Executive Summary

Chapter 1: National Circumstances Relevant to Greenhouse Gas Emissions and Removals

Japan is an archipelago stretching approximately between latitudes 24° and 46° north, and consists of four major islands as well as more than 6,800 smaller islands. Japanese territory extends over 37,790,000 hectares, or about 0.3 percent of the earth's terrestrial surface, of which about 80 percent is either forested or agricultural land. Japan stretches over a great distance from north to south with a vast range of climatic zones and has distinct defined seasons.

As of 2000, Japan's population was 127 million, and the population density was 340 inhabitants per square kilometer. The ratio of the elderly amongst the population has rapidly increased at a higher rate than ever, and the population segment aged 65 or older was 17%. The number of households has increased consistently combined with declining of the average size of households, there were 46.78 million households in Japan in 2000. In line with the general shift of the Japanese economy towards the tertiary industries, the amount of floor space devoted to the business sector has steadily increased. Since 1965, it has increased at an average of 4.1% annually.

From fiscal 1970 to fiscal 1998, Japan's gross domestic product (GDP) increased by 2.6 times to 481 trillion yen. However, in the early 1990s, the prices of land, securities, and other assets nose-dived. Combined with an adjustment in consumer durables and capital stock, and reductions in expenditure on consumables led to the stagnation of economic activities. Since fiscal 1992, growth of less than 1 percent or negative growth has continued except for in fiscal 1995 and 1996. In particular, since fall 1997, economic status is getting worse further while the aftereffects of the 'bubble economy' have predominated.

In terms of the industrial structure, the yen continued to appreciate from the spring of 1990 through the spring of 1995, influencing the processing and assembly industries and spurring on a structural shift among Japanese firms towards greater overseas production. On the other hand, the information, telecommunications, and other nascent industries recorded large growth.

Domestic passenger and freight traffic grew significantly with growth of economic, throughout the period of rapid economic growth of the 1960's. The growth rate of passenger and freight traffic during the early 1980's lowerd, but it suddenly increased in the latter 1980's along with the economic expansion. On the other hand, road traffic's share has increased. In the

1990's, however, traffic volumes and the shares of each transportation mode have remained almost constant. The number and total travel distance of passenger car has increased since the 1960's. From 1995, however, its increase rate has slowed down. Since 1980 until the present, preferences have shifted to saloon cars and recreational vehicles (RVs) and the average weight of light weight cars has been increasing following legislation to improve their safety, and the ratio of heavy vehicles has increased accordingly.

Final energy consumption continued to increase significantly with the Japanese economy's rapid growth during the 1960's and until the first oil crisis in 1973, after which it leveled off and eventually decreased. From 1986 onwards, however, the economic pickup primed new growth in energy consumption, equivalent to $15{,}565 \times 10^{15}$J in fiscal 1999. These trends from 1990 can be summarized for different sectors as follows. Energy consumption leveled off in the industrial sector. On the other hand, it has significantly increased in the residential and commercial sector. In transport sector, it has significantly increased between 1990 and 1995, however, its increase rate has slowed down over 1995.

Japan's dependence on foreign sources peaked in fiscal 1973 at 89.4 percent of its energy supply; since then, this dependence has been reduced by efforts to find substitutes for oil; in recent years, foreign dependence has remained about 80 percent, putting the nation in an extremely vulnerable energy-supply situation. In fiscal 1999, the shares of the total primary energy supply for oil, coal, natural gas and nuclear power are 52%, 19%, 13% and 13%, respectively. The shares of natural gas and nuclear power have swiftly increased from the fiscal year 1973.

Japan's total primary energy supply per capita as of 1999 is 181×10^{9}J, a level that has remained steady recently. Japan's total primary energy supply per unit of GDP has improved significantly brought about by the oil crisis, but it has remained static during the 1990's.

Chapter 2: Greenhouse Gas Inventory Information

On the basis of the United Nations Framework Convention on Climate Change, all Parties to the Convention are required to submit national inventories of greenhouse gas emissions and removals to the Secretariat of the Convention every year.

The calculation methods and the reporting format of the inventory are in accordance with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, prepared by the IPCC (Inter-governmental Panel on Climate Change) (hereafter, 'Revised 1996 IPCC Guidelines'). In 2000, a 'Good Practice and Uncertainty Management' report was drawn up in which was described calculation selection methods that take into consideration the different circumstances of each country and quantitative assessment methods for uncertainties.

Japan's inventory was also calculated and reported in accordance with the Revised 1996 IPCC Guidelines. However, some portions were calculated using methods that differ from the methods indicated in the Revised 1996 IPCC Guidelines in order to ensure that the results would reflect national circumstance of Japan. Application of the 'Good Practice and Uncertainty Management' report is being examined and has not yet been applied to the inventory submitted in 2001.

Total emissions of greenhouse gases (calculated by multiplying each greenhouse gas emissions by global warming potentials (GWP), and aggregate them) in fiscal year 1999 is 1,307 million tons of carbon dioxide equivalents. It had increased by about 6.8 % compared to emissions (1,224 million tons) in the base year (1990 for CO_2, CH_4, and N_2O, while 1995 for HFCs, PFCs and SF_6) under the Kyoto Protocol, and also increased by about 2.1 % compared to previous year.

Table 1 Changes in emissions of each greenhouse gas

(million tons of CO2 equivalents)

	GWP	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Carbon dioxide (CO2)	1	1,124.4	1,124.4	1,147.8	1,162.2	1,144.0	1,214.1	1,217.8	1,236.2	1,233.5	1,187.0	1,225.0
Methane (CH4)	21	30.5	30.5	30.3	30.1	30.0	29.7	29.5	28.9	27.7	27.3	27.0
Nitrous oxide (N2O)	310	20.8	20.8	20.3	20.4	20.3	21.5	21.8	22.8	23.5	22.3	16.5
Hydrofluoro-carbon (HFCs)	HFC-134a :1300, etc	20.0						20.0	19.7	19.6	19.0	19.5
Perfluoro-carbon (PFCs)	PFC-14 :6500, etc	11.4						11.4	11.2	14.0	12.4	11.0
Sulfur Hexafluoride (SF6)	23,900	16.7						16.7	17.2	14.4	12.8	8.4
Total		1,223.8	1,175.6	1,198.4	1,212.7	1,194.2	1,265.2	1,317.3	1,335.9	1,332.7	1,280.8	1,307.4

Chapter 3: Policies and Measures

In Japan, the Global Warming Prevention Headquarters was established in December 1997 by order of the Cabinet to implement specific and effective countermeasures against global warming in reaction to the Third Session of the Conference of the Parties to the UNFCCC (COP3, also known as the "Kyoto Conference on Global Warming Prevention"). The "Guideline for Measures to Prevent Global Warming" was drawn up in June 1998 by the headquarters.

Subsequently, new "Guideline for Measures to Prevent Global Warming" was concluded on 19th March 2002, as additional measures need to be promoted to achieve the commitment stipulated in the Kyoto Protocol as emissions continue to increase.

This chapter is based on Chapters 1 through 4 of this new Guideline.

1. Basic Policies

○We are endeavoring to prepare and establish a mechanism to ensure contribution to both the environment and economy by make the best use of technological innovation and innovative ideas in economic circles to link the various measures to prevent global warming and to create labor opportunities by stimulating the economy in Japan. ("**Contribution to both the Environment and Economy**")

○The progress of domestic policies and measures and the state of greenhouse gases emissions shall be assessed and reviewed periodically (2004, 2007) to consider necessity of additional policies and measures. ("**Step-by-Step Approach"**)

○It will not be easy to achieve the commitment stipulated in the Kyoto Protocol, cooperation between all parties is indispensable, by having the government, local authorities, businesses, and citizens each playing their roles. We continue to promote the voluntary action of businesses, and in particular, measures for residential/commercial sector and transport sector strongly. ("**Shared Responsibility"**)

○Japan continues its maximum efforts for the establishment of a common rule in which all countries including the USA and developing countries participate. ("**Ensuring international cooperation for measures to prevent global warming"**)

2. Main Points of the new Guideline

○This new Guideline show an overview of the specific measures with details of how to achieve the 6% reduction commitment stipulated in the Kyoto Protocol. This Guideline stipulates more than 100 domestic measures and policies to achieve the commitment. The statutory Kyoto Protocol Target Achievement Plan shall be drafted based on the new Guideline according to the Bill for revising a part of the Law Concerning the Promotion of Measures to Cope with Global Warming.

○We shall try to achieve the 6% reduction commitment stipulated in the Kyoto Protocol based on the following targets for the time being. Even if adequate progress is expected for targets ①-⑤ within the first commitment period, further emission reductions shall be promoted as well as continuously and steadily promoting earlier measures without allowing any complacency. Furthermore, Japan shall study the utilization of the Kyoto mechanisms while taking account of international situation and bearing in mind the commitment achievement responsibility and the general rule that Kyoto mechanisms stipulated in the Kyoto Protocol are supplementary to domestic measures.

○The Global Warming Prevention Headquarters shall conduct assessment and review of the Guideline in 2004 and 2007. In carrying out the above, the Headquarters shall

comprehensively assess and review the various economic frames assuming this Guideline to review measures and policies flexibly.

○We have just established this Guideline bearing in mind public comments and the deliberation results of the Relevant Advisory Councils. In order to establish the Kyoto Protocol Target Achievement Plan based on this Guideline, we shall listen to the various opinions from various sectors and layers of the public.

3. Measures for each of greenhouse gases and other segments (main examples)

①CO_2 emissions from energy source (±0.0%)

Targets: total amount of emissions will be ±0% compared to the base year in this segment

	Industrial Sector	Residential and Commercial Sector	Transport Sector
Energy Conservation measures reduction amounts of additional measures (The following is the same) [22 Mt-CO_2]	• Steady implementation and follow-up of the voluntary action plan (Target of the Keidanren Voluntary Action Plan on the Environment is to reduce CO_2 emissions for 2010 to no more than 1990 levels.) • Technological development and diffusion of its results, such as Highly efficient boilers and lasers • Promoting introduction of high performance industrial furnaces	• Energy management system that applies to large-scale factories is adopted for large-scale office buildings through revision of the Law Concerning the Rational Use of Energy. • Gas equipment, etc. that were not previously targeted are added based on the Top Runner Approach. • Promotion of distribution of high efficiency water heater • Promoting distribution of the HEMS and BEMS	・ Rapid introduction of vehicles that meet Top Runner Approach, and accelerating the development and distribution of low emission vehicles including clean energy vehicles ・ Measures on the traffic flow by Promotion of Intelligent Transport Systems (ITS), etc. ・ Improving efficiency of freight services including promotion of modal shift to shipping, etc. ・ Promoting use of public transportation
New Energy mesasures [34Mt-CO_2]	・ Placement biomass energy and snow ice cryogenic energy in the Law Concerning Promotion of the Use of New Energy ・ Proposal to establish the Bill Concerning the Use of New Energy by Electric Utilities ・ Promotion of introduction support for photovoltaic power generation, solar thermal utilization, wind power generation, waste power generation, and biomass energy, etc. ・ Strengthening the support for technological developments and demonstration tests, etc. concerning fuel cells, photovoltaic power generation, and biomass energy, etc.		
Fuel switching, etc. [18Mt-CO_2]	・ Subsidization towards part of the cost of converting old coal fired power generations to natural gas power generations ・ Subsidization towards part of the cost of fuel switching such as industrial boilers ・ Preparation of safety standards for natural gas pipelines		
Promotion of nuclear power	・ Promotion of nuclear power generation with giving priority to safety ・ Promotion of the Power Sited Regions Promotion Measures related to location of nuclear fuel cycle facilities		
(*1)	Approx. 462Mt-CO_2 (▲7%)	Approx. 260Mt-CO_2 (▲2%)	Approx. 250Mt-CO_2 (+17%)

(*1) ( ) is percentage of reduction compared to base year 1990 of each sector

※The emission reduction targets in each sector are set as benchmarks estimated to be achievable in the event that the measures on the energy supply side and demand side achieve their intended effect as economic growth in Japan is achieved in line with the latent growth rate.

※It is appropriate to evaluate measures with a certain degree of flexibility from an overall viewpoint for the energy supply and demand structure while adopting the reduction and implementation target amounts.

※The Kyoto mechanisms also allow the participation of private sectors. Therefore, it is expected that these mechanisms will be used by them to achieve their own emission reduction target more cost-effectively.

②Emissions of CO_2 from non-energy sources, CH_4, and N_2O (▲0.5%)

Target : reduction amount will be 0.5% compared to the total GHG emissions in the base year

CO_2 from non-energy sources	Setting up National targets in waste management policy based on the Waste Management and Public Cleansing Law and related individual recycling regulations Expansion of the utilization of timber and wood materials Promotion of compost deoxidization and green manure cultivation in farmland
CH_4	Trying to halve the volume of waste disposed in landfills based on Food Recycling Law, etc. Improvement of farmland management Development of technologies to reduce greenhouse gas emissions from agricultural sector
N_2O	Sophistication of combustion for wastewater sludge based on the sewerage facility plan, etc.

③Development of innovative technology and further extensive efforts by the public (▲2.0%)

Target : reduction amount will be 2.0% compared to the total GHG emissions in the base year

Strengthening research and development of advanced and innovative energy- and environment-related technologies	Promotion of Research and Development of energy efficient new steel production process, energy efficient new chemical process, material for lighter vehicles, energy efficient electric appliances, and low energy loss electric distribution system
Further Activities to prevent Global Warming carried out by various sectors and layers of the public	Changing incandescent lamps to fluorescent lighting, Reduction in upwards luminous lux of outdoor lighting in the evening, Efficient use of refrigerator, Introduction of water-saving shower head, Temporarily turning off lights in offices, Reduction in wasteful copies

④Emissions of HFCs, PFCs, SF_6 (+2.0%)

Target : increase amount will be +2% compared to the total GHG emissions in the base year

total emissions is controlled to increase in +2% from increase in +5% on business as usual case

- Follows up progress of voluntary action plans of industries
- Research and development of new alternative substances
- Development of inexpensive and compact fluorocarbon recycling and destruction technologies
- Appropriate enforcement of Home Appliance Recycling Law and Fluorocarbon Recovery and Destruction Law

⑤Sinks(▲3.9%)

Target: ensure removals of about 3.9% compared to the total greenhouse gas emissions in the base year as agreed at COP7 through sink activities in Japan

Sound forest management including planting, weeding, and thinning, etc., Promotion of utilization of timber and wood biomass, Promotion of Urban Greening

Chapter 4: Projections and the Total Effect of Policies and Measures

In Japan, the Guideline of Measures to Prevent Global Warming ("old Guideline") was established in 1998 and the government have been implementing the measures for the purpose of reducing greenhouse gases. When the old Guideline was established, it was estimated that greenhouse gas emissions would increase significantly if no special measures were taken. As a result of promoting various measures based on the old Guideline, total greenhouse gas emissions in 2010 is estimated at about 1,320 million tons of CO_2, and it is expected to be reduced to about a 7% increase compared to the base year.

On the other hand, our total greenhouse gas emissions in the base year is 1,229 million tons of CO_2. In order to achieve the 6% reduction commitment for Japan stipulated in the Kyoto Protocol, we must also strive to reduce emissions by about 13% (approximately 165 million tons of CO_2) over and above existing measures.

Therefore, a reexamination of global warming countermeasures was promoted by the concerned government ministries beginning in 2000 and, by March 2002, new Guideline of Measures to Prevent Global Warming were established setting forth quantitative targets for each measure. In this task, emissions were predicted as of 2010, the central year of the first commitment period, premised on currently existing measures and additional measures were formulated and examined to cover insufficiencies in the goals set for each sector. The total estimated amounts for emission reduction by the additional policies and measures is 144 million tons of CO_2 in 2010.

Table 4.2. Actual emissions and future outlook for greenhouse gases by sector

(unit: million tons of CO_2)

Sector	Actual emissions			2010 projection			
	Base year	1999	% Change	Without measures	With measures	With additional measures	% Change
CO_2 from energy sources	1,053	1,148	9.0%	※2	1,126	1,052	-0.1%
Following 3 substances	128 (123)	127 (121)	-0.1%	140	122※3	122※3	-4.8%
CO_2 from non-energy sources	77 (72)	77 (77)	-0.3%	88	85	85	10.1%
CH_4	29 (30)	25 (27)	-12.4%	25	24	24	-18.2%
N_2O	22 (21)	25 (17)	10.6%	27	16	16	-27.1%
Other greenhouse gases	48	39	-19.3%	107	73	73	51.4%
HFC	20	19	-2.7%				
PFC	11	11	-3.4%				
SF_6	17	8	-50.1%				
Development of innovative technology, further extensive efforts by the public	—	—	—		-4	-26	—
Sinks	—	—	—		—	-48	—
Total	1,229 (1,224)	1,314 (1,307)	6.9% (6.8%)		1,317	1,173	-4.6%

※1：Figures in parentheses ( ) are the reported values (Chapter 2) of the inventory submitted in 2001 (refer to the footnote of 4.2. Future outlook)

※2：Forecast for 2010 of CO_2 from energy sources (case without measures) has not been carried out.

※3：The reason why it is 3 million tons of CO_2 less than total CO_2 from non-energy sources, CH_4 and N_2O is because there is considered to be a reduction of 2.60 million tons of CO_2 due to measures that do not specify the amount of reductions resulting from the expanded use of mixed cement, etc., in this sector in the Guideline.

Chapter 5: Vulnerability Assessment, Climate Change Impacts and Adaptation Measures

This chapter reviews the results of research being conducted on climate change in Japan and presents quantitative evaluations of the projected impacts.

Research to date indicates that climate change may have a major effect on Japan's agriculture, forestry, fisheries, water resources, coastal management, natural ecosystems, and human health.

For example, it is estimated that, due to global warming, the number of typhoons will decrease and their maximum intensity will increase slightly. In terms of rice cultivation in paddy fields, it is estimated that the production volume will increase in upper latitudes while problems may occur with growth due to higher temperatures in lower latitudes. It is thought that demand for water supply will increase by 1.2 ~ 3.2 percent per 3°C increase in temperature. Furthermore, it is thought that heat stress will increase due to higher temperatures in summer, with effects also seen on human health due to increased vectors and improved growth conditions for pathogenic organs and parasites.

Meanwhile, several important items are considered to be issues for future research but are not addressed in this report. These include forecasting climate change per area, and indirect effects on Japan's socioeconomic system such as problems with importing foodstuffs, energy, and other resources. It is also clear that climate change will have a massive effect on natural ecosystems, but at present it is extremely difficult to quantitatively assess such an effect.

The Framework Convention calls for measures to mitigate the adverse effects of climate change and for adaptive measures that will facilitate adaptation to climate change. Japan is studying adaptive measures related to coastal areas, social infrastructure, and agricultural production.

Chapter 6: Financial Resources and Transfer of Technology

The government of Japan identifies environmental conservation as a basic philosophy of Japan's Official Development Assistance (ODA) and states that "the pursuit of environmental conservation and development in tandem" must be one of the basic principles of ODA. The government of Japan tries to realize sustainable development on a global scale through assisting the self-help efforts of developing countries.

In particular concerning global-warming issue, the government of Japan announced the Kyoto Initiative on aid for global warming programs in developing countries during the COP3 in December 1997. Under the Initiative, the government of Japan provides active support for global warming programs and projects. Specifically, as a cooperation in Capacity Development, about 4,600 people have already been fostered during the three years from fiscal 1998 to fiscal 2000 through training courses both in Japan and developing countries, and by the experts and JOCV

members dispatched by Japan. Also, the government of Japan has provided ODA loans on the most concessional terms (interest rate: 0.75%; repayment period: 40 years) available internationally primarily with regard to energy saving technologies, new and renewable energy sources, forest conservation and afforestation, and air pollution-related measures in order to achieve sustainable development while dealing with global warming issues. Approximately ¥580 billion has been committed from December 1997 to March 2001. In addition, the government of Japan will support developing countries efforts by using technology and know-how acquired in the process of combating its own pollution and energy problems, and developing and transferring such global warming-related know-how as best suited to the actual status in developing countries, as well as sending survey groups and holding workshops.

Other support is being provided through comprehensive project-type technical cooperation that includes dispatch of experts, acceptance of trainees, and provision of equipment, Grant Aid for Global Environment to support in the energy-related and afforestation fields which lead to reduce and limit the emission of greenhouse gases, and F/S projects for CDM and JI.

Chapter 7 Research and Systematic Observation

The Council of Ministers for Global Environment Conservation draws up a Comprehensive Program for the Promotion of Global Environmental Research, Monitoring and Technological Development each fiscal year. The program comprehensively promotes surveys, research, observation, monitoring, and technological development for the protection of the global environment and follows up on the implementation of efforts in these fields.

In August 1990, the 'Basic Program for Research and Development in Global Science and Technology', which was approved by the Prime minister, was made up. The program specifies that Japan shall prioritize international activities for research and development. Also, promote studies of prediction of global change comprehensively, including global warming, under cooperation with various universities, ministries and agencies concerned.

In December 2000, the Cabinet drew up a new Basic Environment Plan in accordance with the Basic Environment Law. This states the promotion of global warming-related measures as one of its strategic programs, and also specifies measures for the government to take in this field by including sections on 'adequate surveys, research, monitoring, and observation, and promotion of proper technologies' and 'ensuring international cooperation for surveys, research, monitoring, and observation, etc.'.

1. Research

While giving full consideration to the United Nations Framework Convention on Climate Change and the Kyoto Protocol, the Government of Japan is comprehensively promoting

surveys and research to better understand the present condition and predict the future impacts of global warming, to fix, isolate, and reduce greenhouse gases, and to draw up appropriate countermeasures. And cooperating with the activities of the Inter-governmental Panel on Climate Change (IPCC), the Government of Japan will contribute to establish guidelines for the implementation of the Kyoto Protocol and methods for assessing the removal of greenhouse gases by forests, and so on. Moreover, the government will prioritize the promotion of relevant research to contribute to the IPCC Fourth Assessment Report, the preparation of which is scheduled to begin in the near future. In addition, based on the 'Global Warming Research Initiative' included in the promotion strategy of environmental sciences decided by the Council for Science and Technology Policy in September 2001, individual research projects should be integrated into the research programs such as climate change prediction, impacts and risks assessment, control policy research, and so on, and research and development is promoted under collaboration among industry, academia, and government.

Japan participates and cooperates in the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme of Global Environmental Change (IHDP), and other international global environmental research programs, conducts surveys and research based upon an appropriate international division of tasks, and otherwise promotes joint research and other initiatives together with overseas research organs. Also, Japan is promoting research on global environmental change in the Asia-Pacific region in cooperation with researchers from throughout the area, as well as developing a regional research network on global environmental change.

2. Systematic Observation

The Government of Japan promotes the 'Comprehensive monitoring program for global warming' included in the 'Global warming research initiative', for placing special priority on promoting the observation and monitoring to identify the status, causes, and impacts of global warming and climate change. And more, the Government participates and cooperates in the Global Environmental Monitoring System (GEMS), the Global Atmosphere Watch (GAW) Program, the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS) and other international observation and monitoring programs, and plans to facilitate implementation of observation and monitoring throughout the Asia-Pacific region. In addition, Japan has been promoting the 'Integrated Global Observing Strategy Partnership (IGOS-P)' that cooperates with and coordinates international study programs, observation systems, and international organizations, etc. Moreover, for global observation by satellites, the Government is actively participating in the activities of the Committee on Earth

Observation Satellites (CEOS) and other international forums and is promoting the development, launch, and operation of satellites in conformity with these activities.

Chapter 8 Education, Training, and Public Awareness

Carbon dioxide emissions have been consistently increasing in recent years in the residential/commercial and transport sectors, which are closely related to the lifestyles of citizen. To mitigate global warming, all citizens must shift from the mass consumption and disposal lifestyle to resource and energy conservation. At the same time, consideration should be given for the usage of non-fossil fuel energy, including new and renewable energy and nuclear energy. To that end, opportunities to learn about the global warming issue, as well as the energy issues closely involved with it, are provided for homes, schools, and society at large. Japan is also trying to develop the Prefecture Centers for Climate Change Actions nationwide, and promotes improved awareness through advertising in the mass media, distribution of pamphlets, and the holding of symposiums, etc. Also, Japan is committed to increasing the support for environmental NGOs, which promise to play a leading role as advisors in citizen efforts to address the global warming problem.