

## **Policy Integration in Developing Countries**

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### **Abstract**

The purpose of this paper is to develop the idea of integrating global environmental policies with local ones in developing countries. We discuss the concepts of policy integrations and possible barriers to encouraging international joint activities in this sense. Also, a specific program of Japan to pursue policy integration is given as an example. We apply this new paradigm to the Korean case in which various scenarios are set up to measure CO<sub>2</sub> and SO<sub>2</sub> emission reductions in steel and cement industries, and residential sector, to show the benefit of policy integration. In Korea the issues of global warming as well as acid rain are matters, countermeasures against the local air pollution and global environmental issues at the same time, are considered as the most serious problem, just like other developing countries.

In conclusion, we point out the following. First of all, to understand the situations of developing countries, to identify the possible barriers and solve the problems is important more than anything else. In a practical manner, developed countries must provide developing countries analysis tools for evaluating the policy integration measures. Second, try to find possible areas of international joint activities in order to realize that global environmental policies are, in the long run, helpful to find the solutions of local environmental problems. Third, to share the experience of developed countries efforts on both global and local policies in accordance with the private sector.

### **1. Introduction**

It seems to me that the global warming issue has become one of the key international agenda. However, at the same time, this issue is one of most difficult problems for developing countries to solve. Most of developing countries now face how to sustain development and preserve environment simultaneously. A new paradigm of local and global environmental policy integration has been developed to answer this question.

The purpose of this paper is to develop the idea of integrating global environmental policies with local ones in developing countries. In section 2, we discuss the concepts of policy integrations and the possible barriers to encourage international joint activities in this sense. Also, a specific program of Japan to pursue policy integration is given as an example. In section 3, we apply this new paradigm to Korean case in which various scenarios are set up to measure CO<sub>2</sub> and SO<sub>2</sub> emission reductions in the steel and cement industries, and residential sector, to show the benefit of policy integration. In Korea the issues of global warming as well as acid rain are matters, countermeasures against the local air pollution and global environmental issues at the same time, are considered as the most serious problem, just like other developing countries. Section 4 is for concluding remarks.

## **2. Policy Integration**

### **2.1. Concept**

Since the global and local environmental problems are intertwined, it is quite important and necessary to figure out these problems on the same basis, integrating relevant policies. Especially, most developing countries where local environmental issues seem to be more urgent and serious, may have better opportunity to meet both goals at the same time.

If both developed and developing countries could cooperate on global environmental problems, both would considerably reduce their abatement costs. In other words, the framework of international joint implementation will continue to develop as the demand for this kind of cooperation grows. Once a common understanding of global issues on a mutual basis exists, then the next step is to take advantage of this framework immediately in implementing local environmental policies for developing countries (where local and domestic environmental issues are more sensitive and seriously considered than global ones).

If international cooperation targeting mitigation of CO<sub>2</sub> emissions was linked with policy measures taken by developing countries to reduce SO<sub>x</sub>, NO<sub>x</sub> and other pollutant emissions, it would clearly be for possible to cut the costs of environment protection and provide better life conditions those countries. However, there are many barriers to overcome for the integration of policies to be realized. First of all, even if most developing countries realize the importance of global warming issues, environmental policies for this matter usually take lower priority. Priority of policies and their implementations are the results of choice sets among policy candidates that seem to be conflicted, through various political, social and economic decision making processes. Hence in those countries, global warming policies take a lower position compared with other urgent ones. Second, the huge burden of financing for implementing global warming policies is also an important factor why the developing countries can not pursue these policies positively. Third, the lack of appropriate technologies cannot be ignored. Obviously weak infrastructure, information network, management skills, rigid institutional structures etc., are major factors to overcome.

Therefore, it is most important to identify the possibilities for international cooperation where both developed and developing countries can attain mutual benefits by doing so. For example, the transfer of technologies to preserve the environment, fostering industries related to environment in developing countries, may be more plausible when both developed and developing countries have the incentives to work together. If both sides can find their common interests in economic and non-economic senses, joint implementation will occur in a practical sense. Obviously the policy makers and NGOs play an important role to make these activities realized. Then, activities to handle both global and local environmental problems will be effective through this international cooperation.

### **2.2. Example**

Under the new paradigm of policy integration, the Environment Agency of Japan (1996) developed a specific program called "Eco-policy linkage", which proposed a set of strategies to implement the concept of policy integration that is described above. In this section, we briefly summarize the proposals of "Eco-policy linkage". According to this program, there are five possible strategies to integrate a country's domestic and local environmental policies with global, regional ones.

#### **(1) Air Pollution Prevention Linked Strategy (AIRS)**

The idea of this strategy is to link the emission controlling policies of developing countries. Most countries take more serious consideration for local air pollution problems rather than

greenhouse gases; therefore, the efforts to reduce SO<sub>x</sub> or NO<sub>x</sub> emissions can be jointly implemented with developed countries to mitigate CO<sub>2</sub> emissions, simultaneously.

**(2) Natural Resource Recovery Linked Strategy (NATS)**

This strategy is to design programs to integrate a developing country's policies for forest management, reforestation, soil recovery, so on, with the international policies for recovering natural resources, mitigating greenhouse gas emissions, and minimizing the damage of global warming. The idea of this strategy is to institute local and regional level of activities to preserve the environment, and link these to international and global ones for the developing countries to sustain development.

**(3) Recycling Promotion Linked Strategy (RECS)**

This strategy is for linking developed countries' recycling policies with international policies for resource development, constructing recycling networks, and stimulating recycling business to conserve global resources. This strategy contains joint international activities for both developed and developing countries.

**(4) Biodiversity Protection Linked Strategy (BIOS)**

The idea of this strategy is to protect biodiversity and natural environments at the global, regional and subregional levels. By doing so, a new concept of tourism can be established in both developed and developing countries, which tries to achieve both biodiversity protection and economic benefits at the same time.

**(5) Water Pollution Prevention Linked Strategy (WATS)**

This strategy is to encourage water quality management in developing countries. Water quality control in rivers and high seas can not be achieved by one country only. The neighbor countries should work together to prevent water pollution. This implies that there are a lot of opportunities for both developed and developing countries to find joint activities. Also, this strategy inevitably requires high technologies, increasing the possibility of technology transfer. In Table 1, on the following page, the five strategies are categorized according to their regional levels and policy types.

### **3. Simulation Results of Policy Integration: The Case of Korea**

In this sector, we try to analyze possible scenarios for the reduction of CO<sub>2</sub> emissions and SO<sub>x</sub> emissions in Korea, as a case of global and local environmental policy integration.

The National Institute for Environmental Studies (NIES) in Japan is developing the Asia Integrated Model (AIM) which covers most Asian countries. AIM is a bottom-up approach to measure the effect of technology selections for mitigating relevant emissions.

The AIM/Korea CO<sub>2</sub> Model and SULFUR Model, revised the CO<sub>2</sub> and SO<sub>2</sub> countermeasures for Korea on the basis of AIM and was used for analyses. Both models can reflect mechanisms of energy saving and fuel substitution on the premise of setting up such detailed conditions as energy effectiveness of relevant technology, possibility of fuel substitution, final energy consumption, energy price, etc.

The sectors analyzed are the steel and cement industry, and the residential sector. In this study, however, we excluded desulfurization facilities from the possible technology selections made, though installment of desulfurization facilities reaching the level of current standard of Japan was introduced from outside of the model. Both models take 1992 as the base year.

Table 1: Potential of Eco-Policy Linkages

Global/ Regional/ Subregional							
	Global	Acid	Eco-tourism	World	World	World	Marine
Policies	Warming	Rain	Development	Nature	Resource	Resource	Pollution
Cuntry/ Local	Abatement	Abatement		Conversion	Development	Recycling	Control
Policies							
Air Pollution Control	X	X					
Biodiversity	X		X	X			
Conservation							
Reforestation	X		X	X	X		
Soil Recovery			X		X		
Food Production					X		
Recycling	X				X	X	
Waste Management	X					X	X
Water Pollution Control							X
Water Resource							
Management						X	

Source: "A Long-term Perspective on Environment and Development in the Asia-Pacific Region", Environment Agency of Japan, 1996.

### 3.1. AIM/KOREA CO<sub>2</sub> Emission Model

In the steel industry, CO<sub>2</sub> emissions in 1992 were 14.5 million tones of carbon, which represented 41% of the total for manufacturing industries and 17% of total CO<sub>2</sub> emissions in Korea. Scenarios are set up as followings: BAU scenario, scenario of carbon tax and subsidy (sc1), scenario of increasing share of electric furnace (sc2), scenario of technology selection for independent power generation (sc3) and scenario of introducing new technology, COREX (sc4).

In the cement industry, CO<sub>2</sub> emissions in 1992 were 9.0 million tones of carbon, which represented 25.4% of those in manufacturing industries and 10% of total CO<sub>2</sub> emissions in Korea. Scenarios are set up as following: BAU scenario, scenario of carbon tax and subsidy (sc1), scenario of increasing share of blast furnace cement (sc2), and scenario of technology selection for independent power generation (sc3).

In the residential sector, CO<sub>2</sub> emissions in 1992 were 18.7 million tones of carbon, which represented about 22% of total CO<sub>2</sub> emissions in Korea. Scenarios are set up as followings: BAU scenario, scenario of carbon tax and subsidy (sc1), scenario of technology selection for insulation and solar heating pumping (sc2), and scenario of extension of payback period (sc3). In each sector, 20,000 Won on (equivalent to about 23US\$) of carbon tax is imposed.

For each sector, BAU scenario forecasts 32.4 million tones of carbon, 18.7 million tones of carbon, and 35.6 million tones of carbon, respectively (Refer to Figure 1).

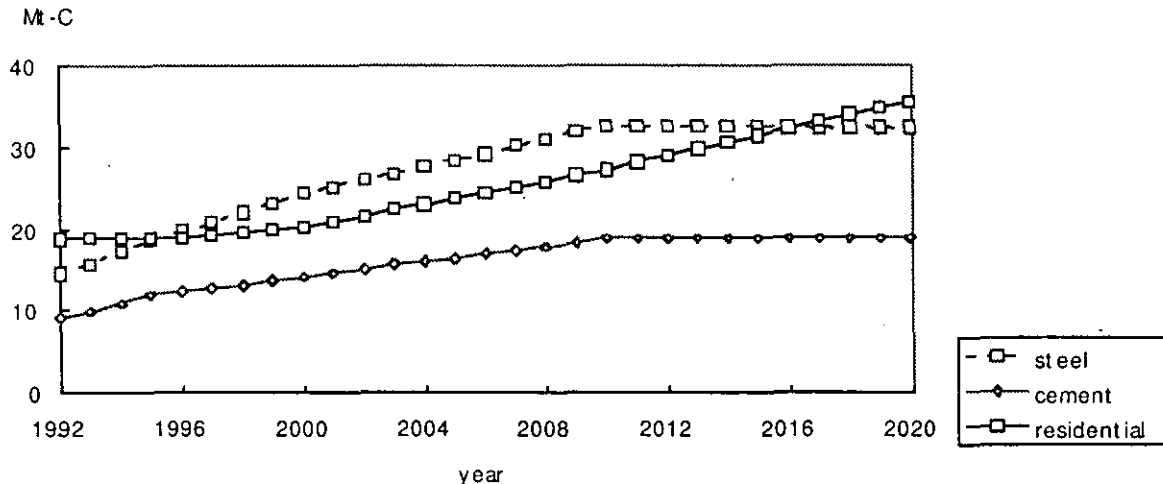


Figure 1: CO<sub>2</sub> Emissions under BAU Scenario in Korea

The simulation results can be summarized as follows. In the steel industry, as long as production keeps increasing, there is little room to reduce CO<sub>2</sub> emissions. With the increase of electric arc furnaces and the introduction of new technology, COREX can only reduce CO<sub>2</sub> emissions in this sector by 7.7% and 5.9% respectively in 2020, compared with BAU (Refer to Figure 2).

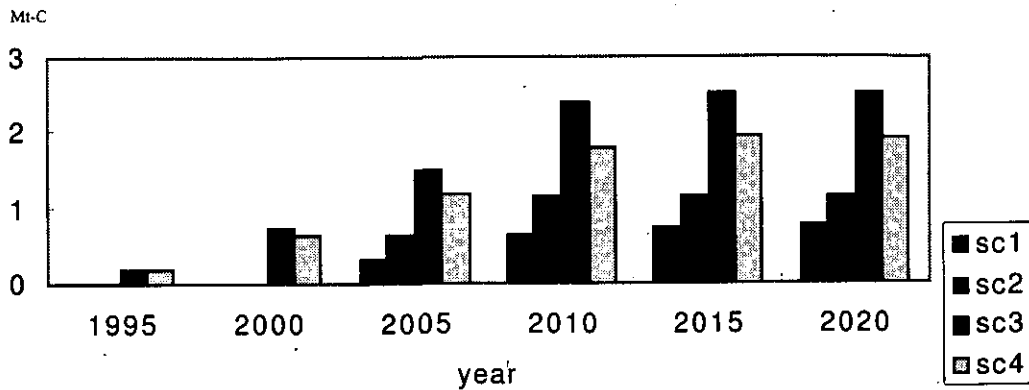


Figure 2: CO<sub>2</sub> Emission Reductions in Steel Industry

In the cement industry, as long as production keeps increasing there is little room to reduce CO<sub>2</sub> emissions, as in the steel industry. The increase of blast furnace cement, and the introduction of independent power generation, can reduce CO<sub>2</sub> emissions only by 0.5 million tones of carbon and 0.1 million tones of carbon respectively, in 2020, compared with BAU (Refer to Figure 3).

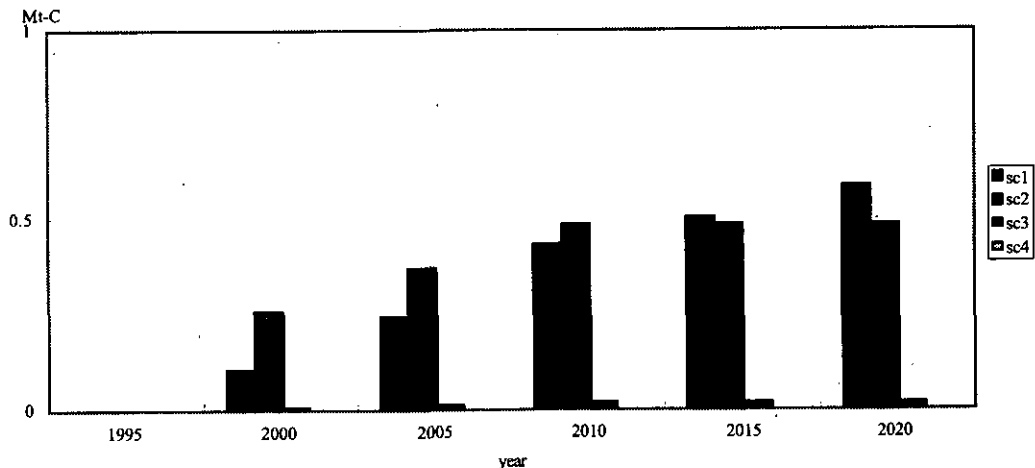


Figure 3: CO<sub>2</sub> Emission Reductions in Cement Industry

In the residential sector, carbon tax scenario shows a large reduction of CO<sub>2</sub> emissions with 20,000Won per carbon tone, which represents a 41.8% reduction of BAU in 2020. The introduction of insulation and solar heating also shows a 19.1% reduction in 2020. If the payback period is extended by 20 years, then 43.5% reductions of CO<sub>2</sub> emissions of BAU can be possible in 2020. This implies that stabilization of CO<sub>2</sub> emissions in this sector, with strong reduction policies, might be achievable in the year 2020 at the CO<sub>2</sub> emission level of 1992 (Refer to Figure 4).

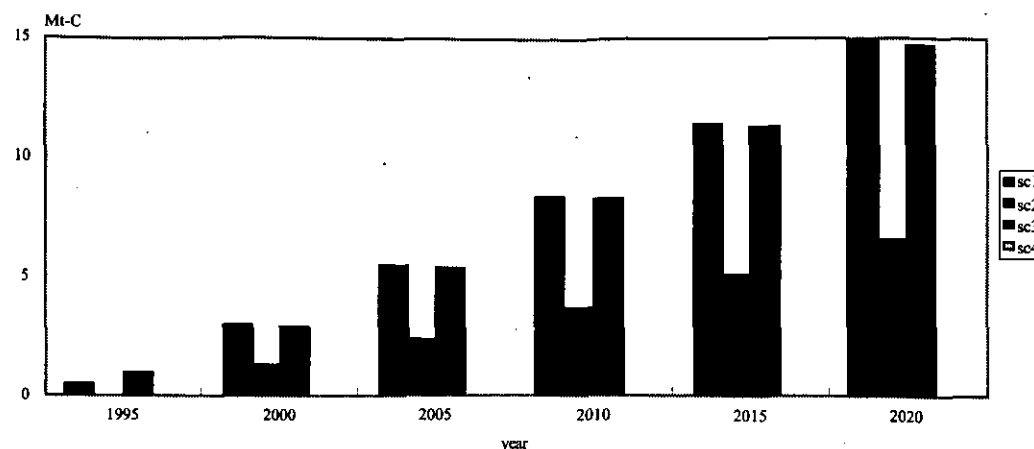


Figure 4: CO<sub>2</sub> Emission Reductions in Residential Sector

### 3.2. AIM/KOREA SO<sub>2</sub> Emission Model

The SO<sub>2</sub> emissions in Korea were 1.61 million tons in 1992. The simulation set up 0.8% and 1.0% of autonomous energy efficiency improvement (AEEI), with 0.5% AEEI as base case. In the SO<sub>2</sub> Concentration scenario, SO<sub>2</sub> emissions increase due to the increase of energy consumption accompanying economic development and increased production. The Korean Environmental Protection Agency (EPA) then introduces policies to reduce the concentration of SO<sub>2</sub>. These conflicting driving forces lead to the final result that SO<sub>2</sub> emissions decrease to 0.44 million tons, and reach the level of 0.01 ppm. In addition, for the costs of desulfurization facilities, the scenarios of \$500 and \$1,000, for the costs of SO<sub>2</sub> per one ton storage, were used.

As a result, with only fuel substitution it is impossible to sustain a SO<sub>2</sub> concentration of 0.01 ppm; after year 2001 the introduction of desulfurization facilities are necessary. Furthermore, if the introduction of desulfurization facilities are delayed, the goal of policies in Ministry of Environment might be attained as late as the year 2012.

The SO<sub>2</sub> emissions were 252 thousand tones in the steel industry sector in 1992, which was 32% of that in the whole industry sector, and 16 % of the total SO<sub>2</sub> emissions. The simulations set up 5 scenarios: which are BAU scenario, scenario of sulfur tax and subsidiary introduction, scenario of electric arc increment, scenario of technology selection for independent power generation, and scenario introducing the desulfurization facilities.

The SO<sub>2</sub> emissions in the cement industry in 1992 was 106 thousand tons, which is about 13% of SO<sub>2</sub> emissions of total industries, and about 7% of total SO<sub>2</sub> emissions in Korea. The simulations set up 5 scenarios: BAU scenario, scenario of sulfur tax and subsidiary introduction, scenario of increment of blast furnace cement, scenario of the use of low sulfur Bunker C, and scenario of introducing the desulfurization facilities (Refer to Figure 2). The scenario of increment of blast furnace cement accelerates the market penetration of blast furnace cement to reach 18% in year 2020, which is the current share of this type cement in Japan. In BAU scenario, it is expected that the share of blast furnace cement will reach 11% in year 2020. The scenario of the use of low sulfur Bunker C is to require 1.0% sulfur content after 1997. The current sulfur content in Bunker C is 4%. The other scenarios are the same as in the case of the steel industry.



The SO<sub>2</sub> emissions in the residential sector in 1992 was 276 thousand tons, which is about 17% of total SO<sub>2</sub> emissions in Korea. In this sector, we also set up the following five scenarios: BAU scenario, scenario of sulfur tax, scenario of subsidiary, scenario of rapid penetration of LNG as heating sources, and scenario of introducing desulfurization facilities (Refer to Figure 5).

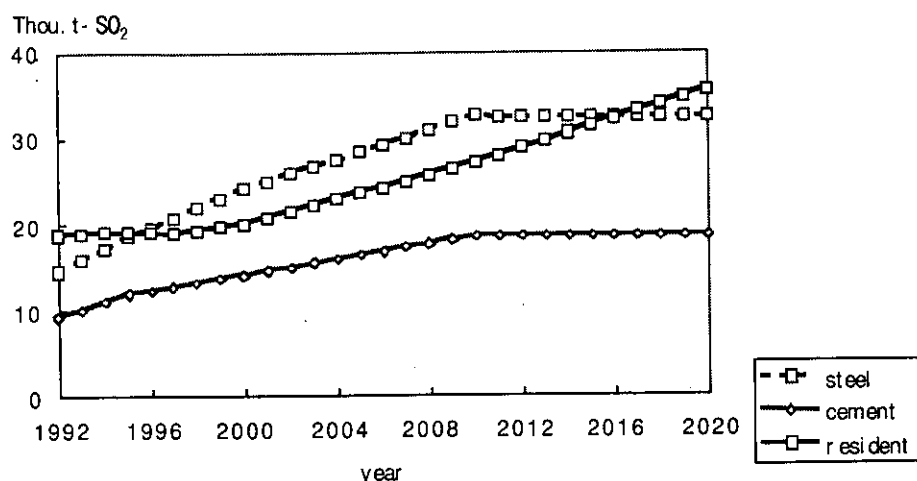


Figure 5: SO<sub>2</sub> Emissions under BAU Scenario in Korea

In the BAU scenario, SO<sub>2</sub> emissions increase to 5,860 thousand tons until the year 2020, which is 2.3 times as much as that of 1992. Such a high increase happens because of huge amounts of steel production. This high increase is due to the very large amounts of steel production. However, the effect of receiving 100 thousand won (approximately 13 thousand yen) from a sulfur tax – using the reference case of Norway and Sweden where a sulfur tax is imposed at present – and utilising these sulfur tax returns subsidiary as resources to tackle SO<sub>2</sub> emissions, leads to predicted decreases of 51 thousand tons, as much as 8.7% of BAU scenario. Also regarding the increment of electric arc and the selection of independent electric power technology, it diminished respectively six thousand tons and 96 thousand tons, in 2020. In addition, with the introduction of desulfurization facilities equivalent to those relating to Japanese SO<sub>2</sub> emissions, it showed that the SO<sub>2</sub> emissions in 2020 reach 59 thousand tons or as little as one third of that of the BAU scenario. This SO<sub>2</sub> emission level is equivalent to 23 % of total SO<sub>2</sub> emissions in 1992.

From these results, the effectiveness of measures such as introduction of energy saving devices and fuel substitution, to reduce SO<sub>2</sub> in the steel industry sector, seem plausible. In order to lower SO<sub>2</sub> emissions to the levels found of Japan, it requires importing of desulfurization facilities. This is because considerably many energy saving devices have been imported for each manufacturing procedure in the Korean steel industry, and manufacturing procedures or technology available for fuel substitution are rare (Refer to Figure 6).

In the BAU scenario, SO<sub>2</sub> emissions increase to 2,190 thousand tons until year 2020, which is 2.1 times as much as that of 1992. Such a high increase happens because of huge expansion of cement productions. As a result of levying 100 thousand won (approximately 13 thousand yen) from a sulfur tax and using sulfur tax returns subsidiary as resources for SO<sub>2</sub> emissions,

decreases of 6 thousand tones are observed representing as much as 2.7% of the BAU scenario. Also, the scenario of increment of blast furnace cement reduces SO<sub>2</sub> emissions by 6 thousand tones in 2020. And the scenario of low use sulfur Bunker C reduces SO<sub>2</sub> emissions by 29 thousand tones in 2020. If the introduction of desulfurization facilities reaches the current level of Japan, the SO<sub>2</sub> emissions in 2020 will be 23 thousand tones, which is just 10% of the BAU scenario. This level of SO<sub>2</sub> emissions is only 21% of SO<sub>2</sub> emissions in 1992.

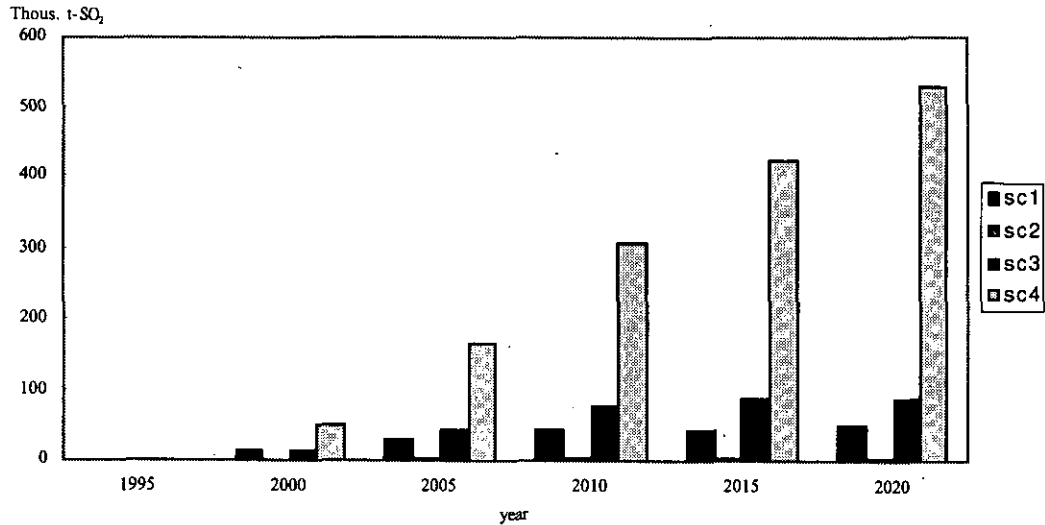


Figure 6: SO<sub>2</sub> Emission Reductions in Steel Industry

These results tell us that the measures (such as the introduction of energy saving devices and fuel substitution to reduce SO<sub>2</sub> emissions in cement industry sector) are feasible as has been observed in the steel industry. However, in order to lower SO<sub>2</sub> emissions to as little as the level of Japan, it also requires the installation of desulfurization facilities in this sector (Refer to Figure 7).

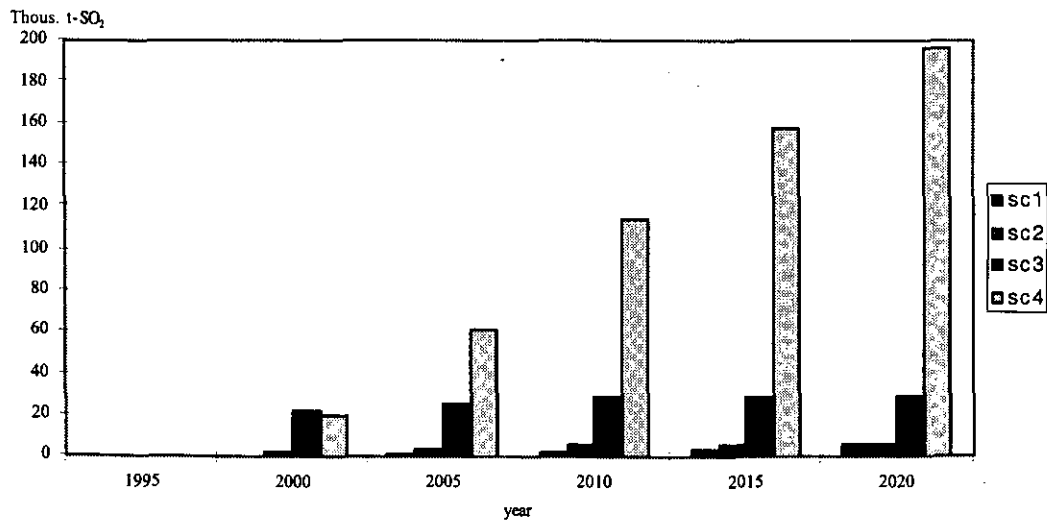


Figure 7: SO<sub>2</sub> Emission Reductions in Cement Industry

In the BAU scenario, SO<sub>2</sub> emissions of the residential sector decrease to 2,510 thousand tones in year 2020, which is 10% reduction of those in 1992. Surprisingly enough, in year 2000 the SO<sub>2</sub> emissions in this sector will decrease to 170 thousand tones, which is a 40% reduction of those in 1992. These results in BAU scenario are mainly due to the rapid fuel substitution from coal to the cleaner energy source, LNG. Since this substitution rate is much higher than the rate of energy consumption in this sector, these results are possible. If the same sulfur tax is imposed as in industrial sectors, 690 thousand tones of SO<sub>2</sub> emissions will be reduced, which represents different results from those in industrial sectors. In the residential sector, the cost of introducing new technology is cheaper, compared with the industrial sectors where 10 thousand Won sulfur tax is much lower than the cost of new technology or energy. In addition, if a subsidy is provided with the sulfur tax, an additional 3 thousand tones of SO<sub>2</sub> emissions are reduced. In the scenario of rapid penetration of LNG, that implies there will be no LNG supply constraints and that SO<sub>2</sub> emissions will be 2,220 thousand tones in 2020. If the introduction of desulfurization facilities reaches the current level of Japan, the SO<sub>2</sub> emissions in 2020 will be 590 thousand tones, which is just 20% of the BAU scenario. This amount of SO<sub>2</sub> emissions is only 21% of the SO<sub>2</sub> emissions in 1992. The installment of desulfurization facilities in this sector means it is necessary to install these facilities at power generation plants in order to supply electricity with lower sulfur to each household.

From these results, emphasizing fuel substitution as a key element of the policies to reduce SO<sub>2</sub> emissions in this sector seems to be effective. However, the installment of desulfurization facilities can lead to more SO<sub>2</sub> emissions reductions (Refer to Figure 8).

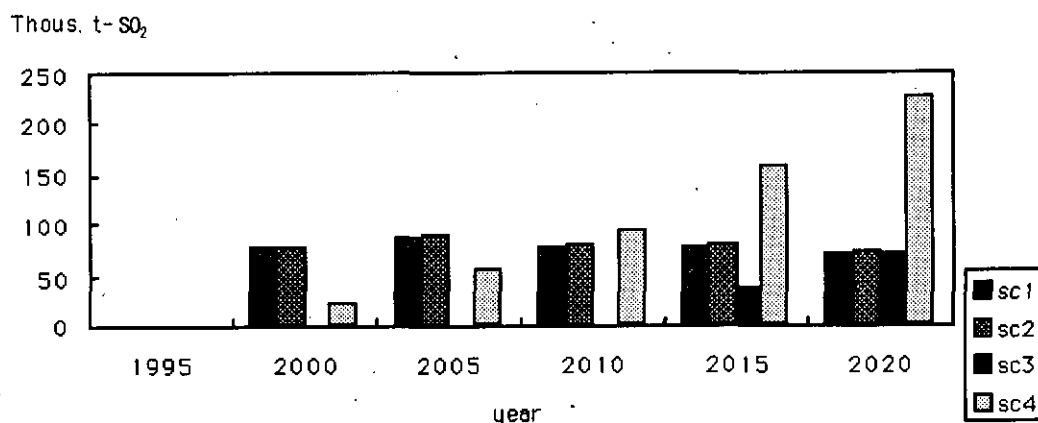


Figure 8: SO<sub>2</sub> Emission Reductions in Residential Sector

#### 4. Conclusion

In this paper, we argue that it is important to develop a new paradigm to integrate global and local environmental policies in developing countries. The following should be realised out to make this happen.

First of all, to understand the situations of developing countries, to identify possible barriers to policies and solve existing problems, is more important than anything else. In a practical manner, developed countries must provide developing countries analysis tools for evaluating policy integration measures. Second, try to find possible area of international joint activities in order to realize that global environmental policies are, in the long run, helpful to find the

solutions of local environmental problems. Third, it is necessary to share the experience of developed countries efforts, on both global and local policies, in accordance with the private sector in developing nations.

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