Chapter5 Environmental Economic Evaluation of CDM Project: The Case of Chongming Power Plant in Shanghai, China[xiii]

5-1 CDM project in Chongming Power Plant

This chapter discusses five kinds of CDM projects. Figure 5-1 is an illustration of the CDM project #3 that we treat in this chapter.

The base line case is a project to construct 2 power plants of 0.3 million kW with IGCC technology. If this base line project is not undertaken, CMD project that constructs 2 power plants of 0.3 million kW with semi-critical technology put into practice. Since CDM case is more energy efficient, the CDM project can reduce emissions of air pollutant and GHG through fuel saving.

5-2 Environmental Economic Evaluation Method

It is necessary to set “the range of evaluation” of selecting the evaluation item and the evaluation subject based on a certain standard in order to evaluate CDM projects in general. The standard to determine the range of the evaluation depends on the “purpose of the evaluation”. Therefore, the range of the evaluation of the CDM project in this chapter was set, considering the purpose of this research, as shown in Table 5-1, where the vertical axis of the matrix is the “change” when comparing the case of the CDM project and the base line and the horizontal axis is the subject to evaluate this “change”. That is to say, the contents of the matrix show how each “Change” is related to the subject. This matrix is called a “benefit structure table” that shows how much benefit (or cost) each stakeholder will enjoy (or pay) in what item by operating the CDM project. The column of “investor” in the table shows the evaluation from a point of view of the CDM investor, so-called financial evaluation. Though the financial evaluation should be done in detail including the funding plan, the repayment schedule, and so on, in an actual project evaluation, this procedure would be simplified here in this chapter.

This table provides such valuable information as the structure of the conflicts among stakeholders, the conditions for the CDM projects to undertake and the possibility of cooperation among different sectors relating the projects, by taking into account the both points of views of project investor and the developing country. This chapter introduces the evaluation regarding the item of (1) to (7).

5-3 Results of Project Evaluation

Table 5-2 shows the evaluation results in case the credit period is for ten years and for twenty-one years separately. The project cost includes the construction cost of the new IGCC power plant, increment the management and the maintenance cost, and the transaction cost. The construction cost of Chongming power plant (sub-critical) that is already assumed in the base line is subtracted from the project cost. It is assumed the increment of management and maintenance cost outside the credit period is paid by the local power plant. Moreover, it is assumed that the fuel saving benefits during the credit period are for the project investor and that those outside the credit period belong to the local power plant.

Let us take Project # 3 as an example. Figure 5-2 shows the net benefit that each stakeholder of this project will obtain when Project #3 is implemented. Though this project is not profitable from the investor’s point of views, this project is socially meaningful because its health benefit to the residents is estimated large enough thanks to the cleaner air, reduction of air pollution in the surroundings. As to the period of the project, it is natural that the longer project (21 year project) is preferable for the investors. On the other hand, longer project is less preferable for the local power plants since the revenue from fuel saving gets smaller. Similar calculation was for other projects[xiv].

The air pollutant reduced by the project is of fuel origin consumed in the power plant. Table 5-3 shows how much amount of the fuel consumption is reduced by the project. In the Project #4 and #5, the amount of natural gas consumption as fuel will increase, the table chows the amount of natural gas consumption increase as well as the amount of coal consumption reduction. Because Project #1 is a repair of the small power plant, the reduction of the fuel consumption is small compared with other projects #2, #3, #4 and #5. Both Project #2 and #3 are the projects of IGCC construction. However, the amount of fuel reduction in Project #2 is smaller since its fuel consumption in the base line is smaller. Similar consideration can be applicable to Project #4 and #5.

Next, the amount of the reduction of the air pollutant of each project is shown in Table 5-4 and Figure 5-3 Since the air pollutant is of fuel origin, the amount of the reduction is basically proportional to the amount of the fuel consumption reduction shown in Table 5-3. However, the amount of the reduction depends on the assumed measures like SO2 control measures and NOx control measures. The reason that the amount of the reduction of the air pollutant in Project #1 is relatively small is that the original fuel consumption and the reduction of fuel consumption are both small.

Let us compare the reduction of the air pollutant between of Project #2 and #3. The difference of the amount of the SO_2 reduction between Project #2 and #3 originates in the difference of the amount of the fuel consumption reduction as already mentioned since sulfur content of the coal and the desulfurization rate are assumed to be common concerning the Project #2 and #3. As to NO_x, the reduction in Project #2 is larger. The reason is that NO_x deduction measures are not considered in Chongming power plant in the base line of Project #2, and as a result the amount of the "reduction" by the project becomes larger. As to dust, the reduction in Project #2 is also larger. The reason is the same as the case of NO_x reduction, that is, electrical dust catchers are not equipped in Chongming power plant in the base line of Project #2, and as a result the amount of the "reduction" by the project becomes larger. When comparing Project #4 with #5, similar consideration can be applicable.

Next, let us compare Project #2 and #4 or Project #3 and #5, which corresponds to a comparison between IGCC and the natural gas combined cycle power generation. As is shown in Table 5-4, the effect of IGCC concerning the air pollutant reduction is considerably similar that of the natural gas combined cycle power generation. However, dust reduction effect of IGCC is a little larger than that of the natural gas combined cycle power generation. In general, a natural gas power generation is regarded dust free. We obtained, however, such result since we summed very high dust catching rate of 99.9% on IGCC in this research.

Next, in Table 5-5 and Figure 5-4, let us show the benefit from the air pollution improvement by each project in case the discount rate is 11% per year. The amount of reduction is calculated as a product of "the amount of the reduction" and "the cost of damage per ton of each pollutant". Therefore, the results have the same tendency as the case of GHG reduction shown in Table 5-7 and Figure 5-8. However, adjustment by the discount factor makes some deference in the results. For example, GHG reduction in Project #4 is almost same as that in Project #5 (Table 5-7), but benefit from NO_x reduction in Project #4 is much larger than that in Project #5. That originates the fact that the NO_x reduction in Project #4 starts earlier than Project #5.

Next, as to the relation of the size of benefit and the benefit, suppose discount rate is 0%, the benefit of Project #1 increases by 1.5 times those of Project #2, #3, #4, and #5 increase by three times. Project #1 is not much influenced by the value of discount rate because the evaluation period is assumed for ten years. Moreover, when the discount rate is assumed to be 20% oppositely, benefit of Project #1 decreases by 30% and those of Project #2, #3, #4, and #5 decrease by 40%. We can see it is an important matter to determine the value of the discount rate because the benefit from the project changes greatly depending on the value of discount rate.

Table 5-6 and Figure 5-5 show the benefit from the damage reduction by acid rain for Japan and South Korea when the discount rate is set 11%. We can see that the benefit for Japan is larger than Korean's partly because the deposition of SO_2 and NO_x in Korea is larger than in Japan and partly because Japanese damage cost by SO_2 and NO_x is larger that Korean's. Moreover, compared with benefit by the air pollution reduction around the power plant in China, benefits in

Jana and Korea are very small (1/30 in Japan, 1/100 in Korea). This result is plausible because deposition in Japan or Korea is less than 1%. However, regardless uncertainty concerning the transportation model of acid materials, this amount cannot be neglected taking it into consideration that at least 1% of benefit of the project emerges in Korea or Japan.

Next, let us evaluate the project from the investor's point of view. The amount of GHG reduced by the project during the credit period is important for the investor of the project. The annual and total reduction of GHG of each project is sown in Table 5-7, where the credit period for Project #2, #3, #4, and #5 is assumed to be 21 years.

It would be natural that GHG reduction in Project #1 is smaller than that of another, since the scale of the project itself is relatively small. As to Project #2, #3, #4, and #5, GHG reduction by natural gas combined cycle power generation (Project #4 and #5) is three times as large as that by IGCC power plant (Project #2 and #3). Though IGCC is considered leading edge of coal power generation technology, environmental load is considerably large from the viewpoint of GHG emissions compared with the natural gas power generation. Therefore, introducing the natural gas combined cycle power generation gains more considerable credit than IGCC can get.

Next, let us see the components of the cost and benefit though the net benefit was estimated negative. Table 5-8 and Figure 5-6 show the structure of "Project operation cost" that the investor pays, "fuel saving benefit" and "gain by selling CER" the investor will obtain. The figures are represented as present value with 11 % discount rate. The credit price is assumed to be $5/ton C and the credit period for Project #2, #3, #4 and #5 is assumed to be 21 years. We can see that the credit price of $5/ton C is below break-even point for all of the projects. However, Project #4 and #5, which use the natural gas combined cycle power generation, have a possibility to be profitable depending on the credit price because the amount of the GHG reduction in Project #4 and #5 is large. On the other hand, we can say that this kind of project is of "high risk and high return" as far as the profit of the project is due to the credit price.

Next, let us see how earnings of the project will change, when the credit (CER) price and the discount rate change, which are assumed fixed in the previous analysis. Figure 5-7, Figure 5-8, Figure 5-9, Figure 5-10 and Figure 5-11 show the earnings of each project when the discount rate is set 0% - 20% and the CER price is set $0, $5, $10, $20, $50 /ton CO2. The intersection of the graph and the horizontal axis is so-called FIRR (financial internal rate of return). This means the discount rate that makes the profit of the project zero. Generally speaking, the larger is the discount rate, the less profitable is the project, since the initial cost of project is large. Therefore, FIRR is used as a index of profitability of the project. In case FIRR is large, the project is more profitable. However, in CDM project, FIRR is vulnerable to the CER price because the earnings depend on the price of CER.

The shape of the graph for Project #4 and #5 is right hand side up, since there exists not initial cost but initial earnings; the construction cost of the baseline power plant is higher than that of the natural gas combined cycle power generation and the increase of the fuel expense emerges later during the project period. Even though this is an exceptional case, as far as we are faithful to the evaluation principle that the earning is calculated based on the comparison of the project with the base line, result is as is shown in the Figure 5-10 and Figure 5-11. We ca see that it is very important for profitability of the project to determine how to share the cost between the investor and the local power plant.

Finally, let us think how much the break-even CRT price is. We guess that must be very important for the investor. Table 5-9 shows the result of each project. Since it is said that the market price of CER would be roughly $5 to $20, it would be considerable difficult that the investor undertake Project #2 and #4 by financial reason. On the other hand, we can say that Project #1, #3 and #5 could be realized depending on the level of the CER price.

5-4 Discussion

Project #3, we have evaluated in this research, has positive net-benefit since its benefit from reduction of air pollutant is large enough. Therefore, Project #3 should be undertaken to promote social welfare. In other words, it would be possible for this project to be a so-called "Win-Win game" for China and Japan. However, investors as far do not have an incentive to undertake this project as far as the credit price is no more than five dollars. As is shown in this chapter, the profitability of the project greatly changes depending on the discount rate and the assumed CER price. Let us point out three issues to be discussed henceforth in order to make the project more feasible.

The first issue is that those who enjoy ancillary benefit from the project pay a part of the cost of the project. We found in this research that East Asian region including Japan, as well as China, could enjoy the ancillary benefit from the project. Since we modestly evaluated the value of the ancillary benefit from the project, the above-mentioned idea will come to be more realistic if the real value of the ancillary benefit should be larger.

The second issue is that change in the manner to share the cost and benefit among stakeholders could improves the investor's incentive. In this research, we assumed that benefit from the reduction of emission charge belongs to the local power plant while the benefit by fuel saving and CER dealing belongs to the investor. And we also assumed that the management and maintenance cost of the power plant would be paid by the investor at least during the credit period. However, the stakeholders should determine how to share the cost and benefit among them taking the condition of each individual project into account. As a result, changing the manner of risk sharing could make the project more feasible.

The third issue is that joint finance with some other public fund, say ODA, or collaboration of CDM with some other investment instruments could improve the feasibility of the project. This respect will be discussed more in detail in the next chapter.

Reference

Konishi M, A. Mori, and K. Ueta (2004) "Environmental Economic Evaluation of CDM Project: the Case of Chongming Power Plant in Shanghai, China," mimeo.

[xiii] This chapter is based on Konishi et. al. (2004).
[xiv] See, Konishi et.al.(2004))

Table 5-1 Range of Evaluation of CDM

	Investor	Local power plant	Chinese Government	Residents around the plant	Japan	Korea	Developing Countries	Total
Cost of CDM Project	(1) Construction, operation and management cost of CDM							
Fuel Saving	(2) Benefit from fuel saving	(Possible to get a part of fuel saving benefit)						
Reduction of GHG Emissions	(3) Revenue by selling CER	(Possible to get a part of revenue by selling CER)	(Possible to get a part of revenue by selling CER)				(7) 2% of CER reserved as a fund for developing countries	
Reduction of SO_2, d NOx and Dust	(Possible to get a part of reduction of emission charge)	(4) Reduction of Emission Charge as expenditure	(4) Reduction of Emission Charge as revenue	(5)Improvement of air quality	(6) Reduction of acid rain	(6) Reduction of acid rain		
Total								

Table 5-2 Evaluation of Project #3 (evaluation period: 30 years)

(Unit LMB)

	Investor	Local Power Generator	Chinese Government	Residents around the Plant	Japan	Korea	Developing Countries	Total
Operating Cost of CDM	-1,201,527,486	-72,761	0	0	0	0	0	-1,201,600,248
	-1,201,779,684	-16,052	0	0	0	0	0	-1,201,795,736
Fuel Saving	572,666,677	245,688,649	0	0	0	0	0	818,355,327
	764,153,245	54,202,081	0	0	0	0	0	818,355,327
Reduction of GHG emissions	125,125,794	0	0	0	0	0	2,806,140	127,931,934
	171,567,293	0	0	0	0	0	3,847,663	175,414,956
Reduction of SO_2 and NOx emissions	0	81,911,412	-81,911,412	1,010,063,093	43,542,617	9,563,063	0	1,063,168,773
	0	81,911,412	-81,911,412	1,010,063,093	43,542,617	9,563,063	0	1,063,168,773
Total	-503,735,015	327,527,300	-81,911,412	1,010,063,093	43,542,617	9,563,063	2,806,140	807,855,786
	-266,059,146	136,097,442	-81,911,412	1,010,063,093	43,542,617	9,563,063	3,847,663	855,143,320

Note) Upper row: Credit period is 10 years.

Lower row: Credit period is 21 years.

Table 5-3 Amount of Energy Saving

	Project #1	Project #2	Project #3	Project #4	Project #5
Reduction of Coal Consumption (ton)	216,764	8,836,056	9,326,772	56,706,127	57,196,843
Increase of Natural Gas Consumption (m3)	-	-	-	22,649,155,200	22,649,155,200

Tab 5-4 Reduction of Air pollutant (Unit: ton)

	Project #1	Project #2	Project #3	Project #4	Project #5
SO_2 (ton)	889	164,160	227,816	169,885	233,541
NOx (ton)	993	191,684	188,522	107,136	103,974
Dust (ton)	110	6,112	2,765	3,601	254

Table 5-5 Benefit from Reduction of Air Pollutant of each Project (Unit:LMB)

	Project #1	Project #2	Project #3	Project #4	Project #5
SO_2	5,607,742	594,318,287	707,216,945	612,091,224	724,989,882
NOx	3,240,431	328,771,258	302,846,148	192,951,498	167,026,388

Table 5-6 Benefit from Reduction of Acid Rain (Unit:LMB)

	Project #1	Project #2	Project #3	Project #4	Project #5
Japan SO_2	254,445	23,122,832	32,089,163	23,929,259	32,895,590
Japan NOx	122,551	11,645,566	11,453,455	6,508,946	6,316,835
Korea SO_2	46,166	4,195,350	5,822,180	4,341,667	5,968,496
Korea NOx	40,027	3,803,630	3,740,884	2,125,927	2,063,181

Table 5-7 GHG Reduction in each Project

	Project #1	Project #2	Project #3	Project #4	Project #5
Annual GHG Reduction (CO2t /year)	41,350	602,385	585,364	2,106,806	2,089,786
Total GHG Reduction (CO2t/Credit Period)	413,499	12,650,076	12,292,652	44,242,922	43,885,498

Table 5-8 Cost and Benefit for the Investor (LMB)

	Cost of Project	Fuel Saving	Revenue from CER
Project #1	-76,357,889	39,928,302	8,838,826
Project #2	-5,994,941,500	947,893,561	207,415,596
Project #3	-1,201,779,684	764,153,245	171,567,293
Project #4	-2,211,386,110	-5,523,851,571	647,384,267
Project #5	2,349,463,665	-5,671,149,086	612,505,405

Table 5-9 Minimum required CER price for project implementation (US Dollars)

Discount rate	Project #1	Project #2	Project #3	Project #4	Project #5
0%	5.75	54.20	-7.92	129.58	35.72
5%	12.30	83.90	0.88	93.62	31.28
10%	19.20	115.34	10.72	79.77	26.22
15%	26.30	146.74	20.97	75.06	21.10
20%	33.45	177.10	31.13	74.47	16.22

Figure 5-1 Outline of the CDM Project

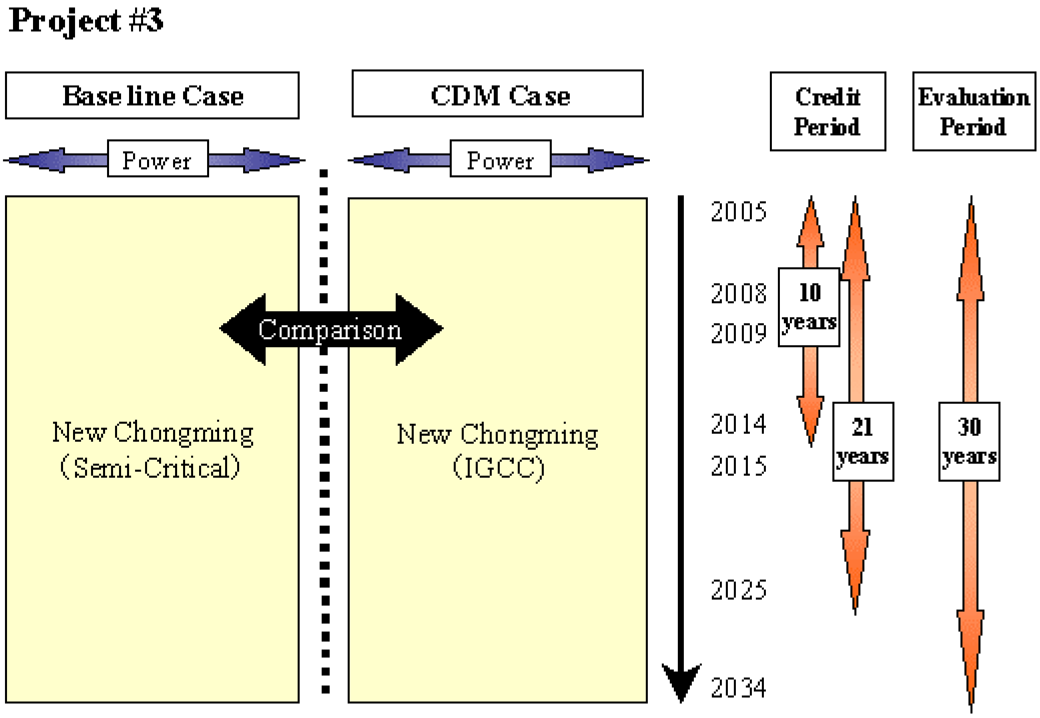


Figure 5-2 Net benefit of stakeholders

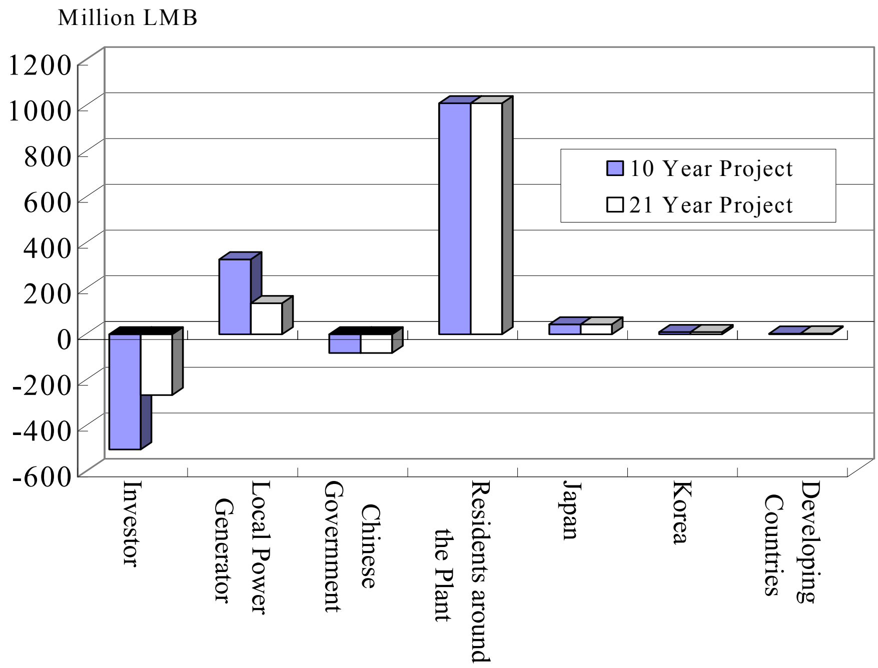


Figure 5-3 Reduction of Air Pollutant of each Project

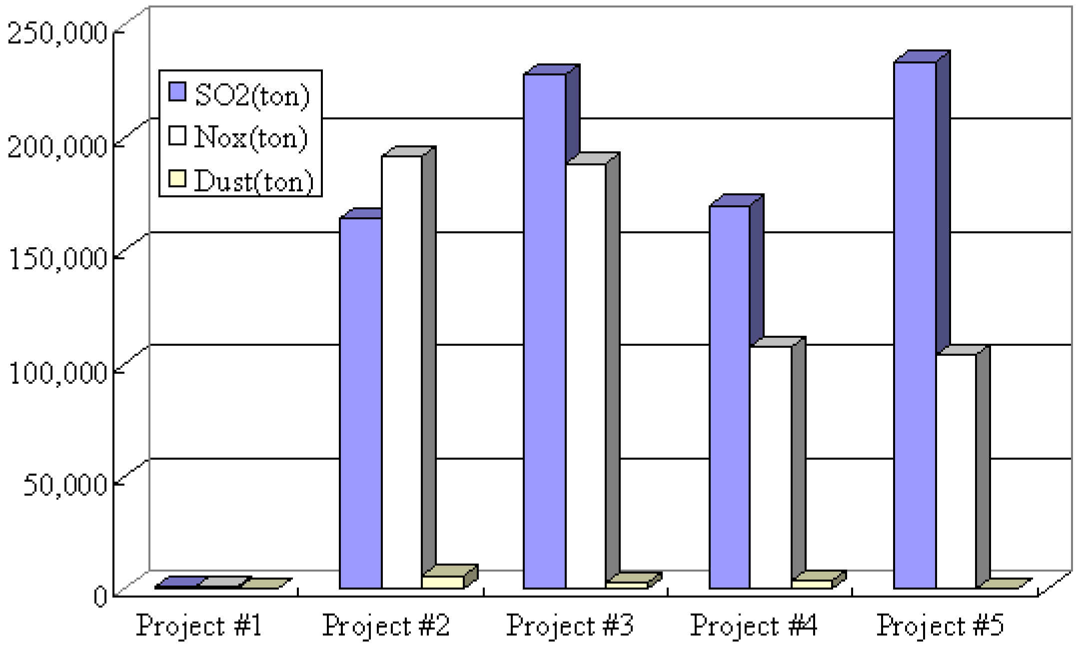


Figure 5-4 Benefit from Reduction of Acid rain

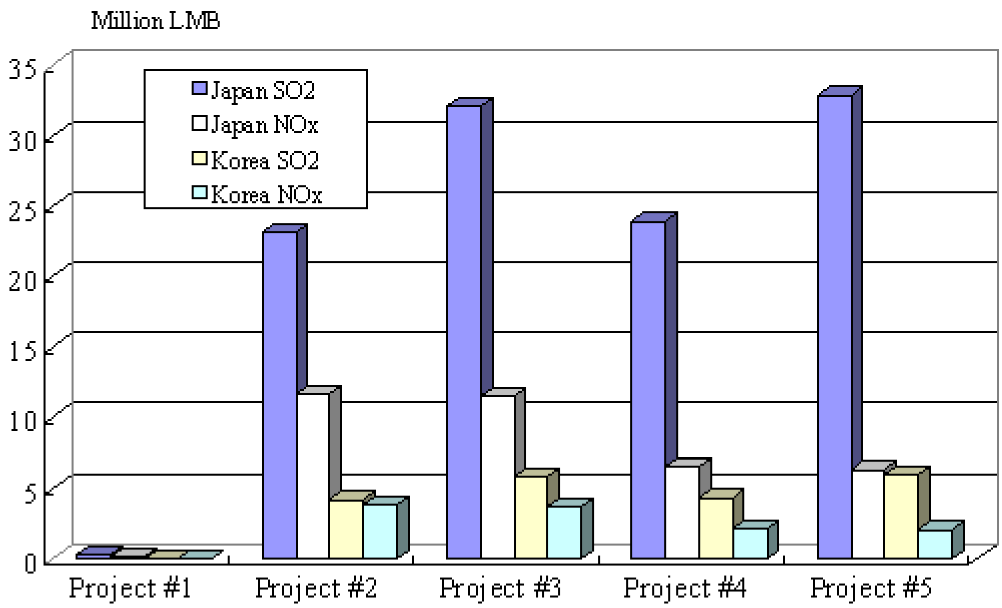


Figure 5-5 benefit from reduction of air pollutant (LMB)

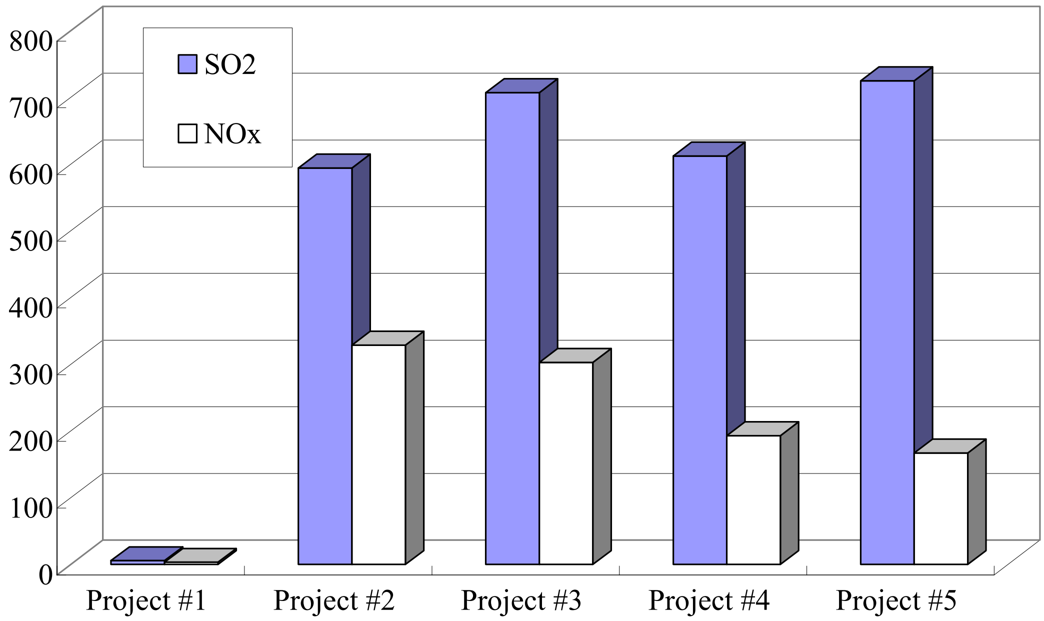


Figure 5-6 Revenue and Cost for the Investor

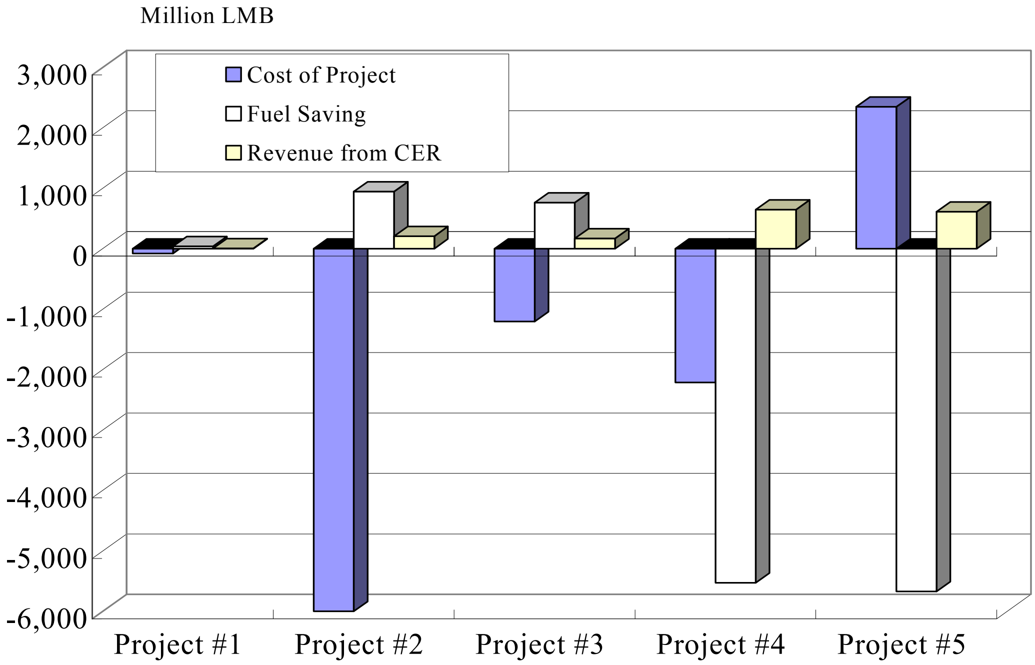


Figure 5-7 Discount Rate, CER Price and Revenue in Project #1

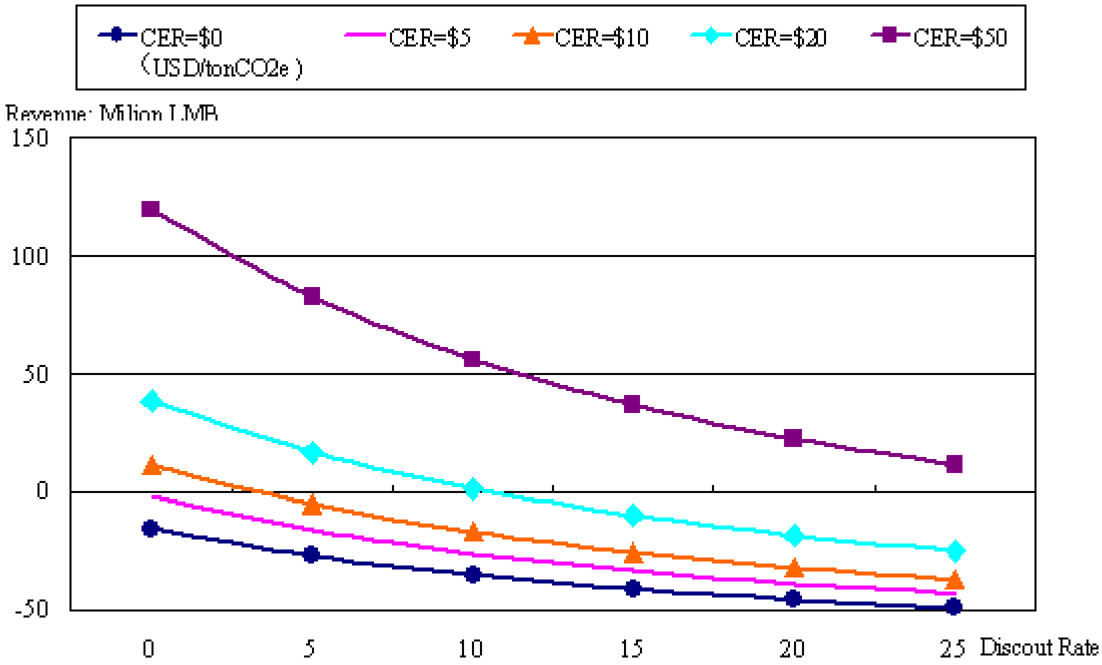


Figure 5-8 Discount Rate, CER Price and Revenue in Project #2

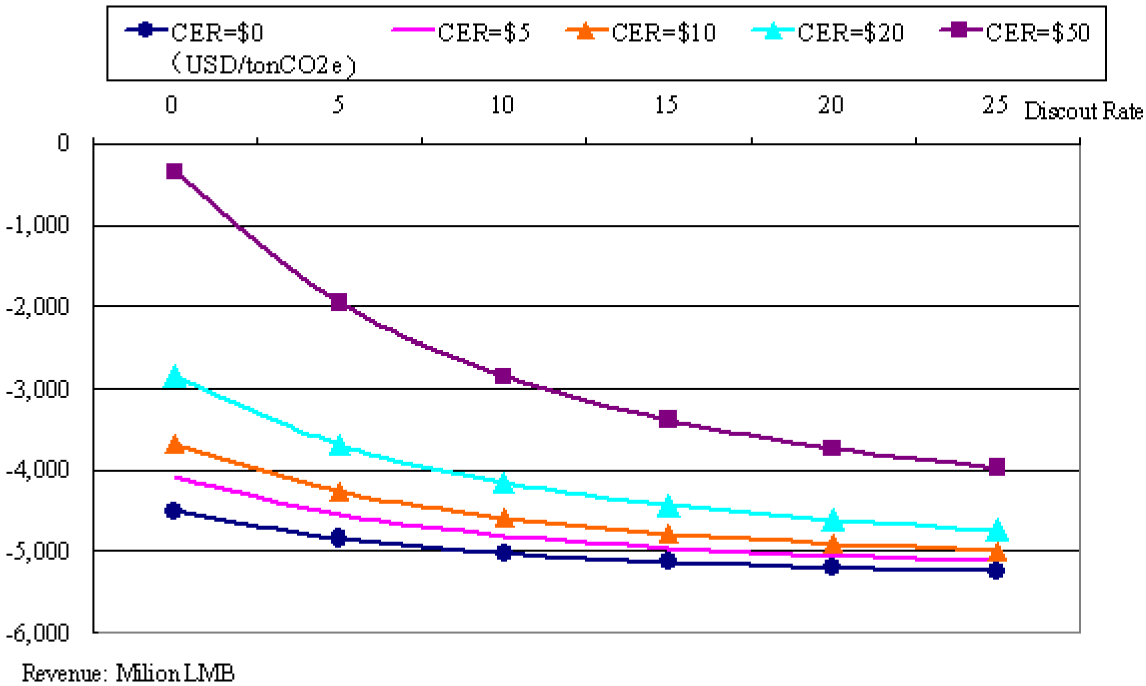


Figure 5-9 Discount Rate, CER Price and Revenue in Project #3

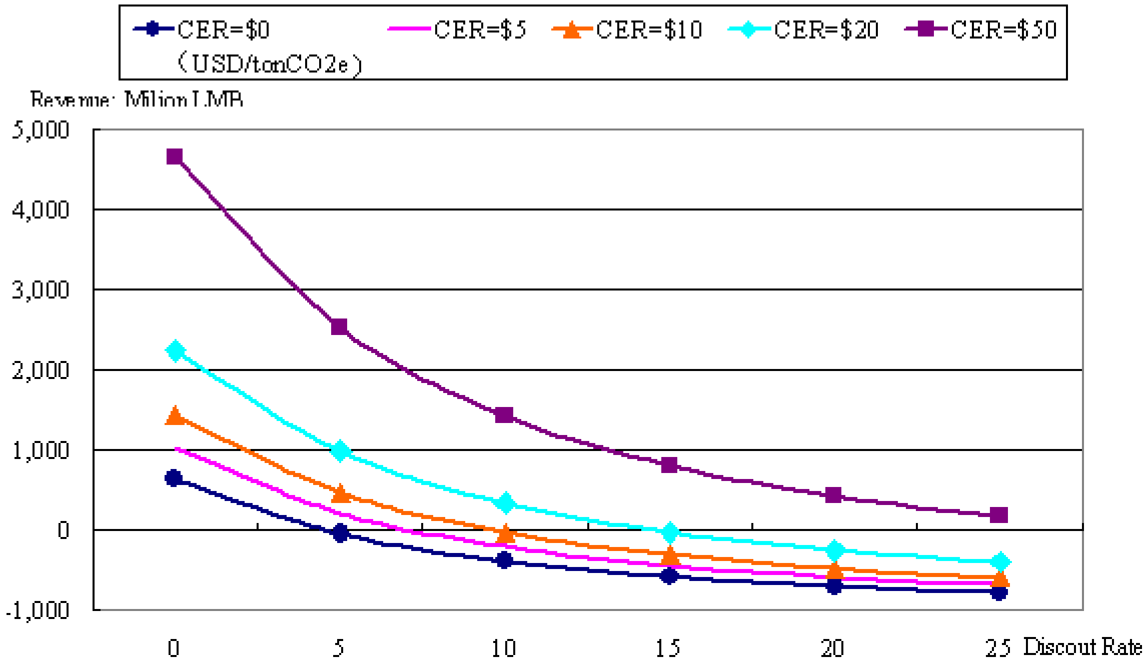


Figure 5-10 Discount Rate, CER Price and Revenue in Project #4

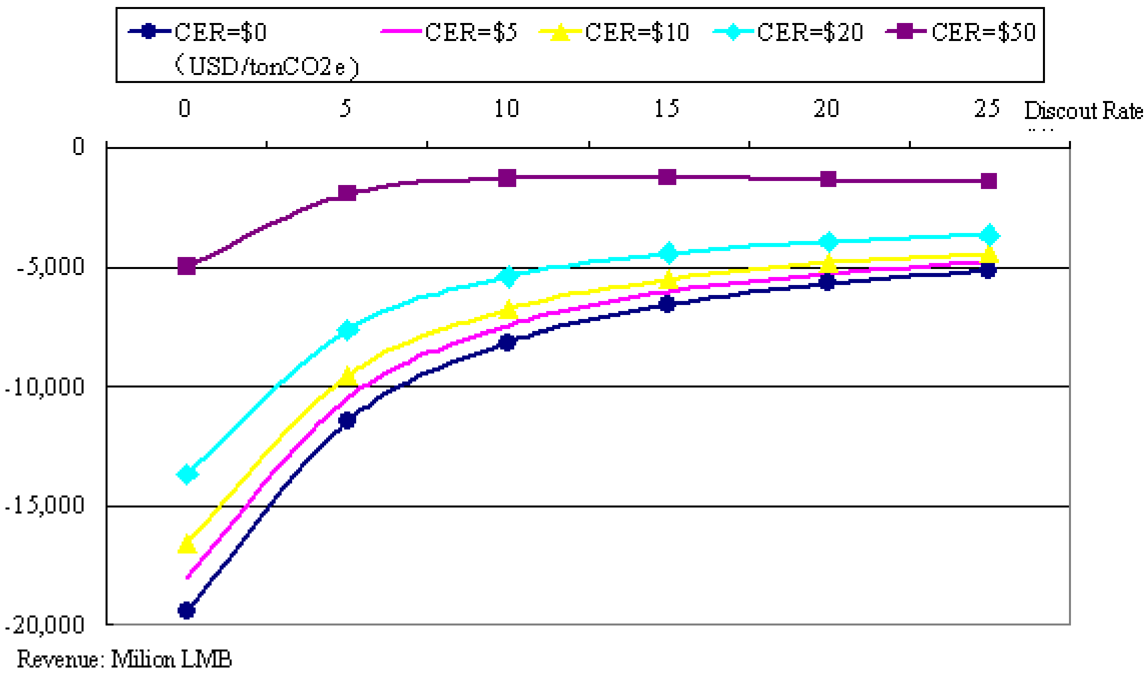
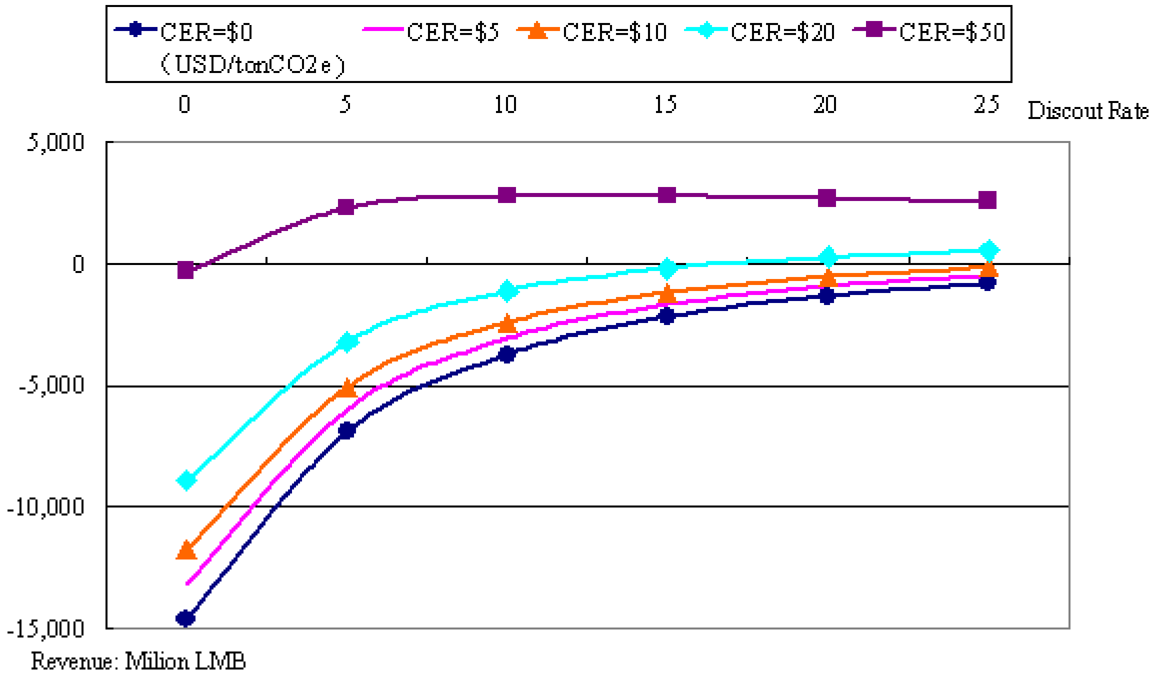


Figure 5-11 Discount Rate, CER Price and Revenue in Project #5



Chapter6 Integration of Climate and Development Policies through the CDM

6-1 Introduction

At COP3, Japan undertook obligations of reducing the emissions of greenhouse gas (GHG) 6% below 1990 levels in the 1st commitment period (2008-2012). Measures for achieving the emission reduction target can be classified into two major categories: the promotion of domestic emission reduction measures and the utilization of Kyoto mechanism. Climate change is an issue of preserving global public goods; therefore it is desirable that the reduction can be achieved in a way that minimizes the emission reduction costs. As shown in chapter 3, the marginal cost of reducing GHG emissions in Japan is significantly higher compared to other developed and developing countries in the world, therefore its GHG emission reduction target can be achieved with less cost by utilizing the Kyoto mechanism rather than enhancing domestic reductions as climate change mitigation measures. However, the international rule for the enforcement of the Kyoto mechanisms was agreed with considerable difficulty. Japanese government has come to ratify the treaty. In the Marrakech Accords, the use of the Kyoto mechanisms shall be supplemental to domestic action and that domestic action shall thus constitute a significant element of the effort made by each Party included in Annex I to meet its quantified emission limitation and reduction commitments (Decision15/CP.7). Japanese climate change policy intends to reduce 1.8% of the 6% reduction target by utilizing the Kyoto mechanism. Accordingly, within the Japanese climate change policy, it is considered that domestic reduction measures and the Kyoto mechanism do not compete with each other but coexist and complement mutually in order to achieve the reduction target of GHG emissions.

The purpose of the CDM shall be to assist developing countries in achieving sustainable development, and to assist developed countries in achieving compliance with quantified emission limitation and reduction commitments (Article 12 Kyoto Protocol)

As it is shown in the analysis in chapter 5, CDM projects between Japan and China could bring win-win results to both countries. Up to now, however, there have been few records of CDM projects internationally. It is also difficult to expect CDM projects to be activated quickly in the near future. What are the factors that make the implementation of CDM more difficult compared to other measures of the Kyoto mechanism? Furthermore, if there are any inherent factors that explain the difficulty in implementing CDM projects between Japan and China, they should also be clarified. Supposing that the utilization of CDM in Japan as a climate change mitigation measure could bring win-win results to both Japan and China, it should be examined under what conditions the CDM could have precedence over JI or IET and could actually be implemented. Moreover, it is necessary to investigate possible policy measures that would encourage the CDM projects between China and Japan.

6-2 Potential Benefits of CDM

As is well known, within the Kyoto mechanism agreed by the Kyoto Protocol, there are International Emissions Trading (IET) and Joint Implementation (JI) other than CDM. IET has four possible cases of trading. The first case is AAUs (Assigned Amount Units) that generates from a part of primary assigned amount calculated by the base year emissions and quantified targets. The second one is RMU (Removal Units) generating from sink activities carried out in developed countries. The third case is ERUs (Emission Reduction Units), credits issued by Joint Implementation. The last one is CERs (Certified Emission Reductions), credits issued by CDM. Theoretically, each country's marginal cost of reducing GHG emissions by the Kyoto mechanism equals to equilibrium price of international emissions trading market.

On the other hand, when the Japanese government purchases emission permits traded in the international emissions trading market, the benefits resulting from the trading (avoidance of damages by reducing GHG emissions + ancillary benefits) differ according to the kind of credit. Introduction of the Kyoto mechanism induces not only global environmental benefits emerging from the reduction of GHG emissions (the avoided damage costs) but also regional environmental improvements (e.g. abatement of acid rain damages, or some other economic benefits for both investment and host countries) as ancillary benefits.

First of all, let us consider that case of trading AAUs. Among Annex B countries, transition economies are mainly considered to be the countries actually capable of providing emission permits generating from AAUs. It is because in the former Soviet Union / East European countries such as Russia and Ukraine, their quantified targets for reducing GHG emissions are already achieved without introducing domestic policies to do so, as their emissions have significantly decreased compared to the base year level due to economic stagnation and difficulties. Consequently, it is anticipated that a large amount of emission permits would be supplied to the international emissions trading market. This is the so-called hot air issue. In this case, even if the Japanese government purchases emission permits originating from AAUs in Russia, it merely means income transfers from Japan to Russia and there would be no additional reductions of GHG emissions by the trading.

The second case that requires examination is when credits generating from JI and CDM are traded. In these cases, global environmental benefits and ancillary benefits emerge since there are actual reductions of GHG emissions. Taking CDM and JI projects as examples, benefits generated by the reduction of GHG emissions are examined below. Each benefit for CDM and JI are given by:

$$\sum_{i=X,Y} B_i^{JI} = \sum_{i=1,n} D_i(or,ERU_Y) + L_X + \sum_{i=1,n} R_i + K_X + K_Y \quad (1)$$

$$\sum_{i=X,Y} B_i^{CDM} = \sum_{i=1,\cdot n} D_i(or,CER_Y) + L_A + \sum_{i=1,n} R_i + K_X + K_Y \quad (2)$$

Country X denotes a host country, country Y is a investing country, ΣD_i is the sum of global benefits emerging from the reduction of GHG emissions in country i, L_i represents local environmental benefits generating in the host country (e.g. abatement of air pollution damage), ΣR_i is regional environmental benefits generating in the investing country and other regions other than the host country, and K_i represents other ancillary benefits.

Each benefit of CDM and JI are the sum of local environmental benefits (L_i), other ancillary benefits (K_i) and regional environmental benefits generating in the investing country and other regions other than the host country(ΣR_i). When the sum of local environmental benefits and ancillary benefits of CDM equals to those of JI, the size of benefits of CDM and JI are found in accordance with the size of each regional environmental benefit.

As shown in chapter 4, since China, among Eastern Asian region, is a major source of releasing sulfur oxide and nitrogen oxides, CDM projects implemented in China would bring benefits not only to Japan as the host country, but also significant regional environmental benefits of reducing acid rain damages in the Eastern Asian region. Therefore, the larger the amount of CERs originating from CDM projects in China existing in the international emissions trading market as tradable emission permits are, the larger the benefits of Japan would be.

However, it is not likely that Japan would actually be able to purchase CERs generating from CDM in the international emissions trading market. There are two major reasons for this. Firstly, there is the issue of hot air in the transition economies. More specifically, it is anticipated that the countries capable of providing emission permits to the international emissions trading market (country as seller) are economies in transition, and they would become AAUs mainly originating from hot air. Secondly, it is expected that the emissions trading market would become oversupply by the withdrawal of the U.S. from the Kyoto Protocol as they were anticipated to be the major buyer of emission permits, and the transaction price is expected to be low. In fact, there have been few records of CDM internationally, being far below the original expectation.

Let us assume equation (1) as a case that Japan conducts JI projects in Russia and Eastern European countries, and equation (2) as a case that Japan conducts CDM projects in China. As far as global benefits generating from the reduction of GHG emissions are concerned, the same results would be achieved by not only the purchase of CERs and ERUs by Japan in the international emissions trading market, but also by

Japan-China CDM projects, and JI projects between Russia if they would obtain the same amount of credit. However, as examined in chapter 4 and 5, from the viewpoint of Japan, the environmental benefits generating from Japan-China CDM projects would be much greater than those of Japan-Russia JI projects.

To put it amplificatory, the size of the benefits of Japan- China CDM projects differ according to the region they are implemented and the type of projects to be selected. There are three major standards for qualifying a project as a CDM project. Firstly, a region or a project that would maximize the benefits of China should take priority. In other words, a region or a project for CDM should be selected as to maximize local environmental benefits and other ancillary benefits in China. China's most concerned local environmental issue is the damage of air pollution and acid rain caused by the emission of SOx. Secondly, a region or a project that would maximize the benefits of Japan should be given preference. Thirdly, a region or a project that would generate the largest sum of benefits should be prioritized. Therefore, in order to activate Japan-China CDM projects, it is indispensable to grasp the various kinds of benefits of CDM projects and design a comprehensive evaluation standard for CDM projects, basing on not only the benefits resulting from CO_2 emissions reduction in both countries.

6-3 Barriers of CDM in Japan and China

From the discussions in chapter 4, 5 and the previous sections in this chapter, it is clarified that the utilization of Japan-China CDM projects could bring win-win results to both countries. However, there have been no case of obtaining CERs by Japan-China CDM projects up to this time, and it is not expected to increase quickly in the future. Classified broadly, the following four factors can be considered as reasons for this.

Firstly, compared to other projects, the risk of implementing CDM projects is relatively higher to private project implementers. In addition to the project risks that private companies would face when implementing a project abroad, there are risks that are inherent to CDM projects. Specific examples are a risk of host country withdrawing from the Kyoto Protocol, and a risk of being unable to obtain CERs due to rejection by the executive board of CDM. Also, compared to regular projects, a risk in discovering a project and a risk of host country's government rejecting the project are higher, because companies and the government of host country often lack thorough knowledge of the Kyoto mechanism or CDM projects itself.

Furthermore, regarding the profits generated by obtaining CERs, the largest benefit for private businesses, the risk is higher than a project for constructing and operating power plants by PFI (private financial initiative) method. In PFI method, usually a "take-or-pay" contract, a contract to purchase electricity is made with the government of host country. This is a kind of contract that makes public power corporations or the government of host country responsible to pay the amount equivalent to the contracting electricity even when the need to provide contracting electricity no longer exists due to a decrease of electricity demand in the host country. Thas is to say, the private enterprises would avoid market risk in most cases of projects for constructing and operating power plants by the PFI method. However, with CDM projects, private enterprises need to take all the market risk, since the price of CERs are decided by the international emissions trading market and host country would provide no price guarantee of any kind. Moreover, the transaction price in the international emissions trading market is expected to be very low due to the existence of hot air in the economies in transition and the withdrawal of the U.S., making the CDM much less attractive.

Secondly, within the framework of Japanese climate change policy, private enterprises do not have much incentive to utilize the Kyoto mechanism. In the industrial sector, Japan Federation of Economic Organizations (Keidanren) has submitted a voluntary action plan as a measure for reducing GHG emissions. However, it does not impose legally binding targets to reduce GHG emissions. Moreover, the industrial sector is supposed to take priority in reducing domestic GHG emissions. Consequently, there would be no motivation to implement CDM projects by priority, even if there are private enterprises capable of implementing CDM projects.

Thirdly, there is an issue of attribution of benefits. Benefits emerging from CDM are categorized into economic benefits by the acquisition of CERs and ancillary benefits. Private project implementers would make decisions whether or not to implement a project by considering the size of the economic benefits gained by the acquisition of CERs as a profit-making source. However, it is difficult take into consideration the ancillary benefits including regional environmental benefits such as the reduction of damages by acid rain, and local environmental benefits such as the abatement of air pollution damages in China, as in the equation (2). In other words, when a project's net benefit is not positive without adding the ancillary benefits, private enterprises do not have incentives to willingly implement the project.

Fourthly, there is an issue of different standpoints of Japan and China with regard to the implementation of CDM projects. With the background of having playing a key role in the G+77 group since the negotiation of the Framework Convention of Climate Change started, China has a compelling reason to consider regional allocation of CDM projects among the developing countries[xv]. Moreover, China does not approve sink projects as CDM Projects. Therefore, China's attitude toward CDM projects can be summarized as to decide the size of the overall CDM projects with taking the regional allocation among developing countries into consideration, make a list of prioritization from the viewpoint of Chinese domestic policy, and certify them. On the other hand, Japan, in spite of being the largest investing country regarding CDM projects, does not have incentives to limit CDM projects to those requested by China, since Japan has many alternatives to CDM projects in achieving its reduction target (at least from the viewpoint of marginal abatement cost of CO_2 emissions).

6-4 Collaboration of CDM with Different Measures

In order to enhance active implementation of Japan-China CDM projects in the future, it is necessary to have some political support as described below.

Firstly, it is indispensable to reduce project costs. Specifically, establishment of highly transparent and clear-cut guideline is required to reduce the risks concerning the approval of projects by the executive board of CDM, and it would also be effective to strengthen the host country's capacity to implement CDM projects and support their research on feasibility in order to discover possible projects and reduce the risks concerning the approval of projects by the government of the host country. Also, a system to have the government of investing country to buy out CERs should play a certain role in reducing market cost.

The Japanese government is actually taking these measures. Ministry of Economy, Trade and Industry (New Energy Development Organization: NEDO) and Ministry of Environment (Global Environment Center: GEC) are supporting host countries to strengthen their capacity to implement CDM projects and conduct the research on feasibility. Also, Japan Bank for International Cooperation (JBIC) and Development Bank of Japan (DBJ) are planning to establish a Japanese Carbon Fund in 2004 based on the investment by private companies (January 10, 2004, Nihon Keizai Shimbun). The major purpose of the establishment of the fund is to facilitate the finance of mid and small-sized CDM projects.

However, even if these measures are taken, the benefits received by private enterprises may still be smaller compared to their costs and risks. Within the benefits of Japan gained from Japan-China CDM projects, it is necessary to have equivalent financial support with regard to the benefits of private enterprises other than their private benefits. Thus, it should be effective to have policy measures that enable both the Japanese government and the Chinese government to "compensate" for the marginal increment of regional environmental benefits enjoyed by Japan and the marginal increment of local environmental benefits enjoyed by China, respectively.

[xv] In a field survey, multiple parties involved confirmed this fact.

Table 6-1 Risk of CDM Project and Public Financial Scheme

Type of Risk		Public Financial Scheme
Forced Majesty		
Natural Disaster		NEXI's Export and Investment Insurance
War		NEXI's Export and Investment Insurance
Political Risk		
Property Expropriation		NEXI's Export and Investment Insurance
Law Enforcement		
	Violation of bilateral investment agreement	NEXI's Export and Investment Insurance
	Violation/unilateral change of contracts	NEXI's Export and Investment Insurance*
Policy Change		(Buy-out contract between private company and host government)
	Non-Ratification to Kyoto Protocol**	Setting-Up Clear and Transparent Guidelines
Foreign Exchange		(Risk hedge at foreign exchange futures market by private company)
Commercial Risk		
Project Finding		
	Search costs	Financial and Technical Assistance of F/S by NEDO and GEC
	Negotiation costs	Seminar for capacity building by NEDO
	Baseline determination costs**	Setting-Up Clear and Transparent Guidelines
Financial Arrangement		JBIC's investment loan -- cow bell effect
Loss of Concession/ Permission		
	Failure to obtain concession from host country	(Private company)
	Failure to obtain permission from CDM Board**	Financial and Technical Assistance of F/S by NEDO and GEC
Construction Incompletion		(Contract with constructor)
Inappropriate Operation and Maintenance		(Contract with operator)
Fall of Tariff (Price of CER)**		(JBIC's Japan Carbon Fund***)
Financial Arrangement Cost		
Syndicate loan		JBIC's investment loan
Credit Assurance		(JBIC's investment loan)

Note1: Nippon Export and Investment Insurance (NEXI) provides insurance to this risk at a special term of condition.
Note2: Risks which are specific to CDM projects
Note3: JBIC made it public that it would create similar type of the Carbon Fund as the World Bank in February 2003 and January 2004. However, any such fund has been created by January 2004.

Conclusion

China is one of the key countries for global climate change since China is the second largest energy consumer, or CO2 emitter. China's marginal cost to abate GHG emissions is lower than industrialized countries like Japan. Therefore, the research aims to analyze how it could be possible for China and Japan to cooperate in win-win strategies of technological cooperation on climate change policy. This research also aims to integrate climate change policy and air pollution control policy in China, because for China it is more urgent issue to control local air pollution.

Although in China the system of charge on SO_2 emissions has been implemented for several years, the negative effects resulted from sulfur deposition has grown into a serious problem not only in China but also in Northeast Asia region. If the damage costs attributed to acid rain is considered, the optimal rate of emission charge is increased. These analytical results indicate that not only domestically, but also regionally optimal policy framework will effectively mitigate the damages caused by SO_2 emissions in Northeast Asia.

The potentiality of CDM and its economic impacts are analyzed using GTAP-E model and Energy Balance Model. We confirmed efficiency improvement in Chinese economy through CDM is much more practical to mitigate global warming than environmental taxation policy in Japan.

Based on a project-based cost benefit analysis on a CDM project in Shanghai Chongming power plant, we may conclude that CDM projects between Japan and China could bring win-win results to both countries. Up to now, however, there have been no case of obtaining CERs by Japan-China CDM projects, and it is not expected to increase quickly in the future. We examined under what conditions the CDM could have precedence over JI or IET and could actually be implemented.

Political support to reduce the risks and costs of CDM project is indispensable to enhance active implementation of Japan-China CDM projects in the future. Highly transparent and clear-cut guideline is necessary to reduce the risks concerning the approval of projects. Strengthening the host country's capacity to implement CDM projects and to discover possible projects is also very effective. The establishment of the financial mechanism such as carbon fund to facilitate the finance of mid and small-sized CDM projects would also contribute to increase the feasibility of the CDM project. Additional policy measures might be necessary to enable both the Japanese government and the Chinese government to "compensate" for the marginal increment of regional environmental benefits enjoyed by Japan and the marginal increment of local environmental benefits enjoyed by China, respectively.