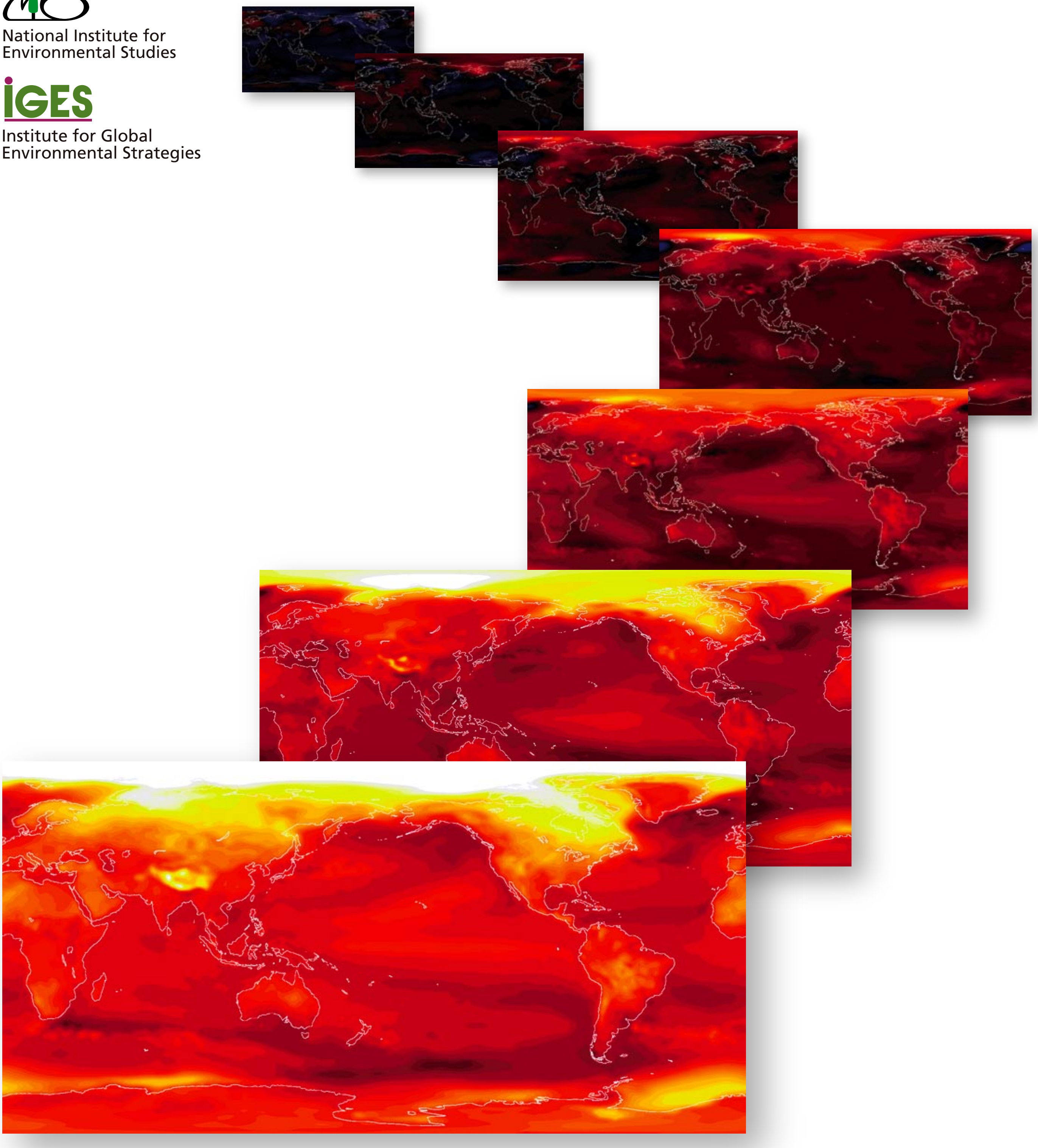
Framing Climate Protection Regime: Long-term Commitments and Institutional Options

National Institute for Environmental Studies

Institute for Global Environmental Strategies



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Embedded images of the front page:
Temporal evolution of surface air temperature change due to anthoropogenic climate change projected by CCSR/NIES/FRCGC high-resolution coupled climate model (CCSR: Center for Climate System Research, University of Tokyo; FRCGC: Frontier Research Center for Global Change, Japan Agency forMarine-Earth Science and Technology)

Forword

Climate change is a worldwide threat that affects global ecosystems and human life over the next several centuries. While adverse effects of climate change are likely to spread out over many decades and centuries, actions to minimize such impacts are required immediately. The challenge we face is to decide on short-term actions while thinking from a long-term perspective.

This brochure is a summary of the efforts by a group of individual researchers, who are leading research in Japan on climate-related issues. The backgrounds of researchers are diverse; some model climate change and its impact, while others examine its institutional aspects. The aim of the group is to start from a long-term view of climate change, and conclude by identifying key elements for short-term actions.

There have already been many studies around the world on this topic, but few of them are convincing enough in linking the long-term goal and short-term actions. Although we do not dare to say we have yet succeeded in entirely fulfilling this objective, we consider that our exercise made a good analysis of the debates on this issue.

Subsequent to the publication of the IPCC Third Assessment Report, there is now a stronger recognition among policy makers and other stakeholders that something needs to be done to mitigate climate change. The UN Framework Convention on Climate Change and the Kyoto Protocol were important first and second steps towards this objective. It is now time to start taking the third step in the right direction. We hope this brochure would assist policy makers in considering the potential third step.

Sixteen experts are involved in creation of this brochure. I would like to mention, however, the late Dr. Tsuneyuki Morita as another expert who had contributed to stimulating research activity on this topic in Japan. Although he passed away on September 4, 2003, his desire to contribute to the global environmental protection continues to stimulate and guide the authors' thoughts.

Dr. Shuzo Nishioka
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Contents

1.1 Climate change observed in Japan

Historical trend of annual mean surface temperature:

The IPCC Third Assessment Report shows the change in the global surface temperature over the last 100 years as 0.6 °C. A similar rise has been observed in Japan too. Throughout the 20th century, the Japan Meteorological Agency monitored the annual mean surface temperature at 17 observation sites where human interference in temperature changes due to urbanization was regarded as minimal (**Figure 1.1**). The temperature increased gradually within the lower level until 1940, then turned sharply upwards in the 1960s and 1990s. The annual increase in mean temperature in the 20th century was l.0 °C, which is higher than the global mean temperature rise of 0.6 °C. Such a rise in temperatures accelerated in the mid 1980s, and temperatures were clearly higher than before in the 1990s. Of the ten hottest years in the past century, eight were in the past decade. This feature coincided with the global trend. The rise in temperature in urban areas for the past 100 years was more than 2 °C, with that in Tokyo reaching 3 °C (**Figure 1.2**). Such a steep rise in the urban areas is caused by both global warming and the heat island phenomenon.

Figure 1.3 shows historical trends in the annual number of extremely hot days on which maximum temperature exceeded 35 °C in three urban areas – Kyoto, Fushiki, and Sakai. Kyoto is one of the highly urbanized areas, whereas Fushiki and Sakai are among the less urbanized areas. The data show that extremely hot days have increased since 1990 in parallel with an increasing trend of the annual mean temperature.

Heat wave:

Recent research shows an increasing trend in the number of days with maximum temperatures above 35 °C and a decreasing trend in incidences of extremely low temperatures in the 1990s. In July 2004, many places in Japan experienced record-breaking extremely high temperatures (**Figure 1.4**), and the number of heat stroke-affected patients, who were transported to hospitals by ambulances, was more than 600 in the Tokyo metropolitan area.

Heavy precipitation:

Extremely heavy precipitation has become a public concern of late. However, the relationship between heavy precipitation and climate change has not yet been confirmed with the observed data, particularly at short temporal scales such as hourly intervals. In 2004, a few locations in Japan experienced heavy precipitation caused by baiu-front and typhoons. Such events were not identified to have a close connection to the current global warming, but they caused a large-scale damage to the society.

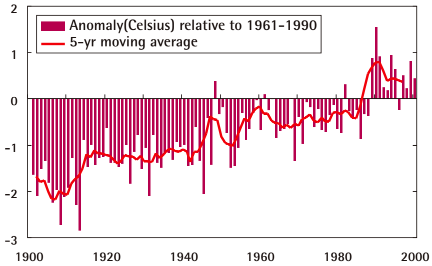

Figure 1.1 Historical trend of annual mean temperature in Japan
Data Source : Japan Meteorological Agency

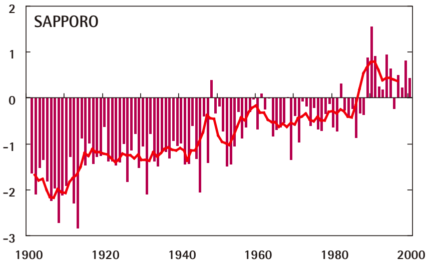

Figure 1.2(a) Historical trend of annual mean temperature in Sapporo
Data Source : Japan Meteorological Agency

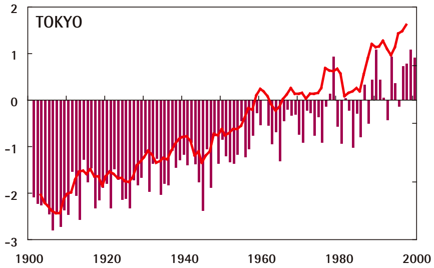

Figure 1.2(b) Historical trend of annual mean temperature in Tokyo
Data Source : Japan Meteorological Agency

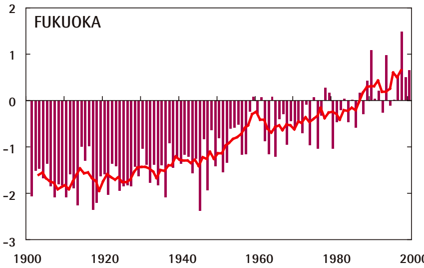

Figure 1.2(c) Historical trend of annual mean temperature in Fukuoka
Data Source : Japan Meteorological Agency

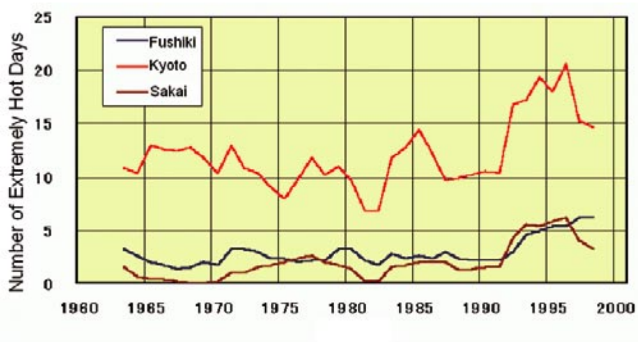

Figure 1.3 Historical trend of the number of extremely hot days (5 year moving average) of Kyoto, Fushiki, and Sakai
Data Source : Japan Meteorological Agency

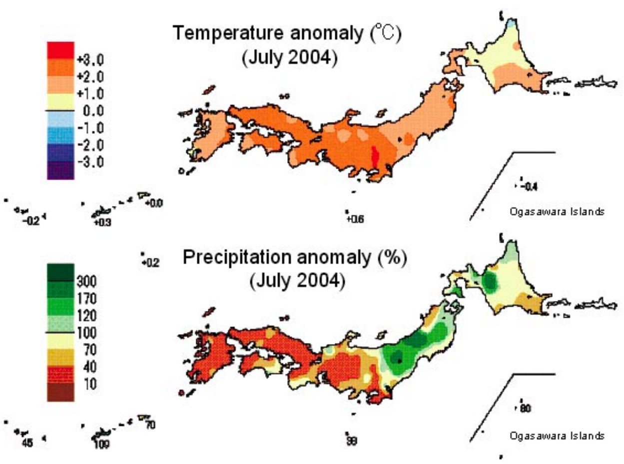

Figure 1.4 Temperature and precipitation anomaly observed in July of 2004
Source : Japan Meteorological Agency

1.2 Projection of future climate

Spatial projection of temperature change in future

Figure 1.5 shows the geographical distribution of changes in surface air temperature at the time of doubling CO_2 relative to the present, calculated with a high-resolution coupled ocean-atmosphere climate model running on the 'Earth Simulator', which is the fastest super-computer in the world. The climate model has been collaboratively developed by the Center for Climate System Research of the University of Tokyo (CCSR), the National Institute for Environmental Studies (NIES) and the Frontier Research Center for Global Change (FRCGC) of Japan Agency for Marine-Earth Science and Technology. The horizontal resolution of the atmospheric part is approximately 120km, while that of the oceanic part is approximately 25km. The brighter color denotes a greater heating and the brightest (white) areas roughly correspond to a seven-degree heating. Though the general features like enhanced heating over northern high-latitudes is similar to what has been suggested by conventional lower-resolution models, regional elements of climate change are more realistically represented in outcomes of this high-resolution model.

Alternative futures

Figure 1.6 shows the time sequence of global and annual mean surface air temperatures simulated with a coupled ocean-atmosphere climate model (CCSR/NIES/FRCGC model) based on historical forcing and various future scenarios. The 'Control' run shows the model can be integrated stably (note that the model does not use the 'flux correction'). The '20C3M' (20th Century Climate in Coupled Models) run is affected by various historical forcings including solar and volcanic forcings, GHG concentration, various aerosol emissions and land use, and agrees well with the observed historical temperature record (not shown). Three of the SRES marker scenarios, A2, A1B and B1, are also calculated and the latter two are followed by idealized stabilization scenarios, in which GHG concentration and aerosol emissions are assumed to stabilize in the year 2100. In the 'Committed climate change' run, they are assumed to stabilize in the year 2000, for demonstrating the lower limit of climate change. Though idealized, these stabilization climate scenarios could be used as physical basis for the discussion of long-term goals of climate protection.

Baiu (Asian monsoon rain belt)

The enhanced resolution of the CCSR/NIES/FRCGC model permits representation of the more realistic regional climate changes, leading to a significant advance in regional impact assessment studies. **Figure 1.7** shows the climate change pattern over the Asia-Pacific region in summer (June-July-August) projected by the model. The contours, arrows and colors denote changes in 500hPa height, 850hPa wind and precipitation rate, respectively. The area with blue color extending from the southeastern edge of China to the southeast of Japan indicates an increase in precipitation over the Meiyu/Changma /Baiu front (east Asian monsoon rain belt). It is affected by two high-pressure anomalies – one is located to the northeast of the Philippines, and the other over the eastern Siberia and the Sea of Okhotsk. The former is caused by the El Nino-like tropical Pacific warming (warming over central to eastern tropical Pacific). It tends to form a low-pressure anomaly to the north of it and provides warm moist air to the rain belt. The latter is caused by the enhanced continental warming and tends to hinder the northward migration of the rain belt.

Extreme events

High-resolution climate models are expected to capture changes in extreme events, which is another important issue in the impact assessment studies. One of the major causes of extremely heavy rainfall over the East Asia is tropical cyclones. **Figure 1.8** shows the daily rainfall amount caused by tropical cyclones averaged over 20 years in a present climate (left) and a doubled CO_2 climate (right) as projected by the CCSR/NIES/FRCGC climate model. The overlaid thin black lines are tracks of the simulated tropical cyclones. Although the number of tropical cyclones is decreased in the doubled CO_2 climate over this region, the mean daily precipitation caused by the tropical cyclones is significantly enhanced in the changed climate. In general, the probability of extremely heavy precipitation is expected to increase in the warmed climate due to an increased atmospheric water vapor.

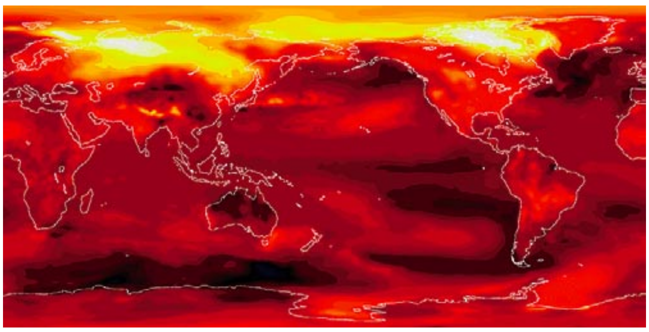

Figure 1.5 Temperature change at the time of $2xCO_2$ relative to the present

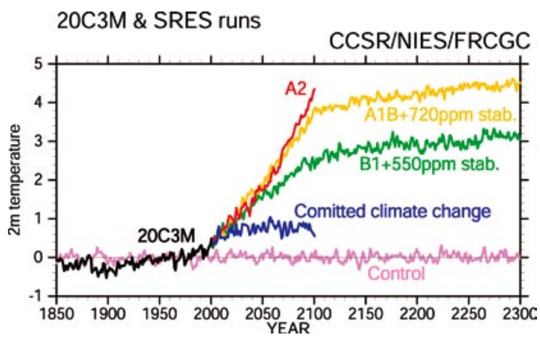

Figure 1.6 Time sequences of global and annual mean surface air temperature

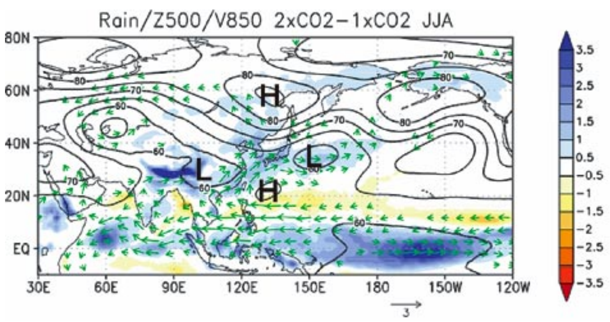

Figure 1.7 Changes in 500hPa height, 850hPa wind and precipitation rate

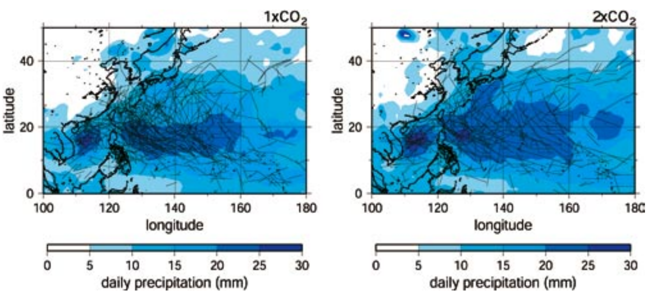

Figure 1.8 Daily rainfall amounts caused by tropical cyclones averaged over 20 years in the present climate (left) and a doubled CO_2 climate (right)

1.3 Observed and predicted climate change impacts in Japan

Changes in vulnerable ecosystems

Among the phenological observations conducted nationwide by the Japan Meteorological Agency since 1953, the changes in the flowering date of the Japanese cherry (*Prunus yedoensis*) are particularly striking. These trees now flower 5 days earlier on average than they did 50 years ago (**Figure 1.9**).

Other examples of detected impacts of global warming are listed below.

- Decreased alpine flora in Hokkaido, the north island in Japan
- Expanded distribution of the southern broad-leaved evergreen trees such as the Chinese Evergreen Oak
- Appearance in Mie Prefecture in the 1990s of Nagasakiageha (*Papilio memnon thunbergii*) for which the northern border has traditionally been Kyushu and Shikoku Islands
- Appearance in the Tokyo area in the 1980s of the southern tent spider, which was seen only in western Japan in the 1970s
- Expansion of the wintering spot of the White-Fronted Goose to Hokkaido
- Shifting habitats of ermine and grouse on mountains such as Hakusan and Tateyama to higher elevations, with some dangerous prospects for their complete disappearance

Figure 1.10 shows the present and predicted distribution of beech forest. Beech forests are typical of the cool temperate zone, and are distributed widely in Japan. However, at their southern limit of the distribution, global warming may cause the transition of these forests into evergreen forests.

Impacts on coastal region and disaster prevention

In Japan, cities and towns facing the ocean account for 48% of the population, 48% of industrial shipment value, and 62% of commercial sales. Currently, there are 2 million people and assets of 54 trillion yen in areas below the high water level. With a 1 m rise in sea level, these figures would more than double to 4.1 million and 109 trillion yen, respectively. In addition, sea-level rise would reduce the function and stability of disaster prevention facilities on the coast. To maintain the function of seawalls and dikes at their current levels against 1 m sea-level rise, seawalls should be raised 2.8 m on open sea coasts, and harbor quays be raised 3.5 m in semi-closed bay.

Impacts on industry and energy sector

As global warming proceeds, people's consumption patterns may also change thereby leading to changes in industrial structure. For example, if mean temperature from June to August increases by l °C, the consumption of summer products may increase by about 5%. And if the period of high temperatures in summer lengthens, the consumption of air conditioning, beer, soft drinks, and frozen desserts will increase, so that electronics and food makers will likely need to reinforce their production systems for seasonal goods. Various impacts may also be felt in the supply and demand for electricity (**Figure 1.11**). Forty percent of the power demand in summer is for air conditioning, so a 1 °C rise in temperature can lead to an increase in power demand of approximately 5 million kW (amount for 1.6 million households). The generation efficiency of thermal and nuclear power plants depends on the temperature of the cooling water, and a 1 °C rise in coolant temperature will reduce the thermal power output by 0.2 - 0.4%, and nuclear power output by 1-2%.

Impacts on health

Rising temperatures will have a direct impact on human health, with an increased overall death rate from heat stroke and other disorders. The elderly and people with underlying medical conditions will be at the greatest risk. **Figure 1.12** shows daily maximum temperature and number of heat stroke patients, who were transported to hospitals in Tokyo, in July 2001. Worsening atmospheric pollution and epidemics of vector-borne infectious diseases such as malaria and dengue are also possibilities. There have been recent reports of mosquitoes which transmit communicable diseases moving northward to the Tohoku region, and the risk of infectious diseases may become a reality as the mosquito habitat expands.

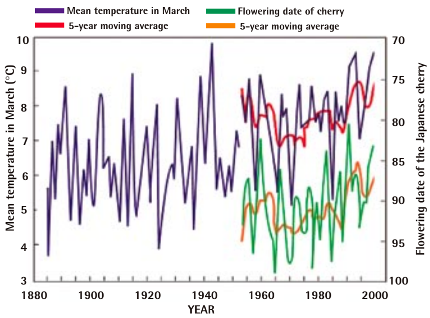

Figure 1.9 Annual changes in flowering date of the Japanese cherry (*Prunus yedoensis*) and mean temperature in March in Kyoto, Japan. Bold lines indicate five-year running means (after Dr. Keiko Masuda)

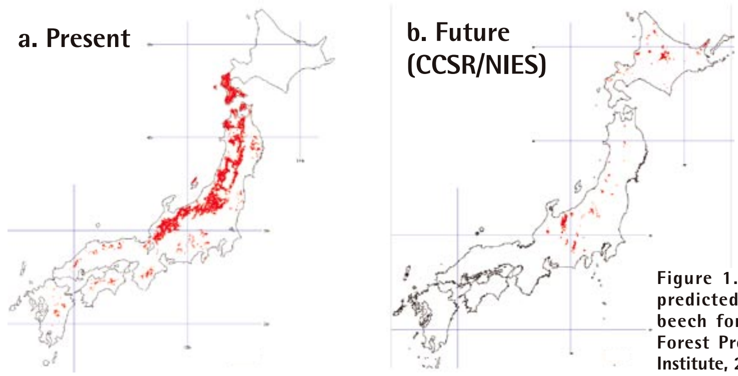

Figure 1.10 Present and predicted distribution of beech forest (Forest and Forest Products Research Institute, 2002)

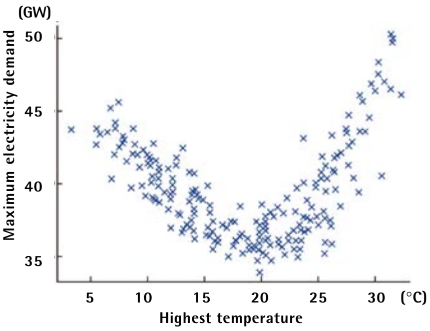

Figure 1.11 Relationship between temperature and the maximum electricity demand (Global Warming Research Initiative, 2004)

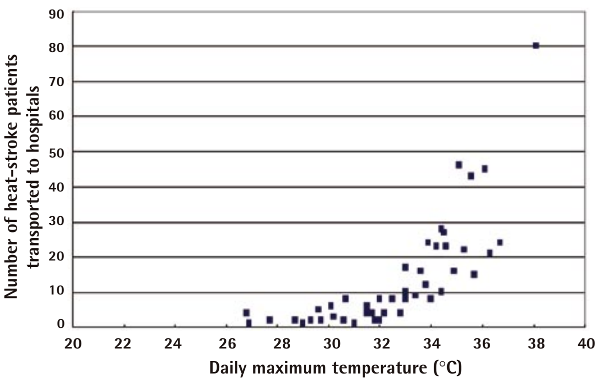

Figure 1.12 Daily maximum temperature and the number of heat stroke-affected patients transported to hospitals in Tokyo, in July 2001

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1.4 Impact assessment at global scale/adaptation

Impact assessment at global scale

Studies on global impact assessment have advanced in leaps and bounds during the last decade. By taking spatial outputs of climate models as input data, impacts on the most vulnerable sectors such as water resources, agriculture, human health, and natural vegetation have been assessed under alternative future socio-economic/emission scenarios.

For example, by considering spatial distributions of water demand (water withdrawal is mainly affected by socio-economic environment) and supply (renewable water resource is affected by climate and land environment) simultaneously, water stress index (WSI) in each river basin has been estimated (Definition of WSI is explained in the figure) using the AIM/Impact model collaboratively developed by the National Institute for Environmental Studies (NIES), Kyoto University and other institutes in Asian countries. **Figure 1.13** shows the WSI in 2000 (now) and in 2100. For the projection of 2100, two alternative future scenarios ((B1) unsustainable and (B2) sustainable) were adopted. The unsustainable scenario assumes SRES-A2 socio-economic/GHG emission scenario and a low rate of water-use efficiency improvement. The sustainable scenario assumes SRES-B1 scenario and a high rate of water-use efficiency improvement. Under the unsustainable scenario, which reflects a high-rate of population increase and a low rate of water-use efficiency improvement, WSI will significantly increase especially in developing countries. It means drought risk will increase in future. On the other hand, under the sustainable scenario, WSI will not increase so much in developing countries or even slightly decrease in developed countries.

Impact assessment considering adaptation measures

Importance of adaptation measures to mitigate negative impacts of climate change has been long recognized. However, quantitative evaluation of adaptation measures has not been conducted so much, especially at the global scale. It is definitely an urgent research task.

Figure 1.14 shows the potential productivity of wheat in 2000 and in 2050 estimated with the AIM/Impact model. For estimating potential productivity in 2050, two alternative levels of adaptation were considered. In developing countries, negative impact of climate change might be compensated with the productivity increase derived from intensive irrigation and mechanization (Adaptation case). However, if adaptation measures are not taken appropriately, the decrease in productivity will be significant (No adaptation case).

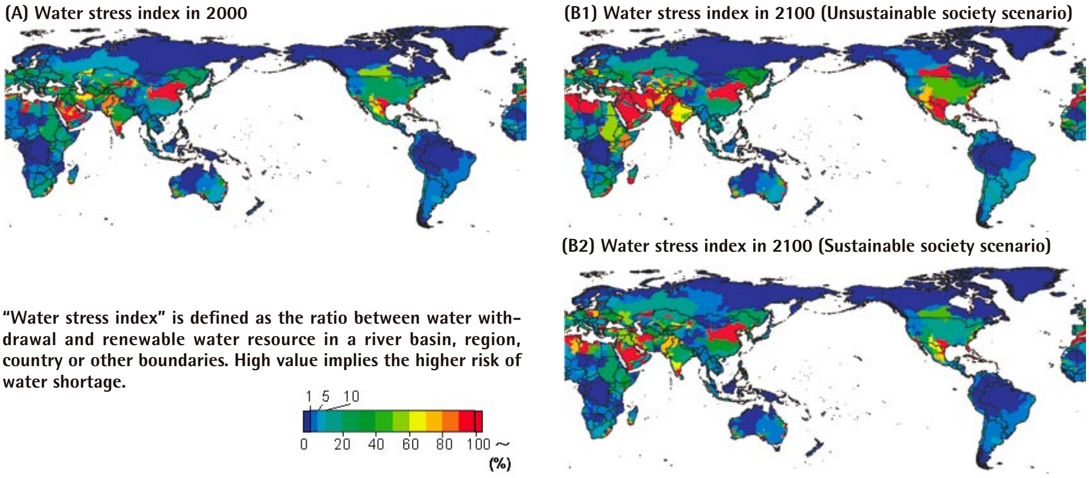

Figure 1.13 Water stress index in 2000 and 2100

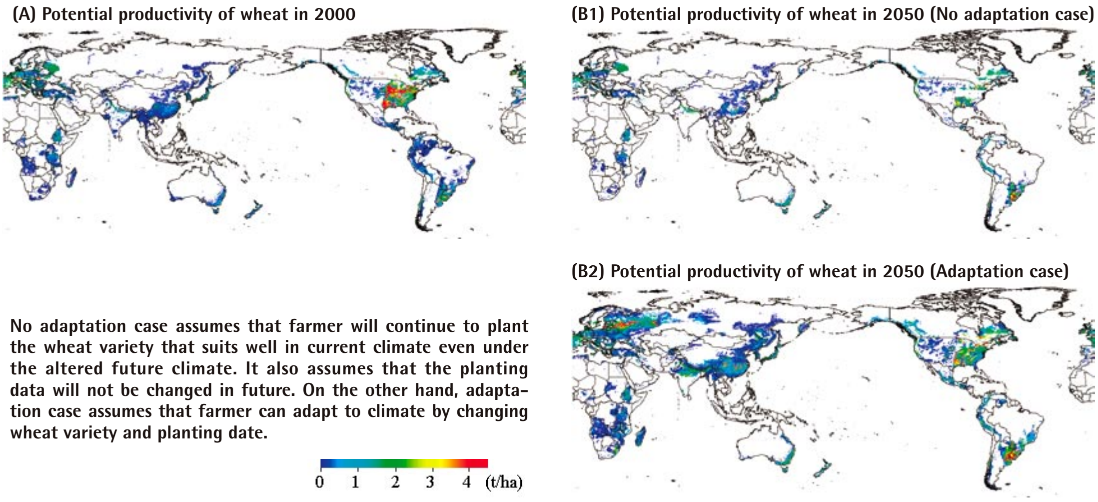

Figure 1.14 Potential productivity of wheat in 2000 and 2050

Long-term targets

2.1 Approaches for medium and long-term targets

Why are long-term targets important?

There are several reasons why it is important to consider long-term targets when discussing short-term actions. First, climate change is a threat that is likely to exist in the next centuries. Thus, it is necessary to assess the consequence of short-term actions in the next 100-200 years. Secondly, both cause and effect of climate change are likely to occur at global level over a long period of time, which means decisions today affect climate decades from now. Thirdly, the scale of effect of climate change may be large enough to risk basic human needs.

Climate change circle and stages of targets

Targets may be set at different levels. **Figure 2.1** shows those levels of climate change circle where targets may be set. Stage 1 (human activities) and 2 (emissions of GHGs) could be altered relatively in a short-term after decisions have been made. Thus, short-term targets may be set at those levels. Stage 3 (atmospheric concentration of GHGs) and 4 (global mean temperature rise) could be altered only decades after changes at State 1 and 2 have occurred. Thus, long-term targets are most suitable for those levels. Stage 5 (adverse effect of climate change) happens as the consequence of global mean temperature rise. Setting a target for Stage 5 is considered to be challenging as various types of adverse effect is expected at regional /local levels as was described in the previous pages.

Although the ultimate objective of taking action is to prevent or minimize Stage 5, targets are set in other stages mainly because of its too much long-term effect and of its uncertainty as to exactly when, where and how much the adverse effect of climate change is likely to occur at Stage 5. However, setting targets in other stages are also not easy because, at least for now, no one can define the dangerous level, and also because different types of uncertainties exist between stages.

Handling long-term targets

Selecting a single level at Stage 3 or 4 as a long-term target, such as 550ppm or 2 °C is of course one way of setting a long-term target, but many other approaches to set long-term targets have been suggested.

* Allowing a certain range of acceptable level in Stage 3 and 4, such as 450-600ppm;
* Hedging strategy, where targets are set to avoid the worst-case scenario;
* Agreeing on a process for regular assessment of a long-target;
* Setting a mid-term target (see **Table 2.1**)

are some of the ideas that could be reflected in the future commitment.

Table 2.1 Types of targets in three time frames

	Characteristics	Types of Targets
Long-term target (2100~)	- Indicator for human activities & decision-making - Assessment of future global risk	- Non-binding target - A range of target - Hedging strategy - Regular assessment
Mid-term target (2030~2050)	- Milestone for achieving long-term targets - Directional role to stimulate technology investment	- Non-binding target - Linking long and short term targets to assess level of achievement
Short-term target (2010~2020)	- Concrete actions with little uncertainty - Clear mandates to all stakeholders	- Mandatory and/or voluntary target - Quantitative and/or qualitative target

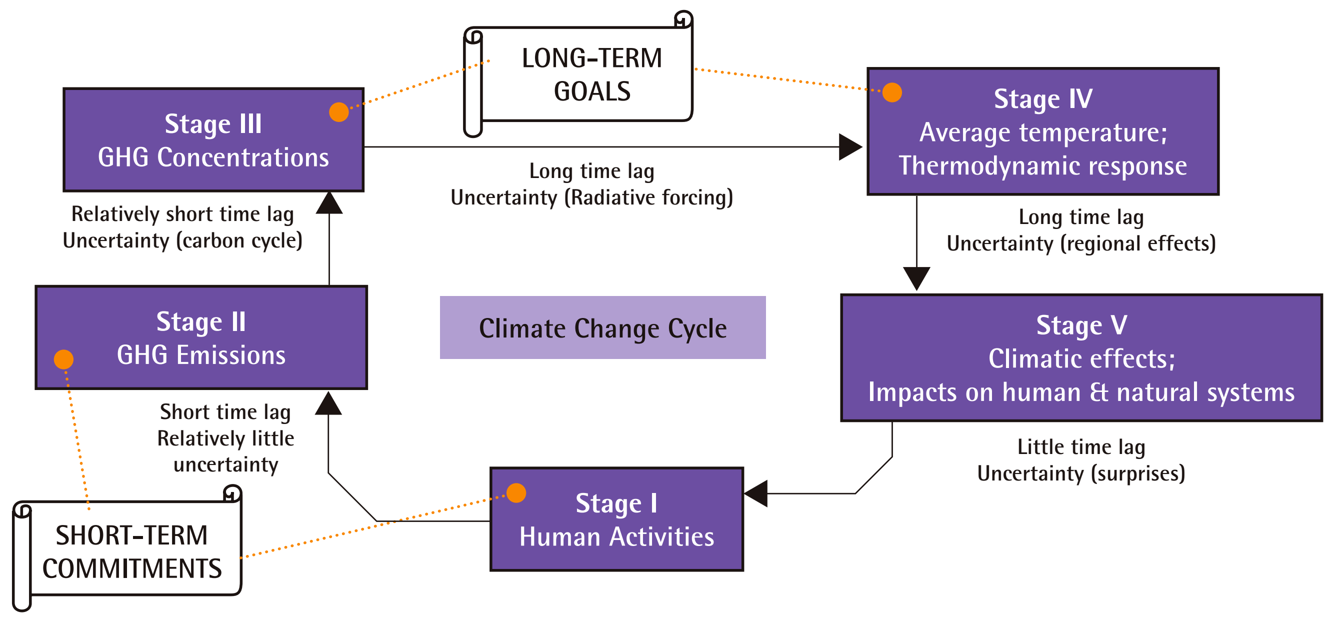

Figure 2.1 Long-term goals and short-term commitments in climate change cycle

Note: This figure is originally from Pershing and 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, p.15.

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2.2 Medium and long-term targets in European countries

As discussed in the previous section, consideration of long term goals is important to define the commitments and measures to be taken to address climate change, i.e. to stabilize the concentrations of greenhouse gases (GHGs) in time.

Some argue, however, that it is too early to consider long term targets, due to the scientific uncertainties concerning the climate change impacts as well as technological developments and political uncertainty concerning the future of Kyoto protocol.

Since a few European countries already published reports on long term targets, we shall examine the experiences of those countries and draw implications for Japan to set a long term target.

2.2.1 Reports on Long term targets in the European countries –Motives, Institutions, and Processes

<Germany>

Several reports regarding medium- and long-term GHGs reduction targets and future climate regime have been published since 2002 in Germany by Enquete Kommission (a Parliamentary study commission) and Federal Environmental Agency (Umwelt Bundesamt, UBA).

In October 2003, the Expert Group on global environment (Wissenschaftlicher Beirat fuer Global Umwelt, WBGU) published "Climate Protection Strategies for the 21st Century: Kyoto and beyond." The report defined "climate window," the threshold to avert dangerous climatic changes, by a maximum warming of 2 °C relative to pre-industrial values based on the examination of various aspects of impacts of climate change upon ecosystems. In order to control energy- and industry-related GHGs within the WBGU climate window, the WBGU recommended a hedging strategy to aim at a CO_2 concentration target below 450ppm by considering the uncertainties concerning the climate system. It examined technological and economic viabilities of emissions profiles, comparing trajectories across regions and over time by means of scenario computations.

In order to allocate emission rights for GHGs in controlling CO_2 concentration below 450ppm, the WBGU adopted the "contraction and convergence" approach, taking 2050 as the year of convergence in consideration of the fundamentally equal right of all individuals to emissions and the principle of constancy.

The report is characterized as not only setting a long term target but proposing a number of elements to be included in the future international climate regime based on the above analysis.

<UK>

In June 2000, the Royal Commission on Environmental Pollution (RCEP), an Advisory Council for Queen, Parliament, and the Government, published a report titled "Energy: the Changing Climate." It recommended a reduction of CO_2 emissions by 60% by 2050 in the UK to stabilize GHGs concentration at 550 ppm.

In February 2003, the Department of Trade and Industry published an Energy white paper titled "Our Energy future-creating a low carbon economy" with four pillars, namely, environment, energy reliability, affordable energy for the poorest, and competitive markets for businesses, industries and households. It mentioned the medium- and long-term targets in the environment section, considering a close linkage between energy and climate change issues.

The report emphasized the existence of strong scientific evidence that climate change is happening and that it is being accelerated by human activity. In order to avoid the worst effects of climate change, concentrations of GHGs in the atmosphere should be stabilized.

It recognized that the level of concentration is not agreed, but quoted the EU member states' agreement in 1997 to aim for a global average temperature increase of no more than 2 °C above the pre-industrial level and therefore a CO_2 concentration below 550ppm, about twice the pre-industrial concentration- to prevent the most damaging effects of climate change.

In order to stabilize CO_2 concentrations at no more than 550ppm, it set the long term target for world's developed economies to reduce CO_2 emissions by 60% by 2050.

It admitted that climate change has to be tackled globally and UK's own actions will have no impact on climate change unless they are part of a concerted international effort. Nevertheless, the UK is taking leadership to bring the world in that direction through achieving the UK commitment. Therefore, the UK set the target to reduce UK domestic CO_2 emissions by 60% by about 2050 with real progress by 2020 accepting to the recommendation by the RCEP.

It also emphasized the necessity of early, well-planned actions to provide a framework within which businesses and the economy generally can adjust to the need for change.

The report analyzed the likely impacts on the UK economy of cutting emissions by 60% by 2050. It confirmed actions aimed at stabilizing atmospheric CO_2 concentrations at no more than 550ppm would lead to a loss of 0.5% -2% in projected GDP provided that the world's leading nations all act together.

Although this report is published under the name of DTI, it is regarded as a government-endorsed target, since Prime Minister Tony Blair confirmed this target in the foreword of the report.

<France>

Since 2000, several reports on short, medium-, and long-term strategies on GHG reduction have been published as benchmarks for policy discussions in France. Most of the reports have been published through MIES (Mission interministerielle sur l'effet de serre), including the National Programme on tackling climate change (PNLCC), focus on short and medium term goals, such as those by 2012 or 2025.

In March 2004, MIES published a report titled "Reducing CO_2 Emissions Fourfold in France (La division par 4 des emissions de dioxide de carbon en France d'ici 2050)" discussing French strategies to reduce its GHG emissions fourfold by 2050. The report analyzed the current condition in major sectors – industry, residential -tertiary, transportation, and electricity production sectors – and proposed ways to achieve the national goal to reduce GHG emissions by 75%, based on discussions made within the 2002 report of the parliamentary commission on climate change (Technological and scientific choices for 2025, 2050 and 2100). The report claims that the reduction by 75% makes it possible to stabilize the atmospheric concentration of GHG at 450ppm. It also claims that to achive this target, it is necessary to reduce the global per capita CO_2 emissions to 0.5 tCO_2. Although the report does not mention which model is used to support the arguments, it seems that these numerical targets are presented based on the idea of contraction & convergence, which supports the idea of the equity among nations.

The MIES report suggests several policy options to industries and policy makers. The major idea is that energy replacement/switching from liquid fuel to renewable sources together with the use of CO_2 sequestration are indispensable to achieve the ambitious goal of France. The suggestions made in the report are referred to in the Government report "Plan Climat 2003" and "Plan Climat 2004."

The report is treated as an introduction to the debate within France and the EU, targeting the major industries. By showing what the government (MIES) is considering as strategies to reduce GHG emissions dramatically in the medium term like by 2050, the government aims to give directions to domestic industries and lead discussions within the EU. However, the detailed scientific data and evidence to support the suggestions seem to be lacking in this report.

<Sweden>

Sweden's climate strategy is focused on reaching a series of goals over different time frames. Based on the belief that setting a long term target would help the government and industries establish their short- and medium term goals with regard to GHG emissions reduction, Swedish EPA published the report "Kyoto and Beyond-Issues and Options in the Global Response to Climate Change" in November 2002. Reviewing the current global situation and setting long- and medium-term goals supported by IPCC SRES and other well-recognized scenarios, this report suggests what should be done immediately in Sweden and other developed countries in order to achieve the goal in 2050 mentioned in Climate Strategy.

In its strategy, Sweden set much more strict

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criteria than the other countries. While the others focus on stabilizing emissions of CO_2, Sweden decided to adopt a long term goal of stabilizing emissions of all major GHGs at 550ppm by 2100, which is a global target that Sweden wishes to see, achieved through the efforts of all countries. In order to achieve this, it was estimated that by 2050 per capita emissions of CO_2 and other GHGs of developed countries must be reduced to less than 4.5 tCO_2e by 2050 and reduced drastically thereafter. Although it is not clearly mentioned in the report, this number seems to be set based on the contraction & convergence. This is the government-endorsed medium term goal for Sweden.

The EPA report requests the Swedish and international actors to take actions immediately in order to achieve the medium term goal (2050).

2.2.2 Logics to set up medium- and long-term targets in the reports

Table 2.2 summarizes the main elements included in various reports.

Based on the examination of the reports published in Germany, UK, France and Sweden, the following points were drawn as logics to set medium- and long- term targets.

- Recognize that climate change is happening, and is being accelerated by human activities based on the existing scientific knowledge (Germany, UK, Sweden)
- Define dangerous climate change as a maximum warming of 2 °C relative to the pre-industrial values (Germany, UK)
- Set the GHGs stabilization target to 450ppm or 550ppm with a target year 2050 (Germany, UK, France, Sweden) in order to control the rise of temperature within 2 °C (explicitly described in the German and UK reports)
- Decide to take on early action due to various uncertainties concerning science and policy of climate change (Germany, UK), and to give a strong signal to businesses and industries for deciding their short and medium term actions (UK, France and Sweden)
- Allocate GHG emissions to countries based on contraction & convergence approaches to achieve the goal to stabilize the GHGs concentration (Germany, France and Sweden) and set the GHGs reduction target.
- Set its own medium- and long-term targets to reduce the total amount of GHGs emissions or per capita GHGs

2.2.3 Issues identified from the experiences in European countries to set up the medium- and long-term targets

Based on experiences in European countries, the following issues were identified as necessary to be discussed and to have consensus among stakeholders to set up the medium- and long-term targets.

- What is the dangerous climate change?
- In order to avoid the dangerous climate change, at what level must GHGs be stabilized?
- What kind of approaches is used to allocate GHG emissions to countries?
- Is it economically and technically feasible to stabilize GHGs concentrations?

The reports examined here are missing some of the abovementioned points.

Furthermore, although all reports recommended ambitious reduction targets for industrialized countries and some reports recommended measures to achieve the targets, it is still open to question whether these countries will and can achieve the targets, considering that much lower targets set in the Kyoto Protocol are difficult to be achieved in the short term.

2.2.4 Implications for Japan to set a long term target and relevant activities undertaken in Japan

Despite a few abovementioned concerns, reports from the European countries tell us rationale and importance of setting up medium- and long-term targets in near future. Particularly, the way they treat uncertainties as a reason for immediate action should be paid attention, while some other countries use uncertainties as the reason for taking no current action or to take no-regrets actions. The WBGU report showed that Germany is taking a hedging strategy to set lower concentration level targets, 450ppm considering the large uncertainties related to the climate system. Once the concentration level is above 450ppm, it is considered too late to bring the GHGs concentration back to 450ppm, and 450ppm is recognized as the necessary level.

In Japan, there are different views on setting medium- and long-term targets among stakeholders, including different ministries, industries, NGOs, and researchers. However, there exist activities to set medium- and long-term targets and to propose the future regime based on it.

In April 2004, Ministry of the Environment launched an international strategic expert meeting under the Central Environmental Council and an umbrella working group at the Institute for Global Environmental Strategies (IGES) to have intensive discussions on the framework for future climate regime. Several research initiatives funded by the Global Environmental Research Fund were also launched.

Thus Japan is moving forward to set medium- and long-term targets in order to contribute to achieving the ultimate objective as described under the Article 2 of United Nations Framework Convention on Climate Change to stabilize the GHGs concentration in time.

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Table 2.2 Analysis of basic features of medium and long term GHG emission targets in European countries

	UK		Germany		France	Sweden
Title of the Report	Energy: the Changing Climate	Energy White paper, our energy future: creating a low carbon economy	Sustainable Energy Supplies in View of Globalization and Liberalization	Climate Protection Strategies for the 21st Century: Kyoto and beyond	Reducing CO_2 Emissions Fourfold in France – Introduction to the debate-	Kyoto and Beyond – Issues and Options in the Global Response to Climate Change-
Date of publication	June, 2000	February, 2003	November, 2002	October, 2003	March 2004	November 2002
Author	Royal Commission on Environmental Pollution	DTI (Department of Trade and Industry)	Enquete Kommission	WBGU	MIES Prospect 2050 (Pierre Radanne)	Swedish EPA
Status of authors	Advisory Council for the Queen, Parliament, and Government	Government ministry	Study Committee established in Parliament consisting of Parliamentarians and scientists	Advisory Council for the federal government	Inter-ministerial Task Force on Climate Change	Government
CO_2 concentrations	Less than 550ppm	Quote the EU agreement in 1997 A global average temperature increase of no more than 2 degrees C above the pre-industrial level A concentration no more than 550 ppm of CO_2 (about twice the pre-industrial concentration)		A global average temperature increase of no more than 2 degrees C above the pre-industrial level A concentration below 450 ppm of CO_2	Less than 450ppm CO_2	(By 2050) less than 550ppm CO_2 (By 2100) less than 450ppm CO_2
Target	Reduce CO_2 emissions by 60% by 2050	Reduce CO_2 emissions by 60% by 2050 with real progress by 2020	Reduce CO_2 emissions by 80% by 2050	Reduce CO_2 emissions by 45-60% until 2050 (base year 1990) Reduce CO_2 emissions by 20% by 2020	Reduce CO_2 emissions by 75% by 2050 (For France to reduce its annual CO_2 emissions to 32MtC)	Reduce per capita CO_2 emissions to 4.5tC by 2050
Target coverage		world Target by 2020 is for UK		Global target	French target	Global target
Approach	Contraction & Convergence			Contraction & Convergence	Contraction & Convergence	Contraction & Convergence

3 Emissions scenarios & technology

3.1 Emissions scenarios

Background

Many scenarios have been proposed related to energy, societal and climate change. Some have specific names such as techno-garden and policy reform, and some have symbolic names such as A1 and B2. It is very difficult to classify them, because they have different axes for evaluation. The future world varies depending on technological innovation and the penetration rate of such technologies. It also depends on societal change; with and without social renovation. Environmental burden will be improved under some scenarios. Some scenarios focus on global emissions, and some on regional emissions and country emissions. IPCC, UNEP/GEO, and OECD/IEA scenarios focus on global issues. We can also find many country level studies. **Table 3.1** shows some of these wide varying scenarios.

IPCC SRES Scenarios

One of the most well known scenarios is a set of IPCC SRES Scenarios. Six GHG emission reference scenarios groups (not including specific climate policy initiatives), organized into 4 scenario families, were developed by IPCC and published as the Special Report on Emissions Scenarios (SRES). Scenario families A1 and A2 emphasize economic development but differ with respect to the degree of economic and social emergence; B1 and B2 emphasize sustainable development but also differ in terms of degree of convergence. Some characteristics are illustrated in **Figure 3.1** and **3.2**. For six illustrative SRES emissions scenarios, the projected concentration of CO_2 in the year 2100 ranges from 540 to 970 ppm, compared to about 280 ppm in the pre-industrial era and about 368 ppm in the year 2000. Projections using the SRES emissions scenarios in a range of climate models result in an increase in globally averaged surface temperature of 1.4 to 5.8 °C over the period 1990 to 2000.

IPCC Post-SRES Scenarios

Post-SRES Studies analyze policy and technology options for achieving certain stabilization targets, corresponding impact on economy, energy and other indicators, and their region-wise characteristics. Nine Integrated Assessment modeling teams were engaged in analyzing Post-SRES options for stabilizing atmospheric CO_2 concentrations at 450-750 ppmv by 2150 under six different developmental paths.

Major findings of this stabilization study can be summarized as follows:

(i) Different developmental paths (baselines) require different technological and policy measures for achieving same levels of stabilization of CO_2 concentration, and show different costs of mitigation due to differences in the amount of required reduction (**Figure 3.3**). Thus CO_2 emission trajectories for stabilization are influenced by the baseline scenarios.

(ii) A portfolio of multiple measures is necessary for timely development, adoption and diffusion of desired mitigation options. Policy integration across different technologies, sectors and regions is the key.

(iii) The robust technological and policy options across different carbon mitigation scenarios include (a) continuous improvements in energy efficiency, (b) afforestation, (c) introduction of low-carbon energy especially natural gas in the early 21st century and biomass over next hundred years, (d) technological innovations like gas combined cycle with carbon removal and storage; hydrogen fuel cells; solar photovoltaics; solar thermal power; advanced nuclear technologies; biomass integrated gasification power plants; high temperature fuel cells; and scrubbing technologies.

(iv) Known technological options can potentially stabilize CO_2 concentrations in the range of 450-500 ppmv over the next 100-150 years; however, associated socio-economic and institutional changes are necessary to realize this potential in practice.

Table3.1 A Classification of literature on scenarios of energy, societal and climate change

Environment burden	Societal change	Economy-Technology Scenario	Global level studies	Country level studies
Heavy ↑		High growth with existing technologies	IPCC/SRES(2000)/A1FI IEA/WEO(2002)/Ref SEI/GSG(2002)/Market-Forces Shell(2001)/Dynamic-as-Usual WBCSD(1999)/First-Raise-Our-Growth	Canada/ETF(2000)/Life-Goes-On Netherlands/LOES(2000)/Free-Trade UK/EWP(2003)/World-Market France/Reducing CO_2 fourfold(2004)/BaU Japan/Japan Energy Ooutlook(2004)/Ref WWF Japan/Power Switch(2003)/Ref
	Without social renovation	Medium growth with littletechnological progress	IPCC/SRES(2001)/A2 IEA/Energy to 2050(2003)/ Clean-but-not-Sparkling SEI/GSG(2002)/Barbarization	Canada/ETF(2000)/Grasping-at-Straw Netherlands/LOES(2000)/Isolation
		High growth with technological innovation	IPCC/SRES(2001)/A1T IEA/WEO(2002)/Alt.Policy IEA/Energy to 2050(2003)/ Dynamic-but-Careless SEI/GSG(2002)/Policy-Reform Shell(2001)/Spirit-of-Coming-Age	Canada/ETF(2000)/Take-Care-of-Business Netherlands/COOL(2001)/VisionA UK/EWP(2003)/Global-Sustainability France/Reducing CO_2 fourfold(2004)/ Factor4
	With social renovation	High growth with technological innovation	IEA/Energy to 2050(2003)/ Bright-Skies WBCSD(1999)/Jazz	Canada/ETF(2000)/Come-Together Netherlands/LOES(2000)/Solidarity WWF Japan/Power Switch(2003)/ WWF-Scenario
↓ Light		Medium growth with deep penetration of existing technologies	IPCC/SRES(2001)/B1 SEI/GSG(2002)/Great-Transition WBCSD(1999)/GEOpolicy	Netherlands/LOES(2000)/Ecology-on-a-small-scale Netherlands/COOL(2001)/VisionB

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Multi-gas Analysis

Post-SRES Scenarios concentrate mainly CO_2 mitigation. There is a high potential to mitigate greenhouse gas (GHG) emissions if multi-gases are considered. EMF21 Working Group conducted a comprehensive multi-gas policy assessment for long-term GHG mitigation using 18 models. Two policy scenarios – one focusing on CO_2 mitigation only and the other covering multi-gas mitigation – to stabilize radiative forcing at 4.5 W/m^2 by 2150 relative to pre-industrial times were analyzed. Under reference scenario, different models indicate an increase in average global surface temperature of 2.8-3.8 °C by 2100 relative to the pre-industrial times. This reduces to 1.8-3.0 °C in case of policy scenarios.

While the policy scenario results for atmospheric CO_2 concentration from different models show stabilization within 450-550 ppmv range by 2100, those for atmospheric methane concentration show a wide variation (1190-3350 ppmv by 2100). However, all models show that the amount of CO_2 reduction required in case of 'CO_2-only Abatement' is more than that in case of 'Multi-gas Abatement' policies to achieve same stabilization target. Thus the carbon permit price in case of 'Multi-gas Abatement' is less than that in case of 'CO_2-only Abatement' policies (**Figure 3.4**).

Future works

In the coming years, GHG mitigation research is likely to witness a greater exploration of policy instruments for realizing CO_2 mitigation options; uncertainty in scenarios; country level scenarios and mitigation options especially for developing countries; stabilization of CO_2 at levels other than 550 ppmv; scenarios and mitigation options for non-CO_2 GHGs and particulates; and linkages between sustainable development and climate change objectives.

Land-use change and carbon sequestration are likely to be among the other thrust areas of future development. Greater multi-disciplinary research, covering statistical, ecological and socio-economic modeling approaches, would enhance the knowledge of dynamics of land-use change and carbon sinks, their relation to human activities and natural disturbance, and costs and benefits of mitigation options. Moreover, an increased collaboration between emissions and impacts researchers is expected. This would enable more integrated assessment of mitigation and adaptation strategies and trade-offs.

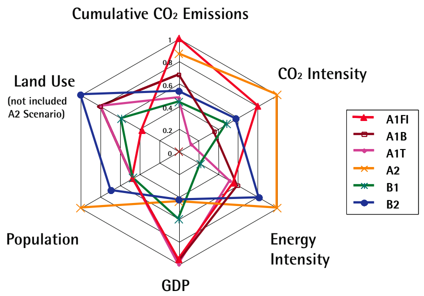

Figure3.1 Characteristics of SRES Scenarios

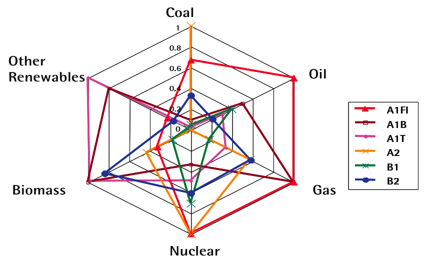

Figure 3.2 Primary Energy Structure of SRES Scenarios

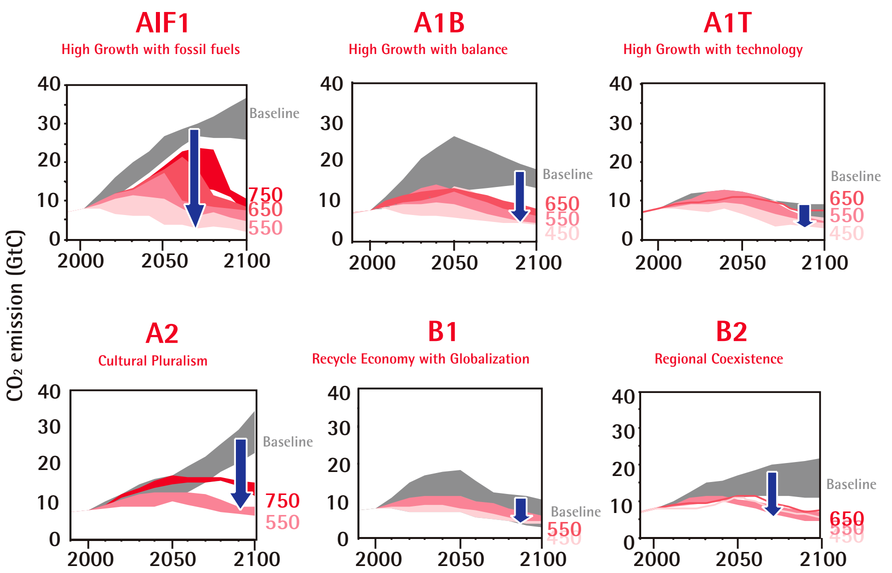

Figure 3.3 CO_2 stabilization under different baseline scenarios

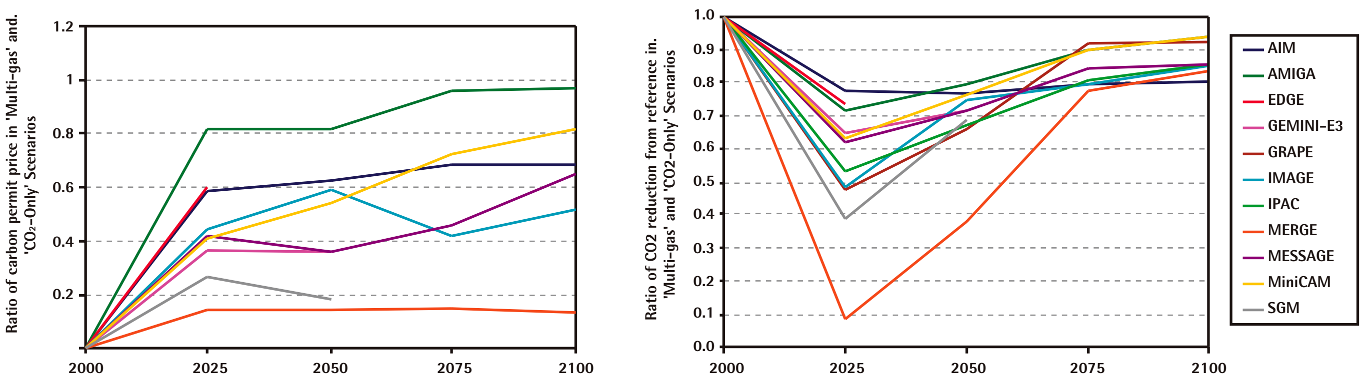

Figure 3.4 Comparison of "Multi-gas" and "CO_2-Only" abatement policies

3.2 Technology options

Background

It is important to set the mid- and long-term goals in view of stabilizing the climate system at a safe level. It is also essential to discuss greenhouse gas (GHG) emission scenarios in order to realize such a goal. In this section, technological prospects, timeframe for technology development and dissemination, and institutional implications in the context of several stabilization scenarios are discussed.

Prospect of Mitigation Technology

Table 3.2 shows examples of climate mitigation technologies, ranging from existing ones to innovative ones that include mega-science. These technologies can be categorized into three types: energy efficiency improvement, low carbon intensity, and others such as carbon-sink. Generally speaking, there are a wide range of technology options, but there remain several economic and social barriers to overcome in terms of technology introduction and dissemination. It should be also noted that some of these technologies may cause environmental and/or societal impacts other than climate change.

Figure 3.5 shows ranges of rates of energy-intensity change in different mitigation scenarios provided by different models and model runs for 1990-2100. The required rate of decrease in energy intensity (energy per unit GDP) in order to meet the given CO_2 concentration stabilization targets is within the range of historically achieved rates for stabilization above 550 ppm, and possibly even at 450 ppm, but the required rate of improvement in carbon intensity (carbon emissions per unit energy) to stabilize at levels below about 600 ppm is higher than the historically achieved rates. As a consequence, the cost of mitigation rises as the stabilization level decreases, and does so more steeply below a target of about 600 ppm than above.

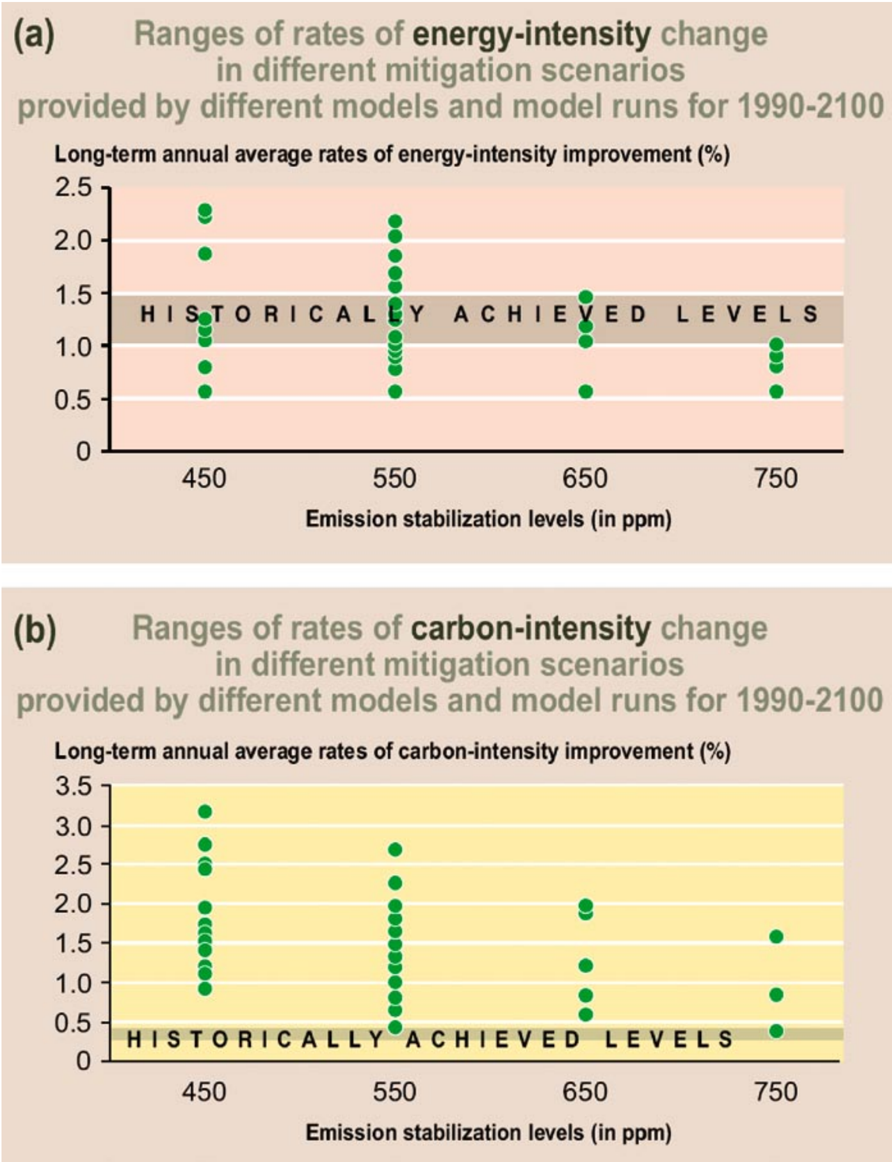

Figure 3.5 Acceleration of energy system change
(Source) Climate Change 2001: Synthesis Report (IPCC, 2001)

Table 3.2 Examples of climate mitigation technology

	Energy end-use technologies (Improvement of energy intensity)	Energy supply technologies (Improvement of carbon intensity)	Others
Existing technologies ↕ Innovative technologies	- High-efficiency industrial furnace - High-efficiency heat pumps - BEMS / HEMS - LED lightings - Hybrid vehicles - Hydrogen storing alloys - Fuel cell vehicle - Bio-technology	- Natural gas combined cycle generation - Fuel cell co-generation - Low cost and high-efficiency PV - High-efficiency generation with super heat resistant materials - Super conductivity power generation - Space solar power system - Nuclear fusion	- Enhancement of CO_2 sink capacity through afforestation - Removal of catalysts for CH_4/N_2O emission from agriculture - Carbon sequestration technologies

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Timeframe for Technological Development and Introduction

There are two approaches to stabilize the climate change: early and gradual action, or late and sudden action as shown in **Figure 3.6**. Rationale for the former approach is as follows:

- Considering the impact caused by rates of temperature increase (°C/decade);
- Considering the uncertainty of development and dissemination of innovative technologies;
- Considering the inertia of energy systems;
- Risk-hedge against the uncertainty of future constraints of GHG concentrations;
- Stimulation of technology development and capital investment.

An example of the second point is shown in **Figure 3.7**. It has taken over 30 years to demonstrate the integrated coal gasification combined cycle (IGCC) generation in Japan.

On the other hand, reasons for the latter approach are:

- Lowering the cost of mitigation technologies;
- Gaining time to develop innovative technologies.

In this case, it should be noted that the costs of damage and adaptation are not considered.

Considering the irreversibility of climate change, feasibility and timeframe of innovative technologies, it is essential to take advantage of existing technologies in both demand-side and supply-side for several decades and to bridge a gap between now and the future when climate stabilization would be required. On the other hand, innovative technology development should be pursued in a long-term perspective. This strategy would be robust even when required to stabilize GHG concentrations at a lower level.

Institutional Implications of Technology Development and Dissemination

There are two types of institutional arrangement to promote technology development and dissemination. One is an approach to stimulate the demand-side behavior by setting goals or standards (pull-type). Another one is an approach to support the supply-side by providing subsidies (push-type). **Table 3.3** shows a comparison between these two approaches.

It is important to introduce a combination of these two approaches corresponding to short-, mid-, and long-term goals. In other words, it is required to proceed both short-term and mid-long term program while these two programs are implemented in a harmonized way.

As a short-term stimulating policy, a "pull-approach", such as reduction targets stipulated in the Kyoto Protocol, would be effective in following a gradual reduction at an earlier stage as shown in **Figure 3.6**.

As for a short and mid-term policy, the Clean Development Mechanism (CDM) is an international innovative institution that has both "pull" and "push" characteristics and contributes to climate mitigation technology development and dissemination in both developed and developing countries.

On the other hand, promotion of international technology development programs would be a possible approach for mid and long-term "push" policy. However, it should be noted that mid and long-term reduction targets would be a continuous signal for future technology development.

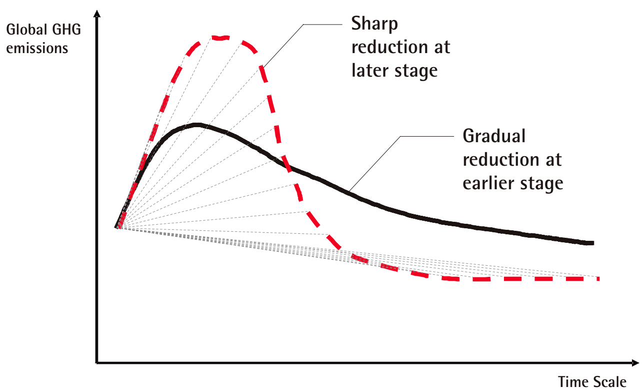

Figure 3.6 Timing of GHG emission reductions

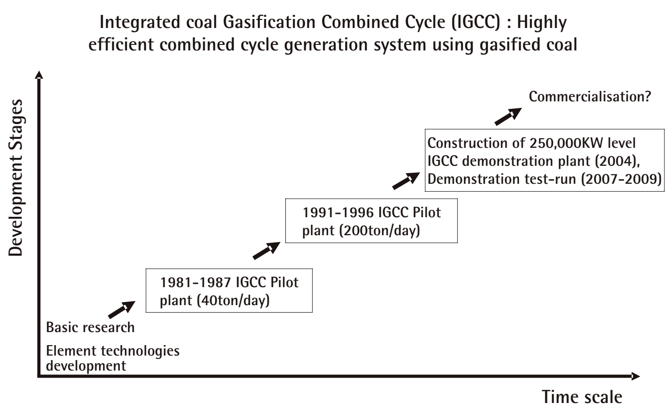

Figure 3.7 An Example of required time period for development of particular energy technology

Table 3.3 Comparison between "pull" and "push" approach

	Certainty	Incentive	Acceptability	Leading Time
Demand-stimulating(pull)	○	○	○	△
Supply-supporting(push)	△	○	○	△

4 Analysis of countries' perspectives

4.1 European Union

Policy direction of a party often represents the party's national (or regional) interests in a given policy area. This means that it entails (at least part of) the party's existing incentives for playing a role in the future climate change regime. For this reason, we now turn to the policies of selected parties before investigating options for future climate change regime that are currently available.

EU's emissions and commitment under the Kyoto Protocol

The EU as a whole is the second largest emitter of GHGs in the world. The EU has committed to 8% reduction of GHGs under the Kyoto Protocol, which is redistributed among 15 member states based on the burden sharing agreement. The new 10 member states continue committing to their own targets set in the Protocol. The EU total GHGs emission decreased by 2.9% in 2002 relative to 1990 level, but Emissions trends are diverse among member states.

The two faces of the EU as an international actor

The EU has an external face, acting as one cohesive coalition in international negotiation process. It has continuously aimed at exerting leadership in international climate negotiations. Representatives of the EU member states – often composed of the "EU troika", which consists of the current, past and future Presidency – negotiate internationally on behalf of the EU.

Internally, on the other hand, targets are divided for member states under the burden sharing agreement, but most of the policies and measures are left in the hands of member sates.

EU Domestic Policies and Measures

After adopting the Kyoto Protocol in 1997, in which the EU committed to the 8% reduction target as a Community, the European Commission (especially the leading DG of climate policy, DG XI) has taken initiatives to develop common and coordinated policies and measures in order to enhance efforts of all member states to achieve their targets and thereby to achieve the EU's target.

The development of common and coordinated policies and measures centered on the European Climate Change Programme (ECCP) published in June 2000. Under the ECCP, a number of working groups were set up to develop further policies and measures focusing on the energy, transport and industry sectors.

The highlight of the common and coordinated policies and measures developed under the ECCP is the community-wide emissions trading scheme (EU ETS), which is expected to start in January 2005. The expected positive impact of EU ETS is on creating a common market, which is the EU's original objective. A key for success in the introduction of emissions trading scheme prior to other industrialized countries is the EU ETS institution building (For more details, please refer to Watanabe 2004 a, b). A successful institution building will enhance the cohesiveness of the EU as an international actor, which is a key for the EU's leadership in international negotiation process. This may also facilitate linking EU ETS with other emissions trading schemes.

Incentives for the EU to participate in a multilateral climate regime

As described above, the EU so far has aimed at being proactive towards climate change issue. The following are drawn as major incentives for the EU to participate in multilateral climate institutions.

- To contribute to its original objective to create a single market
- To proceed with the same kind of approach as the Kyoto Protocol, as EU ETS is based on the assumption of internalization of hierarchical targets from global to installation.
- To play leadership role in international politics in general and climate change in particular, before the US

The EU is expected to continue to play a positive role in multilateral approach in tackling climate change. Attempts by some member states to set up mid- and long-term targets described in Section 2 are considered as positive signs as they would provide with a guideline.

However, several factors to have both positive and negative impacts on the EU's attitude towards climate change issue are observed.

Critical factors that influence the EU position

EUETS

There are some uncertainties regarding the future of EU ETS. However, based on historical institutionalism, the course of policy is considered as hard to change once an institution such as EU ETS is successfully built, and once its linkage with other institutions is being made.

Janus-faced EU as an international actor

All member states have to agree on their positions on all issues as the EU prior to international conferences. It gives the EU more negotiation power on the one hand; however, deprives of flexibility for leading a compromise on the other.

The enlargement of the EU from 15 to 25 member states from May 2004

The enlargement could have reciprocal impacts. Including central and eastern European countries, whose emissions have been decreasing, could bring the EU into more positive attitudes towards multilateral approach to climate policy. With the number of member states and the areas of the Union enlarge, the power bases (e.g. size of economy) also increase. However, the funds to be transferred to new entrants, the increasing diversity among member states, and the potential economic growth accompanied with emissions growth in new entrants, could have negative impacts on the EU's position.

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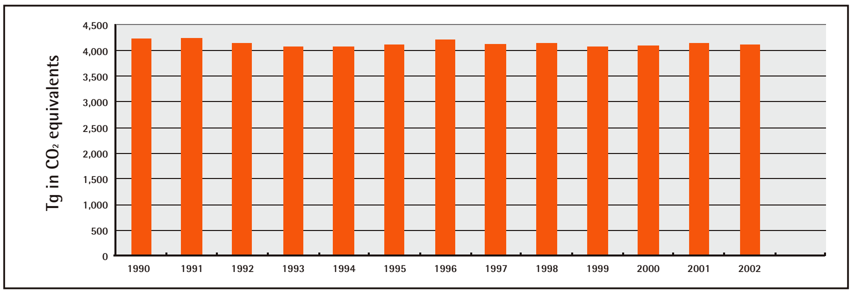

Figure 4.1 GHGs emissions trend in EU 15 member states
Data source: Annual European Community greenhouse gas inventory 1990-2002 and inventory report 2004, European Environment Agency

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4.2 United States

The US is the largest emitter of GHG and has one of the most dynamic and innovative markets in the world, hence its engagement is critical to the success of any international effort against global climate change. Such structural elements enable the US to exercise power over the direction and pattern of climate regime by not only its "action" but also its "inaction".

Domestic Political Economy and International Inaction

In 2001, the Bush administration decided not to place the Kyoto Protocol before the Senate for ratification, because it was not in the US interests. The withdrawal of the US made the future of the Kyoto Protocol uncertain, leaving to Russia the power to decide whether or not the Kyoto Protocol will come into force. This inaction by the US would also negatively affect not only the environmental effectiveness but also the price of emission permits under the Kyoto Protocol.

After defecting from the Kyoto Protocol, the Bush administration launched three policy initiatives: GHG intensity reduction by 18% between 2002 and 2012 by voluntary measures; research and development of climate-friendly technologies; and a program for improving climate science. This policy package, however, is frequently criticized for lacking near-term domestic actions to curb actual GHG emissions and failing to propose an alternative international framework.

Between 1990 and 2002, total US GHG emissions increased by 11.5%, or from 6,155.8 million metric tons to 6,862 million metric tons (estimated) (**Figure 4.2**). With this upward trend in emissions, there is not much prospect of revising the US support for the Kyoto Protocol, whoever wins the White House, because it has an only slim chance to comply with the Kyoto target (7% reduction compared to the 1990 level by 2012).

Immaturity in Domestic Consensus

The emergence of national consensus on domestic policies is a precondition for the US to be re-engaged in international efforts against climate change. Such consensus never emerges from a political vacuum, but rather it is shaped through a political process where various social groups interact. In the US, the ratification of any international treaty requires a two-thirds majority in the Senate and the existence of domestic implementation authority. These institutional features set a high threshold for ratification and increase the importance of domestic consensus.

Several domestic factors have contributed to the formation of current, general preference for a long-term technology-oriented solution to near-term mitigation actions. They include the automobile-dependent way of life, the high rate of population growth and large potential for economic growth in relation to other industrialized countries, an abundance of cheap domestic coal, and the entrenched interests of the fossil energy industries in policymaking process. Even with the general preference for technology development, however, there is still discord on how to allocate resources to specific technologies. The political complexity of climate issues in the American context has hindered the development of a consensus in national policy on climate change.

Promoting the US Actions

Despite the policy gridlock at the federal level, various actions taken at the local and private firm levels are potentially able to provide a breakthrough. State-level actions, for example, range from a regional cap-and-trade scheme, transportation issues, to waste management. They are motivated by awareness of local vulnerability to climate change as well as realized and/or perceived cost saving and co-benefits. The best of these state activities can provide models for new federal policy. Moreover, many private firms are committed to climate change activities, some of which are reported to go far beyond the existing federal policy. These firms find that such activities enable them to improve energy efficiency, save energy costs, promote new technology, and obtain new marketing tools.

The rest of the world can facilitate these sub-federal initiatives, which in turn can help build domestic consensus on climate policy in the US. Successful mitigation policies by other countries can promote the perception that there are various benefits stemming from mitigation projects. By developing markets that reward climate-friendly businesses and technologies, other countries can encourage those American firms that operate in such markets to advance their climate-friendly activities and relieve their concerns about the US domestic climate commitments. If other countries succeed in implementing mitigation policies, they can further the US domestic interests in favor of near-term mitigation commitments. This paves the way for re-engagement of the US in international efforts against climate change.

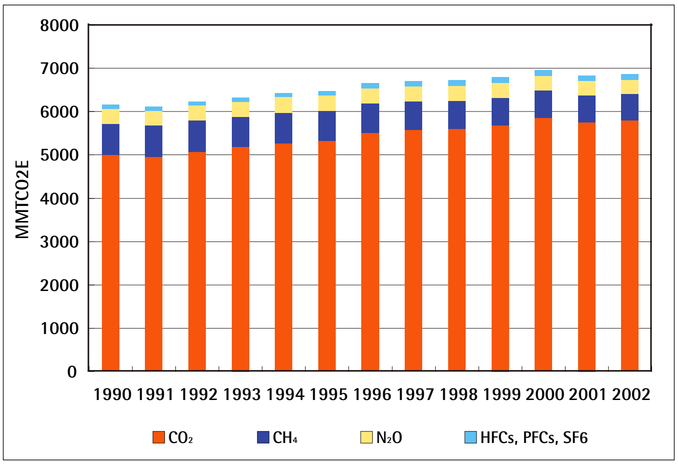
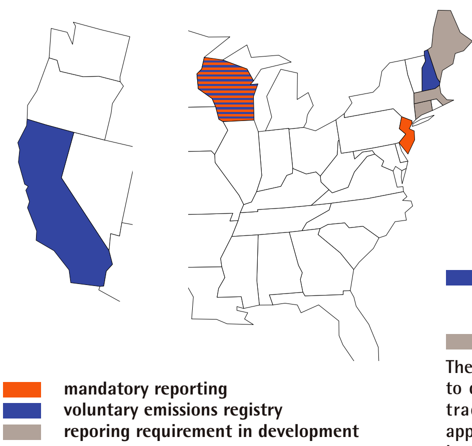
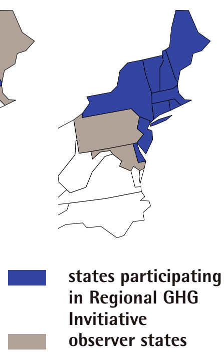


Figure 4.2 Emissions of Greenhouse Gases in the US, 1990-2002





These11 states are working to develop a CO_2 cap-and-trade system that would apply to power generations in the region.

Figure 4.3 Mandatory GHG/CO_2 Reporting and Voluntary Registries

Figure 4.4 Regional Emissions Trading Initiative

source: Pew Center on Global Climate Change http://www.pewclimate.org/what_s_being_done/in_the_states/

4.3 Japan

The summer of 2004 was a record-breaking summer in Japan. Tokyo counted 40 consecutive mid-summer days (Daily maximum temperature exceeding 30 °C), which has become a new historical record.

Emissions from Japan

Although Japan is a Party to both the UNFCCC and the Kyoto Protocol, its greenhouse gas (GHG) emissions are still on the rise. Even with all the new policies to mitigate the growth of emissions, the latest data show that the total GHG emissions from Japan in 2002 have been 7.6% (tentative figure) more than that in 1990. Emissions growth in the last decade is observed exceptionally in residential/commercial and transportation sectors. The Japanese population is expected to start decreasing in 2005 or 2006, but GHG emissions are estimated to continue their growth due to aging and growth in the number of households. Additional measures are deemed necessary to achieve the 6% reduction target in the Kyoto Protocol. (**Figure 4.5**)

Guideline of Measures to Prevent Global Warming

The central climate policy in Japan is the Guideline of Measures to Prevent Global Warming, which was revised in June 2002 to adjust the domestic policies based on what was agreed upon in the Marrakech Accords. The revised Guideline sets an emission target for each sector such as industry and transportation. Under this revised Guideline, various policies and measures are implemented to reach the assigned emission goal. To alter the growing trend of emissions, the Guideline is to be revised again by end of this year (2004) and additional measures are expected to be implemented accordingly.

Willingness and concerns in the Japanese domestic decision-making on climate change

Japan is the fourth largest emitter of carbon dioxide (CO_2) after the U.S., China, and Russia. Around 2% of the world population is responsible for around 5% of the total CO_2 emissions of the world. On the other hand, Japan is relatively less responsible for climate change among the industrialized countries in terms of emissions per capita or of energy efficiency. One Japanese person, for example, emits about 9.7 tonnes of CO_2, while one American emits 20.0 tonnes, and one German 10.4 tonnes (figures for the year 1999).

Turning our eyes to the Japanese foreign policy in general, its basic position since 1945 has been to ally with the U.S., Japan's most important partner both from security and economic perspectives. On the other hand, when it comes to national circumstances concerning energy consumption, Japan is much closer to Europe.

Such conflicting dimensions have been fundamental factors that have formed rather ambiguous Japanese positions on climate change debate in the past negotiations.

On one side, Japan recognizes its own responsibility to mitigate climate change, as well as its willingness to move forward aiming at a more energy-efficient world. On the other side, there are oppositions against moving forward without participation of Japan's largest partner, a country that is emitting much more than Japan. The latter side of the two perspectives is strong exceptionally in the industry sector. These two aspects have both been observed throughout the past decade of negotiation on climate change, with emphasis shifting from one to another. This trend is likely to continue in the future.

Incentives for Japan to participate in future climate institutions

The two aspects of Japanese decision-making on climate policy are the determinants of Japan's commitments towards future actions for climate change mitigation. Incentives and benefits for Japan to participate in a future climate institution lie where the two aspects are satisfied simultaneously.

- Emphasis on the economic benefits of shifting to a less carbon-intensive society: Simply reducing emission per se does not always lead to economic benefit. On the other hand, shifting to a less-carbon intensive society would more or less mean shifting to a more sustainable society in terms of consumption of energy and natural resources. Structural change, rather than a mere collection of end-of-the-pipe technologies, is to be sought for.
- Japan's role in international society: There are debates in Japan whether Japan should favour bilateral over multilateral agreements related to climate change. Bilateral agreements may be relatively easier to reach an agreement, as there are fewer countries involved. On the other hand, it may be more difficult for bilateral agreements to aim for a long-term target for the same reason. If Japan is to sincerely commit to climate protection, it should stimulate discussion multilaterally, while at the same time making progress at the bilateral level.

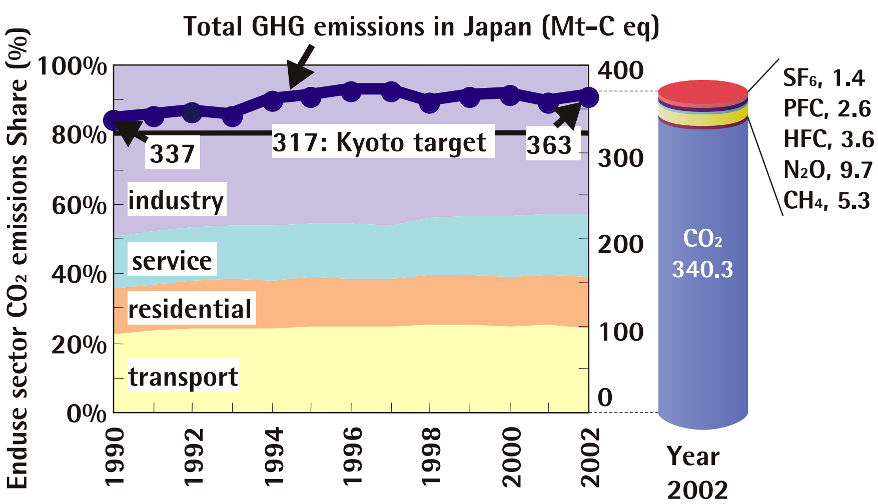


Figure 4.5 CO_2 emissions from Japan (by Dr. Junichi Fujino, NIES)

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4.4 Developing countries, Russia and other EITs

4.4.1 Developing Countries

(a) Role of the developing countries

Strategic use of "meaningful participation" by the US

The main point of the Byrd-Hagel resolution adopted by the US Senate just before the COP3 in 1997 was a criticism regarding the lack of developing countries' legally binding commitment on the GHG emission reduction (limitation). The same argument was used by the current US administration when it declared to walk out from the Kyoto Protocol in 2001, which brought tremendous impact onto the fate of the Kyoto Protocol. However, at COP 8 in 2002, the same US administration took a totally opposite position toward the need of developing countries' commitment, which might be possible to be interpreted that the US position was not based on the principle but on the strategic judgment, which aimed to make the confrontation more harsh and to make the negotiation more difficult to reach consensus.

Importance of equity

Although there are many things that the developing countries are demanding, the most common perception on their requirement is to properly address the issue of equity, as it has a paramount importance for the developing countries (**Figure 4.6**). Considering how harmful and disproportionate the impact of the GHG emissions is to the people of developing countries, and how important it is to address the issue of the way to consider the allocation of the natural resources equitably, it is difficult to deny the liabilities of the developed countries.

Leakage and competitiveness

Leakage may occur when the commitment of the developed countries to reduce GHG emissions just means lowering, for example, one's fossil fuel generation capacity or steel producing capacity only to find another country increase its production level. If this is the case, global emissions will be unchanged and impacts on competitiveness will be problematic. However, in many cases, the origin of competitive disadvantage comes not from the environmental regulation, but from the difference in labor cost. For example, quite recently, a big Japanese firm in the heavy industry which consumes high amounts of fossil fuels has decided to start production in China not because of regulation in Japan but because of very low investment cost just one-fifth of Japan in China.

(b) Ways forward for the developing countries

Differentiation among the developing countries

Since developing countries are diverse, it is quite logical to think that different countries have different roles for climate protection. One method (grand rule) of differentiation is to set up the index that is composed of, for example, per capita emissions and per capita income. Using this index, the least developed countries will be able to gain through emissions trading. On the other hand, more advanced developing countries with relatively high per capita emissions/income are supposed to make a commitment that is similar to that of developed countries.

Adaptation

Although there are high degree of uncertainties, there is no doubt that the human beings, especially people in developing countries, should prepare to face the impact of temperature increase, which would be at least 1°C. Therefore, it is quite understandable that developing countries view adaptation equally important as mitigation. In this context, a new scheme such as an adaptation protocol as well as disaster relief financing for developing countries would be necessary to advance the negotiation between developed countries and developing countries on the commitment of developing countries.

Restructuring of the Clean Development Mechanism (CDM)

The biggest problem of the carbon market is its currently low carbon credit price. The fact is that the revenue from the sales of carbon credits makes little difference on the commercial viability of the projects. Therefore it is necessary to maintain the carbon price to a certain level, for example, by limiting the supply or by imposing minimum quantity/quality obligation for buyers. It is also important that, to keep the CDM alive, there must be a strong demand in the market, which in turn means that the developed countries must have a legally binding quantitative emission reduction obligation in the second commitment period with no hot-air in the market.

Inter-linkage

Many future climate regime proposals focus on enhancing developing countries' participation. However, it would be extremely difficult to persuade developing countries to accept commitments by simply pointing out the threat of climate change and the responsibility to address it, because they have legitimate counter-arguments that the developed countries are responsible for historical GHG emissions. Therefore it is essential to address inter-linkage issues (ancillary benefits) of climate policy, in order to persuade developing countries to take on stronger commitments. The challenge is how to incorporate the inter-linkage perspective in a concrete proposal for the future regime.

4.4.2 The Russian Federation

The Russian Federation has a rationale to postpone the decision making on the ratification. The more it delays the ratification, the more it may get the political/economical concessions from the EU, Japan and the US. Although the EU seems to have already made a deal with the Russian Federation using the WTO card, the timing of the ratification is not yet clear at this moment. It is also difficult to rule out the possibility that the Russian Federation will demand additional concessions. Therefore, to some degree, it is necessary to impose political/economical/ethical pressures on the Russian Federation before the CDM and other schemes in the Kyoto Protocol become non-functional. It is also important to let the Russian Federation understand that the hot air is not an environmentally legitimate endowment and it is difficult to ask for it again in the second commitment period.

4.4.3 Other EITs

As being under the EU Emission Trading Scheme and being acceded to the EU, the Economies in Transition (EITs) are going to be fully incorporated in the EU. EITs have general characteristics such as the medium to high level of per capita emissions and low to medium level per capita incomes. Therefore it is important for them to change the energy system as well as social infrastructure, which may pose heavy burden if the emissions per capita become a key index to differentiate the commitments among countries.

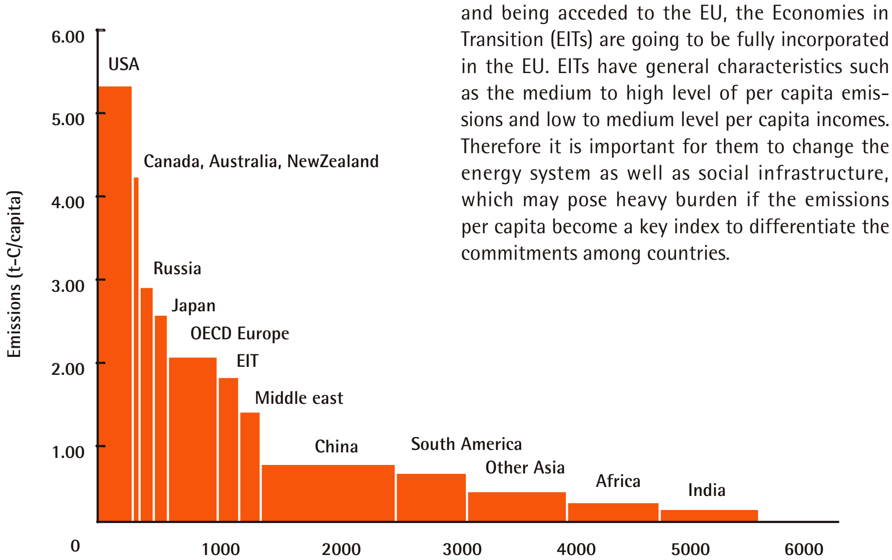

Figure 4.6 The Current Distribution of CO_2 Emissions

5 Institutional options for the future

5.1 Decision-making under uncertainty

In order to address climate risks, reducing critical uncertainties is undoubtedly necessary. However, further scientific research may identify new uncertainties, hence leading to an increased level of uncertainty. Therefore, in order to address climate risks, one should not wait for an uncertainty-free evidence to implement climate protection policies, otherwise irreversible adverse impacts of climate change could occur. The notion of "precaution" has thus definitely emerged to address the environmental risks (**Table 5.1**), although there has been a controversy on whether it is a "principle" or "approach". The UNFCCC (Art. 3.3), like other MEAs, provides the legal basis for pursuing precautionary climate policy.

From the Japanese perspective, it was decided by the Cabinet Council (Dec. 2000) that environmental policy elucidated in the Basic Plan should be guided by the "precautionary approach" to address various uncertainties confronting environmental risks. The Plan stipulates the precautionary approach as one of the four basic concepts guiding the Japanese environmental policy to construct a sustainable society in the 21st century. Concretely it stipulates that the lack of scientific evidence such as cause-effect relationships should not be the reason for postponing implementation of mitigation actions but be seen as an opportunity to encourage scientific research and to implement necessary precautionary measures to address environmental problems which have the potential of adversely and irreversibly harming the society. We believe that climate change is the exact case for Japan to implement precautionary measures as it is stipulated in the Environmental Basic Plan and therefore to pursue discussions and implementation of a future climate regime on a precautionary basis.

The notion of "precaution" gives us some suggestions for elaborating a future climate regime. First, such a regime should be based on the best available scientific knowledge, and every regime development should be reviewed in light of new scientific knowledge. Second, given the irreversible nature of climate change effects, the future regime including the stabilization target and its time-scale should be set, leaving enough policy choices to future generations so that they would not be forced to go with the worst case scenario.

Table 5.1: Precautionary Principle/ Precautionary Approach in Multilateral Environmental Agreements
❇ "Blanks" in the table indicate "no mention" or "not specified"

Environmental Agreement MEA (Year of adoption)	Objective	When does the principle apply	About what does uncertainty exist	Action required in face of uncertainty	Note
UNFCCC (1992)	Preventing climate change	Guiding principle for the parties implementing the UNFCCC		Should not use as a reason for postponing precautionary measures.	Taking into account that policy and measures should be cost-effective.
Biodiversity Convention (1992)	Protecting biodiversity			Should not use as a reason for postponing measures to avoid or minimize such a threat.	Stipulated in the preamble
Convention on the Protection and Use of Transboundary Watercourses and Lakes (1992)	Preventing pollution of international rivers and lakes	Guiding principle for the parties taking measures referred to in Articles 2.1 and 2.2	A causal link between hazardous substances and the potential transboundary impact	Action to avoid the potential transboundary impact of the release of hazardous substances shall not be postponed on the ground that scientific research has not fully proved such a causal link.	
OSPAR Convention (1992)	Protecting the marine environment		A causal relationship between the inputs of substances or energy and the effects	Preventive measures are to be taken	Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992 (entered into force in 2000)use a similar language.
Protocol on Further Reduction of Sulphur Emissions of the LRTAP (1994)	Preventing transboundary air pollution			Should not use as a reason for postponing precautionary measures.	• Taking into account that such precautionary measures should be cost-effective • Stipulated in the preamble
1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (1996)	Protecting the marine environment	General obligation in the parties' implementing the protocol	A causal relation between inputs and their effects	Appropriate preventative measures are taken to protect the environment from dumping of wastes or other matters	
Biosafety Protocol (2000,)	Controlling transboundary transfer of the living modified organisms (LMOs)	In the Party's taking a decision on the import of the LMO	The extent of the potential adverse effects of a LMO on the conservation and sustainable use of biological diversity in the Party of import	Shall not prevent that Party from taking a decision on the import of the LMO in order to avoid or minimize such potential adverse effects	
		When the risk assessments are carried out in accordance with Annex III	The level of risk	May be addressed by requesting further information or by implementing appropriate risk management strategies and/or monitoring the LMO in the receiving environment.	
Stockholm Convention on Persistent Organic Pollutants (POPs) (2001)	Managing chemical pollutants	When the Committee decides on the listing of chemicals in Annexes A, B and/or C		Shall not prevent the proposal from proceeding	The Conference of the Parties shall decide, in a precautionary manner, whether to list the chemical, and specify its related control measures, in Annexes A, B and/or C

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5.2 Equity

The IPCC TAR emphasized that negative effects of climate change would often impinge on poor people the most, who contributed the least to the overall GHG emissions. Such position, by intuition, seems unfair. Therefore, it is not surprising that equity issues have been at the core of the climate change debate both explicitly and implicitly. This section provides an overview of equity issues associated with climate change, focusing on the question of hierarchy among various equity principles and its operationalization in the future climate regime.

1. Equity in the Climate Change context

We can find the following statements in documents of the UNFCCC and IPCC:

The Parties should protect the climate system for the benefit of present and future generations, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities... (Article 3.1)(UNFCCC, 1992)

The specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change, and of those Parties, especially developing country Parties, that would have to bear a disproportionate or abnormal burden under the Convention, should be given full consideration'.(Article 3.2)(UNFCCC, 1992)

"The impacts of climate change are likely to fall disproportionately upon the poorest countries and the poorest persons within countries, and thereby exacerbates existing inequities in health status and access to food, clean water and resources" (IPCC, Third Assessment Report, 2001)

By referring to these texts and recent studies on the future regime (Ringius et al. 2000; den Elzen et al. 2003), important equity principles may be summarized as follows:

Egalitarian: All human beings have equal rights to: 1) be protected from the dangerous climate change, and 2) to 'use' the atmosphere.

Sovereignty and acquired rights: All countries (people) have a right to use the atmosphere, and current emissions constitute a 'status quo right'.

Responsibility: Mitigation efforts should be distributed in proportion to a country's share of responsibility for causing the problem.

Capability/Capacity: Mitigation efforts should be distributed in proportion to a country's ability to pay, as well as its mitigation opportunities.

Need: All individuals have equal right to pollution permits, and securing basic human rights is a minimal requirement; it includes the right to a decent standard of living, i.e. respect for individual (equal) rights for development.

Although there are many perspectives on equity, one could, in fact, derive a hierarchy of above principles based on moral arguments (van Vuuren et al. 2003). In such a hierarchy, the basic need principle comes fast, as it exempts one even from the principle of proportional contribution. The capability/capacity principle would rule out the responsibility principle as one cannot be expected to contribute proportionally to one's responsibility if climate change constitutes a disproportional or an abnormal burden. Finally, the sovereignty principle comes last, as one is not allowed to continue to emit freely if emissions are known to be harmful to others.

2. Operationalization of the Equity Principle

Article 2 and the precautionary approach

Although the equity issue is being argued mainly in terms of sharing the burden of the future commitments, it is important to address the fact that the any amount of anthropogenic climate change is dangerous from the perspective of equity. In other words, every human life lost is an irreversible harm and every human has a right to be protected (egalitarian principle). In fact, we are trading away lives and species in order to advocate an "economically reasonable" definition of the dangerous anthropogenic interference, which in turn defines the long-term commitments (Baer 2004). Considering that humans have no experience with global climate change and the risk is unique, it is obvious that we should take precautionary approach.

Meaningful participation of the developing countries

As per the Berlin Mandate, the industrialized countries pledged to make the first move by accepting, at least for a while, binding greenhouse gas (GHG) emission reductions from which the South would be exempt. The mandate, which declares that the rich would go first, was the key that opened the future of the climate negotiations (Muller 2003). However, it can be argued that we need to start thinking on differentiation among the developing countries by using indices, for example, per capita emission and per capita income, which comply with the hierarchy of the equity principles mentioned above.

Free-riding

From an egalitarian perspective, it is not equitable to allow free-riders that do not participate in the coalition to protect climate. Since free-riding is mainly derived from economic incentives, it might be necessary to persuade the free-riders to join the coalition by using not only the moral argument, but also economic sanctions such as trade measures.

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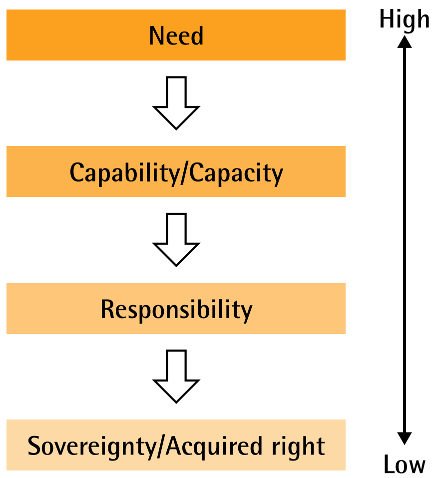

Figure 5.1 Hierarchy of the equity principle
Source: den Elzen *et al.* (2003)

5.3 Multilateralism: basic framework of a future climate regime

A perusal of various proposals on the future climate regime reveals a fundamental difference in conception, which enables us to group the proposals into 2 types: a single universal regime or bilateral/regional-based plural regimes.

It is true that the latter type, although very few in number, have some advantages. The core part of an international regime is based on an agreement among states through international law making process, which is totally different from the one at the national level. No state is legally bound by international rules without its consent and as a result, the more states participate in a regime the lower the level of an agreement among states to be achieved in the regime tends to be: states can only reach an agreement the level of which all states participating in the regime can agree upon. That comes from the structure of international society without a supreme legislative authority over sovereign states. Like some successful examples such as regional sea agreements, one could expect to raise the level of an agreement to a higher one by intentionally reducing the number of regime participants.

However, it is neither possible in all cases nor automatically that this kind of "bottom-up" approach works effectively. In some cases such as climate change, reducing the number of regime participants might not necessarily lead to a higher level of agreement within the regime. As regards climate change, although taking mitigation actions causes costs to be assumed by states, there is no guarantee that it does return corresponding benefits to them. In such a case, even though the number of regime participants is limited, incentives to raise the level of an agreement in the regime will not work without a strong political will shared by the regime participants towards such a direction. Moreover, fragmented plural regimes under this bottom-up approach might easily lead to disparities in mitigation efforts and thereby costs to be assumed between different regimes. Since taking mitigation measures could affect the competitiveness of industries, such disparities could act as an incentive for a regime possibly reaching a higher level of agreement to lower its level up to the level of other regimes. Above all, this approach cannot guarantee that global emissions reduction necessary for preventing climate change will be achieved. For this approach to work, a kind of coordination mechanism between separate regimes will be needed: it means some global regime will then be necessary.

In addition to such limits involved in this approach, there are other convincing reasons for supporting a single universal regime as basis of a future regime in the sense that any country wishing to participate is allowed to be a member of the regime. First, all countries have an interest in how a future regime would be framed because adverse impacts of climate change could occur in any part and any country of the world. Climate science can tell us climate change would lead to disastrous impacts on ecosystem and our society, but cannot tell us exactly which country would be affected to what extent. If it excludes some countries, especially the most potentially affected ones, it could be considered unfair and its legitimacy could be called into question. The regime's recognition as legitimate and fair has a critical influence on participation in the regime by countries; the regime that is considered unfair hinders countries' participation in it. The second reason is that a single universal regime might offer guarantee to some extent that no country could free-ride. Taking mitigation actions may lead to additional costs to countries and affect countries' competitiveness, so assuring that every country take on reducing its emissions under the regime is a driver for countries' participation and then their implementation of commitments.

The purpose here is not saying bilateral/ regional-based regime has no role or function in a future climate regime. Under certain conditions, such a regime could play an important role for tackling climate change. However, even *in order to make such a "bottom-up" approach work effectively, a global universal regime coordinating the bilateral/ regional regimes is necessary.*

GATT: Is it a useful model for the climate regime?

There is an idea that GATT/WTO regime could be applied as model of the future climate regime. Under the GATT regime, states negotiate on tariff concessions on a bilateral basis. When states agree on lowering and eventually eliminating their tariffs, the agreed tariffs apply to all parties, including third parties, under the most-favored-nation principle. The idea with respect to climate change is that states negotiate bilaterally on mitigation targets for each sector until the agreed levels could totally attain the global target enough to prevent climate change.

It is true that the GATT system has some attractive points. Among others: i) outsiders of the regime cannot receive any benefits of tariff concessions, which provides countries with incentives to participate in the regime; ii) only parties wishing to arrive at an agreement take part in negotiations, which could possibly make negotiations proceed more smoothly.

However, we find some critical difficulties in this kind of proposal. It should be noted that *climate regime is fundamentally different from the free trade regime in terms of the nature of issue on which each regime is based.* First, negotiations on tariff concessions under the GATT return the benefits of concessions directly to negotiating countries, if only the negotiations arrive at an agreement. Here is the incentive for countries to take a lead in going into negotiations and in reaching an agreement. In regard to climate change regime, negotiating and reaching mitigation target does bring about common benefits to all countries, but not necessarily return the corresponding benefits to each country taking actions, although mitigation efforts are not without cost to countries. In such a case, incentives to start negotiations and reach an agreement might not work. Second, this proposal does not tell us how to attain the required global target. The GATT leaves everything to countries' discretion after all, including whether they negotiate or not and at what level of target they agree on. Current scientific assessments require a deep cut of emissions in a couple of decades, and the GATT model cannot ensure how the regime could succeed in achieving required global reductions in a required period.

A regime without States?: State's role in a future regime

GHG emissions are mainly due to our human activities. In that sense, various actors are responsible for climate change and their role is very much important for effective solution of climate change. However, it does not mean that things should be left to each of these actors as they like and that states have little or no role in this regime. Climate change issue we face now arises from the "market failure". In this case, letting actors do as they like cannot give us a solution. We definitely need a "policy" with view to attaining the objective of preventing climate change as well as doing it in the most cost-effective way both at national and international levels. Furthermore, at this moment in international society, no supra-national entity has the power to directly regulate and induce individuals and economic actors; only states have the power to do so. There are numerous precedents in which states exercise the power on private actors through their policies for achieving internationally agreed objective, including quantified targets.

Making full use of the UN process and the UNFCCC

Therefore, a future regime should be universal, in which all countries can be members. In this regard, the regime should be based on the UN process, where almost all countries in the world have participated. Another supportive rationale is that other issues such as development issues closely linked to climate change have been dealt with in the UN process for long time. Making use of the UN process could make these related issues possible to be dealt with in an integrated way. From that perspective, the UNFCCC based on the UN process, in light of its quasi-universal participation and well-constructed administrative structure with over 10 years of experience, will be expected to provide the most appropriate forum as basis of the future climate regime.

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5.4 The Kyoto Protocol as the first step towards the long-term goal

Assessments of the Kyoto Protocol vary from one to another. Many consider the Kyoto Protocol as an important first step of a long journey towards climate change mitigation. Others consider the Protocol as a complete flaw. A thorough look at the Kyoto Protocol is important in order to recognize what is necessary in the next round of strategies for climate protection.

Kyoto Protocol as a signal to achieving a multilateral agreement aiming at climate protection

The foremost and the most significant impact of the Kyoto Protocol on the global climate policy is its existence as a treaty agreed upon multilaterally. If no agreement were reached at COP3, there would not have been any pressure to act by each country at both domestic and regional levels. Failure to achieve an agreement could have been a justification for non-action.

The Kyoto Protocol sets an emission target for each Annex I country. While some countries are reluctant about, or having difficulty with, achieving their targets, the targets surely work as criteria to evaluate countries' efforts for climate protection. Many countries have adopted major climate policies or programs at domestic level since the adoption of the Kyoto Protocol. Those policies and programs show plans for achieving their respective emission targets. Such drastic policy changes at the domestic level did not happen at the time of entry of UNFCCC.

Targets are also useful to assess how much more we need to do in order to avoid crossing a dangerous level of climate change. It is worthwhile to note that none of the critics of the Kyoto Protocol has been able to come up with an alternative proposal that assures the long-term climate protection.

Kyoto Protocol as an institution kicking off the Kyoto mechanisms

The Kyoto Protocol has not entered into force, but a few mechanisms established by the Protocol have already begun to develop. They are the three Kyoto mechanisms, namely international emissions trading, joint implementation and the Clean Development Mechanism (CDM). The EU regional emissions trading, which is due to start in 2005, may not have been possible without the Kyoto Protocol, as the EU was reluctant on allowing international emissions trading in the Kyoto Protocol during negotiations up to COP3. The EU changed its position on emissions trading dramatically after the adoption of the Kyoto Protocol.

A similar comment could be made for the CDM. There were many obstacles ahead when the CDM was introduced in 1997. However, as the Parties discussed detailed rules of the CDM and reached an agreement at the Marrakech Accords in 2001, it started to become more realistic and reliable than before. Today, the CDM Executive Board works extensively to see further development of the CDM project activities.

Kyoto Protocol as "the only show in town"

The Kyoto Protocol is an achievement after five years of negotiation since adoption of the UNFCCC. The Marrakech Accord is also another significant achievement. It took a lot of negotiation time and effort of thousands of participants to finalize those two documents.

The Kyoto Protocol consists not only of emission targets and the Kyoto mechanisms. It has established other significant rules such as procedural rules for accounting, monitoring, reporting and reviewing, several funding mechanisms, and procedures for compliance.

In the next round of negotiation, some elements of the Kyoto Protocol could be altered if necessary, but it would not be institutionally efficient to start negotiations all over again. It would be efficient to make the best use of existing mechanisms and rules.

Kyoto Protocol and climate regime: ways ahead

In the next round of negotiation, new commitments for the present Annex I countries and "participation" of non-Annex I countries are likely to be the two most debatable agendas. For the latter, means of "participation" can vary, starting from amendments of Annex I and B, addition of new Annexes in the UNFCCC or the Kyoto Protocol, to addressing a new Protocol under the UNFCCC. In any case, the Kyoto Protocol will be the initial starting point of the future negotiation.

Photo 5.1 COP 3 in Kyoto, Japan

Table 5.2 Countries that have ratified the Kyoto Protocol as of July 2004 (indicates an Annex I Party to the UN Framework Convention on Climate Change.)

ANTIGUA & BARBUDA	CYPRUS	ICELAND	MICRONESIA	SEYCHELLES
ARGENTINA	CZECH REPUBLIC	INDIA	MONGOLIA	SLOVAKIA
ARMENIA	DENMARK	IRELAND	MOROCCO	SLOVENIA
AUSTRIA	DJIBOUTI	ISRAEL	MYANMAR	SOLOMON ISLANDS
AZERBAIJAN	DOMONICAN REPUBLIC	ITALY	NAMIBIA	SOUTH AFRICA
BAHAMAS	ECUADOR	JAMAICA	NAURU	SPAIN
BANGLADESH	EL SALVADOR	JAPAN	NETHERLANDS	SRI LANKA
BARBADOS	EQUATORIAL	JORDAN	NEW ZEALAND	SWEDEN
BELGIUM	GUINEA	KIRIBATI	NICARAGUA	SWITZERLAND
BELIZE	ESTONIA	KYRGYZSTAN	NIUE	THAILAND
BENIN	EUROPEAN	LAO DEMOCRATIC	NORWAY	TOGO
BHUTAN	COMMUNITY	PEOPLE'S REP	PALAU	TRINIDAD & TOBAGO
BOLIVIA	FIJI	LATVIA	PANAMA	TUNISIA
BOTSWANA	FINLAND	LESOTHO	PAPUA NEW GUINEA	TURKMENISTAN
BRAZIL	FRANCE	LIBERIA	PARAGUAY	TUVALU
BULGARIA	GAMBIA	LITHUANIA	PERU	UGANDA
BURUNDI	GEORGIA	LUZEMBOURG	PHILIPPINES	UKRAINE
CAMBODIA	GERMANY	MADAGASCAR	POLAND	UK OF GREAT BRITAIN &
CAMEROON	GHANA	MALAWI	PORTUGAL	NORTHERN IRELAND
CANADA	GREECE	MALAYSIA	REPUBLIC OF KOREA	UNITED REPUBLIC
CHILE	GRENADA	MALDIVES	REPUBLIC OF MOLDOVA	OF TANZANIA
CHINA	GUATEMALA	MALI	ROMANIA	URUGUAY
COLUMBIA	GUINEA	MALTA	RWANDA	UZBEKISTAN
COOK ISLANDS	GUYANA	MARSHALL ISLANDS	SAINT LUCIA	VANUATU
COSTA RICA	HONDURAS	MAURITIUS	SAMOA	VIETNAM
CUBA	HUNGARY	MEXICO	SENEGAL	

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5.5 Proposals on climate institutions for the future

Proposals on climate institutions for the future

Informal dialogues on "what should be done after 2012" or "what should be the future course of action if the Kyoto Protocol does not enter into force" have become popular of late among researchers and those having high stakes in climate change negotiations. Many have written articles proposing the next steps required to improve the current situation. The nature and contents of those articles, however, differ from each other.

Some of the proposals reported in the literature in the last several years and their features are summarized in **Table 5.3**. It should be emphasized, however, that the proposals listed are only a small portion of what have been presented lately. It should also be noted that many studies have not given a comprehensive picture of their respective proposing institutions, so the number of check marks in each column are given according to interpretations by authors of this section, and thus, there may well be objections against such an assessment. However, this type of assessment is useful to recognize the overall trend among proposals or to compare salient characteristics of the proposals.

Challenges towards an uncertain risk

Some proposals clearly aim at achieving the long-term objective to mitigate climate change, while others involve some other objectives for implementation, such as technological research & development. The former group tends to emphasize the need to take an early action in order to achieve a certain long-term objective. The latter group of proposals tends to prefer waiting until mitigation costs become more acceptable. As was mentioned in previous sections of this paper, inclusion of means to deal with long-term goals in a climate regime is important in order to adequately assess short-term actions. From this perspective, the former type of proposals should stem fundamental basis of future climate regime.

Equity

Many proposals intend to assure equity across countries and between the North and the South. Such equity considerations have been made by, for example, differentiation of the level of emission targets, level of standards or price of tax, or differentiation of types of commitments, such as by classifying countries according to their GDP per capita. Some proposals, on the other hand, hardly reflect equity concerns. Full use of power of the market system might be a trade-off for not considering equity (although "market-justice" is sometime considered as one of equity criteria). As is explicated in Section 5.2, consideration on equity is indispensable for achieving an agreement at multilateral level. Various types of equity principles exist, but they do not need to conflict with one another. Several different types of equity principles may be fulfilled by maintaining a delicate balance among commitments and rules in a climate regime.

Incentives of countries to participate

Many proposals that deal with rules for burden-sharing or emissions allocation across countries are advantageous in reflecting equity concerns, but such proposals are relatively short of incen-

Table 5.3 Feature of proposals on future institutions for climate change

Proposals	Does the proposal directly aim at achieving environmental objective?	Does the proposal include means to assure equity between developed and developing countries?	Does the proposal assure equity among countries within the developed or developing groups?	Does the proposal include economic incentives to stimulate participation?
Simple Extension of Kyoto	√√√√√	√√√√	√√√	√
Contraction & Convergence (Meyer 2000)	√√√√√	√√√√√	√√√√√	√√√
Triptych (Groenenberg et al 2000)	√√√√√	√√√√	√√√√√	√√√
Multi-sector convergence (Sijm et al 2001)	√√√√√	√√√√	√√√√√	√√√
Multi-stage approach (den Elzen et al2003)	√√√√√	√√√√√	√√√√√	√√√
Widening Brazilian proposal (Brazil 1997)	√√√√√	√√√	√√√√	√√
2-track approach (Kameyama 2003)	√√√√√	√√√√	√√√√	√√√
Kyoto+Technology Protocol (Tamura 2003)	√√√√√	√√√√	√√√√	√√√
Intensity target (Baumert et al. 1999)	√√√√	√√√√√	√√√√	√√√√√
2 types emission permits (McKibbin 2000)	√√√	√√√√√	√√	√√√√
Safety-valve (Aldy et al 2001)	√√√	√√	√	√√√√√
Auctioning permits (Bradford 2001)	√√√	√√	√√	√√√√√
Emission efficiency standards (Benedick 2001)	√√√	√√	√√√	√√√√
International carbon tax (Nordhaus 2001)	√√√	√√	√√√	√√√√
U.S & China, others=Kyoto Protocol (Stewart & Wiener 2003)	√√√	√	√	√√√
Technology fund (Barrett 2003)	√√√	√	√	√√√√√
Sector approach of major emitters (METI 2003)	√√	√	√	√√√√
Climate Marshall Plan (Schelling 2002)	√√	√√√	√	√√√√
Orchestra approach (Sugiyama 2003)	√√	√	√	√√√
Grouping countries (Claussen & McNeilly 1998)	√√√	√√√√	√√√	√√
Sector-based CDM (Samaniego et al 2002)	√√	√√√√√	√√√	√√√√
SD-PAM (Winkler et al 2002)	√√√	√√√√√	√√√	√√√√
Regional (EU, Asian, etc.) bubbles	√√√	√	√	√√√√√
Regional agreements (Buckner & Carraro 2003)	√√√	√	√	√√√√
Tariffs (Biermann & Brohm 2003)	√√√√	√√	√√√	√√√√√
Major countries' energy efficiency(Ninomiya 2003)	√√	√√	√√√	√√√√

Note: Many studies have not clearly addressed some of the criteria listed above. The assessments were made as per the authors' interpretations and assumptions. In some cases, the assessment may hold true only for some countries. Thus, the results of the above assessment may contradict with the intentions of the original author(s).

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tives for some of the major emitting countries to participate in a global institution. Other proposals look for ways for major countries to participate in the institution. Those studies analyse economic aspects of actions to find the most cost-effective ways to tackle climate change. Such proposals might be relatively short of considerations on ways to secure the long-term environmental goal and equity. Economic benefit of climate mitigation policies may vary according to underlying assumptions. As is indicated in Section 3, economic cost required for emission stabilization differs according to scenarios the world is to follow. Cost of technology decreases rapidly when adequate policies are implemented. Proposals for future climate regime need to take these points into consideration.

Multilateralism

Some proposals require almost all countries to participate in the institution from the beginning, while some other proposals allow less developed countries to achieve a certain level of wealth before they are requested to commit to any commitments. Some other proposals are more voluntary or regional. Multilateral negotiations are in many cases time-consuming and end up with the least common denominator. On the other hand, setting a single rule (or standards, etc.) sends out a signal to all countries at once, which leads to a cost-effective solution. As is elaborated in Section 5.3, multilateral agreements under the UNFCCC process should be the basis of a future climate regime.

There are proposals that set a target at nation-state level, while other proposals set commitments only for specific sectors such as energy standards. Although the latter may seem more feasible to achieve an agreement, such institution does not necessarily bring about structural changes in societies such as energy-intensive transportation system, or even changes in human behaviour. From this perspective, the future agreement should cover not only one or few sectors but a wide range of sectors where GHG emissions are observed.

No proposal is perfect by itself

A plausible way to move forward may be to combine several institutions of different features, so that weaknesses of one institution could be masked by strengths of the other institutions. For instance, there are proposals that aim for the achievement of an equitable solution, but which do not include many economic incentives. Such institutions could be supplemented by other institutions that aim for stimulating economic incentives. Simply restructuring the climate institution from A to B just because A was not fully successful may bring about other problems. It would be most appropriate to be on the side of institutional efficiency, reassess existing institutions, discuss elements that could be maintained, dismissed or added, and finally start dealing with each of those elements.

Table 5.2 Feature of proposals on future institutions for climate change (continue)

Does the proposal include means to achieve sustainable development in developing countries?	Is the proposal intended to stimulate participation of large emitters?	Is the proposal intended to stimulate participation of the developing countries?	Does the proposal require participation of all countries from the beginning?	Is the proposal intended to set emission targets to each country Party?	Does the proposal aim at simplifying institution for reducing administrative & transaction costs?
√√	√√	√√√	√√√√√	√√√√√	√√√
√√		√√√√√	√√√√√	√√√√√	√√√
√√	√√	√√	√√√√√	√√√√√	√√
√√	√√	√√	√√√√√	√√√√√	√√
√√	√√	√√√	√√√√	√√√√	√√
√√	√	√	√√√	√√√√√	√√
√√	√√	√√√	√√√√√	√√√√√	√
√√√	√√√	√√√	√√√√	√√√√√	√
√√√	√√√√	√√√√√	√√√√√	√√√√√	√√√
√	√√√√	√√√	√√√√	√√√√√	√√√
√	√√√√	√√	√	√√√√	√√√√
√√√√	√√√	√√√	√√√	√√√√	√√√√
√√√√	√√√	√√	√√√√	√	√√√√
√√√	√√√	√√	√√√√	√	√√√√
√√√	√√√√√	√√√	√√√√√	√√√√	√√√√
√√√	√√√√√	√√√	√√	√	√√√√
√	√√√√√	√√	√	√	√√√√
√√√	√√√	√√√√√	√√	√	√√√√
√	√√√√√	√√√	√√	√	√√√√
√√	√√√√	√√√	√√√√	√√	√√√
√√	√√√	√√√√√	√√√√	√√√	√√√
√√√√	√√√	√√√√√	√√√√	√	√√√
√	√√√	√√√	√√√√√	√√√√	√√√
√√	√√√√	√√√	√√√√	√√√	√√√√
√√	√√√√	√√	√√√√√	√√	√√
√√	√√	√	√	√	√√√√

Conclusions

* The scientific basis of climate change and its impact has become more concrete in recent years. Japan has been experiencing various signs of climate change, such as the earlier blossoming of cherry trees in spring and an increasing number of intensely hot days in summer, which could well be interpreted as the part of the adverse impacts of anthropogenic climate change. Although scientific uncertainty still exists, argument is now largely over the scope of the dangerous level, rather than whether climate change is real or not.

* Long-term targets play a significant role not only for assessing the integrity and value of short-term actions but also for showing the direction in which our world must proceed. Long-term targets can take various forms, ranging from an activity-based target, a GHG emission reduction target, a GHG concentration target, to a temperature target, though a careful examination is necessary for adopting such targets. Hedging strategy and review process for regular assessment of targets are some ideas to adequately implement medium term targets. In addition to setting mere numerical long-term targets, it is important to give the public an image of the future society to which such climate policies would ultimately lead. Such an image can help people to envisage how the future world would look like and serve to mobilise their actions. Some countries and regional entities have already set such long-term targets as their national goals. Such goals are treated not merely as climate protection policy, but as a part of comprehensive national strategy, in line with their energy and economic policies.

* Emission scenarios show various options for the world in terms of economic development and climate mitigation. It is both cost-effective and efficient to shift to a climate-sound society at an early stage rather than implementing drastic emission mitigation policies after limitless growth. Technological options do exist to achieve such climate-sound society. It should be noted that mitigation policies and measures, although not inexpensive, have a positive impact on technology innovation and diffusion, and constitute an important driver for a sustainable society.

* Countries have begun to take actions to tackle climate change even without the Kyoto Protocol's entry into force. As for now, the Kyoto Protocol could be seen as a strong signal to indicate that climate mitigation must remain as a global strategy for sustainable future. The countries' actions, both at national and local levels, may indeed become less motivated if such a signal disappears after 2012. For those countries that have ratified Kyoto Protocol, achieving the Kyoto Protocol is very important, as it will deliver the most significant message to the rest of the world, especially to the countries that have not ratified, for taking further actions to tackle climate change. It will also provide a solid foundation to the arguments and proposals on international institutions after 2012.

* There are many proposals on international institutions after 2012, or on alternatives to the Kyoto Protocol. Each proposal has its own strong and weak points. It is important to assess those characteristics, and to be able to combine different types of strengths in the future institution. The future institution would also be most robust with full linkage with medium term targets. The Kyoto Protocol was, and still is, an important fundamental basis on which future regime could build upon. Existing climate agreements such as the UNFCCC and the Kyoto Protocol should remain as basic international rules on climate protection. In addition, any kind of agreement, either multilateral or bilateral, global or regional, intergovernmental or non-governmental, could be agreed upon to increase incentives for countries and sub-national stakeholders to participate in climate protection. So the question to be considered now will be the one on how to bridge and accommodate such a bottom-up approach with global long-term target and perspective.

* Japan is in a crucial position for the development of future international climate regime. Traditionally, Japan had always followed either the US or the EU to determine its position on climate negotiations, but such a "follower" position is not likely to be helpful in the future. Indeed, its distinct position in the international economy gives Japan several opportunities to take the lead. Once Japanese firms including the Japan-based multinational companies are fully geared up to carry out climate-friendly corporate measures, for example, they can put considerable pressures on the rest of the world in terms of technology development and marketing. To fulfil its pivotal role in the development of the future international climate regime, Japan needs to take the following three steps in earnest. First, Japan should set its own medium and long-term climate goals, to show all Japanese stakeholders, such as industry, agriculture, civil society organizations or ordinary citizens, the way the government is trying to lead the society to. Second, Japan should fully utilize its capacity (human, financial, technological, etc.) to introduce necessary short-term policies and measures to achieve such targets, both at the domestic and international levels. Third, Japan should take the lead in establishing necessary legitimate rules at the international level to stimulate introduction of such short-term policies and measures.

* The world is already facing severe adverse impacts of climate change. There is no time to wait!!

About Us

About Us:

The authors contributed to the publication as independent researchers. Their views do not necessarily represent those of the institutions they are affiliated to.

Much of the contents of this brochure come from various research projects funded by the Japanese Ministry of the Environment listed below, but it does not mean the contents reflect any positions of the Ministry. The brochure should be treated as a compilation of academic activities in Japan.

* Research Project on "Beyond-2012" (http://www.nies.go.jp/social/post2012/index.html): Yasuko Kameyama, Yukari Takamura, Norichika Kanie, Kentaro Tamura, Rie Watanabe, Izumi Kubota, Kunihiko Shimada

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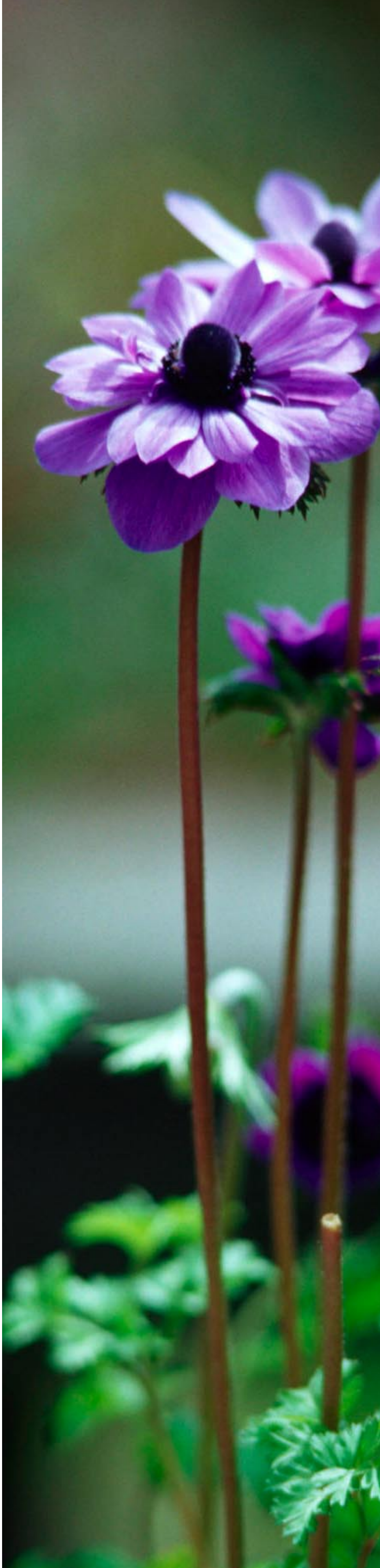
* Research Project on "Asia-Pacific Integrated Model (AIM)" (http://www-iam.nies.go.jp/aim/index.htm)
  Mikiko Kainuma, Hideo Harasawa, Kiyoshi Takahashi

Acknowledgment:

The authors thank the Ministry of the Environment, Japan, for giving several opportunities to work together, and for the financial support.

(A Part of this study has been funded by Science Research Fund of Ministry of Education, Culture, Sports, Science and Technology (MEXT))



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