CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

(1) The title of the project activity:
Mokpo Landfill LFG Gas Recovery to Electricity Generation project

(2) The version number of the document:
Version Number 01

(3) The date of the document:
16 January 2009

A.2. Description of the small-scale project activity:

Mokpo Landfill LFG Gas Recovery to Electricity Generation project was developed by Hanwha Corporation in the Republic of Korea. Objectives of this project were to collect the CH_4 in the LFG from the landfill site as a renewable energy and to utilize CH_4 to generate electricity.

Mokpo Landfill, which is located in Daeyang-dong, Mokpo City, Jeollanam-do, has disposed 275 tons of an average waste per day, for over 11 years. The total area is 290,490 m^2, the site area is 180,000 m^2 and the amount of available landfill capacity is 2,897,000 m^3. About 1,774,000 m^3 of waste has been disposed at the Mokpo Landfill since 1996.

The landfill gas (LFG) has been emitted to the atmosphere directly without treatment before this project was proposed. This is presented in baseline scenario. The proposed project involves the installation of a highly efficient collecting system, transmitting system, pre-treatment system and two electricity generators. Two generators will be installed with a total capacity of 2.130 MW (1.065MW × 2 generators). The generated electricity from this project will be exported to a grid. In terms of CO2 reductions, it would be estimated to be 25,358 tons CO_2 of annual average over the 10 years period.

In the absence of the proposed project, LFG generated by organic matter in MSW (Municipal Solid Waste) would be released into the atmosphere. The objective of the project is as follows; 1) helping to dispose of the flammable constituents, particularly methane safely and to control odor nuisance, health risk and adverse environmental impact and 2) replacing electricity from the fossil fuel power plants to LFG power plants by the proposed project.

Date	Work
March 2008	Hanwha decided construction of the proposed project
April 2008	starting date of construction for gas collecting system
September 2008	Completed date of generator installation
	The starting date of commercial operating (electricity sales)
April 2009	The expected date of installing an additional generator

Data source: Hanwha official report (April 2008)

Moreover, the project is improving the Host Country to fulfil its goals of promoting sustainable development and will have the positive social and environmental impacts.

- To prevent potentially explosive situations and to support environmentally sound policy associated with subsurface gas migration

- To minimize environmental damage through reducing methane emissions (global warming), odor nuisance and significant risk to human health from hazardous landfill gas.

- To Increase job opportunities related to the management, operation and maintenance of collecting LFG system and generating electricity.

- To optimize the use of biogas (renewable energy) in substitution for fossil fuel and the clean technology demonstration project. So, sustainable and socio-economic development through significant technology transfer is promoted.

A.3. Project participants:

Table 1: Project Participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
The Republic of KOREA (host)	Hanwha Corporation	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

The Republic of Korea

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

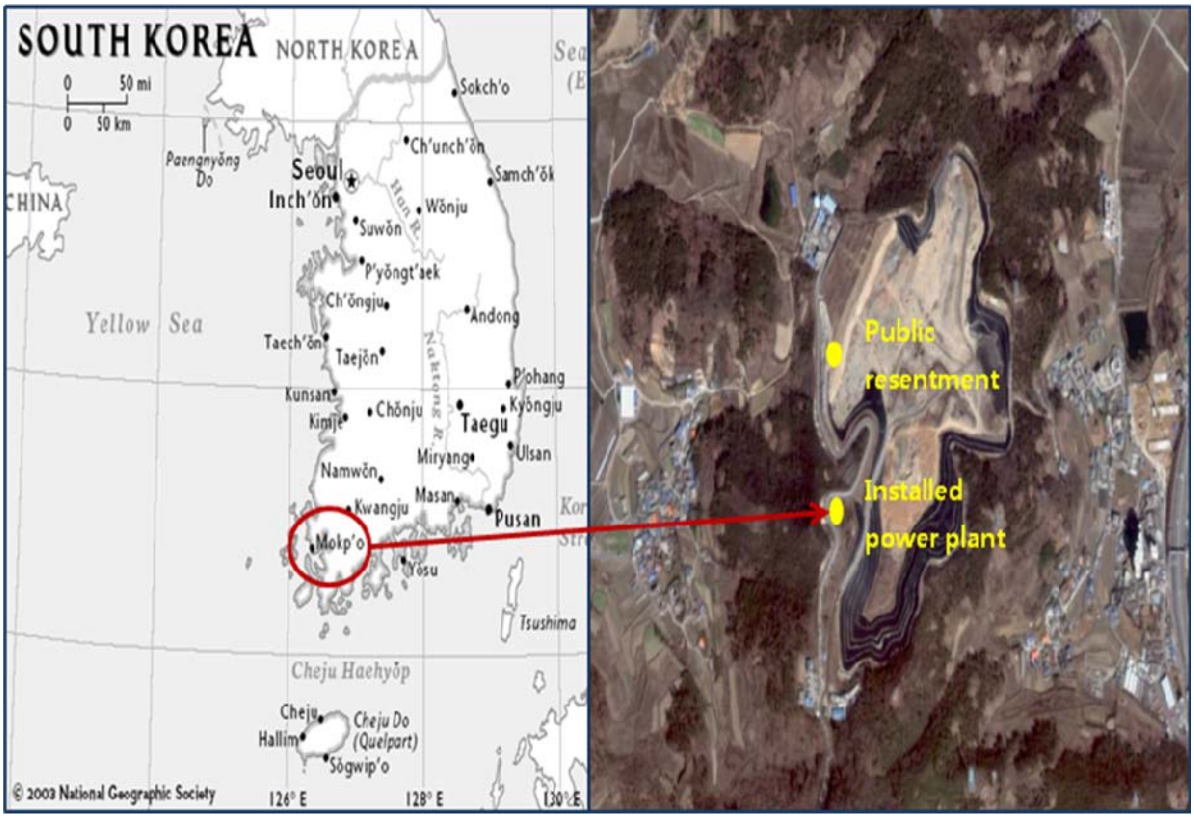
Daayang-dong

A.4.1.3. City/Town/Community etc:

Mokpo city

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The installed power plant in Mokpo landfill is located in Mokpo City, Jeollanam-do. The coordinates of the landfill site have a longitude of 34:48 N and latitude of 126:22 E.



<Fig. A-1> The location of the project landfill site and the whole site view of the project

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

According to Annex A of the Kyoto Protocol, this project is involved in following sectoral scope:

01-Energy industry (renewable and non-renewable sources
13-Waste handling and disposal

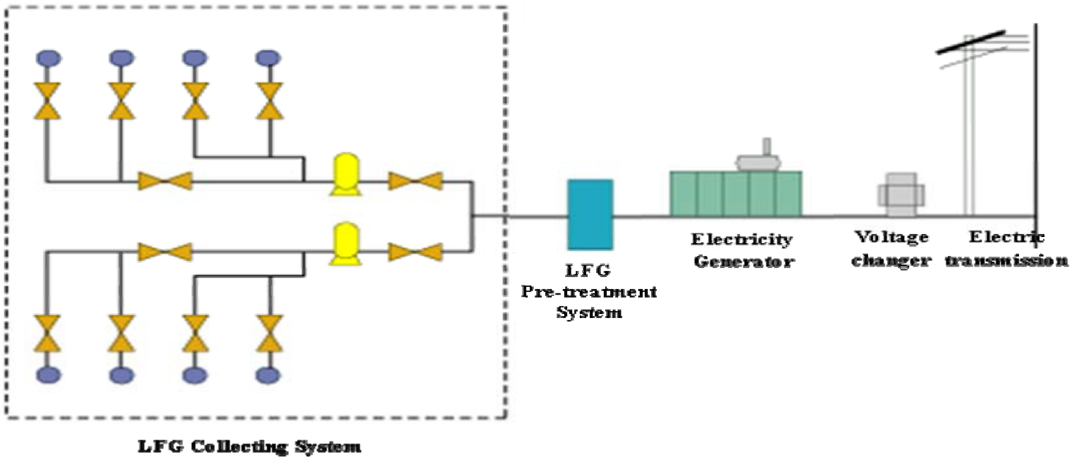
Project activity: Landfill gas capturing and generating electricity

Appendix B of the simplified modalities and procedures for small scale CDM project activities, the project falls into:

Type III – other project activities and category G – Landfill Methane Recovery; and
Type I – Renewable energy projects and category D – Grid connected renewable electricity generation.

The description of the technology to be proposed in the project is provided below:

The main process of the project is a landfill gas collecting system, a landfill gas pre-treatment system and an electricity generation system. The best available technology of each process for collecting and recycling LFG effectively has been adopted into the proposed project.



<Fig. A-2> The main process of the proposed project

- ***Landfill Gas Collecting System***

The landfill gas collecting system is a gas transportation network, consisting of gas collecting wells, lateral gas collecting sub-pipes and a main pipe to cover all of the landfill. The landfill gas collected from the gas wells is delivered to the main-heater pipe through sub-pipes, and the gas from the collecting system is delivered into the CSV (Condensate Separation Vessel). High-density polyethylene (HDPE) collecting system is installed to convey the landfill gas from the wells to the blower.

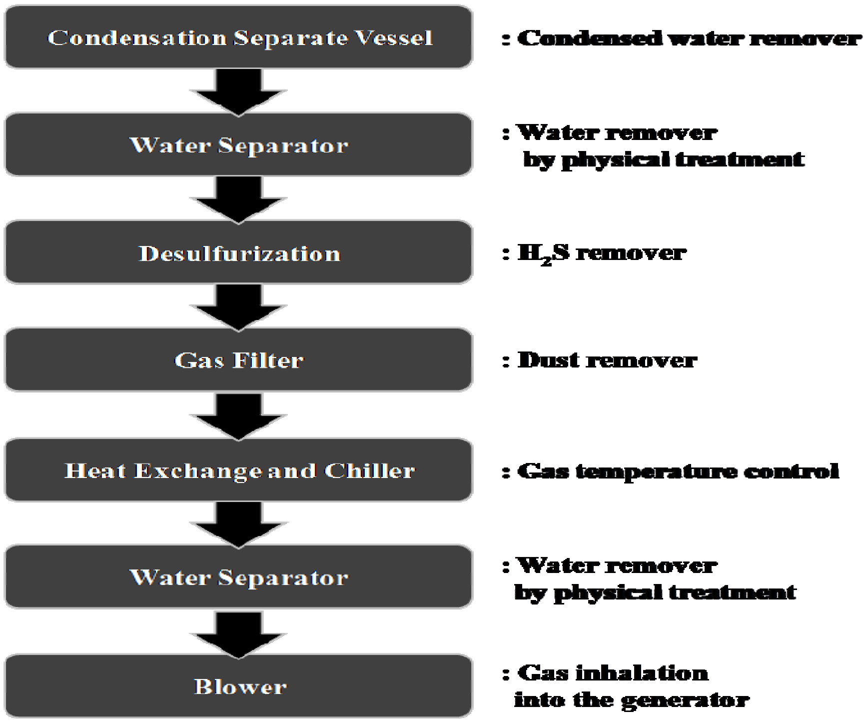
<Table A-1> Landfill gas collecting facilities

Facility	Function	Number
Vertical well	LFG capture (75mm HDPE)	97
Wellhead	Collecting LFG from vertical gas wells	9
Barrel trap	Trapping the condensate from the main pipeline	10
J-Trap	Trapping the condensate from the vertical well	100
Main Pipeline	LFG supply to the gas engine (250mm)	1

- ***Landfill Gas Pre-treatment System***

Prior to electricity generation, LFG must be pre-treated to remove its impurities and moisture to prevent corrosion which could cause generators shutdown. Therefore, LFG must be pre-treated prior to utilizing

LFG as an energy source. The pre-treatment consists of 1) CSV (Condensate Separation Vessel), 2) water separator 3) H2S remove, 4) gas filter, 5) heat exchange and chiller, 6) water separator and 7) blower.



<Fig. A-3> The process of pre-treatment system

- ***Electricity Generation System***

The design of the proposed project includes 2 generators with capacity of 2.130 MW (1.065MW * 2 generators). One generator was installed to landfill site with capacity of 1065 kW in September 2008 and the other generator with same capacity will be added at the same landfill site in April 2009 (expected date). The collected landfill gas is sent to the generators only. The electricity generated by power generators will be exported to the power grid connected to the Korea Electric Power Corporation (KEPCO) supply system.

<Table A-2> The facility of main power generator based on 1MW generator

Facility	Capacity/Function
Generator Module	Output : 1065kW
	Voltage : 380 V
	Frequency : 60Hz

A.4.3. Estimated amount of emission reductions over the chosen crediting period:

The crediting period is 10 years, from 01/06/2009 to 30/06/2019 and the expected emission reductions are 254,358 tons for the crediting period. The following table shows the estimated emission reductions of the proposed project over the crediting period.

<Table A-3> Annual estimation of emission reductions

Years	Annual estimation of emission Reductions tonnes of CO_2e
2009	11,159
2010	24,283
2011	24,791
2012	25,214
2013	25,560
2014	25,834
2015	26,042
2016	26,189
2017	26,280
2018	26,320
2019	11,903
Total estimated reductions (tonnes of CO_2e)	253,576
Total Number of crediting years	10
Annual average over the credit period of estimated reductions (tonnes of CO_2e)	25,358

A.4.4. Public funding of the small-scale project activity:

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

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According to Appendix C of the simplified modalities and procedures for the small-scale CDM project activities, the project is not a part of any large scale project and/or program, and not a de-bundled component of a large project activity. The project participants further confirm that they have not registered any small scale CDM activity or applied to register another small CDM project activity within the same project boundary.

The project participant confirms that is not a debundled component of a larger scale project activity and there is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small scale activity at the closest point.

SECTION B. Application of a baseline and monitoring methodology

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

According to Annex A of the Kyoto Protocol, this project fits in sectoral categories:
1. Energy Industry, and;
13. Waste Handling and Disposal.

The approved small-scale CDM baseline methodologies;
- AMS I. D: Grid connected renewable electricity gerneration_V13
- AMS III. G: Landfill methane recovery_V06

And the tools referred by the approved methodology;
- Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site_V04
- Tool to calculate the emission factor for an electricity system_V01

B.2 Justification of the choice of the project category:

The project activity is based on collecting LFG (reducing greenhouse gases effect), utilizing LFG to electricity (replacing electricity from the fossil fuel power plants to LFG power plants) and supplying electricity to local power purchaser. Thus the proposed project is satisfied with the condition of AMS-III.G methodology for measures to capture methane from landfill and AMS-I.D methodology for electrical energy generation.

The project is justified with applicability criteria of a small-scale project during every year of crediting period, as follows:

- For grid connected renewable electricity generation (AMS-I.D), the capacity is less than 15MW
- For landfill methane recovery (AMS-III.G), emission reduction is less than 60 ktCO_2e.

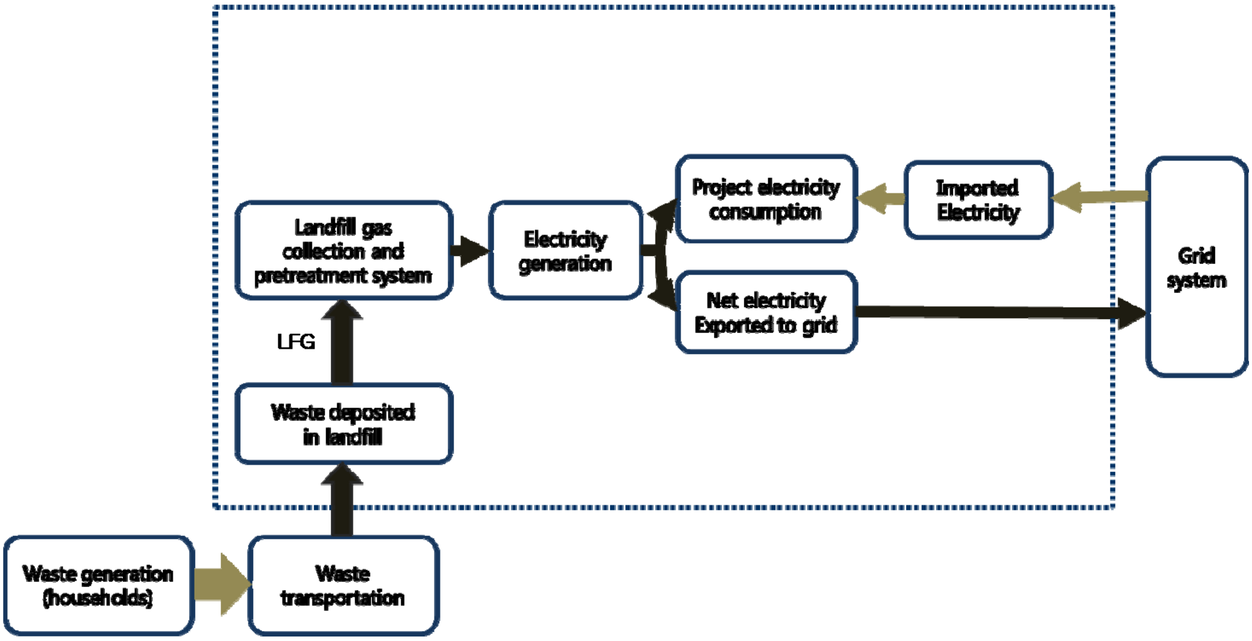
<Table B-1> Justification of methodologies for proposed project

Small-Scale Methodology	Estimated reductions of proposed project	Small-Scale criteria
AMS-I.D	2,709 ton CO_2e/ annual average 2.130 MW (1.065MW * 2 generators)	15MW

AMS-III.G	25,358 ton CO_2e/ annual average	60,000 ton CO_2e

B.3. Description of the project boundary:

According to AMS-III.G methodology and AMS-I.D methodology, the project boundary should encompass the physical/geographical site of the landfill at where the gas should be captured and destroyed to use the renewable generation source. Thus, the project boundary is the site of the project activity, named Mokpo Landfill, where LFG is captured and used to generate electricity and the power generation sources connected to grid is included in the project boundary as well. Net electricity generated from the proposed project will be exported to the grid system and imported electricity will be purchased from the grid system which is maintained by the Korea Electric Power Corporation (KEMPCO) and will replace the electricity generated by fossil fuel in the grid.



<Fig. B-1> The proposed project boundary

The following project activity and emission sources are considered within the project boundary and baseline scenario can be identified in the below table.

<Table B-2> Emission sources and justification from Mokpo landfill.

Source		Gas	Justification/Explanation
baseline	Emission from decomposition of waste at the landfill site	CH_4	The major source of emissions in the baseline and methane released to atmosphere due to decomposition of the organic waste
	Emissions from electricity generation	CO_2	CO_2 would be otherwise emitted by grid connected power plants (using fossil fuel) without this project utilizing LFG
project	Emissions from electricity generation	CO_2	CO_2 emitted to generate the quantity of electricity imported from grid by this project

B.4. Description of baseline and its development:

Baseline scenario is in the absence of the project activity, biomass and other organic matter shall exclude methane emissions that would have to be removed to comply with national or local safety requirement or legal regulations.

Consistency of laws and regulations:

The alternatives should be in compliance with the Korean laws and regulations. According to enforcement regulation annexed list, there are no forcible laws and regulations to manage LFG on landfill, but all the landfills have to install pipe lines (landfill gas venting system) for local safety, landfill stabilization from the sources of odor/hazard materials and potential explosion. Under the Article 7, enforcement ordinance of the waste management laws, the landfill which emits landfill gas from organic waste should collect and burn landfill gas to satisfy Korean laws and regulations.

LFG capturing and venting systems were installed to meet above laws and regulations. But Mokpo landfill do not satisfy with national waste management laws as burning system has not installed to Mokpo landfill, since starting landfill.

In Korea, most of landfills are under manage and/or control of local government and Mokpo landfill was certificated to operate landfill treatment from local government of Jeollanam-do (http://english. jeonnam.go.kr/). Jeollanamdo noticed that landfill gas in Mokpo should be emitted to atmosphere with venting system rather than burned to satisfy national government laws, as Mokpo landfill is located near mountain (see the fig. A-1) and some distance away from inhabitants. It's not unsatisfying waste management laws but preventing forest fire, resulting from burning collecting landfill gas.

In the absence of the proposed project, the current situation would be continuously dumped into Mokpo landfill with anaerobic decay condition and LFG would be released into the atmosphere through venting system.

As above reason, Mokpo landfill gas has not been destructed by flaring and/or taken utilisation, Adjustment factor (AF) will be zero.

There are four alternative baseline scenarios considered:

Alternative 1: Maintain the status quo.
The landfill gas will continue to emit to the atmosphere without management and control LFG.

Alternative 2: Production and sale of electricity, without CDM revenue.
Addition of landfill gas capture and electricity generation technology, implemented without considering CDM revenue. This alternative would face investment barrier. Investment barrier is outlined in section B.5 below.

Alternative 3: Flaring landfill gas
Installing collection and flaring systems to treat LFG. As mentioned above, alternative 3 is not applicable to operate flaring system in Mokpo landfill, as Mokpo landfill is located near mountain. This project could bring forest fire.

Alternative 4: Sale the raw gas to customer
This alternative consists of the installing LFG collection and treatment system to permit the sale of the gas. There is no customer to purchase raw gas close to the landfill site. This project will not be implemented.

As a result of baseline scenarios, alternative 1 is the only remaining plausible alternative Therefore, the participants do not require investing in it and then would not face investment barrier.

Consequently, alternative 2 faces more barriers than alternative 1. It means alternative 2 is not attractive to participants and then it is hardly implemented in the absence of the CDM.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

The determination of project scenario additionality is done following Attachment A of Appendix B of the simplified modalities and procedures for small-scale CDM project activities, which states that additionality can be proved through demonstration of at least one of following barriers:

- Investment barrier
- Technological barrier
- Barrier due to prevailing practice
- Other barriers

Investment barrier

The biggest barrier of the project 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, LFG utilization is not attractive alternative as power generation. It can be identified by calculating Internal Return Rate of cash flow of the project. Internal Return Rate (IRR) is one of the financial indicators calculated by abstracting present value of cost flow from present value of revenue flow.
The proposed project will invest a LFG collection and power generation plant in Mokpo landfill site to reduce CH_4 and CO_2 emissions. In order to demonstrate additionality of the proposed project, financial analysis is provided to determine whether the proposed project activity is financially less attractive without the credit revenues (hereafter, CERs). The investment analysis is analyzed in the following steps.

Step 1: Determine appropriate analysis method:

The three analysis methods, suggested by" *Tools for the demonstration and assessment of additionality"* are 1) simple cost analysis (option I), 2) investment comparison analysis (option II) and 3) benchmark analysis (option III). For this proposed project, Option III-Benchmark analysis could be supplied; the project IRR of total investment is compared to benchmark.

Step 2: Option III-Apply benchmark analysis:

IRR (Internal Rate of Return) is selected for the financial analysis indicator. The project is not financially attractable, when IRR is lower than host country's corporate bonds yield rate. In order to examine the financial feasibility, IRR should be compared with the 3 years-term government bond yield rate in 2006.

4.83% (the 3 years-term government bond yield rate) is applied as discount rate. As a result of the calculation, the project IRR is lower than benchmark value. Thus this project is not economically attractive without CERs, which has been used for feasibility studies of the power project investments.

<Table B-3> Basic parameters for calculation of financial indicators

Used values for economic analysis		
Content	Value	Data sources
Analysis period (year)	15	feasibility study report (selected upon equipment life time)
Discount rate (%)	4.83	feasibility study report (3 years-term government bond yield rate in 2006)
Unit cost of electricity purchase	81.5	feasibility study report (applied SMP cost of 2007)
Details of economic analysis implementation		
Parameters	Value	Data sources
Total Investment (thousand won)	3,016,700	Feasibility study report
Annual Operational and Maintenance cost (thousand won/year)	572,100	Feasibility study report
Capacity Generator (MW)	2.130 (1065kW * 2 generators)	Feasibility study report
Net Power export to grid (MWh)	About 5,000	Feasibility study report
Depreciation cost of Generators (thousand won/year)	201,113	Feasibility study report
Income Tax (%)	income tax below 100 millions : 13% and income tax over 100 millions : 25%	Feasibility study report
Outcome		
Scenario	IRR	Benchmark
Without the CDM revenues	-	4.83%
With the CDM revenues	7.41%	

The table above is obviously shown that the proposed project is not attractive without CDM revenues and any investors doesn't interested in it, while the project IRR with CERs revenues is 7.41%, interesting project to investors.

<u>Step 3: Sensitive analysis:</u>

Sensitivity analysis was conducted by altering the following parameters in favour of this project.

- Price of electricity sold to KEPCO
- Investment Cost
- Operation Cost

Those parameters were selected as the most likely to fluctuate over time. Financial analyses were performed altering each of those parameters by 5% and 10%, and assessing the associational impact on the project IRR (refer to table below). As the table below, the project IRR remains lower than the benchmark IRR (3-year government bond yield rate).

<Table B-4> The result of sensitivity analysis

Scenario	IRR (%)	NPV (thousand won)
Standard	-	-4,125,882
Increase of electricity sale price by 5%	-	-3,914,377
Increase of electricity sale price by 10%	-	-3,713,093
Decrease of investment cost by 5%	-	-4,612,882
Decrease of investment cost by 10%	-	-4,468,997
Decrease of operation cost by 5%	-	-4,490,891
Decrease of operation cost by 10%	-	-4,229,572

In conclusion, the project IRR remains lower than benchmark even with an increase in electricity sale price and a decrease in investment cost and operation cost. The sensitivity analysis shows that this proposed project is not substantial enough to warrant investment to this project.

Without CDM revenues, the proposed project is not attractive to investors and not implemented.

CDM Consideration

Mokpo landfill CDM project had been considered by another investor in 2007 as Mokpo City announced this project to the public. But that investor waived to invest money in it as following reasons: in the consideration of the investment against revenue, and growth price of operating and incidental expenses over recent years. According to the research paper, it said “a small scale project of the renewable energy market is hard to bring up benefits”. (the research paper is submitted to DOE)

After that, Hanwha Corporation took part in this project and started facilities construction in accordance with pre-conditions of the Contract (“LFG Utilization & Power Generation Project of Mokpo City sanitary landfill”) in which facilities construction should be started in advance.
Thereafter, Hanwha Corporation has started writing the PDD for the CDM project along with the Contract.

But the schedule arrangement for the validation has been suspended because DOE has large loads from their works.

As above reason, the collection system and 1MW generator was installed in Mokpo landfill site before CDM project get registered by UNFCCC.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The baseline scenario of the project is total atmospheric release of the LFG from the landfill site and the emission reduction is claimed for displacing electricity generation. According to the condition, the emission reduction corresponds to the applicability condition in the approved small-scale baseline methodology AMS-Ⅲ.G; "Landfill Methane Recovery---Version 6" is applicable to the project.

The project activity applies AMS I.D, because this project transmits electricity to grid connected system. Appendix B of the simplified modalities and procedures for small-scale CDM project activities for project under category I.D "Grid connected renewable electricity generation" comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal, and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.

Formula for ER ex-ant in the PDD:

According to the AMS-III.G Landfill methane recovery, the emission reductions achieved by the project activities can be estimated ex-ante by:

Project emissions:
Project activity emissions consist of CO_2 emissions related to the power used by the project activity facilities. Emission factors for electricity shall be calculated from AMS-I.D. When the proposed project is under the operation, the electricity consumed by the proposed project will be supplied by the project.

Leakage:
Methane destruction component: Not applicable as the methane recovery technology is not transferred from another activity.

Grid displacement component: Not applicable as the energy generating equipment is not transferred from another activity.

Emission Reductions:
The emission reduction achieved by the project activity is constituted by both the methane destruction and grid displacement components.

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

Parameter	Unit	Description
$ER_{y,estimated}$	tCO_2e	Estimated emission reduction from both methane destruction

		and grid displacement
BE_y	tCO_2e	Baseline emissions from both methane destruction and grid displacement
PE_y	tCO_2e	Project emissions from electricity or fossil fuel use (only applicable to methane destruction component)
Leakage	tCO_2e	Leakage emissions from both methane destruction and grid displacement

The actual emission reduction achieved by the project during the crediting period will be calculated using the amount of methane recovered and destroyed/gainfully used by the project activity, calculated as:

ER_{y}*, calculated =* $(MD_y – MD_{reg,y})+(BE_{electricity,y}) – PE_y$ *– Leakage*

Parameter	Unit	Description
$ER_{y,calculated}$	tCO_2e	Calculated emission reduction
MD_y	tCO_2e	CO2 equivalent of the methane captured and estroyed/ gainfully used by the project activity in year y;
$MD_{reg,y}$	tCO_2e	Methane emissions that would be captured and destroyed to comply with national or local safety requirements or legal regulations in the year ‘y’
$BE_{electricity,y}$	tCO_2e	Baseline emissions from grid displacement
PE_y	tCO_2e	Project emissions from electricity or fossil fuel use (only applicable to methane destruction component)
Leakage	tCO_2e	Leakage emissions from both methane destruction and grid displacement

In case of flaring/fuelling it shall be measured using the conditions of the flaring process:
Flaring/fuelling is comprised in this proposed project

$MD_y = LFG_{burnt,y} * wCH_{4,y} * DCH_{4,y} * FE * GWPCH_4$

Parameter	Unit	Description
$LFG_{burnt,y}$	Nm^3	Landfill gas flared or used as fuel in the year ‘y’
$w_{CH4,y}$	%	Methane content in landfill gas in the year ‘y’(mass fraction)
$D_{CH4,y}$	ton/m^3	Density of methane at the temperature and pressure of the landfill gas in the year ‘y’
FE	%	Flare efficiency in the year ‘y’
GWP_{CH4}	tCO_2/tCH_4	Global warming potential of methane

Baseline emissions:
Based on both AMS III.G and AMS.I.C, the baseline scenario for the proposed project activity is:

$BE_y = BE_{CH4,SWDS,y} – MD_{reg,y}$

Where:
BE_y the baseline emissions in year y (tCO_{2e})
$BE_{CH4,SWDS,y}$ the methane generation from the landfill in the absence of the project activity at year y (tCO_{2e})

The methane emission potential of a solid waste disposal site, **$BE_{CH4,SWDS,y}$** in **tCO2e,** is undertaken using the followed equation in the "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site."

$$BE_{CH4,SWDS,y} = ø*(1-f)*GWPCH_4*(1-OX)*16/12*F*DOC_f*MCF*\Sigma\Sigma W_{j,x}*DOC_j*exp(-k_j*(y-x))*(1-exp(-k_j))$$

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
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 (0.0)
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 site operation to the the year y for which avoided emission is calculated (x = y)
y	Year for which avoided emissions are calculated

The captured gas will be used for electricity generation where emission reductions will be claimed; and the excess gas will be flared. The generation component of the project will use Methodology for Small Scale Activities Type I.D Grid connected renewable electricity generation (<15MW).

$MD_{reg,y}$ 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})

As mentioned above B.4. ***$MD_{reg,y}$*** = 0

$$ER_{y,\ electricity} = BE_{y,\ electricity} - PE_{y,\ electricity\ y} - Leakage$$

$BE_{y,\ electricity}$	GHG that the grid-connected system would be emitted to produce electricity as much as the same quantity displaced by this project in the absence of this project (tCO2e)

$PE_{y,\ electricity}$ emission to generate electricity imported from grid system (tCO2e)

Leakage Emission caused by transportation in case power generation equipment is transferred from another activity, or existing equipment is transferred to another activity (tCO_{2e})

Calculation of GHG reduction by electricity generation and transmission to the grid:

According to the methodology AMS I.D. Version 13, baseline of the project activity is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO2e/kWh) 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'.

OR

(b) The weighted average emissions (in kg CO2equ/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Therefore the baseline for this project was calculated according to "Tool to calculate the emission factor for an electricity system (version 01.1)". Calculations is based on data from an official source and made publicly available in the website of Korea power exchange.

A combined margin (CM) was calculated as the baseline emission factor (EF_y), consisting of the combination of operating margin (OM) and build margin (BM) factors in line with the following six steps of 'Tool to calculate the emission factor for an electricity system'. A combined margin (CM) applied the originated data from existing power plants that provide electricity to the current grid-connected electricity generation. They were collected from the 'Statistics of Electric Power in KOREA published at the most recent 3 years (2005-2007) from KEPCO'.
Tool to calculate the emission factor for an electricity system" and the calculation is as follows:

STEP 1. Identify the relevant electric power system

For the purpose of determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

Similarly, a connected electricity system, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. If such delineations are not available, project participants should define the project electricity system and any connected electricity system and justify and document their assumptions in the CDM-PDD. In doing, so the following criteria can be used to determine the existence of significant transmission constraints:

• In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of more than 5 percent between the systems during 60 percent or more of the hours of the year.

• The transmission line is operated at 90% or more of its rated capacity during 90% percent or more of the hours of the year.

In this sense, the electricity of proposed project is connected to KEPCO grid, which cover national grid. Thus relevant electric power system is KEPCO grid to determine electricity emission factor.

<Fig. B-2> Electricity power grid in Korea
Source: 2008 Annual Report, Korea Electric Power Corporation

STEP 2. Select an operating margin (OM) method

The calculation of the Operating Margin emission factor (EFgrid,OM,y) shall be calculated basis on one of the four following methods:

Option (a) Simple OM, or
Option (b) Simple adjusted OM, or
Option (c) Dispatch Data Analysis OM, or
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 average data of most recent 5 years (2003-2007) shows that the rate of low cost/must run is **41.49%** (Source: KEPCO).

Therefore, Option (a) Simple OM is available and below Table shows yearly proportion of the generation of electricity based on the source of energy (Source: KEPCO).

<Table B-5> Gross generation by energy sources (Unit: million kWh)

Source	2003	2004	2005	2006	2007	Total
Hydro*	6,887	5,861	5,189	5,219	5,042	28,198
Domestic Coal*1	5,398	4,603	4,484	4,312	4,470	23,267
Bituminous Coal1	114,878	122,556	129,174	134,894	150,204	651,706
Heavy Oil1	23,656	21,591	20,079	18,596	20,769	104,691
Diesel Oil1	2,870	474	412	599	446	4,801
Gas	39,091	55,999	58,118	68,302	78,427	299,937
Nuclear*	129,672	130,715	146,779	148,749	142,937	698,852
Alternative*	-	350	404	511	829	2,094
Total	322,452	342,148	364,638	381,181	403,124	1,813,543
The rate of low cost/must run power generation (%)	41.49%					

Source: Electricity statistics on Electricity quantity from Korea Electric Power Corporation

* : low-operating cost and must-run power plants

1 : Thermal

And the Simple OM emission factor can be calculated using either of the two following data vintages for years(s) y:

• Ex ante option: 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, without requirement to monitor and recalculate the emissions factor during the crediting period, or

• Ex post option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required calculating 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. On this PDD, ex-ante data were applied. The Simple OM emission factor is calculated as followed step 3.

STEP 3. Calculate the Operating Margin emission factor (EFgrid,OM,y)

The simple 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. And it is calculated based on data on fuel consumption and net electricity generation of each power plant /unit (Option A) as follows:

$$EF_{grid,\,OMsimple,\,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NVC_{i,y} \cdot EF_{CO2,i,j}}{\sum_{m} EG_{m,y}} \qquad \textbf{(1)}$$

where

EFgrid,OMsimple,y is Simple operating margin CO2 emission factor in year y (tCO2/MWh)
FCi,m,y is Amount of fossil fuel type i consumed by power plant / unit m in year y (mass or volume unit)
NCVi,y is Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
EFCO2,i,y is CO2 emission factor of fossil fuel type i in year y (tCO2/GJ)
EGm,y is Net electricity generated and delivered to the grid by power plant / unit m in year y (MWh)
m is All power plants / units serving the grid in year y except low-cost / must-run power plants / units
i is All fossil fuel types combusted in power plant / unit m in year y
y is Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in ***step 2***

In case of this project, the applied parameters are presented for estimation of Operating Margin emission factor (***EFgrid,OM,y***) in Annex 3. As a result, the OM emission factor (**EFgrid,OM,y**) is 0.6817 (tCO_2/MWh).

STEP 4. Identify the cohort of power units to be included in the Build Margin emission factor (EFgrid,BM,y)

The sample group of power unit m used to calculate the build margin consists 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) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation.

As a general guidance, a power unit is considered to have been built at the date when it started to supply electricity to the grid.

Power plant registered as CDM project activities should be excluded from the sample group m. However, If group of power units, not registered as CDM project activity, identified for estimating the build margin emission factor includes power unit(s) that is(are) built more than 10 years ago then:

(i) exclude power unit(s) that is (are) built more than 10 years ago from the group; and

(ii) include grid connected power projects registered as CDM project activities, which are dispatched by dispatching authority to the electricity system.

Capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor.

In terms of vintage of data, project participants can choose between one of the following two options:

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 to the DOE. For the third crediting period, the build margin emission factor calculated for the second 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 shall be updated annually, ex-post, including those units 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 year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex-ante, 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 was taken to calculate the Build Margin emission factor, ***EFgrid,BM,y*** ex-ante, and it is estimated as below Table, in line with each regulation to compose proper sample group(m) that the electricity quantity of candidate sample groups and it ratio to total generation in Korea.

<Table B-6> Sample Plant group (m) for determining Build margin Emission factor

Sample group(m) Classification	"The five power plants that have been built most recently"	"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	33 MWh	84,736,759 MWh	Total generation is 385,990,619 MWh in Korea (based on KEPCO's data of the year 2007) CDM registered power plants generation is 376,177 MWh.
Proportion (ratio to total generation in Korea)	0.00001%	21.953%	

The annual generation of "the five power plants that have been built most recently" was 33MWh (0.00001% of total generation of the grid system), and the annual generation of "the power plants capacity additions in the electricity system that comprise 21.953% of the system generation and that have been built most recently" was 84,736,759MWh. Therefore, the latter was chosen for this project as a lager figure than the other one. It is presented in Annex 3 that the sample group of plants used in the Build Margin emission factor (***EFgrid,BM,y***).

STEP 5. Calculate the build margin emission factor (EFgrid,BM,y)

The build margin emissions factor is the generation-weighted average emission factor (tCO2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (2)$$

Where:
EFgrid,BM,y is Build margin CO2 emission factor in year y (tCO2/MWh)
EGm,y is Net quantity of electricity generated and delivered to the grid by power unit m in year
y (MWh) EFEL,m,y is CO2 emission factor of power unit m in year y (tCO2/MWh)
m is Power units included in the build margin
y is Most recent historical year for which power generation data is available

According to the BM calculation formula and variables of above tables, ***EFBM,y*** is 0.3933(tCO2/MWh).

STEP 6. Calculate the combined margin emissions factor (EFgrid,CM,y)

The combined margin emissions factor is calculated using the following formula:

$$EF_{grid,CM,y} = w_{OM} \cdot EF_{grid,OM,y} + w_{BM} \cdot EF_{grid,BM,y} \quad (3)$$

Where:
EFgrid,BM,y is Build margin CO2 emission factor in year y (tCO2/MWh)
EFgrid,OM,y is Operating margin CO2 emission factor in year y (tCO2/MWh)
wOM is Weighting of operating margin emissions factor (%)
wBM is Weighting of build margin emissions factor (%)

• Wind and solar power generation project activities: wOM = 0.75 and wBM = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods.

• All other projects: wOM = 0.5 and wBM = 0.5 for the first crediting period, and wOM = 0.25 and wBM = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

Alternative weights can be proposed, as long as wOM + wBM = 1, for consideration by the Executive Board, taking into account the guidance as described below. The values for wOM + wBM applied by project participants should be fixed for a crediting period .

Therefore baseline emission factor (***EF grid,CM,y***) for this project is = 0.5375(tCO2/MWh) as follows :

$$EF_{grid,CM,y} = w_{OM} \cdot EF_{grid,OM,y} + w_{BM} \cdot EF_{grid,BM,y}$$
$$= 0.5 \cdot 0.6817 \text{ (tCO2/MWh)} + 0.5 \cdot 0.3933 \text{ (tCO2/MWh)}$$
$$= 0.5375 \text{ (tCO2/MWh)}$$

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**ø**
Data unit:	NA
Description:	Model correction factor to account for model uncertainties
Source of data used:	Default value "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site"
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Oenk et el.(1994) have validated several landfill gas models based on 17 realized landfill gas projects. The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% is applied to the model results.
Any comment:	

Data / Parameter:	**OX**
Data unit:	NA
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
Source of data used:	Use the IPCC 2006 Guidelines for National Greenhouse Gas Inventories for the choice of the value to be applied.
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	For managed solid waste disposal sites which are covered with oxidizing material such as soil or compost. Mokpo landfill has daily soil cover, thus OX is 0.1
Any comment:	

Data / Parameter:	**DOC_f**
Data unit:	%
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	The above default value is suggested in "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site," which must be used to estimate methane emission potential in accordance with AMS III.G.
Any comment:	

Data / Parameter:	**DOC_j**
Data unit:	%
Description:	Fraction of degradable organic carbon (by weight) in the waste type j

Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4, and 2.5)
Value applied:	<table><tr><th>Waste type j</th><th>DOC_j (% wet waste)</th></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, metal, other inert waste</td><td>0%</td></tr></table>
Justification of the choice of data or description of measurement methods and procedures actually applied :	Using 2006 IPCC default values; conservation factor was chosen for DOC_j.
Any comment:	

Data / Parameter:	**f**
Data unit:	
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	AMS III.G ver.6
Value applied:	0%
Justification of the choice of data or description of measurement methods and procedures actually applied :	0.0 may be used in accordance with AMS III.G ver.6
Any comment:	Mokpo landfill only has controlled LFG to diffuse into the atmosphere through pipes.

Data / Parameter:	**MCF**
Data unit:	NA
Description:	Methane correction factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	For anaerobic managed solid waste disposal sites.
Any comment:	

<table>
<tr><td>Data / Parameter:</td><td>k_j</td></tr>
<tr><td>Data unit:</td><td>NA</td></tr>
<tr><td>Description:</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data used:</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 3.3)</td></tr>
<tr><td>Value 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, cardbord (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>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>Climate data for the Mokpo landfill: 30 years was chosen as a period long-term average.
Mean annual temperature: 13.8 ℃
Annual precipitation: 1125.1 mm
Potential evaporation: 1164.2 mmr</td></tr>
<tr><td>Any comment:</td><td>Based on data observed at meteorological observatory in Mokpo data source: Korea Meteorological Administration</td></tr>
</table>

Data / Parameter:	**$W_{j,x}$**
Data unit:	%
Description:	Amount of organic waste type j prevented from disposal in the SWDS in the year x (tons)
Source of data used:	Mokpo landfill data
Value applied:	Refer to Xls sheet named "composition rate - Estimation of waste composition rate in Mokpo landfill (1996-2004) - The result of re-classification using IPCC(2006) Guideline grouping criteria (2005-2006)
Justification of the choice of data or description of measurement methods and procedures actually applied :	The information of waste composition for the project landfill site is calculated by the two different waste composition rates. Under the regulation, food waste prohibited from filling in the landfill by 2005. Each year data of 1996-2004 was applied to calculate waste composition rate before the regulation of food waste was taken out enforcement and the average data of 2005-2006 was applied to calculate waste composition rate to meet Korean waste management regulations.
Any comment:	Ministry of Environment, "Status of waste disposal and treatment (1996-2006)"

Data / Parameter:	**F**
Data unit:	NA
Description:	Fraction of methane in the SWDS gas (volume faction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5

Justification of the choice of data or description of measurement methods and procedures actually applied :	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
Any comment:	

Data / Parameter:	**Operation Margin Emission Factor (*EF_{OM}*)**
Data unit:	ton CO_2 e/MWh
Description:	The generation-weighted average of CO_2 emission per electricity unit generated by the existing grid-connected power plants.
Source of data used:	"Statistics of Electric Power in Korea"
Value applied:	0.6817
Justification of the choice of data or description of measurement methods and procedures actually applied :	The simple OM method is used to calculate **EF_{OM}** in accordance with the guidance of AMS-I.D. which allows the above method where low-cost/must-run resources constitute less than 50% of total grid generation. The generating sources do not include low-cost and must-run plant in conformity with the direction of AMS-I.D. **EF_{OM}** is calculated using the data for the most recent 3 years (2005-007) for which data are available at time of this PDD submission, and fixed for the crediting period.
Any comment:	The detail data is described on Annex

Data / Parameter:	**Build Margin Emission Factor (*EF_{BM}*)**
Data unit:	ton CO_2 e/MWh
Description:	The generation-weighted average of CO_2 emission per electricity unit generated by additionally constructed power plants.
Source of data used:	"Statistics of Electric Power in Korea"
Value applied:	0.3933
Justification of the choice of data or description of measurement methods and procedures actually applied :	**EF_{BM}** is calculated ***ex-ante*** based on the most recent information available on plants already built for sample group at this PDD submission. According to AMS-I.D., the sample group consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation and that have been built most recently. In this project, the latter is selected because project participant has to select the sample group that comprise the larger annual generation in guidance with the direction of AMS-I.D. the value **EF_{BM}** is fixed for the crediting period.
Any comment:	The detail data is described on Annex

Data / Parameter:	**CO_2 Emission Intensity of the Electricity displaced (*$CEF_{electricity}$*)**
Data unit:	ton CO_2 e/MWh
Description:	The weighted average of ***EF_{OM}*** and ***EF_{BM}***
Source of data used:	"Statistics of Electric Power in Korea"
Value applied:	0.5375
Justification of the choice of data or description of	CO_2 Emission Intensity has to be calculated by combining ***EF_{OM}*** and ***EF_{BM}*** with an appropriate weight, because the quantities of electricity displaced are come from both existing power plant and new plant. The weight is suggested by

measurement methods and procedures actually applied :	default in AMS-I.D. 0.5 for both EF_{OM} and EF_{BM}.. In this project, the default weight is used.
Any comment:	The detail data is described on Annex

B.6.3 Ex-ante calculation of emission reductions:

In guidance with AMS III.G and AMS I.D, the GHG emission reduction by this project can be calculated to add the emission reduction by CH_4 destruction and electricity displacement.

$$ER_{y,\ estimated} = ER_{y,\ CH4} + ER_{y,\ electricity}$$

$ER_{y,\ estimated}$ emission reduction achieved by the project activity in year, y
$ER_{y,\ CH4}$ emission reduction achieved by CH_4 recovery and combustion in year, y
$ER_{y,\ electricity}$ emission reduction achieved by displacing electricity in year, y

<Table B-7> Emission reduction by this project (unit: ton CO_2e)

year	$ER_{y,estimated}$	=	$ER_{y,\ CH4}$	+	$ER_{y,\ electricity}$
2009	11,159	=	10,519	+	640
2010	24,283	=	21,569	+	2,714
2011	24,791	=	22,020	+	2,771
2012	25,214	=	22,396	+	2,818
2013	25,560	=	22,703	+	2,857
2014	25,834	=	22,946	+	2,888
2015	26,042	=	23,131	+	2,911
2016	26,189	=	23,262	+	2,927
2017	26,280	=	23,343	+	2,937
2018	26,320	=	23,378	+	2,942
2019	11,903	=	11,221	+	682

$$ER_{y,\ CH4} = BE_{y,\ CH4} - PE_{y,\ CH4} - Leakage$$

$ER_{y,\ ,estimated}$ Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site during the period from the start of the project activity to the end of the year (tCO2e)
$BE_{y,CH4}$ Baseline CH4 emission (tCO2e)
$PE_{y,\ CH4}$ emission related to the power used to operate the LFG capture and utilization facility (tCO2e)
Leakage Emission caused by transportation in case methane recovery equipment is transferred from another activity, or existing equipment is transferred to another activity (tCO2e)

Project emission is considered in calculation of $ER_{y,\ electricity}$. There is no leakage effect in this project, because this project employs new facilities to utilize landfill gas.

<Table B-8> Emission reduction by capture and combustion of CH_4

year	$ER_{y, CH4}$	=	$BE_{y, CH4}$	-	$PE_{y, CH4}$	-	Leakage
2009	10,519	=	10,519	-	0	-	0
2010	21,569	=	21,569	-	0	-	0
2011	22,020	=	22,020	-	0	-	0
2012	22,396	=	22,396	-	0	-	0
2013	22,703	=	22,703	-	0	-	0
2014	22,946	=	22,946	-	0	-	0
2015	23,131	=	23,131	-	0	-	0
2016	23,262	=	23,262	-	0	-	0
2017	23,343	=	23,343	-	0	-	0
2018	23,378	=	23,378	-	0	-	0
2019	11,221	=	11,221	-	0	-	0

$$\mathbf{BE_{y,CH4} = BE_{CH4,SWDS,y} - MD_{reg,y}}$$

$BE_{CH4,SWDS,y}$ Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site during the period from the start of landfill to the end of the year, y (tCO2e)

$MD_{reg,y}$ Methane emission that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year, y

<Table B-9> Baseline emission of CH_4

year	$BE_{y,CH4}$	=	$BE_{CH4,SWDS,y}$	-	$MD_{reg,y}$
2009	10,519	=	10,519	-	0
2010	21,569	=	21,569	-	0
2011	22,020	=	22,020	-	0
2012	22,396	=	22,396	-	0
2013	22,703	=	22,703	-	0
2014	22,946	=	22,946	-	0
2015	23,131	=	23,131	-	0
2016	23,262	=	23,262	-	0
2017	23,343	=	23,343	-	0
2018	23,378	=	23,378	-	0
2019	11,221		11,221		0

There is no leakage effect in this project, because this project employs new facilities to utilize landfill gas.

<Table B-10> the emission reduction claimed for the displaced electricity

year	$ER_{y, electricity}$	=	$BE_{y, electricity}$	-	$PE_{y, electricity}$	-	Leakage
2009	640	=	684	-	44	-	0
2010	2,714	=	2,804	-	89	-	0
2011	2,771	=	2,862	-	91	-	0
2012	2,818	=	2,911	-	93	-	0
2013	2,857	=	2,951	-	94	-	0
2014	2,888	=	2,983	-	95	-	0
2015	2,911	=	3,007	-	96	-	0

2016	2,927	=	3,024	-	97	-	0
2017	2,937	=	3,034	-	97	-	0
2018	2,942	=	3,039	-	97	-	0
2019	682	=	729	-	47	-	0

$$\mathbf{BE_{y,\ electricity} = EG_y * (1 - p_{IC,\ y}) * CEF}$$

EG_y Gross quantity of electricity generated by the project activity in year, y (MWh)

$p_{IC,\ y}$ The proportion of the quantity consumed to operate and maintain the project facilities to the gross quantity of electricity generated by the project activity (0.03)

CEF Combined emission factor in electricity generation by grid system; weighed average of EF_{OM} and EF_{BM}. (0.5375 ton CO_2e/MWh)

<Table B-11> Baseline emissions from electricity by the project

year	$BE_{y,\ electricity}$	=	**EG_y**	*	**$(1-p_{IC,\ y})$**	*	**CEF**
2009	684	=	1,272	*	(1-0.03)	*	0.5375
2010	2,804	=	5,216	*	(1-0.03)	*	0.5375
2011	2,862	=	5,325	*	(1-0.03)	*	0.5375
2012	2,911	=	5,416	*	(1-0.03)	*	0.5375
2013	2,951	=	5,490	*	(1-0.03)	*	0.5375
2014	2,983	=	5,549	*	(1-0.03)	*	0.5375
2015	3,007	=	5,594	*	(1-0.03)	*	0.5375
2016	3,024	=	5,626	*	(1-0.03)	*	0.5375
2017	3,034	=	5,645	*	(1-0.03)	*	0.5375
2018	3,039	=	5,654	*	(1-0.03)	*	0.5375
2019	729	=	1,357	*	(1-0.03)	*	0.5375

$$\mathbf{EG_y = (LFG_y / LFG_{max}) * O_y * GC * h_{year}}$$

LFG_y Quantity of LFG generated from the project landfill site (m^3/min)

LFG_{max} Maxium limit of LFG input to the project generator (m^3/min) (18.33)

O_y Operating ratio of the project generator in year, y (hour) (1)

GC Generation capacity (MW) (2.130)

h_{year} hours per year (8,000)

<Table B-12> Gross quantity of electricity generated by the project activity in year, y

Year	EG_y	=	$(LFG_y$	/	$LFG_{max})$	*	**O_y**	*	GC * h_{year}
2009	684	=	2.91	/	18.33	*	1	*	2.130*8,000
2010	2,804	=	5.97	/	18.33	*	1	*	2.130*8,000
2011	2,862	=	6.10	/	18.33	*	1	*	2.130*8,000

2012	2,911	=	6.20	/	18.33	*	1	*	2.130*8,000
2013	2,951	=	6.28	/	18.33	*	1	*	2.130*8,000
2014	2,983	=	6.35	/	18.33	*	1	*	2.130*8,000
2015	3,007	=	6.40	/	18.33	*	1	*	2.130*8,000
2016	3,024	=	6.44	/	18.33	*	1	*	2.130*8,000
2017	3,034	=	6.46	/	18.33	*	1	*	2.130*8,000
2018	3,039	=	6.47	/	18.33	*	1	*	2.130*8,000
2019	729	=	3.11	/	18.33	*	1	*	2.130*8,000

$$\mathbf{LFG_y = BE_{CH4,SWDS,y} / GWP / D_{CH4} / w_{CH4,y} / Min_{year}}$$

GWP Global warming potential (21)

D_{CH4} Density of CH4 (m^3 CH_4/m^3 LFG) (0.0007168)

$w_{CH4,y}$ Methane fraction in landfill gas (%) (0.5)

Min_{year} Minutes per year (min) (525,600)

<Table B-13> the Quantity of LFG generated from the project landfill site

Year	LFG_y	=	$BE_{CH4,SWDS,y}$	/	GWP	/	D_{CH4}	/	$w_{CH4,y}$	/	Min_{year}
2009	2.91	=	10,519	/	21	/	0.0007168	/	0.5	/	480,000
2010	5.97	=	21,569	/	21	/	0.0007168	/	0.5	/	480,000
2011	6.10	=	22,020	/	21	/	0.0007168	/	0.5	/	480,000
2012	6.20	=	22,396	/	21	/	0.0007168	/	0.5	/	480,000
2013	6.28	=	22,703	/	21	/	0.0007168	/	0.5	/	480,000
2014	6.35	=	22,946	/	21	/	0.0007168	/	0.5	/	480,000
2015	6.40	=	23,131	/	21	/	0.0007168	/	0.5	/	480,000
2016	6.44	=	23,262	/	21	/	0.0007168	/	0.5	/	480,000
2017	6.46	=	23,343	/	21	/	0.0007168	/	0.5	/	480,000
2018	6.47	=	23,378	/	21	/	0.0007168	/	0.5	/	480,000
2019	3.11	=	11,221	/	21	/	0.0007168	/	0.5	/	480,000

B.6.4 Summary of the ex-ante estimation of emission reductions:

<Table B-14> Emission Reduction from methane destruction

Year	Estimation of project activity emissions (ton CO_2e)	Estimation of baseline emissions (ton CO_2e)	Estimation of leakage (ton CO_2e)	Estimation of emission reductions (ton CO_2e)
2009	0	10,519	0	10,519
2010	0	21,569	0	21,569
2011	0	22,020	0	22,020
2012	0	22,396	0	22,396
2013	0	22,703	0	22,703
2014	0	22,946	0	22,946

2015	0	23,131	0	23,131
2016	0	23,262	0	23,262
2017	0	23,343	0	23,343
2018	0	23,378	0	23,378
2019	0	11,221	0	11,221
Total (ton CO2e)	0	226,489	0	226,489

<Table B-15> Emission Reduction from grid displacement

Year	Estimation of project activity emissions (ton CO2e)	Estimation of baseline emissions (ton CO2e)	Estimation of leakage (ton CO2e)	Estimation of emission reductions (ton CO2e)
2009	44	684	0	640
2010	89	2,804	0	2,714
2011	91	2,862	0	2,771
2012	93	2,911	0	2,818
2013	94	2,951	0	2,857
2014	95	2,983	0	2,888
2015	96	3,007	0	2,911
2016	97	3,024	0	2,927
2017	97	3,034	0	2,937
2018	97	3,039	0	2,942
2019	47	729		682
Total (ton CO2e)	94	39,018	0	37,322

<Table B-16> Estimation of emission reductions from the project

Year	Estimation of emission reductions from LFG destruction (ton CO2e)	Estimation of emission reductions from gird displacement (ton CO2e)	Estimation of emission reductions (ton CO2e)
2009	10,519	640	11,159
2010	21,569	2,714	24,283
2011	22,020	2,771	24,791
2012	22,396	2,818	25,214
2013	22,703	2,857	25,560
2014	22,946	2,888	25,834
2015	23,131	2,911	26,042
2016	23,262	2,927	26,189
2017	23,343	2,937	26,280
2018	23,378	2,942	26,320
2019	11,221	682	11,903
Total (ton CO2e)	226,489	37,322	253,576

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	$LFG_{electricity, y}$
Data unit:	m^3/y
Description:	Amount of landfill gas combusted in power plant
Source of data:	Measured by using the flow meter
Value of data :	Not applied.
Brief description of measurement methods and procedures to be applied:	Measured automatically by a continuous flow meter. The measured data will be monitored in a computer by Mokpo Operation team.
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing, to ensure accuracy. Calibrate the meter every three year
Any comment:	Archived data are to be kept during the crediting period and two years after. Daily data will be documented in paper an archived in electronic file.

Data / Parameter:	$w_{CH4,y}$
Data unit:	%
Description:	Methane fraction in LFG
Source of data:	Measured by using the gas analysers
Value of data :	50% (IPCC default value)
Brief description of measurement methods and procedures to be applied:	Methane fraction will be measured with continuous gas analysers. The measured data will be monitored in a computer by Mokpo Operation team.
QA/QC procedures to be applied:	The gas analyzer will be subject to a regular maintenance and testing regime in accordance with the manufacturer's specification at once, to ensure accuracy Calibrate the meter every three year
Any comment:	Archived data are to be kept during the crediting period and two years after. Daily data will be documented in paper and archived in electronic file.

Data / Parameter:	T
Data unit:	℃
Description:	Temperature of the landfill gas to fed into gas engine
Source of data:	Reading from flow-meter
Value of data :	Not applied.
Brief description of measurement methods and procedures to be applied:	Measured continuously to determine the density of methane. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
QA/QC procedures to be applied:	The flow meter is subject to a regular maintenance and testing regime, to ensure accuracy. Calibrate the meter every three year
Any comment:	Archived data are to be kept during the crediting period and two years after.

Data / Parameter:	P
Data unit:	bar
Description:	Pressure of the landfill gas to fed into gas engine
Source of data:	Reading from flow-meter
Value of data :	Not applied.
Brief description of measurement methods and procedures to be applied:	Measured continuously to determine the density of methane. No separate monitoring of pressure is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
QA/QC procedures to be applied:	The flow meter is subject to a regular maintenance and testing, to ensure accuracy. Calibrate the meter every three year
Any comment:	Archived data are to be kept during the crediting period and two years after.

Data / Parameter:	$EL_{EXP, PJT, y}$
Data unit:	MWh
Description:	Total amount of electricity exported out of the project
Source of data:	Read from watt-hour meter
Value of data :	The estimation result is presented in Table B-7.
Brief description of measurement methods and procedures to be applied:	The amount of exported electricity will be measured automatically by certified meter. The measured data are transferred to Korea Power Exchange and will be checked and achieved daily, weekly, monthly in electronic way by Mokpo Operation team. Measured by watt-hour meter
QA/QC procedures to be applied:	The watt-hour meter is subject to a regular maintenance and testing regime to ensure accuracy. Comply with “Act for measurement”, “Regulation for operation of electricity market” of South Korea Calibrate the meter every two year
Any comment:	Archived data are to be kept during the crediting period and two years after. Daily data will be documented in paper and archived in electronic file.

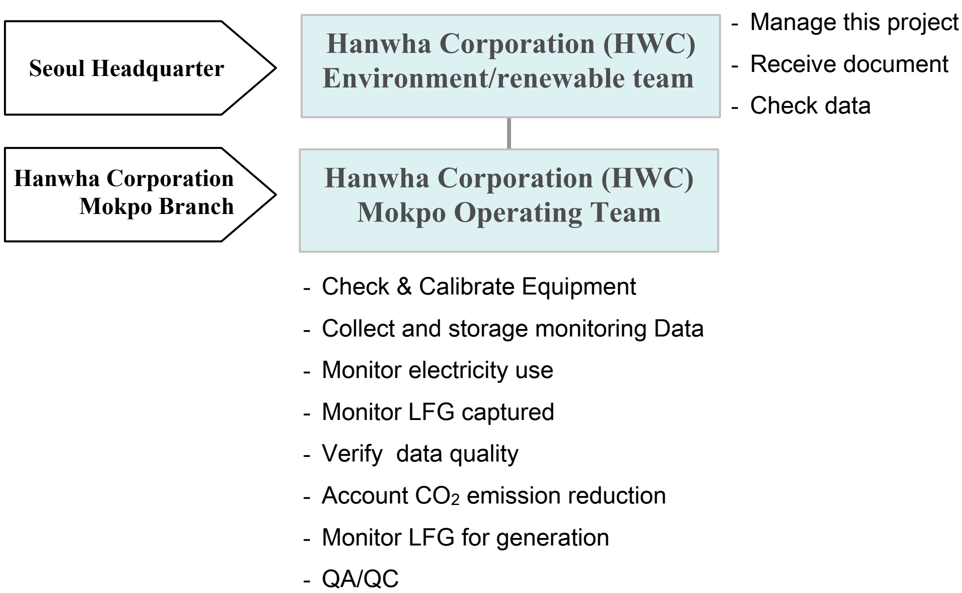
Data / Parameter:	$EL_{IMP, PJT, y}$
Data unit:	MWh
Description:	Total amount of electricity imported to meet project requirement
Source of data:	Measurement by watt-hour meter
Value of data :	The estimation result is presented in Table B-7.
Brief description of measurement methods and procedures to be applied:	The amount of imported electricity will be measured automatically by certified meter. The project participant will check the amount of the imported electricity at the web site (http://cyber.kepco.co.kr) and get the paper bill from KEPCO monthly. Measured by watt-hour meter
QA/QC procedures to be applied:	The watt-hour meter is subject to a regular maintenance and testing regime to ensure accuracy. Calibrate the meter every two year
Any comment:	Archived data are to be kept during the crediting period and two years after. The monthly data will be archived in paper bill from KEPCO.

B.7.2 Description of the monitoring plan:

Data and parameters provided in Section B.7.1 will be monitored and the measurement method of them will be referred to Section B.7.1 as well.

Monitoring organization and the role of each party

The following figure describes the operational and management structure that will monitor the project activity and the below table shows the responsible party for each task of monitoring.



<Figure B-3>The structure of monitoring system

<Table B-17> The responsible party for each task of monitoring.

Item	Sub-item	Responsible person
Measure & Archive	**$LFG_{electricity, y}$**	Responsible person/department for the project : LFG Plant Manager/Mokpo Operating Team of HWC Mokpo branch
	$w_{CH4,y}$	
	T	
	P	
	$EL_{EXP, PJT, y}$	
	$EL_{IMP, PJT, y}$	
Measuring Instrument Check & calibration	**Centralized monitoring system**	Responsible person/department for the project : LFG Plant Manager/Mokpo Operating Team of HWC Mokpo branch
	Flow meter	
	Gas analyzer	
	Watt-hour meter	Responsible person/department for the project: Korea Power Exchange (According to “Law

<table>
<tr><td></td><td></td><td>regarding measurement” and : Act on operation of electricity market”)</td></tr>
<tr><td colspan="2">Establish monitoring plan</td><td rowspan="2">Responsible person/department for the project : LFG Plant Manager/Mokpo Operating Team of HWC Mokpo branch</td></tr>
<tr><td colspan="2">Task Coordination</td></tr>
<tr><td colspan="2" rowspan="2">Monitoring report</td><td>Responsible person/department for the project : LFG Plant Manager/Mokpo Operating Team of HWC Mokpo branch</td></tr>
<tr><td>Responsible person/department for the project: LFG CDM Project Manager /
Environment · Renewable Team of HWC Headquarter</td></tr>
</table>

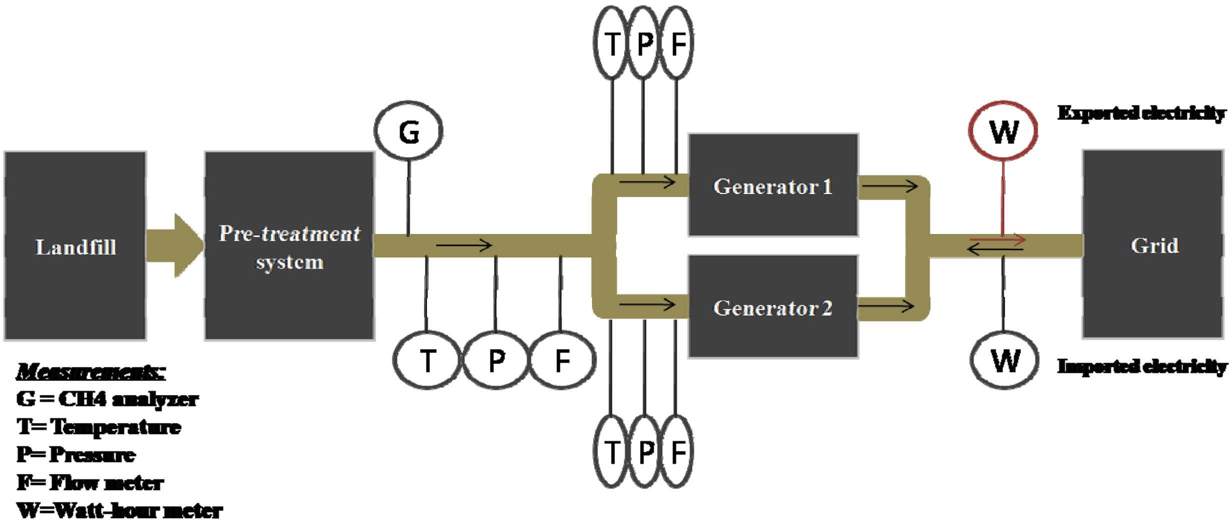
Quality control and quality assurance procedures

LFG Plant manager (Mokpo operating team) will be responsible for quality management, which ensures the quality and accuracy of the measured data. Quality management will include data records, data storage, equipment calibration and maintenance, corrective action and Emergency procedures for unintended emissions.

Plan to measure amount of methane

- Location of the measurement instrument:

A gas flow meter was installed between the blower and generating facility to measure LFG flow rate, temperature, and pressure. A Methane analyzer is located before the above flow meter 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 grid-connected system is measured by Watt-hour meters installed behind the generator, respectively.



<Figure B-4> the Location of the Monitoring facilities

- Data collection and archive:

All the data relevant to CDM project will be measured and collected as detailed in section B.7.1. all the data required for verification will be backed-up and kept for two years after the end of the crediting period.

Plan to measure amount of net electricity export

- Location of the measurement instrument:
The watt-hour meter is installed to measure the quantity of electricity exported and imported respectively in accordance with regulation for electricity market management in South Korea. The certified sheet of measurement registration was submitted to DOE.

- Data Storage
The quantity of electricity both exported and imported power to grid will be measured automatically by the watt-hour meter. The measured data are simultaneously transferred to KEPCO central control system. The amount of electricity measured under the watt-hour meter will be collected and archived daily, weekly, and monthly. The data will be kept until 2 years after the credit period.

Training

All employees involved in this project will be trained by skilled people and technician in Generator maker and participate in train program.

Operation reporting, review, internal audit and corrective action

LFG Plant manager will report all issues and data related to plant operation to LFG CDM Project manager (Environment/renewable team).
Operation review, internal audit and corrective action will be carried out by Environment/renewable team, according to “Operation manual”

Emergency procedure
In case of emergency situation, proper action will be carried out to minimize damage.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

The date of completion of the baseline and monitoring methodology: 16 January 2009
Responsible person / entity is as follows

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Email: jihyunpark@Hanwha.co.kr

Jung ju, Park
EeoNetwork Co., Ltd.(Climate Chagne Consulting)
137-888 # 502, 13-10, Sukbong B/D., Yangjae-dong, Seocho-gu, Seoul, The Republic of Korea
Phone: 82-2-723-3913

Email: dasol017@paran.com

The detailed information is attached to Annex 1.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1. 1. Starting date of the project activity:

10/04/2008 (the date is real action for the project activity)

C.1. 2. Expected operational lifetime of the project activity:

15years

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

C.2.1. Renewable crediting period

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

C.2.1.2. Length of the first crediting period:

C.2. 2. Fixed crediting period:

C.2.2.1. Starting date:

01/06/2009

C.2.2.2. Length:

10years

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

Environmental Impact Assessment (EIA) was not performed under the Korean regulation, because total capacity of generating electricity is less than 10MW, according to EIA law ; energy development's promotion of energy development for the development power resources; article two tells as to LFG generation, EIA is necessary when the electricity capacity is over 10MW

The Korean regulation document on Environmental Impact Assessment is submitted to DOE.

The Project will actively collect and utilize LFG, thereby improving overall landfill management and reducing greenhouse gases and local adverse environmental effects of landfill. Thus contributes to climate change and emissions of LFG, the relative to significant health and safety.

The project will bring below positive environmental impacts:
- Reducing risk of explosions and/or fires either within the landfill or outside its project boundary,
- Significantly less harmful toxic effects to humans from concentrated emissions of LFG,
- Reducing odor/other pollutants and greenhouse gas emissions.

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

Although environmental impacts assessment is not enforcement for the project, project participant should assess possible environmental impacts caused by the project activity or landfill operation.

EIA should be assessed for protecting the populations and landfill surroundings by period and should get public confidence by publishing the result of EIA to the populations while operating Mokpo landfill under the EIA regulation.

The EIA result of Mokpo landfill was satisfied in Korean regulations and the project had no significant environmental impacts. The project not only reduces uncontrolled release of LFG, but also the pollutants caused by the landfill to the air, water and soil quality in the local area.

From environmental protection perspectives, the Project was in compliance with national industry policy, promoting sustainable development and utilization of waste. During phase of the project design and construction, all the mitigation measures proposed by EIA report will be implemented and addressed:

The recent EIA report was performed for waste treatment system on landfill in 2008

<table>
<tr><td>The study period</td><td colspan="2">During February 2007 to February 2008</td></tr>
<tr><td rowspan="4">The subject of study</td><td>Air</td><td rowspan="4">Each season</td></tr>
<tr><td>Noise</td></tr>
<tr><td>Water</td></tr>
<tr><td>Soil</td></tr>
</table>

- Air

Under the fundamental law of environmental policy, 6 air pollutants have been measured for condition of air quality. The result of the measure was satisfied to regulations of the environmental policy.

- Water

Under the fundamental law of environmental policy, water quality was measured including 14 pollutants. Four points (watercourse, lake, underground water, and leachate) were tested and analyzed to show water quality to meet the environmental policy regulation.

- Noise and Vibration

The level of noise around the landfill site is below the Korean regulation level and the landfill site is far away from residential area at where is not influenced directly. Considering those study, the problem from noise or vibration does not occur in the landfill site.

- Soil

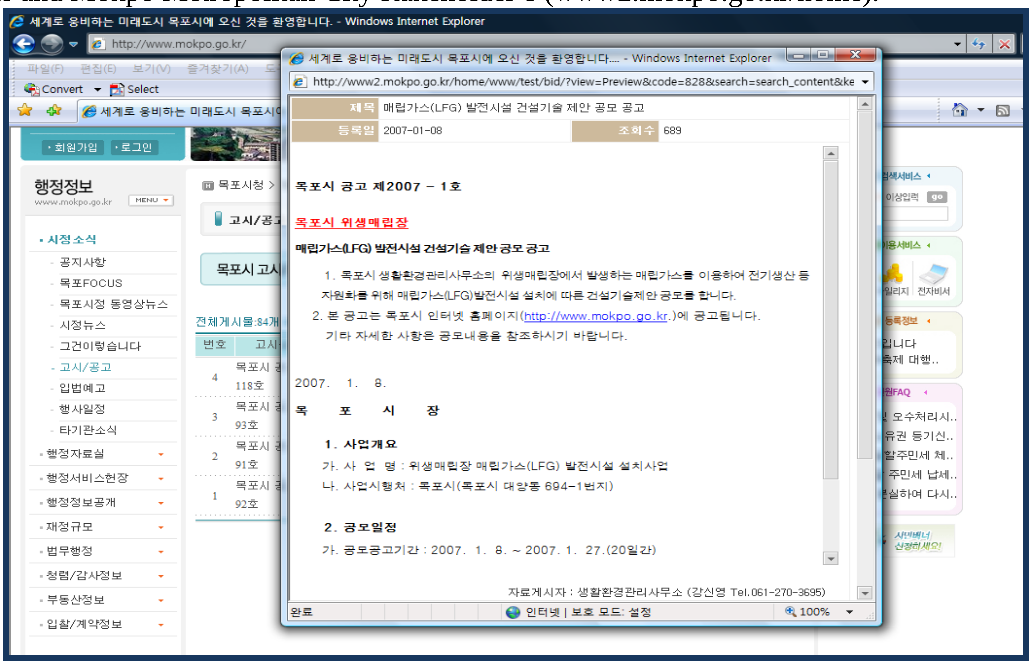
Under the fundamental law of environmental policy, soil quality was measured including 13 pollutants. According to the measure, the below part of Mokpo landfill was not influenced by landfill.

SECTION E. Stakeholders' comments

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

EIA is not necessary for installation of generators in the Landfill. It is necessary, only if the electricity capacity is over 10MW under the EIA regulation.

Prior to announcement of proposed project, the proposed project activities were announced in the local newsletter and Mokpo Metropolitan City stakeholder's (www2.mokpo.go.kr/home).



<Fig. E-1> Project announcement of Mokpo landfill project

Mokpo Metropolitan City has held a meeting to describe the proposed project and visited project site with 42 participants and stakeholders on November 2006. Presentations about proposed project was made to allow stakeholders to understand the proposed project, related to climate change, it's consequences and the aims of the Kyoto Protocol, as well as the most important features of the "Mokpo landfill LFG

Recovery to Electricity project". Furthermore the comments from local experts have been advised on the proposed project activities.

The meeting was composed of the below contents

- General explanation of proposed project
- The necessity of utilizing LFG to electricity
- The plans of installing collecting system and generators
- The operating plans

E.2 . Summary of the comments received:

The stakeholders agreed to the project plan which has many benefits for environment and stakeholders; by collecting and using LFG emitted from landfill, it brings sanitary treatment and stabilization of landfill as well as resolving stakeholders' comments from odors and pollutants. As those reasons, there is no reason to make adverse effect from project activities.

The contents of Mokpo Metropolitan City's suggestions and comments

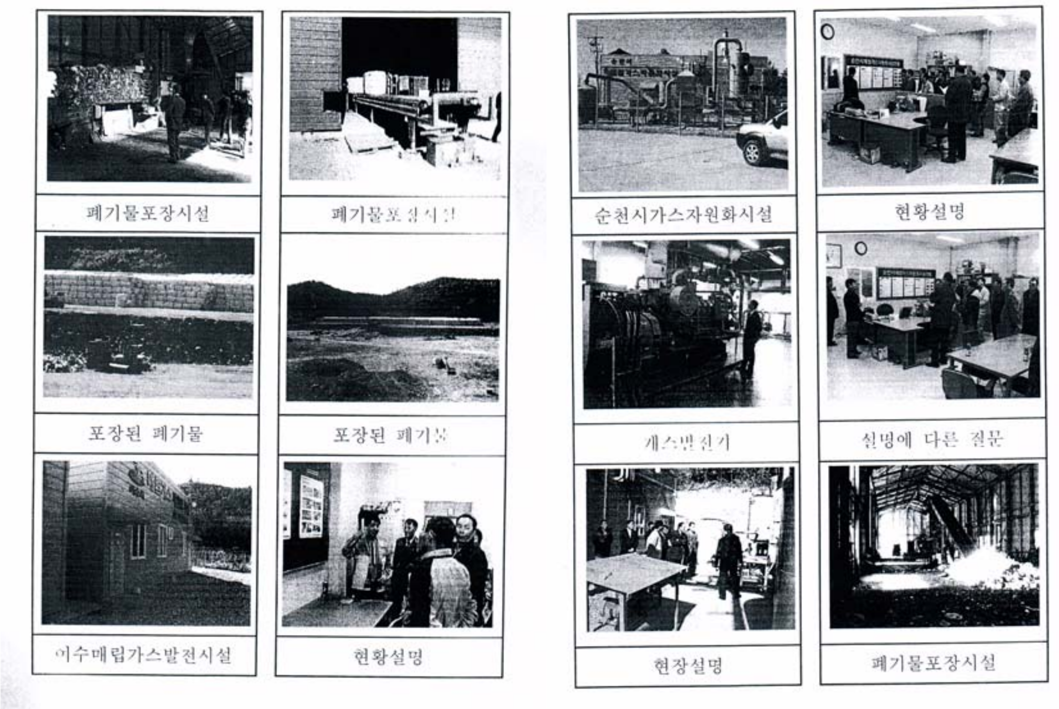
- Prevention of safety concerns about air pollutants, odors problems and explosion from LFG
- Resolving public hatred and saving money by the proposed project

The contents of stakeholders' suggestions and comments

- Prevention of safety concerns about air pollutants, odor problem and explosion from LFG
- All the stakeholders allowed Investor to utilize LFG to electricity and CDM project
- But, the generators should be dismantled clearly after project

And no other comments have been received from stakeholders except above contents stakeholders' suggestions and comments, since they understand the benefits to both utilizing LFG and CDM project for Mokpo city and stakeholders from the proposed project.

Stakeholders' comments will have been received continuously until the end of the proposed project via Mokpo Metropolitan City's Website (http://www.mokpo.go.kr). The comments should be reported and discussed on the stakeholder meeting.



<Fig. E-2> the pictures to study and discuss for Mokpo landfill project
Source: Mokpo official letter, November 2006

시정조정위원회 심의결과 의견서

□ 위생매립장 매립가스(LFG)발전시설 설치 심의(안)

직 위	직 명	성 명	심의결과			
			가	부	심의의견	서명
위원장	시 장	정종득			없음	정종득
부위원장	부 시 장	이종범	o		없음	이종범
위원	기획관리 국 장	조성평	o		없음	조성평
"	주민복지 국 장	박철린	o		없음	[illegible]
"	관광문화 국 장	박병옥	o		없음	박병옥
"	경제환경 수산국장	추영동	o		"	추영동
"	도시건설 국 장	길의식	o		없음	[illegible]
"	보건소장	김일용	o		없음	김일용
"	상하수도 사업소장	정은면			[illegible]	
위원	도시개발 사업소장	서강열	o		없음	서강열

Fig. E-3> the signatures of stakeholders
Source: Mokpo official letter, November 2006

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

Through the meeting, the project was fully explained to stakeholders and there were no significant comments. The stakeholders have understood the project;

- Carries out environmental protection
- Improve social and economical benefits
- Increase job opportunities

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Represented by:	Cheon chae, Jeong
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Salutation:	Mr.
Last Name:	Jeong
Middle Name:	
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E-Mail:	jihyunpark@hanwha.co.kr
URL:	http://english.hanwhacorp.co.kr/
Represented by:	Jihyun Park
Title:	
Salutation:	Ms.
Last Name:	Park
Middle Name:	
First Name:	Jihyun
Department:	Trade Division, Business Development Department

Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the project.

Annex 3

BASELINE INFORMATION

The total quantity of GHG emission reduction by this project is calculated by summing the CO2 equivalent amount of the methane destroyed in the gas engine and the amount of CO2 expected to be emitted from the grid connected power generating system to generate the same amount of the power displaced by the project. For the first, the procedure to estimate the amount of the LFG generated from the landfill and the estimation result are presented in Step1. Next, the appropriate equations to calculate CO_2 emission intensity factor of the electricity displaced and the source data are provided in conformity with the approved methodology selected in the section B.

1. Emission for the amount of waste filled up in landfill

Further waste estimation is calculated by multiplying the population growth of Mokpo city (-0.32%) and increase rate of per capita municipal waste disposal (-0.42%). The result of further estimation waste going to Mokpo landfill is shown below table from 2006 to 2022.

<Table Annex-1> Factor to estimate the future waste disposal in the project landfill site

year	waste disposal and treatment (per capital)	population (Mokpo)
2002	1.03	245,315
2003	1.14	241,460
2004	0.88	242,380
2005	1.02	242,988
annual average growth rate	-0.42%	-0.32%

source : Master plan for waste disposal and treatment in Jeollanam-do 2007

The actual quantity in 2006 and the next quantity waste estimated in 2007 – 2023 is shown below table. Mokpo landfill starting year was in 1995 and expected completion year will be 2022

<Table Annex -2> Result of further estimation waste going to Mokpo landfill

year	existing waste	estimation
1996	63,875	63,875
1997	58,400	58,400
1998	66,795	66,795
1999	59,495	59,495
2000	80,300	80,300
2001	73,949	73,949
2002	75,336	75,336
2003	83,476	83,476
2004	57,634	57,634
2005	61,466	61,466
2006	67,124	67,124
2007		66,627

2008		66,134
2009		65,644
2010		65,158
2011		64,676
2012		64,197
2013		63,722
2014		63,251
2015		62,783
2016		62,318
2017		61,857
2018		61,399
2019		60,944
2020		60,493
2021		60,046
2022		59,601

Source : Ministry of Environment, "Status of waste disposal and treatment" 1996-2006

Methane emission potential of landfill site shall be estimated to determine the baseline CH_4 emission of this project in accordance with AMS III.G_V6. The estimation is to be undertaken using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal." The table below shown presents variables, parameters, and data sources needed to determine the baseline emission for CH_4.

< Table Annex-3>Data used to determine the CH_4 baseline emissions

Variable /Parameter	Unit	Description	Source
ø	0.9	Model correction factor to account for model uncertainties	Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site
f	0	Fraction of methane captured at SWDS and flared, combusted or used in another manner	Project developer-no LFG captured or utilized on site
GWP_{CH4}	21 tCO_2/tCH_4	Global warming potential of methane	Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site
OX	0.1	Oxidation factor	Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site
F	0.5	Fraction of methane in the landfill	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
DOC_f	0.5	Fraction of degradable organic carbon (DOC) that can decompose	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
MCF	1	Methane correction factor	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
$W_{j,x}$	Tonnes	Total amount of organic waste type j filled in the year, x	Ministry of Environment, "Status of waste disposal and treatment" 2002, 2003, 2004, 2005,2006
DOC_j	-	Fraction of degradable organic	IPCC 2006 Guidelines for National

Variable /Parameter	Unit	Description	Source
		carbon (by weight) in the waste type j	Greenhouse Gas Inventories
k_j	-	Decay rate for the waste type j	Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site * Korean metrological agency

< Table Annex-4>Data used to determine the CO_2 baseline emissions

Variable /Parameter	Unit	description	Source
EG_y	MWh	Electricity generated by the project in year, y	Feasibility study report (expected value according to design of the project)
$F_{i,j,y}$	ton or m^3	The amount of fuel *i*(in a mass or volume unit) consumed by relevant power sources j in year(s) y, *j* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid	Statistics of Electric Power in KOREA (2005, 2006, 2007) (KEPCO)
$CV_{i,j,y}$	Kcal	Net Calorific Values of fuel *i* consumed by power source *j* in year, *y*	Statistics of Electric Power in KOREA 2004, 2005, 2006 (KEPCO)
EF_i	TC/TJ	Carbon Emission Factor of fuel *i* (tC/TJ)	IPCC 2006 Revised Guidelines
OXID	-	Fraction of Carbon Oxidised (OXID)	IPCC 2006 Revised Guidelines
EF_{OM}	ton CO_2/MWh	Operating Margin Emissions Factor	Calculated
EF_{BM}	ton CO_2/MWh	Build Margin Emissions Factor	Calculated
CEF	ton CO_2/MWh	Combined Emissions Factor	Calculated

Annex 4

MONITORING INFORMATION

All parameters will be monitored as stated in section B. 7.