

# PROMOTION OF TECHNICAL RESEARCH AND DEVELOPMENT FOR PREVENTION OF GLOBAL WARMING

## Contents

<b>Preface</b>	<b>1</b>
<b>I. Introduction</b>	<b>2</b>
1. The Context of the Warming Problem	2
2. An Overview of the Guideline of Measures to Prevent Global Warming	3
3. Toward the Promotion of Measures to Prevent Global Warming	4
<b>II. The Status of Research and Development</b>	<b>7</b>
<b>III. Research and Development Promotion Strategy</b>	<b>10</b>
1. Technologies Expected to be Realized During the First Commitment Period	10
2. Technologies of Importance in the Medium to Long Term Perspective	10
3. Critical Technology for the Future Construction of an Environmentally Harmonious Society	13
4. The Importance of Diffusion Measures	14
<b>IV. Related Matters of Importance</b>	<b>16</b>
1. Promotion of Active Engagement by All Levels and Sectors of Society	16
2. The Importance of Life Cycle Assessment	16
3. The Necessity for an International Perspective	17
4. Human Resource Development	17
5. The Importance of Basic Research	18

## **Preface**

The Council for Science and Technology Policy established a Project Team for Technology to Prevent Global Warming under the Expert Panel on Promotion Strategy of Prioritized Areas on June 19, 2002. With a membership from academics, industry, and other knowledgeable parties, the project team was founded to conduct an intensive investigation of research and development strategy for technologies to reduce greenhouse gases.

The Project Team investigated the status of research and development in the energy conservation, new energy, and innovative environmental and energy technologies specified in the Guideline of Measures to Prevent Global Warming, further possibilities for development of technology to

prevent warming during or even following the first commitment period (2008–2012), and human resource development and other related matters of importance. Eight team meetings have been held since the first on August 1, 2002, and interviews were conducted with the government agencies concerned, the Nippon Keidanren (Japan Business Federation), and knowledgeable parties as investigation proceeded and the findings were put into organized form.

The Council for Science and Technology Policy will use this report to provide feedback for the upcoming Guidelines on Budgetary/Personnel Resource Allocation in Science and Technology. It is to be hoped that this will contribute to the setting of priorities in the government technical development budget, and that government agencies will engage actively in further promotion of related measures. It is also to be hoped that this will contribute to the scheduled formulation of plans and so on for achieving the targets set by the Kyoto Protocol.

It is to be borne in mind that evaluation of scientific technology is subject to change with circumstances. In this light, it is crucial that research and development in new areas be proposed or reconsidered as appropriate.

## **I. Introduction**

### **1. The Context of the Warming Problem**

The global warming problem arises when greenhouse gases generated by human activity cause the concentration of greenhouse gases in the atmosphere to increase. As a result, the temperature of the whole earth's surface and the atmosphere gradually rises, with harmful effects to the natural ecosystem and to human beings. Given the magnitude and seriousness of the effects that have been forecast, this constitutes a most critical environmental problem that impacts the very foundations for the survival of the human race.

The world community addressed this issue by adopting the International Framework Convention on Climate Change in May 1992, and putting it into effect in March 1994. Japan signed the convention at the UN Conference on Environment and Development in June of the year it was adopted, and ratified it in May 1993. The Kyoto Protocol was then adopted in December 1997 as an initial step toward long-term, sustained reduction of emissions in line with the principles of the Framework

Convention on Climate Change. This protocol legally binds the advanced countries to reduce greenhouse gases according to their commitment. Japan ratified the Kyoto Protocol in June 2002 and committed to achieving a 6% reduction of greenhouse gas emissions relative to the base year during the first commitment period (2008–2012).

The volume of greenhouse gases<sup>1</sup> emitted by Japan was 1.233 billion tons (carbon dioxide equivalent) in 1990, the base year set by the Kyoto Protocol, and this was reported to have risen to 1.332 billion tons in fiscal 2000 (Council of Ministers Concerned with Global Environmental Protection and Global Warming Prevention Headquarters, July 19, 2002), which is an increase of approximately 8%<sup>2</sup> over the base year. The increase of energy consumption in the consumer and transportation sectors had a particularly large impact. Meeting the reduction commitment, therefore, will require a reduction of 14%, to include that increase of 8%.

## 2. An Overview of the Guideline of Measures to Prevent Global Warming

In June 1998, the government took the Third Conference of the Parties to the United Nations Framework Convention on Climate Change as the occasion to issue the Guideline of Measures to Prevent Global Warming (hereafter the old Guideline) in order to realize specific and effective measures to prevent global warming. Subsequently, however, emissions of greenhouse gases continued to trend upward, and it became clear that further measures must be taken to meet the Kyoto Protocol commitment.

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<sup>1</sup> The Kyoto Protocol defines the greenhouse gases that are subject to quantified commitments for reduction or emissions limits to be carbon dioxide from energy sources that are generated in the consumption of fossil fuels, typically oil, and additionally carbon dioxide from non-energy sources, methane, dinitrogen monoxide, and CFC replacements that are known to be ozone-depleting substances, such as HFCs, PFCs, and SF6. The emissions volumes here are adjusted by the global warming potential and converted to represent the magnitude of the carbon dioxide greenhouse effect.

<sup>2</sup> According to the record of energy demand for fiscal 2001 (preliminary estimate of January 31, 2003, General Policy Division, Agency for Natural Resources and Energy), emissions of carbon dioxide from energy sources showed a decline of 2.7% over the previous fiscal year.

In March 2002, therefore, a new Guideline of Measures to Prevent Global Warming (hereafter the Guideline) was issued with the intention of clarifying the overall picture of such measures in order to provide specific support for implementation of Japan's reduction commitment under the Kyoto Protocol. The Guideline defines a package of more than 100 separate kinds of measures and policies involving the entire government.

An overview of the Guideline follows:

The basic approach with regard to formulation and implementation of measures to prevent global warming is (1) to prepare and establish mechanisms that contribute to the balance between the environment and the economy, (2) to take a step-by-step approach, (3) to promote a united effort by the national government, local governments, public institutions, businesses, and the public, and (4) to ensure international cooperation for measures to prevent global warming. Item (2), in particular, is slated for evaluation of the status of progress, emissions, and so on in 2004 and 2007, whereupon additional measures will be devised as necessary.

The commitment for a 6% reduction (approximately 14% reduction from fiscal 2000) is to be met for the immediate future by achieving the below targets. In the event that the targets appear likely to be adequately achieved during the first commitment period, however, measures are to be pressed forward without any slackening on that account, and still further emission reductions are to be sought.

- (1) Carbon dioxide from energy sources ( $\pm 0.0\%$ ): The target is to limit emissions to fiscal 1990 levels.
- (2) Carbon dioxide from non-energy sources, methane, dinitrogen monoxide ( $-0.5\%$ ): The target is to achieve a reduction of 0.5% from fiscal 1990 levels as a proportion of total emissions in the base year.
- (3) Innovative technological development and further promotion of activities to prevent global warming undertaken by Japanese people from all sectors of society ( $-2\%$ ): The target is to achieve a 2% reduction from fiscal 1990 levels as a proportion of total emissions in the base year.
- (4) Three gases including chlorofluorocarbon replacements ( $+2.0\%$ ): The target is to hold the effect of +5% in the natural state down to the order of +2%.
- (5) Promotion of measures for absorption of greenhouse gases ( $-3.9\%$ ): The target is to ensure absorption of approximately -3.9% as agreed in COP7.

These additional measures set forth in the Guideline are expected to reduce emissions by an estimated 22 million tons in energy conservation, 34 million tons in new energy, and 18 million tons in fuel conversion and other such measures. Intensified development of innovative environmental and energy technologies is expected to bring about a reduction in emissions of approximately 7.44 million tons (approximately 0.6% relative to the base year) and further promotion of activities to prevent global warming undertaken by Japanese people from all sectors of society are expected to bring about a reduction in emissions of approximately 12.44–18.34 million tons (1.0–1.5% relative to the base year).

The Kyoto Protocol stipulates the so-called Kyoto Mechanism as an international system to facilitate more cost-effective measures to meet commitments. It will be necessary to put the Kyoto Mechanism to appropriate use, on the understanding that it is, as a rule, to be used to supplement domestic measures.

The commitments set forth in the Kyoto Protocol are by no means easy to achieve. As indicated in connection with the emission reduction volumes shown above, it will be essential for actors in every sector and level of Japanese society to join together in performing their respective functions to that end.

### 3. Toward the Promotion of Measures to Prevent Global Warming

Measures to prevent global warming involve urgent topics arising from measures directed to the first commitment period (2008–2012) established by the Kyoto Protocol, and at the same time must also continuously promote efforts with a medium to long term perspective. The year now is 2003, and the time remaining until the first commitment period is by no means long. While promoting the creation of technologies from research and development programs that are underway in the present, it is also necessary to devise means for their adoption and diffusion. Moreover, from the medium to long term perspective it is even more important that research and development deal with the reduction of greenhouse gases. Technology-based approaches are significant in that they provide measures capable of meeting targets for global warming prevention in ways that contribute to enhance economic activity and job creation without forcing

customers to bear their burden. This is why it is so important to engage actively in those measures specified in the Guideline that are related to research and development.

Looking ahead to the first commitment period, it is particularly important to implement measures so that technological topics that are presently undergoing research and development will be adopted and diffused in society (in the business community and ordinary households) in practically effective form. To this end, it is necessary to promote research and development and also to devise appropriate measures related to adoption and diffusion, such as operational trials, development for practical application, cost reduction, reevaluation of controls and institutional systems, improvement of infrastructure, and so on, according to the results from research and development and the field of application.

The rapid expansion of energy demand in recent years has brought calls for more active energy conservation in the consumer and transportation sectors, which have shown conspicuous increases in greenhouse gas emissions. It is essential to press ahead forcefully with measures for the adoption and diffusion of technologies that are presently undergoing research and development.

In the medium to long term perspective, it is important to promote strategic research and development of new energy, energy conservation, fuel conversion technology, carbon dioxide recovery and fixation, provision of new absorption sources, and so on. It is of particular importance to engage in active, focused research and development on topics that will have a significant impact in terms of measures to prevent global warming.

Active engagement in measures to prevent global warming shows good promise for creation of new markets and business and the expansion of the environmental and energy industries, as stated by the Cabinet Secretariat in its "Strategy for Industrial Development: Technological Innovation" of December 5, 2002.

The Nippon Keidanren has formulated a voluntary environmental action plan as a responsible way for industry to address the problem of global warming. Activities are underway on the basis of that plan, and the government, for its part, seeks to further increase their transparency and credibility by providing necessary assistance as well as by following up on the progress of energy conservation measures under the voluntary action plan.

The present report clarifies topics that are considered important under present circumstances in addressing measures for prevention of warming that are covered in the Guideline by the approach described above, and extending to topics not covered in the Guideline. It presents a coherent research and development strategy needed to further promote measures to prevent warming by investigating such subjects as the nature of the research activities, the timeframe from research and development to diffusion, the potential of each technology for reducing greenhouse gas emissions, and the importance of measures for adoption and diffusion as well as of research and development.

This report does not touch on research and development of nuclear power. The promotion of nuclear power is, however, recognized as a crucial issue not only in terms of energy policy but also in view of measures to prevent global warming. The recent shutdown of nuclear power plants in connection with problems they have experienced is causing an electric power shortage that constitutes an energy problem. At the same time, the resulting increase in replacement operation of thermal power plants is causing an increase in carbon dioxide emissions—i.e., global warming—which is cause for concern. If Japan is to continue satisfying energy demand that is expected to continue growing while also meeting its reduction targets, then it will be essential to expand and build new nuclear power plants, which do not emit carbon dioxide when generating power. Therefore, on the major premise of its assured safety, Japan will promote nuclear power, and it will be necessary to continue promoting research and development for this purpose.