Systems Analysis Group

Development of Scenarios for Sustainable and Effective Measures against Climate Change

1. Introduction

The thirteenth Conference of the Parties (COP 13) took place in December 2007, in Bali, Indonesia and the negotiations resulted in the agreement of a two-year negotiating process, the Bali Roadmap, setting a deadline for the negotiations in Copenhagen to conclude the post 2012 framework on Climate Change. In the COP14 meeting held in Poznan, Poland, it is agreed that the contributions of Annex I parties to the scale of emission reductions should be informed by consideration of, inter alia, the analysis of the mitigation potential, commitment period, base year. In December 2009, the COP 15 was held in Copenhagen, Denmark. The Copenhagen Conference marked the culmination of a two-year negotiating process to enhance international climate change cooperation under the Bali Roadmap, and many world leaders attended the conference. There was concern that negotiations ended up being broken down, but political agreement entitled the "Copenhagen Accord" was taken note in the last minute. This event reminded us of the difficulty to enhanced action and international cooperation on climate change.

As Copenhagen approached most of major countries prepared to propose individual midterm reduction targets, inter alia quantified economy-wide emission targets for 2020. On Wednesday 10th June 2009, the Japanese former Prime Minister Taro Aso announced that Japan will cut greenhouse gas emissions by 15 percent from 2005 levels as its midterm target for 2020. After a change of government, Japan's new leader Yukio Hatoyama of the Democratic Party of Japan (DPJ), announced the revised Japan's mid-term target at the U.N. Climate Change Conference to be held on September 22 in New York. For its mid-term goal, Japan will aim to reduce its emissions by 25% by 2020, if compared to the 1990 level, on condition that a fair and effective international framework is established, in which all major economies participate.

The Systems Analysis Group has been conducting studies on the climate change, which include very complex and a wide range of issues, by using systematic approaches in order to gain a big picture with paying attention details. We've also made efforts to inform the public about our analysis correctly and contributed to the decision making process on setting midterm target in Japan as mentioned above by providing our scientific and rational research results.

In this paper, we would like to introduce our major analysis and their implications as a report of our research activities.

2. International comparisons of energy efficiency

Long term and global wide perspectives are essential to reduce carbon dioxide emissions steadily. There is usually a time lag between climate change and carbon dioxide emissions through human activities, addressing climate change with the long time scale is indispensable. Even if focusing on CO_2 reducing masseuses, plants and facilities for power sectors and energy-intensive industries usually have long lifetime, it is quite difficult to make a deep cut in the short or medium term, which leads to involve huge cost to achieve deeper cut. The changing global climate poses profound challenges to us. We need to take into consideration the timing of technological development and its implementation in order to reduce emissions effectively.

A global perspective is also crucial. There are huge gaps in energy efficiency across countries as shown in Figure 1. Countries with low energy efficiency are relatively easy to improve energy efficiency and have larger CO_2 emission reduction potentials. Taking effective measures with global perspective is necessary to fully realize emission reductions. Note that Figure 1 shows economy wide energy efficiency in aggregate form, so specific characteristics of national economy, such as industrial structure, are not considered. Manufacturing industries consume larger quantities of energy than non-manufacturing industries. Therefore, energy efficiency of a country like Japan with higher ratio of manufacturing in its economy may be biased.

Technology based efficiency is more significant to implement effective measures against global warming. To this end, precise assessment of energy efficiency on the basis of sector or even technology is necessary. We need detailed date for this analysis but international statistics is not necessarily well developed. Alternatively, better understanding of each sector helps our fair assessment of energy efficiency. Figure 2 shows energy efficiency in iron and steel sector across the countries. This results show Japanese steel sector is the most efficient in energy use. Most of countries, including China and India, have improved efficiency between 2000 and 2005 while some countries like Russia have became less efficient. This figure implies that there is still a lot of potential to reduce CO_2 emission globally through international technology cooperation.

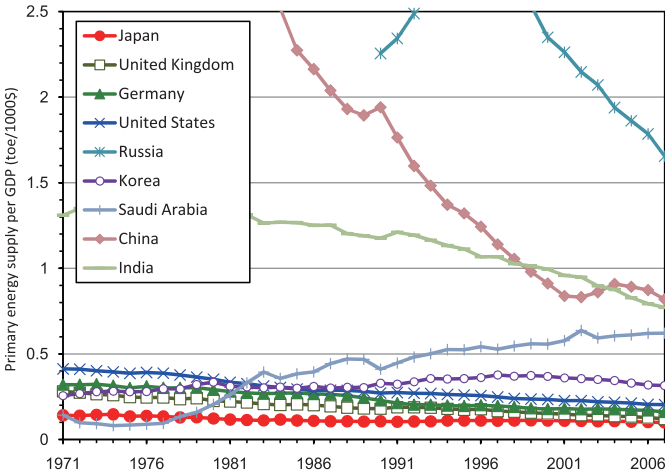

Figure 1 Energy efficiency by country

(Source) IEA Statistics

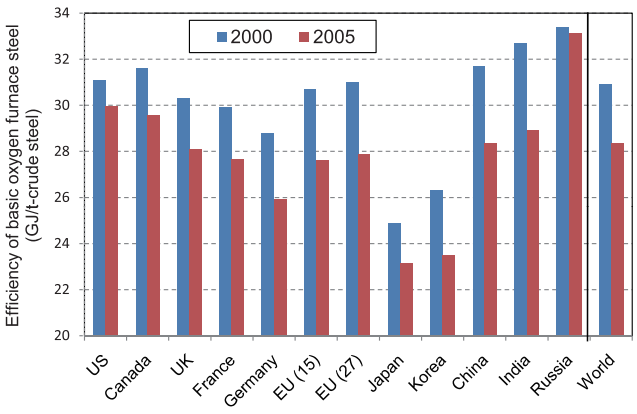

Figure 2 Energy Efficiency in the Iron and Steel sector (BF-BOF process), 2000 and 2005

(Source) RITE

3. Assessment / Analysis of Japan's midterm target and emission reduction targets around the world

The Systems Analysis Group has developed the high resolution DNE21+ model, in which various technologies to reduce CO_2 emissions in each sector are included. This model enables us to analyze emission reduction measures backed by technological practicability. This model is also capable of estimating mitigation costs on a global basis, which allows us to compare emission reduction target of each country. Our modeling results offer the basic data necessary for climate change negotiations domestically as well as internationally.

The Japanese government announced that by 2020 Japan will try to cut greenhouse gas emissions by 15 percent from 2005 levels as the midterm target. Overseas emission credits and the sink through forest sink were not counted in this target, which was supposed to achieve only domestic efforts. Incumbent prime minister Yukio Hatoyama of the DPJ announced the revised Japan's mid-term target to reduce its emissions by 25% by 2020, if compared to the 1990 level, on condition that a fair and effective international framework is established, in which all major economies participate. Overseas emission credits and the sink through forest sink are counted in this target. Note that we cannot make a simple comparison between these two targets because their assumptions are different. Comparatively speaking with the Kyoto's 2010 target, the former one reducing GHG emissions 15% below 2005 level (8% below 1990 level) should be compared with the figure of 0.6% below 1990 level (official target) or 3% above 1990 level (count out purchased emission credits by private sector). On the other hand, the latter target to reduce emissions by 25% below 1990 level should be compared with the Kyoto target, -6% for Japan. (Figure 3)

In any case, it is vital that we recognize how much it cost to achieve these goals and put them in a proper perspective in the context of global fairness and equitability. As a member of a team to investigate their validity for the government, RITE engaged with the project.

Figure 4 shows the marginal abatement cost (MAC) curves derived from the RITE model. The least cost solution involves implementation of all the measures at a price below the marginal cost shown in Figure 4. Given that Japan is an energy efficient country and the United States has large reduction potential partly because they are currently operating a lot of low efficient coal power plant, the shape of MAC curves are totally different, which imply Japan has less mitigation potential compared to the United States and the EU with the same cost.

If Japan try to achieve a target of 25% emission reduction below 1990 level in 2020 with only domestic efforts, the marginal abatement cost is estimated to be 476$/$tCO_2$, almost 10 times as much as the costs for the EU or the United States to achieve their respective targets. This huge cost gap will incur financial outflow from Japan not only to developing countries but also to the EU and the United Stated in order to purchase emission credits under the Kyoto mechanism. It also implies carbon leakage will occur, which does not to contribute to CO_2 emission reduction of the world as a whole.

All countries, at least all major developed economies, should make the same level of efforts to realize steady emission reduction in Japan and to contribute to global-wide emission reduction. Japan's salient target may be inappropriate from the global perspective. In addition to that, major emitters, even major developing country emitters, should have effective mitigation targets to some extent. Otherwise, we cannot ensure long-term sustainable efforts to combat climate change. Table 1 shows emission reduction targets, marginal abatement costs, and abatement costs per GDP of major countries pledged before the COP15 with baseline adjustment. In the "Copenhagen Accord", Annex I Parties are requested to sub-

mit individually or jointly the quantified economy-wide emissions targets for 2020 and Non-Annex I Parties are requested to submit their mitigation actions. Promotion of having ambitious targets for all Annex I countries and establishment a fair and effective international framework would be imperative to achieve the 25% emissions reduction target of Japan.

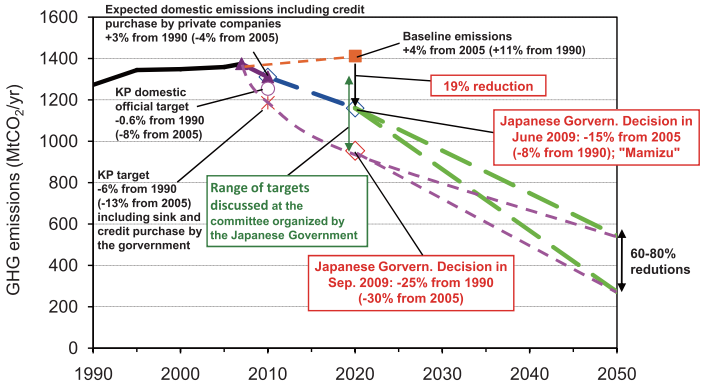

Figure 3 Mid- and Long-term Emission in Japan

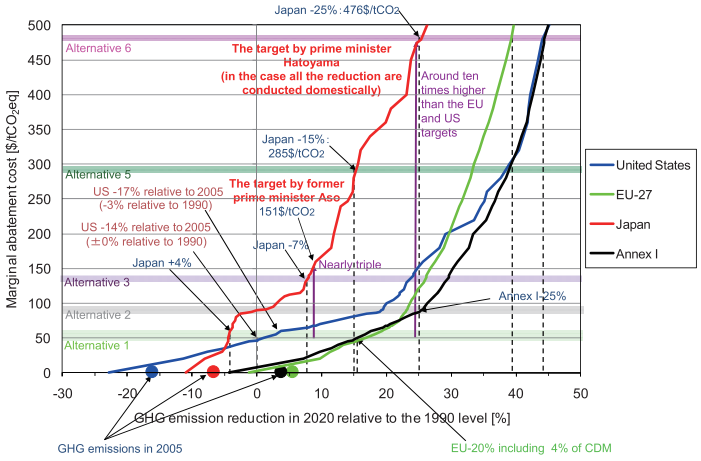

Figure 4 Marginal Abatement Cost Curve by country, 2020

(Source) RITE

Marginal Abatement Cost: Relationships between tons of emissions abated and the CO_2 price. A Metric of costs of complying with the target for reducing greenhouse gases.

4. For sustainable and effective measures against climate change

We only have ten years left by the year 2020. Within the time span, we need to implement existing technologies more widely and make steady development for innovative technologies. We have, however, various options to reduce GHG emissions in the long run. It would be possible to make deeper cut if we could enhance the solidarity of the international community over the issue of global warming. In conclusion, we would like to suggest three important points for sustainable and effective measures against climate change. First, a collaborative relationship among industry, government and academia and international cooperation would be essential to accelerate RD&D for innovative technologies, which drastically reduce cost and emissions. Second, we need to integrate various technologies, social infrastructure and social system, so that we can reduce costs substantially in a systematic manner. Our challenges are not limited to global warming, so we need to link climate change issues to other challenges in order to produce a better solution for maximizing social welfare. Finally, we need to change our society into an environmentally sustainable one in which measures taken against climate change could increase the utility of consumers, fostering greater environmental awareness. For this purpose, not only environmental education but also steady economic growth is crucial.

The Systems Analysis Group intends to continue precise analysis and review on measures to reduce carbon emissions, and would like to propose truly effective policy and measures for society against global warming, so that our research could help solve the problem confronting humankind ultimately.

Table 1 Mid-term Targets by country

	Target	Target relative to 1990	Target relative to 2005	Marginal abatement cost [$/tCO$_2$]	Per-GDP Cost [%]
Japan	-25% relative to 1990	-25%	-30%	476	1.13
EU	-20% – -30% relative to 1990	-20% – -30%	-14%– -25%	48–135	0.08–0.26
United States	-17% relative to 2005	-3%	-17%	60	0.29
Canada	-20% relative to 2006	-3%	-22%	111	0.43
Australia	-5% – -25% relative to 2000	+13% – -11%	-11% – -30%	45–92	0.19–0.58
Russia	-20% – -25% relative to 1990	-20% – -25%	+17% – +25%	<$0/tCO$_2$ (Hot air)	
Annex I total[*1]		-13% – -18%	-9% – -14%	41–61	0.07–0.15
cf. Mitigation costs for –25% relative to 1990 in Annex I total	*-25% relative to 1990*	*-25%*	*-22%*	*88*[*2]	*0.38*[*3]
Korea	-4% relative to 2005	+80%	-4%	21	0.16
China[*4]	-40% – -45% for per-GDP emission relative to 2005	+327% – +366%	+105% – +88%	<0 (Hot air) – 3	<0 (Hot air)– 0.07
India[*5]	-20% – -25% for per-GDP emission relative to 2005	+344% – +373%	+142% – +127%	<$0/tCO$_2$ (Hot air)	

[Notes for Table 1]

*1 Any target for aggregated Annex I countries is not proposed, but it is estimated here by aggregating the targets of countries in Annex I. The marginal abatement cost and the per-GDP cost are estimated assuming that the least cost measures are taken over the aggregated Annex I countries.

*2 The marginal abatement cost is estimated assuming the least cost measures over the aggregated Annex I countries, that is, the marginal costs are equal among all Annex I countries.

*3 The per-GDP costs are conditioned to be equal among all Annex I countries.

*4, *5 The targets of China and India are declared to be only for energy-related CO_2 emissions, and therefore, the estimation was considered accordingly.