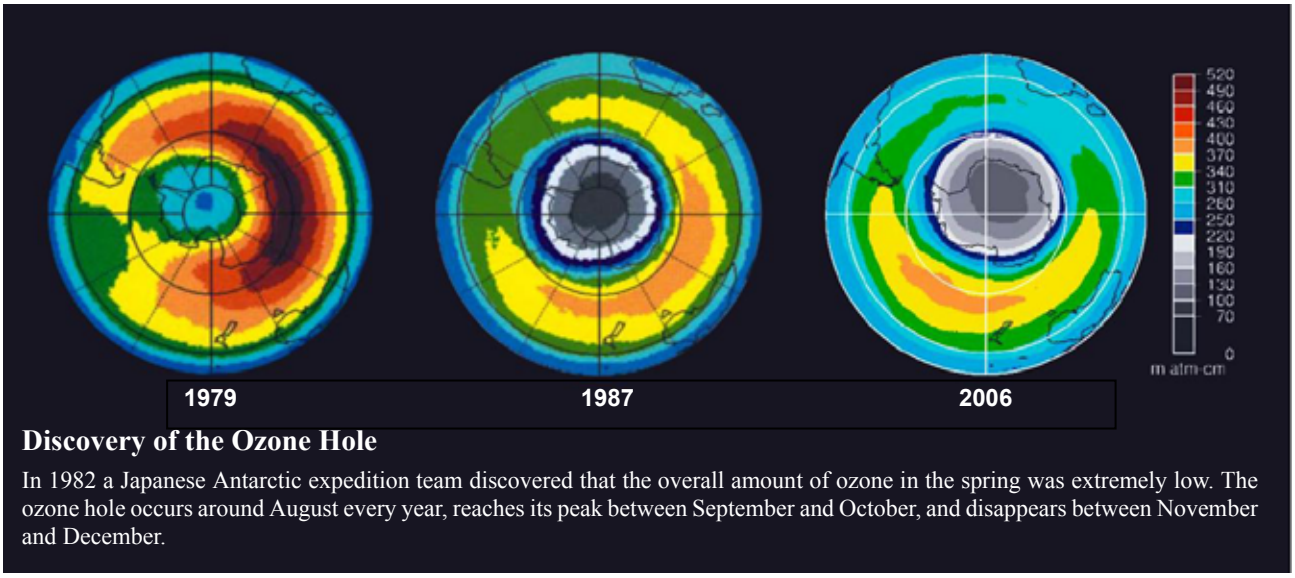
(2) Toward the Issue of Global Warming

Meanwhile, fluorinated gases that do not deplete the ozone layer (HFCs) as alternative substances for specified fluorinated gases were developed and have become widely used. However, Alternative substances (HFC, PFC and SF6) have a different problem, as they cause global warming. P.7

In 1992, the "United Nations Framework Convention on Climate Change" was concluded with the aim of preventing global warming, and the "Kyoto Protocol" was adopted in 1997 and was put into effect in 2005. Furthermore, the "Plan for Achieving Kyoto Protocol Targets" was approved in a Cabinet meeting as a necessary measure to ensure that Japan fulfills her commitment to reduce greenhouse gas emissions by 6%. P.8

Since artificial substances, "HFCs, PFCs and SF6," cause greenhouse effects hundreds to tens of thousands times more than carbon dioxide, and the best efforts have been asked to reduce their emissions.

CFCs and alternative CFCs benefit our lives by making them easier, but we need to maintain these benefits as best we can as we reduce ozone depleting substances, and at the same time we must also take the responsibility for dealing with the extremely complicated problem of reducing alternative CFCs and other substances that are used as substitutes.



Discovery of the Ozone Hole

In 1982 a Japanese Antarctic expedition team discovered that the overall amount of ozone in the spring was extremely low. The ozone hole occurs around August every year, reaches its peak between September and October, and disappears between November and December.

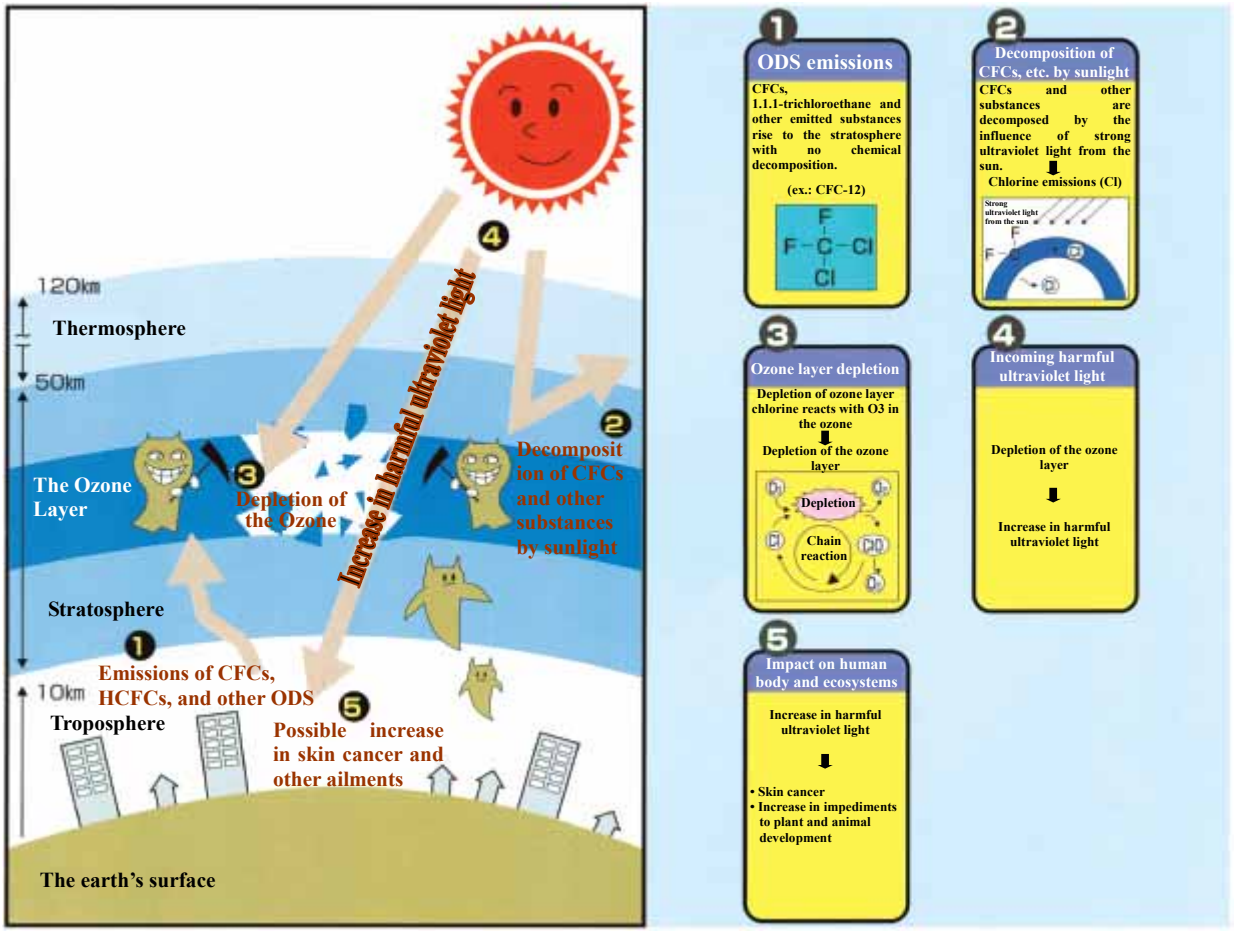
Note: Monthly averages for October of the distribution of total ozone

Data: Provided by NASA and prepared by the Japan Meteorological Agency

What is Ozone Layer Depletion?

The ozone layer, located in the upper stratosphere (10 — 50 km above the earth's surface), plays the highly important role in protecting life on this planet by absorbing harmful ultraviolet light (UV-B) with wavelengths of between 280-315nm. Since the late 1970's, we have been aware of the damage being caused to the important ozone layer by CFCs (chlorofluorocarbons) and other chemical substances emitted into the atmosphere.

Ozone depleting substances, such as CFCs and HCFCs (hydrochlorofluorocarbons), tend not decompose chemically. When these substances are emitted into the atmosphere, they are able to travel through the troposphere (up to roughly 10 km above the earth's surface) to the stratosphere with almost no chemical decomposition. Once in the stratosphere, these substances decompose due to exposure to ultraviolet light (decomposition by light from the sun), which results in the formation of chlorine atoms. These chlorine atoms then act as a catalyst, setting off a chain reaction that depletes ozone in the stratosphere. When the amount of ozone (the overall amount of ozone/ozone partial pressure) decreases, the amount of harmful ultraviolet light that reaches the earth's surface increases. Increased ultraviolet light exposure may cause higher rates of skin cancer and cataracts and may also have a profound impact on ecosystems.



Q. I often hear the word "Freon." What is Freon?

A. The official name for these substances is "fluorocarbons" (chemical compound containing carbon and fluorine).

Among these substances, CFCs (chlorofluorocarbons) and HCFCs (hydrochlorofluorocarbons) are ozone depleting substances.

In addition these, there are HFCs (hydrofluorocarbons), which are also called "alternative CFCs." HFCs do not include chlorine and thus do not deplete the ozone layer. However, CFC alternatives cause greenhouse effects hundreds to tens of thousands times more than that of carbon dioxide and thus have become an issue as a cause of the global warming.

Note: In the late 80s and early 90s when the main issue was substituting for CFCs, alternative fluorinated gas generally referred to HCFC, but now that CFCs have almost all been replaced by other substances, the problem has become that of replacing HCFC with HFCs so that the latter are now referred to as alternative fluorinated gas. CFCs and HCFCs are referred to as ODSs

Kinds of ODS and Outline of the ODS Phase-out Schedule

In 1988, Japan enacted the "Law concerning the Protection of the Ozone Layer through the Regulation of Specified Substances and Other Measures (Ozone Layer Protection Law)" on the basis of the international framework for regulating Ozone Depleting Substances (Montreal Protocol) and started to regulate producing, importing, and exporting ODS in July 1989. Other policies have also been carried out to reduce the demand for ODS smoothly and steadily.

Phase-out Schedule stipulated in Montreal Protocol

(1) HCFCs (hydrochlorofluorocarbons, listed in Group I of Annex C of the Protocol)

- Ozone Depleting Potential (ODP[*1]): 0.005 — 0.52
- Global Warming Potential (GWP[*2]): 1,500 (HCFC-22)
- Main applications: Refrigerants for air-conditioners, foaming agents for various heat insulating materials, cleaning agents for electronic and metallic components

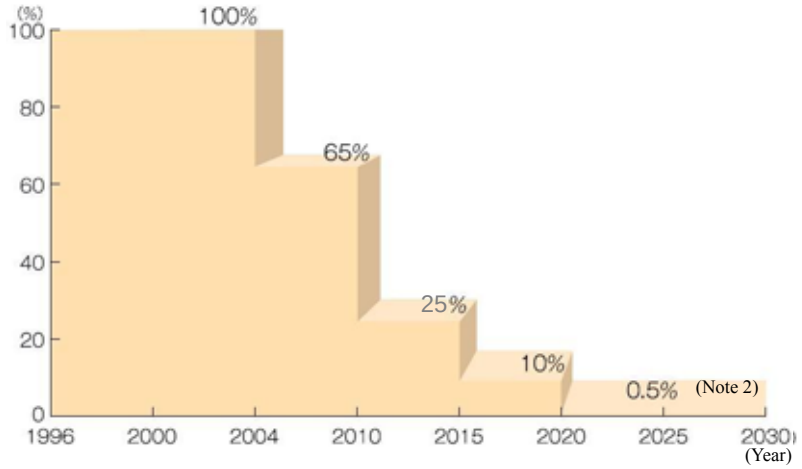
Phase-out Schedule

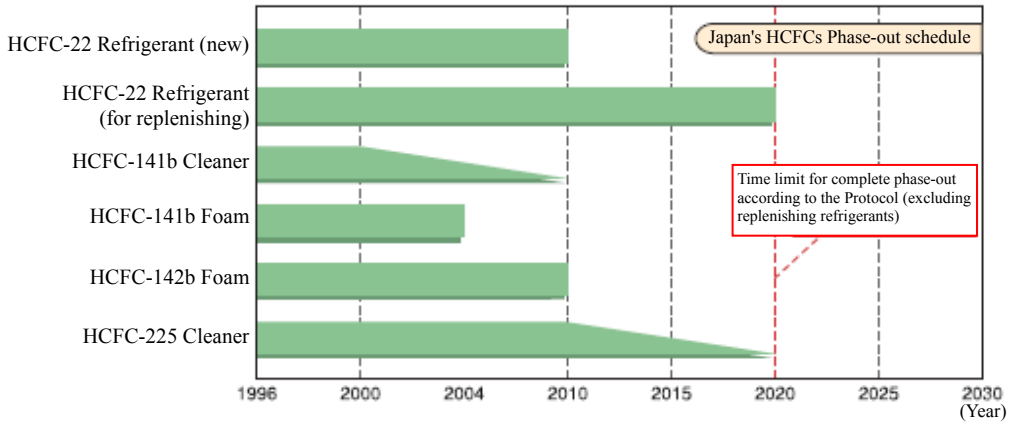
Based on the actual consumption (production amounts + import amounts − export amounts) in 1989:

From January 1, 1996: not to exceed 100%
From January 1, 2004: not to exceed 65%
From January 1, 2010: not to exceed 25%
From January 1, 2015: not to exceed 10%
From January 1, 2020: not to exceed 0%

Note 1: The production amount must not exceed the average of the reference production amount and the reference consumption amount from 2004 onward.
Note 2: Production of these substances will be allowed up to 0.5% of the consumption amount in 1989 until 2029, but only for use to replenish existing refrigeration and air-conditioning facilities.

*Reference amount = (HCFCs consumption amount/production amount in 1989)
+ (CFCs consumption amount/production amount in 1989) × 2.8%





■ Tightening regulations through the Montreal Protocol (Developed countries)

Regulated substances (base year)	Start of phase-out	At the Time of Enactment (1987)	London Amendments (1990)	Copenhagen Amendments (1992)	Vienna Amendments (1992)	Montreal Amendments (1997)	Beijing Amendments (1999)
CFC-11, etc (86)	From 7/89	50% or less from 1998	Complete phase-out from 2000	Complete phase-out from 1996			
Halon (86)	From 1/92	100% or less from 1992	Complete phase-out from 2000	Complete phase-out from 1994			
Other CFCs (89)	From 1/93	-	Complete phase-out from 2000	Complete phase-out from 1996			
Carbon tetrachloride (89)	From 1/95	-	Complete phase-out from 2000	Complete phase-out from 1996			
1.1.1-trichloroethane (89)	From 1/93	-	Complete phase-out from 2005	Complete phase-out from 1996			
HCFC (89)	From 1/96	-	-	Complete phase-out from 2030	Complete phase-out from 2020 (consumption)		Not exceed 100% from 2004 (production)
HBFC (-)	From 1/96	-	-	Complete phase-out from 1996			
Methyl Bromide (91)	From 1/95	-	-	Not exceed 100% from 1995	Complete phase-out from 2010	Complete phase-out from 2005	
Bromochloromethane (-)	From 1/02						Complete phase-out from 2002

Note: The Montreal protocol established regulations for the production and consumption amounts (production amount + import amount − export amount) for each substance based on the results of the base. (There is a difference between the consumption and production phase-out schedules for HCFCs.)

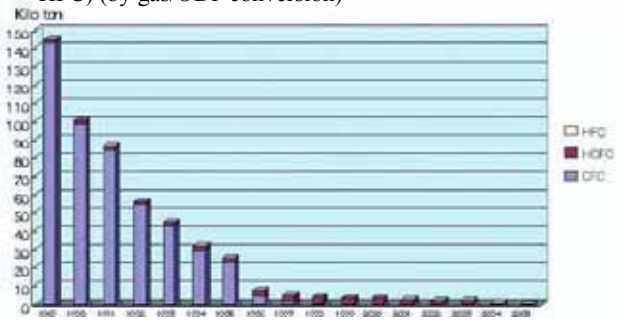
(2) Other Substances

	CFC-11,12,113,114,115	Halons	Other CFCs	Carbon tetrachloride	1.1.1-trichloroethane	HBFCs (hydrobromofluorocarbons)	Bromochloromethane	Methyl bromide
Protocol Annex	Group I of A	Group II of A	Group I of B	Group II of B	Group III of B	Group II of C	Group III of C	Group I of E
Ozone Depletion Potential (ODP)	0.6 - 1.0	3.0 - 10.0	1	1.1	0.1	0.1 - 14	0.12	0.6
Global Warming Potential (GWP)	8100 (CFC12)	5400 (Halon 1301)	-	1400	100			
Main applications	Refrigerants for automobile air-conditioners, refrigerators, etc., foaming agents for various heat insulating materials, cleaning agents for electronic and metallic components, etc.	Fire extinguishing agents	Refrigerants	Feed stock materials for CFCs, etc., solvents	Cleaning agents for electronic and metallic components, etc.	Fire extinguishing agents (Halon alternative)	Feed stock for synthesizing medical intermediate	Soil fumigation agent for dry crops, etc., quarantine fumigation agent when exporting lumber, grains, etc.
Production Phase Out	Completely phased out as of January 1, 1996	Completely phased out as of January 1, 1994	Completely phased out as of January 1, 1996			Completely phased out as of January 1, 1996	Completely phased out as of January 1, 2002	Completely phased out as of January 1, 2005
	*Excluding production and consumption for essential use							
								* Amount used for import/export quarantining not subject to regulations

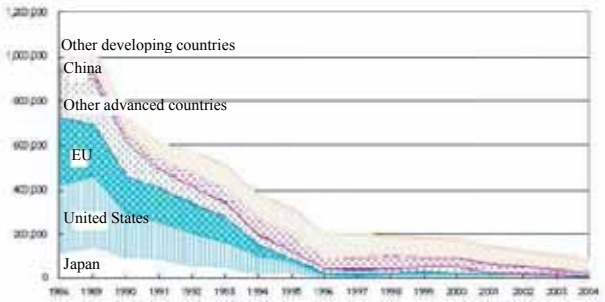
*1 Ozone Depletion Potential (ODP):
ODP is a relative value of the ozone destructive potential of a chemical substance by unit weight emitted into atmosphere, with the unit weight of CFC-11 as 1.0.

*2 Global Warming Potential (GWP):
GWP is a relative value of the global warming effect caused by a chemical substance by unit weight emitted to the atmosphere, with the unit weight of CO2 as 1.0. For this material, a 100 year integration period value is indicated. (GWP shown in this pamphlet does not include the indirect effects by depletion of the ozone layer by CFCs and other relevant substances. Actually, ozone in the atmosphere, which is one of the greenhouse gases, is depleted by these substances. Therefore, the net GWP of CFCs is smaller than that shown in this pamphlet.)

Transition in Shipping Volume of fluorocarbons (CFC, HCFC, HFC) (by gas/ODP conversion)



Transition in CFC + HCFC consumption amount (ozone depletion potential (ODP) conversion)



Source: UNEP, Production and Consumption of Ozone Depleting Substances under the Montreal Protocol (1986-2004)

- Japan made reductions by 99.3% based on ODP (ozone depletion potential)
- Advanced countries made reductions by over 99% and developing countries by 73% for a world total of 95%. (Consumption = production + imports)

Evaluation of the Ozone Hole

At the Science Assessment Panel (SAP) for the Montreal Protocol, it was reported that "the total concentration of ozone depleting substances in the stratosphere demonstrates a decreasing trend as compared to the latter half of the 1990s when the total concentration reached its peak" at a meeting of contracting states held in November 2006. The Japan Meteorological Agency is also reporting that in the northern hemisphere, areas where there is a moderately increasing trend in the total amount of ozone are observed.

Forecasts for Repair of the Ozone Hole

(Published by the National Institute for Environmental Studies on May 19, 2006)

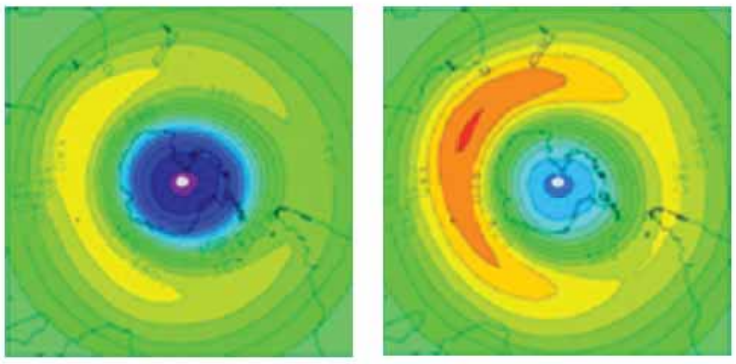


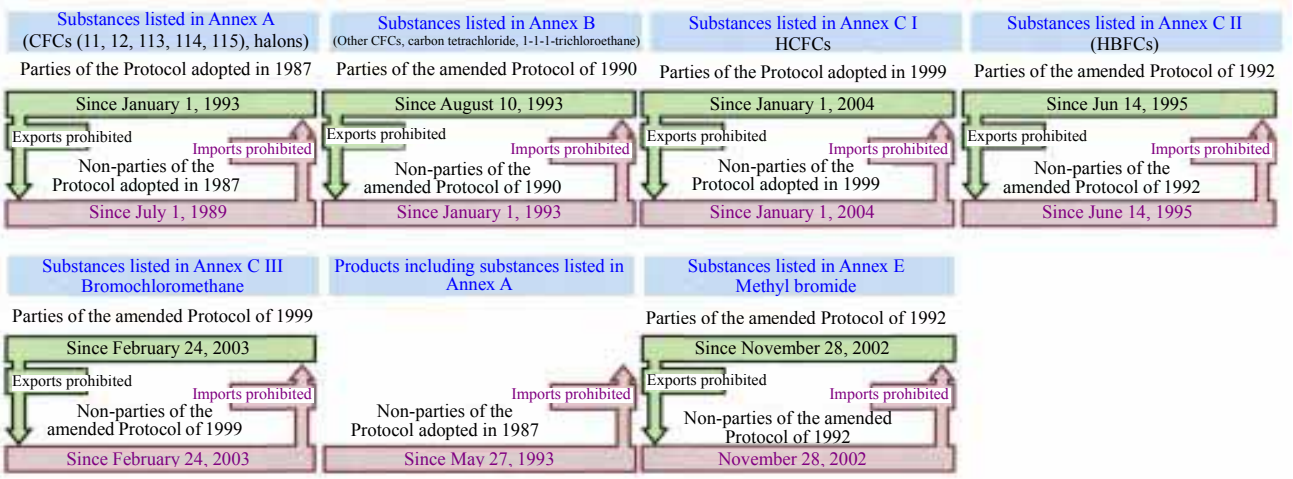
Figure:
Forecasting of Changes to the Ozone Hole through Numerical Model Experiments (Average of 5 years)
(Source: National Institute for Environmental Studies)

Left: 1998 – 2002
Right: 2038 - 2042

Small←Total amount of ozone→Large

Outline of Trade Regulations

1. Regulations on Trade (Imports/Exports) with Non-parties of the Montreal Protocol



2. Japanese Import/Export License System

(1) Imports (Article 4 of the Import Trade Control Order)

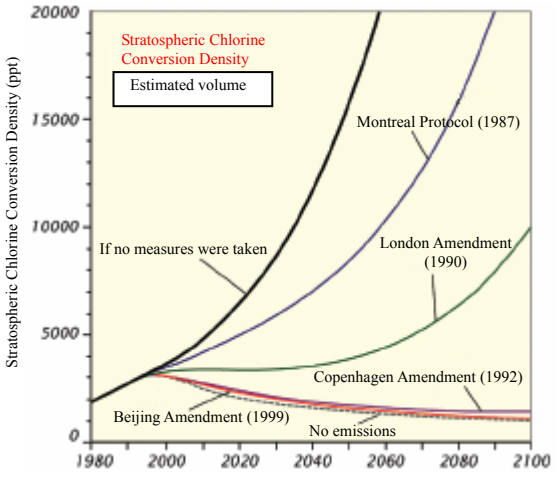
1) Import quotas based on No. 2 of the Import Notice and Article 9 of the Import Trade Control Order shall be required for importing HCFCs the consumption amount of which is in the process of being phased out in accordance with the Montreal Protocol.
2) Import of other ODS is basically prohibited. However, the import of the following substances is admitted as exceptions

a. All ODS used as feed stock for substances other than themselves. (However, import confirmation based on Section 7-10 of No. 3 of Import Notice shall be required.)
b. CFCs, carbon tetrachloride, 1.1.1-trichloroethane used for Laboratory and Analytical use, hydrobromofluorocarbons (HBFC), bromochloromethane and methyl bromide (However, import confirmation based on Section 7-11 of No. 3 of Import Notice shall be required.)
c. Methyl bromide used for applications accepted in the Parties to Montreal Protocol. (However, the obtainment of import quotas based on Article 9 of the Import Trade Control Order and No. 2 of the Import Notice shall be required.)
d. Methyl bromide used for the quarantine at the time of export and import of cargoes. (However, import confirmation based on Section 7-12 of No. 3 of Import Notice shall be required.)

(2) Exports

1) Export license (Article 2 of the Export Trade Control Order)
Export license based on Article 2 of the Export Trade Control Order shall be required for exporting any of the regulated substances (CFCs, halons, carbon tetrachloride, 1.1.1-trichloroethane, HBFCs, HCFCs, bromochloromethane, and methyl bromide).
2) Export report (Article 17 of the Ozone Layer Protection Law)
Exporters shall be required to submit an export report after exporting any of the regulated substances (CFCs, halons, carbon tetrachloride, 1.1.1-trichloroethane, HBFCs, HCFCs, bromochloromethane, and methyl bromide).

■ Effects of regulations on production of ODS
(Scenarios forecasted scientifically by UNEP)



Twenty Questions and Answers about the Ozone Layer (WMO, 2003)

International Cooperation for Ozone Layer Protection

Non-Article 5 countries including Japan have completely phased out the consumption and production of CFCs as of the end of 1995. As the Montreal Protocol provides Article 5 countries (developing countries) with a grace period to start the phase-out schedule of consumption and production of CFCs, these countries started regulating in 1999 and will completely phase out by 2010. Non-Article 5 countries have established multilateral funds based on contribution from individual countries and have been supplying funds for projects to support Article 5 country conversion so that Article 5 countries can smoothly comply with the phase-out schedule under the Montreal Protocol.

Japan, which ranks the same as the United States, is the largest contributor to this fund (approximately 22%), providing about $35 million for the year. Article 5 countries have high expectations for this fund. Japan, as a leading contributor, is required to make efforts to ensure appropriate use of the funds. Recently, Japan provided $5.6 million to India for a metal cleaning carbon tetrachloride conversion project (approved by the 41st executive committee in December 2004), $4.5 million to China for refrigerant recovery project (approved by the 44th executive committee in December 2004), and $0.7 million to Africa for a chiller conversion demonstration project (approved by the 48th executive committee in April 2006). Thus Japan is making a major contribution in developing countries toward converting from ozone depleting substances.

In addition, Japan's successful technologies for and experience in converting to alternative substances have been highly praised by other countries. The Japanese government has implemented the following as a way to introduce and transfer this technology and experience to Article 5 countries.

• JICA Training Seminar on Ozone Layer Protection Measures

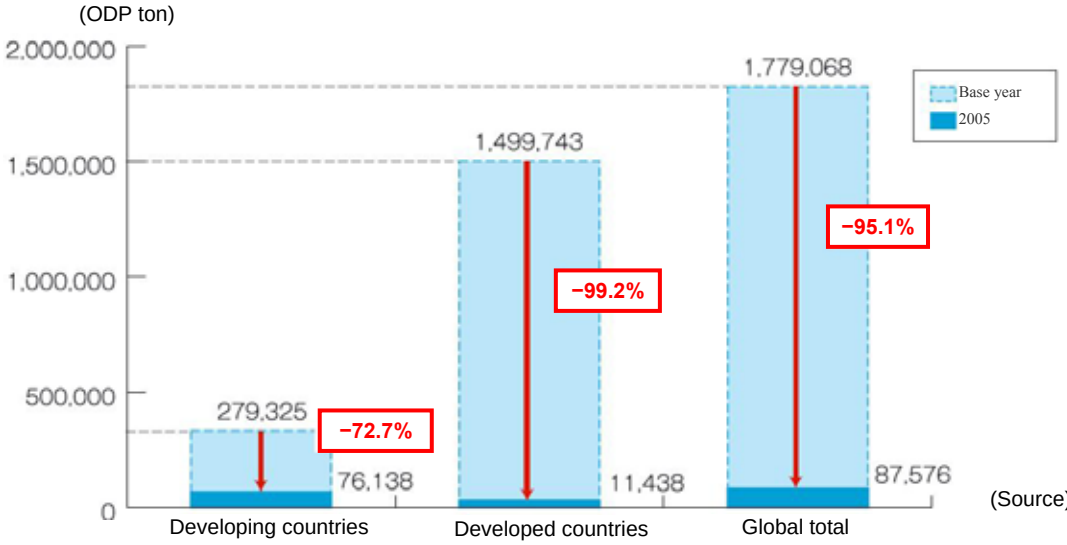
The purpose of this seminar is to help Article 5 countries smoothly phase out ODS such as CFCs. Government officers in charge of ozone layer protection policies in Article 5 countries are invited to Japan to listen to a wide variety of lectures about Japanese alternative technologies and legislative frameworks.

■ Overview of Phase-out schedule in Article 5 countries

	Start of Phase-out schedule	Complete Phase-out	Base year level
CFC-11, others	1999	2010	Average between 1995 — 1997
Halons	2002	2010	Average between 1995 — 1997
Other CFCs	2003	2010	Average between 1998 — 2000
Carbon tetrachloride	2005	2010	Average between 1998 — 2000
1.1.1-trichloroethane	2003	2015	Average between 1998 — 2000
HCFCs	2013	2030	Average between 2009 — 2010
Methyl Bromide	2002	2015	Average between 1995 — 1998

(Base on 2007 Montreal Adjustment)

■ Global Changes in ODS Consumption (2005)



(Source) UNEP

What is Global Warming?

Global temperature is kept constant based on a balance between solar isolation from the sun and heat emitted from the earth (average 15°C). Solar isolation from the sun passes straight through the atmosphere and is absorbed into the ground, and heat is emitted from the heated ground in the form of infrared light. Greenhouse gases absorb this heat, emit part of it downward again and heat the ground and lower atmosphere.

However, as human activity and the use of fossil fuels have increased, a large amount of greenhouse gases has been emitted to the atmosphere and their concentration has increased. Heat absorbed into the atmosphere has thus increased, and a global rise in temperature (global warming) has been accelerating. This is global warming.

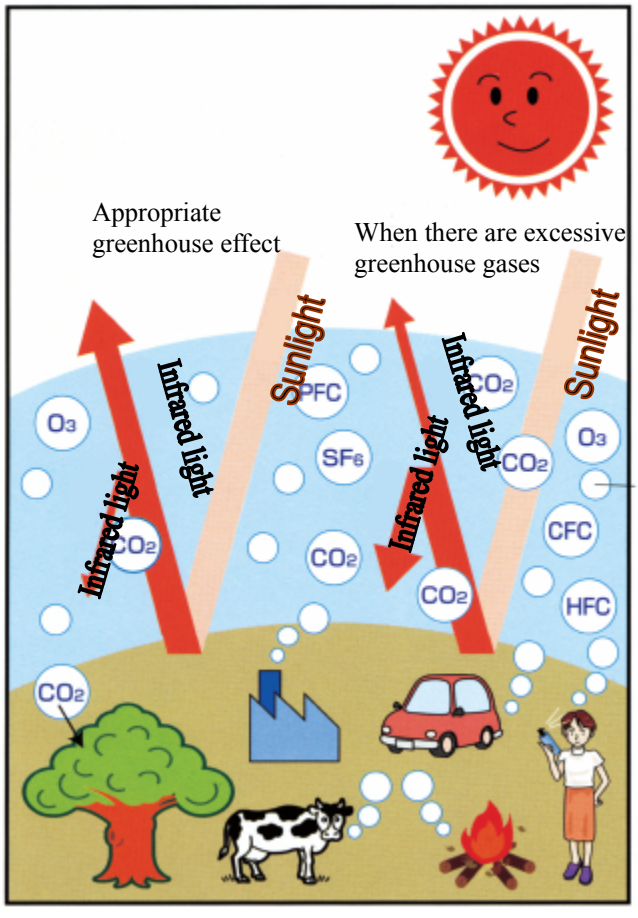
In addition, as the production and consumption of ODS has come to be regulated in recent years, alternative substances, such as HFCs, PFCs and SF6 have been developed and come into wide use.

However, since HFCs, PFCs and SF6 cause greenhouse effects hundreds to tens of thousands times more than carbon dioxide, their emission into the atmosphere has been a problem, as it will promote global warming with an increase of carbon dioxide. Therefore, measures to reduce HFCs, PFCs and SF6 should be taken to harmonize ozone layer protection measures with actual use and trends in each industrial field.

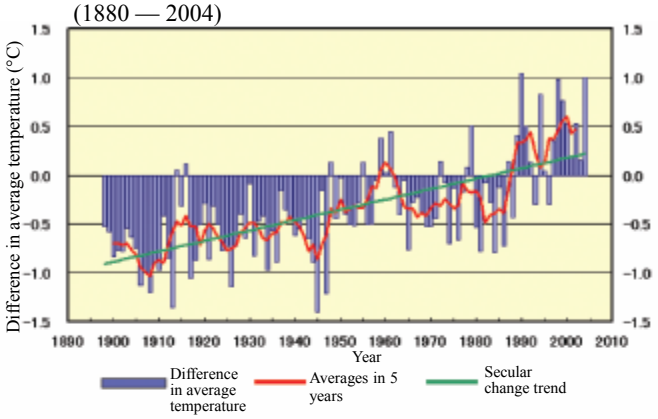
The IPCC Third Assessment Report warns that average global temperature will rise 1.4-5.8°C during the period from 1990 to 2100 and sea-level will rise 9-88 cm on the average due to the swelling of sea water and the melting of ice caused by global warming.

What is the IPCC?
IPPC is an abbreviation of "Intergovernmental Panel on Climate Change." It is a gathering of scientists that was created under the WMO (World Meteorological Organization) and UNEP (United Nations Environment Programme) in 1988.
The IPCC's work includes compiling the latest data on the concentration of greenhouse gases in the atmosphere, making temperature rise predictions, and studying the effects of climate change on human society and nature.

■ Mechanism of Greenhouse Effect



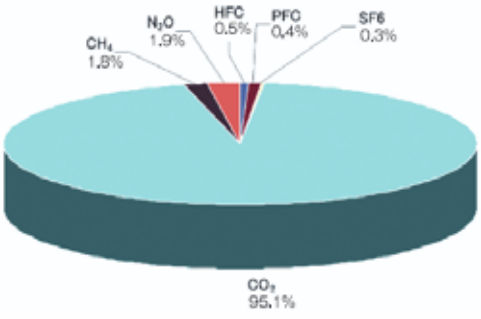
■ Secular change in difference of the annual average global ground temperature from that of the average year (1880 — 2004)



Climate Change Monitoring Report for 2004 (Japan Meteorological Agency)

Greenhouse gases: CO_2, CH_4, O_3, N_2O, CFC, HCFC, HFC, PFC, SF_6, etc. (CFC and HCF are not subject to Kyoto Protocol)

■ Emission of greenhouse gases (CO2 basis) (2005)



(Based on "Emission of Greenhouse Gases in FY2005")

Outline of Greenhouse Gases and Regulations

HFCs, PFCs, and SF6 have been widely used in a variety of applications as alternative substances for ODS. However, all of these gases have high greenhouse effect, and so have been recognized as subject to reducing emissions in the Kyoto Protocol adopted in December 1997, along with carbon dioxide, methane, and carbon monoxide

1. Greenhouse Gases subject to the Kyoto Protocol

1. CO_2 (originates from energy consumption): Combustion of fossil fuels
   CO_2 (does not originate from energy consumption): Industrial process
2. Methane (CH_4): Livestock, paddy field, waste
3. Dinitrogen monoxide (N_2O): Fertilizer application, industrial processes
4. HFCs (alternatives fluorinated gas): Refrigerants, foaming agents for heat insulating materials, propellant
5. PFCs: Solvents, cleaning agents, etching gas for manufacturing semiconductors and liquid crystal, cleaning gas
6. SF6: Insulating materials for power generation, cover gas for magnesium casting

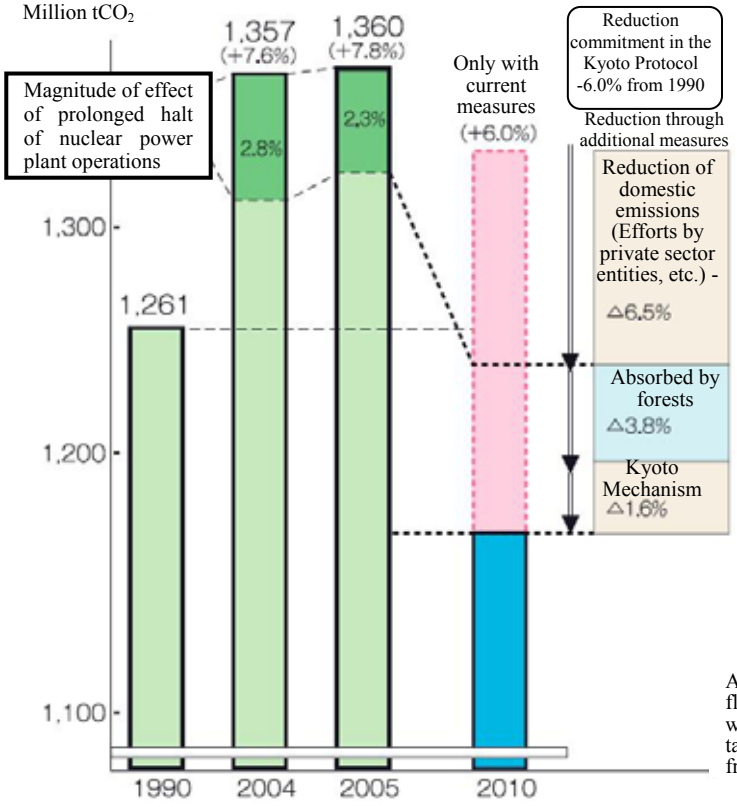
2. Major Annex I Country emission reduction Targets for Entire Greenhouse Gases

In terms of major Annex I countries (35 countries), it shall be aimed to reduce the total emission of greenhouse gases by the following rate compared to 1990 during the first commitment period (2008 — 2012).
Compared to 1990: Japan: −6% US: −7% EU: −8% Canada: −6% Russia: −0%

3. Plan for Achieving Kyoto Protocol Targets

With the coming into effect of the Kyoto Protocol in February 2005, in April of the same year, a cabinet decision put in effect the Plan for Achieving Kyoto Protocol Targets formulated by Global Warming Prevention Headquarters based on provisions of the Law Concerning the Promotion of the Measures to Cope with Global Warming as a necessary measure to ensure that Japan fulfills her commitment to reduce greenhouse gas emissions by 6%.

■ Commitment to Reducing Greenhouse Gas Emissions by 6% and Japan's Greenhouse Gas Emissions



Classification	Former targets	Plan for achieving targets
Greenhouse gases	- 0.5%	- 0.5%
(i) CO_2 (originates from energy consumption)	- 2.0%	+ 0.6%
(ii) CO_2 (does not originate from energy consumption)	- 0.5%	- 0.3%
(iii) Methane		- 0.4%
(iv) Dinitrogen monoxide		- 0.5%
(v) HFCs, PFCs, and SF6	+ 2.0%	+ 0.1%
Absorber (forests, etc.)	- 3.9%	- 3.9%
Kyoto Mechanism	- 1.6%	- 1.6%
Total	- 6.0%	- 6.0%

Emission Reduction in Japan

An amendment review was performed concerning the three alternative fluorocarbon gases for the Framework for Promoting Measures to Cope with Global Warming. As a result, the plan for reaching Kyoto Protocol targets is set at +0.1% for these substances. This target is 1.9% over the framework's target quota.

4. Targets for Measures for Mitigating Emissions of HFCs, PFCs and SF6

In terms of emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6), we shall try to contain the impact to +0.1% (approx. 5,100 million ton Co_2) compared to the total greenhouse gas emissions in the base year (1995) during the first commitment period.

5. Specific Measures for Reducing Emissions of HFCs, PFCs and SF6

(1) Promote systematic action plans for industry

- 22 business organizations in 8 sectors have established action plans to limit emissions, and have steadily implemented them.
- The Industrial Structure Council has been following up every year on the progress of the action plans implemented by specific industries.
- Efforts will be made to improve the transparency and reliability of the action plans and to ascertain the achievement of the target.
- Those business associations that have not yet established their own action plans shall be encouraged to do so.

(2) Develop new alternative substances and promote use of products using alternative substances

(Develop new alternative substances, etc.)

- Development of energy-saving synthetic technologies for Fluorocarbon Replacements (FY2002 – FY2006)
  (Outline) From a viewpoint of protecting the ozone layer and preventing global warming, the selection of alternative substances and development of synthetic technologies has been carried out in order to put new alternative substances with high energy efficiency and low environmental burdens into practical use.
- Development of non-fluorocarbon, energy-saving refrigeration and air-conditioning systems (FY2005 – FY2009)
  (Outline) Efforts have been made to develop new safety-conscious refrigeration systems that are both highly efficient and free from fluorocarbon that can be used for showcase purposes and in air conditioners for use in homes, places of business and transportation.
- Project to develop SF6-free highly functional manifestation magnesium alloy structure control technology, etc. (FY2004 – FY2006)
  (Outline) Efforts have been made to reduce emissions of SF6 that are used in magnesium solution, and to enhance production processes and functions of magnesium alloys by improving creep property, developing technologies to homogenize crystallization phases in the casting processes and rolling processes such as extrusion and rolling, and developing technologies to control crystal particles.

(Promote use of alternative substances)

- Support region-based projects to prevent global warming
- With all due consideration for safety, economy, and energy efficiency, information provision and awareness campaigns shall be promoted for products using alternative substances or using HFCs, PFCs or SF6 that have less impact on global warming.

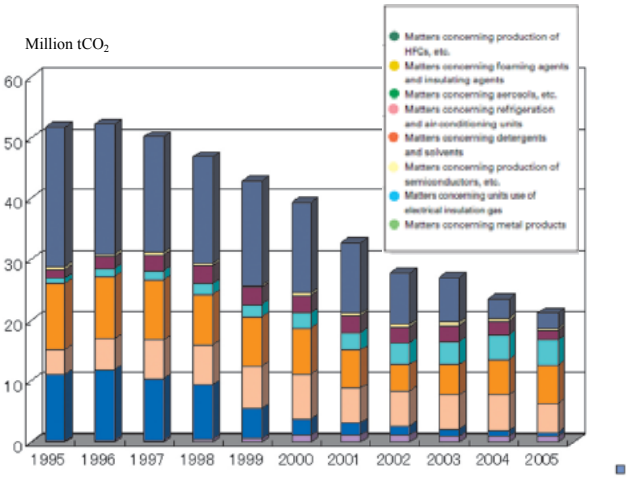
(3) Recover HFC charged in equipment as a refrigerant

- The proper recovery of HFC refrigerants from equipment shall be promoted through appropriate enforcement of the CFC Recovery and Destruction Law, the Home Appliance Recycling Law, and the Automobile Recycling Law.

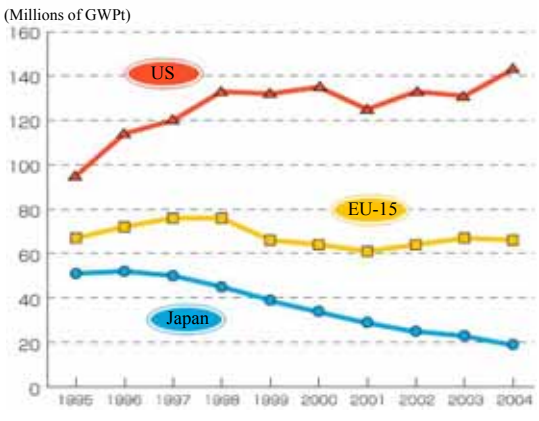
■ Change in Estimated Emissions of HFCs, PFCs, and SF6 (1995 — 2006)

(Unit: million GWPt)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Estimated emissions	51.2	51.8	50.1	45.3	38.7	34.0	28.8	25.1	23.5	19.3	17.2	16.6



■ Transitions in the Emission Amounts of HFCs, PFCs and SF6s in Advanced Countries

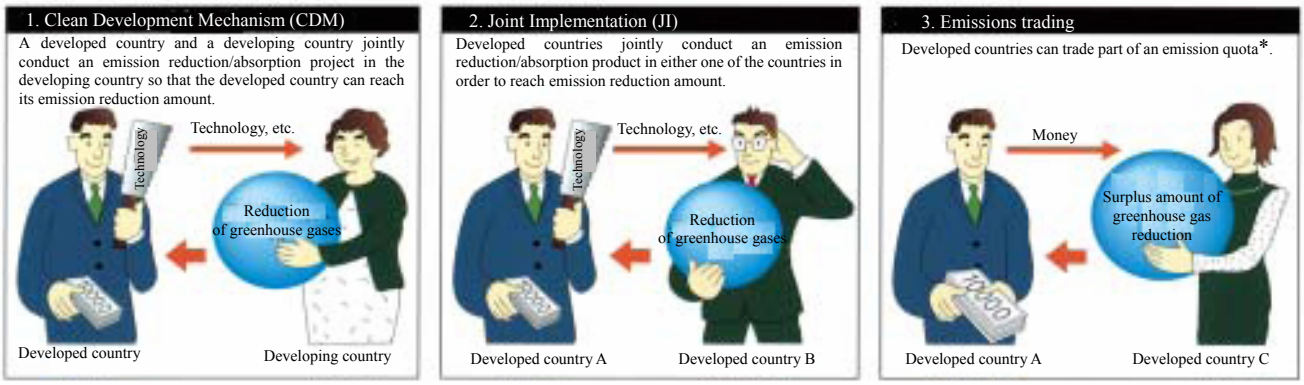


Source: UNFCCC

Utilizing the Kyoto Mechanism

The Kyoto Protocol allows using part of the amount of reduced emissions, etc. in other countries (Kyoto Mechanism) as a flexible measure for achieving the commitments of each country. Japan has already created an energy-saving economic society, so the marginal costs of reducing greenhouse gases in Japan are considered the highest in the world. Therefore, obtaining emission reduction amounts by supporting projects in other countries has attracting attention as a highly cost effective method.

HFCs, PFCs and SF6 especially have an extremely high global warming potential (GWP), so measures to reduce their emissions are considered to be more cost-effective than measures to reduce CO_2 emissions in many fields. The three kinds of Kyoto Mechanisms are as follows:



* Permissible emission levels determined based on individual countries' numerical reduction targets

If a private sector company has implemented CDM or JI, the company may freely trade to acquire the right to emit (credit). If a company has implemented an efficient emission reduction project, the difference between the cost and the sale price of the credit is retained as company profit.

Since acquiring credits by Japanese companies is a highly cost-effective measure to prevent global warming for Japan as a whole, the government is establishing a credit market and preparing support measures.

■ List of CDM/JI Projects concerning HFCs, PFCs and SF6

Date of the government approval	Applicant	Country	CDM/ JI	Name of the project	Estimated emission reduction (annual) (tCO_2)
Mar. 13, 2006	Sumitomo Corp.	Russia	JI	Project to reduce emissions of GHG caused by thermal destruction of HFC23 in Russian Federation	About 0.39 million
Dec. 14, 2005	Mitsubishi Corp. Nippon Steel Co.	China	CDM	Shandong Dongyue HFC destruction project	About 10.11 million
Nov. 11, 2005	JMD GHG gas emission reduction Co.	China	CDM	Zhejian Juhua Co. HFC23 decomposition project	About 5.8 million
May 19,2004	Sumitomo Corp.	India	CDM	Project to reduce emissions of GHG caused by thermal destruction of HFC23 at HCFC22 production Plant of GFL Co. in Gujarat	About 3.38 million
Jul. 15, 2003	Ineos Chemical	South Korea	CDM	HFC destruction project in Ulsan	About 1.4 million

Promote Recovery and Destruction of Fluorinated Carbon Used as Refrigerants

With regard to emission control of ozone depleting substances, conversion was promoted in the past through so-called “faucet regulations," which are production and import regulations based on the “Ozone Layer Protection Law.” However, hydrofluorocarbons (HFCs), which are what such substances are converted into, are subject to reduction in the Kyoto Protocol as greenhouse gases, and it is necessary to control emission of HFCs into the atmosphere. For this purpose, conversion into non-fluorocarbon is being promoted in various sectors, but with regard to fluorocarbons that are used as refrigerants for air-conditioning and refrigeration units, although some non-fluorocarbon products have been developed, it is inevitable to continue using HFCs in the future since there is no effective alternative refrigerant.

The fluorocarbons that are used as refrigerants are sealed inside the units while being used, but when the units are disposed, the fluorocarbons, if not properly processed or recovered, are released into the atmosphere.

As a result, recovery of fluorocarbons contained in products has been made obligatory based on the Fluorocarbons Recovery and Destruction Law, Home Appliance Recycling Law and End-of-life Vehicle Recycling Law. It is necessary for consumers, manufacturers, distribution outlets, wholesale agencies (various parties involved, such as construction companies and demolition operators), recovery/destruction operators to cooperate by fulfilling their respective obligations.

Recovery of fluorocarbons requires that the reduction targets in the Kyoto Protocol be achieved, and also contributes to an early recovery of the ozone layer.

System of Recovery and Destruction of Fluorocarbons Law

Commercial refrigeration and air-conditioning units

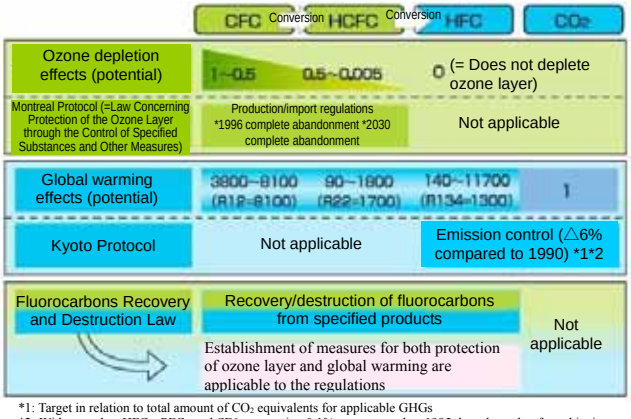
- Law for ensuring the Implementation of Recovery and Destruction of Fluorocarbons concerning Specified Products (CFC Recovery and Destruction Law) (enacted in June 2001, amended in June 2006)

Commercial refrigeration and air-conditioning units have been used for various purposes and have widely varied design specifications, such as air-conditioning units for buildings (various kinds of air-conditioning units such as package-type and large size turbo-type units), showcase units for food storage, large size freezers and refrigerators, and cold storage warehouses. Fluorinated carbon used as refrigerants is sealed inside the units while being used. However, when the units are disposed, the fluorinated carbon, if not properly processed or recovered, is released into the atmosphere.

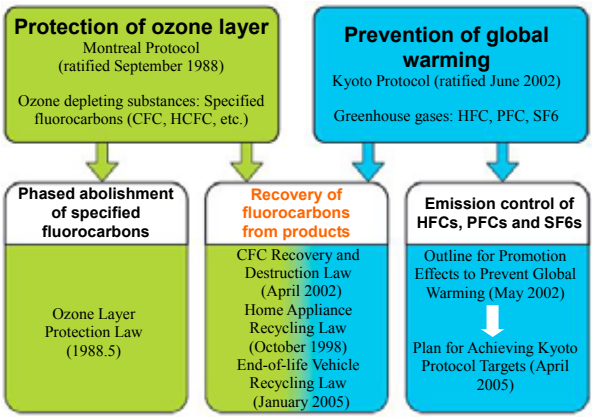
- Target Fluorocarbon: CFCs, HCFCs, HFCs

When disposing of commercial refrigeration, the users are required to ask Category 1 Fluorinated carbon recovery operators to recover fluorinated carbon from the products.

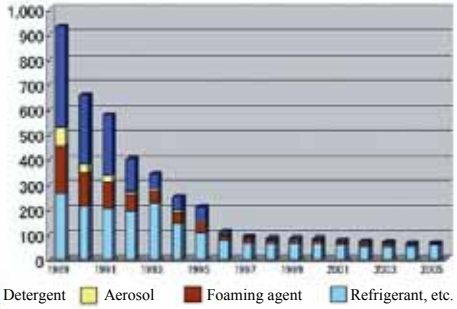
Correspondence Relationship between Montreal/Kyoto Protocols, Domestic Laws and Fluorocarbons



*1: Target in relation to total amount of CO_2 equivalents for applicable GHGs
*2: With regard to HFCs, PFCs and SF6s, target is +0.1% as compared to 1995, based on plan for achieving targets for global warming (approved by the Cabinet in April 2005)

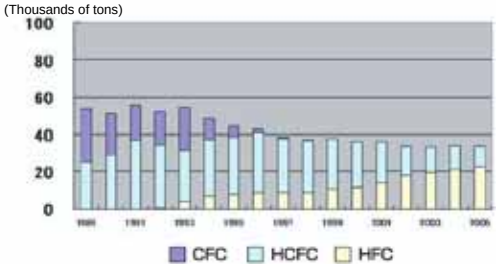


Transitions in Shipment Amounts of Fluorocarbons (CFC, HCFC, HFC) (according to use/CO_2 equivalent)



In addition to conversion of gas and elimination of fluorocarbons as based on the Montreal Protocol, there is also conversion to gases with a low global warming potential among HFCs, which are highly effective towards reduction as GHGs.

Transitions in Shipment Amounts of Fluorocarbons (CFC, HCFC, HFC) (for purpose of refrigerant only/as-is tons)



Since HFCs used as refrigerants do not have an effective conversion destination, reductions in the total amount cannot be expected, and it is necessary to use fluorocarbons for the moment. With an increase in conversion to HFCs, the increase in operating products on the market will cause HFCs applicable to the Kyoto Protocol to increase as well.

Amended Fluorocarbons Recovery and Destruction Law was enforced on October 1, 2007

System for Fluorocarbons Recovery and Destruction Law

Commercial refrigeration and air-conditioning units (commercial freezers/refrigerators and air-conditioning units)

- Law concerning the Recovery and Destruction of Fluorocarbons (Fluorocarbons Recovery and Destruction Law) (formulated June 2001, amended June 2006)

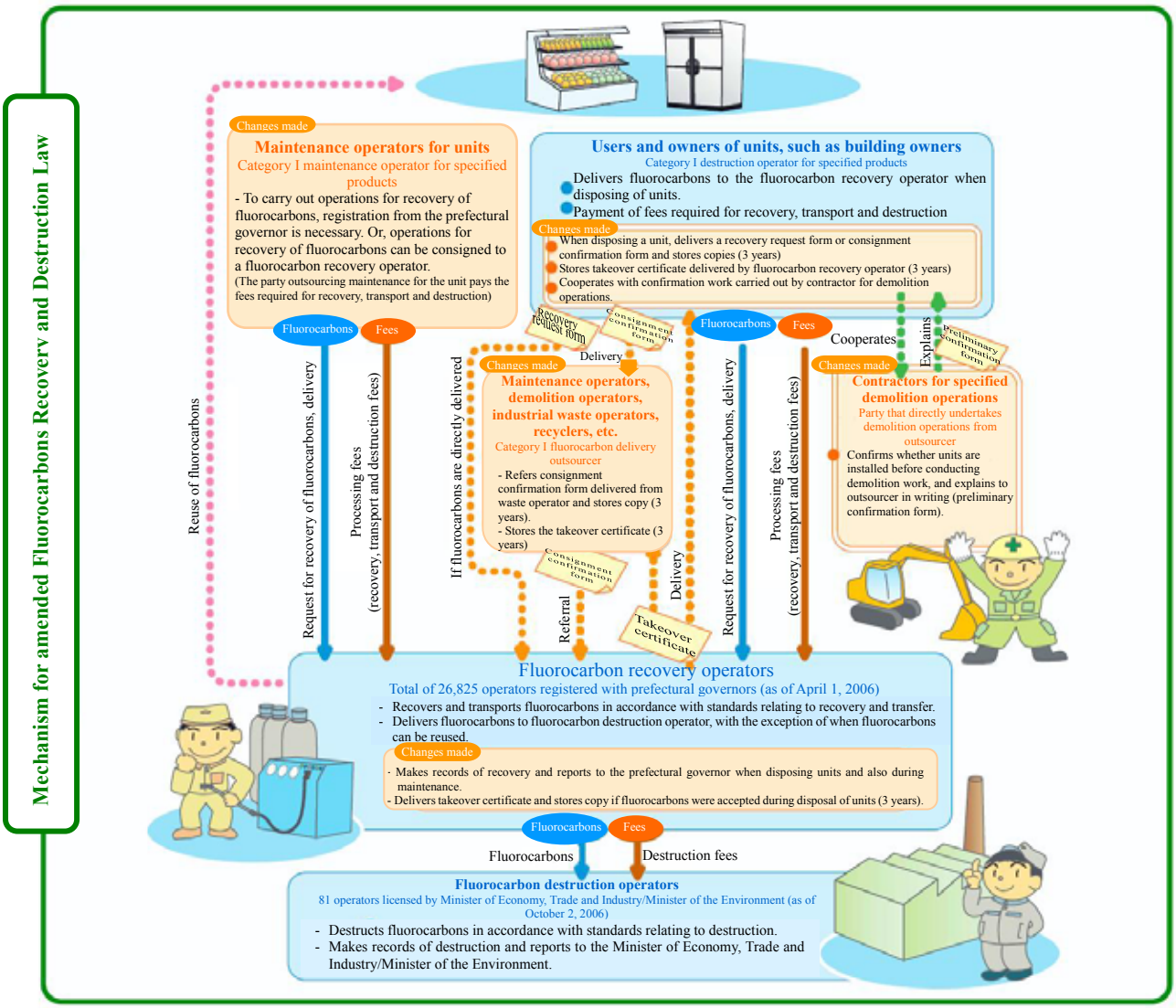
The amended Fluorocarbons Recovery and Destruction Law will be enforced on October 1, 2007.

Various commercial refrigerators/freezers and air-conditioning units will be applicable.

- Freezing/refrigeration units (freezers, refrigerators, showcase units for food storage, large cold storage warehouses, etc.)
- Air-conditioning units (air-conditioners, air-conditioning units for buildings (package-type and large-size turbo-type units)
- Refrigeration and freezing units used in transport units, units used in processes at factories, etc.

Applicable fluorocarbons: CFC, HCFC, HFC

- When disposing of commercial freezing and air-conditioning units, and when recovering (extracting) fluorocarbons when performing maintenance for units, recovery of fluorocarbons by a Category I recovery operator that has obtained registration from the prefectural governor is necessary.
- Operators that are trying to undertake demolition work of buildings must confirm beforehand whether there are any commercial freezing and air-conditioning units installed in the building, and must explain the results of the confirmation to the outsourcer of the work through a preliminary written confirmation.
- The disposer of commercial freezing/air-conditioning units (owner, user, etc.) must deliver a manifest (recovery request form or consignment confirmation form) if delivering fluorocarbons to the recovery operator and the principle contractor.
- If the fluorocarbon recovery operator receives the manifest (recovery request form or consignment confirmation form), they must recover fluorocarbons from the applicable unit and deliver the manifest (takeover certificate) to the disposer of the unit and the entrusted person for delivery of CFCs.
- Forms (manifests) in writing that are necessary when delivering fluorocarbons that fulfill particulars prescribed by law may be issued by the Industrial Network for Fluorocarbon Recovery Promotion (INFREP). (http://www.infrep.jp)

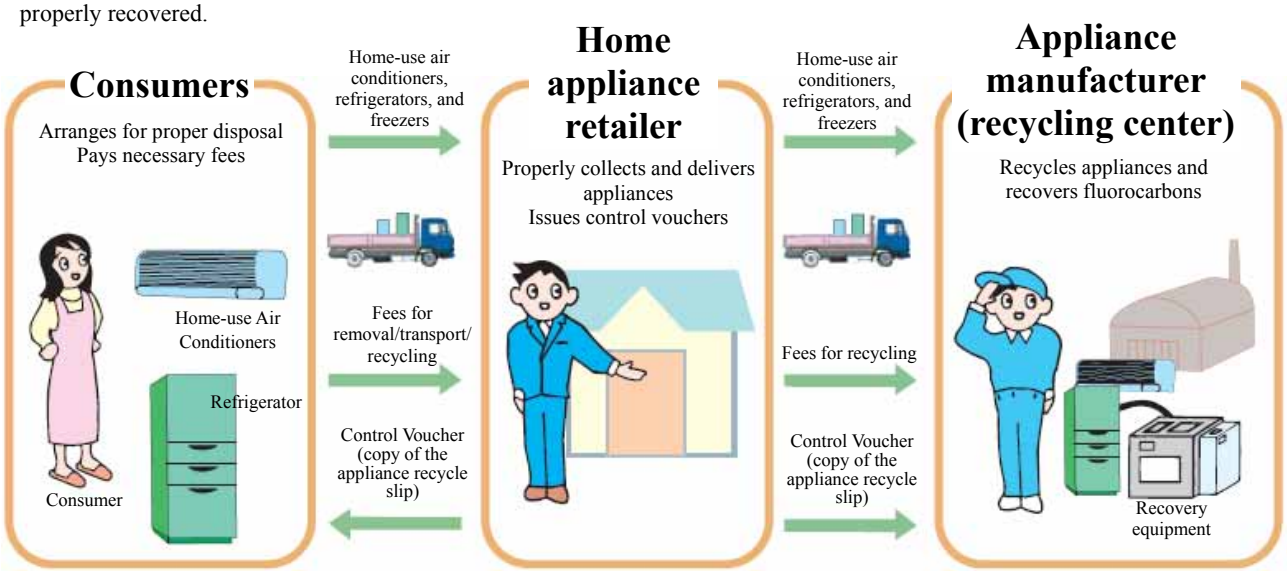


The Home Appliance Recycling Law System

Home-use air conditioners, refrigerators, and freezers

• Law for the Recycling of Specified Home Appliances (Home Appliance Recycling Law) (enacted in May 1998)
• Target fluorinated gases: CFCs, HCFCs, HFCs

When disposing of home-use air conditioners, refrigerators, and freezers, the user must have a home appliance retailer to dismantle and transfer them. Home appliance retailers are required to transport these items to a recycling center where fluorinated gases can be properly recovered.

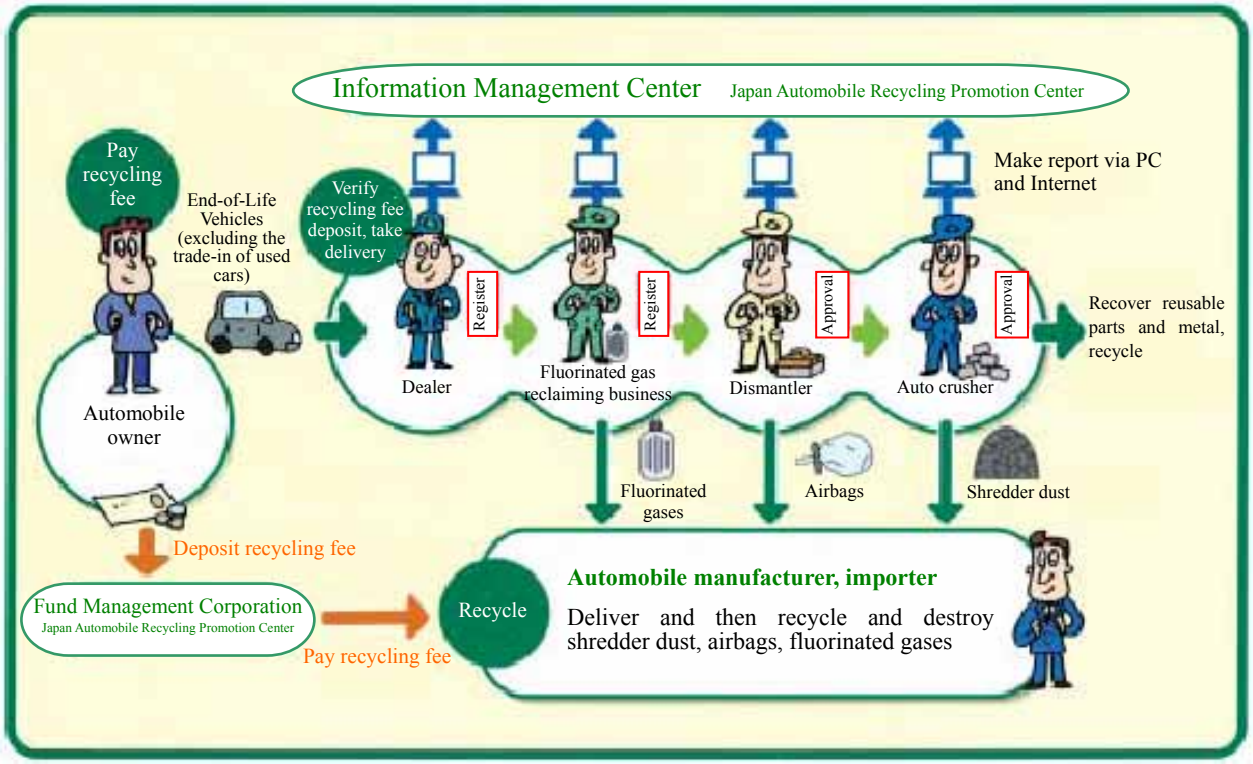


■ Started: April 2001

The Automobile Recycling Law System

• The Law for Recycling of End-of-Life Vehicles (the Automobile Recycling Law) (enacted in July 2002)
• Target fluorinated gases: CFCs, HCFCs, HFCs

When disposing of an automobile, hand it over to a dealer within the local government jurisdiction in which it is registered. The dealer delivers automobiles with air conditioners to a business that reclaims fluorinated substances to ensure that fluorinated gases are recovered.



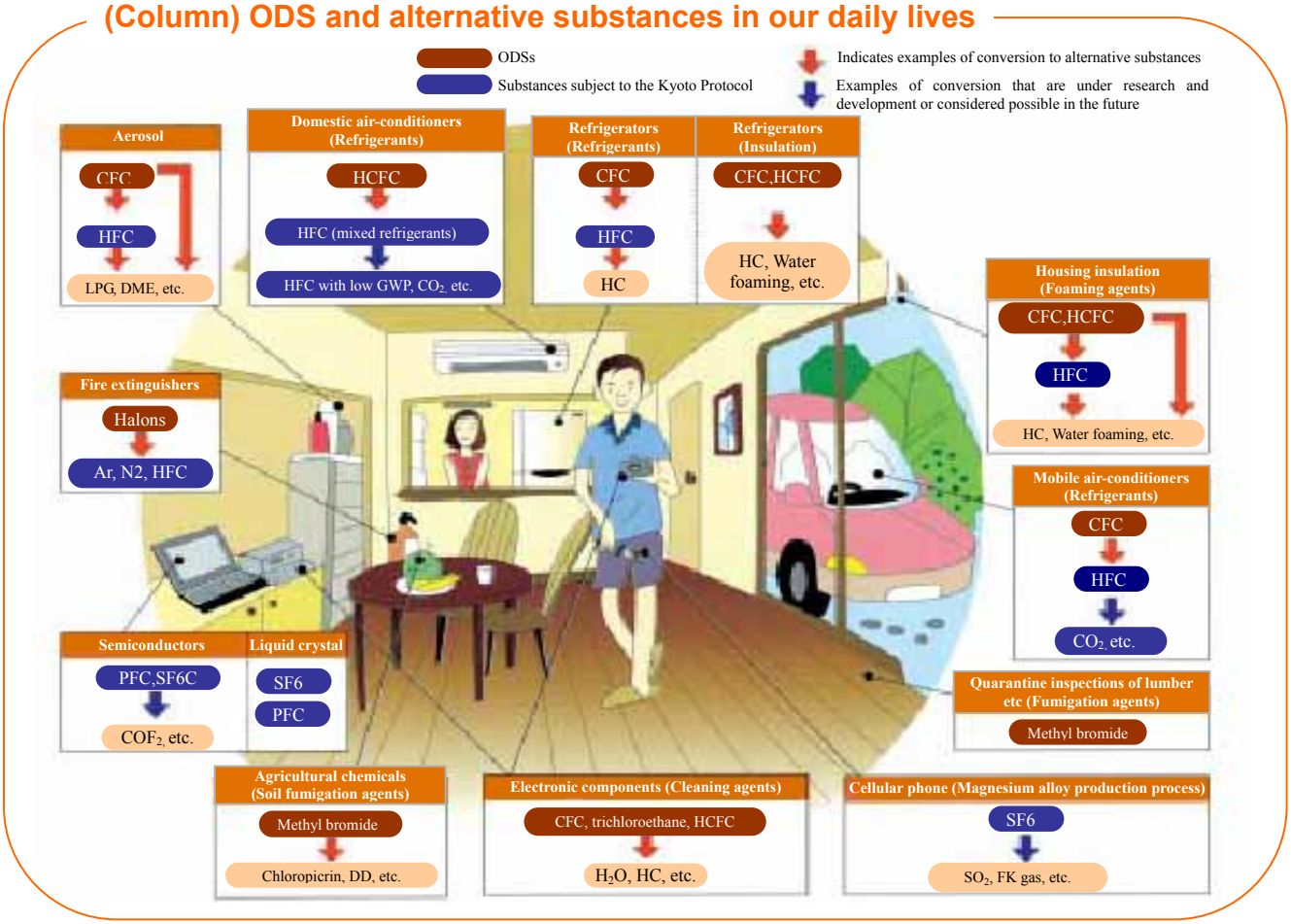
■ Started: January 2005

Support Measures for Replacing Equipment

In order to make steady progress in regulating the production, export and import of ODS and measures for reducing their emissions, it is necessary to gradually reduce domestic demand without upsetting markets. Therefore, the government provides tax incentives, financial assistance and other support measures to reduce the amount of ODS and greenhouse gases used by industries and to promote a smooth conversion to alternative substances and technologies.

	Cleaning equipment	Refrigeration/air-conditioning equipment	Others
● Financial Incentives			
(1) Ozone Layer Protection Measures (for example, by bringing in equipment that reduces CFC and HCFC emissions).			
Financing to promote the introduction of facilities for ozone layer protection strategies Measure: Lower interest rates on 40% of the financing (Interest rate difference is covered by the Industrial Structure Improvement Fund) Contact: Environment & Energy Department, Development Bank of Japan Tel: 03-3244-1620	○	○	○ (Recovery equipment, Recovery site facilities, Recycling equipment, Destruction equipment, etc.)
(2) Global Warming Strategies (for example, by bringing in equipment that reduces HFC, PFC, and SF6 emissions).			
Financing to promote global warming strategies targeting HFCs and other substances Measure: Lower interest rates on 40% of the financing Contact: Environment & Energy Department, Development Bank of Japan Tel: 03-3244-1620	○	○	○ (Recovery equipment, Recovery site facilities, Recycling equipment, Destruction equipment, etc.)

(Column) ODS and alternative substances in our daily lives



ODS, CFC Alternatives, etc. Regulations

In the past, specified fluorocarbons (CFC, HCFC) were used in a wide variety of applications, but most have now been converted to HFCs and nonfluorinated gases in accordance with production regulations. The following diagram indicates some examples of conversion, including to HFCs, which are greenhouse gases.

	ODSs		CFC Alternative, etc
Names of substance	**CFC**	**HCFC**	**HFC (CFC alternative)** **PFC** **SF6**
	Ozone layer destruction Global warming	Ozone layer destruction Global warming	Global warming
Ozone Depleting Potential (CFC-12 = 1.0)	(Example: CFC-12) 1.0	(Example: HCFC-22) 0.055	(Example: HFC-134a) 0.0
Global Warming Potential (CO_2 = 1.0)	8100	1700	1300
Applications	<Refrigerants> → <Refrigerants> Automobiles, Refrigerators <Refrigerants> → <Refrigerants> → <Refrigerants> Freezers, Air-conditioning units <Cleaning agents> → <Cleaning agents> → <Cleaning agents> <Foaming agents> → <Foaming agents> → <Foaming agents> Refrigerators, Insulation foams <Aerosol> → <Aerosol (mainly for dust blower)> <Semiconductor etching> <Electrical insulation>		
Phase-out Schedule	**The Montreal Protocol**		**The Kyoto Protocol**
	1989 Start of phase-out January 1996 Complete phase-out of production	1996 Start of phase-out January 2020 Scheduled for Complete phase-out of production 2004: not exceed 65% 2010: not exceed 35% 2015: not exceed 10% 2020: not exceed 0%	2008 — 2012 Note: The goal is to restrain the increase of the total emissions to no more than +0.1% compared to the total emissions in 1995.

* CFCs (Chlorofluorocarbons): An ODS. The production of CFCs has been completely phased out as of the end of 1995 on the basis of the Montreal Protocol.

HCFCs (Hydrochlorofluorocarbons): HCFCs were developed as alternative substances for CFCs. Although HCFCs have less effect on ozone layer depletion, they were later added to the restrictions. HCFCs will be completely phased out by the end of 2019.

HFCs (Hydrofluorocarbons): Non-ODS, so called CFC alternative.

PFCs (Perfluorocarbons): Non-ODS

SF6 (Sulfur hexafluoride): Non-ODS

Note: 2008 through 2012 is the target period based on the Kyoto Protocol. Japan's target year is 2010 on the basis of the Guideline of Measures to Prevent Global Warming.

History of Recovery and Destruction of CFCs

■ Recovered CFCs (FY2002 – FY2004)

(Unit: tons)

	2002	2003	2004	2005
Commercial refrigeration and air-conditioning units	1,958	1,889	2,102	2,298
Automobile air conditioners	389*1	638	702*2	806*2
Home air conditioners	807	860	995	1,122
Home refrigerators and freezers	234	287	311	311

*1 Amount recovered between October 2002 and March 2003
*2 Total amount recovered based on Fluorocarbons Recovery and Destruction Law and Law for Recycling of End-of-life Vehicle

■ Destroyed CFCs (FY2002 – FY2004)

(Unit: tons)

	2002	2003	2004	2005
Commercial refrigeration and air-conditioning units Automobile air conditioners	1,653	2,429	2,976	2,790
Home air conditioners*1	-	-	976	1,118
Home refrigerators and freezers*1	-	-	312	310

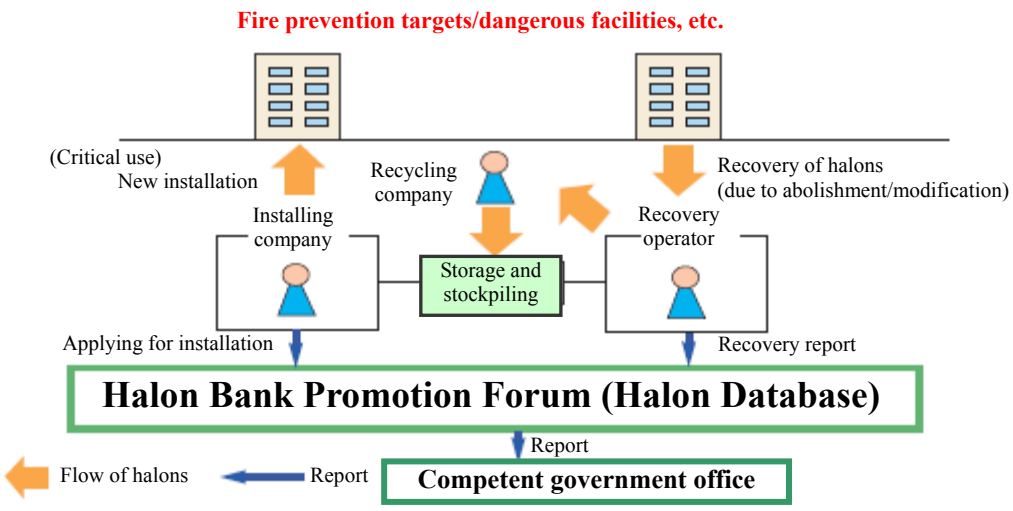
*1 Amount destroyed in FY2002 and FY2003 is not available.

Promote Recovering and Recycling Fire-Fighting use Halons (Halon Recovery/Recycling System)

Halons used for gas-based firefighting equipment efficiently extinguish fire, are less toxic, have excellent insulation properties, and do not deface the environment when used. Nonetheless, since they have powerful ozone depleting properties, their production was completely phased out in 1994.

Researchers all over the world have been trying to develop an alternative fire extinguishing agent that has the same excellent performance as halons but are environmentally friendly, but an equivalent substitute has yet to be developed.

Therefore, the government has worked to build a database concerning halons that have already been produced or installed within the "Specific Nonprofit Corporation Syoubou Kankyo Network (which gave approval to the involvement of the Halon Bank Promotion Council on January 1, 2006)" to prevent uncontrolled halon emissions into the atmosphere and to ensure the effective use of halons in special cases where no adequate fire extinguishing substitute exists (critical use) by coordinating suitable measures for the recovery and recycling of halons.



History of Ozone Layer Protection Measures

Global

Japan

1974/9

Indicated Impact of CFCs on Ozone Layer
Professor F.S. Roland of the University of California brought attention to the depletion of the ozone layer by CFCs and the possibility of the harmful effects of CFCs to the human ecosystem.

1978/3

The United States decided to gradually prohibit the use of CFCs in aerosol propellants.
Europe (EC) decided to freeze production and reduce the use of CFC-11 and CFC-12.

1980/3

/12 Recommended freezing the production and reducing the use of CFC-11 and CFC-12

1985/3

Adopted the Vienna Convention for the Protection of the Ozone Layer

1987/9

Adopted the Montreal Protocol on Substances that Deplete the Ozone Layer

1988/2 Made an interim report on principles for regulating ODS

1988/5 Established the Ozone Layer Protection Law that sets the regulations for ODS

1989/4 Established the Ozone Layer Protection Countermeasures Office (current Ozone Layer Protection Policy Office) in MITI

/5

/6 Established the Council for Promotion of the Rational Use of ODS (current Japan Industrial Conference for Ozone Layer Protection) in the industrial trade

Adopted the Helsinki Declaration
Decided to completely phase out specified CFCs by 2000

/7 Started regulations on CFCs (CFC-11, 12, 113, 114, 115)

1990/6 Chemical Products Council:
Made a report on Future measures for protecting the ozone layer

1991/2

2nd Meeting of Parties to the Montreal Protocol (London)
Amended the Montreal Protocol
Decided to tighten regulations including expanding the list of restricted substances (carbon tetrachloride, 1.1.1-trichloroethane, other ODSs)

/3 Made partial amendment of the Ozone Layer Protection Law
Added 1.1.1-trichnoloethane, other CFCs and carbon tetrachloride to the list of the substances subject to production regulations

1992/1 Started regulations on Halons

/3

Japan/U.S./Thailand Ozone Layer Conference
Similar conferences were also held with Malaysia, Indonesia, Vietnam and the Philippines as part of efforts to share technologies with developing countries to support phase out of their ODS use.

/11

1993/1 Started regulations on other CFCs and 1.1.1-trichloroethane

/12 Completely phased out Halon production

4th Meeting of Parties to the Montreal Protocol (Copenhagen)
Amended the Montreal Protocol
(1) Regulations applied to HCFCs, HBFCs and methyl bromide.
(2) Decided to greatly accelerate the schedule for complete phase-out of CFCs and other substances focusing on complete phase-out in 1996

1994/6 Made partial amendment of the Ozone Layer Protection Law
Added HCFCs, HBFCs and methyl bromide to the list of substances subject to production regulations

1995/1 Started regulations on carbon tetrachloride and methyl bromide

/12 Completely phased out the production of CFCs, 1.1.1-trichnoloethane and carbon tetrachloride

7th Meeting of Parties to the Montreal Protocol (Vienna)
Amended the Montreal Protocol
(1) Decided to tighten regulations on HCFCs in Non-Article 5 countries and determined the schedule for phasing out methyl bromide.
(2) Decided the schedule for CFC regulations in Article 5 countries.

1996/1 Started regulations on HCFCs and HBFCs

/3 Chemical Products Council:
Made an interim report on Future measures for protecting the ozone layer

1997/4 MITI (current METI) developed a program for recovering ODS.

/9 Industrial trade developed a voluntary plan for recovering ODS.

1998/10 Established the Law for Recycling of Specified Kinds of Home Appliance

1999/12

9th Meeting of Parties to the Montreal Protocol (Montreal)
Amended the Montreal Protocol
Decided to tighten regulations on trading methyl bromide.

2001/6 Established the Chlorofluorocarbons Recovery and Destruction Law

/7 Presented CFC management strategy

11th Meeting of Parties to the Montreal Protocol (Beijing)
Amended the Montreal Protocol
(1) Decided to regulate HCFC production
(2) Decided to regulate bromochloromethane consumption and production
(3) Decided that Non-Article 5 countries draft and present CFC management strategy

2004/12 Completely phased out the production of methyl bromide

2005/1 Established the Law for Recycling of End-of-life Vehicle

2006/6 Partial amendment of the Fluorocarbons Recovery and Destruction Law.

2007/4 Established the Industrial Network for Fluorocarbon Recovery Promotion

History of Global Warming Mitigation Measures

Global

Villach Conference (Austria) — 1985/10
First world conference on global warming

Toronto Conference (Canada) — 1988/6
A specific numerical target, reduction of CO2 by 20% by 2005, was presented for the first time.

Established the IPPC — /8
The IPPC (Intergovernmental Panel on Climate Change) was established.

IPCC First Assessment Report — 1990/8

Agreed to the United Nations Framework Convention on Climate Change (New York) — 1992/5

Held the Earth Summit (Rio de Janeiro) — /6

The United Nations Framework Convention on Climate Change came into effect. — 1994/3

COP1: First Conference of the Parties (Berlin) — 1995/3
Decided to adopt a protocol for an international framework to prevent global warming from 2000 onward by the end of the Third Conference of the Parties (COP3). Also decided to not introduce any new reduction commitments for developing countries other than the obligations under existing treaties (Berlin Mandate).

IPCC Second Assessment Report — /12

COP2: Second Conference of the Parties (Geneva) — 1996/7
COP = Conference of the Parties

Adopted the Kyoto Protocol COP3: Third Conference of the Parties (Kyoto) — 1997/12
Decided greenhouse gas emission reduction targets for developed countries, but left the handling of the Kyoto Mechanism and forest sinks as well as specific rules for compliance issues and support to developing countries to future decision

COP4: Fourth Conference of the Parties (Buenos Aires) — /11

COP5: Fifth Conference of the Parties (Bonn) — 1999/10

COP6: Sixth Conference of the Parties (Hague) — 2000/11
Conducted negotiations on the Kyoto Mechanism, sinks, compliance issue and issue of developing countries, discontinued the negotiations because country interests were too intricately intertwined with each other.

The U.S. expressed its disapproval of the Kyoto Protocol. — 2001/3
The U.S. expressed its disapproval of the Protocol“ because the Kyoto Protocol excludes developing countries and may have a harmful effect on the U.S. economy.”

IPCC Third Assessment Report — /4

COP6.5: Resumed Session of the Sixth Conference of the Parties (Bonn) — /6, /7
Adopted the “Core Elements for the Implementation of the Buenos Aires Plan of Action (Bonn Agreement)” and agreed on the flexible use of the Kyoto Mechanism and the handling of forest sinks, etc.

COP7: Seventh Conference of the Parties (Marrakech) — /10
Based on the ”Bonn Agreement,” adopted legal grammar for the implementation of the Kyoto Protocol

World Summit on Sustainable Development (Johannesburg) — 2002/3, /8

COP8: Eighth Conference of the Parties (New Delhi) — /10, /11

COP9: Ninth Conference of the Parties (Milan) — 2003/12

The Kyoto Protocol came into effect — 2005/1, /2

Start of First Commitment Period for Kyoto Protocol — /4
(January 2008 to December 2012)

Japan

1997/12
- 1998/4 Industrial arena developed a voluntary action plan for regulating emissions of HFCs, PFCs and SF6 Chemical Products Council:
- /5 Made an interim report on Measures for reducing emissions of HFCs, PFCs and SF6
- /6 The Cabinet decided the Guideline of Measures to Prevent Global Warming.
- /10 Enforced the Law for Recycling of Specified Kinds of Home Appliance
- /11 Established the Law Concerning the Promotion of the Measures to Cope with Global Warming

2000/11
- /6 Established the Chlorofluorocarbons Recovery and Destruction Law.

2002/3
- /6 Amended the Guideline of Measures to Prevent Global Warming (decided by the Cabinet)
- /6 Japan ratified the Kyoto Protocol.
- /8 Chemicals and Biochemistry Committee, Industrial Structure Council:
- /10 Made an interim report on measures for reducing emissions of HFCs, PFCs and SF6 in the future
- /11 Formulated the Responsible Use Principles for HFCs (in cooperation with the US Environmental Protection Agency and the UN Environment Programme)

2005/1
- Established the Law for Recycling of End-of-life Vehicle

/4
- The plan for reaching Kyoto Protocol targets (decided by the Cabinet)

2006/6
- Partial amendment of the Chlorofluorocarbons Recovery and Destruction Law.

2007/4
- Industry established the Industrial Network for Fluorocarbon Recovery Promotion

/10
- Enforced the amended Fluorocarbons Recovery and Destruction Law

2008/1

Inquiries about fluorocarbon recovery of commercial freezing/air-conditioning units

Industrial Network for Fluorocarbon Recovery Promotion (INFERP)
Tel: 03-5842-2380 URL http://www.infrep.jp

Inquiries about the automobile recycling system

Japan Automobile Recycling Promotion Center
Tel: 03-5673-7396 URL http://www.jars.gr.jp/

Inquiries about home appliance recycling

Association for Electric Home Appliances (RKC: Recycling Ken Center)
Toll-free: 0120-319640 URL http://aeha.or.jp/

Inquiries about the Halon Bank

Halon Bank Promotion Forum
Tel: 03-5404-2180
4F NKK Bldg., 2-18-2 Nishi-Shimbashi, Minato-ku, Tokyo 105-0003

Inquiries about this brochure

Ozone Layer Protection Policy Office, Manufacturing Industries Bureau,
Ministry of Economy, Trade and Industry Tel: 03-3501-4724 (direct)

Ministry of Economy, Trade and Industry

1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8901
Tel: 03-3501-1511 URL: http://www.meti.go.jp/

Hokkaido Bureau of Economy, Trade and Industry Environmental Protection and Natural Resources Department
Environmental Protection Administration Division 011-709-1754
Tohoku Bureau of Economy, Trade and Industry Industrial Department
Manufacturing Industry Division 022-215-7236
Kanto Bureau of Economy, Trade and Industry Industrial Policy Department
Environmental Protection and Recycling Division 048-600-0293
Chubu Bureau of Economy, Trade and Industry Industrial Policy Department
Environmental Protection and Recycling Division 052-951-2768
Kinki Bureau of Economy, Trade and Industry Industries, Commerce and Distribution Department
Manufacturing Industry Division 06-6966-6022
Chugoku Bureau of Economy, Trade and Industry Industrial Department
Manufacturing Industry Division 082-224-5684
Shikoku Bureau of Economy, Trade and Industry Industrial Department
Manufacturing Industry Division 087-831-3141ex.333
Kyushu Bureau of Economy, Trade and Industry Environmental Protection and Natural Resources Department
Recycling Promotion Division 092-482-5472
Okinawa General Bureau Department of Economy, Trade and Industry Environmental Protection and Natural Resources Division
098-866-0068