FY 2005 CDM/ JI project survey commissioned by Ministry of Environment

# Jelekong LFG Collection & Energy Recovery CDM Project

## Report Summary

### 1.Basic factors regarding the implementation of the project

#### (1) Overview of the proposed project and planning background

Fig.1 Location of the Jelekong site

Since most of the waste disposal sites in Indonesia adopt the open- dumping system, water pollution, abnormal and bad odour stemming from disposal sites has had caused serious health consequences to the residents in the surrounding area. Waste disposal sites also emit biogas (Landfill Gas: LFG), including methane, rich in Global Warming Potential, to the atmosphere. The purpose of this survey is to evaluate the feasibility of a project to collect LFG generated from organic fermentation in the Jelekong waste disposal site, located about 25km south from the center of Bandung city, the third largest city in Indonesia, both for power generation and Greenhouse Gas (GHG) emissions reduction.

#### (2) General description of the host country

General description of Indonesia is indicated below.

| | |
|---|---|
| Country name: | Republic of Indonesia |
| Capital: | Jakarta |
| Area: | approximately 1.86million km$^2$ |
| Climate: | Oceanic tropical climate (Rain season Oct.~ Mar. /Dry season Apr.~ Sep.) |
| Population: | about 217million (2004) |
| Ethnic makeup: | Java(45%), Sundanees(14%), Madurese(8%), Malay living near the shore(7%) |
| Language: | Behasa Indonesia |
| Religion: | Muslim87%, Christian10%, Hindu2% |
| Main Industries: | Mining (oil, LNG, aluminum, tin), Agriculture (rice, rubber, palm oil), Industry/Manufacturing (wood products, cement, fertilizer) |
| Currency: | Rupiah (9,345Rp. / US dollar) as of Feb. 2006 |

(3) CDM-related policies and conditions of the host country including the criteria for CDM approval and establishment of DNA

a. Current status of the ratification of the Kyoto Protocol

Indonesia ratified the UNFCCC as a non Annex 1 country in August 1994. The national parliament approved the draft for the ratification of the Kyoto Protocol in June 2004 and the ratification was officially registered in the UNFCCC on 3rd December in the same year. In July 2005, Indonesia established an assessment system for the CDM project and the Designated National Authority (DNA) was officially established.

b. Setting up the DNA

The National Committee for CDM in Indonesia is designated as the DNA, which consists of representatives from 9 ministries including the Ministry of Environment. The secretariat and the technical team form a subcommittee under the National Committee for CDM. Table 1 describes their roles.

Table 1: The role of subcommittee under the National Committee for CDM

| Committee | Role |
|---|---|
| Secretariat | The secretariat is in charge of all paperwork necessary for the smooth proceeding of CDM examinations, including approval of CDM application. |
| Technical Team | In order to support the National Committee for CDM, it examines the appropriateness of the project according to the criterion for sustainable development from an experts' point of view. |
| Experts Advisor | This group is to provide advices when the National Committee for CDM or the Technical Team finds it difficult to judge the appropriateness of the project or when the different expertise is required in order to make judgments. |
| Stakeholder Forum | This forum is convened when the National Committee for CDM decides to do so. |

c. As expressed in Table 2, the Indonesian government has clarified the criteria and indicators, which need to be met in order to get approval as the CDM project.

Table2: Criteria for the CDM project

| Criteria | Key indicators |
|---|---|
| Environmental sustainability | Maintained sustainability of ecological functions.<br>Not exceeding environmental threshold values or quality standard applicable both nationality and locally (not creating air, water, or land pollution). |
| Economic sustainability | Not reducing local community's income.<br>Available measures to tackle any possible impacts resulting in the reduction of the income of certain communities. |
| Social sustainability | Existing consultation with local community. |

| | |
|---|---|
| | Responses and follow-ups with respect to any comments, complaints, and inputs from the local community. |
| Technology sustainability (Technology transfer) | Not creating dependency on foreign counterparts in respect of the knowledge and know-how.<br>Not using trial technology and obsolete technology. |

(4) Contribution to the sustainable development of the host country and technology transfer

The implementation of this project will not only improve the regional environment, but also create new employment opportunities when the new power plant is constructed. With expected ripple effects on the regional society and economy, the project could contribute to sustainable development in Indonesia. The specific contributions, which are expected with regard to sustainable development, are as follows.

a. Improvement of the regional environment

・Alleviation of abnormal and bad odour, reduction of greenhouse gas by collecting LFG from waste disposal sites.

・The regime of efficient use of waste will improve the waste collection system, thus easing hygiene and environmental problems facing the city.

b. Improvement to the welfare of all the country and regional area

・The construction and operation of facilities will create job opportunities and invigorate the regional economy.

・Displacing fossil fuel in power generation will lead to the preservation and the efficient use of national resources.

・The safe closing and stabilization of the waste disposal site.

・Increasing opportunities for foreign capital investment under the CDM system.

(5) The implementation structure of the survey (Japan, the host country and others)

Primarily Tohoku Electric Power Co., Inc., with the cooperation of Kajima Corporation, carried out the survey. Kajima Corporation, which had conducted research and analysis of CDM projects using LFG in Indonesia and Malaysia, was in charge of the drilling the site to collect solid waste samples and Total Organic Carbon (TOC) analysis in this survey. Furthermore, the Badan Pengkajian dan Penerapan Teknologi (BPPT), the governmental agency of Indonesia, collected necessary data and provided advice and cooperation for the survey. It also arranged and coordinated discussions with relevant bodies.

2. Planning of the project

(1) Specific content of the project

a. Site overview

The overview of the Jelekong waste disposal site is described in Table 3

Table 3: The overview of the Jelekong waste disposal site

| | |
|---|---|
| Name | The Jelekong waste disposal site |
| Location | Warga Mekar village |
| Start of operation | 1994 |
| Site area | Approximately 10ha（reclaimed part: about 7ha） |
| Disposal Volume | 1,719$m^3$/day（planned） |
| Site owner | PD Kebersihan |
| Site operator | PD Kebersihan |

The Jelekong waste disposal site was originally built to receive solid waste from surrounding regions such as Bandung. The landslide disaster at the Leugajah waste disposal site, which collected solid waste from a wider areas, occurred in February 2005 and the use of the site became prohibited (It remains closed), and the Jelekong waste disposal site was forced to receive solid waste collected from Bandung city, Cimahi city and Bandung prefecture. Planned disposal volume at the Jelekong waste disposal site was estimated at 1,719 ㎥/day. But the Jelekong site had accepted relatively small amount of solid waste for a long period of times until the Leugajah landslide broke out. Therefore the initial plan to close the landfill in 2001 was put on hold and its operation was expected to extend to 2010.

However, due to the accident at the Leugajah waste disposal site, there was a marked increase in the amount of solid waste taken to the Jelekong waste disposal site. Despite attempts to install a small-scale incineration facility and to extend the landfill, the Jelekong waste disposal site was almost closed as of the end of 2005 because of opposition from the local residents to the extension of waste disposal sites.

As described in Fig.2, a waste disposal site is basically divided into 3 areas. In 1995, the waste landfill began and Area 1 and 2 were covered by soil. In the second half of last year, waste landfill was carried out in the extended part of Area 3, but as described earlier, the site was almost closed at the end of 2005. According to a rough measurement, the landfill is about 150 meters wide (A) and about 240 meters long (B).

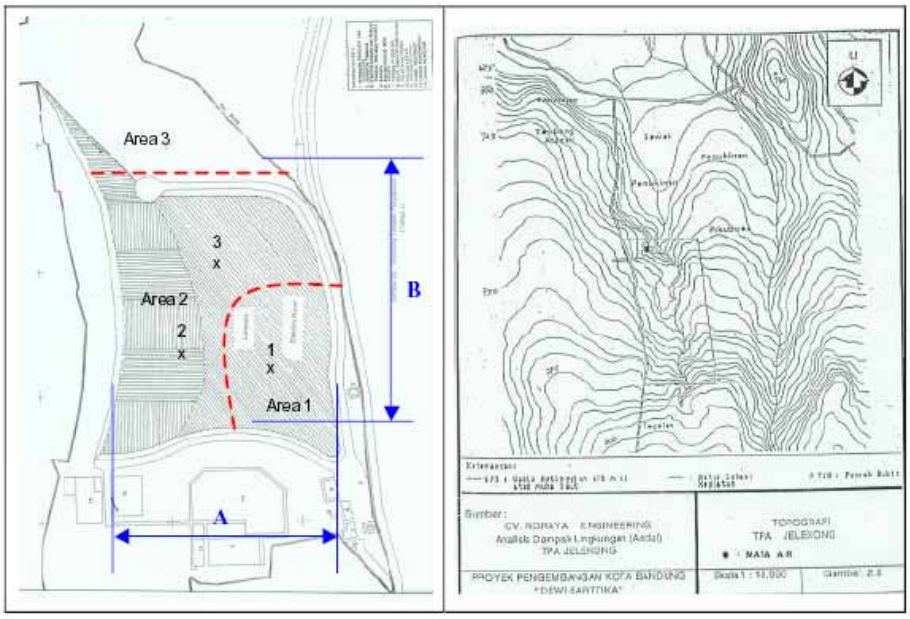


Fig. 2 Overview of the Jelekong waste disposal site

Fig. 3 Photo of the site

b. System flowchart

This project intends to collect LFG from the waste disposal site and use it as fuel for a power generation. The greenhouse effect of methane, the main component of LFG, is 21 times higher than $CO_2$, so preventing methane from being naturally emitted to the atmosphere could help reduce GHG emissions. The project is planning not only to sell generated electricity to the PLN, but also to get CERs by reducing GHG emissions. The system flow of the project is shown in Fig.4. It is divided into “LFG recovery facilities”, “LFG treatment facilities” and “power generation facilities”.

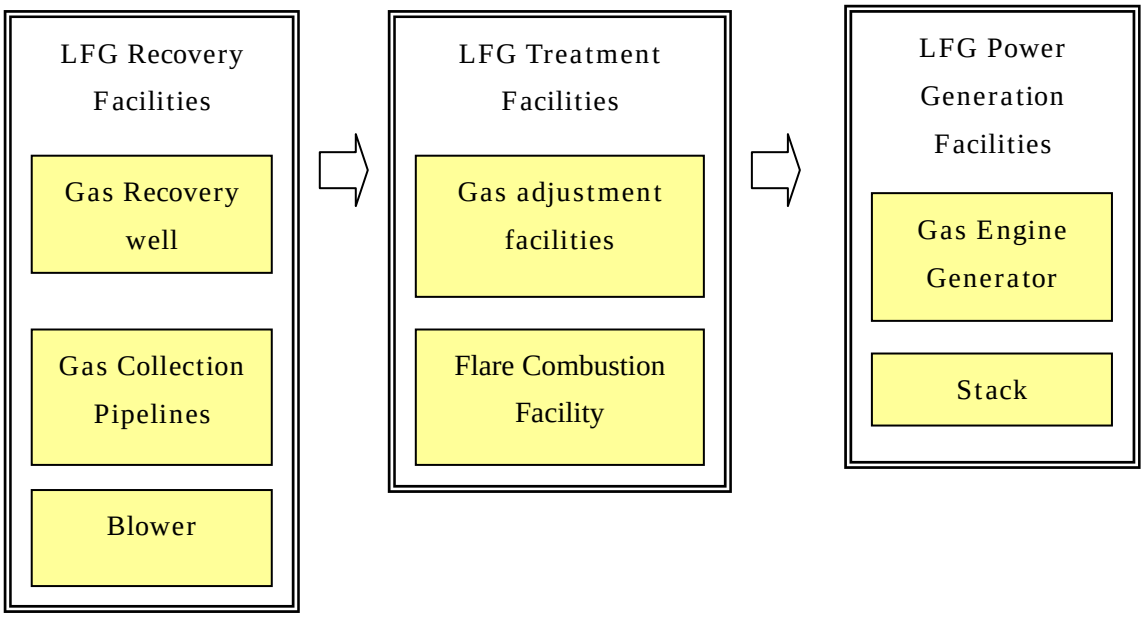


Fig.4 System flow

2) Project boundary, baseline and additionality

a. Project boundary

The project aims to supply electricity to the grid as well as to obtain CERs by displacing the grid electricity generated by fossil fuel; therefore, project boundary includes the Jelekong waste disposal site and the grid.

b. Baseline

The Baseline Methodology used is ACM0001"Consolidated baseline methodology for landfill gas project activities". This methodology can be applied to the project that claims emissions reductions for displacing or avoiding energy from other sources. Taking the result of the site survey, we identify the following 3 scenarios.

- Scenario 1: After the closed waste disposal site is covered with soil, pipes are installed in the ground, through which LFG is collected for power generation.
- Scenario2: After the closed waste disposal site is covered with soil, pipes are installed in the ground, through which LFG is collected for combustion.
- Scenario3: After the closed waste disposal site is covered with soil, extracting gas collection pipes are installed to emit LFG directly to the air.

At present, there are no regulations or laws, which oblige collection of LFG from waste disposal sites regardless of whether they are in operation or not and no projects using LFG have been carried out at waste disposal sites in Indonesia until now. Considering that, when waste disposal sites are closed, they are just covered with soil without any special treatment. After the closing of the Jelekong waste disposal site, the most likely scenario is 3, which can be the baseline of the CDM.

c. Additionality

The survey used the "Tool for the demonstration and assessment of additionality" presented by the CDM executive board and went through the following steps.

Step 0: Preliminary screening based on the starting date of the project activity

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Step 2: Investment analysis

Step 3: Common practice analysis

Step 4: Impact of CDM registration

Following the above analysis, the project proves to be additional by being implemented as the CDM project.

(3) GHG emission reductions and leakage from the project activity

a. Site survey

In order to decide the amount of TOC in solid waste, (which is a significant parameter in evaluating GHG emission reductions), and the value "k", which refers to the LFG generation constant rate, solid waste samples from the landfill was collected by drilling in three places at the site and analyzed. Through holes, measurement

wells were installed to measure the specification of the landfill gas.

Fig.5 Drilling wells

Fig.6 Measuring the flow speed of LFG

Table 4 describes the amount of TOC in solid waste samples taken from 3 places according to depth. The calculation was made assuming that the amount of TOC included in wood chips is 50% in terms of dry weight. According to the analysis; the amount of TOC in solid waste in the Jelekong waste disposal site was 10.6% on average, lower than the default value of 17% indicated in the IPCC guideline. If the amount of TOC in wood chips, whose LFG generation constant rate is extremely low, is not included, it is an average 0.55%. In conclusion, overall, the Jelekong waste disposal site has limited potential to generate LFG.

Table 4: The TOC of solid waste samples

| Objects of analysys | Place of drilling | The amount of TOC in solid waste samples according to depth(%) | | | | |
|---|---|---|---|---|---|---|
| | | 3～6m | 6～9m | 9～12m | 12～15m | 15～16m |
| Small fraction & wood chips | №1 | 6.765 | 5.966 | 6.992 | 7.697 | ——— |
| | №2 | 11.545 | 21.668 | 18.534 | ——— | ——— |
| | №3 | 10.403 | 8.731 | 9.419 | 14.086 | 5.952 |
| Small fraction (Without wood chips) | №1 | 0.375 | 0.098 | 1.555 | 0.456 | ——— |
| | №2 | 0.786 | 0.339 | 0.186 | ——— | ——— |
| | №3 | 0.137 | 0.789 | 0.452 | 0.747 | 0.616 |

**b．** Calculation method for the GHG collected at the site

The survey calculates an amount of GHG collected at the waste deposal site applying formula (1), which is widely used in Europe, and the First Order Decay model (2).

$$G_e = 1.868 \times C_0 \times (0.014 \times T + 0.28) \quad \cdots (1)$$

$G_e$: LFG generation potential ($m^3/t$)

1.868: LFG generation potential from unit organic carbon ($m^3/kg$)

$C_0$: Amount of organic carbon in solid waste (kg/t)

$T$ : Temperature in landfill(℃) (20<℃<40)

$$G_t = G_e \times \left(1 - e^{-kt}\right) \times F_c \quad \cdots (2)$$

$G_t$ : Amount of LFG emission until the year t ($m^3/t$)

$G_e$ : LFG generation potential ($m^3/t$)

$k$ : LFG generation constant rate ($0.05 \leqq k \leqq 0.15$)

$t$ : Year of LFG generation (years)

$F_c$ : Capture ratio

**c.** Calculation for GHG emission reductions

This project is expected to reduce GHG emissions by collecting methane as a fuel for power generation and displacing the grid electricity generated by fossil fuel. Combining both effects, the GHG emission reductions are calculated to be 196,778 $CO_2$-ton during the 10-year project period from2008 to 2017, and about113,134 $CO_2$-ton during the first commitment period of the Kyoto Protocol.

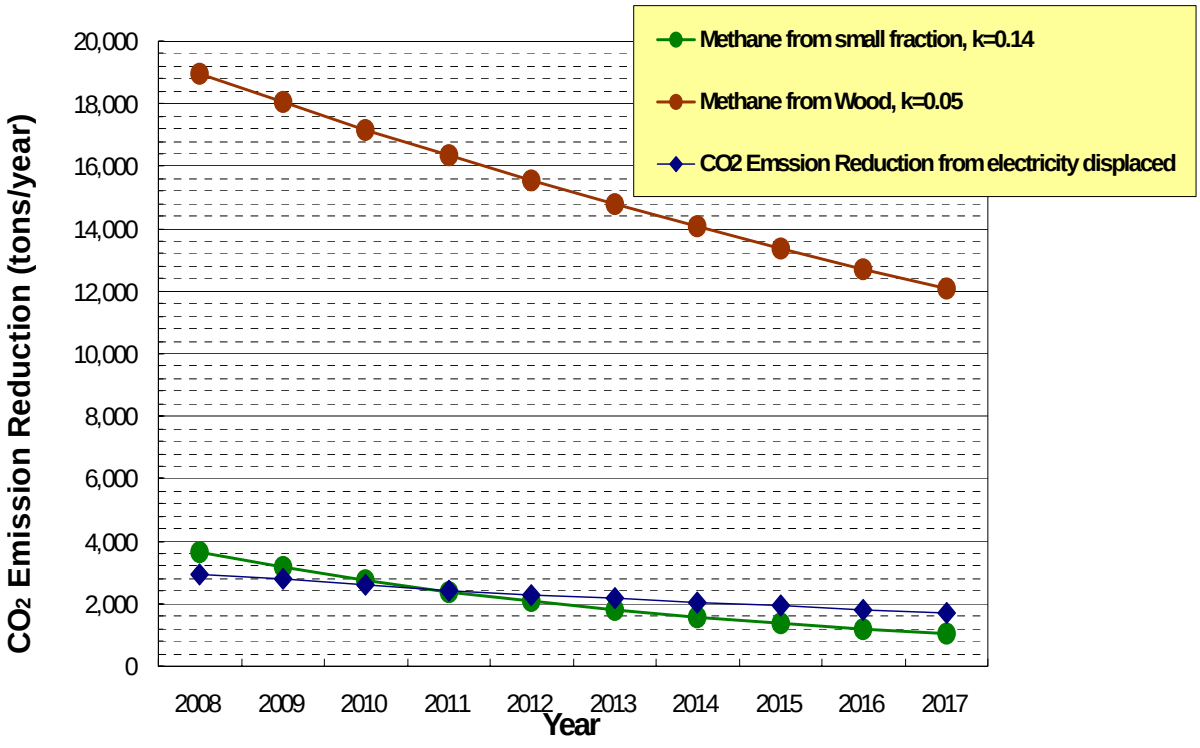


Fig.7 $CO_2$ emission reductions

**d.** Leakage

The project will be implemented inside the waste disposal site after the site closure, making the project a closed system that does not stimulate off-site emissions. Thus no leakage is considered to be likely in this proposed project.

**(4)** Monitoring plan

An approved methodology,ACM0001 " Consolidated monitoring methodology for LFG Collection project activities" is applied to this project.

(5) Environmental impact and other indirect impacts

**a.** Necessary environmental approval

This project doesn't belong to project category, (generation for 10MW and more) which requires environmental impact assessment (EIA) by Indonesian law. Therefore, environmental approval is likely to be obtained simply by submitting the Analysis of Environmental Impact (UKL) and the Environmental Management Plan (UPL) or the like, so the procedure and content is easier than in the case of EIA.

**b.** Environmental impact

The project contributes not only to the global reduction of GHG, but also to the regional environment through improving the abnormal, foul odour. Environmental impacts including noise and vibration during the construction period and exhaust gas and noise from the generators and other equipment used in the operating period are expected, but these will be very limited impacts in consideration of the project size and in-site project.

**c.** Other indirect impacts

With the rising awareness of citizens over human rights due to the progress in democratization in Indonesia over recent years, it is extremely difficult to build new waste disposal sites in the country. How to dispose of the growing waste has become a serious social problem. In this sense, this project, which could improve both regional environment and the safety of the waste disposal site, is considered to be of high priority in the region. Residents' feelings over waste disposal sites are expected to become positive during implementation of the project.

**(6)** Stakehoders'comment

Interviews were taken at the briefing on the results of the survey and upon visiting relevant organizations.

**a.** A briefing on survey results in the region

Date： 17/January/2006 (Tue)

Place： A conference room of the West Java Environmental Protection Agency

Participants： Thirty-eight people, who are engaged in the environmental and public cleaning sector.

Those who play a part in the environment and public cleaning sector in the province participated in the local briefing session. Participants actively exchanged opinions and it was a meaningful briefing in terms of sharing the survey results and for the capacity building among the local people concerned. They expressed a strong hope that the Japanese survey group will continue its activities leading to the CDM project.

Fig.8: Briefing session №1

Fig.9: Briefing session №2

**b.** Comments from government agencies

We visited the central government agencies, including the Ministry of Environment and the Ministry of Public Works, and the local government agencies, such as the Bundung Cleaning Department, to hear comments. All agencies expressed all-out support for the survey and the project.

3. Towards the implementation of the project

(1) Project implementation structure (Japan, Indonesia and others)

To implement the project, a special purpose company (SPC) will be established in Indonesia. The companies, which will invest in the SPC, include Tohoku Electric Power Company, other Japanese companies, and private companies in Indonesia.

(2) Financial plan for the implementation of the project

The necessary funds for the project will be procured through the Project Finance, which is a common way to finance the IPP. Specifically, the equities from investors, including Tohoku Electric Power Company and loans from the JBIC and Japanese commercial banks will be used to implement the project. Furthermore, we will also consider for obtaining a Japanese grant, which the Ministry of Environment in Japan has been promoting CDM/JI project, in order to enhance the stability as the CDM project.

(3) Cost effectiveness

**a.** Evaluation of economic feasibility

To evaluate the economic feasibility of the project, this survey uses the Project Internal Rate of Return (Project IRR) premising that all necessary funds are provided by equity investment. Actually, most of the funds will depend on loans from financial institutions . However, considering the financial risk of the PLN, which is to purchase the generated electricity, there are a lot of uncertainties about raising funds through financial institutions. Therefore, we evaluate the economic feasibility using the Project IRR, which assess the profitability of the project itself without loans. Table 5 describes the assumed conditions, and Table 6 shows the results of the analysis.

Table5: Assumed conditions（base case）

| Item | | Value | Unit |
|---|---|---|---|
| Initial cost | | | |
| | Plant cost | 1,289 | 1,000USD |
| | Project development cost | 65 | 1,000USD |
| Annual cost | | | |
| | O & M cost (annual) | 110 | 1,000USD |
| Revenue | | | |
| | Electricity sales price | 400 | IDR/kWh |
| | CERs price | 10 | USD/ton |

※ 400[IDR] 0.0423[USD]

Table6: Results of the analysis

| | Project IRR(%) |
|---|---|
| Without CERs value | ———— |
| With CERs value | 2.8 |

The calculation shows that, if the CERs value is not taken into account, it is impossible to recover the investment for the 10-year project period. On the other hand, if the CERs value, which amounts to 10[USD/ton], is added to the revenue, the Project IRR will become 2.8%. Accordingly the additionality with regard to investment barrier as a CDM project can be identified. However, a 2.8% return is extremely low; it can be concluded that investing in this project as a CDM project will be less economical.

**b．** Sensitive analysis

The base case sets the electricity sales price at 400[IDR/kWh] and the CERs price at 10[USD/ton]. Here, a sensitive analysis is carried out to see the impact of profitability in case both parameters change. Fig. 10 show the results. As described in Fig. 10, not only the CERs price, but also the electricity sales price to the PLN will have a great deal of impact on the profitability of the project. If the necessary IRR for an investor is assumed to be around 20% with a CERs price of 5[USD/ton], the electricity sales price will have to be 700[IDR/kWh], which is about 1.8 times higher than the present price. Meanwhile, if the CERs price rises to 20[USD/ton], the project will be considered profitable with the electricity sales price at the level of 500[IDR/kWh].

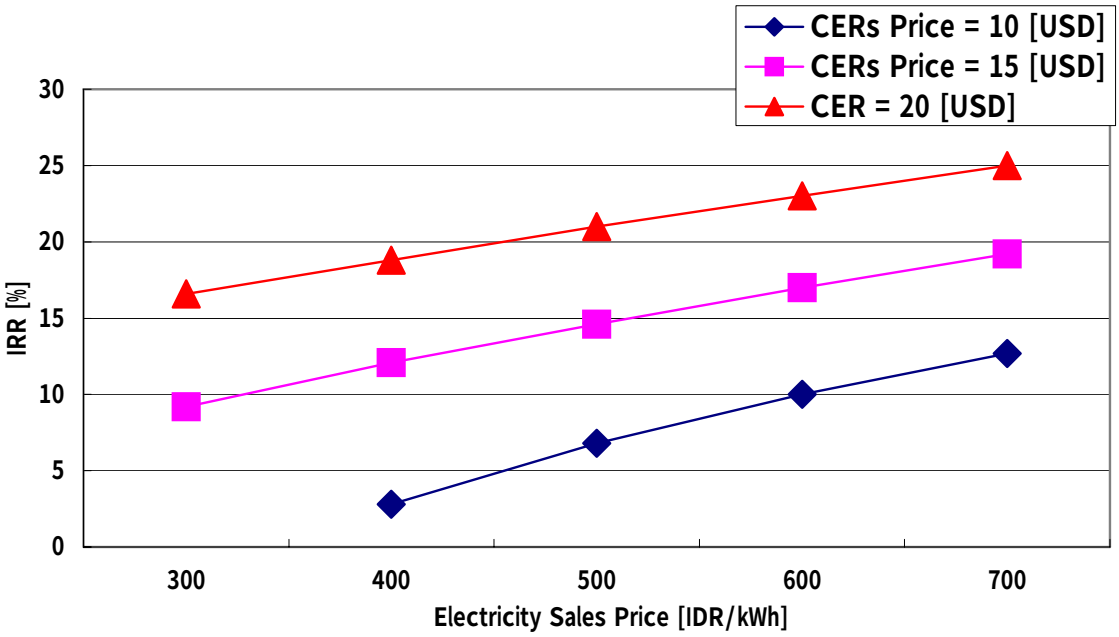


Fig.10 Results of sensitive analysis

c． Profitability of the alternative project, which is only LFG flaring without power generation

In the case of LFG flaring without power generation, the Project IRR is 5.4% at a CERs price of 10[USD/ton]. The profitability will improve a little compared to the Project IRR of 2.8%, which comes only from power generation. However, considering various risks, profitability is not sufficient, so the rise in the market value of the CERs price will be necessary to carry out this option.

(4) Possibility and issue toward project implementation

a． Possibility toward project implementation

This survey has evaluated the feasibility of the power generation project utilizing biogas produced at the Jelekong waste disposal site based on drilling research and chemical analysis of solid waste. In conclusion, the feasibility of the project is considered to be low at present. The reasons for this are as follows.

・ Total TOC in the waste

The IPP guideline estimates the default value of the amount of TOC in waste in Indonesia to be 17%. However, chemical analysis of solid waste has indicated that the amount of TOC was actually only 10.6% including wood chips. If limited to components except wood chips, the amount of TOC was mere 0.55%. As a result, CERs will actually be about 197,000 tons, which is less than half then the initial assumption of 470,000 tons during the 10-year credit period. This is considered to be a prime cause for the low feasibility of the project. The cause of low TOC remains unclear, but it may be attributable to the LFG generation constant rate

under high temperature, high humidity, and washing away of the TOC component by rain. This has made us reaffirm the risk of proceeding projects depending solely on the theoretical figure of the IPCC guideline and the importance of verification made by actual measurements.

・The problem posed by the site area at the Jelekong waste disposal site

This landfill site belongs to a medium scale waste disposal site with 10ha of the total site area (waste landfill is available for 7 ha). Before the survey, we assumed that 7 ha of area could be used and the site area is likely to be expanded given that there are not many waste disposal sites in the Bandung region. However, the landslide disaster at the Leugajah waste disposal site has worsened the public image of waste disposal sites, and residents living in the surrounding area have rejected plans to expand the Jelekong waste disposal site more fiercely than was expected. As a consequence, the Jelekong waste disposal site was almost closed at the end of December 2005. No precise measurements were carried out in this survey, but rough measurements indicate the area of waste landfill is around 3.6 ha. If the waste contained a lot of TOC, it would compensate for the small scale of the area and the small amount of waste. However, it is concluded that the amount of TOC was considerably low in the Jelekong waste disposal site and the necessary methane couldn't be collected.

**b.** The issue toward project implementation

Though we have concluded that the feasibility of the methane collection and power generation project at the Jelekong waste disposal site is low, the plan should be reevaluated when the following positive changes occur.

・Expansion of the waste disposal site

A new waste disposal sites is planed around Bundung city, but residents have staged demonstrations there, too. The Jelekong waste disposal site appears to be being used for a couple of months on a temporary basis. The solid waste problem in the Bundung region remains serious and if some troubles arise in operating new waste disposal sites, the reuse and expansion of the Jelekong waste disposal site might be considered an option. We will closely follow the solid waste problem in the Bundung region, including the reuse and expansion of the Jelekong waste disposal site.

・ Electricity off-take price raising

The PLN has an obligation to buy electricity generated by renewable energy (less than 1MW), but its price is about 80% of the average generating cost of the electric power stations connected to the main Grid. There is no price privilege system for renewable energy at this moment. Meanwhile, the Indonesian government (the Ministry of energy and Mineral Resources) has come up with a policy of raising the rate of renewable energy in power generation to over 5%. Indonesia, which is one of OPEC members and has slipped to de facto importing country in spite of its membership to OPEC, regards the utilization of renewable energy in place of fossil fuel as important. Financial analysis demonstrates that the electricity sales price has a huge impact on the profitability of projects. Thus, if the Indonesian government decides to increase the electricity off-take price, the feasibility of the project will be enhanced.

・ A rise in market price of CERs

It is obvious from financial analysis that a rise in market price of CERs holds the key to increasing the feasibility of the project.

**c.** Feasibility of the project, which is LFG flaring without power generation

Based on the conclusion that the feasibility of the project is low at present, we have studied the profitability of the alternative project, which is collected LFG flaring without power generation. The results show that although project revenue will decrease, the Project IRR will improve a little compared to what it is by power generation because of the decline in the initial investment and the O&M cost. However, taking risks regarding the country and the troubles of equipment into account, its profitability is not sufficient to attract investors as CDM project. The rise in the market price of the CERs will be a necessary condition to carry out this option.

According to interviews from the Ministry of Environment, it seems unclear whether or not a CDM project, which is LFG flaring without power generation, is consistent with sustainable development of Indonesia. This needs to be checked when further study regarding this project is carried out.

**d.** Potential issues regarding the implementing LFG collection projects in Indonesia.

This survey has made clear that there are potential issues when implementing projects utilizing colleted LFG in Indonesia. They are as follows.

- Although the population in Indonesia is over 200 millions, there are only a few large scale disposal sites only around Jakarta and Surabaya. The reasons may be attributed to the fact that the population is scattered over many islands and it is difficult to transport the solid waste for long-distance due to unimproved road infrastructure. As a result, small disposal sites are built around cities. In conclusion, there is limited potential for LFG collection projects in Indonesia.
- At the point of constructing waste disposal sites, collecting LFG is not considered, and few sites are covered by soil during operations. In these sites, potential for methane production becomes low due to the progress of aerobic fermentation and organic components may also be wiped out because much rain soaks through waste in the tropical weather. Therefore, effective collection of LFG is considered to be difficult.

When LFG collection projects are studied in Indonesia, project sites need to be properly selected taking into account the problems mentioned above. If possible, it might be necessary for project organizers to give technical advices in the planning and designing phase of waste disposal sites having the implementation of LFG collection projects in mind.