CDM/JI Project in FY 2005

Study for Laogang Landfill Gas Utilization and Energy Recovery Project in China

Summary

March, 2006
Japan Engineering Consultants Co., Ltd.

1. Basic Elements Regarding Project Implementation

(1) Outline of the Proposed Project and Background for Project Conception and Planning

The City of Shanghai where the project site is located is the largest city in the People's Republic of China (hereinafter referred to as "China") and is the centre of the Chinese economy. The city covers an area of some 6,300 km^2 with a population of some 17.4 million in 2004. The GDP of Shanghai has shown a rapid increase in recent years and the accompanying rapid increase of the electricity demand has created a very tight electric supply and demand situation. The city's Laogang landfill site has an area of some 600 ha and some 6,000 tons of waste are currently disposed at this site per day. The present project aims at collecting landfill gas (LFG), the main constituent of which is methane (a GHG produced at the landfill sites), and using this LFG for power generation. The project has been conceived and planned to improve the global environment using LFG as a clean energy source and to contribute to the sustainable development of the project area through environmental and economic benefits.

(2) Outline of the Host Country

China, the host country, has an area of some 9.6 million km^2 and is the third largest country in the world after Russia and Canada. It has a population of 1,292.27 million (as of the end of 2003) and the capital is Beijing. Although the economic growth of China temporarily slowed down around 1998 and 1999 due to the Asian financial crisis in 1997, the acceleration of foreign trade and the inflow of foreign capitals in the aftermath of China's accession to the WTO in December, 2001 have resulted in high economic growth of 8 – 9% a year in more recent years. This high economic growth has been rapidly increasing the country's power demand, causing a serious power supply shortage, primarily in coastal regions. The continuation of this high economic growth in the coming years is expected to rapidly increase the domestic energy demand. Based on this understanding, the Government of China is promoting the twin goals of the development of the energy sector and energy saving. In terms of energy development, the main focus is placed on the development of power sources, principally relying on coal but also on oil and natural gas. The active development of alternative as well as renewable energies is also planned.
Meanwhile, the vigorous consumption accompanying the rapid expansion of industrial production and economic development has made the issue of waste (pollution by solid waste) a serious problem. In urban areas, the generated volume of solid waste has been increasing at an average annual rate of more than 8% which is roughly the same as the country's economic growth rate. The total urban solid waste dealt with a year passed the 100 million ton mark in 1995 from 30 million tons in 1980. At most landfill sites in China, LFG, the main constituent of

which is methane, is produced from waste, causing not only a serious impact on global warming but also worsening the local environment in terms of bad odour and a fire hazard.

(3) CDM Policies and Situation of the Host Country, Including Acceptance Criteria for CDM and State of DNA Installation

China ratified the Kyoto Protocol in August, 2002. The designated national agency (DNA) was established in July, 2004 within the National Development and Reform Commission. Because cooperation with CDM projects is still a new concept in China, the Government of China had held discussions with research institutions in various sectors and has basically established a project of reviewing and signing CDM projects and a relevant policy scheme based on the principles of "transparency" for policy and management and "simplicity" for processes. The provisional CDM Operation and Management Act was promulgated on 31st May, 2004 and was enforced on 30th June in the same year. Moreover, this provisional act was abolished on 12th October, 2005 and was replaced by the CDM Project Operation and Management Act. The priority fields for CDM projects as recommended by the Government of China are (i) improvement of the energy efficiency, (ii) development and utilisation of alternative and renewable energies and (iii) collection and utilisation of methane gas and coal seam gas.

As part of the CDM certification system, the CDM Review Council has been established under the National Climate Change Coordination Commission (NCCCC) (see Fig. 1).

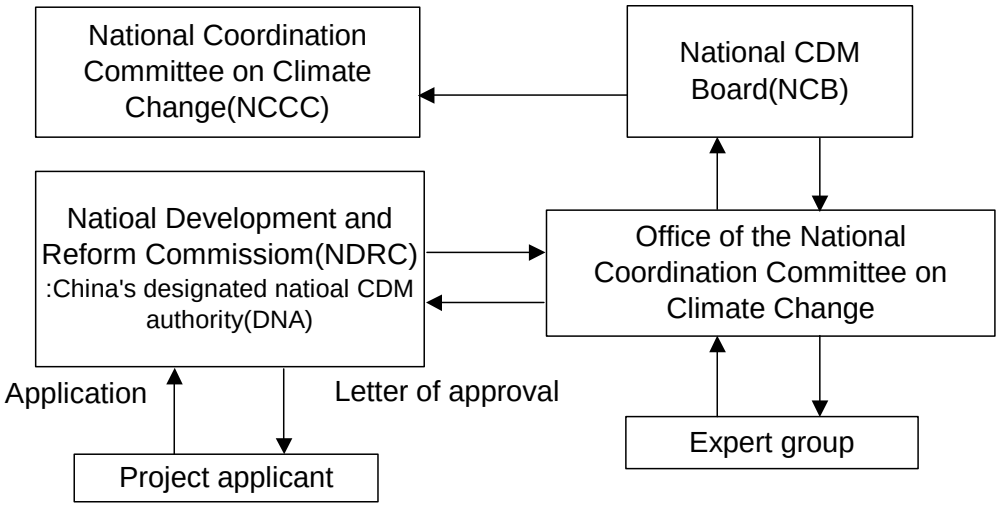

Fig. 1 Organizational flow Chart for CDM Project Approval System

(4) Contribution and Technology Transfer of Proposed Project to Sustainable Development of the Host Country

The Project intends to generate 8 – 15 MW of electric energy to supply electricity to several tens of thousands of people. As the flaring of LFG is not an improvement measure sought by the Government of China, the voluntary improvement envisaged by the Project is judged to

contribute to the sustainability of the local environment. The Project can develop awareness of recycling among local residents that power can be generated from waste at a landfill site and the implementation of the Project will facilitate the effective use of waste.

The Project can also contribute to vocational development and the creation of jobs as it will be necessary for the project management company to employ at least some 20 people. In terms of technological development, the Project will contribute to the spread of similar facilities nationwide, stimulating further development. The GHG targeted by the Project is methane. The electricity generated by the collected methane can be sold to an electricity company to reduce the electric energy to be generated by the existing power station(s). The amount of CO_2 which would have been emitted to generate the reduced portion of electric energy, i.e. reduction of the fuel consumption, will constitute the CO_2 emission reduction under the Project.

(5) Implementation System of the Study (Japan, Host Country and Others)

The implementation body for the Study is Japan Engineering Consultants Co., Ltd. For the preparation of the PDD (project design document) as part of the Study, assistance was provided by Mizuho Information and Research Institute. The field survey was assisted by the Shanghai City Appearance and Environmental Sanitation Administrative Bureau, Shanghai Laogang Waste Disposal Corporation, Shanghai Chengtou Environment Industry Development Co., Ltd. and Shanghai JEC Environmental Consultant Co., Ltd.

2. Planning of the Project

(1) Concrete Contents of the Project

Under the Project, LFG collection wells will be installed at the landfill site and the collected LFG will be fed to the gas engine for power generation after pre-treatment by the gas adjuster. The generated electric energy will be sold except for the portion used by the landfill site and the surplus LFG not used by the gas engine will be burned by flaring.

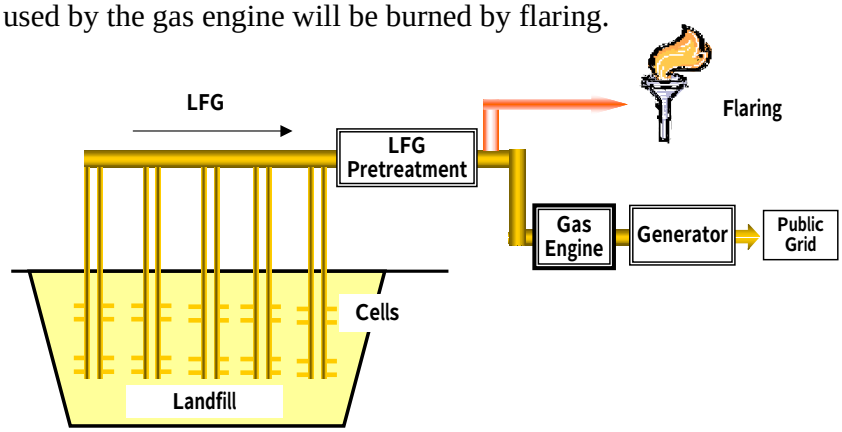

Fig. 2 Conceptual Drawing of LFG Collection and Power Generation at Landfill Site

① LFG Collection System
The LFG collection system will use both vertical and horizontal wells and will be basically the same system which is installed at landfill sites in Japan.

② Gas Engine Generating System
In order to improve the economy of LFG power generation which uses unstable methane gas at a low density, a gas engine using methane constituting 40 – 60% of the LFG fuel will be introduced.

③ LFG Flaring System
The release of methane, a principal constituent of LFG, into the atmosphere is problematic. For this reason, surplus methane will be burned by the flaring system to convert it to CO_2.

(2) Establishment of Project Boundary and Baseline and Proof of Additionality

① Project Boundary
The system boundary for this CDM project is shown in Fig. 3. The system boundary includes the collection of LFG at the landfill site, power generation using methane gas and the supply (sale) of electricity to the power grid. However, as the Project does not cover the collection and transportation of solid waste or the construction and operation of a landfill site, the system boundary excludes the impacts of collection vehicles and others.

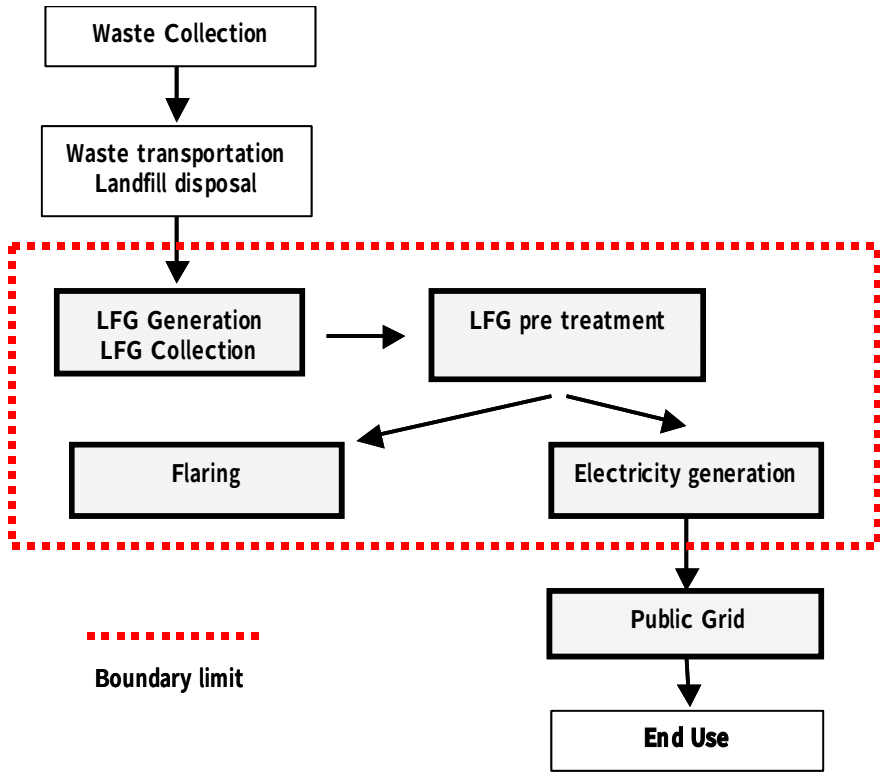

Fig. 3 Flow Chart of System Boundary

② Establishment of the Baseline
For LFG projects, a number of methodologies to determine the baseline (baseline methodologies) for the volume of GHG emission are already approved by the CDM Executive Board. The baseline methodology used for the Project is ACM0001 “Consolidated baseline methodology for landfill gas project activities”. As the purpose of the Project is to achieve an emission reduction effect through the use of an alternative

energy source by using collected methane for power generation with a view to supplying the generated power to the grid, the application of a consolidated methodology is believed to be possible.

Therefore, ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources (the baseline methodology for substituted electricity/heat) is also applied so that the Project can demand CO_2 credit through substitution of system power source.

③ Proof of Additionality

Compared to the existing business practice (baseline) where LFG is neither collected nor burned, the development potential of the Project is evaluated by the bench mark determined by the IRR for the Project and the loan interest rate applicable to investment activities in China (host country). Here, the loan interest rate is 6.12% which is the interest rate charged by commercial banks in China for long-term loans. When the IRR for a project is equivalent to or lower than this rate, the feasibility of the project is considered to be low. The IRR for the Project, excluding the CO_2 credit, is 3.8% and is lower than the commercial interest rate (6.12%). In other words, a methane collection and power generation project which does not anticipate CO_2 credit is not attractive for investors and, therefore, its feasibility is low.

China still does not have any law which makes methane collection at landfill sites a compulsory requirement. As such, most landfill sites do not meet either international construction standards or environmental standards because of the lack of sufficient capital as well as technology.

(3) GHG emission reduction by Project Implementation and Leakage

The amount of GHG emission reduction due to the implementation of the Project is calculated based on the following three elements.

- Emission reduction of methane due to burning for power generation
- Emission reduction of methane due to flaring
- Emission reduction of CO_2 from fossil fuel for the power generation system substituted by the sale of electricity generated by methane

The methane gas to be burned under the Project originates from biomass which absorbs CO_2 in the growth process. As such, CO_2 emission under the Project is considered to be carbon neutral. As the direct monitoring of the emission reduction is conducted under the Project, calculation of the reduction amount is not affected by indirect emission. The calculation of GHG reduction in the case of the Project recognises the difference between with-project which is designed to reduce GHG emission and without-project as the amount of reduction. In the case of this CDM project, GHG emission after the implementation of the Project is interpreted as "0" and, therefore, the reduction amount under the Project is identical to the reduction amount from the baseline (Table 1).

Table 1 Baseline Emission Total

Year of Operation	Year	Reduction of Methane Emission by Power Generation and Flaring (tons-CO_2)	Reduction of CO_2 emission through Substitution of Power System Source (tons-CO_2)	Baseline (tons-CO_2)
1	2007	571,436	48,776	620,212
2	2008	675,238	55,279	730,518
3	2009	780,095	92,056	872,151
4	2010	792,042	92,056	884,098
5	2011	802,941	93,319	896,260
6	2012	812,723	93,506	906,229
7	2013	821,043	86,021	907,064
8	2014	829,052	86,021	915,073
9	2015	835,856	80,181	916,037
10	2016	756,852	80,181	837,033
Total		7,677,279	807,396	8,484,675

(4) Monitoring Plan

The monitoring methodology adopted by this CDM project is ACM0001 “Consolidated baseline methodology for landfill gas project activities”. A LFG collection and utilization project is characterised by its ability to directly measure the amount of emission reduction achieved by the collection and utilisation of LFG which is not released into the atmosphere. For this reason, it is unnecessary to compare the baseline emission amount with the emission amount under the Project to calculate the amount of emission reduction to be achieved by the Project. The monitoring system to be used for the Project is shown in Fig. 4.

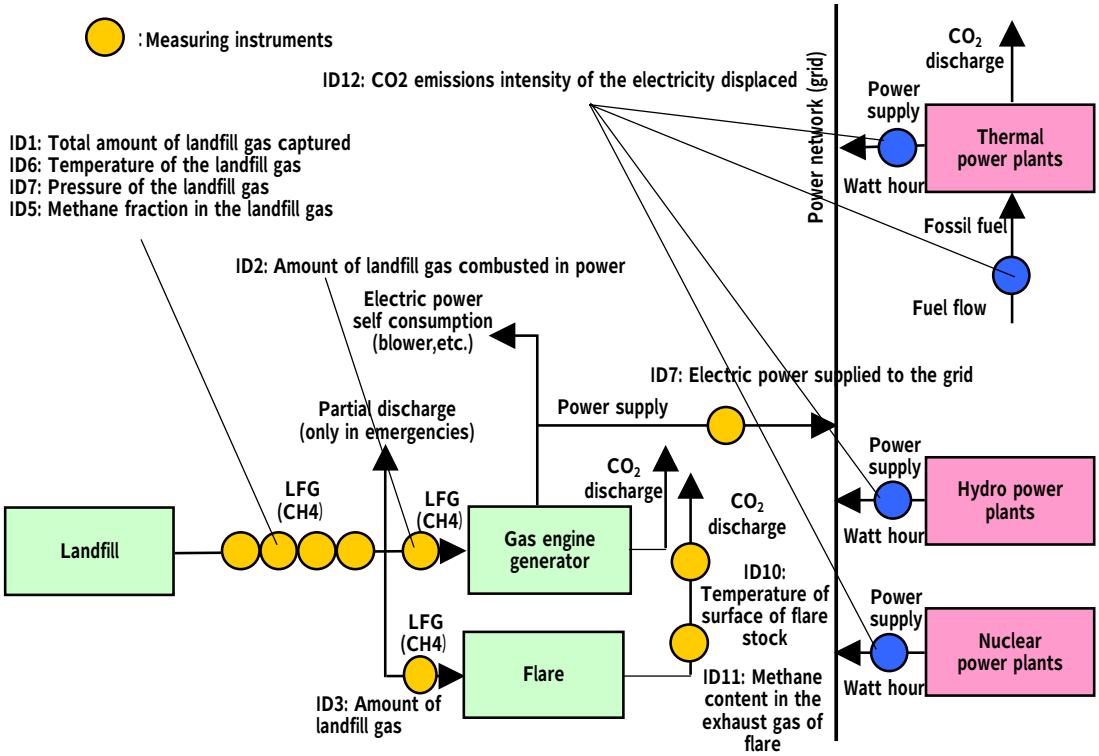

Fig. 4 Monitoring System

(5) Environmental Impacts/Other Indirect Impacts

The anticipated environmental impact factors involved in this CDM project and their assessment results are described below.

① Water Quality
The risk posed by effluent will be reduced due to the drainage of rainwater and reduction of effluent, in turn caused by the cover of the ground surface at the landfill site, alleviating the causes of soil and seawater contamination. The overall risk for a worsening of the water quality will, therefore, be reduced.

② Air
The adverse impacts on the atmospheric conditions, including poisoning by the toxic gases contained in LFG, will be substantially reduced from the present level. The beneficial effects include curtailment of global warming through the collection of methane and other GHGs and the prevention of bad odour.

③ Noise
The Laogang landfill site is located in a suburban area and there are no residents nearby. The huge area of this site will allow the installation of the gas engine, presumably the main source of noise, at an appropriate distance from the site boundary. Moreover, this gas engine will be installed inside a building and the resulting noise level should be reasonably low.

(6) Comments by Stakeholders

The assumed stakeholders for this CDM project are the Ministry of Construction, the Shanghai City Appearance and Environmental Sanitation Administrative Bureau, Shanghai Laogang Waste Disposal Co., Ltd., environment experts of Tongji University and local residents living around the site. Their concrete comments are reproduced below.

① Comment from the Viewpoint of Socioeconomic Development
The flaring of LFG is not an improvement measure sought by the Government of China. With respect to socio-economic development, this landfill gas utilization and energy recovery project is expected to greatly stimulate to utilize waste effectively.

② Comment from the Viewpoint of Environmental Protection
The risk posed by effluent will be reduced due to the drainage of rainwater and reduction of effluent, in turn caused by the cover of the ground surface, alleviating the causes of soil and seawater contamination. The adverse impacts on the atmospheric conditions, including poisoning by the toxic gases contained in LFG, curtailment of global warming through the collection of methane and other GHGs and the prevention of bad odour, will be substantially reduced from the present levels.

③ Comment from the Viewpoint of Impacts on Local Life
The project management company will employ at least some 20 people, contributing to vocational development and improved employment opportunities.

3. Towards Project Materialisation

(1) Project Implementation System (Japan, Host Country and Others)

For the purpose of implementing the CDM project in question, a local company (joint venture: special purpose company (SPC)) will be set up with investment by the Japanese and Chinese sides (Fig. 5). The role of each participating company is described below.

- Investors for local company : Shanghai Chengtou Environment Industry Development Co., Ltd and other Chinese companies.
  Japan Engineering Consultants Co., Ltd and other Japanese companies.
- Preparation of PDD : Mizuho Information and Research Institute
  Japan Engineering Consultants
  Shanghai JEC Environment Consultant Co., Ltd.
- Obtaining of credit : Local company
- Electricity purchaser : Huadong Power Grid Co., Ltd. (Head Office: Shanghai)
- Site management : Shanghai Laogang Waste Disposal Co., Ltd.
- Municipal window : Shanghai City Appearance and Environmental Sanitation Administrative Bureau

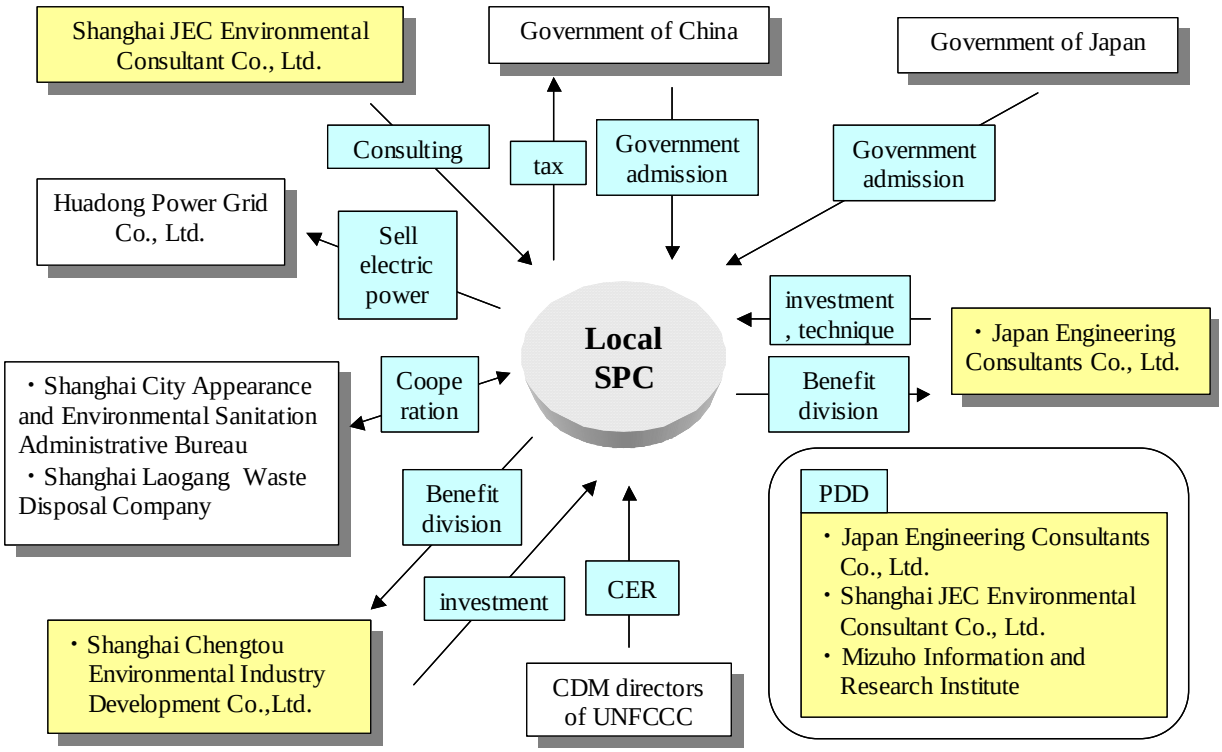

Fig. 5 CDM Project Implementation System

(2) Funding Plan for Project Implementation

The total initial investment cost of the Project will be ¥3,508 million which breaks down to ¥155 million for the detailed study, ¥2,321 million for the manufacture of equipment and systems, ¥673 million for civil engineering work, ¥23 million for the installation of a generator, ¥24 million for test operation and ¥312 million for the contingency budget. The paid capital of the new company will be 30% of the total initial investment cost (¥3,508 million) or ¥1,052 million and the SPC will obtain bank loans to cover 70% (¥2,456 million) of the total cost.

① Paid Capital
The investors on the Chinese side and Japanese side will be Shanghai Chengtou Environment Industry Development Co., Ltd., Japan Engineering Consultants Co., Ltd and other Chinese and Japanese respectively.

- Shanghai Chengtou EID ,etc. : ¥852 million
- Japan Engineering Consultants CO., LTD ,etc. : ¥200 million

② Borrowing by SPC (¥2,456 million)
The SPC plans to borrow ¥2,456 million from city banks in China.

(3) Cost Effectiveness

When the economy of the Project is examined by comparing the without CO_2 credit case (CER) to the with CO_2 credit (at a rate of US$5 (¥550)/ton-$CO_2$) case, the IRR of the Project is substantially higher, indicating the high potential of this LFG collection and power generation project as a CDM project (Table 2).

Table 2 Comparison of IRR Between With and Without CERs

	IRR	Payout Period for Investment
Without CERs	3.8%	8 years
With CERs (US$5/ton-$CO_2$)	16.3%	5 years

At present, there are no preferential taxation and other measures for renewable energies in China. Accordingly, the unit price of CER significantly affects the profitability of a CDM project. The results of the sensitivity analysis based on the CER unit price of US$5/ton-$CO_2$ (¥550/ton-CO_2), US$7/ton-$CO_2$ (¥770/ton-CO_2) and US$10/ton-$CO_2$ (¥1,100/ton-CO_2) indicate a good IRR at US$5/ton-$CO_2$. At the present stage, therefore, a credit level of US$5/ton-$CO_2$ or higher is hoped for (Table 3).

Table 3 Sensitivity Analysis Results

CERs Unit Price / Evaluation Item	Without CERs	US$5/ton-$CO_2$	US$7/ton-$CO_2$	US$10/ton-$CO_2$
IRR (%)	3.8%	16.3%	20.6%	26.4%
Payout Period for Investment	8 years	5 years	5 years	4 years

(4) Prospect of Project Materialisation and Pending Issues

A methane collection and utilization project is a type of CDM project which is given priority by the Government of China. As the Project for the Collection and Utilization of LFG for Power Generation at the Shanghai Laogang Landfill Site which is a CDM project matches the CDM policy of China, the Project can be judged to be the type of project which is likely to be approved by the NDRC (the DNA in China). The implementers of this CDM project will be Chinese and Japanese (JEC) companies. A local company (SPC), more than 50% of the shares of which are held by the Chinese side, will be established as a joint venture to manage the Project.

The Government of China is planning to control the CER price by setting a minimum CER price for CDM projects to avoid confusion. According to the interview results with Mr. Wang of the NDRC (DNA), the Government of China is considering US$7 (¥770) per ton-$CO_2$ as the minimum CER price as of December, 2005. Bearing this minimum CER price in mind, efforts are currently being made to find a Japanese buyer (Japanese Company).

The planned schedule for this CDM project is given below.

April, 2006	:	Establishment of the SPC
April – August, 2006	:	CDM application (China, Japan and the UN)
September – December, 2006	:	Installation of equipment/system
January, 2007	:	Commencement of operation