Toward promotion of CDM activities in China

--- A study of CDM potential in China focusing on electric power sector and energy-intensive industries ---

Keio University, Tokyo and Tsinghua University, Beijing 5 year joint research work during 1999-2003 funded by NEDO (New Energy and Industrial Technology Development Organization), Japan

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Preface

This paper shows tentative outcome of Keio/Tsinghua Universities' 5-year joint project on CDM in China since April 1999. At the end of March, 2004, final conclusion will be drawn.

The above joint project is one of various projects undertaken between Keio University and Tsinghua University under the uniform title of 3E study sponsored by NEDO (New Energy and Industrial Technology Development Organization), Japan.
3E stands for Economy, Energy and Environment.

The purpose of the study is to contribute sustainable development of China through promoting CDM activities. For that purpose a cost-effective and reliable methodology of estimating CO_2 emission reduction potential has been developed. This would become never possible without time-consuming and persevering efforts performed by Professor Lu and other members of Tsinghua University and staffs in various power plants in China. Another purpose of the study is to provide reliable figures on emission reduction potentials and costs of CDM activities in China to prospective investors worldwide. Though this is a joint project between two countries, it was thought that the outcome should be distributed all over the world so that all interested investors would be able to refer.

The Keio/Tsinghua joint project is characterized as adopting thorough bottom-up approach. No macro-economic model has been applied. Especially in power generation sector, most of time had been spent to gather actual data (basic key data of all power generation units in North China as well as detailed data for selected model units). Based on these data, and applying actual prices of coal and natural gas provided by Tsinghua/power company team in China, it became possible to estimate figures of CO2 emission reductions in this sector. The members of the joint project consist of various experts ranging from climate expert (such as a member of the methodology panel set up under the Executive Board) and economist, to business people from both countries, including a mechanical engineer who used to station in China and actually designed boilers and other equipments in Chinese power plants. This best mix of experts of the team made the outcome of the research more realistic.

As to the targeted sectors, power generation sector was selected first of all, because it was supposed that this is the sector where the potential of emission reduction would be the biggest. Thereafter, other energy intensive sectors have been picked up. They are Iron and Steel, Pulp and Paper, Cement, Oil Refinery and Chemical sectors. Due to time constraint, however, data for those energy intensive sectors (other than power generation sector) have been collected from various Japanese model projects in China funded by NEDO (For paper & Pulp sector, data of the model project in Philippine have been used due to limited data availability in China). With this regard, there exists a room for improving data quality in the future.

Process of analysis is as follows; Firstly, based on collected data and literatures, model plant/unit and applicable technology for CDM project is selected. Secondly, baseline emission is calculated. At this stage, "existing actual emission" described as one of three baseline methodologies in the Marrakesh Accord (FCCC/CP/2001/L.24/Add.2) has been adopted[1]. Thirdly, CO_2 emission reductions of the selected model plant/unit equipped with selected technology are calculated. Fourthly, with the supposition that all plants/units are almost similar to the model plant/unit, total emission reductions in the selected sector throughout China is calculated. As explained in part 1 of this paper, all the plants/units that have either already installed or no such feasibility to install the

1 Due to data availability, another two methodologies seem to be difficult to employ. In addition, after discussion between climate experts of both countries, we came to the conclusion that the methodology adopted in this paper was most plausible. For example, as to baseline emission of fuel switching project of 300 MW power unit, it was calculated on the assumption that coal would be used continuously in the absence of CDM project due to cost element. With regard to application of the baseline methodology, however, further study and discussion would follow in future.

technology selected for CDM, are excluded. At this stage, physical emission reduction potential of CDM projects of each sector by corresponding technologies becomes available (but without taking consideration of cost factors). Then, adopting the costing methodology described in detail in part 1, cost to reduce one ton of CO_2 is calculated. Discount rate of 8% is adopted based on the information provided by Tsinghua University. Finally a table of CO_2 reduction potential corresponding to various costs is shown. Readers will notice how potential reduction of CDM project varies according to market value of CO_2.

Outcome of the joint study is quite stimulating. Following the above process, total (physical) emission reduction potential by sector is shown below.

Table 1 Comparison of CDM reduction potential by sector

Sector	Reduction potential, 1000 CO2 t/y
Power Generation	73,429
Iron & Steel	5,744
Paper & Pulp	394 – 1,172
Cement	13,275
Oil Refinery & Chemical	8,625
Total	101,473 – 102,245

From table 1, it is very clear that, among major emitting sectors, power generation sector is the most promising one. This outcome is in line with general feelings. Among potential reductions in this sector, reduction from fuel switching projects from coal to natural gas in 300 MW units is the biggest (45, 550 thousand t/y).

Once cost factor has been taken into consideration, however, the above picture changes rather drastically. Figure 1 shows reduction potential by technology corresponding to reduction cost on the assumption of crediting period of 7 years.

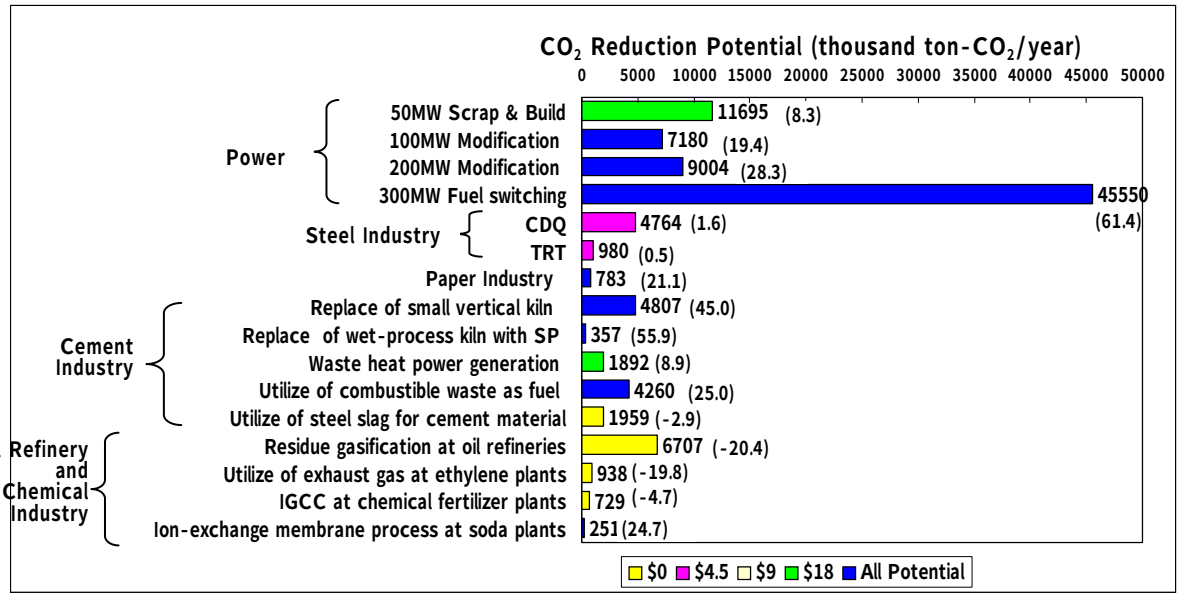

Figure 1 Reduction Potential corresponding to cost

What Figure 1 tells us is that there exist, even at negative cost, several CDM options, such as residue gasification at oil refineries and utilization of steel slag for cement material etc. However, total potential is rather limited as 10,333 CO2t/y (just one tenth of physical reduction potential). At reduction cost of $4.5 per ton of CO_2 the technologies in Iron & Steel sector will come into market, but reduction figure increases not so much, only up to 16,077 CO_2t/y. At cost of $9, no new technology appears into market, and only at cost of $18, power generation projects for scrap and build of old 50 MW units will be materialized. As shown in Figure 1, seemingly most promising fuel switching projects at power plants will never be introduced until investors will emerge who do not mind to pay as high as $61.4 to reduce one ton of CO_2 emission annually. In view of current CO_2 price of around $3 – 5, this means potential for commercially viable CDM project is not so large, especially so for fuel switching projects at power plants. Furthermore, as existing emission is used as baseline, and as model units/plants are the ones that are rather old, it may be reasonable to assume that baseline emissions will be on high side. This being the case, the above assumption on the commercially viable project potential may also be on high side. This means, at the same time, that public funding is essential to promote CDM projects further in China.

The above is a "tentative" conclusion of the joint study. However, further works to improve quality and reliability of this study should be pursued.

1) Baseline methodology should be re-examined to reflect recent executive board's discussion. It is absolutely necessary to prove that the methodology adopted in this paper is most plausible. Thanks to cooperation of Tsinghua team and members of CDM study committee in Japan, project design documents (PDD) are being prepared for selected pilot projects. Through this procedure, baseline methodology is expected to become more reliable.
2) Appropriateness of selection of model units/plants should be revisited. Inappropriate selection of model units/plants may lead to misleading conclusion.
3) There are still lots of rooms for data quality improvement. For example, except for power generation units, data used in this study were picked up from various feasibility studies funded by NEDO. As a result, basic data, such as price of coal differs by each study. For example, for paper & pulp sector, price of 115 yuan/t was used, whereas for other sectors except for power generation 177 yuan/t was adopted (for power generation sector, 115 – 126 yuan/t was applied based on the actual data provided by local utility companies[2]). These should be aligned into actual prices by asking Tsinghua University and related industries to provide current data. As

[2] Data of coal price provided by Tsinghua University varies by location of power plant from yuan 115/t to yuan 230/t. 115 – 126 yuan/t are the price of coal for the model units chosen.

to the price of natural gas used in this study, it is more than eight times as high as price of coal. However the price may differ at the location near to extraction site such as Inner Mongolia. Also it will be necessary to examine whether discount rate of 8% will be most plausible or not. If these data change, estimation of CDM potential should change.

4) It would be a good idea to compare with other top-down model outcome of CDM potential in China. It will help to make clear pros and cons of each methodology.
5) It is absolutely necessary to take transaction cost into consideration. As shown in Michael Axelowa's paper[3], also through our experience, transaction cost may become a key factor in deciding whether to proceed CDM project or not. This will be especially true when credit price of CO_2 is low enough reflecting current slow demand.

Finally it is our desire to explore applicability of this methodology to other developing countries.

[3] Axel Michaelowa et al., "Transaction costs of the Kyoto Mechanisms", HWWA Discussion Paper 175, Hamburg Institute of International Economics, 2002