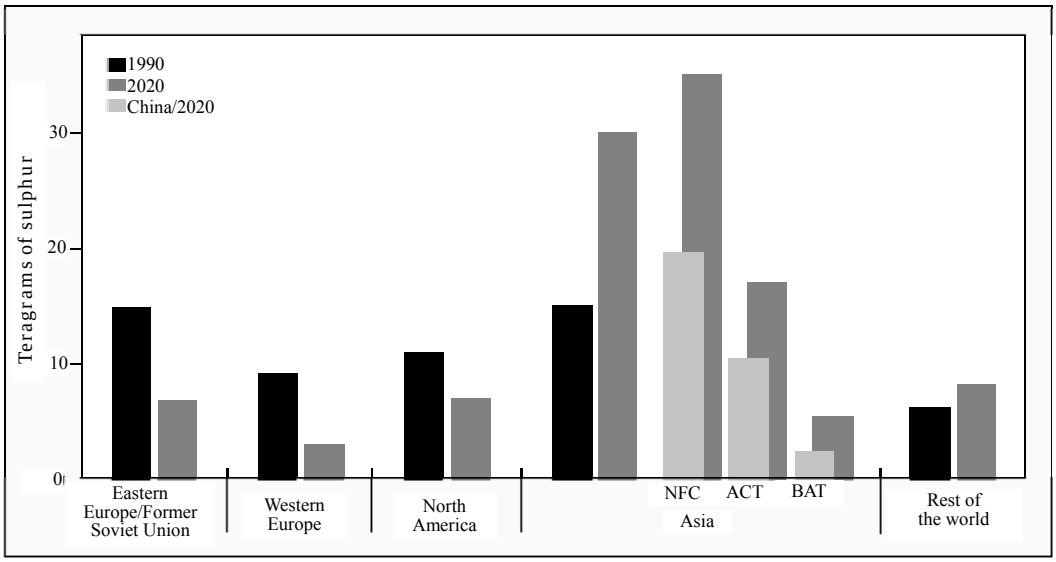
6. Environmental Measures

6.1 Reinforcement of Conventional Environmental Measures in Developing Countries

[Points]

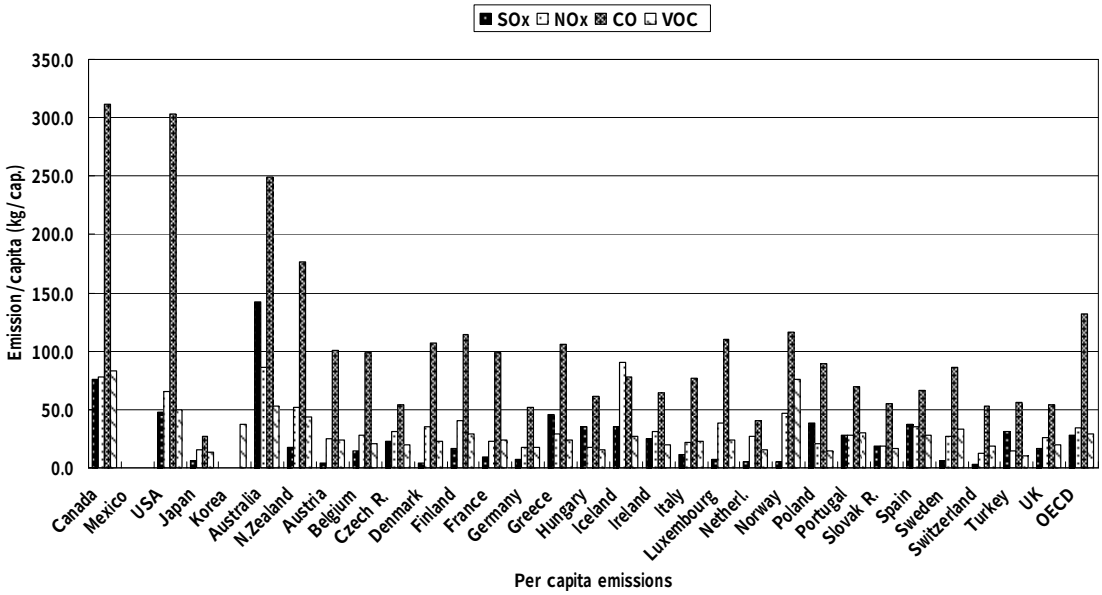
- In Asia, especially in China, emissions of SOx and other air pollutants are expected to increase as countries consume more fossil fuels, including coal, in line with economic development (Figure 6.1-1, Figure 6.1-2).
- Some studies have claimed that the relationship between income levels and environmental burden shows an inverted U-shape, called "Environmental Kuznets Curve." This curve indicates that environmental burden increases in the beginning of economic development and then, after a threshold, starts decreasing with further development. Experts attribute the decrease in environmental burden to a shift in the socioeconomic structure and changes in the social system, in addition to technological development and deployment and improved financial circumstances (Figure 6.1 3).
- It is indispensable to form a framework in which developing countries are encouraged to claim latecomers' advantages in making the best use of technological expertise and information accumulated by developed countries, in order to overcome the threshold of Kuznets Curve earlier.

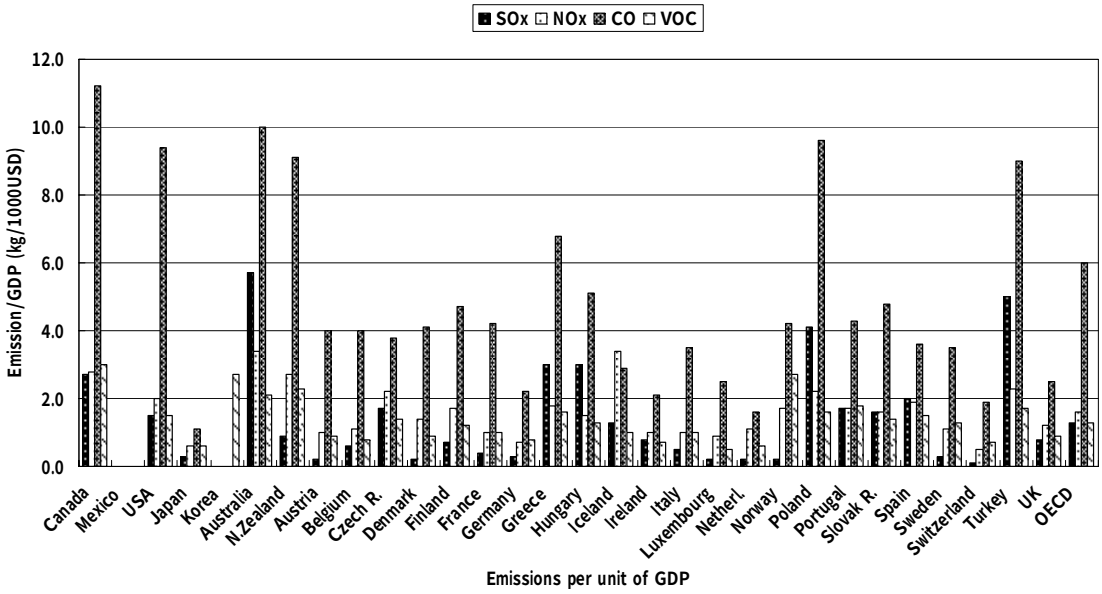
[Related Data and Facts]



Source: OECD ENVIRONMENTAL DATA COMPENDIUM 2004 (OECD).

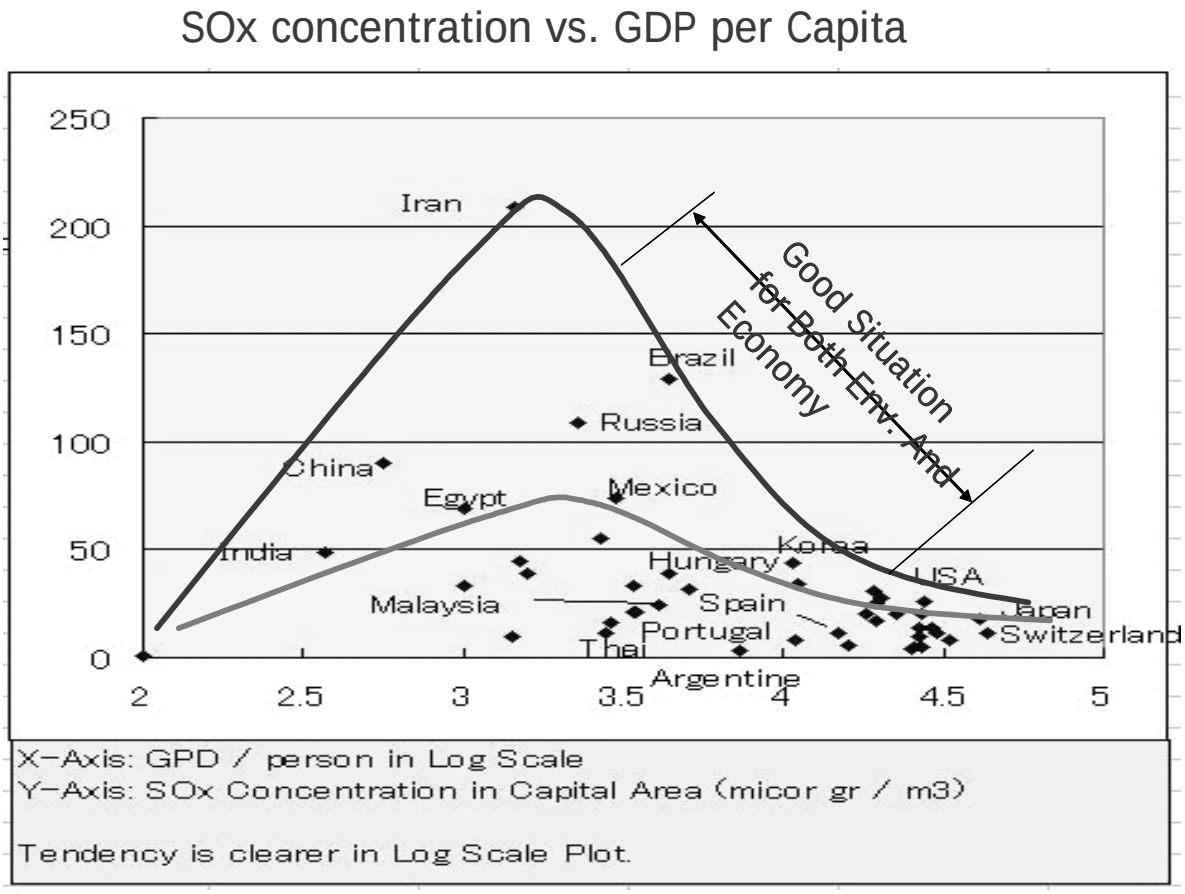
Figure 6.1-1 World outlook for SOx emissions by region





Source: Compiled on the basis of OECD ENVIRONMENTAL DATA COMPENDIUM 2004 (OECD).

Figure 6.1-2 Air pollutant emissions in major OECD countries



Source: Symposium on Energy and Global Warming (December 16, 2006)
: Presentation materials from United Nations University Vice-Rector Itaru Yasui

Figure 6.1-3 Environmental Kuznets Curve for SOx emissions

6.2 Positioning of CO_2 Capture and Storage Technology and Promotion of Technological Development

[Points]

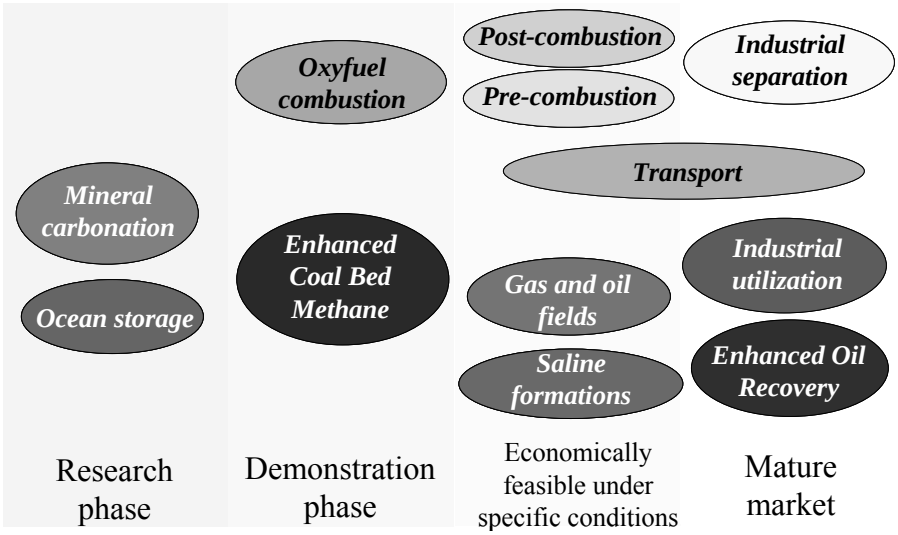
- Carbon dioxide capture and storage (CCS) technology is designed to separate and collect CO_2 from massive CO_2 emission sources and store CO_2 in stable geological formation or in the ocean, thus permanently isolating CO_2 from the atmosphere.
- The IPCC guidelines released in October 2006, which includes new evidence, provided a guideline in the accounting of CCS in the national inventory, but were yet to specify whether to apply emission reductions achieved by CCS to the first commitment period under the Kyoto Protocol. Discussion is also still under way about the applicability of CCS in the clean development mechanism (CDM).
- Under Central Environment Council's Global Environment Committee, the Advisory Panel on Carbon Dioxide Storage reported that CCS technology should be an effective technology that could serve as a "temporary bridge" to the emergence of a safe and secure innovative technology.
- Nevertheless, CCS can be an important mid- and long-term option against global warming if it is implemented in a proper manner to minimize its environmental impacts, since CCS has huge potential of emission reduction (Table 6.2-1). In this respect, more effort should be directed to research and development of elemental CCS technology (Figure 6.2-1).
- Some experts have expressed concerns about CCS, including the unknown behavior of stored CO_2 and the potential environmental impacts of CO_2 (especially, ocean sequestration). For these reasons, many countries are more cautious about CCS than about other renewable energy technologies or energy saving measures (Figure 6.2-2). To make CCS more acceptable, we need to improve assessment techniques for cost, safety, and environmental impact.

[Related Data and Facts]

Table 6.2-1 CCS reduction (storage) potential

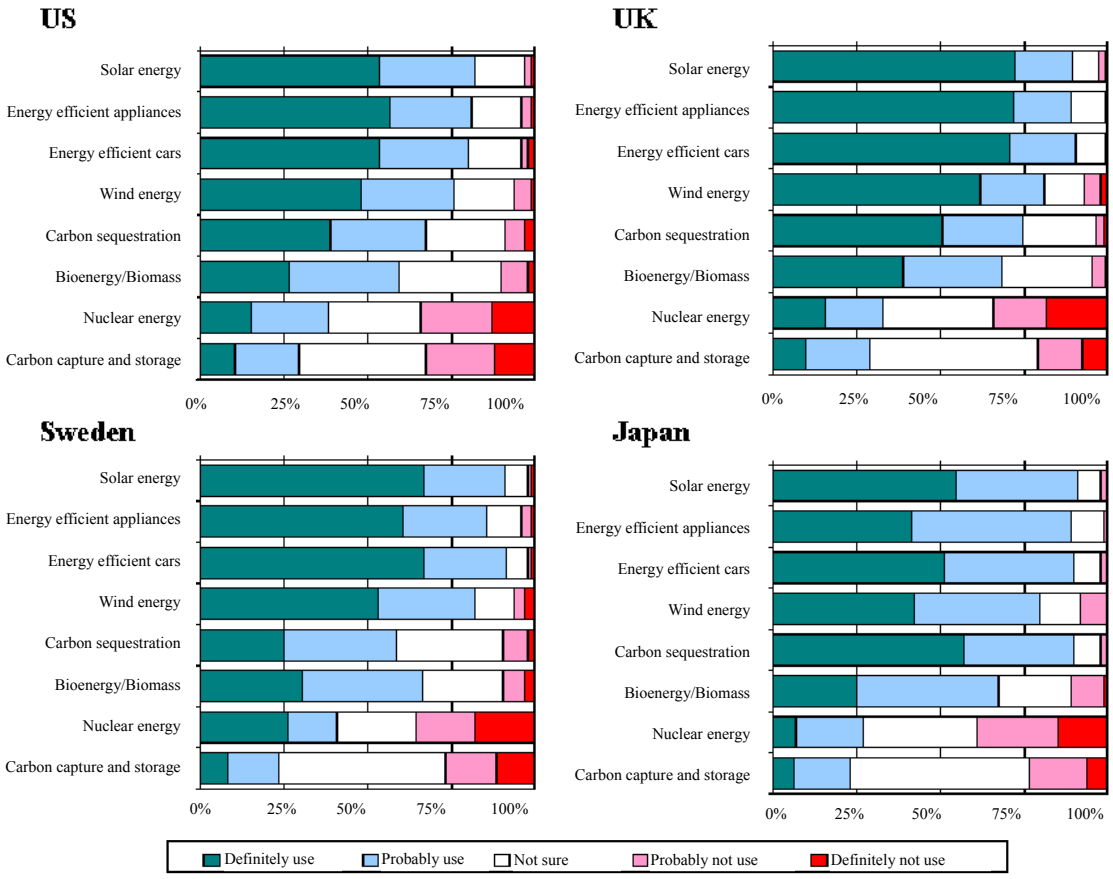
Reservoir type	Lower estimate of storage capacity ($GtCO_2$)	Upper estimate of storage capacity ($GtCO_2$)
Oil and gas fields	675[a]	900[a]
Unminable coal seams (ECBM)	3-15	200
Deep saline formations	1,000	Uncertain, but possibly 10^4

Source: IPCC Special Report on Carbon Dioxide Capture and Storage, 2005



Source: IPCC Special Report on Carbon Dioxide Capture and Storage, 2005

Figure 6.2-1 CCS technology and degree of maturity



Source: David Reiner et al, "An international comparison of public attitudes towards carbon capture and storage technologies"

Note: Results of a consciousness survey on technology employed by persons who might hypothetically take charge of global warming activities

Survey year: 2004 on the U.S., 2005 in U.K., 2006 in Sweden, 2004 in Japan.

Figure 6.2-2 National consciousness of CCS (survey of general public)

6.3 Reduction of Greenhouse Gases other than Energy derived CO_2

[Points]

- Non-CO_2 gases account for about 23% of global greenhouse gases (Table 6.3-1). Globally, a large number of inexpensive measures are available to deal with non-CO_2 gases discharged from waste treatment facilities and manufacturing processes (Figure 6.3-1). To reduce greenhouse gases at lower costs, it is important to promote reductions in non-CO_2 gases (Figure 6.3-2).
- In Japan, most greenhouse gas emissions are attributable to CO_2, while there has been a significant reduction in non-CO_2 gasses since the base year under the Kyoto Protocol (Figure 6.3-3). Still, in agriculture, stockbreeding, and waste management sectors in Japan, many cost-effective measures to reduce greenhouse gas emissions are remained (Table 6.3-2).
- Efficient measures should also be implemented to reduce non-energy CO_2 and non-CO_2 gas emissions by collecting and analyzing data concerning costs and potential for greenhouse gas reductions.

[Related Data and Facts]

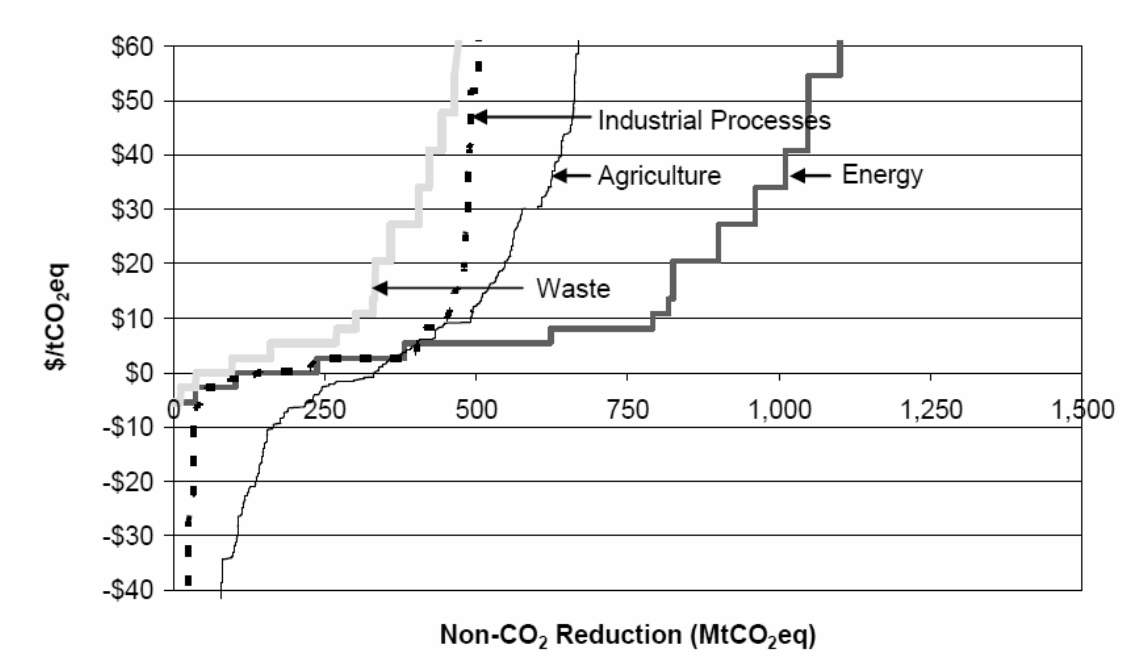
Table 6.3-1 Global Greenhouse Gas (GHG) Emissions for 2000

($MtCO_2eq$)

Sectors	CO_2	CH_4	N_2O	High-GWP	Global Total	Percentage of Global Totl GHGs
Energy	23,408	1,646	237		25,291	61%
Agriculture	7,631	3,113	2,616		13,360	32%
Industry	829	6	155	380	1,370	3%
Waste		1,255	106		1,361	3%
Global Total	31,868	6,021	3,114	380	41,382	
Percentage of Global Total GHGs	77%	15%	8%	1%		

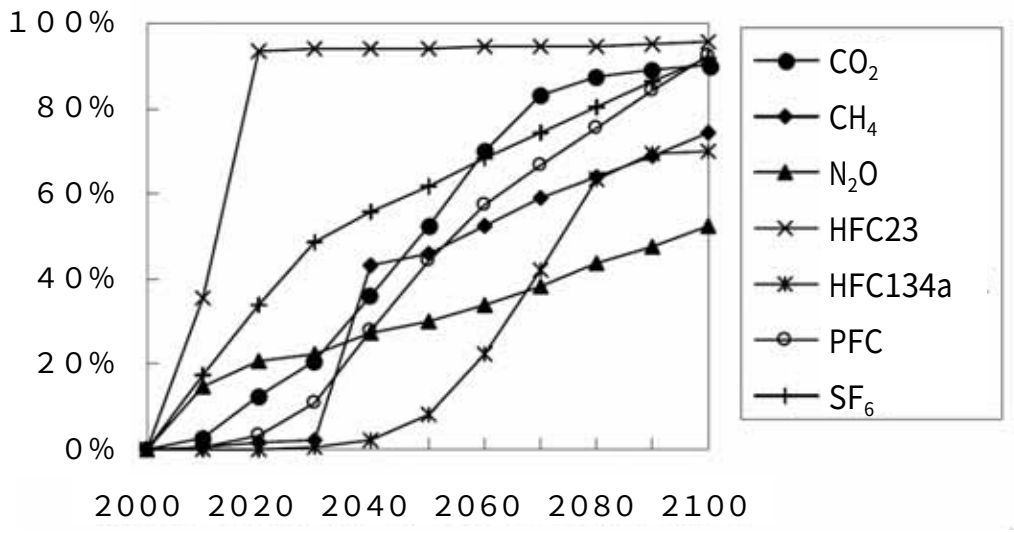
Source: Adapted from de la Chesnaye et. Al. in press: USEPA, 2006

Source: EPA "Global Mitigation of Non-CO_2 Greenhouse Gases"



Source: EPA "Global Mitigation of Non-CO_2 Greenhouse Gases"

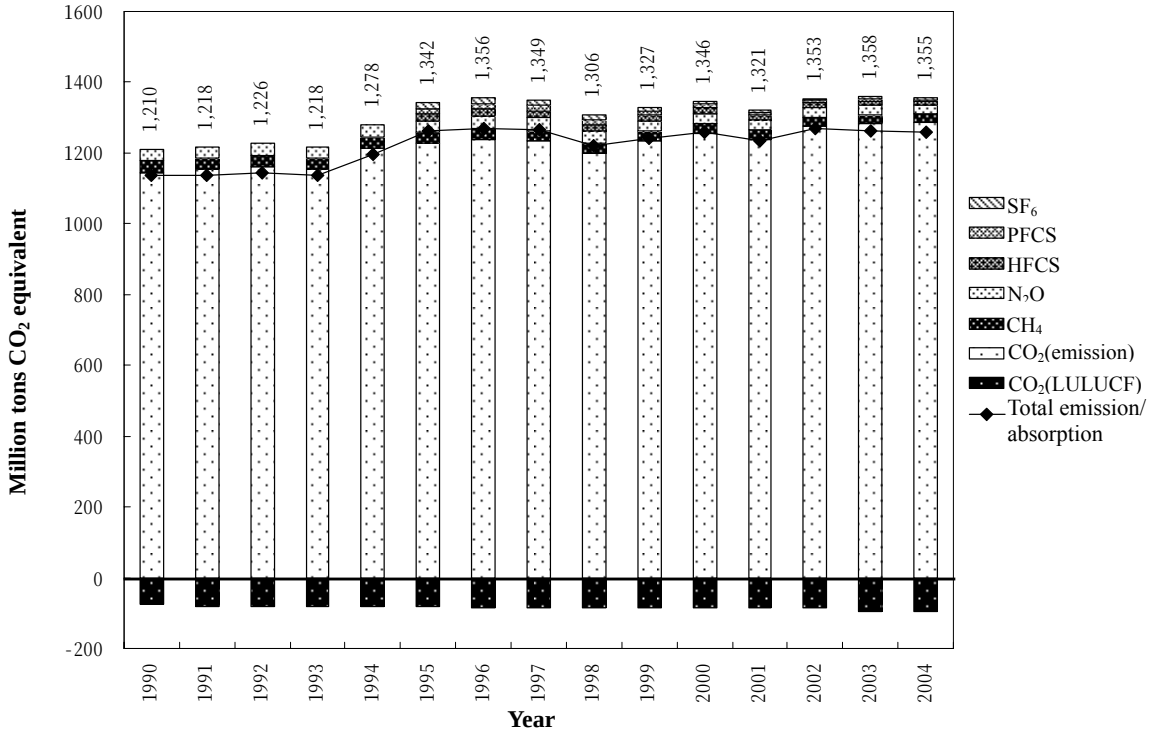
Figure 6.3-1 Marginal cost curve for global non-CO_2 gas reduction by sector (2020)



Source: Atsushi Kurosawa (The Institute of Applied Energy)
"MULTIGAS REDUCTION STRATEGY UNDER CLIMATE STABILIZATION TARGET"

Note: The figure provides the results of analysis using an optimized integrated assessment model with respect to energy, macroeconomics, land utilization, climate change, and environmental impacts with a 2100 reduction target of 1ºC below the level at which no measure is taken against climate change. Close connections are modeled between emissions of CO_2, CH_4, and N_2O and energy consumption and between emissions of methane, dinitrogen monoxide, and fluoride gases and macroeconomics.

Figure 6.3-2 Economic path for global greenhouse gas reduction



Source: Japan Greenhouse Gas Inventory Report, 2006

Figure 6.3-3 Changes in greenhouse gas emissions in Japan

Table 6.3-2 Japan's potential for non-energy-derived CO_2 greenhouse gas reduction

Area	Calculation category	Reduction potential [thousand tons-CO_2]	Measure and technology	Cost-benefit performance [yen/t-C]
Agriculture, Stockbreeding	Fermentation in animal gastrointestinal tract	663 to 709	Improvement in livestock productivity	0
			Improvement in livestock feed composition	57,000
	Animal manure treatment	1,711 to 2,721	Improvement in animal manure treatment systems	0
	Rice cultivation	1,147 to 2,372	Improvement in water management systems	0
			Acceleration of rice straw decomposition	567,400
	Fertilization	20 to 98	Improvement in fertilization procedures	69,300 to 298,000
Waste	Landfill	566 to 741	Recycling of food waste	3,497,000
			Soil covering of final disposal sites	3,300 to 13,200
	Sewage treatment	271 to 375	Improvement in sewage treatment systems	2,220,000
			Domestic wastewater measurement technology by bio- and eco-engineering	2,570,000 to 3,520,000
	Incineration	1,858 to 2,400	Reduction in waste plastic emissions	0
			Waste plastic utilization for blast furnaces, etc.	4,400 to 5,320
			Reduction in emissions from sewage incineration furnaces	20,300 to 35,100
Industrial process		2,910	Promotion of the use of cement in blast furnaces and the use of fly ash cement	—
		76 to 156	Promotion of the use of eco-cement	234,667

Source: Compiled based on Ministry of the Environment, Committee on Global Environment, Subcommittee for Goal Achievement Scenarios, "Evaluation of the current policy and future reduction potential concerning non-energy carbon dioxide, methane, and dinitrogen monoxide, 2001"