



Ministry of the Environment
Japan

Climate Regime Beyond 2012

Key Perspectives

Interim Report

December 2004

Sub-Committee for
International Climate Change Strategy
Global Environmental Committee
Central Environmental Council

Climate Regime Beyond 2012
Key Perspectives
Interim Report

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The Central Environmental Council is advisory body for the Minister of the Environment (MoE). The Minister asks the council for advice on the basic direction of environmental policy regarding various important issues.

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Purpose and the Scope of Discussions at Sub-Committee for International Climate Change Strategies

<Interim Report of the Global Environment Committee of Japan's Central Environment Council on International Climate Regime Beyond 2012>

- In January 2004, the Global Environment Committee of Japan's Central Environment Council published an Interim Report, "Climate Regime Beyond 2012: Basic Considerations." In this paper, the Committee has spelled out the basic considerations that will guide the Government of Japan as negotiations are launched on the climate regime beyond 2012 (hereinafter referred to as "the next regime") that aims to build a common framework in which all countries of the world can join.
- The Interim Report of the Committee spells out the following seven basic considerations in approaching the issue of the climate regime beyond 2012.
 - (1) **Maintaining Progress towards Meeting the Ultimate Objective of the UNFCCC**

With respect to the climate regime beyond 2012, it is vital to maintain progress in order to meet the ultimate objective of the UNFCCC, that is, to ensure the environmental integrity of the climate regime.
 - (2) **Bringing the Kyoto Protocol into Effect and Fulfilling Commitment**

The Kyoto Protocol has taken the first step towards achieving specific reductions of GHG emissions. In approaching the climate regime beyond 2012, Japan should first of all make efforts to bring the Protocol into effect and fulfill its commitment.
 - (3) **Achieving Global Participation**

Ensuring environmental integrity of the climate regime requires global participation. The climate regime beyond 2012 needs to be built so as to achieve the participation of all countries, including the USA and developing countries.
 - (4) **Ensuring Equity Based on the Principle of Common but Differentiated Responsibilities**

In accordance with the principle of "common but differentiated responsibilities" in Article 3.1 of the UNFCCC, equity needs to be ensured between developed and developing countries, among developed countries and among developing countries. Differentiated commitments need to be developed that accord with diverse national circumstances.

(5) Negotiations Building on Existing International Agreements

International negotiations on climate change resulted in the adoption and entry into force of the UNFCCC, and culminated in the adoption of the landmark Kyoto Protocol; negotiations have continued subsequent to the adoption of the Protocol. Through such invaluable efforts and agreements, a common ground is being built for countries to take measures to address climate change. Building on these international agreements that serve as the basis for negotiating the climate regime beyond 2012, further discussions are necessary on how to develop and improve the architecture of the Convention and the Protocol, bearing in mind such considerations as the need for maintaining progress towards meeting the ultimate objective of the UNFCCC and for achieving global participation.

(6) International Consensus-Building by National Governments with the Participation of Various Actors

National governments are held responsible for the international regime, and it is important that they achieve a consensus in the process of international negotiations, while disclosing relevant information and ensuring the participation of various actors, such as businesses and non-governmental organizations.

(7) Making the Environment and Economy Mutually Reinforcing

In order to sustain efforts over a long period of time, we need structural reforms of the economy that aim to build a mutually reinforcing relationship between the environment and economy. This relationship is like a 'virtuous circle,' in which each component enhances the other's quality, so that combating climate change contributes positively to economic development, and vice versa. Technology will play one of the most important roles in promoting such reforms.

<Establishment of the Sub-Committee and Its Approach>

- In the process of compiling the Interim Report, the Global Environment Committee invited public comment. As a result, 50 comments were submitted from inside Japan and 12 from overseas, and many of these called for studies on specific details of the next regime. In order to collect and organize the materials needed to put the considerations in the Interim Report into more concrete terms, in January 2004 the Committee set up an sub-committee to consider Japan's international climate change strategy.

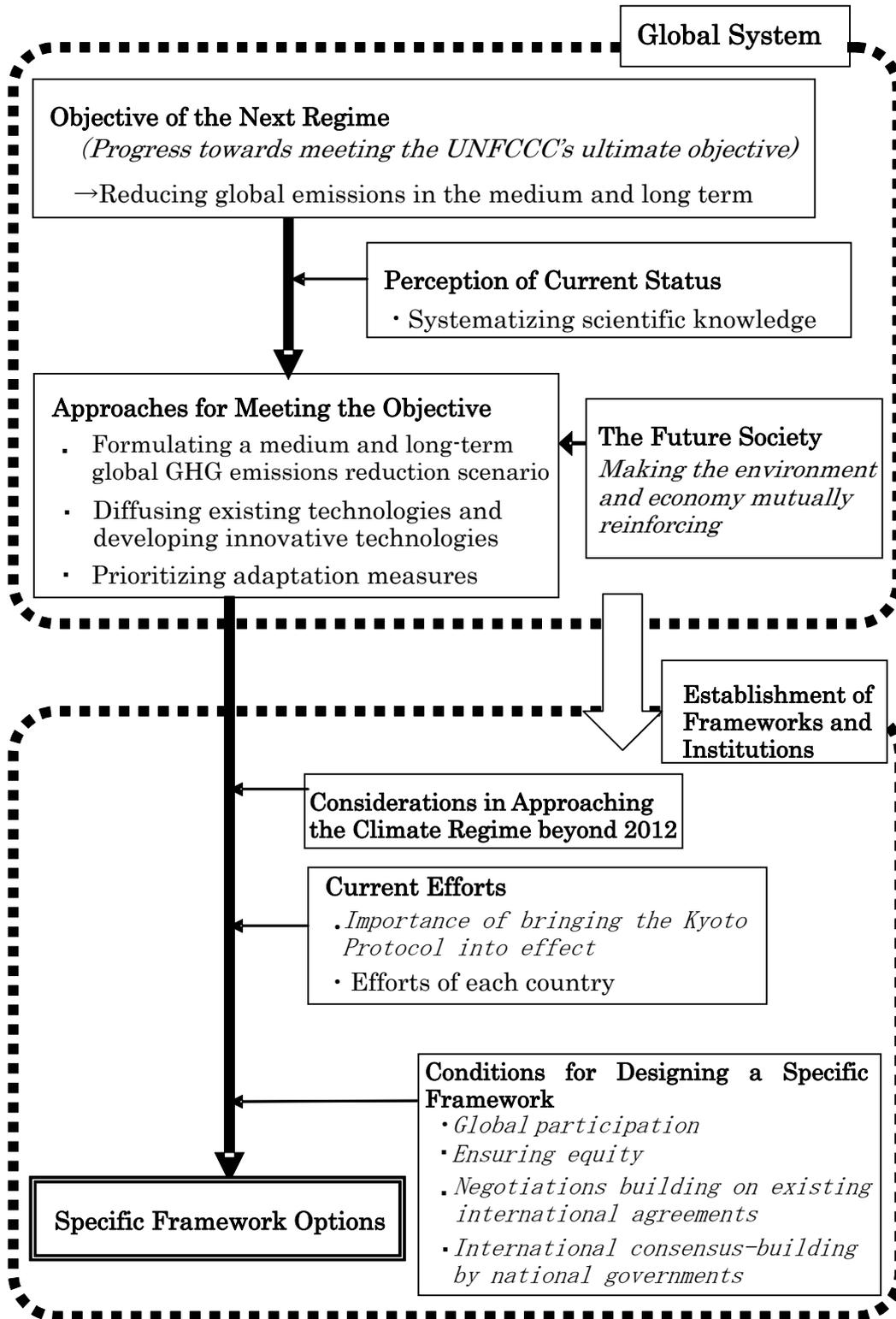
- The sub-committee began its discussions in April 2004, roughly dividing the relevant issues into two categories (see Figure 0.1). The first category addresses what a global system should be like. Legally, the goal of coping with climate change is supposed to aim at achievement of the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC). Because this objective is qualitative in nature, the issue at hand is how to set specific goals for the world as a whole. Such goals need to be established on the basis of scientific knowledge about climate change and on international agreements that function as policy judgments. Next, it is necessary to clarify the basic concepts of measures designed to meet the ultimate objective of the UNFCCC. Based on an understanding of these concepts, discussions on what approaches should be adopted are then needed in order to give shape to what is meant by "maintaining progress towards meeting the ultimate objective of the UNFCCC," one of the basic considerations recommended by the January 2004 Interim Report. Such discussions would also include "making the environment and economy mutually reinforcing" as the basis for an approach for meeting the ultimate objective in the next regime.

The second category of issues addresses the establishment of the next regime, that is, how to establish a global framework to tackle climate change in the years beyond 2012 that can realize the creation of the global system discussed in the first category. In accordance with the other considerations identified in the Interim Report, the aim of these discussions would be based on the principle of "ensuring equity based on the principle of common but differentiated responsibilities", and on "negotiations building on existing international agreements" through "international consensus-building by national governments with the participation of various actors", as well as to evolve global participation in order to prevent further climate change.

Also, the Government of Japan is promoting efforts to bring the Kyoto Protocol into effect and fulfill its commitments, and Government Councils such as the Central Environment Council are now going through a process of discussion regarding the review and assessment of Japan's Climate Change Policy Program.

- This interim report was compiled to present the outcome of discussions in the Sub-Committee's 7 meetings to date. At present, the Sub-Committee has not proceeded so far as to summarize all the concrete options found in the Framework, but will continue its deliberations while remaining cognizant of future international trends.

Figure 0.1 Outline of Discussions regarding the Next Framework



Terms in italics refer to basic considerations in the Interim Report, "Climate Change Beyond 2012 basic considerations"

Attachment 1

Members of the Sub-Committee for International Climate Change Strategy

〈 N A M E 〉

〈 T I T L E 〉

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Professor
Center for Water Environment Studies
Ibaraki University

Yozo YOKOTA

Professor, Chuo Law School

○ Chairperson

Attachment 2

Schedule of Discussions (2004)

The 1st Meeting

Date: April 8th, Thursday

Time: 10:00-12:00

Place: Tojo Imperial Palace Hotel

- Topics: 1. Establishment of the Sub-committee
2. Scientific Knowledge on Climate Change
3. Issues to be Discussed by the Sub-committee

The 2nd Meeting

Date: May 31st, Monday

Time: 13:00-16:30

Place: Ministry of the Environment

- Topics: 1. Impacts of and Adaptation to Climate Change
2. Setting Medium to Long Term Targets
3. Presentation by Dr. Lester Brown

The 3rd Meeting

Date: July 2rd, Friday

Time: 10:00-13:00

Place: Toranomom Pastoral Hotel

- Topics: 1. Climate Change and Socio-Economic Development Scenarios
2. Climate Change and the Role of Technology
3. Summary of Discussions (1)

The 4th Meeting

Date: September 3rd, Friday

Time: 10:00-13:00

Place: Ministry of the Environment

- Topics: 1. Summary of Discussions (2)
2. View on Climate Regime Beyond 2012
3. Risk-management thoughts on setting Climate Regime Beyond 2012
4. Equity issues in Climate Regime Beyond 2012
5. Role of developing countries, Russia, and Central and Eastern

Europe in Climate Regime Beyond 2012

The 5th Meeting

Date: October 5th, 2004 (Tuesday)

Time: 10:00-13:00

Place: Ministry of the Environment

- Topics:
1. Overview of UNFCCC and Kyoto Protocol
 2. Climate Change Policies of the United States
 3. Climate Change Policies of the European Union
 4. The Roles of Governments and Consensus Between Governments in International Society
 5. Report on Informal Meeting on Further Actions against Climate Change
 6. Report on 14th Asia-Pacific Seminar on Climate Change

The 6th Meeting

Date: October 26th, 2004 (Tuesday)

Time: 13:00-16:00

Place: Mita Conference Hall

- Topics:
1. Proposal for Commitment during Second Commitment Period
 2. Adaptation to Climate Change
 3. Outline of Draft Interim Report

The 7th Meeting

Date: November 26th, 2004 (Friday)

Time: 10:00 -12:00

Place: Ministry of the Environment

Topic: Draft Interim Report

These discussions are planned to continue after this Interim Report.

(Summary)

1. The Goal of the Climate Change Measures

1.1 Meeting the Ultimate Objective of the UNFCCC

The goal for the international community in addressing climate change is to meet the UNFCCC's ultimate objective: "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."

1.2 Stabilization of GHG Concentrations

Atmospheric concentrations of greenhouse gases (GHG) become stable when GHG emissions in the atmosphere reach equilibrium with the capacity of sinks in marine and terrestrial ecosystems. However, atmospheric GHG concentrations continue to rise because GHG emissions are exceeding the capacity of sinks.

1.3 Stabilization Levels of GHG Concentrations

Various emission paths that lead to various stabilization levels of GHG concentrations can be described. It should be noted, however, that even after emissions have been reduced, CO₂ concentrations will not stabilize until 100 to 300 years later, and temperatures after several hundred years.

1.4 Impacts of Climate Change

- The IPCC Third Assessment Report concludes that most of the warming observed over the last 50 years is attributable to human activities.
- The impacts of climate change have already begun to appear around the world, including Japan. The IPCC Report shows that the risks associated with climate change will increase with higher temperatures and that if temperatures rise about two degrees Celsius over the next 100 years, the distribution of negative impacts will begin to extend to most regions of the world.
- The level of impacts will vary depending on the country or region. The risk of adverse effects will increase as the rate and scale of temperature changes increase.
- In recent years, extreme weather events are occurring frequently around the world. There is a concern that climate change could result in more frequent and more severe extreme weather events, with increasing damage.

2. Approaches for Achieving the Ultimate Objective of the UNFCCC

2.1 International Agreements on Stabilization Levels of GHG Concentrations

- In setting specific numerical targets to achieve the ultimate objective of the UNFCCC to avoid dangerous levels, the time lags between the stabilization of GHG concentrations, temperature increases, etc. and the occurrence of impacts should be fully taken into account.
- Even when progress is made in reducing emissions, some impacts are inevitable, especially on highly vulnerable natural ecosystems. For this reason, consideration should be given not only to emission reduction but also to the inevitable impacts of climate change.

2.2 Equity Issues to Consider in Examining the Establishment of a Stabilization Level

One characteristic of the climate change issue is that it involves two types of equity issues. One involves equity between GHG emitting countries and countries vulnerable to the adverse effects of climate change (mainly developing countries). For example, 84 percent of global emissions are attributable to 40 countries, while 71 countries that are highly vulnerable to impacts of climate change account for about one percent of global emissions. The other involves equity between present and future generations; GHG emissions from the current generation will affect human health and welfare in the future. In addition, it should be noted that per capita emissions in developing countries are still relatively low compared to those of the developed countries.

2.3 Environmental Risk Management on a Global Scale

- Global risk management is needed to address climate change.
- Although some scientific uncertainty still remains, there is little room for doubt that climate change is in progress and will proceed further, and that unless prompt, far-reaching and powerful measures to reduce emissions are taken, there is the danger that substantial adverse impacts will occur in future.

2.4 A Global System to Initiate an Emission Reduction Trend Needs to be Built Between 2020 and 2030

- Various CO₂ stabilization levels can be assumed, but in order to achieve a stabilization level of 550ppm, which is approximately twice what it was before the Industrial Revolution, global CO₂

emissions must enter a downward trend between 2020 and 2030.

- We should consider what kind of global system should be established over the next 10 to 20 years. The scientific background needed for the relevant decision-making is already available. Its application now depends on political decision-making. An awareness of this and an awareness of time constraints will be called for in designing the next framework.

2.5 Adaptation as Complementary Measures to Mitigation

- Mitigation measures –reducing GHG emissions and enhancing CO₂ sinks- are the fundamental measures for addressing climate change. At the same time, the inevitable impacts of climate change should also be taken into consideration. Thus, adaptation measures are required to moderate and prevent damage as a complement to mitigation measures.
- With respect to the cost of climate change related measures, the costs of adaptation and those of damage from climate change from insufficient adaptation should be taken into account as well as the costs of emission reduction measures.

3. Setting Targets in the Short, Medium, and Long Term

—Necessity of the Perspective Regarding the Timeframe—

In order to meet the ultimate objective of the UNFCCC, setting targets in the medium term (2030-2050) and long term (after 2100), in addition to short term (until around 2020), will promote effective global risk management.

4. Socio-Economic Development Scenarios and Climate Change Initiatives

- The future paths and volumes of GHG emissions will greatly differ depending on what kind of socio-economic development takes place. Thus, socio-economic development processes that internalize GHG emission regulation need to be sought as soon as possible.
- The kind of socio-economic development processes each country or region needs to follow should be considered as well, with reference also to the unique circumstances of each country or region.

5. The Role of Technology

5.1 Technology Needed to Create a Low Carbon Emitting Economy

In order to reduce greenhouse gas emissions, the ratio of carbon intensity in energy needs to be lowered more quickly than has been seen in historical precedent, so the development and broad-scale diffusion of technology in the field of low-carbon emission will be important.

5.2 Time and Pre-conditions Necessary for Technology Development & Diffusion

The development and diffusion of technology is concerned not only with single, self-contained technologies, rather, technology must be viewed in the context of the entire systems that support it. Also, in diffusing technology across international borders as opposed to within a single country, various types of difficulties arise at every level, resulting in the likelihood that global-scale diffusion may require several decades.

5.3 Approaches for Promoting Technology Development & Diffusion and the Role of Government

To promote technology development & diffusion, a balance is needed between demand-side technology, which is developed and diffused mainly through the establishment of goals and standards, and supply-side technology, which is promoted mainly through the provision of subsidies for research, development and diffusion. Government also has a major role to play in technology development and diffusion.

5.4 Strategy for Future Development & Diffusion of Technology on a Global Scale

In view of the inertia inherent in climate system, characteristics of energy systems and the time needed for the development & diffusion of technology, measures need to be taken as soon as possible in order to avoid the risks posed by global warming. Thus, while taking a long-range view in promoting the development of innovative technology that can potentially achieve substantial emission reductions, during the next few decades existing technologies need to be applied to the maximum extent possible.

6. Institutional Framework of the UNFCCC and Kyoto Protocol Regime

It is important and practical to build the future regime to address climate change upon the foundation of international agreement that has been achieved thus far. In this respect, the framework of the UNFCCC and the Kyoto Protocol offer a solid foundation on for the next regime.

7. Basic Considerations on a Climate Regime Beyond 2012

7.1 Equity Issues

It is more realistic to ensure equity in a comprehensive way by structuring the overall future climate regime to consider various factors, such as fund for developing countries and special consideration to the circumstances of the countries with vulnerability, rather than by simply setting of emissions targets.

7.2 Risk Management

- To promote risk management, a hedging strategy and an attitude that supports precautionary measures are needed.
- To judge the tolerable level of risk for society, decision-making is needed to be done through multi-stakeholder participation. It is also important to review that judgment to reflect accumulated scientific knowledge.

7.3 Climate Regime Beyond 2012 for Low Carbon Emitting Economy

In order to stabilize GHG concentrations, developed countries must continue making emissions reductions, and developing countries must slow their emissions growth as soon as possible, and reduce emissions thereafter.

Considering these and other factors, while keeping in mind the long term targets (the ultimate objective of the UNFCCC), future framework should take the following points into account:

1. It is essential to realize the participation of the United States.
2. Future developments in the European Union will attract special attention as it moves forward with various initiatives that go beyond the Kyoto Protocol.
3. Regarding developing countries, it is important to start by encouraging mitigation efforts through the CDM, and in the future climate regime, taking the principle of “common but

differentiated responsibilities” into account, it will be important to establish a framework that ensures concrete mitigation efforts from the developing countries whose level of GHG emissions exceeds that of many developed countries, and is expected to increase rapidly in future, such as China and India.

The challenge to create a low carbon emitting economy should be regarded as an opportunity to create a mutually beneficial cycle between the environment and the economy that will contribute to sustainable development.

7.4 The Role of Governments and Agreements Among Them

Multilateral negotiations under the United Nations framework offer many advantages in addressing climate change issues now and the future. Thus, it is important to support establishment of the international framework with the UNFCCC as the core. It is also important that countries (i.e., national governments), which bear the responsibility for national commitments, play a central role in establishing this framework.

At the same time, a relevant framework with multi-stakeholder participation that complement multilateral discussions under the United Nations framework will surely enhance the effectiveness of the agreements among countries.

8. A Climate Regime Beyond 2012

8.1 Proposals Regarding Commitments

A variety of proposals have been made relating to commitments under the next climate regime, and it is important to scientifically analyze their advantages and disadvantages from a broad perspective. In regards to the targets, it is possible to set long-term, medium-term, and short-term targets. By setting these targets, it is expected that they will help countries achieve their concrete emissions reductions, the diffusions and development of technology in the medium-term, and achievement of the ultimate objective of the UNFCCC.

When deciding on commitments, it is important to have criteria in order to evaluate the proposals. There are a number of criteria for evaluation, and one of the major topics in future will be on how to conceptually organize the tradeoffs and prioritization of these criteria in order to assist the evaluation.

8.2 Adaptation: Key Points and Issues

A number of issues arise regarding adaptation to climate change. Some of these include the role of adaptation as complementary measures to mitigation; how to distinguish between the projects on adaptation to climate change and those on infrastructure management; and how to incorporate climate change adaptation into other policies and development plans.

9. Further Points to Consider in Realizing a Low Carbon Emitting Economy

9.1 Additional Viewpoints for Consideration

The issue of climate change is the problem that humans will unavoidably have to deal with over the next 100 or more years. Reducing GHG emissions is the most fundamental measure for dealing with climate change, but it is desirable to deal with climate change in a more forward-looking manner, and a more positive attitude adopted in seeking to create a low carbon emitting economy. Also, Japan is expected to take on this issue using a well-defined strategy.

9.2 Topics for Further Deliberation

The Sub-Committee for International Climate Change Strategy has identified the following as the points for future deliberation, while continuing to address the points elaborated above.

[Basic Elements for Future Regime]

- Methods for setting specific short, medium and long term targets
- Further analysis of the various international policy options to address climate change.
- Concrete methods for canceling the factors obstructing the development and diffusion of relevant technology
- Treatment of the Kyoto mechanisms, and identification of the possibilities for further development of these mechanisms
- Ways to deal with the carbon sinks
- Approaches to the financial mechanisms
- Prospects for systematically internalizing the linking of measures to the combat warming with the economy in a mutually beneficial cycle

[Concerns for Japan]

- Scenarios for realizing a low carbon emitting economy in Japan
- The impacts of various international policy options on Japan and the Japanese Strategies

[Cooperation with Various Stakeholders]

- Roles of local governments, industry, NGOs, etc.
- Possibilities for the cooperation both inside and outside (i.e., countries with reduction obligations and those without them; the parties and the non-parties)
- Prospects for roles of the regional cooperation and other informal processes, and the development of these prospects
- Coordination with official development assistance (ODA) and other forms of the international assistance
- Interlinkage with other major international concerns, such as international peace and security.

etc.

Glossary:

This is a list of terms and definitions that are employed throughout this Interim Report.

- **Mitigation**

Methods to reduce the anthropogenic GHG emissions that cause climate change or enhance the amount of sinks. For example, options such as the control of the fossil fuels use, introduction of the energy-saving facility, forest management, carbon sequestration and storage are categorized as mitigation measures.

- **Adaptation**

Methods to deal with the adverse impacts caused by climate change. As the examples of the adverse effects, it is possible to list the situations, including temperature rise, sea level rise, intense typhoon, drought, and extension of the malaria-affected areas.

- **Commitment**

National responsibilities under the UNFCCC and the Kyoto Protocol. For example, under the Kyoto Protocol, developed countries face the obligations to reduce their GHG emissions.

- **COP (Conference of the Parties)**

Conference of the Parties to United Nations Framework Convention on Climate Change. The process started in 1995 (COP1) and this year (2004), COP10 will be held. The equivalent conference for the Kyoto Protocol is called COP/MOP (Conference of the Parties serving as the meeting of the Parties).

- **IPCC (Intergovernmental Panel on Climate Change)**

Organization established by United Nations Environment Programme (UNEP) and World Meteorological Organization (WMO) in 1998 as the international expert group that collects and analyzes scientific knowledge on climate change. There are 3 working group, assessing scientific aspects of the climate system and climate change (Working Group 1), vulnerability of socio-economic and natural systems to climate change, negative and positive consequences of climate change and options for adapting to it (Working Group 2) and options for limiting GHG emissions and otherwise mitigating climate change (Working Group 3). Other than these working groups, there is the Task Force on National GHG Inventories (TSU) that is responsible for the IPCC National GHG Inventories Programme. As of November 2004, IPCC has published 3 reports.

- **AIM (Asia-Pacific Integrated Model)**

The Asian Pacific Integrated Model (AIM) is a large-scale computer simulation model developed by the National Institute for Environmental Studies in collaboration with Kyoto University and several research institutes in the Asian-Pacific region. The AIM assesses policy options for stabilizing the global climate, particularly in the Asian-Pacific region, with the objectives of reducing greenhouse gas emissions and avoiding the impacts of climate change.

- **AOSIS (Alliance of Small Island States)**

AOSIS is a group of countries formed during the Second World Climate Conference in 1990 that includes 35 states from the Atlantic, Caribbean, Indian Ocean, Mediterranean and the Pacific. AOSIS countries are small islands and low-lying coastal developing countries that are particularly vulnerable to the effects of climate change, such as sea level rise, coral bleaching and the increased frequency and intensity of tropical storms. These countries share a common objective on environmental and sustainable development matters.

1. The Goal of the Climate Change Measures

This part summarizes the discussion regarding how to make progress towards meeting the ultimate objective of the UNFCCC based on scientific knowledge.

1.1 Meeting the Ultimate Objective of the UNFCCC

The goal for the international community in addressing climate change is to meet the ultimate objective of the UNFCCC: "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." (Article 2)

<The Goal of the Climate Change Measures >

- The goal of measures to address climate change is stipulated in the UNFCCC, which now enters into force with the participation of most countries in the world, including the United States and many developing countries. Achieving the ultimate objective of the UNFCCC is the goal for the international community in coping with climate change.
- The Convention states that its ultimate objective is to achieve "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system," and that this level "should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner," (Article 2).

1.2 Stabilization of GHG Concentrations

Atmospheric concentrations of greenhouse gases (GHG) become stable when GHG emissions in the atmosphere reach equilibrium with the capacity of sinks in marine and terrestrial ecosystems. However, atmospheric GHG concentrations continue to rise because GHG emissions are exceeding the capacity of sinks.

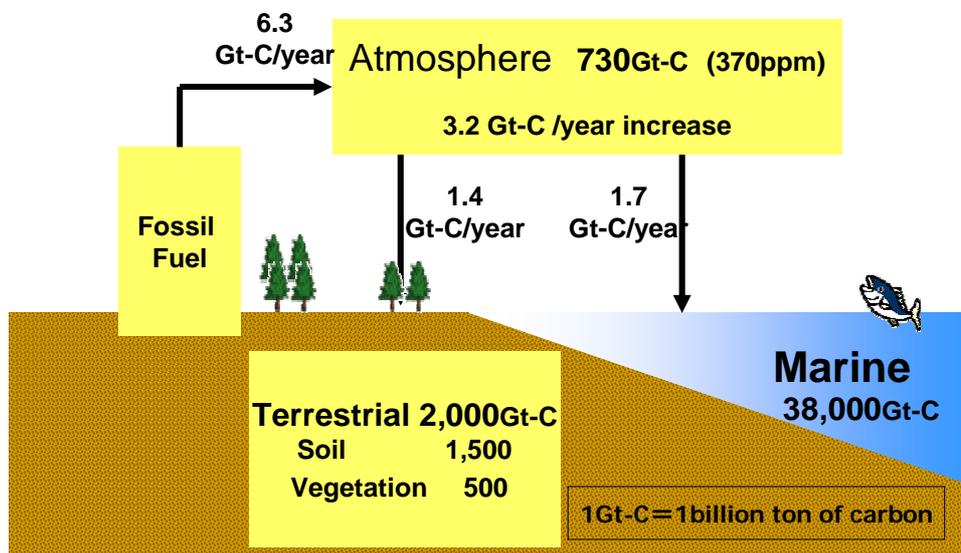
<Reaching an Equilibrium between GHG Emissions and Global Sink Capacity>

- "Stabilization of greenhouse gas concentrations" as noted in the ultimate objective of the UNFCCC is defined as an equilibrium between global emissions of greenhouse gases (GHG) and the capacity of global sinks. Sources of atmospheric GHG emissions include both natural factors and human activities, while global sinks include marine ecosystems and terrestrial ecosystems such as forests.

<Anthropogenic GHG Emissions Greatly Exceed Global Sink Capacity>

- At present, anthropogenic carbon dioxide (CO₂) emissions from fossil fuel combustion amount to 6.3 billion tons of carbon equivalent annually, twice as much as the annual capacity of sinks (3.1 billion tons). Thus about 3.2 billion tons of carbon are accumulating in the atmosphere every year (see Figure 1.1).

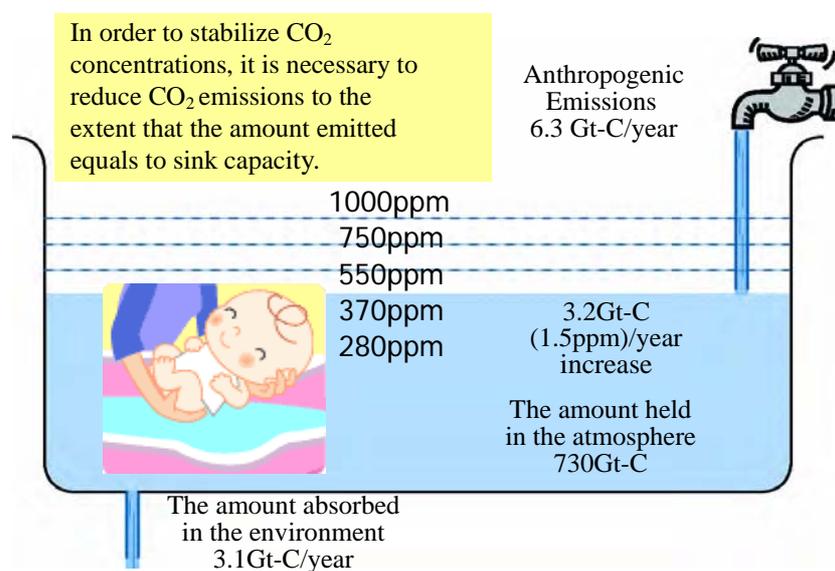
Figure 1.1 The Estimated Global Carbon Balance



Source: Adapted from the IPCC Third Assessment Report(2001)

- Due to past CO₂ accumulations, concentrations of atmospheric CO₂ rose from 280 parts per million (ppm) in 1750, prior to the Industrial Revolution, to 368 ppm in 2000. Figure 1.2 shows that, in order to stabilize atmospheric CO₂ concentrations by attaining an equilibrium between anthropogenic CO₂ emissions from fossil fuel combustion and the natural sink capacity, it is necessary to make the pace of emissions (the amount emitted per year) equal to the pace of absorption (the amount absorbed per year), which means achieving further reductions from our current emissions level.

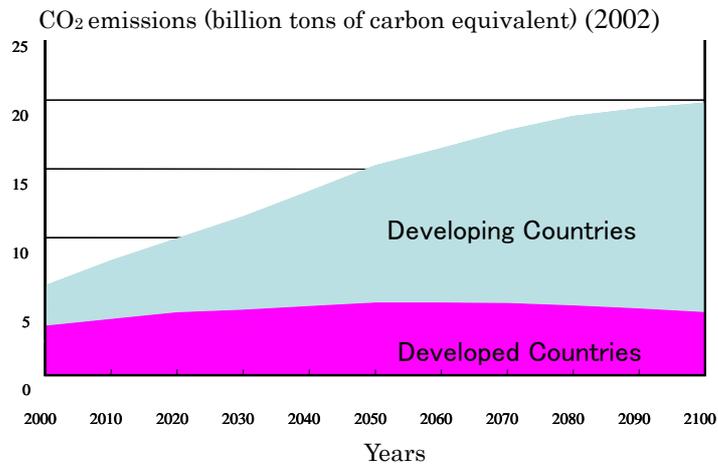
Figure 1.2 Relationships among Emissions, Sink Capacity, and Atmospheric CO₂ Concentrations



- However, it is estimated that CO₂ emissions will further increase from fossil fuel combustion.

Figure 1.3 shows estimated global CO₂ emissions based on the IPCC B2 scenario (see Table 4.1). It indicates that future emissions from developing countries in particular will greatly increase, and that emissions from developing countries will be about 3 times the emissions from developed countries by 2100.

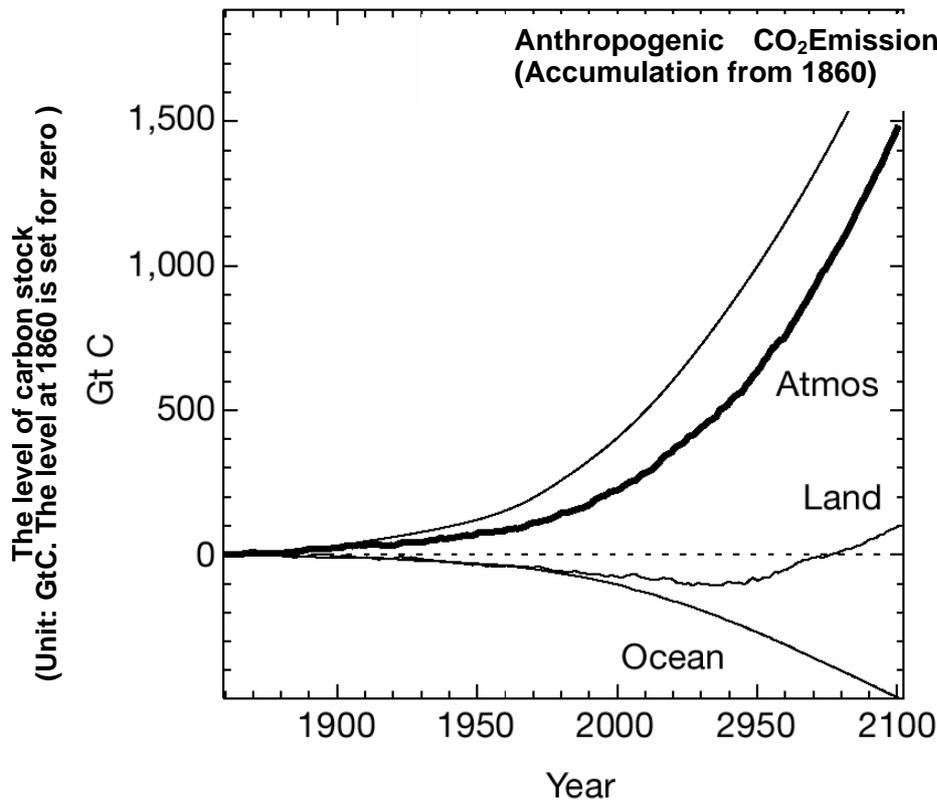
Figure 1.3 Prediction of future CO₂ emissions



Source: Kainuma, et al. (2002)
"Climate Policy Assessment"

- The global capacity of sinks changes depending on the level of atmospheric CO₂ concentrations. In recent years, simulation research is being done to connect a dynamic vegetation model with climate models and take into account the feedback from changes in terrestrial surface carbon sink capacity to climate. In the long-run, it is projected that the temperature increase would stimulate respiration of plants and microorganisms in the soil, which then would reduce carbon sink capacity of the land. This would accelerate climate change, which would reduce the carbon sink capacity of the land to zero at around the year 2050, turning the land surface from a carbon sink into carbon source after that time (see Figure 1.4).

Figure 1.4 Changes in the Levels of Carbon Stock (Atmosphere, Land Surface, and Ocean)



Source: Cox, P.M., Betts, R.A., Jones, C.D., Spall, S.A. and Totterdell, I.J. (2000) Acceleration of global warming due to carbon-cycle feedbacks in a coupled climate model, *Nature*, 408, .

<Typical Case of Unsustainable Development>

- We human beings are currently emitting twice as much CO₂ as can be absorbed given the global carbon sink capacity so atmospheric CO₂ concentrations are increasing. Some research estimates that anthropogenic CO₂ emissions will continue to rise for the next hundred years, while the global CO₂ sink capacity will decrease due to increased temperature. This would accelerate an increase of atmospheric CO₂ concentrations and further global warming, leading to elicitation of large-scale climate change. This is a typical case of unsustainable development.

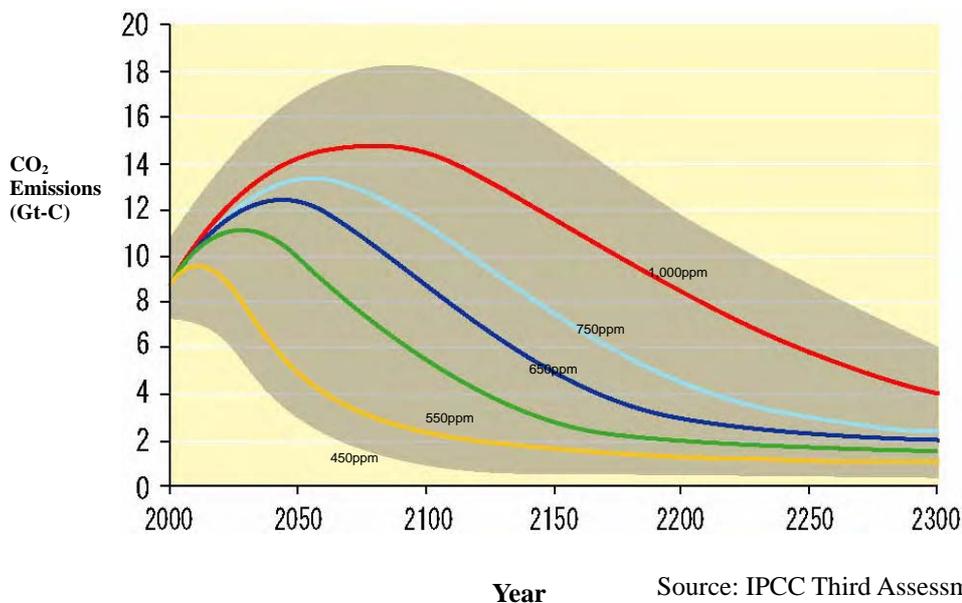
1.3 Stabilization Levels of GHG Concentrations

Various emission paths that lead to various stabilization levels of GHG concentrations can be described. It should be noted, however, that even after emissions have been reduced, CO₂ concentrations will not stabilize until 100 to 300 years later, and temperatures after several hundred years.

<Emissions Scenarios for Various Concentration Levels>

- The level at which GHG concentrations stabilize depends on the cumulative amount of emissions up until stabilization is achieved. Various stabilization levels for CO₂ concentrations can be conceived, for example, at 450, 550, 650, 750, and even 1,000 ppm. The IPCC has provided a graph, as shown in the Figure 1.5, which illustrates the path of global CO₂ emissions corresponding to these concentration levels. The shaded part indicates uncertainty regarding the relationship between the amount of CO₂ emitted and the CO₂ concentration; specifically, uncertainty regarding CO₂ sink capacity of the land and ocean. Because there are greenhouse gases other than CO₂, concentrations, these gases also need to be taken into consideration with regard to the stabilization of GHG concentrations.

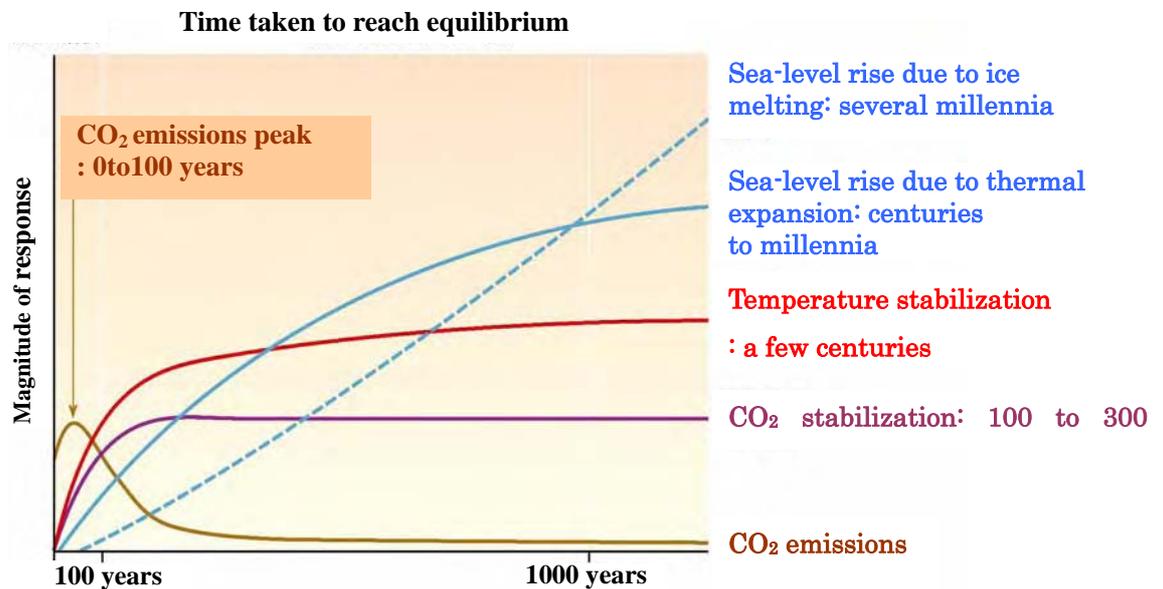
Figure 1.5 Changes in Global CO₂ Emissions Corresponding to Different Stabilization Levels



<The Time Lag between Atmospheric GHG Emissions and Stabilization of GHG Concentrations and Impacts>

- GHG concentrations will not immediately stabilize even if GHG emissions reach equilibrium with global sink capacity. There is a time lag. There will be an additional time lag between stabilization of GHG concentrations and stabilization of temperature and sea level. It is necessary to take into account the time lag when thinking of the levels at which the concentration of atmospheric GHG is stabilized.
- The figure 1.6 illustrates the time lags attending CO₂ emissions, stabilization of CO₂ concentrations, stabilization of temperature, and sea-level rise. Even if global CO₂ emissions are successfully reduced during the next 100 years, CO₂ concentrations will only stabilize after the lapse of an additional 100 to 300 years, temperature after several hundred years, and sea-level rise due to thermal expansion after several hundred to several thousand years.

Figure 1.6 Relationships among CO₂ Emissions, CO₂ Concentrations, Temperature, and Sea Level Rise



Source: IPCC Third Assessment Report (2001)

1.4 Impacts of Climate Change

- The IPCC Third Assessment Report concludes that most of the warming observed over the last 50 years is attributable to human activities.
- The impacts of climate change have already begun to appear around the world, including Japan. The IPCC Report shows that the risks associated with climate change will increase with higher temperatures and that if temperatures rise about two degrees Celsius over the next 100 years, the distribution of negative impacts will begin to extend to most regions of the world.
- The level of impacts will vary depending on the country or region. The risk of adverse effects will increase as the rate and scale of temperature changes increase.
- In recent years, extreme weather events are occurring frequently around the world. There is a concern that climate change could result in more frequent and more severe extreme weather events, with increasing damage.

<Significance of Sharing Scientific Background Knowledge>

- Precise and impartial scientific background knowledge is required in order to address climate change. Also, in promoting measures to cope with climate change, it is also important to ensure that this scientific background knowledge is shared at both the local and global levels.
- It is especially important to share scientific background knowledge about causal links between anthropogenic GHG emissions and impacts on human and ecosystems due to temperature rise and climate change, and about the levels of these impacts. When such knowledge becomes available, the issue of acceptable levels of impacts becomes more a matter of policy, than of science, and should be regarded as a matter for decisions to be made by human society.

<Observed Phenomena and Impacts of Climate Change >

- Impacts of climate change have already appeared. Regarding their causes, the IPCC Third Assessment Report concludes that "there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."
- Temperature increases have been observed in various parts of the world. Over the 20th century, the average global temperature rose by 0.6 ± 0.2 degrees Celsius, and it is likely that the 1990s was the

warmest decade of the millennium. The IPCC Report summarizes the changes that have already been observed (see Table 1.1).

Table 1.1 Changes Observed in Recent Years

Indicator	Observed changes
Global mean surface temperature	Increased by 0.6 over the 20th century
Global mean sea level	Increased by 10-20centimeters over the 20th century
Hot days/heat index	Increased (likely)
Cold/frost days	Decreased for nearly all land areas
Heavy precipitation events	Increased at mid-and high northern latitude (likely)
Drought	Increased frequency in some regions
Glaciers	Widespread retreat
Snow cover	Decreased in area by 10% (since the1960s)
Weather-related economic losses	Ten-fold increase (over the last 40years)

Source: IPCC Third Assessment Report (2001)

○ Phenomena that seem to be impacts of climate change have also been observed in Japan, such as the following:

- *Prunus yedoensis* (cherry trees) now start blossoming [on average] five days earlier than they did 50 years ago.
- The distribution of alpine plants has decreased and the distribution of forested area has increased in Hokkaido, the northernmost island of Japan.
- Inland distribution of broad-leaved evergreen trees such as *Quercus myrsinifolia* (Japanese white oak) has increased.
- The distribution areas of butterflies, moths, dragonflies, and cicadas have moved north as they disappear from the southern limits of distribution.
- *Papilio Memnon* (a butterfly), whose northern limit of distribution used to be the islands of Kyushu and Shikoku, were first observed in Mie Prefecture on Honshu Island in the 1990s.
- *Cyrtophora moluccensis* (a tent spider) that were formerly observed only in western Japan in the 1970s appeared in Tokyo and vicinity in the 1980s.
- *Anser albifrons* (white-fronted goose) extended its wintering sites to Hokkaido.
- Tropical fish species have appeared in Osaka Bay.

Source: “Global Warming and Japan – Estimated Effects on Nature and People”
(Harasawa and Nishioka, eds. 2003)

<Estimated Future Impacts of Climate Change>

- Various possible adverse effects are predicted in the future (see Table 1.2).

Table-1.2 Various Projected Impacts of Climate Change

Subject	Projected Impacts
Global mean surface temperature	Increased by 1.4-5.8°C from 1990 to 2100
Global mean sea level	Increased by 9-88cm from 1990 to 2100
Impacts on weather events	Increase of flood and drought
Impacts on human health	Increase of heat stress and infectious diseases such as malaria
Impacts on ecosystem	Extinction of some animal and plant species, migration of ecosystem
Impacts on agriculture	Decrease of grain harvest at many regions, temporary increases in some regions
Impacts on water resources	Change in supply and demand balance, adverse effects on water quality
Impacts on market	Large economic loss especially in developing countries which rely on primary products

Source: IPCC Third Assessment Report (2001)

- Possible adverse effects are predicted in Japan. For example,
 - if the sea level rises one-meter, more than 90 percent of the beaches in Japan will disappear. Also tidal wetlands where migratory birds feed will disappear.
 - Increased temperature may lead to fluctuations in rainfall, affecting watersheds
 - The potential malaria distribution area may expand to include western Japan.
 - Increased incidence of heat stroke due to heat waves.

Source: Harasawa and Nishioka, eds. 2003

<The Relationship between Temperature Rise and Impact Risks>

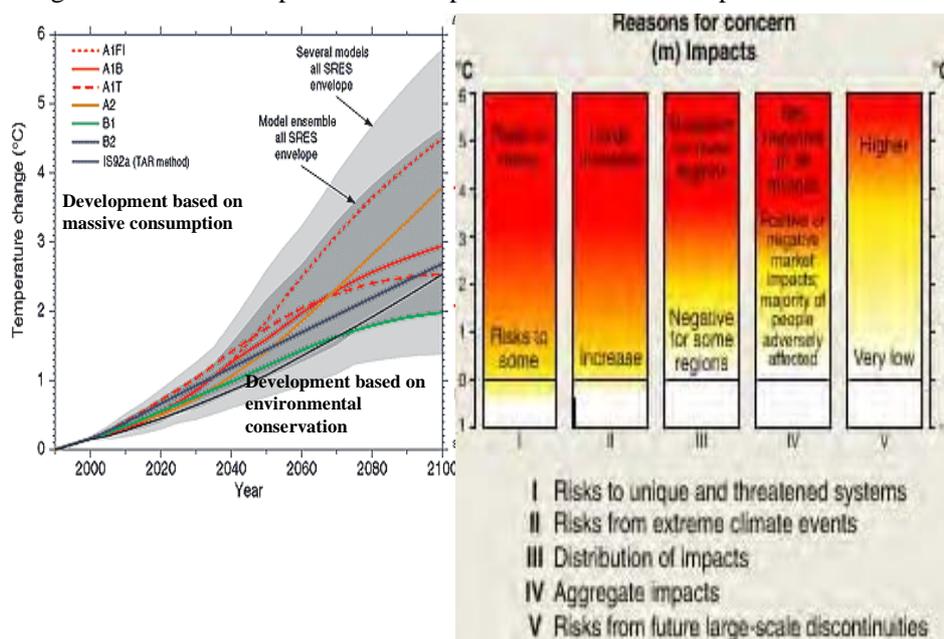
- The IPCC Third Assessment Report looks at the degree of the temperature increase and its effects on the level of the risks by using five indicators on each of its future socio-economic development scenario (see Figure 1.7). This two-part figure shows that a small increase in temperature may cause positive impacts in some regions. However, the more the temperature rises, the greater will the risks of climate change become. For

instance, if the global mean temperature rises more than 2 °C in the next 100 years, the probability of the adverse effects cause by climate change becomes higher.

<Regional Differences in Impact Occurrence >

- The levels of impacts are not the same around the world, but vary according to country or region. Levels of damage to humans and ecosystems also vary according to levels of preparedness to these impacts. Impacts are thought to be particularly serious in developing countries in tropical and subtropical zones, due to geographical factors that make them vulnerable to climate change impacts as well as their inability to sufficiently prepare for such impacts.

Figure 1.7 Relationship between Temperature Rise and its Impacts and Risks

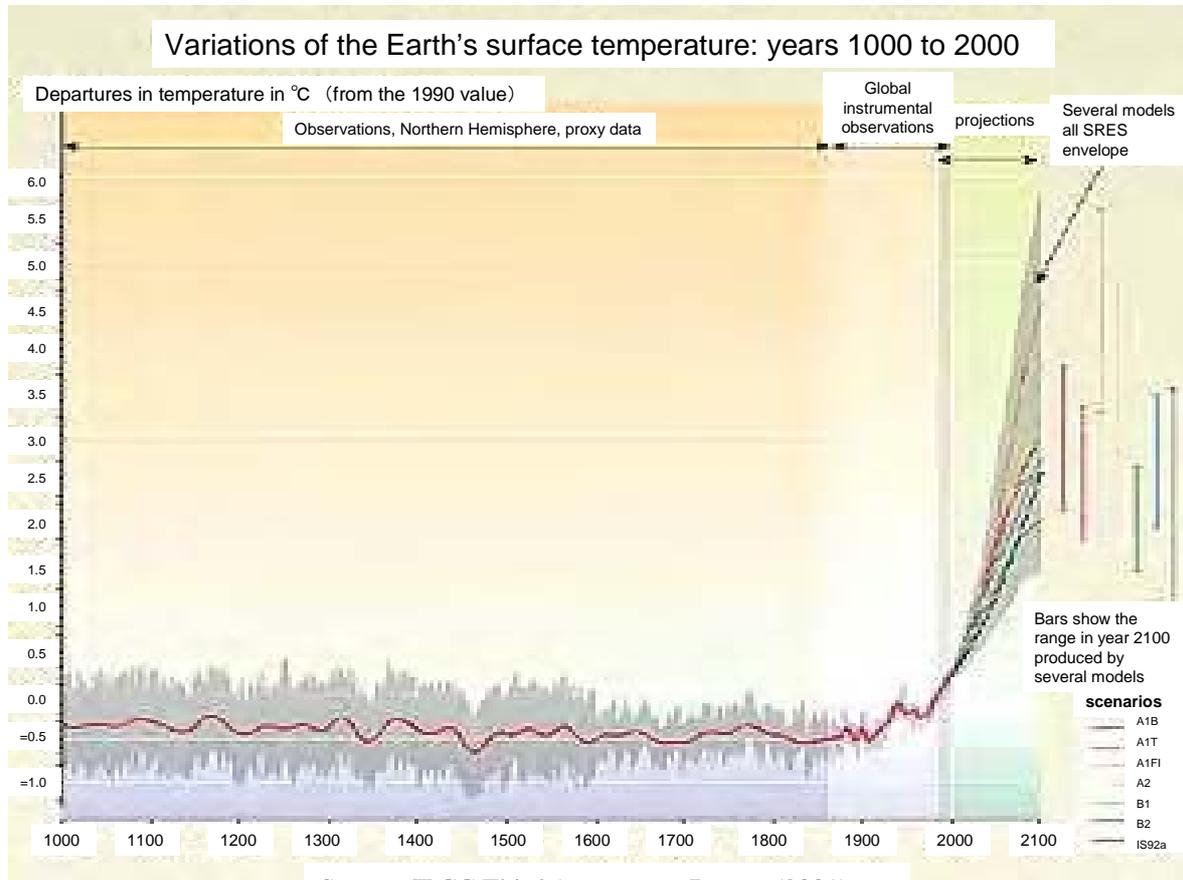


Source: IPCC Third Assessment Report (2001)

<Rate of Change and Impact Levels>

- In addition to the level of temperature change, the rate of change is also important in considering impacts on ecosystems and on agriculture. According to the temperature rise predicted by models, although there are some variations depending on the models and scenarios used, it is clear that every model predicts a drastic temperature rise compared to that of the last 1000 years (see Figure 1.8).

Figure 1.8 Prediction of Drastic Temperature Change



Source: IPCC Third Assessment Report (2001)

<Extreme Weather Events and Climate Change Impacts>

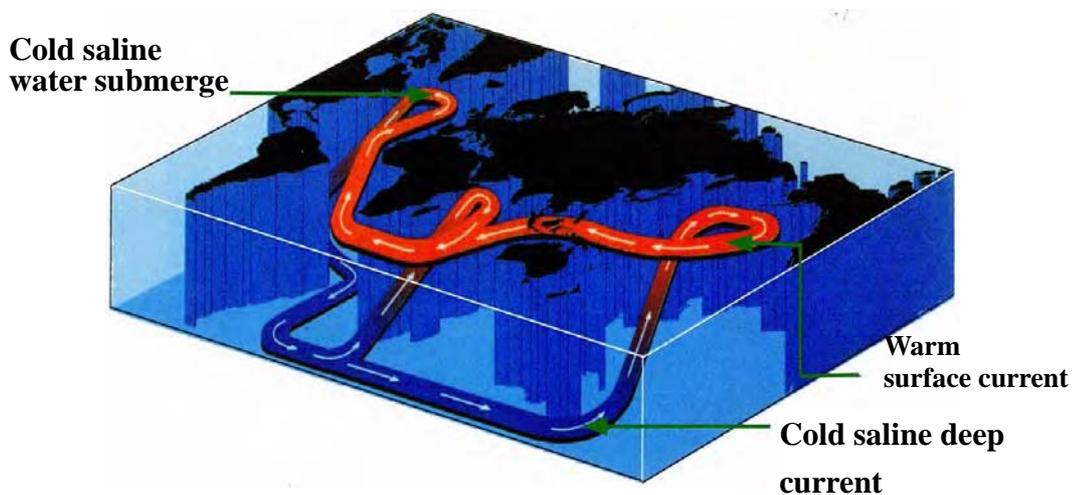
- According to the IPCC Third Assessment Report, climate change will not only have medium and long-term impacts, but may also cause increased frequency and intensity of extreme weather events.
- In particular, much concern has been expressed recently that the frequent extreme weather events now happening around the world, such as drought and abnormally high temperatures, might be part of climate change. It is necessary to compile and analyze observation data that may have a bearing on future extreme weather events around the world in order to enhance scientific knowledge of climate change impacts.
- Scientific study on the impacts of climate change has so far focused on predictions of average global impacts. It is expected, however, that extreme weather events that are unpredictable using conventional methods based on past weather data will frequently occur as impacts of climate change

in various parts of the world. It is therefore necessary from now on to undertake further studies of the occurrence of the extreme weather events that are accompanying climate change and their regional impacts, in addition to the global impacts of climate change.

<Probability of Catastrophic Events>

- While catastrophic events are estimated to be unlikely during the 21st century, there is some concern regarding the following possibilities: rapid climate change due to rapid emissions of GHG being held in the marine and terrestrial biosphere; significant rise of sea level due to melting of the Antarctic and Greenland ice sheets (4-6 meter rise in case of irreversible collapse of the Western Antarctic Ice Sheet); and a colder Europe due to the collapse of the global ocean circulation system. For example, the ocean circulation system circulates every 2000 years, maintaining climate with its vast heat capacity. Figure 1.9 shows the possibility of Europe becoming colder due to changes in the speed and direction of the Gulf Stream (a warm current) triggered by climate change.

Figure 1.9 Example of Catastrophic Event Caused by Extreme climate change (Collapse of the oceanic circulation system)



- Although catastrophic events are estimated to be unlikely during the 21st century, rapid climate change could increase the probability of such events occurring.

2. Approaches for Achieving the Ultimate Objective of the UNFCCC

This section summarizes the discussions about what kind of approaches the international community at large should take, and what pre-conditions and issues need to be considered in seeking to achieve the ultimate objective of the UNFCCC.

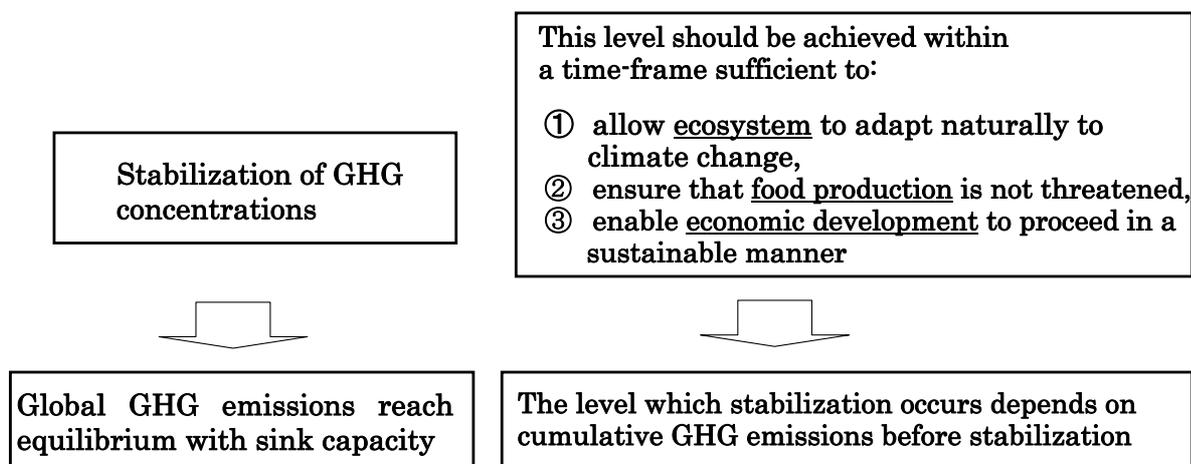
2.1 International Agreements on Stabilization Levels of GHG Concentrations

- In setting specific numerical targets to achieve the ultimate objective of the UNFCCC to avoid dangerous levels, the time lags between the stabilization of GHG concentrations, temperature increases, etc. and the occurrence of impacts should be fully taken into account.
- Even when progress is made in reducing emissions, some impacts are inevitable, especially on highly vulnerable natural ecosystems. For this reason, consideration should be given not only to emission reduction but also to the inevitable impacts of climate change.

<Items for Consideration in Pursuing Agreements on Stabilization Levels of GHG Concentrations>

Article 2 of the UNFCCC states that its ultimate objective is "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system," and that this level "should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner" (See Figure. 2.1).

Figure. 2.1 The ultimate objective of UNFCCC



- However, numerical targets for GHG concentration levels are not specified in the Convention, and the international community has not yet reached agreements on the target level for GHG concentrations and climate stabilization.
- Determining what constitutes a dangerous level of climate change involves value judgments, and though it is being reduced every year, scientific uncertainty still remains as well. The level to be identified will depend on the future development in scientific background knowledge and international agreements. In this regard, relationships between stabilization of GHG concentrations and the impacts of climate change, as well as of the significant time lag between stabilization of GHG concentrations and stabilization of temperature and sea level must be taken into account.

<Stabilization of GHG Concentrations and the Inevitable Impacts of Climate Change>

- When a certain stabilization level for GHG concentrations is set by agreements of the international community, the level agreed upon can be seen both as an upper limit not to be exceeded, as well as a tolerable level. Table 2.1 shows the impacts predicted for several stabilization levels of CO₂ concentrations. It indicates that even stabilization at 450 ppm will cause some impacts on unique and threatened systems and lead to increases in extreme climatic events.

Table 2.1 CO₂ Stabilization Levels and their Predicted Impacts

CO ₂ concentrations	Impacts at the lower limits of the temperature range	Impacts at the higher limits of the temperature range
450ppm	<ul style="list-style-type: none"> • Rise of global mean temperature by 1.5°C • Impacts to unique and threatened systems • Increased extreme climatic events • Negative impacts on some regions • Positive and negative impacts on market • The majority of people adversely affected • Unknown but probably low risk of large-scale high-impact events 	<ul style="list-style-type: none"> • Rise of global mean temperature by 4.0°C • Severe impacts to many unique and threatened systems • A large increase in extreme climatic events • Negative impacts on most regions • Negative impacts in all sectors, including agriculture • The majority of people adversely affected • Probable medium risk of large-scale high-impact events
550ppm	<ul style="list-style-type: none"> • Rise of global mean temperature by 2.0°C • Greater impacts to unique and threatened systems • Increased extreme climatic events • Negative impacts on some regions • Positive and negative impacts on market • The majority of people adversely affected • Unknown but probably low risk of large-scale high-impact events 	<ul style="list-style-type: none"> • Rise of global mean temperature by 5.0°C • Severe impacts to many unique and threatened systems • All sectors suffering severe impacts • The majority of people adversely affected • High risk of large-scale high-impact events
750ppm	<ul style="list-style-type: none"> • Rise of global mean temperature by 3.0°C • Moderate impacts to unique and threatened systems • Probable moderate increase in extreme climatic events • Approximately even balance between regions experiencing negative Impacts and those do not • Positive and negative impacts on market • The majority of people adversely affected • Unknown but probably medium risk of large-scale high-impact events 	<ul style="list-style-type: none"> • Rise of global mean temperature by 7.0°C • Extremely adverse impacts in all forms

Source: United Kingdom Department of Trade and Industry: “The scientific case for setting a long-term emission reduction target.”

- Because it is not realistic to expect that GHG emissions will be substantially and immediately reduced or that GHG concentrations will stabilize at their current level (approx. 370 ppm), impacts will be inevitable to a certain extent.
- Thus, when the international community agrees on a stabilization level for GHG concentrations, it should take into account the inevitable impacts of climate change, as well as the need for GHG emission reduction.

2.2 Equity Issues to Consider in Examining the Establishment of a Stabilization Level

One characteristic of the climate change issue is that it involves two types of equity issues. One involves equity between GHG emitting countries and countries vulnerable to the adverse effects of climate change (mainly developing countries). For example, 84 percent of global emissions are attributable to 40 countries, while 71 countries that are highly vulnerable to impacts of climate change account for about one percent of global emissions. The other involves equity between present and future generations; GHG emissions from the current generation will affect human health and welfare in the future. In addition, it should be noted that per capita emissions in developing countries are still relatively low compared to those of the developed countries.

<Equity between countries that reduce emissions and countries that are affected by climate change>

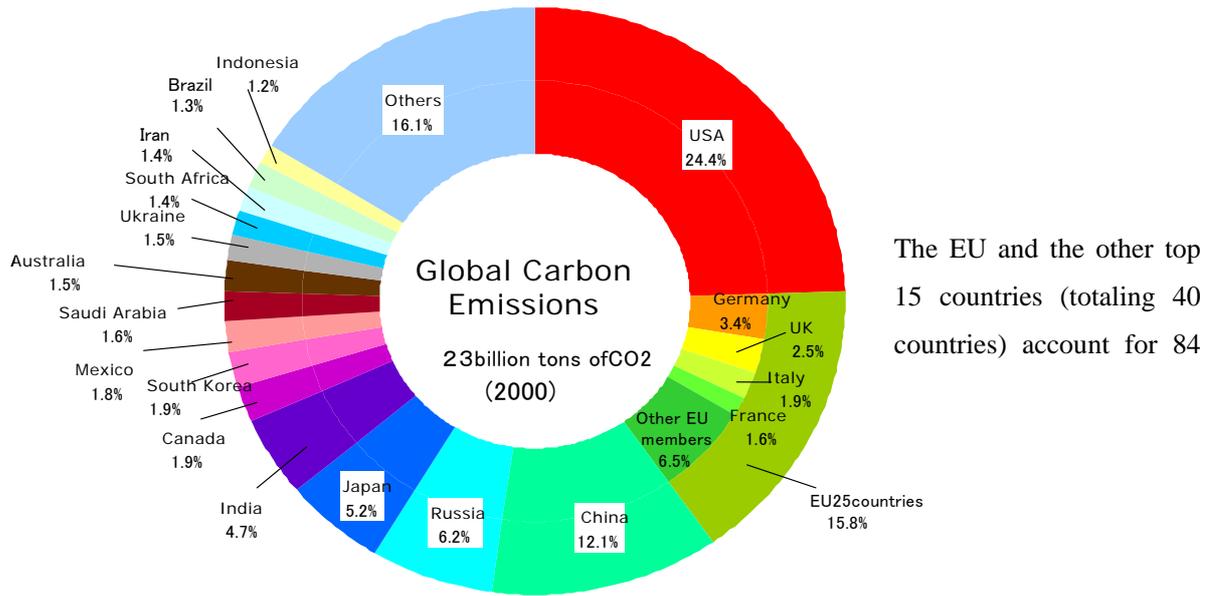
- Two types of equity issues need to be considered in relation to climate change. One involves equity between GHG emitters and the countries that are more seriously affected by climate change. The emitters that are contributing to climate change are not necessarily the same as the countries suffering from its adverse impacts.
- The five largest CO₂ emitters, the United States, China, Russia, Japan, and India, account for more than half of global CO₂ emissions. In addition, when emissions of these five countries and those of the European Union (EU: composed of 25 countries) are added together, these 30 countries account for 68.4 percent of global emissions. Furthermore, the EU plus the other top 15 countries (totaling 40 countries) account for 84 percent of global emissions (see Figure 2.2 and Table 2.2).

- On the other hand, the total CO₂ emissions of the least developed countries that fall under any of the categories of countries that are "vulnerable to the adverse effects of climate change," as defined in the UNFCCC, (totaling 48 countries), account for only 0.46 percent of global CO₂ emissions. Even when emissions from other countries that are members of the Alliance of Small Island States (AOSIS) are added (totaling 71 countries), their share amounts to only 1.1 percent of the world's total emissions (see Table 2.3).

- In particular, people in vulnerable areas of developing countries are expected to suffer serious impacts. The risks of climate change-induced impacts faced by such people are a result of emissions by large emitters, giving rise to a characteristic situation in which those most at risk are not in a position to manage those risks. Judgments about the acceptability of impacts should not be made by the large emitters that are causing the problem, but should be entirely in the hands of affected countries. However, the difficulty in building a global system for dealing with global climate change lies in the fact that the voices of people in vulnerable areas of developing countries are not being reflected in the process of international consensus-building. This also leads into the discussion on how to shape the global commons.

- Now, all countries of the world become more interdependent. Therefore, GHG emitting countries are also likely to be affected by climate change. For example, since Japan has a low food self-sufficiency ratio, it will be indirectly but significantly affected if climate change affects the agriculture productions in other countries. As the development and liberalization of the world trade become apparent, the degree of the interdependency among countries will be higher and the importance of the food security in relation to climate change will attract more attentions. In addition, large GHG emitters whose level of the readiness for the adaptation to impacts, that does not reach to the sufficient level in some regions, such as China and India, will also suffer from heavy damage once they are hit by extreme weather events.

Figure 2.2 Breakdown of World CO₂ Emissions (by country)



The EU and the other top 15 countries (totaling 40 countries) account for 84

Source: Oak Ridge National Laboratory (USA)

Table 2.2 Major CO₂-Emitting Countries

		Emissions (million tons of CO ₂)	Share	Per capita emissions (tons of CO ₂ /person)
1	USA	5,605	24.4%	19.86
2	EU 25 countries	3,644	15.8%	8.06
	Germany	786	3.4%	9.57
	UK	568	2.5%	9.50
	Italy	428	1.9%	7.41
	France	362	1.6%	6.16
	Other EU members	1,500	6.5%	7.75
3	China	2,792	12.1%	2.20
4	Russia	1,436	6.2%	9.86
5	Japan	1,185	5.2%	9.35
6	India	1,071	4.7%	1.06
7	Canada	436	1.9%	14.19
8	South Korea	427	1.9%	9.06
9	Mexico	424	1.8%	4.36
10	Saudi Arabia	374	1.6%	17.49
11	Australia	345	1.5%	18.00
12	Ukraine	343	1.5%	6.93
13	South Africa	327	1.4%	7.48
14	Iran	310	1.4%	4.88
15	Brazil	307	1.3%	1.83
16	Indonesia	269	1.2%	1.28
	Others	3,706	16.1%	--
	World total	23,001	100.0%	3.80

Source: Oak Ridge National Laboratory (USA)

Table 2.3 Countries vulnerable to adverse effects of climate change

Types of countries vulnerable to adverse effects of climate change	Least developing countries (48 countries)
(1) Small island countries	<p>(Africa)</p> <p>Angola Benin Burkina Faso Burundi Central African Republic Chad Congo Djibouti Equatorial Guinea Eritrea Ethiopia Gambia Guinea Guinea-Bissau Lesotho Madagascar</p> <p>(Asia)</p> <p>Afghanistan Bangladesh Bhutan Cambodia Laos Myanmar Nepal Yemen</p> <p>(Small island countries)</p> <p>Cape Verde Comoros Haiti Kiribati Maldives Samoa Sao Tome and Principe Solomon Islands Tuvalu Vanuatu</p>
(2) Countries with low-lying coastal areas	
(3) Countries with arid and semi-arid areas, forested areas and areas liable to forest deterioration	
(4) Countries with areas prone to natural disasters	
(5) Countries with areas prone to drought and desertification	
(6) Countries with areas of high urban atmospheric pollution	
(7) Countries with areas of fragile ecosystems, including mountainous ecosystems	
	<p>Other AOSIS members (23 countries)</p> <p>Antigua and Barbuda Bahamas Barbados Belize Cuba Dominica Fiji Grenada Guyana Jamaica Marshall Islands Mauritius</p> <p>Micronesia Palau Papua New Guinea St. Kitts and Nevis St. Lucia St. Vincent and the Grenadines Seychelles Singapore Suriname Tonga Trinidad and Tobago</p>

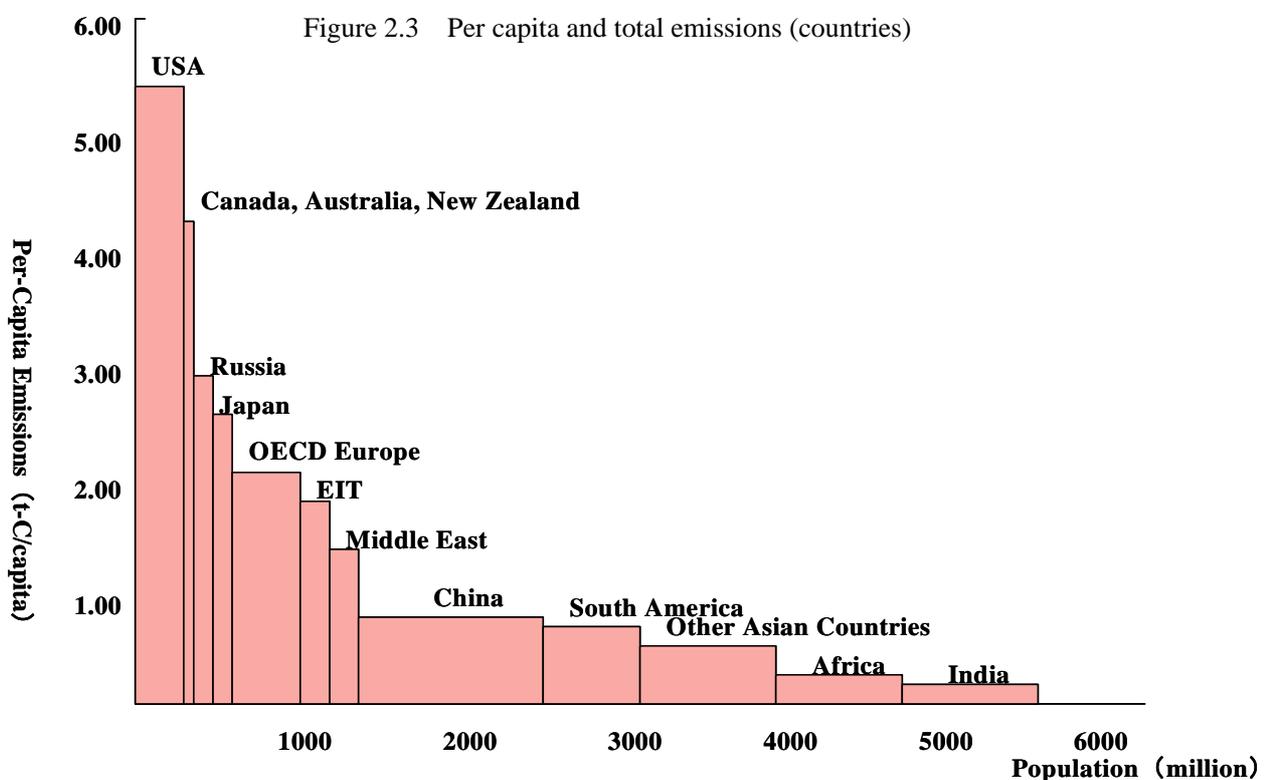
- Every least developing country belongs to one or more categories of countries vulnerable to the adverse effects of climate change. The total CO₂ emissions of these 48 least developing countries amount to 104.71 million tons of CO₂ equivalent (accounting for 0.46 percent of global emissions).
- CO₂ emissions of the least developing countries and other AOSIS member countries total 247.29 million tons of CO₂ equivalent (accounting for 1.1 percent of global emissions).
- The above calculations based on data from the Oak Ridge National Laboratory (USA)

<The generation now taking action and the generations that will be affected in future>

- The second type of equity issue exists between generations. The climate change issue is one in which GHG emitted by the current generation will affect human survival in the future. Just as in the relationship between emitters and victims, the difficulty again lies in the fact that those who ought to judge whether the effects are acceptable or not should be the victims, in this case future generations, instead of the perpetrators, humans in the current generation. However, it is not possible for future generations to take part in the present international consensus-building process. Thus, how the present generation is to consider the issue of future generations is a difficulty inherent in the task of creating a global system to deal with climate change.

<Other equity issue>

- In addition to the above equity issues, it should be noted that, as stated in the preamble of the UNFCCC, the largest share of historical and current global emissions of GHG originated in developed countries and that per capita emissions in developing countries are still relatively low compared to those of the developed countries, as shown in the Figure 2.3. .



Source: Benito Muller (2003) "FRAMING FUTURE COMMITMENTS A PILOT STUDY ON THE EVOLUTION OF THE UNFCCC GREENHOUSE GAS MITIGATION REGIME"

2.3 Environmental Risk Management on a Global Scale

- Global risk management is needed to address climate change.
- Although some scientific uncertainty still remains, it is possible to evaluate that there is little room for doubt that climate change is in progress and will proceed further, and that unless prompt, far-reaching and powerful measures to reduce emissions are taken, there is the danger that substantial adverse impacts will occur in future.

<Environmental Risk Management on a Global Scale>

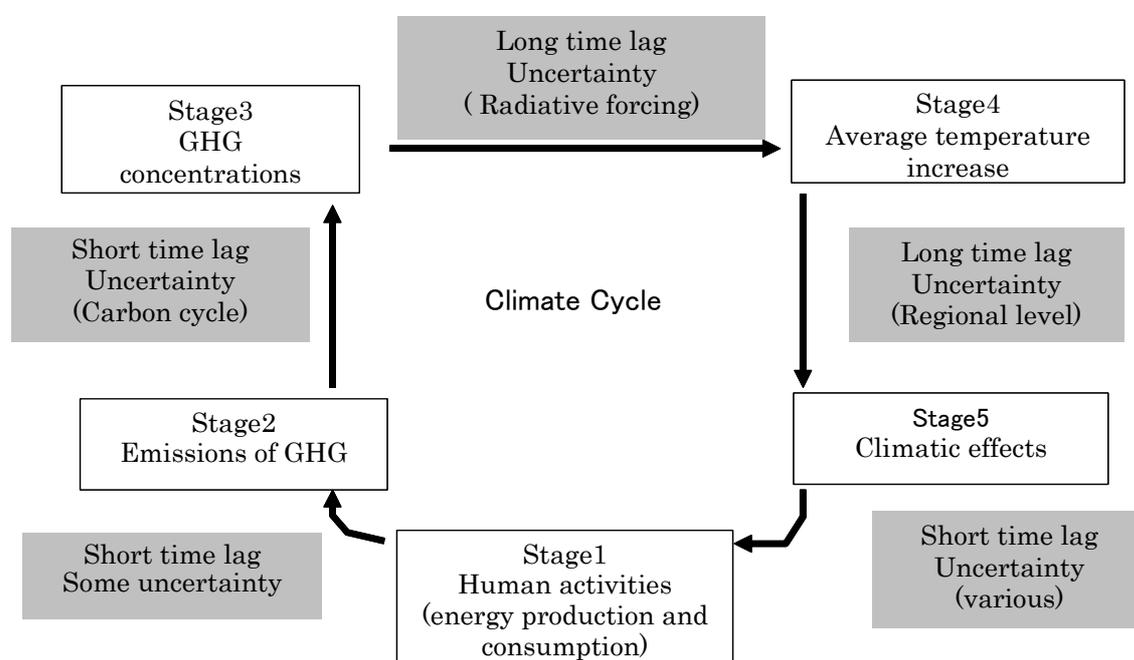
- The long-term impacts of climate change reach across centuries, and their causes and effects are global in scale. In view of the scale and seriousness of its projected impacts, it has been recognized that climate change could affect the very foundations of human existence. The UNFCCC forms the basic regime for climate initiatives, but achieving its ultimate objective will require practical action on a global scale over the medium and long-term.
- Coping with climate change requires deciding on concrete measures for the moment to reduce the future damage, by assessing the degree, the probability, and the kind of climate change impacts. In other words, the question is about how to manage environmental risks on a global scale.

<Uncertainty and the Time Lag between Emissions and Their Impacts>

- The ultimate objective of the UNFCCC is the stabilization of GHG concentrations. With respect to setting the concrete levels, it is stated in the Convention as "Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" which also describes such levels in terms of the impacts on ecosystems, agricultural production, and sustainable development.
- Because what kind of impacts might affect humankind and ecosystems is of great importance, the targets of measures to address climate change will in practice be considered in terms of the impact stage. However, there are in fact several other, prior stages to consider. Before the impact stage

there is the temperature stabilization stage, and before that the atmospheric GHG concentration stabilization stage, and before that the anthropogenic GHG emission stabilization stage. And, scientific uncertainty exists in relation to all stages, including the stabilization of anthropogenic GHG emissions, of atmospheric GHG concentrations and of temperature, as well as in relation to climatic impacts,(see Figure 2.4).

Figure 2.4 Scientific Uncertainties and Target Establishment for Each Stage in the Climate Change Cycle



Source: Pershing, J. and F. Tudela (2003) "A long-term target: Framing the climate effort", in *Beyond Kyoto: Advancing the international effort against climate change*. Washington D.C.: Pew Center on Global Climate Change,

- Determining the level of climate change-induced danger involves some factors subject to value judgments, and what that level will be should become apparent through the development of scientific knowledge and international agreements. In this regard, while it should be kept in mind that there are different types of uncertainty about the relationships among the stabilization of GHG emissions, concentrations, temperature and sea level and climatic effects, the long time lag between causes and effects also merits attention. It should be noted that the uncertainties listed in Figure 2.4 indicate scientific uncertainties.

<Accumulation of Scientific Knowledge and Uncertainty about Social Choices >

- The systematic accumulation of scientific observation and knowledge has been reducing scientific uncertainty in predictions relating to climate change. According to the scientific knowledge of the IPCC, although some scientific uncertainty still remains, it can be evaluated that there is little room for doubt that climate change is in progress and will proceed further, and that unless prompt and far-reaching measures to reduce emissions are taken, there is a real danger that substantial adverse impacts will occur in future.
- There are two types of uncertainty related to climate change. In addition to scientific uncertainty, for example differences in model calculations, there is also uncertainty involving social choices about how to develop the economy and society. Scientific uncertainty is being overcome as observation data and knowledge accumulate and as models incorporating various elements, etc., are developed. Yet, it is still difficult to foresee what kind of society the future generations would choose. Therefore, uncertainty in climate change predictions relies to a great extent on uncertainty in social choices.
- Uncertainty will remain even while measures are being taken, and scientific uncertainty will exist under any circumstances. Based on these pre-conditions, the question is what policy judgments to make. While governments still make these judgments, it is preferable that they do so through dialogues and close cooperation with various stakeholders.

2.4 A Global System to Initiate an Emission Reduction Trend Needs to be Built Between 2020 and 2030

- Various CO₂ stabilization levels can be assumed, but in order to achieve a stabilization level of 550ppm, which is approximately twice what it was before the Industrial Revolution, global CO₂ emissions must enter a downward trend between 2020 and 2030.
- We should consider what kind of global system should be established over the next 10 to 20 years. The scientific background needed for the relevant decision-making is already available. Its application now depends on political decision-making. An awareness of this and an awareness of time constraints will be called for in designing the next framework.

<The Necessity for a Reduction Trend in Global Emissions Needed Between 2020 and 2030>

- While science plays a role in providing information for humans to make social choices, the IPCC acknowledges that continuing increase in CO₂ emissions will further accelerate global climate change. Therefore, we must reverse our ever-increasing anthropogenic GHG emissions so that they enter a downward trend, and stabilize atmospheric GHG concentrations at a level that will make it possible to achieve the ultimate objective of the UNFCCC.

- Which year should be set as the peak year for GHG emissions –in other words, when do our ever-increasing GHG emissions need to start decreasing - in order to achieve stabilization levels for atmospheric GHG concentrations that will enable us to meet the ultimate objective of the UNFCCC? Although there is no international agreement regarding this level, if the stabilization level for atmospheric CO₂ concentrations is to be set at between 450 and 750 ppm, the necessary peak for anthropogenic GHG emissions is generally set between 2010 and 2050 (see Table 2.4). If the stabilization level of atmospheric CO₂ concentrations is to be set at 550 ppm, which is about twice its pre-Industrial Revolution level, the necessary peak for global emissions is normally set between 2020 and 2030. That means humankind need to survive in a carbon-constraint society.

Table 2.4 Relationships between CO₂ emissions and CO₂ concentration stabilization levels

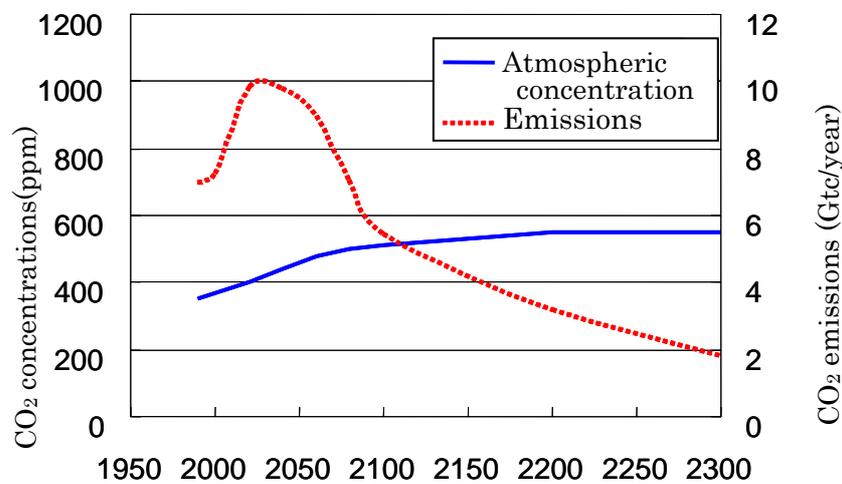
Eventual CO ₂ stabilization level	Time of stabilization	Mean surface temperature change by 2100 (average)	Mean surface temperature change at equilibrium (Average)	CO ₂ emissions (billion tons of CO ₂ /year)		Timeframe for peak annual emissions in order to reach the indicated stabilization level
				2050	2100	
450ppm	2090	1.2-2.3°C (1.8°C)	1.5-3.9°C (2.5°C)	3-6.9	1-3.7	2005-2015
550ppm	2150	1.6-2.9°C (2.2°C)	2.0-5.0°C (3.5°C)	6.4-12.6	2.7-7.7	2020-2030
650ppm	2200	1.8-3.1°C (2.5°C)	2.4-6.1°C (4°C)	8.1-15.3	4.8-11.7	2030-2045
750ppm	2250	1.9-3.4°C (2.6°C)	2.8-7.0°C (4.6°C)	8.9-16.4	6.6-14.6	2040-2060
1000ppm	2375	2.0-3.5°C (2.7°C)	3.5-8.7°C (6°C)	9.5-17.2	9.1-18.4	2065-2090

Source: IPCC Third Assessment Report (2001)

<Continual Efforts Needed to Reduce Emissions>

- Figure 2.5 illustrates the relationship between CO₂ emissions and concentrations given the goal of stabilizing concentrations at 550 ppm. It shows that stabilizing atmospheric CO₂ concentration will require continual reductions of CO₂ emissions even after initially reaching the stabilization level.

Figure 2.5 Example - Course of Stabilization at 550 ppm



Source: Calculated from the AIM model (Based on IPCC TAR)

<The next 10-20 years will be vital in initiating a global emission reduction trend>

- If the stabilization level of atmospheric CO₂ concentrations is to be set at 550 ppm, which is about twice its pre-Industrial Revolution level, the necessary peak for global emissions is normally set between 2020 and 2030. That is, global CO₂ emissions must enter a downward trend within about the next 15 to 25 years, and emission reductions must continue after that as well.
- Measures to address climate change must of course extend over the long term, but in order to meet the ultimate objective of the UNFCCC, we should consider what kind of global system should be established over the next 10 to 20 years. The scientific background needed for the relevant decision-making is already available. Its application now depends on political decision-making. An awareness of this and an awareness of time constraints will be called for in designing the next framework.

- In view of this, an international framework for the period beyond 2012 that aims to achieve a downward trend in global emissions needs to be immediately considered and implemented, although the first implementation period of the Kyoto Protocol ends in 2012.

2.5 Adaptation as Complementary Measure to Mitigation

- Mitigation measures –reducing GHG emissions and enhancing CO₂ sinks- are the fundamental measures for addressing climate change. At the same time, the inevitable impacts of climate change should also be taken into consideration. Thus, adaptation measures are required to moderate and prevent damage as a complement to mitigation measures.
- With respect to the costs of climate change related measures, the costs of adaptation and those of the damage from climate change from insufficient adaptation should be taken into account as well as the costs of emission reduction measures.

< Mitigation as the Fundamental Climate Change Measures >

- The fundamental measures for addressing climate change are mitigation - reducing GHG emissions and enhancing CO₂ sinks. Especially on CO₂, because the top 40 countries account for 84 percent of global emissions, it is crucial to establish a system for GHG emissions reduction and enhancement of the sinks in these countries for the measures to address climate change.

<Adaptation for the Inevitable Impacts >

- However, even if GHG emission reduction and sink enhancement measures, that is, mitigation measures, are taken, some impacts on highly vulnerable natural ecosystems are inevitable and even more severe impacts may be predicted in future. Thus, adaptation measures should be taken to moderate damage to complement emission reduction measures. Also, if the international community decides to accept some impacts by setting a level of atmospheric GHG concentrations mentioned in the UNFCCC, it will also have to implement measures to deal with those impacts.
- Thus, the international community is expected to take two basic types of measures in addressing climate change: mitigation to reduce GHG emissions and enhance CO₂ sinks, and adaptation to moderate the impacts of climate change.

<Costs of Emission Reduction and Adaptation>

- So far, study of the costs of climate change measures has focused on the costs of GHG reduction in order to mitigate climate change. However, because a certain level of impacts is unavoidable, the costs of the damage of the climate change impacts and the compensation costs as well as those for taking the measures to avoid or minimize impacts should also be examined.
- The costs of adaptation have not yet been sufficiently studied due to the many challenges that entail “value judgments,” such as how to deal with the gap in calculations of loss between developed and developing countries, how to estimate compensation for the loss of human life and of ecosystems, and how to assess future damage in the present. Also, in comparing the costs of adaptation, including those of the compensation, with those of reducing greenhouse gases, sufficient discussion is needed to evaluate whether or not it is appropriate to calculate the loss of human life and of other living things merely in economic terms. Nonetheless, studies are progressing in these areas.
- In this context, because of the equity issue in which the countries that bear the cost of GHG emission reduction are not necessarily the ones that are suffering only adverse impacts from climate change, attentions should be paid not to underestimate adaptation costs. At the same time, while bearing in mind that the measures to reduce GHG emissions are essential, it should be noted that the implementation of adaptation measures in adversely-impacted countries should not serve as an excuse for large emitters to postpone or fail to implement emission reduction measures.

<Examples of Adaptation Measures>

- Adaptation measures include the following (measures regarding GHG reductions will be dealt with in a subsequent section):
 - Water resources
 - Improving efficiency of water use
 - Constructing reservoirs and other impoundments
 - Reviewing design standards for dams, levees, etc.
 - Food
 - Adjusting crop planting and harvesting cycles
 - Enhancing the potential of soil to retain moisture and nutrients
 - Coastal areas

- Building levees and breakwaters to protect coastal areas
- Planting trees along the shoreline to prevent sand drift
- Human health
 - Improving public health infrastructure (water supply and sewerage systems, etc.)
 - Developing infectious disease prediction and early warning systems
- Financial services
 - Diversifying risks by using private and public insurance and reinsurance

Examples of Adaptation Measures

Japan's Ministry of the Environment published "Climate Variability and Change and Sea-level Rise in the Pacific Islands Region: A Resource Book for Policy and Decision Makers, Educators and other Stakeholders" in cooperation with the South Pacific Regional Environment Programme (SPREP) in May 2003. This report aims to clarify knowledge about climate variability and change, about the sea-level rises that are severely affecting the South Pacific region, and about the gap in citizens' awareness and need for measures, while indicating a desirable direction to take in order to overcome these challenges. The information in this book was based on the Environment Ministry's FY 1999 survey of measures to address climate change in the South Pacific region, conducted together with the International Global Change Institute (IGCI) of the University of Waikato in New Zealand.

This resource book elucidates five themes related to climate variability and change and sea-level rise: processes and projections of variability and change; consequences of variability and change; mitigation; adaptation; and international responses. It was co-authored by experts from Japan and the South Pacific region, including Prof. Nobuo Mimura of Ibaraki University, who is also a member of the sub-committee, source of the present report.

3. Setting Targets in the Short, Medium, and Long Term

– Necessity of the Perspective Regarding the Timeframe -

This section describes the discussions about setting long, medium and short term goals as a specific approach in seeking to achieve the ultimate objective of the UNFCCC.

In order to meet the ultimate objective of the UNFCCC, setting targets in the medium term (2030-2050) and long term (after 2100), in addition to short term (until around 2020), will promote effective global risk management.

<Significance of Long and Medium Term Targets>

- In order to meet the ultimate objective of the UNFCCC, setting targets in the medium term (2030-2050) and long term (after 2100), in addition to the short term (until around 2020), will promote effective global risk management.
- Although at present no international agreements have been reached on long or medium-term targets, the process of setting medium and long-term targets is expected to give various actors a chance to think about what they can and must do to deal with the risks of climate change faced by citizens, society, and the market. It should also promote consensus-building among actors.
- While the process of setting medium and long-term targets is significant for building agreements in the international community, it will also be important for Japan to make a proposal for some kind of targets. In doing so, Japan can increase its range of collaboration with other countries, and can contribute to progress in obtaining international agreements.

<Long, Medium and Short-term Targets>

- Long-term targets are the embodiment of the ultimate goal under the UNFCCC, and are exemplified by targets for the stabilization level of GHG concentrations, etc. These targets also serve to encourage the international community to recognize that some impacts of climate change are inevitable, and to undertake GHG reduction and impact adaptation measures. For example, they can serve as guidelines for human activity and decision-making about what ought to be done on what

kind of schedule, and for assessing the future risks of climate change and specifying measures for mitigation and adaptation.

- Medium-term targets are regarded as milestones on the road towards long-term target achievement. More specifically, one medium-term target could be a 60 percent cut in CO₂ emissions by 2050. Medium-term targets can be set in the context of specifying restrictions on carbon, checking the efficacy of various measures and strengthening efforts where necessary, materializing necessary actions (what to do now in view of how long it takes to develop and diffuse technology and to reform socio-economic structures) and promoting investment in technology and equipment to cope with climate change and providing the needed physical and institutional infrastructure..

- Medium and long-term targets can be set for any of the following five stages.
 - Stage 1: Human activity (energy production and consumption, etc.)
 - Stage 2: GHG emission
 - Stage 3: GHG concentrations
 - Stage 4: Average temperature rises
 - Stage 5: Climate change-induced impactsThere is a time lag between stages as well as differences in levels of uncertainty.

- Short-term targets are for specific commitments to which will be applied until around 2020. At present, the reduction commitments under the Kyoto Protocol correspond to the short-term targets although no such targets have been set beyond 2012 yet.

- The Kyoto Protocol aims to achieve the reduction of greenhouse gas emissions by developed countries to 5% less than 1990 levels between 2008 and 2012, and is of great significance as the first specific action taken by the international community towards reducing greenhouse gases. However, at the same time this is merely a first step towards reaching stabilization of greenhouse gas concentrations and realizing the ultimate objective of the UNFCCC, and the international community must work together to deal with the fact that further reductions on a global scale are an unavoidable necessity.

<Flexibility in Medium and Long-Term Targets>

- One way to ensure flexibility in long-term targets would be to have the relevant language call for policy to be devised that will prevent major adverse effects, and on that basis, specific targets can be identified in view of current scientific knowledge This would also allow for modification of targets

in accordance with future changes in circumstances and improvements in scientific knowledge. Medium-term targets could be somewhat more specific than long-term targets.

- In relation to risk management that entails uncertainty, the following techniques could be used in setting medium and long-term targets:
 - Review targets after a certain period of time,
 - set targets on the safe side, and
 - set targets based on current scientific knowledge, while clearly stating the degree of uncertainty.

<Examples of Medium and Long-term Targets in European Countries>

- Some examples exist of medium and long-term targets that have been set by major European countries (see Table 3.1). Many of the long-term targets take the form of atmospheric GHG concentrations, for example a target of stabilizing CO₂ concentrations at 450 / 550 ppm or less and concentrations of all GHG in the Kyoto Protocol at 550 ppm (equivalent to CO₂ concentrations of 500 ppm or less). Many of the medium-term targets that aim for 2050 deal with emissions, for example, a target of reducing national emissions by 60 percent, or of reducing global GHG emissions to 3 billion tons of carbon equivalent.
- In addition, the EU has reached agreements on the need to control rises in temperature at the surface of the Earth to within 2.0 degrees Celsius of the pre-Industrial Revolution level. This was also reaffirmed at the meeting of the Council of the European Union held in Luxembourg on the 14th of October, 2004.

Table 3.1 Examples of Long and Medium-term Targets set by European Countries

Country / Issued date	Agency	Long-term target	Medium-term target
Germany (Oct. 2003)	German Advisory Council on Global Change (WBGU; Wissenschaftliche Beirat der Bundesregierung Globale Umweltveränderungen)	<ul style="list-style-type: none"> • Limit surface temperature rise to 2 degrees Celsius or less as compared to pre-industrial levels and to 0.2 degrees Celsius or less per decade. • Limit CO₂ concentrations to below 450 ppm. 	Reduce energy-related CO ₂ emissions by 45-60 percent compared to 1990 levels by 2050.
UK (Jun.2000/ Feb. 2003)	Energy White Paper	Prevent atmospheric CO ₂ concentrations from exceeding 550 ppm.	Reduce CO ₂ emissions by 60 percent compared to current levels by 2050.
France (Mar. 2004)	Interministerial Task-Force on Climate Change (MIES; Mission Interministérielle de l'Effet de Serre)	Stabilize CO ₂ concentrations at 450 ppm or less.	<ul style="list-style-type: none"> • Limit per capita CO₂ emissions to 0.5 tC (by 2050). • Reduce global emissions to 3 billion tC (by 2050).
Sweden (Nov. 2002)	Swedish Environmental Protection Agency	Stabilization of atmospheric concentrations of all GHGs at 550 ppm (CO ₂ concentrations at 500 ppm or less) as stipulated in the Kyoto Protocol	Reduce per capita emissions of CO ₂ and other GHGs of developed countries to below 4.5 tC by 2050, and increasingly reduce thereafter (8.3 tC currently).

Sources: German Advisory Council on Global Change (2003); UK Energy White Paper (2003), French Interministerial Task Force on Climate Change (2004); Swedish Environmental Protection Agency (2002)

4. Socio-Economic Development Scenarios and Climate Change Initiatives

This section describes the discussions about the socio-economic development scenarios closely related with mid- to long-term climate initiatives.

- The future paths and volumes of GHG emissions will greatly differ depending on what kind of socio-economic development takes place. Thus, socio-economic development processes that internalize GHG emission regulation need to be sought as soon as possible.
- The kind of socio-economic development processes each country or region needs to follow should be considered as well, with reference also to the unique circumstances of each country or region.

<The IPCC Socio-economic Development Scenarios>

- In considering future measures and in establishing mid- and long-term goals, it is necessary to examine the kind of social vision to be envisaged. Because the amounts and paths of CO₂ emissions will depend on how the socio-economic system develops, specific scenarios for socio-economic development need to be considered.
- The IPCC initially describes several future socio-economic scenarios in which a variety of factors including environmental considerations are taken into account, but which assume that measures to cope with climate change have not been taken. Two axes are described; one contrasts priority being given to economic growth with aiming for harmony between the environment and the economy, and the other contrasts aiming for a globalized system with aiming for locally-based systems. The results include four scenarios: the (A1) scenario describes very rapid economic growth, (A2) describes a very heterogeneous world, (B1) describes a cycling-oriented society and (B2) a world society with a local/regional emphasis. (See Table 4.1)

<Extent of Climate Change Measures Differ Depending on the Development Scenario>

- According to the IPCC, significantly different levels of GHG emissions and temperature increases will accompany each scenario. Its studies show significant differences in the amount of GHG emission reductions needed to achieve stabilization at each GHG stabilization level (see Fig. 4.1).

<Possible Socio-Economic Development Processes>

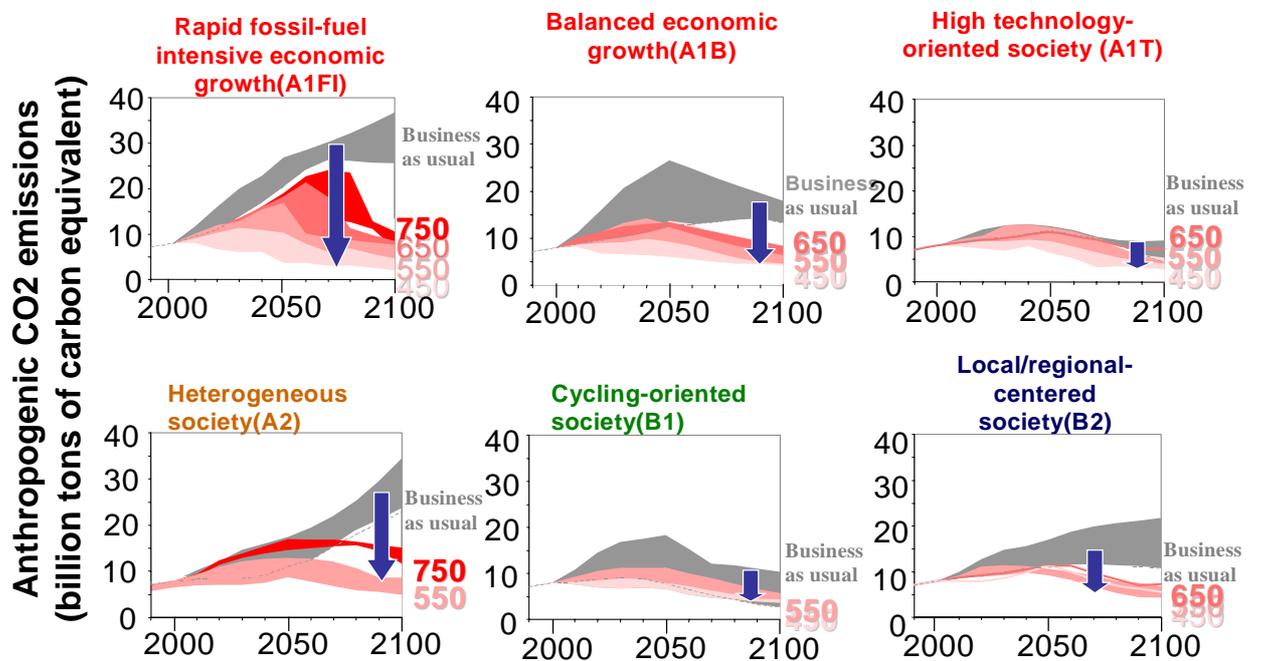
- Depending on the scenario, the necessity could arise in future for extremely large emission reductions, moreover in a very short space of time, though the possibility that this could actually be achieved must be seen as low. This leads to an understanding that we must not stop at taking measures to cope with climate change, but we must also reform the entire socio-economic structure if we wish to avoid an intolerable situation. That is, socio-economic development processes that incorporate GHG emission limitations need to be sought as soon as possible.

Table 4.1 Types of Future Socio-economic Scenarios

	Outline
A1 Scenario	A low-population growth/very rapid economic growth scenario. Barriers among global regions minimized and inter-regional society built, with per capita income and other factors tending towards convergence. It is divided into 3 sub-sets distinguished by types of technological change in the energy system; A1B (Balanced energy consumption), A1F1(Fossil fuel intensive), and A1T(High -efficiency energy technology).
A2 Scenario	This scenario describes a heterogeneous world. Regions form blocks, and indigenous traditional cultural patterns remain largely intact. Rapid economic growth based on free trade is not highly valued. Thus, world population at its maximum reaches about 15 billion. Dependence on regional energy sources is relatively high and progress in technology relatively low, one result being that regions with rich coal sources in Asia and elsewhere will not decrease their dependence on coal, raising GHG emissions to a high level.
B1 Scenario	As in A1, low population growth and very rapid economic growth, but in which technology choices place importance on sustainability, favoring low resource consumption, development and application of green energy sources, etc. Thus, levels of economic activity are lower than in A1. Regionalism will encourage regional value systems, resulting in GHG emissions in 2100 that are lower than the 1990 level. Because the society itself will place importance on the environment, special effort will not be required in taking climate initiatives, and costs of accelerating such measures will be low. However, realization of this kind of society will require a drastic shift from present reality.
B2 Scenario	Regionalism will be relatively strong, and economic, social and environmental sustainability will be sought within regional limits. Thus, much of the world's diversity will remain. However, due to awareness of the need to protect the environment, a situation as extreme as in the A2 scenario will not result. Population will reach mid-levels of UN predictions. Though it is somewhat conservative, it might be called the middle-path scenario.

Source: IPCC/SRES Report (2001)

Figure 4.1 Emission reduction needed for stabilization of [GHG] concentrations



Source: IPCC Third Assessment Report (2001)

<Construction of a Global System Based on a Regionally Diverse Development Scenario>

- The analyses in the IPCC development scenarios are presently premised on the assumption that all countries of the world will develop in line with each scenario. However, in our present world, diverse development patterns are followed in each country and region, and it is difficult to imagine a single socio-economic development pattern being adopted globally.
- Therefore, it would be more realistic in future to think about the kind of development process each country and region might follow in view of their varying circumstances, taking as a pre-condition consideration of a global-scale system for dealing with climate change that involves the whole world. From the point of view of global sustainable development, it is also important to consider how climate change-related efforts are to be integrated with other issues of concern to the international community, e.g. poverty.

About a Research Project - Japanese Climate Scenarios Toward 2050

In order to provide scientific support for global environmental protection policy, Japan's Ministry of the Environment is promoting research through the Global Environmental Research Fund (GERF). The Japanese Climate Scenarios Toward 2050 Project (full name: Comprehensive Research Project for Diverse and Comprehensive Evaluation, Forecasting and Planning for Mid- to Long-term Policy Options Aimed at Creating a Low Carbon Emitting Economy) is being carried out under the auspices of this funding program.

The project leader for the Japanese Climate Scenarios Toward 2050 Project is Dr. Nishioka Shuzo, chairman of the sub-committee and executive director of the National Institute for Environmental Studies (NIES). The project aims to build a mid- to long-term scenario for dealing with climate change in Japan based on the latest scientific knowledge. Its specific research themes are itemized below:

1. Long-term scenario research aimed at evaluation methods for climate initiatives,
2. Research on establishing multi-lateral evaluation criteria for climate initiatives,
3. Evaluation of the efficiency of mid- to long-term CO₂ emission reduction measures taken for urban areas,
4. Research on comprehensive technological, life style and social system measures for coping with climate change,
5. Research on a mid- to long-term strategy for CO₂ reduction in the transport sector with careful consideration of technological innovation and changes in demand

The time 5 year time period for the Japanese Climate Scenarios Toward 2050 project is divided into Phase I (2004 – 2006) and Phase II (2007 – 2008).

5. The Role of Technology

This section describes the role of technology that will be of importance as medium- to long-term climate initiatives, including strategies for future technology development and diffusion on the global scale.

5.1 Technology Needed to Create a Low Carbon Emitting Economy

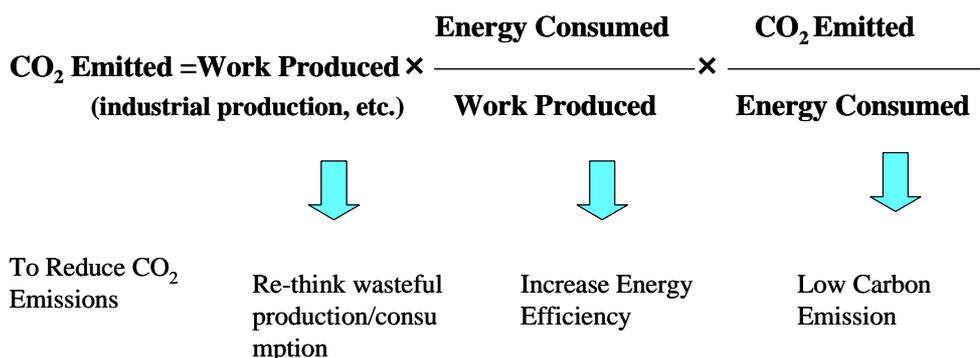
In order to reduce greenhouse gas emissions, the ratio of carbon intensity in energy needs to be lowered more quickly than has been seen in historical precedent, so the development and broad-scale diffusion of technology in the field of low-carbon emission will be important.

<The Role of Technology in Creating a Low Carbon Emitting Economy>

- The effectiveness and efficiency of future efforts to reduce emissions and the possibilities for realizing goals aimed at stabilizing GHG concentrations and climate change will to a large extent depend on the technologies that are developed and diffused in future. Thus, once mid- and long-term targets are established and the most appropriate scenarios for achieving these goals are considered, describing the outlook for the development and diffusion of relevant technology will also be of great importance.

<Technologies for the rationalization of the work produced, enhancement of energy efficiency and low carbon emission intensity >

- CO₂ emissions from energy sources can be decomposed into three main factors, namely, work produced, energy efficiency, and the ratio of carbon intensity in emissions. Balance measures need to be utilized with these factors. Moreover, technologies that rationalize the work produced (industrial production, etc.), increase energy efficiency, and decrease the ratio of carbon intensity in energy (CO₂ emissions per unit energy) are very important.



- According to the IPCC Third Assessment Report, a comparison with historical rates of technological change shows that a rate that is higher than historical precedents is now needed for low-carbon intensity in energy technology if goals for stabilizing GHG concentrations are to be met. Thus, development and broad-scale diffusion of technology in this field are particularly important.

<Existing Technology and Innovative Technology>

- The IPCC Third Assessment Report describes both existing and innovative technologies for increasing energy efficiency and for achieving low carbon intensity in energy. Table 5.1 lists specific technologies for reducing GHG emissions. Development and diffusion of a variety of technologies are expected in future.
- Japan's Climate Change Policy Programs also takes note of GHG emission reduction through the use of innovative technology. Because in 1998, at the time when these Programs were drawn up for the first time, some of these technologies were not yet being practically applied, they are categorized differently than in the IPCC report. For example, high-performance smokestack technology is listed as an innovative technology in the Programs. Based on the IPCC Third Assessment Report, the present report considers a technology that is in use or in the pilot plant plants stage as an existing technology and new technologies as innovative technology still requiring a significant breakthrough. Thus, technologies that will be ready for introduction by 2010, such as high-performance smokestack technology, are listed as existing technologies.

Table 5-1 Examples of Technology for Reducing GHG Emissions

	Increased energy efficiency (mostly demand-side)	Low-carbon emitting (mostly supply-side) technology	Other
Existing technology	<ul style="list-style-type: none"> • High-performance smokestacks • High-efficiency heat pumps • Building & home energy management systems • LED lighting • Hydrogen absorbing alloys • Hybrid vehicles • Biotechnology • Fuel cell vehicles • Materials 	<ul style="list-style-type: none"> • Nuclear Power • Natural gas combined cycle electric generation • Fuel cell battery co-generation • Low-cost high-efficiency photovoltaics • High-efficiency power generators using super-heat resistant materials • Super-conducting power generators & transmission cables • Nuclear fusion • In-orbit photovoltaics 	<ul style="list-style-type: none"> Enhanced absorption by forests • Catalysts for removing N₂O&CH₄ originating in livestock production • Carbon isolation/sequestration technologies
Innovative technology			

Source: Created by Ministry of Environment of Japan, based on the information provided by Mizuho Information Research Institute

<Taking into Account the Uncertainties Inherent in Developing Innovative Technology>

- Prospects to technology development are associated with the inherent uncertainty in technology development itself. In particular, the more innovative the technology, the greater is the uncertainty about its development. In introducing such technology to the market, not only its ability to reduce greenhouse gases, but its impacts on ecosystems, the environment and society must also be assessed. There is a gap between some innovative technologies in terms of their potential for practical applicability, so discussions about these technologies need to make distinctions among them in accordance with their practical applicability.
- Moreover, even if an innovative technology will be developed and applied in practical ways, it is necessary to examine whether it can be diffused among the major GHG emitting developed and developing countries before 2050, or even between 2020 and 2030, for instance. No matter what kind of the climate-friendly technology it will be, it is of no use unless it can actually be diffused and contribute to reduce GHG emissions.

5.2 Time and Pre-conditions Necessary for Technology Development & Diffusion

The development and diffusion of technology is concerned not only with single, self-contained technologies, rather, technology must be viewed in the context of the entire systems that support it. Also, in diffusing technology across international borders as opposed to within a single country, various types of difficulties arise at every level, resulting in the likelihood that global-scale diffusion may require several decades.

<Provision of Systems to Support the Diffusion of Individual Technologies>

- Even when a technology that can reduce GHG emissions has been developed, sometimes that technology cannot be diffused by itself. Thus, not only technology itself, but the entire systems that support the technology also need to be included in any consideration of technology development & diffusion.
- Because many CO₂ emission reduction technologies are related to energy systems, their development and diffusion must be accompanied by energy system reform. For example, diffusion

of hydrogen requires the development and diffusion of technology at all relevant stages – production, transport, supply infrastructure and equipment for using the energy. Because energy systems are also integrated into the social infrastructure, etc., changing them often poses immense practical difficulties.

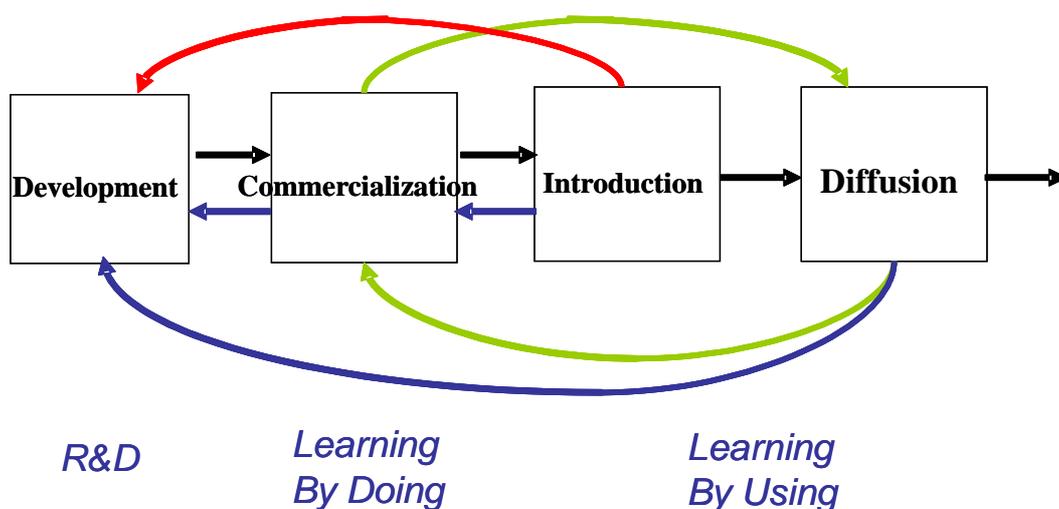
<Intellectual Property Rights>

- It should be recognized that particular difficulties influence various aspects of technology diffusion on the global level, as compared to technology diffusion within a single country. For example, when technology is diffused across international borders from a rich country to a developing country, the issues of intellectual property rights and patents must be dealt with. Although intellectual property rights and patents function as incentives for developers, from the point of view of those wishing to apply the technology, the higher costs associated with such rights and patents form a significant barrier to countries with little economic strength.

<Feedback in Technology Development & Diffusion>

- Technology development and diffusion in the real world does not normally progress in a linear fashion from development -> commercialization -> market introduction -> diffusion. Instead, it should be noted that it repeatedly moves back and forth between each stage in the process, while improvements are added and costs lowered as the technology is diffused (see Fig. 5.1).

Fig. 5.1 Technology Development & Diffusion Process

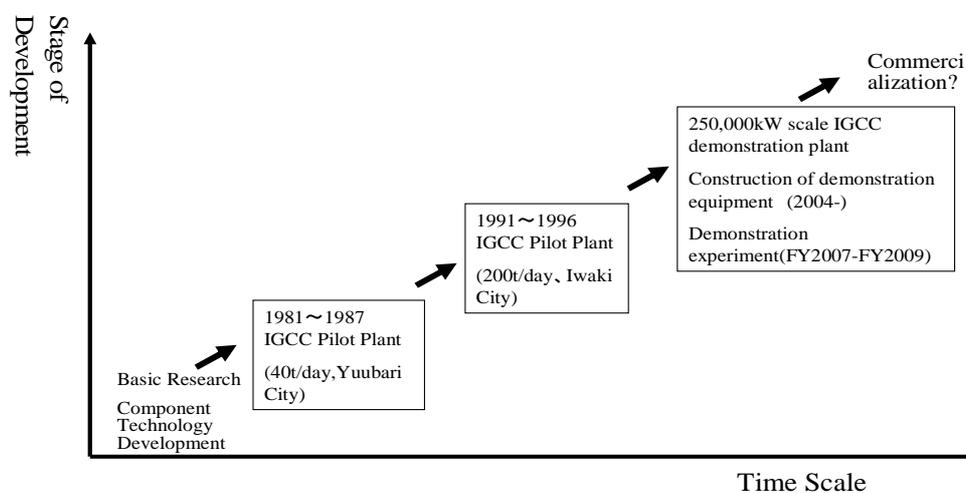


Source: Edwards S. Rubin

<Time and Considerations Needed for Globally Diffusing New Technology>

- New GHG emission reducing technology requires not only the technology itself, but also the provision of support systems, and there are obstacles to diffusion such as intellectual property rights, etc. As technology development & diffusion progress through the process of repeated feedback, it is likely that the interval between the time a technology is first developed and the time it is diffused and applied on a global scale will extend to something on the order of several decades.
- Some technologies require long periods of time for development. Figure 5.2 shows the development stages and time-frame for integrated gasification combined cycle (IGCC) technology. This technology has been tried on increasingly large scales and 30 years will have passed since the time when a pilot plant initially started operation until a demonstration experiment was completed.

Figure 5.2 Example- Development of Integrated Gasification Combined Cycle



5.3 Approaches for Promoting Technology Development & Diffusion and the Role of Government

To promote technology development & diffusion, a balance is needed between demand-side technology, which is developed and diffused mainly through the establishment of goals and standards, and supply-side technology, which is promoted mainly through the provision of subsidies for research, development and diffusion. Government also has a major role to play in technology development and diffusion.

< Approaches for Promoting Technology Development & Diffusion >

- There are two main types of approaches for promoting technology development & diffusion; the “demand-side type” that promotes technology development & diffusion mainly through the establishment of goals and standards, and the “supply-side type” that supports technology R&D and diffusion mainly through the provision of subsidies, etc. A well-balanced combination of both is needed. Other promotion methods include the use of market incentives, such as carbon taxation and emissions trading.
- The seeds of many new GHG emission reduction technologies have begun to sprout, particularly in the case of demand-side type technologies. To nurture these embryonic technologies, a method needs to be established for clearly evaluating their practical applicability, while greater efforts are made to remove the various types of systemic obstacles in their path.
- In diffusing new technology on the global scale, the international community must reach mutual agreements not only on the diffusion of the individual technologies themselves, but also on the introduction of the social systems needed to facilitate diffusion of these new technologies into the societies of various countries.

<The Importance of Government's Role in Technology Development & Diffusion >

- While it is important to take maximum advantage of the power of the market to promote the development and diffusion of GHG emission reduction technology, government also plays an important role. However, the extent of the role government should play depends on what kind of technology is given priority for development. With this in mind, social judgment needs to be applied in order to determine which direction technology development should take in future.

<Government's Role in Providing Infrastructure >

- Firstly, the government is expected to provide the infrastructure needed to diffuse the GHG reducing technology for which the private sector is taking the initiative. Governments must take into account the fact that in developing & diffusing technology, it will not suffice to merely develop a self-contained technology, but rather that the systems and infrastructure to support that technology must also be built.

<Active Participation by Government in Technology Application>

- Secondly, governments participate in the practical application of technology that requires very large initial capital outlay. Technology can be said to have been practically applied only when it has diffused through the market, but for promising technologies that require very large initial capital outlay, diffusion cannot be expected to occur if the initial phases depend on market forces. For example, in the case of an innovative technology such as marine sequestration, the initial capital investment requires large sums, and it is not easy to predict whether a return will be forthcoming on the investment. Governments are expected to actively play a major role by supporting the development and creating a set of circumstances that will facilitate the diffusion of this kind technology.

<Guidance to Identify a Direction for Technology Development & Diffusion by the Private Sector>

- Thirdly, technology development and diffusion can proceed in a clearly planned-out direction, but unexpected technology can also arise that ends up making a significant contribution to society. Thus, an indication by government of a direction for technology development & diffusion can promote technology development by the private sector. The role government can play in this case is not limited to guidance through regulatory measures, but includes awarding economic incentives and creating frameworks that value effort expended in pursuit of development and diffusion of relevant technology.

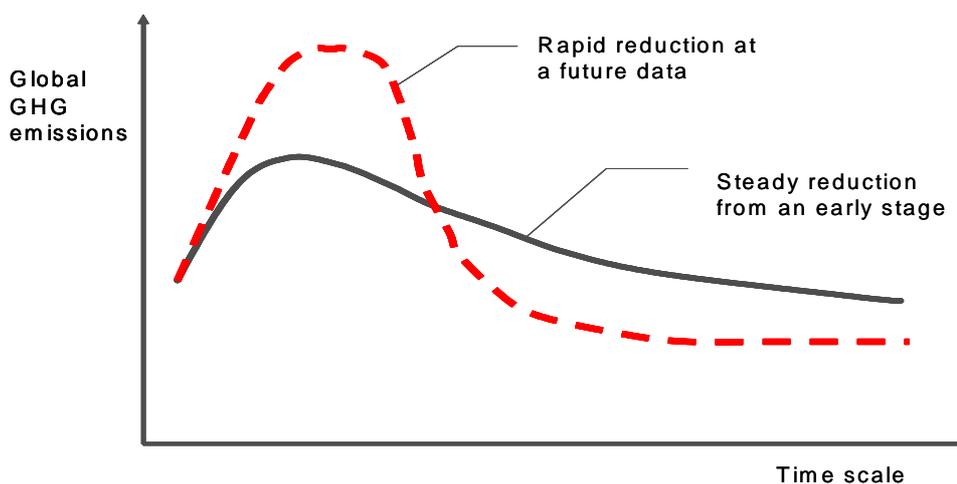
5.4 Strategy for Future Development & Diffusion of Technology on a Global Scale

In view of the inertia inherent in the climate system, the characteristics of energy systems and the time needed for the development & diffusion of technology, measures need to be taken as soon as possible in order to avoid the risks posed by global warming. Thus, while taking a long-range view in promoting the development of innovative technology that can potentially achieve substantial emission reductions, during the next few decades existing technologies need to be applied to the maximum extent possible.

<Diffusion of Existing Technology and Development & Diffusion of Innovative Technology>

- There are two approaches to the question of how to reduce emissions of greenhouse gases; one that would apply existing technology and diffuse it throughout the world to steadily reduce emissions at an early stage, and another that would, for the time being, pour resources into the development of innovative technology that could drastically reduce greenhouse gas emissions, and utilize that technology to rapidly reduce emissions in the future (see Figure 5.3).
- In the debate over which technological strategy to choose, some assert that the latter approach of relying on innovative technology will result in lower emission reduction costs than the former, existing-technology approach. However, it must be noted that this evaluation fails to take account of the costs to deal with adverse impacts of rapid temperature rises during earlier phases. This issue must be examined in light of various considerations, such as the stabilization level of atmospheric GHG, the time scale for establishing a downward trend in GHG emissions and the need to continue reductions thereafter, the varying levels of certainty about development and practical application of technology, the possibilities for diffusing technology on the global scale, the costs of providing not only the technology but the infrastructure to support it, and so on.

Figure 5.3 Greenhouse Gas Emission Scenarios and Technology



<Realizing Rapid Diffusion of Existing GHG Reduction Technology>

- In order to stabilize atmospheric concentrations of GHG at a level that will achieve the ultimate

objective of the UNFCCC, an emission peak must be reached for the entire world, including not only developed countries, but also countries currently categorized as developing countries such as China and India, no later than about 2050. In view of the uncertainties and difficulties bearing on the diffusion of innovative technology on the global scale, no assumptions can presently be made about how long it will take for innovative technology development to result in GHG emission reductions. Thus, resolution of these issues cannot be entrusted exclusively to the future development and diffusion of innovative technologies. Also, even in the case of technologies already in use, it is assumed that their diffusion will also take time.

- Moreover, in view of the irreversibility of climate change, it will be essential during the next few decades to put to complete and comprehensive use existing technologies of both the demand-side and supply-side type. That is, the first task is to take measures to steadily reduce emissions from an early stage.

<Development of Innovative Technology that May Enable Drastic GHG Reductions>

- Based on a strategy of diffusing to the greatest extent possible existing GHG emission reduction technology over the short- and mid-term, development of innovative technology is also important from a long-term point of view in order to increase the efficiency of countermeasures in future and to make possible more drastic emission reductions. Thus, this kind of R&D should be promoted taking a long-range view.
- The role of government is particularly important in the development and diffusion of innovative technology. If innovative technology can be developed and applied, this will increase the probability for realizing further GHG reductions after 2050. Practical application and diffusion could be immediate in some developed countries, making even more GHG reduction possible, and if such technology could be diffused to developing countries, this might result in stabilization of atmospheric GHG at an even lower level in future.

6. Institutional Framework of the UNFCCC and Kyoto Protocol Regime

This section summarizes the development and framework of the UNFCCC and the Kyoto Protocol, which will provide the basis for the creation of a climate regime beyond 2012.

It is important and practical to build the future regime to address climate change upon the foundation of international agreement that has been achieved thus far. In this respect, the framework of the UNFCCC and the Kyoto Protocol offer a solid foundation for the next regime.

<The UNFCCC and Kyoto Protocol: The Outcome of Extensive Negotiations>

- Climate change was first addressed as a major international political issue at the G8 Summit in Toronto in 1988. The Second World Climate Conference in Geneva in 1990 recommended the start of negotiations on a treaty on climate change, and then, the negotiations for the United Nations Framework Convention on Climate Change began in 1991. Over the 15 years from that time until the present day, international negotiations on climate change have continued without pause, on a United Nations platform. Reviewing the past international negotiations, it is important and practical to build the future regime to address climate change upon the foundation of international agreement that has been achieved thus far. In this respect, it is important to analyze and understand the framework of the UNFCCC and the Kyoto Protocol as the solid foundation of a next regime.

<Structure of the UNFCCC>

- The UNFCCC was adopted in May 1992 and entered into force in March 1994. Japan ratified the Convention in May 1993. Almost all of the countries are the parties to this Convention (190 countries and regions had ratified the Convention as of November 2002), which makes it the most comprehensive and fundamental framework to promote international responses to climate change.
- The Convention sets important foundations of international efforts on tackling global climate change. For example, it states that its ultimate objective is “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic

interference with the climate system,” and it is based on the principles that “Parties should protect the climate system ... in accordance with their common but differentiated responsibilities and respective capabilities,” “developed country Parties should take the lead in combating climate change and the adverse effects thereof,” “where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing [precautionary] measures,” and all should be “taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost.”.

United Nations Framework Convention on Climate Change

Article 3 Principles

In their actions to achieve the objective of the Convention and implement its provisions, the Parties shall be guided, inter alia, by the following:

1. The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.
2. The specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change, and of those Parties, especially developing country Parties, that would have to bear a disproportionate or abnormal burden under the Convention, should be given full consideration.
3. The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. To achieve this, such policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors. Efforts to address climate change may be carried out cooperatively by interested Parties.
4. The Parties have a right to, and should, promote sustainable development. Policies and measures to protect the climate system against human-induced change should be appropriate for the specific conditions of each Party and should be integrated with national development programmes, taking into account that economic development is essential for adopting measures to address climate change.
5. The Parties should cooperate to promote a supportive and open international economic system that would lead to sustainable economic growth and development in all Parties, particularly developing country Parties, thus enabling them better to address the problems of climate change. Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade.

Background

The obligations of Parties to the UNFCCC include the following:

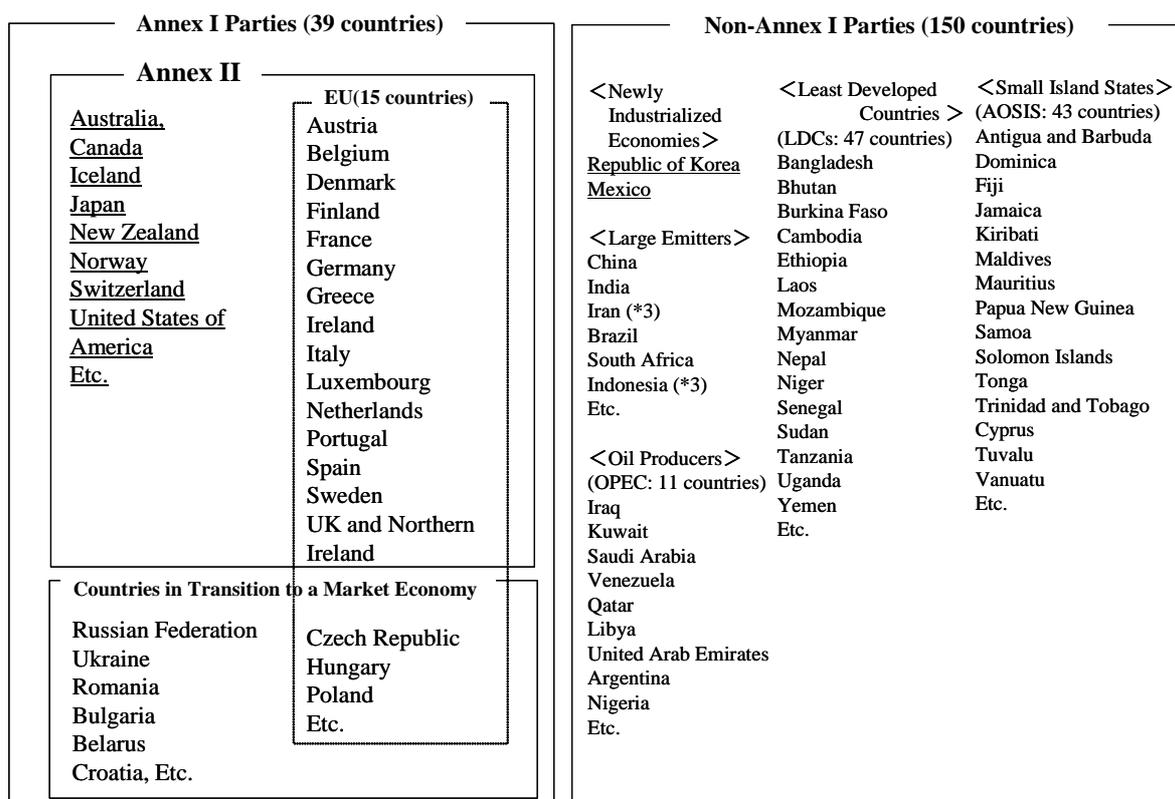
1. Obligations of all Parties
 - (1) Prepare, report, and update inventories of emissions and sinks.
 - (2) Formulate, implement and publish programmes, including mitigation and adaptation measures.

2. Obligations of Annex I countries, i.e., developed countries (including economies in transition):
 - (1) Prepare policies to modify long-term trends in anthropogenic GHG emissions, and develop response measures.
 - (2) Periodically communicate information relating to the above to the Conference of the Parties (with the aim of returning the GHG emissions to 1990 levels by 2000).

3. Obligations of Annex II countries, i.e., developed countries excluding economies in transition:

Provide funding and technology transfers to developing countries.

Figure 6.1 Annex I and Non-Annex I Countries in the UNFCCC



※1 This figure shows selected Parties only, not all Annex I and non-Annex I Parties.

※2 Underlined Parties belong to the OECD.

※3 Both Iran and Indonesia were classified here as large emitters, although they are also members of OPEC.

- Provisions in the Convention cover the review of obligations of the Parties and of the institutional framework, and based on these provisions, the Berlin Mandate was adopted in 1995 at the first session of the Conference of the Parties to the UNFCCC (COP 1).
- The Berlin Mandate recognized that the commitment of developed countries under the UNFCCC to return GHG emissions to 1990 levels by 2000 was not sufficient. It was based on recognition that the provisions of the Convention for stabilization of GHG emissions at 1990 levels were merely non-binding targets and that it would probably not be possible for many countries to achieve them, and that the Convention contained no provisions for concrete actions after 2000.
- Based on this awareness, agreement was reached in the Berlin Mandate to aim for adoption of a protocol or some other legal instrument at COP 3 in 1997, and to begin discussions for that purpose. At the same time, it was recognized that under the new framework no new obligations would be introduced for developing countries. The negotiations based on the Berlin Mandate led to adoption of the Kyoto Protocol at COP 3.

<Structure of the Kyoto Protocol>

- The Kyoto Protocol was adopted at COP 3, which was held in Kyoto, Japan in December 1997. As of November 2004, 127 countries and the European Union had concluded the Protocol. Japan ratified the Protocol in June 2002. On 18 November 2004, Russia deposited an instrument of ratification, with the result that all conditions for the Protocol's entry into force were met, meaning that the Protocol would enter into force ninety days later, on 16 February 2005.

- The negotiations that created the Kyoto Protocol were replete with difficulties until the last day of the COP 3 meeting. A major reason for these problems was that countries were strongly advocating different frameworks based on their differing political, economic, social and natural circumstances.

 - Even at the final stage of the negotiations, some parties did not yield on their positions. Japan argued for the introduction of different numerical targets for each country in order to reflect past efforts to promote energy conservation; the European Union stressed that it should be treated as a single group, and aimed to introduce a system that would admit the collective achievements of the emissions targets only for its members; meanwhile, the United States, in order to make it possible to achieve numerical targets in the most cost-effective manner, called for the expansion of the number of the target gases, the introduction of flexible mechanisms, such as emissions trading, and concrete efforts of developing countries (especially countries with high levels of GHG emissions) for mitigation and emissions limitation.
 - The United States made strong demands for the *meaningful* participation of developing countries although this point was supposed to have already been settled under the Berlin Mandate. Developing countries, meanwhile, demanded adequate emissions reductions by developed countries, and strongly demanded a reconfirmation of the decision of the Berlin Mandate which stated there would be no new obligations for developing countries.
 - Moreover, there was a large gap between countries such as the United States, Australia and New Zealand, which claimed that it was necessary to incorporate some way to deal with sinks, and parties such as Japan, EU, AOSIS, and Brazil who were quite opposed to this proposal due to the uncertainties involved.
 - At the final stage, the arguments of all countries were considered, and in return, each country was asked to make compromises. The result was the Kyoto Protocol that included not only the numerical targets for developed countries, but also a variety of other elements that arose in the course of negotiations, and then, the Protocol was adopted as a package.

- The Kyoto Protocol was a landmark achievement in establishing the obligations on the developed countries to limit or reduce their GHG emissions, and the important first step to achieve the ultimate objective of the UNFCCC. The main pillar of the Kyoto Protocol is that it gives Parties the responsibility to achieve their commitments for short-term reductions at the country level. At the same time, several important elements were adopted:
 - To allow adequate flexibility in the system, the selection of the policies and measures to achieve the targets is left to each country;
 - Emissions targets are differentiated for each country;
 - CO₂ absorption by forests and other sinks are counted as a part of the commitments; and
 - The Kyoto Mechanisms (joint implementation, the Clean Development Mechanism, and emissions trading) were introduced as the methods to achieve targets in the most cost-effective manner through international collaboration.

- As a result of incorporating the various demands of countries, the Kyoto Protocol is structured with much diversity in its provisions. When designing a climate regime beyond 2012, it will be important to give adequate consideration to these provisions and the circumstances and backgrounds that created them.

Table 6.1 Outline of the Kyoto Protocol

Target gases	Carbon dioxide, methane, nitrous oxide, and 3 CFC alternatives (HFC, PFC, SF ₆), for a total of 6 gases
Sinks	Carbon sequestration by forests and other sinks are counted.
Base year	1990 (For HFC, PFC and SF ₆ 1995 may also be used)
Commitment period	Five years (2008 - 2012)
Numerical targets	Reductions: Japan ▲6%, United States ▲7%, EU ▲8%. Developed countries will achieve a 5% reduction as a whole.
Features	Introduction of the methods to achieve targets cost-effectively through international collaboration (the Kyoto Mechanisms)

Table 6.2 Obligations under the Kyoto Protocol

	Obligations of all Parties	Obligations of Annex I Countries
Overarching	• In accordance with UNFCCC	• In accordance with UNFCCC
Mitigation measures	• In accordance with UNFCCC	<ul style="list-style-type: none"> • 5% reduction in overall GHG emissions during the period from 2008 to 2012 (each country has its own target) • Make demonstrable progress in achieving commitments by 2005 • Implement policies and measures in order to promote sustainable development in achieving national commitments • Establish a national system to estimate emissions removals by sinks by 2007
Adaptation measures	• In accordance with UNFCCC	• Voluntary contributions to adaptation fund (a decision on COP 7)

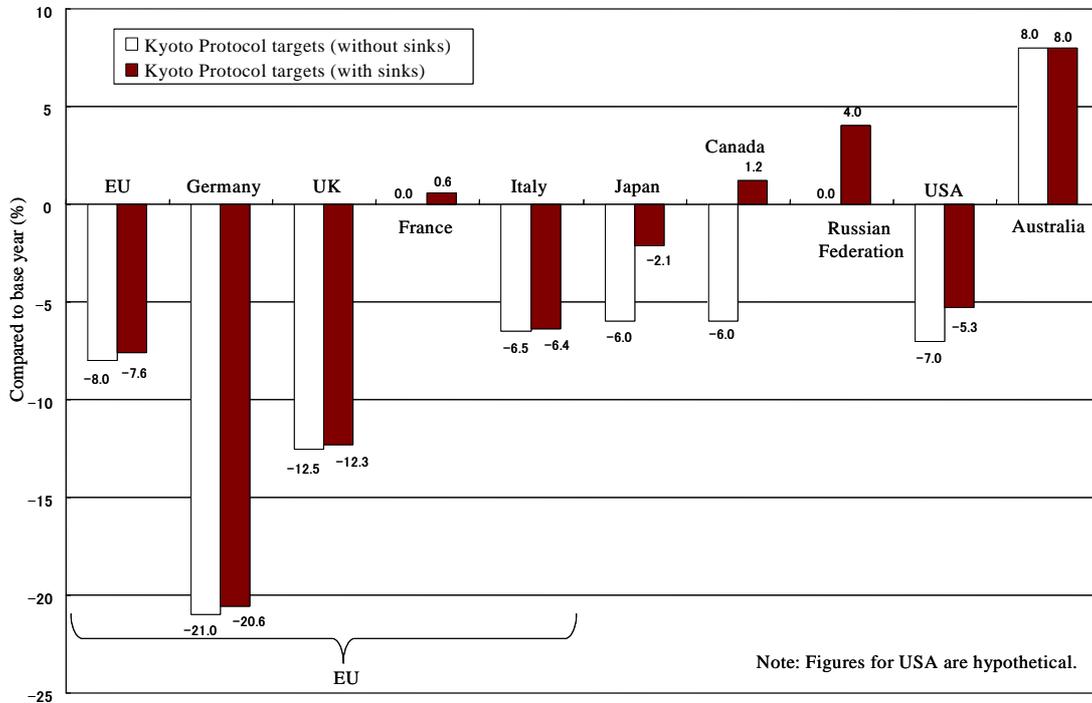
<Implementation Rules of the Kyoto Protocol: The Marrakech Accords>

- Negotiations have continued even after the adoption of the Kyoto Protocol in order to establish operational rules and solid international framework. As a result, the operational rules for the Kyoto Protocol were adopted as a legal framework at COP 7 in the form of the Marrakech Accords, which included the agreements that a fund to assist developing countries would be established, that utilization of the Kyoto Mechanisms would not imply acceptance of a legally binding compliance system, that there would be upper limits for each country's use of sinks from forest management, and that measures could be taken in the event of non-compliance. With these Accords, the preparations for the ratification of the Kyoto Protocol were completed.

Table 6.3 Outline of Marrakech Accords

Developing country issues	<ul style="list-style-type: none"> ● Established a fund to assist capacity building, technology transfers, and enhancement of measures, etc., in developing countries (voluntary contributions by developed countries)
Kyoto Mechanisms	<ul style="list-style-type: none"> ● Use of the Kyoto Mechanisms will not be conditional on acceptance of a legally binding compliance system. ● Emissions credits obtained through the CDM, joint implementation (JI), etc., can be traded with no conditions. ● The use of Mechanisms are supplemental to domestic action (quantitative limits will not be applied, however). ● Parties using JI and CDM are to refrain from using emission reductions generated from nuclear facilities to meet their commitments ● To prevent overselling in emissions trading, countries are required to maintain a commitment period reserve of 90% of the Party's assigned amount or five times Party's most recent emissions, whichever is lowest.
Sinks	<ul style="list-style-type: none"> ● Set an upper limit for each country on removals by sinks from forest management (Japan secured 3.9% of base year emissions; Russia secured 33 million tons as requested; EU 0.45%) ● Afforestation and reforestation are recognized as sink activities under the CDM.
Compliance	<ul style="list-style-type: none"> ● In the event of failure to achieve a commitment, 1.3 times the amount of excess emissions is deducted from the Party's assigned amount for the second commitment period. ● Procedures and mechanisms relating to compliance is to be decided at the first Meeting of the Parties to the Protocol (MOP 1) after it enters into force.

Figure 6.2 Numerical Targets After Counting Sinks



< Issues for the Post-Kyoto Era >

- International agreements has been established over the years in order to support actions based on the regime of the Kyoto Protocol, which is finally about to enter into force.

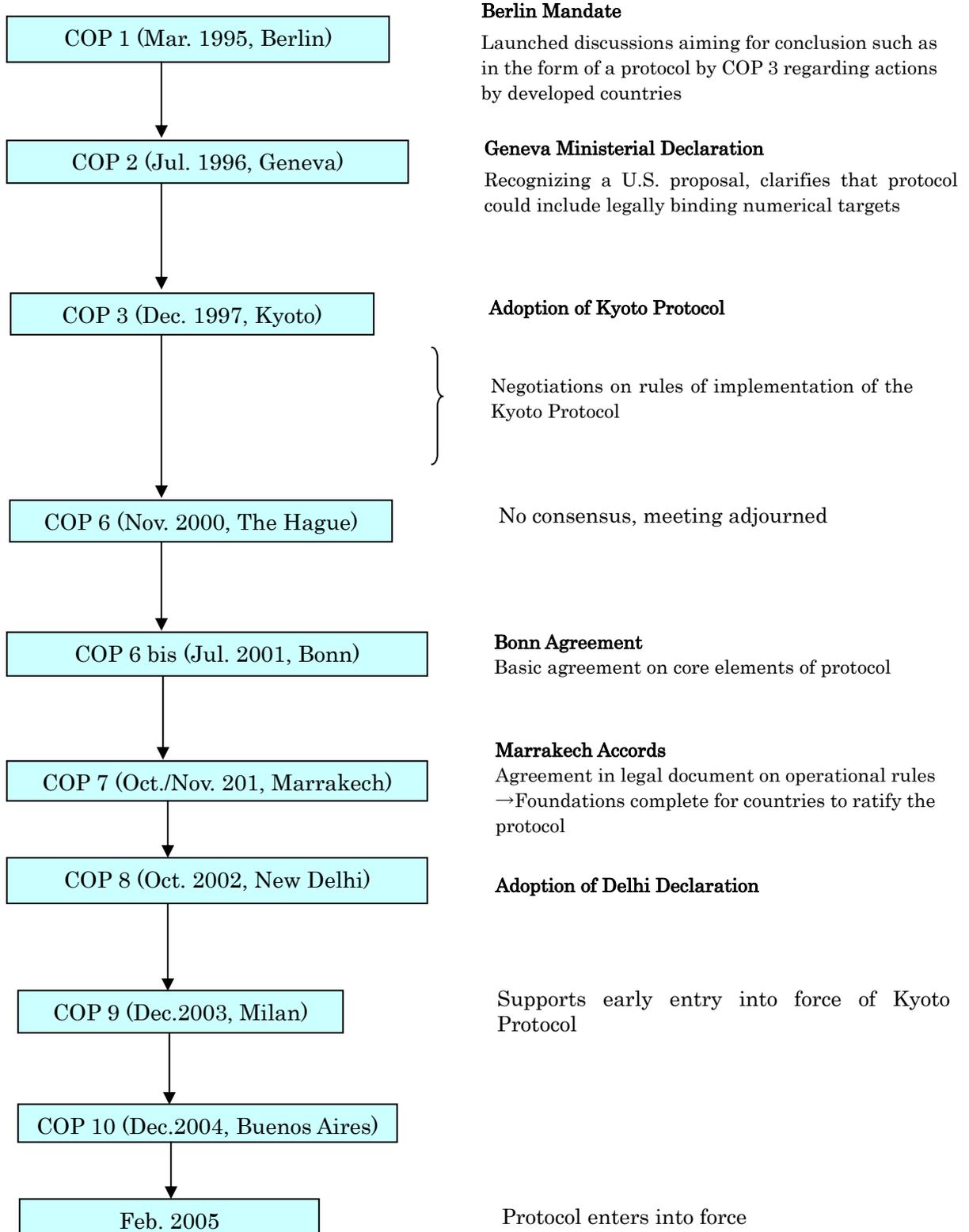
Some argue that a shortcoming of the Kyoto Protocol is the fact that developing countries such as China face no obligation to reduce emissions under the Protocol. However, it was built upon the principles clearly stated in the UNFCCC (that actions should be “in accordance with common but differentiated responsibilities and respective capabilities,” and “developed country Parties should take the lead in combating climate change”), and in this sense, it is the appropriate first step to achieve the ultimate objective of the UNFCCC (Article 2).

Some also argues that, from the Japanese perspectives, the UNFCCC is an extremely unfair agreement for Japan, considering the fact that it has already achieved a high level of energy efficiency. This is why, while the European Union, the United States and others were calling for common targets at the COP 3 in Kyoto, the Japanese government was calling for differentiated reduction targets, and even when they were set, respecting the Japanese appeals, at ▲6%, ▲7% and ▲8% respectively for Japan, the United States, and the European Union, Japan still called

for 3.7% for sinks and flexibility through the introduction of the Kyoto Mechanisms. With regard to sinks, under the Marrakech Accords, the amounts for Japan and the European Union were set respectively at 3.9% and 0.45%, implying that further differentiation had been achieved at a net 2.1% reduction in the GHG reduction targets for Japan and 7.6% for the European Union.

- As a next step, it is important for developed countries to fulfill their commitments under the Kyoto Protocol. But meanwhile, it has become clear that fulfillment of the Kyoto commitments by the participating developed countries alone is not enough to achieve the ultimate objective of the UNFCCC. It will be necessary to overcome some key issues, such that the United States—the world’s largest emitter of GHG—has not altered its policy of not participating in the Protocol, and that the Protocol applies no concrete obligations to developing countries over and above what is stated in the UNFCCC although countries like China and India are indeed emitting more than many developed countries and their emissions are expected to grow rapidly in future.
- In the establishment of next climate regime, how to develop and improve the existing international agreements must become the key agenda from the perspective of the need for further enhancing and strengthening global actions to address climate change.

Figure 6.2 History of International Negotiations from COP 1 through Entry into Force of the Kyoto Protocol



7. Basic Considerations on a Climate Regime Beyond 2012

This section summarizes basic considerations that should be reflected in a climate regime beyond 2012. It discusses matters from the institutional perspective, based on the “Approaches for Achieving the Ultimate Objective of the UNFCCC” described in Section 2.

7.1 Equity Issues

It is more realistic to ensure equity in a comprehensive way by structuring the overall future climate regime to consider various factors, such as fund for developing countries and special consideration to the circumstances of the countries with vulnerability, rather than by simply setting of emissions targets.

< Various Perspectives on Addressing Equity >

- As stated in Section 2.2 regarding the establishment of stabilization levels which are the ultimate objective of the UNFCCC, there is an issue of equity between countries that reduce emissions and those that will be affected by climate change. Also, there is an issue of equity between the generation that develops the policies and the generations that will be affected. In addition, developed countries account for the greater part of GHG gases that have been emitted historically, and even today the emissions per capita in developing countries is relatively low. These too are equity issues. Thus, equity is an essential concept when discussing a climate regime beyond 2012.

- A number of approaches to classify thinking about equity have been proposed. Thompson and Rayer (1998) and Rose et al. (1998) offer some noteworthy approaches to classify the equity principle in terms of allocating the burdens of addressing climate change. Their general categories are as follows (and these principles can be broken down into more detailed categories):
 - Equity based on allocation of global emissions
 - Equity based on the results of implementation of a climate regime
 - Equity in terms of the process to decide on allocation of global emissions
 - * Thompson M. and S. Rayner (1998) "Cultural discourses", in *Human Choice & Climate Change, The Societal Framework Vol.1*, S. Rayner, E. Malone eds. Battelle Press, Columbus OH, p.195-264
 - * Rose et al. (1998) Rose, A. B. Stevens, J. Edmonds and M. Wise (1998) "International Equity and Differentiation in Global Warming Policy", *Environment and Resources Economics*, 12, p.25-51

<Treatment of Equity Issues in the UNFCCC and Kyoto Protocol>

- Equity is clearly addressed as an essential concept in the UNFCCC. Equity was a topic of discussion during the drafting of the Kyoto Protocol as well, regarding the points shown below.
 - ① Emissions targets: Should there be just the uniformed rate of emissions reductions for developed countries, or should differentiated rates be applied?
 - ② Kyoto Mechanisms: Developing countries strongly opposed emissions trading, claiming that it was a system that would favor rich countries.
 - ③ Developing countries' issues: Developing countries asserted that new obligations for them should come only after developed countries had implemented measures to meet their own obligations. The United States, meanwhile, asserted that developing countries with high levels of emissions should have also emissions targets.
 - ④ The European Union asserted that implementation of the common policies and measures.
 - ⑤ Developing countries asserted that funding mechanisms should be established to assist them.
 - ⑥ Consideration should be given to countries that are likely to experience adverse effects (from implementation of adaptation and response measures). (Articles 4.8 and 4.9 of the UNFCCC.)
 - ⑦ Brazilian proposal that the reduction targets should be decided based on the historic responsibility for causing climate change (i.e., cumulative emissions).

- As a result of such discussions, the Kyoto Protocol addressed the equity issues in the following ways;
 - ① Emissions reduction obligations were applied only to Annex I Countries (developed countries), and no new obligations were applied to developing countries.
 - ② Annex I countries faced the differentiated reduction targets. Russia and other economies in transition within the Annex I countries were permitted to use years other than 1990 as the base year. Agreement was reached on various points that would enable each country to take the most efficient measures depending on its particular social, economic and natural characteristics. Examples include counting the total amount of carbon dioxide equivalent for six gases for counting reductions; counting the amount of CO₂ absorption by sinks; introducing a system allowing the European Union member countries to achieve emissions targets jointly; and introducing the Kyoto mechanisms, including emissions trading(ET) and joint implementation(JI) between Annex I countries, as well as the clean development mechanism (CDM) which controls emissions through cooperation between developed and developing countries.

- It can be recognized that no principle of equity has been applied across the border in any past negotiation process. By reflecting these past negotiations, it can be concluded that it is more practical and ensure equity in the overall future climate regime design by taking into account of various issues, such as funds for developing countries and special consideration to the circumstances of the countries with vulnerability, besides setting of the emissions target.
- In addition, there is discussion about equitable procedures. That is to say, how should equal opportunity be ensured for the parties to participate in the process until reaching agreements? There are a number of important points here. For example, how should equal access to information be ensured for all parties? How should the cost burden be shared relating to participation for developing country delegations to the COP meetings? How should final decisions be made relating to the conclusions of COP and other meetings (e.g., by consensus, or by majority vote)?

<Equity between Generations >

- Most proposals on the climate regime beyond 2012 consider equity within generations, but they seem to fail considering equity *between* generations.
- If the efforts of the current generation to reduce GHG are inadequate, future generations will be forced not only to make large reductions over a short period of time, but also to pay higher cost for adaptation to climate change.

<Equity in terms of the Impacts of Climate Change >

- The parties emitting GHG (i.e., the largest GHG emitters) and those affected are not necessarily the same. Also, geographically speaking, the impacts of climate change vary among the regions. Thus, equity in terms of the impacts of climate change is also an issue, in the sense that countries that experience severer damage will have to undertake more aggressive adaptation measures, regardless of the amount of their own GHG emissions. These situations make it clear that proper consideration on the adaptation issues is also important from the perspective of ensuring equity. In this regard, funds relate to adaptation are established.
- Since the adverse effects of climate change are caused by the GHG emissions, it is possible to

think one way of thinking that it is desirable that, from the perspective of equity, the countries or entities that emitted the GHG causing global warming should compensate for the damage in proportion to their contribution to global warming. At this moment, however, it is extremely difficult to prove a cause-effect relationship between the damage and climate change, and the conditions to include such an approach in the actual rule setting have not been established yet. Nonetheless, if it becomes possible to identify the cause-effect or establish the legal principle that admits the existence of such cause-effect relationship, there may be a possibility to apply such ideas into practice.

<Addressing Equity Issues in the Next Regime >

- An examination of proposals to date from governmental bodies, research institutes, NGOs, and others reveals that many of them express the view that the world should aim for uniformed amount of per-capita emissions (allowing for minor adjustments to reflect local climate conditions, etc.) in the medium to long term (e.g., by 2050), in order to put the principle of equity into practice. Many different opinions have been expressed their support on the idea of the differentiation of reduction targets depending on per capita income.
- However, as explained in details in Chapter 8 “Climate Change Regime Beyond 2012,” a wide range of perspectives may exist regarding the short-term commitments. Thus, in the next climate regime it is necessary to deal with the issue of equity by reflecting the diverse circumstances of each country. It is essential to decide on the final form of the future regime in combining various types of equity and other criteria such as efficiency.
- It may also be worthwhile considering other aspects of ensuring equity than simply dividing the world the two categories of developed and developing countries. These criteria, for example, might include total national emissions, per capita emissions, and per capita GDP. However, it is important to note that there are several issues to be considered such as, international comparisons of the GDP are strongly affected by currency exchange rates, and the per-capita indicators are also strongly affected by the level of energy consumption that vary depending on the cultural and climatic conditions among regions.

<Other Points Regarding Equity >

- Equity and environmental integrity (i.e., reducing GHG emissions) are not necessarily positively

correlated. That is to say, obligations solely considered the need to ensure equity may fail to produce the largest possible emissions reductions. For example, on one hand, there is climate regime that many countries recognize as equitable even though the expected amount of the national aggregated emissions reductions are relatively small. On the other hand, there is another regime that can achieve larger emissions reduction although not so many countries are willing to participate. Although many countries are likely to evaluate the former system as equitable, it is still probable that the latter system will be more effective in reducing total GHG emissions around the world,

7.2 Risk Management

- To promote risk management, a hedging strategy and an attitude that supports precautionary measures are needed.
- To judge the tolerable level of risk for society, decision-making is needed to be done through multi-stakeholder participation. It is also important to review that judgment to reflect accumulated scientific knowledge.

<The Need for Large Emissions Reductions at the Earliest Possible Time, Based on Solid Scientific Knowledge>

- When it comes to scientific knowledge on climate change, the IPCC has produced some robust predictions on the issue. It found that by reproducing temperature changes in the twentieth century using climate model simulations, the climate change observed in the past few decades cannot be explained without accounting for the effects of increased GHG emissions; and that rising atmospheric GHG concentrations will cause a range of temperature increases that could cause significant or irreversible adverse effects.
- The climate system contains many forms of inertia. For example, even if the atmospheric GHG concentrations stabilize at a certain level, it could still take several decades to several centuries to stabilize the climate. Even if the GHG emissions were reduced now, it would take decades for the effects to appear. Considering this kind of a lag, it is crucial to take actions at the earliest possible date, while taking the best possible scientific predictions into consideration at each point of time.

- Global warming is in fact already underway, and it is impossible to stop further warming. The task for humanity is to halt the warming at a level that will not cause irreversible damage, and to adapt to those impacts of warming that cannot be avoided. In order to do this, it is essential to strengthen actions towards large reductions in emissions at the earliest possible time.

<Precautionary Measures as a Form of Risk Management >

- Meanwhile, there is a still certain amount of scientific uncertainty in predictions. When discussing climate change and the risk of its adverse impacts, therefore, as stated in Section 2.3, it is necessary to promote environmental risk management with the understanding that uncertainty does exist in responding to the questions, such as : If GHG increase in the future?: what degree of climate change is likely to occur and with what probability? : and what kinds of impacts will occur?
- There is a growing international agreements that precautionary approaches are needed, facing the threat of serious or irreversible damage. This kind of approach is reflected in the UNFCCC stating, "Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such [precautionary] measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost" (Article 3.3).
- Precautionary action requires to be considered based on various conditions. For example, it should be based, as much as possible, on adequate scientific evaluation and risk assessment; the question of what measures are to be taken should be based on judgment on the acceptable level of the risk to setting; it is important for this judgment to be made in as transparent a manner as possible; decision making requires the participation of the stakeholders who are impacted by or have interests in the problems; and this judgment should be reviewed to reflect the body of scientific knowledge.
- The situation where uncertainty remains in predictions implies that a hedging strategy should be used in establishing a future climate regime. This means that the targets and timing of responses should be set by understanding the possible worst-case scenario and making the level of risk acceptable to society even in the worst case, rather than using the scenario with the smallest predicted impacts. Such a hedging strategy is particularly important for the issue of global warming because the worst-case scenario takes the potential for irreversible changes from which recovery is impossible into account.

- Moreover, even if a target of 550 ppm were set for the stabilization level of atmospheric GHG concentrations, it is conceivable that the body of scientific knowledge may later indicate that 450 ppm is actually the level needed to prevent dangerous anthropogenic interference with the climate system. Therefore, even if the stabilization target were set at 550 ppm, it would be important to select emissions paths with a certain amount of flexibility, so that technologies, institutions and society are not constrained by such specific concentration levels in future.

7.3 Climate Regime Beyond 2012 for Low Carbon Emitting Economy

In order to stabilize GHG concentrations, developed countries must continue making emissions reductions, and developing countries must slow their emissions growth as soon as possible, and reduce emissions thereafter.

Considering these and other factors, while keeping in mind the long term targets (the ultimate objective of the UNFCCC), future framework should take the following points into account:

1. It is essential to realize the participation of the United States.
2. Future developments in the European Union will attract special attention as it moves forward with various initiatives that go beyond the Kyoto Protocol.
3. Regarding developing countries, it is important to start by encouraging mitigation efforts through the CDM, and in the future climate regime, taking the principle of “common but differentiated responsibilities” into account, it will be important to establish a framework that ensures concrete mitigation efforts from the developing countries whose level of GHG emissions exceeds that of many developed countries, and is expected to increase rapidly in future, such as China and India.

The challenge to create a low carbon emitting economy should be regarded as an opportunity to create a mutually beneficial cycle between the environment and the economy that will contribute to sustainable development.

<The Emission Reduction Needs in Developed and Developing Countries >

- Regarding stabilization of the atmospheric GHG concentrations, various levels are possible, but whatever level is chosen as a target, in order to stabilize the atmospheric GHG concentrations,

developed countries must continue reducing their emissions, and developing countries must slow their emissions growth as soon as possible, and reduce emissions thereafter.

- Since the economic growth and increasing trend of the energy consumption are expected, it is crucial to realize the GHG emissions reductions without sacrificing the economic growth. In other words, it is essential to decouple the economic growth from rising CO₂ emissions. By considering other essential issues, including the principle of “common but differentiated responsibilities” and the precautionary measures as well, the future climate regime attain the following while reflecting their “respective capabilities” based on the concept of “common but differentiated responsibilities”:
 - * Certain achievement of adequate emissions reductions by developed countries, including the United States, and;
 - * Concrete mitigation efforts by developing countries, particularly those whose level of the GHG emissions is greater than that of many developed countries and is expected to grow rapidly in future.

In accomplishing this, regarding mitigation and other actions on GHG emissions, it would be good to consider various response strategies, depending on the circumstances and capabilities of each country. This approach also implies that the developed countries participating in the Kyoto regime need to strengthen their commitments in tackling climate change.

<The Importance of U.S. Participation>

- President Bush was re-elected in the US Presidential Election in the November 2004, and the Republican Party came to dominate both houses of Congress. Therefore, it is very likely that the United States will maintain its policies on climate change issues. However, it is obvious that the participation of the United States in any international framework is essential when considering various policy dimensions such as the effectiveness of the international responses to climate change, leadership role of the developed countries in responses under the principles of the UNFCCC; and application of the principle of equity in any international efforts
- To encourage the United States to participate in the international efforts on tackling climate change, it is important for Japan and the European Union to present the world that they are steadily moving forward with GHG policies to achieve the Kyoto target, and that these efforts will benefit the world both the environmentally and the economically..

<The Significance of Developments in the European Union>

- The European Union has been introducing a number of policies and measures to meet its targets under the Kyoto Protocol, and moving forward with various initiatives concerning the post-Kyoto framework at the same time. This was reaffirmed at the meeting of the Council of the European Union in October 2004 that “it is expected for the meeting of the Council of European Union in 2005 to consider the strategies for GHG emission reductions both in the medium and the long term that would contribute to attain the ultimate goal under the UNFCCC.” Since the EU will be like to make suggestions based on their considerations at international arena, it is important for Japan to pay careful attention to the efforts of the European Union.

<Developing Countries and the CDM>

- Although developing countries are not obliged under the Kyoto Protocol to make GHG emissions reductions under the Kyoto Protocol, they are expected to play important roles in the CDM. Therefore, it is crucial to encourage developing countries to promote mitigation efforts in their countries through forming and implementing CDM projects.

<The Role of Developing Countries based on the Principle of “Common but Differentiated Responsibilities”>

- Regarding developing countries, it is important to start by encouraging mitigation efforts through the CDM, and in the future climate regime, taking the principle of “common but differentiated responsibilities” into account, it will be important to establish a framework that ensures concrete mitigation efforts from the developing countries whose level of GHG emissions exceeds that of many developed countries, and is expected to increase rapidly in the future, such as China and India.
- While developing countries often have a common position in many international negotiations, there are wide range of differences regarding their actual socio-economic circumstances and perspectives. For example, the conditions of large countries such as India and

China are different from those of relatively developed economies such as Korea and Mexico, OPEC countries, least developed countries, and small island states. Moreover, regardless of what criteria and specific levels are chosen—whether they be total national GHG emissions, GDP, per capita GDP, or per capita emissions, it is not very likely to see the situations where none of the countries that are currently categorized as developing countries attain a specific level and only developed countries exceed such a level. Thus, in the next regime, there will be a possibility to seek for the need and approaches that do not necessarily identify developing countries as one simple category.

- Also, the greatest concern of developing countries in relation to the climate change policies is about adverse impacts on their economic development. Thus, it must be important to explain as concretely as possible that global warming measures and the economic development can complement each other.
- Equipment investments in the energy infrastructure in developing countries will have a great important on the amounts of their future GHG emissions. Therefore, in order to make these investments contribute both to reduce GHG emission and create other benefits such as the pollution control, it is necessary to make efforts with long-term and strategic perspectives through .through the systems for international cooperation such as, official development assistance (ODA).
- To promote effective climate change policies, the climate regime beyond 2012 will need to comprise of the system that ensures concrete mitigation efforts in key GHG-emitting countries whose level of the GHG emissions are already higher than many developed countries and is expected to grow rapidly in future, such as China and India.

<The Challenge to Become a Low Carbon Emitting Economy >

- The shared term of “sustainable development” at the Rio Summit and Johannesburg Summit is interpreted as a development that meets the present needs without compromising the ability of future generations to meet their own needs. The challenge to create a low carbon emitting economy should be regarded as an opportunity to create a mutually beneficial cycle between the environment and the economy that will contribute to sustainable development.

- Through that challenge, it is possible to decouple GHG emissions from economic growth. For Japan, the progress towards more climate-friendly society is also connected to energy security, and stronger international competitiveness through development of new technologies.

7.4 The Role of Governments and Agreements Among Them

Multilateral negotiations under the United Nations framework offer many advantages in addressing climate change issues now and the future. Thus, it is important to support establishment of the international framework with the UNFCCC as the core. It is also important that countries (i.e., national governments), which bear the responsibility for national commitments, play a central role in creating this framework.

At the same time, a relevant framework with multi-stakeholder participation that complement multilateral discussions under the United Nations framework will surely enhance the effectiveness of the agreements among countries.

<Decision-Making at the International, National, and Sub-National Levels>

- Decisions to address international issues could be described at three levels: international, national (i.e., national governments), and sub-national (i.e., private sector and local governments). What should be decided at which level depends on the nature of the decision.
- For the climate change issue, it is necessary to make decisions at all levels. Discussions at the international level are necessary because all countries emit GHG and the impacts of the climate change affect all countries of the world. The governments (national level) then become responsible for making decisions on the matters decided at the international level in order to implement the necessary domestic measures, as GHG emissions are associated with activities in all sectors, including domestic industry, transportation and households. Moreover, domestic entities such as corporations, individuals, and local governments are the actors that actually limit the GHG emissions. Thus, it is necessary to have discussions at the sub-national level about the most efficient methods for them.
- In recent years, the structure of international politics has become more complex. However, there has been no change in the fact that national governments are the most important actors in

decision-making. Sub-national actors (corporations, environmental groups, researchers, etc.) have increasingly built direct links with various actors domestically and internationally (i.e., becoming trans-national actors) without going through governments. However, this trend does not necessarily diminish the roles of governments, rather, actually increases the effectiveness of agreements among governments all the more.

< Climate Change Negotiations Under the UN Framework are Essential >

- The UNFCCC, as a multilateral agreement under the auspices of the United Nations, has the following advantages:
 - ① Understanding climate change issue: Since GHG emissions reductions and climate change adaptation measures are relevant for the activities of all countries, the development of the climate regime requires the involvement of all countries for the efforts to understand the problem through the measures like, data collection on GHG emissions, monitoring of temperature increases, rainfall, and extreme weather events, emissions trading measures and other matters.
 - ② Utilization of existing United Nations Framework: Since institutional arrangements, such as for the procedural rules and scope of work of secretariats, already exist, it would be efficient to use existing institutions. Climate change problem is also related to other global environmental problems, such as biodiversity and desertification, and synergies among them are likely to emerge when working under the UN system, which allows the mutual arrangements among other international frameworks working on similar issues. The same could be said regarding the funding mechanisms.
 - ③ Dignity of multilateral agreement: Regardless of whether or not they are within the United Nations framework, the agreements in which many countries have participated are more likely to be accepted by countries than those in which only a few countries have participated. This leads to greater stability, potential for future development, and continuity of the policy framework.
 - ④ Legitimacy of procedure: The participation of all parties is essential to ensure equity, and to make decisions on the issues dealing with uncertainties. It can be said that agreement reached through legitimate procedures is the only genuine agreement.
 - ⑤ Maximization of the diplomatic powers by using the United Nations: For Japan, its diplomatic power could generate positive outcomes more efficiently through negotiations under the United Nations framework than bilateral negotiations. In particular, Japan can contribute positively and actively in addressing global environmental issues with its response

technologies and human and financial resources.

- Multilateral negotiations under the United Nations framework offer many advantages in addressing climate change issues now and the future. Thus, it is important to support establishment of the international framework with the UNFCCC as the core. It is also important that countries (i.e., national governments), which bear the responsibility for national emissions reductions commitments, play a central role in creating this framework. At the same time, multi-stakeholder participation in the process will surely enhance the effectiveness of agreements among countries by complementing multilateral discussions under the United Nations framework.

<The Usefulness of Other Frameworks to Complement Climate Change Negotiations Under the UN>

- Meanwhile, various challenges arise in multilateral discussions under the United Nations framework in which more than 180 countries participate, such as:
 - ① Negotiation process is likely to be very complex since it is necessary to take many different opinions into account
 - ② While dealing with various views, multilateral negotiation is likely to result in the form of compromises, which may miss the ideal targets.
 - ③ Other issues, such as poverty alleviation, will be brought into the negotiations focusing on climate change issues.
 - ④ It takes enormous time to reach an agreement.
- Taking into account these perspectives, the effectiveness of agreements among countries could be enhanced by complementing multilateral discussions under the United Nations framework in other ways. Some of the suggestions are as follows:
 - Discussions among the selected countries (bilateral, several countries, regional, etc.)
 - Discussions on specific topics (technology, emissions trading, etc.)
 - Discussions with the participation of various domestic actors (e.g., exchanges of opinion with members of same industry in different countries, exchanges of opinion with environmental groups and researchers, etc.)

8. A Climate Regime Beyond 2012

A variety of proposals have been made relating to commitments under the next climate regime, and it is important to scientifically analyze their advantages and disadvantages from a broad perspective. This section summarizes key points regarding commitments, and also introduces features and issues regarding adaptation that must be considered in the design of the future climate regime.

8.1 Proposals Regarding Commitments

A variety of proposals have been made relating to commitments under the next climate regime, and it is important to scientifically analyze their advantages and disadvantages from a broad perspective. In regards to the targets, it is possible to set the long-term, medium-term, and short-term targets. By setting these targets, it is expected that they will help countries achieve their concrete emissions reductions, the diffusion and development of technology in the medium-term, and achievement of the ultimate objective of the UNFCCC.

When countries consider different options for commitments, it is important to have criteria in order to evaluate the proposals. There are a number of criteria for evaluation, and one of the major topics in future will be on how to conceptually organize the tradeoffs and prioritization of these criteria in order to assist the evaluation.

<Positioning of the Proposals on Commitments>

- In the discussions concerning the future regime, the form of the commitments is one of the major elements. Indeed, various proposals that are already presented publicly suggest the forms of the commitments. Therefore, this section discusses the proposals on the commitments in the future regime. In order to secure equity, however, it is more realistic to ensure equity in a comprehensive way by structuring the overall future climate regime to consider various factors, such as fund for developing countries and special consideration to the circumstances of the countries with vulnerability, rather than simply through the setting of emissions targets.

<Elements of Proposals Regarding Commitment>

- Key elements of the proposals regarding the commitments can be listed as follows.
 - Long-term targets
 - Medium-term targets
 - Short-term targets
 - Policies and measures
 - Target actors and the form of the agreements
 - Types of the commitments
 - Differentiation of the commitments
 - Supplemental Measures for the commitments

The proposals regarding the commitments will be compiled as a package combining various elements.

- Regarding the targets, it is possible to choose an approach that establishes the long-term, medium-term, and short-term targets and creates strategies for each target, including scenarios, technology development and diffusion, and social system creation. In this way, it can be expected to develop effective plans to make progress with the effects of the actions in the short term, technology development and diffusion strategies in the medium term, and achievement of the ultimate objective of the UNFCCC in the long term. In addition, in order to set the concrete targets and plans, it is essential to analyze the strengths and the weaknesses of the options, such as setting all the targets simultaneously and separately.
- The key issues for discussion on the long-term targets will be not only their levels, but also the targets of actions (i.e., GHG concentrations, emissions amounts, or temperature increase, etc.) and their timeframes. For example, the European Union has set a maximum temperature increase of 2 degrees Celsius and a target atmospheric concentration of 550 ppm (CO₂ equivalent) for all GHG specified under the Kyoto Protocol. In order to make the climate change measures, strategic and effective for the long-run, it could be beneficial for the world to agree on setting such numerical medium and long-term targets.
- Regarding the medium-term targets, the key issues for discussion will be the target of the GHG emissions for the entire world. There are some other issues that should be addressed, such as the timing of when global GHG emissions should start declining, what the total annual emissions will be, and what the emissions of the world's major emitters will be at that time.

- Regarding the short-term targets, besides the issues mentioned for the medium and long-term targets, several issues, including the target gases, the treatment of sinks, the treatment of emissions from bunker oil (used for international aviation and international shipping), and the commitment period, should be discussed. Even when discussing solely the proposal on the emissions targets, there are several options to be considered, such as total emissions, emissions intensity, per capita emissions, and cumulative historical emissions.
- Regarding medium-and short-term targets, various proposals have been made regarding the issues of setting the common policies and measures. This could also be the topic of future discussions. Besides, there are several concrete proposals on issues including, energy efficiency standards, the amount of renewable energy introduced, efficient resource use, world-wide introduction of carbon taxes, abolition of fossil fuel subsidies, technology development, cooperation and transfer; and adaptation measures.
- There are various approaches on several issues, such as the targeted actors (global scale, regional, national government, local government, private sector, or specific industrial sector), the form of agreement (multilateral such as within/outside the UN or within/outside the UNFCCC; inter-regional; or bilateral), and the format (legally binding or non-binding, measures for non-compliance).
- Regarding the differentiating national commitments, a key point of discussion will be about how their commitments should be differentiated. An approach is suggested to set different commitments depending on different stages, and when a country achieves the threshold point of a certain stage (graduation index), it will advance to the next stage.
- As for the supplemental measures for the commitments, various approaches are being presented. For example, flexible measures, such as banking from the previous and borrowing from the next commitment periods, utilization of market mechanisms such as in the Kyoto Mechanisms, and a “safety valve” approach that would lower the targets once the costs for achievement exceeded a certain value.

<Evaluation Criteria for Proposals on Commitments>

- When countries consider the different options for the commitments, it is important to have

criteria in order to evaluate the proposals. Some examples of such criteria for evaluating such proposals are as follows:

- Environmental integrity
- Equity
- Cost-effectiveness
- Political feasibility
- Implementation feasibility (implementability)

In future, it is crucial to conceptualize how to treat the tradeoffs and prioritization of these criteria in order to assist the evaluation.

- What needs to be emphasized here is the genuine need of the criteria that respect environmental integrity. It is important to remember that GHG emissions reductions are needed on a global scale, and whatever kind of commitment is chosen, emissions predictions should be the top priority. For example, if the long-term target is set at limiting the temperature rise from global warming to 2 degrees Celsius, and the average climate sensitivity 2.5 is chosen, GHG emissions must peak in 2020 and then, be reduced to the 1990 level by around 2030. In this case, developed countries must reduce emissions significantly, and developing countries must start their efforts to reduce emissions even if their levels of per capita income are still considerably below the level at which developed countries started reducing emissions.
- Also, when it comes to criteria for ensuring equity, there are crucial issues including ensuring basic needs, economic capability, responsibility for past emissions, and emissions rights (sovereignty, acquired rights, etc.). Regarding these points, it is necessary to evaluate the priorities for each of them.
- When designing a climate regime beyond 2012, it is also necessary to adequately consider the issues of credibility in international negotiations, as well as incentives for action. For example, if the Kyoto Protocol regime were to be scrapped completely, there would be considerable damage in the credibility that makes future negotiations much more difficult. Although proposals have been made for maintaining the Kyoto Mechanisms but without numerical targets for emissions reductions, it ceases to function unless international agreements will be made to establish innovative system on incentives that can substitute for the numerical targets.

Examples of Proposals on Commitments

Institutions like RIVM of the Netherlands have analyzed three proposals on commitments, namely, Per Capita Convergence, the Brazilian Proposal, and the Multi-Stage Approach, to identify each of their strengths and weaknesses. The characteristics of these three proposals are as follows:

Table 8.1 Examples of Proposals on Commitments

Per capita convergence	<ul style="list-style-type: none"> • Emissions rights will be allocated equally based on the principle that the atmosphere is a common good., • Per capita emissions converge in 2050 or 2100. • Respect the principles of equity and sovereignty • Proposal has gained a certain level of support from developed and developing countries
Brazilian Proposal	<ul style="list-style-type: none"> • Differentiate in terms of the contribution to temperature increase • Initial goal of the proposal: To demand historical responsibility of developed countries • The only framework being considered under the UNFCCC • Assessment may vary considerably depending on reference year, starting year, types of gases, and whether or not to count forest sinks/emissions
Multi-Stage Approach	<ul style="list-style-type: none"> • Step by step commitments for each country <ul style="list-style-type: none"> – Stage 1: No obligation for quantitative reductions – Stage 2: Emissions intensity target (CO₂/GDP) – Stage 3: Stabilization of emissions – Stage 4: Emissions reductions (differentiation with emissions per capita) • Unlimited variations for the units to determine the threshold (graduation index). E.g., a combination of per capita GDP (purchasing power parity) and per capita emissions.

8.2 Adaptation: Key Points and Issues

A number of issues arise regarding adaptation to climate change. Some of these include the role of adaptation as complementary measures to mitigation; how to distinguish between the projects on adaptation to climate change and those on infrastructure management; and how to incorporate climate change adaptation into other policies and development plans.

<The Need for Adaptation>

- A certain degree of impact of global warming is inevitable, given that it is not realistic to expect immediate large GHG emissions reductions and stabilization of GHG concentrations at the current level (about 370 ppm). Thus, when seeking agreement on the stabilization level of GHG concentrations, it is necessary to think about not only reducing GHG emissions (mitigation), but also adapting to the impacts of climate change (adaptation).
- Regarding the adaptation measures, unlike the mitigation measure that many concrete proposals on the commitments have made, there has not made any such proposals yet. Therefore, this section focuses on identifying the key issues regarding adaptation measures.

<Key Points Regarding Adaptation>

- The IPCC Third Assessment Report (2001) recognizes adaptation as being complementary to mitigation, and provides the following comments:
 - Adaptation has potentials to reduce adverse impacts of climate change significantly and enhance beneficial effects, but will not be able to prevent all damages.
 - Natural systems are only allowed to adapt to climate change *ex post* while human systems have the ability to make anticipatory adaptations.
 - Planned adaptation can reduce vulnerability and offer the potential to take advantage of available opportunities.
 - Adaptation to current climate risks (e.g., drought, severe storms, flooding) also works as adaptation measures to climate change.
 - The costs of adaptation often are marginal to other management or development costs.

- To improve the effectiveness of adaptation to climate change, it is necessary to consider the stresses other than climate, and ensure consistency with existing policy criteria, development objectives, and management systems.
 - The ability to adapt differs by region, country and social group. It also changes over time.
 - The ability for adaptation depends on wealth, technology, information, skills, infrastructure, management capabilities, and access to resources.
 - Activities required for enhancement of adaptive capacity are essentially equivalent to those promoting sustainable development. Climate adaptation and sustainability goals can be jointly advanced by policy changes that lessen pressure on resources, improve management of environmental risks, and enhance adaptive capacity.
 - Policy making, implementation and planning of development measures have a huge impact on trends in adaptive capability.
- Adaptation is a serious issue for not only developing countries but also developed countries. It is important to note, however, that some countries, such as small island states, are extremely vulnerable to climate change and sea level rise while their contribution to the global GHG emissions is extremely small. For those countries, adaptation must be the main response to climate change in contrast to the situation of many developed countries.

<Key Issues Regarding Adaptation>

- The starting point of discussions about adaptation is the role of adaptation measures as a climate change response that complement mitigation. In other words, it is necessary to answer what could the best combination of mitigation and adaptation be. When addressing this problem, it is important to give adequate considerations to the differences in the key features of adaptation and mitigation, as shown in the table below.

Table 8.2 Comparison of Mitigation and Adaptation

	Mitigation	Adaptation
Impacts and scope of measures	Global	Local
Time until effects are felt	Long	Relatively short
Criteria	Amounts of the GHG emissions reduction and the increase of sinks	No common measure to evaluate the adaptation to different impacts
Target countries	Major emitting countries	All countries, particularly the vulnerable developing countries

- A second issue regarding adaptation is how to distinguish between the projects on adaptation to climate change and those on infrastructure management. It is also essential to define “adaptation”.

Present infrastructure, whether it be urban or agricultural, has been designed based on the assumptions of relatively stable climate condition for the past several decades or recent centuries. Meteorological events that exceed these stable climatic assumption generally called as “abnormal” or “extreme” weather events. “Extreme weather” is a weather pattern that occurs only rarely, not regularly. However, it is predicted that, as a result of global warming, the occasions that are now classified as extreme become more frequent, and this trend is expected to continue in the future. Therefore, the assumptions for infrastructure design and improvements will have to change dramatically. If there will be a need to upgrade infrastructure in response to climate change in near future, there will be pressing needs for huge financial resources in both developed and developing countries.

Even if it remains difficult to specify the impacts of anthropogenic climate change, a realistic approach is to seek for the response measures by formulating the questions in a way like, where an impact is obviously caused by climate change, and the impact will be beared by the area that is extremely vulnerable to the impact of climate change.

- Third, it is also important to consider how to incorporate adaptation into other policies and development plans. It is crucial to not only integrate climate change adaptation into national development plans and disaster prevention plans of individual countries, but also link it with other international frameworks in fields other than climate change responses, such as disaster prevention.

- Discussions concerning where responsibility lies for implementation of adaptation and cost sharing are also crucial. It is indeed difficult for a country to work alone to respond to climate change. For developing countries, in particular, regional and international cooperation are essential for taking any response measures. When considering the form of cooperation, it is necessary to take country-specific needs concerning adaptation responses, capacity building, and international cooperation into account. Moreover, in designing such adaptation measures, it is essential to make use of each region's local conditions, traditional frameworks for mutual help, and local technologies.

- Finally, based on the needs for the maximum use of the limited resources, it is also possible to include the adaptation components into the existing ODA framework. This allows a country to use ODA more effectively in achieving its objectives.

9. Further Points to Consider in Realizing a Low Carbon Emitting Economy

This section summarizes the points for further consideration by the sub-Committee regarding ways to create a Low carbon emitting economy, with the aim of realizing the ultimate objective of the UNFCCC

9.1 Additional Viewpoints for Consideration

The issue of climate change is the problem that humans will unavoidably have to deal with over the next 100 or more years. Reducing GHG emissions is the most fundamental measure for dealing with climate change, but it is desirable to deal with climate change in a more forward-looking manner, and a more positive attitude adopted in seeking to create a low carbon emitting economy. Also, Japan is expected to take on this issue using a well-defined strategy.

<Establishing a Climate Change Strategy on a Global Scale>

- While climate change is a global-scale issue for the whole world, it is also a national issue. Climate change and the measures taken to combat it presently have, and will have in future, an extremely broad-ranging effect on Japan. Thus, based on an analytical consideration of what kind of impacts Japan will sustain from climate change arising on the global scale as well as from the international framework for promoting measures for reducing GHGs and for adapting to their impacts, and in view of Japan's roles and responsibilities with respect to the international community, together with our own national interest and ability to secure international competitiveness as a technologically-advanced country, Japan needs to deal with this issue using a concrete strategy with clear-cut targets, i.e. short, medium and long-term targets, and a comprehensive vision of how best to achieve these targets and attain international agreements.

<Towards Constructing a Global Scale System>

- Regardless of what long- or mid-term targets are set and distinct from the discussion of those targets, discussion is needed of what kind of processes and social systems will lead to achievement of those targets.

- The necessary trends in system building include a trend towards creating the political will to reform society in accordance with international agreements, and a trend towards incorporating climate change measures into the economic system so that they will progress of their own accord.

<Building a Low Carbon Emitting Economy will Result in a Prosperous Society>

- The issue of climate change is the problem that humans will unavoidably have to deal with over the next 100 or more years. Reducing GHG emissions is the most fundamental measure for dealing with climate change, but it is desirable to deal with climate change in a more forward-looking manner. Implementing environmental measures results not only in protection of the environment, but also has positive effects in the form of energy security, prosperity for new industries, and strengthened international competitiveness due to enhanced technological prowess. In constructing a global-scale system that attracts the participation of not only developed but also developing countries, it is important for Japan to present how to maximize these positive effects to the world.
- Ways need to be devised to make climate change measures incorporated in the context of sustainable development so that the promotion of these measures will contribute to sustainable development. This will allow developing countries to find climate change measures in a more positive way. For example, some developing countries are promoting air pollution measures that can contribute to coping with climate change, and this kind of measures should be promoted even more vigorously in future.

<Usefulness of Japan's Social Vision>

- The kind of strategy Japan aims for will depend on what kind of social vision Japan creates for itself in response to the global-scale climate change issue. At present, in order to meet its target for the first commitment period of the Kyoto Protocol, Japan has established the Climate Change Policy Programs, however, further efforts are being called for to envisage a socio-economic vision for building a low carbon emitting economy over the mid- to long-term.
- By having clear social visions, it becomes possible for Japan to not only construct the domestic infrastructures more strategically but also make well-designed proposals on the forms of the global system.

9.2 Topics for Further Deliberation

- The Sub-Committee for International Climate Change Strategy has identified the following as the points for future deliberation, while continuing to address the points elaborated above.

[Basic Elements for Future Regime]

- Methods for setting specific short, medium and long term targets
- Further analysis of the various international policy options to address climate change
- Concrete methods for canceling the factors obstructing the development and diffusion of relevant technology
- Treatment of the Kyoto mechanisms, and identification of the possibilities for further development of these mechanisms
- Ways to deal with the carbon sinks
- Approaches to the financial mechanisms
- Prospects for systematically internalizing the linking of measures to the combat warming with the economy in a mutually beneficial cycle

[Concerns for Japan]

- Scenarios for realizing a low carbon emitting economy in Japan
- The impacts of various international policy options on Japan and the Japanese Strategies

[Cooperation with Various Stakeholders]

- Roles of local governments, industry, NGOs, etc.
- Possibilities for the cooperation both inside and outside (i.e., countries with reduction obligations and those without them; the parties and the non-parties).
- Prospects for roles of the regional cooperation and other informal processes, and the development of these prospects
- Coordination with official development assistance (ODA) and other forms of the international assistance
- Interlinkage with other major international concerns, such as international peace and security.

etc.

Appendix: Current Status of Countries

When considering the design of a climate regime beyond 2012, it is important to know and understand the stance of countries, and to seek arrangements that enable all countries to participate, and ensure effectiveness and efficiency. This section provides a summary of the status and efforts in selected countries.

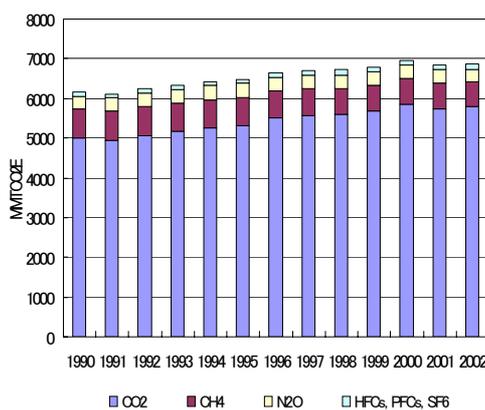
(1) United States

<World's Top Emitter of GHG>

- The United States is the world's top emitter of CO₂, accounting for about one-quarter of the global emissions (see Figure A-1). The national emissions continue to rise year-on-year, and in 2000 were about 11.5 percent above 1990 levels. One driving factor here is population growth. The U.S. population growth rate is considerably higher than in countries such as Japan and the European Union. The emissions increase from this factor is known as "social increase." Examining the details of emissions, one key feature is that the share of emissions from the U.S. transport sector is larger than in countries like Japan.

○

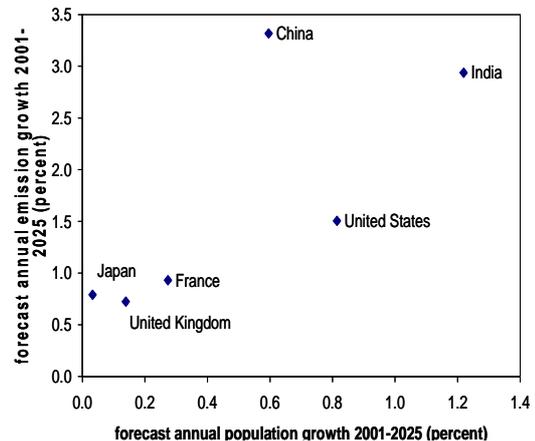
Figure A-1 U.S. GHG Emissions (1990-2002)



Source:

Energy Information Administration (2004) "Emissions of Greenhouse Gases in the United States 2002" Washington DC., available at <http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html>

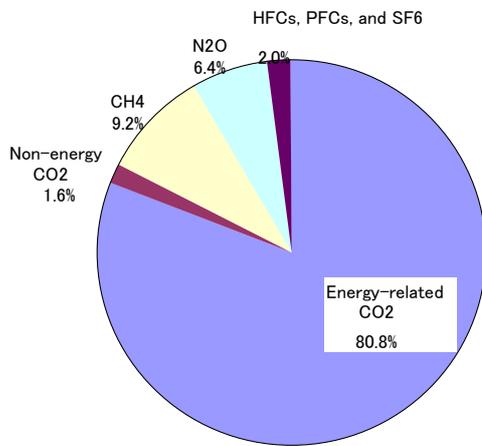
Figure A-2 Emissions and Population Growth in Selected Countries (annual rate, 2001-2025)



Source:

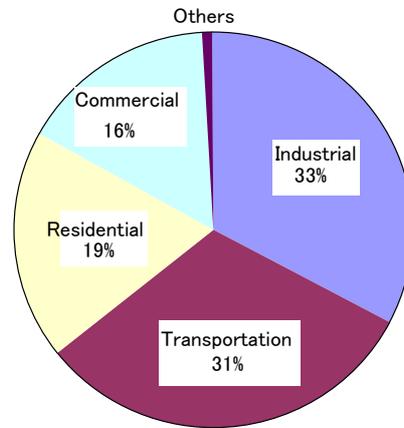
William Pizer, "U.S. Perspectives on Beyond-2012", presented at Open Symposium *International Climate Regime beyond 2012: Issues and Challenges*, Tokyo, October 7, 2003, hosted by Institute for Global Environmental Strategies and National Institute for Environmental Studies.

Figure A-3 Analysis of U.S. GHG Emissions, by Gas (1999)



Total emissions: 6.746 billion

Figure A-4 Analysis of Energy-Related CO₂ Emissions in the U.S., by Sector (1999)



Note: Emissions from electricity generation are allocated

Source: Both graphs from 3rd U.S. National Communication (2002).

<Climate Change Policy of the U.S. Government>

- The United States signed the UNFCCC in October 1992 and is undertaking initiatives based on that framework. With regard to the Kyoto Protocol, however, in March 2001, the Bush Administration announced that it would not participate in the protocol process. Reasons cited were that it would impose serious impacts on the U.S. economy and employment, and that the protocol did not obligate developing countries, including China and India, to make emissions reductions. For the United States to ratify the Kyoto Protocol, it must be approved by a two-thirds majority in the Senate.

- The Bush Administration has created its own climate change policies. These include a target of reducing GHG emissions per unit of GDP to 18 percent below the 2002 level by 2012; voluntary initiatives by industry; and the development of innovative technologies.

Some of the major initiatives are described below.

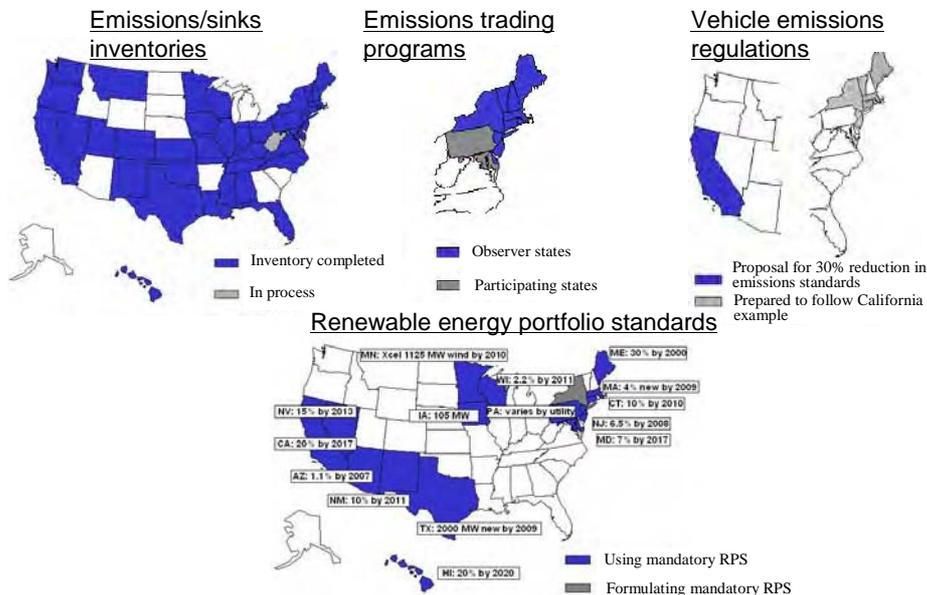
- ① Climate Vision (February 2003): This coordinates the voluntary targets of the Business Roundtable and 12 major industrial sectors (including electric utilities, iron and steel, semiconductors, etc.).
- ② Revisions to 1605(b) Registry (starting 2002): Revised guidelines are being prepared for the Voluntary Reporting of Greenhouse Gas Emissions based on Section 1605(b) of the Energy Policy Act.

- ③ Support for development of innovative technologies; financial assistance for research and development of hydrogen energy (fuel cells); and support of technological development for carbon separation and sequestration.
- Even if the United States achieves the stated target of its own policies, however, an average GDP growth of about 3 percent would still mean that emissions in 2012 will be 30 percent above the 1990 level.
- The U.S. efforts in the international arena are focused on technological development and promotion of activities such as those shown below:
 - Carbon Sequestration Leadership Forum (June 2003),
 - Hosting of Earth Observation Summit (July 2003),
 - International Partnership for the Hydrogen Economy (November 2003),
 - Methane-to-Markets Partnership (July 2004)

<Initiatives by Congress, States, and the Private Sector>

- A variety of initiatives are evident at different levels, including Congress, state governments, and the private sector. At the level of Congress, the McCain -Lieberman Climate Stewardship Act, aiming to introduce a mandatory national cap-and-trade emissions trading system, was voted down 55 to 43 in October 2003, but since then activities towards strengthening national policies have continued, including similar bills being proposed to Congress.
- At the state level, a variety of measures are being taken, including the setting of GHG emissions reduction targets, emissions trading, and measures dealing with GHG emissions from automobiles.

Figure A-5 State-Level Initiatives



Source: Pew Center (2004)

- At the private sector level, progress is being made with climate change initiatives such as the establishment of voluntary emissions reductions targets, and implementation of voluntary emissions trading, etc. Some of these initiatives are described below.

Leading activities by some corporations

Examples: - American Electric Power Co. invests 3.5 billion dollars in emissions reduction technologies, and published a report (August 2004) stating that it would not have been seriously affected even if the McCain –Lieberman Bill had passed.

- DuPont will reduce GHG emissions 65 percent below 1990 levels, and supports implementation of domestic emissions trading.

Emissions trading at the Chicago Climate Exchange

Implementing voluntary GHG emissions trading based on the cap-and-trade approach. At present, 56 entities (including electrical utilities, iron and steel, automobile and chemical industries) are participating, including DuPont and Ford. The market price is at about 90 cents per metric ton of CO₂.

Investors demanding industry to take action

- At shareholders' meetings of electrical utilities and oil companies, shareholders are demanding that measures be taken to address climate change.
- Pensions and other funds are considering climate change initiatives when deciding on investments.

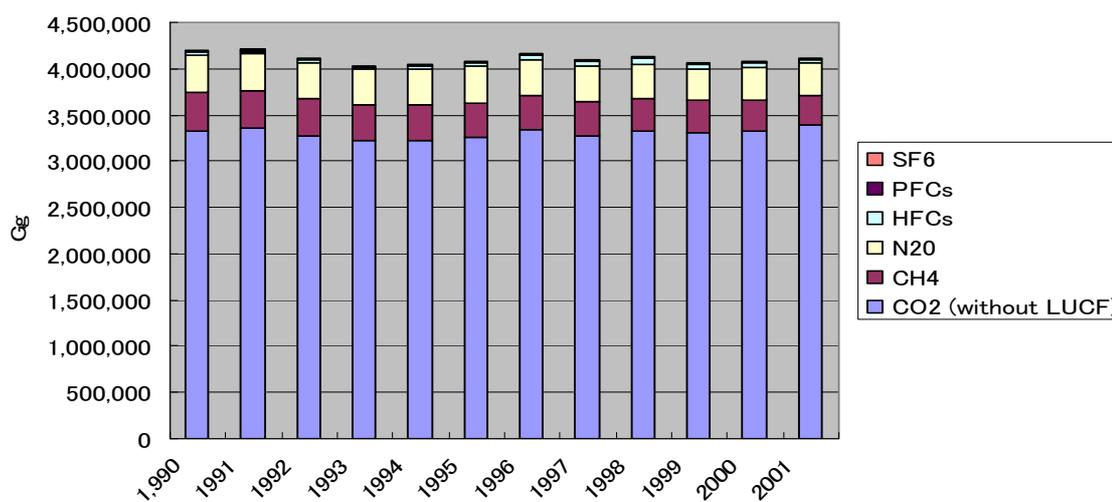
- In some cases, the development and diffusion of these kinds of domestic policies tend to become a precondition domestically for the U.S. government to participate in international framework. Hence, the bottom-up development of these measures might be essential for the active participation of the U.S. to international efforts.

(2) European Union

<Status of the European Union>

- Ten more countries joined the European Union in May 2004, bringing the total to 25 countries. The expanded European Union is roughly equal in economic size to the United States, and it now represents a huge economic zone.
- Regarding GHG emissions, the European Union had already reduced emissions to about 2 percent below 1990 levels by 2001. Major factors in here were the effective emissions reductions by the top emitting countries, including Germany and the United Kingdom.

Figure A-6 European Community GHG Emissions(Gg)(1990-2001,without LCF)



Source: Based on Annual European Community greenhouse gas inventory 1990-2001 and inventory report 2003, EEA

<Climate Change Policies of the European Union>

- The 15 country-European Union ratified the Kyoto Protocol in May 2002. These countries bear the commitment of the overall European Union under the Kyoto Protocol, and they are promoting initiatives in order to meet their commitments through cooperation within the region. As long as the total emissions of the region do not exceed the sum of each country's allocated emissions, the EU will achieve its commitments jointly, based on Article 4 of the Protocol.
- The European Union is introducing a variety of policies and measures across the entire region for achievement of the targets under the Kyoto Protocol. Particularly mention, a European Union-wide emissions trading system will be launched in January 2005, and its development attracts much attention.

Table A-1 Policies and Measures in European Union to Achieve Kyoto Protocol Targets

2000 (Mar.)	Adopted the European Climate Change Programme
2003 (Oct.)	Adopted the EU Emissions Trading Directive
(Oct.)	Adopted the EU Directive on the Community Framework for the Taxation of Energy Products and Electricity Establishes the minimum rates of taxation applicable to energy products when used as motor or heating fuels and to electricity. However, exceptions will be permitted on an interim basis, considering circumstances in each country.
2004 (Feb.)	Adopted the Commission Decision for Monitoring Mechanism of Community Greenhouse Gas Emissions
(Feb.)	Adopted the Directive to promote combined heat and power(CHP)
(Sept.)	Amended Directive Establishing a Scheme for Greenhouse Gas Emission Allowance Trading within the Community, in respect of the Kyoto Protocol's Project Mechanisms is in process

Table A-2. Overview of the EU Emissions Trading Scheme

Item	Details
Trading period	1st period: 1 Jan. 2005 through 31 Dec. 2007 2nd period: 1 Jan. 2008 through 31 Dec. 2012 Thereafter, will be operated in 5-year periods.
Target facilities/ gases	During 1st period, CO2 emissions from facilities involved in energy activities (petroleum refineries, coke furnaces, and combustion facilities over 200 MW other than those that incinerate hazardous waste and urban garbage incinerators), steel production and processing, manufacturing, and other activities (pulp and paper, etc.).
Domestic allocation plans and methods	During each period, each country is to formulate a domestic allocation plan describing total quota amount and allocation method, and publish it to the European Commission and other members. Countries are to allocate 95% of quotas at no charge during the 1st period, and 90% at no charge during the 2nd.
In event of exceeding quota	Pay a penalty of 40 euros per tonne of carbon dioxide equivalent during 1st period, and 100 euros from 2nd period onwards, and must submit the unsubscribed quota during the next period.
Linkage with domestic trading systems outside the EU	Permitted to trade quotas through treaty arrangements.
Linkage with JI/CDM	Permitted to utilize JI/CDM credits.

<Establishment of Medium and Long-Term Targets>

- The European Union is not limiting its efforts simply at participation in the Kyoto Protocol, but also looking further ahead through various initiatives. More specifically, it has agreed to a goal of limiting the global temperature increase to less than 2.0 degrees Celsius compared to before the Industrial Revolution. In addition, some countries (United Kingdom, Germany, France, etc.) have announced medium and long-term targets for CO2 emissions reductions of 45 to 75 percent by the year 2050. (See Table 3.1)

- Especially the United Kingdom, which will host the G8 Summit in 2005, is proposing climate change as one of the key topics for discussion and showing other proactive developments in terms of promoting international efforts.

- British Prime Minister Tony Blair presented a speech on the importance of climate change on 14 September 2004. Selected points from his speech are provided below.
 - Continuing increases in GHG emissions are unsustainable in the long term.
 - The difficulty of dealing with the climate change problem has two aspects: (1) the fact that it is necessary to make political decisions *before* the effect is felt to its full extent, and (2) no one nation alone can resolve it.
 - Prompt responses to the climate change problem are necessary. Now is the time to act.
 - Scientific agreements about climate change already exists.
 - The United Kingdom is on track to meet its Kyoto target. It is also taking on the challenge of reducing CO2 emissions by 60 percent by 2050.
 - There are immense business opportunities in moving to a low carbon economy.
 - It is necessary to invest on a large scale in existing technologies, and to stimulate innovation in the longer term.
 - Nuclear power will not be excluded in order to meet GHG reduction targets.
 - Efforts will be made to promote new schools, new housing and re-invigorating "Local Agenda 21."

(3) Russia and Other Economies in Transition

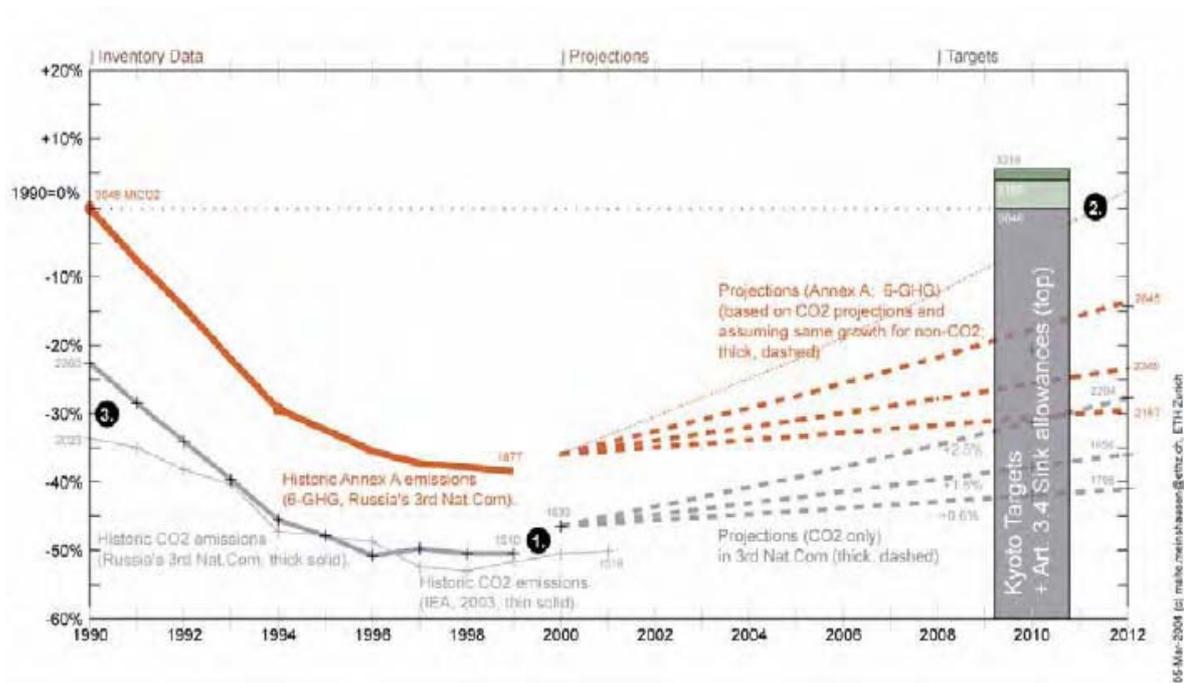
<Russia's Steps Towards Ratification of the Kyoto Protocol>

- On 18 November 2004, Russia deposited an instrument of ratification for the Kyoto Protocol, completing its domestic procedures for ratification. As a result the Protocol will enter into force on 16 February 2005

<The Potential for Surplus Emissions>

- Many emissions prediction models indicate that Russia and many Central and Eastern European economies in transition hold surplus emissions that could be supplied to a carbon credit market (see Figure A-7). They also predict that the amount they could potentially supply is large.

Figure A-7. GHG Prediction Forecasts for Russia



Source: Berk, M.M. and den Elzen, M.G.J. (2004) "What if the Russians don't ratify?", RIVM report 728001028/2004, p.16.

Table A-3. Prediction of GHG Surplus Emissions (5 Years)
in Central and Eastern Europe

Country	Gap Between Business-As-Usual Scenario and Base Year (2008-2012) Mt-CO ₂ e
New EU Members	
Czech Republic	-9.1
Estonia	-76.0
Hungary	-85.0
Latvia	-43.6
Lithuania	-58.2
Poland	-742.8
Slovakia	-8.6
Slovenia	7.0
Total	-1,016.2
EU Member Candidates	
Bulgaria	-335.5
Romania	-476.8
Total	-812.3

Sources: Langrock, T.; W. Sterk and M. Bunse (2004). "Linking CDM and JI with EU Emission Allowance Trading," Institute for European Environmental Policy, p.2.

- A number of concerns existed about carbon credit trading in Russia and other Central and Eastern European countries: (1) the risk that the Kyoto Protocol would not enter into force, and (2) the lack of transparency in the relationship between governments and corporations (provinces) that would be sellers, etc. But even under those circumstances, corporations in Russia for example, were preparing for entry into the carbon business, with the formation of corporate associations such as the Russian Industrialist Corporation Federation, the National Carbon Union (NCU), and the Energy Carbon Fund (ECF). In fact, companies in the western Russian province of Arkhangelsk (population about 1.5 million) based on guidance from the provincial government, placed a bid for JI credits through ERUPT, an international competitive bidding system in the Netherlands. Because the Kyoto Protocol is sure to enter into force, in the

future more of these proactive efforts are likely to appear in Russia and other Central and Eastern European countries.

- On the other hand, however, there are also predictions that the potential supply from Russia and other Central and Eastern European economies in transition may exceed global demand, due to the U.S. rejection of the Kyoto Protocol. For this reason, some have expressed the view that some countries may take strategic action such as supply restrictions and banking into the next period.

<Promotion of Joint Implementation (JI) Projects>

- With the entry into force of the Kyoto Protocol, it is expected that there will be a big jump in project investment based on Kyoto Mechanisms such as joint implementation (JI) and the Clean Development Mechanism (CDM). These initiatives lead to a reduction of GHG emissions, of course, but they are also supposed to contribute to the sustainable development of host countries. For this, developed countries must, at the governmental and other levels, proactively support the formation and implementation of JI projects conducted among the economies in transition in Central and Eastern Europe. As one precondition for this, improvements in host-countries' national institutional capacity such as GHG emissions and sinks inventories are urgently needed. International cooperation is important to achieve those improvements. At present, some countries still do not have adequate inventories of their GHG emissions. It could be expected that, based on experience and success with such JI projects, solid achievements in reduction commitments by these countries will have a positive impact on the design of a climate regime beyond 2012.
- However, because many of the new members of the European Union are the economies in transition in Central and Eastern Europe, as the European Union environmental standards will be taken as the baseline, some people have predicted that the potential for JI is not as big as originally expected. In addition to such circumstances, under the European Union's regional emissions trading market (EU ETS) which is planned to be introduced in 2005, a proposal has been made to prevent double-counting, by canceling EAUs (EU Allowance Units) in the event that a participating company conducts a JI project (although at the moment the methodology has not yet been fully established). Accordingly, the potential for JI may shrink even more with the introduction of EU ETS.

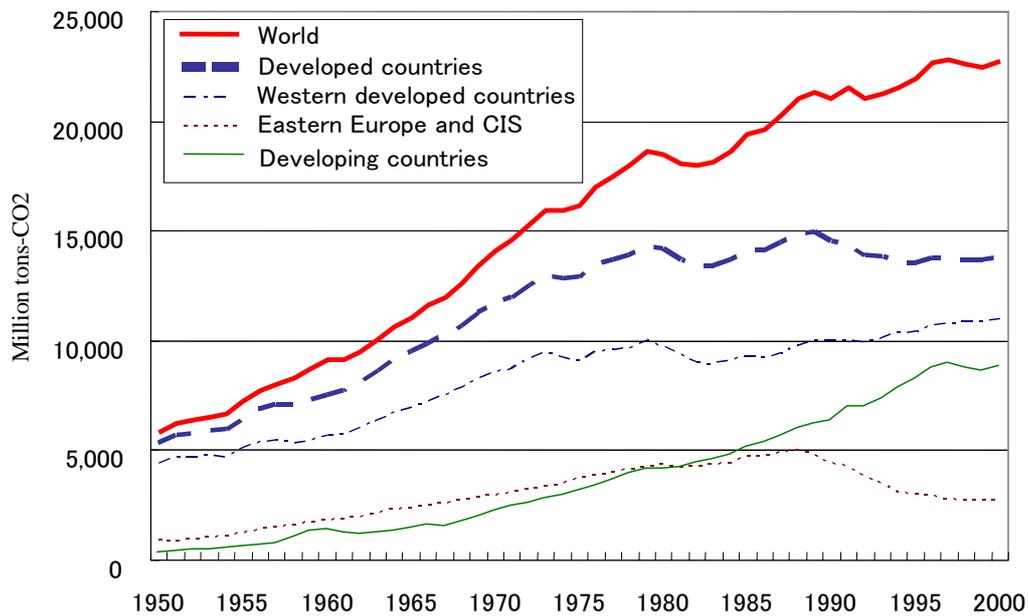
- Meanwhile, over concerns such as about (1) risks and transaction costs of JI projects, and (2) the lack of transparency involved in routine emissions trading, there has been some consideration of arrangements to ensure environmental integrity by making it mandatory to reinvest the proceeds from the sale of emissions allowances into GHG emission reductions projects. One example of such a scheme is the Green Investment Scheme (GIS, also known as Green AAU).

(4) Developing Countries

<Emissions Trends in Developing Countries>

- The emissions per capita in developing countries is still only a fraction of what it is in developed countries, However, almost 2 billion people, most of them are in developing countries, still live in the areas that do not have electricity.
- However, due to increasing emissions associated with the economic growth and growing populations, GHG emissions from developing countries have steadily increased over the past few decades. Indeed, since the growth rate of the emissions from developed countries peaked in the 1980s, most of the recent increases of GHG emissions have attributed to developing countries.

Figure A-8. Emissions Trends Since 1950



Source: Oak Ridge Institute

- Meanwhile, for the future, many emissions prediction models indicate that total developing (non-Annex I) country emissions will surpass developed (Annex I) country emissions some time between 2030 and 2050. (see Figure 1.3). For example, even counting China alone, the future emissions are predicted to increase considerably (Table A-4).

Table A-4. Predicted CO₂ Emissions from China under Various Economic Models

Units: Mt-C

Source	1990	2000	2010	2020
ADB (1998)	567	915	1320	1695
CASS (2000)	NA	841	1090	1330
EIA (2003)	617	780	1109	1574
IEA (1998)	657	NA	1450	1929
World Bank (1994)	650	987	1512	2045
Zhang (1997)	587	899	1441	NA

Source: Zhang, Z. X. (2004). "Towards an Effective Implementation of CDM Projects in China," East West Center. (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=555906), p.11

<Critical Policy Issues for Developing Countries>

- For developing countries, the improvement of the energy efficiency becomes the top priority issue from the perspective of reducing energy-related costs, improving the productivity, and securing the energy security. These efforts will make a large contribution to the reduction and limitation of GHG emissions as well as to the reduction of emissions of atmospheric pollutants.

<Developing Countries and the CDM>

- Many developing countries are making preparations for the Clean Development Mechanism (CDM), which was introduced under the Kyoto Protocol.
- For example, the Indian government is extremely supportive of the CDM, and has already

formulated standards to evaluate CDM proposals based on contribution to “sustainable development,” and “consistently with development objectives.” Partly due to the impact of government arrangements such as these, according to a World Bank study (Lecocq, 2004), three countries (India, Brazil and Chile) accounted for 56 percent of all JI/CDM proposals since 2001, and if Romania and Indonesia are included, these top five countries account for two-thirds. Of 23 international competitive tenders from the government of Finland in the spring of 2003, twelve went to India. According to CDM Watch (2004), among 112 CDM candidate projects whose PDD is available as of 5 November, 21 were in India, and here too India ranked first (followed by Brazil, at 17 projects).

- In China, workshops are being organized proactively under the initiative of the Chinese government, and there is now a website dedicated to the CDM (<http://cdm.ccchina.cn/>), as well as a CDM newsletter. The Interim Measures for Operation and Management of Clean Development Mechanism Projects in China was promulgated at the end of June 2004. Memorandums of understanding (MOUs) have already been signed with Austria, Denmark, Finland, Germany, Italy, and Netherlands (project base), and progress is being made on a credit trading agreement with the World Bank’s Prototype Carbon Fund.
- Meanwhile, some issues remain regarding the CDM, include the following: (1) uneven distribution of host countries (i.e., very few from Africa), (2) low prices for credits, (3) high transaction costs and risks, (4) difficulty of confirming that a project contributes to a host country’s sustainable development, and (5) competition with other carbon credits.