CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

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SECTION A. General description of project activity

A.1 Title of the project activity:

Jelekong LFG Collection & Energy Recovery CDM Project

A.2. Description of the project activity:

This project aim to recover the biogas derived from Jelekong waste disposal site in Indonesia due to organic fermentation and to utilize the biogas for generating electricity.

Jelekong waste disposal site is in Warga Makar Village, which is located 25km south from Bandung City (the 3rd biggest city in Indonesia), Waste Java State. The total area of landfill site is 10ha (effective area: 7ha). This landfill site had been operated since 1994 with an average disposal volume planed 1,719m^3/day. Since the landslide disaster at the Leuwigajah final waste landfill Site, which was the biggest landfill in this area, was occurred at the end of February 2005 and all solid waste from Bundung city, Cimahi city and parts of Bundung regency, previously disposed to Leuwigajah final waste landfill Site, was disposed to Jelekong waste disposal Site, solid waste volume to Jelekong waste disposal site was raised to 10 times than normal disposal. Therefore, the local government intended to expand the disposal site and extend the operation life. However, Jelekong waste disposal Site was closed at the end of 2005 due to the objections of local residents. Since there are no other capable landfill sites receiving solid waste nearby, future handling of Jelekong waste disposal Site remain fluid.

The project involves installing equipment for landfill gas collection for fuel and energy recovery with gas engine generator. The plant will consist of gas collection pipeline system, a gas dryer, a gas holder, and gas engine generators.

This kind of technology is useful for other Indonesian open dumping waste disposal sites, which are now suffering from smell and natural occurrence of fire. The technology prevents such disasters and can be applied countrywide.

The project is intended to play an important role in the safety closure of the landfill site by eliminating the emission of landfill gas. The project is consistent with the national criteria and indicators of sustainable development, which is mentioned in “Indonesian DNA’s Approval Mechanism”, policy paper of the Ministry of Environment.

A.3. Project participants:

Country	Organization	Intention to participate in the project (Yes/No)
Indonesia (host)	To be determined	Yes
Japan	Tohoku Electric Power Co., Inc.	Yes

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Indonesia

A.4.1.2. Region/State/Province etc.:

West Java

A.4.1.3. City/Town/Community etc:

Warga Makar Village

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

The project site is located in Warga Makar Village, which is located 25km south from Bandung City, Waste Java State. The location map is shown in the following.

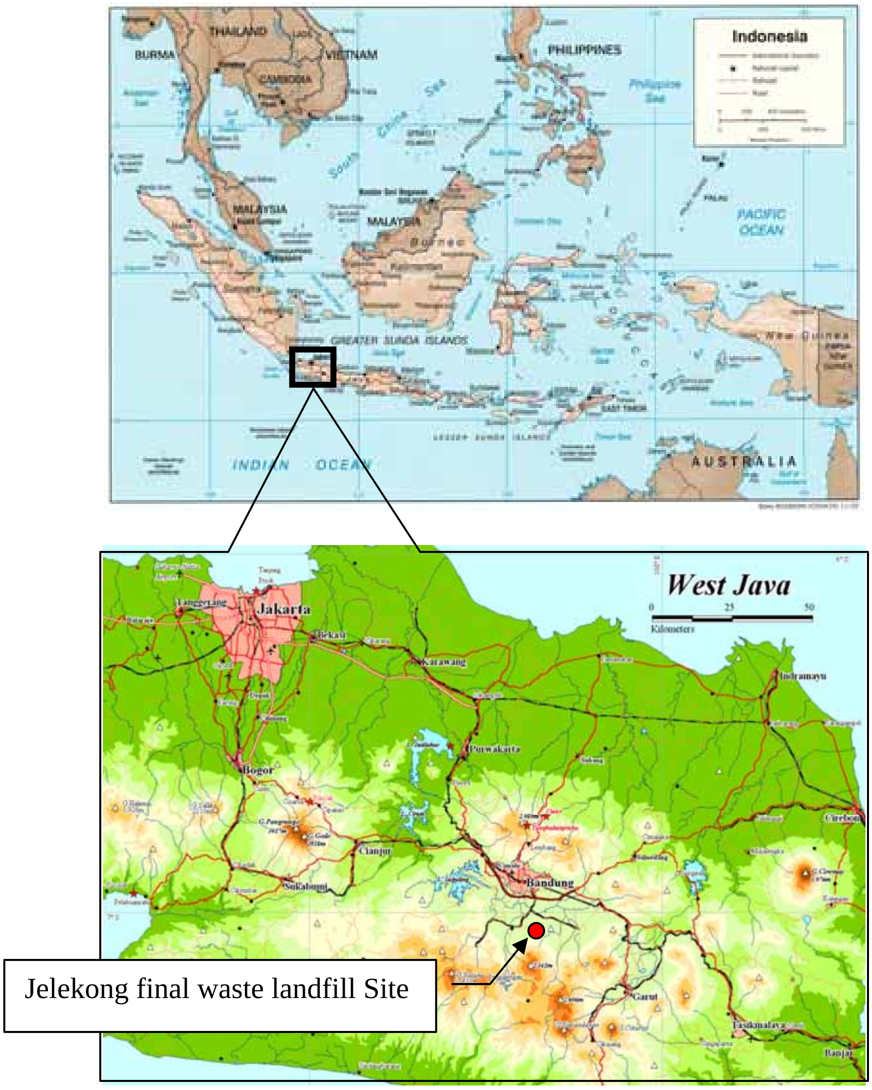

Figure-1 Location of Project Site

A.4.2. Category(ies) of project activity:

Waste handling and disposal

A.4.3. Technology to be employed by the project activity:

The project will involve proven technology and hardware for the recovery, collection and treatment of landfill gas (LFG) and power generation by utilizing gas. The facilities proposed for the project consist of LFG recovery facilities, LFG treatment facilities, and LFG power generation facilities as shown in Figure-2. The details of each system are as follows.

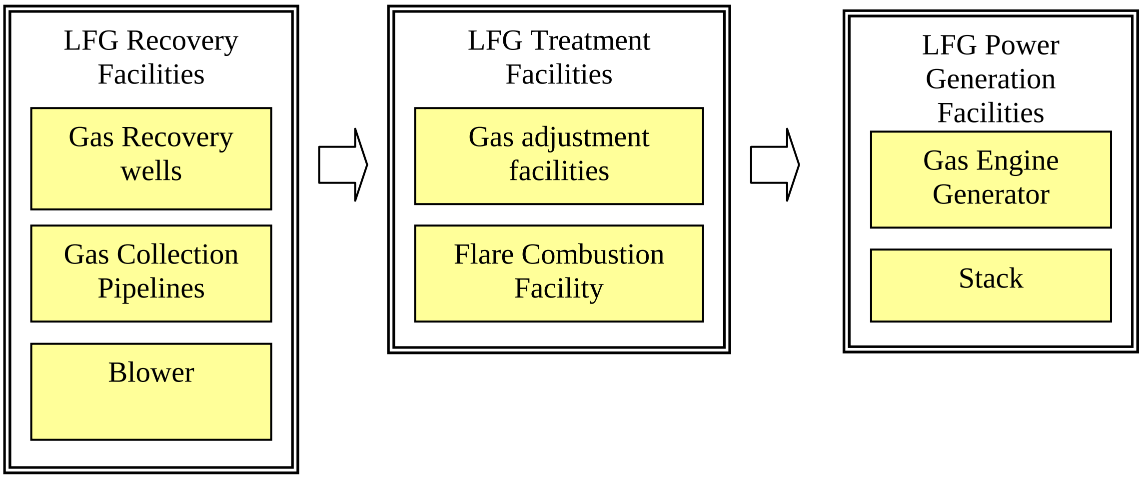

Figure-2 Overview flowchart of the LFG facilities

LFG Recovery Facilities

In the LFG recovery facilities, LFG is collected through gas recovery wells located at the landfill area and conveyed to LFG treatment facilities and power generation facilities by LFG collection pipelines.

LFG Treatment Facilities

The LFG treatment facilities consist of gas adjustment facilities and flare combustion facility. The gas adjustment facilities bring LFG to an appropriate state for the LFG power generation facilities. The flare combustion facility burns excessive LFG beyond the gas engine capacity and collected LFG during maintenance (inspection and malfunction) of the gas engine generator.

LFG Power Generation Facilities

Gas engine generator combust the gas as fuel and generate electricity. All the electric power generated by the facility excluding its in-house consumption is sold to Perusahaan Listrik Negara (PLN), Indonesia's state-own electricity company, including power generation, transmission, distribution and retail sale of electricity, and a regional power generator and distributor.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the

emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

This project is based on two complementary activities as follows:

- The collection and flaring of landfill gas, converting its methane content into CO2 reducing its greenhouse gas effect; and
- The generation and supply of electricity to the regional grid, displacing a certain amount of fossil fuels used for electricity generation.

At present, there are no regulations or laws, which oblige collection of landfill gas from waste disposal sites regardless of whether they are in operation or not in Indonesia. Therefore no projects using landfill gas have been carried out in Indonesia. Accordingly unless this project is not carried out, landfill gas from Jelekong waste disposal site will be continuously released to the atmosphere.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

The data of total waste volume was not collected in Jelekong final waste landfill site. Therefore total waste volumes are estimated 702,000 ton based on the dimension and the average layer thickness of the site and unit weight of the waste. Parameters necessary for calculating total waste volumes are shown Table-1. The site map is shown in Figure-3.

Table-1 Parameters for total waste volumes estimation

Dimension (A × B)	$150m \times 240m = 36,000m^2$
Average layer thickness	15m
Unit weight of the waste	$1.35ton/m^3$

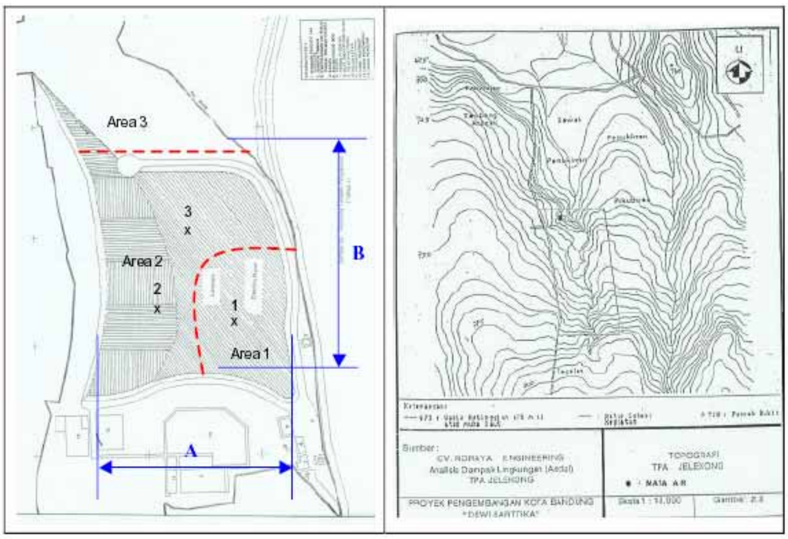

Figure-3 Site map

Based on the total waste volume estimated above, gas volume at the site is calculated by formula (1) and (2), which is widely used in Europe.

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

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)

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

G_t : Amount of LFG emission until the year t (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

Parameters necessary for calculating gas volume are determined based on the result of sample tests of waste and gas measurement at the site as shown in Table-2

Table 2 Parameter for Gas Volume Estimation

	Small Fraction	Wood
Amount of total organic carbon in solid waste	0.55%	10%
k	0.14	0.05
T	30℃	
Methane Content in LFG	55%	
F_c	80%	
Generation Capacity	500kW	
Generation efficiency	25%	
Plant Availability	94%	
Auxiliary ratio	5%	
Carbon emission factor	0.879 ton-CO_2/MWh	

This project is expected to reduce GHG emissions by collecting methane as a fuel for power generation and displacing the fossil fuel for supplying electricity to the grid. The following Table-3 shows annual gas emission volumes and GHG reduction by using collected methane for power generation and Table-4 shows GHG reduction by displacing the fossil fuel for supplying electricity to the grid. Combining both effects, the GHG emission reductions are calculated to be 196,779 CO_2-ton during the 10-years project period from2008 to 2017, and about113,135 CO_2-ton during the first commitment period of the Kyoto Protocol.

Table 3 CO_2 emission reduction by combusting methane

Year	Amount of LFG emission	Amount of methane emission	Amount of methane collection	Amount of CO_2 emission reduction

	(m^3/day)	(m^3/day)	(m^3/day)	(ton/year)
2008	9,367	5,152	4,121	22,610
2009	8,787	4,833	3,866	21,210
2010	8,251	4,538	3,631	19,917
2011	7,756	4,266	3,413	18,721
2012	7,297	4,013	3,211	17,613
2013	6,871	3,779	3,023	16,584
2014	6,474	3,561	2,849	15,628
2015	6,105	3,358	2,686	14,737
2016	5,761	3,169	2,535	13,907
2017	5,440	2,992	2,394	13,132
Total amount of CO_2 emission reduction (2008-2017)				174,059
Total amount of CO_2 emission reduction (2008-2012)				100,071

Amount of emission reduction by displacing the grid electricity is shown in Table 4.

Table 4 CO_2 emission reduction by displacing the grid electricity

Year	Power generation per day (MWh/day)	Power generation per year (kWh/year)	Amount of CO_2 emission reduction (ton/year)
2008	10.3	3,534,000	2,951
2009	9.7	3,328,000	2,779
2010	9.1	3,122,000	2,607
2011	8.5	2,916,000	2,435
2012	8.0	2,745,000	2,292
2013	7.6	2,608,000	2,178
2014	7.1	2,436,000	2,034
2015	6.7	2,299,000	1,920
2016	6.3	2,162,000	1,805
2017	6.0	2,059,000	1,719
Total amount of CO_2 emission reduction (2008-2017)			22,720
Total amount of CO_2 emission reduction (2008-2012)			13,064

A.4.5. Public funding of the project activity:

No public funding will be provided.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

The Baseline Methodology used is ACM0001 “Consolidated baseline methodology for landfill gas project activities.”

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

ACM0001 can be applied to a project that claims emission reductions for displacing or avoiding energy from other sources.

The proposed project is defined as follows:

- To collect landfill gas from a closed landfill.
- To generate electricity using collected landfill gas.
- To flare excess landfill gas.

The proposed project claims emission reduction for the captured landfill gas and for displacing electricity from other sources.

The baseline methodology ACM0001 is applicable to landfill gas capture project activities, where the baseline scenario is the partial or total atmosphere release of the gas and the project activities include situation such as:
a) The captured gas is flared; or
b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources; or
c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable". If capacity of electricity generated is less than 15MW, and/or thermal energy displaced is less than 54TJ (15GWh), small-scale methodologies can be used.

The proposed project meets the third condition. Because the captured gas is used to produce electricity, and emission reduction are claimed for displacing grid electricity.

B.2. Description of how the methodology is applied in the context of the project activity:

The baseline approach adopted by this methodology is "Tool for the demonstration and assessment of additionality".

This approach provides for a step-wise approach to demonstrate and assess additionality. These steps include:

- Identification of alternatives to the project activity;
- Investment analysis to determine that the proposed project activity is not the most economically or financially attractive;
- Barriers analysis;
- Common practice analysis; and
- Impact of registration of the proposed project activity as a CDM project activity.

The economic attractiveness of alternatives are evaluated with IRR without revenue from carbon credits (CERs) compared with a reasonable expected return on investment in Indonesia.

Barriers analysis is the process of identifying barriers that would prevent the implementation of proposed type of the alternatives.

Based on information about activities similar to the proposed project activity, the common practice analysis is to complement and to reinforce the investment and barriers analysis.

Figure-4 shows outlines of demonstrating additionality.

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

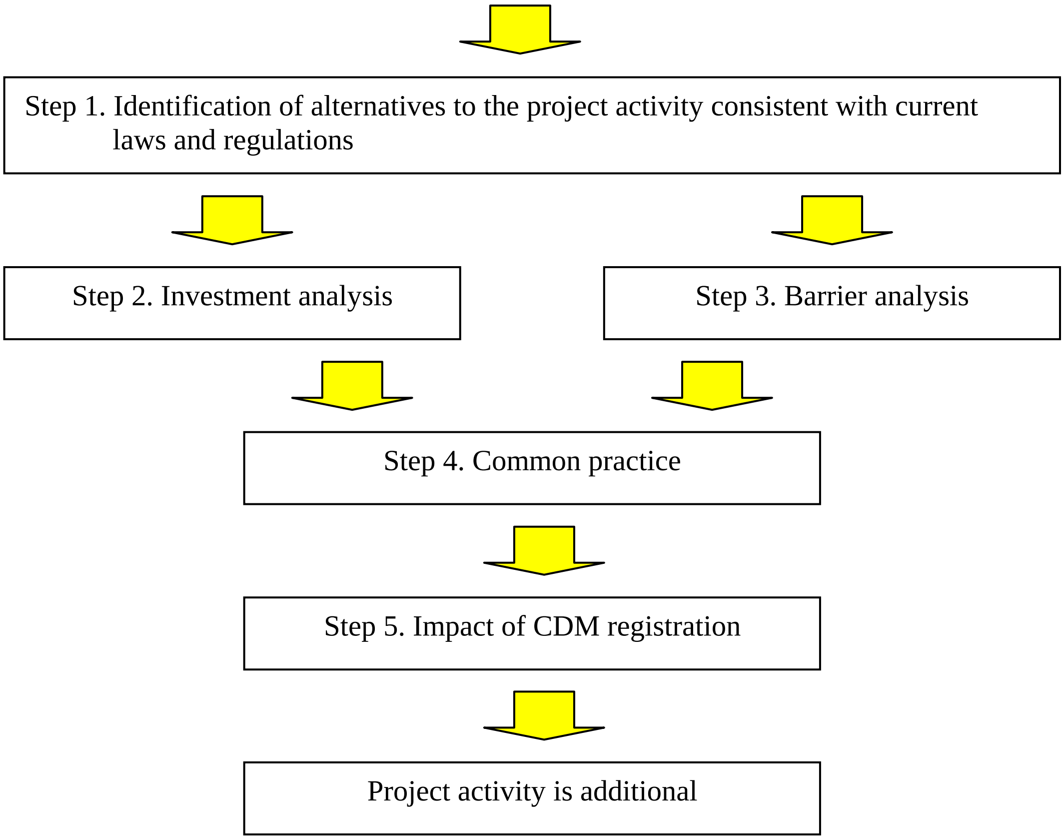

Figure-4 Flowchart of Additionality Scheme

The following paragraphs describe how the proposed baseline methodology is applied to single out the baseline scenario for the proposed project, and prove that the proposed project is additional. As mentioned above, we here demonstrate the project additionality according to "tools for the demonstration and assessment of additionality."

Step 0: Preliminary screening based on the starting date of the project activity
The proposed CDM project won't claim the credits before the registration. We therefore skip this step.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations
Landfill (open dumping) is a generally accepted solid waste management system in Indonesia. Composting system have also now been implemented tentatively.
Taking local situations and contribution to sustainable development into account, we propose three plausible scenarios for safety closure of landfill sites and valid use of solid wastes as follows.

Sub-step 1a. Define alternatives to the project activity:
Alternative 1: Generating electricity by landfill gas (Proposed project)
• In this alternative, a landfill is closed with soil cover and biogas is captured through vertical pipes deeply installed into a landfill. Electricity is generated by collected landfill gas (biogas). The project will

involve proven technology and hardware for recovery, collection and treatment of LFG and power generation by utilizing gas.

･Although they are not CDM projects, several projects of same kind have been already executed in many countries .

･There are many pilot plants for gas utilization and executed in many countries.

LFG projects also could contribute to local sustainability by improving local environment.

Alternative 2: Soil covering with flaring gas

･In this alternative, a landfill is closed with soil cover and biogas is captured through vertical pipes deeply installed into a landfill. Captured gas is flared by burners, instead of generating electricity.

･This alternative is applied just for safety operation of landfill sites. This alternative cannot control methane gas emitted from landfill site or accelerate producing biogas.

･There are some techniques required to maintain pilot burners safely and to operate burning systems as a whole.

･This alternative yields no profit except CERs.

Alternative 3: Soil covering with installing shallow vertical pipes

･Almost all landfill sites in Indonesia have no special treatment for closing sites.

･There are no enforcement or guidelines for regulating safety closure of landfill sites.

･It is unlikely that safety closure of landfill would be achieved by voluntary control.

･Although this closure treatment is not commonly used in Indonesia, this treatment is sometimes used for safety closure of open-dumping landfill sites in many other countries.

Sub-step 1b. Enforcement of applicable laws and regulations:

There are no official enforcements or guidelines regulating biogas emitted from landfill sites. Moreover, there are no regulations for closure treatment.

We apply Step2 investment analysis for Alternative 1 and Alternative 2,

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

We here apply simple cost analysis for Alternative 2 and apply benchmark analysis for Alternative 1.

Sub-step 2b. – Option I. Apply simple cost analysis

Alternative2 produces no economic benefits other than CERs in spite of some additional cost for burning equipment and operating cost. It is quite clear that Alternative2 is not financially attractive.

Sub-step 2b – Option III. Apply benchmark analysis

Based on the ex-ante estimation of gas emission volume analysed by site measurement and laboratory sample tests, we evaluated gas emission volume and evaluated the economic feasibility of Alternative 1 by IRR.

Cash flow analysis of Alternative 1 indicated that the project IRR for ten years without CERs turned out to be negative. Obviously Alternative 1 is financially unattractive course of action. Therefore Alternative 1 is additional and cannot be a baseline scenario. (See Annex 3) The only revenue generated by the Alternative 1 is the sale of electricity. The following conditions were set for the IRR calculations.

･Electricity sale price: 0.0423 US$/kWh

･Inflation Rate: 5.0%

･Corporate Tax: 30%

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and III):

Comparing Alternative 1 and Alternative 2, Alternative 2 won't produce any profit other than CERs. There is no income from the project except CERs. From the financial point of view, therefore Alternative 1 is more plausible scenario.

Step 3. Common practice analysis

As for Alternative1, the proposed pilot project mentioned above (step1) has not been put into practice (because of economic feasibility) yet. This fact clearly proves that Alternative1 is not a common practice.

As for Alternative2, there are no landfill sites flaring biogas from gas collecting wells in Indonesia. Therefore Alternative2 is not a common practice.

As for Alternative3, Almost all landfill sites in Indonesia have no special treatment for closing sites. There are no enforcement and guidelines for regulating safety closure of landfill sites.
Many common landfill sites have no special closure treatment in Indonesia. Although Alternative3 is not a common practice for ordinary landfill sites in Indonesia, the part of project site has already been soil-covered. As far as this project, therefore Alternative3 will be a common practice.

Step 4. Impact of CDM registration

There are a large number of open dumping landfill sites in Indonesia such as the Jelekong landfill site. Appropriate closure treatment and valid use of collected biogas from landfill sites will contribute to not only preventing global warming but also improving local environment.

Moreover, spread of this kind of project will contribute to technological sustainability as well as environmental sustainability determined as Indonesian environmental policy.

Although Alternative1 is not a financially attractive course of action as well as Alternative2, according to the analysis stated above, Alternative2 is not likely to be a reasonable scenario. We therefore defined Alternative 1 as a project scenario and Alternative 3 as a baseline scenario.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

The proposed project scenario is based on the collection of the landfill gas and its combustion for the generation of electricity. Combustion of the landfill gas to produce electricity will convert the highly potent methane content to less potent carbon dioxide, and result in significant greenhouse gas emission reductions.

Emission Reduction

The greenhouse gas emission reduction achieved by the project activity during a given year "y" (ER_y) is the difference between the amount of methane actually destroyed / combusted during the year ($MD_{project,y}$) and the amount of methane that would have been destroyed / combusted during the year in the absence of the project activity ($MD_{reg,y}$), times the approved Global Warming Potential value of for methane (GWP_{CH4}), plus the net quantity of electricity displaced during the year (EG_y) multiplied by the CO_2 emissions intensity of the electricity displaced ($CEF_{electricity,y}$).

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWP_{CH4} + EG_y \times CEF_{electricity,y} \quad (1)$$

ER_y is measured in tonnes of CO_2 equivalents (tCO_{2e}). $MD_{project,y}$ and $MD_{reg,y}$ are measured in tonnes of methane (tCH_4). The approved Global Warming Potential value for methane (GWP_{CH4}) for the first commitment period is 21 tCO_{2e}/tCH_4. EG_y is measured in megawatt hours (MWh). The CO_2 emissions intensity, $CEF_{electricity,y}$ is measured in tonnes of CO_2 equivalents per megawatt hour (tCO_{2e}/MWh) and ET_y is measured in TeraJoules (TJ).

In the case where the $MD_{reg,y}$ is given /defined as a quantity that quantity will be used.

In case where regulatory or contractual requirements do not specify $MD_{reg,y}$ an "Adjustment Factor" (AF) shall be used and justified, taking into account the project context.
Since there is no enforcement regulating LFG emission in Indonesia, AF turned out to be 0.
Therefore,

$$MD_{reg,y} = MD_{project,y} \times AF = 0 \quad (2)$$

Project proponents should provide an ex ante estimate of emissions reductions, by projecting the future GHG emissions of the landfill. In doing so, verifiable methods should be used. Ex ante emission estimates may have an influence on $MD_{reg,y}$. $MD_{project,y}$ will be determined ex post by metering the actual quantity of methane captured and destroyed once the project activity is operational.
The methane destroyed by the project activity ($MD_{project,y}$) during a year is determined by monitoring the quantity of methane actually flared and gas used to generate electricity.

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} \quad (3)$$
$$MD_{flared,y} = LFG_{flare,y} \times W_{CH4,y} \times D_{CH4} \times FE \quad (4)$$

Where $MD_{flared,y}$ is the quantity of methane destroyed by flaring, $LFG_{flare,y}$ is the quantity of landfill gas flared during the year measured in cubic meteres (m^3), $W_{CH4,y}$ is the average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3 CH_4 /m^3LFG), FE is the flare efficiency (the fraction of the methane destroyed) and D_{CH4} is the methane density expressed in tonnes of methane per cubic meter of methane (tCH_4 /m^3CH_4).

$$MD_{electricity,y} = LFG_{electricity,y} \times W_{CH4,y} \times D_{CH4} \quad (5)$$

where $MD_{electricity,y}$ is the quantity of methane destroyed by generation of electricity and $LFG_{electricity,y}$ is the quantity of landfill gas fed into electricity generator.

Calculation for GHG emission reductions

This project is expected to reduce GHG emissions by collected methane as a fuel for power generation and replacing the fossil fuel power source supplying electricity to the grid. Combining both effects, the GHG emission reductions are calculated to be 196,779 CO_2-t during the 10-year project period from2008 to 2017, and about113,135 CO_2-t during the first accounting period of the Kyoto Protocol.

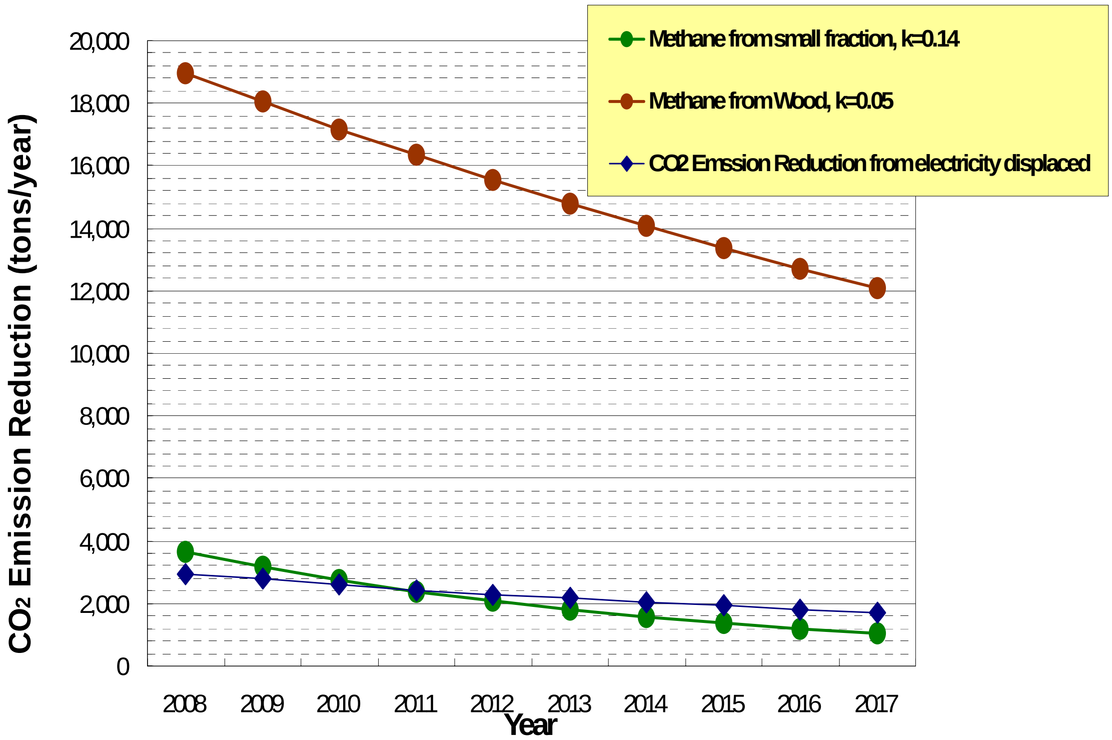

Figure-5 CO_2 emission reduction

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

A full flow diagram of the proposed project and system boundaries are presented in Figure-6.The flow diagram comprises all possible elements of the landfill gas collection system and the equipment for electricity generation.

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

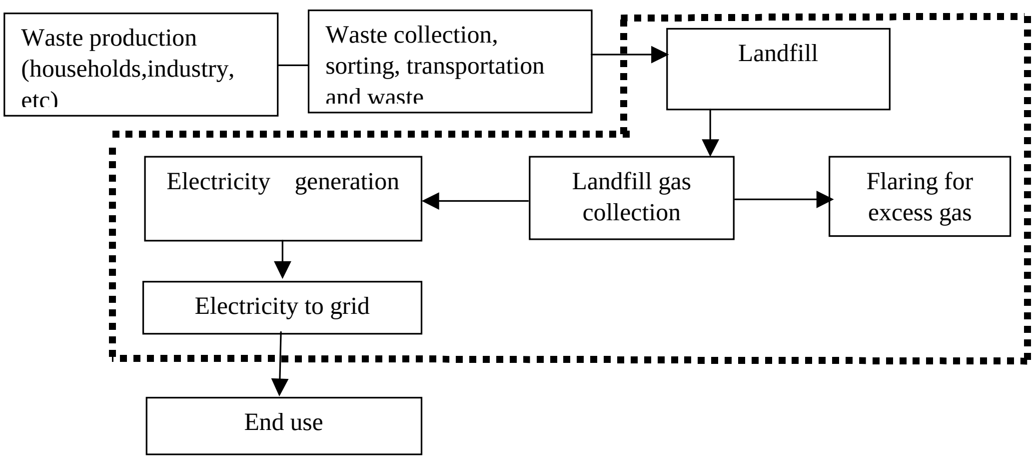

Figure-6 Flow chart of system boundaries

Table-5 contains a summary of the system and project boundary for the proposed project.

Table-5 Summary of System and Project Boundary

Activities	Source		Gas	Remarks
Baseline	Direct onsite	Landfill gas	CH_4	Considered
			CO_2	Carbon neutral
	Direct offsite	Fuel combustion for grid power	CO_2	Considered
			N_2O	Not considered on conservative side
Project	Direct onsite	Landfill gas	CH_4	Considered
			CO_2	Carbon neutral
		LFG combustion for power	CO_2	Carbon neutral
			N_2O	Negligible
		Battery use for start-up	CO_2	Nominal (ignored)
		Project Operation	CO_2	Electricity by LFG used and carbon neutral

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

B.5.1. Date of completing the final draft of this baseline section

31/03/2006

B.5.2. Name of person/entity determining the baseline:

Takeyoshi Yaegashi
Overseas Business, Group Business Department
Tohoku Electric Power Co., Inc.
1-7-1, Honcho, Aoba-ku, Sendai, Miyagi, 980-8550, Japan
Email: w820159@tohoku-epco.co.jp
Fax: +81-22-213-5190
Direct Dialling: +81-22-799-6281

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

01/01/2008

C.1.2. Expected operational lifetime of the project activity:

10 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:
01/01/2008

C.2.2.2. Length:
10 years

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:
ACM0001 "Consolidated monitoring methodology for landfill gas project activities"

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:
This methodology is applicable to landfill gas capture project activities, where the baseline scenario is the partial or total atmosphere release of the gas and the project activities include situation such as:

a) The captured gas is flared; or
b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources; or
c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable". If capacity of electricity generated is less than 15MW, and/or thermal energy displaced is less than 54TJ (15GWh), small-scale methodologies can be used.

Given that the project is a landfill project activity that the captured gas is used to produce electricity or flared and emission reductions are claimed for displacing energy generation from other sources, the situation c) is applicable to the proposed CDM project activity
The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the flare platform and the electricity generating units to determine the quantities.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

Not applicable

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Not applicable

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Not applicable

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the flare platform and the electricity generating energy unit except CO_2 emissions intensity ($CEF_{electricity,y}$), which will be obtained from the latest available annual report issued by PLN. The monitoring plan provides for continuous measurement of the quantity and quality of LFG flared and the electric energy generated.

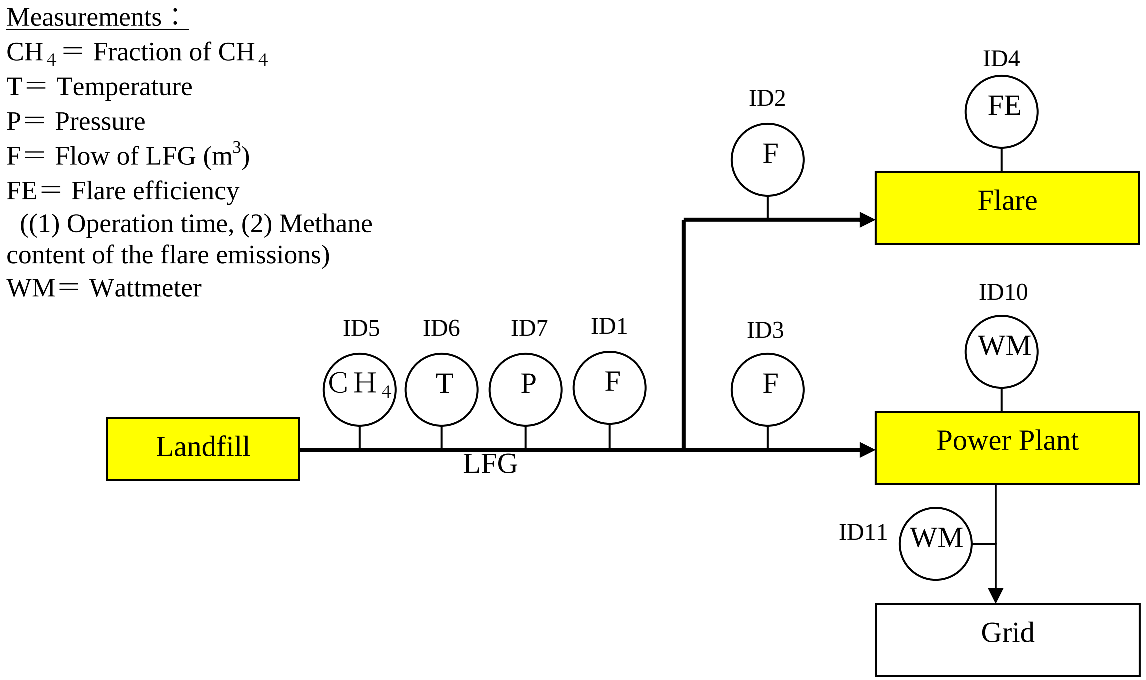

Figure-7 Monitoring Plan

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	*LFGtotal,y*	*Total amount of landfill gas captured*	*m^3*	*m*	*Continuous*	*100%*	*electronic*	*Measured by a flow meter.* *Data to be aggregated monthly and yearly*
2	*LFGflare,y*	*Amount of landfill gas flared*	*m^3*	*m*	*Continuous*	*100%*	*electronic*	*Measured by a flow meter.* *Data to be aggregated monthly and yearly*
3	*LFGelectricity,y*	*Amount of landfill gas combusted in power plant*	*m^3*	*m*	*Continuous*	*100%*	*electronic*	*Measured by a flow meter.* *Data to be aggregated monthly and yearly*
4	*FE*	*Flare/combustion efficiency, determined by (1) the operation hours and (2) the methane content in the exhaust gas*	*%*	*m /c*	*(1) Continuous (2) Quarterly, monthly if unstable*	*n/a*	*electronic*	*(1) Continuous measurement of operation time of flare (e.g. with temperature)* *(2) Periodic measurement of methane content of flare exhaust gas*
5	*w_CH4,y*	*Methane fraction in the landfill gas*	*$m^3 CH_4$/ $m^3 LFG$*	*m*	*Continuous*	*100%*	*electronic*	*Measured by continuous gas quality analyser*
6	*T*	*Temperature of the landfill gas*	*℃*	*m*	*Continuous*	*100%*	*electronic*	*Measured by continuous thermometer.* *Measured to determine the density of methane D_{CH4}*
7	*P*	*Pressure of the landfill gas*	*Pa*	*m*	*Continuous*	*100%*	*electronic*	*Measured by continuous manometer.* *Measured to determine the density of methane D_{CH4}*

8	*Etotal,y*	*Total amount of electricity and/or energy carriers used in the project for gas pumping and heat transport (not derived from the gas)*	*MWh*	*m /c*	*Continuous*	*100%*	*electronic*	*Electricity for project activity is the difference between the quantity of electricity generated and the quantity of electricity displaced (=electricity transferred to the PLN grid). There is no significant consumption of other energy for project activity. Required to determine CO_2 emissions from use of electricity to operate the project activity*
9	*CEFenergy.y*	*CO2 emission intensity of the electricity and/or other energy carriers in ID8*	*tCO_2/MWh*	*c*	*Annually*	*100%*	*electronic*	*Required to determine CO_2 emissions from use of electricity or other energy carriers to operate the project activity*
10	*EGtotal,y*	*Quantity of electricity generated*	*MWh*	*m*	*Continuous*	*100%*	*electronic*	*Measured by continuous power meter*
11	*EGy*	*Quantity of electricity displaced*	*MWh*	*m*	*Continuous*	*100%*	*electronic*	*Measured by continuous power meter installed and controlled by PLN*

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

The formulae used to calculate project emission reduction is:

$$Er_y = (Md_{project,y} - Md_{reg,y}) \times GWP\_CH_4 + EG_y \times CEF_{electricity,y}$$

Where:

y : Duration of the project activity (10 years)

Er_y : Greenhouse gas emission reduction measured in tonnes of CO_2 equivalents (tCO_2e)

$Md_{project,y}$: Amount of methane actually combusted measured in tonnes of methane (tCH_4)

$Md_{reg,y}$: Amount of methane that would have been combusted during the absence of the project activity measured in tonnes of methane (tCH_4) and currently $Md_{reg,y}$ = zero

GWP_CH_4 : Approved Global Warming Potential value for methane (GWP_{CH4}) for the first commitment period is 21 tCO_2e/tCH_4

EG_y : Quantity of electricity displaced measured in mega watt hour (MWh)
$CEF_{electricity,y}$: CO_2 intensity of the electricity displaced expressed in tonnes of CO_2 equivalents per mega watt hour (tCO_2e/MWh)

$Md_{project,y}$ is sum total $Md_{electricity,y}$ and $Md_{flare,y}$ as follows.

$$Md_{project,y} = Md_{electricity,y} + Md_{flare,y}$$

and each formulae used to calculate $Md_{electricity,y}$ and $Md_{flare,y}$ is as follows.

$$Md_{electricity,y} = LFG_{electricity,y} \times w_{CH4,y} \times D_{CH4}$$

Where:
$LFG_{electricity,y}$: Quantity of landfill gas combusted in power plant measured in cubic meters (m^3)
$w_{CH4,y}$: Methane fraction of the landfill gas measured in cubic meters of methane per cubic meters of landfill gas (m^3CH_4/m^3LFG)
D_{CH4} : Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4) and determined by temperature and pressure of LFG

$$Md_{flare,y} = LFG_{flare,y} \times w_{CH4,y} \times D_{CH4} \times FE$$

Where
$LFG_{flare,y}$: Quantity of landfill gas flared measured in cubic meters (m^3)
$w_{CH4,y}$: Methane fraction of the landfill gas measured in cubic meters of methane per cubic meters of landfill gas (m^3CH_4/m^3LFG)
D_{CH4} : Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4) and determined by temperature and pressure of LFG
FE : Flare efficiency is expressed in percentage (%) and determined by the operation hours of flare combustion and the methane content in flare exhaust gas

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

As shown in the baseline study, leakage is not likely. Data on this will be therefore not collected.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

See item A.4.4.1 for the full explanation

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1. LFGtotal,y	*Low*	*Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy.*
2. LFGflare,y	*Low*	*Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy.*
3. LFGelectricity,y	*Low*	*Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy.*
4. FE	*Medium*	*Regular maintenance should ensure optimal operation of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values.*
5. w_CH4,y	*Low*	*The gas analyse should be subject to a regular maintenance and testing regime to ensure accuracy.*

6. T	*Low*	*The thermometer should be subject to a regular maintenance and testing regime to ensure accuracy.*
7. P	*Low*	*The manometer should be subject to a regular maintenance and testing regime to ensure accuracy.*
10. EGtotal,y	*Low*	*The power meter should be subject to a regular maintenance and testing regime to ensure accuracy.*
11. EGy	*Low*	*The power meter should be subject to a regular maintenance and testing regime to ensure accuracy.*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

For the operation and maintenance (O&M) of the project, O&M section is established in the project company (SPC). The O&M section is composed of some engineers. Monitoring procedures and QC/QA activities are conducted by the O&M section at the plant for 24 hours according to ISO9001. In addition to that, displacement of grid electricity with landfill gas generated electricity is monitored and assured by both PLN and SPC.

D.5 Name of person/entity determining the monitoring methodology:

Takeyoshi Yaegashi
Overseas Business, Group Business Department
Tohoku Electric Power Co., Inc.
1-7-1, Honcho, Aoba-ku, Sendai, Miyagi, 980-8550, Japan
Email: w820159@tohoku-epco.co.jp
Fax: +81-22-213-5190
Direct Dialling: +81-22-799-6281

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

Not applicable, because the project directly measures the methane gas captured, which will be the emission reduction by the proposed project. See the detailed monitoring plan in section D. The project boundaries in B.4 identify only one source of greenhouse gases, which is the landfill gas emitted from the landfill.

E.2. Estimated leakage:

No leakage effects need to be accounted under ACM0001 methodology.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Not applicable, because the project directly measures the methane captured, which will be the emission reduction by the proposed project. See the detailed monitoring plan in section D.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Not applicable, because the project directly measures the methane captured, which will be the emission reduction by the proposed project. See the detailed monitoring plan in section D.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

E.6. Table providing values obtained when applying formulae above:

Table-6 Amount of emission reduction

Crediting Period	Emission Reduction
10years	196,779 tCO_2

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

This project is consisted of LFG collection and small power generation utilizing it and therefore the project will contribute to improve the local environment by collection and combustion of the uncontrolled LFG at the site while there is limited environmental impact by generation.

In Indonesia environmental impact assessment is required in the case of construction of new landfill site having the extent area more than 10ha or construction of electricity generation facility having the capacity more than 10MW and this is not the case. This project does not aim to establish any new landfill site. In addition, the capacity of electricity generation is approximately 1MW.

The following environmental impact and other indirect impacts of the landfill gas energy project have also been addressed:

a. Necessary environmental approval

This project doesn't belong to the projects, (generation for 10MW and more) which require environmental impact assessment by Indonesian law. Therefore, environmental approval is likely to be obtained simply by submitting the Environmental Management Planning, UKL and Environmental Monitoring Planning, UPL, 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. Expected environmental impacts include noise and vibration during the construction period and exhaust gas and noise from the generators and other equipment used in the operating period.

c. Other indirect impacts

With the raising 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 deposal 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.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

No significant negative impacts to the environment will result from the project activity.

SECTION G. Stakeholders' comments

G.1. Brief description how comments by local stakeholders have been invited and compiled:

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

a. A briefing session on survey results in the region

Date：2006/1/17(Tue)

Place：A conference room of 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 of the local people concerned. They expressed a strong hope that the Japanese survey group will continue its activities leading to the CDM project.

b. Collecting comments by visiting relevant bodies

Comments of local stakeholder were compiled through interview survey in three categories summarized below from August 2005 to January 2006.

Table-7 List of Stakeholders

Category	Stakeholders	Status	Survey Period

Central government	Ministry of Public Works	Responsible ministry of solid waste management policy	29 August 2005 20 January 2006
	Ministry of Energy and Mineral Resources	Responsible ministry of renewable energy policy	29 August 2005
	Ministry of Environment	Responsible ministry of environmental policy	1 September 2005 20 January 2006
	PLN	National electric power company	1 September 2005
Local government	West Java Environment Protection Agency	Responsible for environmental policy in West Java	31 August 2005 14 October 2005
	Bandung Prefectural Cleansing Department	Responsible for solid waste treatment in Bandung prefecture	31 August 2005
	Bandung City Cleansing Department	Responsible for solid waste treatment in Bandung City	31 August 2005 13 October 2005
	Bale Endah County	Responsible for administration in Bale Endah County	14 October 2005
	Warga Mekar Village	Responsible for administration in Warga Mekar Village	14 October 2005

G.2. Summary of the comments received:

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

Central government organizations of Ministry of Public Works as responsible ministry of solid waste management policy, Ministry of Energy and Mineral Resources as responsible ministry of renewable energy policy and Ministry of Environment as responsible ministry of environmental conservation have welcomed the project from the point that the government is encouraging the development of renewable energy projects for diversifying the source of energy and that the project will environmentally contribute to the safety closure of urban solid waste landfill site.

Local governments of West Java who dispose their municipal waste at the Jelekong Landfill site and the cleansing department of Bandung City who govern the landfill site as an administrative office of the area also accepted the project. In addition to the reasons mentioned above, they support this project because they expect the post closure utilization of the landfill site after the acceleration of landfill stabilization by extracting methane gas by the project.

G.3. Report on how due account was taken of any comments received:

We held a briefing session at West Java Environmental Protection Agency on 17 January 2006 and thirty-eight people, who were engaged in the environmental and public cleaning sector, attended the session.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Tohoku Electric Power Co., Inc.
Street/P.O.Box:	7-1 Honcho 1-chome, Aoba-ku
Building:	
City:	Sendai
State/Region:	Miyagi
Postfix/ZIP:	980-8550
Country:	Japan
Telephone:	+81-22-799-6281
FAX:	+81-22-213-5190
E-Mail:	w820159@tohoku-epco.co.jp
URL:	http://www.tohoku-epco.co.jp/
Represented by:	Takeyoshi Yaegashi
Title:	Manager
Salutation:	Mr.
Last Name:	Yaegashi
Middle Name:	
First Name:	Takeyoshi
Department:	Overseas Business, Group Business Department
Mobile:	
Direct FAX:	+81-22-213-5190
Direct tel:	+81-22-799-6281
Personal E-Mail:	w820159@tohoku-epco.co.jp

Annex 2

BASELINE INFORMATION

1. Gas generation potential

Gas generation potential G_e is calculated by using the following equation practiced in Europe. The parameters in the equation are determined by site measurements and laboratory tests of samples collected at the Jelekong landfill site.

$$G_e = 1.868 \times C_0 \times (0.014 \times d + 0.28)$$

G_e: gas generation potential
C_0: amount of total organic carbon in waste, and
d: temperature in landfill

2. An annual gas generation

An annual gas generation is calculated by using the following First Decay Model (the IPCC Gudelines for National Greenhouse Gas Inventories Volume 3: Reference Manual (1996), p.6.11).

$$V_j = M_i \times G_e \times k \times e^{-k(j-i)}$$

V_j: LFG volume emitted in the year j from the solid waste deposited in the year i
M_i: amount of solid waste deposited in the year i (ton)
k: decay rate (1/year)

3. Assumption
Parameters for calculating quantity of LFG are shown in the following table 8. In this evaluation, we assume different parameters between small fraction component and wood component in the waste because decomposition rate constant of them are definitely different.

Table 8 Parameters

	Small fraction	Wood
Quantity of total organic carbon in waste	0.55%	10%
k	0.14	0.05
d	30℃	
Methane content in LFG	55%	
Capture ratio of Methane gas	80%	
Generation capacity	500kW	
Generation efficiency	25%	
Plant Availability	94%	
Auxiliary ratio	5%	
Emission factor of grid	0.879ton-CO_2/MWh	

4. Estimation of CO_2 equivalent emission reduction by the project

CO_2 reduction by project is calculated as a sum of emission reduction by methane actually destroyed /combusted and emission reduction by displacing the grid electricity during the project period. Quantity of emission reduction by combusting methane gas as fuel for electricity generation is shown in Table 9.

Table 9 CO_2 emission reduction by combusting methane

Year	Amount of LFG emission (m^3/day)	Amount of methane emission (m^3/day)	Amount of methane collection (m^3/day)	Amount of CO_2 emission reduction (ton/year)
2008	9,367	5,152	4,121	22,610
2009	8,787	4,833	3,866	21,210
2010	8,251	4,538	3,631	19,917
2011	7,756	4,266	3,413	18,721
2012	7,297	4,013	3,211	17,613
2013	6,871	3,779	3,023	16,584
2014	6,474	3,561	2,849	15,628
2015	6,105	3,358	2,686	14,737
2016	5,761	3,169	2,535	13,907
2017	5,440	2,992	2,394	13,132
Total amount of CO_2 emission reduction (2008-2017)				174,059
Total amount of CO_2 emission reduction (2008-2012)				100,071

Amount of emission reduction by displacing the grid electricity is shown in Table 10.

Table 10 CO_2 emission reduction by displacing the grid electricity

Year	Power generation per day (MWh/day)	Power generation per year (kWh/year)	Quantity of CO_2 emission reduction (ton/year)
2008	10.3	3,534,000	2,951
2009	9.7	3,328,000	2,779
2010	9.1	3,122,000	2,607
2011	8.5	2,916,000	2,435
2012	8.0	2,745,000	2,292
2013	7.6	2,608,000	2,178
2014	7.1	2,436,000	2,034
2015	6.7	2,299,000	1,920
2016	6.3	2,162,000	1,805
2017	6.0	2,059,000	1,719
Total amount of CO_2 emission reduction (2008-2017)			22,720
Total amount of CO_2 emission reduction (2008-2012)			13,064

As a result, the quantity of CO2 emission reduction is 196,779tonnes during the project period (2008-2017) and 113,135 tonnes for the first commitment period of Kyoto Protocol. Without the project, all those amount of greenhouse gas will be emitted to the atmosphere. Therefore this condition can be defined as a baseline scenario.

Annex 3

MONITORING PLAN

1. Introduction

This plan contains a proposed monitoring system to determine the reduction of the greenhouse gas emission. In the case of the proposed project, the greenhouse gas will be reduced by collecting, flaring and using LFG (landfill gas) as fuel for electricity generation with installation of gas extraction wells, collection pipe system, flare combustor and power plant facilities. These LFG collection and electricity generation facilities will be provided with a monitoring system to quantify the reduction of greenhouse gas emission. The verification for the reduction of the greenhouse gas emission will be conducted according to this monitoring plan.

2. Process

Jelekong landfill is generating LFG, containing approximately 55% of methane gas that is greenhouse gas and has the greenhouse effect of 21 times more than CO_2.
The LFG will be extracted from gas wells at the landfill site and delivered to the power plant for electricity generation through gas collection pipe system while the surplus or total gas during stoppage of the generation units will be treated in the flare combustor.

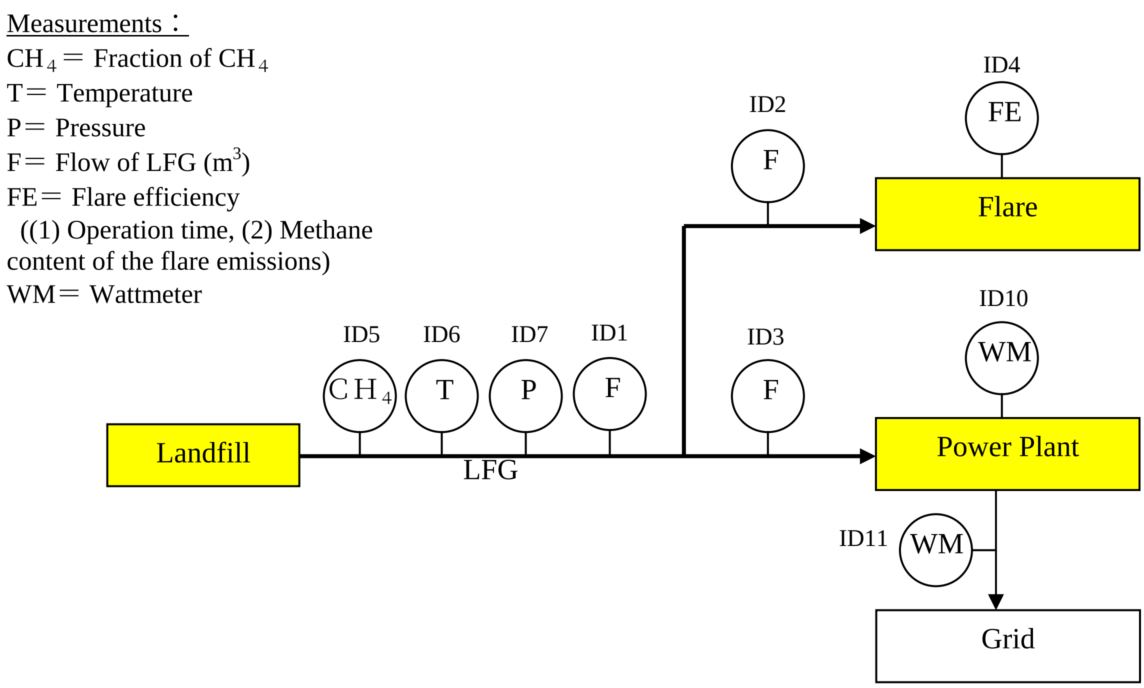

Figure- 8 Monitoring Plan

3. Article of Monitoring

In order to determine the data for calculating the amount of greenhouse gas emission reduction, the following data will be measured, monitored and/or collected and recorded electrically.

Table 11 Monitoring Items and Measuring Devices

ID number	Data variable	Source of data	Unit	Measuring device
1	$LFG_{total,y}$	Total amount of landfill gas captured	m^3	Flow meter
2	$LFG_{flare,y}$	Amount of landfill gas flared	m^3	Flow meter
3	$LFG_{electricity,y}$	Amount of landfill gas combusted in power plant	m^3	Flow meter
4	FE	Flare/combustion efficiency, determined by (1) the operation hours and (2) the methane content in the exhaust gas	%	Thermometer and sampling/ laboratory analysis
5	w_CH4,y	Methane fraction in the landfill gas	m^3CH_4/ m^3LFG	Analyzer
6	T	Temperature of the landfill gas		Thermometer
7	P	Pressure of the landfill gas	Pa	Manometer
8	$E_{total,y}$	Total amount of electricity and/or energy carriers used in the project for gas pumping	MWh	Power meter
9	$CEF_{energy,y}$	CO_2 emission intensity of the electricity and/or other energy carriers in ID8	tCO_2/ MWh	Given data
10	$EG_{total,y}$	Quantity of electricity generated	MWh	Power meter
11	EG_y	Quantity of electricity displaced	MWh	Power meter