Ministry of the Environment
Japan

Report of Discussions on International Climate Change Strategy

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

Report of Discussions on
International Climate Change Strategy

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Report of Discussions on International Climate Change Strategy (Summary)

Preface

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.

In order to collect and organize the materials needed to put the considerations in the Interim Report into more concrete terms, the Committee set up an expert committee to consider Japan's international climate change strategy and began its discussions in April 2004. This "Report of Discussions" was compiled to sum up the progress in discussions up to this point, in order to help promote and guide further discussion in the expert committee.

1. The Goal in Addressing Climate Change

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 lead to various stabilization levels of GHG concentrations can be described. It should be noted, however, that even after emissions have been reduced, CO_2 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 Consensus on Stabilization Levels of GHG Concentrations

- In setting specific numerical targets that correspond to the UNFCCC’s ultimate objective, 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.

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 Building a Global System to Initiate an Emission Reduction Trend by 2050 at the Latest

- Various CO_2 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 CO_2 emissions must enter a downward trend between 2020 and 2030.
- The important question is what type of global system will be established in the next 10 to 20 years. The scientific background necessary for making the relevant decisions is already available, and realizing the establishment of a global system now depends on political decision-making.

2.5 Two Types of Measures; Mitigation and Adaptation

- Mitigation measures –reducing GHG emissions and enhancing CO_2 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 of damage from climate change given 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

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 Society Designed to Address Climate Change

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. Further Points to Consider in Creating a Society Designed to Address Climate Change

The issue of climate change is one that humankind will unavoidably have to deal with over the next 100 or more years. Thus, it would be best if this issue could be dealt with in a more forward-looking manner, and a more positive attitude adopted in seeking to create a society designed to address climate change. Also, Japan is expected to take on this issue using a well-defined strategy.

Preface

<"Climate Regime Beyond 2012: Basic Considerations" Interim Report of the Global Environment Committee of Japan's Central Environment Council>

○ 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).

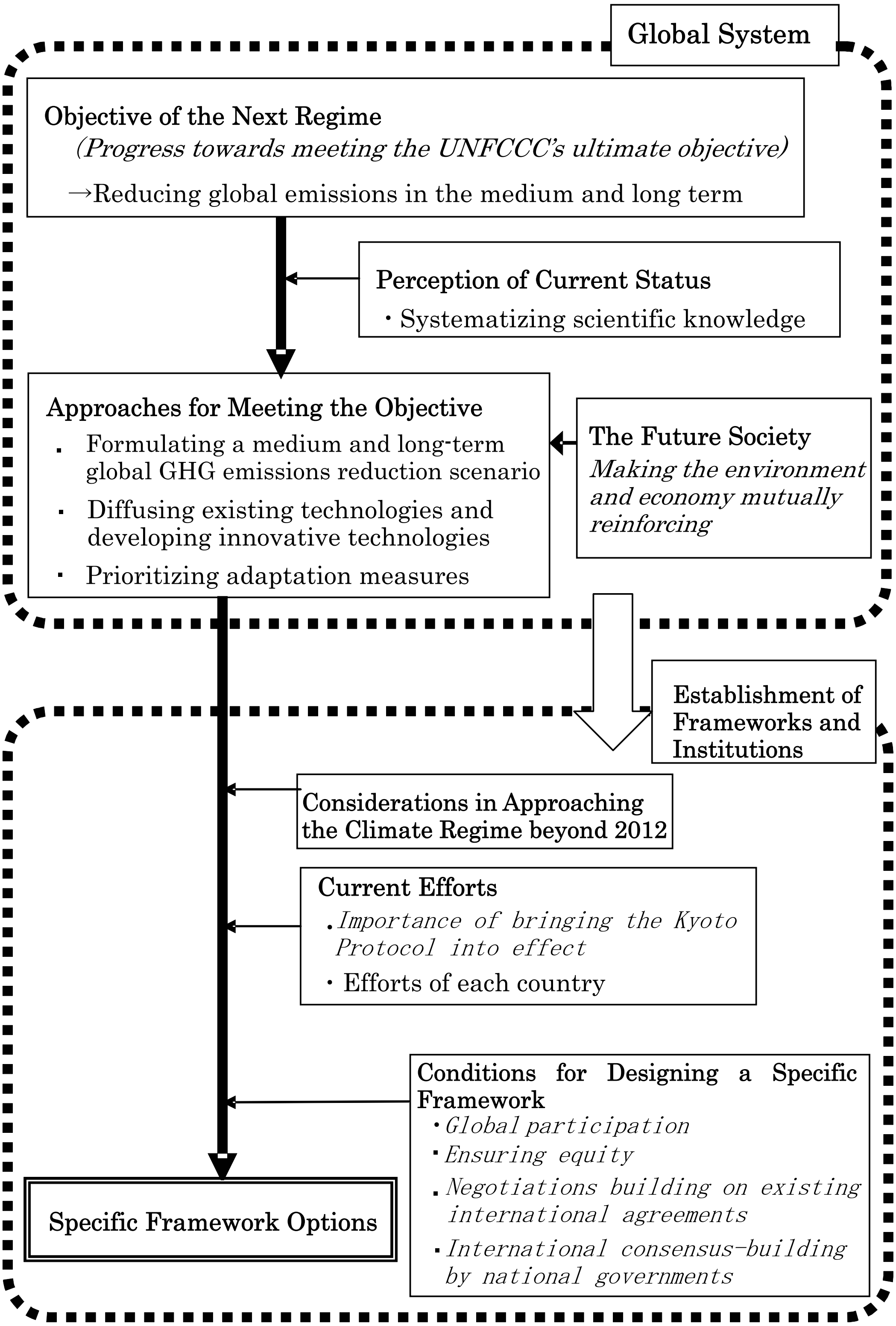
The first category addresses what a global system should be like. Legally, the goal of coping with climate change is supposed to aim at achievement of the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC). Because this objective is qualitative in nature, the issue 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 "Summary of Discussions" was compiled to sum up the progress in discussions up to this point regarding a global system for taking measures to address climate change, in order to help promote and guide further discussion in the sub-committee.

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"

1. The Goal in Addressing Climate Change

It is important to make progress towards meeting the ultimate objective of the UNFCCC, the goal in addressing climate change. This part sums up the discussion regarding how this goal is to be realized 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 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."

<The Goal in Addressing Climate Change >

○ The goal of measures to address climate change is stipulated in the UNFCCC, which is now in effect with the participation of most countries in the world, including the United States of America and many developing countries. Achieving the UNFCCC’s ultimate objective 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.

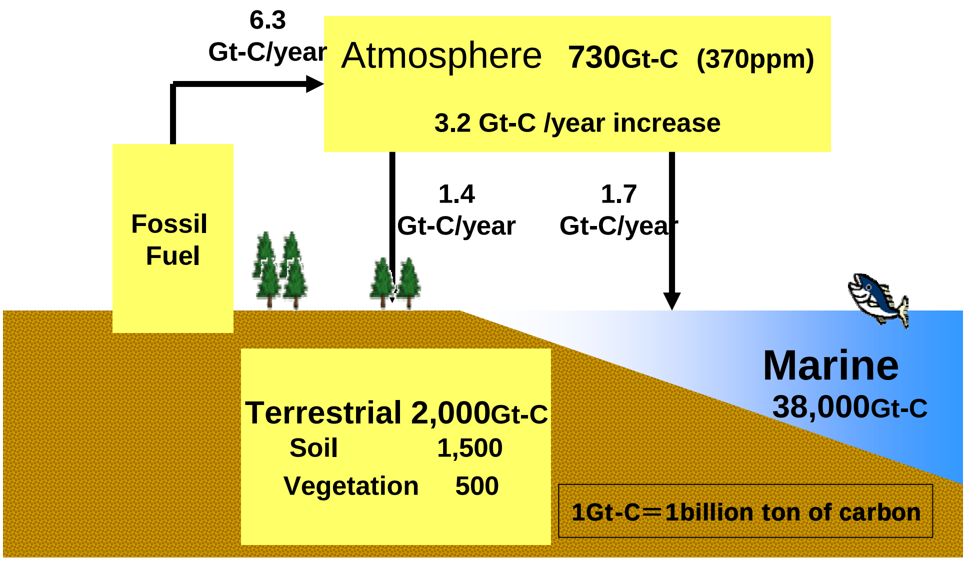
<Reaching an Equilibrium between GHG Emissions and Global Sink Capacity>

○ "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 (CO_2) emissions from fossil fuel combustion amount to 6.3 billion tons of carbon equivalent annual, 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).

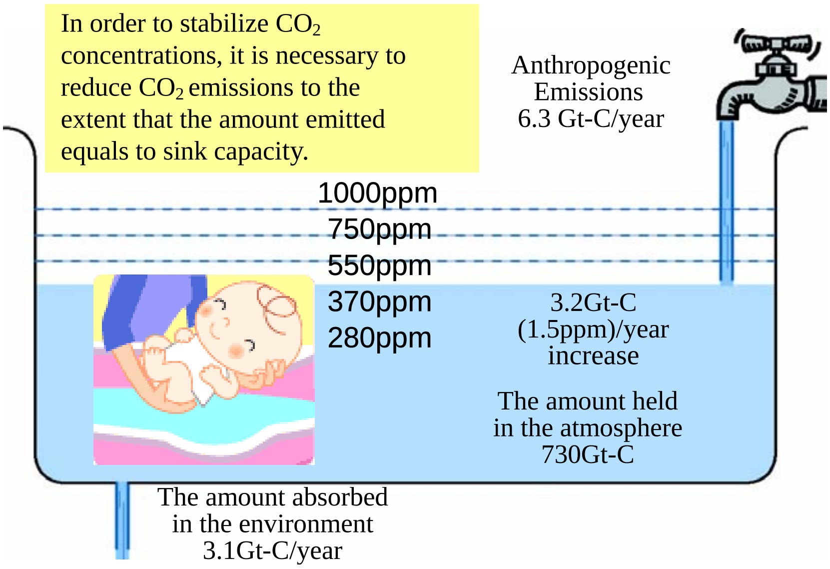
Figure 1.1 The Estimated Global Carbon Balance



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

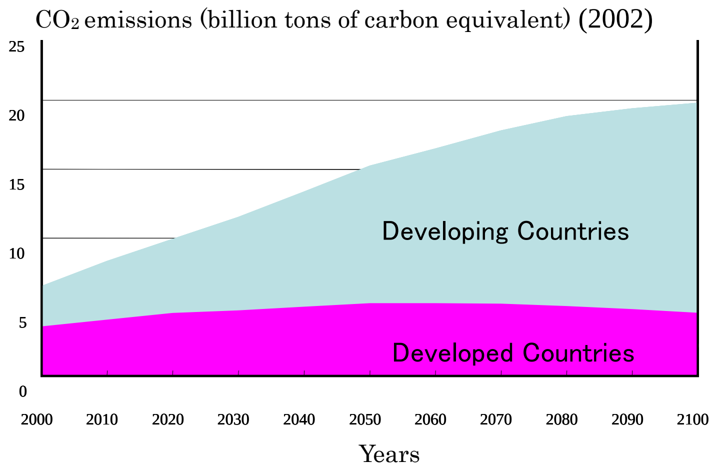
○ Due to past CO_2 accumulations, concentrations of atmospheric CO_2 rose from 280 parts per million (ppm) in 1750, prior to the Industrial Revolution, to 368 ppm in 2000. Figure 1.2 shows that, in order to stabilize atmospheric CO_2 concentrations by attaining an equilibrium between anthropogenic CO_2 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 CO_2 Concentrations



○ However, it is estimated that CO_2 emissions will further increase from fossil fuel combustion. Figure 1.3 shows estimated global CO_2 emissions. It indicates that future emissions from developing countries in particular will greatly increase.

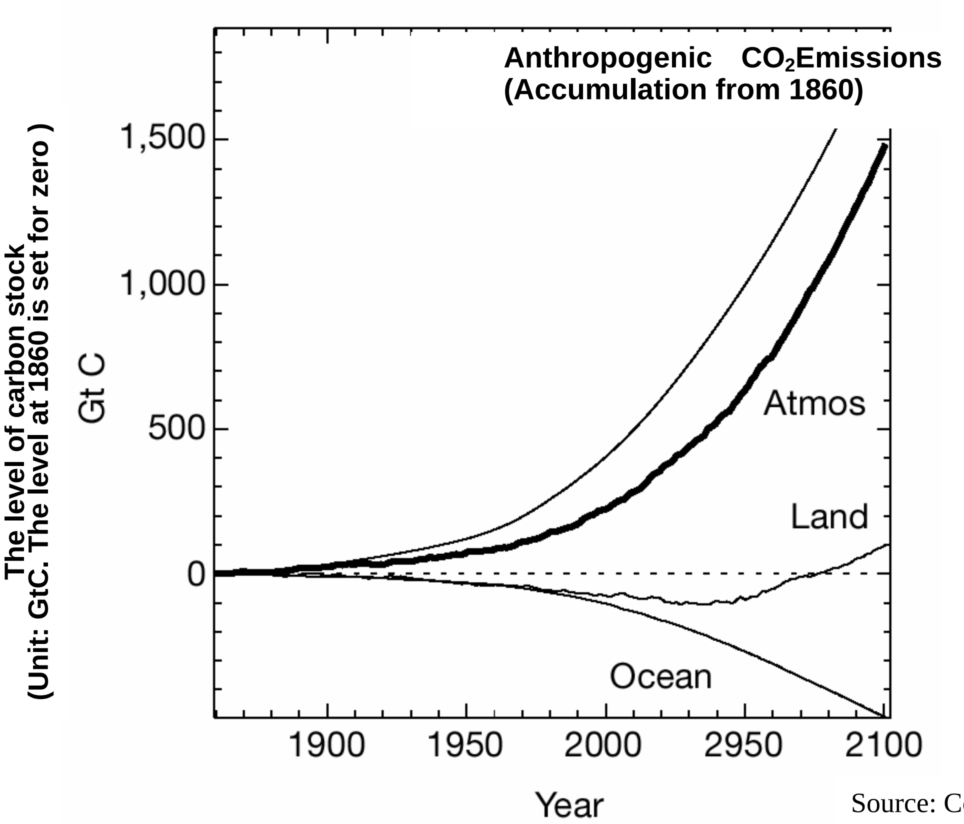
Figure 1.3 Prediction of future CO_2 emissions



Source: Kainuma, et al. (2002)

○ The global capacity of sinks changes depending on the level of atmospheric CO_2 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. Some research estimated that increased temperature 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 et al. (2000)

<Typical Case of Unsustainable Development>

○ We human beings are currently emitting twice as much CO_2 as can be absorbed given the global carbon sink capacity so atmospheric CO_2 concentrations are increasing. Some research estimates that anthropogenic CO_2 emissions will continue to rise for the next hundred years, while the global CO_2 sink capacity will decrease due to increased temperature. This would accelerate an increase of atmospheric CO_2 concentrations and further climate change, leading to large-scale climate change. This is a typical case of unsustainable development.

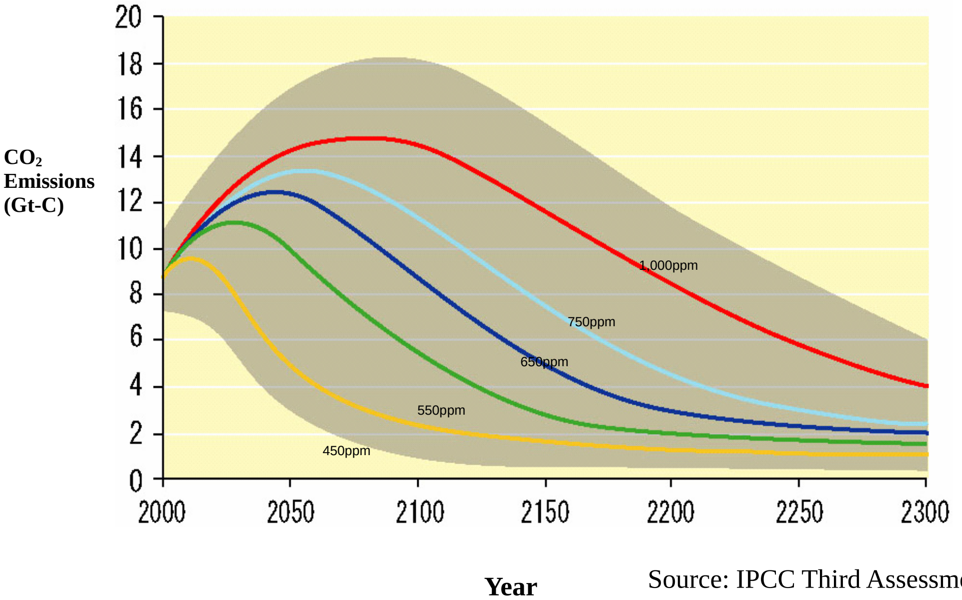
1.3 Stabilization Levels of GHG Concentrations

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, CO_2 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 CO_2 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 CO_2 emissions corresponding to these concentration levels. The shaded part indicates uncertainty regarding the relationship between the amount of CO_2 emitted and the CO_2 concentration; specifically, uncertainty regarding CO_2 sink capacity of the land and ocean. Because there are greenhouse gases other than CO_2, concentrations of these also need to be taken into consideration with regard to the stabilization of GHG concentrations.

Figure 1.5 Changes in Global CO_2 Emissions Corresponding to Different Stabilization Levels



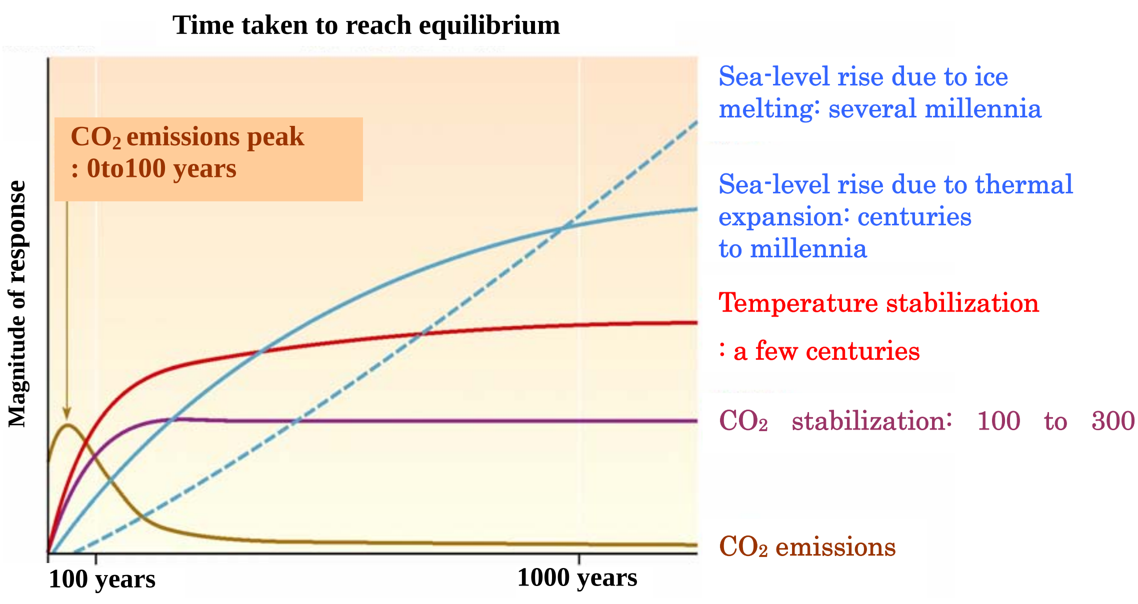
Source: IPCC Third Assessment Report (2001)

<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 will be 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 CO_2 emissions, stabilization of CO_2 concentrations, stabilization of temperature, and sea-level rise. Even if global CO_2 emissions are successfully reduced during the next 100 years, CO_2 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 CO_2 Emissions, CO_2 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 economy and policy, etc., than of science alone, 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 10-20centimaters 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 predicted in Japan include a one-meter sea level rise, which will lead to the loss of more than 90 percent of its beaches. 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

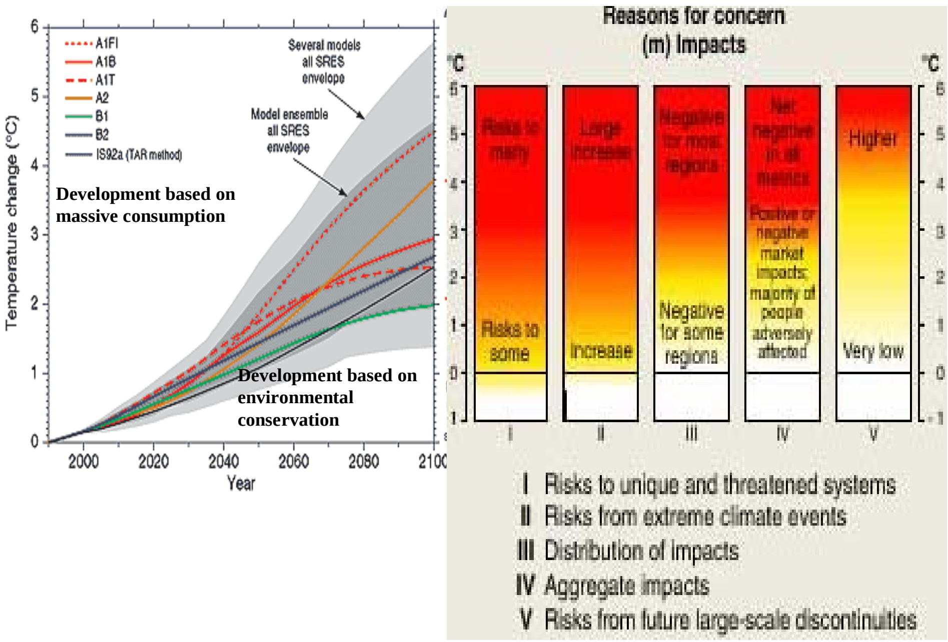
<The Relationship between Temperature Rise and Impact Risks>

○ The IPCC Third Assessment Report looks at how the scale of temperature increases will affect the level of risks for five factors and in accordance with various future socio-economic development scenarios (see Figure 1.7). This two-part Figure shows that a small increase in temperature may bring about climate change that could have positive impacts on some regions and in some areas of concern, but that the risks of climate change will increase with greater temperature increases. If temperature rises two degrees Celsius over the next 100 years, the distribution of negative impacts will begin to extend to most regions of the world.

<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 vis a vis 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

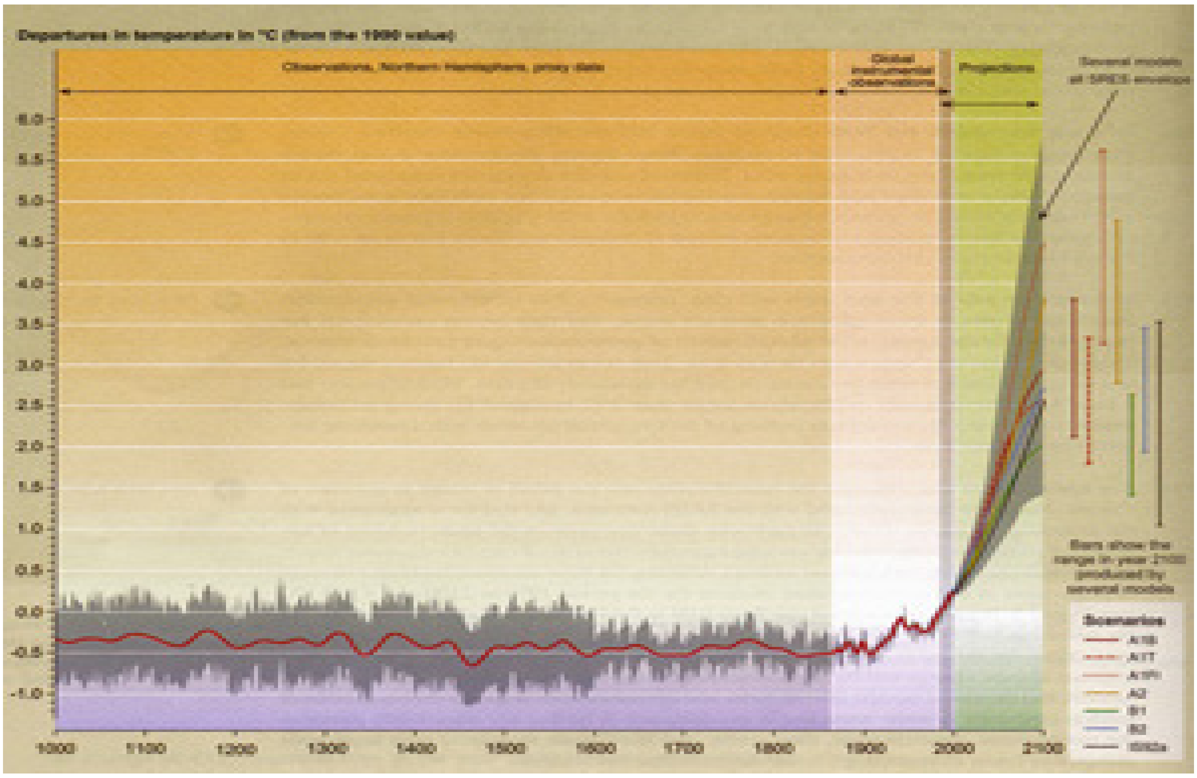


Source: IPCC Third Assessment Report (2001)

<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 temperature rise that is drastic compared to 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.

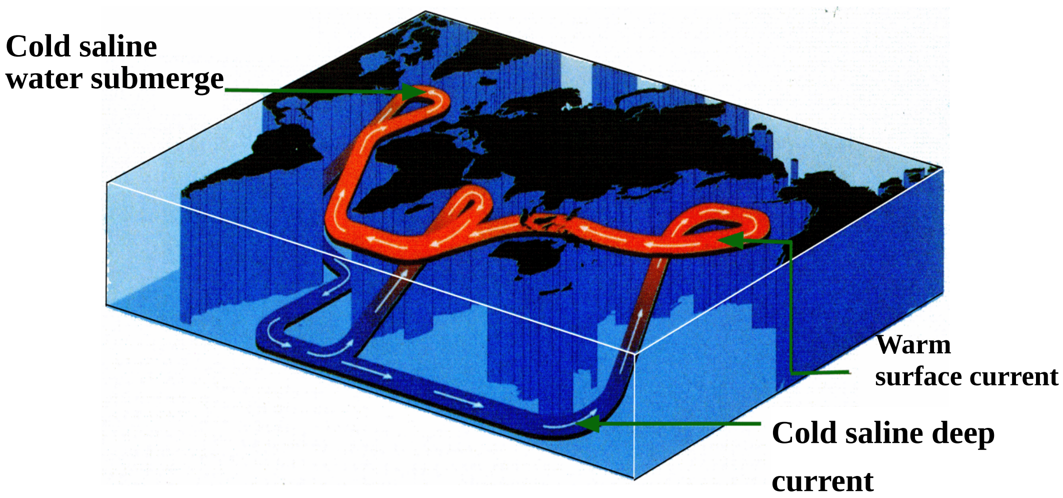
○ In particular, much concern has been expressed recently that the frequent extreme weather events now happening around the world, such as drought and abnormally high temperatures, might be part of climate change. It is necessary to compile and analyze observation data that may have a bearing on future 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 describes the discussions held about what kind of approaches the international community at large should take, and what kind of pre-conditions and issues need to be considered in seeking to achieve the ultimate objective of the UNFCCC.

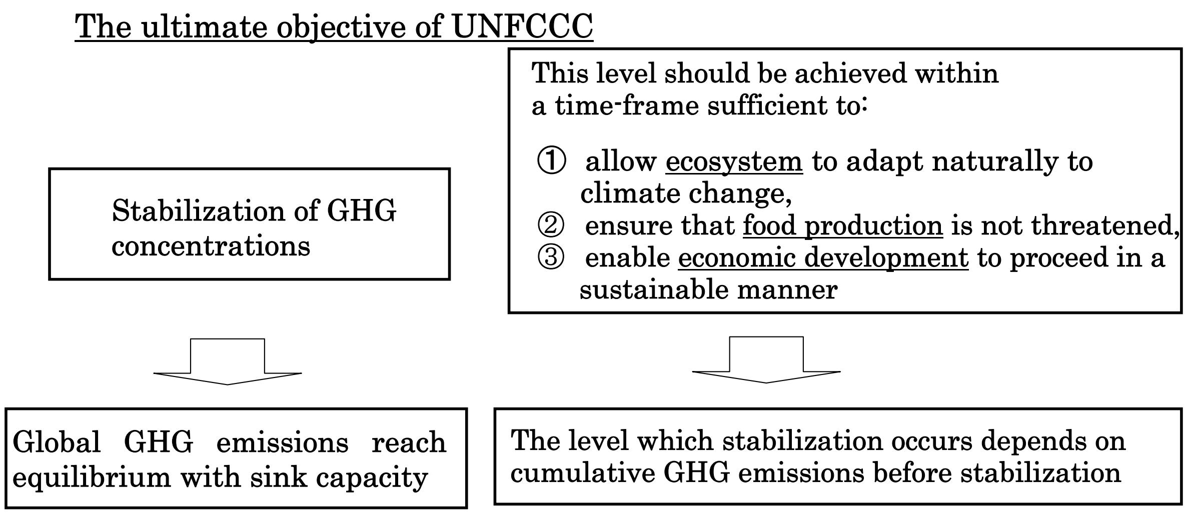
2.1 International Consensus on Stabilization Levels of GHG Concentrations

- In setting specific numerical targets that correspond to the UNFCCC's ultimate objective, 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 Consensus 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 the UNFCCC



○ However, numerical targets for GHG concentration levels are not specified in the Convention, and the international community has not yet reached consensus 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 consensus 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 CO_2 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	・Rise of global mean temperature by 1.5℃ ・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	・Rise of global mean temperature by 4.0℃ ・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

	・Unknown but probably low risk of large-scale high-impact events	・Probable medium risk of large-scale high-impact events
550ppm	・Rise of global mean temperature by 2.0℃ ・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	・Rise of global mean temperature by 5.0℃ ・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	・Rise of global mean temperature by 3.0℃ ・Moderate impacts to unique and threatened systems ・Probable moderate increase in extreme climatic events ・Approximately even balance between regions experiencing negative Impacts ・Positive and negative impacts on market ・The majority of people adversely affected ・Unknown but probably medium risk of large-scale high-impact events	・Rise of global mean temperature by 7.0℃ ・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.

<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 type of equity issue exists between large GHG emitters and the countries that are more seriously affected by climate change. The emitters that are causing climate change and the countries that only suffer its impacts are not necessarily the same countries.

○ The five largest CO_2 emitters, the United States of America, China, Russia, Japan, and India, account for more than half of global CO_2 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).

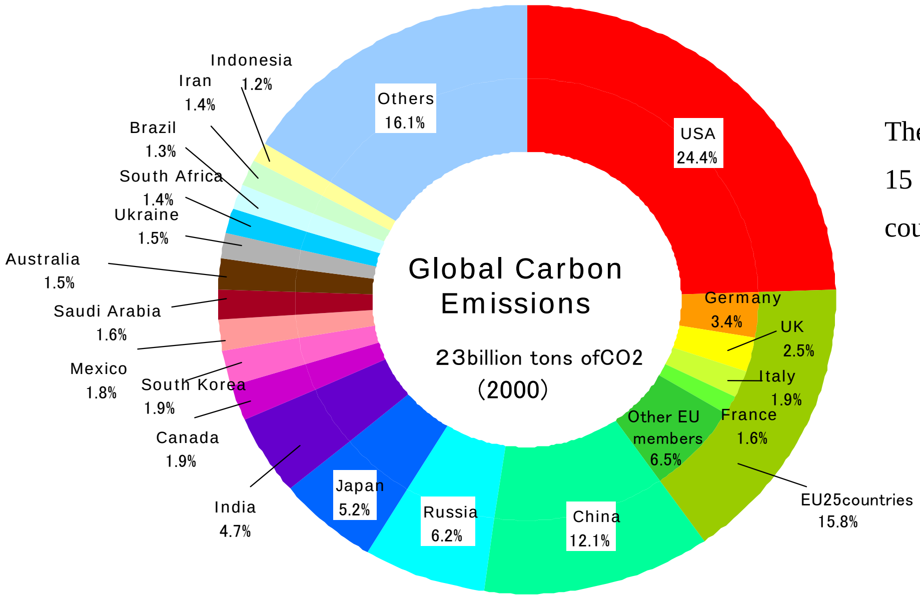
○ On the other hand, the total CO_2 emissions of the least developed countries that fall under any of the categories of countries that are "vulnerable to the adverse effects of climate change," as defined in the UNFCCC,(totaling 48 countries), account for only 0.46 percent of global CO_2 emissions. Even when emissions from other countries that are members of the Alliance of Small Island States

(AOSIS) are added (totaling 77 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 that all countries of the world have become more interdependent, however, GHG emitting countries are also affected by climate change. For example, Japan has a low food self-sufficiency ratio and will be indirectly but very significantly affected if climate change affects agriculture in other countries. In the ongoing development and liberalization of world trade, countries are becoming more interdependent, and the impacts of climate change are becoming important issues in the context of food security. In addition, large GHG emitters that are insufficiently prepared for adaptation to impacts will suffer heavy damage when they are hit by extreme weather events.

Figure2.2 Breakdown of World CO_2 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 CO_2-Emitting Countries

			Emissions (million tons of CO2)	Share	Per capita emissions (tons of CO2/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	Brazil		307	1.3%	1.83
15	Iran		310	1.4%	4.88
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	**(Africa)**	
	Angola	Tanzania
	Benin	Zambia
(2) Countries with low-lying coastal areas	Burkina Faso	Liberia
	Burundi	
	Central African Republic	
(3) Countries with arid and semi-arid areas, forested areas and areas liable to forest deterioration	Chad	**(Asia)**
	Congo	Afghanistan
	Djibouti	Bangladesh
	Equatorial Guinea	Bhutan
	Eritrea	Cambodia
(4) Countries with areas prone to natural disasters	Ethiopia	Laos
	Gambia	Myanmar
	Guinea	Nepal
	Guinea-Bissau	Yemen
(5) Countries with areas prone to drought and desertification	Lesotho	
	Madagascar	
	Malawi	**(Small island countries)**
	Mali	Cape Verde
(6) Countries with areas of high urban atmospheric pollution	Mauritania	Comoros
	Mozambique	Haiti
	Niger	Kiribati
	Rwanda	Maldives
(7) Countries with areas of fragile ecosystems, including mountainous ecosystems	Senegal	Samoa
	Sierra Leone	Sao Tome and Principe
	Sudan	Solomon Islands
	Togo	Tuvalu
	Uganda	Vanuatu
	Other AOSIS members (23 countries)	
	Antigua and Barbuda	Micronesia
	Bahamas	Palau
	Barbados	Papua New Guinea
	Belize	St. Kitts and Nevis
	Cuba	St. Lucia
	Dominica	St. Vincent and the Grenadines
	Fiji	
	Grenada	Seychelles
	Guyana	Singapore
	Jamaica	Suriname
	Marshall Islands	Tonga
	Mauritius	Trinidad and Tobago

- Every least developing country belongs to one or more categories of countries vulnerable to the adverse effects of climate change. The total CO_2 emissions of these 48 least developing countries amount to 104.71 million tons of CO_2 equivalent (accounting for 0.46 percent of global emissions).
- CO_2 emissions of the least developing countries and other AOSIS member countries total 247.29 million tons of CO_2 equivalent (accounting for 1.1 percent of global emissions).
- The above calculations based on data from the Oak Ridge National Laboratory (USA)

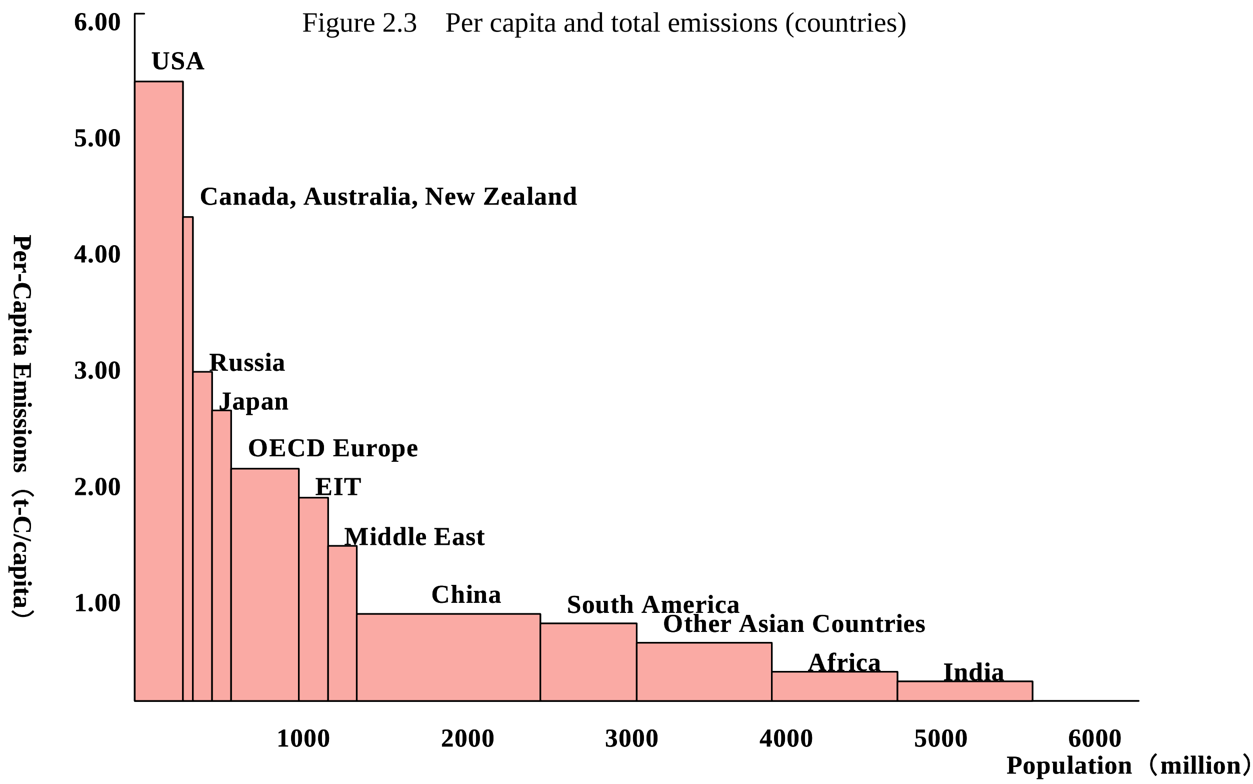
<The generation now taking action and the generations that will be affected in future>

○ The second type of equity issue exists between generations. The climate change issue is one in which GHGs 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 the largest share of historical and current global emissions of GHGs originated in developed countries and that per capita emissions in developing countries are still relatively low, as is stated in the preamble of the UNFCCC.

Figure 2.3 Per capita and total emissions (countries)



Source: Benito Muller (2003)

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.

<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.

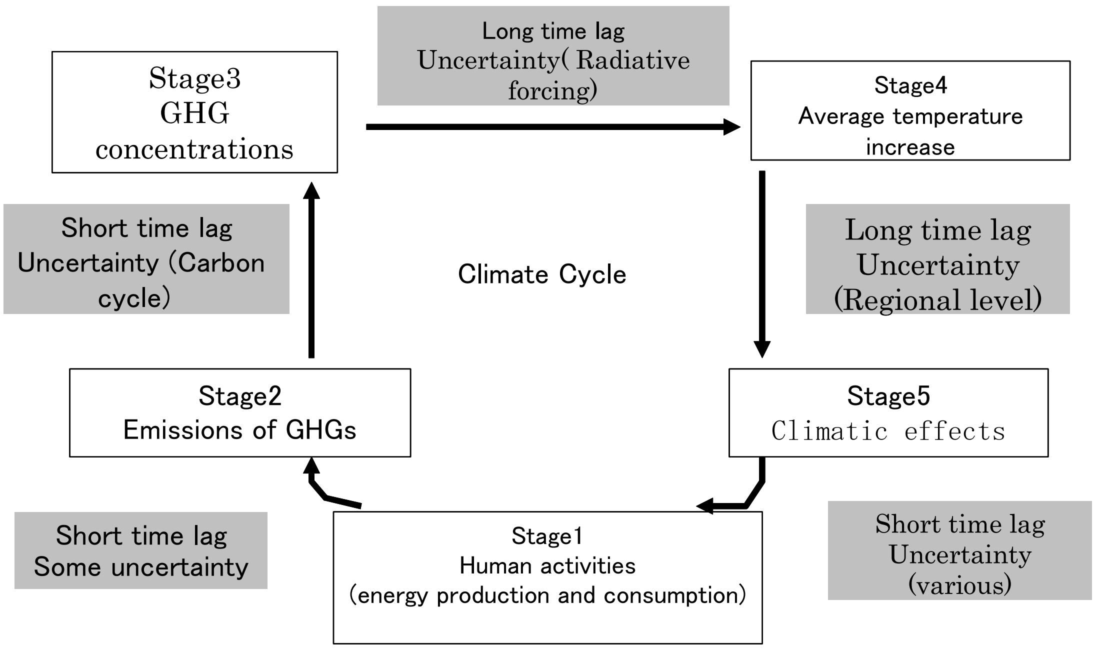
○ Coping with climate change will also mean determining what to do now to reduce future damage. Should GHGs continue to increase, we need to consider to what extent climate change will occur and how probable those changes are, as well as what impacts will occur. In other words, the question is how to manage environmental risks on a global scale.

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

○ The ultimate objective of the UNFCCC is stabilization of GHG concentrations. With respect to what specific levels should be set, these are expressed as "Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" in the Convention, which also describes them in terms of impacts on ecosystems, agricultural production, sustainable development, etc.

○ 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 and Tudela (2003)

○ 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 consensus. 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. Please note that the uncertainties listed in Figure 2.4 indicate scientific uncertainties.

<Accumulation of Scientific Background Knowledge and Uncertainty in the Choices of the International Community >

○ The systematic accumulation of scientific observation and knowledge has been reducing scientific uncertainty in predictions relating to 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 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. Uncertainty about social choices, however, has not yet been overcome, and uncertainty in making predictions about climate change is to a great extent contingent on uncertainty in making 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 it is governments that make these judgments, it is best if they do so while conducting dialogue and cooperating with various stakeholders

2.4 Building a Global System to Initiate an Emission Reduction Trend by 2050 at the Latest

- Various CO_2 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 CO_2 emissions must enter a downward trend between 2020 and 2030.
- The important question is what type of global system will be established in the next 10 to 20 years. The scientific background necessary for making the relevant decisions is already available, and realizing the establishment of a global system now depends on political decision-making.

<Building a Global System that will Enable Global Emissions to Enter into a Reduction Trend between 2020 and 2030>

○ While science plays a role in providing information for humans to make social choices, all humanity already shares the knowledge that continuing increase in CO_2 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 CO_2 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 CO_2 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, humankind in future will survive as a carbon-constraint society.

Table 2.4 Relationships between CO_2 emissions and CO_2 concentration stabilization levels

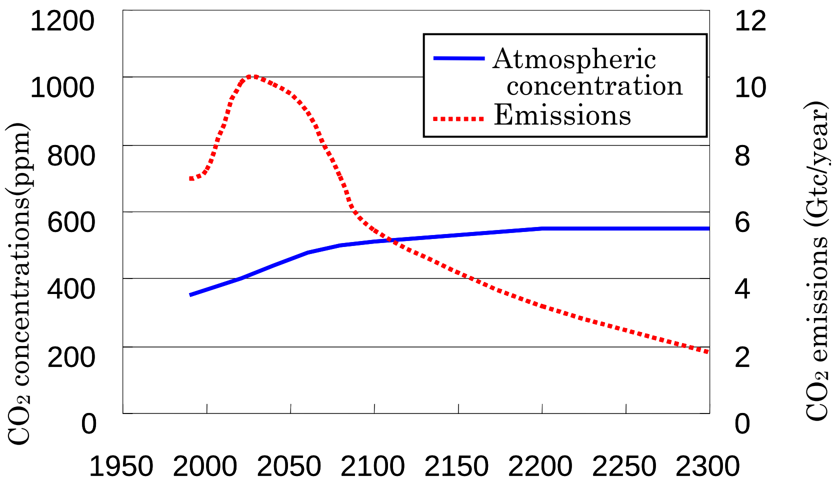
Eventual CO_2 stabilization level	Time of stabilization	Mean surface temperature change by 2100 (average)	Mean surface temperature change at equilibrium (Average)	CO_2 emissions (billion tons of CO_2/year)		Timeframe for peak annual emissions in order to reach the indicated stabilization level
				2050	2100	
450ppm	2090	1.2-2.3℃ (1.8℃)	1.5-3.9℃ (2.5℃)	3-6.9	1-3.7	2005-2015
550ppm	2150	1.6-2.9℃ (2.2℃)	2.0-5.0℃ (3.5℃)	6.4-12.6	2.7-7.7	2020-2030
650ppm	2200	1.8-3.1℃ (2.5℃)	2.4-6.1℃ (4℃)	8.1-15.3	4.8-11.7	2030-2045
750ppm	2250	1.9-3.4℃ (2.6℃)	2.8-7.0℃ (4.6℃)	8.9-16.4	6.6-14.6	2040-2060
1000ppm	2375	2.0-3.5℃ (2.7℃)	3.5-8.7℃ (6℃)	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 CO_2 emissions and concentrations given the goal of stabilizing concentrations at 550 ppm. It shows that stabilizing atmospheric CO_2 concentration will require continual reductions of CO_2 emissions even after initially reaching the stabilization level.

Figure 2.5 Example - Course of Stabilization at 550 ppm



Source: Calculated from the AIM model

<The Next 10-20 Years will be Vital in Initiating a Global Emission Reduction Trend>

○ If the stabilization level of atmospheric CO_2 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 CO_2 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 a long period of time, but in order to meet the ultimate objective of the UNFCCC, we need to think about what measures the international community should take in the period from 2010 to 2030, that is, what kind of global system we should establish over the next 10 to 20 years. The scientific background needed for that decision is already available, and its application now depends on political decision-making.

○ The first implementation period of the Kyoto Protocol ends in 2012. 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.

2.5 Two Types of Measures; Mitigation and Adaptation

- Mitigation measures –reducing GHG emissions and enhancing CO_2 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 of damage from climate change given insufficient adaptation should be taken into account as well as the costs of emission reduction measures.

< Mitigation as the Fundamental Measures>

○ The fundamental measures for addressing climate change are mitigation; reducing GHG emissions and enhancing CO_2 sinks. Especially because the top 40 countries account for 84 percent of global CO_2 emissions, a system for GHG emission reduction by these countries should also be built as well as with a global system for 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 at the same time as 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.

(Note)
Mitigation: reduction of anthropogenic GHG emissions or enhancement of CO_2 sinks
Adaptation: adjustment to the impacts of climate change (moderation or prevention of 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 CO_2 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 GHG reduction in order to mitigate climate change. However, because a certain level of impacts is unavoidable, the costs of impacts when they happen, of measures to avoid or minimize impacts, and of compensation for damage from impacts should also be examined.

○ Adaptation costs 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 adaptation costs, including compensation, with the costs of reducing greenhouse gases, there needs to be sufficient discussion of 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 negative impacts from climate change, care should be taken not to underestimate adaptation costs. At the same time, bearing in mind that the fundamental measures are reduction of GHG emissions, the cause of climate change, it should be noted that the implementation of adaptation measures in negatively-impacted countries does 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

This section describes the discussions held 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 consensus has 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 consensus 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 consensus.

<Long, Medium and Short-term Targets>

○ Long-term targets are the embodiment of the ultimate goal under the UFCCC, 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 impacts

There is a time lag between stages as well as differences in levels of uncertainty.

○ Short-term targets require specific commitments, and apply to a time range extending to about 2020. At present, reduction commitments under the Kyoto Protocol correspond to the definition of short-term targets, although they have not been set for anytime beyond 2012.

○ 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 are in the form of atmospheric GHG concentrations, for example a target of stabilizing CO_2 concentrations at 450 / 550 ppm or less and concentrations of all GHGs at 550 ppm (equivalent to CO_2 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 reducing global GHG emissions to 3 billion tons of carbon equivalent.

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)	・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 CO_2 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.	・Limit per capita CO_2 emissions to 0.5 tC (by 2050). ・Reduce global emissions to 3 billion tC (by 2050).
Sweden (Nov. 2002)	Swedish Environmental Protection Agency	Stabilize atmospheric concentrations of all GHGs at 550 ppm (CO_2 concentrations at 500 ppm or less).	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 held 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 CO_2 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>

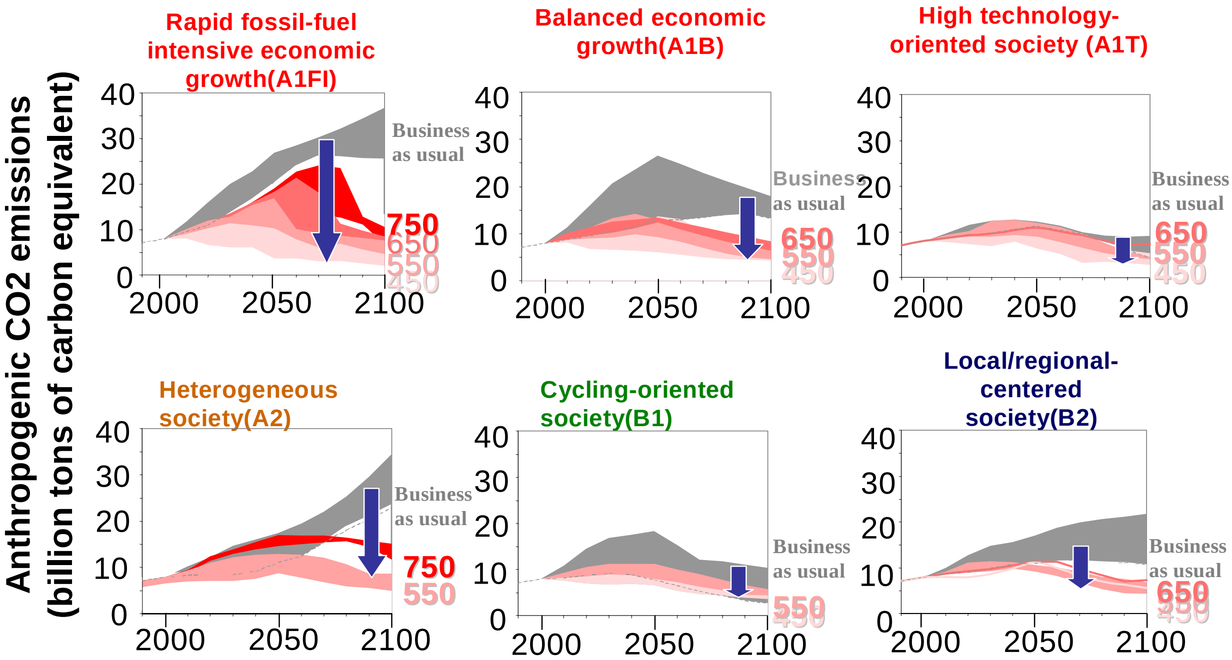
○ Depending on the scenario, the necessity could arise in future for extremely large emission reductions, moreover in a very short space of time, though the possibility that this could actually be achieved must be seen as low. This leads to an understanding that we must not stop at taking measures to 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 Society Designed to Address Climate Change) 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 CO_2 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 CO_2 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 discussions that took place regarding the role of technology that will be of importance as mid- to long-term climate initiatives, including strategies for future technology development and diffusion on the global scale.

5.1 Technology Needed to Create a Society Designed to Address Climate Change

> 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 Society Designed to Address Climate Change>

○ 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.

<Energy efficient technology and technology for low carbon emission intensity >

○ Considerations regarding CO_2 emissions from energy sources address three main factors; work produced, energy efficiency and the ratio of carbon intensity in emissions. A system that achieves balance among these three factors is thought necessary, and technology in particular can also be divided into technology that seeks to increase energy efficiency, and that which seeks to decrease the ratio of carbon intensity in energy (CO_2 emissions per unit energy).

$$\mathbf{CO_2\ Emitted = Work\ Produced} \times \frac{\mathbf{Energy\ Consumed}}{\mathbf{Work\ Produced}} \times \frac{\mathbf{CO_2\ Emitted}}{\mathbf{Energy\ Consumed}}$$

(industrial production, etc.)

To Reduce CO_2 Emissions	⇩	⇩	⇩
	Re-think wasteful production/consu mption	Increase Energy Efficiency	Low Carbon Emission

○ 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 **Innovative technology**	･High-performance smokestacks ･High-efficiency heat pumps ･Building & home energy management systems ･LED lighting ･Hydrogen absorbing alloys ･Hybrid vehicles ･Biotechnology ･Fuel cell vehicles ･Materials	･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	Enhanced absorption by forests ･Catalysts for removing N_2O&CH4 originating in livestock production ･Carbon isolation/ sequestration technologies

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

○ The applicability of technology development itself shares in the uncertainty inherent in all future predictions. 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.

○ Also, even if an innovative technology can be developed and practically applied, it is necessary to examine whether, for example, it can be diffused among the top 20 or so developed and developing countries that are emitting the majority of greenhouse gases before 2050, or even between 2020 and 2030. No matter what the technology, it is of no use unless it can actually be diffused and function 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 CO_2 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.

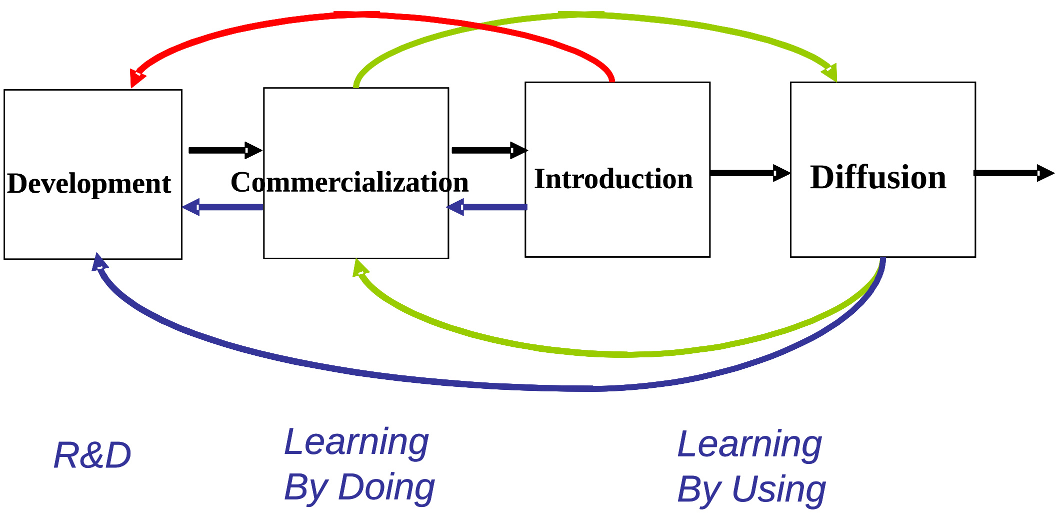
<Intellectual Property Rights>

○ 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, but instead 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). This means that the nature of the market economy may play a significant role. More thought needs to be given to the relationship between the market economy and technology development & diffusion.

Fig. 5.1 Technology Development & Diffusion Process



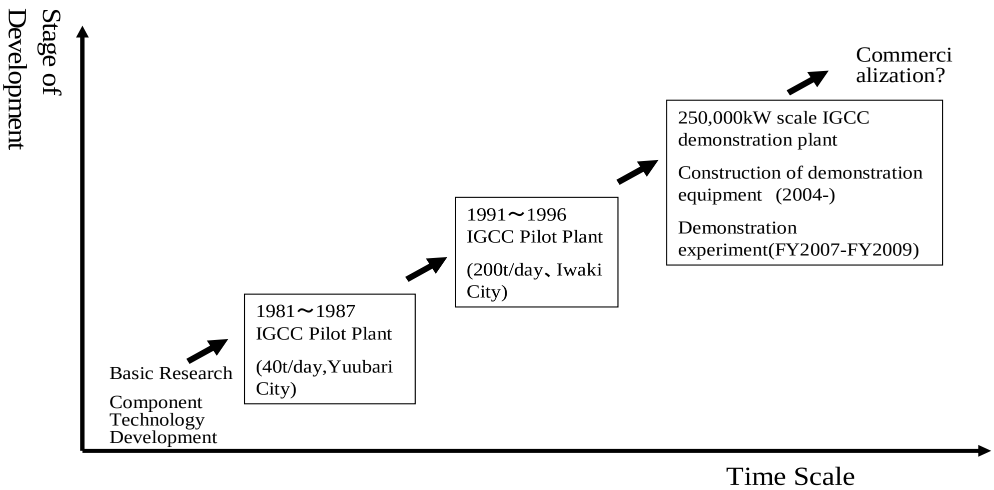
Source: Edwards S. Rubin

<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 between the time a pilot plant initially started operation and a demonstration experiment is 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 consensus 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

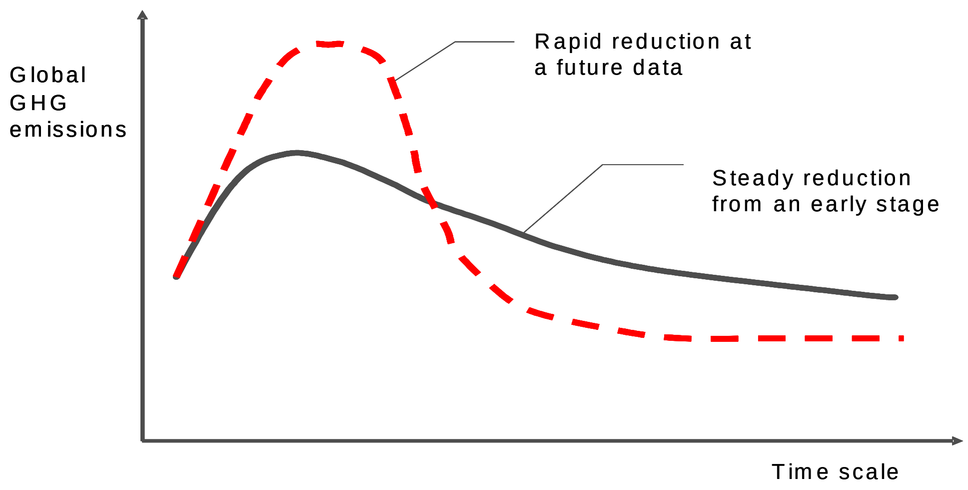
In view of the inertia inherent in the climate system, the characteristics of energy systems and the time needed for the development & diffusion of technology, measures need to be taken as soon as possible in order to avoid the risks posed by global warming. Thus, while taking a long-range view in promoting 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 of 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, the 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 regarding 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. 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. Further Points to Consider in Creating a Society Designed to Address Climate Change

This section summarizes the discussions about points for further consideration by the sub-Committee regarding ways to create a society designed to address climate change, with the aim of realizing the ultimate objective of the UNFCCC.

> The issue of climate change is one that humankind will unavoidably have to deal with over the next 100 or more years. Thus, it would be best if this issue could be dealt with in a more forward-looking manner, and a more positive attitude adopted in seeking to create a society designed to address climate change. 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 an issue for the whole world, it is also an issue for our country. Climate change and the measures taken to combat it presently have, and will have in future, an extremely broad-ranging effect on Japan. Thus, Japan is expected to deal with this issue with a strategy that is based on an analytical consideration of what kind of impacts climate change and the framework for dealing with it will have on Japan, and that also considers Japan's roles and responsibilities with respect to the international community, as well as our own national interest and ability to secure international competitiveness as a technologically-based country.

<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 mutual 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 Society that Address Climate Change will Result in a Prosperous Society>

○ The issue of Climate change is something humankind will unavoidably have to deal with during the next hundred or more years. Reducing GHG emissions is the most fundamental measure for dealing with climate change, but efforts to deal with climate change should be made in a more forward-looking manner, and a more positive value system adopted. Implementing environmental measures results not only in protection of the environment; it also has positive effects in the form of prosperity in new industries, strengthened international competitiveness due to enhanced technological prowess, as well as an enhanced living environment. How to maximize these positive effects will be important as a concept for Japan to propose to the world, and also for building a global-scale system that includes not only developed but also developing countries.

○ Ways need to be devised to give climate change measures priority in the context of sustainable development and to design them so they will contribute to sustainable development. This will allow developing countries to promote climate change measures in a more positive way. For example, some developing countries are promoting air pollution measures so that they also contribute to coping with climate change, and this kind of measure should be promoted even more vigorously in future.

<Usefulness of Japan's Social Vision>

○ The kind of strategy Japan will aim for will depend on the kind of social vision we choose. At present, in order to meet its international commitment for the first implementation phase of the Kyoto Protocol, Japan has established the Climate Change Policy Programs, but further efforts towards superceding these programs and describing a socio-economic vision for building a society that address climate change over the mid- to long-term are now being called for.

○ Clarifying Japan's social vision will serve to outline the major directions in which society needs to progress. Infrastructure is also needed that will facilitate the creation of a society designed to address climate change as well as the realization of other cherished mid-term goals such as urban renewal and establishing a hydrogen-based society.

Attachment 1

Members of the Sub-Committee for International Climate Change Strategy

	〈N A M E〉	〈T I T L E〉
○	**Shuzo NISHIOKA**	Executive Director (Research) National Institute for Environmental Studies
	ASUKA-ZHANG Shouchuan (Jusen)	Professor, Center for Northeast Asian Studies Tohoku University
	Mikiko KAINUMA	Chief Integrated Assessment Modeling Section National Institute for Environmental Studies
	Yasuko KAMEYAMA	Senior Researcher Social and Environmental Systems Division National Institute for Environmental Studies
	Hiroki KUDO	Group Manager, Environment Group The Institute of Energy Economics, Japan
	Akimasa SUMI	Professor Center for Climate System Research University of Tokyo
	Kazuo TAKAHASHI	Professor, Division of International Studies International Christian University
	Yukari TAKAMURA	Associate Professor (International Law) Ryukoku University
	Hidenori NIIZAWA	Professor, School of Economics University of Hyogo
	Hideo HARASAWA	Deputy Director Social and Environmental Systems Division National Institute for Environmental Studies
	Ryuji MATSUHASHI	Professor, Institute of Environmental Studies Graduate School of Frontier Sciences University of Tokyo
	Nobuo MIMURA	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 2rdt, Friday
Time: 10:00-13:00
Place: Toranomon 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 3rdt, 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