2. Approaches for Achieving the Ultimate Objective of the UNFCCC

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

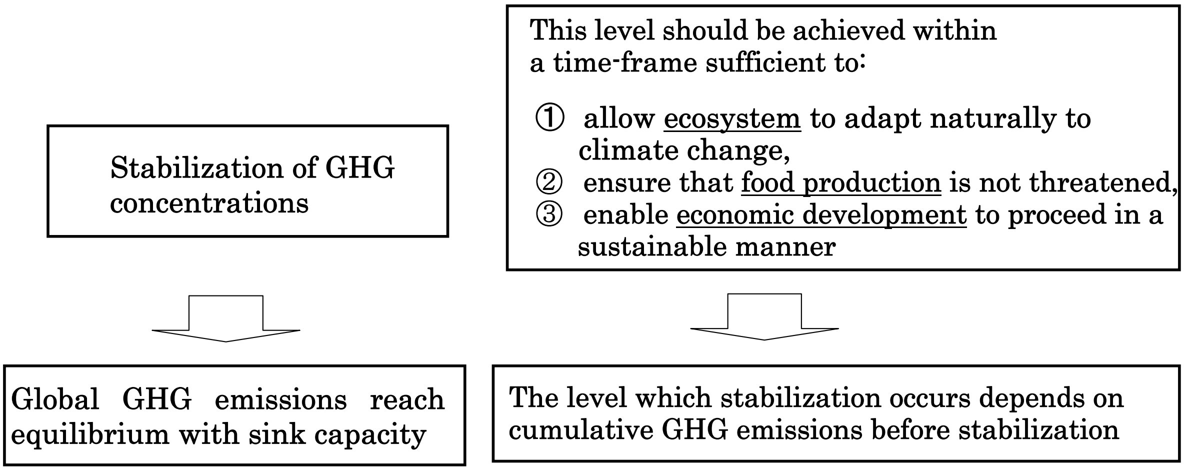
2.1 International Agreements on Stabilization Levels of GHG Concentrations

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

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

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

Figure. 2.1 The ultimate objective of UNFCCC



○ However, numerical targets for GHG concentration levels are not specified in the Convention, and the international community has not yet reached agreements on the target level for GHG concentrations and climate stabilization.

○ Determining what constitutes a dangerous level of climate change involves value judgments, and though it is being reduced every year, scientific uncertainty still remains as well. The level to be identified will depend on the future development in scientific background knowledge and international agreements. In this regard, relationships between stabilization of GHG concentrations and the impacts of climate change, as well as of the significant time lag between stabilization of GHG concentrations and stabilization of temperature and sea level must be taken into account.

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

○ When a certain stabilization level for GHG concentrations is set by agreements of the international community, the level agreed upon can be seen both as an upper limit not to be exceeded, as well as a tolerable level. Table 2.1 shows the impacts predicted for several stabilization levels of CO_2 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 ・Unknown but probably low risk of large-scale high-impact events	・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 ・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 and those do not ・Positive and negative impacts on market ・The majority of people adversely affected ・Unknown but probably medium risk of large-scale high-impact events	・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 compared to those of the developed countries.

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

○ Two types of equity issues need to be considered in relation to climate change. One involves equity between GHG emitters and the countries that are more seriously affected by climate change. The emitters that are contributing to climate change are not necessarily the same as the countries suffering from its adverse impacts.

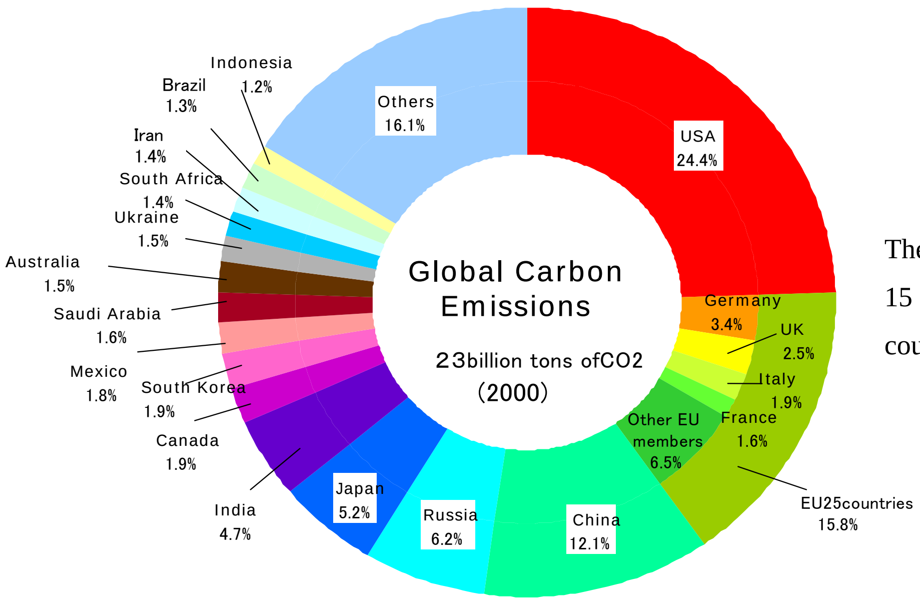
○ The five largest CO_2 emitters, the United States, China, Russia, Japan, and India, account for more than half of global CO_2 emissions. In addition, when emissions of these five countries and those of the European Union (EU: composed of 25 countries) are added together, these 30 countries account 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 71 countries), their share amounts to only 1.1 percent of the world's total emissions (see Table 2.3).

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

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

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	Iran		310	1.4%	4.88
15	Brazil		307	1.3%	1.83
16	Indonesia		269	1.2%	1.28
	Others		3,706	16.1%	--
	World total		23,001	100.0%	3.80

Source: Oak Ridge National Laboratory (USA)

Table 2.3 Countries vulnerable to adverse effects of climate change

Types of countries vulnerable to adverse effects of climate change	**Least developing countries (48 countries)**	
(1) Small island countries	**(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	Seychelles
	Grenada	Singapore
	Guyana	Suriname
	Jamaica	Tonga
	Marshall Islands	Trinidad and Tobago
	Mauritius	

- 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)

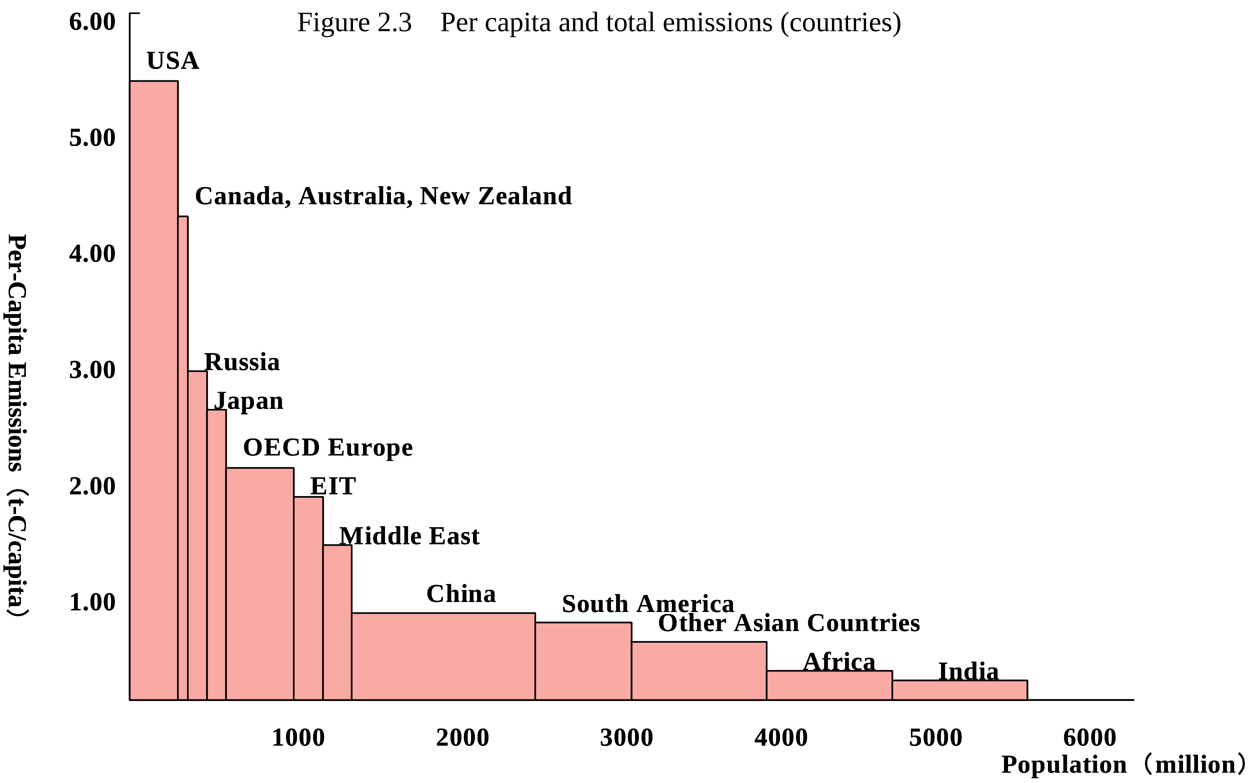
<The generation now taking action and the generations that will be affected in future>

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

<Other equity issue>

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

Figure 2.3　Per capita and total emissions (countries)



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

2.3 Environmental Risk Management on a Global Scale

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

<Environmental Risk Management on a Global Scale>

○ The long-term impacts of climate change reach across centuries, and their causes and effects are global in scale. In view of the scale and seriousness of its projected impacts, it has been recognized that climate change could affect the very foundations of human existence. The UNFCCC forms the basic regime for climate initiatives, but achieving its ultimate objective will require practical action on a global scale over the medium and long-term.

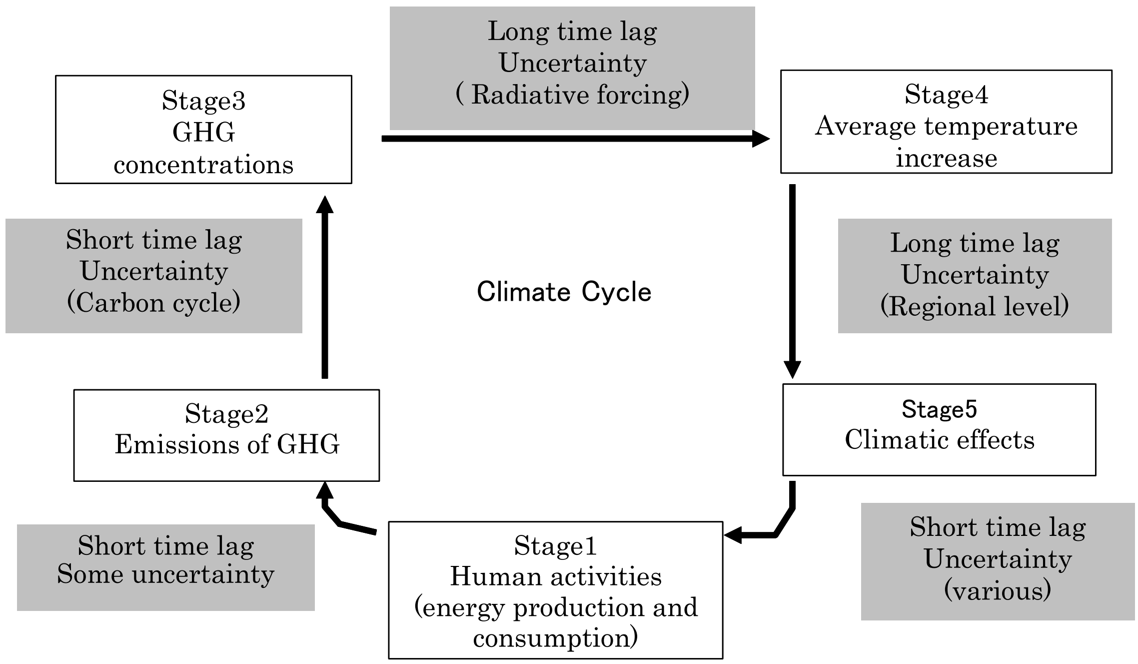
○ Coping with climate change requires deciding on concrete measures for the moment to reduce the future damage, by assessing the degree, the probability, and the kind of climate change impacts. In other words, the question is about how to manage environmental risks on a global scale.

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

○ The ultimate objective of the UNFCCC is the stabilization of GHG concentrations. With respect to setting the concrete levels, it is stated in the Convention as "Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" which also describes such levels in terms of the impacts on ecosystems, agricultural production, and sustainable development.

○ Because what kind of impacts might affect humankind and ecosystems is of great importance, the targets of measures to address climate change will in practice be considered in terms of the impact stage. However, there are in fact several other, prior stages to consider. Before the impact stage there is the temperature stabilization stage, and before that the atmospheric GHG concentration stabilization stage, and before that the anthropogenic GHG emission stabilization stage. And, scientific uncertainty exists in relation to all stages, including the stabilization of anthropogenic GHG emissions, of atmospheric GHG concentrations and of temperature, as well as in relation to climatic impacts,(see Figure 2.4).

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



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

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

<Accumulation of Scientific Knowledge and Uncertainty about Social Choices >

○ The systematic accumulation of scientific observation and knowledge has been reducing scientific uncertainty in predictions relating to climate change. According to the scientific knowledge of the IPCC, although some scientific uncertainty still remains, it can be evaluated that there is little room for doubt that climate change is in progress and will proceed further, and that unless prompt and far-reaching measures to reduce emissions are taken, there is a real danger that substantial adverse impacts will occur in future.

○ There are two types of uncertainty related to climate change. In addition to scientific uncertainty, for example differences in model calculations, there is also uncertainty involving social choices about how to develop the economy and society. Scientific uncertainty is being overcome as observation data and knowledge accumulate and as models incorporating various elements, etc., are developed. Yet, it is still difficult to foresee what kind of society the future generations would choose. Therefore, uncertainty in climate change predictions relies to a great extent on uncertainty in social choices.

○ Uncertainty will remain even while measures are being taken, and scientific uncertainty will exist under any circumstances. Based on these pre-conditions, the question is what policy judgments to make. While governments still make these judgments, it is preferable that they do so through dialogues and close cooperation with various stakeholders.

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

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

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

○ While science plays a role in providing information for humans to make social choices, the IPCC acknowledges that continuing increase in 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 means humankind need to survive in a carbon-constraint society.

Table 2.4 Relationships between CO_2 emissions and CO_2 concentration stabilization levels

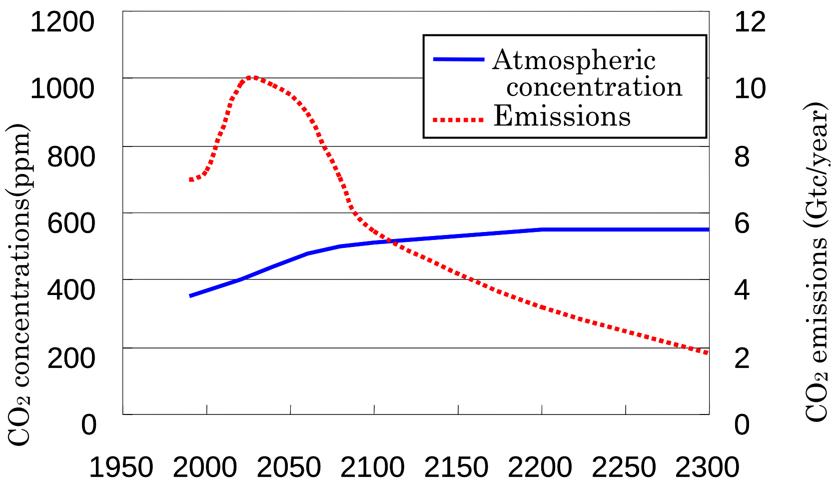
Eventual CO2 stabilization level	Time of stabilization	Mean surface temperature change by 2100 (average)	Mean surface temperature change at equilibrium (Average)	CO2 emissions (billion tons of CO2/year)		Timeframe for peak annual emissions in order to reach the indicated stabilization level
				2050	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 (Based on IPCC TAR)

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

○ If the stabilization level of atmospheric 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 the long term, but in order to meet the ultimate objective of the UNFCCC, we should consider what kind of global system should be established over the next 10 to 20 years. The scientific background needed for the relevant decision-making is already available. Its application now depends on political decision-making. An awareness of this and an awareness of time constraints will be called for in designing the next framework.

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

2.5 Adaptation as Complementary Measure to Mitigation

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

< Mitigation as the Fundamental Climate Change Measures>

○ The fundamental measures for addressing climate change are mitigation - reducing GHG emissions and enhancing CO_2 sinks. Especially on CO_2, because the top 40 countries account for 84 percent of global emissions, it is crucial to establish a system for GHG emissions reduction and enhancement of the sinks in these countries for the measures to address climate change.

<Adaptation for the Inevitable Impacts>

○ However, even if GHG emission reduction and sink enhancement measures, that is, mitigation measures, are taken, some impacts on highly vulnerable natural ecosystems are inevitable and even more severe impacts may be predicted in future. Thus, adaptation measures should be taken to moderate damage to complement emission reduction measures. Also, if the international community decides to accept some impacts by setting a level of atmospheric GHG concentrations mentioned in the UNFCCC, it will also have to implement measures to deal with those impacts.

○ Thus, the international community is expected to take two basic types of measures in addressing climate change: mitigation to reduce GHG emissions and enhance 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 the costs of GHG reduction in order to mitigate climate change. However, because a certain level of impacts is unavoidable, the costs of the damage of the climate change impacts and the compensation costs as well as those for taking the measures to avoid or minimize impacts should also be examined.

○ The costs of adaptation have not yet been sufficiently studied due to the many challenges that entail "value judgments," such as how to deal with the gap in calculations of loss between developed and developing countries, how to estimate compensation for the loss of human life and of ecosystems, and how to assess future damage in the present. Also, in comparing the costs of adaptation, including those of the compensation, with those of reducing greenhouse gases, sufficient discussion is needed to evaluate whether or not it is appropriate to calculate the loss of human life and of other living things merely in economic terms. Nonetheless, studies are progressing in these areas.

○ In this context, because of the equity issue in which the countries that bear the cost of GHG emission reduction are not necessarily the ones that are suffering only adverse impacts from climate change, attentions should be paid not to underestimate adaptation costs. At the same time, while bearing in mind that the measures to reduce GHG emissions are essential, it should be noted that the implementation of adaptation measures in adversely-impacted countries should not serve as an excuse for large emitters to postpone or fail to implement emission reduction measures.

<Examples of Adaptation Measures>

○ Adaptation measures include the following (measures regarding GHG reductions will be dealt with in a subsequent section):

・Water resources
  - Improving efficiency of water use
  - Constructing reservoirs and other impoundments
  - Reviewing design standards for dams, levees, etc.

・Food
  - Adjusting crop planting and harvesting cycles
  - Enhancing the potential of soil to retain moisture and nutrients

・Coastal areas

- Building levees and breakwaters to protect coastal areas
- Planting trees along the shoreline to prevent sand drift

・Human health
- Improving public health infrastructure (water supply and sewerage systems, etc.)
- Developing infectious disease prediction and early warning systems

・Financial services
- Diversifying risks by using private and public insurance and reinsurance

Examples of Adaptation Measures

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

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