Chapter 4

Projections and the Total Effect of Policies and Measures

4.1 Basic Approach

Several outlooks have been proposed regarding Japan's future greenhouse gas emission and energy consumption. Out of these, the future target presented in the Kyoto Protocol Target Achievement Plan (hereinafter the "Target Achievement Plan") indicates most explicit relevance to the implemented policies and measures, involves broad and numerous organizations in its formulation, and is based on the most recent information. This future target will be described here as the future outlook, due to its indication of Japan's future development in greenhouse gas emission, as well as the overall effectiveness of the policies and measures currently adopted and those planned for the future.

The Target Achievement Plan adopted by the Cabinet in April 2005, as its basic approach, placed particular importance on the assessment and review process, and stated that in FY2007, one year before the start of the first commitment period, the Government will comprehensively evaluate the progresses of measures and policies in the Target Achievement Plan and the state of emissions and conduct a review of the Plan as a whole.

To that end, in November 2006, the Government began deliberations on the assessment and review of the Target Achievement Plan at the Central Environment Council, the Industrial Structure Council and other forums. They considered the assessment of progress of measures and policies in each sector, conducted hearings from experts, relevant ministries and agencies and other organizations concerned, and considered the review of countermeasures and policies in each sector. Based on these efforts, the Government estimated the outlook for total greenhouse gas emissions in FY2010 assuming that the countermeasures and policies currently adopted and those planned for the future continue to be implemented under the current domestic situation (hereinafter the "existing countermeasures scenario").

As a result, it was estimated that with emissions of energy-originated CO_2 likely to rise 4.6-5.9 percent over the base year of the Kyoto Protocol and total emissions including greenhouse gases other than energy-originated CO_2 likely to increase 0.9-2.1 percent over the base year, total emissions would not decline by 0.6 percent from the base year in FY2010, the target year under the Target Achievement Plan as countermeasures to reduce greenhouse gas emissions. (The Interim Report on the Assessment and Review of the Kyoto Protocol Target Achievement Plan, September 2007）

Thus, the Government continued to deliberate on the addition and strengthening of countermeasures and policies necessary to enhance the probability of achieving Japan's commitment of reducing total emissions by 6 percent under the Kyoto Protocol and reviewed the Target Achievement Plan.

Consequently, the Government formulated a totally revised version of the Target Achievement Plan in March 2008. The totally revised Plan indicates the total emission outlook of greenhouse gases in FY2010 when additional countermeasures and policies are implemented (hereinafter “enhanced countermeasures scenario”).

Table 4.1 Setup of Cases in the Estimation of Future Outlook

Cases	Meaning
Existing countermeasures scenario (With measures)	Future forecast premised on the latest future outlook for the society and economy at the time of assessment (FY2007) and the implementation of policies and measures decided prior to the time of assessment (Kyoto Protocol Target Achievement Plan, April 2005)
Enhanced countermeasures scenario (With additional measures)	Future forecast premised on the latest future outlook for the society and economy at the time of assessment (FY2007) and the implementation of additional policies and measures planned after the time of assessment (Kyoto Protocol Target Achievement Plan, March 2008)

This future outlook was estimated on the basis of the latest information available in FY2007, the year for the assessment and review of the Target Achievement Plan. Emissions used were based on the inventory information submitted to the secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) and the latest available information was used for other information as well. In addition, the subject year for forecast is FY2010, the middle year of the first commitment period.

Table 4.2 Future Outlook and Results by Category of Greenhouse Gas Emission
(Existing Countermeasures Scenario)

(Unit: Million tCO_2)

Classification	Kyoto Protocol base year	Estimates for FY2010				Target Achievement Plan
		Higher Case		Lower Case		
		Emissions	% Change against base year	Emissions	% Change against base year	
Energy-originated CO_2	1,059	1,107	4.6%	1,122	5.9%	
Industrial sector	482	438	-9.1%	441	-8.5%	
Civilian (Commercial and other sector)	164	211	28.5%	215	30.9%	
Civilian (Residential sector)	127	145	13.4%	148	16.1%	
Transport sector	217	245	12.7%	249	14.5%	
Energy industries sector	68	68	0.9%	69	1.0%	
Non-energy-originated CO_2	85	86	1.7%	86	1.7%	
CH_4	33	23	-31.5%	23	-31.5%	
N_2O	33	25	-23.7%	25	-23.6%	
Three fluorinated gases	51	32	-38.1%	32	-38.1%	1,253
Total emissions	1,261	1,273	0.9%	1,287	2.1%	(-0.6%)

* Base-year total emissions ratio = (emissions for each case in each sector - base year emissions in each sector) / base year total emissions)

* When the estimates are rendered uncertain by differing assumptions, the estimates, including the most probable estimates, are categorized into the two cases of “Higher Case” and “Lower Case.”

Source: Interim Report on the Assessment and Review of the Kyoto Protocol Target Achievement Plan, September 2007

Table 4.3 Future Outlook and Results by Category of Greenhouse Gas Emission
(Enhanced Countermeasures Case)

(Unit: Million tCO_2)

	Kyoto Protocol Base Year	Target Emissions in FY2010*	
		Emissions	**Base-year total emissions ratio**
Energy-originated CO_2	1,059	1,076 – 1,089	**+1.3% – +2.3%**
Industrial sector	482	424 – 428	-4.6% – -4.3%
Commercial and other sector	164	208 – 210	+3.4% – +3.6%
Residential sector	127	138 – 141	+0.9% – +1.1%
Transport sector	217	240 – 243	+1.8% – +2.0%
Energy industries sector	68	66	-0.1%
Non-energy-originated CO_2, CH_4, N_2O	151	132	**-1.5%**
Non-energy-originated CO_2	85	85	0.0%
CH_4	33	23	-0.9%
N_2O	33	25	-0.6%
Three fluorinated gases	51	31	**-1.6%**
HFC	20	22	0.1%
PFC	14	5	-0.7%
SF_6	17	4	-1.0%
Greenhouse Gas Emissions	1,261	1,239 – 1,252	**-1.8% – -0.8%**

* Due to rounding, the totals in the table above may not match the sum of the columns.

* The target emissions are set for both the case when countermeasures achieved the maximum of assumed effects and the case when countermeasures achieved the minimum of assumed effects. Needless to say, the Government pursues the case where countermeasures achieve the maximum effects, but the targets are set so as to achieve the Kyoto Protocol targets even when countermeasures produce the minimum effects.

Source: Kyoto Protocol Target Achievement Plan, March 2008

Chapter 3 of this report describes the countermeasures and policies considered in both cases and their respective effects that can be expected. This chapter indicates the future outlook, anticipating the overall effects brought about by these countermeasures and policies.

The classification applied here is different from the classification used in Chapter 2. This classification is commonly employed in Japan for the purpose of conducting the assessment of progress by sector and the review of countermeasures and policies in a steady manner, while taking into account the activities of each entity and the utilization of statistics. Special attention should be paid to energy-originated CO_2 as it indicates emissions of CO_2 involved in the generation of electricity and heat distributed by each sector in final consumption (indirect emissions). All emissions by sector in this chapter are shown in the form of indirect emissions.

The future outlook based on the revised version of the Target Achievement Plan (March 2008), the

latest Plan for Japan, is shown below.

4.2 Future Outlook

Japan's base year total greenhouse gas emissions (hereinafter referred to as the "base year total emissions") were 1.261 billion t-CO_2. In order to achieve the 6% reduction commitment, it is necessary to reduce annual average total emissions to 1.186 billion t-CO_2 per year in the first commitment period.

On the other hand, Japan's total emissions of greenhouse gases in FY2005 were 1.359 billion t-CO_2, a 7.7% increase over base year level. Japan now has to reduce emissions by 13.7% to achieve its reduction commitment.

The main reason for this is because the emissions of energy-originated carbon dioxide, which account for approximately 90% of Japan's greenhouse gas emissions, have greatly increased (an increase of 11.3% in FY2005 relative to the base year total emissions), even though there has been progress in the reduction of methane, nitrous oxide and the three fluorinated gases. The factors behind the increase in energy-originated carbon dioxide emissions include the following; the cessation of nuclear power generation in the second half of 2002 and other one-off factors; the economic expansion of China; the transformation of industrial structure; increased energy consumption in offices and households due to an expansion of the floor area of office and other buildings; and increased numbers of personal computers, home appliances or the like. The emissions from the *industrial* sector, which account for around 40% of carbon dioxide emissions, have not shown much change, and those from the *transport* sector, which account for roughly 20%, have increased by about 20% as compared to FY1990 level but have been on a downward trend for the last few years. On the other hand, the emissions from the *commercial and other* sector, which account for approximately 20%, and those from the *residential* sector, which account for around 10%, have greatly increased.

4.2.1 Future Outlook for Energy-Originated CO_2

The emissions of energy-originated carbon dioxide, which account for 90% of Japan's greenhouse gas emissions, can statistically be divided into five sectors: *industrial,*[4] *commercial and other,*[5] *residential, transport,* and *energy conversion.*[6] It is also possible to look at the effects of measures and policies for each of these sectors. Approximate targets of future emissions in each sector are shown in Table 3. Provisional calculations show that these approximate targets can be achieved if Japan maintains the currently forecast level of economic growth,[7] all countermeasures on the energy supply side produce the anticipated results, and all countermeasures in each sector on the energy demand side also produce the

[4] Factories, agriculture, construction, etc.
[5] Office buildings, retail stores, hospitals, schools, etc.
[6] Self-consumption at power plants and petroleum processing facilities, etc.
[7] *Course and Strategy of the Japanese Economy* (Cabinet Decision of January 18, 2008)

anticipated results. Table 3 gives the upper and lower limits of approximate targets: the upper limit will be reached if the countermeasures demonstrate their maximum effects, and the lower limit will be reached if they show their minimum effects. Although the Government will certainly aim to maximize their effects, the targets have been set to meet the Kyoto Protocol target even if the countermeasures have their minimum effects.

The approximate target for energy-originated carbon dioxide emissions in FY2010 is 1.3-2.3% above base year (FY1990) level as the ratio to the base year total emissions (approximately 1,076 to 1,089 million t-CO_2).

* It is estimated that emissions will increase by economic growth and other factors if no measures or policies are taken. Thus, the approximate targets provisionally calculated and established for each sector will be achieved through measures and policies to reduce emissions from FY2005 levels by 25 to 29 million t-CO_2 in the *industrial* sector, by 29 to 31 million t-CO_2 in the *commercial and other* sector, by 32 to 35 million t-CO_2 in the *residential* sector, by 14 to 17 million t-CO_2 in the *transport* sector, and by 13 million t-CO_2 in the *energy conversion* sector.

Table 4.4 Approximate Targets of Energy-originated Carbon Dioxide in Each Sector

Estimated results		Base year (FY1990)	FY2005 level of emissions		Approximate targets[Note] in each sector in FY2010		<Reference> Differences between FY2010 targets and FY2005 level of emissions
		A	B	(B－A)/A	C	(C－A)/A	
		million t-CO_2	million t-CO_2	(Percentage change relative to base year by sector)	million t-CO_2	(Percentage change relative to base year by sector)	
		1,059	1,201		1,076 –1,089		
Energy-originated CO_2	*Industrial* sector	482	452	(-6.1%)	424–428	(-12.1%) – (-11.3%)	It is estimated that if no measures or policies are taken, emissions will increase through increases in the volume of production resulting from economic growth or other factors. Provisional calculations show that emissions can be reduced by 25 to 29 million tons from FY2005 level through measures and policies.

	Commercial and other sector	164	239	(+45.4%)	208–210	(+26.5%) – (+27.9%)	It is estimated that if no measures or policies are taken, emissions will increase through increases in the floor area in buildings or other factors. Provisional calculations show that emissions can be reduced by 29 to 31 million tons from FY2005 level through measures and policies.
	Residential sector	127	174	(+36.4%)	138–141	(+8.5%) – (+10.9%)	It is estimated that if no measures or policies are taken, emissions will increase through increases in the number of households and the device ownership rate per household or other factors. Provisional calculations show that emissions can be reduced by 32 to 35 million tons from FY2005 level through measures and policies.
	Transport sector	217	257	(+18.1%)	240–243	(+10.3%) – (+11.9%)	It is estimated that if no measures or policies are taken, emissions will increase through increases in the number of automobiles owned or other factors. Provisional calculations show that emissions can be reduced by 14 to 17 million tons from FY2005 level through measures and policies.
	Energy conversion sector	68	79	(+16.5%)	66	(-2.3%)	This is self-consumption at power plants, petroleum processing facilities or the like. Provisional calculations show that emissions can be reduced by 13 million tons from FY2005 level by continuing to steadily promote efficient energy use in these facilities.

*In each column, the numbers in all sectors may not add up exactly to the total due to rounding.

Note: The upper and lower limits of approximate targets are provided: the upper limit will be reached if the countermeasures demonstrate their maximum effects, and the lower limit will be reached if they show their minimum effects. Although the Government will certainly aim to maximize their effects, the targets have been set to meet the Kyoto Protocol target even if the countermeasures have their minimum effects.

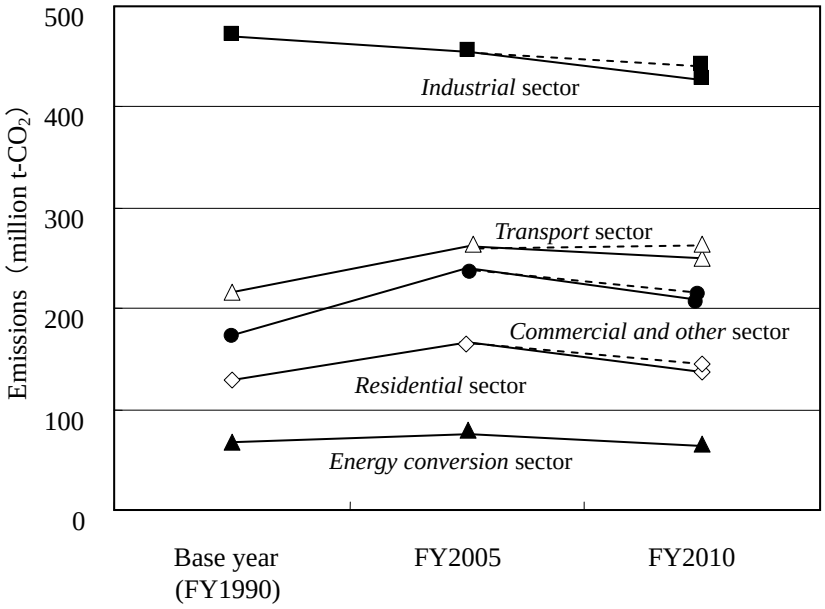


Figure 4.1 Approximate Targets of Energy-originated Carbon Dioxide Emissions in Each Sector

4.2.2 Future Outlook for Non-energy-originated Carbon Dioxide

The target for non-energy-originated carbon dioxide[8] emissions is 0.04% below base year (FY1990) level as the ratio to the base year total emissions (approximately 85 million t-CO_2).

Table 4.5 Emissions and Targets of Non-energy-originated Carbon Dioxide

(Unit: Million tCO_2)

	Base year	FY2005		Approximate Target Emissions in FY2010	
	Emissions	Emissions	**Base-year total emissions ratio**	Emissions	**Base-year total emissions ratio**
Non-energy-originated Carbon Dioxide	85	91	+0.4%	85	-0.0%

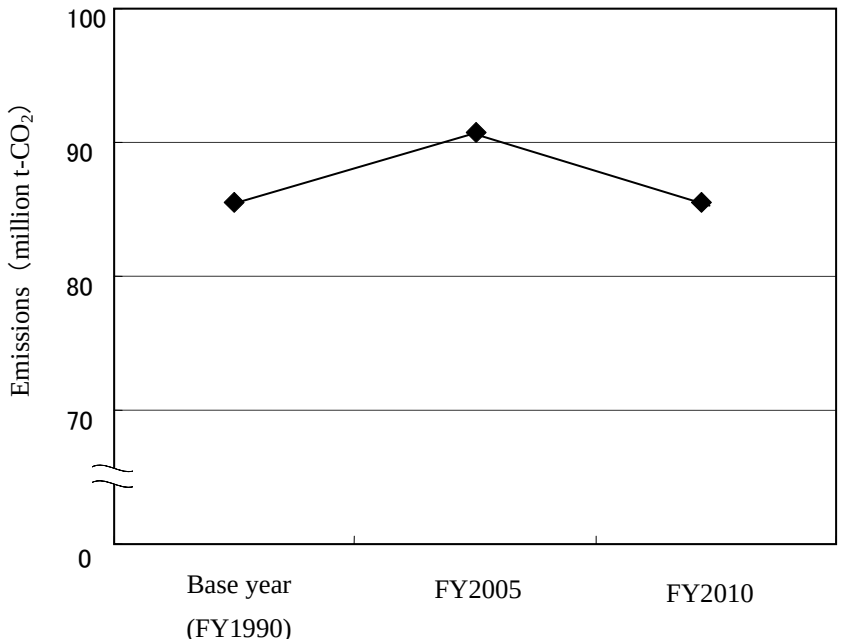


Figure 4.2 Emissions and Target for Non-energy-originated Carbon Dioxide

[8] When promoting countermeasures, it is sometimes necessary to strike a balance among non-energy-originated carbon dioxide, methane and nitrous oxide, because, for example, effective countermeasures for reducing methane emissions in the treatment of human waste can increase nitrous oxide emissions.

4.2.3 Future Outlook for Methane

The target for methane emissions is 0.9% below base year (FY1990) level as the ratio to the base year total emissions (approximately 23 million t-CO_2).

Table 4.6 Emissions and Targets of Methane

(Unit: Million tCO_2)

	Base year	FY2005		Approximate Target Emissions in FY2010	
	Emissions	Emissions	**Base-year total emissions ratio**	Emissions	**Base-year total emissions ratio**
CH_4	33	24	-0.7%	23	-0.9%

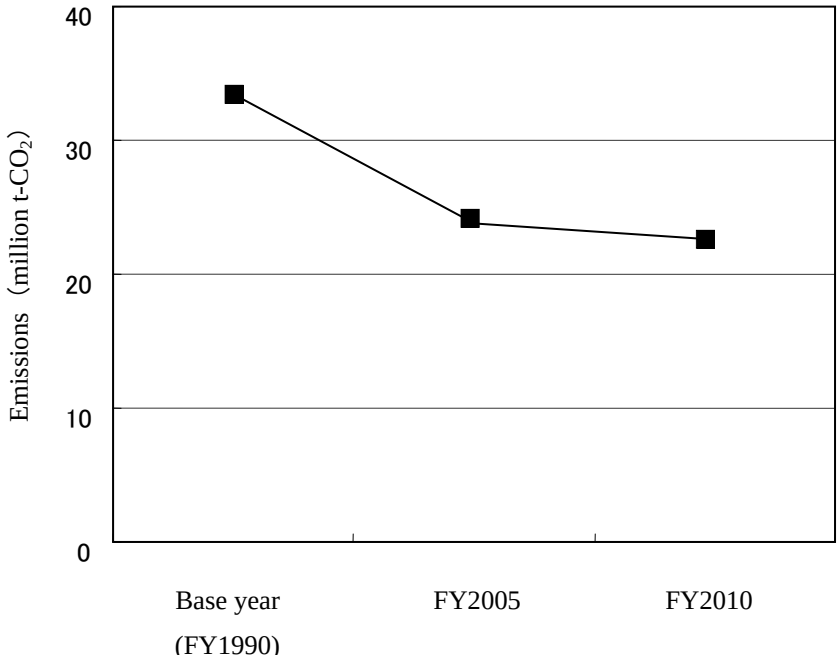


Figure 4.3 Emissions and Target for Methane

4.2.4 Future Outlook for Nitrous Oxide

The target for nitrous oxide is 0.6% below base year (FY1990) level as the ratio to the base year total emissions (approximately 25 million t-CO_2).

Table 4.7 Emissions and Targets of Nitrous Oxide

(Unit: Million tCO_2)

	Base year	FY2005		Approximate Target Emissions in FY2010	
	Emissions	Emissions	**Base-year total emissions ratio**	Emissions	**Base-year total emissions ratio**
N_2O	33	25	-0.6%	25	-0.6%

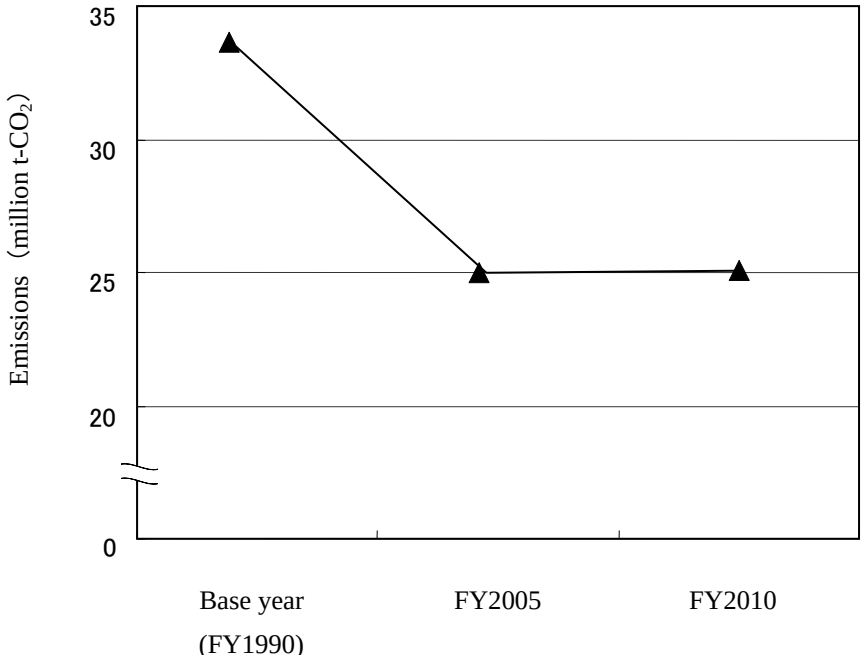


Figure 4.4 Emissions and Target for Nitrous Oxide

4.2.5 Future Outlook for Three Fluorinated Gases

The target for the three fluorinated gases (HFCs, PFCs and SF_6) is 1.6% below base year (CY1995) level as the ratio to the base year total emissions (approximately 31 million t-CO_2).

In some cases, measures and policies are implemented for all of these three fluorinated gases because they are used interchangeably in some businesses. Therefore, it is appropriate to combine measures and policies according to technology and market conditions so as to minimize the social costs and obtain the maximal results. For this reason, the figures for each gas are shown as rough indications of the breakdown in order to more steadily achieve the target of "1.6%" reduction for the three fluorinated gases collectively, on the assumption of the current technology and market conditions. It is necessary to keep in mind the fact that these figures would fluctuate depending on future changes in these conditions.

Table 4.8 Emissions and Target for the Three Fluorinated Gases and Rough Indications of the Breakdown for Each Gas

(Unit: Million tCO_2)

	Base year (CY1995)	CY2005		Target for the three fluorinated gases and rough indications of the breakdown for each gas	
	Emissions	Emissions	Ratio to the base year total emissions	Emissions	Ratio to the base year total emissions
Three fluorinated gases	51	18	-2.6%	31	-1.6%
HFCs	20	7	(-1.0%)	22	(+0.1%)
PFCs	14	6	(-0.6%)	5	(-0.7%)
SF_6	17	4	(-1.0%)	4	(-1.0%)

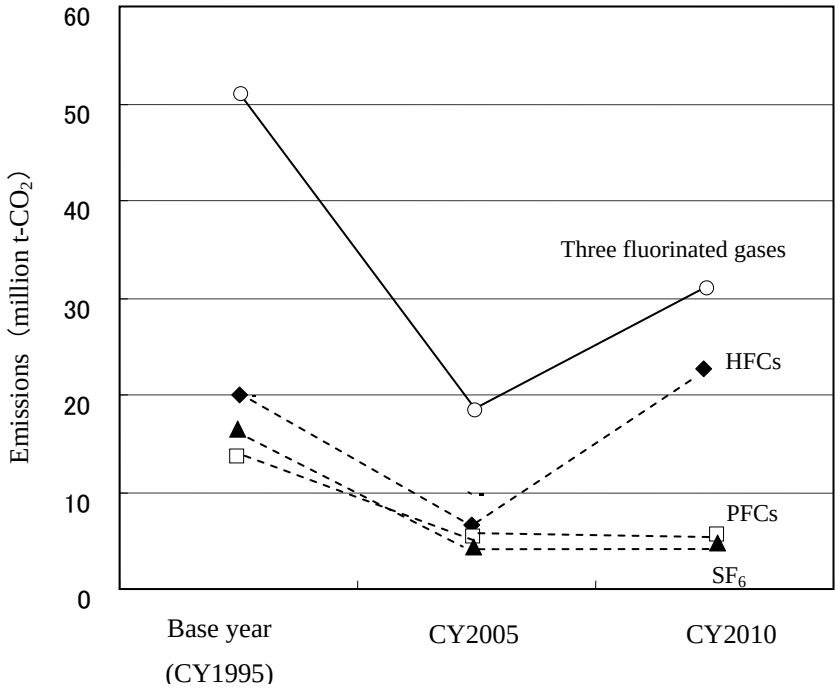


Figure4.5 Emissions and Target for the Three Fluorinated Gases and Rough Indications of the Breakdown for Each Gas

Table4.9 Approximate Targets of Greenhouse Gas Emissions in FY2010

	Base year	FY2005		Approximate targets of emissions in FY2010[Note]	
	million $t\text{-}CO_2$	million $t\text{-}CO_2$	Ratio to the base year total emissions	million $t\text{-}CO_2$	Ratio to the base year total emissions
Energy-originated CO_2	1,059	1,201	**11.30%**	1,076–1,089	**(+1.3%) – (+2.3%)**
Industrial sector	482	452	-2.30%	424–428	(- 4.6%) – (- 4.3%)
Commercial and other sector	164	239	5.90%	208–210	(+3.4%) – (+3.6%)
Residential sector	127	174	3.70%	138–141	(+0.9%) – (+1.1%)
Transport sector	217	257	3.10%	240–243	(+1.8%) – (+2.0%)
Energy conversion sector	68	79	0.90%	66	(-0.1%)
Non-energy-originated CO_2, CH_4, N_2O	151	140	**-0.90%**	132	**(-1.5%)**
Non-energy-originated CO_2	85	91	0.40%	85	(-0.0%)
CH_4	33	24	-0.70%	23	(-0.9%)
N_2O	33	25	-0.60%	25	(-0.6%)
Three fluorinated gases	51	18	**-2.60%**	31	**(-1.6%)**
HFCs	20	7	-1.00%	22	(+0.1%)
PFCs	14	6	-0.60%	5	(-0.7%)
SF_6	17	4	-1.00%	4	(-1.0%)
Greenhouse gas emissions	1,261	1,359	**7.70%**	1,239–1,252	**(-1.8%) – (-0.8%)**

* In each column, the numbers in all sectors may not add up exactly to the total due to rounding.

Note: The upper and lower limits of approximate targets are provided: the upper limit will be reached if the countermeasures demonstrate their maximum effects, and the lower limit will be reached if they show their minimum effects. Although the Government will certainly aim to maximize their effects, the targets have been set to meet the Kyoto Protocol target even if the countermeasures have their minimum effects.

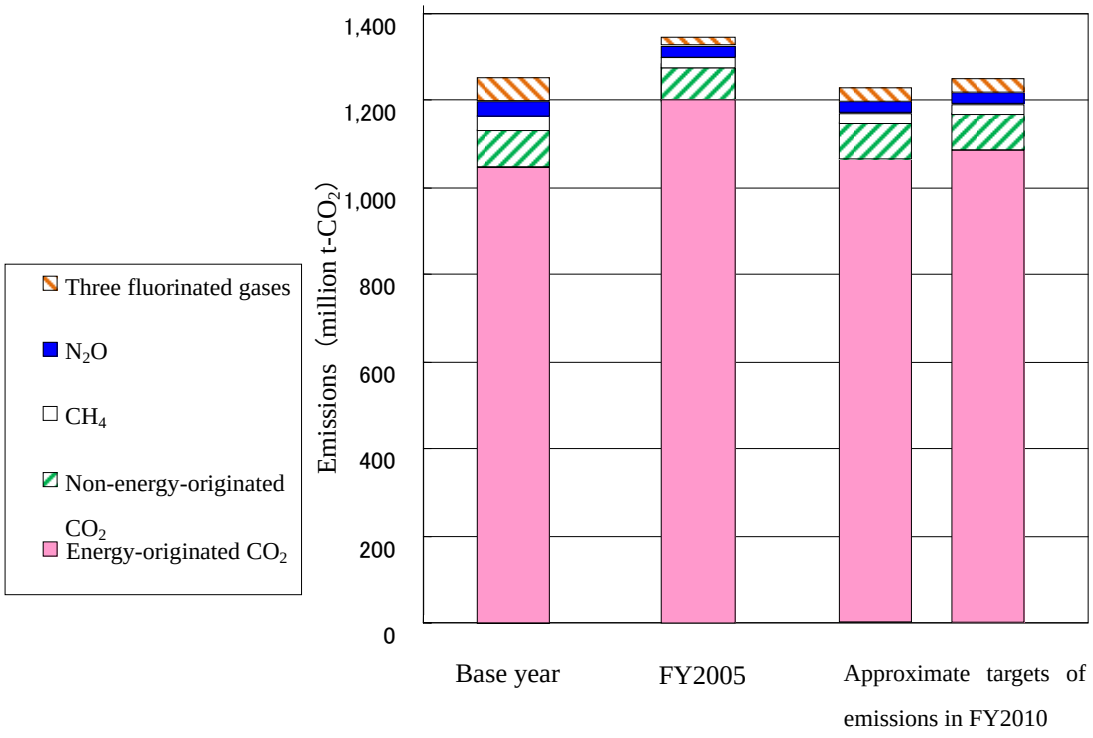


Figure 4.6 Approximate Targets of Greenhouse Gas Emissions by Gas Type

4.2.6 Future Outlook for Greenhouse Gas Sinks

The target for sinks is to ensure removal of 13 million t-C (47.67 million t-CO_2; approximately 3.8% compared to the base year total emissions), which was decided on at the Seventh Conference of the Parties to the UNFCCC (COP7) as the amount of removal by Japan's forest management, for all forests subject to Article 3, Paragraph 3 and 4 of the Kyoto Protocol.

4.2.7 Kyoto Mechanisms

Concerning the difference between emissions equivalent to the reduction commitment in the first commitment period of the Kyoto Protocol and actual greenhouse gas emissions (this refers to emissions after deduction of greenhouse gas removal) in the same period, the target is to utilize the Kyoto Mechanisms.

Even if any of the targets for greenhouse gases and greenhouse gas carbon sinks are confidently expected to be achieved in the first commitment period, the Government of Japan will not rest but rather will

continue to steadily promote countermeasures.

Note: If it is based on the emissions projections for each gas from the results of each kind of countermeasure being undertaken at the time the Kyoto Protocol Target Achievement Plan was revised, the difference is 1.6 percent of total emissions in the base year, but fluctuations may occur due to the results of various countermeasures and policies, economic trends, etc.

4.2.8 Targets of Individual Countermeasures

In order to give an overall picture of countermeasures with specific grounding to achieve the 6% reduction commitment under the Kyoto Protocol, this Plan provides nationwide countermeasure evaluation indices, estimated volumes of emissions reductions, national policies to promote countermeasures, and examples of policies that local governments are expected to implement, for each countermeasure to achieve the targets by type of greenhouse gas or other category and the approximate targets for energy-originated carbon dioxide emissions in each sector described in Section 2. These are shown in tabular form for each sector and category (Refer to Appendix 1).

Countermeasure evaluation indices are stipulated as targets for individual countermeasures designed to achieve the targets by type of greenhouse gas and the approximate targets for energy-originated carbon dioxide emissions in each sector.

The estimated volume of reductions in greenhouse gas emissions (carbon dioxide equivalent) resulting from a certain countermeasure is calculated by encompassing factors other than the results of the countermeasure in question. Therefore, the assumptions of calculation at the time of drafting this Plan are clarified to make ex-post verifications possible.

4.3 Method of Estimation

4.3.1 Energy-originated CO_2

(1) Overview of Models

To estimate energy-originated CO_2 emission, a combined model group of Macroeconometric Model, Optimum Power Generation Model, Bottom-up Model, and Distributed Generation Technologies Capacity Introduction Model were used as sub models of the Energy Supply-Demand Model (Econometric Model) based on the energy balance table. The overview of the models is shown below.

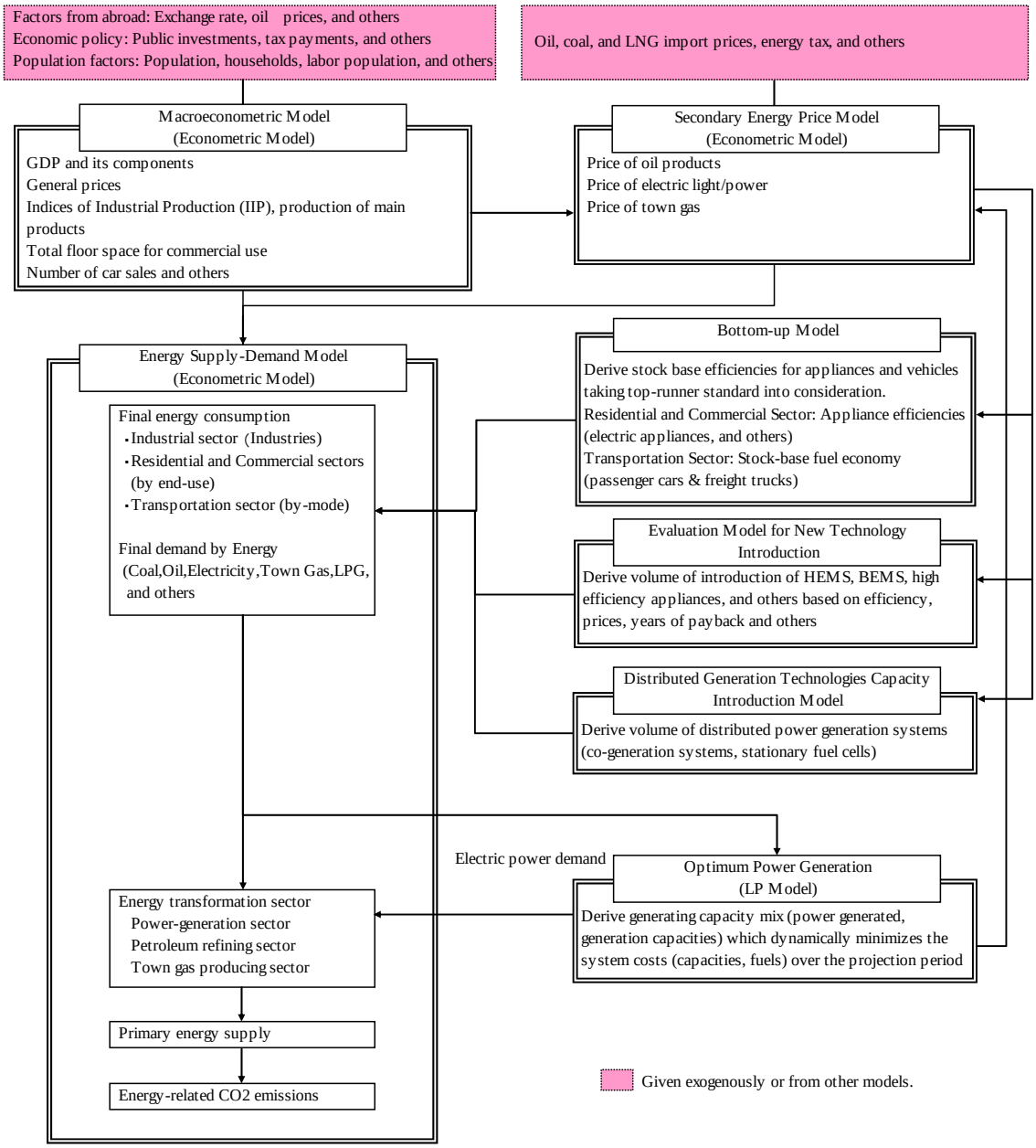


Figure 4.7 Overview of the Models

[Macroeconometric Model]
The model derives economic activity index that directly and indirectly affects the energy demand by calculating macro frames with integral balance between income distribution, industrial markets, labor markets and general prices.
- GDP and its components, production, IIP, total floor space for commercial use, and automobile sales volume, etc.

[Secondary Energy Price Model]
The model derives the energy purchase price that affects choice behavior and energy demand from the general domestic price index as well as import prices of petroleum, LNG, and other energies.
- Price of oil products, price of electric light/power, and price of town gas.

[Optimum Power Generation Model]
The model derives the economically rational and optimal power source mix (power generated, generation capacities) by dynamically minimizing the total system costs (equipments, fuels) of assumed electricity demand at discounted present value over the projection period. It utilizes Linear Programming Model for optimization.
- Power source mix (generation capacities, power generated)

[Bottom-up Model]
The model derives energy conservation indicators such as automobile fuel efficiency and household appliance efficiency, in order to explicitly incorporate the efficacy of the top-runner standard difficult to process with a regression macro model.
- Stock-base fuel economy in transport sector and appliance efficiencies in the commercial and residential sector.

[Evaluation Model for New Technology Introduction]
The model derives volume and effectiveness of introduction of HEMS, BEMS, efficient water heater, and others that are expected to be introduced in the future based on introduction rate by incorporating price decline led by diffusion, years of payback and others.
- HEMS and BEMS penetration rate and number of efficient water heaters and others introduced.

[Distributed Generation Technologies Capacity Introduction Model]
The model derives the market size, which fuel cells and industrial, commercial and residential co-generation system are introduced, from competitive energy price, heat demand and past results.
- Distributed power generator mix (generator capacities, power generated, heat quantity)

[Energy Supply-Demand Model]
The model derives the energy demand in each final sector from economic activity index, price index, and energy conservation indicators gained from the models above. Then, it derives the primary energy supply by undergoing energy transformation from the electricity generation sector.

The model also derives the amount of CO_2 emission based on primary energy consumption of each energy source.

- Sectoral final energy consumption, primary energy supply by energy source, and CO_2 emission, etc.

(2) Outlook on Macro Frame

The macro frame of the outlook for 2010 is assumed as follows.

(i) Population and Labor Force

The population is assumed to decline after its peak in FY2004, based on the "medium variant" population projection publicized by the National Institute of Population and Social Security Research in December 2006.

FY	1990	1995	2000	2005	2010
Total population (10,000 people)	12,361	12,557	12,693	12,777	12,718
Labor force (10,000 people)	6,414	6,672	6,772	6,654	6,443

Note 1: The total population peaked in FY2004 (127.79 million people), based on "medium variant birth and death" estimates.

Note 2: Labor force reached to a peak of 67.94 million people inFY1997.

(ii) Standard Currency Exchange Rate

The exchange rate is assumed to remain at ¥110=US$1, in reference to the Direction and Strategy for the Japanese Economy (decided by the Cabinet in January 2008), etc.

(iii) Energy Prices

The energy price is assumed as below between FY2005 and FY2010, in reference to the Direction and Strategy for the Japanese Economy, etc.

(In real terms)
Petroleum: 56$/b → 79$/b (Based on dollar value in US$2005)
LNG: 330$/t → 565$/t
Coal: 63$/t → 63$/t

(iv) Economic Growth

Based on the prospects indicated in the Direction and Strategy for the Japanese Economy and its references (prepared by the Cabinet Office), the real GDP growth rate is assumed to remain in the lower half of the 2 percent level through FY2010.

FY	2005	2006	2007	2008	2009	2010
Real GDP Growth Rate (%)	2.4%	2.3%	1.3%	2.0%	2.3%	2.5%

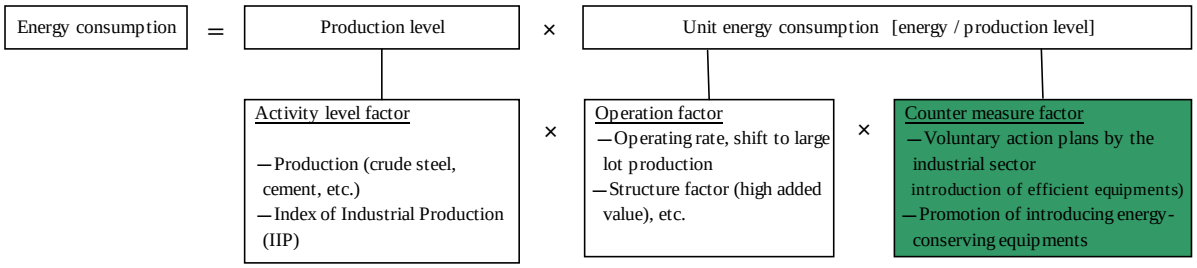
(v) Final Demand Components (Macro Components)

The future economy is assumed to see growth led by private demand as in private consumption and corporate investment. The public sector, on the other hand, is assumed to see restrain in expenditures, taking into account the Direction and Strategy for the Japanese Economy.

(3) Trends and Calculation Methodology by Sector

(i) Industrial Sector

[a] Basic Structure of the Industrial Sector



[b] Activity Level Factor (Production Level) and Operation Factor

In the manufacturing industry in general, activity of the metal and machine industry and others will expand, and the material industry will shift more to a processing and assembly industry. On the other hand, amid the strengthening of production capacity in Asia and slowing domestic demand, the overall production level is showing a trend of slight increase toward 2010, supported by external demand, particularly from China. At the same time, the Index of Industrial Production (IIP) will generally increase due to the growing tendency toward higher value added.

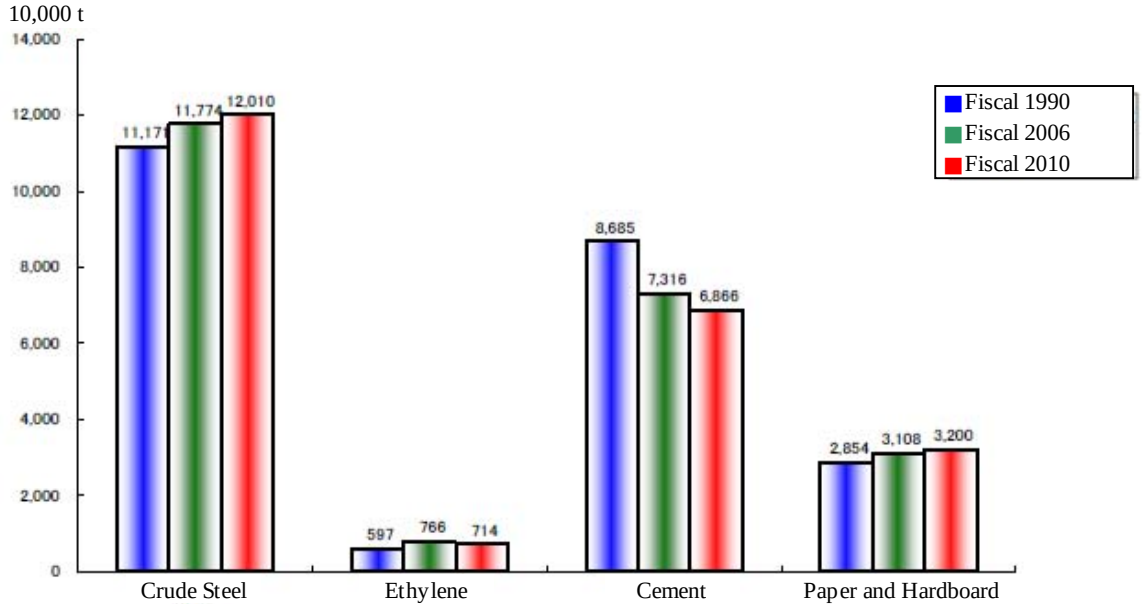


Figure 4.8 Production Estimate on Four Major Energy Consuming Industries

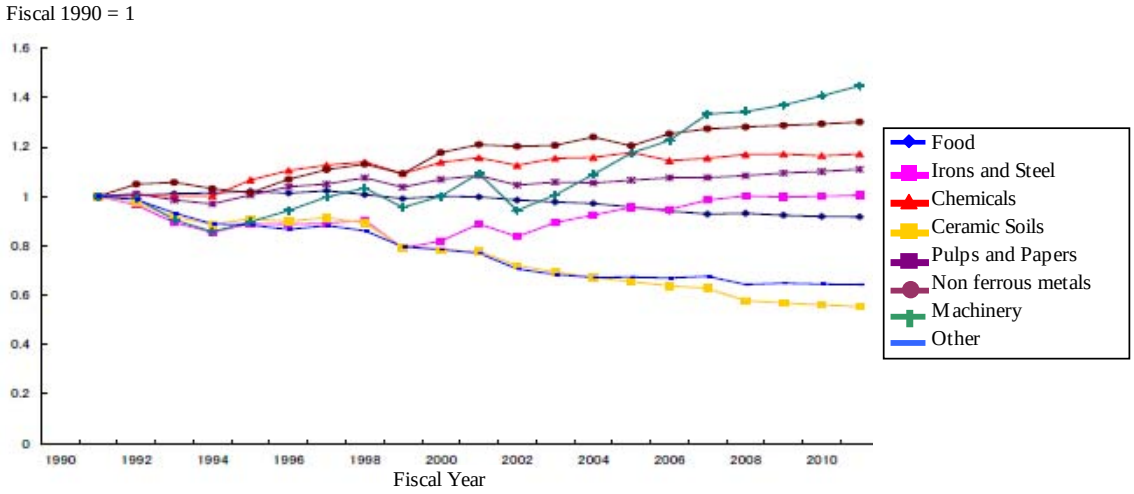
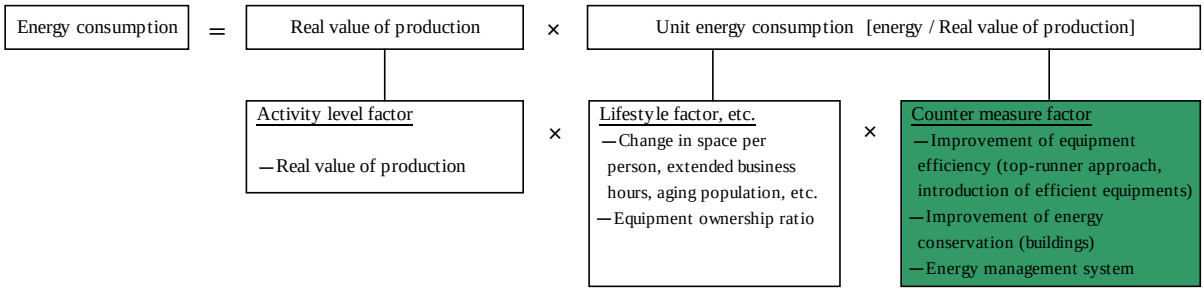


Figure 4.9 Index of Industrial Production (IIP) Assumption

(2) Commercial and Other Sector

[a] Basic Structure of the Commercial Sector



[b] Value of Services Production, Lifestyle Factor, etc.

- The value of production in the services industry will increase against the backdrop of the aging of the population and the shift in preferences toward services.
- In line with the graying population, medical and welfare-related services will expand steadily.

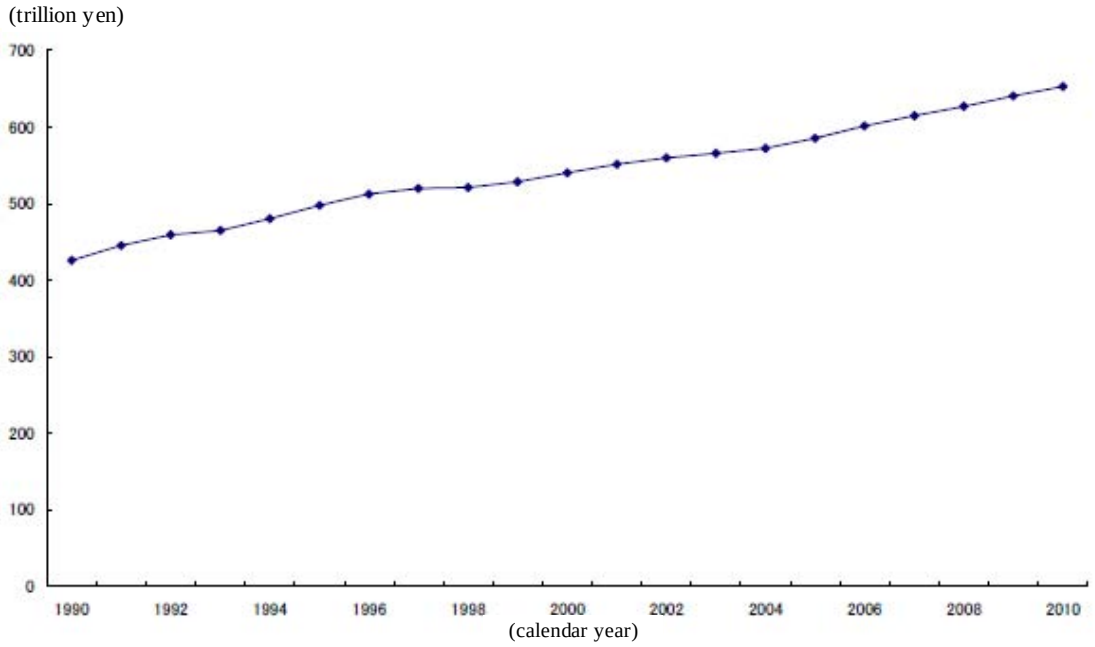
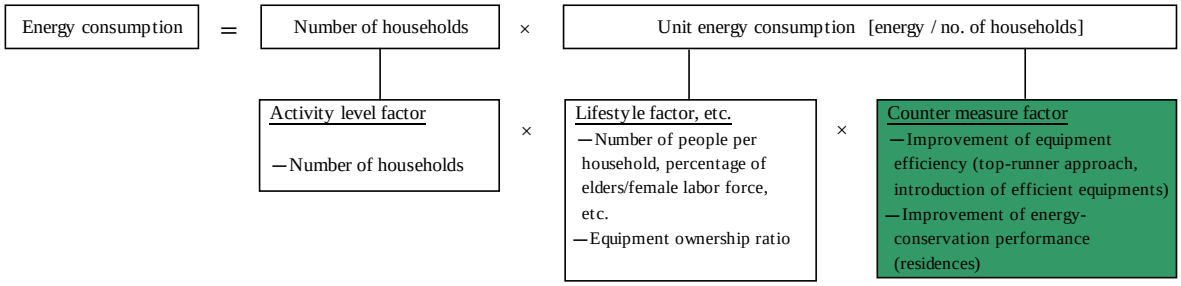


Figure 4.10 Real Value of Production in the Services Industry

(iii) Household (Residential) Sector

[a] Basic Structure of the Household Sector



[b] Number of Households and Lifestyle Factor

- With the decrease in population, the increase in the number of households will tend to slow down.
- The equipment ownership ratio (number of equipment owned per household) will increase while the growth in size and the tendency to heighten the added value will progress.

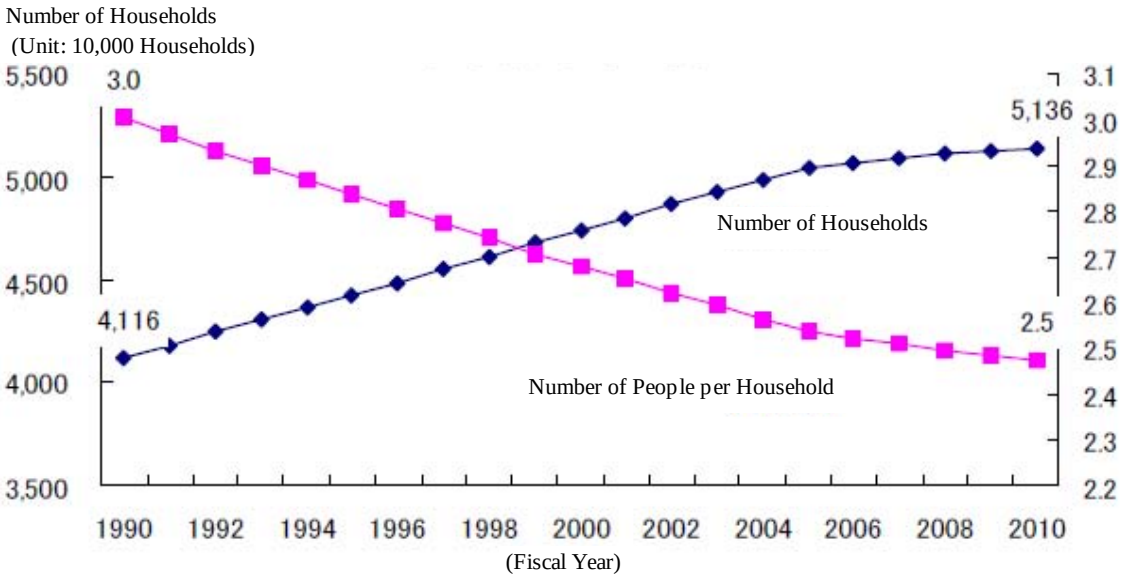


Figure 4.11 Number of Households and Number of People per Household

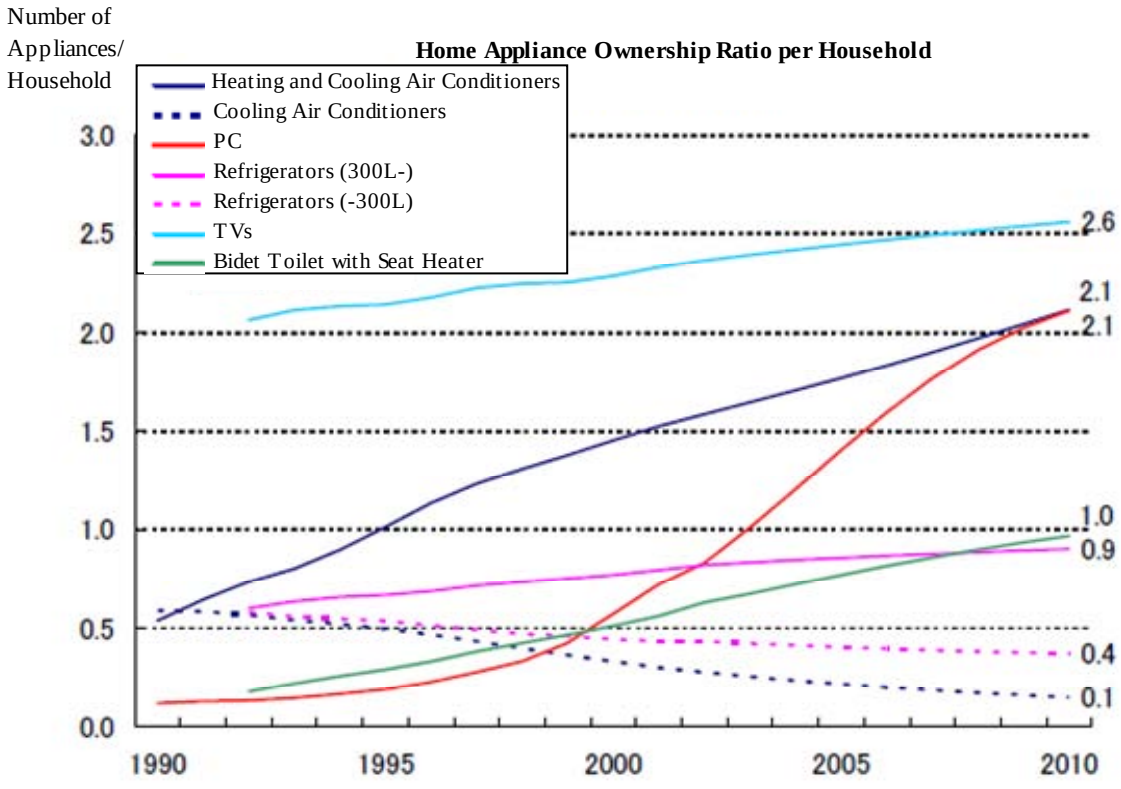
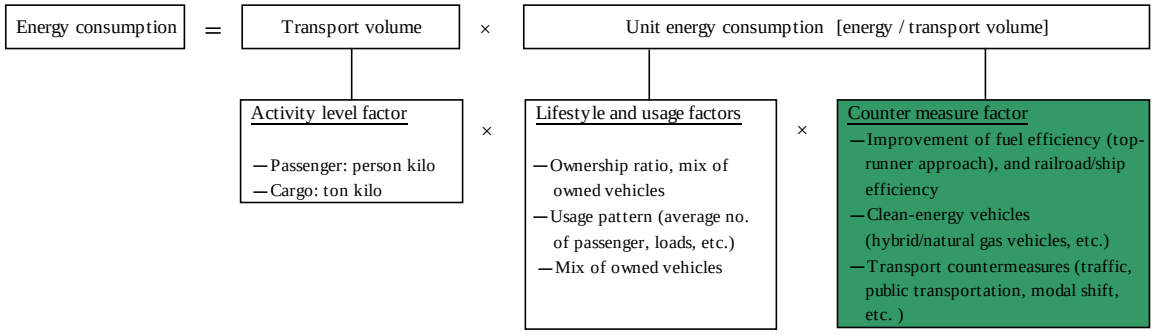


Figure 4.12 Home Appliance Ownership Ratio per Household

(iv) Transport Sector (Passenger and Cargo)

[a] Basic Structure of the Transport Sector



[b] Transport Volume

- Passenger transportation will increase. Cargo transportation will recover moderately on the back of improving economic activities.

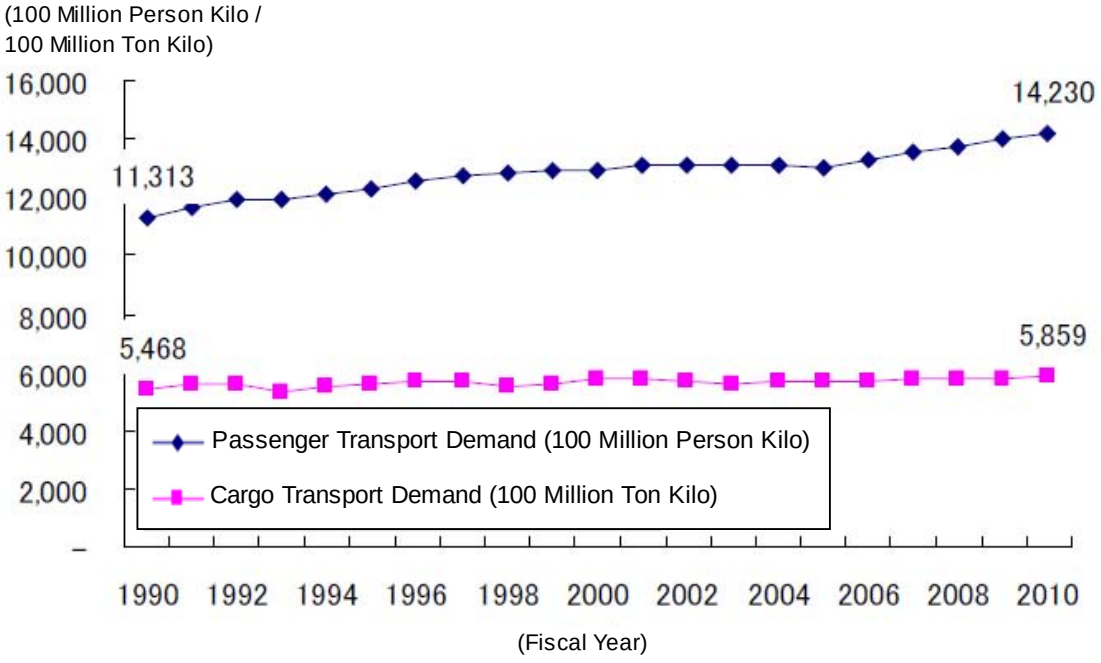


Figure 4.13 Transition of Transport Demand

4.3.2 Non-energy-originated CO_2, CH_4, and N_2O

Greenhouse gas emissions in FY2010 are estimated using the method and classification of calculation adopted by Japan's National Greenhouse Gas Inventories Programme (in principle, the calculation is made using the formula <emission coefficient in FY2010> x <amount of activity in FY2010> for each sector and gas).

○ Amount of activity in FY2010
Estimated for each sector (see below).

[Fuel-burning sector]
The amount of activity used for the estimation of energy-originated CO_2 is used.

[Sector for leakage from fuels/industrial process sector (other than three fluorinated gasses including HFCs)/sector for utilizing solvents and other products]
The amount of activity in these sectors is estimated principally on the basis of the outlook for socioeconomic activity, but estimated based on past trends for sectors without estimated values or those not linked to the amount of socioeconomic activity.

[Agricultural sector]
For livestock and crop species for which target values for FY2015 are provided by the Basic Plan for Food, Agriculture and Rural Areas, the values between values for FY2005 and target values for FY2015 are estimated through the interpolation of these two sets of values. For other livestock and crop species, the estimation is based on the extrapolation of past trends.

[Waste sector]
Assuming the promotion of waste reduction targets under the Waste Management and Public Cleansing Act and the Master Plan for Promotion of Recycling-Oriented Society, the amount of activity is estimated by taking into account the population for general waste and industry-related indicators (amounts of raw materials produced, index of industrial production, industry production outlook, etc.) for industrial waste.

○ Outline of the method of estimation

(1) Non-energy-originated CO_2

- Expansion of Blended Cement Utilization
  Emission associated in cement production = amount of clinker production × emission coefficient
- Promotion of Countermeasures for Emission of CO_2 Derived from Waste Incineration
  Emission associated in waste incineration = amount of incineration by category × emission coefficient by category

(2) CH_4

- Disposal of waste

[1] CH_4 emission associated in landfill of general and industrial waste:

Emission associated in landfill = volume of waste decomposing during the computation period by category × emission coefficient by category

[2] CH_4 emissions associated with incineration of general waste and industrial waste

Emissions associated with general waste incineration = amount of waste incineration by incineration method x emission coefficient by incineration method

Emissions associated with industrial waste incineration = amount of waste incineration by waste type x emission coefficient by waste type

- Shift in organic matter management method in rice cultivation

Emissions from rice paddies (intermittent irrigation rice paddies) = Σ (area of rice paddies x ratio of intermittent irrigation rice paddies x ratio of area by soil type x ratio of organic matter management method x emission coefficient by sold type and organic matter management method)

- Mobile emission sources

Automobiles: Emissions associated with driving = mileage x emission coefficient per mileage

Airplanes, ships and railroads: Emissions associated with operations = fuel consumption x emission coefficient per fuel consumption

- Fixed emission sources

Emissions associated with fuel burning at fixed emission sources =Σ (fuel consumption by fuel type, furnace type and sector x emission coefficient by fuel type and furnace type)

(3) N_2O

- Installation of a N_2O Decomposer in the Manufacturing Process of Adipic Acid

Emission associated with manufacture of adipic acid = production volume of adipic acid × emission coefficient

- Incineration of sewage sludge

Emissions associated with incineration of sewage sludge = Amount of sewage sludge incineration x amount of sewage sludge incineration by aggregating agent type, furnace type and temperature x corresponding emission coefficient

- Incineration of general waste and industrial waste

Emissions associated with general waste incineration = amount of waste incineration by incineration method x emission coefficient by incineration method

Emissions associated with industrial waste incineration = amount of waste incineration by waste type x emission coefficient by waste type

- Reduction in the amount of fertilizers applied to agricultural land

Emissions associated with the application of chemical fertilizers to soil of agricultural land = amount of nitrogen contained in chemical fertilizers applied to soil of agricultural land x emission coefficient x 44/28

- Mobile emission sources

  Automobiles: Emissions associated with driving = mileage x emission coefficient per mileage

  Airplanes, ships and railroads: Emissions associated with operations = fuel consumption x emission coefficient per fuel consumption

- Fixed emission sources

Emissions associated with fuel burning at fixed emission sources =Σ (fuel consumption by fuel type, furnace type and sector x emission coefficient by fuel type and furnace type)

Table 4.10 Premise Utilized in Estimating Future Prospects

		Unit	Performance Value				Target Value
			FY 1990	FY 1995	FY 2000	FY 2005	FY 2010
Cement production		1,000 t	86,849	97,496	82,373	73,931	69,820
Paddy planting area		1,000 ha	2,055	2,106	1,763	1,702	1,669
Number of feeding livestock	Dairy cow	10,000	207	193	173	164	163
	Beef cow	10,000	281	290	281	276	308
	Swine	10,000	1,134	990	979	962	950

Cement production volume: calculation based on 'Statistical Yearbook for the Ceramics and Building Materials Industries' and 'Annual Trade Statistics.'

Paddy planting area: Performance value 'Statistics on Cultivated Land and Planted Area'; Estimated value: linearly interpolated based on target values for FY2015 under 'Basic Plan for Food, Agriculture and Rural Areas'

Livestock feeding headage: Performance value 'Statistical Survey on Livestock'; Estimated value: linearly interpolated based on target values for FY2015 under 'Basic Plan for Food, Agriculture and Rural Areas'

4.3.3 Three Fluorinated Gases

Emission of the three fluorinated gases, such as HFC, is individually estimated and calculated utilizing the suitable method, either bottom-up or top-down, to each category while referring to the data submitted by the industry.

Since the three fluorinated gases are substitutes for ozone depleting substances of which production and consumption is based on the Montreal Protocol, when countermeasures are not implemented, a substantial degree of increase (five percent increase compared to total emission in the base year) will be expected. Through the promotion of systematic efforts by industries, development of alternative substances and the recovery under law of HFC filled in appliances as refrigerant (see 3.1.3.2 I.1.(4)), it was estimated that by 2010, there would be a reduction of 34 million tCO_2 and an increase from total emission in the base year could be contained to 2 percent. This plan was revised in FY2004 and FY2007, with a new target set to

reducing a total of 76 million tCO_2 and suppressing total emissions to 1.6 percent less than the level in the base year.

4.3.4 CO_2 in Land-Use Change and Forestry Sector

Regarding forest sinks, Japan aims to secure 13 million tC of sink by forest management activities under Article 3, paragraphs 3 and 4 of the Kyoto Protocol. This target i.e. equal to the upper limit on accountable removals by “forest management” agreed at the Seventh Conference of the Parties to the UN Framework Convention on Climate Change (COP 7, Marakesh Accord).

As for the methodologies for accounting the removals by forests, Japan has developed methodologies in accordance with the formulation of the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry in 2003. .

The future outlook and targets were estimated on the basis of the following assumptions:

[a] Forest management activities under Article 3, paragraph 4 of the Kyoto Protocol

- Ikusei-rin forests: Forest management measures implemented since 1990 in order to keep forests in a proper condition (succession, soil preparation, land surface disturbance, planting, etc), fostering (undercutting, improvement cutting), thinning, regeneration cutting
- Tennensei-rin forests: protection and conservation measures such as tree cutting and land conversion regulations under law

[b] Average removals per unit area (estimated based on data of growth of major tree species)

- Average removals by Ikusei-rin forests: 1.35 tC/ha
- Average removals by Tennensei-rin forests: 0.42 tC/ha

[c] Forest area for forest management coverage necessary to secure sinks of 13 million tC

- Ikusei-rin forests: 7.55 million ha (secure management coverage area by forest management measures such as tree thinning)
- Tennensei-rin forests: 6.60 million ha（secure management coverage area by expanding the area of protection forests）

[d] Outlook and targets of forest sinks

<Ikusei-rin forests>

Removals by Ikusei-rin forests are accounted for when thinning and other forest management activities are taken

7.55 million ha×1.35 tC / ha (average removals by Ikusei-rin forests) ≒ 10.2 million tC

<Tennensei-rin forests>

Removals from Tennensei-rin forests are accounted for when maximum efforts are made to expand the area of protection forests

6.6 million ha ×0.42 tC / ha (average removals by Tennensei-rin forests) ≒ 2.8 million tC

Removals likely to be secured by forest management activities are estimated as below:

10.2 million + 2.8 million = 13 million tC

In order to achieve the target of 13 million t-C of forest sinks, Japan has been implementing forest management activities such as 550,000 hectares of thinning over a six-year period between FY2007 and FY2012. This means additional 200,000 hectares of thinning to the previous level of 350,000 hectares, and result in total of 3.3 million hectares over six years.

4.4 Future Prospects of CO_2 Generated from International Bunker Fuel Sold in Japan

A forecast of CO_2 emissions in 2015 attributed to international aviation bunker fuels sold in Japan has been made.
The following assumptions were used in the forecast.

[a] Assuming that Japan has a 1.8 percent annual economic growth rate until 2015, the forecast of the volume of international air transportation to and from Japan is forecast as shown in the following table.

Table 4.11 Actual Figures from 2005 and Predictions for 2015 regarding the Volume of International Air-Transport to and from Japan.

	Total number of passengers (10,000 people)	Total Cargo weight (1,000t)
2005	5,650	3,370
2015 (forecast)	7,714	5,058

Source: Report by the Air Transport Subcommittee, the Council for Transport Policy – 'Concerning Measures for Future Development and Operations of Airports and Air Navigation System'

[b] For the average distance of air-transport of passengers and cargo, apply average figure between 1990 and 2005.

[c] For the average weight of CO_2 per ton-kilometer of air-transport, apply average figure between 1990 and 2005.

The predicted CO_2 emission in 2015 from the international aviation bunker fuel sold in Japan based on the preceding hypotheses is approximately 33.64 (million tCO_2).

Regarding the above prediction, it is necessary to note that the numbers bear uncertainty due to the following reasons.

[a] The predicted values may change depending on how the premised conditions are set. The prediction of air-transport volume is premised by the predicted annual economic growth rate until 2015 at 1.8 percent, which in itself bears uncertainty. Also it uses the past average values as it is difficult to predict advances in future technologythat would lead to the decrease of CO_2 emission per ton-kilometer of air-transport..

[b] The total volume of air-transport used in calculating the prediction is the total volume of international air-transport to and from Japan. Therefore the effect of air-transport to Japan that is assumed to be refueled outside of Japan cannot be completely excluded from the calculation of CO_2 emission of international aviation bunker fuel sold in Japan.

On the other hand, the relationship between the various indicators regarding oceangoing shipping arriving and departing Japan to the volume of sales of marine bunker fuel in Japan could not be found. This is thought because oceangoing ships refuel not only at ports of arrival and departure, but at any point on there shipping route where fuel prices are cheap. Thus it is not possible to report on the predicted value of CO_2 emission generated from marine bunker fuel sold in Japan.

Table 4.12 Actual Figures and Future Prospects of CO_2 from International Bunker Fuel Sold in Japan

(Unit: Million tCO_2)

Classification	Results			Future Prospects
	1990	2005	Rate of increase or decrease	2015
International aviation	13.2	21.3	+61 %	33.6
Oceangoing shipping	17.5	22.1	+26.3%	―

(Created by: Ministry of Land, Infrastructure, Transport and Tourism)

4.5 Effects of Policies and Measures

Under the Target Achievement Plan completely revised in March 2008, the Global Warming Prevention Headquarters or the Directors' Meeting of the Global Warming Prevention Headquarters, twice a year around June and before the end of the year, reviews the progress in all measures listed in the Target Achievement Plan and considers a strengthening of measures.

The contents of the results of the latest review, "Progress in the Kyoto Protocol Target Achievement Plan" (Global Warming Prevention Headquarters, July 2009) are described below.

4.5.1 Method to Review Progress

(1) Method to Manage Progress under the Kyoto Protocol Target Achievement Plan

The Target Achievement Plan states that the Global Warming Prevention Headquarters "will rigorously inspect the progress of policies implemented by the Government for individual countermeasures annually." Since accurate inspections need the data about the latest conditions, each ministry and agency will strive to promptly calculate actual figures required for conducting inspections, including countermeasure evaluation indices, volume of emission reductions and other related indices (hereinafter referred to as "countermeasure evaluation indices and others").

The plan further states: "Specifically, every year around June, the Global Warming Prevention Headquarters will clarify the actual figures of the year before the previous year of inspection for all countermeasure evaluation indices and others (including the previous year's actual figures if possible), and will at the same time indicate the projected countermeasure evaluation indices and others for greenhouse gases from the year of review until 2012 (for each year if data are available). At this time, the Headquarters will specify the status of the policies implemented in the previous year in order to support the projections as well as the policies scheduled to be implemented in that year."

(2) Inspections by each ministry and agency

The latest report on the inspections of the progress was put together by the Global Warming Prevention Headquarters after hearing comments on the policies and measures implemented at advisory councils of responsible ministries and agencies.

Advisory councils related to the responsible ministries and agencies, which held their respective meetings to deliberate on the progress of the Target Achievement Plan, include: Global Environment Subcommittee, Planning Committee, Council of Food, Agriculture and Rural Area Policies; Global Environment Subcommittee, Policy Committee, Forestry Policy Council; Global Environment Subcommittee, Planning Committee, Fisheries Policy Council; Global Environmental Subcommittee, Environmental Committee, Industrial Structure Council; Global Warming Prevention Measures Subcommittee, Chemicals and

Bio-Industry Committee, Industrial Structure Council; Environment Committee, Panel of Infrastructure Development; Environment Subcommittee, Transportation System Committee, Council for Transport Policy; and Global Environment committee, Central Environment Council.

4.5.2 Progress in Measures

(1) Total emissions and necessary reductions of greenhouse gases for Japan

Japan's total greenhouse gas emissions reached some 1,374 million tonnes in terms of CO_2 in FY2007, representing an increase of 9 percent compared with the base year. Thus, in order to achieve sector-by-sector targets under the Target Achievement Plan between FY2007 and FY2010, it is necessary to reduce emissions of energy-originated CO_2 by 9.2-10.0 percent in the industrial sector (share of total emissions in the base year: 38 percent), by 11.1-12.0 percent in the commercial sector (share: 13 percent), by 21.5-23.1 percent in the household sector (share: 10 percent), by 2.4-3.8 percent in the transport sector (share: 17 percent) and by 20.1 percent in the energy conversion sector (share: 5 percent).

As for non-energy-originated CO_2 (share: 7 percent), CH_4 (share: 3 percent) and N_2O (share: 3 percent), as emission levels have already achieved targets for FY2010, it is necessary to continue to implement measures so as not to allow them to increase in the future.

For the three fluorinated gases (share: 4 percent), it is necessary to contain the rise to 28.7 percent, though there are several factors contributing to the increase, including an expected growth of HFC emissions due to the progressing substitution from ozone layer-depleting substances.

Furthermore, as additional forest development of 200,000 ha a year is needed over a six-year period between FY2007 and FY2012 as forest sink measures, the Government plans to develop forests at the rate of 780,000 ha a year from FY2008 onward. With 750,000 ha of forests developed in FY2007, it is necessary to continue with forest development and secure forest sinks equivalent to 3.8 percent of total emissions in the base year.

As for the utilization of the Kyoto Mechanism, Japan concluded contracts to acquire credits equivalent to 95.10 million tCO_2 by April 1, 2009, with the acquisition of the bulk of the target amount of some 100 million tonnes already in sight. Japan will continue efforts to acquire credits while paying heed to the principle of complementarity.

See 4.5.3 for details about the state of emissions.

(2) Progress in each measure and policy

In the latest inspections, the Government kept tabs on emission reductions under policies and measures and countermeasure evaluation indices incorporated in the Target Achievement Plan from FY2000 through

FY2007 in principle (and those for FY2008 if possible), as well as estimates from FY2008 to FY2012[1] as long as data were available. The Government also assessed the performance trends in light of these estimates and surveyed the status of additional and enhanced measures and policies, putting them together in Appendix 2.

As a result, the performance trends of most of the measures proved largely as estimated. For the measures whose performance trends fell short of the expectations, the Government has been urging relevant organizations to step up efforts under their respective voluntary action plans and also adding and strengthening other measures and policies. Total emissions of greenhouse gases in FY2007 increased 9 percent over the base year. This is primarily because of a major impact of the deterioration in unit CO_2 emissions in the electric power sector on the increase in total emissions due to a significant decline in utilized capacity of nuclear power plants stemming from the suspension of operations of the Kashiwazaki Kariha nuclear power plant of the Tokyo Electric Power Co. in Niigata Prefecture in the wake of the Chuetsu Offshore Earthquake in 2007. Regarding unit CO_2 emissions in the electric power sector, the Federation of Electric Power Companies plans to achieve the estimated reductions in the first commitment period under the Target Achievement Plan through continued (1) promotion of nuclear power generation on the basis of securing safety and restoring trust; (2) further enhancement of thermal efficiency of thermal power generation and consideration of operational methods for thermal power sources; and (3) utilization of the Kyoto Mechanism.

Going forward, from the summer of 2009 the Government will present the outlook for total greenhouse gas emissions in Japan for the entire first commitment period (five years), comprehensively evaluate the progress of measures and policies set forth in the Target Achievement Plan and the status of emissions, and take necessary measures. The Government will continue to strive to steadily promote measures and policies, and in order to make a comprehensive evaluation feasible, regarding measures and policies for which the Government has yet to see the outlook for countermeasure evaluation indices for each year from FY2008 to FY2012, it is necessary to obtain the outlook for countermeasure evaluation indices for each fiscal year promptly.

Furthermore, since there still are measures and policies for which the degree of progress is not known at the present stage due to the unavailability of data of actual results or those for which performance data is produced late, extra efforts need to be made to obtain performance data at an early date and develop data expeditiously.

[1] Values for each fiscal year of “countermeasure evaluation indices” and “estimated emission reductions” in Appendix table of the Target Achievement Plan. For measures for which the relevant appendices show only the average value for the first commitment period, the value for each fiscal year of the relevant measures considered after the Cabinet’s adoption of the Target Achievement Plan are presented.

4.5.3 Transition and Outlook of Japan's Greenhouse Gas Emissions

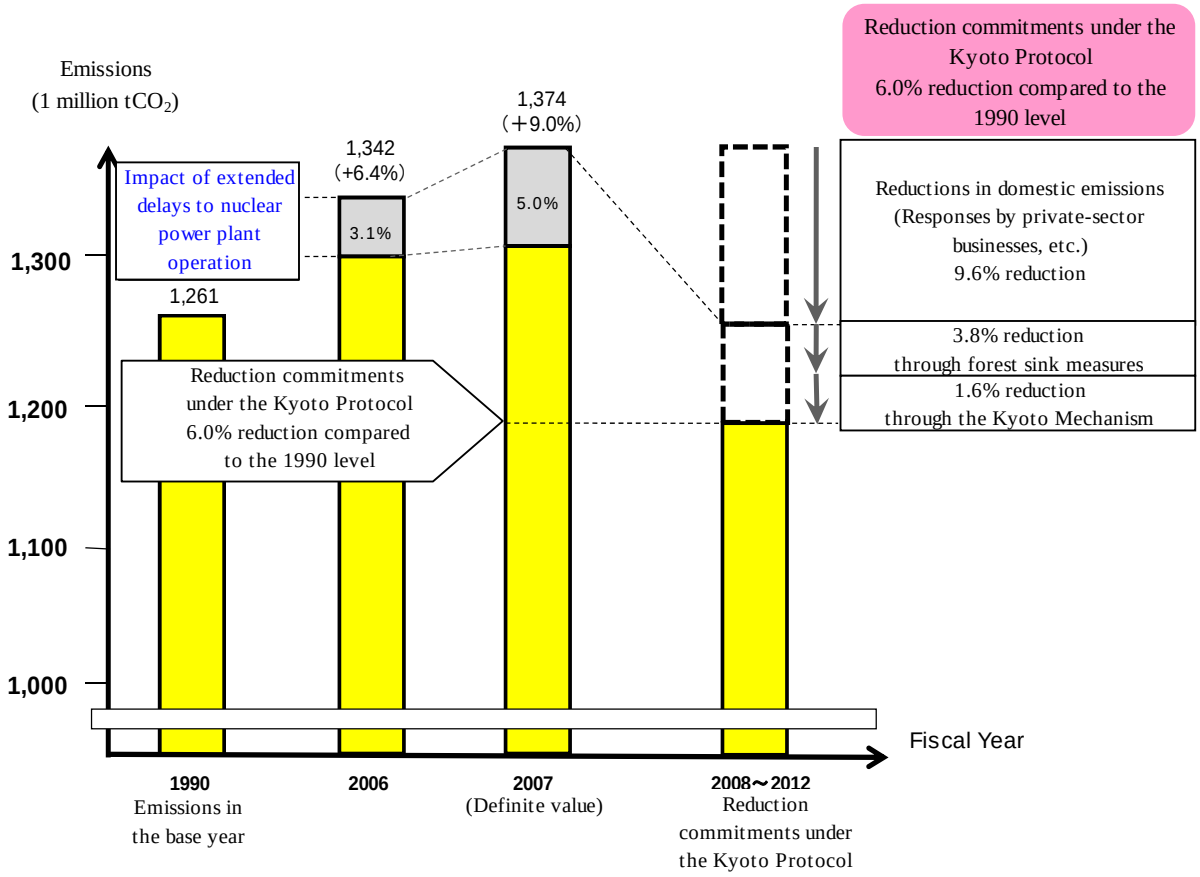


Figure 4.14 Transition and Outlook of Japan's Greenhouse Gas Emissions

Table 4.13 State of Greenhouse Gas Emissions

(Unit: Million tCO_2)

	Base Year (Ratio to Total Emissions)	Actual Performance in FY2007 (% Change from the Base year)	Targets for FY2010 (Necessary Reductions from FY2007 Levels)
Energy-originated CO_2	1,059 (84%)	1,219 (+15.1%)	1,076 – 1,089 (-10.7 – -11.8%)
Industrial sector	482 (38%)	471 (-2.3%)	424 – 428 (-9.2 – -10.0%)
Commercial and other sector	164 (13%)	236 (+43.8%)	208 – 210 (-11.1 – -12.0%)
Residential sector	127 (10%)	180 (+41.2%)	138 – 141 (-21.5 – -23.1%)
Transport sector	217 (17%)	249 (+14.6%)	240 – 243 (-2.4 – -3.8%)
Energy industries sector	67.9 (5%)	83.0 (+22.2%)	66 (-20.1%)
Non-energy-originated CO_2	85.1 (7%)	84.5 (-0.6%)	85 (0%)
CH_4	33.4 (3%)	22.6 (-32.3%)	23 (0%)
N_2O	32.6 (3%)	23.8 (-27.1%)	25 (+4.0 – +4.2%)
Three fluorinated gases	51.2 (4%)	24.1 (-53.0%)	31 (+28.7%)
Total	1,261 (100%)	1,374 (+9.0%)	1,239 – 1,252 (-8.9 – -9.9%)

* Base-year figures are calculated by the method of calculation used for a report on assigned amounts submitted to the UNFCCC secretariat in August 2006.
* The actual results for FY2007 are the greenhouse gas emissions (definite value) for FY2007 announced in April 2009.
* Targets for FY2010 are targets calculated using the method of calculation at the time of revision to the Target Achievement Plan.

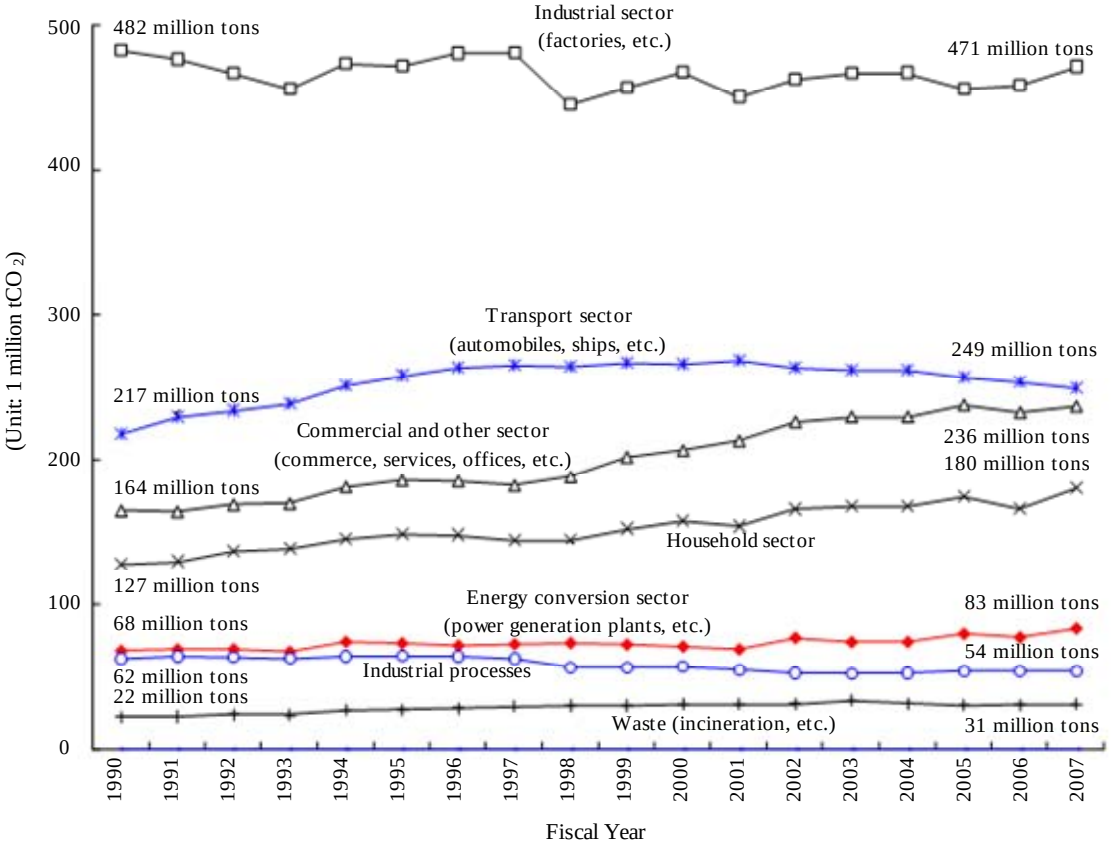


Figure 4.15 State of Greenhouse Gas Emissions

4.5.4 Progress in Measures and Policies Concerning Greenhouse Gas Reductions and Absorptions

Regarding individual measures and policies presented in the Kyoto Protocol Target Achievement Plan, the following list shows the results of consideration of the changes in the actual values of countermeasure evaluation indices and their future outlook as well as the need for additional and stronger measures and policies (see Appendix 2, the table of inspection results, at the bottom of this report).

While the Government conducts a detailed consideration of individual measures and policies in its annual inspection, these reports are omitted here because they are so voluminous. For details, see “Progress in the Kyoto Protocol Target Achievement Plan” (Global Warming Prevention Headquarters, July 2009) (http://www.kantei.go.jp/jp/singi/ondanka/). (However, reference materials are available only in Japanese language because of time and cost constraints as inspections are conducted twice a year.)