

# Analysis of the Kyoto Mechanisms by the AIM Model

M. Kainuma\*, Y. Matsuoka\*\*, T. Morita\*,  
X. Hu\*\*\*, and K. Jiang\*\*\*

\* National Institute for Environmental Studies

\*\* Kyoto University

\*\*\* Center for Energy, Environment and Climate Change, Energy Research Institute, China

Global climate change has become one of the key issues of global environment that has attracted many attentions both domestically and internationally in many countries, especially in the Asian-Pacific region. It is obvious that the implementation of response measures for global climate change will exert significant impacts on social and economic developments. To promote such countermeasures, it is necessary to predict the amount of greenhouse gases emitted or absorbed by each country and the effects resulting from the introduction of measures to mitigate emissions. In order to predict and make judgments on these issues, the Asia-Pacific Integrated Model (AIM) has been developed by an Asian collaborative project team composed of NIES and Kyoto University of Japan, and seven research Institutes of China, India, Korea and Indonesia.

The AIM is a large-scale computer simulation model for scenario analyses of greenhouse gas emissions and the impacts of global warming in the Asia-Pacific region. The AIM model consists of a greenhouse gas emission model, a climate change model and an impact model. This model is used to forecast the CO<sub>2</sub> emissions in the Asia region and to analyze the effects of policy measures to mitigate them.

## **Japanese CO<sub>2</sub> emission forecasts and reduction potentials**

Figure 1 shows Japanese CO<sub>2</sub> emission projections based on four kinds of mechanisms for introducing technologies: frozen, market, carbon tax, and carbon tax plus subsidy cases. The frozen case means that the share of technologies is fixed at 1998 level and new technologies will not be introduced into the market. CO<sub>2</sub> emissions will increase by 18% compared to the 1990 level by the year 2010 in the frozen case. The introduction of new technologies is anticipated.

The market case means the cheapest technology spreads based on the market

mechanism. In this case, CO<sub>2</sub> emissions will increase by 10% by the year 2010. Even if the energy-saving technologies are somewhat expensive, the spread of these technologies will proceed because it is possible to recover the costs through fuel savings in a short period of time.

In either case, if no special countermeasures occur such as government intervention, the amount of CO<sub>2</sub> emissions will continue to increase. Quick action is necessary to stabilize and reduce CO<sub>2</sub> emissions.

The carbon tax case assumes 30,000 yen per ton of carbon tax to promote the introduction of energy-saving technologies and the carbon tax plus subsidy case assumes 3,000 yen per ton of carbon tax and the tax is to be returned to companies and households in the form of subsidies for introducing energy-saving and recycling technologies. In these cases the emission is reduced by 2.5% by the year 2010.

Figure 2 shows the changes in CO<sub>2</sub> emissions in 2010 compared to the 1990 levels. A large reduction can be expected in the industrial and residential sectors, but it is very difficult to reduce emissions in the transportation sector. To achieve the Kyoto Protocol targets, further policies are necessary such as promoting new transportation system, modal shift, and energy-saving lifestyle, and utilization of the Kyoto mechanisms.

### **The analysis to achieve the Kyoto target**

During the Kyoto conference, three mechanisms for international cooperation on global climate change issues had been presented as Emission Trading (ET), Joint Implementation (JI) and Clean Development Mechanism (CDM). Effective international cooperation may help us find a way out to fight against the global climate change issues more efficiently, economically and fairly.

Figure 3 shows marginal costs to achieve the Kyoto Protocol at 2010 domestically and by emission trading. Japanese marginal cost in the no trading case is 234\$, while the marginal cost in the Annex I trading case and the global trading case are 65\$ and 38\$, respectively in 2010. The marginal costs in the trading cases are significantly lower than those in the no trading case. Although the costs to reduce CO<sub>2</sub> emissions will be decreased in the trading cases, there are several problems. One problem

concerns the so-called “hot-air” issue. This refers to the possibility that some Annex I countries might meet the Kyoto targets without any domestic action at all. In this case they would be able to sell their surplus emission allowance (hot air) without incurring any abatement cost. Another problem is the issue of carbon leakage. About 8.5% leakage is observed in the no trading case.

CDM is also an effective way to reduce global emissions. Figure 4 shows emission intensity of CO<sub>2</sub> in 2025 in China. The emission in China was 863 Million ton carbon in 1996 and is expected to increase 1.8 times through 2010. Figure 5 shows CO<sub>2</sub> emission reduction potential by introducing energy saving technologies in China in 2010. Large amount of reductions can be achieved if energy-saving technologies are introduced effectively.

If efforts are made to reduce CO<sub>2</sub> emissions even further than as mandated by the Kyoto Protocol, the necessary costs will certainly become larger. These are costs that corporations and households will have to bear. On the other hand, there will be an increase in effective demand for producers of energy-saving technologies. There is a high possibility that the indirect cost will be extremely small through energized environmental industries. The business opportunities for environmental industries will also increase as projects to reduce CO<sub>2</sub> emission jointly with developing countries are implemented. Earlier investment in environmental industries will reduce the total cost in the long term.

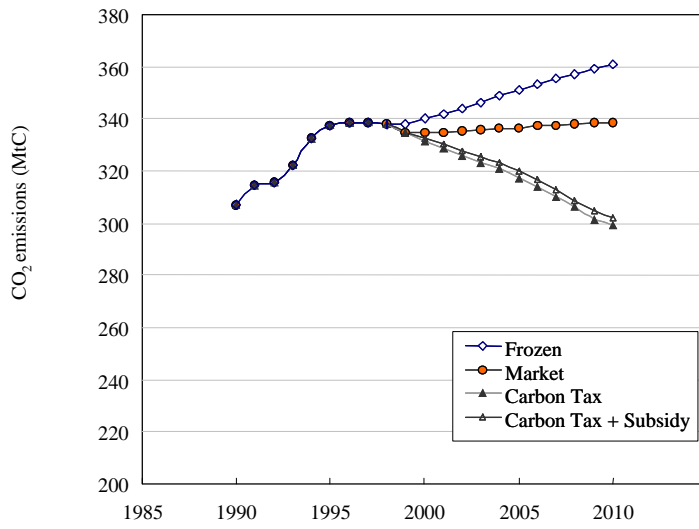


Fig. 1 CO<sub>2</sub> emission projections in Japan

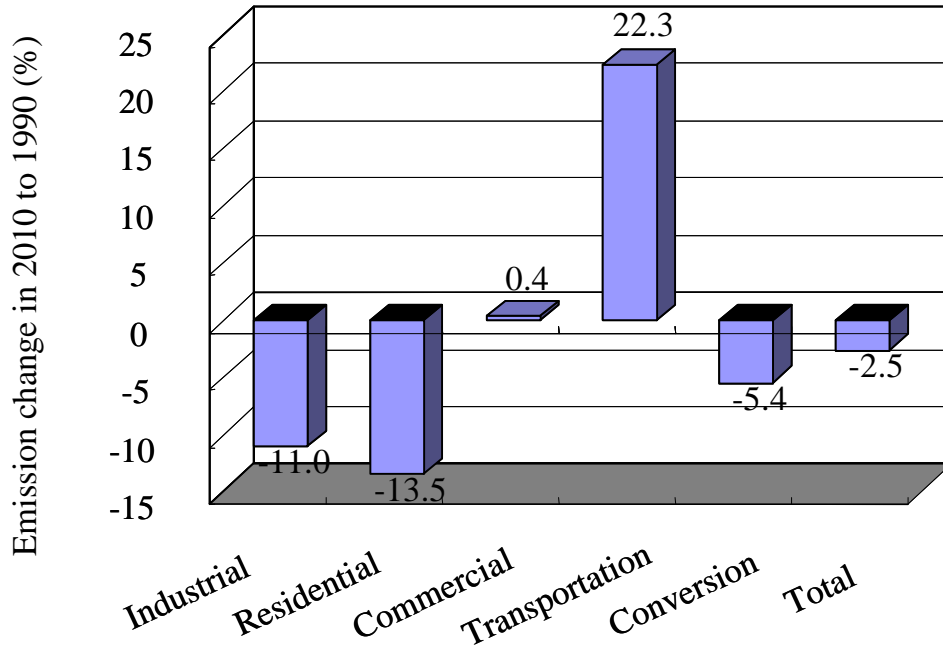


Fig. 2 Change of Japanese CO<sub>2</sub> emissions in 2010 to 1990 level (Carbon tax case)

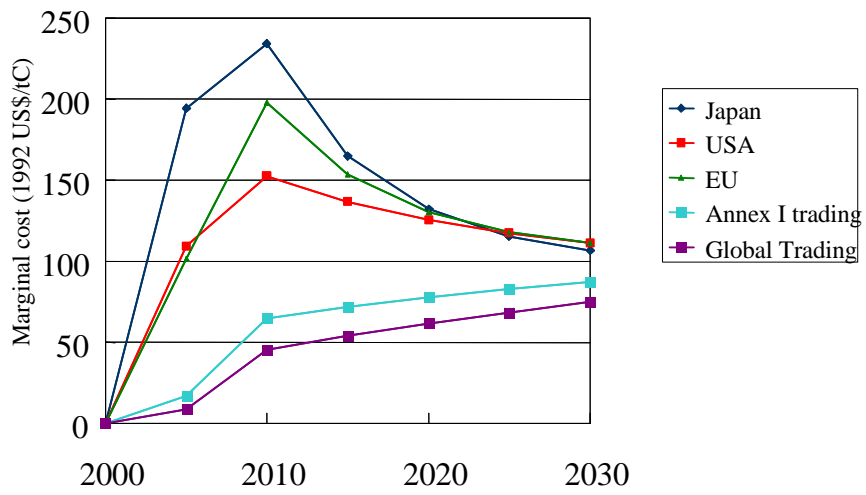


Fig. 3 Emission right prices

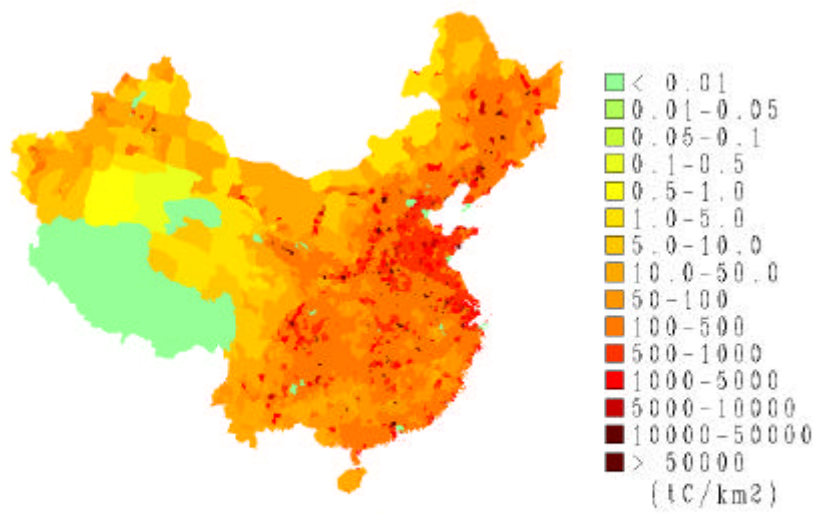


Fig. 4 Emission Intensity of CO<sub>2</sub> in 2025, High Growth scenario C-B

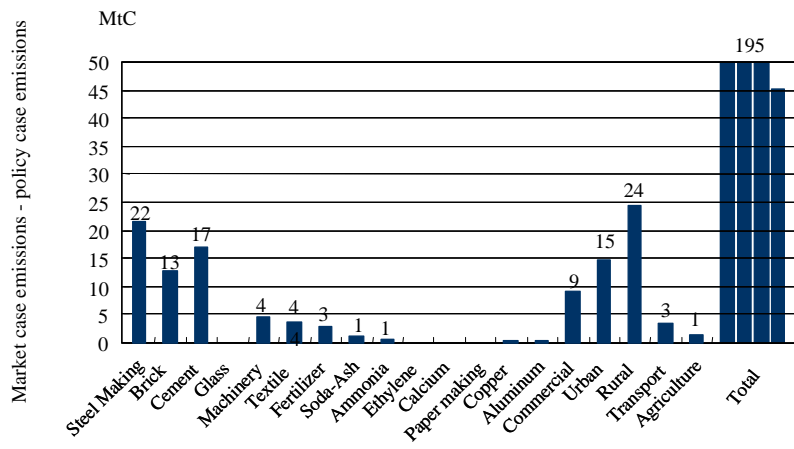


Fig 5 CO<sub>2</sub> emission reduction potential in China in 2010