Report of the First Phase Strategic Research

Climate Change

March 2001

Institute for Global Environmental Strategies

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Outline of the Project

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2. Project Period April 1998 – March 2001

3. Project Members

Project Leader Shuzo Nishioka

Research Staff

Senior Research Fellow	Naoki Matsuo (1998.4–)
Research Fellow	Tae Yong Jung (1999.4–)
	Kiyoto Tanabe (1999.4–) (concurrently serving as Programme Officer of TSU)
Research Associates	Aki Maruyama (1998.4–)
	Koson Enoki (1998.4–2000.7)
	Minoru Nakada (1998.4–2000.3)
	Takahiro Fukunishi (1999.8–2000.3)
	Mitsutsugu Hamamoto (1998.4–1999.3)
Visiting Researchers	Cui Cheng (2000.9–)
	Robert Dixon (1998.10–1999.1)
	Maithili Iyer (1998.11–1999.7)
	Li Yun (1999.1–2000.1)
Eco-Frontier Fellowship	Dong Hongmin (2000.11–)
	Damasa B. Magcare-Macandog (1999.9–2001.3)
	Li Yue (1999.11–2000.3)
Intern	Shobhakar Dhakal (2000.11–)
Project Secretary	Miya Iwase (1998.8–)
	Saho Moriguchi (1998.4–1998.8)

4. Project Expenses (yen)

Total project cost:	**320,941,241**	
FY1998:	74,590,833	(actual)
FY1999:	133,049,408	(actual)
FY2000:	113,301,000	(budgeted amount)

5. Summary of the Report

The research activity of the Climate Change Project in the first phase of IGES research was carried out focusing on the policy proposals responding to the process of UN Framework Convention on Climate Change and the Kyoto Protocol. Emphasis was put on the system design of the Kyoto Mechanisms such

as emissions trading or the clean development mechanism, comparative study on the domestic policy measures in Japan, and analysis on the possibility of cooperation in the region of Northeast Asia. Also, this project promoted network building among researchers in the Asian region in order to contribute to the making of an accurate greenhouse gas inventory system in the region. This was done to assist the Technical Support Unit of the Inventory Task Force of the Intergovernmental Panel on Climate Change, the TSU being located in IGES.

The research results were frequently presented at the side events of the Convention's Conferences of the Parties or its Subsidiary Body for Scientific and Technological Advice and the other related workshops. Domestically, the project members participated in governmental committees and councils in the related field, reflecting the research results in the policy-making process. Some of the project members are actively contributing to the activity of IPCC as well.

Toward the establishment of the foundation for long-term research of the project, an energy-environment model in the Asian region (IGEM) has been developed in the project.

6. Keywords

Climate change, Kyoto Protocol, Kyoto Mechanisms, CDM, emissions trading, joint implementation, GHG inventory, IPCC, best practice, financial mechanism, NAPIID

1. Introduction and background of the Project

The issue of climate change is the first serious difficulty that we face as humanity tries to move towards sustainable societies. A stable climate is a prerequisite for all living things on earth. Procreation and living have been carried out in a relatively stable climate in the past. However, the expansion of human activity has now begun to destroy the stability.

In 1990, Intergovernmental Panel on Climate Change (IPCC), composed of several thousand international scientists, compiled existing knowledge and analysis of the climate change issue and submitted its first assessment report. The report warned the world about the alarming possibility of global warming in the next one hundred years and stated that the range of the effects will be extremely broad, with impacts on entire ecosystems, water resources, agriculture and the well-being of humanity. It also indicated that the reduction of greenhouse gas emissions, which cause global warming, would be quite difficult due to their relation with energy use and agriculture.

The United Nations Framework Convention on Climate Change (UNFCCC) was signed at the United Nations Conference on Environment and Development in 1992 and came into effect in 1994. The actual implementation of the provisions in the convention were to be decided in a protocol, and in December 1997 the Kyoto Protocol was adopted at the COP-3 (the third session of the Conference of the Parties). Through this Protocol, the international community made some initial steps toward global warming mitigation.

The international negotiation process is, however, proceeding with difficulty due to differences in opinions of developed and developing countries. COP-6 was unable to produce a conclusion for the details of the Kyoto Protocol, and has been postponed until the spring or summer of 2001.

Developed countries' reduction targets set in the Protocol are still far from what is required for stabilization of the climate. At the same time, however, IPCC warned in its Third Assessment Report that the climate change caused by human activity is advancing. It is essential to draw up a reduction plan which can achieve international agreement.

The most important issue in climate change policy is the development of the domestic measures to achieve national reduction targets, and this has a strong connection with the international framework. The participation of developing countries is indispensable, and this is related to the world trade order and policies for development assistance. It can be said that the climate change issue is the front-runner of challenges towards a sustainable world and an urgent task that deeply affects progress towards a sustainable society.

(Shuzo Nishioka)

2. Report of first phase of project activities

2.1 Objectives and targets

The aim of this research to propose a concrete climate policy based on policy analysis that includes climate change-related communication to the stakeholders. Additionally, we aim to stay ahead of progress on the UN Framework Convention on Climate Change, and to develop a framework over the whole range of climate change countermeasures, applicable to national, regional and global cooperation to address climate change, particularly in the Asia-Pacific region.

2.1.1. Research topic and structure of project

The project started and implemented its research by making proposals to contribute to the designing of the Kyoto Mechanisms, regional cooperation mechanisms in Asia, and the formation of each country's domestic policy measures, along the process of the negotiation of climate change framework after the Kyoto Protocol. The project also participated in the IPCC activities to consolidate the scientific findings and constructed a researchers' network for a Greenhouse Gas Inventory in the Asian region.

This Project started four months after the formal adoption of Kyoto Protocol in December 1997. The Kyoto conference (COP-3) agreed on the reduction targets of developed countries on the final day of the meeting. Agreement was reached to allow international cooperative mechanisms (the Kyoto Mechanisms), including joint implementation, emissions trading, and the clean development mechanism (CDM), etc. Details of the mechanisms were entrusted to the future Conferences of the Parties and UNFCCC Subsidiary Body (SB) meetings. Therefore, during the first year of our project the urgent international task was to contribute to the design of the Kyoto Mechanisms. It was recognized that the following are the important issues which should be agreed upon at COPs: the design of the emissions trading market among the Annex I countries, the design of joint implementation taking into account the "hot air" in Russia, and setting up a framework of the CDM which aims at reducing greenhouse gas (GHG) emissions in developing counties.

The setting of baselines is one controversial point in analyzing the effects of the Kyoto Mechanisms, needed in order to have standardized methods to evaluate the effects of these reduction measures. In 1998, the Buenos Aires Action Plan was adopted at COP-4 in order to elaborate on the details of the Kyoto decisions. The details were left to be decided at COP-6 in 2000.

During the ensuing period, the following issues were actively discussed in the field of international climate policies: proposals concerning concrete design of the mechanisms, search for actual projects of joint implementation, reducing uncertainties related to the CDM in non-Annex I countries and evaluation, and the possibility of Annex I countries achieving their targets based on the above-mentioned issues.

To achieve the emission reduction targets of developed countries, one of the important key issues is to ascertain how to assess the sequestration of carbon by terrestrial ecosystems such as forests and soil. The UNFCCC requested the IPCC to assess the amount of sinks from the physical point of view, and how we could reasonably calculate the emission reduction amounts of each country. The IPCC submitted a special report on sinks in June 2000, which showed that without a concrete definition of forests or management activities, countries would have great differences in the amount of sinks used to calculate emission reductions. This problem created controversy in the international policy discussions leading up to COP-6.

The GHG emissions from developing (Non-Annex I) countries are expected to exceed the amount emitted by developed (Annex I) countries in the next ten years. Hence, the reduction of emissions in developing countries is a pressing need. To realize emission reductions, it is hoped that at the earliest stage developing countries will incorporate policy measures for global warming mitigation in their long-term economic development plans.

To support this, it is also necessary to accelerate technological transfers from the developed countries and to construct communication channels and capacity building in the developing countries. How to enhance technology transfers effectively by utilizing the existing bilateral assistance or multilateral funding mechanisms such as the Global Environment Facility (GEF), is one of the main issues faced by the UNFCCC. As for the CDM, it is regarded as a prospective measure that could help realize both technology transfers and GHG emissions reductions. It is necessary to assess the *economic effects of its implementation in the Asian region*.

Taking into account the growing economies of populous countries such as China and India, it is certain that the Asian region will become a huge emission source. This means that concrete analyses of the amount of reductions possible in each country are essential, and efforts must be made to ascertain the level of reductions that can be achieved by regional cooperation.

After COP-3, each country was to start full-scale *domestic policy measures* to achieve the emissions reduction targets. In particular, European nations established GHG emissions reduction policy measures, which included regulation, carbon taxes, and the voluntary action plans in industrial sectors.

In Japan, a sectional reduction plan was prepared at the time of the examination of the Kyoto Protocol in 1997. However, emissions have been increasing and there is need for additional policy measures. To control emissions from sources scattered thinly among many sectors, policy formation under national consensus is essential. Thus, there is a need to create the opportunity for such *policy-making with public participation***.**

The task of the *IPCC* is to accumulate and evaluate the knowledge from the physical and social sciences in order to form the policy measures mentioned above. This work, which started in 1988, involves the ongoing writing of special reports on topics such as technology transfers, emissions scenarios, regional impacts, and carbon sequestration, in response to requests from the UNFCCC after the IPCC's Second Assessment Report was released in 1995. The Third Assessment Report, which has been under preparation since 1997, was published in 2001.

The third report provides more accurate information for future policy-making work related to the UNFCCC. The amounts of national *GHG emissions* reported to the UNFCCC secretariat are calculated by guidelines prepared by the Inventory Task Force of the IPCC. The Technical Support Unit (TSU) of the Inventory Task Force has been located at IGES since 1998. The TSU is accumulating scientific information from many countries in order to more comprehensively estimate emission amounts from various sources. The units of emission amounts differ greatly depending on regional conditions. Therefore, it is essential to consolidate the results of measurement by the network of scientists from many countries and many fields. This kind of effort at the regional level has been assisted by the United States, Japan, the European Union and international organizations such as the GEF.

2.1.2. Targeted level of each research topic

Research activities of this project have been carried out in parallel with developments of the UNFCCC and its research results have contributed to various decision-making processes. The details of research results of each topic will be discussed in the next section.

Scientific Level: Assessment of the research results of physical and social sciences concerning the climate change issue. Contributions to the IPCC (emissions scenarios, technology transfers, vulnerability assessments) ↓

International Negotiations: UNFCCC processes, analysis of international negotiations after COP-6, designing elements of Kyoto Mechanisms such as baselines, joint implementation and emissions trading ↓

Regional Cooperation: Regional cooperation mechanisms, assessment of the CDM at the regional level, funding mechanisms, measurement of the effects of assistance, cooperation in Northeast Asia ↓

National Policy: Domestic policy measures for climate change mitigation, domestic emissions trading, domestic

consultation processes on the issue, estimations of GHG emissions, review of national communications to the UNFCCC, accurate methods of measurement for GHG inventories

2.1.3. Comparison with original research plan

In November 1997, IGES held an international workshop entitled "Global Environmental Strategic Research," inviting researchers and policy makers from related fields. At the workshop, a three-year research plan was drawn up for all of the research projects.

The original plans for the Climate Change Project in the first phase are listed below.

(1) Forecast the agenda in global warming negotiations
The project should identify solutions to facilitate UNFCCC and related negotiations, in particular, by sorting out the controversial points emerging from the issue of the participation of developing countries in the Asian region.

(2) Analyze the significance of global warming issues from the viewpoint of regional long-term development and the environment
Regional long-term economic and energy analysis on the effects of global warming from a macro point of view should be conducted to forecast the future environment.

(3) Concrete proposals of international cooperation frameworks
Present a framework of incentives for international cooperation such as joint implementation and emissions trading markets. There was a suggestion for a pilot study which would contribute to actual implementation methodologies. Assessment methods should also be established.

(4) Examination of effective support measures from international and regional perspectives
Make proposals for multilateral and bilateral assistance in the international framework, and examine effective assistance within the region.

(5) Examine effective ways to include global warming mitigation measures and international assistance in national economic development plans.
Support other countries to prepare national policies for global warming mitigation, and support the formulation of policies and plans.

The research activities have been basically carried out in accordance with the original plan. The Climate Change Project has made considerable achievements in terms of covering research topics, although it is a little delayed in the issue of introducing global warming mitigation measures in the Asian countries.

As the negotiation process of the UNFCCC progressed, the project found additional issues which had not been identified in the original research plan, i.e., proposals for national policies for global warming mitigation, and the establishment of accurate measurement methods for GHG inventories in the Asian region taking into account the TSU located at IGES.

(Shuzo Nishioka)

2.2 Outline of research results

2.2.1 International regime to address climate change—Kyoto Mechanisms

a. Analysis of international negotiations after COP-3

As mentioned above, two international structures have been established to address the climate change issue. The Intergovernmental Panel on Climate Change (IPCC) was created to address the natural science and socio-economic science-related aspects of climate change as the basic input for policy-making. The UN Framework Convention on Climate Change (UNFCCC) provides the international legal framework for implementation of climate change mitigation (and adaptation) measures.

In December 1997, the governments agreed to adopt the Kyoto Protocol at the third session of the Conference of the Parties (COP-3). The Protocol's aim is to limit greenhouse gas (GHG) emissions first in the industrialized countries (so-called Annex I countries), reflecting the guiding principle of "common but differentiated responsibilities" mentioned in the UNFCCC. As an inseparable part of the emission targets, the Kyoto Protocol gives remarkable flexibility to comply with the quantified emission targets by using the market-based "Kyoto Mechanisms" (emissions trading, joint implementation (JI) and the clean development mechanism (CDM)). These Kyoto Mechanisms serve to integrate business and climate change mitigation. At COP-4 in Buenos Aires in 1998, the rules on how to operate such mechanisms were left to be decided at COP-6 (in The Hague in 2000). Figure 1 illustrates the various elements in this discussion.

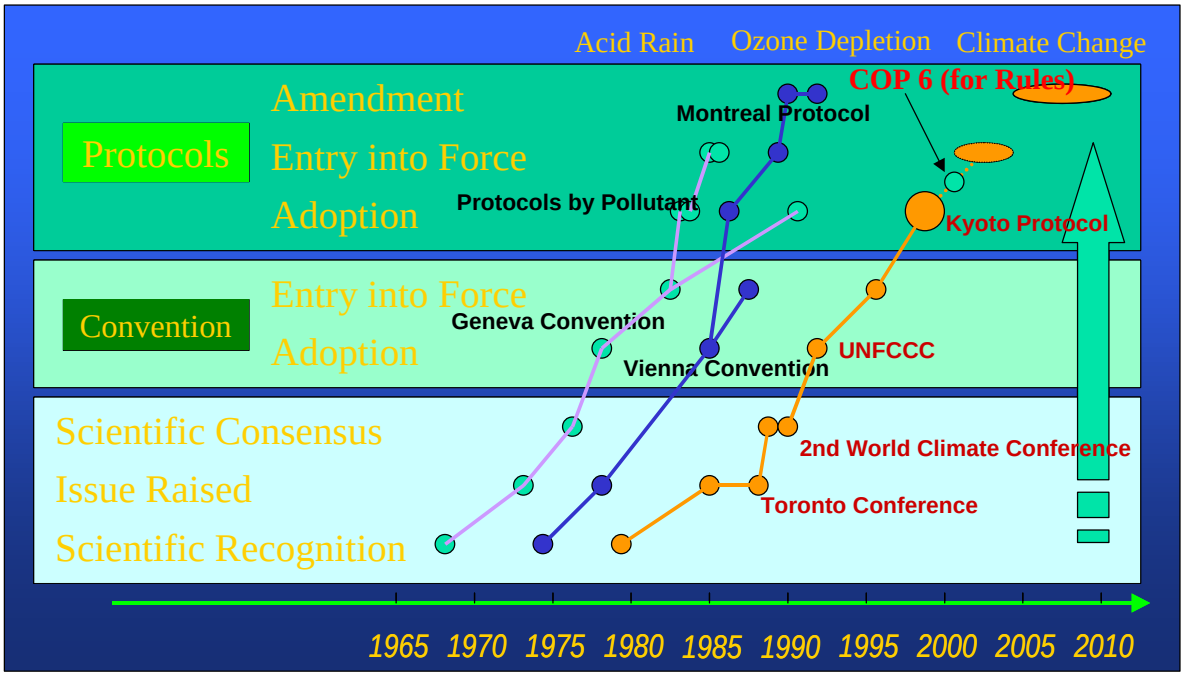


Figure 1. Development of international environmental treaties and the position of Kyoto Protocol

The Climate Change Project of IGES, which was established just after the Kyoto Conference, has steadily produced many useful outputs from the beginning for international and domestic stakeholders, especially relating to the Kyoto Mechanisms. The Kyoto Mechanisms have not been well understood in their true meaning from environmental and business perspectives. The IGES Climate Change Project has clarified their implications in the real world and has proposed many aspects of the design of international rules as well as domestic policies and measures.

The following are outlines of the research and policy recommendations of the IGES Climate Change project for *international* rule-making relating to the Kyoto Mechanisms.

b. Emissions trading and joint implementation

Emissions trading and joint implementation (JI) are the flexibility mechanisms for Annex I countries, which are bound by quantified targets under the Kyoto Protocol, to comply with their commitments by allowing acquisition of emission permits (emissions trading) or emission reduction credits through climate mitigation projects (JI) within Annex I countries.

In particular, emissions trading is a new and innovative instrument for countries except for the United States, which has experienced many federal and local schemes to address air pollution, for example, SO_2 emission control. A variety of difficulties remain in designing a GHG emissions trading regime suited to diverse countries as a workable *international* mechanism.

Dr. Naoki Matsuo (Senior Research Fellow, Climate Change Project) produced a comprehensive paper entitled “Points and Proposals for the Emissions Trading Regime of Climate Change—For Designing Future System (version 1 and 2)” (English and Japanese) on the proposed international and domestic emissions trading (and joint implementation) regimes, within a couple of months after establishment of IGES. The paper analyzed most of the key issues and provided a package of policy proposals based on the analysis.

Frequently, emissions trading is studied from the perspective of cost-effectiveness in an ideal world from the perspective of neo-classical economics, and applied to the real world without consideration of the gap between theory and reality. In contrast, the paper paid attention to the real world where the market is not perfect and difficulties are found in reducing emissions due to social- and political reasons. The key message of the paper was that the utilization of the emissions market is not only consistent with but also synergistic with the promotion of emission reductions. More specifically, if emissions follow a rising trend, the increase of permit prices will drive someone, somewhere, to reduce their emissions. This market mechanism provides very strong incentives and distinguishes the cap-and-trade system from the cap-without-trading system. In the real world, compliance provisions of the international environmental treaties cannot be powerful. If the “market” aspects of the Kyoto Protocol do not work adequately, the emissions in the Annex I region may exceed the target set in the Protocol.

The paper provided some possible solutions for the key issues like “hot-air,” monitoring institutions, voluntary participation of developing countries, and (non-) compliance institutions based on the understanding mentioned above. One typical example is the attribution attached to the permits. The EU prefers a kind of buyer-liable system in which the buyer (in other words, the market) judges the possibility of the seller’s non-compliance (especially by overselling) like a national bond market. This kind of differentiation of the permit country-by-country seems to promote facilitation of compliance on the one hand, but suppress the liquidity and functionality of the market on the other. The paper recognized the importance of the latter as a strong emissions reduction (or limitation) mechanism utilizing the market and supports the pure seller-liable system with uniform single permits as a commodity irrespective of its originating country. The paper also proposed the five step (automatic) non-compliance procedures with recognition of the difficulty in international environmental treaties and the strong linkage between energy conservation and economic growth.

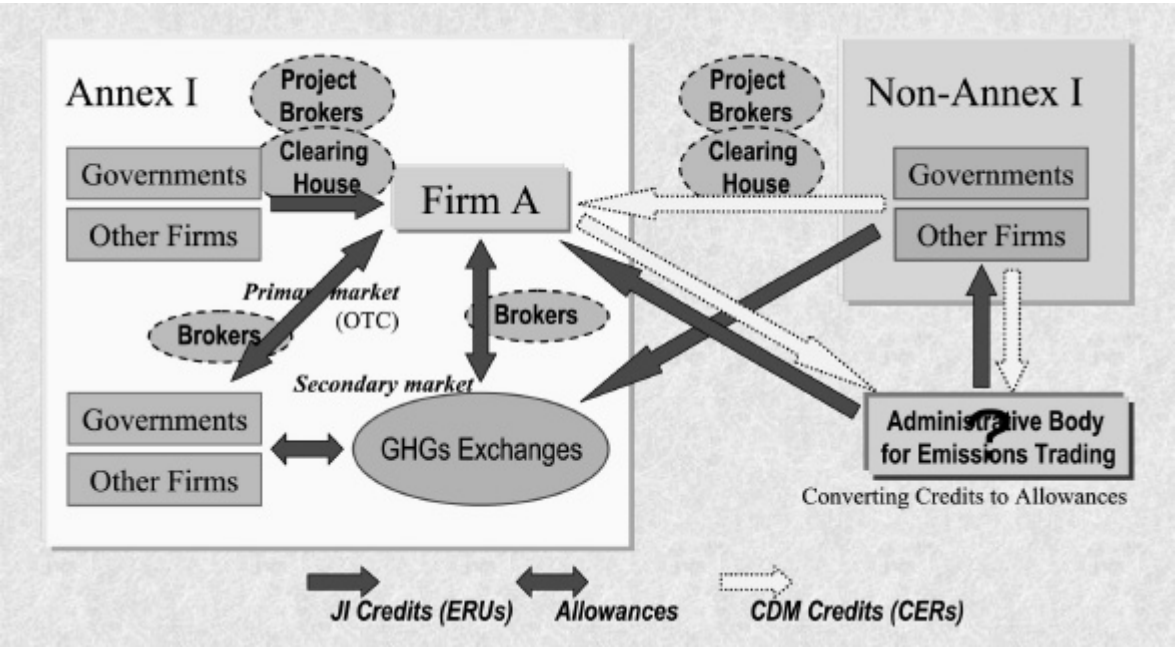


Figure 2. Conceptual image of the emissions market

In addition to and based on these papers, the IGES Climate Change Project held several two-day “Brain Storming Forums” in order to exchange views and discuss concerns intensively among many stakeholders in Japan (government ministries, companies, researchers and environmental NGOs). The IGES CC project has become recognized as a focal point of information accumulation and delivery of climate-related issues, in spite of its recent establishment.

As a related topic, Dr. Matsuo released a paper entitled "A Proposal on the Supplementarity Issue for Emissions Trading and Joint Implementation" (in English and Japanese). The supplementarity issue is often recognized as if to set a ceiling on tradable amounts of emissions as proposed by the European Union. However, his proposal focuses on another side of the issue by promoting domestic policies and measures through development of the common physical indicators (intensities), and utilizes "yardstick" type competition. This was proposed at the IGES Special Event at COP-4 and published in the *Linkages Journal* of the International Institute for Sustainable Development (IISD).

Dr. Matsuo had opportunities as an expert to participate in and give detailed discussions at the Emissions Trading Policy Dialogue held by the Center for Clean Air Policy (in Washington, D.C.) and the Dutch Government (in Toronto and Leiden) with negotiators and industry representatives from Annex I countries. The discussions of the policy dialogue were reported in depth to the Japanese stakeholders with explanations.

He also presented his proposal for the prompt start of JI with stringent procedures like the CDM at the IGES Special Event at the Lyon Subsidiary Body meeting just before COP-6.

c. Clean Development Mechanism

The IGES Climate Change project has started a comprehensive and precise study on the Clean Development Mechanism (CDM), called the Kyoto surprise (because of its unexpected proposal for everyone), from the early stage. "Issues and options in the design of the Clean Development Mechanism" (in English and Japanese) by Matsuo, Maruyama, Hamamoto, Enoki and Nakada discussed the key points such as modalities, eligibility, baselines, credit sharing, adaptation fund, ways to reduce transaction costs, matching of needs and seeds, and incentives for investors.

This comprehensive paper does not step into the policy proposals, but identifies some possible solution sets related to the importance of an information clearing house, possible eligibility criteria, investment additionality, credit sharing, adaptation fund raising, and effective utilization of existing international institutions based on the spirit of the Kyoto Protocol, particularly, assisting the sustainable development of the host country.

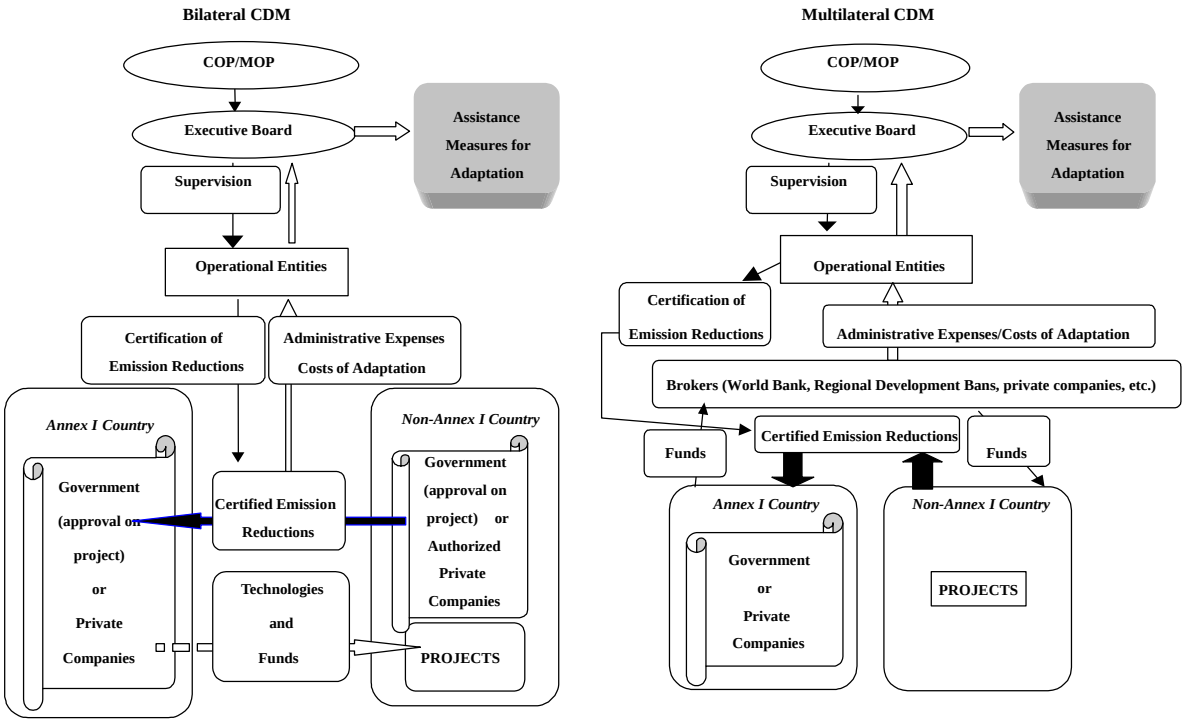


Figure 3. Bilateral and Multilateral Forms of CDM Projects

The paper provided a basis for the further studies on the CDM. One is the area of project investment as mentioned later, mainly studied by Ms. Aki Maruyama. Another is the area of project eligibility. Dr. Naoki Matsuo released a paper,

entitled “How Is the CDM Compatible with Sustainable Development?—A View from Project Guidelines and Adaptation Measures” (in English and Japanese), on the practical eligibility criteria to assist host countries’ sustainable development and presented it at the IGES COP-4 Special Event.

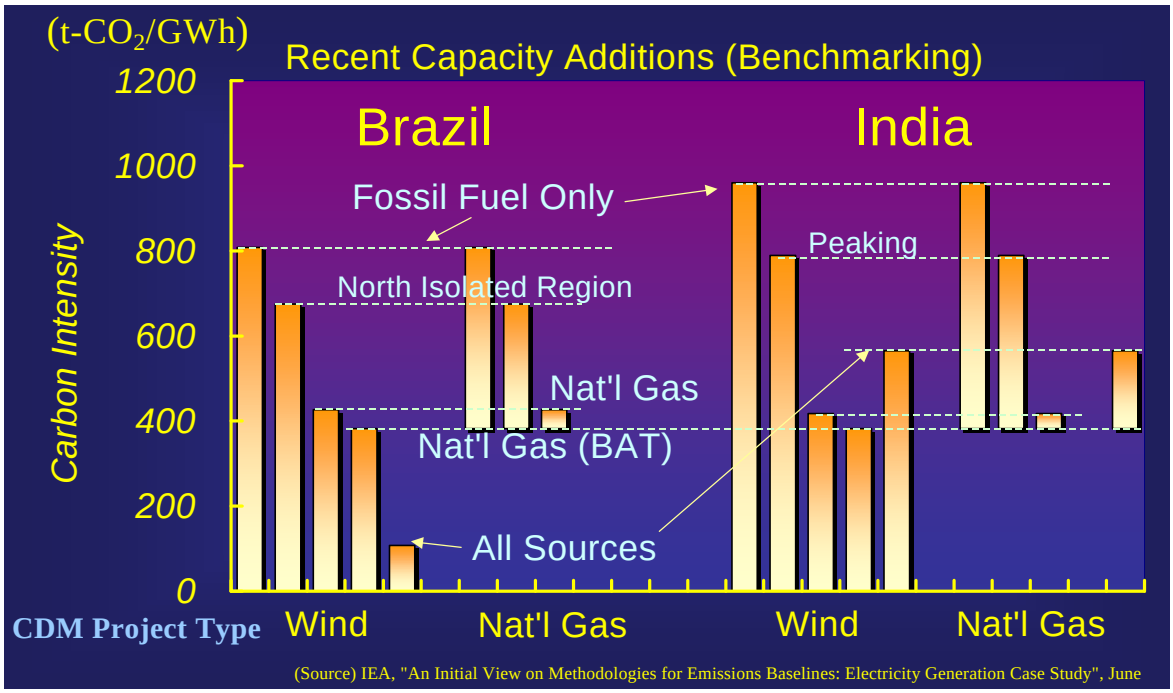


Figure 4. Arbitrariness in the choice of reference in benchmarking approach (electricity generation cases in Brazil and India)

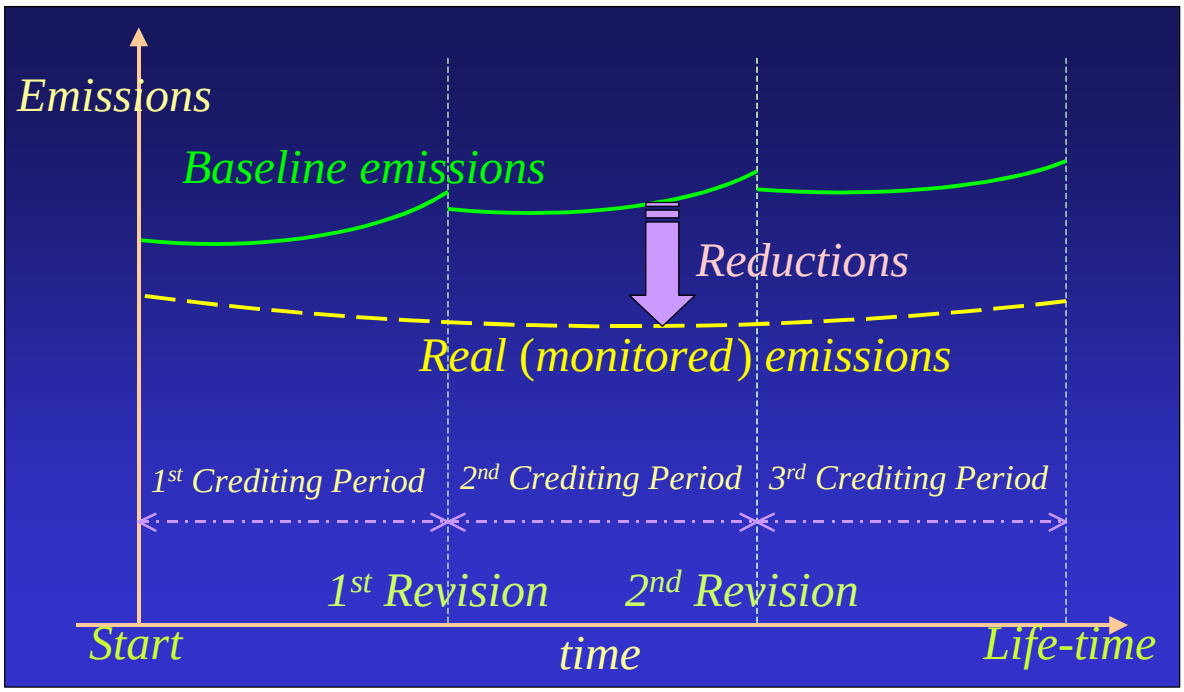


Figure 5. Time-dependence concepts in the baseline emissions

Dr. Matsuo also released a series of technical papers over two years on the baseline issue of the CDM. This theme is how to establish the standardized methodologies to evaluate the emissions most likely to occur in the absence of a project. He clarified the definitions of confusing terminology, such as time-dependence of the baseline (dynamic baseline). The main point of the paper is to identify a weak point of the commonly used benchmarking approach—large arbitrariness in selection of the reference case—and proposed another standardization approach from project-specific to generalized methodology development. This proposal provides the flexibility not to prepare the perfect methodologies from the beginning and does not need arbitrary choice of a reference or averaging. The CDM Reference Manual by Chairman Kok Kee Chow of the Kyoto Mechanism and the related discussions in Japan are heavily dependent on this idea. He presented the idea at the Special Events at the COPs and Subsidiary Body's meetings and other workshops such as the Quantifying Kyoto Workshop at Chatham House. The latest one in the six series of papers is "Proposal for Step-by-Step Baseline Standardization for CDM—From Project-Specific to Generalized Formula (Version 3)" (English for the latest, Japanese versions are available for the former papers).

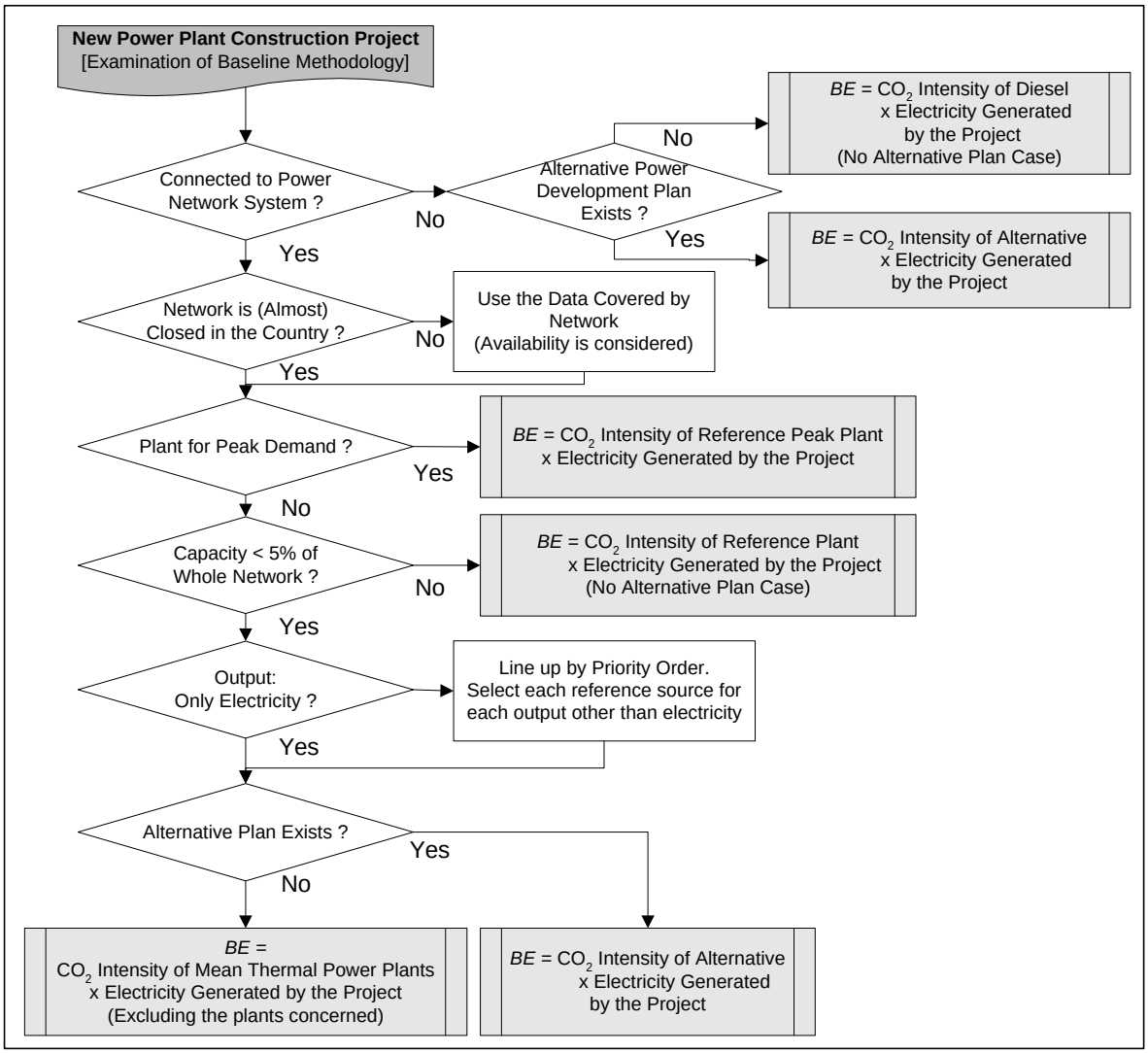


Figure 6. Example of a project specific to standardized baseline methodology

The IGES Climate Change Project invited Dr. Robert K. Dixon as a visiting researcher for half a year. As his position to be the Director of the U.S. Initiative on Joint Implementation (USIJI; AIJ Program of the U.S. Government) and the

U.S. Countries Study Program, he accumulated much knowledge at IGES. He edited a book entitled “The UN Framework Convention on Climate Change Activities Implemented Jointly (AIJ) Pilot: Experiences and Lessons Learned” (Kluwer) with a number of experts in the field of AIJ and CDM worldwide. This book provides very useful experiences of the AIJ Pilot Phase under the UNFCCC, which serves as a prototype of the CDM. Dr. Dixon played a role as both an author of five chapters and as reviewer/editor of the entire book. Dr. Matsuo also wrote a chapter related to the market aspects of the CDM and Maithili Iyer (visiting researcher from TERI, India) played the role of reviewer from the IGES side. This book is recognized as a reference book of AIJ pilot projects through the compilation of experiences and findings with the participation of 34 authors and 44 reviewers. It was presented at COP-5 at an event attended by many of the authors and reviewers.

(Naoki Matsuo)

d. Other business

IGES released the outline and implications just after the COP and other workshops to Japanese stakeholders. After the annual COP meeting, IGES held Post-COP Seminars with the Global Industrial and Social Progress Research Institute (GISPRI) and reported the outcome through the presentations by negotiators and analyses by the researcher on its implication to the industrial sector.

Dr. Matsuo and other researchers have presented their research outputs and policy proposals with information dissemination to stakeholders through many channels, such as governmental committees, academic societies, lectures, and materials for journals.

IGES researchers also translated and published the book "Kyoto Protocol—A Guide and Assessment" (Michael Grubb) into Japanese during the COP-6 sessions in November 2000. This book is expected to be a very good information source for Japanese stakeholders who previously had only limited access to good quality information in Japanese on the international framework negotiations. The quality of the book is very high and includes extensive analyses.

(Naoki Matsuo)

2.2.2 Proposal for co-operative mechanisms in the Asian region

a. IGES GHG Emission Model (IGEM) development and evaluation of CDM for China

The IGES GHG Emission Model was developed by Dr. Tae Yong Jung (Research Fellow, Climate Change Project). The original motivation to develop IGEM was the need for an analytical tool that can address issues relating to the CDM, primarily quantification issues. As mentioned, the typical form of CDM projects will be bilateral, project-base activities to mitigate GHG emissions. Hence, at the first stage of its development, IGEM will focus on country-specific structures that properly represent each economy. Since the CDM will be implemented on a project basis, the potential of GHG emission reductions relies heavily on the choice of technology. Therefore, inevitably bottom-up models to analyze technology-specific issues must be applied. At the same time, the CDM will affect both investing and hosting countries through international financial transactions and technology transfers, which have macroeconomic implications. Therefore, the objective of IGEM is to develop a macroeconomic energy model that can conduct analysis of the CDM with proper linkages to existing bottom-up models. To meet this objective, it is crucial that the economy is properly replicated, which requires careful model specification of each sector, including energy. This task requires local expertise.

There are eight modules in IGEM. The basic structure of IGEM is an open one-country model linked with other countries through international financial modules. The projection method for this model is basically an econometric approach with other methods such as the CGE model (see below), if necessary. Since IGEM is not a global or regional scale model, the proper replication of each economy is quite important. In IGEM, in principle, most of the parameters will be estimated, based on country-specific local data, allowing replication of the economic structure of each country. Hence, IGEM can be called a "hybrid econometric country" model.

In the Production Module, primary industries such as agriculture, secondary industries such as manufacturing, and tertiary industries such as services are classified following the conventional classification of J. Clark. In this module, input factor substitutability and technological change are estimated by defining the flexible functional form of the production function. In a Macro Economic Demand Module, the demand side of an economy is specified. The behaviors of private consumption are specified, one of the important determinants of energy demand in the residential sector. Private investment behavior is also important, especially for implementing the Kyoto Mechanisms to achieve GHG reductions. The investment function is specified, based on a simple finance theory of economics. The basic structure of the government sector is also specified. In particular, the tax structure at an aggregated level is considered to figure out the secondary effects of new taxes such as carbon or energy taxes on the economy. Dr. Jung presented a

paper on the macroeconomic impact analysis of environmental taxes at an international symposium on green taxes in Asia held in Seoul, Korea (Jung 2000).

The international transactions of physical goods are accounted for in export and import specifications. In a Bilateral Financial Module, the bilateral financial flows between two countries are determined. The main reason for separating this part from the general macroeconomic structure is to take into account the scenario options of the CDM or technology transfers. Since the economic channels of such options are through the international financial transactions, it is technically appropriate to separate this sector from the conventional international part of an economy.

The Computable General Equilibrium (CGE) Module is used for analyzing the economic impact of some changes such as implementation of the CDM. Dr. Jung and Prof. Moon jointly presented a paper on the methodology issue at the AIM international workshop held at NIES in Tsukuba, Japan (Jung and Moon 2000b). Such options will obviously affect each industry in terms of inputs and outputs. In IGEM, the key question here is how to localize the huge sets of parameters that should be given in CGE approach. We try to estimate them with local data as much as possible to reflect the local situation properly. The functional form of the specific equation is basically to follow the economic and econometric specifications. The detailed classification of sectors is quite flexible, depending on the situation of each economy. In particular the analysis of the CDM is the main interest of IGES, so the analysis of external impacts is emphasized, rather than that of domestic options such as carbon taxes.

In an Energy Demand Module, energy-related GHG projection is directly linked. The final energy demand in each end-use sector is specified in detail. The main sectors will be industrial, transport, residential and commercial. Once the detailed sectors are specified, the energy demands of different energy sources are simultaneously estimated and projected, since in some sectors, fuel substitution occurs, something which is not properly captured by individual estimations of each type of energy demand. In particular, how to treat the effect of fuel substitution in the model for the country where fuel substitution is rapidly occurring is a critical issue. Jung et al. (2000) published a paper to address the issue of structural changes in developing countries in the *Journal of Technological Forecasting and Social Change*, Vol. 63.

The Linkage Module is quite necessary in terms of model construction, since the main characteristic of IGEM is an open, top-down country-specific model. Hence, inevitably, IGEM cannot incorporate strong aspects of other approaches or models. In some cases, the outputs or results of other models should be used for important inputs of IGEM. For example, to analyze the effects of CDM options, it is quite necessary to figure out the technical aspects of a specific project, which is supposed to mitigate GHG emissions in a host country. Micro evaluation of a specific project in terms of financing cost, so forth, it is also a tool that is necessary to do this. This kind of analysis is usually conducted by a bottom-up approach. Also, the technical specification of CDM projects should be evaluated project by project, a task more easily handled by various bottom-up models. Therefore, it is more reasonable to have a module that can link other models, rather than to include all possible aspects of GHG mitigation into one model.

The Scenario Module is basically to generate scenarios, which means the assessment of the future. The technical question of this module is to generate scenarios in a systematic and efficient way to be suitable to IGEM. This module is a kind of “scenario generator,” which is basically the interpretation of the future into quantitative terms that can be recalculated through the model structure of IGEM. The Output Module is basically to generate outputs in a comprehensive manner: GHG emissions, energy demand, economic activities, and so on.

The empirical application of IGEM is conducted in Japan, China and Korea. For example, the energy demand for the residential sector in Japan has steadily increased, except for the second oil shock period of 1980 to 1982. The energy demand in this sector is projected to reach 76 million tons of oil-equivalent (TOE) in 2020. The annual average growth rate from 2000 is less than 2 percent. However, one distinct feature of the BAU trend in this sector is that the share of electricity demand keeps increasing. After 2010, the share of electricity takes more than half of the total energy demand in this sector. The corresponding CO_2 emission projection for this sector has also steadily increased except for the second oil shock period of 1980 to 1982 like the steady increase of energy demand. The CO_2 emissions in this sector are

projected to reach 27 million tons of carbon (TC) in 2020, excluding the CO_2 emissions from electricity usage. The annual average growth rate after 2000 is less than 1 percent. It is noted that more than half of CO_2 emissions will come from gas in 2020. In IGEM, many policy scenarios such as use of the CDM and other domestic policy measures can be tested. This work is now underway and will be one of the main applications of IGEM for the second phase of research.

One visiting fellow from China's Energy Research Institute (Mr. Li, Yun) conducted research on the CDM in China ("The Costs of Implementing the Kyoto Protocol and Its Implications to China" in *International Review for Environmental Strategies*, Vol. 1, No. 1). He identified the potential of the CDM and the priority fields in China. First, energy demand and carbon emissions of China in 2010 are forecasted by analyzing energy conservation potential and the relationship between energy conservation potential and the CDM's potential. Energy conservation potential comes from direct (technology advancement) and indirect (industrial structure change) energy efficiency improvements. Since the CDM needs real and measurable carbon emissions reduction, the potential of the CDM can only come from direct energy conservation potential. The approach used separates direct energy conservation from the total energy conservation in terms of energy intensity improvement. The CDM potential of China in 2010 is estimated, according to the contribution rate of direct energy conservation to the total energy conservation. The potential of energy conservation and the CDM will be different under different reference cases.

Another study focuses on the cost of reducing carbon in China, which is a case study on the Hengshui thermal power co-generation project. In this study, the Hengshui thermal power co-generation project is taken as the case study to estimate the unit cost of reducing carbon emissions in China. For calculating carbon emissions reductions during the project lifespan, a dynamic baseline method is used. Since there is no CDM project or widely accepted model for the CDM project, the cost for reducing carbon emissions is difficult to identify. The unit cost is very different under different total costs, such as operating cost, fixed-asset investment and financial net present value. The cost depends on the model of the CDM project, especially on the financial mechanism of the CDM project.

Another study measures global warming impacts on China, using MERGE3.1, which is used to simulate the world economy and global warming in the next century. According to this study, if no countermeasures are adopted, by the end of the next century the atmospheric temperature will increase by 2.7 degrees centigrade above that in 1990, which will bring about damages of $4.2 trillion to the whole world, equivalent to 1.5 percent of the GDP. However, because of its location and level of economic development, China will be subject to damages of 1.7 percent of GDP. China's importance in the world will increase in this century. The shares of the GDP, primary energy consumption and carbon emissions of China will increase dramatically. Per capita energy consumption and per capita carbon emissions from China will exceed the world average before 2050 and at the beginning of the 2030s, respectively. If the Kyoto Protocol is implemented, per capita energy consumption and per capita carbon emissions from China will exceed these of the world average before 2040 and around 2020, respectively. Great potential exists for energy efficiency improvements in China. Considerable energy conservation can be achieved by improving the industrial structure. In addition, China could postpone the day when its per capita energy consumption and per capita carbon emissions exceed the world average.

(Tae Yong Jung)

b. Financial mechanisms

One research associate of the project, Ms. Aki Maruyama conducted analysis on the financial mechanisms ("Public-Privates Synergy in Financing Climate Change Mitigation in Asia," and "Promotion of Cooperative Measures to Mitigate Climate Change in Asia: Cooperation through the CDM") and the results of the analysis were presented at the IGES International Workshop on the CDM and at an international meeting of the Eco-Asia Long-term Perspective Project.

In order to reduce GHG emissions in developing countries in the Asian region, which are expected to grow rapidly, large amounts of financial assistance are needed from developed countries in the near future. So far, assistance for climate change mitigation has come mainly from public financing. Despite some efforts, little progress has been made

in investments in so-called climate-friendly projects that generally entail higher risks and higher initial costs than conventional projects. Under these circumstances, the introduction of the CDM is expected to facilitate private sector investments in climate-friendlier projects in developing countries. In this connection, research on the related issues, including the design of the CDM, its potential and constraints from various viewpoints, and a way forward to the construction of more effective financial mechanisms, are necessary. The research results are presented at several regional and international workshops and seminars, and discussed actively with experts and policy-makers in the region.

Funding sources for GHG mitigation projects in developing countries have always been one of the crucial issues in the international debate about tackling climate change. So far, several steps have been taken to assist developing countries in financing climate change mitigation, including grants provided by the GEF, and AIJ activities. The CDM is considered to have a significant potential. In order to construct wider and more efficient financial mechanism options for climate change mitigation projects in Asia, this project analyses relevant issues from the financial point of view. First, it presents an overview of current climate change-related financial mechanisms and their problems, arguing for stronger private sector involvement. It further analyses the potential and barriers of the CDM as a financial mechanism to facilitate private sector investments in relevant sectors. Finally it considers the complementary roles of public funds and private investments via the CDM, and points out some of the issues for further consideration.

Examination on the existing financial mechanisms under the UNFCCC, such as the GEF and AIJ, as well as other relevant multilateral support by international financial institutions (the World Bank and Asian Development Bank) and bilateral assistance from OECD countries (including Japan's Special Environmental ODA and Green Aid Plan which has a great presence in the region) show that current climate-related financial mechanisms have several problems including some noted below (Table 1).

Table 1. Problems with Existing Climate Financial Mechanisms

- Shortage of funds to facilitate necessary climate-friendlier technology transfers
- Lengthy approval process
- Consultant-driven project finding, not necessarily addressing local and country needs
- Uneven geographical distribution of projects
- Need for market incentives for private sector involvement
- Lack of adequate mechanisms to address risks of climate friendly investments
- No funding assistance mechanism for adaptation
- Lack of co-ordination in financial assistance, due to uncertainty associated with the outcome of the future negotiations
- Unclear status of AIJ (with the introduction of the CDM)

It can be argued that financial assistance using limited GEF or ODA resources is not sufficiently promoting private sector investments in mitigation projects, in the face of huge private flows to climate-relevant conventional projects in developing countries. It is reported that among the contracts brought to fruition from 1990 to 1997, large "green field" private independent power producer (IPP) projects exceeding 100 MW were comprised of 137 projects, worth US$65 billion of investment. Of this, IPPs mobilized US$51 billion in private funds. In contrast, the total amount of GEF grants during the similar period (1991-1998) was only US$735million. Without relevant environmental regulation in place, and with cheap energy prices due to governmental subsidies, justifying climate-friendlier investments which are not internalized in economic appraisals of the projects is even more difficult in developing countries than in developed countries. However, the mobilization of private sector investment is the key to achieving global GHG emissions reductions, particularly in developing countries, because of the size of its flows and the importance of foreign direct investment (FDI) and the sustainability of projects. In this connection, the CDM could offer great potential in directing

FDI to climate-friendlier investments by giving market-based incentives and internalizing externalities associated with mitigation projects.

Although the details of the CDM are as yet unclear, by carrying out mitigation projects in developing countries the mechanism has the potential to help developed countries to meet their national emissions reduction targets while contributing to sustainable development in developing countries. With appropriate domestic measures to give the sector incentives for investments (such as introduction of domestic emissions trading systems, early reductions rewarding schemes, voluntary reduction agreements, regulations, or tax breaks etc.), the CDM could offer cost-effective reduction options and new business opportunities to the private sector. The sale of the credits generated from the CDM projects (CER: Certified Emissions Reduction) offers the prospect of recovering a part of the high investment cost associated with climate-friendly investments, thereby reducing some of the barriers associated with financing mitigation projects. Further, given proper identification of potential CDM projects by developing country governments, CDM flows could provide a substantial source of income, which can bring co-benefits, addressing also other social development goals, such as local environmental problems, rural development, poverty alleviation, and employment generation etc. Projections made by several studies using economic models show that the potential size of the CDM market could be 67－723 MtC in terms of emissions, depending on the different assumptions, and US$457-4513 million in terms of annual value in 2010. The Asian region is expected to have the largest potential for GHG emissions reductions with ample cost-effective mitigation opportunities.

Despite the huge potential, the CDM has several obstacles for its implementation. Even assuming that the CDM becomes fully operational, the cost recovery of the sale of CERs may be just one of the numerous complex elements in financing a project negotiation. To illustrate this point, the table below summarizes various risk factors from the financiers' and investors' point of view (Table 2).

Table 2. Risks associated with mitigation/ CDM projects in project finance

Conventional Projects	Mitigation Projects	CDM Projects
● **Project Performance** (Completion, Operational) ● **Technology** ● **Sponsor** ● **Management** ● ***Force majeure*** (natural hazards etc.) ● **Market** (quantity, price) ● **Country** **Regulatory:** underdeveloped regulatory system in asset & finance **Political**: war, nationalization **Economic**: Forex, currency transfer, local financing, creditworthiness of local partner and clients **Social & institutional**	**Increased risks, due to** non-conventional project non-conventional technology insecurity of energy source unfair regulation on investment & import of climate friendly technologies low energy prices ● **High initial costs** ● **Uncertain (usually low) rate of return** ● **Small project size & implicit transaction costs**	● **Ratification of Kyoto Protocol** ● **Rules and Design of the CDM design** **Amount of CER:** Baseline, leakage, Eligibility **Cost-effectiveness:** high transaction cost, adaptation fee ● **Uncertainties associated with the Market** (price, behavior) ● **Delivery of CER** ● **Institutional arrangement for CDM**

In order to facilitate climate-friendlier investments though the CDM, it would be effective to utilize public funds to complement the private investment and reduce some of the risks and barriers. Normally, risk mitigation measures for conventional projects in a project financing include contractual agreements, financial design of the project, and insurance and guarantees provided both by the private and public financial institutions. We could distinguish those best covered by multilateral/ regional banks by reinforcing existing risk coverage measures, those best addressed by development of new financial products by the private financial institutions, or those to be covered by government guarantees or bilateral export credits agencies.

Beside risk management measures, public funds should also address the issues which the CDM (private investment) could not address. They may include the following areas:

- Technology transfers entailing high transaction costs
- Creation of an enabling environment for private sector investments (including maintenance of basic surrounding infrastructure, capacity building, potential project identification, and support for monitoring and verification, etc.)
- Ensuring the regional balance of the project implementation
- Facilitation of technological innovation

With a view to constructing wider and more effective options for climate change-related financial mechanisms, it would be necessary to take a holistic approach making the best use of market enhancing functions of various public funds to complement private investment via the CDM. In doing so, relevant parties should strive for the early formation of international consensus on the rules and modalities of the CDM. At the same time, it is necessary to examine a host of factors including efficient risk sharing mechanisms, private sector investment behavior, and areas where the private sector is difficult to address.

There are also some issues which will require careful examination in the future. They include the relationship between the public financial supporting measures and OECD trade or the World Trade Organization (WTO) rules. In the long-term, climate concerns could be incorporated as one of the important factors in country-specific aid strategies. At the same time, it will become increasingly important that developing country governments should strive for the reduction of investment risks and the introduction of policy measures to promote climate-friendlier technology transfers and energy sector reforms.

(Aki Maruyama)

c. Examination of the effectiveness of economic assistance

Although development assistance to environmental areas in developing countries is increasingly diversified in recent years, it is very difficult to evaluate its effectiveness. Under the present circumstances where improvements in regional and global environmental problems are not progressing at a noticeable speed, the effectiveness and quality of aid is an issue of critical examination. With this awareness of the issue, some basic research has been done on the effectiveness of economic assistance in the relevant climate area ("Potential and Constraints of Private Sector participation in the CDM," presented at the UN ESCAP Regional Workshop on Promotion of Energy Efficiency and related Public and Private Investments, and "Towards Construction of Effective Financial Mechanisms Options for Climate Change Mitigation in Asia – Utilization of the CDM and its Potential," *Journal of International Development Studies* Vol. 9, No. 1, The Japan Society for International Development.)

With the growing demand for energy accompanied by rapid economic growth, developing countries are beginning to recognize renewable energy as an effective option in terms of energy security, rural electrification, improvement of local air pollution, economic development and creation of employment. Particularly in recent years, renewable energy sources are also attracting great attention as a means of climate change mitigation. In this connection, developing countries could make use of economic assistance from developed countries including official development assistance

and other financing sources which are available for environmental improvement. Economic assistance is normally utilized based on policy measures of the recipient governments. However, whether the aid is made full use of or not depends on the effectiveness of the whole government policy in the relative area. Therefore, it could be argued that examining the effectiveness of the government policies in the relevant area rather than the activities themselves which are directly financed by the aid finance, would benefit from further improvements of the use of aid, by identifying the problems and specific area for policy reinforcement.

Taking up wind energy, the most cost-competitive renewable energy today, this research analyses the effectiveness of the supporting policy measures for wind energy by the Indian government whose installed wind energy capacity is the world's fifth-largest among other OECD countries. It also tries to draw some implications for future directions of renewable energy policies and measures by other developing countries. The study first classifies wind energy supporting policy measures by countries with top wind energy installed capacity, with a focus on economic incentive measures. It then reviews the existing studies on various economic incentive measures of each of those countries to identify some of the common elements in successful supporting measures, to serve as a set of indicators for evaluation. In addition to general performance indicators such as the growth of installed capacity, generation cost reduction and the number of local manufacturers, it added the indicators from the above analysis, and thereby evaluated the effectiveness of the supporting policy measures by the Indian government.

Supporting measures for renewable energy mostly come in the form of economic incentives. They include measures such as subsidies for capital investment, loans with preferential terms, various tax measures (reduction or exemption of taxes), obligation of the purchase of generated electricity either at fixed (premium) price or under competitive bidding, green pricing, or green certificates. Supporting measures by different governments were diverse, and a simple comparison of their effectiveness cannot be made, due to specific circumstances of each country. However, regardless of the types of the measures, the review of existing study on supporting measures in the countries where the installed capacity of wind energy is larger seem to suggest there are some common elements in the successful measures. These include (1) incentives based on generation performance (rather than based on investment), (2) stable supporting programs based on long-term political objectives, (3) facilitation measures for ownership of wind power facilities/ involvement of wind power association by individuals, and (4) comprehensive supporting policies covering measures other than economic incentives (including policies and law/regulations on the relevant areas such as research and development of facilities and equipment, quality maintenance, grid connection, standard for construction site and basic mapping research for wind resource). These four elements could be considered as a set of indicators for successful supporting programs for wind energy.

The Government of India has been actively taking supporting measures for renewable energy development, with the lead by Ministry of Non-Conventional Energy Sources (MNES). It has been successful in creating a strong institutional arrangement for supporting renewable energy, making use of both bilateral (Swiss and Danish, etc.) and multilateral (World Bank, GEF and Asian Development Bank, etc.) funding as well. MNES deregulated the wind energy sector in 1992, provided fiscal incentives (various tax measures), and financial incentives (concessional loans) through the Indian Renewable Energy Development Agency (IREDA), one of its subsidiary financial institutions. Bilateral and multilateral funding in most cases is utilized though IREDA. As a rough illustration, the supporting measures in India can be classified as fiscal incentives provided by the central government (including one hundred percent depreciation of equipment investment costs in the first year, various reductions and exemptions of taxes on the wind energy facilities, etc.), soft loans though IREDA, and measures by local governments (including a subsidy for initial investment, exemptions and reductions of various taxes, purchases of generated electricity by State Electricity Board (SEB), etc.).

Taking a general view of the performance of the Indian wind sector, several observations can be made. Unlike the trend of wind energy in developed countries reviewed, Indian supporting measures show that they did not lead to the reduction of the generation cost, and instead they put pressure on government fiscal budgets. Further, in contrast to its impressive total installed capacity, the growth of the installed capacity peaked in 1995/1996. The price of wind turbines in India is reported to be increasing in spite of the declining costs worldwide. Market share of India's approximately

fifteen domestic manufacturers has also been low since 1995/1996. Moreover, the assessment of the effectiveness of supporting measures using the aforementioned four indicators suggests what follows below.

Supporting measures for wind energy by the Indian government can be rated highly in terms of its contribution to the growth of the installed capacity. They are also based on clear long-term political views (although some measures by local government are inconsistent with those by central government), and make good use of overseas economic assistance to reinforce their efforts. On the other hand, the appraisal shows that the most powerful fiscal incentives to the investors in India, i.e., one hundred percent depreciation of investment in the first year, did not provide appropriate incentives for actual power generation and cost minimization, causing similar problems experienced in California in the 1980s.

The lack of comprehensive policy measures in areas other than economic incentives created additional technical problems such as low performance and high cost of wind turbines. Furthermore, drastic revisions may be required to solve the problems associated with the grid connection of low performing wind turbines, poor co-operation between SEB and wind power promoters, and maintenance of relevant regulations. Aside from providing incentives according to the actual generation capacity to achieve the gradual reduction of the generation cost, future efforts should be targeted at more comprehensive measures. These may include the following: facilitation of further basic research and development, smooth approval process of wind projects, improvement of grid connection and quality control of the equipment exploration of the possibility of institutional arrangements for ownership of facilities by individuals and associations, particularly in rural areas.

There is a limitation in this type of comparative analysis based on the secondary data, due to the unique circumstances of each country in terms of energy pricing, supply arrangements, the degree of deregulation and maturity of the energy market, the quality of the electricity to be fed in the grid and ownership of the land, etc. Besides, because of the difference in the primary motives of renewable energy development, India's supporting measures may not follow the trends shown in the experience of OECD countries. Therefore, it is necessary to construct a better framework for the appraisal to reflect India's political objectives and the future development of policy measures. Nevertheless, it is meaningful to learn from the experiences of other countries in developing policy measures, and the analysis could be useful as a basic research. Future tasks include more detailed research on the differences in the market and the extension of the results of this study to identify concrete areas for further economic assistance.

(Aki Maruyama)

d. Regional collaboration mechanism in Northeast Asia: IGES GHG Emission Model (IGEM) development and evaluation of CDM for China

In this research, we recognize the importance of regional collaboration in Northern Asia in terms of energy and economic collaboration, as well as the collaboration in climate policies. This research is undertaken now, under APN funding by an international team consisting of the Russian Academy of Science, the Chinese Energy Research Institute, the Korean Energy Institute and the IGES Climate Change and Environmental Governance Projects, reaching to the stage of the first draft. The objectives and motivation of this research are to analyze possibilities and constraints in developing collaboration among four countries (Japan, Russia, China and Korea) in this region. In particular, we focus on national approaches for the UNFCCC, to explore the joint effort, strategies and practical steps for mitigating GHG emissions among those countries.

First of all, we describe the general situation of four countries, developing possible indicators that make the comparison among four countries. Since the situations of the four countries are quite different, it is quite necessary to have general descriptions on climate change policy issues in both domestic and international policies. In particular, it is appropriate to raise detailed questions related to the Kyoto Mechanisms, such as early action, supplementarity, technological transfer, additionalities, baselines, etc., to understand the position of each country relative to the UNFCCC.

In the case of Russia, after disaggregation of the Former Soviet Union, this country is now in economic transition.

Institutional modernization in the energy sector and energy efficiency improvements have been identified as urgent tasks in Russia. However, recently, we have observed a turning point of economic recovery in Russia, which is important for predicting the world GHG emission profiles. Hence, it is quite critical to identify those new factors that affect GHG emissions and economic development in Russia

The other important topic in this research is to identify domestic institutional and policy formulation between Japan and Russia, since both belong to the Annex I countries of the UNFCCC, which have quantified targets for mitigating GHG emissions. First of all, institutional barriers for collaboration between two countries should be identified. So far, there are thirty existing NEDO projects between the two countries, which should be further examined in the climate policy perspective. In particular, one or two specific projects under the AIJ framework done by NEDO might be good examples.

In a broader perspective, the energy and economic collaboration among these four countries will change the whole profile of GHG emissions in this region. For example, the potential of a gas-operated electric power plant in Sakhalin for exporting electricity to Japan is now under discussion between two countries. The analysis on Siberia's gas pipeline project should be included, which is attractive to every country in this region. The bilateral collaboration between countries in this region would also give many insights for formulating international collaboration to mitigate GHG emissions. In the case of Japan and China, it is possible to collaborate for the CDM. In the case of Korea and China many cases for economic collaboration can be identified, but it is difficult to fit these into the Kyoto Protocol at this stage. In the case of Russia and China, there is currently collaboration in the power generation sector. (China buys electricity from Russia, which is the reverse case of the CDM.) CDM projects from Russia to China are theoretically possible but there is a low possibility of such cases being put into practice. Hence, it is necessary to analyze specific case studies of various combinations among countries in order to derive meaningful climate policy implications.

(Tae Yong Jung)

e. Sustainability indicators for the CDM

Article12 of the Kyoto Protocol makes provisions for cooperation between Annex I and non-Annex I countries through the CDM. Instituted primarily to provide flexibility to Annex I countries, the CDM is expected to lead to additional and clean investments for mitigation projects that meet the criteria for sustainability in host countries. One research subject conducted by a visiting researcher from TERI (Dr. Iyer, Maithili) draws attention to the challenging task of operationalizing sustainable development for formulating eligibility criteria for projects under the CDM. Clarifying the issue of sustainability in CDM projects can secure greater consensus among the parties about the usefulness of projects. Further, it also illustrates how concepts or practices associated with sustainability may be used for criteria-setting for project selection. Dr Maithili's paper, "Removing the Myth of Sustainable Development in CDM: First Step Towards Operationalization," draws on data from existing projects funded by the Global Environment Facility (GEF), to illustrate joint benefits for investor and recipient countries by implementing projects under the CDM.

The paper notes that sustainable development remains a fuzzy concept and has been conceptualized and defined in numerous ways, several of which are reviewed here. The paper also points to the fact that for industrial countries environmental stewardship involves entrusting tomorrow's legacies to the integrity of today's guardians. However, for the poverty-cursed people of many developing countries, "tomorrow" is not a poetic allusion to a time many decades hence. For millions of people in Africa, Asia and Latin America—and even for many in the industrialized countries—tomorrow is just the day after today. Their challenge is to sow, make, sell, or trade enough to get through a day at a time. To the planners and politicians of developing countries, sustainable development involves not simply preserving resources and maintaining options for generations yet unborn, but to bring their own struggling societies a decent living in the current day context. The confusion inherent in sustainable development thinking creates serious problems for practical applications on the ground for the Third World. If parties to the Kyoto Protocol truly intend to embark on the challenging task of sustainable development of the non-Annex I countries, economic growth must not only be vigorously promoted, but it also must be channeled along paths that are sensitive to local environmental

considerations.

The aim behind criteria-setting for project eligibility and selection is not to come up with a tool that can be applied across the board. This paper illustrates three different concepts for criteria setting: the topic-based, goal-based, and the pressure-state-response frameworks. Assessment of these frameworks shows that irrespective of how sustainable development is defined, the goal-based framework lends itself better to the characteristics of the CDM. The paper also establishes that the existing gaps in the current design of the CDM are not likely to affect the issue of criteria-setting for project eligibility. The Chinese gas transmission and distribution project used in this paper to evaluate the sustainability criteria illustrates types of ancillary benefits that may be expected from a typical CDM project (the GEF project used for evaluating the project's worth cannot be considered as a typical CDM project, but it can be taken as a close approximation).

In conclusion, the paper points to the importance of the process of creating consensus, which is normally based on shared definitions of reality. Credibility, acceptability, and trust are factors that determine the extent to which these alliances are formed. Toward this end, it is essential to take into consideration the social-cognitive basis of dialogue. It may help the international negotiation process to focus on building this knowledge base and cultivating the requisite trust through resolution of issues that are at the heart of sustainable development. Developing a set of indicators for the countries will certainly help in identifying projects that can benefit from the CDM. In the ultimate analysis, it is important to remember that indicators do tell us a story about the possible effects of implementing a certain project. However, they are indicators, and the numbers are relative and only approximate, at best. The final decision about project eligibility and implementation rests with the negotiating parties and the Executive Board. The exercise of developing indicators can only provide a road map for making that decision. The decision about the path, however, should lie with the host countries.

(Maithili Iyer)

2.2.3 Proposals for domestic policy measures

a. Portfolio of domestic policies/measures and emissions trading

IGES focuses on the international aspects of environmental issues, in general. However, it is important to pay attention to the domestic issues in the developed countries from the perspective of implementation of mitigation options to meet international target- and incentive-setting for the development of the CDM and technology transfer. In this sense, design of domestic policies and measures in Japan is an important research theme of IGES Climate Change Project. In particular, introduction of the Kyoto Mechanisms (especially the case of emissions trading) indicates the importance of firm level emissions trading as a domestic regulatory framework.

IGES Climate Change Project has focused on domestic emissions trading schemes along with the international ones from the beginning. It has held discussions with domestic stakeholders through many channels like Brainstorming Forums and gave progressive remarks at the governmental committees, etc. The latter part of Dr. Matsuo's paper, "Points and Proposals for the Emissions Trading Regime of Climate Change—For Designing a Future System (version 1 and 2)," mentioned above, also studied domestic emissions trading comprehensively (Figure 7).

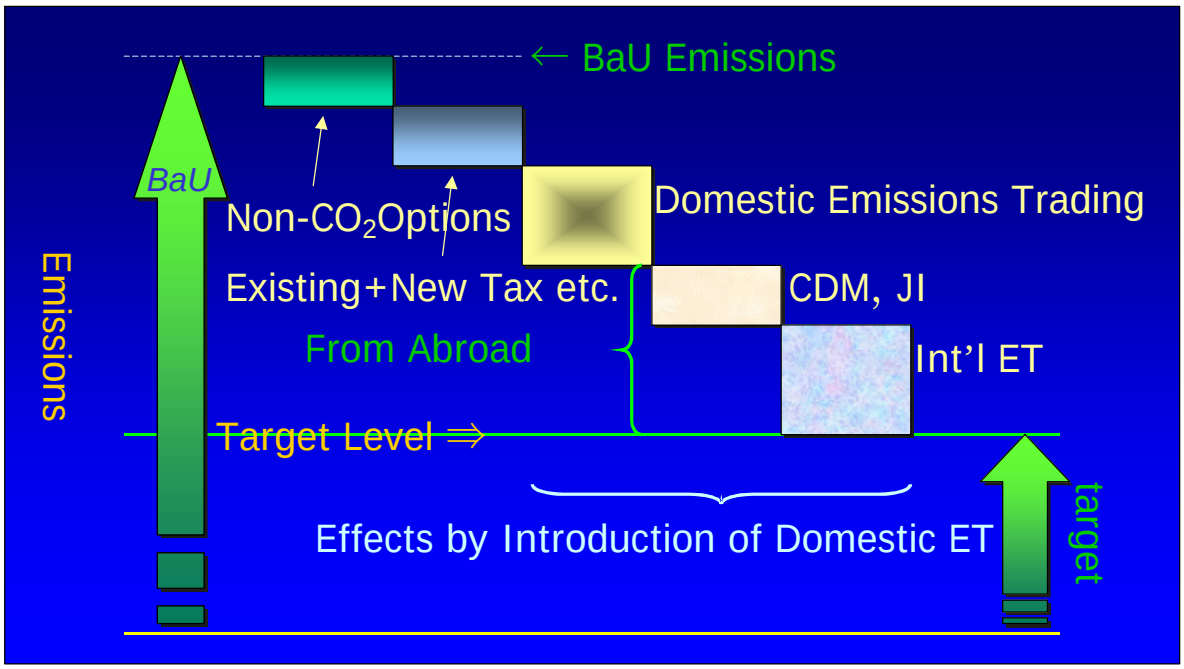
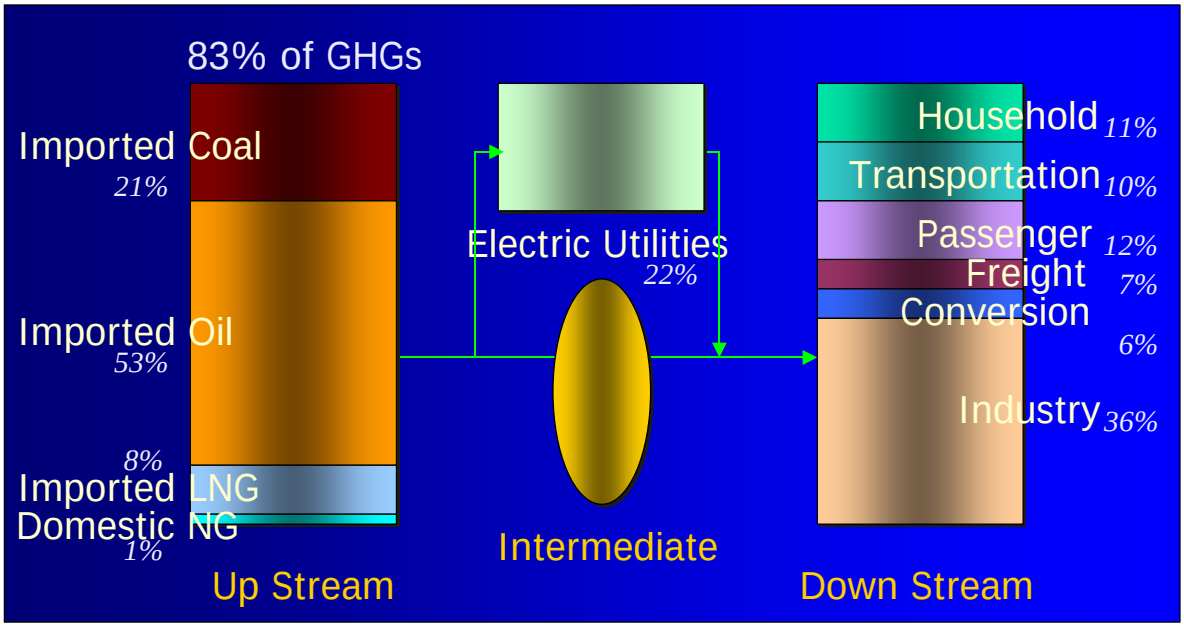
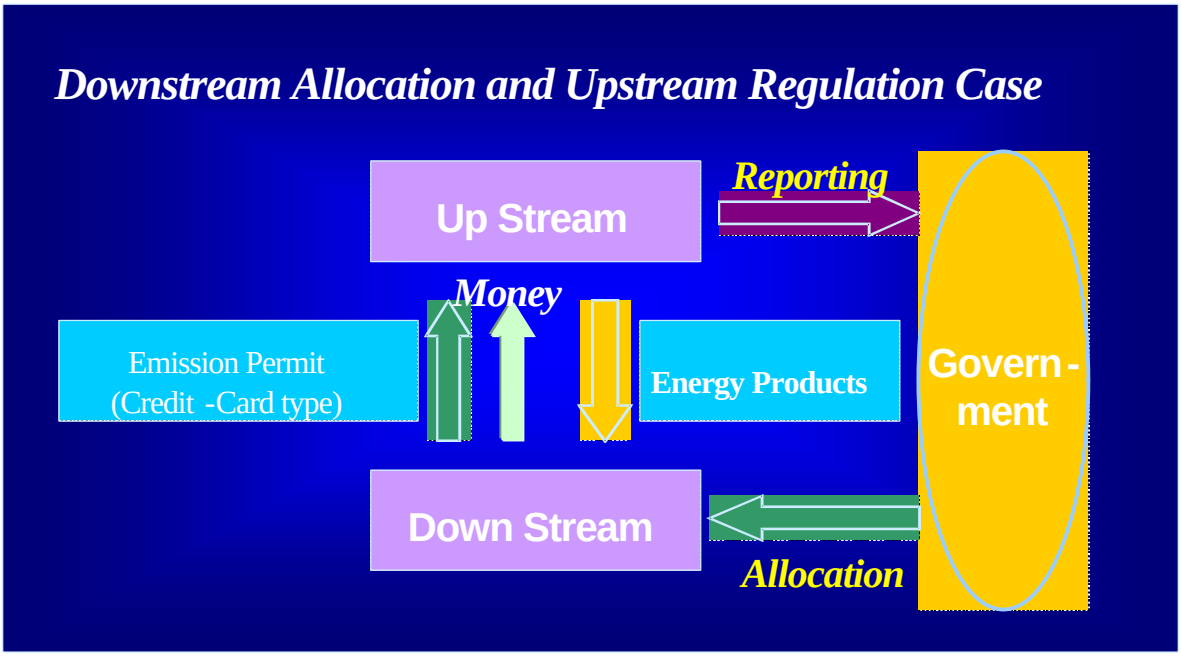


Figure 7. Domestic emissions trading as non zero-sum domestic mitigation measure

As the paper covers a broad range of the issues, the most difficult and controversial designing issue among them is the initial distribution of the permits. One related point is which level (up stream as supply side or down stream as demand side) of energy flow the permits should be allocated to. In addition, criteria for allocation include very important considerations of equity. The paper discusses an interesting idea which allocates permits to downstream and reports back to the government at upstream for former issue. As for the initial distribution criterion, the paper clarifies the shortcomings of auction which are often recognized as desirable economically and concludes that a kind of "grandfathering" based gratis allocation is better. The main reason is that on the one hand the emissions trading maintains economic efficiency by "trading," while on the other hand it deals with equity considerations by allocation. Any newly introduced measure should consider equity; allocation is explicitly allows for this in the case of emissions trading. On the other hand, auctioning seems equitable. However, there remains such an issue *implicitly* when the revenues are expensed.

It is difficult to collect appropriate and accurate information in Japan on how other developed countries address the issue of domestic emissions trading design, although it is an important input. The IGES Climate Change Project reported thorough information on this subject from background to implications. This has been revised to version 5 and provided useful information in the related discussions in Japan. In particular, the approach in the United Kingdom is very informative for Japanese stakeholders. In the United Kingdom, the government decided to introduce a Climate Change Levy on energy consumption in the business sector. In addition, a relief measure was introduced for energy intensive industries by applying so-called negotiated agreements with the government. As a counterproposal from the industry sector, domestic emissions trading emerged (including design of the scheme) in order to comply with the agreements. A similar example can be found in Norway, where the industry sector proposed and also designed domestic emissions trading (linked to international emissions trading) as a countermeasure of the existing carbon tax.


83% of GHGs
Imported Coal
21%
Imported Oil
53%
8%
Imported LNG
Domestic NG
1%
Up Stream
Electric Utilities
22%
Intermediate
Household 11%
Transportation 10%
Passenger 12%
Freight 7%
Conversion 6%
Industry 36%
Down Stream


Downstream Allocation and Upstream Regulation Case
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Money
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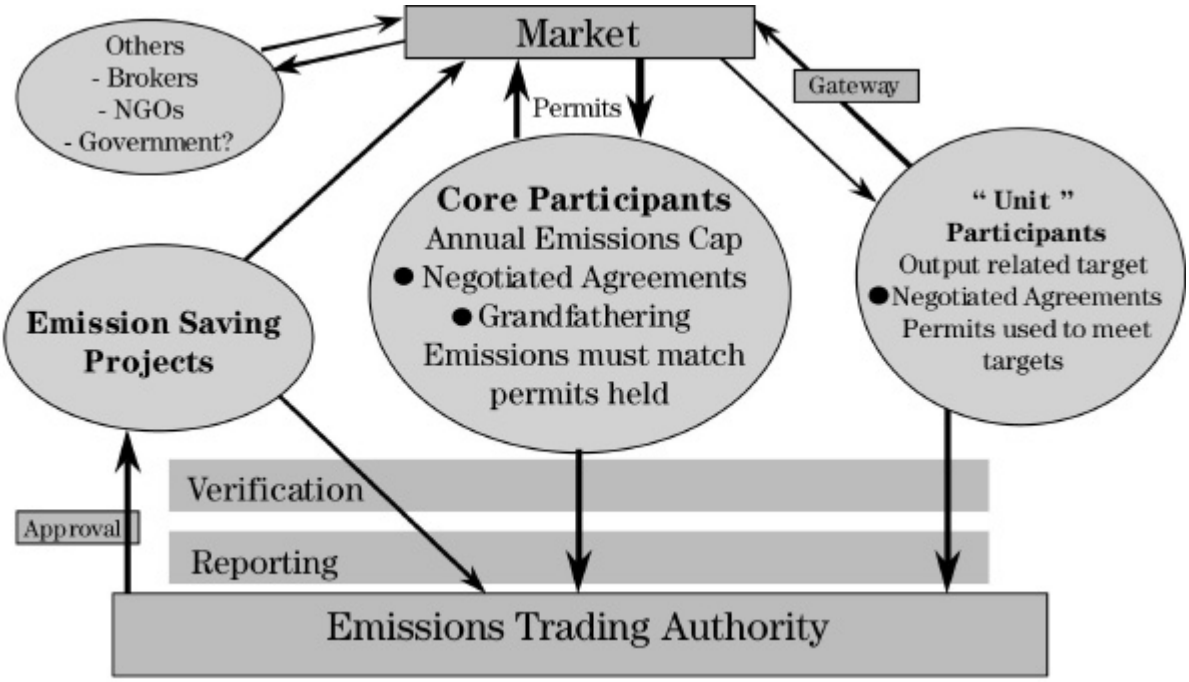

Figure 10. Outline of the UK domestic emissions trading scheme

This kind of portfolio of policies and measures may provide a desirable organic package promoting the merits and complimenting the demerits of each measure. Matsuo proposed a grand design of such a portfolio at the IGES Open Forum on Climate Policy with a paper entitled "A Portfolio of Domestic Instruments for Climate Change Mitigation in Japan to Implement the Kyoto Regime (version 1)," in which domestic emissions trading forms the backbone of the portfolio. In order to develop a portfolio of policies and measures, the comprehension of the features of each policy and measure (emissions trading, carbon taxation, command-and-control measures, subsidies, voluntary approaches, etc.) and the synergetic reconciliation with objectives other than climate change is important. Considering these things, six "Guidelines" are indicated for policy-making and suggestions for packages of the instruments to put those "Guidelines" into practice.

Table 3. Categorization of instruments

Category / Coverage		Regulation	Voluntary Target	Market-based Instrument
Element Technology		Common	Occasionally	Subsidy, Deposit
Firm level	Fuel-type	Cap on Fuel *or* Cap on Emissions	Common (by Firm)	Energy Tax (by Fuel)
Economic sector level		Cap on Emissions (by Sector)	Common (by Sector)	Carbon Tax *or* ET in a Sector
Nation-wide		QERLC	Occasionally	Domestic ET
Region-wide		Bubble	(Bubble)	Kyoto Mechanisms

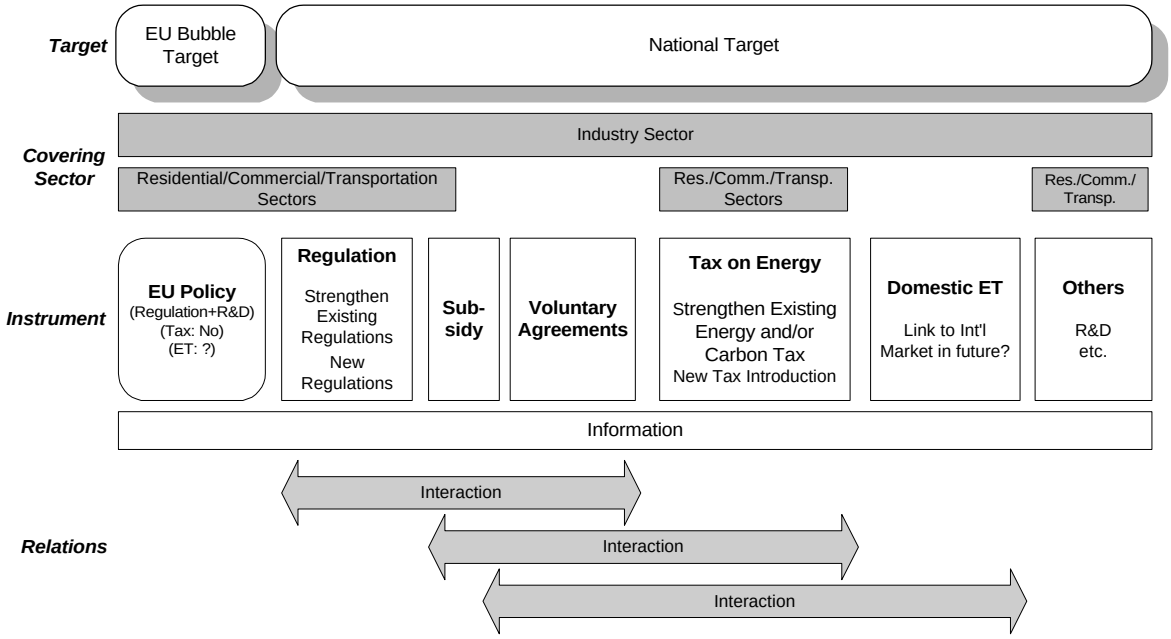

Figure 11. Policies and measures in the EU and their relations

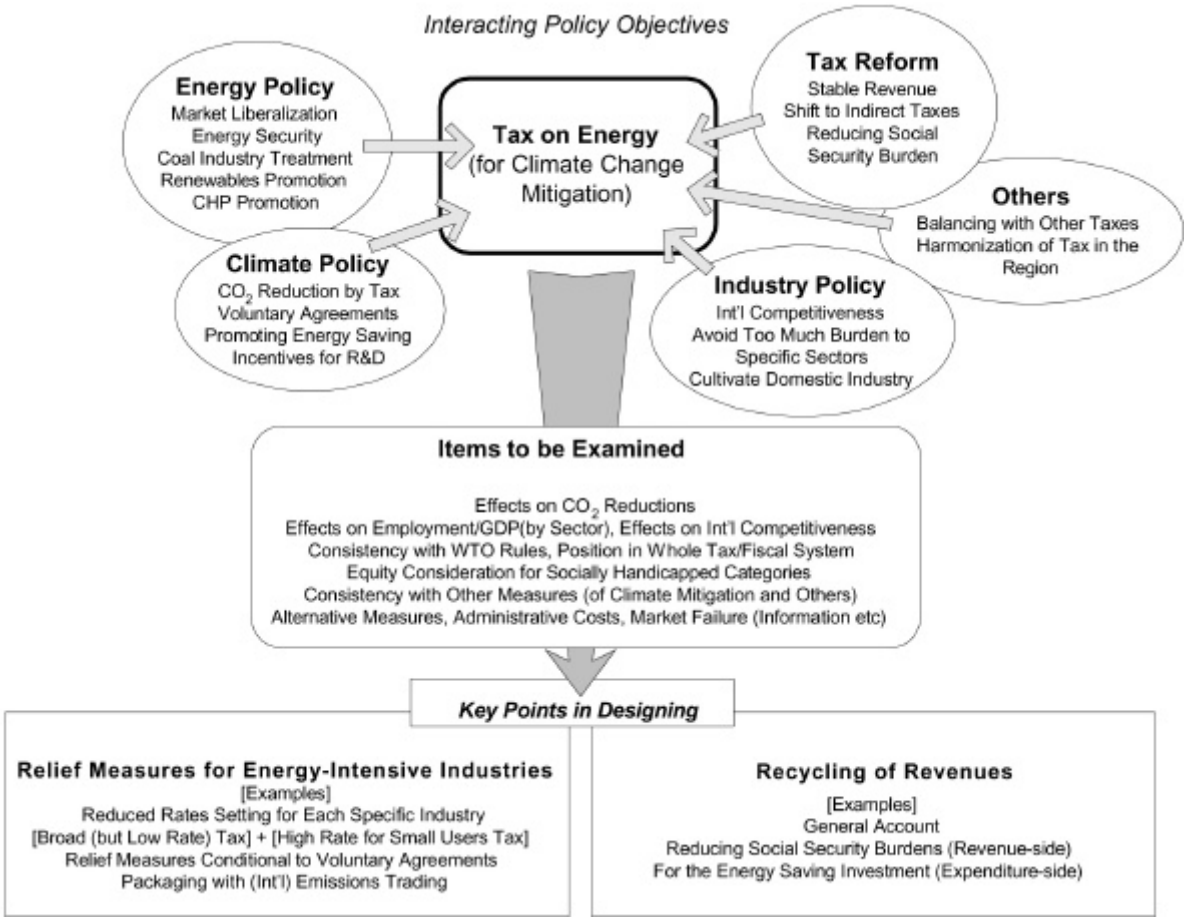

Figure 12. Interacting policy objectives for carbon taxation

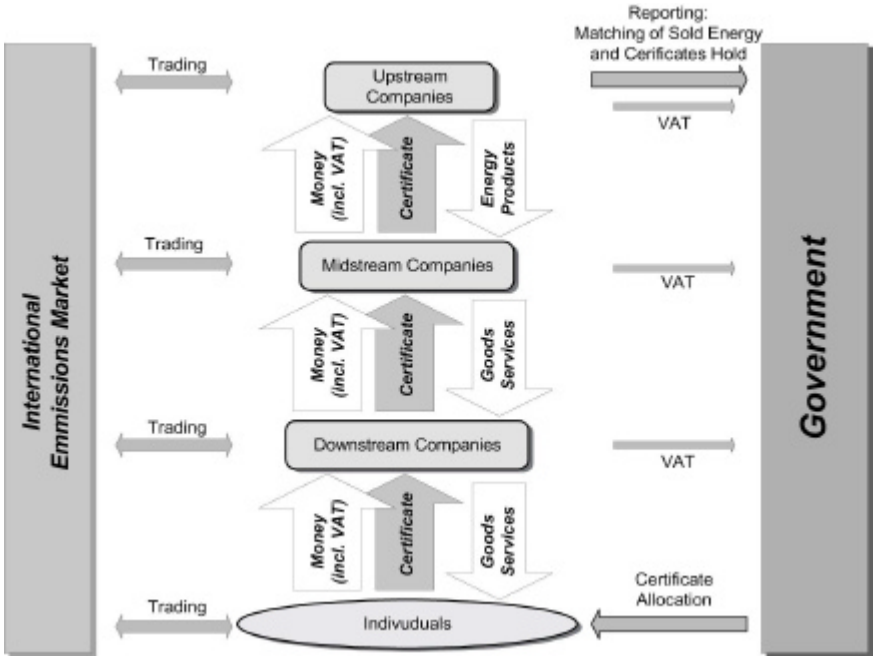

Figure 13 Concept of “carbon economy” proposal

The key points of the Guidelines are, inter alia, a scheme to automatically comply with the Protocol commitment, the pursuit of economically rational behavior and the clarification of the role of governments in relation to this; and incentives for the private sector in the liberalized market. A focus is set on the preparation of an enabling environment for each emitter to behave rationally, especially concerning the role of the government.

In the proposal, the emissions trading scheme is situated as the major component of a portfolio, being divided into two phases, before and after the year 2008: the former is the extended version of the “Voluntary Action Plan” of the Keidanren (Japan Federation of Economic Organizations) which is a relatively easy transition from the current status (up to the year 2007), and the latter is a fairly radical proposal to create a new economy called the carbon economy (per-capita allocation base after the year 2008). In addition, exclusive carbon tax for small-scale users will be levied to provide financial resources for subsidies to mitigate climate change (and as funds for corporate tax reduction). As for other measures, there will be no specific differentiation before and after the year 2008. There will just be a comprehensive package of small measures emphasizing the promotion of business-based efforts, like ESCO, and the establishment of institutions in order to realize ideas from the public and to share various good practices.

(Naoki Matsuo)

b. Domestic policy measures for global warming abatement—forming the opportunity for national debate, gathering opinion and reflecting it in policy measures

IGES and the Climate Change Project held a seven-part series of forums on global warming mitigation in order to establish a national consultation process on the issue of climate policy. Outcomes of discussions were compiled, analyzed and conveyed to policy-makers.

Under the Kyoto Protocol, Japan has agreed to reduce GHG emissions by six percent from the level of 1990. Since then, various efforts have been made to achieve targets; for example, energy-saving laws were amended and the Law Concerning the Promotion of the Measures to Cope with Global Warming was put into effect. However, noting that the total emissions in 1998 were ten percent above the level in 1990, it will presumably be difficult to achieve the goal. It is almost time to step up the enforcement of policies and measures further. To this end, the Central Environment Council and the Advisory Committee for Energy of the government of Japan have already embarked on discussions.

The measures to prevent global warming require that people from all sectors of society to join. Thus, to enhance the integrity of measures, it is essential that a broad range of stakeholders engage in brainstorming, exchange of views and consensus-building starting at an early stage of policy planning, rather than only a handful of government officials making decisions. Even before the Kyoto Conference, many proposals had come from academic circles and private sources. Much to our regret, however, such proposals were not fully reflected in the policies because the associated talks were not always conducted systematically.

Aiming to establish a consultation process with continuous contribution to the domestic measures through brainstorming among people and public discussion, this forum was inaugurated in January 2000 under the initiative of Akihiro Amano (Kwansei Gakuin University), Akio Morishima (Central Environment Council/IGES) and Shinji Fukukawa (Dentsu Institute of Human Studies). The forum meetings were held seven times between January and July 2000. Fourteen proponents from academic circles, industry and NGOs offered policy recommendations, which came under evaluation and discussion of the designated panelists. The meetings were open to the public and each meeting was attended by between 100 and 160 people (413 different people, total attendance of 885) with constantly animated and lively discussions among the panelists and participants. In the meantime, an electronic mailing list was used to transmit proposals and discussions were promoted on the Internet, which yielded many suggestions.

At this seven-part forum, every conceivable policy measure was proposed for the purpose of preventing global warming. These policies were diverse and comprehensive, ranging from economic incentives like emissions trading, carbon/environment tax and subsidies to control or guide approaches like independent efforts and establishment of improvement criteria and to a change in energy supply systems and environmental education. In addition to institutional efforts, there were also discussions based on quantitative analyses that used models. The features of each policy and measure that were revealed in the discussions are summarized as a table in the report of the forum.

The Climate Change Project organized this forum, and its leader contributed as the chairman. The project members provided opinions, and collected and analyzed the proposals provided by the presenters. Please refer to the list of speakers at the end of this section.

The forum gained much support from a wide range of participants, and it was requested that the forum be continued in the future. The results of each of the meetings were compiled and made into a report and published on the IGES website. After the final forum, all the reports were compiled into a document entitled “IGES (2000): Climate Policy Debate in Japan – IGES Open Forum 2000 for Global Warming Abatement, November 2000,” which was distributed at domestic and international meetings such as COP-6. The Central Environment Council of the Japanese government requested us to report on the results of the forum. As a result, the project leader was able to contribute twice to the policy-making process by giving presentations to the Council.

Proposals from various sectors

- Proposals Based on Carbon Tax

Carbon tax has been most widely utilized as either a core or complimentary policy measure. T. Sawa (Kyoto University) proposed carbon tax covering all sectors, stating that it is more stable in tax rate (price) than emissions trading, and thus, more convenient for business management. His proposal incorporates tax exemption for exports and imposition for imports, an aspect that relates to international competitiveness. In order to rectify the shortcomings of carbon tax and difficulties in emission controls, T. Morotomi (Yokohama National University) proposed to set tax rates at the same level as prices in the international emissions trading market and to allow emission sources free use of international trade that will enable them to automatically comply with the quantified targets. With the aim of mitigating the burden on emitters and providing double dividends, his proposal embraces the use of tax revenues in the form of subsidies for technologies that emits less carbon dioxide, and for supplementing social welfare payments. He proposed relief for energy intensive industries, including tax reduction and the introduction of emissions trading.

M. Kuroda (Keio University) presented his estimates of required carbon tax rates. The projection was based on economic model analysis. An amount of 440,000yen/t-C of carbon tax will be required on average to restrict emissions in 2010 at the 1990 level, assuming that the construction of nuclear power plants will be limited to below half the level of government plans. In order to mitigate such a heavy burden, Y. Kaya (Keio University) proposed an external carbon tax on consumers, which was expected to reduce emission rates by raising tax awareness. T. Morita (National Institute for Environment Studies), on the other hand, proposed a smaller carbon tax combined with subsidies financed by tax revenue. With double economic incentives for sources, tax and subsidies, this option could reduce emissions with a lower tax rate, projected as $30/t-C for a 3 percent reduction from the 1990 level in 2010. (Government plans to expand nuclear power up to 7000 KW have been already revised downward.)

- Proposals based on Emission Trading

Emission trading has advantages in controlling the total volume of emissions and relieving burdens by gratis allocation. However, it is often argued that the effectiveness of emissions reduction “downstream” (in energy consuming sectors) is insufficient when regulated “upstream” (in energy supply sectors) to cover most emission sources. This is because an invisible price increase is the only incentive for sources to reduce emissions.

Tackling this problem, A. Amano (Kwansei Gakuin University) proposed a system of regulating “downstream” large-scale energy consumers while controlling “upstream” small-scale energy consumers. Gratis allocation is adopted for “downstream” regulation in order to reduce the burden on energy intensive industries but in contrast, auction is used for “upstream” regulation to avoid rent-taking by energy supply industries.

N. Matsuo (IGES) further proposed individual allocation of permits as a more radical form of “downstream” regulation; they would be collected in exchange for energy consumption by energy suppliers who are required to match energy sales and permits. In his proposal, the payment of permits is required for even indirect energy consumption and accordingly it necessitates permits for purchase of all kinds of goods and services. Business sectors earn permits from consumers and they are used for payment of their own direct/indirect energy use. Finally, all permits are from energy supply industries, that is, permits circulate in the economy as well as money.

All proposals mentioned above incorporated command-and-control measures as supplementary policies to enhance technological development and emissions reduction in the residential and transportation sectors. Also, one proposal included emissions trading with gratis allocation as an alternative to carbon tax for energy-intensive industries in order to mitigate heavy burdens on emitters.

- Proposals Based on Command-and-Control

Command-and-control was regarded as effective for raising awareness among the consumers, and for encouraging technological development. It was adopted as a measure for residential and transportation sectors in most of the proposals. H. Nakagami (Jyukankyo Research Institute Inc.) claimed that price mechanisms alone would not be sufficient for emission reduction in the residential sector. He proposed measures to raise awareness of consumers, such as reduction of electricity used by the “standby” mode of electric appliances, daytime light service, and tightening the performance standards and heat insulation standards of houses.

Y. Hayashi (Nagoya University) presented his analysis of progressive vehicle-related taxes according to the size of vehicle. A two percent increase in fuel tax every year would reduce the share of large vehicles and emissions in the transportation sector in 2010 and would be restricted to a 20 percent increase from the 1990 level (compared to a 78 percent increase in the business-as-usual case). Furthermore, he proposed to construct urban infrastructure to reduce vehicle use, such as park-and-ride, and cycle-and-ride systems.

T. Nishizutsumi (Toyota Motor Corporation) reported the developments of hybrid cars, natural-gas-powered cars, electric cars, and fuel cell cars for improvements in fuel efficiency.

N. Hata (Kiko Network) presented a policy package based on command-and-control consisting of various regulations such as emission standards for factories and office buildings, mandatory generation/purchase of electricity from renewable energy, sales/ownership targets of clean energy vehicles, eco-labels and so on. His proposal incorporated a low rate of carbon tax a complementary measure and expected the package would achieve a six percent reduction from 1990 levels without use of the Kyoto mechanisms.

By and large, even in proposals based on carbon tax or emissions trading, command-and-control measures were embedded as complimentary measures mainly for residential and transportation sectors.

- Proposals Based on Voluntary Actions

Proposals based on voluntary actions were presented mainly by industry participants. Y. Hosoya (Tokyo Electric Power Co., Inc.) and T. Nishizutsumi proposed voluntary actions promoted by the Japan Federation of Economic Organizations (Keidanren) Voluntary Action Plan on the Environment, planned and implemented by industry. As industries have the best knowledge of reduction costs and methods this is the most preferable measure for the industrial sector.

The Voluntary Action Plan on the Environment, already in operation, currently has the participation of 31 industrial associations and organizations that account for 75 percent of the total industrial emissions. Its aim is to stabilize the overall emissions of participating industries in 2010 at the 1990 level. Each industrial association has set up its own reduction target, which varies in units used, such as CO_2 emission volumes, energy consumption, CO_2 emission per unit of production, energy per unit of production, and so forth.

Although compulsory measures against failure to comply are not included, it was explained that industries would be sufficiently driven to achieve their goals by annually following up and publicizing the results and reporting to governmental committees. They further proposed that firms utilize credits acquired from JI and CDM projects and from the international credit market for the attainment of targets, though they rejected domestic emissions trading, mentioning that a cap on private industrial emissions would be a kind of controlled economy.

From outside of the industrial sector, there were proposals to include “agreements” which represent voluntary actions, as well as legal agreements with the government.

As a measure for industry, N. Hata suggested institutional development of voluntary agreements including common units of targets, CO_2 volume, and measures to take in the case of failure to comply. Likewise, N. Matsuo included voluntary agreements in his proposal for the period until 2008.

- Proposals concerning Alternative Energy

Proposals concerning alternative energy were presented at the forum as a component of domestic measures. As a measure to promote the use of renewable energies, T. Iida (Japan Research Institute) proposed to allow the trading of electricity generated from renewable energy sources in the liberalized electricity market, instead of current subsidy policies for the initial investment. In practice, the electricity markets would be deregulated to facilitate new entries, and power companies would be obliged to purchase electricity generated from renewable energy at a fixed price, while the overhead surpassing a market price would be covered by subsidies. He further suggested the Green Certificate Program, based on Denmark’s system, as a future policy. Electrical companies would be required to hold a certain amount of green certificates, which would be issued for future power from renewable energies, and would be tradable. Y. Kaya explained the possibility of introducing renewable energy. According to his account, economies of scale and technological development would lower the costs of renewable energy, but still the gap between cost and market price of electricity would need to be paid by consumers. Thus, the possibility of renewable energy would depend on the extent to which consumers can bear the additional costs. To promote energy shifts towards natural gas, H. Kudo (Institute of Energy Economics) proposed a system of gas pipelines in East Asia, from natural gas fields in the western

China and southern Siberia, through Korea to Japan. On the basis of an existing plan to build pipelines to eastern China, he proposes to extend an additional pipeline to Japan, and to construct a domestic inland pipeline in Japan spanning 3000 km from Kyushu to Hokkaido. He explained that it could be expected to cover 80 percent of the population and 90 percent of natural gas demand. The stable supply of natural gas will certainly reduce CO_2 emissions. Furthermore, it will help promote a shift towards small-scale micro-turbines and fuel cells that use natural gas, which emit less CO_2.

Common Understanding

At the forum, a common understanding was shared among the speakers and commentators on the following points.

- Combination of Multiple Policy Measures

Throughout the forum, it was found that each of the policy measures—such as carbon taxes, emissions trading, command-and-control policies, and voluntary agreements—had both advantages and disadvantages. Therefore, it was commonly recognized that a combination of several policy measures should be used to make the most of the respective advantages and compensate for the disadvantages. In particular, great importance was attached to the implementation of measures for development and diffusion of technology as well as those for regulating emissions. All the comprehensive proposals covering the domestic measures consisted of a combination of multiple policy measures. The next topic to be discussed is how to find the optimum combination of policies when considering the characteristics of energy consumption in each sector.

- Importance of CO_2 Reduction/Energy Conservation Technologies

While attention was focused on economic measures such as carbon taxes, the importance of technological development was repeatedly stressed as the means to ensuring the reduction of CO_2 emissions. Economic measures that reduce emissions through price changes will be less effective unless practical energy-saving technologies are available. Economic measures will encourage technological development, but many of the proposals consisting of carbon taxes or emissions trading also included measures for the promotion of technological development through subsidies, regulations, etc.

- The Need to Change Lifestyles

From a technological standpoint, analysts pointed out the necessity to restrict energy consumption and energy-intensive activities, since adequate CO_2 reductions could not be only through technological development alone. From an economic standpoint, analysts also expected economic measures to reduce energy consumption through higher energy prices. Consequently, it was commonly recognized that the reduction of energy consumption and a change in underlying lifestyles, in addition to technological development, are indispensable in order to achieve the quantified emissions targets that are stipulated in the Kyoto Protocol.

- Marginal Reduction Cost in Japan

According to M. Kuroda's and T. Morita's reports, a carbon tax of 30,000 to 50,000 yen/t-C, about $300-500/t-C, would be required to reduce CO_2 emissions from 0 percent to 3 percent below the 1990 levels in the year 2010 (without the Kyoto Mechanisms and relief measures). This tax rate also serves as an approximation of the domestic marginal cost of emissions reductions in Japan.

- Neutrality of Government Revenues

There was a common understanding that government revenues from the implementation of policies should be returned to emission sources in some form, or should be used as subsidies for the development of energy conservation technologies. The government revenues themselves are not necessarily for emission reduction, but just the result of additional charges for economic incentives made by measures to encourage reduction. Therefore, if they are given back

to emission sources, the burdens on them can be significantly relieved without impairing the effects of incentives. There was no proposal for incorporating government revenues into the general budget, at least in the short-and mid-term. However, some participants claimed that the radical greening of the taxation system in the long-term, which incorporates carbon tax revenues in the general budget while reducing conventional taxes, such as income tax, is necessary.

- Necessity to Relieve the Burden on Energy-Intensive Sectors

The above tax rate will place enormous burdens on energy-intensive industries and have a serious impact on their international competitiveness. For this reason, it was almost unanimously claimed in the proposals to the forum that relief measures are essential for the sectors which are subject to significant burdens. (Refer to A. Amano and M. Kuroda in “Grandfathering”; T. Morotomi in “Reduction/Exemption of Carbon Tax and Approval of Emissions Trading”; T. Morita in “Combination of Low-rate Carbon Tax and Subsidies”; Y. Kaya in “Low-rate Carbon Tax”; T. Nishizutsumi and Y. Hosoya in “Voluntary Actions by Industries” and Matsuo in “Tax Imposition Only on Small-Volume Emission Sources”).

- Broad Use of Alternative Energy

In the discussions covering technical aspects many participants, including those from the industrial sector, pointed out that as alternatives to electricity that have with fewer CO_2 emissions, such as renewable energy (wind, solar, biomass, geothermal energy, etc.), and natural gas, untapped energy, should be considered from a long-term perspective. As measures to encourage alternative energy, conventional measures such as subsidies for initial investment were regarded as ineffective. Instead, policies to stimulate trade of electricity generated by alternative energy in a liberalized market were recommended (such as fixed-priced purchase, mandatory purchase and green certificates). Regarding nuclear power generation, it was concluded that its promotion should not be determined from the standpoint of CO_2 reductions alone.

Issues That Are Still Under Discussion

Policies for domestic measures are roughly divided into six types: emissions trading, carbon tax, voluntary actions, command-and-control, subsidies, and education/advocacy. There were differences concerning the evaluation of each policy instrument, and the priority of evaluation criteria among the speakers and commentators. In particular, priority of valuation criteria seemed to affect the selection of core policy instruments.

- Domestic Reduction and/or Use of the Kyoto Mechanisms

There were differences of view regarding an important premise of policy design: to what extent should the Kyoto Mechanisms be used instead of domestic emissions reductions? Some participants supported reducing CO_2 to 6 percent below the 1990 levels only through domestic reduction, while others suggested that the Kyoto Mechanisms should be used freely until the marginal reduction cost becomes equal to the permit price in the international market. However, the dominant opinion was that complete dependence on domestic measures would impose too heavy a burden on emission sources, while completely free use of the Kyoto Mechanisms would delay the development and diffusion of energy conservation technologies. Balancing domestic reduction and use of Kyoto Mechanisms were considered important, but the discussion did not cover a specific share of each, and this topic was left for future discussion.

- Effectiveness of Policy Measures on Emission Reductions

There were inconsistencies among the analyses on the effectiveness of the policy measures for emission reductions—emissions trading, carbon tax, voluntary action and command-and-control.

First, the incentives for emission reduction, and policy measures regarding consumers, were discussed from two different aspects. A question was raised about the effectiveness of incentives for emission reductions through price

mechanisms. Based on the relations between prices and demand seen in the past, including the oil shock period, some participants pointed out that the residential and transportation sectors had low price elasticity and consequently, substantial price increases would be needed for sufficient emission reduction. Therefore, command-and-control, or voluntary actions, which did not place a huge burden on industry, were superior to economic instruments. In addition, there were discussions as to whether there was a difference in the strength of reduction incentives when the point of regulation (taxation) was "downstream" or "upstream." It was claimed that because "downstream" regulation (taxation) directly places additional costs on energy consumers, it would have a greater awareness effect. It would bring about greater awareness of additional costs than "upstream" regulation that places burdens on consumers only indirectly. Therefore, carbon tax, which could have a wider coverage of the "downstream" sector, was superior to emissions trading. However, no conclusion was formed regarding the difference of incentives between "upstream" and "downstream" regulation.

Second, regarding the control of total emission volume, it was claimed that emissions trading was most effective, if the need for balance of emission reductions among sectors was not overemphasized. Under command-and-control, control of total emissions is difficult due to reliance on standards of CO_2 intensity, double-counting or rebound effects. Carbon tax often needs a change of tax rate in accordance with a change in economic situation, and in addition, accurate control of the emission volume is almost impossible. Voluntary actions, which have no enforcement measures, leave uncertainties in terms of total emission control. The advantage of emissions trading was emphasized, since the control of total emissions is critical in considering the fulfillment of quantified emissions targets as an international commitment. At the same time, it was pointed out that domestic emissions trading would discourage domestic efforts for emission reductions, since it would be likely to facilitate the purchase of credits from the international market.

- Reduction in Residential and Transportation Sectors

Throughout the debate, there was agreement as to the importance of reduction in the residential and transportation sectors, but opinions differed as to the weight of importance and reduction measures.

Command-and-control measures, which generally impose restrictions on energy consumers, can directly force regulated emission sources to cut their emissions. In the case of emissions trading or carbon tax, emission sources with high reduction costs can help reduction simply by paying taxes or buying emissions permits, and thus, reduction will be implemented from emission sources with lower reduction costs. As a result, allocation of reduction volume among sectors will be based on reduction costs rather than on emission volume, and accordingly, volume of reduction is likely to be smaller than that of emissions in the residential and transportation sectors. The proponents of command-and-control measures claimed that in the long-term there was a need to change energy-intensive lifestyles or economic systems based on mass production, consumption and dumping. A change in lifestyle would be brought about by emission reductions in the industrial, residential and transportation sectors. They also pointed out that there was no decisive means for the those sectors, and various measures including urban planning and campaigns, in addition to regulations or subsidies. It was also indicated that importance should be attached to pushing energy conservation on a commercial level as in the case of ESCO (Energy Saving Company).

In contrast, the proponents of carbon taxes or emissions trading claimed that economic instruments could enhance emission reductions in the residential and transportation sectors when regulated "downstream," and that all proposals using economic instruments take the form of "downstream" regulation.[1] At the forum, no conclusion was reached as to the effectiveness of price mechanisms on energy demands in the residential and transportation sectors. However, T. Morita's presentation at the third forum meeting suggested that reductions in commercial use in the residential and transportation sectors would be much less than in other sectors. In particular, it was recognized that there could be a tendency for emissions trading to hamper the progress of reduction in those sectors, because of the difficulties in

[1] All proposals to push carbon taxes imposed the taxes on consumers. For proposals of emissions trading, A. Amano proposed downstream regulations on large-volume consumers, while N. Matsuo proposed downstream regulations on an individual quota basis.

directly controlling small-volume energy consumers, and linkages to the international emission permits market, which would significantly discourage domestic efforts.

- Economic Efficiency

The economic efficiency of each policy instrument was frequently covered in the discussions. It was repeatedly pointed out that under quantified targets, emissions trading and carbon tax had the least adverse effect on the economy at large and were economically the most efficient. Command-and-control and subsidies were inferior in terms of efficiency, even when implemented by the government with a large amount of information and excellent means of prediction. But the proponents of command-and-control raised questions about the importance of economic efficiency. In addition, there was the opinion that in the long-term, it would be more effective to intensively promote the technological development of the residential and transportation sectors, and change energy demands of these sectors at an early stage. In response to this, there was the opinion that relieving the burden on the economy at large was critical for early implementation of CO_2 reduction measures, because it could reduce the adverse effects on economies, such as a loss in GDP, unemployment and weakened international competitiveness. For a more accurate comparison, quantitative analysis would be required, outside of this forum, of the reduction cost of command-and-control measures.

- Fairness

Regarding fairness, discussions focused on initial allocation of permits under the emissions trading system. There was the argument that under "grand-fathering" allocation, in relation to conventional emission amount, it would disadvantage those emission sources that had already engaged in the improvement of energy efficiency, and also new entrants. Carbon taxes, or command-and-control measures—for which uniform standards were applied—would be considered as previous reduction efforts and thus, would be fairer. However, command-and-control has been a problem regarding the fairness among different sectors, and carbon taxes could be unfair if relief measures were applied to energy-intensive industries. In the case of voluntary actions, a question was raised about whether the targets set by industrial associations would be fair or not in terms of the appropriate sharing of reduction quotas within the national economy.

Position in the argument and Selection of Policy Measures[2]

Various factors affect the prioritizing of policy measures. Careful review of discussion at the Forum shows that the assertion of one policy measure depends on what point he/she wishes to emphasize.[3] The approximate relationship between the policy measures and the points emphasized in the arguments are summarized as shown in the table below (Table 4).

Of the above issues, the question of which should come first—"economic efficiency" or "reduction in residential and transportation sectors"—seems to be particularly closely related with basic attitudes of proponents towards the global warming problem, and has the greatest influence on the selection of policy measures. The table shows the trade-offs clearly. Economic instruments are economically efficient, because they facilitate reductions starting from the emission sources whose reduction costs are lower regardless of sector. For this reason, reductions in the residential and transportation sectors, which have lower price elasticity, will not make much progress, while enforcement of reduction would hamper economic efficiency. Therefore, the trade-off is a choice between whether reduction targets should be set by sector or by type of emission source, or be set regardless of sector. This choice results in discrepancies among important criteria for policy evaluation.

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[2] The arguments here are based on the chairperson's and the secretariat's view and are not necessarily based on the consent of the speakers and commentators.

[3] Other factors include administrative costs, connection with and transition from the existing systems, linkage to the international reduction credit market, and relation to other policy aims.

Table 4. Factors in selection of policy measures

	Use of Kyoto Mechanisms	Reduction effectiveness	Reduction incentive	Reduction in residential and transportation sectors	Economic efficiency
Emissions trading	Emphasized	Emphasized		Emphasized	
Carbon tax			Emphasized	Emphasized	
Command-and-control			Emphasized	Emphasized	
Voluntary actions		Emphasized		(Emphasized)	

Note: For voluntary actions, it is assumed that a reasonable target for total emissions is set based on previous emissions. Reduction in the residential and transportation sectors is labeled as emphasized, because the total emissions for these sectors are automatically determined when target for the industrial sector is set.

First, choice of policy measures raises the issue of fairness. Economic instruments result in only small reductions in residential and transportation sectors, where a rapid increase of emissions is anticipated, and that fact is considered as unfair in terms of balance between emissions to be reduced, and the volume of current emissions. In that case, ensuring emission cuts in those sectors will reduce burdens on the industrial sector and contribute to the attainment of fairness among the sectors. On the other hand, if the concentration of burdens on energy-intensive industries is regarded as a problem, it can be considered that equalizing reduction costs among emission sources is essential for fairness. In this case, measures with higher economic efficiency are preferable from the view of fairness.

Second, this choice relates with how to evaluate the total costs incurred in the economy. If a policy instrument is economically efficient, then it will minimize the burdens on the entire economy. On the other hand, forced reduction in the residential and transportation sectors increases the burden on the economy because reduction will be implemented regardless of reduction costs. With smaller social costs, policy measures against global warming will be accepted more smoothly, and the quantified targets are more likely to be fulfilled. Therefore, policy measures that are efficient in total are more favorable. However, the tendency of consumers to avoid inconvenience, even when faced with high expense, affects attitudes about reducing energy consumption, and is the very reason why emission reductions in the residential and transportation sectors are so difficult to achieve. Debate exists about whether the cost incurred to avoid inconvenience should be regarded as a burden on the economy.[4]

Third, this choice has different effects on lifestyles, which determine the patterns of energy consumption in society at large. It is expected that a change in lifestyle will be expedited if reduction measures are implemented in the residential and transportation sectors, which include the largest number of energy consumers. Forceful measures in those sectors are of great importance when we consider shifting the economy towards a more environmentally friendly and resource-recycling one. It is essential for long-term measures in order to prevent global warming and other environmental problems. In addition, considering the social cost in long run, early implementation of policy measures might reduce social costs, and if so, a reduction in the residential and transportation sectors will turn out to be more efficient in the long-term.

Fourth, the choice of policy measures differs in terms of incentive effects for the development and diffusion of technologies, which are essential for long-term global warming abatement. For command-and-control, which is

[4] In the field of economics, this kind of inconvenience is called disutility, and is included in social costs when considering efficiency.

effective for emission reduction in the residential and transportation sectors, the government usually sets specific targets for the development/adoption of technologies (sectional target, emission standards, recommendation of adopting specific technologies, etc.). As a result, command-and-control policies will provide strong incentives. On the other hand, carbon taxes and emissions trading offer indirect incentives for technological development through price mechanisms, and the targets for development/adoption of technologies are determined in the market. For this reason, it is normally considered that these measures provide a minor incentive to technological development, although they cover a much broader sector of energy consumption.

Fifth, in connection with the above argument, the choice of policy measures results in differences concerning who should determine the reduction scheme (i.e. allocation of reduction amount among sectors, technologies to be adopted, direction of technological development, etc.), and whether these should be regulated by the government or the market. In the case of emissions trading or carbon taxes, the "market" determines the reduction scheme (laissez-faire), while in the case of command-and-control approaches the government determines the appropriate direction (normative).

How one thinks about the above criteria will determine the balance of importance between "reduction in residential and transportation sectors" and "economic efficiency" in domestic measures, and will accordingly affect the selection of a core policy instrument.[5] For example, those who think that a shift towards an environmentally friendly economy is essential, that strong measures must be imposed to change the residential and transportation sectors, and/or that the government's role in correcting for market failure is important, tend to choose command-and-control approaches as their core policy. On the other hand, those who think that domestic measures based on command-and-control approaches will make early implementation difficult due to higher costs of emissions reductions, and/or that market mechanisms will automatically result in an appropriate economic system (or consider that the governmental control is detrimental), tend to choose emissions trading or carbon taxes (although not all proposals are consistent on this point).

For other issues, each policy measure can be dealt with flexibly by changing the details of policy design. For example, emissions trading can enhance reduction incentives of consumers by regulating "downstream." Carbon tax can control the total emission volume by adjusting tax rates through trial and error and finding the appropriate rate to achieve control of total emissions. This is also true for the use of the Kyoto Mechanisms. Technically, credits purchased in the international market can be incorporated into either command-and-control approaches or voluntary actions. Specifically, "reduction effectiveness" or "use of the Kyoto Mechanisms" cannot be core policy choices because no decisive difference is likely to come out of such policy instruments, whereas their characteristics can be changed to some extent by changing the details of design. In contrast, "economic efficiency" and "reductions in residential and transportation sectors" are critical factors in the selection of policy instruments.

However, there was a common understanding among most speakers and commentators that both features (rather than just one or the other) in economic and regulatory approaches were required as a set. Most of the proposals consisted of a combination of carbon taxes or domestic emissions trading and command-and-control approaches or subsidies. At the seventh forum meeting, great importance was attached not only to the policies to control CO_2 emissions at the level of the entire economy but also policies to develop technologies as a means for emission control. This suggests that economic measures should be combined with command-and-control approaches or subsidies that provide a strong incentive to technological development. However, the selection of a core policy in a combination is affected by its position in the arguments above. The main factors to be considered in the selection of domestic measures are balance of "economic efficiency" and "emission reductions in residential and transportation sectors," and how to combine them in a compatible manner. Additionally, "reduction effectiveness," "use of the Kyoto Mechanisms" (linkages to the

[5] In a strict sense, differences of views on these issues (i.e., in the definition of fairness or in the images of future economic systems) do not have much affect on the selection of policy instruments. It is also affected by differences in recognition about the importance of these issues (to which issue should greater importance be attached?) or differences in understanding about the effectiveness of policy instruments on these issues (for example, whether or not the reduction costs for command-and-control approaches are substantial, and whether or not a realistic carbon tax system will provide a high level of economic efficiency).

international market for emissions reduction credits), administrative costs, relationship to existing systems and other policy aims need to be considered.

Long-term Efforts

Although the central agenda of the forum was domestic measures targeted at the first commitment period of the Kyoto Protocol (2008-2012), at the seventh forum meeting, the importance of long-term strategy was emphasized as a premise for immediate domestic measures.

- The Importance of Technological Development and Diffusion

The speakers and commentators pointed towards the importance of the development and diffusion of technology. They claimed that it is technology options for CO_2 reduction/energy conservation that actually made it possible to reduce emissions, and that none of the policy instruments would have functioned effectively unless sufficient technological options were available. In this connection, it was pointed out that discussions for both policy instruments and technology development/diffusion would be necessary for the effective reduction of emissions (the relationship was metaphorically described as “cheerleaders” and “players” on the baseball ground, and that technology was the “catcher” of policy instruments). As a means for this, it is essential not only to intensify regulation on subsidies, but also to declare clear policy signals toward sustainable economy.

- Sustainable City Planning

Participants introduced the idea that a change in lifestyles should be supported over the long run by renovating transportation and urban planning, and by developing an energy-saving infrastructure. An expansion of energy-saving infrastructure, such as public transportation and local power supply systems with lower CO_2 emissions will help people to shift towards less energy-intensive lifestyles, a shift which is difficult to attain under the current infrastructure. It was mentioned that the initiatives of local governments are important, as well as comprehensive policy packages aiming at reduction of total regional energy consumption.

- IT and Global Warming

The influence of Information Technology (IT) on reducing global warming was raised. It was claimed that IT would have significant effects on CO_2 emissions reduction through improvements in the efficiency of logistics, reduction in surplus inventories, improvements in productivity, and reductions in carbon intensity per unit of GDP, and thus, future studies about domestic policies should included in these effects.

Direction of the Forums in the Future

It was suggested that a future Forum, to discuss the policy mix designing a comprehensive policy package based on the results of this Forum, should stretch beyond a simple comparison of single policy measures. It was indicated that since the effectiveness of policy measures depends on how they are designed, actual quantitative analysis of reduction costs, amount of emission reductions, influences on GDP and other factors must be based on a detailed and realistic policy package. It was also indicated that links to international mechanisms should be considered on the basis of the results of COP-6. In addition, participants pointed out that treating different industries collectively might hinder an understanding of their different circumstances and assertions, and that this needs to be improved for subsequent forums. A suggestion was also made that the forum should be held in local cities in the future in order to promote efforts on a local level.

(Takahiro Fukunishi, Shuzo Nishioka)

c. Estimation of CO_2 emissions in Japan

The first step of climate change mitigation policies is to estimate the amount of CO_2 emissions. In Japan, annual calculations are conducted by the former Environment Agency (now the Ministry of the Environment) in order to

contribute to the national communication to the UNFCCC secretariat. The amounts of CO_2–emitting activities, such as energy consumption, cement production and waste disposal, are calculated by the respective ministry and agency and then multiplied by emission factors (CO_2 emissions per unit of activity).

The resulting estimate is announced publicly quite some time after the end of the relevant fiscal year, usually one and a half years later. This delay is because, as in the case of the statistics for waste material, for example, the numbers are aggregated by each local government and then checked by the national Ministry of Health and Welfare, with the process taking more than one year before the public announcement. The Ministry of the Environment is unable to make the public announcement until the statistics are confirmed, since its announcement is regarded as "official."

As stipulated in the Kyoto Protocol, Japan is to reduce the GHG emissions by six percent by the year of 2010, in comparison with the 1990 level. However, the amount of emissions has continued to increase since 1990. If it takes more than a year-and-a-half to estimate the national emission, the country is unable to measure the effect of emissions mitigation policies during that period. This could cause a serious delay in the mitigation process.

CO_2 emissions account for 93 percent of Japan's GHG emissions (after converted with GWP), and the emissions from the energy sector amount to ninety percent of this figure. As for CO_2 emissions from the energy sector, the Agency of Natural Resources and Energy aggregates and announces the total emissions based on the energy production and demand and supply statistics after about six months after the end of the fiscal year, to make up for the delay in the Ministry of the Environment.

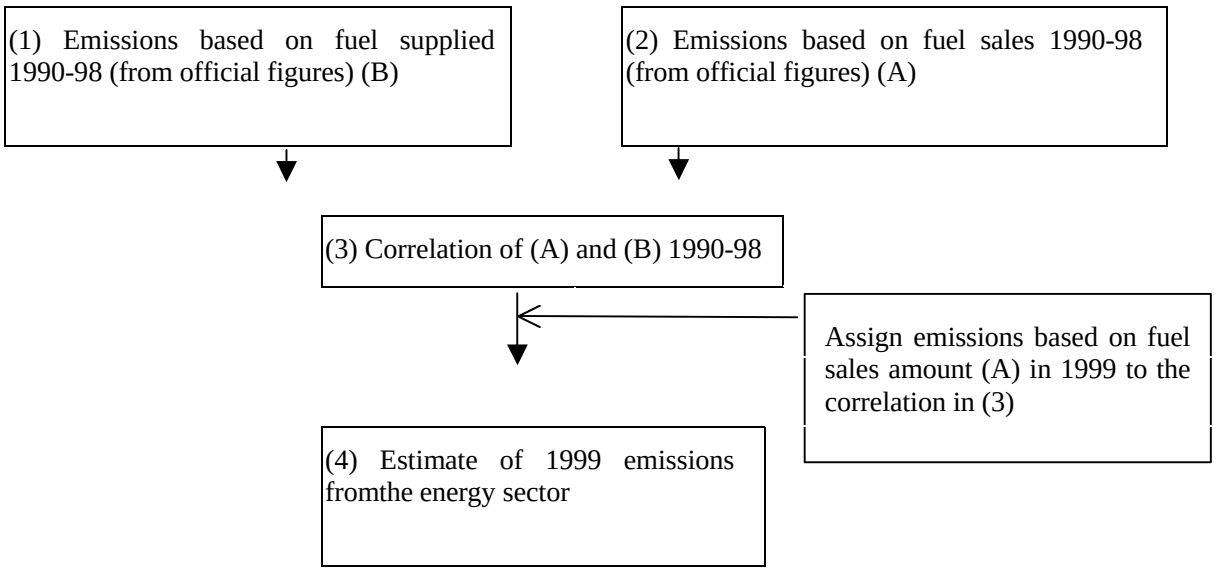
In cooperation with the Sanwa Research Institute Corporation, the IGES Climate Change Project established a method to estimate the national emissions as quickly and comprehensively as possible. Using this method the project announced publicly the estimated emissions in August 1998 for the fiscal year 1998, and in December 2000 for the fiscal year 1999. There was a large response from the industrial sector and policy-makers, who were provided with beneficial information without delay.

The estimation method of IGES/Sanwa is based on the statistics of energy demand (each energy sale), which is suitable for quick reporting. It is also advantageous in measuring the effects of the policy measures on energy use. As for the degree of accuracy, the difference from the official statistics, which were released one year later, is only 0.3 percent. Therefore, it can be said that this estimation method is quite competent for the purpose. In this estimate, the CO_2 emissions in Japan had increased by 9.8 percent by 1997 compared to the level of 1990. In 1998, it decreased to 5.6 percent due to the economic recession. However, in 1999 it went up to 9.8 percent again. The main factors for the increase are the transportation, business, and residential sectors, but it should also be pointed out that the basic mitigation measures in the industrial sector are not working effectively, seeing that the increase is affected by the economy. Serious efforts, based on timely information, are clearly needed to achieve a reduction of the new 9.8 percent gain plus the six percent reduction commitment in the next ten years.

Estimation of CO_2 Emissions in 1999

CO_2 emissions can be classified into two categories: energy and non-energy sectors. IGES aggregated the statistics for both.

(1) CO_2 emissions from energy use



Note 1

1. CO_2 emissions based on fuel supplied 1990-98 (from official figures) (B) are used.
2. From MITI's statistics of energy production and demand, sales of all types of fuel and household consumption 1990-1998 are used as basic data. The emission factors used in the national communication report to the UNFCCC Secretariat since 1996 are used to calculate each year's emissions based on fuel sales in (A).
3. For the correlation of (A) and (B) from 1990 to 1998, the following correlation formula is used.
   $B=1.11A-1.20\times10^5$ ($R^2=0.9811$) (Units: kt-CO_2 for A and B)
4. By using this correlation formula, the estimate for emissions from the energy sector in 1999 are obtained. Emissions based on fuel supplied 1990-98 (B) were obtained by applying this formula to fuel sales (A).

Results of calculation:

Estimate for emissions from the energy sector in 1999: 1,157 million tons

Note 2: Calculation method for emissions based on fuel supplied

From the Agency of Natural Resources and Energy's general energy statistics, the data for domestic supply of primary energy is utilized to calculate the total carbon from the fuel supplied to Japan. The supply base top-down method, which compensates for the portion of non-conbustable, is also used in addition to the data. This enables us to estimate the carbon amount from the aspect of supply.

Emissions based on fuel supplied＝((domestic amount supplied) - (portion for non-combustables) - (portion for industrial processes)) × (emissions factor)

- Calculation method of emissions based on fuel sales

Basically it is calculated as (domestic sales + household consumption) × emissions factor, but the following points are

also taken into consideration:

1. For asphalt, only fuel asphalt is counted.
2. For lubrication oils and nafsa, only 20 percent of total sales are counted as being for combustion.
3. Materials which lack sales data, such as natural gas or the oil cokes, are counted using production or shipment volumes.
4. Coal and oil cokes used for coke production, 5 percent is counted as non-combustible.

(2) CO_2 emissions from non-energy sectors

CO_2 emissions from energy amount to 93.4 percent (1998) of total emissions, and the balance are from industrial processes and the incineration of waste. As for the CO_2 emissions from industrial processes, the main factor is the limestone used in cement production. It accounts for almost half of emissions that are not from energy.

For these non-energy CO_2 emissions in 1999 which originated from industrial processes, it is possible to use production statistics to calculate by multiplying the units of production activity by the relevant emissions factor, except for the production of ammonia (coal, oil coke, input of liquid natural gas and coke oven gas). For the production of ammonia, the latest data is from 1998, therefore the calculation is done assuming that the value in 1999 is the same as 1998. As for CO_2 emissions from general and industrial waste, incineration data is available only up to 1995; therefore, for later years the estimate is done using other statistics that indicate trends.

The result of the above estimation is shown in Table 1, "CO_2 emissions from non-energy sectors."

Result of calculation:

Estimated amount of CO_2 emissions from non-energy sectors in 1999: 77 million tons

(3) Total CO_2 emissions in 1999

From estimates (1) and (2) above, the total CO_2 emissions can be calculated as follows.

Result of calculation:

Estimated total CO_2 emissions in 1999: 1,157 + 77 = 1,235 million tons

111 million tons increase from 90, 47 million increase from 98

Analyses

The estimated amount of total CO_2 emissions in 1999 was calculated as 1,235 million tons. There was 9.8 percent increase compared to 1999, which is the standard year. It is also an increase by 4.0 percent compared to the amount in 1998, which was 1,188 tons.

The CO_2 emission trends 1998 and 1999 indicate that the emissions from the energy sector, particularly the use of liquid natural gas and gasoline is increasing steadily, and emissions from coal for power generation and the steel industry are increasing significantly. This is especially due to the following factors: increase of consumption of coal for the steel industry, which is linked to the recovery in basic steel production (seven percent increase from the previous year), and

an increase of LNG and coal consumption caused by increased demand for electric power. Also, the steady increase of gasoline consumption by cars in the transportation sector is one factor in the increase of the emissions. On the other hand, the emissions in the non-energy sectors are decreasing, since the emissions from cement production processes decreased sharply from the year before. (Note: the increase in basic steel production is mainly due to exports to Asian countries.)

It is possible to compare the trends in CO_2 emissions with GDP, a main economic indicator.

The amount of CO_2 emissions per unit of energy provides an index that shows the effectiveness of emissions reductions by fuel conversion. The fact that the rate remained at 12.2 from 1990 to 1999, except for 1998, means that the effect of fuel conversion is not adequate. In fact, emissions from the supply of electric power, decreased with greater use of nuclear power, but increased due to more use of coal, resulting in no net change.

Energy consumption per GDP shows the rate of overall energy saving in Japan. During the period from 1990 to 1999, the amount started to increase in 1994, showed a slight decrease in 1998, but it returned to 0.197, the same as in 1990. This means either that structural changes of the Japanese economy are not adequate, or the trend towards a service-based economy leads to excessive energy consumption. Either way, it can be said that energy conservation is making no progress.

Total CO_2 emissions, the sum of these two factors, have shown almost no change since 1990. From this fact it can be pointed out that the Japanese economy is continuing to emit CO_2 with no major changes (Table 5).

Table 5. Japan's total CO_2 emissions

Fiscal Year	1990	91	92	93	94	95	96	97	98	99
Total CO_2 Emission (Million t)	1124.4	1147.8	1162.2	1144.0	1214.1	1221.1	1236.9	1233.9	1187.5	1234.8
Compared to previous year		2.1%	1.3%	-1.6%	6.1%	0.6%	1.3%	-0.2%	-3.8%	4.0%
Compared to year 90		2.1%	3.4%	1.7%	8.0%	8.6%	10.0%	9.7%	5.6%	9.8%
(Emissions from Energy)	1052.8	1072.7	1085.1	1064.6	1133.5	1138.6	1153.6	1150.8	1109.8	1157.4
Actual GDP (Trillion Yen)	436	448.9	450.6	452.8	455.7	469.4	489.9	487.8	478.3	480.7
Compared to the previous year		2.9%	0.4%	0.5%	0.6%	3.0%	4.4%	-0.1%	-1.9%	0.5%
Total CO_2 Emission/ Actual GDP (Million t-CO_2/ Trillion Yen)	2.58	2.56	2.58	2.53	2.66	2.60	2.52	2.53	2.48	2.57
CO_2 Emission from Energy / Energy consumption Amount (t-CO_2/10^7kJ)	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.1	12.2
Energy consumption Amount /GDP (10^10kJ/ Billion Yen)	0.197	0.196	0.198	0.193	0.204	0.199	0.193	0.193	0.190	0.197

Note: 1. Real GDP is based on the 1990 calender year.
2. Only CO_2 emissions are shown in this table. However, the actual reduction target of six percent includes six kinds of greenhouse gases, of which CO_2 accounts for 89 percent.

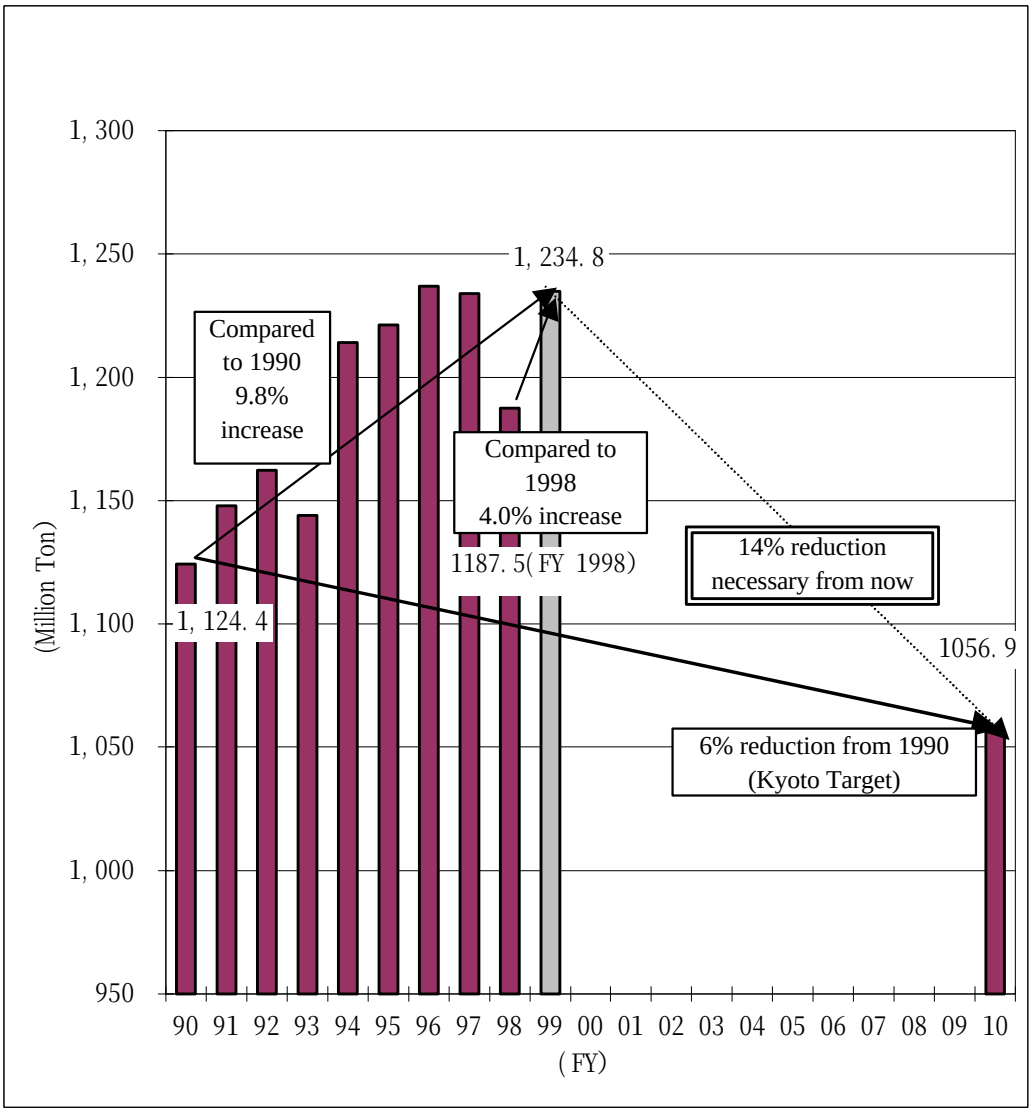


Figure 14. Japan's total CO_2 Emissions (Energy + Non-Energy)

(Shuzo Nishioka)

d. Comparative analysis of domestic best practices in G8 countries to address climate change

To realize the GHG emissions reduction targets adopted in the Kyoto Protocol, Annex-I countries are promoting domestic policy measures. The policy measures differ from country to country, reflecting each country's situation, but at the same time many ideas can be helpful if shared. In this spirit, the Environmental Futures Forum was proposed for environmental policy-makers of G8 countries, participants from industrial sectors and NGOs to exchange experiences about domestic "best practices" in addressing climate change. The IGES Climate Change Project took on the task of collecting information about the domestic best practices of each G8 country, on request from Japan's Environment Agency.

The IGES Climate Change Project had already begun research on other countries' domestic measures as input for Japanese policy development relating to climate change. On request from the Environment Agency, IGES sent questionnaires to the concerned agencies in each country. The results were then compiled and the background of each domestic policy was analyzed. IGES commissioned Pacific Consultants, Co., Ltd. to collect all the relevant data. Ten to fifteen best practices were recommended from each country. The actual examples of these policies were unified in a form of spreadsheets for easier reference and summarized into a report. The project leader, Prof. Nishioka, reported the

results of the comparative analysis at the G8 Environment Futures Forum held in February 2000 with the participation of the concerned agencies of each country, representatives of international organizations and experts (eighty participants in total).

From the comparative analysis, it can be said that every country puts stress on the energy/industrial sectors, but measures in the transportation or agriculture and land-use sectors are emphasized more in some countries. Other than these sectoral efforts, in every country there are initiatives by governments and local communities to promote comprehensive measures, such as improving laws, reforming taxes and establishing a system to enhance the participation of the general population.

As a result of the discussions at the Futures Forum, and as the recommendations for enhancing efforts in G8 countries, the following point can be emphasized: Most of the best practices are a blanket package of comprehensive measures. It is not just one of the measures, but a combination of the measures, that brings great benefits. However, many difficulties hinder the quantification of cost effectiveness, and the impacts on the overall economy have not been adequately considered. Greater effectiveness can be expected by providing more information to stakeholders such as consumers or actors at the regional level, or by more cooperative efforts between sectors.

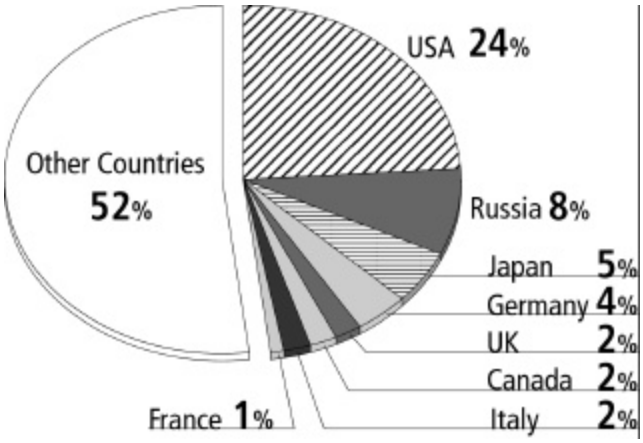
The outcomes of the forum were reported at the G8 environment ministers' meeting held in April 2000 in Shiga Prefecture, Japan and reflected in each country's policy measures. The outcomes were also distributed to the major local governments in Japan, to be used as a reference for their own policy-making.

Background of the Climate Change Issue in G8 Countries

Quantitative data and indicators on G8 countries, such as greenhouse gas emissions, GDP, and energy consumption were analyzed in order to clarify the relationship between G8 countries and climate change. The main results of the analysis are summarized below.

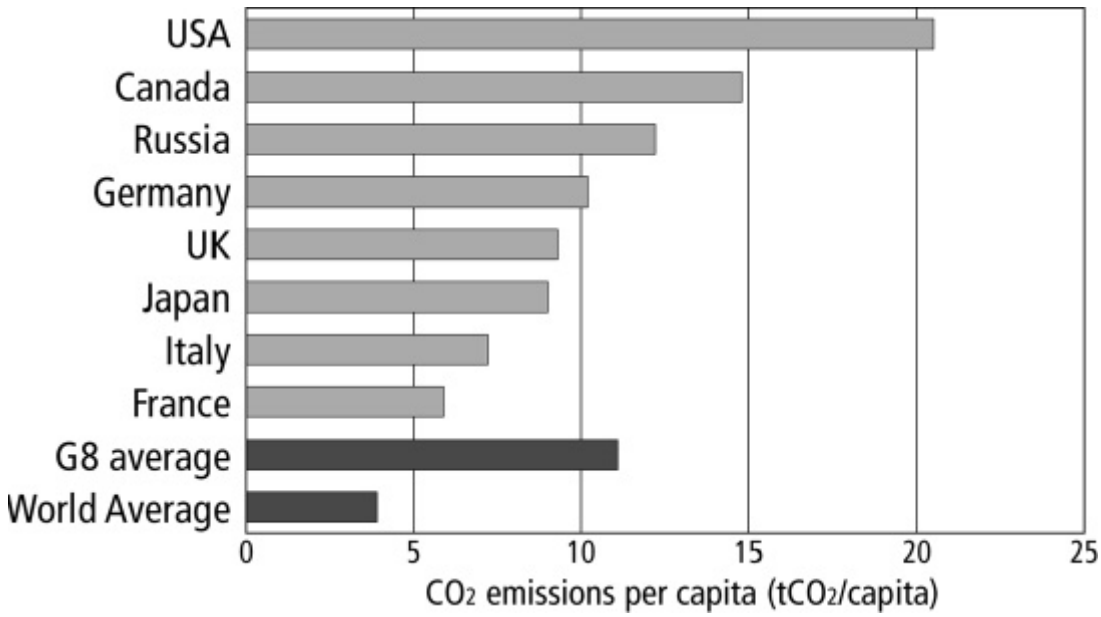
- GHG emissions in G8 countries

A large share of CO_2 emissions from fossil fuel burning and cement manufacturing originates in G8 countries (Figure 15). G8 countries accounted for 48 percent of the world's CO_2 emissions in 1995. The United States emitted about 24 percent of the global total, the Russian Federation 8 percent, Japan 5 percent and Germany 4 percent. Furthermore, CO_2 emissions per capita in G8 countries were much higher than the world average (Figure 16). The average GHG emissions of G8 countries were 11.1 tons per capita (CO_2 equivalent), compared to the world average of only 3.9 tons 1995.



Source: CDIAC Environmental Science Division, Oak Ridge National Laboratory

Figure 15. Share of CO2 emissions from fossil fuel burning and cement manufacturing in 1995

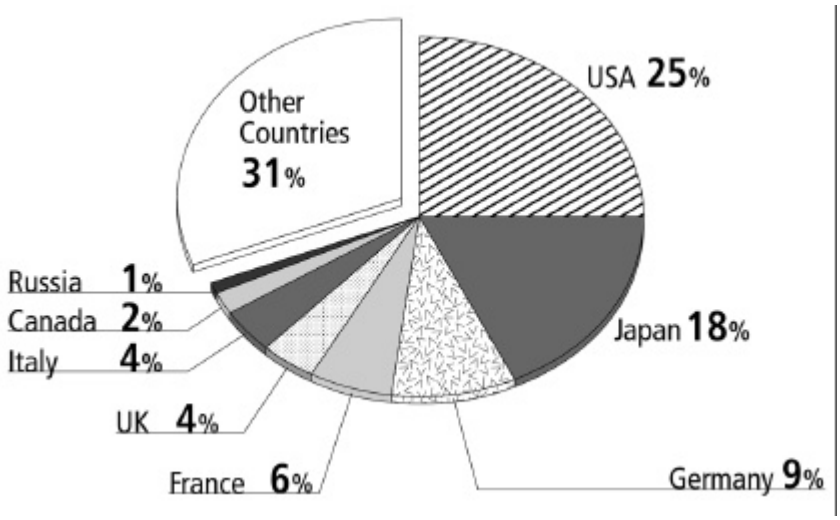


Source: CDIAC Environmental Science Division, Oak Ridge National Laboratory

Figure 16. CO_2 emissions per capita in G8 countries and world average (1995)

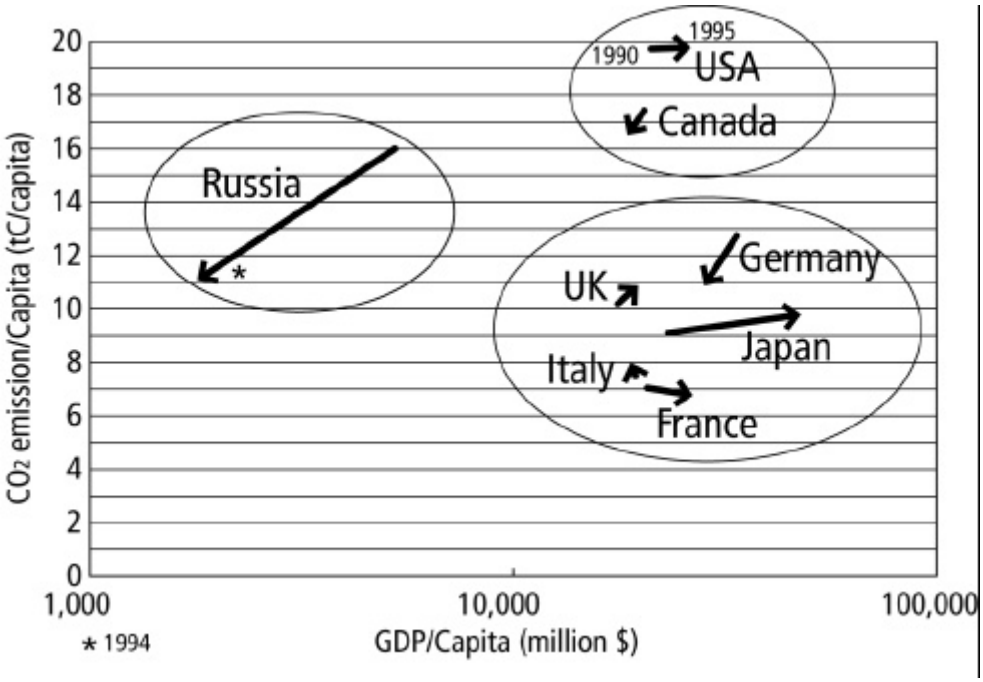
- GHG emissions and GDP

G8 countries account for approximately seventy percent of the total global GDP (Figure 17). Analysis of the relationship between GDP per capita and CO_2 emissions per capita shows that G8 countries can be divided into three groups: the United States and Canada with high CO_2 emissions per capita; Germany, the United Kingdom, Japan, Italy and France with comparably low CO_2 emissions per capita and high GDP per capita; and the Russian Federation with low values for both (Figure 18). (Note: The starting point of each arrow indicates the value in 1990; the end point indicates the value in 1995.)



Source: World Development Indicator 1997, World Bank

Figure 17. Share of GDP in 1995

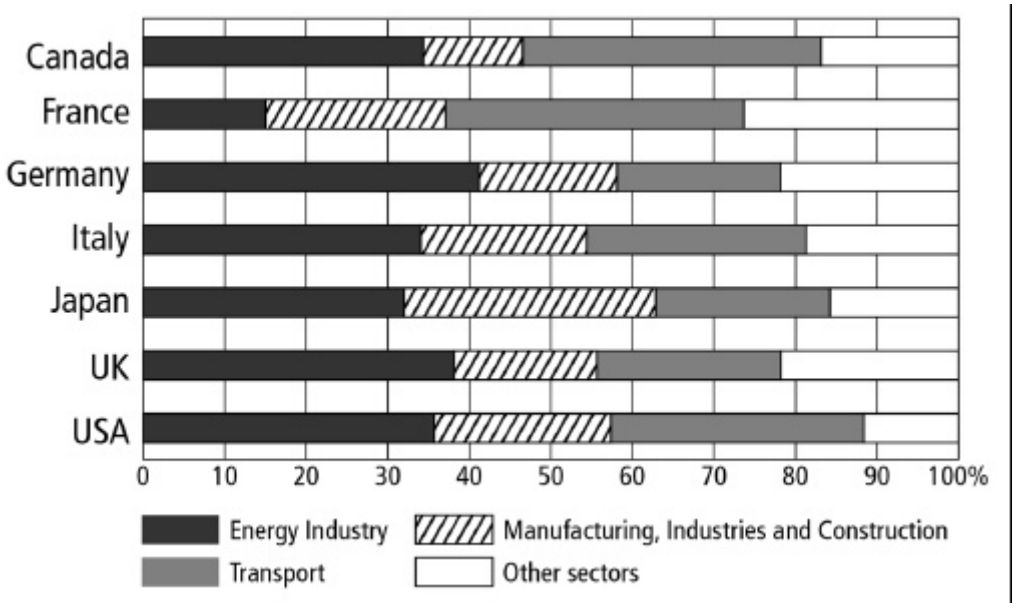


Source: Greenhouse Gas Inventory Database, UNFCCC; National Accounts Database of the Statistics Division of the UN Secretariat

Figure 18. Relationship between GDP per capita and CO_2 emissions per capita

- CO_2 Emissions from Each Sector

The energy industry accounts for 30 to 40 percent of CO_2 emissions from each country except France (Figure 19). Japan has the largest ratio of CO_2 emissions from manufacturing, industry and construction, despite its efforts to promote energy saving in these sectors. Canada, France, and the United States have a comparably high ratio in the transport sector. (Appropriate data to compare the Russian Federation with other G8 countries are not available.)

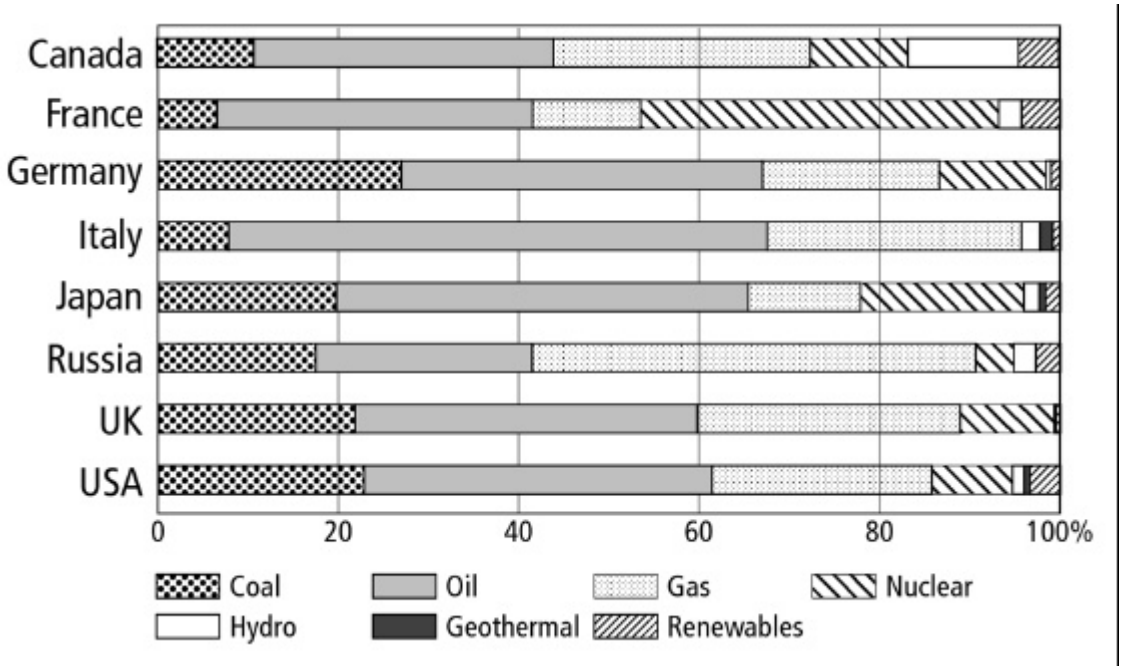


Source: Greenhouse Gas Inventory Database, UNFCCC

Figure 19. Ratio of CO_2 emissions from each sector (1995)

- Composition of Energy Supply

The composition of the energy supply in G8 countries varies, reflecting different natural and social characteristics in each country (Figure 20). The energy supplied from coal was comparably high in Germany, the U.S, and the United Kingdom. Italy tends to depend on oil, whereas the dependency on nuclear power is comparably high in France. Hydroelectric, geothermal, and renewable energy comprises a very small proportion of the energy supply in every country.



Source: National accounts database of the Statistics Division of the United Nations Secretariat

Figure 20. Composition of energy supply (1995)

- Results of Analysis

The above analysis leads to three important conclusions: (1) Because the total GHG emissions from G8 countries account for about 50 percent of total global emissions, those countries should implement effective domestic measures to reduce their own emissions; (2) High GDP levels of G8 countries imply that they are influential actors, and their policies and measures can have repercussions on the world; (3) Similarities and differences among G8 countries, such as energy supply and economic conditions, imply that some common policies and measures can be implemented, while others need to be developed that are suitable for the different characteristics of each country.

Survey of Best Practices in G8 Countries

- Methodology of the Survey

Information about Best Practices that have already been implemented in each G8 country to mitigate climate change was collected by asking the environmental ministries of each country and the Environmental Directorate of the European Union (EU) to select and describe 10 to 20 of their most effective practices, and summarize them according to a set format. Countries were asked to describe three key aspects of each Best Practice: special characteristics of the practice; reasons for inclusion as a Best Practice; and problems faced during implementation and how they were overcome or resolved. They were also asked to attach relevant materials on each Best Practice, such as data or other supporting materials. All G8 countries selected their Best Practices and sent them to the Environment Agency.

- Definition of Best Practices

The following definition of Best Practices was proposed for the survey so that all countries could share a common awareness selecting and discussing them:

> Practices that represent the optimal or most progressive initiatives among the domestic measures being undertaken by a country or other social actors within the country to prevent global climate change.

The description for the survey also stated that the term may include policies, plans and other initiatives which have indirect impacts, effects over a wide region, or effects over the medium or long term. The social actors who implement Best Practices include national and local governments, businesses, NGOs and individuals. Just as the practices of each separate actor are important, so are practices promoted through cooperation between actors.

In addition, the following basic guidelines were suggested in order to aid selection. Best Practices:

- Have actually been effective in reducing GHG, and provide excellent examples of past efforts
- Are challenging and emerging approaches
- Can contribute to the formation of future policies to prevent global warming
- Are useful for consideration by social actors other than G8 countries implementing domestic initiatives in developed countries
- Can be evaluated quantitatively and/or qualitatively
- Can be appropriate for application in, or technical transfer to, developing countries
- Utilize local know-how and experience
- Must be suitable to the natural environment and society of the country or area where they are implemented.

- Results of Survey

Summary of Best Practices in G8 countries

A total of 81 practices were reported where the number from each country varied from 2 to 19 (Table 6).

Table 6. Number of Best Practices

G8 country	Best Practices reported
Canada	9
France	7
Germany	5
Italy	7
Japan	17
Russian Federation	2
UK	13
USA	19
EU	2
Total	81

- Classification of the Best Practices

The questionnaire requested information about Best Practices in five main categories: energy and industry, household and commercial, transportation, agriculture, land use and forestry, and cross-sectional. The results of the classification were compiled based on those categories. (Tables 7 to 11)

It should be noted that the practices could be classified in a number of ways. For example, the practices could be categorized by stakeholder (e.g., citizen, private company, non-governmental organizations, and government). Another useful way may be to classify the practices according to type of measure (e.g., regulations, economic incentives, voluntary actions, and education). In this survey, the above-mentioned sector-based classification was selected in order to encourage discussions in the working groups.

Table 7. Distribution of Best Practices

G8 countries	Energy and industry	Household and commercial	Transportation	Agriculture, land use, forestry	Cross-sectoral	Total
Canada	4			1	4	**9**
France	2	3		1	1	**7**
Germany	2	2			1	**5**
Italy	3		3		1	**7**
Japan	3	4	3	2	5	**17**
Russian Federation					2	**2**
UK	5	3	2	1	2	**13**
USA	9	4	1		5	**19**
EU			1		1	**2**
Total	**28**	**16**	**10**	**5**	**22**	**81**

Note: "Best Practices" reported refer here to either individual practices/policies or "packages" of multiple practices, depending on the reporting style of countries in their submissions to the EAJ survey. In addition, it must be noted that countries submitted Best Practices based on their ability to contribute to useful discussions at EFF 2000, thus they neither include nor represent all initiatives being undertaken.

Energy and Industry Best Practices

Energy and industry Best Practices refer to practices in the energy supply sector such as electric power and gas companies, as well as practices in industrial sectors (i.e. manufacturing). Twenty-six practices were in the energy and industry categories which were generally thought to be the most important sector to implement policies and measures to mitigate climate change because of their large contributions to GHG emissions. The United States selected nine practices in this sector.

Table 8. Energy and industry Best Practices

Total	**28**
(1) Restructuring/privatization of electric companies	2
(2) Promotion of renewable energy and unutilized/underutilized energy	5
(3) Industries' voluntary agreements and voluntary plans for emission reductions	12
(4) Development of innovative technologies for reducing GHG emissions	5
(5) Establishment of information infrastructure regarding energy use technologies and energy-related policies	4

Household and commercial Best Practices

Best Practices in the household and commercial sectors include measures related to activities in daily life and purchasing and those related to houses and buildings. Commercial sector here refers to the non-manufacturing sector. Sixteen practices were categorized in this group, and practices improving the energy efficiency of houses and buildings were selected by most G8 countries.

Table 9. Household and commercial Best Practices

Total	**16**
(1) Measures related to daily life	3
(2) Measures by NGOs	2
(3) Promoting introduction of energy saving goods in purchasing	2
(4) Improving the energy efficiency of houses and buildings	9

Transportation Best Practices

Transportation Best Practices include both policies and measures to change existing transportation infrastructure and land-use patterns and those related to demand management of transportation. Ten practices were classified in this category. Italy selected three such practices, half of the total number for that country.

Table 10. Transportation Best Practices

Total	**10**
(1) Reform of fuel taxes	2
(2) Shift to alternative vehicle fuels and energy sources for transportation	1
(3) Changing behavior and promoting voluntary restraint of transportation by automobiles	
(4) Development of innovative technologies for vehicles	1
(5) Regulation and encouragement to smooth automobile transportation (Transportation Demand Management)	3
(6) Application of new technologies to automobile transportation systems	1
(7) Enhancement of means of transportation other than automobiles	2

Agriculture, land use and forestry Best Practices

Only five practices were selected in the agriculture, land use and forestry category, reflecting the characteristics of industrialized G8 countries.

Table 11. Agriculture, land use, and forestry Best Practices

Total	**5**
(1) Reduction of GHG emissions from agricultural systems	3
(2) CO_2 sequestration by forest conservation and afforestation	1
(3) Carbon substitution	1

Cross-sectoral Best Practices

Cross-sectoral Best Practices relate to issues affecting multiple sectors. Many practices can be placed in this category. Practices collected from G8 countries were sub-categorized into several groups, including integrated policy design and legislation, taxation systems, funding mechanisms, central/regional government assistance and regional/local government initiatives, measures corresponding to the Kyoto mechanisms, and other indirect measures. Twenty-two practices were included in this category (Table 12).

Table 12. Cross-sectoral Best Practices

Total	**22**
(1) Integrated policy design and legislation	3
(2) Establishment of taxation systems	3
(3) Creation of funding mechanisms for climate change prevention	4
(4) Central/regional government assistance; regional/local government initiatives	6
(5) Measures corresponding to the Kyoto Mechanisms	3
(6) Promotion of indirect measures for preventing climate change	3

Key Findings and Key Questions

Based on the above-mentioned results of the survey, key findings and key questions were extracted as follows:

(1) G8 countries are actively undertaking initiatives to mitigate climate change; domestic Best Practices to mitigate climate change are being introduced into national policies and measures. Practices reported in the G8 survey reveal considerable diversity in what countries consider to be Best Practices; an indication that a common understanding of the selection of Best Practices varies.

(2) It appears that the Best Practices considered to be high priority differ in each country. Given the wide diversity in national circumstances, this is to be expected.

(3) It appears that restructuring and privatization of the energy sector in G8 countries are not being done expressly for the purpose of mitigating climate change, but the survey results and countries' experiences suggest that the fundamental policies of the energy sector do have an effect on climate change measures.

(4) Industrial sectors in G8 countries are actively making voluntary agreements and voluntary plans to reduce GHG emissions.

(5) G8 countries are domestically promoting education and awareness-raising for climate change mitigation.

(6) In the transportation sectors of G8 countries, it appears that efforts to limit CO2 emissions from automobiles are receiving a high priority. At the same time, G8 countries are also paying attention to improvements of alternative transportation modes and traffic demand control.

(7) Some G8 countries did not report much activity in the field of agriculture in their selection of Best Practices. In the future they may attach more importance to policies and measures relating to carbon sinks in forests, and to the enormous role of soil carbon.

(8) Regional (i.e. provincial, state, prefectural, etc.) and local governments, having many opportunities for close interaction with local citizens, are promoting climate change mitigation activities at the local level, and central governments are actively providing support. Experiences in some countries suggest that mechanisms functioning between the levels of government within a country will be increasingly important in future efforts to mitigate climate change.

(9) Financial mechanisms such as taxation, funding assistance, and subsidies are being used to attempt to mitigate climate change in G8 countries. Experiences suggest that because such mechanisms are highly flexible, in some cases there may be merit in expanding them at the cross-sectoral level and in various sectors.

(10) G8 country responses to the questionnaire did not refer much to linkages between the Kyoto Protocol (including the Kyoto Mechanisms and carbon sinks) and G8 countries' domestic Best Practices addressing climate change. This could be because countries are awaiting outcomes of the current international discussions on these topics.

In addition to the above-mentioned major findings, the following findings in each sector were extracted.

Energy and industrial sector

- Restructuring/privatization of electric companies were highlighted in the United States and the United Kingdom.
- Renewable energy and unutilized/underutilized energy are being promoted in most G8 countries. Promotion of solar energy and wind power generation was highlighted in Germany. Various types of approaches are being taken, such the use of regulation, taxation, subsidies, and research and development.
- Industries' voluntary agreements and voluntary plans for emission reduction are being implemented in most G8 countries.

Household and commercial sector

- Education and awareness-raising activities by most G8 governments and sub-national governments about lifestyles were highlighted.
- Labeling and the "top-runner approach" are being used to promote the improvement of energy efficiency.
- Improvement of energy efficiency of houses and buildings is being promoted in most G8 countries. Various kinds of approaches are being taken, such as regulation, subsidies, and information provision.

Transportation sector

- The United Kingdom, Italy, Germany, and Japan submitted a number of practices in this area, although this share of emission from transportation sector is comparatively low in those countries. The United States reported on its program to fund R&D of low-emissions vehicles.
- The use of taxation to promote fuel efficiency was highlighted in the United Kingdom and Italy.
- The promotion of alternative means of transportation was highlighted in Italy and the United Kingdom.

Agriculture, land use and forestry sectors

- The reduction of GHG emissions from agricultural systems in the United Kingdom, Japan and Canada is being promoted through research, education and campaigns, rather than regulatory approaches.
- Only one Best Practice was highlighted in the forestry sector.
- France proposes the practice of carbon substitution using wood fuel.

Crosscutting sector

- Top-down comprehensive policies are being implemented in Germany, Canada and Japan.
- The creation of funding mechanisms was highlighted in Canada, France and the United Kingdom.
- Central, federal, state and provincial government assistance and regional/local government initiatives are being undertaken by most G8 countries.
- Practices that involve emissions trading are being implemented in Canada and the United States. Plans for an industry-led voluntary program are also underway in the United Kingdom.

Conclusions and Recommendations of G8 Environmental Futures Forum 2000

G8 Environmental Futures Forum was held 14-15 February 2000 at the Shonan Village Center in Japan. The participants discussed domestic Best Practices in addressing climate change, based on the report on the analysis mentioned above. Discussions at the forum in five working groups and plenary sessions resulted in the following general conclusions and recommendations to the G8 countries, in addition to the conclusions and recommendations from each working group.

General Conclusions

Best practices are often comprehensive packages of policies that function in an integrated way to mitigate climate change. They often entail multiple benefits rather than singular outcomes. Best practices are those that are suited to national circumstances and achieve results in the area of greenhouse gas emissions reductions. Best practices involve all stakeholders and at a variety of levels. Their effects are quantifiable whenever possible. They are cost-effective. They should reflect and aim to stimulate long-term changes in technology.

Barriers to the development and implementation of Best Practices include the difficulty of properly evaluating the benefits of practices; the lack of full reflection of environmental externalities in market prices; competing priorities of stakeholders and potential difficulties in justifying efforts to address climate change; lack of awareness; reluctance to take up new technologies and approaches; insufficiency of signals to consumers; lack of agreement among stakeholders in terms of issues and approaches; and a lack of inter-sectoral collaboration.

General Recommendations

Above all, the Forum found the exchange of information and views to be valuable, and recommended that G8 countries continue information exchanges and evaluations regarding Best Practices addressing climate change, including both successes and failures. In addition, the following are the general recommendations.

- That G8 countries increase their efforts to utilize comprehensive and integrated policy approaches;
- That G8 countries develop and implement practices and measures which result in multiple benefits not merely limited to greenhouse gas emissions reductions while reducing implementation costs;
- That G8 governments should work to involve all stakeholders early in the policy development process;
- That G8 countries promote cooperation among stakeholders and dialog between producers and consumers to create new and/or expanded markets;
- That G8 countries may influence consumer decision-making through such options as labeling, market signals, and public education of consumers and other intermediary parties;
- That G8 governments design practices and measures with the acceptability to stakeholders in mind in order to increase the degree of take-up of such measures by those stakeholders;
- That G8 governments design and implement regulatory, voluntary, and informational measures and economic incentives to promote desirable behavior;
- That G8 countries promote an increased emphasis on community-based approaches and local initiatives;
- That G8 governments at all levels set positive examples for society in areas such as green procurement;
- That G8 countries exchange information on and continue to develop indicators in order to facilitate the identification and evaluation of Best Practices;
- That G8 countries actively pursue research and development and demonstration (RD&D) of innovative technologies such as information technologies; and
- That G8 countries make efforts to exchange, disseminate, and share experiences with other countries, including developing countries, in cooperation, wherever practicable, with relevant international organizations

(Shuzo Nishioka)

e. In-depth reviews under the UNFCCC

Under the UNFCCC, each Party to the Convention (especially Annex I Parties) has an important commitment to provide national communications every three or four years in the form of a national report that includes a GHG inventory, policies and measures, future projections, etc. In-depth reviews of such communications are vitally important to facilitate the effectiveness of the UNFCCC commitments, although they are not so strong.

In the second in-depth review process of the national communications, Dr. Matsuo was nominated as an expert from Japan to be a member of the team that reviews New Zealand. His role is to check the appropriateness of the policies and measures and the projections of New Zealand's national GHG emissions. He was also in charge of the first in-depth review process of Canada. The reports can be obtained at the UNFCCC website (http://www.unccc.int/).

(Naoki Matsuo)

f. Environmental taxes in Asia

In October of 2000, IGES and the Korea Environment Institute (KEI) jointly held a symposium on Green Tax Reform in Asia. In this symposium, IGES Climate Change Project members (Dr. Tae Yong Jung, and Dr. Naoki Matsuo) presented papers on environmental tax issues that are being considered as domestic policy measures to mitigate GHG emissions. The following are the points and messages from this symposium.

In the early 1990s, OECD member nations in Northern Europe began discussions on environmental-friendly tax reforms (i.e., green tax reform or eco-friendly tax reform). Green tax reform is aimed at both environmental conservation and economic growth by reducing environmental-unfriendly subsidies and tax expenditures, and introducing new environmental taxes. Some European countries are introducing an environmental-friendly tax system in part by introducing carbon (or energy) taxes. Recently, Asian nations, which have been gradually overcoming the recent foreign currency crisis of late 1997, have begun to pay close attention to the seriousness of domestic and global/regional environmental pollution and to effective solutions. Asian countries that want to harmonize the economy with the environment have recognized environmental taxes as an important cost-effective environmental policy tools for achieving economic growth and environmental improvements at the same time. Environmental taxes are under active discussions in many Asian countries including Japan, Korea, China, and numerous Southeast Asian countries. However, there have only been a few opportunities to meet and share viewpoints and experiences amongst these countries.

The reform of tax systems to accommodate green taxes does not need to work in the same way for each country since the environmental and economic conditions in each country are different. In developing countries, government policy has been pursuing economic growth without considering the environmental impacts of rapid economic growth. However, developed countries have designed various policy measures in order to deal with serious environmental problems since the 1960s. In addition, some OECD countries in northern Europe have reformed the tax system to include green taxes. Thus, the present environmental situation and policy measures in each country should be considered before they reform their tax systems. In the green tax reform, introducing a separate environmental tax is not an urgent issue in developing countries. More important is the reform of current economic instruments. Even though there are various economic instruments, the rates are often too low to have enough incentives. They should be reformed to provide greater incentive for the reduction of pollution. More emphasis should be given to the environment in the future reform on energy taxes. Very important, but often neglected in discussion, is the reducing of the environmentally harmful tax exemptions and subsidies. Public prices, such as water prices, should also be set to induce environmentally friendly behavior. Introducing separate environmental taxes in developing countries can be considered after reforming the current economic instruments.

Over the last decade, environmental taxes have been developed in a number of OECD countries, and, in some cases, in the context of comprehensive green tax reforms. However, most Northeast Asian countries have not adopted environmental taxes yet even though they are interested in striking a balance between economics and ecology.

In Japan, the Basic Environmental Law of 1993 provides the economic measures to prevent interference with environmental conservation. This is the first legislation that recognizes the necessity of economic instruments for environmental protection. Nonetheless, the Japanese government has not adopted environmental taxes yet. On the other hand, among the tax systems in use, there are some cases of taxes that were not intended to be environment related taxes in their introduction, but came to be regarded as such later on. The typical example is energy taxes imposed on gasoline consumption. Also, many municipalities began to charge for collecting garbage. While the Japanese government

recently states that economic measures, including the carbon tax, shall be regarded as an important tool for achieving the target for reducing greenhouse gases in the Kyoto Protocol, businesses and industries are strongly opposed to adopting them.

In China, a system of pollution charges has been implemented since 1979 as a major economic incentive for environmental protection. This system, however, has not been able to adapt to economic development under market conditions. The system could not create effective incentives for pollution control because the rates of pollution charges were low compared to the operating expenses of control facilities. In addition, state-owned large and medium sized enterprises are the only main targets of pollution charges, while Township and Village Enterprises (TVEs) are excluded from pollution charges. Because the cost increased when enterprises invested in pollution control while others did not invest, the inequitable enforcement of law led to an unequal competition, which resulted in passive reaction of enterprises against pollution control.

From Asian perspectives, there are important questions such as why environmental taxes have not been more widely employed in Asian countries and why they do not effectively function as expected in the countries that had already employed the system partially. One of the key factors for these questions is likely to be the features and characteristics of environmental governance systems in Asian countries. In order to use tax systems for an environmental purpose, it is inevitable to build inter-ministerial co-operation within the structure of central government. Environmental policies, however, still tend to be separated or isolated from the mainstream policies of economic planning and industrial/agricultural development in Asian countries. In addition to the Ministry of Environment, many governmental ministries and agencies are responsible for environmental issues under their respective jurisdiction. As a consequence, the overlapping or duplication of policies and efforts can often be found in a number of policy domains related to environmental governance. This delays the adoption of environmental taxes in Asian countries.

Subsidies include all kinds of direct payments, indirect payments such as preferential tax treatments, regulatory measures such as lenient environmental standards or favorable spatial planning decisions. They can come out of government budgets or out of consumers' pockets.

Subsidies are given mainly in the economic and social interests of particular politically powerful pressure groups. Economic analysis of subsidies, however, reveals that often they are very inefficient ways of achieving their stated objectives. Their effects are ultimately determined by demand and supply elasticities. As a consequence a large share (in some rather common cases as much as eighty percent) of a subsidy may end up in the pockets of non-intended recipients. Still those subsidies often change relative prices, possibly adversely affecting the environment.

Most pollution control measures in Japan have not been economic instruments, but rather, regulatory instruments that are implemented through administrative guidance as well as voluntary agreements. However, recent considerations in the Japanese environmental policy field have centered on the introduction of economic instruments into the climate change field and waste management. The introduction of carbon taxes on various carbon-emitting technologies for reducing CO_2 emissions has been intensively discussed. It also estimates the effects of combining a carbon tax with subsidies.

The Japanese discussion on carbon tax is expanding to a more general green tax system. The State Committee of Tax System is planning to start an intensive discussion on the green tax system, and the Ministry of the Environment plans to establish the Division of Environmental Economic Policies in order to introduce integrated economic instruments. New research programs to respond to the recent trend have also been started in Japan.

In the case of Korea, according to macroeconomic simulations, it is very difficult to stabilize the CO_2 emissions of 2030 at the level of 2000 even with a carbon tax of 200,000 Won/t-C. This finding implies that the introduction of a carbon tax has some limitations in stabilizing CO_2 emissions in Korea, where economic forces are still strong. It is inevitable that Korea will sacrifice some economic growth, once carbon tax is introduced. New energy taxes will reduce energy use and lower GHG emissions, particularly CO_2 emissions. But they will certainly degrade the international

competitiveness of Korea's major strategic export industries. However, it is clear that Korea cannot expect to keep international competitiveness in these energy intensive industries in the long run, given the prospect that petroleum will no longer be available as cheaply as in the past.

The analysis of the effects of carbon taxes on industries raises a policy question regarding whether we apply the same rate to every industry or not. Since the effects of carbon taxes differ according to each industry, this causes some conflict with other policy objectives. This argument is also relevant for treating end-use sectors, when we design a carbon tax scheme. The index of energy intensity is an important indicator to explain the aggregate energy consumption pattern of an economy. To improve energy intensity, various energy policies and measures in energy savings and efficiency improvements are quite necessary. When a carbon tax scheme is considered, the integration of carbon tax with various energy policies is one of the key elements for the success of carbon taxes in mitigating carbon emissions. Another important effect of the carbon tax is that the introduction of carbon tax will accelerate fuel substitution to a less carbon-intensive fuel, since carbon tax is imposed, based on the amounts of carbon emissions. When policy makers consider how to design a carbon tax, it is very important to analyze the effect of fuel substitution due to the tax.

The issue of how to spend carbon tax revenue is a critical question that is related to which ministry is in charge of carbon tax collection and spending. The institutional arrangement for carbon tax schemes is extremely important for the success of this taxation. It is very crucial to carefully analyze the recycling of carbon tax revenues, before this tax is actually introduced, since where to reallocate the revenue is the key factor in minimizing the economic loss caused by the introduction of such a tax.

(Tae Yong Jung)

2.2.4 Contributions to the IPCC

a. Role of the IPCC and contributions of IGES researchers

The Intergovernmental Panel on Climate Change (IPCC) was established with the objective of providing a policy-relevant and credible scientific basis for policy makers. It releases full assessment reports every five to six years as a credible compilation of the scientific knowledge at that time, and several special and technical reports. It is a scientific community with thousands of scientists involved as well as an intergovernmental panel. At present, the Third Assessment Report (TAR) is in the final stage of preparation. Each of the three working groups is to approve a report for it by March 2001 and the Synthesis Report is scheduled to be approved at the September IPCC Plenary in London.

IGES researchers have contributed much to this important international exercise to accumulate knowledge.

Dr. Shuzo Nishioka, project leader of the IGES Climate Change Project, is actively participating the TAR Working Group II (Impact and Adaptation) Report as a lead author of Chapter 2. He serves as an active organizer of the climate research society in Japan and as one of the most senior researchers in Japan participating in the IPCC process since 1998.

Dr. Naoki Matsuo, Senior Research Fellow, has supported Prof. Taniguchi, Vice-Chair of IPCC at GISPRI. He contributed to three chapters of the TAR Working Group III (Mitigation) report, including crosscutting issues, and the Synthesis Report process.

Dr. Tae Yong Jung, Research Fellow, participated in the Special Report on Emission Scenarios as a lead author and reviewed Chapter 2 of TAR Working Group III. The Special Report, recognized as an epoch-making report in modeling GHG emissions, progressed very much in the scenario writing process in the IPCC.

Dr. Robert K. Dixon and Dr. Maithili Iyer (both Visiting Research Fellows) participated in the Special Report on Technology Transfer as lead authors. This report includes both theoretical/top-down analysis and bottom-up accumulation of experiences and is the textbook for developing and transition economy countries to shift to lower GHG emission levels and a more sustainable development path.

(Naoki Matsuo)

b. World structural changes and GHG emissions

One researcher (Dr. Tae Yong Jung) in the Climate Change Project of IGES served as one of the lead authors for the Special Report on Emission Scenarios (SRES) of IPCC. He contributed to the part of driving forces of GHG emissions, especially related to world structural changes and their energy and GHG emissions.

Structural shifts have various meanings. Each country has different mitigation options as well as possible adaptation policy measures to face the anticipated climate changes in the next century. The concept of sustainable development is emerging as one of the major challenges for economic development. In other words, each country can plan its economic development strategies in an environmentally sound manner to achieve the global environmental goal of stabilizing GHG emissions. This new issue on the international agenda implies that some capitalistic processes of economic development that have dominated most western societies since the Industrial Revolution may have to change. Now it is time for both developed and developing countries to take into consideration another key challenge, climate change, in their long-term economic development plans.

Key driving forces of structural shifts that explain the dynamic processes of changing a society are summarized. Issues related to climate change are particularly emphasized, since they affect the path of economic development of currently developing countries for the next century, and sustainable economic development of developing countries inevitably requires increases in energy demand, which leads to an increase in GHG emissions.

Another aspect of structural shifts will be driven by the change in lifestyles in the developed countries. Since the Industrial Revolution, mass production and consumption have prevailed among developed countries. Hence, whether this pattern will continue for the next century is one of the important key issues to be considered. In addition, this issue also closely related to the formation of a new paradigm of an international economic order. Structural shifts are the outcomes of key driving forces and their relationships within each society.

The anticipated structural shifts, from an economic point of view, are as follows. For the production side, each economy, including the world economy, has a system in which the total output of an economy is represented as a function of key input factors such as labor, capital, energy, and land. Technology represents the relationship between input factors and outputs. Quantitatively, the increase of input factors such as labor, capital, and energy will increase production with technology improvements. Obviously, technology is critically linked to the productivity of input factors. A production increase will bring about an increase in the income level of each economic agent in the economy. The change in this production mechanism is quite important in terms of explaining structural shifts.

Qualitatively, it is also crucial to know which economy produces what commodities and services. This issue has been important to economists for a long time. Kuznets studied these phenomena and developed economic growth theory based on empirical evidence found in developed countries. As an economy develops, it progresses from the first industries—such as agriculture and fisheries—to manufacturing industries, and then to service industries. Empirically, the innovations in the manufacturing and service sectors occur faster than in agriculture and fisheries, and will accelerate over time. Hence, the lifecycle of a product will be shorter and information and knowledge-based industries will expand rapidly, resulting in sharp changes in production and consumption.

On the demand side, the expected consumption behavior of each economic agent is to increase private utility for an economy, and it is to improve social welfare with the least possible cost. This implies that the rational consumption behavior motivates the creation of a new commodity or service. Economic agents, and indeed national economies, are no longer limited to within their own national borders. Hence, the role of multinational enterprises, which create global markets, will become increasingly important. The international activities of multinational enterprises will remove the quality differentiation of commodities and make them available around the world. This change in production behavior will induce changes in consumers' behavior and enlarge the choice of commodities.

This structural shift heavily depends on the new international economic structure. Many developed and developing countries are deregulating and restructuring their economic and legal systems in order to become competitive in both

domestic and international markets. The globalization and integration of each economy is also an important incentive for flexible mobility of both labor and capital. This process of reshaping the economic structure will be another key driving force for the structural shifts we anticipate in the next century.

For qualitative driving forces, three important driving forces that influence future emissions are (1) institutional structure, (2) social and cultural processes, and (3) technological learning. These are referred to as qualitative driving forces, since their manifestations are diverse and are not readily measurable in quantitative terms. Interventions that alter institutional structure are among the most accepted solutions in recent times for shaping economic structure and its associated energy use and emissions. Three important aspects of institutional structure are (1) the extent of centralization and participation in decisions, (2) the extent (spanning from local to global) and nature of mechanisms, and 3) processes for effective interventions (e.g., the mix of market and regulatory processes). In this regard, the institutional structures vary considerably across nations with similar levels of economic development, despite vast differences between industrialized and developing nations. The importance of understanding institutional structure lies in the fact that institutional interventions are often the most effective means for achieving goals such as national economic development and mitigation of climate change. Although no consensus exists on the desirability of a specific type of institutional framework, experience suggests that more participative processes, greater use of market mechanisms, and better global coordination enhance the ability of institutions to make effective interventions.

Social and cultural processes influence the future in a myriad of ways. They shape the institutions and how they function. Social norms of ownership and distribution have a vital influence on the structure of production and consumption. And most vitally, the social and cultural processes determine the quality and extent of the so-called social "infrastructure" sectors, such as education, which is paramount to capacity building and technological progress. Unlike institutional factors, social and cultural processes are often more inflexible and difficult to influence. However, specific sectors like education are amenable to interventions. Barring some negative features, such as segregation for instance, there is no consensus as to the interventions that are necessary or desirable to alter social and cultural processes. On the other hand, understanding their role is crucial for assessing the evolution of the social infrastructures that underlie technological progress and human welfare.

The other important qualitative driving force is the so-called "technological learning" effect, which derives from prevailing institutions and social and cultural processes, but more importantly is flexible enough to respond to interventions. Structural factors like urbanization and industrialization vitally influence learning. Most importantly, technological progress derives from organized learning that is inherent in industrial competition, and which is therefore reinforced by directed research and development (R&D) as well as from learning-by-doing under mass production and use of technology. The scale and nature of these processes vary across nations, which leads to diversity of technological competence across nations. A vital aspect of bridging this gap has been the globalization process, whereby knowledge and embodied technologies are transferred and diffused rapidly to preserve and gain comparative advantage. Another significant factor in the spread of technological learning is the increasing migration of skilled workers. While these forces tend to equalize technological learning across the globe, other factors such as diversity of economic development, social and cultural processes, as well as national policies, differentiate technological learning across the globe.

(Tae Yong Jung)

c. Evaluation of methodologies in vulnerability assessment and adaptation assessment: (WG II Report, Chapters 2.3, 2.4)

Starting in 1997, Working Group II of the IPCC Third Assessment Report has been conducting surveys and analysis of the research related to sectional and regional vulnerability and adaptation methods in the issue of climate change. Chapter 2 of the report evaluates the scientific "maturity" and applicability of the methods, which are used in the whole WG-II report: detecting impacts on the eco-system, vulnerability assessment, economic evaluation methods, uncertainty assessment, and decision analysis. Thus, it can be said that the work of the working group is to conduct

comparative examination on each methodology, which is used to estimate the effects brought about by climate change, from the viewpoint of scientific maturity.

The project leader of the Climate Change Project, Prof. Nishioka, was an author for Chapters 2.3 and 2.4 with other co-authors, drafting and completing the manuscript copy through discussions and cooperation. As a result of thorough examination of a variety of research on methodologies, this chapter analyses vulnerability assessment and adaptation methods as the major factors to evaluate the effects of climate change. It also analyses how reliable the scenarios and models used in the third assessment report can be, and what the points are to be improved. This analysis will serve as a guideline for policy-makers in studying the effects of climate change from the report of WGII. The contributors for this chapter are as follows: Dr. Thomas Downing/Oxford University and Dr. Stephen Schineider/Stanford University as co-authors, Dr. Gelhard Petchel-Held/IGES visiting researcher from PIK as a contributing lead author, Dr. Richard Warrick/Waikato University and Dr. Q. K. Ahmad/Bangladesh Unnayan Parishad as coordinating lead authors to edit the whole chapter. This report was approved at the working group held in February 2001.

Prof. Nishioka, as the convening lead author since 1990 for the "Guidelines for climate change effects and adaptation methods" in the IPCC second assessment report, took charge of drafting this chapter, considering the applicability and the limited use of the guidelines is becoming clearer, as the regional vulnerability assessment is promoted based on the guidelines. This evaluation of the methodologies would be of great benefit as a guidance in developing the research on impacts of climate change.

Special thanks to Dr. Hideo Harasawa of National Institute of Environment Studies and Dr. Anne McDonald of Miyagi University, who cooperated and contributed in this task.

(Shuzo Nishioka)

2.2.5 Improving national GHG inventories: forming an Asian expert network

a. Background and objectives

National inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol (national GHG inventories) are quite important both scientifically and politically in considering climate change issues. First, they are vital for quantifying the release of GHGs into the atmosphere and for assessing the impacts of increasing GHGs in the changing patterns of climate change. Second, they are also critical in evaluating the cost-effectiveness and feasibility of mitigation strategies and emission reduction technologies. Third, the United Nations Framework Convention on Climate Change (UNFCCC) calls for the Parties to the Convention to develop, periodically update and publish national GHG inventories. And fourth, national GHG inventories will facilitate determination of compliance with commitments under the Kyoto Protocol.

The quality of GHG inventories depends on the reliability of the relevant parameters, including emission factors to use in the calculation. It is preferable to use parameters that reflect national circumstances in order to enhance the quality of GHG inventory. However, many Asian countries seem to have difficulties in obtaining such local data and tend to rely on default data provided by the *IPCC Guidelines for National Greenhouse Gas Inventories*. In some cases this is because of the lack of relevant data or research activities in the region, while in other cases this is because of relatively poor accessibility to such data in the region. A strong need for research activities to improve availability of and accessibility to appropriate data in Asian region has been identified.

In this context, the Climate Change Research Project, with financial support from the National Institute for Environmental Studies (NIES), decided to undertake this activity to improve national GHG inventories and formation of the network of inventory experts in the Asian region. This activity was also meant to support and contribute to the Technical Support Unit (TSU) of the IPCC National Greenhouse Gas Inventories Programme (IPCC-NGGIP) which has been hosted by IGES since September 1999. Major contributors are: Mr. Kiyoto Tanabe (TSU, CC), Dr. Shuzo Nishioka (CC), Dr. Damasa B. Magcale-Macandog and Ms. Li Yue (Eco-Frontier Fellow of APN, CC)

Fully aware of the aforementioned, this research has been conducted with a view to improving the compilation of national GHG inventories for the Asian region. Its specific objectives are as follows:

- To present the current state of knowledge on GHG inventories in the Asian region
- To initiate the development of a database for GHG inventories in the Asian region
- To identify data gaps and problems in GHG inventories for the Asian region
- To evaluate the current methods used in compilation of inventories in the Asian region and, where possible, improve the methods
- To form a network of GHG inventory experts in the Asian region with a view towards designing future collaborative work and information/data sharing
- To contribute to the work of the IPCC National Greenhouse Gas Inventories Programme

b. Findings, conclusions and recommendations

Since the autumn of 1999, several efforts have been made as the first step towards achieving objectives of this research. Those efforts include the following:

- Collecting existing national GHG inventories in the Asian region from various publications to make a preliminary database on parameters used in GHG inventory preparation in the region
- Participating in international meetings on this issue with a view to obtaining relevant data and information
- Exchanging views, relevant data and information with experts in Japan
- Organizing an international workshop on this issue

Major findings obtained and conclusions reached through these efforts are as follows.

(1) Reconfirmation of the necessity to promote research activities to develop country-specific parameters to be used in GHG inventory preparation

A preliminary database on parameters used in GHG inventory preparation in the Asian region was made by reviewing the following data sources:

- Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
- Reports of ALGAS (Asia Least-cost Greenhouse gas Abatement Strategy) Project that was funded by GEF and implemented by ADB
- Asian countries' national communications (including Japan's) to the Conference of the Parties to UNFCCC submitted through the Convention Secretariat

Table 13. CH_4 emission factors and other parameters used in various reports from Asian countries (Extracted from overall table)

❖ Local emission factor
● IPCC Default Value
♋ Supposed to be the IPCC Default Value (not identified)
❍ Modified IPCC Default Value
□ Using other country's data
⌘ Unidentified
- Not Estimated

category			IPCC's default values	Unit of Emission Factors	VietNam	Indonesia	Thailand		
Agriculture									
Enteric Fermentation									
	Cattle	Dairy	56	kg CH4/head/Year	● 56	● 56	❖ 78.808	Cow	
							❖ 24.778	Female, 0-1 yr	
							❖ 43.062	Female, 1-2 yr	
							❖ 48.57	Heifer, >2 yr	
		Non-dairy	44	kg CH4/head/Year	● 44	● 44	❖ 49.506	Cow	
							❖ 24.524	Female, 0-1 yr	
							❖ 41.008	Female, 1-2 yr	
							❖ 42.453	Female, >2	
							❖ 51.862	Bull	
							❖ 27.182	Male, 0-1 yr	
							❖ 48.269	Male, 1-2 yr	
							❖ 55.1	Male, >2 yr	
	Buffalo		55	kg CH4/head/Year	● 55	● 55	❖ 58.746	Mature Female	

Table 13 shows an extract from the preliminary database that contains data/information on five major IPCC source/sink categories (Energy, Industrial Processes, Agriculture, Land Use Change and Forestry, and Waste) for twelve Asian countries (Bangladesh, China, India, Indonesia, Japan, Mongolia, Myanmar, Pakistan, Philippines, Republic of Korea, Thailand and Vietnam). This preliminary database indicated that in most sectors it was only a few countries that used their country-specific parameters. Apparently most countries had recourse to IPCC default data that might not fully reflect specific national conditions. Thus, lack of country-specific data in the Asian region was reconfirmed, hence the necessity to promote research activities to explore such data for better GHG inventories in the region.

An attempt to update this preliminary database on parameters used in GHG inventory preparation in the Asian region is being continued. We hope this database will serve inventory compilers in the Asian region as a useful source of data in the future.

(2) Identification of data gaps and problems that should be addressed with priority in future research

Bearing in mind the objectives of this research, we held a workshop on "GHG inventories for Asia-Pacific Region" on 9 and 10 March 2000 in Hayama, Japan, with participation of about forty experts from China, India, Malaysia, Philippines, Thailand, Japan and some international organizations. This workshop was funded by the Environmental Agency of Japan, and hosted by IGES and National Institute for Environmental Studies (NIES) of Japan.

The workshop focused on three main sectors: agriculture; land use change and forestry (LUCF); and waste. This was because emission factors and other parameters in these sectors would vary widely depending on the local or national conditions, and hence region-specific discussion was considered important. The workshop participants discussed data gaps and problems in GHG inventories in the region, evaluated and assessed the current methods for compilation of inventories, proposed improvements on the compilation of GHG inventories.

As a result, the workshop participants identified the following factors or areas, for example, as the ones that should be studied with high priority in order to improve the quality of GHG inventories in the region.

Agriculture

- For the livestock component, there is a need to develop simple, inexpensive methods for determining the emissions factors for enteric fermentation and standardization of sample collection.
- For all the other components of the agriculture sector, there is a need to develop models using geographic information system (GIS) software.

Land Use Change and Forestry

- Forest typology needs to be elaborated. Ideally, the typology should be linked to entities that can be distinguished by remote sensing, that reflect the actual biomass density and that are functional from a land-use perspective. Existing national statistics are often based on administrative entities that cannot be directly linked to biomass densities. Harmonization efforts are needed based on the type of data available per country. However, it is acceptable that countries use their own typology, as long as it is connected to estimates of growth rates.
- Growth rates for each forest type need to be further studied. There are many data and estimates available, but they may not be directly comparable. The use of GIS-based simulation (or multiple regression) models will be helpful for generating default estimates.
- Area of forest cleared should be also studied by forest type. This can be derived from time-series of remote sensing imagery, but there is a big gap between theoretical possibilities (in pilot areas) and the application of the techniques on a national scale. A clearinghouse for (cross-boundary) remote sensing imagery will be helpful.

Waste

- Degradable Organic Carbon (DOC) should be determined on a regionally disaggregated basis in each country.
- The fraction of waste that is subject to open burning should be clarified and taken into account in estimations of GHG emissions from this sector. The workshop participants agreed that the current IPCC Guidelines do not fully meet the needs of the Asia region in this regard. They emphasized the importance of establishing typical municipal solid waste flowcharts by region in each country where relevant, and of establishing a more appropriate format for data reporting. Finally the workshop participants proposed a new format, which will be provided to the TSU of the IPCC-NGGIP as input from Asian experts for future revision of the current IPCC Guidelines.

(3) Formation of a network of GHG inventory experts in the Asia-Pacific region (NAPIID)

The highlight of the workshop was the formation of a network of GHG inventory experts in the Asia-Pacific region that will focus on improving GHG inventories. The objectives of this network are to improve the database of activity data and emission factors in the region, to develop methodologies to improve estimates of GHG inventory, to assist Asia-Pacific countries in improving their GHG inventories, and to support the TSU of the IPCC-NGGIP.

It was suggested that the network be established in two stages. In the first stage, IGES may serve as the focus of a private network, comprised of individual experts from the region. In the second stage, the network should firmly establish its role in supporting the work of the TSU of the IPCC-NGGIP, and link with the UNFCCC National Focal Points of each country.

In this context, after the workshop a private network of inventory experts was established as NAPIID (Network for Asia Pacific to Improve (GHG) Inventories Database). This network currently consists of more than thirty experts in Asian countries, and is coordinated by Dr. Damasa B. Magcale-Macandog at University of the Philippines at Los Banos (a former Eco-Frontier Fellow of APN, CC) and Mr. Kiyoto Tanabe, Research Fellow of the Climate Change research project of IGES (Figure 21). (URL http://www.iges.or.jp/cc/napiid/NAPIID.htm)

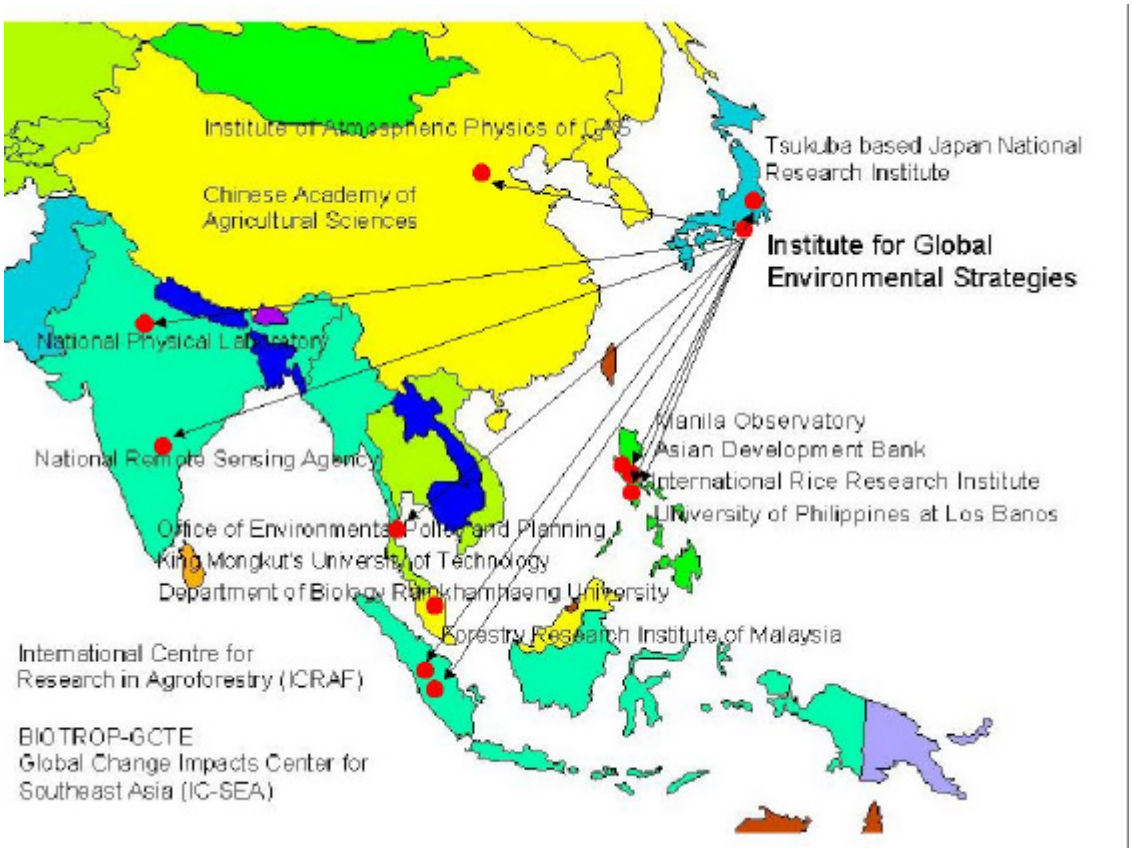


Figure 21. Organizations and institutions to which NAPIID experts belong

c. Dissemination of the outcomes

The outcomes of this research were reported to the National Institute for Environmental Studies (NIES) and the Environment Agency of Japan because this research was entrusted to IGES by NIES as part of Japan's Global Environment Research Program. In addition, the outcomes have been disseminated on the following occasions.

Presentation

- APN-funded workshop with GCTE, LUCC, STAR, IDGEC [IGBP-IHDP] "Land Use Change and the Terrestrial Carbon Cycle in the Asia-Pacific Region"(Kobe, Japan, 29 January - 1 February 2001)

Distribution of workshop proceedings

- 13th Session (Part I) of Subsidiary Bodies of UNFCCC
  (Lyon, France, 4 – 15 September 2000)
- 6th Session of Conference of the Parties to the UNFCCC (COP-6)
  (The Hague, Netherlands, 13 – 25 November 2000)

Introduction of NAPIID or the preliminary database

- IPCC Expert Meeting on Establishing a Database on GHG Emission Factors (New Delhi, India, 24 – 25 July 2000)
- UNFCCC regional workshop of the Consultative Group of Experts on National Communications from Non-Annex I Parties of the Asian region (Bangkok, Thailand, 16–20, October 2000)
- NAPIID is referred to in the report of this workshop (FCCC/SBI/2000/INF.10).

(Kiyoto Tanabe)

3. Conclusions

3.1 Conclusions

During the three years of the first phase of IGES research, in response to the progression of international policy-making, the Climate Change Project has made many timely proposals that contributed to the policy-making process, both internationally and domestically. The project also established a basis for a long-term research by developing original methodologies, such as Regional Energy or Environmental Model (IGEM). The network-building among the international and domestic researchers or stakeholders was also a success. As a result, the IGES Climate Change Project is now recognized both internationally and domestically as a core research center of the climate change issue in Japan and the Asian region. As a result, many invitations to major international research projects or to international conferences have been received. From these outcomes, it can be said that the project has fully achieved the original research plan.

Towards the implementation of the Kyoto Protocol, which has been a pressing issue in the world, the project has contributed to the discussions under the UNFCCC by making proposals at major international conferences on the design of key elements such as emissions trading, supplementarity and the Clean Development Mechanism. At the conferences held in the Asian region, the project has made proposals on the following issues: funding mechanisms for developing countries such as the CDM, technology transfer, possibility and assessment of cooperation of the four countries in the Northeast Asia, analysis on the effects of carbon taxes, cost analysis of the CDM. The project has developed a network of researchers from twelve Asian countries for the purpose of improving GHG inventories. For this network the project has been requested to cooperate in global research programs such as the GCTE (Global Change and Terrestrial Ecosystems, part of the International Geosphere-Biosphere Programme). In Japan, the project has contributed to the domestic policy-making process though the participation in governmental committees and councils, and has been recognized and is functioning as a base for the transmission of information by holding brainstorming forums, symposiums and seminars. As for the IPCC, which contributes scientific information to the policy-making process, several project members are contributing by writing synthesis reports, working group reports and special reports. These activities cover most of the range of the research and the levels of decision-making originally planned, and it can be said that solid foundations have been laid for research activity in the second phase of IGES research.

3.2 Remaining issues and future targets

The three years of the first phase represented a start-up period of IGES as an institute, as well as a period when the issue of climate change itself expanded both internationally and domestically. The Climate Change Project was fully engaged in tracking the international negotiation process and the domestic policy-making process. There are several remaining issues relating to the research targets and intellectual infrastructure. The project's research ability will be reinforced by including the following issues in the second phase research plan.

- Newly Emerging Issues

The issue of the adaptation methods of developing countries after COP-6 is arising, including the developed countries that are the equity participants. The issue of sinks will remain as a controversial point.

- Policy Proposals in the context of sustainable development

Humanity's efforts to address the issue of climate change could provide clues to promote sustainable development. In the future, multidisciplinary research is needed in the context of sustainable development on issues such as water resources, food security, ecosystem conservation, soil degradation and energy.

- Newly arising points in discussions

Quantitative analysis methods to evaluate effects of reduction measures and legal, institutional and policy measures should be developed for governments as well as industries.

- Development of Methodologies

Besides the case-by-case proposals, it is also necessary to establish the comprehensive methodologies for long-term analysis and assessment. Development of the IGES GHG Emission Model has almost been completed, and in addition to this, it is necessary to have energy-economy analytical methods for the assessment of domestic policy measures, while accumulating the relevant data.

- Sharing of Research Themes with Other IGES Projects

Researchers tend to work individually on different research themes. More effective research results can be expected through greater cooperation. It is necessary to have discussions with the other research projects in IGES, as well as within the Climate Change Project itself, to draw upon a more focused and effective research plan, and a system to carry out the plan.

4. Evaluation of achievements

4.1 Assessment of major outputs

a. Originality of the research project

The IGES Climate Change Project is unique in Japan and the Asian region for making comprehensive policy proposals focused on the issue of climate change. The project works closely with Tata Energy Research Institute (TERI) and Thai Environment Institute (TEI), both IGES signatory institutes. It continually takes into consideration the current state of UNFCCC processes and our research is maintains a high degree of flexibility to meet emerging needs. Research results are provided in a timely manner to the policy-making processes, both international and domestic. This is possible because the project carries out its research activities in close relation with the UNFCCC, the IPCC and the Japanese government.

Research is focused on the proposals on policy and measures for international framework making. Recognizing that the participation of developing countries is an important part of the process of attaining international agreement, our project focuses on the Asian region by analyzing cooperation systems such as the CDM, the effects of funding mechanisms to support the systems, and case studies focused on Northeast Asia. We also focus on Japan and make proposals for domestic emissions reduction policies. The project conducts, as illustrated above, consistent research to provide input into policy measures, from the international and regional to domestic levels. Thus, the project has developed a system that enables us to make consecutive proposals for policy measures.

The issue of climate change can be described as a showcase of the issues of sustainable development. It requires the efforts of many specialists of various fields and extensive information from various countries. The project's research is carried out not only by IGES but also in cooperation with many international research institutes. It has accepted visiting researchers from the following institutes to conduct research from an international viewpoint: TERI, the Energy Resource Institute and Agricultural Laboratory China, Potsdam Research Institute for Climate Change (PIK), University of the Philippines, and the United States Department of Energy. We also conduct cooperative research utilizing the network formed by organizing international workshops. This kind of research style can be regarded as one of the unique characteristics of our project.

b. Advancement of the existing research level

Climate change research is at the frontier stage for various aspects of physical and social science. Scientific factors become the basis of environmental policy which is analyzed by the IPCC, and the UNFCCC then constructs concrete policy mechanisms using the results. Research to respond to on-going policy processes such as those related with climate change needs to be one in an integrated (synthesized) rather strictly analytical way. Evaluations of that research activity should take into account the extent to which it provides policy recommendations in a timely manner in accordance with the demands of the policy-making process. In that sense, the IGES Climate Change Project has succeeded in producing unique and unprecedented research results.

On the other hand, our limited manpower was just enough to stay up with the pace of developments in climate change, and therefore a delay sometimes occurred in summarizing our research results in the form of one consistent methodology or as a sequence of structured ideas. Responding to critical advice on the lack of tools for quantitative assessments as a basis for making proposals, we started developing an energy model for the Asian region during the second year of the first phase of research.

Research institutes similar to and competing with IGES have well-established and well-staffed research frameworks. Our project needs to carry out more intense research supported by theory and quantitative analysis.

c. Influence on policy-making process

One of our main targets is to provide timely proposals to international and domestic policy-makers, by taking account of the policy-making process of the UNFCCC. The Climate Change Project members work in close communication with the government and actively participate in the activities of the UNFCCC, IPCC and domestic governmental committees. This close communication has helped us to be successful in providing timely and influential proposals into the policy-making process.

At present, through its Central Environment Council the Japanese government is examining domestic climate change mitigation measures such as environmental taxes and emissions trading. Prof. Morishima, Director of the Board of IGES, is currently the President of that Council. The project leader of this project is a member of the Council's subcommittee on climate change mitigation and has been reporting IGES research results, including elaboration of domestic policy measures, results of the IGES open forum for global warming mitigation, comparative studies on G8 countries' policies, and GHG emissions estimates, etc. These reports have been adopted as a part of the subcommittee report. The project leader frequently makes proposals based on the project's research results, as a member of a governmental committee on the examination of GHG emissions system, and the Committee on Global Warming Issue, which is at the center of the scientific examination of the issue in Japan.

In addition, the project leader has commented on the effective use of the fund of GEF (Global Environmental Fund) and assistance for developing countries, as a member of Science and Technology Advisory Panel of GEF.

The members of the Climate Change Project have been invited to provide input not only to the Environment Agency but also by other committees held by the Ministry of International Trade and Industry, the Science and Technology Agency, the Ministry of Foreign Affairs, the Japan Bank for International Cooperation, and others. The project has growing influence on policy-making processes by presenting research results and participating in the writing of reports of committees. Besides these inputs toward policy measures made by individual researchers, we have developed opportunities to provide the policy-making process with the opinions of citizens, by conducting discussions on policy recommendations by all the relevant sectors of society (private industry, NGOs, government, etc.) in forums such as the IGES open forum on domestic policy measures (a seven-part series), the IGES brainstorming forum on the issue of baselines and emissions trading (attended by nearly sixty participants each time).

Climate change is one of the main policy issues in the Asian region. The IGES Climate Change Project conducted research on funding mechanisms in the Asian region and its results have been included, as a part of the activity of the IGES New Development Patterns Project, in the report submitted to the ECO ASIA ministerial meeting, which was co-organized by the Environment Agency and IGES. The members of the Climate Change Project have worked closely with the business sector, industrial organizations and environmental research institutes. In addition, they have also gained a stronger voice for each sector and country by conducting cooperative research with people committed to international funding mechanisms, such as the South Korean government and the World Bank.

Our proposals related to the Kyoto Mechanisms were presented at the side events of COP and SBSTA meetings. Various proposals related to the Kyoto Mechanisms were announced at these side events and discussed by policy-makers and experts. Our proposals have frequently been integrated into international policy formulation. As for IPCC activities, seven Climate Change Project researchers (three full-time researchers, four visiting researchers) are contributing by writing assigned chapters for the IPCC report as lead authors. Moreover, one of the full-time researchers bears a cross-sectoral role in the IPCC working groups, by participating in the Synthesis Report as an advisor to the vice-chairman of the IPCC.

Committees and councils in which project staff participated

Shuzo Nishioka

- Scientific and Technological Advisory Panel (STAP), Global Environment Facility (GEF)
- Scientific Steering Committee (SSC), Systems for Analysis of Research and Training (START), ICSU

- Pollution Control and Climate Change Working Group, China Council for International Cooperation of Environment and Development (CC/CED)
- Scientific Planning Committee (SPC), Asia-Pacific Network for Global Environmental Research
- Lead Author, Chapter 2, IPCC Working Group Ⅱ
- Policy Planning Panel, Central Council for Environment of Japan
- Working Group for Climate Change, Central Environment Council, Japan
- Chairman, Working Group for Emission Analysis of Inventory of Japan (MOE)
- Chairman, Working Group for Climate Change Impacts to Japan, Science Committee for Global Warming (MOE)
- Chairman, Working Group for Science and Technology of Climate Change, Science and Technology Agency

Aki Maruyama

- ESENA Project (Energy Security Environment in Northeast Asia) project (Nautilus Institute/International Univ.) 1999
- New technologies for cleaner coal use for global environment (NEDO/Japan Institute of Energy) 1999
- Economic co-operation contributing to climate change mitigation (Ministry of Foreign Affairs /International Development Center of Japan) 2000
- Carbon Finance Study (Mitsubishi Research Institute) 2000
- Policy Recommendation to State Development Planning Commission Supporting the Deployment of Clean Coal Technologies in China, study team member (The World Bank) 2000
- Research on financial mechanisms for global environmental problems in developing countries (Ministry of Environment) 2000

d. Appropriateness and timeliness to stakeholders' needs

The stakeholders related to the issue of climate change represent various sectors, including policy-makers (governments), local governments, industry, the general public, media, researchers, universities, and overseas research institutes. Some proactive research activities conducted by this project have been well recognized and it has provided a large number of proposals for commissions, consultations, joint research, lectures and general information sharing. We make every effort to respond, but currently it is difficult to meet every request. For commissioned research, from the Environment Agency we have had the following tasks: G8 Best Practices comparative study, IGES Open Forum for Global Warming Abatement, and the preliminary report on GHG emissions estimates. From the Ministry of Foreign Affairs we were commissioned with the work of target setting for the second commitment period of the Kyoto Protocol. As the picture of mitigation measures for climate change becomes clearer, business sectors are showing more interest in the results of the research on the mitigation measures such as emissions trading, the Carbon Fund Initiative by the World Bank, etc. The members have been providing information to the industrial sector and have provided comprehensive guidance on the issue.

Enhancing public awareness in order to encourage people to take action at home and office is indispensable to prevent climate change. The members of the Climate Change Project are frequently responding to invitations as much as possible to speak at seminars and meeting held by local governments, citizens groups and universities, in order to explain the meaning of international and domestic policies such as environment taxes, and to share the latest information and scientific knowledge on climate change.

For international activities, we have received offers for joint research or network development from international institutes such as TERI (India), the Energy Resource Institute China, Wuppertal Institute, RIIKA, the Russian Academy of Science and the World Bank. We are now conducting joint research with China, Russia and the World Bank.

e. Outreach

The role of the IGES Climate Change Project is to obtain research results by a precise methodologies and to make the best use of these results in relation with the policy decision-making process. From this point of view, we should first

consider the research results to be reflected in the policy-making process. During the first phase of research, Project members made more than 250 oral presentations inside Japan and 30 outside Japan at events such as academic conferences, lectures at IGES, seminars at COP meetings, guest seminars, etc. Among these events, the side events at COP and SBSTA meetings, and the lecture at the Chatham House were especially effective as they were attended by experts from all over the world. Moreover, as previously described, we have submitted documents and materials and made oral presentations to governmental committees. These are the most effective ways to contribute to policy-making. The results of the international workshops on the CDM and the GHG inventory are recorded in reports, and have been distributed to the main research institutes in the world (usually 1,000 copies). Post-COP Seminars, co-organized with GISPRI, are always welcomed by governments, industry and the public who wish to know the result immediately after the COP meetings are over.

The reports of the CDM workshop and the inventory workshop were extremely popular among the participants from developing countries at COP and SBSTA meetings and ran out of stock in a few days. The research results of the project were conveyed to stakeholders by holding brainstorming forums two to three times a year with domestic experts. Thus, the results of the research have been open to the public to be contributed as materials for discussions. All members of the Project participated in the Japanese translation of a book that explains the climate change issue and the meaning of the Kyoto Protocol to general readers. Media, such as television and the newspapers, are valuable for wide dissemination of the research results. The project is actively communicating its work to the media. For example, before COP-6 we held a press lecture for twenty journalists of major newspapers on the issues that would arise at the COP-6 meeting, which they very much appreciated. To improve the quality of the research, the Climate Change Project encourages the participation of its members in academic conferences. The researchers participate in such conferences twice a year, both overseas and in Japan, in order to present the research results.

4.2 Evaluation of the performance of the Project

The Climate Change Project was expected to carry out the following activities and in general has accomplished them in accordance with the original plan: (1) research, (2) increase influence in domestic and international policy-making based on research results, and (3) become a center for information exchange for researchers, policy-makers and other stakeholders.

The work of individual researchers was extremely active during the first phase. Project members made thirty presentations of research results, although the number of the presentations at academic conferences was as high, since the researchers were occupied with staying up to date with the rapid progress of negotiations on climate policies and measures. The number of project personnel was not sufficient to address many of the themes involved with the issue of climate change. As the negotiation process developed, it became increasingly important to have close contact with researchers and stakeholders overseas by attending international workshops, meetings, etc. One result was a lack of time to concentrate on academic research. As for domestic activities, the researchers were also constantly busy attending various committees and meetings, and responding to outside requests.

During the UNFCCC negotiation process, the issue of carbon sinks arose as a critical issue. However, the lack of manpower prevented us from fully addressing this issue. In addition, it was not possible to address the issue of renewable energy, such as biomass, which was listed in the original research plan. As written in this report, the Climate Change Project has made significant efforts to have our research results reflected in the policy-making process. Overall, the project has gained considerable momentum during the three years of the first phase of research.

As a result of our research and outreach activities, the project is now recognized worldwide as part of the core of the climate change policy research in Japan, and the project is becoming a center for information exchange and personal contact.

4.3 Evaluation of management of the Project

At the beginning, the project started with six Japanese researchers (two with a doctor's degree, three with a master's degree, and one researcher transferred from an electrical company) and one project secretary. In succeeding years, we short-term visiting researchers came from the U.S. Department of Energy, TERI and PIK. From the Energy Resource Institute China, researchers were dispatched for one-year period. In addition, we accepted researchers from the Eco-Frontier Fellowship (University of the Philippines, Agricultural Research Institute of China) for GHG inventory-related issues. From the TSU, a research fellow whose focus is on inventory (meteorology) has an additional post in this project.

One research associate (master's degree in economics) was newly hired in the second year but was soon transferred to another research institute. During the second year, a research fellow from Korea (Ph.D. in economics) joined the project. Currently, the core members of the project are as follows: a project leader (Ph.D., system analysis), a senior research fellow (Ph.D., environment and energy science), a senior research fellow (Ph.D., energy economics, Korea), a research associate (master's degree, development economics) and the project secretary. The project is also have a visiting researcher (Ph.D., ERI, China), two post-doctoral researchers (Ph.D., Agricultural Research Institute of China and Ph.D., soil science, Philippines), an intern (urban engineering, Nepal), and the research fellow from TSU for the inventory issue (additional post).

The project management relating to research quality and personnel management was relatively smooth. However, we still have several areas needing improvement, as described below.

- Insufficient research guidance and obstacles in decision-making

Because the project leader works in this role on a part-time basis and is occupied with other tasks outside IGES, the research guidance and job allocation for young researchers was insufficient. The lack of decision-making for important or daily matters slowed overall progress of research activities.

- Gap between senior and junior researchers

Related to this, a gap existed between researchers who set targets independently and those who were not able to do so. As a result, the project was only able to retain the former type as project members, and was unable nurture young researchers. It is clear that we need to reinforce the system of research guidance, when we think of the educational functions of IGES and the continuation of the project. However, currently this is difficult to achieve due to the large volume of requests for research on the climate change issue.

- Utilization of researchers from overseas institutes

The potential of visiting researchers from foreign research institutes was not always fully realized due to the briefness of their time with the project, or the lack of preparatory discussions on research themes. As one exception, one of the Eco-Frontier Fellows conducted the research activity extremely positively and actively. This issue is also related to the project leader's work and system for research guidance.

4.4 Economic efficiency of project management

The policy of fund management in the Climate Change Project is as follows:

- Personnel expenses represent the major cost since the actual research is performed by our human resources. As much as possible, regular funds from the institute were allotted to personnel expenses.
- Themes of commissioned research should be matched with existing research themes as much as possible. Too much commissioned work or work not related to the project specialty could decrease research efficiency. Work that requires large time commitments should be handled by outsourcing.

- External funding should be applied as much as possible to cover costs other than personnel expenses. The use of external funding is essential since we apply most of our regular budget for personnel expenses.
- For travel costs of overseas business trips, we do not set tight limits, taking into consideration the nature of our work.
- Outsourcing should be limited as much as possible. Effective use of project staff is indispensable.

In this phase, the budget was smoothly executed in accordance with the original plan. As for the commissioned work, work related to cooperative research in Northeast Asia was commissioned from the APN, work related to accurate inventory systems, and a comparative study on G8 Best Practices were commissioned by the Environment Agency. For the G8 Best Practices study, we applied outsourcing, since the work consisted mainly of collecting documents and holding a symposium. The IGES Open Forum was held jointly with the IGES Secretariat. At the Open Forum, we collected participation fees from the participants other than IGES affiliate members. We organize the seminars after the COP meetings every year in cooperation with GISPRI, which covers a share of the costs.

4.5 Suggestions for improving the Project in the second phase

Climate change issues are complex in nature and require multidisciplinary approaches in research. In this sense, the Climate Policy Project of IGES will focus more on the integration of both internal and external research activities related to this project. To achieve the research objectives of the Climate Policy Project, we will emphasize the aspects described below.

Climate policy cannot be easily separated from other policy areas such as energy and economics. It is crucial to find a way to integrate all relevant policies. For example, local environmental policy to mitigate air pollution in a country will also affect the country's GHG emission profiles in some way. Hence, it is important to link this local environmental policy to climate policies. For this purpose, the project will strengthen broader contact with relevant research communities; this will also contribute to extending the research networks of IGES and researchers.

The research in IGES is not primarily targeted at generating purely academic research outputs; this implies that continuous communication with policy-makers is one important ingredient for climate policy research. Hence, opportunities for discussions with policy-makers in both formal and informal ways will be explored and expanded as much as possible.

The sharing of research outputs, results and discussions among IGES researchers and among the researchers in this project can provide important input for improving research quality. This approach is also important to integrate each researcher into the Climate Policy Project of IGES. For this purpose, internal seminars, free discussion and working papers will be highly encouraged in this project.

Our research activity in the second phase will continue to aim at finding desirable policy measures both internationally and domestically, corresponding to developments in negotiations at under the UNFCCC. During the second phase of IGES research, from 2001 to 2003, the details of international mechanisms will be decided at the resumed COP-6 meeting, and countries will be implementing domestic policy measures. Countries have been requested to report to the UNFCCC substantial progress in domestic policy measures by 2005. During this period, the rules for international emissions trading will be clarified in order to achieve the quantified targets to be accomplished by 2008, which is the first commitment period.

The participation of developing countries will be the next major issue. Therefore, it will be necessary to examine and analyze actual measures for technology transfer to developing countries, such as the CDM. The inventory made in developing countries for national communications will also contribute to the promotion of technology transfers. It will also be necessary to have proposals for the effective implementation of adaptation methods, which will be funded from the share and proceeds of the CDM.

Original methodologies or tools are required for the effective research implementation. In addition to further improvements on the environmental energy model in the Asian region (IGEM) that we developed during the first phase, proprietary methods should be developed for policy analysis and policy evaluation of models, comparative studies, group discussions and the use of geographic information systems.

Edited by Shuzo Nishioka and Miya Iwase

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Li, Yun. 2000. The Costs of Implementing the Kyoto Protocol and Its Implication to China. In *International Review for Environmental Strategies*. Vol. 1, No. 1, 159 – 174.

Maruyama, Aki. 1998. *Towards the promotion of investment in the CDM by the private sector: scope for finance support by Japanese government*. IGES Discussion Paper FY 1998.

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Maruyama, Aki. 1999b. *Potential and Constraints of Private Sector Participation in the CDM*. Paper presented at the UN ESCAP Regional Workshop on Promotion of Energy Efficiency and related Public and Private Investments, Bangkok, 30 November - 2 December 1999.

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Maruyama, Aki, and S. Nishioka. 2000. *Promotion of Co-operative Measures to Mitigate Climate Change in Asia: Co-operation through the Clean Development Mechanism*" Paper presented at ECO-ASIA Long-term Perspective Project International Workshop, Lofos Shonan, Kanagawa, Japan, 22-23 February 2000.

Matsuo, Naoki. 1998. *Points and Proposals for the Emissions Trading Regime of Climate Change-For Designing Future System* (Version 1&2. In discussion papers of IGES Climate Change Project FY1998.

———. 1998. *A Proposal on the supplementarity issue for Emissions Trading and Joint Implementation*. In discussion papers of IGES Climate Change Project FY1998.

———. 1998. *How is the CDM compatible with sustainable development?—A view from project guidelines and adaptation measures.* In discussion papers of IGES Climate Change Project FY1998.

———. 1999. *Proposal for Step-by-Step Standardization for CDM—From Project-Specific to Generalized Formula (version 3)*. In discussion papers of IGES Climate Change Project.

———. 1999. *The U.N. Framework Convention on Climate Change Activities Implemented Jointly (AIJ) Pilot: Experiences and Lessons Learned*. In discussion papers of IGES Climate Change Project.

Matsuo, N., A. Maruyama., M. Nakada, M. Hamamoto, and K. Enoki. 1998. *Issues and Options in the Design of the Clean Development Mechanism*. In discussion papers of IGES Climate Change Project FY1998.

List of Achievements

1. Commercial Publications

FY1999

DIXON, Robert (ed.) (1999) "*The UN Framework Convention on Climate Change Activities Implemented Jointly (AIJ) Pilot: Experiences and Lessons Learned*" Kluwer Academic Publishers, 422pp.

FY2000

GRUBB, Michael, VROLIJK, Christiaan and BRACK, Duncan. Translation supervision by Naoki MATSUO (2000) "*The Kyoto Protocol: A Guide and Assessment*" Energy Conservation Center, 316pp.

2. Books Published by IGES

FY1998

MATSUO, Naoki (1998) "*IGES-CC Discussion Paper No.1*: *How is the CDM Compatible with Sustainable Development? - A View from Project Guidelines and Adaptation Measures*" Hayama, IGES, 12pp.

MATSUO, Naoki (1998) "*IGES-CC Discussion Paper No.2*: *A Proposal on the Supplementarity Issue for Emissions Trading and Joint Implementation*" Hayama, IGES, 10pp.

MATSUO, Naoki (1998) "*IGES-CC Discussion Paper No.3*: *Outline of the First IGES Brainstorming Forum on Emissions Trading*" Hayama, IGES, 20pp.

MATSUO, Naoki (1998) "*IGES-CC Discussion Paper No.4*: *Points and Proposals for the Emissions Trading Regime of Climate Change*" (version 1), Hayama, IGES, 31pp.

MATSUO, Naoki (1998) "*IGES-CC Discussion Paper No.5*: *Points and Proposals for the Emissions Trading Regime of Climate Change-For Designing Future System*" (version 2), Hayama, IGES, 47pp.

MATSUO, N., MARUYAMA, A., NAKADA, M., HAMAMOTO,M. and ENOKI,K. (1998) "*IGES-CC Discussion Paper No.6: Issues and Options in the Design of the Clean Development Mechanism*" Hayama, IGES, 37pp.

FY1999

IGES Climate Change Project (ed.) (1999) "*Discussion Papers in FY1998 for the Design of Effective Framework of Kyoto*", 169pp.

FY2000

IGES (2000) "*Climate Policy Debate in Japan:IGES Open Forum 2000 for Global Warming Abatement*" Hayama, IGES, 18pp. (in English and Japanese)

IGES(2000) "*Potential and Barriers to the CDM: Enhancing GHG Mitigation Through International Cooperative Mechanisms in Asia*" Proceeding of the IGES International Workshop on the Clean Development Mechanism

IGES and GISPRI (2000) "*Post-COP6 Seminar*" IGES/GISPRI, 42pp. (in English and Japanese)

IGES and NIES(2000) "*Proceedings of the IGES/NIES Workshop on GHG Inventories for Asia-Pacific Region*"

3. Workshops and Seminars organized by IGES

FY1998

Date	Title of workshop	Lecturers and participants	Place
Jun. 20-21, 1998	The First Brainstorming Forum on Emissions Trading	Yasuko KAWASHIMA, Taishi SUGIYAMA, Shunsuke HAMAOKA, Naoki MATSUO	Shonan Village Center/ Hayama
Aug. 9-10, 1998	The Second Brainstorming Forum on Emissions Trading	Shunsuke HAMAOKA, Tomoaki SAITO, Taishi SUGIYAMA, Naoki MATSUO	Shonan Village Center/ Hayama
Oct. 27, 1998	IGES Seminar for Affiliate Members before COP4	Akio MORISHIMA, Kazuo MATSUSITA, Naoki MATSUO, Mitsutsugu HAMAMOTO, Aki MARUYAMA, Koson ENOKI	Landmark Tower/ Yokohama
Nov. 2-13, 1998	UNFCCC/COP 4: Presentation in IGES's Independent Booth		Buenos Aires/ Argentina
Nov. 5, 1998	COP 4 Seminar: Climate Change - Message from Japan (Joint-release with the Government of Japan)	Hiroshi OHKI, Kazuo AICHI, Sujata GUPTA, Atiq RAHMAN, Joe ASAMOH, Jiro AKITA, Tatsuyoshi SAIJO, Akio MORISHIMA, Kazuo MATSUSITA, Naoki MATSUO	Buenos Aires/ Argentina
Nov. 27, 1998	Post COP4 Seminar(GISPRI)	Narumoto KAJIWARA, Kazuhito SAKURAI, Yasuko KAWASHIMA, Naoki MATSUO	Keidanren Hall/Tokyo
Dec. 20-21, 1998	The Third Brainstorming Forum on CDM	Robert DIXON, Hiroyasu SATO, Kazumasa OZEKI, Naoki MATSUO, Mitsutsugu HAMAMOTO, Aki MARUYAMA	Shonan Village Center/ Hayama

FY1999

Date	Title of workshop	Lecturers and participants	Place
May 21,1999	GHGs Emissions /Sink Inventory Workshop	Ryutaro YATSU (Environment Agency of Japan), Hideyuki MORI (Environment Agency of Japan), Gen INOUE (National Institute for Environtment Studies), Yuichi MORIGUCHI (National Institute for Environment Studies), Haruo TSURUTA (National Institute of Agro-Environmental Science), Masahiro AMANO(Forestry & Forest Products Research Institute), Ikuo WATANABE (National Institute of Public Health), Yuhei INAMORI (National Institute for Environment Studies)	Shonan Village Center/Hayama
Jun. 17, 1999	Workshop on the GHGs Sink Issues	Masahiro AMANO (Forestry & Forest Products Research Institute), Tomoyuki HAKAMADA (National Institute of Agro-Environmental Science), Mariko HANDA (Parks and Greens Management) , Gen INOUE (National Institute for Environment Studies), Tsubasa SATO (Sumitomo Forestry Co. Ltd.), Masatoshi ENDO (Oji Paper Co. Ltd.), Yoshiki YAMAGATA (National Institute for Environment Studies), Hideyuki MORI (Environment Agency of Japan), Yasuhisa TANAKA (Agriculture, Forestry and Fishery Ministry), Naoki MATSUO	Shonan Village Center/Hayama
Jun. 23, 1999	Lecture by Dr. Axel MICHAELOWA	Axel MICHAELOWA (Hamburg Institute for Economic Research)	Shonan Village Center/Hayama
Aug. 2, 1999	Discussant at US/Japan Forum on Environment by IGES	Tae Yong JUNG	Shonan Village Center/Hayama
Sep. 21, 1999	4th Brainstorming Forum	Taishi SUGIYAMA (Central Research Institute of Electric Power Industry), Taisuke HAMAOKA (The Industrial Bank of Japan)	Shoko Kaikan/Tokyo
Oct. 28, 1999	IGES COP5 Seminar	R. K. DIXON (US Department of Energy), C. JEMPA(University of Groningen), M. MENDIS (Alternative Energy Development), J. HEISTAR(World Bank), C. FIGUERES (Center for Sutainable Develomment in the America's), I. MINSTZER (Pacific Institute for Development, Environment and Security), N.MATSUO	Maritim Hotel/Bonn/ Germany
Nov. 22, 1999	Post COP5 Seminar (IGES, GISPRI)	Sigemoto KAJIHARA (Environment Agency of Japan), Midori TANI (Ministry of International Trade and Industry) , Haruo HOSOYA (Japan Federation of Economic Organizations (Keidanren))	Nadao Hall/Tokyo

Jan. 26-27, 2000	International Workshop on the CDM	Chow Kok KEE(Malaysian Meteorological Service),Chin-Seung CHUNG (Korea Advanced Institute of Science and Technology/ KAIST), Liu DESHUN(Tsinghua University), Yasumasa FUJII (University of Tokyo), GUNARDI (The State Ministry of Environment of Indonesia), Erik HAITES (Margaree Consultants Inc.), Kejun JIANG (Energy Research Institute of State Planning Commission), Yuji KANO (The Industrial Bank of Japan, Ltd.), Toshihiko MASUI (National Institute for Environmental Studies), Daisuke MATSUNAGA (Ministry of Foreign Affairs, Japan), Naoki MORI (Japan Bank for International Cooperation/JBIC), Choon-Geol MOON (Hanyang University), Elena NIKITINA (Russian Academy of Science),Ronald D. SANDS (Battelle-PNNL), Priyadarshi Ramprasad SHUKLA (Indian Institute of Management), Govinda Raj TIMILSINA (Asian Institute of Technology), Masami TSUJI (Asian Development Bank), Keiichi YOKOBORI (Asia Pacific Energy Research Center), Jong Soo YOON (Permanent Mission of the Republic of Korea to UN), Zhong Xiang ZHANG (University of Groningen), Shuzo NISHIOKA, Naoki MATSUO ,Tae Yong JUNG, Aki MARUYAMA	Shonan Village Center/ Hayama
Jan. 28, Feb.29, Mar. 30, 2000	IGES Open Forum to Address Global Warming	The First Open Forum (January 28,2000) Tadashi OSUKA (Gakushuin University), Saburo KATO (Japan Association of Environmental and Society for the 21st Century), Taisuke HAMAOKA (IBJ Finance Technology Co.Ltd.), Naoki MATSUO	Toranomon Pastoral/ Tokyo
		The Second Open Forum (Febuary 29,2000) Akihiro AMANO (Kwansei Gakuin University), Yasuo HOSOYA (Tokyo Electric Power Co.Ltd), Toru MOROTOMI (Yokohama National University), Hidenori NIZAWA (Kobe University of Commerce), Masami TAMURA (Nagasaki University)	Fukokuseimei Bldg./ Tokyo
		The Third Open Forum (March 30,2000) Masahiro KURODA (Keio University), Tsuneyuki MORITA (National Institute for Environmental Studies) , Isao IWABUCHI (Sky Aluminium Co.Ltd.) Noriyuki GOTO (The University of Tokyo)	Nippon Press Center Bldg./Tokyo
Mar. 9-10, 2000	Workshop on GHG Inventories for Asia-Pacific Region	Prodipto GHOSH (Asian Development Bank/ADB), Hongmin DONG (Chinese Academy of Agricultural Sciences), Gao QINGXIAN (Center for Climate Impact Research/SEPA), Meine van NOORDWIJK (International Centre for Research Programme/ ICRAF), Ashesh Prosad MITRA (National Physical Laboratory), Krishna Prasad VADREVU (National Remote Sensing Agency), Daniel MURDIYARSO(Global Change Impacts Centre for Southeast Asia/ICSEA), Rhoda S. LANTIN (International Rice Research Institute/IRRI), Masahiro AMANO (Forestry and Forest Products Research Institute, Ministry of Agriculture, Forestry and Fisheries), Aixin HOU (National Institute of Agro-Environmental Sciences), Hisao ITABASHI(Tokyo University of Agriculture and Technology), Motoyuki MIZUOCHI (National Institute for Environmental Studies), Nathsuda PUMIJUMNONG (National Institute for Environmental Studies), Yasuhito SHIRATO (National Institute of Agro-Environmental Sciences), Fuminori TERADA (Ministry of Agriculture, Forestry and Fisheries), Haruo TSURUTA (National Institute of Agro-Environmental Sciences), Ikuo WATANABE (National Institute of Public Health), Masato YAMADA (National Institute of Public Health), Yoshiki YAMAGATA (National Institute for Environmental Studies), Khali Aziz HAMZAH (Forest Research Institute of Malaysia), Jose Ramon T. VILLARIN (Manila Observatory), Kansri BOONPRAGOB (Ramkhamhaeng University), Aspadorn KRAIRAPANOND(International environmental Affairs Division, Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment), Sirintornthep TOWPRAYOON(King Mongkut's University of Technology Thonburi)	Shonan Village Center/ Hayama
Mar. 14, 2000	IGES Japan-Germany Policy Dialogue	Wolf-Rudiger GROHMANN (Deutsche BP AG), Udo HARTMANN (Daimler Chrysler), Hermann OTT (Wuppertal Institute for Climate,Environment and Energy), Heinrich-Hermann SCHULTE (Buderus Heiztechnik GmbH), Shigeru KUWABARA (Tokyo Gas Corporation Ltd.), Masayuki SASANOUCHI (Toyota Motor Corporation Ltd.), Hiroyuki SATO (Green Purchasing Network), Kazuhiko TAKEMOTO (Environment Agency of Japan), Koji YAMAGUCHI (NEC Corporation), Tsuneo TAKEUCHI, Naoki MATSUO	Nippon Press Center Bldg./Tokyo

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Date	Title of workshop	Lecturers and participants	Place
May. 10, 2000	The 4th Open Forum: Suggestion for Domestic Policy Measures from Technological Viewpoint	Yoichi KAYA(Keio Univeristy),Toru NISHIZUTSUMI(Toyota Motoer Corporation), Tetsunari IIDA(Japan Research Institute), Yoji UCHIYAMA(Tsukuba University),Shunsuke MORI(Science University of Tokyo), Shuzo NISHIOKA	Toranomon Pastral/ Tokyo
Jun. 1, 2000	The 5th Open Forum: Policy Measures to Enhance the Development of Technology for Global Warming in the Residential and Transportation Sector	Hidetoshi NAKAGAMI(Jyukankyo Research Institute Inc.), Yoshitsugu HAYASHI(Nagoya University), Ken ASAKURA(Mitsubishi Research Institute,Inc.), Yurika AYUKAWA(WWF Japan), Hiroki KUDO(Institute of Energy Economics), Yuichi MORIGUCHI(National Institute for Environment Studies), Shuzo NISHIOKA	Plaza Hall, Kasumigaseki Bldg./ Tokyo
Jun. 29, 2000	The 6th Open Forum : Overall Framework of Domestic Policy Measures(Part 2)	Takamitsu SAWA(Institute for Economic Research, Kyoto University), Naoyuki HATA(KIKO Network), Toshihiro OKA(Fukui Prefectural University), Tatsuyoshi SAIJO(Osaka University), Mitsutsune YAMAGUCHI(Keio University), Naoki MATSUO, Shuzo NISHIOKA	Press Center Bldg./ Tokyo
July. 13, 2000	The 7th Open Forum: Wrap-up Discussion	Tadao ISHIUMI(Global Industrial and Social Progress Research Institute), Kazuhiro UETA(Kyoto University), Takaaki MOROTO(C. Itoh & Co., Ltd.), Shuzo NISHIOKA	Fukoku Seimei Bldg/ Tokyo
July. 19, 2000	Seminar on IPCC Special Report & FCCC SBSTA Meeting(IGES, GISPRI)	Tomihiro TANIGUCHI(Tokyo University), Masahiro AMANO(Forestry & Forest Products Research Institute), Yoshiki YAMAGATA(National Institute for Environmental Studies), Tsuneyuki MORITA(National Institute for Environmental Studies), Syunsuke MORI(Science University of Tokyo), Shigemoto KAJIH ARA(Environment Agency of Japan), Tadao ISHIUMI(Global Industrial and Social Progress Research Institute), Naoki MATSUO	Fukoku Seimei Bldg./ Tokyo
Sept. 11, 2000	SBSTA IGES Special Event: Issues and Opportunities for Investing in the CDM	Michael GRUBB(RIIA),Yong-Gun KIM(KEI), Kimihiko HIRAISHI(IPCC TSU/IGES), Naoki MATSUO, Tae Yong JUNG, Aki MARUYAMA	Palais des CongresLyon/France
Oct. 11-12, 2000	APN Project: Policy Design of Climate Change Collaboration in Northern Asia	Elena Nikitina(Russian Academy of Science), Songli Zhu(Energy Research Institute), Shuzo NISHIOKA, Naoki MATSUO, Tae Yong JUNG, Aki MARUYAMA, Cui CHENG, Shinji KANEKO, Wakana TAKAHASHI	IGES/Hayama
Oct. 24-25, 2000	International Symposium on Green Tax Reform in Asian Countries(IGES, Korea Environment Instiute(KEI))	Hidenori NIIZAWA(Kobe University of Commerce), Tsuneyuki MORITA(National Institute for Environment Studies), Dr. Kejun JIANG(Energy Research Institute), Ma ZHONG(China Renmin University), Yohei HARASHIMA(Takusyoku University), OECD and Korean scholars, Akio MORISHIMA, Naoki MATSUO, Tae Yong JUNG, Shinichi ARAI	Sejong Center /Seoul/ Korea
Nov. 18, 2000	COP6 Special Event: Cooperation and Competition for Implementation of the Kyoto Regime	Hiroshi OHKI(MP of Japan, President of the Kyoto Conference: COP3),Takuji YANAGIMOTO(MP of Japan), Michael GRUBB(Imperial College.), Zhou DADI(Energy Research Institute), Stephen H. SCHNEIDER(Stanford University), Rae Kwon CHUNG(Ministry of Foreign Affairs), Michael J. WALSH(Environmental Financial Products), Bert J.M. de VRIES(RIVM), Akio MORISHIMA, Naoki MATSUO	Netherland Conference Center/The Hague/The Netherlands
Dec. 20, 2000	Post COP6 Seminar(IGES, GISPRI)	Shigemoto KAJIHARA(Environment Agency of Japan), Midori Tani(Ministry of International Trade & Industry), Takanobu Yasumoto(Global Industrial and Social Progress Research Institute), Akio MORIshima, Shuzo NISHIOKA, Naoki MATSUO	Nadao Hall/Tokyo
Mar. 15-16, 2001	International Workshop on Social-Economy Assessment for CDM and Other Mechanisms(Energy Research Institute(ERI), IGES, UNEP Collaborating Center on Energy & Environment(UCCEE))	Erik HAITES(Margaree), Liu DESUN(Tsing University), Kim OLSEN(UCCEE), Peng XIMING(Electricity Power Research Center), Jorge ROGAT(UCCEE), Shi HAN(Clean Technology Center), M.K. LEE(UCCEE), Naoki MATSUO, Aki MARUYAMA	Xindadu Hotel/Beijing/ China

4. Academic Papers

(i) Papers compiled and published by IGES

FY1998

MARUYAMA, Aki (1999) "Towards the Promotion of Investment in the CDM by the Private Sector: Scope for Financial Support by the Japanese Government" *Proceedings of the Workshop on Flexibility Mechanisms and Climate Change Policy in Asian Countries: Experiences and Technology Response from EC Research, Asian Institute of Technology, Bangkok.January 1999* p. 115-123 , Center for Energy-Environment Research & Development (CEERD), Aisian Institute of Technology

MATSUO, Naoki, MARUYAMA, Aki (1999) "Flexibility Measures and Proto-Type Carbon Funding by the World Bank: Possibility of Investment and Loan" *Commissioned report by OECF, March 1999* p. 84, Hayama, IGES

FY1999

MATSUO, Naoki (1999) "Toward an Integrated Emissions Market of Kyoto Mechanism : Perspective for Future Development" *The UN Framework Convention on Climate Change Activities Implemented Jointly (AIJ) Pilot: Experiences and Lessons Learned*, edited by R. DIXON, Kluwer Academic Publishers, p.383-405

FY2000

JUNG, Tae Yong (2000) "Green Tax Reform toward a Sustainable Society" p.31,KEI/IGES

JUNG, Tae Yong (2000) "Macroeconomic Impact Analysis of Environment Tax :Focusing on Carbon Tax" *Proceedings of the International Symposium on the Green Tax Reform in Asian Countries*, p.17

MARUYAMA, Aki (2000) "Effectiveness and Issues of Economic Incentive Policy Measures in Developing Countries :The Cases of Indian Wind Energy Policy and its Implication for Development Assistance" Paper presented at 11th general meeting of The Japan Society for International Development, December 2000, p.9, The Japan Society for International Development

MARUYAMA, Aki (2001) "Financila Assistance Under Major Environmental Agreements" Commissioned report by MOFA *Focusing on UNFCCC*, Vol.1, March 2001

MATSUO, Naoki (2000) "A Portfolio of Domestic Instruments for Climate Change Mitigation in Japan to Implement Kyoto Regime" (version 1.0), p.35

MATSUO, Naoki (2000) "Guide for Comprehending the Negotiations at the Hague" p.20

MATSUO, Naoki (2000) "Key Elements in Designing a Portfolio of Instruments to Mitigate Climate Change" Paper for KEI-IGES Symposium on Environmental Taxation,p.3

MATSUO, Naoki (2000) "Notes for Comprehending the Negotiations at the Hague:To Understand What Was Discussed at COP6", p.8

MATSUO, Naoki (2000) "Outline and Impressions of the SBSTA Meeting at Lyon:Possibilities of COP6" p.6

MATSUO, Naoki (2000) "Outline of the Discussion on the Designing of Domestic Emissions Trading Regime" (version 5.1), p.42

MATSUO, Naoki (2000) "Proposal for Step-by-Step Baseline Standardization for CDM" p.24

MATSUO, Naoki (2000) "Proposal for Step-by-Step Baseline Standardization for CDM:From Project-Specific to Generalized Formula" (version 3.0), p.30

MATSUO, Naoki (2000) "Proposals on the Framework of Domestic Policy Measures for Climate Change Mitigation in Japan :Toward the Compliance of Kyoto Protocol" (version 1.0), p.34

MATSUO, Naoki (2000) "Thorough Reports of Globe 2000 Conference Focusing on Domestic Emissions Trading" p.7

MATSUO, Naoki (2000) "What is and How to Set Baselines for CDM Projects? :Paper for 10th Asia-Pacific Seminar on Climate Change in Malaysia" p.16

MATUSO, JUNG, CHENG, MARUYAMA and TAKAHASHI (2001) "Policy Design of Climate Change Collaboration in Northern Asia:Possible Options and Constraints for Co-operative Effort between Russia, Japan, China and Korea" p.100, APN Project

(ii) Contributions to journals outside of IGES

FY1998

HAMAMOTO, Mitsutsugu (1998) "Current Situation of Emissions Trading" *Energy Review* 18(11), p.42-45, Energy Review Center

MATSUO, Naoki(1998) "International Framework on Climate Change after the COP3 : Key Elements of the Kyoto Protocol and the Prospects of the Emissions Trading" *Energy in Japan* July, p.1-35, The Institute of Energy Economics

MATSUO, Naoki (1998) "Measures for Energy Consumption in the Household and Transportation Sector in Japan: Views on the Measures Utilizing the Market" *Energy and Resource* 19(4), p.317-321, Japan Society of Energy and Resouce

NAKADA, M. and PEARCE, D. (1998) "Acid Rain in East Asia: Side-Payments and Cost Reduction in Abatement Technology" *CSERGE Working Paper GEC* 1998, p.1-29, Centre for Social and Economic Researchon the Global Environment(CSERGE)

NAKADA, Minoru (1999) "Report on IGES COP4 Seminar" *Kankyo(Environment)* 1999(1), p.5-6, Environment Agency

FY1999

JUNG, Tae Yong(1999) "A Study on an Reduction Measures of CO2 Emissions in the Commercial Sector of Korea" (with Dong K. LEE and So W. YOUN), *Journal of Environmental Impact Assessment*, Vol. 8, No.4 (in Korean)

JUNG, Tae Yong(1999) "A Fundamental Study on Sulfur Dioxide Emission Estimation for the Mitigation of Sulfur Dioxide in Korea : On City and Country Levels" (with Dong K. LEE, Yong J. KIM and Seung W. JEON), *Journal of Environmental Impact Assessment*, Vol. 8, No.4 (in Korean)

LI, Yun (1999) "The Costs of Implementing the Kyoto Protocol and its Implications to China" *International Review for Environmental Strategies*, Vol.1, No.1, p.159-174

LI, Yun (2000) "The Potential of the Clean Development Mechanism in China" presented in January 2000 at Climate Change Project International Workshop

MARUYAMA, Aki (1999) "Potential and Constraints of Private Sector Participation in the CDM" paper presented at the UN ESCAP Regional Workshop on Promotion of Energy Efficiency and related Public and Private Investments, Bangkok, Thailand, Nov.30-.Dec. 2, 1999

MARUYAMA, Aki (2000) "International Economic Cooperation Contributing to Climate Change Mitigation" Commissioned Report for Ministry of Foreign Affairs

MARUYAMA, Aki (2000) "Pubic-Private Synergy in Financing Climate Change Mitigation in Asia" *Proceedings of IGES International Workshop on the Clean Development Mechanism Potential and Barriers to the CDM, IGES, Hayama*

MARUYAMA, Aki and NISHIOKA, Shuzo (2000) "Promotion of Cooperative Measures to Mitigate Climate Change in Asia :Cooperation through the Clean Development Mechanism" paper presented at ECO ASIA Long-term Perspective Project International Workshop, Lofos Shonan, Kanagawa, Japan, 22-23 Feb.2000

MATSUO, Naoki (1999) "Baseline as the Critical Issue of CDM:Possible Pathway to Standardization" *GISPRI CDM Workshop Proceedings*

MATSUO, Naoki (1999) "Prospects for the Future Development of Kyoto Mechanisms:GHG Emission Control through the Emissions Market" *Environment Research,* No. 113

MATSUO, Naoki (1999) "Outline of Kyoto Mechanisms and Emissions Trading" *Cogeneration*, Vol. 14, No.2

MATSUO, Naoki (1999) "A Proposal on the Supplementary Issue for Emissions Trading and Joint Implementation" *Linkage Journal*, Vol. 4, No. 3

MATSUO, Naoki (1999) "The Characteristics of Transport Energy Demand in the APEC Region : The Relationship between Transport Energy Demand and Economic Development" *the Proceedings of 22nd IAEE International Conference, June 1999, Rome*

MATSUO, Naoki (2000) "Implications of Various Domestic Emissions Trading and Carbon Taxation Schemes" *Environment Research*, No. 117

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JUNG, ROVRE, GAY, SHUKLA and ZHOU (2000) "Structural Changes in Developing Countries and Their Implication to Energy-related CO2 Emissions" *Technological Forecasting and Social Change*, vol. 63, p.111-136

MARUYAMA, Aki (2000) "Towards Construction of Effective Financial Mechanism Options for Climate Change Mitigation in Asia:Utilization of the Clean Development Mechanism (CDM) and its Potential" *Journal of International Development Studies*, Vol.9, No.1, p.95-113, The Japan Society for International Development

MARUYAMA, Aki(2001) "Current Status of Financial Assistance to Developing Countries Under International Environmental Agreements" *Some Implications for Support for Climate Change Mitigation*, Chapter 1, Commission Report for Ministry of Foreign Affairs

MATSUO, Naoki (2000) "Climte Change Mitigation Actions in the U.S.:Spec of Government/Congress/Indursty on the Market of Emissions Trading" *International Resouce*, May issue, 2000, p.11

MATSUO, Naoki (2000) "Expectations for International Climate Change Mitigation Projects(JI/CDM) Considering the Kyoto Regime:Harmonizing the Market Mechanism and Climate Change Mitigation" *Japan Society of Civil Engineers*, p.5

MATSUO, Naoki(2000) "Points in Designing the Domestic Emissions Trading System" *Annual Report of the Institute of Energy Economics, Japan*

MATSUO, Naoki (2000) "Scientific and Economical Aspects of Climate Change" *ADB/UNEP Capacity Building Seminar Report*, p.35

MATSUO, Naoki (2000) "Trend of the Emissions Trading Regime:From the Viewpoint of Business" *Mitsui & Co., Ltd., 12th Seminar Report*, p.36

MATSUO, Naoki (2000) "Trend of the Emissions Trading Regime:Toward the COP6" *21 Century Forum*, Vol.74, p.8

MATSUO, Naoki (2000) "Viewpoints in the Climate Change Mitigation Actions:Towards Scientific Understanding and Actions" *Industry and Environment*, p.9

5. Lectures at Workshops and Seminars

FY1998

Date	Titles	Lectures	Place
Jul. 18, 1998	"Global Environmental Strategy for Reducing GHG Emissions"	Minoru NAKADA	NagoyaCo-op Culture Center/ Nagoya
Sep.7-Sep.8, 1998	"Policy Dialogue on Emissions Trading" (International Energy Agency (IEA))	Naoki MATSUO	Geneva/Switzerland
Sep. 16, 1998	"Global Warming" Sainokuni Community Forum on Environment Global Warming	Mitsutsugu HAMAMOTO	Saitama Prefectural Citizen's Activities General Center/ Saitama
Sep.24-Sep.25, 1998	"Global Environmental Strategy for Reducing GHG Emissions" Workshop on Domestic Tradable Permit (OECD)	Naoki MATSUO	Paris/France
Sep .26, 1998	"Institutional Design of International GHG's Emissions Trading" Society for Environmental Economics and Policy Studies Annual Meeting 1998 (Society for Environmental Economics and Policy Studies)	Mitsutsugu HAMAMOTO	Keio University/Tokyo
Sep. 26, 1998	"Side-payments and Cost Reduction in Abatement Technology" Acid Rain in North East Asia: Society for Environmental Economics and Policy Studies Annual Meeting 1998 (Society for Environmental Economics and Policy Studies)	Minoru NAKADA	Keio University/Tokyo
Nov. 3, 1998	"On the Relation between International and Domestic Emissions Trading Regimes" OECD COP4 Workshop (OECD)	Naoki MATSUO	Buenos Aires/Argentina
Jan.14-Jan.15, 1999	"Towards the Promotion of Investments in the CDM by the Private Sector" Workshop on Flexibility Mechanisms and Climate Change Policy in Asia (EU & Asian Institute of Technology)	Aki MARUYAMA	Bangkok/Thailand
Feb.26-Mar.2, 1999	"Financing Clean Coal Technology in China: Possibility of GEF & CDM" ESNA Project Workshop Innovative Financing of Clean Coal in China (Mautilus Institute & International University)	Aki MARUYAMA	Barkeley/USA

FY1999

Date	Titles	Lectures	Place
Apr. 20,21,1999	"Trend in Various Domestic Emissions Trading and its Meaning" for Power Companies	Naoki MATSUO	Mitsubishi Research Institute/ Tokyo and Osaka
Apr. 26, 1999	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Petroleum Gas Association/ Tokyo
May 25,1999	Commentator of GISPRI International Symposium of Japan-US Climate Change Policy, 1999	Naoki MATSUO	GISPRI/Tokyo
Jun. 10, 1999	IGES Special Event at the 10th Subsidiary Body Meeting	Naoki MATSUO	Maritim Hotel/Bonn/Germany
Jun. 18, 1999	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Cogenaration Association/ Tokyo
Jun. 22, 1999	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Keio University/Fujisawa
Jun. 24-26,1999	"A Study on Structural Changes of Manufacturing Sector in Korea:The Measurement of Real Energy Intensity and CO2 Emission" the 1999 Open Meeting of the Human Dimensions of Global Environmental Change Research Community	Tae Yong JUNG	Shonan Village Center/ Hayama
Jun. 30, 1999	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Tokyo Gas Co. Ltd./Tokyo
Aug. 3, 1999	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Japan Physics and Chemistry Association/Tokyo
Aug. 23, 1999	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	OECF/Tokyo

Aug. 24, 1999	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Fuji Research Institute Corporation/Tokyo
Aug. 25, 1999	"Trend in the Kyoto Mechanisms and Various Domestic EmissionsTrading and its Meaning"	Naoki MATSUO	Japan Institute of Energy/ Tokyo
Sep. 8, 1999	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	C. Itoh & Co. Ltd./Tokyo
Sep. 15-16, 1999	"Issues Related to the Domestic Emissions Trading Regime" Taiwan-Japan Legal Association	Naoki MATSUO	Taipei/Taiwan
Sept. 21, 1999	"Domestic Emission Trading" 4th IGES Brainstorming Forum	Koson ENOKI	Shoko Kaikan/Tokyo
Oct. 1, 1999	"Trend in Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Keidanren/Tokyo
Oct. 12-14, 1999	Commentator of Most of the Presentations made at ADB/UNEP Capacity Building Workshop	Naoki MATSUO	UNEP/Thailand/Bangkok
Nov. 15-16, 1999	"An Overview of Domestic Emissions Trading Schemes" MRI International Workshop on Carbon Credits	Naoki MATSUO	Mitsubishi Research Institute/ Tokyo
Nov. 19, 1999	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Tokyo Institute of Technology/ Tokyo
Nov. 30-Dec. 2, 1999	Potential and Constraints of Private Sector Participation in the CDM/UN ESCAP Regional Workshop on Promotion of Energy Efficiency and related Public and Private Investments	Aki MARUYAMA	UN ESCAP/Bangkok/Thailand
Dec. 11, 1999	"Outline of the COP5 Outcomes and Expected Future Trends" Global Warming Abatement Committee (Kanagawa prefecture)	Aki MARUYAMA	Kanagawa Plaza for Global Citizenship/Yokohama
Dec. 16, 1999	"Global Warming and the Kyoto Mechanisms"	Naoki MATSUO	Chubu Electric Power Company/Nagoya
Jan. 18, 2000	Discussant on Baseline Standardization at the KEMA Workshop	Naoki MATSUO	Amsterdam/Holland
Feb. 17, 2000	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Institute for Policy Sciences/ Tokyo
Feb. 19, 2000	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	GISPRI/Tokyo
Feb. 22-23, 2000	"Promotion of Cooperative Measures to Mitigate Climate Change in Asia : Cooperation through the Clean Development Mechanism" ECO ASIA Long-term Perspective Project International Workshop	Aki MARUYAMA	Lofos Shonan/Hayama
Mar. 1, 2000	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Mitsui & Co. Ltd./Tokyo
Mar. 6, 2000	"Trend in the Kyoto Mechanisms and Various Domestic Emissions Trading and its Meaning"	Naoki MATSUO	Japan Bank of International Cooperation/Tokyo
Mar. 23-24, 2000	"SO_2 and NO_2 Emission Inventory in Korea" (with Dong K. LEE, Seung W. JEON and Yong J. KIM) The 5th Asia Integrated Model International Workshop	Tae Yong JUNG	National Institute for Environment Studies/Tsukuba
Mar. 23-24, 2000	"Activities in the Fiscal Year 1999 and the Policy Design in Korea : Application of AIM/Korea Model" (with Dong K. LEE and Jeong A. KWON) The 5th Asia Integrated Model International Workshop	Tae Yong JUNG	National Institute for Environment Studies/Tsukuba
Mar. 23-24, 2000	"Outline of Impact Model in Korea" (with Dong K. LEE, Seung W. JEON and Yong J. KIM) The 5th Asia Integrated Model International Workshop	Tae Yong JUNG	National Institute for Environment Studies/Tsukuba
Mar. 23-24, 2000	"IGES Model for CDM Analysis: Model Structure and Initial Results for Japan" (with Choon G. MOON) The 5th Asia Integrated Model International Workshop	Tae Yong JUNG	National Institute for Environment Studies/Tsukuba
Mar. 28, 2000	"Trend in the Kyoto Mechanisms and Various Domestic Emmisions Trading and its Meaning" for Industry (Techno-Information Center)	Naoki MATSUO	Techno-Information Center/ Tokyo

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Date	Titles	Lectures	Place
Apr. 7, 2000	"Emissions Trading" Internal Seminar (Japan Lawyer's Association)	Naoki MATSUO	Japan Lawyer's Association/ Tokyo
Apr. 24, 2000	"Institutional Response to Climate Change Issue and Current Situation of Wind Energy in India: Implications for International Cooperation" Second Meeting of the Study Group for International Cooperation for Global Warming Prevention (International Development Center of Japan)	Aki MARUYAMA	Ministry of Foreign Affairs/ Tokyo
May. 25, 2000	"Emissions Trading" Internal Seminar(Jcoal)	Naoki MATSUO	JCoal/Tokyo
Jul. 5, 2000	"Climate Issue" JICA Training(JICA)	Naoki MATSUO	Shonan Village Center/ Hayama
Jul. 24, 2000	"Climate Issue" Capacity Building Seminar(ADB/UNEP)	Naoki MATSUO	ADB/UNEP/Manila/Philippines
Jul. 27, 2000	"Emissions Trading" Internal Seminar(Techno Research (for Industry))	Naoki MATSUO	Techno Research/Tokyo
Aug. 3, 2000	"Emissions Trading" Internal Seminar(Mitsubishi Heavy Industry)	Naoki MATSUO	Mitsubishi Heavy Industry/ Tokyo
Sep. 19-27, 2000	"GHG Inventories for the Land Use Change and Forestry (LUCF) Sector in Southeast Asia: Status and Strategies to Improve Estimates" Expert consultation on verification of country level carbon stocks and echanges(Food and Agriculture (FAO))	Damasa. B. MAGCALE-MACANDOG	FAO/Rome/Italy
Oct. 6, 2000	"Emissions Trading" Internal Seminar(Institute of Energy Economics, Japan)	Naoki MATSUO	Institute of Energy Economics, Japan/Tokyo
Oct. 10, 2000	"Climate Issue" Energy Conservation Center Capacity Building Seminar for EIT Policy-Makers (Energy Conservation Center)	Naoki MATSUO	Energy Conservation Center / Tokyo
Oct. 11, 2000	"Emissions Trading" Internal Seminar(Osaka Univ. Ecosoc Inst.)	Naoki MATSUO	Osaka Univ. Ecosoc Inst./ Tokyo
Oct. 26, 2000	"Emissions Trading" Lecture for Electric Utilities, Long-Term Planning Division Directors(Meeting for Electric Utilities, Long-Term Planning Division Directors)	Naoki MATSUO	TEPCO/Tokyo
Nov. 6, 2000	"Emissions Trading" Internal Seminar(Keio University Policy-Media Department)	Naoki MATSUO	Keio Univ. Policy-Media Department/Tokyo
Nov. 8, 2000	"Improving Estimates of C Stocks Under Different Fallow Systems in Tropical Asia" Fallow Management Symposium during the Annual Meeting of the American Society of Agronomy(American Society of Agronomy)	Damasa. B. MAGCALE-MACANDOG	American Society of Agronomy/Minneapolis/ U.S.A.
Nov. 20, 2000	"Financial Flows related to Climate Change Mitigation" Nishioka Seminar(Nishioka Seminar,Graduate school, Keio University)	Aki MARUYAMA	Keio Univ./Fujisawa
Nov. 28, 2000	"Emissions Trading" Internal Seminar(Tokyo Sci. University Management Engineering Dept.)	Naoki MATSUO	Tokyo Sci. Univ. Management Engineering Dept./Tokyo
Nov. 29, 2000	"Emissions Trading" Internal Seminar(Sumitomo Corp)	Naoki MATSUO	Sumitomo Corp/Tokyo
Dec. 3, 2000	"Effectiveness and Issues of Economic Incentive Policy Measures in Developing Countries: The Cases of Indian Wind Energy Policy and Its Implication for Development Assistance" 11th Meeting of The Japan Society for International Development(The Japan Society for International Development)	Aki MARUYAMA	Takushoku University/Tokyo
Dec. 6, 2000	"Emissions Trading" Internal Seminar(Keizai Doyukai)	Naoki MATSUO	Keizai Doyukai/Tokyo
Dec. 15, 2000	"Emissions Trading" Internal Seminar(Osaka Gas)	Naoki MATSUO	Osaka Gas/Tokyo
Dec. 18, 2000	"Emissions Trading" Internal Seminar(Japan Natural Energy Corp)	Naoki MATSUO	Japan Natural Energy Corp/ Tokyo

Dec. 22, 2000	"Emissions Trading" Internal Seminar(Institute for Energy Technology)	Naoki MATSUO	Institute for Energy Technology/Tokyo
Feb. 1, 2001	"CDM: In Search of Effective Implementation" Regional Workshop on Climate Change: The Challenges and Opportunities(Chulalongkorn University,NED and Ministry of Science, Technology and Environment of Thai government)	Aki MARUYAMA	Siam Intercontinental/ Bangkok/Thailand
Mar. 15, 2001	"Issues in Financing Mitigation Projects in China" International Workshop on Social-Economy Assessment for CDM and Other Mechanisms (ERI, IGES, UCCEE)	Aki MARUYAMA	Xindadu Hotel/Beijing/China

6. Participation in Committees outside of IGES

FY1999

Hosting organization	Name of committee	Participants from IGES	Term of office
Environment Agency of Japan	Committee for Economic Method in Environmental Policies	Naoki MATSUO	The whole year
Environment Agency of Japan	Committee for Int'l Mechanisms in the Kyoto Protocol	Naoki MATSUO	- Mar. 2000
Environment Agency of Japan	Committee for Emissions Trading Design	Naoki MATSUO	The whole year
Environment Agency of Japan	Committee for CDM / JI Baseline	Naoki MATSUO	- Mar. 2000
International Development Center of Japan	Committee for Int'l Economic Cooperation Contributing to Climate Change Mitigation, commissioned by Ministry of Foreign Affairs	Aki MARUYAMA	Jan, 2000 - Mar. 2000
International University	1999 ESENA Project Study Group (Japanese side) member	Aki MARUYAMA	The whole year
Japan Center of Meteorology, JICA	JICA Group Training Course for Abatement of Global Warming, Lecturer (Moderator)	Aki MARUYAMA	Feb. 2000
Japan Institute of Energy	Committee on the Issue of New Technology in Coal Industry for Global Environment, 1999	Aki MARUYAMA	The whole year
Japan Weather Association, JICA	Lecturer for the "Climate Change Issues" in the JICA Group Training of Fiscal Year 1999	Aki MARUYAMA	- Feb.1, 2000
Ministry of International Trade and Indsutry (MITI)	Committee for Economic Measures	Naoki MATSUO	The whole year
MITI, New Energy and Industrial Technology Development (NEDO)	Study Group for the Baseline Issues	Naoki MATSUO	The whole year
Mitsubishi Research Institute	Committee for Accounting Method of Sink, 1999	Aki MARUYAMA	The whole year
Renewable Energy Promoting Peoples Forum	REPP Assessment Committee	Naoki MATSUO	The whole year
Research Institute of Innovative Technology for the Earth (RITE)	Working Group A of New Earth 21 Program	Naoki MATSUO	The whole year
RITE	IPCC Working Group III Internal Committee	Naoki MATSUO	The whole year

FY2000

Hosting organization	Name of committee	Participants from IGES	Term of office
Environment Agency of Japan	Working Group on Baseline Setting for CDM	Naoki MATSUO	The whole year
Environment Agency of Japan	Working Group on Economical Instruments for Environmental Policy	Naoki MATSUO	-Jun. 2000
Environment Agency of Japan	Working Group on Environmental Taxation	Naoki MATSUO	Jul. 2000
Forestry Agency	Greening Promotion Committee	Naoki MATSUO	The whole year
GISPRI	Certification Committee on Kyoto Flexible Mechanisms	Naoki MATSUO	The whole year
GISPRI	Emissions trading Experiment Group	Naoki MATSUO	The whole year
GISPRI	IPCC Synthesis Report Meeting	Naoki MATSUO	The whole year
GISPRI	IPCC WG III Internal Committee	Naoki MATSUO	The whole year
Japan center of meteorology, JICA	JICA Group Training Course for Abatement of Global Warming, Lecturer (moderator)	Aki MARUYAMA	Feb. 2001
Mitsubishi Research Institute	Study Group on Carbon Finance	Aki MARUYAMA	Sep. 2000-Mar. 2001
RITE	IPCC WG III Internal Committee	Naoki MATSUO	The whole year
RITE	Working Group A of New Earth 21 Program	Naoki MATSUO	The whole year
The World Bank	Study Team Member of "Policy Recommendation to State Development Planning Commission Supporting the Deployment of Clean Coal Technologies in China"	Aki MARUYAMA	Oct. 2000-Mar. 2001

7. Field studies

None

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<Climate Change Project>

Published by Institute for Global Environmental Strategies, March 2001
Editor: Shinichi Arai
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