Economic Evaluation of the International Collaboration Project on Global Warming Mitigation

-From the Experience of Activities Implemented Jointly (AIJ) of the World and Japan-

ASUKA-ZHANG Shouchuan (Jusen)

Tohoku University

The Center for North East Asian studies

Katahira 2-1-1, Aoba-ku, Sendai, Miyagi 980-8577, Japan

Tel&Fax: +81-22-217-5679

asuka@sal.tohoku.ac.jp

July 5, 1999

Abstract

This discussion paper is for the policy makers and researchers to have better understandings on the specific content of the international collaboration project on global warming mitigation, the nature of the negotiation between the host and the investor, and the policy correspondence by the government. To do so, first, this paper has sorted out the issues such as the baseline related to the economic evaluation of greenhouse gases (GHGs) emission reduction project (i.e. estimation of GHGs emission reduction amount and cost). Second, the economic evaluation of the actual Activities Implemented Jointly (AIJ) project between China and Japan has been made. From the results of it, various issues relating to the estimation of the specific size of the GHGs emission reduction cost and amount through negotiation have become apparent. Third, by the monetary valuation of the local emission reduction effect of an air pollutant (Sulfur Dioxide:SO_2) of this AIJ Project, it has quantitatively indicated the rise of the project's economic value. Finally, along with the presentation of the author's opinion relating to the specific type of the project expecting investments, appropriate policies, especially by the Japanese Government to deal with the global warming mitigation projects, and the specific input method of public funds have been discussed.

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Introduction

At the Third Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3 to the UNFCCC) held in 1997, as the greenhouse gases(GHGs) emission reduction by international collaboration, the following was newly introduced:

1) Joint Implementation (JI): the transfer of the emission reduction amount created by the GHGs emission reduction project mainly under the international collaboration between OECD countries and former-Soviet Union & Eastern European countries.
2) Clean Development Mechanism (CDM): the transfer of emission reduction amount created by the GHGs emission reduction project mainly under the international collaboration between Developed countries and Developing countries.
3) International Emission Trading(IET).

The introduction of JI/CDM mechanism that involves transfer of capital and GHGs' emission reduction technology means that GHGs will possesses substantial monetary value (carbon credit) and the GHGs emission reduction amount created by other countries can be subtracted from the its own country's emission amount(carbon offset) . Furthermore, at the Fourth Conference of the Parties (COP4) in 1998 while putting the priority on CDM, it has been decided that every institution building of the carbon offset mechanism will aim for the final decision at the Sixth Conference of the Parties (COP6).

However, the GHGs emission reduction project consists of a great variety, and the project relates to all sorts of factors including technological, economical, and social/political factors. On top of that, there are only a few of the detailed review of the Activities Implemented Jointly (AIJ) project, defined at the COP1 held in 1995[1]. Therefore it is predicted that the institution building of the international mechanism will be highly difficult.

Under these situations, this paper, by putting the knowledge of the AIJ project so far in order, aims at the establishment of the project's economic evaluation (the quantitative analysis relating to the emission reduction amount and emission reduction cost) methodology, which is the foundation of the mechanism. Another objective is to deepen the discussion the specific type of the project and the way the public support should be.

In order to do so, first in **1**, we will clarify the basic points at the project's economic evaluation by quoting specific examples of the AIJ projects which have already implemented. In **2**, we will study in depth the case relating to an actual AIJ projects between Japan and China. In **3**, the author's opinion on the projects expecting positive investments from Japan to developing countries and the way that the Japanese Governmental support ought to deal with are presented.

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[1] Netherland's JIN Foundation and Czech's NGO, SEVEn have analyzed 31 cases in the environmental protection field of various Central and Eastern European countries, most likely useful at the comparison study of the carbon offset project among nations (JIN and SEVEn [1997]). Likely, the Nordic Council [1996] and the Nordic Council [1997] have analyzed the AIJ Project between Scandinavian countries and Central and Eastern European countries. Lile et al [1998] have analyzed 4 cases of the USIJI projects. These analyses are one of the few studies analyzing several projects qualitatively and quantitatively on a unified format.

1. The Point of the Project's Economic Evaluation

Generally, at the GHGs emission reduction project, the project's emission reduction cost is calculated as the following formula:

$$\text{GHG emission reduction cost} = \frac{\text{Project cost}}{\text{GHG emission reduction amount}}$$

This emission reduction cost with some amount of profits is the base of the carbon credit price generated from the GHGs emission reduction project, and will be the most important index when comparing it with the carbon credit traded at other AIJ/JI/CDM projects and at the emission trading market.

The GHGs emission reduction amount, along with being the denominator at calculating the emission reduction cost, will decide the final total amount of the carbon credit. Therefore, both the project's hosts and investors, possess the incentive to calculate a larger figure than that of the actual reduction amount. Moreover, the investors, in order to obtain the credit at an inexpensive value, will as much as possible try to invest on projects where reduction cost is small. On the other hand, the hosts, even though they do want to sell the carbon credit as high as possible, will eventually have to lower the prices when the competition with other AIJ/CDM/JI projects and other carbon offset mechanism(i.e. emission trading) becomes keen.

Since the economic evaluation of these projects will be highly affected by the investors' and the hosts' speculations, the establishment of the methodology to evaluate objectively is not an easy task. In this paper, we will clarify the following basic point of issues while presenting concrete examples of the past AIJ projects, classifying the important factors at time of the evaluation:

1) Project Baseline
2) Transaction Cost
3) Timing of Granting Credit and Project Lifetime
4) Secondary-Benefit
5) Others

1.1 Project Baseline

1) Critical Factors at Setting the Baseline

How the future situation (Baseline Scenario = Reference Scenario) where there would be no projects is considered would change the size of the emission reduction amount along with the emission reduction cost. The decision made against the following issues especially would be a critical one:

① How the circumstantial changes in the progress of future technology, the improvement of production process, the rise of the working rate, the timing of fuel conversions, the change in environmental energy policies, the change in industrial policies, and the change of prices[2] would be predicted?

② How the lifetime of a project would be established?

③ How the project/system boundary would be defined?

Predictions relating to the factors in ① will be specifically reflected, for example, upon the specific discount rate when converting future values to present values. In the case of GHGs emission reduction projects, the discount rate of the project cost and emission reduction amount will greatly vary depending on the type of the project. It is also considered that from the viewpoint of the early stabilization of atmospheric GHGs concentration, higher the discount rate on emission reduction amount the more favorable it is[3]. There has also been a debate on the requirement of the ex-post adjustment of the parameters in the baseline.

2) Recent Discussions on Project Baseline

There are various discussions regarding the establishment method of the baseline. However, in conclusion, the author considers that, although a guideline of some sort is needed, parties concerned will have to eventually consent with each other by dealing it case-by-case. On the other hand, a consensus is being formed regarding the "necessity for the simplification/standardization of the certification process" to reduce the transaction cost and gaming. For example, regarding JI between Annex I Parties decided at the COP3, it is considered that the baseline regarding projects' emission amount may be established without studies in detail[4]. This is because that all emission from Annex I Parties are to be counted, if a country cannot comply with its emission quota, it is anticipated that the country will lose its credentials and that its price of carbon credit will fall as a result. In other words, a facility that would restrain "the inflation of carbon credits by sellers" has been built into the JI defined at the COP3.

On the other hand, with regards to the specific definition of the CDM project eligibility and baseline setting it roughly divided into the following considerations. The first consideration is to examine each project's individual profitability indicator such as the internal rate of return. In this case, the baseline(reference scenario) is the project with the highest return which would be implemented under the business-as-usual scenario. If the proposed projects is not profitable compared to the baseline project, the project would be eligible for the CDM. The second

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[2] As a risk (uncertainty) in the business activities of developing countries, the extent of the possibility that changes in such as price would suddenly occur under the initiative of the governments of developing countries without prior notice is frequently pointed out. These "unpredictable change" would make energy-related investments which need the cost benefit analysis based on a long-term scenario physically difficult. This is one of the reasons that ex-post adjustment of the baseline be necessary.

[3] In the *Nordic Council* [1997] (p.40), it states that "The discount rate of the emission reduction amount from the viewpoint of an early stabilization of atmospheric GHGs concentration generally is 3%".

[4] Specifically, for example, the project baseline would be established exactly the same with the total emission amount's baseline scenario of the host country. For details, refer to *Center for Clean Air Policy* [1998].

consideration for the CDM baseline is to set the performance based benchmark figure for baseline. In this case, if the technology is efficient and advanced enough to outperform the "business as usual" base line, the project would be eligible. However, even if it is “a temporary establishment of target”, the setting of some sort of a figure leading to a future commitment is considered to create high repulsion from developing countries.

1.2 Transaction Costs

Generally, transaction costs can be classified into: 1) the cost regarding the project finding, the evaluation, and the management of the project (equivalent to the normal aid project between two countries), and 2) the cost specially generated as JI (application, documentation, demonstration, monitoring, distribution of credits, etc.). In *Nordic Council* [1997], from the experience of the AIJ project among Scandinavian and Central and Eastern European countries, the extent of the transaction cost has been analyzed as follows:[5]

1) In the case of domestic global warming mitigation projects or in energy conservation-related projects, the cost needed for the preparation of the project is approximately 2% of the project cost. In the case where foreign government-related or foreign corporation-related international trading take place, it is 4%.
2) In the ten AIJ projects analyzed, the total initial investment cost (costs related to project excavations, feasibility studies, and facility constructions) of the transaction cost is approximately 12%, and is directly in proportion with the size of the project.
3) In the case of AIJ projects with onerous financial aids (loans), because of the risk taken into account, the transaction cost becomes higher.
4) The cost specially generated as JI is close to a fixed cost within the expense items. This cost, in the case of the five bilateral projects which was the object of the analysis, in average U.S.$30.0,000 per project and accounted for 0.2%~8% of the total initial investment cost.
5) Other than the two projects that involved loans, the transaction cost generated in order to materialize a bilateral AIJ project instead of a domestic one, accounted for 12%~19% of the overall project cost.
6) In the case of multi-national AIJ projects, transaction costs involving such as the preparation, the implementation, the finance, and business trips would account for 14%~29% of the overall project cost.
7) The smaller the project is, the larger the ratio of the transaction cost becomes.

Needless to say, this is with regards to the projects among Scandinavian and Central and Eastern European countries, it is difficult to compare it with the case of other countries. Moreover, the extent of the transaction cost, other than the social infrastructure to accept new mechanisms such as AIJ/JI/CDM, will differ greatly depending on the factors such as 1) the closeness of the historical and cultural relationship between the investing country and the host country, 2) the geographical location, 3) the intensity of ongoing business affairs, and 4) the existence of other

[5] *Nordic Council* [1997], p.51-52.

capital and technology transfer mechanisms.

1.3 Timing of Granting Credit and Project Lifetime

In most cases, the investing country /corporation of AIJ/JI/CDM expects the grant of the credit simultaneously at the start of the investment. However, in past AIJ projects, the actual emission amount differed greatly with the anticipated emission reduction amount at the feasibility study of the planned project (e.g. at the wind power generation project at Jesenick of Czech Republic, the actual emission amount reached less than 30.0% of the anticipated emission reduction amount). Therefore, in *Nordic Council* [1997] (p.61), it emphasizes that "the granting of carbon credit should take place at the time when the actual emission amount becomes apparent" (Naturally, such rules will restrain investments from developed countries.).

Moreover, as choices of the grant period(project lifetime) that would greatly affect the final amount of the carbon credit, 1) the physical lifetime of the project, 2) accounting lifetime (depreciation period, repayment period, etc.), or 3) the period between the actual start and finish of the emission reduction (or, the mix of the three) can be considered. Generally, the physical lifetime is longer than that of the accounting lifetime. Moreover, in consideration of the maintenance level at developing countries, there are cases where similar physical lifetime in developed countries cannot be applied to that of the developing countries. With regards to the start and the finish of the emission reduction, it will also differ greatly depending how the baseline scenario is considered.

Furthermore, the JI, the CDM, and the emission trading mechanisms will intermingle in the market in the future. In this case, considering that JI/CDM may decide the amount of carbon credit at the time when the actual emission reduction by the project is confirmed, there is a possibility of a "wrong estimation" problem occurred at the host countries. These issues may be solved by the risk averse system such as Hedge Funds, however, since the mechanism of it becomes more complex, there is a possibility that the mechanism becomes less attractive to both the investing and the host country's policy issue with a high priority.

1.4. Secondary-Benefits

Along with GHGs emission reduction, there are many projects that simultaneously affect other environmental externalities, which reduce the emission of air pollutants such as Sulfur Dioxide (SO_2), Nitrous Oxide (NO_X), Total Suspended Particles(TSP), etc. By implementing these projects, 1) emission reduction countermeasures of air pollutants will be avoided at the host country, 2) the local environment will be improved. This means that two types of Secondary-Benefits will occur. This first one is the benefit created by the avoidance of air pollutants emission reduction cost originally needed at the host country(avoided cost). The second is the benefit created by the decrease in damage cost[6] .

The consideration for these Secondary-Benefits at calculating the emission reduction cost will greatly change the aspects of the GHGs emission reduction project's overall evaluation. One of the points of the carbon offset project is the existence of the benefit procurable by the host country. Moreover, even in developing countries, the improvement of air quality is becoming a policy issue with a high priority. Therefore, at negotiations regarding the amount, the price, and the sharing of the

carbon credit between the host and investing country, it is considered that the quantification (monetary valuation) of such Secondary-Benefits generated by the project carry a set of roles.

1.5. Other Factors

Other than the factors stated earlier, there are factors suggested to be considered at the time of implementing the project by the investing and the host country. They are such as the possibility of public fund's availability, the consistency among the host country's economic policies and energy/environmental policies, the impact on the host country's economy, the consistency between corporations' foreign direct investment strategy, and the conditions on the intellectual property rights, etc.

2. Case Study: The AIJ Project between Japan and China (Installment of Coke Dry Quenching Facility)

In this section, while basing squarely on the economic evaluation points in **1** of this paper, based on interviews conducted by the author with parties concerned, we will study the case which includes the economic evaluation of the actual AIJ project between Japan and China. This AIJ project, being the first attempt for both Japan and China, had many issues to be negotiated such as the confirmation of technological specifications, the ratio of fund contribution, the calculation method of emission reduction amount and emission reduction costs, etc. Especially in this study, the negotiation process regarding emission reduction amount and cost that needed to be reported to the Secretariat of the UNFCCC was highly paid attention to. The difference in the way of thinking and the arguments brought about from both parties are intriguing and considered to be helpful to understand the nature of negotiation for the carbon offset project.

2.1 The Outline of the Project

This project started out when Nippon Steel Corporation (hereinafter, Nippon Steel), as one of the projects under the Green Aid Plan[7] of the Ministry of International Trade and Industry (MITI) of Japan, brought it up with China in 1994. The technology that was to be transferred to China (Capital

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[6] The damage cost is the monetary value of the damage the ecosystem suffers by air pollutants, which includes such as the damage amount of agricultural products, medical expense to recover health, and restoration expense of acidification affected buildings, etc. By the GHGs emission reduction project simultaneously reducing air pollutant emissions, this damage cost decreases. It is also possible to consider this cost as "unnecessary cost = avoided cost". However, in this paper, in order to make distinction between "avoided cost", it is referred to as "damage cost".

[7] The Green Aid Plan is the mechanism that MITI, using its own funds, conduct mainly the transfer of renewable technogy, environmental protection technology and energy conservation technology to six Asian nations. Started in 1992, a budget of approximately 13.9 billion Japanese yen was appropriated in 1998. A large portion of the original funds are that of the special accounts relating to the revenue from the energy tax levied on the electricity, and is not counted in the ODA. With regards to the project cost, it is common that Japan contributes to most of the facility expense within the initial cost, and the host country contributes to construction costs, wages, and operational costs.

Steel Corporation of Beijing) was the Coke Dry Quenching facility (hereinafter, CDQ). This was expected to conserve energy and reduce GHGs emission by collecting waste heat from red-heat coke using an inert gas (nitrogen). At cases where these CDQ facility is installed, not only will it contribute to the direct energy conservation effect of collecting waste heat radiated in the former cooling method (wet quenching = water cooling), but will also offer expectations of an indirect energy conservation effect of decrease in energy intensity (the amount of Coke needed to manufacture a ton of liquefied steel in a blast furnace) of Coke used at blast furnaces by the improvement of the quality of the Coke treated at a CDQ facility. Moreover, since the large amount of air pollutants (SO_2, NO_X, TSP, etc.) formed at the time of wet quenching of red-heat Coke would not be present by the airtight dry quenching of the CDQ, it will benefit the effect of a remarkable improvement of air quality surrounding the steel refineries(Secondary-Benefit mentioned in **1.4**) .

This project has been applied to the first public subscription of the AIJ Japan Program in 1997, and has been approved by the Japanese Government as an AIJ Project (New Energy and Industrial Technology Development Organization: NEDO is the implementing body)[8]. And in December of 1997, the Chinese Government approved it as the first AIJ Project. However, at this point, the consensus between Japan and China on the details of the total amount of the initial investment cost, the share ratio of the initial investment cost, the GHGs emission reduction amount, and the emission reduction cost has not yet been formed. Finally, after a year on November 4th, 1998, the consensus was reported to the Secretariat of the UNFCCC by the Japanese Government after negotiations as stated below[9].

2.2 Negotiations Regarding Reduction Amount and Cost

1) Japanese Views on the Emission Reduction Amount

By installing the CDQ facility as stated earlier, there are two effects that can be anticipated: 1) the direct effect of the collection of waste heat from red-heat Coke, and 2) the indirect effect of the reduction of the amount of Coke used in blast furnaces. Therefore, the Japanese side asserted that the total of 87,000 tons of CO_2 per year from direct effects (68,000 tons CO_2/year) and indirect effects (19,000 tons CO_2/year) will be the GHGs emission reduction amount of this project.

2) Chinese Views on the Emission Reduction Amount

In contradiction with the Japanese assertion, the Chinese side claimed to only consider the direct effects, in other words, the effect by collecting waste heat as the emission reduction amount. The reason to this claim was that “the indirect effect of the reduction of the amount of Coke used does not have any merit to the steel refinery concerned”. This Chinese assertion, considering the fact

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[8] According to the interview by the author with the NEDO personnel in charge in August of 1997, the Japanese Government (MITI) held policies that “made requests to the host country that all energy conservation model project under the Green Aid Plan be basically treated as an AIJ Project.” In reality, this kind of policy has the aspect of making the agreement formation regarding the implementation of the Green Aid Plan itself with the host country difficult. For example, China asserts that “the projects of the Green Aid Plan and the AIJ projects be considered separately”.

[9] As of Jan. 1999, the Chinese Government has not reported yet the consensus formed with Japan to the Secretariat of the UNFCCC.

that the Coke at this refinery was purchased from outer source, made it difficult for the Japanese to consent to it. Nevertheless, the Japan-China consensus concluded that only the direct effect portion would be considered as the emission reduction amount.

3) Japanese Views on the Emission Reduction Cost

The Japan-China consensus that the total initial investment cost be approximately 26.8 million U.S. Dollars and the project lifetime be 20 years have already been formed.[10] Therefore, Japan asserted that "U.S.$19.6/ton$CO_2$, which is calculated by dividing the 20 years total of the CO_2 total emission reduction amount (68,000 x 20) by the project's total initial investment cost, should be the reduction cost".

4) Chinese Views on the Emission Reduction Cost

In contradiction, the Chinese claimed that "circumstantial changes such as the future improvement of the technology level and the change of fuel price should be incorporated in the baseline scenario". This is based on the views that "the total emission reduction amount during the 20 year period will be smaller than that in the case where calculated by a static (no changes within the 20 year period) baseline" and that "future costs and benefits will vary greatly by such as the change in prices". Moreover, the Chinese have also asserted that "the running cost created by the introduction of the CDQ facility should be added on to the reduction cost". As the running cost, they have presented a figure of U.S.$10.4/ton$CO_2$ to their Japanese counterpart (**Table 1**).

4) The Final Japan-China Consensus

Although the Chinese asserted a non-static(dynamic) baseline regarding emission amount, its concrete establishment method (the size of the discount rate, etc.) was not presented[11]. Therefore, the consensus was formed by the final total of U.S. $30.0/ton$CO_2$ as this project's GHGs emission reduction cost, which is the addition of the $19.6/ton$CO_2$ (initial investment cost divided by the emission reduction amount) to the $10.4/ton$CO_2$ that the Chinese side asserted as the running cost, and was reported as such to the Secretariat of the UNFCCC by the Japanese Government. Moreover, with regards to the intellectual property right, the following consensus has been formed: 1) the intellectual property right concerning CDQ will be owned by Japan for the first 10 years. During this period, technology contents are not allowed to be leaked, and the technology itself may not be transferred to other parties. After the first 10 years, China (in this case, Capital Steel Corporation) will possess all technologies.

5) Thought on the Negotiations between Japan and China

This project, at least at this point, is an AIJ project that the emission reduction amount do not possess (with small gaming incentive) monetary value as credit. The investment amount (fund

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[10] Generally, the lifetime of a project under the Green Aid Plan is considered to be 20 years.

[11] The reasons why the Chinese side did not present concrete suggestions regarding such as discount rates are considered to be that: 1) both an accurate and a quantitative prediction of the future circumstances was also difficult even for the Chinese side, and 2) was afraid that the setting of a concrete discount rate would make it a *fait accompli* for the target figure of future commitments.

Table 1. The Calculation Process of US$10.4/tonCO2 Presented by Chinese Side to Japanese Side as the "Running Cost"

Cost Items	Unit	In the Case of Cooling by CDQ	In the Case of Existing Cooling Method
Coke Combustion Cost	10,000yuan/year	11,583 2)	11,583
Cooling Cost	10,000yuan/year	2,168 3)	304
Steam Supply Cost	10,000yuan/year	0	1,274 4)
Incremental Cost by Adopting CDQ	10,000yuan/year	590 5)	
Cost per Unit of Emission Reduction Amount	USDollars/tonCO2	10.4 6)	

Remarks:
1) The source is made by author based on the calculation by the researchers of Tsinghua University(Liu [1998]) who handled the economic evaluation of this project on the Chinese side.
2) The Chinese side do not consider the reduction of Coke usage by the installment of CDQ as an effect. Therefore, the Coke Combustion Cost will be the same in both cases.
3) The Cooling Cost is the total of the depreciation cost (the equal installment of the total initial investment amount in 20 years), the operational cost, and the financial cost (interest on current funds).
4) The Steam Supply Cost is the cost of same steam in the case of CDQ needed to be created at existing boilers. The fuel cost required to supply steam occupies a large portion of this cost. This avoided fuel cost is considered as an economic benefit from installing the CDQ facility.
5) The incremental cost by adopting CDQ is calculated by subtracting the cost in the case CDQ is not adopted from the cost in the case CDQ is adopted. In other words, it is calculated as 2168 – (304 + 1274) = 5.9 million yuan/year. This 5.9 million yuan/year includes the reduction portion of the Steam Supply Cost, which is an economic benefit of installing the CDQ.
6) US$10.4/tonCO2, which is the cost per unit of emission reduction amount, is calculated by dividing the incremental portion when adopting CDQ of 5.9 million yuan/year by the total emission reduction amount of 68,000 tons CO2/year.
7) The foreign currency exchange rate agreed between Japanese side and Chinese side is 1 U.S. Dollar=8.3 Chinese Yuan=127 Japanese Yen.

transfer amount = CDQ's facility cost) from Japan was to a certain extent already decided before the negotiations began. From these reasons, it is gathered that the Chinese had the intentions "to negotiate the emission reduction amount as little as possible so that the cost per unit of reduction amount will be as large as possible". For this reason, it is believed that the Chinese did not approve the benefit achievable from indirect effects (decrease usage of Coke) by the installment of the CDQ facility, and that, regarding the baseline, they have also asserted strongly of some sort dynamic baseline setting rather than a flat one. Most probably, in the background of such assertions, it can be viewed that since the amount of the Japanese contribution has been set in prior, to nominally rise the price of the carbon credit at AIJ projects between Japan and China, will strengthen the bargaining power of China in future AIJ/CDM projects with Japan and other developed countries. Needless to say, if the price of the carbon credit is too high, it is possible that the CDM with China will be less attractive. However, as for China, because it has a certain amount of confidence in the "attractiveness of the Chinese market as a carbon credit supply source", predictions can be made that they considered that at the least, "the carbon credit is to be sold high in the beginning".

On the other hand, since it was an AIJ project without carbon credit, and moreover, since the Japanese contribution amount was already almost decided, Japanese side did not necessarily have to strongly push through the assertion concerning the amount of the emission reduction cost (the price of carbon credit). With regards to the emission reduction amount, considering the case that the GHGs emission reduction amount by AIJ projects after the year 2000 holds substantial value as carbon credit, it is viewed that Japan wanted to include the indirect effect portion. However, the fact that the annual reduction amount being calculated as a static one, is a favorable result for Japan. Moreover , since this project holds a "symbolic" meaning as the first AIJ project for Japan, it is also considerable that Japan had strong intentions to materialize the project itself.

However, the agreed emission reduction cost of U.S.$30.0/ton$CO_2$ has accounting problems in the calculation method. The U.S.$19.6/ton$CO_2$ that Japan asserted is the total initial investment cost divided by 20 years worth of the total emission reduction amount, and the fixed capital which is an object of depreciation is included. On the other hand, in the U.S.$10.4/ton$CO_2$ (Chinese calculation) that the Japanese regard as "the running cost consisting of only the variable operation and management cost", depreciation (total initial investment cost divided by 20 years) as the cost of project implementing is also in reality counted in here (refer to remark #3 of **Table 1**). In other words, in the U.S.$30.0/ton$CO_2$ calculated by summing the U.S.$19.6/ton$CO_2$ and the U.S.$10.4/ton$CO_2$, the fixed capital portion of the cost has been double-counted.

If the specific method of the setting baseline is included, there are no uniformly established calculation methods for the emission reduction cost by AIJ projects. However, for example, the World Bank and the Swedish Government define "the difference of the present value of the total cost (the sum total of the initial investment cost and the running cost not including depreciation) in each of the case of the AIJ project being implemented and the case of the baseline scenario divided by the difference of the present value of the according total emission reduction amount" as the emission reduction cost at the evaluation of its own AIJ projects. If this definition(incremental cost) is adopted, U.S.$10.4/ton$CO_2$ (Chinese calculation) [12] will be the emission reduction cost of this AIJ project in the case where the discount rate is zero.

Bringing the above to conclusion, it seems that, as a result, two "misunderstandings" has taken place. The first one is that of the Japanese side's assertion that the U.S. $19.6/ton$CO_2$ which is the total of the initial investment cost solely divided by the total emission reduction amount, is the emission reduction cost of this AIJ project. The second one is that the Japanese side recognized the U.S.$10.4/ton$CO_2$, presented by the Chinese side, as the "running cost not including depreciation". In both cases, the lack of sufficient information and understandings regarding the actual cost and benefit in China, and the lack of communication on both parts may have caused the "misunderstandings".

On the other hand, if the Chinese side presented the U.S.$10.4/ton$CO_2$ to the Japanese side as the "running cost only from variable operation and management cost", knowing that the depreciation portion will be double-counted, it may mean that the Chinese side deliberately raised the emission reduction cost. However, if pointed out, it can be predicted that the Chinese side would insist that it was a "second-best measure inevitable in assuring a dynamic baseline". This assertion,

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[12] In such calculation of the emission reduction cost, the energy conservation effect (saving fuel costs) in where the AIJ project took place will be considered. On the calculation implemented by the Chinese side(U.S.$10.4/ton$CO_2$ as emission reduction cost of the AIJ project) , the conserved portion needed to create steam is considered in the baseline. (Refer to Remark #5 of **Table 1**)

as long as consideration on the future change of the cost/benefit and emission reduction amount at economic evaluation of this project did not actually take place, would have a certain extent of persuasion.

In any rate, considering the fact that implementation of this AIJ project as one of the Green Aid Plan project has already been decided before the negotiation, it seems that there was a difference in the bargaining power of the both at the negotiations. Moreover, an aid program such as the Green Aid Plan where the facility cost that occupies a large portion of the project cost is contributed gratuitously by Japan has limits to it to deal with the carbon offset mechanism where a private voluntary participation based on economic rationality is indispensable. Therefore, in the future, either a reconsideration of the existing public support system, or a new institution building will be needed[13].

2.3 Evaluation of Secondary-Benefits

1) Redefinition of Cost and Benefit

At both the emission reduction cost of U.S.$30.0/ton$CO_2$ agreed between Japan and China and the Chinese-presented U.S.$10.4/ton$CO_2$, the Secondary-Benefit (the avoidance of emission reduction cost and environmental improvement of the host country by the simultaneous reduction of GHGs and other air pollutants such as SO_2) discussed in **1.4** of this paper, is not considered. Therefore, in this section, we will try to re-evaluate the project's economic values by making evident the monetary value of the Secondary-Benefit brought about by the decrease of coal usage as a result of CDQ installments. In order to do so, we will classify and define cost and benefit as follows. Further in the discussion below, the discount rate utilized for the conversion of present value is considered to be zero.

Emission Reduction Cost:

The difference in the present value of the total cost of the case where the project is implemented (as in the case where CDQ is installed) and of the case where the project is not implemented (as in the case where the baseline scenario utilizes the conventional cooling method) divided by the difference in the present value of the total GHGs emission reduction amount will be considered as the reduction cost. In this study, the benefits in ③ and ④ explained below will be considered as the "negative emission reduction cost".

Benefits generated from the Emission Reduction:

① Benefits by the emission reduction of GHGs

② Benefits by energy conservation such as saving fuel costs

③ Benefits by the avoidance of SO_2 emission reduction cost needed originally in the host country itself in which a simultaneous emission reduction of GHGs and SO_2 take place(avoided cost).

[13] MITI has provided a subsidy for feasibility study in correspondence with AIJ/JI/CDM from 1998. The 1998 budget was approximately JPY2.2 billion(U.S.$18 million) , and in July, 1998, subsidies to 37 projects in Russia, China, etc. was decided.

④ Benefits by the decrease in damage costs due to the improvement in the environment of the host country in which a simultaneous emission reduction of GHGs and SO_2 take place.

In case where cost and benefit is defined as such, at the U.S.$10.4/ton$CO_2$ considerable as the GHGs emission reduction cost by this AIJ project, only the GHGs emission reduction in ① above, and the fuel cost savings for the steam generation of ② above, are considered as a benefit.

2) Monetary Valuation of Secondary-Benefit

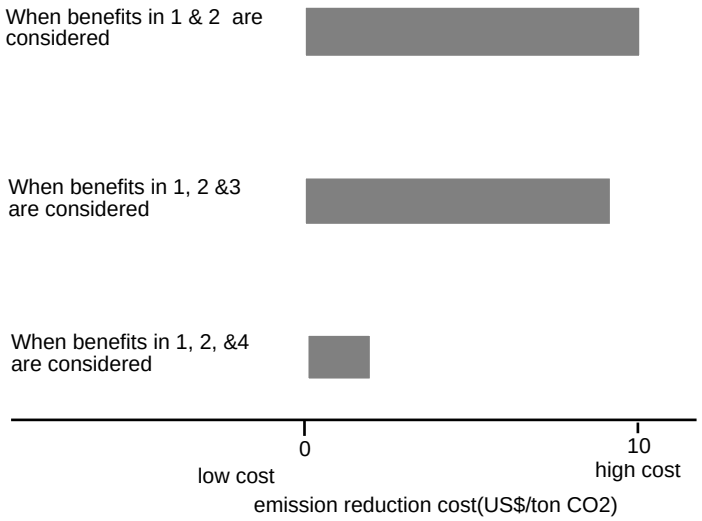
In the case where the conventional cooling method of the baseline scenario is utilized, the amount of coal consumption needed generate steam, according to the Chinese data (*Liu* [1998]) is approximately 37,200 tons/year. If we utilize the emission reduction (JPY20,000 = US$157) [14] per one ton of SO_2 emission in China in the case where simplified and inexpensive method of Fluid-Gas Desulfurization facility, a technology being transferred from Japan to China by other Green Aid Plan projects, is utilized, and the sulfur content of coal is set at 1%, the emission reduction cost (avoided cost) of SO_2 needed originally if the AIJ project did not take place can be calculated as U.S.$117,180/year (37,200 x 0.01 x 157). Therefore, since the CO_2 emission reduction amount is 68,000 tons CO_2/year in this AIJ project, the extent of the benefit in ③ above per 1 ton of CO_2 emission reduction amount would be approximately U.S.$1.70/ton$CO_2$ (117,180/68,000).

Similarly, the extent of the benefit in ④ above for China, generated by the SO_2 emission reduction simultaneously would be approximately U.S.$8.50/ton$CO_2$ when the damage cost per 1 ton of SO_2 emission in China(6,461 Chinese yuan = U.S. $778, *Tsinghua University • Environmental Science Research Institute* ,1998) is utilized. From the above, where the SO_2 emission reduction is considered as a Secondary-Benefit, as well as this benefit be considered as a "negative emission reduction cost", the value (emission reduction cost) of this AIJ project will change as in **Figure 1**[15]**.**

It is also possible that the Chinese counterparts will not show interest (superficially) on such effects generated by Secondary-Benefits. However, as stated in section **1.4** of this paper, the size of this Secondary-Benefit will have great importance to both Japan and China as the judgement index of an overall economic value of the project in the case when comparing with several projects. It is also assumed that If the damage cause by the air pollution became more serious, the Chinese Government would give the Multi Benefits more consideration. Moreover, as for Japan being the investing country, information regarding the size of the Secondary-Benefit would be important as an explanation to the Japanese people at the time of investment with public funds to the carbon offset mechanism.

[14] *Sugiyama et al* [1998].

[15] Only the SO_2 emission reduction is considered as the Secondary-Benefit here. Therefore, when other air pollutants such as NOx and TSP considered, the emission reduction cost becomes smaller and generates a larger economic benefit.



Remarks) Smaller the reduction cost, higher the project's economic value.

Figure 1. Emission Reduction Cost of the AIJ Project (CDQ installment) where Multi-Benefit is Considered.

3. Discussion: Japan's Way of Correspondence

In this section, we will discuss the detailed content of projects expecting investment from Japan where 1) the size of the risk (uncertainty) and transaction cost, 2) the size of the comprehensive benefit considering cash flow , rate of return, the emission reduction of other air pollutants, and 3) the extent of the possibility of agreement between the party concerned, are especially taken into account. Moreover, on the assumption that at this point a public financial support of some sort is indispensable for AIJ/JI/CDM, the author will state the possible way for the Japanese Government to deal with it to deepen specific discussion of the policy formulation for the carbon offset mechanism.

3.1 Project Expecting Investment from Japan

In the light of the present circumstance where GHGs emission quotas and carbon tax has not yet been domestically systemized in Japan, in order for private corporations to participate in the carbon offset mechanism, to select a project with some economic potential and with business opportunities as an AIJ/JI/CDM project would be a choice with the least risk. Moreover, with its close geographical, historical, and business relationship, a project with Asian countries as a host country would be considered attractive, because of its readiness in project finding, the future business opportunity, and the necessity of the emission reduction of GHGs and other air pollutants which has been causing serious health problem of the local people as well as the heavy damage on the ecosystem.

Also within the projects with high economic potentials, demand in developing countries, especially Asia, is large as well as the rehabilitation of and/or establishment of a power generating facilities anticipated as a Secondary-Benefit. For example in China, it has been adding new power generating facilities of approximately 10 million kWh roughly equal to 15 middle-sized thermal power plant, however, most of it have been conventional coal-fired power plants which is considered to be inefficient compared with the level of the developed countries. With regards to power plants, Japanese electric utility companies, manufacturers, and trading firms have already started survey on the possibility of efficiency improvement at aging power plants in developing countries as a part of international collaboration or as a candidate of an AIJ/JI/CDM project. To expect the active involvement of the private capital, several feasibility studies have concluded that constructing a new and middle-or-large sized thermal power plant would be more meaningful as well as economical than just improving efficiency of aging plant which, in some cases, requires enormous efforts as well as substantial fund which is not so different in size compared to that of the construction of new plant[16]. Moreover, it is pointed out that the risk and the transaction cost of supply-side power generation projects are smaller compared with other industrial and demand-side energy-related projects[17]. Therefore, the author considers that from the facts and the study of it, new establishment projects of efficient coal-fired thermal power plants, such as a super-critical units, are considered appropriate for Japan's CDM projects with developing countries in Asia such as China[18].

With regards to the setting of the emission baseline on those cases, setting the CO_2 emission amount per unit amount of power generation of the host country's average power plants as the baseline(benchmark) would make the consensus formation possible and simple. At least in the case of power generation facilities, the assumption of emission amount after construction would be simpler compared with projects of other types. Moreover, in power generation projects over a certain size, the issues on the baseline, additionality, and sharing regarding carbon credit would be able to be dealt as a part of the investment value evaluation issue of the comprehensive negotiation on the project implementation. Furthermore, the gap of the bargaining power between developing countries with conditions that needs the introduction of foreign capital to enlarge power supply and the developed countries is not that big.

In reality, in new power generation projects, it is highly possible that power generation manufacturers in collaboration with trading firms and banks use project financing mechanisms such as BOT (Built-Operate-Transfer) as an IPP (Independent Power Producer). Moreover, along with taking the air pollution issue into consideration, it should also be possible that the Japanese Government strongly suggest to the Chinese Government, the obligation to install desulfurization facilities at power plants newly built by CDM.

3.2 Governmental Correspondence and Usage of Public Funds

Asian countries, especially China, may be considering the existing financial & technological

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[16] For example, *Inoue* [1998], p.89.

[17] *Nordic Council* [1997], p.92.

[18] Needless to say, in reality, the materialization of the project itself involves many difficulties, especially in developing countries. Therefore, the "project expected on Japan" here, does not necessarily agree with the "project easily materialized".

support from Japan as part of the “post-war compensation”. Therefore, it can be predicted that the issue of “financial additionality”, which states that the funds for the international collaboration for global warming mitigation measure should be newly and additional, may strongly be persisted on. Moreover, even if the government of the host country approves utilizing the existing ODA, Japan will be forced to compromise in other parts, and as a result, it is possible that the cost becomes higher.

Therefore, in regards with public funds, it is better to clarify the distinction between the part dealing with fields such as global warming which is a multi-lateral international environmental policy based on economic rationality as well as a domestic industrial economic policy and the part dealing with bilateral development aid which is a diplomatic tool against developing countries with historical complications. Furthermore, it is considered that the Japanese Export/Import Bank loans that does not count as an ODA[19], will be in practical use constructively in the international collaboration on global warming mitigation. In other words, by giving a part of the public fund a “fresh new look”, a title as such as in “Climate Fund” implemented by the Norwegian government, and a special budget on an onerous financial support could be provided. Needless to say, such as an expansion of subsidies (i.e. the current Green Aid Plan by MITI) with energy-related tax as the originating fund and 'flexible' application of the Export Insurance could be considered as well. For example , it could be considered that the Export Insurance system can be modified to be able to absorb the risk of the price volatility of the carbon credit. In this context, establishment of carbon tax as a fund source would be an important issue for further discussion in near future. In any rate, from both sides of the appeal to the international society and of the accountability to the domestic society, the author welcomes the consideration of the introduction of a budget with a new title regarding the public support of global warming mitigation by international collaboration.

Moreover, if Japan takes the global warming issues as important diplomatic and economic issues, and decides to deal with it more positively, it may well help to construct a mechanism in Asia similar to Carbon Brokerage that the World Bank is considering(Prototype Investment Fund). In specific, it can be considered to let the Asian Development Bank (ADB) carry out such function. As a matter of fact, in Europe, the European Bank for Reconstruction and Development (EBRD) has a plan to begin its own Carbon Brokering Program(Energy Efficiency Equity Fund) other than that of the World Bank. Furthermore, it should be possible to relate the institution building regarding the global warming issue with the institution building with regard to the acidification issue which is also an urgent issue in the East Asia. In fact, there have already been plans of emission trading of SO_2 between countries in Europe, and also in the U.S., inter-gas emission trading of CO_2 and SO_2 have actually taken place.

In any rate, the construction of a common policy formation setting of an international environmental policy based on economic rationality can be linked to various diplomatic & economic issues such as energy and food security, foreign direct investment etc. Moreover, the global warming and the acidification of the ecosystem are issues that will largely affect the industrial structure and the whole society of Japan. Therefore, in order to tackle the issues, a simultaneous building of both the international and the domestic mechanisms with the consideration for the various issue-linkages is required, and the government’s strategic correspondence that will link the two will be strongly expected.

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[19] Originating fund is the "Tresuary Investment and Loan" account consisting of the revenue from the Government bond, Postal Savings, etc..

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