Systems Analysis Group

Toward Post-Kyoto Regime

1. Introduction

International frameworks on climate change beyond 2012—the Post-Kyoto Regime—have been discussed extensively. In the COP13 (13th Conference of Parties) to the UNFCCC (UN Framework Convention on Climate Change) in December 2007, a decision was taken to establish a new Ad-hoc Working Group (AWG) comprising all the UNFCCC members for discussion on the framework to be implemented after 2012 and to complete its work in 2009. The framework should provide real benefits not only at the global level but also at the country level.

This paper reports our studies on the desirable long-term global targets for the reduction of greenhouse gas (GHG) emissions, the targets and actions for the reduction of regional emissions, and the sectoral approach, which have been focused upon by the AWG.

2. Toward global agreement on long-term stabilization of GHG concentrations

Article 2 of UNFCCC stipulated "to achieve […] the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The UNFCCC did not decide the specific levels for achieving climate stabilization.

Combating global warming entails a long-term approach, the development and diffusion of innovative technologies for energy saving and low carbon emissions, and drastic changes in social systems. However, these require a long time period. The global sharing of clear long-term targets on global warming will lead to strategic developments and the diffusion of technologies and changes in social systems.

With regard to the long-term targets on global warming, the EU has consistently asserted since 1996 that the global mean temperature should not exceed 2℃ as compared to the preindustrial level. The Japanese government has presented the first long-term strategy on global warming, which aims to "halve greenhouse gas emissions by 2050 relative to the current levels." The G8 Summit in Heiligendamm has agreed on a policy agenda to "consider seriously" the decisions that include at least the halving of global emissions by 2050. However, a global agreement on the concrete long-term targets for the reduction of global emissions is expected to be difficult to be reached in the new AWG. We have conducted a project called PHOENIX (Pathways toward Harmony of Environment, Natural Resources and Industry Complex) during the period from FY 2002 to FY 2006. The project has confirmed several important findings on the global long-term targets with regard to global warming.

Although we recognized the importance of desirable concrete long-term targets for climate stabilization, surprisingly, there were few studies that determined the desirable levels of stabilization through comprehensive analyses and evaluations of the various damages of and the mitigations on global warming. Because of the limitations on resources potentials, considerations on the target levels of CO_2 stabilization should assess the desirable levels in view of the optimal allocations for each resource for the mitigation of global warming; such an assessment should be based on a comprehensive cost-benefit analysis of the costs required for the achievement of each target level and the benefits obtained from the achievement. The determination of the long-term target of CO_2 stabilization also requires value judgments such as the judgment of the allowable level of precaution for warming damages because of relative comparisons between the warming impact events, equity between future generations, and uncertainties in the warming damages. The usual cost-benefit analysis has a limitation. The procedure in the PHOENIX project was as follows. Firstly, the project performed a quantitative analysis and evaluations of warming damages (including increases in the temperature and sea level), agricultural products, human health, terrestrial biodiversity, ocean thermohaline circulation, water resources, etc. and mitigation costs for each CO_2 stabilization pathway (650, 550, and 450 ppmv stabilization); subsequently, a judgment process was performed by experts on the basis of the results of the evaluation of the damages and mitigations. Figure 1 shows the results of the evaluations on global warming by considering distinctions between the scientific evaluations and the value judgments.

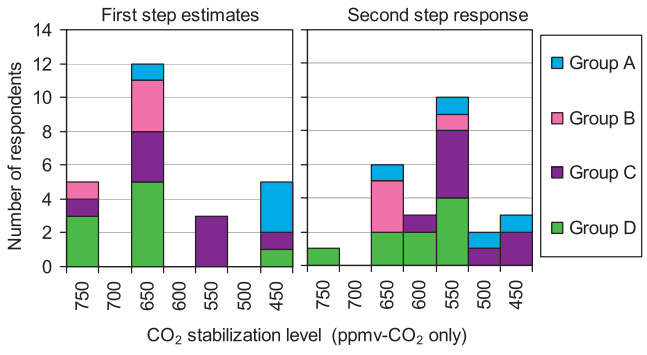

Fig. 1 Desirable CO_2 stabilization levels evaluated in the PHOENIX project

The first step is to obtain quantitative evaluations on the basis of the cost-benefit analysis of impacts on the five factors—sea level rise, agricultural products, human health, terrestrial biodiversity, and ocean thermohaline circulation—and mitigation costs. From the result of the first step, the most desirable level of stabilization obtained by the experts is 650 ppmv (CO_2 only). The second step is to obtain the expert judgments on the desirable level of stabilization by providing all these evaluation results on impacts and mitigation costs and their own preliminary judgments obtained in the first step. From the result of the second step, the average of the desirable level of stabilization obtained by the experts is 550 ppmv (CO_2 only).

At the same time, the real achievement of the long-term targets require the emission reduction agreements to be signed by not only the developed countries but also the developing countries associated with high GHG emissions. Therefore, the targets also seriously consider the acceptability of the commitments of the developing countries. For example, with regard to the target of halving global emissions in 2050 relative to the emissions in 2000, both the developed and developing countries have the same reduction rates of CO_2 emissions from the BaU (Business as Usual) case in which the developed countries have a 60-70% reduction in emissions relative to the emissions in 2000, as shown in Figure 2. In the same case, even when the developed countries achieve zero emissions relative to the BaU emissions, the developing countries have to achieve an approximately 60% reduction relative to the BaU emissions. The results indicate that it is difficult to achieve this level of global emissions. The global target in the case of the 550 ppmv CO_2 stabilization case (corresponding to an approximately +35% increase in global CO_2 emissions in 2050 relative to the emissions in 2000) can easily be agreed to by all the countries because the target has the acceptable concept of burden sharing on the basis of the principle of "common but differentiated responsibility."

These studies provide useful information on the agreements resulting from international negotiations on the long-term targets relating to climate changes.

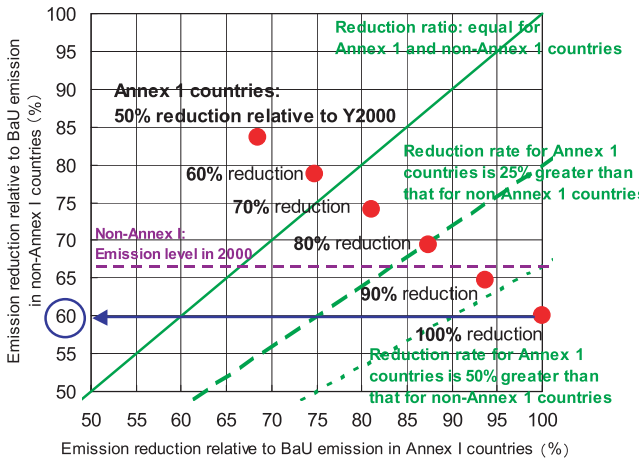

Fig. 2 Burden sharing of the reduction in CO_2 emissions in 2050 relative to 2000 between developed and developing countries

3. Propositions of the middle-term targets and international framework: Sectoral approach

Following the agreements on the long-term global targets on GHG emissions, the middle-term target around 2020 and the international framework to achieve it should be discussed in the new AWG. These discussions require the sectoral approach. Although the sectoral approach has an unclear definition and multiple interpretations, it has the following four advantages:

1) High availability because of the global implementation of the policies for concrete actions on the reduction of GHG emissions.
2) High capability to pursue technological developments, including relatively stringent targets, because of the technological targets in the sector levels.
3) Considerable satisfaction or equity for most of the countries despite stringent reductions in the emissions because of the technological targets in the sector levels.
4) High capability to construct a framework to ensure participation from many countries because of the reasonable harmony with the "pledge and review approach"; this approach allows countries to set individual targets and action plans to decrease CO_2 emissions coupled with a review system.

The achievement of large reductions in CO_2 emissions requires all the above advantages. By the adoption of the sectoral approach, Japan can take the lead in combating global warming because of having "manufacturings" by using technologies with high energy efficiencies and energy-saving products. Therefore, the international framework should focus

on the sectoral approach. However, it was difficult to comprehensively estimate the net effect of the sectoral approach on the reduction in CO_2 emissions, and there were few studies on the sectoral approach. The Systems Analysis Group developed the DNE21+ model that models various technologies for the emission reductions by employing the bottom-up approach; we also analyzed and evaluated the sectoral approach for an international framework by using the DNE21+ model.

Figure 3 shows an example of a comparison of the regional energy efficiencies in the year 2000, which is the base for evaluations with the sectoral approach. The figure is based on various statistical and technological data. Based on such bottom-up data, we have developed the DNE21+ model that can evaluate the regional and sectoral reduction potentials in the future. From the result, Japan is observed to have high energy efficiencies in the iron and steel and cement sectors. Figure 4 shows an example of the evaluations of the effects of reductions in global emissions in the case of the achievement of the intensity targets (benchmarks) for each sector. The result of the evaluations indicates the significant effects of the intensity targets on emission reductions. This approach has a relatively high satisfaction level (equity), high capability for ensuring the participation of many countries, and realistic targets. Thus, studies of the Systems Analysis Group strongly support the framework of the post-Kyoto Regime and the practical targets on the basis of a scientific analysis.

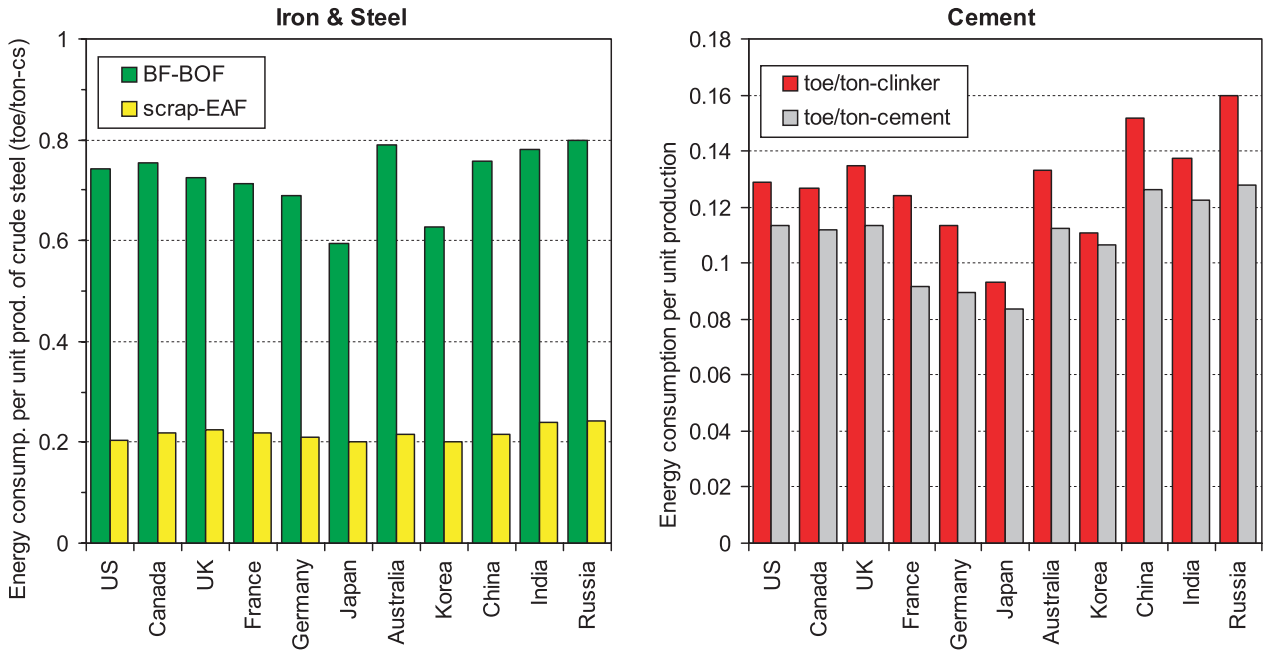

Fig. 3 Comparisons of regional energy efficiencies in iron and steel and cement sectors in the year 2000 (example)

Note: Energy consumption equivalent of electricity is assumed as follows: 1TWh = 0.086/0.33 Mtoe.
The energy consumption of the waste is excluded in the figure.

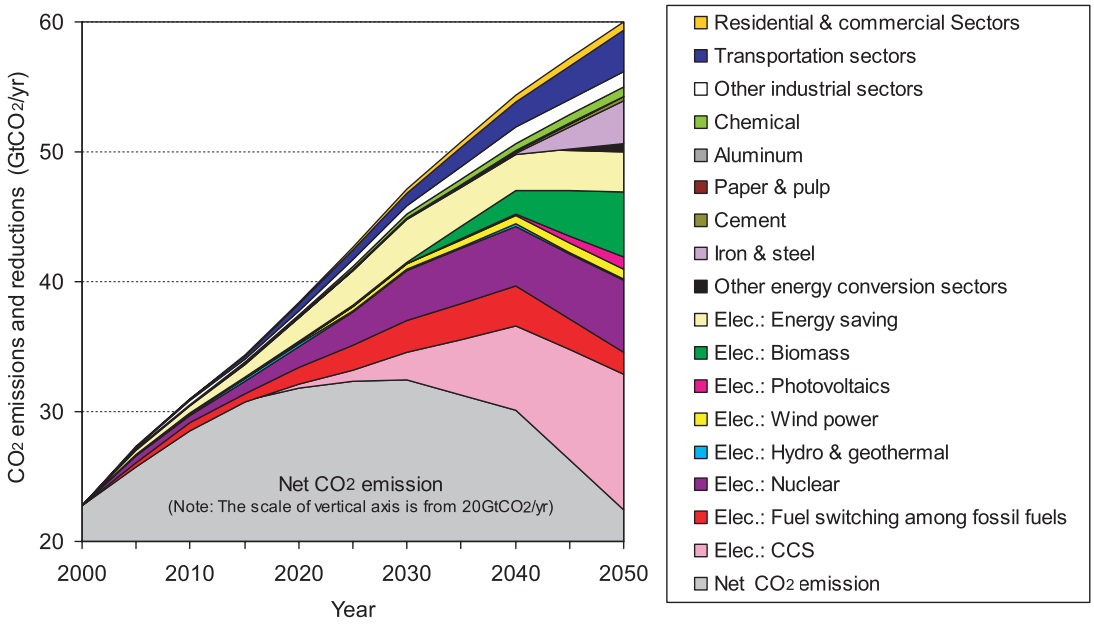

Fig. 4 Effects of reduction in CO_2 emissions on achievement of sectoral intensity targets (example)

Note: This target is that the energy supply and demand sectors can achieve the targeted intensities of CO_2 emission and energy, respectively. In this simulation study, the marginal costs in the region and sector levels are the same.

4. Conclusions

The Systems Analysis Group has conducted studies from a scientific viewpoint for supporting the establishment of the post-Kyoto Regime, which is an urgent global issue. However, the world faces not only the issue of global warming but also many other important issues at the global level. The issue of global warming is one of the significant factors preventing the achievement of a sustainable society. We should deal with this issue in a large context in order to achieve a sustainable society and consider the synergy effects between policies on global warming and a sustainable society; otherwise, we cannot win the long-term fight against global warming. Therefore, in FY 2007, the Systems Analysis Group undertook a new project on sustainable society and climate stabilization, which is called ALPS (Alternative Pathways toward Sustainable Development and Climate Stabilization). The purpose of this project is to develop several descriptive scenarios on a sustainable society and climate stabilization, carry out quantitative and comprehensive evaluations (including the use of indicators of a sustainable society and global warming), and finally provide policies to achieve both climate stabilization and a sustainable society.

As described above, the Systems Analysis Group is carrying out the analysis and evaluations of global warming by using systematic approaches. Our researches offer to help solve important issues regarding climate policies.