Project design document form for CDM project activities

(Version 06.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Gwangju metropolitan city sanitary landfill LFG power plant CDM project
Version number of the PDD	6.0
Completion date of the PDD	02/10/2015
Project participant(s)	Environmental Corporation of Gwangju PANAX ENERGY Co. Ltd. Gwangju Metropolitan City Ecoeye Co., Ltd.
Host Party	Republic of Korea
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	・ Sectoral scope(s) 1: Energy industries (renewable - / non-renewable sources) 13: Waste handling and disposal ・ Selected methodology(ies) AMS-Ⅲ. G. ver. 6 (Landfill methane recovery) AMS-Ⅰ. D. ver. 16 (Grid connected renewable electricity generation)
Estimated amount of annual average GHG emission reductions	30,565 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The proposed project includes LFG(landfill gas) collection and electricity generation with grid connection. The main purpose of this project is to recover landfill gas generated from landfill site and use it to generate electricity. It does not include LFG flaring. The Second purpose of this project is to prevent global warming by combusting methane which is emitted to atmosphere. Moreover, the project activity improves environmental quality and contributes to green domestic electricity supply.

The project facilities are located in Yanggwa-dong, Nam-Gu, Gwangju Metropolitan City, Korea. Current landfill area is 243,733m^2 and its capacity is 1,868,000m^3. However, it is being planned to be expanded by the city before the current area become full. The expansion construction will start in early 2011 and add 751,100m^3 to its current capacity. Municipal Solid Waste (MSW) from Gwangju has been dumped into the landfill since 2005 and 1,195,000 m^3 of the landfill capacity was filled as of March of 2009.

The capacity of the power generation system of the proposed project activity is 2MW. 1MW plant starts operation in 2010 and another 1MW will be added to the plant in 2011. The project facilities consist of largely three systems, which are LFG collection system, LFG pre-treatment system, and electricity generation system. The project activity does not include LFG flaring system and existing flaring tips will not operate after the project implementation. Therefore, the whole captured LFG will be used for electricity generation only. For preventing methane leakage from LFG collection pipes and power generation system, a block system is installed.

The objectives of the project are as follows:

- To dispose the flammable constituents, particularly methane, safely and to control odor, nuisance, health risk, and adverse environmental impacts.

- To replace the electricity from the national grid from which the internal electricity will be supplied. Moreover, the project contributes to the Host Country‟s plan for promoting sustainable energy development and brings about positive social and environmental impacts:

- To prevent a potentially explosive situation in the landfill site and to support an environmentally sound policy related to subsurface gas migration.

- To minimize environmental damage through reducing GHG emissions, odor, nuisance and hazardous gases. - To optimize the use of biogas (renewable energy) in substitution of fossil fuel and the clean technology , which promotes sustainable and socio-economic development through significant technology transfer.

A.2. Location of project activity

A.2.1. Host Party

>>
Republic of Korea

A.2.2. Region/State/Province etc.

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Yanggwa-Dong, Nam-Gu

A.2.3. City/Town/Community etc.

>>

Gwangju Metropolitan City

A.2.4. Physical/Geographical location

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Project activity landfill site is located in #26, Yanggwa-Dong, Nam-Gu, Gwangju Metropolitan City, which is the province located in the south-western part of Korea. 35˚ 05' 18.84" N / 126˚ 53' 10. 79" E (35.088567°/126.886331°)

<Figure A-1> Location of project site

A.3. Technologies and/or measures

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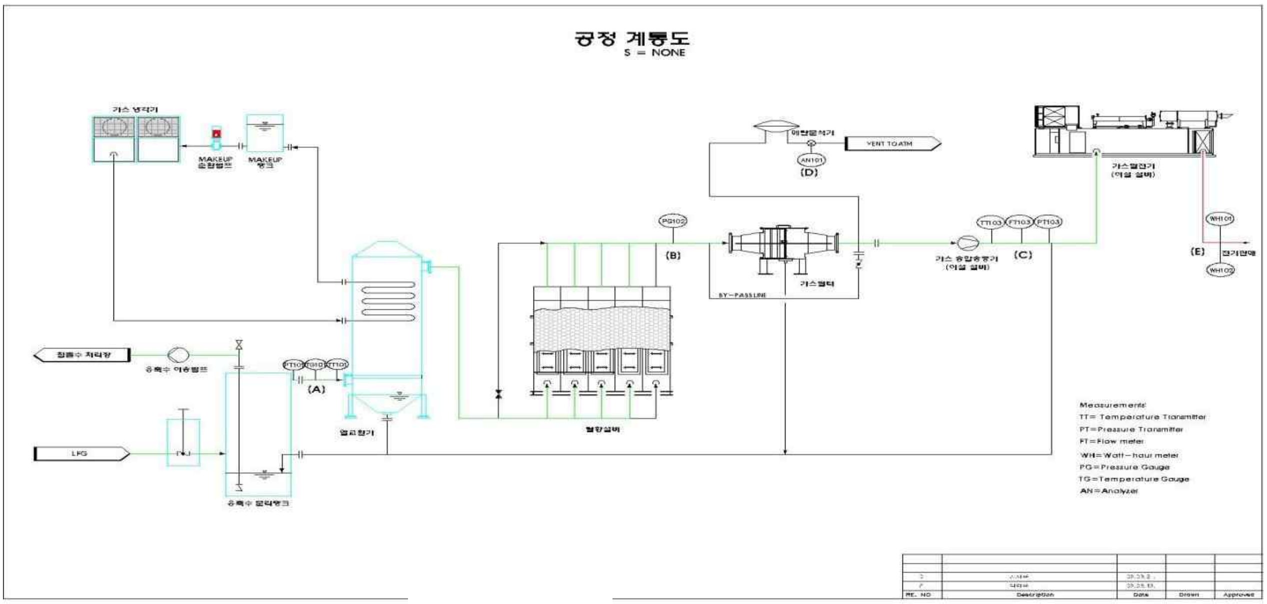
・ Technical process

The proposed project includes LFG(landfill gas) collection and electricity generation with grid connection. The project facilities consist of largely three systems, which are LFG collection system, LFG pre-treatment system, and electricity generation system. The project activity does not include LFG flaring system and existing flaring tips not operate after the project implementation. Therefore, the whole captured LFG used for electricity generation only. For preventing methane leakage from LFG collection pipes and power generation system, a block system is installed.

・ System diagram



공정계통도
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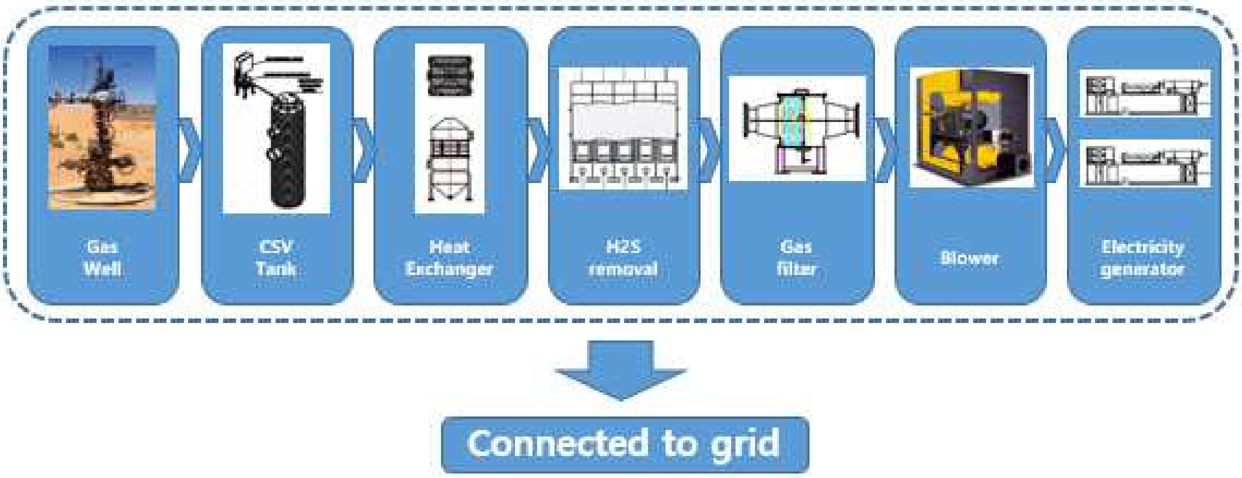


<Figure A-2> Process of this project

The project facility includes collection system, pre-treatment system and electricity generation system.

- **Installed technology**

Type	Details	Quantity
Gas Well & Pipe	· material : PE pipe · main pipe : 100A(5EA), 150A(1EA), 250A(1EA) · Pipe connection : 50A · Gas collection extract tablet : 150A(79EA)	26 wells
CSV Tank	· material : High Density Poly Ethylene	1

	· weight : Approx 1450kg · size : DIA/L : 1,000/4,215mm · pump type : Positive Displacement · flow operating of pump : 80L/min	
Heat Exchanger	· material : STS304, STC302 · weight : 815kg · size : 1,835x1,635x3,652 · volume : 2,000m3/h · design pressure : -15Kpa/MAX	1
H_2S removal set	· type : dry process · H_2S density of input gas : 500ppm · H_2S density of exhaust gas : 50ppm · size : 2,500x1,600x2700mm · volume : 1,200Nm3/hr · max internal pressure : -20kpa	1
Gas Filter	· material : STS304, STC302 · weight : 250kg · size : 1,600x1210x949 · fluid flow : methane · capacity : 1,000m3/h · design pressure : 150KGF/CM2G	1
Blower	· type : SP 125 IM · no. : 3099418 · capacity : 17m^3/min · speed : 1770RPM · discharge pressure : 0.1kg/cm^2	2 set

<Table A-1> Components of project facility construction in 2009

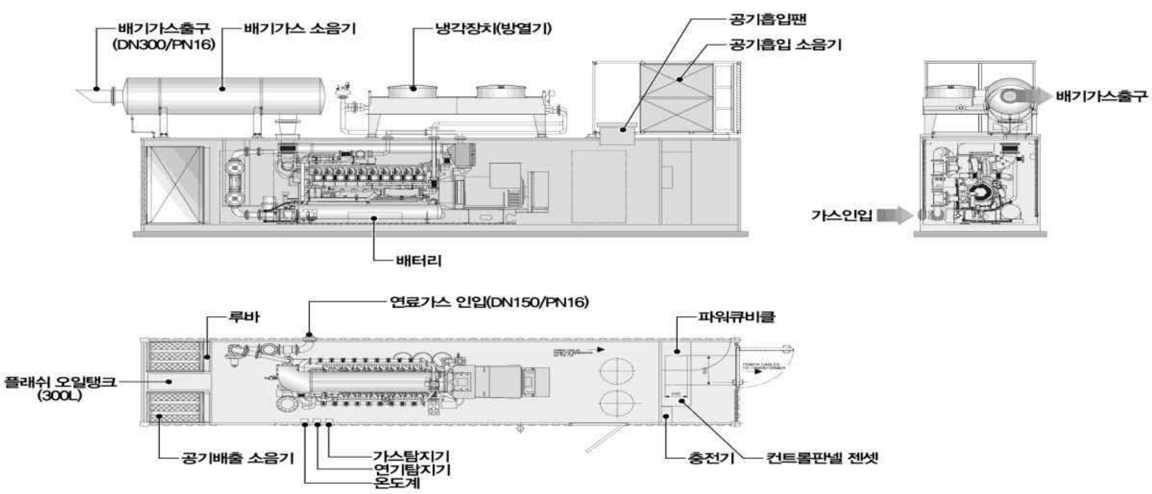
Construction in 2011 consists of mainly installing 1MW generator to the existing power plant that is constructed in 2009 as above. To maximize LFG collection efficiency, more gas wells are to be installed at the landfill site. As exactly when, where or how many additional gas wells are installed is to be studied more technologically as the project activity implements (i.e this cost factor is not decided yet), this cost for installing additional wells are not considered in the investment analysis and additionality demonstration in B.5 below.

Below is information of two project gas generators.

Category	Unit	Description
Manufacturer		STAMFORD
Type		HCI 634 K2
Type rating	kVA	1,438
Driving power	kW	1,095
Ratings at p.f. = 1.0	kW	1,060
Ratings at p.f. = 0.8	kW	1,048
Rated output at p.f. = 0.8	kVA	1,310
Rated current at p.f. = 0.8	A	1,576
Frequency	Hz	60
Voltage	V	480
Speed	rpm	1,800

Permissible overspeed	rpm	2,160
Power factor lagging		0.8-1.0
Efficiency at p.f. = 1.0	%	96.8%
Efficiency at p.f. = 0.8	%	95.7%
Moment of inertia	kgm^2	22.13
Mass	Kg	2,562
Radio interference level to VDE 0875		N
Construction		B3/B14
Protection Class		IP 23
Insulation class		H
Temperature(rise at driving power)		F
Maximum ambient temperature	℃	40
Total harmonic distortion	%	1.5

<Table A-2> Technical information of project gas generators



<Figure A-3>Project gas generator design

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea(host)	Public entity : Environmental Corporation of Gwangju	No

	Private entity : PANAX ENERGY Co., Ltd	
	Public entity : Gwangju Metropolitan City	
	Private entity : Ecoeye Co. Ltd.	

<Table A-4>Project participants of the project

A.5. Public funding of project activity

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This CDM project is not funded by official development assistance or other sources counted towards the financial obligations of Parties included in Annex 1.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

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The version 06 of AMS III.G “Landfill Methane Recovery
“ The version 16 of AMS-I.D “Grid connected renewable electricity generation”
“Tool to calculate the emission factor for an electricity system Ver.2”
”Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site Ver.4”
“Tools for the demonstration and assessment of additionality” Ver.5.2

B.2. Applicability of methodology and standardized baseline

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The methodology AMS-III.G and AMS-I.D are applicable to this small scale CDM project activity since all the requirements set by the methodology are fulfilled here:

As per the Methodology	As per the Project Activity
AMS-III.G Ver.6	
1. This project category comprises measures to capture and combust methane from landfills (i.e., solid waste disposal sites) used for disposal of residues from human activities including municipal, industrial, and other solid wastes containing biodegradable organic matter.	The project recovers LFG generated from the sanitary landfill.
2. The recovered methane may be utilised for the following applications instead of flaring or combustion: (a) Thermal or electrical energy generation directly; or (b) Thermal or electrical energy generation after bottling of upgraded biogas;or	The project utilizes the recovered LFG to produce (a) Thermal or electrical energy generation directly

(c) Thermal or electrical energy generation after upgrading and distribution using one of the following options: (i) Upgrading and injection of biogas into a natural gas distribution grid with no significant transmission constraints; or (ii) Upgrading and transportation of biogas via a dedicated piped network to a group of end users; or (d) Hydrogen production.	
3. If the recovered methane is used for project activities covered under paragraph 2 (a), that component of the project activity shall use a corresponding category under type I.	The project recovers methane for electricity generation. Thus, AMS-I.D is used.
4. If the recovered methane is used for project activities covered under paragraph 2 (b) or 2 (c) relevant provisions in AMS III.H related to upgrading of biogas, bottling of biogas, injection of biogas into a natural gas distribution grid and transportation of biogas via a dedicated piped network shall be used.	Not applicable for the project.
5. If the recovered methane is used for project activities covered under paragraph 2 (d) that component of the project activity shall use corresponding methodology AMS III.O.	No Hydrogen production for the project.
6. Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all type III components of the project activity.	Expected aggregate emission reductions from all type III components of the project activity is less than 60 kt CO_2 equivalent annually
AMS-I.D Ver.16	
1. This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass that supply electricity to a national or a regional grid. Project activities that displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit shall apply AMS-I.F.	This project displaces electricity from the national grid that is consisted of many fossil fuel fired power plants.
2. This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	This project is to (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity
3. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the volume of reservoir; • The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m2; • The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m2.	Not applicable for this project.
4. In the case of biomass power plants, no other biomass types than renewable biomass are to be used in the project plant.	Not applicable for this project.

5. If the new unit has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The proposed project does not exceed the limit of 15MW.
6. Combined heat and power (co-generation) systems are not eligible under this category.	The proposed project is not co-generation system. The project is to generate only electricity.
7. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	The project activity is a green field project.
8. In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	The project activity is a green field project.

<Table B-1>Applicability test comparing methodology and proposed project

B.3. Project boundary

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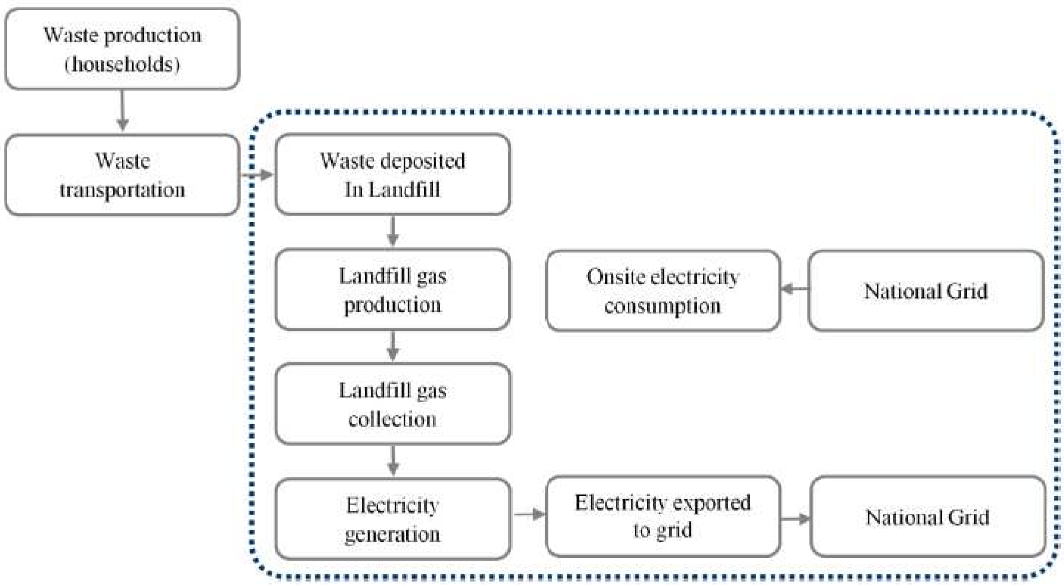
Emission sources within the project boundary:

According to the approved methodology AMS III.G and AMS I.D, both CH_4 emissions from LFG generation and CO_2 emissions from the electricity displaced are used for the determination of the baseline emission. Besides, the electricity consumption of the proposed project activity will lead to CO_2 emissions as the power for the project facility will be supplied by the national grid.

Spatial extent of the project boundary:



<Figure B-1> Project Boundary

<table>
<tr><th colspan="2">Source</th><th>GHGs</th><th>Included?</th><th>Justification/Explanation</th></tr>
<tr><td rowspan="2">Baseline scenario</td><td>Emission from decomposition of waste at the landfill site</td><td>CH_4</td><td>YES</td><td>The major source of the emissions in the baseline.</td></tr>
<tr><td>Emissions from electricity consumption</td><td>CO_2</td><td>YES</td><td>Electricity may be consumed from the grid or generated onsite/offsite in the baseline scenario.</td></tr>
<tr><td rowspan="6">Project scenario</td><td rowspan="3">On-site fossil fuel consumption due to the project activity other than for electricity generation</td><td>CO_2</td><td>YES</td><td>May be an important emission source</td></tr>
<tr><td>CH_4</td><td>NO</td><td>Excluded for simplification. This emission source is assumed to be very small.</td></tr>
<tr><td>N_2O</td><td>NO</td><td>Excluded for simplification. This emission source is assumed to be very small.</td></tr>
<tr><td rowspan="3">Emissions from on-site electricity use</td><td>CO_2</td><td>YES</td><td>May be an important emission source</td></tr>
<tr><td>CH_4</td><td>NO</td><td>Excluded for simplification. This emission source is assumed to be very small.</td></tr>
<tr><td>N_2O</td><td>NO</td><td>Excluded for simplification. This emission source is assumed to be very small.</td></tr>
</table>

<Table B-2>Gases to be considered for the project activity

B.4. Establishment and description of baseline scenario

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According to „General Guidelines to SSC CDM methodologies Ver.14.1", project participants of Type II and III greenfield projects may apply the following steps for the purpose of the most plausible baseline scenario demonstration.

Step 1:
Identify the various alternatives available to the project proponent that deliver comparable level of service including the proposed project activity undertaken without being registered as a CDM project activity.

Step 2:
List the alternatives identified per step 1 in compliance with the local regulations (if any of the identified baseline is not in compliance with the local regulations, then exclude the same from further consideration).

Step 3:
Eliminate and rank the alternatives identified in Step 2 taking into account barrier tests specified in attachment A to Appendix B of simplified modalities and procedures of SSC CDM.

Step 4:
If only one alternative remains that is:
• Not the proposed project activity undertaken without being registered as a CDM project activity; and
• It corresponds to one of the baseline scenarios provided in the methodology; then the project activity is eligible under the methodology.

If more than one alternatives remain that correspond to the baseline scenarios provided in the methodology, choose the alternative with the least emissions as the baseline.

Therefore, the proposed project uses these steps for its baseline scenario development.

B.5. Demonstration of additionality

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Step 1: Identify the various alternatives available to the project proponent that deliver comparable level of service including the proposed project activity undertaken without being registered as a CDM project activity.

There are three alternative baseline scenarios considered

Alternative 1: Maintain the status quo.

The landfill will continue existing flaring activity and emit the LFG that is not flared into atmosphere without any LFG to energy facilities.

Alternative 2: The project activity without CDM revenue.

Install LFG collecting and utilizing system to capture and generate electricity, implemented without considering CDM revenue. This alternative would face investment barrier without the benefit of CERs. Investment barrier is described and demonstrated in section B.5. (Refer to Investment barrier below).

Alternative 3: Flaring the LFGs

Install collecting and flaring system to burn the LFGs. Currently, the domestic regulation, Waste Control Act, requires landfill operators to install pipelines and destruct LFG to some extent to guarantee local environment and resident‟s safety. However, the regulation does not specify on how much LFG should be flared or how efficient flaring system should be installed. Therefore, it poses no benefit to landfill operators when they install new or enhance the existing flaring equipments for better LFG destruction voluntarily, as far as the existing practice meets domestic regulations. In result, this option is not realistic and will not be considered furthermore.

Step 2: List the alternatives identified per step 1 in compliance with the local regulations (if any of the identified baseline is not in compliance with the local regulations, then exclude the same from further consideration).

To satisfy the regulations of CDM project, the baseline scenario should comply with the Korean laws and regulations.

According to the Waste Control Act, an operator of the landfill that emits LFG have to install pipelines (landfill gas venting system) in compliance with its Enforcement Regulation and burn and/or utilize landfill gas in line with the Article 7 of its Enforcement Ordinance to guarantee local environment and resident‟s safety. However, the regulation does not specify on how much LFG should be flared or how efficient flaring system should be installed.

The project site, Gwangju landfill, has burned LFG in the past by simple burning system (flaring tips). After the project implementation, it will stop that flaring because LFG power generator will replace its role.

Therefore, the alternative 1 and 2 above do not violate domestic regulations and are considered further in following steps.

Date/Month/Year	Explanation
Oct/2008	Report on project feasibility and promotion scheme completed by Gwangju environmental installation Co.
23/Apr/2009	Gwangju Environmental Installation Co. invite the public to join in a contest for installing LFG power plant as a CDM project.
28/Apr/2009	"Prior consideration of CDM" was submitted to DNA of Republic of Korea.
May/2009	FS report for the project was made by Seohee Construction Co. Ltd.
6/Jul/2009	- Seohee Construction Co. Ltd. was chosen by the Gwangju Environmental Installation Co as a project developer for the LFG power plant project. - Architectural and execution drawing contract, which is the earliest made between Seohee Construction Co. Ltd. and sub-contractors. (Project starting date as in C.1.1 below)
Oct/2009	Approval on electricity generation business by Gwangju Metropolitan city. Approval on construction business by Nam Gu, Gwangju Metropolitan city.
Oct/2009 ~ Dec/2009	Construction and equipment installation.
Nov/2009	"Prior consideration of CDM" was submitted to UNFCCC
Feb/2010~	Test Operation

<Table B-3> Project promotion history

Step 3: Eliminate and rank the alternatives identified in Step 2 taking into account barrier tests specified in attachment A to Appendix B of simplified modalities and procedures of SSC CDM.

Attachment A to Appendix B of the Simplified Modalities and Procedures for Small-Scale Clean Development Mechanism Project Activities (decision 4/CMP.1, Annex II) should be used to determine whether the project is additional. Attachment A needs the project proponents to justify the additionality of the proposed project by showing that the project activity would not have occurred anyway due to at least one of the following barriers.

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

In this PDD, investment barrier is demonstrated to be applied to demonstrate the additionality.

The incentive from the CDM had been seriously taken into account prior to the starting date of the project activity, aiming to obtain the additional funding to make the project feasible. Because, without CDM, the project is evaluated to be economically unattractive with its NPV below zero.

Investment barrier

The biggest barrier against the project without CDM (Alternative 2 in B.4) is investment barrier. LFG recovery and utilization project requires high investment cost, but the capital return is expected to be low. Due to these reasons, this LFG utilization project is not attractive alternative as power generation. This will be demonstrated by calculating Internal Return Rate of the project activity.

For demonstrating the investment barrier, Step 2 of “Tools for the demonstration and assessment of additionality Ver.5.2” is used. There are three analysis methods available. They are 1) simple cost analysis (option I), 2) investment comparison analysis (option II) and 3) benchmark analysis (option III). For this project, **Option III – Benchmark analysis** is applied and the project NPV is calculated for evaluating the economical value of this project.

Option III. Apply benchmark analysis:

Discount rate is the important factor in NPV analysis. For the proposed project activity, the discount rate is set as 3-year Treasury bond yield issued by government that is 5.27%. This is a very conservative benchmark because the main project developer that is responsible for all the cost of the proposed project activity is Seohee Construction Co. Ltd. (private entity) and it pays the whole cost by their own private funding without public funding or ODA finance.

In the investment analysis of the project, major parameters are as follows;

Gwangju LFG Power plant	Total cost of Construction in 2009	Total cost of Construction in 2011	O&M cost (per year)	Special O&M cost (due only in 2015)	LFG Utilization fee (%)	Save cost of electricity (KRW/kWh)	NPV
	1978.0	645.5	Until 2011: 488.9 After 2011: 352.3	867.3	5%	95.15	-2,060

<Table B-4>Basic parameters for calculation of financial indicators
(Unit: million KRW unless specified otherwise below)

Using the values above, the investment analysis is implemented as follows. The separate calculation sheet has more specific information on the analysis.

<Basic Parameters> Unit: Miilion Won

Cost	Construction Cost in 2009	1978.0
	Construction Cost in 2011	645.5
	O&M cost until 2011	352.3
	O&M cost after 2011	488.9
	Special O&M (Due in 2015)	867.3
	LFG Utilization fee	5.0%
Benefit	Electricity Price (Won/kWh)	95.15
Discount Rate		5.27%

Unit: Miilion Won

Period		Cost			Revenue	Yearly Cashflow	Present Value Factor	NPV	
		Construction Cost	O&M Cost	LFG Utilization fee	Electricity selling			Cost	Revenue
0	2009	1,978				-1,978	1.0000	1,978	0
1	2010		352	23	459	84	0.9499	356	436
2	2011	645	352	26	513	-511	0.9024	924	463
3	2012		489	28	564	47	0.8572	443	484
4	2013		489	31	613	94	0.8143	423	499
5	2014		489	33	661	139	0.7735	404	511
6	2015		1,356	35	706	-686	0.7348	1,023	519
7	2016		489	37	749	223	0.6980	367	523
8	2017		489	36	719	194	0.6631	348	476
9	2018		489	34	689	166	0.6299	330	434
10	2019		489	33	661	139	0.5983	312	396
11	2020		489	32	634	114	0.5684	296	360
12	2021		489	30	608	89	0.5399	280	329
13	2022		489	29	584	66	0.5129	266	299
14	2023		489	28	560	43	0.4872	252	273
15	2024		489	27	537	22	0.4628	239	249
16	2025		489	26	516	1	0.4397	226	227
17	2026		489	25	495	-19	0.4177	215	207
18	2027		489	24	475	-38	0.3967	203	188
19	2028		489	23	456	-56	0.3769	193	172
20	2029		489	22	437	-73	0.3580	183	157
Total								9,261	7,201

*The Project IRR calculation above does not consider corporate tax as a cost factor

NPV	**-2,060**
IRR	**#DIV/0!**

<Table B-5>Economic analysis for the project activity

As a result of the investment analysis of the project, NPV is below zero. It means the project activity itself is not economically attractive.

Detail information of the O&M cost is described in the following list. For construction cost, refer to the separate calculation sheet for further information.

O&M Cost until 2011 (Unit: Thousand KRW)	Labor	84,360
	Insurance	26,754
	Vehicle maintenance	12,002
	Administration cost	24,000

	Electricity purchase	9,600
	Water supply and drainage	1,200
	Maintenance of LFG collection system Maintenance of gas engine	57,762
	Maintenance of gas engine	113,353
	Engine Oil and antifreeze	23,280
	Total	352,311
O&M Cost after 2011 (Unit: Thousand KRW	Labor	84,360
	Insurance	26,754
	Vehicle maintenance	12,002
	Administration cost	24,000
	Electricity purchase	9,600
	Water supply and drainage	1,200
	Maintenance of LFG collection system	57,762
	Maintenance of gas engine	226,706
	Engine Oil and antifreeze	46,560
	Total	488,944

<Table B-6>List of O&M cost

LFG utilization fee is recognized as cost every year during the project period in the analysis. In Korea, it is generally paid to the local authority. Although the payment is not mandatory by national or local regulations so that it is not a tax, project developers currently pay in average 5% of their revenue from selling electricity produced by LFG-based power generation to the local authority that owns the landfill[1]. Therefore, the investment analysis adopted this 5% as a LFG utilization fee as a conservative approach while Seohee Construction should pay 6% of their revenue from the project to the local authority.

In the analysis, E+/E- policies are considered as stated in EB22 Annex 3, "Clarifications on the consideration of national and/or sectoral policies and circumstances in baseline scenarios". According to the document, national and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (so called type E- policy) and that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).

For the project, an E- policy is considered. The policy name is so called „FIT(feed-in-tariff) policy"[2], which officially publish the national subsidy for the price of the electricity produced out of renewable power generation projects . The purpose of subsidy is to compensate the renewable energy power generation projects for the difference between the necessary price for renewable energy-based electricity and the system marginal price of the national grid electricity (SMP). SMP (KRW/kWh) is the standard electricity price in Korea considering the whole grid. According to the policy published in 2008 by Ministry of Knowledge Economy, LFG-based power generation project

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1 'Feasibility study of LFG-based power generation projects at landfills in local authorities', Ministry of Environment, 2009, Publication No. 11-1480000-001039-01.

2 In accordance with „Standard price of electricity generated using alternative energy , the policy was noticed officially first on 29th May of 2002 by the Ministry of Commerce, Industry and Energy (MOCIE) of Korean Government. Its recent amendment was made on 14th May of 2008 by Ministry of Knowledge Economy.B.

under 30MW capacity is to be subsidized by 10 KRW/kWh. Therefore, actual power selling price for the project is SMP+10/kWh.

As this policy has been implemented since May of 2002 and could be regarded as E- policy considering the nature of the policy, it does not need to be considered in baseline scenario establishment. Therefore, the subsidy is not recognized as cost in the investment analysis of the proposed CDM project and SMP is used as power selling price in the analysis.

Sensitivity Analysis

The objective of sensitivity analysis is to show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions.

Sensitivity analysis is conducted by variable parameters including construction cost, operation cost and SMP(electricity price). Power generation factor is exempt from this Sensitivity analysis because the same NPV is resulted from both 'Electricity Price' and „Power Generation" sensitivity analysis (i.e. the calculated NPV of the analysis applying 5%-increased power price is exactly the same as the resulted NPV of the analysis applying 5%-increased power generation).

1.The result of increase of system marginal price(SMP, electricity selling price)

Increase of benefit rate (%)	SMP (KRW/kW)	NPV (Million KRW)
+	95.15	-2,060
5	99.91	-1,718
10	104.67	-1,376

2. The result of decrease of construction cost

Decrease of investment costs rate (%)	Total construction costs (Million KRW)	NPV (Million KRW)
-	2,624	-2,060
5	2,492	-1,932
10	2,361	-1,804

3. The result of decrease of O&M cost

Decrease of operation costs rate (%)	O&M Cost until 2011 (Million KRW)	O&M Cost after 2011 (Million KRW)	Special Operation costs (Million KRW)	NPV (Million KRW)
-	352.3	488.9	867.3	-2,060
5	334.7	464.5	824.0	-1,743
10	317.1	440.0	780.6	-1,426

<Table B-7>Result of sensitivity analysis

As a result of analysis, NPV variations are below zero. Therefore, the proposed activity without CDM (Alternative 2) is not economically feasible.

Step 4:

Step 4 is described in „General Guidelines to SSC CDM methodologies Ver.14.1" as follows;

If only one alternative remains that is:
• Not the proposed project activity undertaken without being registered as a CDM project activity; and
• It corresponds to one of the baseline scenarios provided in the methodology; then the project activity is eligible under the methodology.

In accordance with the guideline above, only one alternative (Alternative 1) remains after Step 3 and this alternative meets the conditions above. Therefore, this is set as a baseline scenario and eligible under the methodology (AMS III.G Ver. 6).

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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For calculating the emissions reductions of methane that would have been released from the project site, AMS III.G Ver. 6 is used. And in accordance with AMS III.G Ver. 6 Paragragh 2, the emission reductions resulted from the electricity generated by the project activity (i.e. displacement of the grid electricity, $BE_{electricity,y}$ below) shall be calculated following AMS I.D Ver.16 guidance.

The emission reduction achieved by the project activity can be estimated ex-ante by:

$$ER_{y,estimated} = BE_y – PE_y - Leakage$$

Where;

$ER_{y,estimated}$	Ex-ante emission reduction by the project activity in year *y* (tCO_2e/yr)
PE_y	Project emissions in year *y* (tCO_2e/yr)
BE_y	Baseline emissions in year *y* (tCO_2e/yr)
Leakage	If the methane recovery technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects are to be considered.

As the proposed project activity does not incur any leakage emission due to the reasons stated above, the leakage will not be considered for $ER_{y,estimated}$ calculation.

The actual emission reduction achieved by the project activity during the crediting period will be calculated as described B.7.

Baseline emissions

Based on both AMS III.G and AMS I.D, the baseline emission for the proposed project activity is:

$$BE_y = MD_y – MD_{reg,y} + BE_{electricity,y}$$

Where;

MD_y	Methane captured and destroyed/gainfully used by the project activity in the year "y" (tCO_2e).
$MD_{reg,y}$	Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year "y" (tCO_2e)

$BE_{electricity,y}$ The baseline emission from the electricity generation in the absence of the project activity at year y (tCO_2e). This parameter is calculated according to AMS I.D.

In ex-ante **BE_y** calculation, LFG capturing efficiency of the project LFG collection system (55%, Source: Seohee Construction Co. Ltd.) is considered as the project facility cannot collect all the LFG generated from the landfill.

Therefore, **MD_y** is calculated as follows;

$MD_y = BE_{CH4,SWDS,y} \times CE$

$BE_{CH4,SWDS,y}$ The methane generation from the landfill in the absence of the project activity at year y(tCO_2e)

CE LFG capturing efficiency of the proposed project LFG collection system

$BE_{CH4,SWDS,y}$ is calculated according to the methodological tool "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site Ver. 4". In the crediting period, MD_y will be calculated based on the actual monitoring data apart from the equation above. For ex-post ER calculation, refer to B.7.

As for $MD_{reg,y}$, AMS III.G Ver.6 does not specify how to calculate it. Therefore, ACM0001 Ver.11 is used as general guidance to calculate it. In ACM0001 Ver.11, it writes as follows:

… In cases where regulatory or contractual requirements do not specify $MD_{BL,y}$ or no historic data exists for LFG captured and destroyed an "Adjustment Factor" (AF) shall be used and justified, taking into account the project context. …(b) In cases, where the baseline system for collection and destruction of methane is not installed prior to project implementation and/or measurements of the amount of methane that is destroyed are not available then the destruction efficiency of the system mandated by regulatory or contractual requirements (ε_{BL}) should be assumed to be equal to the theoretical efficiency of the specific system for collection and destruction of methane that is defined in the regulation or contract. In other cases, a procedure for estimating the amount of landfill gas that would be captured in absence of the project activity shall be provided in the CDM-PDD validated by the DOE. This procedure shall be used to estimate the MD_{Hist} in equation 3 above to estimate the baseline destruction efficiency;…

Currently, Korea government regulates that LFG from landfills should be flared while it does not regulate specific amount, percentage or efficiency for flaring. Therefore, specific amount or percentage of LFG to be destroyed is not specified in the contract or regulation. In this situation, landfills in Korea have different flaring efficiency or some landfills do not even have flaring system because there is no specific standard for this[3]. In addition, no historic flaring data of the project site exists for the LFG captured and destroyed in the past as the landfill operator have not recorded or managed such data. And existing flaring tips will not operate after the project activity implements. Therefore, MDreg,y is calculated and justified, taking into account the project context as described in the excerpt above.

Considering the project context, $MD_{reg,y}$ is calculated as follows;

$MD_{reg,y} = MD_y \times AF_y$

---

[3] Current condition on waste generation and disposal in Korea, 2009 Ministry of Environment

Where;

AF_y Adjustment factor for year *y*

AF_y is calculated as follows;

$$AF_y = \varepsilon_{BL} / \varepsilon_{PR,1}$$

Where;

ε_{BL} Destruction efficiency of the baseline system (fraction)

$\varepsilon_{PR,1}$ Destruction efficiency of the system used in the project activity that will remain fixed for the whole crediting period (fraction)

As the reasons described above, ε_{BL} is estimated based on the related research publication[4] in Korea that is issued by the public agency. The document statistically analyzed the average LFG destruction efficiency in Korean landfills. According to the document, 5.2% of the total LFG generated in the landfills investigated in the research are destructed. Therefore, ε_{BL} is estimated as 5.2%.

$$\varepsilon_{PR,1} = MD_{PR,1} / MG_{PR,1}$$

Where;

$\varepsilon_{PR,1}$ Destruction efficiency of the system used in the project activity that will remain fixed for the whole crediting period (fraction)

$MD_{PR,1}$ Amount of methane destroyed by the project activity during the first year of the project activity (tCH_4)

$MG_{PR,1}$ Amount of methane generated during the first year of the project activity estimated using the actual amount of waste disposed in the landfill as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site Ver.4" (tCH_4)

For the ex-ante calculation, $\varepsilon_{PR,1}$ is estimated 55%, which is gas fraction in $BE_{CH4,SWDS,y}$ recoverable by the project LFG collection system (LFG capturing efficiency). However, $\varepsilon_{PR,1}$ will be calculated using the data during the first year of the project activity.

Therefore, ex-ante $MD_{reg,y}$ is calculated and ex-post **AF_y** will be calculated as follows;

Ex-ante AF_y calculation				
AF_y	**=**	ε_{BL}	/	**$\varepsilon_{PR,1}$**
9.45%	=	5.2%	/	55.0%
Ex-post AF_y calculation (Calculated in the first year of the crediting period and fixed during the crediting period)				
AF_y	**=**	ε_{BL}	/	**$\varepsilon_{PR,1}$**
To be calculated	=	5.2%	/	To be decided based on the actual monitoring data (=$MD_{PR,1}$ / $MG_{PR,1}$)

[4] 1) Survey for estimating GHG emission and establishing statistics in landfill, August 2006, Ministry of Environment.

<Table B-8>Ex-ante and ex-post AF_y calculation

$BE_{electricity,y}$ is calculated as follows:

$BE_{electricity,y} = EG_{BL,y} \times EF_{CO2}$

Where;

$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
EF_{CO2}	CO_2 Emission Factor in year y; tCO_2e/MWh. EF_{CO2} value corresponds to $EF_{grid,CM,y}$ as in B.6.2.

EF_{CO2} is calculated according to „Tool to calculate the Emission Factor for an electricity system". Data on the national Grid for calculating $EF_{Grid,CM,y}$, $EF_{Grid,BM,y}$ and $EF_{Grid,OM,y}$ is available Annex 3 below. EF_{CO2} is calculated once and fixed for the first crediting period (Ex-ante option for simple OM is chosen for the project)

According to the methodology AMS I.D. Version 16, the baseline of the project activity is the electricity produced by the renewable generating unit multiplied by an emission coefficient calculated in a transparent and conservative manner as:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system". Any of the four procedures to calculate the operating margin can be chosen, but the restriction to use the Simple OM and the Average OM calculations must be considered

OR

(b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Between two choices above, (a) has been chosen. A combined margin (CM) has been calculated by referring "Tool to calculate the emission factor for an electricity system" and the calculation is as follows:

The ex-ante calculation of the emission reductions takes following steps:

Parameter	Value	Source
FC $_{i,m,y}$ is the amount of fuel i (in a mass or volume unit) consumed by a relevant power source m in year(s) y, which supplies electricity to the grid, not including low-operating cost and must-run power plants.	Refer to <Table Annex 3-1>	Statistics of Electric Power in KOREA 2006-2008 (Source: KEPCO 2007-2009)
Net Calorific Values by Power Plant	Refer to <Table Annex 3-2>	Caloric value sourced from Statistics of Electric Power in 2006-2008, (Source: KEPCO 2007-2009) (Net Caloric Value = Caloric value

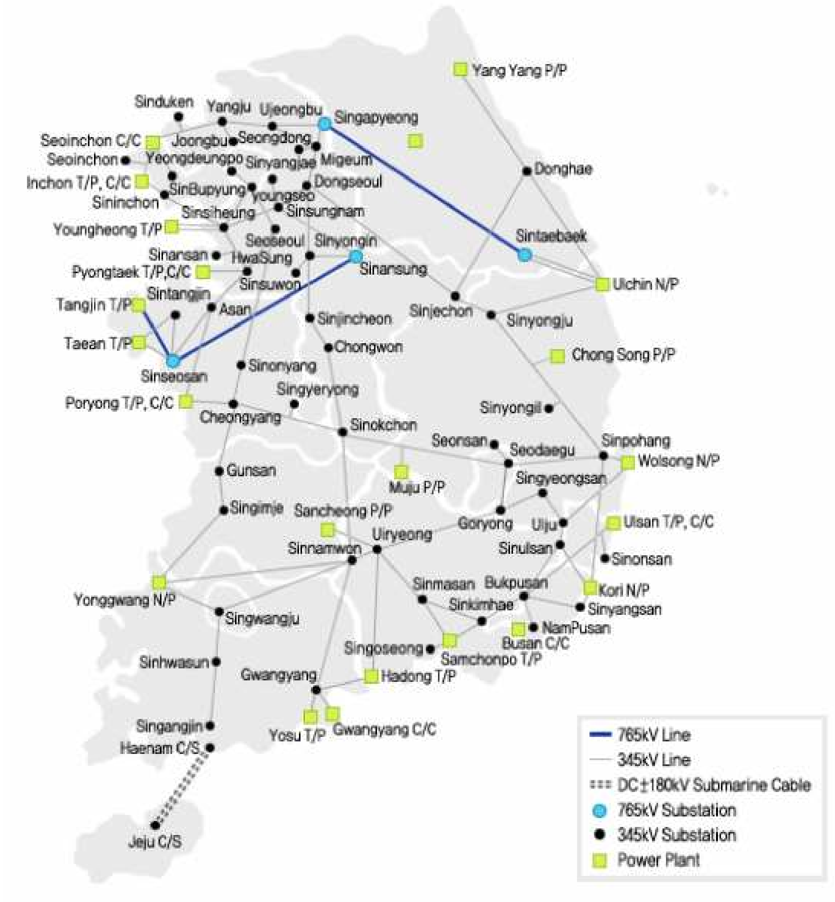
		net × caloric value conversion factor)
$EG_{m,y}$ (MWh) is the electricity delivered to the grid by source *m*	Refer to <Table Annex 3-3> <Table Annex 3-4>	Statistics of Electric Power in KOREA 2006-2008 (Source: KEPCO 2007-2009)
Net Caloric Values Conversion Factor	Solid/Liquid fossil fuel : 0.95 Gaseous fuel : 0.90	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Fuel CO_2 Emission Factor($EF_{CO2,i,y}$)	Refer to <Table Annex 3-5>	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Operating Margin Emissions Factor($EF_{grid,OM,y}$) (in ton CO_2/MWh)	0.6816	Calculated
Build Margin Emissions Factor($EF_{grid,BM,y}$) (in ton CO2/MWh)	0.5221	Calculated
Baseline Emissions Factor($EF_{grid,CM,y}$) (in ton CO2/MWh)	0.6018	Calculated

<Table B-9>Major parameter of emission factor

Step 1. Identify the relevant electric power system

OM (Operating Margin) and BM (Build Margin) are calculated by using the data from existing power plants that provide electricity with the current grid-connected electricity generation, and with this result, the $EF_{grid,CM,y}$ (Baseline Emission Factor) can be calculated. The steps for the Baseline calculation methodology are as follows;

The electricity from the project activities is connected to KEPCO grid, which is the only one in Korea and so relevant electric power system is KEPCO grid.



<Figure B-2>The transmission map of Korea

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)

According to "Tool to calculate the emission factor for an electricity system"(Version 2), there are two options to calculate the operating margin and build margin emission factor:

Option I : Only grid power plants are include in the calculation.
Option II : Both grid power plants and off-grid power plants are included in the calculation.

This project chooses option 1. Only grid power plants are including in the calculation.

Step 3. Select a method to determine the operation margin(OM)

As described in "Tool to calculate the emission factor for an electricity system Ver.2", the OM emission factor is calculated as the generation-weighed emissions per electricity unit of all generating units serving the system, excluding low-operating cost and must-run power plants. Low-operating cost and must run power plants include hydro, nuclear, low cost biomass, geothermal and domestic coal.

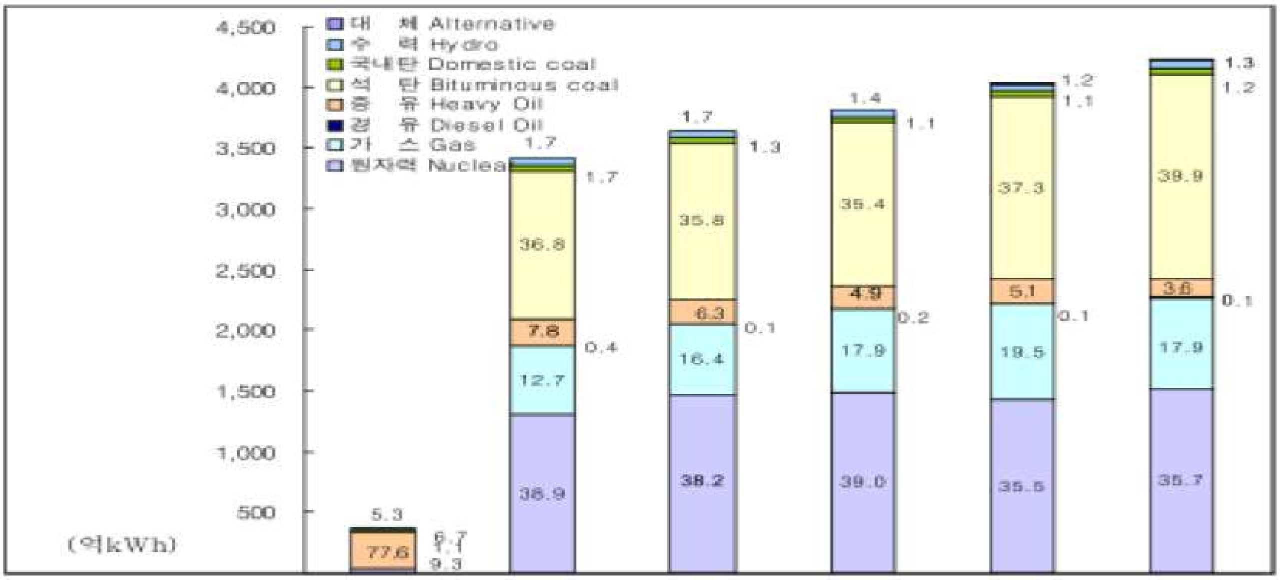
Operating Margin emission factor ($EF_{grid,OM,simple,y}$) shall be calculated basis on one of the four following methods:

Option (a) Simple OM
Option (b) Simple adjusted OM
Option (c) Dispatch Data Analysis OM
Option (d) Average OM

If low-cost/must-run resources constitute less than 50% of total grid generation in average of the five most recent years, simple OM can be chosen.

Referring to the gross electricity generation rate by energy sources of the host country (Republic of Korea), the rate of low cost/must run power generation does not exceed 50% of the total grid. Actually, the most recent 5-year (2004~2008) average data shows that the rate of low cost/must run is 40.40%. (Source: KEPCO)

Therefore, for this project case, “Option (a) Simple OM” is available.



(단위 Unit : 백만kWh million kWh)

구분 Item / 연도 Year		1980	2004	2005	2006	2007	2008
수 력 Hydro		1,984	5,861	5,189	5,219	5,042	**5,563**
화 력 Thermal	국내탄Coal(Dom.)	2,481	4,603	4,484	4,312	4,470	**5,010**
	석 탄Coal(Bitum.)	–	122,556	129,174	134,894	150,204	**168,498**
	중유 Oil(Heavy)	28,876	21,591	20,079	18,596	20,769	**15,033**
	경유 Oil(Diesel)	421	474	412	599	446	**392**
	가 스 Gas	–	55,999	58,118	68,302	78,427	**75,809**
원자력 Nuclear		3,477	130,715	146,779	148,749	142,937	**150,958**
대체에너지 (alternative)		–	350	404	511	829	**1,092**
계 Total		37,239	342,148	364,638	381,181	403,124	**422,355**

<Figure B-3> Gross electricity generation in the Republic of Korea during past 5 years (Korea Electric Power Corporation, 2009)

For the simple OM, the emissions factor can be calculated using either of the two following data vintages:

• *Ex ante option*: If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the 5 most recent calendar years prior to the time of submission of the CDM-PDD for validation.

• *Ex post option*: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year y-2 may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.

For this project, *Ex-ante option* is chosen.

Step 4. Calculate the operating margin emission factor according to the selected method

(a) Simple OM option is chosen for the project as described in STEP 3 above.

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2e/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated using one of the following options;

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

For this project, option A is chosen to calculate the simple OM.

Where Option A is used, the simple OM emission factor is calculated as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where;

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year *y* (tCO_2e/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2e/MWh)
m	All power units serving the grid in year *y* except low-cost / must-run power units
y	The relevant year as per the data vintage chosen in Step 3

Determination of $EF_{EL,m,y}$

For calculating $EF_{EL,m,y}$, Option A1 is chosen as follows;

Option A1. If for a power unit *m* data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Where;

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2e/MWh)
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (Mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2e/GJ)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	All power units serving the grid in year *y* except low-cost/must-run power units
i	All fossil fuel types combusted in power unit *m* in year *y*
y	The relevant year as per the data vintage chosen in Step 3

In the case of this project, the applied values of $EF_{CO2,i,y}$ are based on using conversion factor suggested in the 2006 IPCC Guidelines. And those of $NCV_{i,y}$ and $EF_{CO2,i,y}$ are country-specific. Actually, the calorific values are indicated as country-specific data of gloss calorific value (GCV), and this was recalculated for this PDD as net calorific value (NCV) using conversion factor suggested in the 2006 Revised IPCC Guidelines.The detailed information used in the calculation is presented at tables in Annex 3.

Determination of $EG_{m,y}$

For grid power plants, the information concerning $EG_{m,y}$ is described at the tables in Annex 3. Off-grid power plants are not considered in determination of $EG_{m,y}$.

As a result, the OM emission factor ($EF_{grid,OM,simple,y}$) is 0.6817 (tCO_2e/MWh).

Step 5. – Identify the group of power units to be included in the Build Margin (BM)

The sample group of power units *m* used to calculate the build margin consist of either;

> a) The set of five power units that have been built most recently, or b)The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) which have been built most recently

PP should use the set of power units that comprise the larger annual generation than another option.

According to “Tool to calculate the emission factor for an electricity system (version 02)”, there are two options to choose in order to calculate the BM.

Option 1. For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2. For the first crediting period, the build Margin emission factor ($EF_{grid,BM,y}$)shall be updated annually, *ex-post,* including those unit built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest 27
year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ant,* as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

For this project case, **Option 1** is chosen to calculate the BM emission factor.

To select the sample group *m*, “the five power plants that have been built most recently” and “the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) which have been built most recently” were compared and the results are as follows.

Sample group(m) / Classificatioin	“The five power plants that have been built most recently” (in MWh)	“The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.”	Comments
Electricity quantity	4,813,540	**82,412,683**	Total generation is 404,424,813MWh in Korea (based on KEPCO"s data of the year 2008)
Proportion (ratio to total generation in the Republic of Korea)	1.19022%	**20.378%**	

<Table B-10>Sample plant group(m) for determination of BM emission factor

The annual generation of “the five power plants that have been built most recently” was 4,813,540MWh (1.19% of total generation of the grid system), and the annual generation of “the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.” was 82,412,683MWh (20.378% of total generation of the grid system).

Therefore the “The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.” is chosen as a sample group. For detail information, refer to Annex 3.

Step 6. – Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2e/MWh) of all power units m during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where;

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2e/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2e/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

According to the BM calculation formula and variables of above tables, $EF_{grid,BM,y}$ is 0.5221(tCO_2e/MWh).

Step 7. – Calculate the combined margin (CM) emission factor

Based on the results derived from Step 1, and Step 2, $EF_{grid,CM,y}$ has been calculated using the following formula:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

According to "Tool to calculate the emission factor for an electricity system Ver. 2", the proposed LFG-based power generation project activities are w_{OM} =0.5 and w_{BM} = 0.5 for the first crediting period and for subsequent crediting periods. And $EF_{grid,OM,y}$, $EF_{grid,BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2e/MWh.

Therefore baseline emission factor (***EF*** $_{grid,CM,y}$) for this project is **=** 0.06018tCO_2/MWh) as follows :

$$\begin{aligned} EF_{grid,CM,y} &= w_{OM} \cdot EF_{grid,OM\,y} + w_{BM} \cdot EF_{grid,BM,\,y} \\ &= 0.5 \cdot 0.6816(tCO_2/MWh) + 0.5 \cdot 0.5221(tCO_2/MWh) \\ &= \mathbf{0.6018}\ (tCO_2/MWh) \end{aligned}$$

Project Emissions

All the electricity produced by the project activity will be supplied to the grid while the power needed for the project activity itself will be supplied from the grid. In the crediting period, each of these two parameters ($EG_{BL,y}$, $EC_{PJ,y}$) will be monitored separately by watt-hour meters. The project power consumption is estimated by 60kWh/hour (supplied from the grid). Therefore, in ex-ante ER

calculation, project emissions are calculated based on this estimation. For the ex-post ER calculation, electricity supplied from the grid will be monitored and considered as described in B.7.

In case the project activity brings out the GHG emissions related to $PE_{EC,y}$ (Project emissions from the electricity generated by (an) off-grid fossil fuel fired captive power plants) and/or $PE_{FC,j,y}$ (Project emissions from fossil fuel combustion in process *j* for the project activity during the year *y*), corresponding amount will be monitored as described in B.7.

Leakage Emissions

A Genset module (JGC 320 GS-B.L produced by JENBACHER AG) is transferred from another LFG power generation project at Gwangju City, Korea (the same city as the project activity but different landfill) by the same project developer (Seohee Construction Co. Ltd.), which is so called Unjeong LFG project. Unjeong project is to use LFG for power generation, while other equipments and facilities for this proposed project activity are not derived from any other existing activities. The transferred genset modules were purchased by the project developer in June, 2003 for Unjeong-dong project, for which 3 MW LFG power generators (1.06MW x 3 units) were installed. However, 2 generators have been redundant since the year 2008 due to low LFG availability as described below.

Year	Power generation of Unjeong LFG project(MWh)	No. of Power generators operated for generation
2003	801.7	1
2004	13,733.1	2
2005	13,165.7	2
2006	17,419.3	3
2007	11,415.2	2
2008	7,700.7	1
2009	4,017.7	1

<Table B-11>Historical power selling records of Unjeong-dong LFG project (Source: Seohee Construction Co. Ltd.)

In this situation, the PP chose to use the redundant equipments for the new project activity. 1 generator unit will continuously be operating for Unjeong-dong project while 2 generators will be transferred and used for the proposed project activity according to the installment plan (1 unit for the year 2009 and 2011 each).

As for leakage emissions, the transferred generation sets do not incur any leakage effect because they have not been used for power generation for years at Unjeong-dong site before the transfer. In addition, the GHG emissions due to transportation of the generators will be very small as the both projects are practiced in the same place (Gwangju city). Therefore, the leakage emissions for the project activity correspond to zero. Historical generation record and other information about Unjeong-dong project are submitted to DOE.

For the investment analysis, only the present value of the engine is considered as investment cost considering the depreciation.

B.6.2. Data and parameters fixed ex ante

(Copy this table for each piece of data and parameter.)

Data / Parameter	**ε_{BL}**
Unit	%
Description	Destruction efficiency of the baseline system (fraction)
Source of data	Survey for estimating GHG emission and establishing statistics in landfill, August 2006, Ministry of Environment
Value(s) applied	5.2%
Choice of data or Measurement methods and procedures	Sourced from the research document.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**CE**
Unit	%
Description	LFG capturing efficiency of the proposed project LFG collection system
Source of data	Seohee Construction Co. Ltd.
Value(s) applied	55%
Choice of data or Measurement methods and procedures	Technological survey of Seohee Construction Co. Ltd.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**D_{CH4}**
Unit	tCH_4/m^3CH_4
Description	Methane Density
Source of data	
Value(s) applied	0.0007168 tCH_4/m^3CH_4
Choice of data or Measurement methods and procedures	At standard temperature and pressure(0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH_4/m^3CH_4
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**$EF_{Grid,CM,y}$**
Unit	tCO_2e/MWh
Description	CO_2 emission factor for electricity grid in baseline.
Source of data	Calculated

Value(s) applied	0.6018 tCO_2e/MWh
Choice of data or Measurement methods and procedures	This value was calculated according to “Tool for calculation of emission factor for electricity system “. Applied value was calculated using Statistics of Electric Power in KOREA (2006,2007,2008, KEPCO) and Status of Generation facility(2008) (Korea Power Exchange)
Purpose of data	Calculation of baseline emissions
Additional comment	This value corresponds to EFCO2 in ER calculation. More details described in annex 3

Data / Parameter	$EF_{Grid,OM,y}$
Unit	tCO_2e/MWh
Description	CO_2 Operating Margin emission factor of the grid
Source of data	calculated
Value(s) applied	0.6816 tCO_2e/MWh
Choice of data or Measurement methods and procedures	This value was calculated according to “Tool for calculation of emission factor for electricity system”. Applied value was calculated using Statistics of Electric Power in KOREA (2006,2007,2008, KEPCO) and Status of Generation facility(2008) (Korea Power Exchange).
Purpose of data	Calculation of baseline emissions
Additional comment	More details described in annex 3

Data / Parameter	$EF_{Grid,BM,y}$
Unit	tCO_2e/MWh
Description	CO_2 Build Margin emission factor of the grid
Source of data	calculated
Value(s) applied	0.5221 tCO_2e/MWh
Choice of data or Measurement methods and procedures	This value was calculated according to “Tool for calculation of emission factor for electricity system “.Applied value was calculated using Statistics of Electric Power in KOREA (2006,2007,2008, KEPCO) and Status of Generation facility(2008) (Korea Power Exchange).
Purpose of data	Calculation of baseline emissions
Additional comment	More details described in annex 3

Data / Parameter	**ø**
Unit	N/A
Description	Model correction factor to account for model uncertainties
Source of data	“Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site Ver.4”
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	The above default value is suggested in “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site Ver.4”
Purpose of data	Calculation of baseline emissions

Additional comment	N/A

Data / Parameter	**OX**
Unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Use the IPCC 2006 Guidelines for National Greenhouse Gas Inventories for the choice of the value to be applied.
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	For managed solid waste disposal sites which are covered with oxidizing material such as soil or compost. As Gwangju landfill has daily soil cover, OX is 0.1
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**DOC_j**
Unit	%
Description	Fraction of degradable organic carbon (by weight) in the waste type j
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4, and 2.5)
Value(s) applied	<table><tr><td>Waste type j</td><td>DOC_j(%wet waste)</td></tr><tr><td>Wood and wood product</td><td>43%</td></tr><tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40%</td></tr><tr><td>Food, food waste, beverages and tobacco</td><td>15%</td></tr><tr><td>Textiles</td><td>24%</td></tr><tr><td>Garden, yard and park waste</td><td>20%</td></tr><tr><td>Glass, plastic, matal, other inert waste</td><td>0%</td></tr></table>
Choice of data or Measurement methods and procedures	The above default value is suggested in “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site Ver.4”.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**DOC_f**
Unit	%
Description	Fraction of degradable organic carbon (DOC) that can decompose
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	The above default value is suggested in “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site Ver.4”.

Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**MCF**
Unit	N/A
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	The project site is categorized as „anaerobic managed solid waste disposal site".
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**$W_{j,x}$**
Unit	%
Description	Amount of organic waste type j prevented from disposal in the SWDS in the year *x* (tons)
Source of data	The project site(Gwangju landfill)-specific data collected by Gwangju Environmental Installations Co.
Value(s) applied	Refer to the separate calculation sheet.
Choice of data or Measurement methods and procedures	Since the landfill operation started, Gwangju Environmental Installations Co. has collected the waste amount and composition data by monitoring and analyzing the waste received.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

<table>
<tr><td>Data / Parameter</td><td>k_j</td></tr>
<tr><td>Unit</td><td>N/A</td></tr>
<tr><td>Description</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 3.3)</td></tr>
<tr><td>Value(s) applied</td><td>
<table>
<tr><td colspan="2">Waste type j</td><td>K_j Dry (MAP/PET<1)</td></tr>
<tr><td rowspan="2">Slowly Degrading</td><td>Pulp, paper, cardboard (other than sludge), textiles</td><td>0.04</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.02</td></tr>
<tr><td>Moderately degrading</td><td>Other(non-food) organic putrescible garden and park waste</td><td>0.05</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, beverages and tobacco(other than sludege)</td><td>0.06</td></tr>
</table>
</td></tr>
</table>

Choice of data or Measurement methods and procedures	The above default values applicable for the region where Mean Annual Temperature (MAT) is below 20°C and mean annual precipitation(MAP) is less than Potential evapo-transpiration(PET), according to the “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site.” The MAT of Gwangju city is 13.9°C which is consistent with the above condition. It is assumed that MAP is less than PET in conservative manner because there is no information about PET in Gwangju.
Purpose of data	Calculation of baseline emissions
Additional comment	10 years mean value (1996~2005) MAT(Mean Annual Temperature) : 13.9 MAP(Mean Annual Precipitation): 1524.6 mm PET(Potential evapo-transpiration): N/A Based on data observed at meteorological observatory in Gwangju Data source :Korea Meteorological Association

Data / Parameter	**F**
Unit	N/A
Description	Fraction of methane in the SWDS gas (volume faction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	This factor reflects the fact that some degradable organic carbon doesn‟t degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**f**
Unit	-
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site
Value(s) applied	0
Choice of data or Measurement methods and procedures	According to the AMS.III.G, this value corresponds to zero. $\mathbf{MD_{reg,y}}$ is considered in the ER calculation.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

B.6.3. Ex ante calculation of emission reductions

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In accordance with AMS III.G and AMS I.D, the GHG emission reduction by this project (CH_4 destroy and electricity displacing) is calculated as follows;

$$\mathbf{ER_{y,estimated} = BE_y - PE_y - Leakage}$$

Where;

$ER_{y,estimated}$ Ex-ante emission reduction by the project activity (tCO_2e/yr)
PE_y Project emissions in year *y* (tCO_2e/yr)
BE_y Baseline emissions in year *y* (tCO_2e/yr)
Leakage If the methane recovery technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects are to be considered.

Year	$ER_{y,estimated}$	=	BE_y	-	PE_y	-	Leakage
2011	24,014	=	24,331	-	316	-	0
2012	26,448	=	26,764	-	316	-	0
2013	28,782	=	29,098	-	316	-	0
2014	31,021	=	31,338	-	316	-	0
2015	33,170	=	33,486	-	316	-	0
2016	35,231	=	35,547	-	316	-	0
2017	33,777	=	34,093	-	316	-	0
2018	32,384	=	32,700	-	316	-	0
2019	31,050	=	31,367	-	316	-	0
2020	29,773	=	30,089	-	316	-	0

<Table B-12>Ex-ante Emission reduction by this project(Unit: tCO_2e/yr)

For estimating the project emissions above, only the electricity needed for the project activity (estimated as 60kWh/hour) is considered as no other PE sources (e.g. fossil fuel consumption or power from captive power plants) are expected to occur in the project activity.

$BE_y = MD_y - MD_{reg,y} + BE_{electricity,y}$

Where;

MD_y Methane captured and destroyed/gainfully used by the project activity in the year "y" (tCO_2e).
$MD_{reg,y}$ Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year "y" (tCO_2e)
$BE_{electricity,y}$ The baseline emission from the electricity generation in the absence of the Project activity at year y (tCO_2e). This parameter is calculated according to AMS I.D while other parameters in this equation are calculated according to AMS III.G.

Year	BE_y	=	MD_y ($BE_{CH4,SWDS,y} \times CE$)	-	$MD_{reg,y}$	+	$BE_{electricity,y}$
2011	24,331	=	23,289	-	2,202	+	3,244
2012	26,764	=	25,618	-	2,422	+	3,568
2013	29,098	=	27,852	-	2,633	+	3,879
2014	31,338	=	29,996	-	2,836	+	4,178
2015	33,486	=	32,052	-	3,030	+	4,464
2016	35,547	=	34,025	-	3,217	+	4,739
2017	34,093	=	32,633	-	3,085	+	4,545
2018	32,700	=	31,300	-	2,959	+	4,359
2019	31,367	=	30,024	-	2,839	+	4,182
2020	30,089	=	28,801	-	2,723	+	4,011

<Table B-13>Ex-ante Baseline Emission Calculation

$$MD_y = BE_{CH4,SWDS,y} \times CE$$

Where;

$BE_{CH4,SWDS,y}$ The methane generation from the landfill in the absence of the project activity at year y(tCO_2e)

CE LFG capturing efficiency of the proposed project LFG collection system

Year	MD_y	=	$BE_{CH4,SWDS,y}$	*	CE
2011	23,289	=	42,343	*	55.0%
2012	25,618	=	46,578	*	55.0%
2013	27,852	=	50,641	*	55.0%
2014	29,996	=	54,538	*	55.0%
2015	32,052	=	58,277	*	55.0%
2016	34,025	=	61,864	*	55.0%
2017	32,633	=	59,333	*	55.0%
2018	31,300	=	56,909	*	55.0%
2019	30,024	=	54,588	*	55.0%
2020	28,801	=	52,365	*	55.0%

<Table B-14>Ex-ante MD_y Calculation

The methane emission potential of a solid waste disposal site, $BE_{CH4,SWDS,y}$ in tCO_2e, is undertaken using the followed equation in the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site. Ver. 4".

$$BE_{CH4,SWDS,y} = ø \times (1-f) \times GWP_{CH4} \times (1-OX) \times 16/12 \times F \times DOC_f \times MCF \times \Sigma\Sigma W_{j,x} \times DOC_j \times exp(-k_j \times (y-x)) \times (1-exp(-k_j))$$

Where;

ø Model correction factor to account for model uncertainties (0.9)

f Fraction of methane captured at SWDS and flared, combusted or used in another manner (0)

GWP_{CH4} Global warming potential of methane (21)

OX Oxidation factor - reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste (0.1)

F Fraction of methane in the landfill gas (volume fraction) (0.5)

DOC_f Fraction of degradable organic carbon (DOC) that can decompose (0.5)

MCF Methane correction factor (1.0)

$W_{j,x}$ Amount of organic waste type j filled in the year x

DOC_j Fraction of degradable organic carbon (by weight) in the waste type j

k_j Decay rate for the waste type j (refer to B.6.2 for the value applied)

j Waste type category

x x runs from the first year of landfill operation to the the year y for which emissions are calculated (x = y)

y Year for which avoided emissions are calculated

Waste amount and composition ($W_{j,x}$) is derived from the data that is actually have been measured by Gwangju Environmental Installations Co. since the landfill operation is started.

$MD_{reg,y} = MD_y \times AF_y$

Where;

AF_y Adjustment factor for year *y*

Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year "y" (tCO_2e)					
Year	**$MD_{reg,y}$**	=	**MD_y**	×	**AF_y**
2011	2,202	=	23,289	×	9.45%
2012	2,422	=	25,618	×	9.45%
2013	2,633	=	27,852	×	9.45%
2014	2,836	=	29,996	×	9.45%
2015	3,030	=	32,052	×	9.45%
2016	3,217	=	34,025	×	9.45%
2017	3,085	=	32,633	×	9.45%
2018	2,959	=	31,300	×	9.45%
2019	2,839	=	30,024	×	9.45%
2020	2,723	=	28,801	×	9.45%

<Table B-15> Baseline Methane destruction to comply with legal regulations in the year "y"

AF_y is calculated as follows;

$AF_y = \varepsilon_{BL} / \varepsilon_{PR,1}$

Where;

ε_{BL} Destruction efficiency of the baseline system (fraction)

$\varepsilon_{PR,1}$ Destruction efficiency of the system used in the project activity that will remain fixed for the whole crediting period (fraction)

Year	AF_y	=	εBL	*	εPR,1
2011	9.45%	=	5.2%	*	55.0%
2012	9.45%	=	5.2%	*	55.0%
2013	9.45%	=	5.2%	*	55.0%
2014	9.45%	=	5.2%	*	55.0%
2015	9.45%	=	5.2%	*	55.0%
2016	9.45%	=	5.2%	*	55.0%
2017	9.45%	=	5.2%	*	55.0%
2018	9.45%	=	5.2%	*	55.0%
2019	9.45%	=	5.2%	*	55.0%
2020	9.45%	=	5.2%	*	55.0%

<Table B-16>Ex-ante AF_y Calculation

Ex-post AF_y will be calculated as described in B.6.1.

$BE_{electricity,y}$ is calculated as follows:

$BE_{electricity,y} = EG_{BL,y} \times EF_{CO2}$

Where;

$EG_{BL,y}$	Energy baseline in year *y*; MWh
EF_{CO2}	CO_2 Emission Factor in year y; tCO_2e/MWh. EF_{CO2} value corresponds to $EF_{grid,CM,y}$ as in B.6.2.

Year	$BE_{electricity,y}$	=	$EG_{BL,y}$	*	EF_{CO2}
2011	3,244	=	5,390	*	0.6018
2012	3,568	=	5,929	*	0.6018
2013	3,879	=	6,446	*	0.6018
2014	4,178	=	6,942	*	0.6018
2015	4,464	=	7,418	*	0.6018
2016	4,739	=	7,875	*	0.6018
2017	4,545	=	7,552	*	0.6018
2018	4,359	=	7,244	*	0.6018
2019	4,182	=	6,948	*	0.6018
2020	4,011	=	6,665	*	0.6018

<Table B-17>Ex-ante $BE_{electricity,y}$ Calculation

$EG_{BL,y}$ is calculated based on following parameters. For detail information, refer to separate calculation sheet.

Items	Unit	Value	Source
Gas engine output	MW	2.12	Two gas engines, Manufacturer's manual
Maximum Captured amount of LFG	m^3/min	14.17	Two engines total, Manufacturer's manual
Methane content ratio	%	50%	"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site Ver.4"
Methane density	tCH_4/m^3CH_4	0.0007168	
kcal-kWh	kcal/kWh	860	Korea energy law
Calorific value of methane	$Kcal/Nm^3$	8,560	Korea institute of energy research
Efficiency of gas engine	%	35%	Manufacturer's manual
LFG capturing efficiency of the project LFG collection system	%	55%	Seohee Construction Co. Ltd.

<Table B-18> Basic parameters for calculating $EG_{BL,y}$

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
2011	23,698	316	0	24,014

2012	26,132	316	0	26,448
2013	28,466	316	0	28,782
2014	30,705	316	0	31,021
2015	32,854	316	0	33,170
2016	34,915	316	0	35,231
2017	33,461	316	0	33,777
2018	32,068	316	0	32,384
2019	30,734	316	0	31,050
2020	29,457	316	0	29,773
Total	302,490	3,160	0	305,650
Total number of crediting years	10year			
Annual average over the crediting period	30,249	316	0	30,565

<Table B-19>Summary of the ex-ante estimation of emission reductions

B.7. Monitoring plan

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The actual emission reduction achieved by the project during the crediting period is calculated using the followed equation;

$$ER_y = MD_y - MD_{reg,y} + (EG_{BL,y} - EC_{PJ,y}) \times EF_{CO2} - PE_y - Leakage$$

Where;

MD_y Methane captured and destroyed by the project activity in the year “y” (tCO_2e).

$MD_{reg,y}$ Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year “y” (tCO_2e)

$EG_{BL,y}$ Total amount of electricity exported to the grid by the project activity in the year *y* (MWh)

$EC_{PJ,y}$ Electricity supplied from the grid for the project activity in the year *y* (MWh)

EF_{co2} CO_2 Emission Factor in year y; tCO_2/MWh. EF_{CO2} value corresponds to $EF_{grid,CM,y}$ as in B.6.2.

PE_y Project emissions in year *y* (tCO_2e/yr)

Leakage If the methane recovery technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects are to be considered. The project leakage is zero. For details, refer to B.6.1.

EF_{CO2} will be fixed for crediting period; 0.6018 tCO_2e/MWh.

If the project activity is supplied any electricity from (an) off-grid fossil fuel fired captive power plant(s) or use any fossil fuel during the activity, project emissions will be calculated as follow:

$$PE_y = PE_{EC,y} + PE_{FC,j,y}$$

Where;

$PE_{EC,y}$ Project emissions from the electricity generated by (an) off-grid fossil fuel fired

	captive power plant(s). The project emissions from electricity consumption ($PE_{EC,y}$) will be calculated following the latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".
$PE_{FC,j,y}$	Project emissions from fossil fuel combustion in process *j* for the project activity during the year *y* The project emissions from fossil fuel combustion ($PE_{FC,j,y}$) will be calculated following the latest version of "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

MD_y and $MD_{reg,y}$ is calculated as follows;

$$MD_y = LFG_{burnt,y} \times w_{CH4,y} \times D_{CH4} \times GWP_{CH4}$$

Where;

$LFG_{burnt,y}$	Landfill gas flared or used as fuel in the year "y" (Nm^3)
D_{CH4}	Density of methane at the temperature and pressure of the landfill gas[5]
$W_{CH4,y}$	Methane content in landfill gas in the year "y"
GWP_{CH4}	Global warming potential of CH_4

$$MD_{reg,y} = MD_y \times AF_y$$

Where;

AF_y	Adjustment factor for year *y*

AF_y calculation is specified in B.6.1.

B.7.1. Data and parameters to be monitored

(Copy this table for each piece of data and parameter.)

Data / Parameter	$MG_{PR,1}$
Unit	tCH_4
Description	Amount of methane generated during the first year of the project activity estimated using the actual amount of waste disposed in the landfill
Source of data	Project participants
Value(s) applied	Ex ante εPR,1 is 55%
Measurement methods and procedures	Calculated using "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site Ver.4"
Monitoring frequency	Continuous measuring and reading, hourly recording
QA/QC procedures	As per "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site Ver.4"
Purpose of data	Calculation of baseline emissions
Additional comment	To be used for εPR,1 calculation. To be monitored only for the first year of the project activity.

Data / Parameter	$MD_{PR,1}$
Unit	tCH_4
Description	Amount of methane destroyed by the project activity during the first year of the project activity
Source of data	Project participants

Value(s) applied	Ex ante εPR,1 is 55%
Measurement methods and procedures	Calculated from the monitoring data.
Monitoring frequency	Continuous measuring and reading, hourly recording
QA/QC procedures	Related monitoring equipments (flow meter & gas analyser) are subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data	Calculation of baseline emissions
Additional comment	To be used for εPR,1 calculation. To be monitored only for the first year of the project activity.

Data / Parameter	**$LFG_{burnt,y}$**
Unit	Nm^3
Description	Landfill gas flared or used as fuel in the year *y*
Source of data	Project participants
Value(s) applied	N/A
Measurement methods and procedures	• Measured by flow meter • Measured and archived continuously in form of electronic data file • Calibrate the meter every two years
Monitoring frequency	Continuous measuring and reading, hourly recording
QA/QC procedures	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**$W_{CH4,y}$**
Unit	m^3 CH_4/m^3 LFG
Description	Methane content in landfill gas in the year *y*
Source of data	Project Participants
Value(s) applied	N/A
Measurement methods and procedures	• Measured by gas analyser • Measured and archived continuously in form of electronic data file • Calibrate the meter every three years
Monitoring frequency	Continuous measuring and reading, hourly recording
QA/QC procedures	The gas analyzer is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**T**
Unit	℃
Description	Temperature of the landfill gas
Source of data	Project participants
Value(s) applied	N/A

Measurement methods and procedures	• Measured to determine the density of methane D_{CH4} • No separate monitoring of temperature will be done as the project LFG flow meter automatically measures temperature and pressure, expressing LFG volumes in normalized cubic meters
Monitoring frequency	Continuous measuring and reading, hourly recording
QA/QC procedures	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**P**
Unit	Pa
Description	Pressure of the landfill gas
Source of data	Project participants
Value(s) applied	N/A
Measurement methods and procedures	• Measured to determine the density of methane D_{CH4} • No separate monitoring of temperature will be done as the project LFG flow meter automatically measures temperature and pressure, expressing LFG volumes in normalized cubic meters
Monitoring frequency	Continuous measuring and reading, hourly recording
QA/QC procedures	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	$EG_{BL,y}$
Unit	MWh
Description	Total amount of electricity exported to the grid by the project activity
Source of data	Project participants
Value(s) applied	Specified in B.6.3
Measurement methods and procedures	• Measured by watt-hour meter • Calibrate the meter every three years
Monitoring frequency	Continuous measuring and reading, hourly recording
QA/QC procedures	The watt-hour meter is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	$EC_{PJ,y}$
Unit	MWh
Description	Electricity supplied from the grid by the project activity during the year y
Source of data	Project participants
Value(s) applied	0.06 per hour

Measurement methods and procedures	• The electricity for the project activity is from the grid. If any, corresponding amount will be monitored and considered as $PE_{EC,y}$. • Measured by watt-hour meter • Calibrate the meter every three years
Monitoring frequency	Real-time measurement and monthly records.
QA/QC procedures	The watt-hour meter is subject to a regular maintenance and testing regime to ensure accuracy.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter	**$PE_{EC,y}$**
Unit	tCO_2e/yr
Description	Project emissions from the electricity generated by (an) off-grid fossil fuel fired captive power plant(s).
Source of data	Project participants
Value(s) applied	0
Measurement methods and procedures	• The project is planning to use no electricity from (an) off-grid fossil fuel fired captive power plant(s) in doing project activity. If such electricity is used, corresponding amount will be monitored and calculated according to the latest version of “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Monitoring frequency	If such electricity is used, corresponding amount will be monitored and calculated according to the latest version of “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
QA/QC procedures	If applicable, related monitoring equipments are subject to regular maintenance and testing regime to ensure accuracy.
Purpose of data	Calculation of project emissions
Additional comment	N/A

Data / Parameter	**$PE_{FC,j,y}$**
Unit	tCO_2e/yr
Description	oject emissions from fossil fuel combustion in process *j* for the project activity during the year *y*
Source of data	Project participants
Value(s) applied	0
Measurement methods and procedures	• The project is planning to use no fossil fuel in doing project activity. If any fossil fuel is used, corresponding amount will be monitored and calculated according to the latest version of “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Monitoring frequency	If any fossil fuel is used, corresponding amount will be monitored and calculated according to the latest version of “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
QA/QC procedures	If applicable, related monitoring equipments are subject to regular maintenance and testing regime to ensure accuracy.
Purpose of data	Calculation of project emissions
Additional comment	N/A

Data / Parameter	GWP_{CH4}
Unit	tCO_2e/tCH_4
Description	Global warming potential of CH_4
Source of data	Default value. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	21
Measurement methods and procedures	Refer the decisions under UNFCCC and the Kyoto Protocol
Monitoring frequency	N/A
QA/QC procedures	Annual check for updating the default value, if available.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

B.7.2. Sampling plan

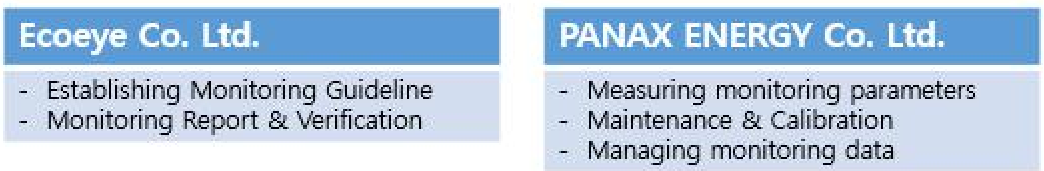
>>
N/A

B.7.3. Description of the monitoring plan

>>
Applied monitoring methodology for the project is AMS I.D. and AMS III.G. Parameters provided in section B.7.1 will be monitored in the crediting period. The section includes measurement methods for them and management plan of monitoring activity.

The monitoring plan is as follows.

· Monitoring organization and the role of each party

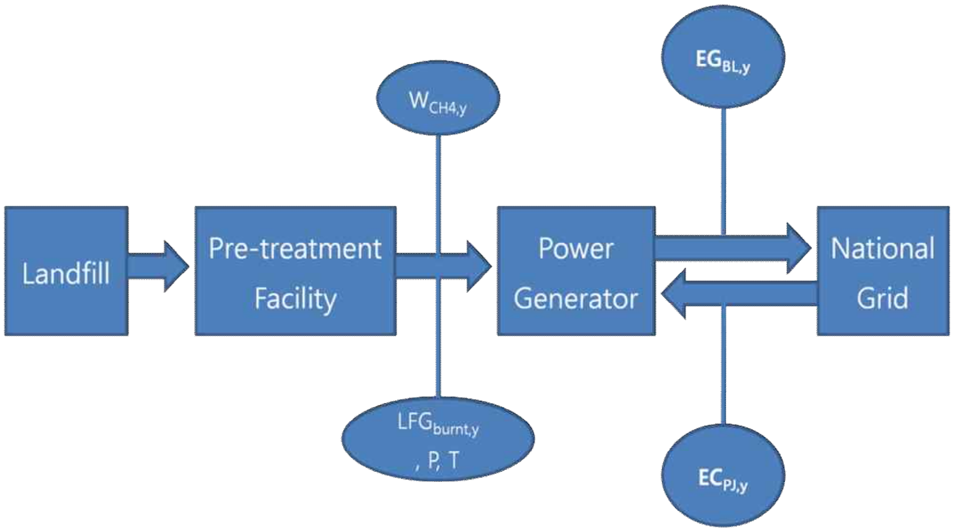


<Figure B-4> Monitoring structure

Ecoeye Co. Ltd. is to prepare monitoring report, verification processes and guidelines in the crediting period. PANAX ENERGY Co. Ltd. is responsible for measuring monitoring parameters, doing maintenance & calibration, and managing monitoring data.

· Location of the measurement instrument

A gas flow meter was installed between the blower and generating facility to measure LFG flow rate. The gas flow meter automatically measure the amount of collected LFG and, at the same time, its temperature and pressure expressing LFG volumes in normalized cubic meters. A continuous methane analyzer is used to measure the fraction of methane in LFG volume fed into the gas engine. The quantity of electricity to be exported to or imported from the grid is measured separately by Watt-hour meters.



<Figure B-5> Location of the monitoring equipments

Apart from the parameters above, other parameters (MGPR,1 MDPR, 1 PEEC,y and PEFC,j,y) will be monitored following the procedures described in B.7.1.

· **Monitoring and management procedure**

<Figure B-6> Organizational chart of management of monitoring data

In the chart above, the site manager is responsible for the whole operation process of the project facilities while an engineer(s) are in charge of maintenance and data management. The site manager reports to the project management team and then the team to the headquarter office periodically. The organizational structure for the monitoring may be changed as the project is implemented in the future.

<Figure B-7> Management procedure of project facilities

Type		Contents	Ref.
Management	Routine Management	Simple management(e.g. oiling, operation check, cleaning)	
	Periodic Management	Preventive management against possible malfunctions/failures	Walk-around inspection of the project facilities Partial overhaul & part change
	Replacement Repair	Performance restoration	Overhaul -> Inspection -> Adjustment & replacement -> Re-operate
	Preventive	Correction of minor malfunctions	

	Repair	found in routine management	
Repair	Emergency Repair	Performance restoration	Repair and preventive measures against unexpected malfunction & failure
	Ex post repair	Appropriate restoration measures to expected low performance & failure	Repair & adjustment
Improvements	Repair for Improvements	Improvements for better reliance, safety, control, economy	Repair facilities & materal
	Construction for Improvements	Improvement for better performance and technology	

<Table B-19> Maintenance & management plan

Monitoring plan as a part of the facility operation plan is systematically specified in the monitoring manual made by the project participants and it will be revised for better management of the project activity. The monitoring reports are made based on the guidance in the related CDM regulations / standards / methodologies.

· **Quality control (QC) and Quality assurance (QA) procedures**

Below is the general introduction of the monitoring manual made by the project participants. All the data collected as part of monitoring will be electronically archived for a period of two years from the end of the crediting period.

1. Monitoring equipment

1-1. Electricity measuring meters shall be set up transparently in accordance with “Law regarding measurement” and “Act on operation of electricity market” and shall be sealed after affirmation of Korea Power Exchange.
1-2 Other monitoring equipments will be installed and operated in accordance with AMS I.D and AMS III.G.
1-3. The monitoring equipments are certified when they are produced. Since then periodic calibration should be made as stated in B.7.1. Calibration frequency is determined in accordance with domestic and UNFCCC regulations. If any monitoring equipments are considered to perform abnormally, appropriate actions will be made immediately.

2. Electricity monitoring

2-1. The amount of electricity transmitted to the grid shall be measured automatically by established meter. The measured data are also checked by central control system of Korea Power Exchange.
2-2. The measured data of electricity production and consumption will be collected daily, weekly, and monthly and shall be archived in electronic way.
2-3. The collected data as in article 2-2 will be compared with those of Korea Power Exchange.
2-4. If the two data compared as in article 2-3 are different each other, project site manager will investigate the reason for the difference. This event and its justification, how the event is

considered in ER calculation will be specified in the corresponding CDM monitoring report. In case meters are improperly operated equipments, internal investigation and correction procedure shall be followed by the site manager.

3. Other parameters monitoring

3-1. The major parameters measured automatically by metering equipments (LFGburnt,y, wCH4,y etc.) will be monitored continuously and recorded automatically in computer.
3-2 Other monitoring parameters will be monitored in accordance with B.7.1.

4. Training & guideline for CDM monitoring

4-1. All employees directly involved in the monitoring process will be trained for monitoring and managing its data and equipments. The engineers at the project site will continuously be in touch with the CDM consultants to get proper guideline for monitoring activity. In addition, the separate monitoring manual is prepared for the engineers to implement monitoring and managing monitoring equipments appropriately.

The monitored data will be archived until 2 years after the end of the period of the project activity.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>

The date of completion of the baseline and monitoring methodology: 15th Feb 2011
Responsible person / entity is as follows

CEO Jae Soo, Jung
Ecoeye Co. Ltd., 401 Building 2 ,Seven Venture Valley Complex1 625, Sampyeong-dong, Bundang-gu Seongnam-City, Gyeonggi-Do, Korea(463-400).
Phone: 82-31-710-7300
Email: civilenvi@ecoeye.com

Consultant Sang hoon, Jang
Ecoeye Co. Ltd., 401 Building 2 ,Seven Venture Valley Complex1 625, Sampyeong-dong, Bundang-gu Seongnam-City, Gyeonggi-Do, Korea(463-400).
Phone: 82-31-710-7308
Email: hiyoung222@ecoeye.com

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

6th Jul. 2009 (Architectural and execution drawing contract, which is the earliest made between Seohee Construction Co. Ltd. and sub-contractors.)

C.1.2. Expected operational lifetime of project activity

>>
20 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Fixed

C.2.2. Start date of crediting period

>>
Date of registration as CDM **(**The project participant will not commence the crediting period prior to the date of registration.**)**

C.2.3. Length of crediting period

>>
10 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
According to the Environmental Impact Assessment Law, LFG utilization facilities do not need to assess the environmental effects.

D.2. Environmental impact assessment

>>
Apart from the Environmental Impact Assessment Law, the provincial subdivision of Ministry of Environment approved the alteration of the landfill site use with the conditions below that are related to environmental impacts.

● Air
: When the work that is dropping wastes or hardening the ground is performed, airborne particulate is produced, and cars which are for transferring waste or for servicing on site etc. are able to be a source of air pollution. However, residential area does not exist inside relevant area.

● Water
: It is concerned that discharged waste water is satisfied with the regulation, and waste water is transferred to leachate treatment facility and it is treated.

● Noise and Vibration
: The level of noise around the landfill site is below the regulation level, and the landfill site is surrounded by mountain. Even though there is residential area which is possibly influenced by the landfill site directly, bad influence by the landfill site is little. Considering those facts, it is concerned that the problem does not arise from noise or vibration caused in the landfill site.

● Odor
: After the project is performed, it is concerned that odor problem is little.

● Declaration of air emission of LFG utilization facility

● Prevention of odor problem under construction

● Prevention of dust problem under excavation for constructing facility

● Safety of gas storage tank

● Safety of gas facility

● The building and facilities which were constructed and installed in the project site had fire inspection on the process of construction permission.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>
Gwangju environmental installations Corporation (GEIC) organized an advisory committee for the project to collect its suggestions. The committee is consisted of professionals in many areas and representatives for local society as stated in Table E.1. There are many opinions and suggestions reported (Number of suggestions: About 40) in technological and environmental area.

The meeting for getting advisory before starting the project activity was held as follows;

1. Date of completing design report for the project activity: July, 2009
2. Date of advisory committee meeting: 8th, Aug. 2009
3. Date of received advisory report from the committee: Aug, 2009
4. Date of publishing revised design report reflecting the advisory: Sep. 2009

Name	Company	Fields of Business
Mr. Park, Gyu-Nam	CEO of Joeun Engineering Co.	Professional of Construction & electricity
Mr. Song, Yong-Soo	Gwangju Metropolitan City hall	In charge of waste treatment
Mr. Yoon, Yeong-Hyun	Resident Support Cooperation	Chairman
Mr. Lee, Yin-Hwa	Chosun University	Professor
Mr. Choi, Gwang-Jin	CEO of Jingwang engineering Co.	Professional of Construction & electricity

<Table E-1> Members of an Advisory committee present at the meeting

The picture below from the local newspaper deals with the project activity. This is reported on the paper on 12nd Feb. 2009 when Gwangju Metropolitan City just started planning LFG development project. The title of the article is „Gwangju metropolitan city starts sanitary landfill LFG power plant project".

광주시, 광역위생매립장 매립가스 발전사업 본격 추진

쓰레기매립장 악취가스를 에너지로

광주시는 쓰레기매립장에서 발생하는 악취가스를 에너지로 활용할 계획이다.

시는 광주시 남구 양과동 광역위생매립장의 매립쓰레기에서 발생하는 가스를 자원화해 전기를 생산하는 '매립가스 발전사업'을 본격 추진한다고 12일 밝혔다.

시는 지난 2005년 매립을 개시한 이후 매립가스 발생량이 충분치 않아 사업시점을 조절하는 과정에서 민간기업의 제안으로 '환경시설공단'이 매립가스 발생량 추이분석 등 기초조사를 실시한 결과, 사업성이 있다는 판단에 따라 추진하게 된 것이다.

<Figure E-1>Article about the project by local newspaper

Apart from these activities, comments from local residents are collected in the meeting officially hold on 31st Mar. 2009. The meeting was publicly announced and prepared by GEIC and Resident Support Board of Gwangju City helped notice to local residents about the meeting. The picture below relates to the report of the meeting.

문서번호	
보존기간	
결재일자	2009. 3. 31.
공개여부	

	담당자	매립환경팀장	폐기물관리사업소장	이 사 장
결재			전결	
협조				

『광주광역시 광역위생매립장』

매립가스자원화 및 CDM 사업 주민설명회 결과보고

광주광역시환경시설공단

Gwangju Metropolitan City Environmental Installations Corporation

<Figure E-2> Report on the meeting for explaining and collecting stakeholders comments

E.2. Summary of comments received

>>

Advisory committee for the project activity issues their opinion as document on 8th Aug. 2009. Thereafter, the project participants accepted almost of their suggestion and revised the design report for the project activity accordingly.

Report on the local residents" comments collection meeting officially hold on 31st Mar. 2009. contains the opinions of the residents on the project and the response of the project participants. As the nature of the project is to relieve the pollution out of the landfill operation and utilize landfill gas for energy, local residents supported the project plan and had no negative opinion on it.

These reports said above are submitted to DOE in validation stage for checking its validity.

E.3. Report on consideration of comments received

>>

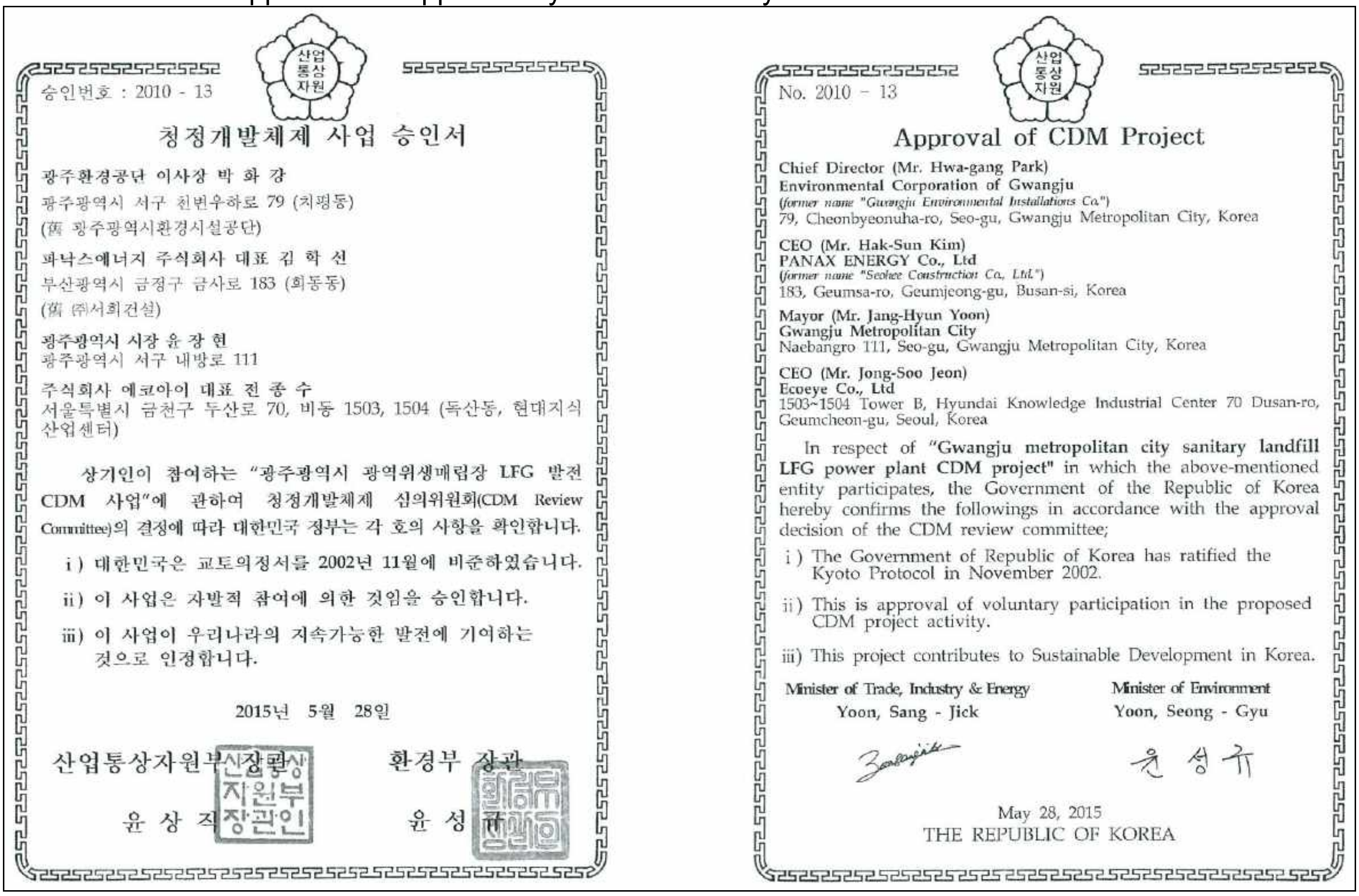
According to the measures reported in the advisory report, the design report for the project activity was revised and re-published in September, 2009. Almost all of the advice raised is accepted by project participants, while some are rejected with detail explanation on their decision. Those explanations are also included in the advisory report. As this advisory committee is held periodically even after the project implementation to ensure the project activity do not pose any harm to the environment and local society.

As for the local residents meeting, local residents do not have any negative opinion and request any counter measures to environmental effects.

SECTION F. Approval and authorization

>>

LoA re-inssuance application is approved by MOE on 28 May 2015.



승인번호 : 2010 - 13

청정개발체제 사업 승인서

광주환경공단 이사장 박 화 강
광주광역시 서구 천변우하로 79 (치평동)
(舊 광주광역시환경시설공단)

파낙스에너지 주식회사 대표 김 학 선
부산광역시 금정구 금사로 183 (회동동)
(舊 ㈜서희건설)

광주광역시 시장 윤 장 현
광주광역시 서구 내방로 111

주식회사 에코아이 대표 전 종 수
서울특별시 금천구 두산로 70, 비동 1503, 1504 (독산동, 현대지식산업센터)

상기인이 참여하는 "광주광역시 광역위생매립장 LFG 발전 CDM 사업"에 관하여 청정개발체제 심의위원회(CDM Review Committee)의 결정에 따라 대한민국 정부는 각 호의 사항을 확인합니다.

i) 대한민국은 교토의정서를 2002년 11월에 비준하였습니다.

ii) 이 사업은 자발적 참여에 의한 것임을 승인합니다.

iii) 이 사업이 우리나라의 지속가능한 발전에 기여하는 것으로 인정합니다.

2015년 5월 28일

산업통상자원부 장관 윤 상 직   환경부 장관 윤 성 규

No. 2010 - 13

Approval of CDM Project

Chief Director (Mr. Hwa-gang Park)
Environmental Corporation of Gwangju
(former name "Gwangju Environmental Installations Co.")
79, Cheonbyeonuha-ro, Seo-gu, Gwangju Metropolitan City, Korea

CEO (Mr. Hak-Sun Kim)
PANAX ENERGY Co., Ltd
(former name "Seohee Construction Co., Ltd.")
183, Geumsa-ro, Geumjeong-gu, Busan-si, Korea

Mayor (Mr. Jang-Hyun Yoon)
Gwangju Metropolitan City
Naebangro 111, Seo-gu, Gwangju Metropolitan City, Korea

CEO (Mr. Jong-Soo Jeon)
Ecoeye Co., Ltd
1503~1504 Tower B, Hyundai Knowledge Industrial Center 70 Dusan-ro, Geumcheon-gu, Seoul, Korea

In respect of **"Gwangju metropolitan city sanitary landfill LFG power plant CDM project"** in which the above-mentioned entity participates, the Government of the Republic of Korea hereby confirms the followings in accordance with the approval decision of the CDM review committee;

i) The Government of Republic of Korea has ratified the Kyoto Protocol in November 2002.

ii) This is approval of voluntary participation in the proposed CDM project activity.

iii) This project contributes to Sustainable Development in Korea.

Minister of Trade, Industry & Energy — Yoon, Sang - Jick
Minister of Environment — Yoon, Seong - Gyu

May 28, 2015
THE REPUBLIC OF KOREA

<Figure E-3>Approval of CDM Project

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Gwangju City
Street/P.O. Box	Naebangro 111
Building	City hall
City	Gwangju City
State/Region	
Postcode	
Country	Republic of Korea
Telephone	+81-62-613-4331
Fax	
E-mail	gjcity@gwangju.co.kr
Website	http://www.gwangju.go.kr
Contact person	
Title	Mayor
Salutation	Mr.
Last name	Yoon
Middle name	
First name	Jang-Hyun
Department	
Mobile	
Direct fax	
Direct tel.	82-62-613-4331
Personal e-mail	horse@korea.kr

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Environmental Corporation of Gwangju
Street/P.O. Box	79, Cheonbyeonuha-ro, Seo-gu
Building	
City	Gwangju City
State/Region	
Postcode	
Country	Republic of Korea
Telephone	+81-62-603-5206
Fax	+82-62-603-5678
E-mail	
Website	www.eco-g.or.kr
Contact person	
Title	Chief director
Salutation	Mr.
Last name	Park
Middle name	
First name	Hwa-gang
Department	
Mobile	
Direct fax	
Direct tel.	82-62-603-5206
Personal e-mail	signing1@naver.com

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	PANAX ENERGY Co., Ltd
Street/P.O. Box	183, Geumsa-ro, Geumjeong-gu
Building	
City	Busan-si
State/Region	
Postcode	
Country	Republic of Korea
Telephone	+82-62-675-0277
Fax	
E-mail	
Website	www.panaxenergy.co.kr
Contact person	
Title	CEO
Salutation	Mr.
Last name	Kim
Middle name	
First name	Hak-Sun
Department	
Mobile	
Direct fax	
Direct tel.	+82-62-675-0277
Personal e-mail	jhlee73@panaxenergy.co.kr

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Ecoeye Co. Ltd.
Street/P.O. Box	70 Dusan-ro, Geumcheon-gu
Building	1503~1504 Tower B, Hyundai Knowledge Industrial Center
City	Seoul City
State/Region	
Postcode	153-813
Country	Republic of Korea
Telephone	+82-2-6480-7300
Fax	+82-2-6480-7398
E-mail	
Website	http://www.ecoeye.com
Contact person	
Title	CEO
Salutation	Mr.
Last name	Jeon
Middle name	
First name	Jong-Soo
Department	
Mobile	
Direct fax	+82-2-6480-7398
Direct tel.	+82-2-6480-7300
Personal e-mail	smilef84@ecoeye.com

Appendix 2. Affirmation regarding public funding

No public funding is involved in the project.

Appendix 3. Applicability of methodology and standardized baseline

Mentioned in the concerned section of the PDD.

Appendix 4. Further background information on ex ante calculation of emission reductions

<Table Annex 3-1 Data on fuel consumption for plants in the Operating Margin - $EF_{Grid,OM,y}$ >

Plant (2006year)		Amount of fossil fuel($FC_{i,m,y}$)			
		Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
Honam	#1	866,853	1,113	279	
	#2	859,736	1,251	359	
Samchonpo	#1	1,696,271		860	
	#2	1,508,082		1,362	
	#3	1,519,385		457	
	#4	1,521,263		1,818	
	#5	1,665,339		977	
	#6	1,770,348		428	
Yonghung	#1	2,004,193		2,548	
	#2	2,129,118		2,545	
Boryeong	#1	1,638,140		306	
	#2	1,389,425		1,137	
	#3	1,323,779		514	
	#4	1,610,928		82	
	#5	1,296,455		541	
	#6	1,553,273		518	
Taean	#1	1,354,832		514	
	#2	1,532,209		162	
	#3	1,338,967		575	
	#4	1,548,909		133	
	#5	1,542,775		544	
	#6	1,294,577		1,113	
	#7	61,910		4,799	
Hadong	#1	1,373,049		515	
	#2	1,543,074		293	
	#3	1,549,094		153	
	#4	1,376,612		796	
	#5	1,554,524		242	
	#6	1,371,801		690	
Dangjin	#1	1,380,527		966	
	#2	1,570,077		161	
	#3	1,402,916		433	
	#4	1,386,317		1,549	

Plant (2006year)		Amount of fossil fuel($FC_{i,m,y}$)			
		Coal (t)	**Heavy oil (kl)**	**Diesel oil (kl)**	**L. N. G (t)**
	#5	1,456,458		745	
	#6	1,216,582		3,051	
	#7	1,008		505	
Ulsan	#1		72,243	605	
	#2		80,187	469	
	#3		96,459	518	
	#4		360,919	3,729	
	#5		375,985	3,678	
	#6		378,331	3,694	
Youngnam	#1		107,090	1,016	
	#2		95,127	1,494	
Yosu	#1		99,129	281	
	#2		215,957	291	
Pyongtaek	#1		261,458	141	3,997
	#2		277,025	166	5,687
	#3		303,858	134	3,891
	#4		245,602	103	3,473
Namjeju	#1		11,406	17	
	#2		9,772	14	
	#3		46,504	2,509	
Jeju	#1		8,603	23	
	#2		113,679	64	
	#3		117,464	67	
Seoul	#4			1	69,383
	#5			1	152,891
Incheon	#1				6,945
	#2				5,223
	#3			311	15,426
	#4			311	12,454
Pyongtaek C/C	C/C			45	84,054
Ilsan	C/C			1,384	556,504
Bundang	C/C				720,381
Ulsan	C/C				536,196
Seoincheon	C/C			1,066	1,199,196
Shinincheon	C/C				1,641,038
Boryeong	C/C				998,683
Incheon	C/C				484,606
Busan	C/C				1,396,417

Plant (2006year)		Amount of fossil fuel($FC_{i,m,y}$)			
		Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
Hallim	C/C			48,475	
Anyang	C/C				230,969
Bucheon	C/C			215	225,713
POSCO POWER	C/C				408,018
G S Bugog	C/C				389,811
Yulchon	C/C				315,132
Namjeju	D/P		51,347	111	
Jeju	G/T			8,264	
Jeju	D/P		52,907		
total		**50,208,806**	**3,383,417**	**111,869**	**9,466,086**

Plant (2007year)		Amount of fossil fuel($FC_{i,m,y}$)			
		Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
Honam	#1	866,853	889	281	
	#2	846,931	811	262	
Samchonpo	#1	1,631,706		296	
	#2	1,804,695		384	
	#3	1,755,374		434	
	#4	1,543,140		677	
	#5	1,850,764		315	
	#6	1,714,320		619	
Yonghung	#1	1,902,557		3,320	
	#2	2,296,289		1,779	
	#3	119,883		3,964	
	#4				
Boryeong	#1	1,466,761		811	
	#2	1,655,488		169	
	#3	1,648,008		187	
	#4	1,347,303		646	
	#5	1,629,904		195	
	#6	1,490,809		387	
Taean	#1	1,524,391		410	
	#2	1,434,221		374	

Plant (2007year)		Amount of fossil fuel($FC_{i,m,y}$)			
		Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
	#3	1,521,349		350	
	#4	1,320,380		422	
	#5	1,342,358		676	
	#6	1,535,931		491	
	#7	1,430,171		2,321	
	#8	919,055		3,636	
Hadong	#1	1,582,726		178	
	#2	1,396,830		637	
	#3	1,424,033		375	
	#4	1,572,409		292	
	#5	1,486,776		452	
	#6	1,585,307		109	
Dangjin	#1	1,512,904		269	
	#2	1,358,316		543	
	#3	1,516,065		119	
	#4	1,519,231		342	
	#5	1,279,796		1,038	
	#6	1,281,318		878	
	#7	1,059,612		6,681	
	#8	467,807		4,873	
Ulsan	#1		107,844	406	
	#2		108,381	483	
	#3		120,571	576	
	#4		341,170	3,525	
	#5		370,712	4,711	
	#6		216,409	3,021	
Youngnam	#1		174,082	1,232	
	#2		122,249	796	
Yosu	#1		121,572	332	
	#2		257,420	367	
Pyongtaek	#1		269,284	114	3,316
	#2		359,870	140	6,339
	#3		349,481	157	4,874
	#4		255,443	117	4,047

Namjeju	#1				
	#2				
	#3		124,559	225	
	#4		127,900	341	
Jeju	#1		1,049	4	

Plant (2007year)		Amount of fossil fuel($FC_{i,m,y}$)			
		Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
	#2		70,122	112	
	#3		98,846	34	
Seoul	#4			1	75,080
	#5			1	206,908
Incheon	#1				30,402
	#2				31,528
	#3			354	41,270
	#4			201	18,892
Bundang	fuel cell				313
Pyongtaek C/C	C/C			67	151,414
Ilsan	C/C				635,260
Bundang	C/C			3	660,899
Ulsan	C/C				649,494
Seoincheon	C/C				1,495,687
Shinincheon	C/C				1,761,001
Boryeong	C/C				1,121,251
Incheon	C/C				494,690
Busan	C/C				1,552,997
Hallim	C/C			17,753	
Anyang	C/C				289,384
Bucheon	C/C				269,651
POSCO POWER	C/C				660,445
G S Bugog	C/C				371,586
Yulchon	C/C				292,336
Kwangyang	C/C				
Namjeju	D/P		35,297	238	
Jeju	G/T			850	
Jeju	D/P		49,613		

total		55,641,771	3,683,575	76,359	10,829,064

Plant (2008year)		Amount of fossil fuel($FC_{i,m,y}$)			
		Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
Honam	#1	793,048	808	177	
	#2	887,772	1,225	167	
Samchonpo	#1	1,759,936		137	
	#2	1,628,693		1,065	
	#3	1,635,809		614	
	#4	1,662,981		726	
	#5	1,718,759		874	
	#6	1,844,647		448	
Yonghung	#1	1,894,596		5,594	
	#2	1,881,013		3,033	
	#3	1,694,625		2,173	
	#4	1,217,547		769	
Boryeong	#1	1,697,622		566	
	#2	1,328,646		196	
	#3	1,528,112		233	
	#4	1,694,212		339	
	#5	1,503,611		642	
	#6	1,704,157		301	
	#7	1,102,498		2,696	
	#8	227,312		1,060	
Taean	#1	1,493,418		589	
	#2	1,570,393		146	
	#3	1,442,632		551	
	#4	1,582,461		122	
	#5	1,566,721		363	
	#6	1,419,495		626	
	#7	1,285,747		1,224	

	#8	1,553,992		635	
Hadong	#1	1,478,000		355	
	#2	1,551,832		311	
	#3	1,573,892		474	
	#4	1,469,828		495	
	#5	1,592,246		256	
	#6	1,525,471		521	
	#7	310,138		2,900	
Dangjin	#1	1,559,086		60	
	#2	1,621,753		136	
	#3	1,474,550		751	
	#4	1,457,994		771	
	#5	1,490,658		250	

Plant (2008year)		Amount of fossil fuel($FC_{i,m,y}$)			
		Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
	#6	1,509,171		132	
	#7	1,264,913		645	
	#8	1,494,311		314	
Ulsan	#1		30,689	565	
	#2		29,228	562	
	#3		32,541	480	
	#4		228,138	4,016	
	#5		163,748	2,965	
	#6		225,645	3,757	
Yeongnam	#1		59,763	1,476	
	#2		40,030	802	
Yeosu	#1		32,576	202	
	#2		111,854	341	
Pyeongtaek	#1		91,937	77	2,562
	#2		125,789	90	4,744
	#3		135,720	145	4,232
	#4		86,454	100	3,020
Namjeju	#1				
	#2				
	#3		132,984	146	
	#4		119,301	127	
Jeju	#1				
	#2		84,258	81	

	#3		89,652	101	
Seoul	#4			1	55,095
	#5			0	138,068
Incheon	#1				28,582
	#2				30,186
	#3			292	32,472
	#4			238	27,637
Pyongtaek	C/C				150,276
Ilsan	C/C				636,633
Bundang	C/C				651,005
Ulsan	C/C				655,938
Seoincheon	C/C			721	1,436,788
Shinincheon	C/C				1,607,180
Boryeong	C/C				894,790
Incheon	C/C				459,923

Plant (2008year)		Amount of fossil fuel($FC_{i,m,y}$)			
		Coal (t)	**Heavy oil (kl)**	**Diesel oil (kl)**	**L. N. G (t)**
Busan	C/C				1,456,370
Hallim	C/C			6,883	
Anyang	C/C				292,931
Bucheon	C/C				302,746
POSCO POWER	C/C				587,956
GS Bugog	C/C				709,116
Yulchon	C/C				347,123
Kwangyang	C/C				
Hyundai-Daesan					
Namjeju	D/P		19,875	482	
Jeju	G/T			503	
Jeju	D/P		46,728		
total		**62,694,298**	**1,888,943**	**59,590**	**10,515,372**

Source: Statistics of Electric Power in 2006-2008, KEPCO 2007-2009

<Table Annex 3- 2 Net Caloric Value>

		Net Caloric value($NCV_{i,y}$)

year	Plant		Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
2006	Honam	#1	4,653	9,318	8,472	
		#2	5,137	9,332	8,426	
	Samchonpo	#1	5,640		8,373	
		#2	5,645		8,373	
		#3	5,565		8,373	
		#4	5,568		8,363	
		#5	4,974		8,550	
		#6	4,993		8,550	
	Yonghung	#1	5,768		8,447	
		#2	5,782		8,454	
	Boryeong	#1	5,479		8,412	
		#2	5,478		8,496	
		#3	5,552		8,496	
		#4	5,533		8,496	
		#5	5,552		8,312	
		#6	5,542		8,312	
	Taean	#1	5,683		8,312	
		#2	5,679		7,952	
		#3	5,684		8,216	

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
		#4	5,680		8,232	
		#5	5,638		8,232	
		#6	5,662		8,232	
		#7	5,667		8,130	
	Hadong	#1	5,670		8,396	
		#2	5,662		8,482	
		#3	5,660		8,481	
		#4	5,671		8,384	
		#5	5,665		8,466	
		#6	5,669		8,456	
	Dangjin	#1	5,588		8,526	
		#2	5,611		8,529	
		#3	5,592		8,556	
		#4	5,581		8,564	
		#5	5,743		8,507	
		#6	5,814		8,450	

		#7	5,527		8,535	
	Ulsan	#1		9,419	8,664	
		#2		9,427	8,664	
		#3		9,423	8,664	
		#4		9,529	8,664	
		#5		9,531	8,664	
		#6		9,533	8,664	
	Youngnam	#1		9,631	8,403	
		#2		9,605	8,419	
	Yosu	#1		9,465	8,358	
		#2		9,456	8,356	
	Pyongtaek	#1		9,222	8,496	11,647
		#2		9,233	8,496	11,647
		#3		9,260	8,501	11,573
		#4		9,208	8,501	11,667
	Namjeju	#1		9,413	8,525	
		#2		9,412	8,504	
		#3		9,403	8,491	
	Jeju	#1		9,377	8,429	
		#2		9,454	8,524	
		#3		9,455	8,524	
	Seoul	#4			8,617	11,716
		#5			8,617	11,594
	Incheon	#1				11,733
		#2				11,725

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	**Heavy oil (kcal/l)**	**Diesel oil (kcal/l)**	**L. N. G (kcal/kg)**
		#3			8,533	11,716
		#4			8,532	11,722
	Pyongtaek C/C	C/C			8,503	11,727
	Ilsan	C/C			8,540	11,715
	Bundang	C/C				11,723
	Ulsan	C/C				11,381
	Seoincheon	C/C			8,740	11,723
	Shinincheon	C/C				11,723
	Boryeong	C/C				11,730
	Incheon	C/C				11,698
	Busan	C/C				11,716
	Hallim	C/C			8,506	

	Anyang	C/C				11,726
	Bucheon	C/C			10,381	11,711
	POSCO POWER	C/C				11,728
	G S　Bugog	C/C				11,727
	Yulchon	C/C				12,039
	Namjeju	D/P		9,734	8,462	
	Jeju	G/T			8,352	
	Jeju	D/P		9,136		
2006 Total			**200,007**	**225,976**	**568,837**	**280,807**
2007	Honam	#1	5,186	9,311	8,497	
		#2	5,190	9,311	8,493	
	Samchonpo	#1	5,545		8,373	
		#2	5,537		8,373	
		#3	5,525		8,349	
		#4	5,540		8,349	
		#5	4,865		8,550	
		#6	4,864		8,550	
	Yonghung	#1	5,745		8,391	
		#2	5,739		8,457	
		#3	5,822		7,878	
		#4				
	Boryeong	#1	5,519		8,496	
		#2	5,515		8,496	
		#3	5,518		8,655	
		#4	5,513		8,944	
		#5	5,520		8,655	
		#6	5,518		8,655	
	Taean	#1	5,733		8,174	
		#2	5,733		8,387	

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	**Heavy oil (kcal/l)**	**Diesel oil (kcal/l)**	**L. N. G (kcal/kg)**
		#3	5,734		8,388	
		#4	5,727		7,963	
		#5	5,686		8,361	
		#6	5,695		8,347	
		#7	5,717		8,044	
		#8	5,722		7,256	
	Hadong	#1	5,647		8,492	
		#2	5,645		8,456	

		#3	5,627		8,469	
		#4	5,639		8,519	
		#5	5,652		8,492	
		#6	5,640		8,495	
	Dangjin	#1	5,660		8,610	
		#2	5,663		8,606	
		#3	5,657		8,617	
		#4	5,659		8,635	
		#5	5,713		8,620	
		#6	5,737		8,613	
		#7	5,725		8,621	
		#8	5,742		8,596	
	Ulsan	#1		9,413	8,664	
		#2		9,420	8,664	
		#3		9,360	8,664	
		#4		9,508	8,664	
		#5		9,511	8,664	
		#6		9,502	8,664	
	Youngnam	#1		9,643	8,402	
		#2		9,643	8,403	
	Yosu	#1		9,464	8,368	
		#2		9,462	8,370	
	Pyongtaek	#1		9,445	8,534	11,650
		#2		9,448	8,530	11,653
		#3		9,447	8,518	11,650
		#4		9,460	8,517	11,651
	Namjeju	#1				
		#2				
		#3		9,411	8,201	
		#4		9,410	8,515	
	Jeju	#1		9,412	8,458	
		#2		9,420	7,906	
		#3		9,419	8,490	

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	**Heavy oil (kcal/l)**	**Diesel oil (kcal/l)**	**L. N. G (kcal/kg)**
	Seoul	#4			7,411	11,727
		#5			8,617	11,727
	Incheon	#1				11,727
		#2				11,730

		#3			8,514	11,730
		#4			8,483	11,730
	Bundang fuel cell					11,673
	Pyongtaek C/C	C/C			8,503	11,739
	Ilsan	C/C				11,725
	Bundang	C/C			8,716	11,728
	Ulsan	C/C				11,610
	Seoincheon	C/C				11,739
	Shinincheon	C/C				11,735
	Boryeong	C/C				11,735
	Incheon	C/C				11,726
	Busan	C/C				11,727
	Hallim	C/C			8,533	
	Anyang	C/C				11,741
	Bucheon	C/C				11,898
	POSCO POWER	C/C				11,756
	G S Bugog	C/C				11,734
	Yulchon	C/C				11,732
	Kwangyang	C/C				-
	Namjeju	D/P		9,419	8,323	
	Jeju	G/T			8,447	
	Jeju	D/P		9,396		
2007 Total			**217,814**	**217,235**	**565,665**	**292,973**
2008	Honam	#1	5,089	9,311	8,484	
		#2	5,105	9,312	8,492	
	Samchonpo	#1	5,524		4,577	
		#2	5,506		8,373	
		#3	5,506		8,349	
		#4	5,524		8,349	
		#5	4,839		8,550	
		#6	4,836		8,550	
	Yonghung	#1	5,871		8,246	
		#2	5,870		8,446	
		#3	5,767		9,564	

year	Plant	Net Caloric value($NCV_{i,y}$)			
		Coal (kcal/kg)	**Heavy oil (kcal/l)**	**Diesel oil (kcal/l)**	**L. N. G (kcal/kg)**

		#4	5,771		8,416	
	Boryeong	#1	5,402		8,496	
		#2	5,442		8,496	
		#3	5,377		10,876	
		#4	5,387		8,558	
		#5	5,380		9,208	
		#6	5,386		8,655	
		#7	5,451		8,139	
		#8	5,401		4,824	
	Taean	#1	5,636		8,366	
2008		#2	5,639		8,398	
		#3	5,632		8,396	
		#4	5,638		8,224	
		#5	5,660		8,226	
		#6	5,662		8,341	
		#7	5,700		8,355	
		#8	5,666		8,393	
	Hadong	#1	5,579		8,377	
		#2	5,569		8,344	
		#3	5,575		8,475	
		#4	5,572		8,466	
		#5	5,573		8,487	
		#6	5,572		8,419	
		#7	5,798		7,546	
	Dangjin	#1	5,520		8,555	
		#2	5,501		8,537	
		#3	5,513		8,554	
		#4	5,503		8,464	
		#5	5,570		8,596	
		#6	5,562		8,537	
		#7	5,581		7,678	
		#8	5,566		8,543	

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	**Heavy oil (kcal/l)**	**Diesel oil (kcal/l)**	**L. N. G (kcal/kg)**
	Ulsan	#1		9,439	8,635	
		#2		9,444	8,664	
		#3		9,440	8,664	
		#4		9,516	8,662	
		#5		9,530	8,662	
		#6		9,513	8,662	
	Yeongnam	#1		9,674	8,446	
		#2		9,676	8,450	
	Yeosu	#1		9,449	8,352	
		#2		9,447	8,352	
	Pyeongtaek	#1		9,423	8,525	11,592
2008		#2		9,430	8,532	11,663
		#3		9,426	8,456	11,615
		#4		9,418	8,522	11,661
	Namjeju	#1				
		#2				
		#3		9,415	8,555	
		#4		9,356	8,557	
	Jeju	#1				
		#2		9,423	8,490	
		#3		9,421	8,490	
	Seoul	#4			8,617	11,739
		#5			8,609	11,734
	Incheon	#1				11,736
		#2				11,737
		#3			8,470	11,739
		#4			8,470	11,734
	Pyongtaek	C/C				11,744
	Ilsan	C/C				11,732
	Bundang	C/C				11,737
	Ulsan	C/C				11,648
	Seoincheon	C/C			-	11,739

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	**Heavy oil (kcal/l)**	**Diesel oil (kcal/l)**	**L. N. G (kcal/kg)**
	Shinincheon	C/C				11,739
	Boryeong	C/C				11,733
	Incheon	C/C				11,697
	Busan	C/C				11,730
	Hallim	C/C			8,536	
	Anyang	C/C				11,816
	Bucheon	C/C				11,191
	POSCO POWER	C/C				11,740
	GS Bugog	C/C				12,084
	Yulchon	C/C				11,737
	Kwangyang	C/C				
	Hyundai-Daesan					
2008	Namjeju	D/P		9,392	8,546	
	Jeju	G/T			8,457	
	Jeju	D/P		9,407		
2008 Total			**237,221**	**207,862**	**571,306**	**281,017**

Source: Statistics of Electric Power in 2005-2007, KEPCO 2006-2008

<Table Annex 3-3 Electricity delivered to the grid by power plants ($EG_{m,y}$) and *EF* for each plant>

Year	Plant		Net electricity generated	EF for each plant
			$EG_{m,y}$ (MWh)	**($tonCO_2$/MWh)**
2006	Honam	#1	1,622,639	0.9340
		#2	1,782,016	0.9313
	Samchonpo	#1	4,161,219	0.8620
		#2	3,703,880	0.8622
		#3	3,779,585	0.8387
		#4	3,816,997	0.8328
		#5	3,761,205	0.8259
		#6	4,065,091	0.8150
	Yonghung	#1	5,337,432	0.8129
		#2	5,727,937	0.8065
	Boryeong	#1	3,988,848	0.8434
		#2	3,423,101	0.8341
		#3	3,409,486	0.8082

	#4	4,133,946	0.8080
	#5	3,364,148	0.8022
	#6	3,987,488	0.8093

Year	Plant		Net electricity generated $EG_{m,y}$ (MWh)	EF for each plant ($tonCO_2/MWh$)
	Taean	#1	3,556,797	0.8116
		#2	4,035,753	0.8081
		#3	3,528,613	0.8086
		#4	4,069,820	0.8101
		#5	4,013,235	0.8125
		#6	3,381,867	0.8131
		#7	159,677	0.8976
	Hadong	#1	3,607,063	0.8092
		#2	4,068,036	0.8049
		#3	4,079,158	0.8056
		#4	3,631,374	0.8061
		#5	4,092,625	0.8065
		#6	3,610,222	0.8077
	Dangjin	#1	3,598,820	0.8040
		#2	4,115,891	0.8021
		#3	3,666,490	0.8020
		#4	3,610,984	0.8041
		#5	3,946,931	0.7947
		#6	3,392,395	0.7836
		#7	1,474	2.3058
	Ulsan	#1	275,016	0.7879
		#2	306,668	0.7832
		#3	376,132	0.7675
		#4	1,511,557	0.7257
		#5	1,583,846	0.7213
		#6	1,589,838	0.7232
	Youngnam	#1	359,205	0.9149
		#2	323,595	0.9043
	Yosu	#1	403,547	0.7367
		#2	906,849	0.7126
	Pyongtaek	#1	1,123,948	0.6879
		#2	1,198,620	0.6875
		#3	1,304,568	0.6899
		#4	1,052,228	0.6884
	Namjeju	#1	34,448	0.9864
		#2	28,686	1.0148
		#3	179,033	0.8082
	Jeju	#1	24,748	1.0328

	#2	462,023	0.7357
	#3	479,676	0.7323
Seoul	#4	306,558	0.6028
	#5	685,011	0.5883
Incheon	#1	32,932	0.5625
	#2	24,366	0.5714

Year	Plant		Net electricity generated $EG_{m,y}$ (MWh)	EF for each plant ($tonCO_2$/MWh)
		#3	78,669	0.5325
		#4	62,414	0.5446
	Pyongtaek C/C	C/C	497,441	0.4507
	Ilsan	C/C	3,038,165	0.4890
	Bundang	C/C	4,059,300	0.4730
	Ulsan	C/C	3,608,435	0.3845
	Seoincheon	C/C	8,726,521	0.3666
	Shinincheon	C/C	11,797,500	0.3707
	Boryeong	C/C	7,089,662	0.3757
	Incheon	C/C	3,648,288	0.3533
	Busan	C/C	10,455,401	0.3557
	Hallim	C/C	175,356	0.7147
	Anyang	C/C	1,286,480	0.4786
	Bucheon	C/C	1,241,795	0.4845
	POSCO POWER	C/C	2,338,128	0.4653
	G S Bugog	C/C	2,911,683	0.3569
	Yulchon	C/C	2,276,276	-
	Namjeju	D/P	239,690	0.6603
	Jeju	G/T	15,986	1.3123
	Jeju	D/P	252,764	0.6045
2006 Total			**206,605,293**	**0.6791**
2007	Honam	#1	1,806,765	0.9343
		#2	1,773,852	0.9303
	Samchonpo	#1	3,903,591	0.8687
		#2	4,398,382	0.8515
		#3	4,311,704	0.8431
		#4	3,840,729	0.8345
		#5	4,074,103	0.8284
		#6	3,823,174	0.8177
	Yonghung	#1	5,020,901	0.8174
		#2	6,081,490	0.8128
		#3	320,502	0.8457
		#4		
	Boryeong	#1	3,604,642	0.8421

	#2	4,120,511	0.8303
	#3	4,214,892	0.8086
	#4	3,438,773	0.8099
	#5	4,162,530	0.8101
	#6	3,817,024	0.8078
Taean	#1	4,055,394	0.8078
	#2	3,796,670	0.8118
	#3	4,039,811	0.8094
	#4	3,504,214	0.8089

Year	Plant		Net electricity generated $EG_{m,y}$ (MWh)	EF for each plant ($tonCO_2$/MWh)
		#5	3,523,988	0.8121
		#6	4,036,733	0.8123
		#7	3,868,817	0.7934
		#8	2,528,587	0.7824
	Hadong	#1	4,140,667	0.8089
		#2	3,681,670	0.8030
		#3	3,727,907	0.8056
		#4	4,115,014	0.8075
		#5	3,905,190	0.8067
		#6	4,158,792	0.8057
	Dangjin	#1	3,968,103	0.8088
		#2	3,595,927	0.8019
		#3	4,010,715	0.8014
		#4	4,009,178	0.8037
		#5	3,443,482	0.7965
		#6	3,497,359	0.7882
		#7	2,904,680	0.7886
		#8	1,297,925	0.7853
	Ulsan	#1	406,685	0.7916
		#2	407,321	0.7955
		#3	458,584	0.7812
		#4	1,418,034	0.7296
		#5	1,540,400	0.7316
		#6	899,604	0.7314
	Youngnam	#1	688,935	0.7748
		#2	474,475	0.7896
	Yosu	#1	497,053	0.7334
		#2	1,071,405	0.7195
	Pyongtaek	#1	1,147,515	0.7085
		#2	1,553,162	0.7031
		#3	1,502,099	0.7037

	#4	1,095,986	0.7070
Namjeju	#1	-	
	#2	-	
	#3	484,459	0.7661
	#4	500,222	0.7623
Jeju	#1	3,019	1.0379
	#2	280,454	0.7455
	#3	396,186	0.7430
Seoul	#4	357,572	0.5598
	#5	962,861	0.5729
Incheon	#1	148,821	0.5446
	#2	157,042	0.5354
	#3	205,530	0.5399

Year	Plant		Net electricity generated $EG_{m,y}$ (MWh)	EF for each plant ($tonCO_2$/MWh)
		#4	95,143	0.5350
	Pyongtaek C/C	C/C	909,449	0.4445
	Ilsan	C/C	3,506,350	0.4830
	Bundang	C/C	3,741,296	0.4710
	Ulsan	C/C	4,383,453	0.3911
	Seoincheon	C/C	10,895,505	0.3664
	Shinincheon	C/C	12,533,994	0.3748
	Boryeong	C/C	7,839,371	0.3816
	Incheon	C/C	3,696,784	0.3567
	Busan	C/C	11,616,221	0.3564
	Hallim	C/C	61,752	0.7457
	Anyang	C/C	1,615,090	0.4783
	Bucheon	C/C	1,523,068	0.4789
	POSCO POWER	C/C	3,788,598	0.4659
	G S Bugog	C/C	2,767,811	0.3581
	Yulchon	C/C	2,083,451	0.3743
	Namjeju	D/P	164,390	0.6430
	Jeju	G/T	1,294	1.6864
	Jeju	D/P	235,626	0.6254
2007 Total			**230,642,413**	**0.6779**
	Honam	#1	1,614,014	0.9388
		#2	1,816,464	0.9371
	Samchonpo	#1	4,230,470	0.8612
		#2	3,931,527	0.8554
		#3	4,024,666	0.8389
		#4	4,118,892	0.8362
		#5	3,779,114	0.8253

		#6	4,071,070	0.8213
	Yonghung	#1	5,137,490	0.8141
		#2	5,112,704	0.8107
2008		#3	4,535,951	0.8087
		#4	3,193,481	0.8251
	Boryeong	#1	4,017,302	0.8558
		#2	3,247,137	0.8346
		#3	3,733,602	0.8249
		#4	4,162,971	0.8217
		#5	3,677,963	0.8247

Year	Plant		**Net electricity generated $EG_{m,y}$ (MWh)**	**EF for each plant ($tonCO_2$/MWh)**
		#6	4,170,094	0.8250
		#7	2,878,738	0.7846
		#8	748,005	0.6171
	Taean	#1	3,894,659	0.8103
		#2	4,093,884	0.8106
		#3	3,763,910	0.8092
		#4	4,119,808	0.8116
		#5	4,089,287	0.8127
		#6	3,711,227	0.8119
		#7	3,482,731	0.7894
		#8	4,186,293	0.7885
	Hadong	#1	3,827,102	0.8076
		#2	4,012,667	0.8072
		#3	4,074,310	0.8073
		#4	3,804,790	0.8069
		#5	4,114,218	0.8084
		#6	3,953,083	0.8061
		#7	870,781	0.7814

	Dangjin	#1	3,991,074	0.8080
		#2	4,162,369	0.8032
		#3	3,800,792	0.8020
		#4	3,737,406	0.8050
		#5	3,908,658	0.7961
		#6	4,006,307	0.7852
		#7	3,336,619	0.7933
		#8	3,992,732	0.7807
	Ulsan	#1	114,753	0.8109
		#2	108,931	0.8146
		#3	123,706	0.7952
		#4	945,479	0.7370
		#5	678,426	0.7386
		#6	937,531	0.7343
	Yeongnam	#1	229,316	0.8135

Year	Plant		Net electricity generated $EG_{m,y}$ (MWh)	EF for each plant ($tonCO_2$/MWh)
		#2	149,357	0.8336
	Yeosu	#1	130,854	0.7475
		#2	454,052	0.7376
	Pyeongtaek	#1	386,361	0.7268
		#2	534,121	0.7260
		#3	576,432	0.7216
		#4	365,269	0.7272
	Namjeju	#1	-	-
		#2	-	-
		#3	559,817	0.7077
		#4	517,866	0.6819
	Jeju	#1	-	-
		#2	336,676	0.7461
		#3	357,666	0.7472
	Seoul	#4	258,052	0.5698

	#5	596,641	0.6173
Incheon	#1	141,085	0.5405
	#2	152,576	0.5279
	#3	162,092	0.5393
	#4	139,637	0.5324
Pyongtaek	C/C	903,201	0.4442
Ilsan	C/C	3,491,175	0.4864
Bundang	C/C	3,748,232	0.4634
Ulsan	C/C	4,454,326	0.3900
Seoincheon	C/C	10,308,626	0.3720
Shinincheon	C/C	11,531,252	0.3720
Boryeong	C/C	6,126,641	0.3896
Incheon	C/C	3,420,631	0.3575
Busan	C/C	10,848,484	0.3580
Hallim	C/C	23,547	0.7584
Anyang	C/C	1,638,638	0.4802
Bucheon	C/C	1,657,898	0.4646
POSCO POWER	C/C	3,328,129	0.4715

Year	Plant		**Net electricity generated**	**EF for each plant**
			$EG_{m,y}$ (MWh)	**($tonCO_2$/MWh)**
	GS Bugog	C/C	5,509,092	0.3536
	Yulchon	C/C	2,488,267	0.3722
	Kwangyang	C/C	-	-
	Hyundai-Daesan		-	-
	Namjeju	D/P	93,201	0.6465
	Jeju	G/T	643	2.0096
	Jeju	D/P	223,630	0.6214
2008 Total			**237,888,670**	**0.6874**

Source: Statistics of Electric Power in 2006-2008, KEPCO 2007-2009

<Table Annex 3-4 Build Margin calculation and CO_2 Emission Factor of the Build Margin, $EF_{Grid,BM,y}$>
Source: Statistics of Electric Power in 2008, KEPCO 2009, Current status of power generating facility (Korea power exchange)

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2008	tCO_2/MWh	EF for each plant (tonCO_2eq./MWh)
2008	1	Boryeong	#8	steam power	Bituminous coal	2008.12	748,005	0.6171	0.0056
	2	Hadong	#7	steam power	Bituminous coal	2008.12	870,781	0.7814	0.0083
	3	Yeongheung	#4	steam power	Bituminous coal	2008.12	3,193,481	0.8252	0.0320
	4	Kyeongcheon		small hydro power		2008.11	1,273		
	5	Seongnam 2		small hydro power		2008.10			
	6	Nulokdo solar		solar		2008.09			
	7	Jeju solar		solar		2008.09	11		
	8	Boryeong fuel cell		fuel cell		2008.09			
	9	Naebyeong solar		solar		2008.08			
	10	Yulhyeon		small hydro power		2008.07	144		
	11	Busan C/C solar		solar		2008.07	167		
	12	Hadong solar		solar		2008.07	554		
	13	Hongikdongjin		small hydro power		2008.06			

	14	Daecheongdaem		small hydro power		2008.06			
	15	Boryeong	#7	steam power	Bituminous coal	2008.06	2,878,738	0.7846	0.0274
	16	Kori-wind power		wind		2008.05			
	17	Samlangjin solar				2008.04			
	18	Boryeong solar		solar		2008.04	449		
	19	Boryeong		small hydro power		2008.03			
	20	Yeongheung		small hydro power		2008.03			
	21	Yeonggwang solar park				2008.03			
	22	POSCO fuel cell		fuel cell		2008.03			
	23	Gunjang heat & power		combined		2008.01			
	24	Seocheon solar		solar		2008.01	1,550		
	25	New solar energy and others		solar		2008	222,779		
	1	Yeongheung	#3	steam power	Bituminous coal	2007	4,535,951	0.8087	0.0445
	2	Taean		small hydro power		2007	3,924		
2	3	Hanbit Sungsan the second solar		solar		2007.12			
0	4	Taein gangjin solar		solar		2007.12			

	5	Suni gangjin solar		solar		2007.12			
0	6	Korea yeongcheon solar		solar		2007.12			
7	7	Solar yungam solar		solar		2007.12			
	8	Changwhan yeongduk solar		solar		2007.12			
	9	Samsung jindo		solar		2007.12			
	10	Hwaseong heat & power		combined		2007.12			
	11	Dangjin	#8	steam power	Bituminous coal	2007.12	3,992,732	0.7807	0.0378
	12	SP solar yonggwang		solar		2007.11			
	13	Dongyang energy sinan		solar		2007.11	4,698		
	14	Ef yungam solar		solar		2007.11			
	15	Dongwon gangjin solar		solar		2007.11			
	16	Solec yonggwang solar		solar		2007.11			
	17	Solar jungeub solar		solar		2007.11			
	18	Sinbuk yungam solar		solar		2007.11			
	19	Hyein haenam solar		solar		2007.11			
	20	Samlangjin solar		solar		2007.11			
	21	Hyosung daegi-wind power		wind		2007.11	409		
	22	Nonhyun heat & power		combined		2007.10			

23	Wuriyungam solar		solar		2007.08			
24	Hwasung solar		solar		2007.08			
25	Yeongju the first solar		solar		2007.08			
26	Muan solar		solar		2007.08			
27	Jangheung solar		solar		2007.08			
28	Gomun		small hydro power		2007.08			
29	Taean	#8	steam power	Bituminous coal	2007.08	4,186,293	0.7885	0.0401
30	Dangjin	#7	steam power	Bituminous coal	2007.06	3,336,619	0.7933	0.0321
31	Munkyung solar		solar		2007.06			
32	Younggwang solar park		solar		2007.06			
33	Yungam Solar		solar		2007.06			
34	Wonjungsu		small hydro power		2007.05			
35	Baekgok		small hydro power		2007.05	518		
36	damyangho		small hydro power		2007.05	1,048		
37	Juam		small hydro power		2007.05			
38	Namjeju	#4	thermal	heavy oil	2007.03	517,866	0.6819	0.0043
39	Eco energy		solar		2007.03	357,529		

	40	hapcheon		small hydro power		2007.02	6,442		
	41	Jeonju-resource recovery facility				2007.02	12,682		
	42	Seoul Marin(suncheon)		solar		2007.02	1,271		
	43	Mirae energy		solar		2007.02			
	44	Seomjingang		small hydro power		2007.02	122,714		
	45	samcheonpo		small hydro power		2007.02			
	46	dalbang		small hydro power		2007.02			
	47	Taean	#7	steam power	Bituminous coal	2007.02	3,482,731	0.7894	0.0334
	48	Yeongju the second solar		solar		2007.01	2,272		
	49	Hyundaedaesan		combined		2007.01			
	1	Cheongsong pumping	#2	pumping		2006.12	276,444		
	2	S&P Solar		solar		2006.10			
	3	Bundang fuel cell		fuel cell	LNG	2006.10			
	4	Namhae Solar		solar		2006.10			
	5	HanlaJeunggong Solar		solar		2006.10			
	6	Yungam Solar		solar		2006.09			
	7	Enepark		solar		2006.09	460		

2006	8	Yeongheung solar		solar		2006.09	1,290		
	9	Cheongsong pumping	#1	pumping		2006.09	206,291		
	10	Namjeju	#3	thermal	heavy oil	2006.09	559,817	0.7077	0.0048
	11	yangyang(pumping)	#4	pumping		2006.08	163,281		
	12	Donghae Solar		solar		2006.08			
	13	Kangwon-wind power		wind		2006.07			
	14	Woljeong-wind power		wind		2006.07	3,445		
	15	yangyang pump windpower		wind		2006.06			
	16	Hadongho		small hydro power		2006.06	996		
	17	yangyang (pumping)	#3	pumping		2006.06	169,538		
	18	Goheung Solar		solar		2006.06			
	19	Jangseong		small hydro power		2006.05	1,937		
	20	yangyang (pumping)	#2	pumping		2006.04	210,031		
	21	Dangjin	#6	thermal	Bituminous coal	2006.04	4,006,307	0.7852	0.0382
	22	Sinchang-wind power		wind		2006.03	3,561		
	23	yangyang (pumping)	#1	pumping		2006.02	141,700		

2005	1	Janghengdam		small hydro power		2005.12			
	2	Suncheon Solar		solar		2005.12			
	3	Samcheonpo solar energy		solar		2005.12	135		
	4	Dangjin	#5	steam power	Bituminous coal	2005.10	3,908,658	0.7961	0.0378
	5	yangyang pump small hydro		small hydro power		2005.10			
	6	Taean solar energy		solar		2005.10	130		
	7	Jeju DP		internal combustion	heavy oil	2005.07	223,630	0.6214	0.0017
	8	WunjeongLFG		internal combustion	LFG	2005.07	7,701		
	9	Yulchon		combined	LNG	2005.07	2,488,267	0.3722	0.0112
	10	Incheon		combined	LNG	2005.07	3,420,631	0.3575	0.0148
	11	Daegok		small hydro power		2005.07	1,635		
	12	Donghwa		small hydro power		2005.07	1,853		
	13	Ulchin	#6	nuclear		2005.04	8,107,887		
	14	Hanrye		LFG	LFG	2005.04	21,265		
	15	Busan Bio-gas		internal combustion	LFG	2005.03	2,884		

16	Sungnam		small hydro power		2004.12			
17	Yungduk-wind power		wind		2004.12			
18	Yongdam		small hydro power		2004.12	110,934		
19	Maebongsan-wind power		wind		2004.12	20,896		
20	Daegwanryeong-wind power		wind		2004.12	4,949		
21	Yeongheung	#2	steam power	Bituminous coal	2004.11	5,112,704	0.8107	0.0503
22	Yeongheung	#1	steam power	Bituminous coal	2004.07	5,137,490	0.8141	0.0507
23	Ulchin	#5	nuclear		2004.07	8,763,822		
24	Busan		combined combustion	LNG	2003.05/2004.03	10,848,484	0.3580	0.0471
Total						**82,412,683**		**0.5221**

- CDM registered power plants are yellow-colored.
- For those power plants whose information is not available, the corresponding spaces are colored as dark-gray.

<Table Annex 3-5 Fuels CO_2 Emission factor>

Fuel Type	$EF_{CO2,i,y}$ (tCO_2/TJ)
Gasoline	67.5
Diesel oil	72.6
residual fuel oil	75.5
LNG	54.3
bituminous coal	89.5
Anthracite	94.6

Source: 2006 IPCC Guidelines (IPCC default value at the lower limit of the uncertainty at a 95% confidence interval data)

Appendix 5. Further background information on monitoring plan

Please refer section B.7.3 for information on monitoring.

Appendix 6. Summary of post registration changes

・ **Corrections**

- On the PDD, the relevant info has been eliminated as it is unnecessary.
(<Table A-3> Technical properties of project gas generator about energy balance), page 8
- The relevant information on PDD has been revised.
(<Table A-1> Components of project facility construction in 2009), page 6
(<Table A-2> Technical information of project gas generators), page 7
(<Table A-4> Project participants of the project), page 9
(B.7.1. Data and parameters to be monitored_$LFG_{burnt,y}$), page 42

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