Project design document form
(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Wonju Landfill Gas Recovery Project for Electricity Generation
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	Version 4.0
Completion date of the PDD	18/01/2021
Project participants	NEWGEN ELECTRICS Co., Ltd. ROEN consulting Co., Ltd.
Host Party	Republic of Korea
Applied methodologies and standardized baselines	Methodology: AMS-I.D "Grid connected renewable electricity generation" (Version 18) AMS-III.G "Landfill Methane Recovery" (Version 09.0)
Sectoral scopes	Sectoral scope 1: Energy industries (renewable - / non-renewable sources) Sectoral scope 13: Waste handling and disposal
Estimated amount of annual average GHG emission reductions	15,733tCO_2e/y

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

Wonju Landfill Gas Recovery Project for Electricity Generation(hereafter referred to as the "Project") developed by NEWGEN ELECTRICS Co., Ltd. (hereafter referred to as "NEWGEN") is a landfill gas(LFG) recovery for power generation project at Wonju City Waste Comprehensive Treatment Complex(hereafter referred to as "Wonju landfill") in Wonju City, Gangwon Province, Republic of Korea.

Wonju landfill has been landfilled since 1995 and Wonju landfill is still being landfilled.

The objective of this project is to capture LFG and generate electricity. The project is aimed at reducing atmospheric emissions of methane, a greenhouse gas (GHG) which contributes to global warming and climate change.

The scenario existing prior to the implementation of the project activity

Wonju landfill installed simple incineration facility and gas emission facility to reduce leakage LFG to the surrounding environment. The simple incineration facility was used to incinerate the gas generated from Wonju landfill site and prevent odour caused by LFG. Gas emission facility was installed using venting system that simply disposed of LFG.

Baseline Scenario

The baseline scenario is that a significant amount of LFG generated at the Wonju landfill was released to atmosphere even though the LFG is captured partially and combusted by the simple incineration facility.
According to the article 7[1] on "ENFORCEMENT DECREE OF THE WASTES CONTROL ACT", a landfill has facilities for gas incineration(such as simple burning system)or power generation and fuel-making are required in order to prevent surrounding environment problem(e.g. air pollution, odour, etc.). However, the regulation does not specify the amount of the LFG flared and captured, efficiency and specification of relevant equipment.
Therefore, the baseline complies with relevant mandatory national policies. The baseline scenario identified in section B.4 is the same as scenario existing prior to the implementation of this project, at the Wonju landfill.

Project Scenario

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 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 is adopted into the proposed project.
The proposed project activity will significantly contribute to a reduction in GHG emissions while at the same time improving local air quality and mitigating some of the existing environmental impacts affecting people working and/or living in the vicinity of the landfill sites.

Based on estimated emissions calculations, the project is expected to generate approximately

[1] [1]ENFORCEMENT DECREE OF THE WASTES CONTROL(Presidential Decree No. 27792, Jan. 28, 2017) Article (7)

15,733 tCO_2e/y emission reductions and 110,133 tCO_2e over the 7year crediting period.

This project activity is not a Component Project Activity that has been excluded from a registered CDM Programme of Activity as a result of erroneous inclusion of CPAs.

Contributes to sustainable development

This project will contribute to local and global sustainable development in the following way:

Environmental benefits:

- The project will contribute to reduce global warming by reducing GHG CH_4, which is the main component in LFG.
- The project will minimize environmental damage through reducing methane emissions (global warming), odour nuisance and significant risk to human health from hazardous LFG.
- The project will replace electricity from fossil fuel power plants to LFG power plants.

Social impacts:

- Properly collecting and destroying flammable LFG will reduce the explosion risk in and around the landfill site.
- The project will optimize the use of LFG in substitution of fossil fuel and the clean technology demonstration project, thus promoting sustainable and socio-economic development through significant technology transfer.
- The project will improve the image of landfill by solving the problem of landfill odour and can affect citizen consciousness improvement through the field trip of project site.

Economic impacts:

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

A.2. Location of project activity

>>

Host Party

Republic of Korea

Region/State/Province etc.

Gangwon Province

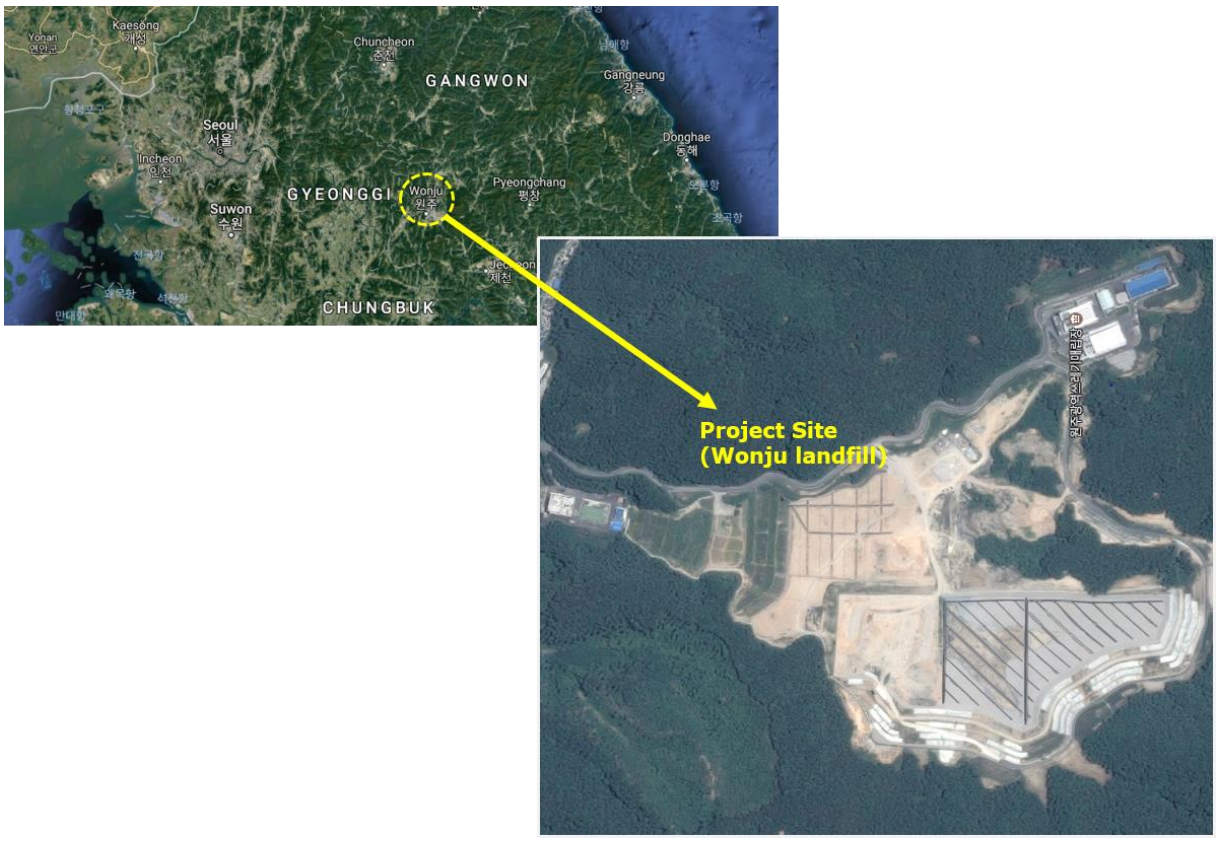
City/Town/Community etc.

Wonju city

Physical/Geographical location

The site of Wonju landfill is located in San 185, Saje-ri, Heungeop-myeon, Wonju-city, Gangwon-Province, Republic of Korea.

The exact location of the project is defined using GPS coordinates latitude North 37.327570° and longitude East 127.869777°



<Figure A-1> The physical location of the Project Activity

A.3. Technologies/measures

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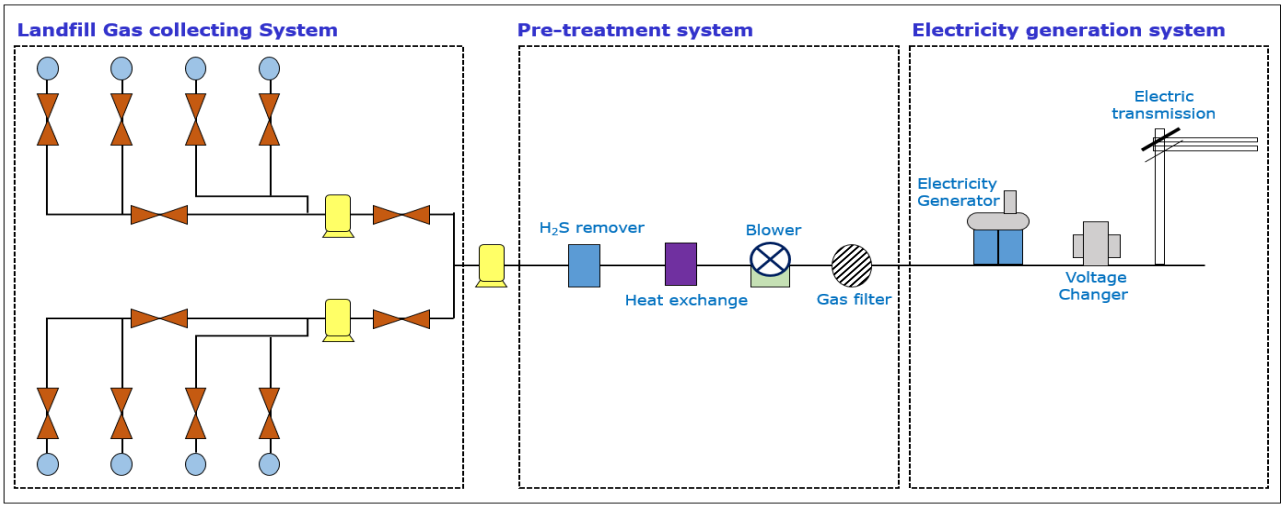
The recovery of methane, is a proven technology, used in numerous projects around the world. In light of the progress of the technology, the project participant will install the most modern and widely used technology in the LFG recovery and renewable electricity generation sector.

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 for each process of collecting and recycling LFG effectively is adopted into the this project.



<Figure A-2> The main process of the this project

The main features of the LFG facilities are presented below.

· Landfill Collecting System

The landfill gas collection system consists of the following elements
- Vertical gas wells that extract the landfill gas from the landfill;
- Gas pipes that collect and transport the extracted gas to the power plant;
- Blowers which draw the gas from the wells through the collecting system and deliver it to gas fueled power generation units.

The type of LFG collecting system is expected to enhance maintenance and LFG collecting efficiency because vertical collecting system has higher collecting efficiency and is easier to maintain and repair system compared to the horizontal collecting system.

· Landfill Gas Pre-treatment System

Prior to combustion in the power generation units, the LFG will be treated in a pre-treatment unit: to remove condensed water by using the Condensation Separate Vessel (CSV) tank, removing moisture of the gas through a heat exchanger, then after removing sulfur through the desulfurization and removing dust in gas filter put it into the generator.

Condensation Separate Vessel (CSV)	Condensed water removal
▼	
H_2S remover	Desulfurization
▼	
Exchange and Chiller	Gas temperature control/water removal
▼	
Blower	Gas Inhalation into the generator
▼	
Gas Filter	Dust Removal

<Figure A-3> The process of pre-treatment system

· Generation System

This project is designed to install the two generators with total capacity of 980kW (490kW * 2set) inside the Wonju landfill. The collected LFG is sent to the generator and the electricity generated is exported to the grid-connected system of the Korea Electric Power Corporation (KEPCO) supply system.

<Table A-1> The technical data of power generator based on full load

1st 2nd	Engine	engine manufacture	Baudouin
		Model	12M26D660E301NG
		Engine Type	Turbocharged & Air-to-Air Aftercooled
	Generator	Generation set manufacture	HANATECH
		Model	BBS-490
		Type	Container Type Landfill Gas
		Maximum Electrical Power Output (kW)	490
		Voltage (V)	380
		Frequency (Hz)	60
		Speed (rpm)	1,800

The expected lifetime of the system is at least 30 years, if the performance is maintained correctly.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea(host)	NEWGEN ELECTRICS Co., Ltd. ROEN consulting Co., Ltd.	No

A.5. Public funding of project activity

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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.6. History of project activity

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We confirm that the proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA). Also the proposed CDM project activity is not a project activity that has been deregistered.

A.7. Debundling

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According to the Glossary of the CDM and the tool “Assessment of debundling for small-scale project activities” (Version 4.0), “De-bundling” is defined as “the fragmentation of a large project activity into smaller parts. A small-scale project activity that is part of a larger project activity is not eligible to use the simplified modalities and procedures for small-scale CDM project activities”.

According to paragraph 9 of the mentioned tool, a proposed small-scale project activity shall be deemed to be a de-bundled component of a large project activity if there is a registered small scale CDM project activity or an application to register another small-scale CDM project activity.

<Table A-2> Assessment of debundling for the project

Debundled component	Project Condition
(a) With the same project participants	The project participant has not applied for registration of another small scale CDM project activity involving LFG collecting.
(b) In the same project category and technology/measure	The project participant has not applied for registration of another small scale CDM project with the same technology/measure that the current CDM project activity.
(c) Registered within the previous 2 years	The project participant has not applied for registration of another small scale CDM project activity within the last 2 years.
(d) Whose project boundary is within 1 km of the project boundary of the proposed small- scale activity at the closest point	The project participant has not applied for registration of another small scale CDM project activity having project boundary within 1 km radius of the currents CDM project activity.

Thus it can be concluded that this project is not a debundled component of a large scale project activity.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

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This project is a small scale project activity and conforms to Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

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

- Type : I – Renewable energy projects and category
  III – Other project activities and category
- Category : The approved small-scale CDM baseline methodologies;
  AMS- I.D “Grid connected renewable electricity generation” (Version 18)
  AMS-III.G “Landfill methane recovery” (Version 09.0)
- Reference : ACM0001 “Flaring or use landfill gas” (Version 17.0)
- Tools Used : “Emissions from solid waste disposal sites” (Version 08.0)
  “Tool to calculate the emission factor for an electricity system” (Version 05.0)

B.2. Applicability of methodologies and standardized baselines

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

Small-Scale Methodology	Applicability Conditions	Project Applicability

AMS-I.D	This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass: (a) Supplying electricity to a national or a regional grid; or (b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	This project comprises renewable energy generation units, such as renewable biomass(LFG) produced by the landfilling of waste from household and industrial activities. This project involves "(a) Supplying electricity to a national or a regional grid". This project will **supply electricity to a national grid**. Therefore, this applicability condition is met.
	Illustration of respective situations under which each of the methodology (i.e. "AMS-I.D: Grid connected renewable electricity generation", "AMS-I.F: Renewable electricity generation for captive use and mini-grid" and "AMS-I.A: Electricity generation by the user) applies is included in the appendix.	For this project the methodology, AMS-I.D is chosen because the **entire amount of electricity produced will be supplied to the national grid**.
	This methodology is applicable to project activities that: (a) Install a Greenfield plant; (b) Involve a capacity addition in (an) existing plant(s); (c) Involve a retrofit of (an) existing plant(s); (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s).	This project involves the "(a) install a Greenfield plant" at a site **where there was no renewable power plant operating prior to the implementation of the project**. Therefore, this applicability condition is met.
	Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: (a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir; (b) 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/m^2 ; (c) 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/m^2 .	This project involves electricity generation by utilizing LFG generated from Wonju landfill. This project does **not involve the installation of hydro power plant**. Therefore, this applicability condition is not relevant to this project.

	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	This project does **not have a non-renewable components**. This project has only renewable components i.e. LFG generator with total capacity of 980kW. Therefore, this applicability condition is not relevant to this project.
	Combined heat and power(co-generation) systems are not eligible under this category	This project does **not combined heat and power (co-generation) systems**. This project only generate electricity.
	In the case of project activities that involve the capacity 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.	This project does **not involve the addition of renewable energy generation units at an existing renewable power generation facility**. This project is a Greenfield project involving the setting up of a new power plant at a site where there were no power plants in the pre-project scenario. This project is only 980kW which is lower than 15MW. Therefore, this applicability condition is not relevant to this project.
	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.	This project does not involve retrofit or modify an existing facility for renewable energy generation. This project is **a new greenfield project activity involving the setting up of a power plant at a site where there were no power plants in the prior to this project**. This project is only 980kW which is lower than 15MW. Therefore, this applicability condition is not relevant to this project.
	In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as "AMS-I.C.: Thermal energy production with or without electricity" shall be explored.	The recovered methane in this project is used **for only electricity generation for supply to a grid not for heat generation or cogeneration**. Baseline for the electricity component in this project follows in accordance with procedure prescribed under AMS-I.D. Therefore, there is no need to explore AMS-I.C in this project.

	In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply.	The recovered methane in this project is used **for only electricity generation for supply to a grid. The methane is not sourced from dedicated plantations.** Therefore, tool "Project emissions from cultivation of biomass' is not applied.
AMS-III.G	This methodology comprises measures to capture and combust methane from landfills (i.e. solid waste disposal sites) used for the disposal of residues from human activities including municipal, industrial, and other solid wastes containing biodegradable organic matter.	This project will **capture LFG generated from Wonju landfill, which was used for the disposal of residues from human activities.** Therefore, this applicability condition is met.
	Different options to utilise the recovered landfill gas as detailed in paragraph 3 of "AMS-III.H.: Methane recovery in wastewater treatment" (version 16.0) are eligible for use under this methodology. The relevant procedures in AMS-III.H shall be followed in this regard.	The recovered methane will be used by the project participant to produce electrical energy directly. The recovered methane is used for this project covered under paragraph 3 (a) in AMS-III.H, that component of this project can use a corresponding methodology under Type I. As this project supplies electricity to a national grid using recovered methane, AMS-I.D under Type I is used. Therefore, this applicability condition is met.
	Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 $ktCO_2$ equivalent annually from all Type III components of the project activity.	The estimated emission reductions for any of the crediting year are less than 60 $ktCO_2e$, as evidenced by the summary of ex ante estimates of emission reductions in PDD section B.6.4. **Maximum expected aggregate emission reductions are 16.3 $ktCO_2e$ in any year of the crediting period**, which is less than 60 $ktCO_2e$. Therefore, this applicability condition is met.

	The proposed project activity does not reduce the amount of organic waste that would have been recycled in the absence of the project activity.	There is no alteration to waste composition as a result of this project. According to article 7 of the "ENFORCEMENT DECREE OF THE WASTES CONTROL ACT", wastes shall be disposed by type, characteristics, and conditions. Therefore, the amount of organic waste to be recycled cannot be treated as landfill by complying with waste disposal standard and method prescribed in the enforcement degree. Therefore, this project has no influence whatsoever on existing segregation/ diversion and recycling practices of organic waste in the area that was served by the landfill.
	This methodology is not applicable if the management of the solid waste disposal site (SWDS) in the project activity is deliberately changed in order to increase methane generation compared to the situation prior to the implementation of the project activity (e.g. other than to meet a technical or regulatory requirement). Such changes may include, for example, the addition of liquids to a SWDS, pre-treating waste to seed it with bacteria for the purpose of increasing the rate of anaerobic degradation of the SWDS or changing the shape of the SWDS to increase methane production.	No design alteration is being carried out to increase the generation of LFG. In absence of project activity, the landfills were designed for unmanaged venting of LFG. Therefore, this applicability condition it met.
Tool "Tool to calculate the emission factor for an electricity system"	This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	This project **exports electricity to grid-connected system**.
	In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	This project will supply electricity to a national grid that is located totally in Republic of Korea which in non-Annex I.

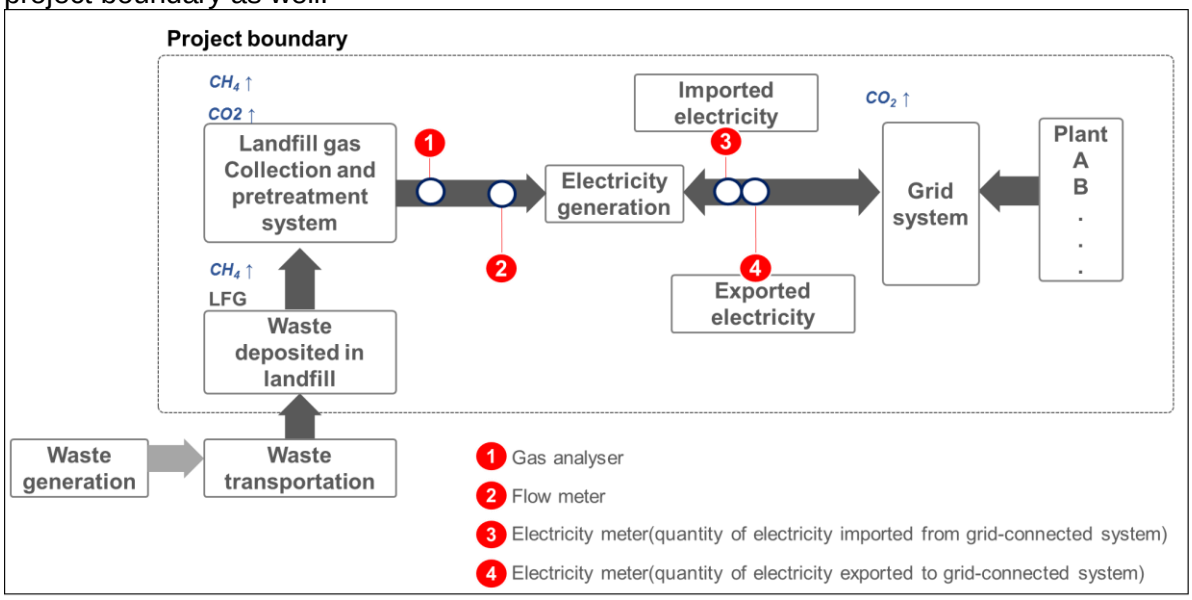
Tool "Emissions from solid waste disposal sites"	The tool can be used to determine emissions for the following types of applications: (a) Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. "ACM0001: Flaring or use of landfill gas"). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS); (b) Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS. An example of this application of the tool is ACM0022, in which municipal solid waste (MSW) is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both ex ante and ex post estimation of emissions. These project activities may apply the simplified approach detailed in 0 when calculating baseline emissions.	This project **mitigates methane emissions from a specific existing SWDS**. (a) Application A is applicable to the project activity, as methane emissions are mitigated by capturing for energy. The tool is only applied for an ex ante estimation of emissions on this project PDD.
	In the case that: (a) different types of residual waste are disposed or prevented from disposal; or that (b) both MSW and residual waste(s) are prevented from disposal, then the tool should be applied separately to each residual waste and to the MSW.	**As the analysis of waste composition of the Wonju landfill as per 'Status of waste disposal and treatment' by Ministry of Environment, this project involves "(a) different types of residual waste are disposed"**. In Wonju landfill, both MSW and residual wastes are separately disposed. In this project, tool should be applied separately to each residual waste and to the MSW. This project is thus complying with all conditions of the tool.

B.3. Project boundary, sources and greenhouse gases (GHGs)

>>

According to AMS-III.G and AMS-I.D, the project boundary should encompass the physical/geographical site of the landfill at where the gas should be captured to use the renewable generation source. And the spatial extent of this project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

Thus, this project boundary is the site of the project activity, Wonju landfill in where LFG is captured and used it to generate electricity, and the grid-connected system is included in the project boundary as well.



<Figure B-1> Project boundary

In this project, the following sources and gases are included in the project boundary.

Source		GHG	Included?	Justification/Explanation
Baseline	Emission from decomposition of waste at the landfill site	CO_2	Yes	The major source of emissions in the baseline and methane released to atmosphere due to the decomposition of the organic waste
		CH_4	No	N_2O emissions are small compared to CH_4 emissions from SWDS. This is conservative
		N_2O	No	CO_2 emissions from the decomposition of organic waste are not accounted, even though CO_2 is also released under the project activity.
	Emissions from electricity generation	CO_2	No	Excluded for simplification. This is conservative
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	Yes	CO_2 would be otherwise emitted by grid-connected power plants (using fossil fuel) without this project utilizing LFG
Project activity	Emissions from electricity consumption	CO_2	No	Excluded for simplification. This is an emissions source assumed to be very small
		CH_4	No	Excluded for simplification. This is an emission source assumed to be very small
		N_2O	Yes	Emissions from electricity consumption due to project activity

The equipment used for monitoring the required parameter is provided in following Table.

<Table B-2> Data and parameter to be monitored

No.	Instrument	Monitored parameter(s)	Unit
①	Gas analyser	$W_{CH4,y}$	%
②	Flow meter	$LFG_{i,y}$	m^3
③	Electricity meter	$EG_{PJ,facility,y}$	MWh
④	Electricity meter	$EG_{PJ,facility,y}$	MWh

B.4. Establishment and description of baseline scenario

>>

In line with paragraph 42 of the CDM Project Standard (Version 9.0) and as per paragraph 15 of applied AMS-III.G, “the baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted to the atmosphere, possibly with capture of LFG and destruction through flaring to comply with regulations or contractual requirements.”

According to the article 7 on “ENFORCEMENT DECREE OF THE WASTES CONTROL ACT”, a landfill has facilities for gas incineration(such as simple burning system)or power generation and fuel-making are required in order to prevent surrounding environment problem(e.g. air pollution, odour, etc.). However, the regulation does not specify the amount of the LFG flared and captured, efficiency and specification of relevant equipment.

The activities of LFG flaring/utilization have not been practiced in landfill sites in Republic of Korea and the project activity has only adopted simple incineration facility in order to prevent odor caused by LFG prior to implementation of the project activity.

The baseline of this project is that where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted to the atmosphere, with partially capture of LFG and combusting LFG by simple incineration facility.

Therefore, the baseline complies with relevant mandatory national policy.

This baseline scenario applies to calculate amount of methane in the LFG that would be flared in the baseline. Further details are described in section B.6.

As per guidelines for baseline in paragraph 19 of applied AMS I.D, "The baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.'

The baseline of this project is that where, in the absence of the project activity, the equivalent amount of power would have been supplied by the grid, which is fed mainly by fossil fuel power plants. The project activity is a greenfield project which generating electricity through captured LFG and the electricity generated is to be exported to the grid-connected system in Korea. Thus, the baseline of the project is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid.

Therefore, this project will supply electricity to the grid-connected system.

B.5. Demonstration of additionality

>>

According to paragraph 2 of Guidelines on the demonstration and assessment of prior consideration of the CDM(EB 62, Annex 13) states "The Board decided that for project activities with a starting date on or after 2 August 2008, the project participant must inform a Host Party designated national authority (DNA) and the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status. Such notification must be made within six months of the project activity start date and shall contain the precise geographical location and a brief description of the proposed project activity, using the standardized form F-CDM-Prior Consideration. Such notification is not necessary if a project design document (PDD) has been published for global stakeholder consultation or a new methodology proposed to the Executive Board for the specific project before the project activity start date".

In accordance with the above provisions, the project participant has notified UNFCCC of their intention to implement the proposal project activity and seek CDM status on 20 Sep 2016.
And the project participant has notified Republic of Korea DNA of their intention on 29 Sep 2016.
The detailed action of notification is mentioned below:

<Table B-3> detailed activity of notification

Activity	Date
Project Feasibility Study	12/05/2015
Local Stakeholder Consultation	16/09/2015
Conclude a Construction contract for CDM project activity(Electrical Construction, Civil/LFG collecting/Pre-treatment Construction)	09/05/2016

Conclude a purchase contract for CDM project activity(Generator purchase and On-site Performance)	30/05/2016
Notification of prior consideration of CDM for the Wonju Landfill project UNFCCC (Within 6 months of starting date of project activity)	20/09/2016
Notification of prior consideration of CDM for the Wonju Landfill project to the host country DNA (Within 6 months of starting date of project activity)	29/09/2016
Permission from generation business	07/06/2016
Pre-inspection check of generation equipment	03/11/2016
Start date of operation	16/12/2016

According to paragraph 13 of AMS-III.G, the following type of project activities are deemed automatically additional, if prior to the implementation of proposed project the LFG was only vented and/or flared but not utilized for energy generation:

(i) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW
(ii) The LFG is used to generate heat for internal or external consumption
(iii) The LFG is flared under monitored conditions

Prior to the implementation of this project, the LFG was vented to atmosphere even though the LFG is captured partially and combusted by the simple incineration facility.
LFG is used to generate electricity in one power plant with a total nameplated capacity that is 0.98MW below 10MW. Thus, this project is automatically additional.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

>>
The simplified baseline and monitoring methodology AMS-III.G have been developed for projects comprising “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 methodology is applicable to landfill gas projects where the baseline is the atmospheric release of the gas and the project activities include situations that utilize the recovered methane for generation. The monitoring methodology is based on measurement of the quantity of methane flow and concentration. AMS-III.G applies to the case of the project where part of the methane generated by the landfill will be captured under this category AMS-I.D.

This project 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 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.

The emission reduction achieved by this project is constituted by both the methane destruction and grid displacement components. According to the methodology AMS-III.G and AMS-I.D, the emission reductions of the project are calculated ex ante.

(1) Baseline Emissions

Baseline emission includes two parts, which is calculated as per AMS-III.G and AMS-I.D separately. Based on both AMS-III.G and AMS-I.D, the baseline scenario for the proposed project is :

$$BE_y = BE_{CH4,y} + BE_{electricity,y}$$

Where:

Parameter	Unit	Description
BE_y	tCO_2e	Baseline emission for in year y
$BE_{CH4,y}$	tCO_2e	Baseline emission from LFG avoidance that otherwise would be emitted to the atmosphere in absence of the Project in year y (tCO_2e) which is estimated as per AMS-III.G
$BE_{electricity,y}$	tCO_2e	Baseline emission from electricity displacement that otherwise would be provided by grid in year y (tCO_2e) which is estimated as per AMS-I.D

Baseline emission from LFG avoidance ($BE_{CH4,y}$):

$$BE_{CH4,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} - (1\text{-}OX) \times F_{CH4,BL,y} \times GWP_{CH4}$$

Where:

Parameter	Unit	Description
η_{PJ}	%	Efficiency of the LFG capture system that will be installed in the project activity. It is used for ex ante estimation only. A default value of 50 percent may be used
$BE_{CH4,SWDS,y}$	tCO_2e	Methane emission potential of a solid waste disposal site calculated using the methodological tool “Emissions from solid waste disposal sites”. This tool may be used: ・With the factor “f=0.0” because the amount of LFG that would have been captured and destroyed is already accounted for in this equation; With the definition of year x as ‘the year since the landfill started receiving wastes, x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)’
OX	-	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste) (dimensionless). A default value of 0.1 may be used.
$F_{CH4,BL,y}$	tCH_4	Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year y. The relevant procedures in “ACM0001: Flaring or use of landfill gas” may be followed, as well as taking into account the compliance with the relevant local laws and regulation if such laws and regulations exist.
GWP_{CH4}	-	Global Warming Potential for methane (value of 25)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool “Emissions from solid waste disposal sites”. The following guidance should be taken into account when applying the tool.

$$BE_{CH4,SWDS,y} = \varphi_y \times (1-f_y) \times GWP_{CH4} \times (1-OX) \times 16/12 \times F \times DOC_{f,y} \times MCF_y \times \sum_{x=1}^{y} \sum_{j} (W_{j,x} \times DOC_j \times e^{-kj*(y-x)} \times (1-e^{-kj}))$$

Where:

Parameter	Unit	Description
$BE_{CH4,SWDS,y}$	tCO_2e/yr	Baseline methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y
x	-	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y)
y	-	Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)
φ_y	-	Model correction factor to account for model uncertainties for year y
f_y	-	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y. As this is already accounted for in $F_{CH4,BL,y}$, "f" in the tool shall be assigned a value of 0.)
GWP_{CH4}	-	Global Warming Potential for methane (value of 25)
OX	-	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	volume fraction	Fraction of methane in the SWDS gas
$DOC_{f,y}$	weight fraction	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y
MCF_y	-	Methane correction factor for year y
$W_{j,x}$	t	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x
DOC_j	weight fraction	Fraction of degradable organic carbon in the waste type j
k_j	1/yr	Decay rate for the waste type j
j	-	Type of residual waste or types of waste in the MSW

$F_{CH4,BL,y}$ is determined using the methodology ACM0001.

According to the article 7 on "ENFORCEMENT DECREE OF THE WASTES CONTROL ACT", a landfill has facilities for gas incineration(such as simple burning system)or power generation and fuel-making are required in order to prevent surrounding environment problem(e.g. air pollution, odour, etc.). A significant amount of LFG generated at the Wonju landfill was released to atmosphere even though the LFG is captured partially and combusted by the simple incineration facility.

Hence, $F_{CH4,BL,y}$ as per table 3 of ACM0001 "Flaring or use of landfill gas" is applicable Case 4(i.e., Requirement to destroy methane exists and LFG capture system exists).

<Table B-5> Cases for determining methane captured and destroyed in the baseline

Situation at the start of the project activity	Requirement to destroy methane	Existing LFG capture and destruction system
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	**Yes**	**Yes**

In accordance with the ACM0001, $F_{CH4,BL,y}$ shall be determined based on information in contract of regulation requirements and data related to the existing LFG capture system, as follows:

$$F_{CH4,BL,y} = max\{F_{CH4,BL,R,y};F_{CH4,BL,sys,y}\}$$

Where:

Parameter	Unit	Description
$F_{CH4,BL,R,y}$	tCH_4/yr	Amount of methane in the LFG which is flared in the baseline due to a requirement in year y
$F_{CH4,BL,sys,y}$	tCH_4/yr	Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system

$F_{CH4,BL,R,y}$ and $F_{CH4,BL,sys,y}$ shall be determined according to the respective procedures for Case 2 and Case 3 in ACM0001.

(1) Case 2(i.e., Requirement to destroy methane exists and no existing LFG capture system)

In Case 2, $F_{CH4,BL,R,y}$ should be determined based on the information contained in the requirement to destroy methane, as follows:

(a) If the requirement specifies the amount of methane that must be flared then that amount is $F_{CH4,BL,R,y}$.

(b) If the requirement specifies a percentage of the captured LFG that is required to be flared, the amount shall be calculated as follows:

$$F_{CH4,BL,R,y} = \rho_{reg,y} \times F_{CH4,PJ,capt,y}$$

Where:

Parameter	Unit	Description
$F_{CH4,BL,R,y}$	tCH_4/yr	Amount of methane in the LFG which is flared in the baseline due to a requirement in year y

$\rho_{reg,y}$	-	Fraction of LFG that is required to be flared due to a requirement in year y
$F_{CH4,PJ,capt,y}$	tCH_4/yr	Amount of methane in the LFG which is captured in the project activity in year y

There is no provision of the amount of methane that must be flared in the "ENFORCEMENT DECREE OF THE WASTES CONTROL ACT". Thus, this project participant is chosen (b) of Case 2.

Project participants may choose to calculate $F_{CH4,PJ,capt,y}$ by either of the two options:
(a) Option 1: Calculate using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", applying the following requirements:
(i) The gaseous stream the tool shall be applied to is the LFG pipeline immediately downstream of the LFG capture system and before any split in the gaseous flow to different uses or flares;
(ii) CH_4 is the greenhouse gases for which the mass flow should be determined;
(iii) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations (3) or (17) in the tool); and
(iv) The mass flow should be calculated on an hourly basis for each hour h in year y.

(b) Option 2: Calculate as the sum of the amount of methane that is sent to the flare, electricity generating or heat generating equipment in year y as measured in section 5.4.1.1 in ACM0001, however, not taking into account the working hours of the equipment;
(i) If the requirement does not specify the amount or percentage of LFG that should be destroyed but requires the installation of a capture system, without requiring the captured LFG to be flared then:

$$F_{CH4,BL,R,y} = 0$$

(ii) If the requirement does not specify any amount or percentage of LFG that should be destroyed, but requires the installation of a system to capture and flare the LFG, then a typical destruction rate of 20 per cent is assumed:

$$F_{CH4,BL,R,y} = 0.2 \times F_{CH4,PJ,capt,y}$$

The project participant apply Option 2 (ii) by bottom condition.

According to the article 7 on "ENFORCEMENT DECREE OF THE WASTES CONTROL ACT", this regulation does not specify any amount or percentage of LFG that should be destroyed. But this regulation is required the installation of a system to capture and flare the LFG. So a typical destruction rate of 20 per cent is assumed.

Thus, in this project it is determined as follows:

$$F_{CH4,BL,R,y} = 0.2 \times F_{CH4,PJ,capt,y}$$

(2) Case 3(i.e., No requirement to destroy methane exists and a LFG capture system exists)

In Case 3, if the amount of methane captured with the existing system can be monitored separately from the amount captured under the project, and the efficiency of the existing system is not impacted on by the project system during the crediting period(s), then $F_{CH4,BL,sys,y}$ is determined as follows:

$F_{CH4,BL,sys,y} = F_{CH4,sent\_flare,y}$

Where:

Parameter	Unit	Description
$F_{CH4,BL,sys,y}$	tCH_4/yr	Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system
$F_{CH4,sent\_flare,y}$	tCH_4/yr	Amount of methane in the LFG which is sent to the flare in year y

$F_{CH4,sent\_flare,y}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" and applying the requirements described in section 5.4.1.1, where the gaseous stream the tool shall be applied to is the pipeline collecting LFG from the existing LFG capture system.
If there is no monitored data available, but there is historic data on the amount of methane that was captured in the year prior to the implementation of the project activity, then in this situation:

$F_{CH4,BL,sys,y} = F_{CH4,hist,y}$

In determining $F_{CH4,hist,y}$ it is assumed that the fraction of LFG that was recovered in the year prior to the implementation of the project activity will be the same fraction recovered under the project activity. If there is no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation, then:

$F_{CH4,BL,sys,y} = 0.2 \times F_{CH4,PJ,y}$

As described above applying Option 2 in Case 2, according to the article 7 on "ENFORCEMENT DECREE OF THE WASTES CONTROL ACT", this regulation does not specify the amount of the LFG flared and captured, efficiency and specification of relevant equipment. Also there was no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of this project.

Thus, in this project it is determined as follows:

$F_{CH4,BL,sys,y} = 0.2 \times F_{CH4,PJ,,y}$

In accordance with above procedure, $F_{CH4,BL,y}$ shall be determined, as follows:

$F_{CH4,BL,y} = max\{F_{CH4,BL,R,y};F_{CH4,BL,sys,y}\} = 0.2 \times F_{CH4,PJ,,y}$
An ex ante estimate of $F_{CH4,PJ,y}$ is required to estimate baseline emission of methane from the SWDS in order to estimate the emission reductions of the proposed project activity in the CDM-PDD. It is determined as follows:

$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y}/GWP_{CH4}$

Where:

Parameter	Unit	Description

$F_{CH4,PJ,y}$	tCH_4/yr	Amount of methane in the LFG which is flared and/or used in the project activity in year y
$BE_{CH4,SWDS,y}$	tCO_2e/yr	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year y
η_{PJ}	%	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	-	Global Warming Potential for methane (value of 25)

Baseline emission from electricity displacement ($BE_{electricity,y}$):
Baseline emissions include only CO_2 emissions from electricity generation in power plants that are displaced due to the project activity.

$$BE_{electricity,y} = EG_{PJ,y} \times EF_{grid,y}$$

Where:

Parameter	Unit	Description
$BE_{electricity,y}$	tCO_2e	Baseline emissions in year y in year y
$EG_{PJ,y}$	MWh	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y As per paragraph 26 of AMS-I.D, If the project activity is the installation of a greenfield power plant, then $EG_{PJ,y} = EG_{PJ,facility,y}$ Where : $EG_{PJ,facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y(MWh)
$EF_{grid,y}$	tCO_2e /MWh	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"

Calculation of the emission factor of the National Grid, Power Grid ($EF_{grid,y}$)

According to the methodology AMS-I.D (Version 18), baseline of this project is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/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 tCO_2 /MWh) 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 05.0). Calculations is based on data from an official source and made publicly available in the website of KEPCO.

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 (2013~2015) from KEPCO’.
As per “Tool to calculate the Emission Factor for an electricity system” (Version 05.0), following steps has to be applied

<STEP 1. Identify the relevant electricity systems>
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.

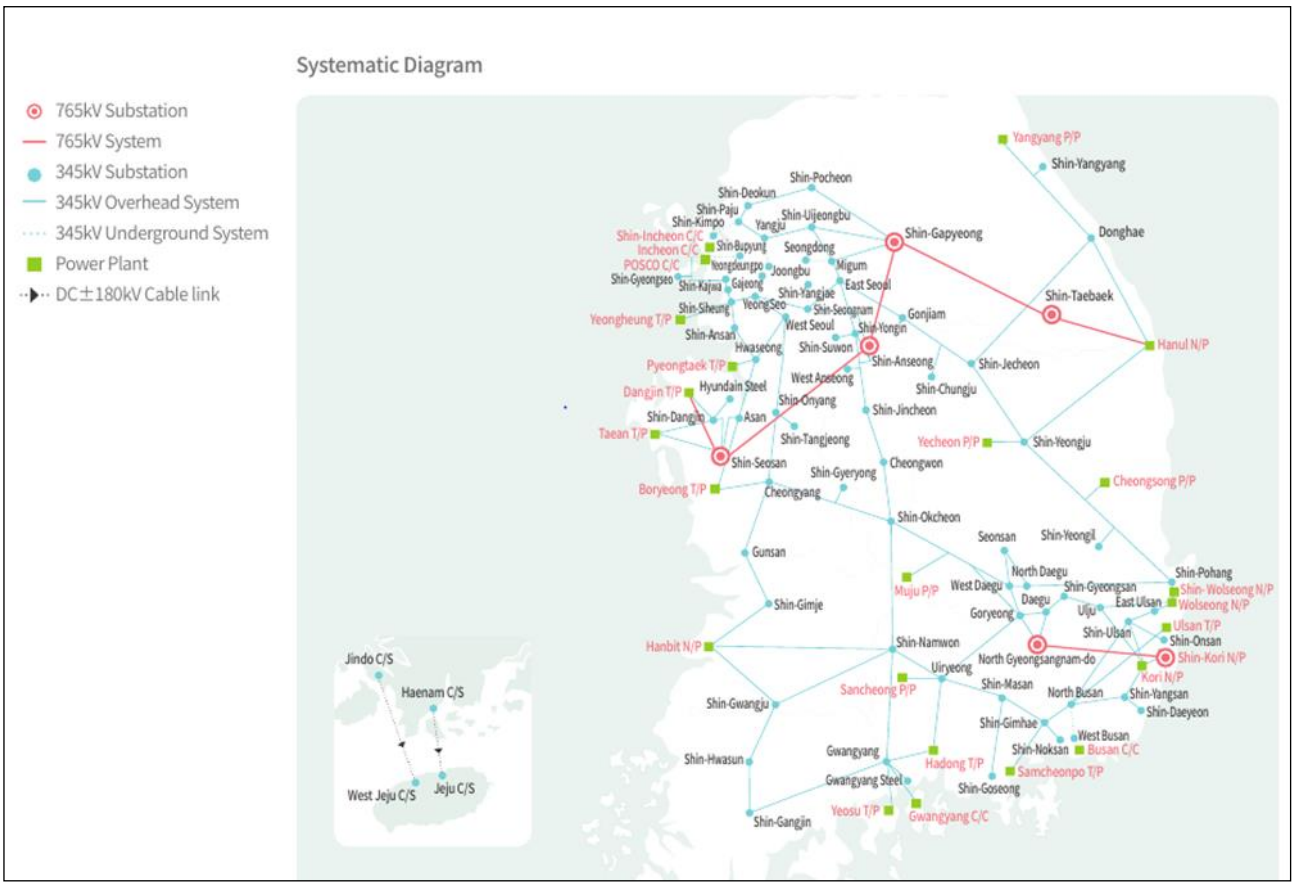
Similarly, a connected electricity system, e.g. national or internationally, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints 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 generated electricity of this project is connected to KEPCO grid, which cover national grid. Thus relevant electric power system is KEPCO grid to determine electricity emission factor.



<Figure B-2> Electricity power grid in Korea
Source: 2016 Sustainability Report, Korea Electric Power Corporation

<STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional)>
Project participants may choose between the following two options to calculate the operating margin and build margin emission factor.

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

This project participant is chosen Option 1.

<STEP 3. Select a method to determine the operating margin (OM)>
The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods, which are described under Step 4:

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

The simple OM method can only be used if any one of the following requirements is satisfied:

Low-cost/must-run resources constitute less than 50 per cent of total grid generation (excluding electricity generated by off-grid power plants) in: 1) average of the five most recent years, and the average of the five most recent years shall be determined by using one of the approaches described below; or 2) based on long-term averages for hydroelectricity production (minimum time frame of 15 years). The low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of

the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.
The average data of most recent 5 years (2011~2015) shows that the rate of low cost/must run is 33.45% (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-6**> **Gross generation by energy sources** (Unit: MWh)

Source	2011	2012	2013	2014	2015	Average
Hydro	7,830,652	7,695,000	8,393,928	7,819,548	5,796,040	7,507,034
Nuclear	154,723,017	150,327,293	138,783,973	156,406,511	164,762,416	153,000,660
*Alternative	7,592,387	8,617,869	10,159,658	14,695,690	17,317,949	11,676,711
Total	170,146,146	166,640,162	157,337,559	178,921,749	187,876,405	172,184,404
The rate of low cost/must run power generation (%)	33.45%					

Source: Electricity statistics on Electricity quantity from Korea Electric Power Corporation
*Alternative : Geothermal, Wind, Low-cost biomass, Solar, LFG

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 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.

Project Participant has chosen ex ante option, thus, no monitoring and recalculation of the emissions factor during the crediting period is required. Project Participant has considered a data vintage of 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.

<Step 4: Calculate the operating margin emission factor according to the selected method>
The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated by one of the following two options:

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

Option B can only be used if:

(a) The necessary data for Option A is not available; and
(b) Only nuclear and renewable power generation are considered as low-cost/must run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation (i.e. if Option I has been chosen in Step 2).

This project participant is chosen Option A.

Under option A, the simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

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

Where:

Parameter	Unit	Description
$EF_{grid,OM\ simple,y}$	tCO_2 /MWh	Simple operating margin CO_2 emission factor in year y
$EG_{m,y}$	MWh	Net quantity of electricity generated and delivered to the grid by power unit m in year y
$EF_{EL,m,y}$	tCO_2 /MWh	CO_2 emission factor of power unit m in year y
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 $EF_{EL,m,y}$:
The emission factor of each power unit m should be determined as follows:

(a) 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:

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

Where:

Parameter	Unit	Description
$EF_{EL,m,y}$	tCO_2 /MWh	CO_2 emission factor of power unit m in year y
$FC_{i,m,y}$	Mass or volume unit	Amount of fuel type i consumed by power unit m in year y

$NCV_{i,y}$	GJ / mass or volume unit	Net calorific value (energy content) of fuel type i in year y
$EF_{CO2,i,y}$	tCO_2 /GJ	CO_2 emission factor of fuel type i in year y
$EG_{m,y}$	MWh	Net quantity of electricity generated and delivered to the grid by power unit m in year y
m	-	All power units serving the grid in year y except low-cost/must-run power units
i	-	All fuel types combusted in power unit m in year y
y	-	The relevant year as per the data vintage chosen in Step 3

(b) Option A2 - If for a power unit m only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}}$$

Where:

Parameter	Unit	Description
$EF_{EL,m,y}$	tCO_2 /MWh	CO_2 emission factor of power unit m in year y
$EF_{CO2,m,i,y}$	tCO_2/GJ	Average CO_2 emission factor of fuel type i used in power unit m in year y
$\eta_{m,y}$	-	Average net energy conversion efficiency of power unit m in year y
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

As the power unit m data on fuel consumption and electricity generation is available, the project participant is chosen Option A1.

As a result, the OM emission factor ($EF_{grid,OM,y}$) is 0.7403 (tCO_2/MWh).

< Step 5: Calculate the build margin (BM) emission factor >

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

(a) 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.

(b) 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.

The project participant is chosen Option 1.

The sample group of power units m used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\ units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total} , in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20 per cent of AEG total (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\ per\ cent}$) and determine their annual electricity generation ($AEG_{SET\geq 20\ per\ cent}$, in MWh);

(c) From $SET_{5\text{-}units}$ and $SET_{\geq 20\ per\ cent}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}); Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET sample started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case ignore Steps (d), (e) and (f).

Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20 per cent of the annual electricity generation of the project electricity system (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);

(e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20 per cent of the annual electricity generation of the project electricity system (if 20 per cent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

(f) The sample group of power unit used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{->}10yrs}$).

For this project case, Option 1 was taken to calculate the Build Margin emission factor, $EF_{grid,BM,y}$ 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-7> **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	12,875,947 MWh	105,305,958 MWh	Total generation is 504,308,910 MWh in Korea (based on KEPCO's data of the year 2015)
Proportion (ratio to total generation in Korea)	2.55%	20.88%	

The annual generation of "The five power plants that have been built most recently" was 12,875,947 MWh (2.55% of total generation of the grid system), and the annual generation of "The power plants capacity additions in the electricity system that comprise 20.88% of the system generation and that have been built most recently" was 105,305,958 MWh. Therefore, the latter was chosen for this project as a lager figure than the other one.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/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 :

Parameter	Unit	Description
$EF_{grid,BM,y}$	tCO_2 /MWh	Build margin CO_2 emission factor in year y
$EG_{m,y}$	MWh	Net quantity of electricity generated and delivered to the grid by power unit m in year y
$EF_{EL,m,y}$	tCO_2 /MWh	CO_2 emission factor of power unit m in year y
m	-	Power units included in the build margin
y	-	Most recent historical year for which electricity generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) should be determined as per the tool in Step 4 section 6.4.1 for the simple OM, using Options A1, A2 or A3, using for y the most recent historical year for which electricity generation data is available, and using for m the power units included in the build margin.

If the power units included in the build margin m correspond to the sample group $SET_{sample\text{-}CDM\text{->}10yrs}$, then, as a conservative approach, only Option A2 from guidance in Step 4 section 6.4.1 can be used and the default values provided in appendix 1 shall be used to determine the parameter $\eta_{m,y}$ for the power units that started to supply electricity to the grid more than 10 years ago.

As calculating build margin emission factor, $EF_{EL,m,y}$ determined Step 4 section 6.4.1 Option A2 for the power units that started to supply electricity to the grid more than 10 year ago and Option A1 for the other power units.

As a result, the BM emission factor ($EF_{grid,BM,y}$) is 0.5644 (tCO_2/MWh).

<STEP 6: Calculate the combined margin emissions factor ($EF_{grid,CM,y}$)>

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

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

Where:

Parameter	Unit	Description
$EF_{grid,BM,y}$	tCO_2 /MWh	Build margin CO_2 emission factor in year y
$EF_{grid,OM,y}$	tCO_2 /MWh	Operating margin CO_2 emission factor in year y
W_{OM}	%	Weighting of operating margin emissions factor
W_{BM}	%	Weighting of build margin emissions factor

The following default values should be used for W_{OM} and W_{BM} :

(a) Wind and solar power generation project activities: W_{OM} = 0.75 and W_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;

(b) All other projects: W_{OM} = 0.5 and W_{BM} = 0.5 for the first crediting period, and W_{OM} = 0.25 and W_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to 'Tool to calculate the emission factor for an electricity system'.

This project is LFG power generation activity neither wind nor solar power generation project activities. For this project, W_{OM} and W_{BM} should be used as (b).

Thus, baseline emission factor ($EF_{grid,CM,y}$) for this project is = 0.6523 (tCO_2/MWh) as follows :

$$EF_{grid,\,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM}$$
$$= 0.7403(tCO_2/MWh) \times 0.5 + 0.5644(tCO_2/MWh) \times 0.5$$
$$= 0.6523\ (tCO_2/MWh)$$

(2) Project Emissions

$$PE_y = PE_{power,y} + PE_{flare,y} + PE_{process,y}$$

Where:

Parameter	Unit	Description
PE_y	tCO_2e	Project emissions in year y

$PE_{power,y}$	tCO_2e	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y
$PE_{flare,y}$	tCO_2e	Emissions from flaring or combustion of the landfill gas stream in the year y
$PE_{process,y}$	tCO_2e	Emissions from the landfill gas upgrading process in the year y, determined by following the relevant procedures described in annex 1 of AMS-III.H

Project emissions from electricity consumption are determined as per the procedures described in the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", "AMS-I.D : Grid connected renewable electricity generation"**.**

According to existing incineration, facility was changed to a gas collection facility, the project emissions from flaring of LFG are not determined considering. The landfill gas upgrading process is not applicable to this project, so it is excluded.

$$PE_y = PE_{power,y}$$

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

(3) Leakage

As per paragraph 42 of AMS-I.D, general guidance on leakage in biomass project activities shall be followed to quantify leakages pertaining to the use of biomass residues. Biomass residues is defined as per CDM glossary of Terms version 9 as "Non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms which is a by-product, residue or waste stream from agriculture, forestry and related industries". This project doesn't pertain to the use of biomass residues, no leakage effects need to be accounted under the AMS-I.D.

As per paragraph 19 of AMS-III.G, if the methane recovery technology is equipment transferred from another activity, leakage effects are to be considered. As this project doesn't involve transfer of any equipment from another activity therefore the leakage has been considered zero.

(4) Emission Reduction

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

$$ER_{y,estimated} = BE_y - PE_y - LE_y$$

Where :

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
LE_y	tCO_2e	Leakage emissions from both methane destruction and grid displacement

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

$$ER_{y,calculated} = (1 - OX) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4} + (EG_{PJ,facility,y} \times EF_{grid,y}) - LE_y$$

Where:

Parameter	Unit	Description
$ER_{y,calculated}$	tCO_2e	Emission reduction from both methane destruction and grid displacement
OX	-	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste) (dimensionless). A default value of 0.1 may be used
$F_{CH4,PJ,y}$	tCH_4	Methane captured and destroyed/gainfully used by the project activity in the year
$F_{CH4,BL,y}$	tCH_4	Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year (tCH_4). The relevant procedures in "ACM0001: Flaring or use of landfill gas" may be followed, as well as taking into account the compliance with the relevant local laws and regulation if such laws and regulations exist
GWP_{CH4}	-	Global Warming Potential for methane (value of 25)
$EG_{PJ,facility,y}$	MWh	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
$EF_{grid,y}$	tCO_2e /MWh	CO_2 emission factor of the grid electricity in year y
LE_y	tCO_2e	Leakage emissions from both methane destruction and grid displacement

Methane captured and destroyed/gainfully used by the project activity ($F_{CH4,PJ,y}$) may be calculated as follows, based on monitoring methane flow and concentration :

$$F_{CH4,PJ,y} = D_{CH4,y} \times w_{CH4,y} \times \sum_i LFG_{i,y}$$

Where:

Parameter	Unit	Description
$F_{CH4,PJ,y}$	tCH_4	Methane captured and destroyed/gainfully used by the project activity in the year
$D_{CH4,y}$	$tonnes/m^3$	Density of methane at the temperature and pressure of the landfill gas in year. If $LFG_{i,y}$ is reported at normal conditions of temperature and pressure, the density of methane is also determined at normal conditions

$W_{CH4,y}$	m^3CH_4/m^3 LFG	Methane content in landfill gas in year. Landfill gas composition shall be measured either on a dry basis or at the same humidity as used to determine $LFG_{i,y}$
$LFG_{i,y}$	m^3LFG	Landfill gas destroyed via method i (flaring, fuelling, combustion, injection to a grid, etc.) in year. The flow or volume measurement shall be made either on a dry basis or at the same humidity as $w_{CH4,y}$

For project activities that utilize the recovered methane for power generation, $F_{CH4,PJ,y}$ may be calculated as follows, based on the amount of monitored electricity generation, without monitoring methane flow and concentration:

$$F_{CH4,PJ,y} = \frac{EG_y \times 3600}{NCV_{CH4} \times EE_y} \times D_{CH4} \times GWP_{CH4}$$

Where:

Parameter	Unit	Description
EG_y	MWh	Electricity generation in year y
3600	-	Conversion factor (1 MWh = 3600 MJ)
NCV_{CH4}	-	NCV of methane (MJ/Nm^3) use default value: 35.9 MJ/Nm^3
EE_y	%	Energy Conversion Efficiency of the project equipment determined from one of the following options: ・Specification provided by the equipment manufacturer specifically for biogas fuel only if the equipment is designed to utilize biogas as fuel. If the specification provides a range of efficiency values, the highest value of the range shall be used for the calculation ・Default efficiency of 40 percent

In this project, $F_{CH4,PJ,y}$ during the crediting period will be calculated using measurement of the quantity of methane flow and concentration.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	η_{PJ}
Data unit	%
Description	Efficiency of the LFG capture system that will be installed in the project activity
Source of data	Manufacturer data
Value(s) applied	50%
Choice of data or Measurement methods and procedures	AMS-III.G default value
Purpose of data	Estimated as baseline emissions
Additional comment	Used for ex ante estimation only.

Data / Parameter	D_{CH4}
Data unit	tCH_4/m^3CH_4
Description	Methane density
Source of data	"Tool to determine project emissions from flaring" Version 02 (EB 68 Annex 15)
Value(s) applied	0.0007168
Choice of data or Measurement methods and procedures	At standard temperature and pressure (0 degree Celsius and 1.013bars), the density of methane is 0.0007168 t/m^3
Purpose of data	Estimated as baseline emissions
Additional comment	-

Data / Parameter	GWP_{CH4}
Data unit	tCO_2e/tCH_4
Description	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data	Decisions under the UNFCCC and the Kyoto Protocol (a value of 25 is to be applied for the second commitment period of the Kyoto Protocol) As per EB 69 Report Annex 3 and IPCC 2007 - Climate Change 2007: Working Group I: The Physical Science Basis (Contribution to Fourth Assessment Report of IPCC), Chapter 2, Table 2.14
Value(s) applied	25
Choice of data or Measurement methods and procedures	Default Global Warming potential of Methane
Purpose of data	Estimated as baseline emissions Calculation of project emissions
Additional comment	-

Data / Parameter	$\varphi_{default}$
Data unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Default value "Emissions from solid waste disposal sites" version 08.0
Value(s) applied	0.75
Choice of data or Measurement methods and procedures	For project or leakage emissions: φ default = 1 For baseline emissions: refer to the table below to identify the appropriate factor based on the application of the tool (A or B) and the climate where the SWDS is located Default values for the model correction factor Humid/Wet conditions: Application A: 0.75; Application B: 0.85 Dry conditions: Application A: 0.75; Application B: 0.80 "Application A" of the tool is used since the project activity mitigates methane emissions from a specific existing SWDS. Default value of the Tool "Emissions from solid waste disposal sites" version 08.0 (EB 94, Annex 7)
Purpose of data	Estimated as baseline emissions
Additional comment	The table above is applicable to Option 1 in the procedure "Determining the model correction factor (φ_y)"

Data / Parameter	OX
Data 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	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Default value "Emissions from solid waste disposal sites" version 08.0
Purpose of data	Estimated as baseline emissions
Additional comment	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO_2. The oxidation factor represents the proportion of methane that is oxidized to CO_2. This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS.

Data / Parameter	F
Data unit	m^3CH_4 / m^3LFG
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default value "Emissions from solid waste disposal sites" version 08.0
Purpose of data	Estimated as baseline emissions
Additional comment	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide

Data / Parameter	$DOC_{f,default}$
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	"Emissions from solid waste disposal sites" version 08.0
Purpose of data	Estimated as baseline emissions
Additional comment	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. This default value can only be used for: (a) Application A; or (b) Application B if the tool is applied to MSW. An alternative to using the default factor is to estimate $DOC_{f,y}$ or $DOC_{f,m}$ using equations (9), (10) and (11) in tool.

Data / Parameter	$MCF_{default}$
Data unit	-
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	"Emissions from solid waste disposal sites" version 08.0 1.0 for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e. waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste
Purpose of data	Estimated as baseline emissions
Additional comment	MCF accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS

Data / Parameter	DOC_j
Data unit	%
Description	Fraction of degradable organic carbon in the waste type j (weight fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	For MSW, the following values for the different waste types j should be applied: Default values for DOC_j

Waste type j	DOC_j(% wet waste)
Wood and wood products	43
Pulp, paper and cardboard (other than sludge)	40
Food, food waste, beverages and tobacco (other than sludge)	15
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal, other inert waste	0

Choice of data or Measurement methods and procedures	As per "Emissions from solid waste disposal sites" version 08.0 (EB 94, Annex 7)
Purpose of data	Estimated as baseline emissions
Additional comment	The percentages listed in table above are based on wet waste basis, which are concentrations in the waste as it is delivered to the SWDS. The IPCC Guidelines also specify DOC values on a dry waste basis, which are the concentrations after complete removal of all moist from the waste, which is not believed practical for this situation.

Data / Parameter	k_j
Data unit	1/ year
Description	Decay rate for the waste type j
Source of data	"Emissions from solid waste disposal sites" version 08.0

<table>
<tr><td>Value(s) applied</td><td>Apply the following default values for the different waste types j:

Since the Mean annual Temperature is lower than 20°C and MAP/PET is more than 1, Hence the Boreal and Temperate, Wet weather is chosen to determine decay rate.

Default values for the decay rate (k_j)
<table>
<tr><td colspan="2" rowspan="2">Waste type j</td><td colspan="2">Boreal and Temperate (MAT≤20°C)</td><td colspan="2">Tropical (MAT>20°C)</td></tr>
<tr><td>Dry (MAP/ PET <1)</td><td>Wet (MAP/P ET >1)</td><td>Dry (MAP< 1000m m)</td><td>Wet (MAP > 1000 mm)</td></tr>
<tr><td rowspan="2">Slowly degrading</td><td>Pulp, paper and cardboard (other than sludge)</td><td>0.04</td><td>0.06</td><td>0.045</td><td>0.07</td></tr>
<tr><td>Wood, wood products and straw</td><td>0.02</td><td>0.03</td><td>0.025</td><td>0.035</td></tr>
<tr><td>Moderately degrading</td><td>Other (non-food) organic putrescible garden and park waste</td><td>0.05</td><td>0.10</td><td>0.065</td><td>0.17</td></tr>
<tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.06</td><td>0.185</td><td>0.085</td><td>0.40</td></tr>
</table></td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>Climate data for the Wonju landfill: 30 years(1981~2010) was chosen as a period long-term average.

Mean Annual Temperature(MAT) : 11.3℃
Mean Annual Precipitation(MAP) : 1,343.6 mm
Potential evapotranspiration(PET) : 1,158.2 mm</td></tr>
<tr><td>Purpose of data</td><td>Estimated as baseline emissions</td></tr>
<tr><td>Additional comment</td><td>Based on data observed at meteorological observatory in Wonju data source: Korea Meteorological Administration(http://www.kma.go.kr)</td></tr>
</table>

Data / Parameter	$W_{j,x}$
Data unit	ton/year
Description	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x (t)
Source of data	Based on information from Ministry of Environment, “Status of waste disposal and treatment (1996~2014)”
Value(s) applied	Refer to xls sheet named “composition rate” - Estimation of waste composition rate in Wonju landfill (1996~2014) - The result of re-classification using IPCC (2006) Guideline grouping criteria
Choice of data or Measurement methods and procedures	Each year data for 1996~2014 is applied to calculate waste composition rate
Purpose of data	Estimated as baseline emissions
Additional comment	Determine “Application B” as per 6.3.2.2 of the Tool “Emissions from solid waste disposal sites” version 08.0 (EB 94, Annex 7)

Data / Parameter	$EG_{m,y}$
Data unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit m in year y
Source of data	"2013~2015 Statistics of Electric Power in Korea"
Value(s) applied	-
Choice of data or Measurement methods and procedures	$EG_{m,y}$ should be determined either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)
Purpose of data	Estimated as baseline emissions Calculation of project emissions
Additional comment	-

Data / Parameter	$FC_{i,m,y}$
Data unit	Mass or volume unit
Description	Amount of fuel type i consumed by power unit m in year y
Source of data	"2013~2015 Statistics of Electric Power in Korea"
Value(s) applied	-
Choice of data or Measurement methods and procedures	$FC_{i,m,y}$ should be determined either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)
Purpose of data	Estimated as baseline emissions Calculation of project emissions
Additional comment	-

Data / Parameter	$NCV_{i,y}$
Data unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fuel type i in year y
Source of data	The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source: Values provided by the fuel supplier of the power plants in invoices — If data is collected from power plant operators (e.g.utilities) Regional or national average default values — If values are reliable and documented in regional or national energy statistics/energy balances IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories As per "2013~2015 Statistics of Electric Power in Korea" provided by KEPCO, $NCV_{i,y}$ values provided by the national energy statistics
Value(s) applied	values provided by the national energy statistics
Choice of data or Measurement methods and procedures	$NCV_{i,y}$ should be determined either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)

Purpose of data	Estimated as baseline emissions Calculation of project emissions
Additional comment	-

Data / Parameter	$EF_{CO2,i,y}$
Data unit	tCO_2/GJ
Description	CO_2 emission factor of fuel type i used in power unit m in year y
Source of data	"Tool to calculate the emission factor for an electricity system" Version 05.0 The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source: Values provided by the fuel supplier of the power plants in invoices — If data is collected from power plant operators (e.g. utilities) Regional or national average default values — If values are reliable and documented in regional or national energy statistics/energy balances IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories Emission factor by fuel in "Guideline for the greenhouse gas target management system(2016.12.30)", $EF_{CO2,i,y}$ values provided by the national average default values
Value(s) applied	National average default values
Choice of data or Measurement methods and procedures	$EF_{CO2,m,i,y}$ is determined either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)
Purpose of data	Estimated as baseline emissions
Additional comment	The detail data is described on B.6.1

Data / Parameter	$EF_{OM,y}$
Data unit	tCO_2/MWh
Description	Operating margin CO_2 emission factor for the project electricity system in year y
Source of data	"2013~2015 Statistics of Electric Power in Korea"
Value(s) applied	0.7403
Choice of data or Measurement methods and procedures	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 (2013~2015) for which data are available at time of this PDD submission, and fixed for the crediting period.
Purpose of data	Estimated as baseline emissions
Additional comment	The detail data is described on B.6.1

Data / Parameter	$EF_{BM,y}$
Data unit	tCO_2/MWh
Description	Build margin CO_2 emission factor for the project electricity system in year y
Source of data	"2013~2015 Statistics of Electric Power in Korea"
Value(s) applied	0.5644
Choice of data or Measurement methods and procedures	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.
Purpose of data	Estimated as baseline emissions
Additional comment	The detail data is described on B.6.1

Data / Parameter	$EF_{grid,y}$
Data unit	tCO_2/MWh
Description	CO_2 emission factor of the grid electricity in year y
Source of data	Calculated
Value(s) applied	0.6523
Choice of data or Measurement methods and procedures	The baseline emission factor ($EF_{grid,y}$) is calculated as the weighted average of the simple OM emission factor ($EF_{grid,OM,y}$) and the BM emission factor ($EF_{grid,BM,y}$). By default, both margins have equal weights (50%)
Purpose of data	Estimated as baseline emissions
Additional comment	The detail data is described on B.6.1

B.6.3. Ex ante calculation of emission reductions

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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 methane destruction and electricity displacement.

(1) Baseline Emissions

Baseline emission from methane avoidance ($BE_{CH4,y}$):

Baseline emissions shall exclude methane emissions that would have to be removed to comply with national or local safety requirements or legal regulations.

$$BE_{CH4,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} - (1\text{-}OX) \times F_{CH4,BL,y} \times GWP_{CH4}$$

Estimation of baseline emission of methane avoidance, in the table below.

<Table B-8> Baseline emission of methane avoidance (unit: tCO_2e)

Year	η_{PJ}	$BE_{CH4,SWDS,y}$	(1-OX)	$F_{CH4,BL,y}$	$BE_{CH4,y}$
2017	50%	31,986	0.9	128	13,114.204
2018	50%	31,785	0.9	129	13,031.677
2019	50%	34,469	0.9	138	14,132.256
2020	50%	34,005	0.9	136	13,941.974
2021	50%	33,546	0.9	134	13,753.686
2022	50%	33,096	0.9	132	13,569.309
2023	50%	32,659	0.9	131	13,390.252

Baseline emission from electricity displacement ($BE_{electricity,y}$):

Baseline emissions include only CO_2 emissions from electricity generation in power plants that are displaced due to the project activity.

$$BE_{electricity,y} = EG_{PJ,y} \times EF_{grid,y}$$

<Table B-9> Baseline emissions from electricity displacement (unit: tCO_2e)

Year	$EG_{PJ,y}$	$EF_{grid,y}$	$BE_{electricity,y}$
2017	3,220	0.6523	2,100.305
2018	3,199	0.6523	2,087.088
2019	3,470	0.6523	2,263.351
2020	3,423	0.6523	2,232.876
2021	3,377	0.6523	2,202.721
2022	3,331	0.6523	2,173.192
2023	3,287	0.6523	2,144.515

The net power supplied to the grid is estimated based on amount of LFG, efficiency of LFG capture system and self-consumption. In crediting period, the amount of imported electricity from the grid shall be monitored ex post, using electric meter.

(2)Project Emissions

This project uses renewable energy to generate electricity and project emissions are zero because of considering the net quantity of electricity in baseline emissions according to AMS-I.D. Therefore, Project emission is 0.

(3)Leakage

There are no equipment transferred in this project, no leakage effects need to be accounted under AMS-III.G and AMS-I.D.

Therefore, Leakage is 0.

(4)Emission Reductions

$ER_{y,estimated} = BE_y - PE_y - LE_y$

Where:

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
LE_y	tCO_2e	Leakage emissions from both methane destruction and grid displacement

<Table B-10> Emission reduction (unit: tCO_2e)

Year	BE_y	PE_y	LE_y	ER_y
2017	15,214	0	0	15,214
2018	15,118	0	0	15,118
2019	16,395	0	0	16,395
2020	16,174	0	0	16,174
2021	15,956	0	0	15,956
2022	15,742	0	0	15,742
2023	15,534	0	0	15,534

$BE_y = BE_{CH4,y} + BE_{electricity,y}$

Where:

Parameter	Unit	Description
BE_y	tCO_2e	Baseline emission for in year y
$BE_{CH4,y}$	tCO_2e	Baseline emission from LFG avoidance that otherwise would be emitted to the atmosphere in absence of the Project in year y (tCO_2e) which is estimated as per AMS-III.G
$BE_{electricity,y}$	tCO_2e	Baseline emission from electricity displacement that otherwise would be provided by grid in year y (tCO_2e) which is estimated as per AMS-I.D

<Table B-11> Detailed emission reduction by methane destruction and electricity (unit: tCO_2e)

Year	$BE_{CH4,y}$	$BE_{electricity,y}$	BE_y	BE_y (down to decimal point)
2017	13,114.204	2,100.305	15,214.509	15,214
2018	13,031.677	2,087.088	15,118.765	15,118
2019	14,132.256	2,263.351	16,395.607	16,395
2020	13,941.974	2,232.876	16,174.850	16,174
2021	13,753.686	2,202.721	15,956.408	15,956
2022	13,569.309	2,173.192	15,742.500	15,742
2023	13,390.252	2,144.515	15,534.767	15,534

As illustrated above, at this project $PE_y = 0$, Leakage = 0.

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

Estimation of emission reduction from project

Year	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage (tCO_2e)	Emission reductions (tCO_2e)
2017	15,214	0	0	15,214
2018	15,118	0	0	15,118
2019	16,395	0	0	16,395
2020	16,174	0	0	16,174
2021	15,956	0	0	15,956
2022	15,742	0	0	15,742
2023	15,534	0	0	15,534
Total	110,133			110,133
Total number of crediting years	7years			
Annual average over the crediting period	15,733	0	0	15,733

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$w_{CH4,y}$
Data unit	%, volume basis(m^3 CH_4/m^3 LFG)
Description	Methane content in landfill gas in the year y
Source of data	Measured by using a methane analyser(measuring methane content directly)
Value(s) applied	50%(Will be monitored ex post)
Measurement methods and procedures	Methane content is continuously measured with gas analyser. Gas analyser is measured directly methane content in the Wonju landfill gas. The measured data is monitored in a computer and Wonju Operation team should check the measured data continuously. - Analyser type is stationary gas analyser - Accuracy of the methane analyser is 0.5% abs. or 5% rel.

Monitoring frequency	Measuring frequency : continuously Recording frequency : hourly
QA/QC procedures	Gas analyser will be subject to maintenance and calibration according to manufacturer recommendations. Span and Zero calibration will be accomplished by means of reference gas(mixture calibration gas) bottles, which will be available at the plant.
Purpose of data	Calculation of baseline emissions(ex post)
Additional comment	The methane content measurement will be carried out close to the location in the system where the landfill gas flow, temperature and pressure measurements take place, and at the same humidity content basis

Data / Parameter	$LFG_{i,y}$
Data unit	m^3
Description	Landfill gas destroyed via combustion in power plant in year y
Source of data	Measured by using gas flow meter
Value(s) applied	Will be monitored ex post
Measurement methods and procedures	The LFG combusted in power plant will be monitored by a continuous thermal gas mass flow meter, the readings will be compensated for normal pressure and temperature values. The measured data is monitored in a computer and Wonju Operation team should check the measured data continuously. - Flow meter type is thermal gas mass flow meter - Accuracy of the gas flow meter is ±0.5 of F.S - Measured range is 0.1~100Nm^3/s - Temperature is -40℃~220℃
Monitoring frequency	Measuring frequency : continuously Recording frequency : hourly
QA/QC procedures	The gas flow meter is subject to a regular maintenance and testing, to ensure accuracy. The gas flow meter will be subject to maintenance and calibration according to manufacturer recommendations.
Purpose of data	Calculation of baseline emissions(ex post)
Additional comment	-

Data / Parameter	$EG_{PJ,facility,y}$
Data unit	MWh
Description	Total amount of net electricity exported to grid-connected system
Source of data	Electricity meter records
Value(s) applied	Will be monitored ex post

Measurement methods and procedures	This parameter should be either monitored using each electricity meter and calculated as difference between (a) the quantity of electricity exported by the project plant/unit to the grid; and (b) the quantity of electricity imported to the project plant/unit from the grid. The amount of electricity is measured automatically by certified meter. In case of (a), the quantity of electricity exported by the project plant is reported by KEPCO meterman visiting at once a month the Wonju landfill. In case of (b), the amount of electricity imported to the project is measured automatically by certified meters. The measured data are transferred to KEPCO and are checked and achieved monthly in electronic way by Wonju CDM Operating team. - Electricity meter's type is watt-hour meter - Accuracy of the electricity meter for (a) is ±0.5 - Accuracy of the electricity meter for (b) is ±1.0
Monitoring frequency	Measuring frequency : Continuously Recording frequency : Monthly
QA/QC procedures	Electricity meters are subject to a regular maintenance and testing to ensure accuracy. Electricity meter for (a) is calibrated regularly in accordance with the "Regulation on operation of electricity market". Electricity meter for (b) is calibrated every 7 years in accordance with "ENFORCEMENT DECREE OF MEASURES ACT". The value will be cross-checked with the invoice from KEPCO.
Purpose of data	Calculation of baseline emissions(ex post)
Additional comment	-

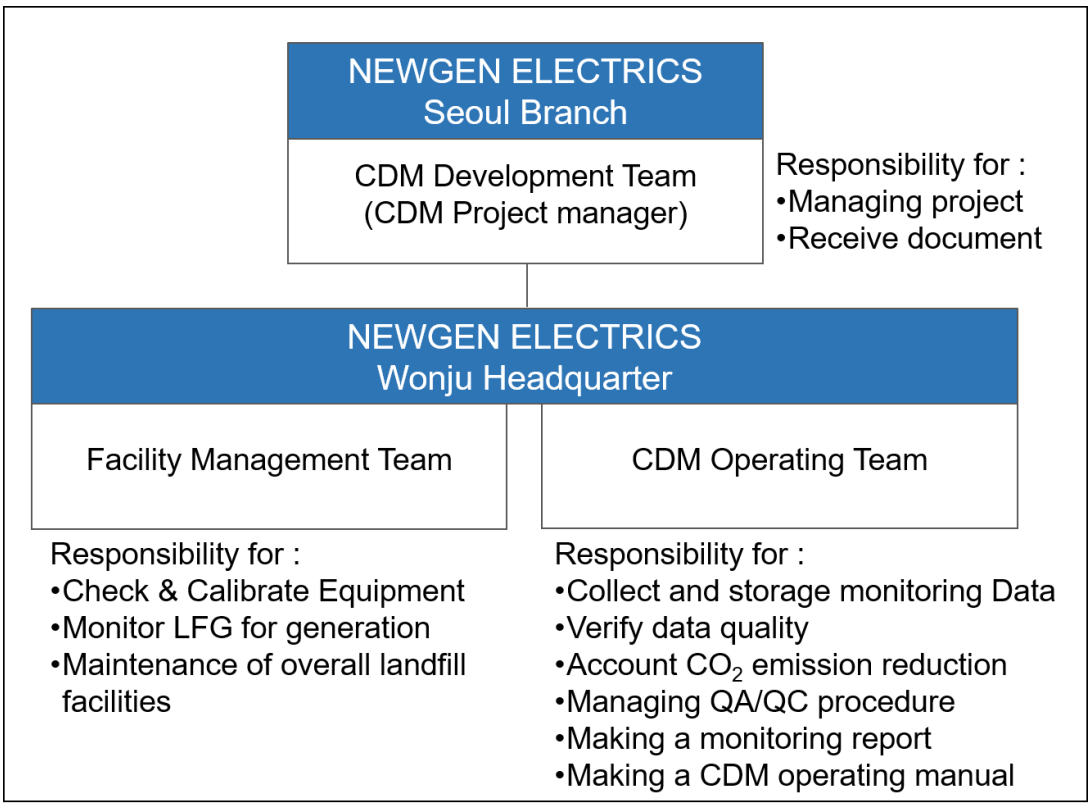
B.7.2. Sampling plan

>>
Not applicable

B.7.3. Other elements of 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.

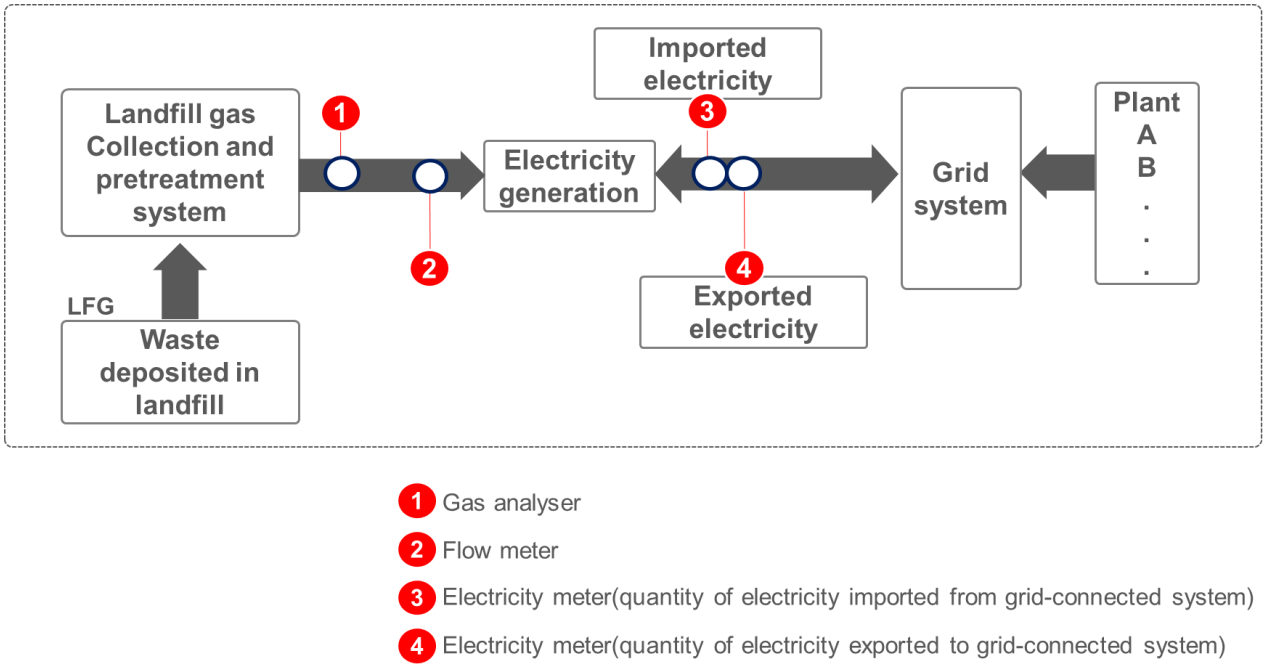
Monitoring organization and the role of each party
The following figure describes the operational and management structure that monitor this project.



<**Figure B-3**> The structure of monitoring system

<Table B-12> The responsible party for each task of monitoring

Item	Sub-item	Responsible department
Measure & Archive	$EG_{PJ,facility,y}$	CDM Operating Team
	$LFG_{i,y}$	
	$w_{CH4,y}$	
Measuring instrument check & Calibration	Centralized monitoring system	Facility Management Team
	Flow meter	
	Gas analyser	
	Electricity meters	Facility Management Team Korea Electric Power Corporation
Establish monitoring plan		CDM Operating team
Monitoring report		CDM Operating team



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

The monitoring equipment to measure amount of methane and electricity

- Gas flow meter is installed between the blower and generating facility to measure LFG flow amount, automatically corrected temperature and pressure.

- A gas analyser is located before the above flow meter to measure the fraction of methane in LFG volume fed into the gas engine. The gas analyser will be carried out close to the location in the system where the LFG flow, temperature and pressure measurements take place, and at the same humidity content basis.

- Electricity meters are installed behind the generator and sealed up after affirmation of KEPCO.

Quality control (QC) and quality assurance (QA) procedures

CDM operating team is composed of has responsible to quality management, which ensures the quality and accuracy of the measured data. For quality management, the following things are included; data records and data storage, equipment calibration and maintenance, corrective action and Emergency procedures for unintended emissions.

- The amount of methane captured will be determined by continuous measurements from flow meter and gas analyser. If a methane analyser has a problem, methane content in the LFG is handled in accordance with “Operating Manual-Wonju LFG Power Plant related CDM project”.
The amounts of the quantity of electricity exported (a) by the project plant and the imported (b) to the project is measured by each certified meter. The quantity of electricity exported (a) is reported by KEPCO meterman visiting at once a month the Wonju landfill. The measured data (b) are transferred to KEPCO and are checked and achieved monthly in electronic way by Wonju CDM Operating team.

Data records and storage:

The monitored data will be archived in electronic file or documented in paper. All monitoring data will be archived for two years after the end of the crediting period. The measured data are monitored in a computer and CDM operating team should check them continuously.

Equipment calibration and maintenance:

Calibration of equipment consists of verifying, by comparison with a standard, the accuracy of a measuring instrument. Measuring instruments will be periodically and appropriately calibrated according to the procedures, timing and methods recommended by the manufacturer, or national/international standards, as available.

- Gas flow meter are subject to a regular maintenance and testing regime to ensure accuracy according to “Operating Manual-Wonju LFG Power Plant related CDM project”.

- A gas analyser is subject to a regular maintenance and testing regime to ensure accuracy according to “Operating Manual-Wonju LFG Power Plant related CDM project”.

- Electricity meters are subject to a regular maintenance and testing to ensure accuracy. The calibration frequency of the meter measuring electricity exported to the grid will be in accordance with the “Regulation on operation of electricity market”. The calibration frequency of the meter measuring electricity imported from the grid will be in accordance with the “ENFORCEMENT DECREE OF MEASURES ACT”.

Corrective action:

CDM Operating Team will report all issues and data related to plant operation to LFG CDM Project manager.

Operation review, internal audit and corrective action is carried out by CDM operating team, according to “Operating Manual-Wonju LFG Power Plant related CDM project”.

Emergency procedure:

In case of emergency situations, proper action is carried out to minimize damage in accordance with “Operating Manual-Wonju LFG Power Plant related CDM project”.

Training

All employees involved in this project should be trained to get knowledge/information of operating equipment and monitoring. “Operating Manual-Wonju LFG Power Plant related CDM project” manual has included training program and its education.

The employees should attain a comprehensive knowledge with regard to the general and technical aspects of CDM project.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>

09/05/2016

C.2. Expected operational lifetime of project activity

>>

30years

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>

Renewable crediting period

C.3.2. Start date of crediting period

>>

01/05/2017 or Date of Registration (whichever is later)

C.3.3. Duration of crediting period

>>
7 years and 0 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
According to the article 31 on “ENFORCEMENT DECREE OF THE ENVIRONMENTAL IMPACT ASSESSMENT ACT”[2], the project participant has to perform the environmental impact assessment if the capacity of electricity generator is more than 10MW. This project does not need to take an EIA as total capacity of the electricity generator is 980kW.

This project does actively collect and utilize Landfill gas, thereby improving overall landfill management and reducing greenhouse gases and local adverse environmental effects. Thus this activity contributes to climate change and environmental health and safety. This project brings 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.

In order to treat properly which oil and filter waste caused by generator operating according to the “WASTES CONTROL ACT”, the waste will be handled at consigned waste management company.

Project participants reviewed the installation of air pollution control equipment according to the “CLEAN AIR CONSERVATION ACT” in order to prevent air pollution due to dust, SOx, NOx emissions when operating the landfill gas treatment facility. In conclusion, the total amount of pollutants were less than the standard, thus exempted from the obligation to install the control equipment.

The project is not expected to have significant impacts on the area beyond project activity boundary. Overall, the project activity is expected to result in an improvement in the environmental quality at the local level and globally.

D.2. Environmental impact assessment

>>

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>
In order to collect the comments from local stakeholders regarding the project, there was a local stakeholder consultation held with local resident council 16/09/2015 and aimed at informing the local people and calling for public inputs.

[2] ENFORCEMENT DECREE OF THE ENVIRONMENTAL IMPACT ASSESSMENT ACT(Presidential Decree No. 27792, Jan. 28, 2017)

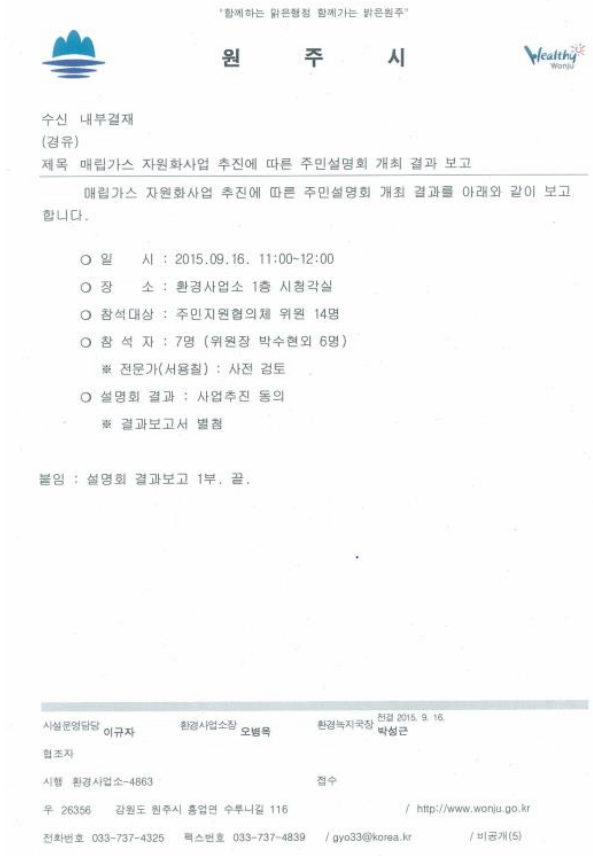
Local resident council consists of community residential support member 14 including professor and chair of the city council and head of community so on.

The main attendants upon briefing are local residents, governors and the relevant staffs from Wonju landfill site and NEWGEN. During the meeting, the project participant introduced the project background, CDM project application as well as governmental positive opinion on the project; more stakeholders asked questions freely and provided their solution or suggestion.

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

Local resident council heard the explanation about the project and agreed to promote the project to use LFG as renewable fuel instead of simple incineration of LFG.

After then, Wonju environment affairs agency officially announced to local resident council the schedule for the future. Local resident council held meeting on 07/06/2016 in order to inform the project status and future schedules.



"함께하는 맑은행정 함께가는 맑은원주"

원 주 시

수신 내부결재
(경유)
제목 매립가스 자원화사업 추진에 따른 주민설명회 개최 결과 보고

매립가스 자원화사업 추진에 따른 주민설명회 개최 결과를 아래와 같이 보고 합니다.

○ 일 시 : 2015.09.16. 11:00~12:00
○ 장 소 : 환경사업소 1층 시청각실
○ 참석대상 : 주민지원협의체 위원 14명
○ 참 석 자 : 7명 (위원장 박수현외 6명)
※ 전문가(서용칠) : 사전 검토
○ 설명회 결과 : 사업추진 동의
※ 결과보고서 별첨

붙임 : 설명회 결과보고 1부. 끝.

시설운영담당 이규자 환경사업소장 오병욱 환경녹지국장 전결 2015. 9. 16. 박성근
협조자
시행 환경사업소-4863 접수
우 26356 강원도 원주시 흥업면 수루니길 116 / http://www.wonju.go.kr
전화번호 033-737-4325 팩스번호 033-737-4839 / gyo33@korea.kr / 비공개(5)

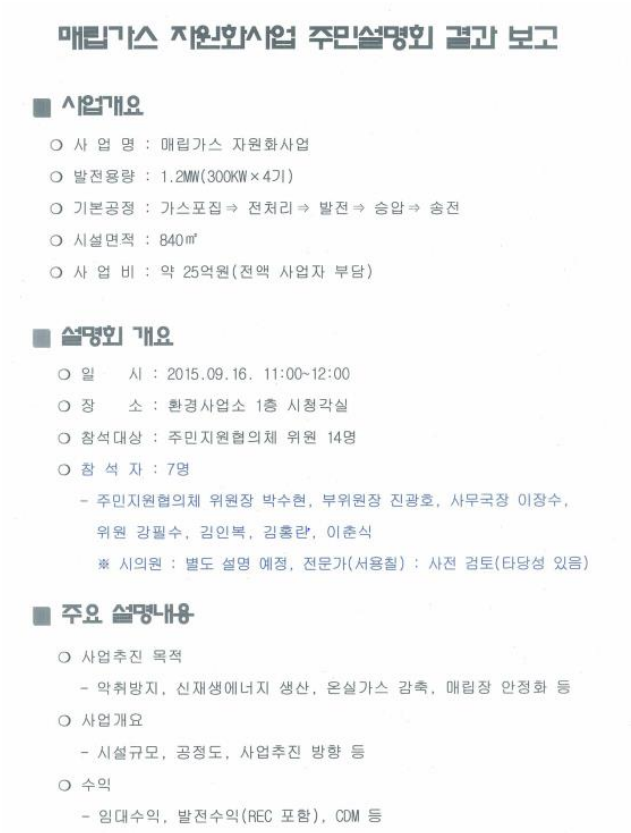
< Official letter of consultion results>

The Official Document

Title : Result report on presentation for residents about Wonju Landfill Gas(LFG) Recovery Project for Electricity Generation promotion

- Date : 11:00~12:00am 16/09/2015
- Place : Audio visual room in the 1st floor of Wonju Environmental Affairs Agency.
- Attendee object : Community Residential Support member 14
- Result on presentation : Wonju Landfill Gas(LFG) Recovery Project for Electricity Generation promotion agreement
- Landfill Gas Recovery

Attached.
Result report on presentation(Reference below)



매립가스 자원화사업 주민설명회 결과 보고

■ 사업개요

○ 사 업 명 : 매립가스 자원화사업
○ 발전용량 : 1.2MW(300KW×4기)
○ 기본공정 : 가스포집⇒ 전처리⇒ 발전⇒ 승압⇒ 송전
○ 시설면적 : 840㎡
○ 사 업 비 : 약 25억원(전액 사업자 부담)

■ 설명회 개요

○ 일 시 : 2015.09.16. 11:00~12:00
○ 장 소 : 환경사업소 1층 시청각실
○ 참석대상 : 주민지원협의체 위원 14명
○ 참 석 자 : 7명
- 주민지원협의체 위원장 박수현, 부위원장 진광호, 사무국장 이장수, 위원 강필수, 김인복, 김홍란, 이춘식
※ 시의원 : 별도 설명 예정, 전문가(서용칠) : 사전 검토(타당성 있음)

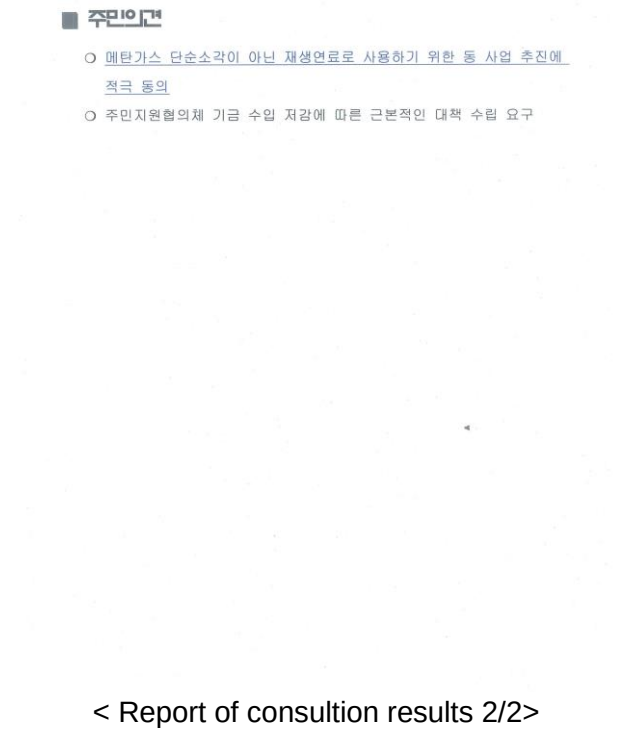
■ 주요 설명내용

○ 사업추진 목적
- 악취방지, 신재생에너지 생산, 온실가스 감축, 매립장 안정화 등
○ 사업개요
- 시설규모, 공정도, 사업추진 방향 등
○ 수익
- 임대수익, 발전수익(REC 포함), CDM 등

< Report of consultion results 1/2>

Attached.
Result report on presentation

■ Presentation outline
- ❍ attendee : Community Residential Support members and other stakeholders in total 7
- ❍ Main description content :
  - Purpose of project : Odour prevention, renewable energy generation, greenhouse gas mitigation, stabilizing landfill etc.
  - Project outline : Facility size , process chart, Project promotion direction etc.
  - Incoming profit : Earnings from leasing and generation(Including REC), CDM etc.



■ 주민의견

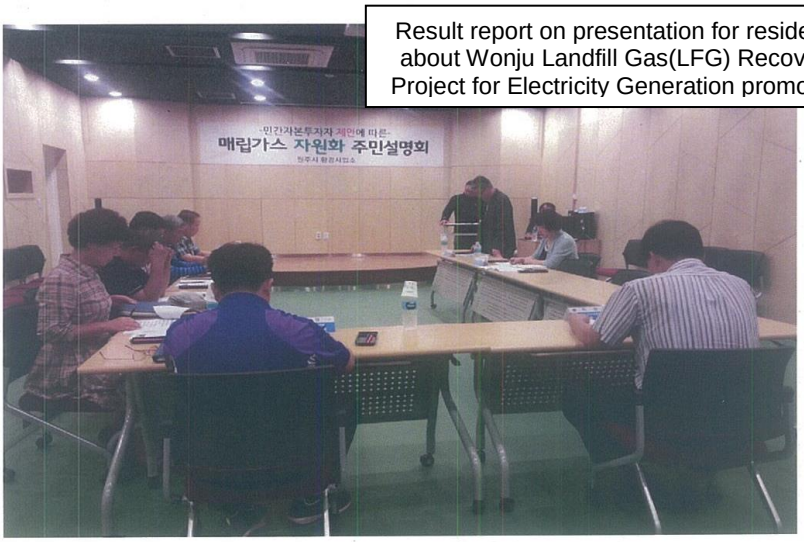
○ 메탄가스 단순소각이 아닌 재생연료로 사용하기 위한 동 사업 추진에 적극 동의
○ 주민지원협의체 기금 수입 저감에 따른 근본적인 대책 수립 요구

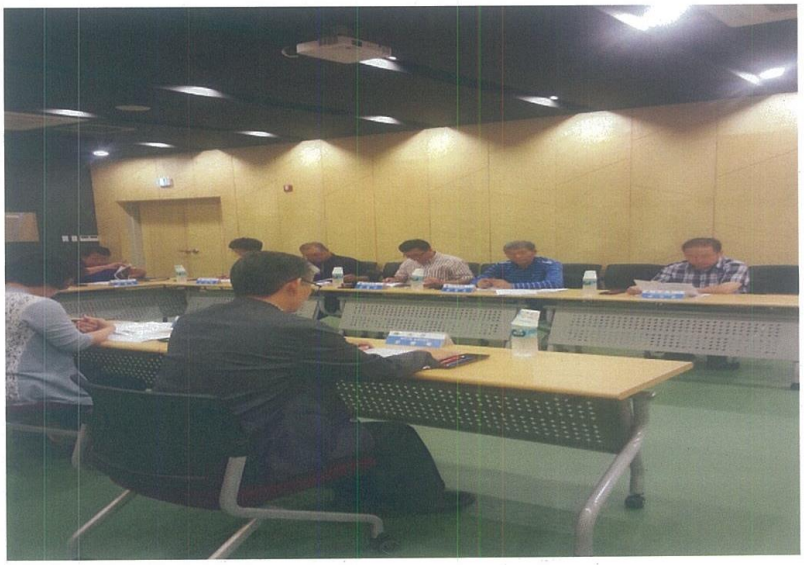
< Report of consultion results 2/2>

■ The local stakeholder's comments
- ❍ Agree to promote the project to use LFG as renewable fuel instead of simple incineration of LFG

매립가스 자원화사업 설명회 사진

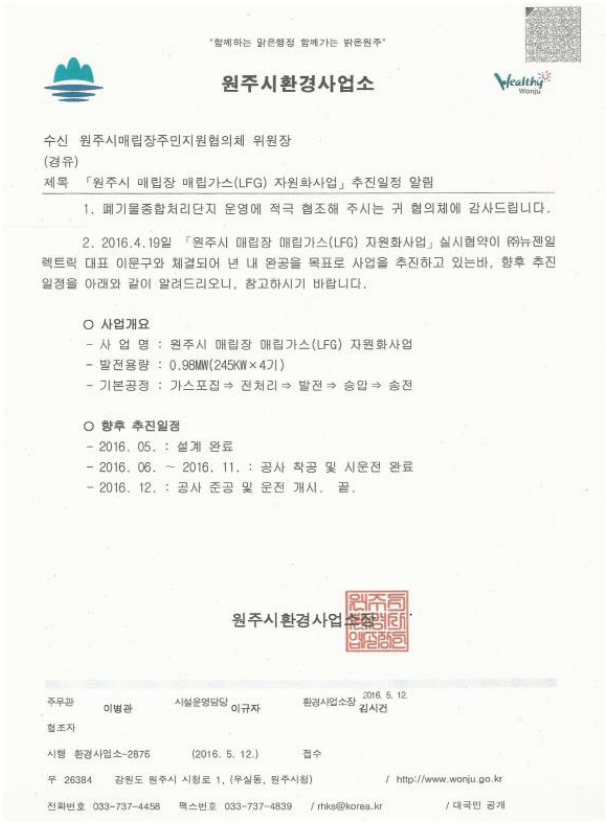
Result report on presentation for residents about Wonju Landfill Gas(LFG) Recovery Project for Electricity Generation promotion





매립가스 자원화 설명회

<Photo of Local stakeholder consultion>



"함께하는 밝은행정 함께가는 밝은원주"

원주시환경사업소

수신 원주시매립장주민지원협의체 위원장
(경유)
제목 「원주시 매립장 매립가스(LFG) 자원화사업」 추진일정 알림

1. 폐기물종합처리단지 운영에 적극 협조해 주시는 귀 협의체에 감사드립니다.

2. 2016.4.19일 「원주시 매립장 매립가스(LFG) 자원화사업」 실시협약이 ㈜뉴젠일렉트릭 대표 이문구와 체결되어 년 내 완공을 목표로 사업을 추진하고 있는바, 향후 추진일정을 아래와 같이 알려드리오니, 참고하시기 바랍니다.

○ 사업개요
- 사 업 명 : 원주시 매립장 매립가스(LFG) 자원화사업
- 발전용량 : 0.98MW(245KW×4기)
- 기본공정 : 가스포집⇒ 전처리⇒ 발전⇒ 승압⇒ 송전

○ 향후 추진일정
- 2016. 05. : 설계 완료
- 2016. 06. ~ 2016. 11. : 공사 착공 및 시운전 완료
- 2016. 12. : 공사 준공 및 운전 개시. 끝.

원주시환경사업소장

주무관 이병관 시설운영담당 이규자 환경사업소장 김시건 2016. 5. 12.
협조자

시행 환경사업소-2876 (2016. 5. 12.) 접수

우 26384 강원도 원주시 시청로 1, (무실동, 원주시청) / http://www.wonju.go.kr

전화번호 033-737-4458 팩스번호 033-737-4839 / rhks@korea.kr / 대국민 공개

<Notice schedules and timelines>

The Official Document

Addressee : Wonju landfill Community Residential Support chairperson

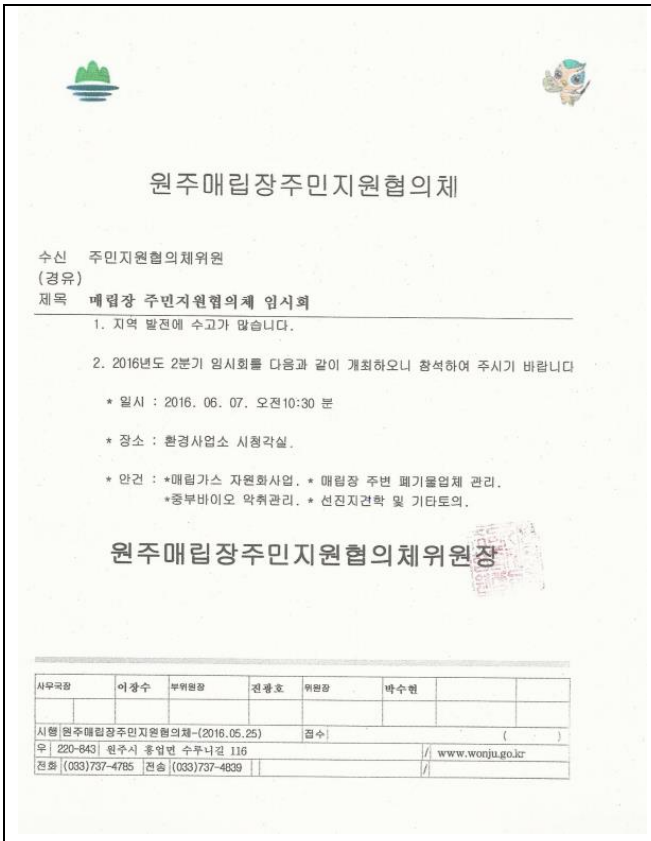
Transmit : Wonju Environmental Affairs Agency

Title : Wonju Landfill Gas(LFG) Recovery Project for Electricity Generation promotion schedule

Main content :
Promotion schedule of project is mentioned below.

- ❍ Business outline
  - Title of the project activity : Wonju Landfill Gas Recovery Project for Electricity Generation
  - The capacity of the generator : 0.98MW(245kW * 4)
  - Process : Gas collecting → generation → pressor → power transmission

- ❍ Promotion schedule
  - 05/2016 : Design completion
  - 06/2016~11/2016 : Starting of construction and completion of testing
  - 12/2016 : Completion of construction and begin operating



원주매립장주민지원협의체

수신 주민지원협의체위원
(경유)
제목 매립장 주민지원협의체 임시회

1. 지역 발전에 수고가 많습니다.

2. 2016년도 2분기 임시회를 다음과 같이 개최하오니 참석하여 주시기 바랍니다

* 일시 : 2016. 06. 07. 오전10:30 분

* 장소 : 환경사업소 시청각실.

* 안건 : *매립가스 자원화사업. * 매립장 주변 폐기물업체 관리.
*중부바이오 악취관리. * 선진지견학 및 기타토의.

원주매립장주민지원협의체위원장

사무국장	이광수	부위원장	전광호	위원장	박수현		

시행 원주매립장주민지원협의체-(2016.05.25) 접수 ( )
우 220-843 원주시 흥업면 수루나길 116 / www.wonju.go.kr
전화 (033)737-4785 전송 (033)737-4839 /

<Local stakeholder consultion invitation>

The Official Document

Addressee : Community Residential Support Chairperson

Transmit : Wonju landfill Community Residential Support chairperson

Title : Landfill Community Residential Support provisional meeting

Main content :
A Guide to the provisional meeting for second-quarter, 2016

- ❍ Date : 10:30 am 07/06/2016
- ❍ Place : Audio visual room in the Wonju Environmental Affairs Agency
- ❍ Item
  - Landfill Gas Recovery Project for Electricity Generation
  - Management in waste company nearby the landfill
  - Bio central the handling odour
  - The field trip on the advanced area and other discussion

E.2. Summary of comments received

>>
The stakeholders agreed to the project plan which has many benefits for environment and stakeholders; by collecting and using LFG emitted from the landfill, it fosters sanitary treatment and stabilization of landfill as well as resolving stakeholders' comments about odours and pollutants. For these reasons, the project activities create no adverse effects.

The contents of local stakeholder's comments
- Agree to promote the project to use LFG as renewable fuel instead of simple incineration of LFG

In summary, no negative comments were received.

E.3. Consideration of comments received

>>
The project participants were obtained the concurrence of all stakeholders about their activities towards environment protection.

SECTION F. Approval and authorization

>>

The Letter of Approval has been issued to the NEWGEN by the Designated National Authority of Republic of Korea on 31st May 2017.

Appendix 1. Contact information of project participants

Organization name	NEWGEN ELECTRICS Co., Ltd.
Country	Republic of Korea
Address	116, Suruni-gil, Saje-ri, Heungeop-myeon
Telephone	82-(0)70-5099-0296
Fax	82-(0)70-5099-0297
E-mail	wonsh@newgen-el.com
Website	-
Contact person	Moon Gu, Lee

Organization name	ROEN consulting Co.,Ltd.
Country	Republic of Korea
Address	30, Gasan digital 1-ro, Geumcheon-gu, Seoul, Republic of Korea
Telephone	82-(0)2-6959-6088
Fax	82-(0)70-5121-0291
E-mail	
Website	
Contact person	Sang Hyeok, Park

Appendix 2. Affirmation regarding public funding

The proposed project will not run under any public incentive/funding scheme and will not be financed with any Official Development Assistance.

Appendix 3. Applicability of methodologies and standardized baselines

The selection of baseline is explained in previous sections of the PDD. Baseline Emission calculations are performed in emission reduction calculation sheet. This sheet will be submitted to UNFCCC as an annexure to the PDD.

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

All information on calculation of emission reductions is explained in previous sections of the section B.6.

Appendix 5. Further background information on monitoring plan

All information on monitoring plan is explained in previous sections of the section B.7.

Appendix 6. Summary report of comments received from local stakeholders

n/a

Appendix 7. Summary of post-registration changes

1) 21/12/2018 (PRC-10379-001)

- Applied temporary deviation: Since the quantity of exported electricity was confirmed by KEPCO every month, the quantity of exported electricity was conservatively recalculated using the highest ratio of the consumption power for the plant in 1st and 2nd monitoring period.

2) 09/07/2020(PRC-10379-002)

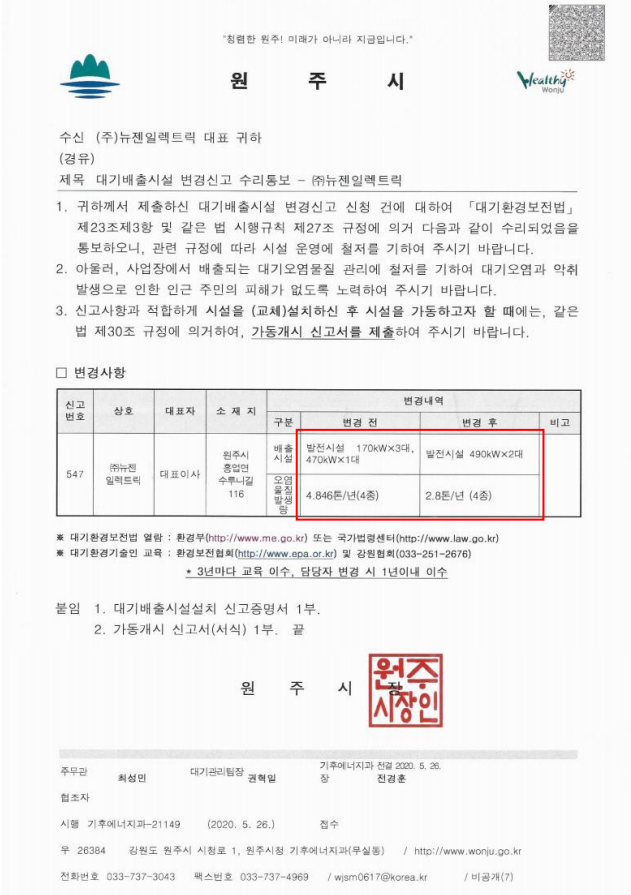
- The changes were carried out in the revised PDD version 3.1, and had applied 2nd monitoring period. The main changes to the registered project were changes to project design of registered project activity at section and changes of plant generator specification.

3) Post Registration Change was requested with the submission of 3rd monitoring.

- The following design changes were done compared to the PDD version 3.1:

(1) The changes of plant generator specification: <Table A-1> at section A.3. have been changed for the following reasons.

- The four generators installed with a total capacity of 0.98MW (0.17MW x 3set, 0.47MW). 2 or 3 of the four generators are operated alternately depending on the amount of the gas, the CH_4 concentration, the condition of the generator, and the seasonal conditions.
- Among them 1st, 2nd, 4th generators were changed to a new generator with the capacity of 0.49MW. And the 3rd generator was upgraded in 0.49MW (0.47MW→0.49MW). But, the total capacity of the generators remains unchanged. For this reason, the name-tag of existing generators and now generators have been changed, in accordance with "CLEAN AIR CONSERVATION ACT", project participant got the "Permission to install air discharge facility (notification)" from the government.



"청렴한 원주! 미래가 아니라 지금입니다."

원 주 시

수신 (주)뉴젠일렉트릭 대표 귀하
(경유)
제목 대기배출시설 변경신고 수리통보 - ㈜뉴젠일렉트릭

1. 귀하께서 제출하신 대기배출시설 변경신고 신청 건에 대하여 「대기환경보전법」 제23조제3항 및 같은 법 시행규칙 제27조 규정에 의거 다음과 같이 수리되었음을 통보하오니, 관련 규정에 따라 시설 운영에 철저를 기하여 주시기 바랍니다.
2. 아울러, 사업장에서 배출되는 대기오염물질 관리에 철저를 기하여 대기오염과 악취 발생으로 인한 인근 주민의 피해가 없도록 노력하여 주시기 바랍니다.
3. 신고사항과 적합하게 시설을 (교체)설치하신 후 시설을 가동하고자 할 때에는, 같은 법 제30조 규정에 의거하여, 가동개시 신고서를 제출하여 주시기 바랍니다.

□ 변경사항

신고번호	상호	대표자	소재지	변경내역			
				구분	변경 전	변경 후	비고
547	㈜뉴젠일렉트릭	대표이사	원주시 흥업면 수뢰니길 116	배출시설	발전시설 170kW×3대, 470kW×1대	발전시설 490kW×2대	
				오염물질 발생량 등	4,846톤/년(4종)	2.8톤/년 (4종)	

※ 대기환경보전법 열람 : 환경부(http://www.me.go.kr) 또는 국가법령센터(http://www.law.go.kr)
※ 대기환경기술인 교육 : 환경보전협회(http://www.epa.or.kr) 및 강원협회(033-251-2676)
• 3년마다 교육 이수, 담당자 변경 시 1년이내 이수

붙임 1. 대기배출시설설치 신고증명서 1부.
2. 가동개시 신고서(서식) 1부. 끝

원 주 시 원주시장인

주무관 최성민 대기관리팀장 권혁일 기후에너지과 전결 2020. 5. 26. 장 진경훈
협조자
시행 기후에너지과-21149 (2020. 5. 26.) 접수
우 26384 강원도 원주시 시청로 1, 원주시청 기후에너지과(무실동) / http://www.wonju.go.kr
전화번호 033-737-3043 팩스번호 033-737-4969 / wjsm0617@korea.kr / 비공개(7)

< acceptance of change of the air emission

The Official Document

Addressee : Wonju landfill Community Residential Support chairperson

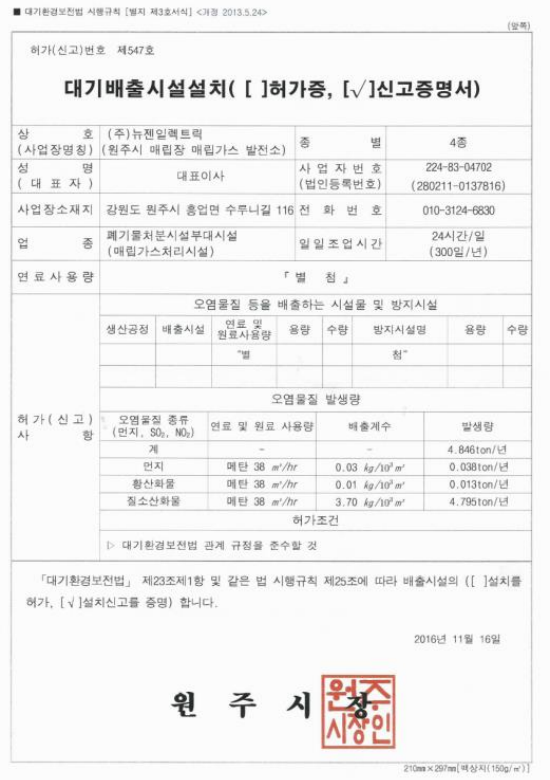
Transmit : Wonju Environmental Affairs Agency

Title : Notification of acceptance of change of the air emission facility.

Main content :
According to 'CLEAN AIR CONSERVATION ACT', accepted the change of the generator capacity.

❍ Changes
(1) **(before)** <generator facility>
170kW x 3, 470kW x 1
(2) **(after)** <generator facility>
490kW x 2

facility >



■ 대기환경보전법 시행규칙 [별지 제3호서식] <개정 2013.5.24>

(앞쪽)

허가(신고)번호 제547호

대기배출시설설치([ ]허가증, [√]신고증명서)

상 호 (사업장명칭)	(주)뉴젠일렉트릭 (원주시 매립장 매립가스 발전소)	종 별	4종
성 명 (대 표 자)	대표이사	사 업 자 번 호 (법인등록번호)	224-83-04702 (280211-0137816)
사업장소재지	강원도 원주시 흥업면 수루니길 116	전 화 번 호	010-3124-6830
업 종	폐기물처분시설부대시설 (매립가스처리시설)	일일조업시간	24시간/일 (300일/년)
연료사용량	「별 첨」		

허가(신고)사항

오염물질 등을 배출하는 시설물 및 방지시설

생산공정	배출시설	연료 및 원료사용량	용량	수량	방지시설명	용량	수량
		"별			첨"		

오염물질 발생량

오염물질 종류 (먼지, SO_2, NO_2)	연료 및 원료 사용량	배출계수	발생량
계	-	-	4.846ton/년
먼지	메탄 38 m^3/hr	0.03 $kg/10^3m^3$	0.038ton/년
황산화물	메탄 38 m^3/hr	0.01 $kg/10^3m^3$	0.013ton/년
질소산화물	메탄 38 m^3/hr	3.70 $kg/10^3m^3$	4.795ton/년

허가조건

▷ 대기환경보전법 관계 규정을 준수할 것

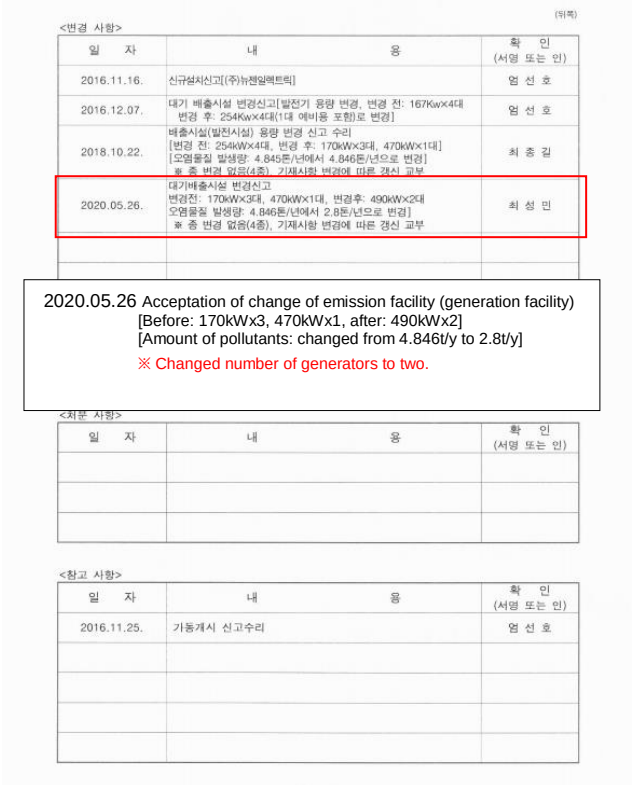
「대기환경보전법」 제23조제1항 및 같은 법 시행규칙 제25조에 따라 배출시설의 ([ ]설치를 허가, [√]설치신고를 증명) 합니다.

2016년 11월 16일

원 주 시 장 원주시장인

210mm×297mm[백상지(150g/㎡)]

<Permission to install air discharge facility (notification)>



(뒤쪽)

<변경 사항>

일 자	내 용	확 인 (서명 또는 인)
2016.11.16.	신규설치신고[(주)뉴젠일렉트릭]	염 선 호
2016.12.07.	대기 배출시설 변경신고[발전기 용량 변경, 변경 전: 167Kw×4대 변경 후: 254Kw×4대(1대 예비용 포함)로 변경]	염 선 호
2018.10.22.	배출시설(발전시설) 용량 변경 신고 수리 [변경 전: 254kW×4대, 변경 후: 170kW×3대, 470kW×1대] [오염물질 발생량: 4.845톤/년에서 4.846톤/년으로 변경] ※ 종 번경 없음(4종), 기재사항 변경에 따른 갱신 교부	최 종 길
2020.05.26.	대기배출시설 변경신고 변경전: 170kW×3대, 470kW×1대, 변경후: 490kW×2대 오염물질 발생량: 4.846톤/년에서 2.8톤/년으로 변경] ※ 종 번경 없음(4종), 기재사항 변경에 따른 갱신 교부	최 성 민

2020.05.26 Acceptation of change of emission facility (generation facility)
[Before: 170kWx3, 470kWx1, after: 490kWx2]
[Amount of pollutants: changed from 4.846t/y to 2.8t/y]
※ Changed number of generators to two.

<처분 사항>

일 자	내 용	확 인 (서명 또는 인)

<참고 사항>

일 자	내 용	확 인 (서명 또는 인)
2016.11.25.	가동개시 신고수리	염 선 호

<Changes>

Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document