Project design document form
(Version 10.1)

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

BASIC INFORMATION	
Title of the project activity	Sihwa Tidal Power Plant CDM project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	Version_ 04.0
Completion date of the PDD	20/09/2018
Project participants	Korea Water Resources Corporation (K-water)
Host Party	Republic of Korea (host)
Applied methodologies and standardized baselines	Methodology : ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources.---version 17"
Sectoral scopes linked to the applied methodologies	Scope : I –Energy industries (renewable-/non-renewable sources)
Estimated amount of annual average GHG emission reductions	251,089 tCO2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

- Purpose of the proposed project

By generating electricity using renewable energy source, Korea will be able to reduce GHG emission and increase sustainable development, and increased sea/inner water circulation by this activity will improve the water quality that has been decreased during Sihwa Lake's salt-to-fresh water process[1].

- Outline of the project Activity

Sihwa Tidal Power Plant Project will generate electricity by utilizing the sea water when it is coming into Sihwa Lake which is an artificial lake made by the tide embankment. The plant is located in Jaggungarisum which is an island in Ansan-city, Gyeonggi Province, Korea. It is equipped 10 turbine generators (25.4MW) of straight inflow bulb type to produce app. 254MW. This means that it will be expected to generate 552.7 GWh a year, and transmit the electricity of 507.629 GWh to the grid annually. The generated electricity will be transmitted to ' Korea Electric Power Corporation South Sihwa substation' which is 10.5 km's distance from the plant. The spatial extent of the project boundary includes the project site and all the power plants connected physically to the electricity system of Korea Electric Power Corporation(hereinafter referred to as KEPCO).

- Contribution of the project activity to government policy and sustainable development

The project supports the Korean government policy as follows;

- Contribute to increase the renewable energy supply ratio by generating electricity with tidal power which Korean government encourages industries to develop.
- Promote, support, and cultivate the use of renewable energy as an alternative energy source.
- Minimize dependence on fossil fuel imports by utilizing tidal power and save the cost by substituting the tidal energy source for the conventional energy source such as fossil fuels.

The project contributes the sustainable development in the following ways.

- Tidal power source, as an alternative energy source, produces many environmental benefits.
- Compared to other energy sources, generating electricity from tidal power does not emit air pollutants and leave residuals into soil after it is processed.
- As a renewable energy source, tidal power provides future generations with environmentally friendly fuel alternatives that can be used sustainably.
- The project activity does not emit any GHGs, and air pollutants such as SO_x, NO_x, and dust.
- By the construction of this project with the capacity of 254MW, the air pollution can be decreased annually as follows;
    - CO_2 : 251,089 tons
    - SO_x : 589tons
    - NO_x : 446tons

---

[1] The construction of the Sihwa tide embankment started in 1987 and finished in 1994. In order to develop reclaimed lands and to provide agricultural water, 12.7 km of tide embankment was constructed which is separating West Sea from Banwol Bay. However, the Korean government decided to turn back Sihwa as seawater lake not as freshwater lake in 2000 because the quality of lake has been dramatically decreased. As well, the plan of the utilization as the source of agricultural water was changed. After that, Korea Water Resources Corporation (hereinafter referred to as K-water) carried out the feasibility study of the construction for the tidal power plant from the year 2002.

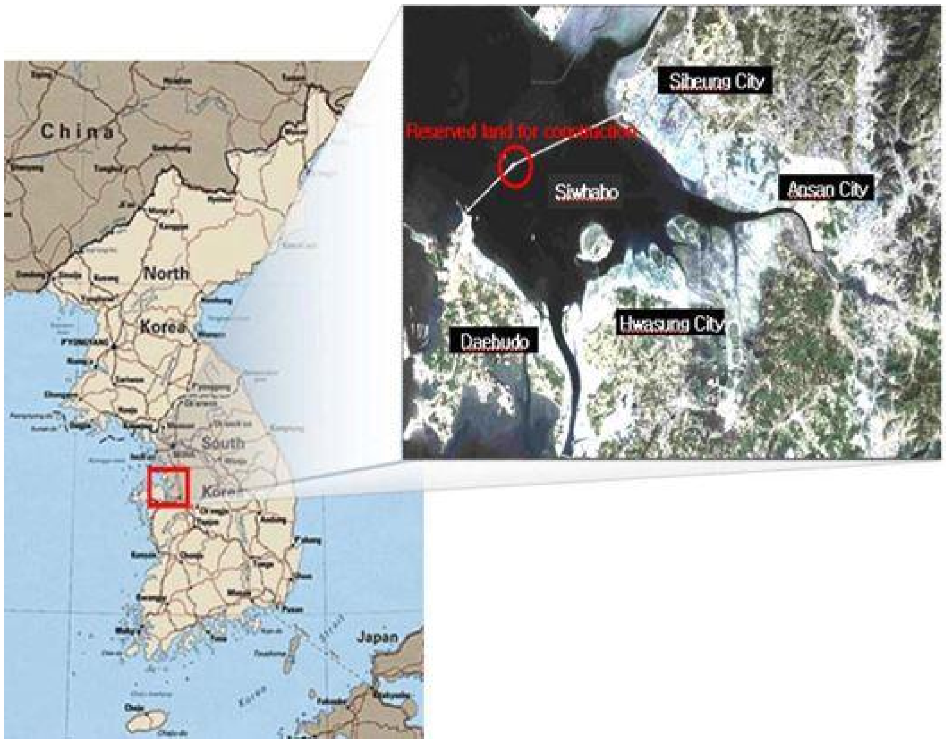
- Dust : 31tons

As the socio-economic aspect, this project can increase the employment rate in the local area, and establish infrastructure, such as access roads and power lines, and these will benefit the local economy. In addition, the tidal power plant can attract tourists from all over the world as well as from Korea and this will increase the economical benefit in the local areas.

A.2. Location of project activity

>>

Sihwa Tidal Power Plant is installed and located in Ansan-city, Gyeonggi Province, Republic of Korea, latitude of 37°18’46’’N and longitude of 126°36’36’’E as marked on the map, as follows.



<Figure 1.> The location of Sihwa Tidal Power Plant

Sihwa embankment was constructed by Korea Agricultural & Rural Infrastructure Corporation (KARICO), as part of Large-scale Integrated Tideland Reclamation Project in the South-western Coast for six years and a half (June, 1987 ~ January, 1994). Sihwa embankment connects Oido, Siheung-city with Daebudong, Ansan-city. The length of the embankment is 12,676m, and the embankment consists of Sihwa 1-ho, Sihwa 2-ho, Daesun, Buldo, and Tando. Sihwa Lake, surrounded by the Sihwa embankment, has an average year precipitation of 1,189mm, and an average year temperature of app. 12℃, and whose size is 56.5 ㎢. In addition, the third sea route of Incheon port is located in front of Sihwa Lake from 2.5 kilometer’s distance, and LNG harbor is located in the north side of the lake. The characteristic features of the Sihwa Lake in which the Sihwa Tidal Power Plant will be installed are as follows;

- Approx. Higher High water level: app. 4.556m
- Approx. Lowest Low water level: app. - 4.604m
- Mean Range of tide: 5.57m
- Mean See Level: - 0.024m

A.3. Technologies/measures

>>

Explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity:

The main objective of the project is to develop, generate, and use this kind of clean electricity which is generated from renewable energy sources without GHGs emissions. Sihwa Tidal Power Plant Project will reduce GHGs emissions by producing electricity with using tidal power source, replacing conventional energy sources such as oils and coals.

Many countries have been developing their industries based on the energy generated by fossil fuel fired power plants which are mainly emitting GHGs that are known to cause the greenhouse effect. The Sihwa Tidal Power Plant will definitely help reduce GHGs emission by replacing fossil fuel power source as the renewable energy source.

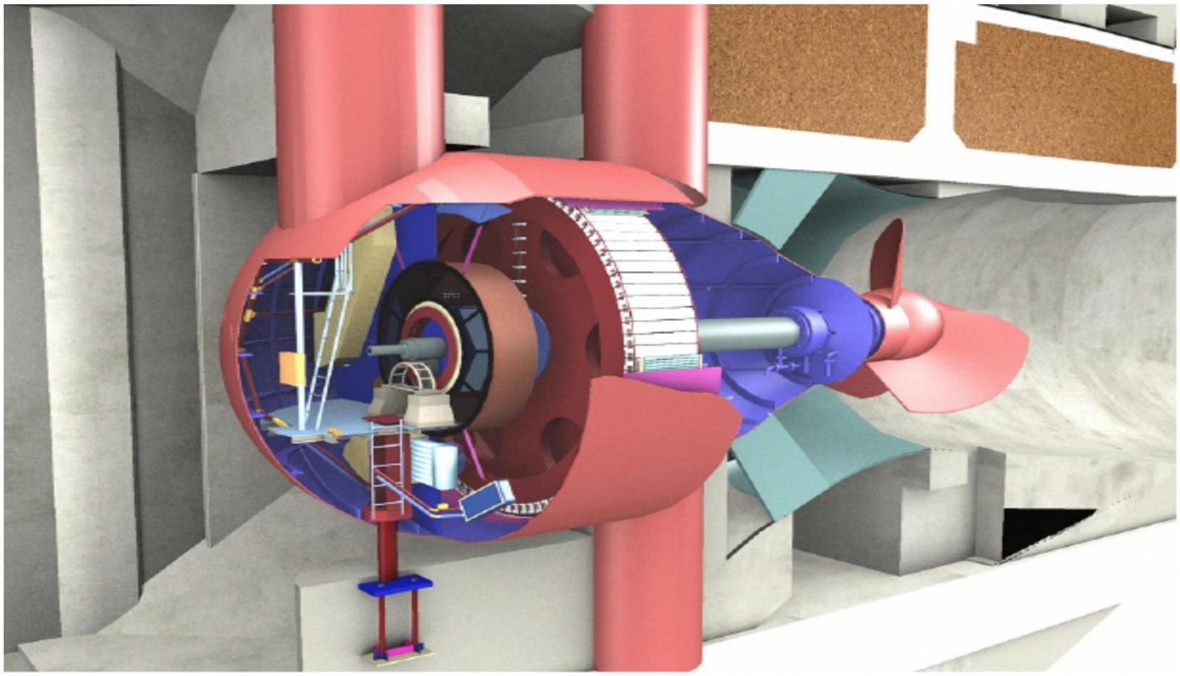
With this project's success, Sihwa tidal power plant will substitute the fossil fuel fired plants, generating 552.7 GWh, so it will bring a CO_2 emission reduction of 251,089 ton per year.

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

Korean government has constructed power plants since 1960's in order to supply the essential electricity to factories and homes, but due to the financial and technological reasons, Korean government chose to build fossil fuel fired power plants. These plants have been emitting GHGs while processing fossil fuels to generate electricity, and 68.7% of the total electricity generation comes from fossil fuel fired power plants in Korea (Source: KEPCO 2017). In addition, less than 5% of the electricity is coming out of the alternative energy sources such as hydroelectric power, wind power, tidal power, or solar power.

By the realization of this project, GHGs emission will be reduced, and it will be the effective driving force to promote the electricity generation industries with using renewable energy sources like tidal power source in Korea.

This project will use non-pumping, one-way-flow, bulb turbine generators which have good energy efficiency, low head drop, and large capacity of 25.4MW. Moreover, these bulb turbine generators have many advantageous features as they are so far widely manufactured, installed, and operated in the world. Ten bulb turbine generators was installed, and the plant will be able to generate 552.7GWh of electricity per year. These turbine generators, as the core equipment of the electricity generation, was manufactured by Va Tech Hydro Austria (www.vatech-hydro.com), and this company will transfer advanced technology to K-water for the operation and maintenance.



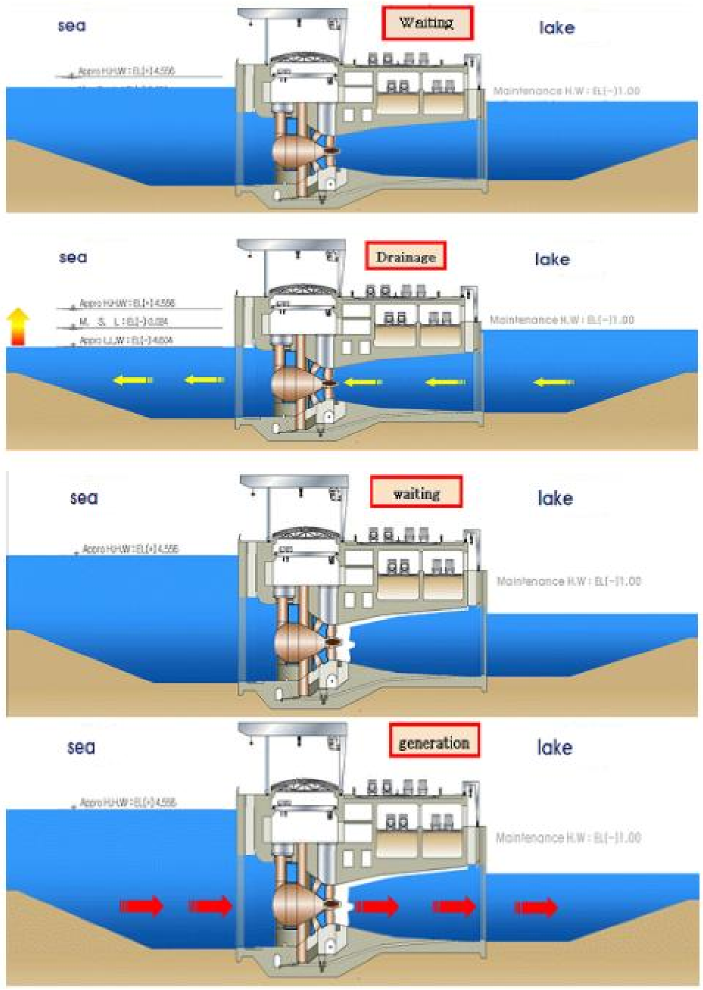
<Figure 2.> The bulb type Turbine

The general characteristics of the bulb turbine generators manufactured by Va tech are as follows;

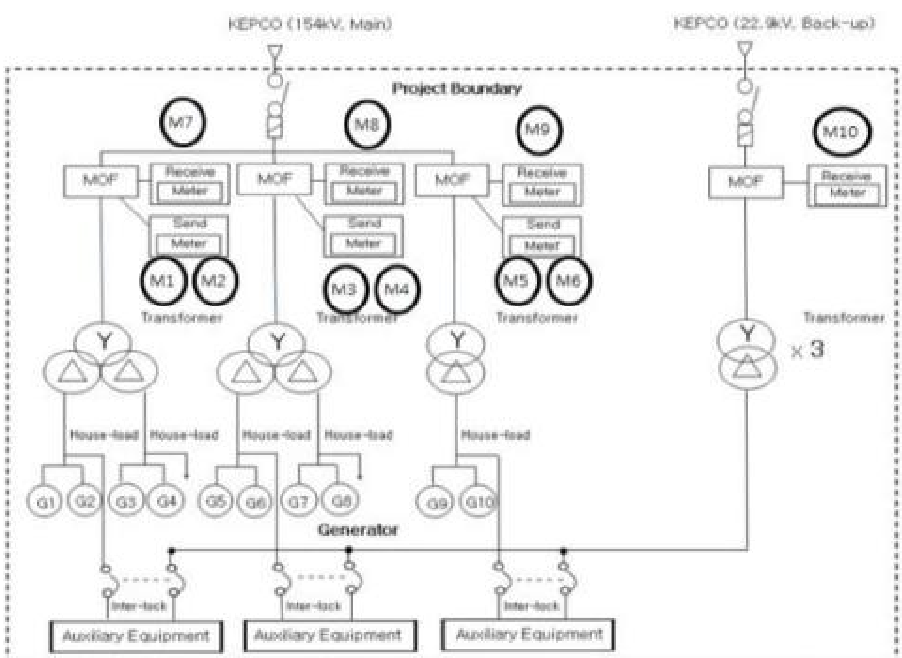
- Rated output: 25.4MW
- Maximum output: 25.4MW
- Velocity: 64.29rpm
- Rating: Continuous rating
- Rated head: 5.82m
- Quantity of flow: 482.13m^3/s

Through the development of Sihwa tidal energy, non-oil energy source can be developed and actively coped with the CO_2 reduction measure including Climate Change Convention. As well, from the development of ocean energy, technical, economical feasibility study and basic plan can be established using the Sihwa tide embankment as one of the ways of stable energy supply.

Item	The Tidal Power Plant in Sihwa
Rated Output	25,400kW X 10 (Generator)
Bulb Diameter	8.2m
Runner Diameter	7.5m
Rated Head Drop	5.82 m (Max. 7.5m, Min. 1.0m) * Spring range - 7.804m, Mean range – 5.570m Neap range -3.336m
Rated Voltage	10,200V
Velocity	64.29rpm
Rotation Direction	Clockwise rotation looking at the sea



<Figure 3> System Diagram of Sihwa Tidal Power Plan



<Figure 4> Skeleton diagram of the tidal power plant

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Korea (host)	Public entity : Korea Water Resources Corporation (K-water(*))	No
Switzerland		No

* Ecoeye(consulting company) withdrew from project participant on 22nd August 2009 as it can be confirmed in UNFCCC web page.

A.5. Public funding of project activity

>>
Public funding is not involved in this project activity.

A.6. History of project activity

>>

- The proposed CDM project activity is not included as a component project activity (CPA) in a registered CDM programme of activities (PoA).
- The proposed CDM project activity is not a project activity that has been deregistered.
- The proposed CDM project activity is not a CPA that has been excluded from a registered CDM PoA.
- A registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) doesn't exist in the same geographical location as the proposed CDM project activity.

A.7. Debundling

>> Not /Applicable

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

>>
ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources---version 17"
http://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN

B.2. Applicability of methodologies and standardized baselines

>>
In this project, the methodology applied to calculate the baseline is "the approved consolidated baseline methodology (ACM0002_version 17)" which can estimate a reduction of GHGs emission from this project activity. ACM0002_version 17 can be applied to the grid connected electricity generated from the tidal power plant – one of the renewable energy sources replacing the fossil fuel fired plant.

This CDM project is to provide electricity through grid-connected electricity generation by using natural tidal power; therefore we use this methodology.

Applicability Conditions	Justification
This methodology applies to project activities that include retrofitting, rehabilitation (or refurbishment), replacement or capacity addition of an existing power plant or construction and operation of a Greenfield power plant.	Applicable : The project activity is a new tidal power plant/unit, hence complies with the applicability criterion.
This methodology is applicable to grid-connected renewable energy power generation project activities that: (a) Install a Greenfield power plant; (b) Involve a capacity addition to (an) existing plant(s); (c) Involve a retrofit of (an) existing operating plants/units; (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s)/unit(s).	Applicable : The project activity is a new tidal power plant/unit, hence this condition (a) Install a Greenfield power plant, applies to the project activity
The methodology is applicable under the following conditions: (a) The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit; (b) In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	Applicable : (a) The project activity is a new tidal power plant/unit, and hence complies with the applicability criterion. (b) The project activity does not involve capacity additions, retrofits, rehabilitations or replacements, hence this condition do not apply to the project activity.
In case of hydro power plants, one of the following conditions shall apply[2]: (a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or (b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3), is greater than 4 W/m2; or (b) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m2; or (c) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4 W/m2, all of the following conditions shall apply: i. The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m2; ii. Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; iii. Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m2 shall be: a. Lower than or equal to 15 MW; and b. Less than 10 per cent of the total installed capacity of integrated hydro power project.	Not relevant : The project activity is a new tidal power plant/unit, hence these conditions do not apply to the project activity

[2] Project participants wishing to undertake a hydroelectric project activity that result in a new reservoir or an increase in the volume of an existing reservoir, in particular where reservoirs have no significant vegetative biomass in the catchments area, may request a revision to the approved consolidated methodology.

In the case of integrated hydro power projects, project proponent shall: (a) Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or (b) Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.	Not relevant : The project activity is a new tidal power plant/unit, hence these conditions do not apply to the project activity
The methodology is not applicable to: (a) Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; (b) Biomass fired power plants/units.	Applicable : This project activity does not involve switching from fossil fuels. Since the project activity is a new tidal power plant/unit, it does not involve biomass fired power plants and hydro power plants, hence this condition is satisfied.
In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is “the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance”.	Not relevant : The project activity is a new tidal power plant. Also, no replacement, modification and retrofit measures are implemented here. Therefore, this is not a relevant criteria for the project activity.
In addition, the applicability conditions included in the tools referred to below apply.[3]	Applicable : Applicability conditions of the applied tool are justified

“Tool to calculate the emission factor for an electricity system” (Version 6.0) was adopted to estimate the emission factor of the project.

Applicability Conditions	Justification
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, i.e. 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).	Applicable : The project activity substitutes grid electricity by supplying renewable power to grid. Hence this criterion is applicable.

[3] The condition in the “Combined tool to identify the baseline scenario and demonstrate additionality” that all potential alternative scenarios to the proposed project activity must be available options to project participants; does not apply to this methodology, as this methodology only refers to some steps of this tool.

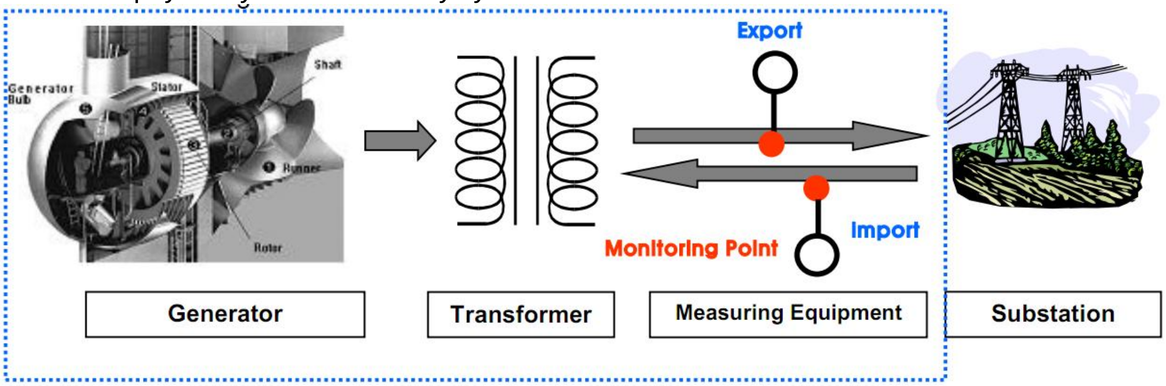
In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	Not relevant : Since the project electricity system is not located partially or totally in Annex I country hence this criterion is not applicable.

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

>>

For the baseline determination, project boundary has been accounted CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to this project activity.

The spatial extent of the project boundary includes the project site and all the power plants connected physically to the electricity system of KEPCO.



<Figure 5.> Project boundary

In the calculation of GHG emissions from the plants included in Project Boundary, the emissions generated during the construction of the power plants, the emissions generated related to electricity transmission and distribution losses, the emissions related to fossil-fuel transportation, mining, water dumping, etc. have not been considered for the baseline.

Source		GHG	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants connected to the grid	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project activity	The proposed project	CO_2	Yes	According to ACM0002 (Version 17.0), project emissions are zero.
		CH_4	No	
		N_2O	No	

B.4. Establishment and description of baseline scenario

>>

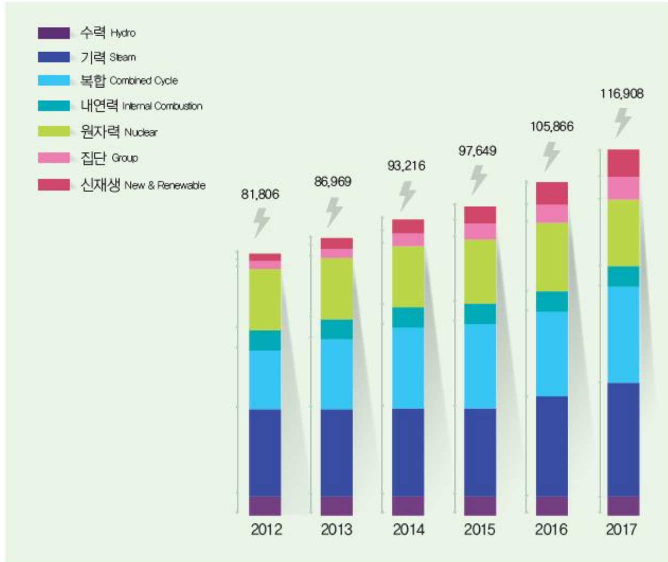
<Table 1.> Key information and data used to determine the baseline scenario

Variable	Data source
$FC_{i,m,y}$ = Amount of fuel type i consumed by power plant/unit m in year y	Statistics of Electric Power in Korea (2015, 2016, 2017) (KEPCO)
$NCV_{i,y}$ = Net calorific value (energy content) of fuel type i in year y	Statistics of Electric Power in Korea (2015, 2016, 2017) (KEPCO)

$EF_{CO2,i,y}$ = CO_2 emission factor of fuel type i used in power unit m in year y	Guideline for the greenhouse gas and energy target management operations in Korea(30. 12. 2016)
$EG_{m,y}$ = Net electricity generated by power plant/unit m, in year y	Statistics of Electric Power in Korea (2015, 2016, 2017) (KEPCO) Status of Generation facility (2017, KPX)
$\eta_{m,y}$ = Average net energy conversion efficiency of power unit m in year y	The default values provided in in Table 2, Appendix of TOOL09:"Determining the baseline efficiency of thermal or electric energy generation systems" (if available for the type of power plant)
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for the project electricity system in year y	Calculated
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor for the project electricity system in year y	Calculated
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor for the project electricity system in year y	Calculated

According to the ‘Baseline’ of methodology ACM0002 (Version 17.0), the baseline scenario for Greenfield power plant is the following:

If the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin(CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.



(단위 : MW)

구분	2012	2013	2014	2015	2016	2017
수력 Hydro	6,446	6,454	6,467	6,471	6,485	6,489
기력 Steam	29,371	29,371	29,611	29,611	33,746	38,265
복합 Combined Cycle	19,799	23,473	27,296	28,512	28,512	32,416
내연력 Internal Combustion	367	330	330	330	329	339
원자력 Nuclear	20,716	20,716	20,716	21,716	23,116	22,529
집단 Group	2,623	3,106	4,323	5,360	6,200	7,682
신재생 New & Renewable	2,483	3,519	4,474	5,649	7,477	9,187
사업자 Public Utility	81,806	86,969	93,216	97,649	105,866	116,908
상용자가 Non-utility in common use	4,044	4,109	3,709	3,941	3,924	3,941
합계	85,849	91,077	96,925	101,590	109,789	120,848

※ 그래프는 사업자용 발전설비 기준임. The graphs exclude non-utility.

<Figure 6.> Trends in generation facility in Korea Rep.

This is evident from the above figure that the installed capacity in Korea is predominantly thermal power plants; thermal power generation is GHG intensive and is a major source of CO_2 emissions. In the absence of the project activity equivalent amount of electricity would have been generated from the existing grid connected power plants and planned capacity additions which are also largely fossil fuel based. Thus generation from the project displaces the electricity generated from existing and planned power plant capacities in the KEPCO grid whose emission intensities are represented by the Combined Margin Emission Factor of the KEPCO Grid.

Also, the emission factor can be calculated in a transparent and conservative manner as follows:

(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(Version 06.0)”.

OR

(b) The weighted average emissions (in tCO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

To estimate baseline emission for this project, (a) has been chosen. For the data to calculate emission coefficient, “Statistics of Electric Power in Korea” which is published by KEPCO every year and “Status of Generation Facility” which is published by Korea Power Exchange(hereinafter referred to as KPX) every year were referred.

Baseline Emission Factor ($EF_{grid,CM,y}$) Calculation

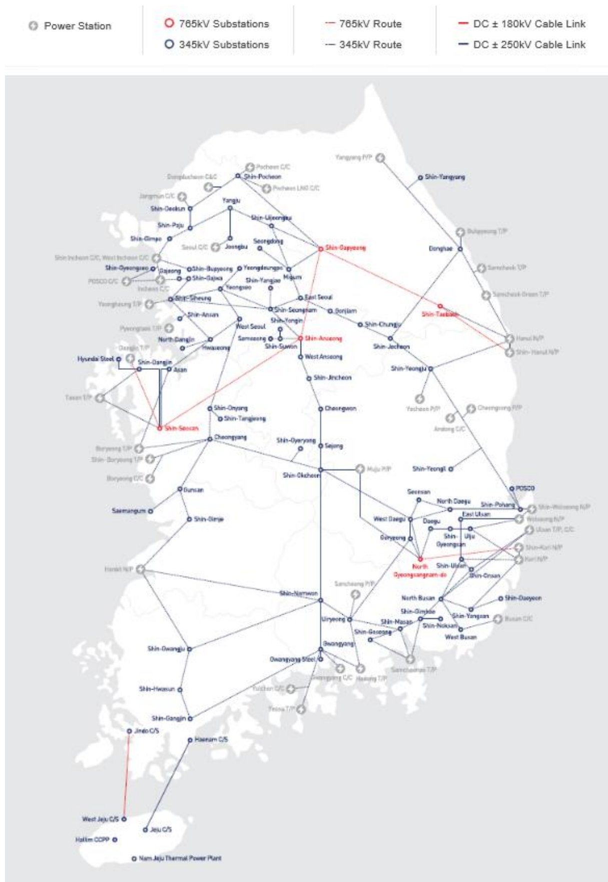
According to the “Tool to calculate the emission factor for an electricity system” (Version 06.0), the baseline emission factor is calculated by combining margin (CM), which is the weighted average of the operating margin (OM) and the build margin (BM).

Emission factor is calculated according to 6 steps as follows:

STEP 1. Identify the relevant electricity systems;
STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional);
STEP 3. Select a method to determine the operating margin (OM);
STEP 4. Calculate the operating margin emission factor according to the selected method;
STEP 5. Calculate the build margin (BM) emission factor;
STEP 6. Calculate the combined margin (CM) emissions factor.

STEP 1. Identify the relevant electricity systems;

For determining the electricity emission factors, first it is needed to identify the relevant project electricity system including any connected electricity systems.



<Figure 7.> KEPCO grid in Korea Rep.[4]

It is clear that the project electricity system is connected to the whole KEPCO grid. All power plants including the proposed tidal power plants in the Korea are physically connected to each other through transmission and distribution lines constituting the KEPCO grid. Therefore the KEPCO grid is chosen as relevant electricity power system for purpose of determining the electricity emission factors.

STEP2. 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.

For the proposed project, Option I is chosen; there are no off-grid power plants included in the calculation.

[4] Source: Korea Electric Power Corporation homepage (http://home.kepco.co.kr/kepco/EN/B/htmlView/ENBAHP003.do?menuCd=EN020103)

STEP3. 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 four following methods:

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

Among the above options, the (a) Simple OM method can be used where low cost/must run resources[5] constitute less than 50% of total grid generation (excluding electricity generated by off-grid power plants) in: 1) average of the five most recent years, or 2) based on long-term averages for electricity production.
In the project activity, low-cost/must-run resources are defined as hydro, geothermal, wind, low-cost biomass, solar, landfill gas, and nuclear and group energy power plants as per the “Tool to calculate the emission factor for an electricity system” (Version 06.0).
Hydro, geothermal, wind, low-cost biomass, solar, landfill gas and tidal power plants are with low marginal generation costs. Nuclear are power plants dispatched independently of the daily or seasonal load of the grid. And group energy is must run in Korea, because electricity supplied to the grid in group energy is preferentially purchased at the electricity market as prescribed in the “Electric utility act” article 31.

During the 5 year period (2013~2017), the average low-cost/must run generation occupies 38.36% of total grid generation (See Appendix 4)[6]

Thus the (a) Simple OM method can be applied in order to calculate the OM emission factor. The Simple OM emission factor($EF_{OM,simple,y}$) is calculated using a 3 years(2015~2017) generation-weighted average (ex-ante) of all generating power plants serving the system, based on the most recent data available at the time of submission of the PDD.

STEP4. Calculate the operating margin emission factor according to the selected method

According to the “Tool to calculate the emission factor for an electricity system” (Version 06.0), the simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2e/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

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

- Option A : Based on the net electricity generation and a CO_2 emission factor of each power unit, or
- Option B : Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

[5] Low-cost/must-run resources are defined as power plants with low marginal generation costs or dispatched independently of the daily or seasonal load of the grid. They include hydro, geothermal, wind, low-cost biomass, nuclear, solar and tidal generation. If a fossil fuel plant is dispatched independently of the daily or seasonal load of the grid and if this can be demonstrated based on the publicly available data, it should be considered as a low-cost/must-run.

[6] The power plants consuming domestic anthracite coal were excluded from low-cost/must-run resources. Because the Korean government’s policy for promoting consumption of domestic anthracite coal has been weakened: the allocated ratio of the domestic anthracite coal was decreased to 8% in 2015 compared to 97% in 2005. Therefore, the anthracite and bituminous coal were included in OM calculation.

Option A : Calculation based on average efficiency and electricity generation of each power units

As the data on the net electricity generation and a CO_2 emission factor of each power units is available, the proposed project can apply the 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:

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

$EF_{grid,OM,simple,y}$ = Simple operating margin CO_2 emission factor in year y (t CO_2e/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (t CO_2e/MWh)
m= All power units serving the grid in year y except low-cost / must-run power units
y= The relevant year as per the data vintage chosen in Step 3

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

In case of the proposed project, for a power unit m, data on fuel consumption and electricity generation is available in most power plants. Thus, Option A1 is chosen and 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:
$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (t CO_2e/MWh)
$FC_{i,m,y}$ = Amount of fuel type i consumed by power plant m in year y(mass or volume unit)
$NCV_{i,y}$ = Net calorific value of fuel type i in year y(GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fuel type i in year y (t CO_2e/GJ)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power plant m in year y (MWh)
m = All power plants serving the grid in year y except low-cost/must-run power plants
i = All fuel types combusted in power plant m in year y
y = The relevant year as per the data vintage chosen in Step 3

In case only data on electricity generation and the fuel types used are available for some power plants m, Option A2 is chosen and the emission factor($EF_{EL,m,y}$) 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:
$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (t CO_2e/MWh)
$EF_{CO2,i,y}$ = Average CO_2 emission factor of fuel type i used in power unit m in year y (t CO_2e/GJ)
$\eta_{m,y}$ = Average net energy conversion efficiency of power unti m in year y (ratio)
m = All power plants serving the grid in year y except low-cost/must-run power plants
y = The relevant year as per the data vintage chosen in Step 3

For the proposed project, $NCV_{i,y}$ and CO_2 emission factor provided by national official data of Korea are used. Simple OM factor during 3 years (2015~2017) is 0.7043 t CO_2/MWh and this value

is fixed along the credit period. Detailed baseline information used in the calculation is presented in Appendix 4.

STEP5. Calculate the build margin emission factor

According to the "Tool to calculate the emission factor for an electricity system" (Version 06.0), in terms of the vintage of data, project participants can choose between one of the two options (Option 1 and Option 2).

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

- **Option 2** : For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

For the proposed project, Option 2 is chosen. As the proposed project applies the Option 2 to calculate BM emission factor, the emission factor is updated annually for the first crediting period. For the second crediting period, the build margin emissions factor will be calculated ex ante. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.
According to the "Tool to calculate the emission factor for an electricity system" (Version 06.0), the sample group of power unit 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($SET_{5\text{-units}}$) 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 percent of AEG_{total} (if 20 percent falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\ percent}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\ percent}$, in MWh);

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\ percent}$ 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);

If the annual electricity generation of that set is comprises at least 20 per cent of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore Steps (e) and (f).

Otherwise:

(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 units m used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{-}>10yrs}$).

In the proposed project, the net generation of 5 most recent power units on 2017($SET_{5\text{-}units}$) is 2,610,416 MWh and the net generation of units that comprise at least 20% of the system generation on 2017($SET_{sample\text{-}CDM}$) is 106,549,362 MWh. $SET_{\geq 20\ percent}$ is selected to calculate the build margin.

The detailed data used in the calculation are presented in Appendix 4 of this document. According to the “Tool to calculate the emission factors for electricity system” (Version 06.0), the build margin emissions factor is the generation-weighted average emission factor (t CO_2 /MWh) of all power units m during the most recent year y for which electricity generation data is available, calculated as follows:

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

Where:
EF$_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (t CO_2/MWh)
EG$_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
EF$_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (t CO_2/MWh)
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 guidance in step 4 for the simple OM, using option 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.

For BM emission factor, $EF_{EL,m,y}$ of Option A1 is calculated by multiplying $FC_{i,m,y}$ by $NCV_{i,y}$ * $EF_{CO2,i,y}$ and Option A2 is considered for the power plants whose only data on electricity generation and the fuel types used are available. Therefore, BM emission factor is 0.4582 t CO_2/MWh. And further information of the calculation for the BM emission factor is shown in Appendix 4 of this document.

STEP6. Calculate the combined emission factor

According to the "Tool to calculate the emission factor for electricity system" (Version 06.0), the calculation of the combined margin emission factor ($EF_{grid,CM,y}$) is based on one of the following methods;

(a) Weighted average CM; or
(b) Simplified CM.

The weighted average CM method (Option a) should be used as the preferred option. For the proposed project, (a) Weighted average CM is used. The combined emissions factor is calculated as follows:

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

Where:
$\mathbf{EF}_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (t CO_2/MWh)
$\mathbf{EF}_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (t CO_2/MWh)
$\mathbf{w}_{OM}$ = Weighting of operating margin emissions factor (25% for the second crediting period)
$\mathbf{w}_{BM}$ = Weighting of build margin emissions factor (75% for the second crediting period)
$EF_{grid,CM,y}$ = 0.7043 (t CO_2/MWh) Ｘ 25% + 0.4582 (t CO_2/MWh) Ｘ 75%
= 0.5197 (t CO_2/MWh)

Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period

According to the Methodological tool of "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (Version 03.0.1)", the stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period are as follows:

Step 1: Assess the validity of the current baseline for the next crediting period

According to the "CHECKLIST FOR REQUESTS FOR RENEWAL OF CREDITING PERIOD OF PROJECT ACTIVITIES" approved by the CDM Executive Board, updated PDD is required to incorporate the impact of national and/or sectoral policies and circumstances existing at the time of requesting for renewal of the crediting period on the current baseline emissions, except for the case where the project activity applies the valid version of an applicable standardized baseline that standardizes baseline scenario. The validity of the current baseline is assessed using the following Sub-steps:

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

In assessing the continued validity of the baseline, it has been assessed that there is no relevant mandatory national and/or sectoral policies that should be considered to define a new baseline scenario for this renewal of crediting period of the proposed project.
In the renewable energy sector in Korea, the "Act on the Promotion of the Development, Use, and Diffusion of New and Renewable Energy (amended on January 2004)" was valid policy during the

1[st] crediting period. The policy has been amended several times and "Act on the Promotion of the Development, Use, and Diffusion of New and Renewable Energy (amended on March 2017)" is currently valid for the proposed project.
However, the Act (amended on March 2017) does not affect the current baseline of the proposed project. Therefore, there are no relevant mandatory national and/or sectoral policies and the current baseline of the proposed project complies with existing policies.

Step 1.2: Assess the impact of circumstances

As per requirement of the sub-step, it has been assessed that there is no impact of circumstances existing at the time of requesting renewal of the crediting period on the current baseline emissions. As per the 2017 Statistics of Electric Power in Korea (published on June 2018) by KEPCO, although diffusion of the new and renewable energy has been encouraged, the new and renewable resource accounts for only 5.63% of total grid generation in KEPCO in 2017. Hence in the absence of the proposed project, electricity would still have been generated in the existing fossil fuel power plants or by the addition of new fossil fuel power plants connected to the KEPCO grid.

Table 2 The status of power generation of the KEPCO grid (2013~2017)

item	2013	2014	2015	2016	2017
New and renewable (GWh)	18,554	22,515	23,114	25,569	31,141
Total generation (GWh)	517,148	521,971	528,091	540,441	553,530
Proportion of new and renewable (%)	3.59%	4.31%	4.38	4.73%	5.63%

Also project participant has updated the emission factor and estimation of the baseline emissions for the 2nd crediting period in line with the methodology ACM0002 (Version 17.0) and the "Tool to calculate the emission factor for an electricity system (Version 06.0)".

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested

In the absence of the proposed project, the amount of electricity would have been generated by the KEPCO grid. Thus, this sub-step is not applicable to the proposed project.

Step 1.4: Assessment of the validity of the data and parameters

Some parameters fixed ex-ante, which were determined at the start of the 1st crediting period, are not valid anymore. Therefore, the current baseline has been updated for the 2nd crediting period according to the "Tool to calculate the emission factor for an electricity system" (Version 06.0).
This update includes CO_2 emission factor of fossil fuel and all values used in its calculation (including OM and BM). In case of CO_2 emission factor of fossil fuel, the value for the 1st crediting period was derived from IPCC default value as provided in the 1996 IPCC Guidelines but current value for renewal of crediting period is derived from national official data of "Guideline for the greenhouse gas and energy target management operations(30.12.2016.)" according to the methodology ACM0002(Version 17.0) and "Tool to calculate the emission factor for an electricity system(Version 06.0)". In monitoring methodology in "Tool to calculate the emission factor for an electricity system(Version 06.0)", it is stated that national average default values can be used for calculation of emission factor. Therefore, the current baseline needs to be updated and Step 2 is applied.

Step2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

As per the Step 1 above, the current baseline scenario is still valid as per the methodology ACM0002 (Version 17.0). The identified baseline scenario of the proposed project is as follows:

- 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.

Also, the baseline emissions for the 2nd crediting period have been updated, without reassessing the baseline scenario. This update was applied in the context of the sectoral policies and circumstances that are applicable at the time of request for renewal of the crediting period. Further information for the updated baseline emissions for the 2nd crediting period can be seen in section B.6.3.

Step 2.2: Update the data and parameters

As stated in Step 1.4 above, all parameters regarding the grid emission factor calculation have been updated for the 2nd crediting period. Further information can be seen in section B.6.

B.5. Demonstration of additionality

>>
The additionality of this CDM project is determined by using the tool for the demonstration and assessment of additionality as published in Annex 1, the sixteenth meeting report of the executive board (EB-16). The CDM consolidated tool for demonstration of additionality includes the steps as follows;

Step 0. Preliminary screening of projects started after 1 January 2000 and prior to 31December 2005

The construction for installing a cofferdam started in January, 2005.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations in Korea

Sub-step 1a. Define alternatives to the project activity:

The proposed alternatives are as follows,

Alternative 1. The proposed CDM project activity is the construction of a new tidal power plant that produces electricity connected to KEPCO's electricity system.
Alternative 2[7]. The construction of conventional plants that are connected to the KEPCO's grid system, and base-load plants are chosen among them.

- Alternative 2-1. 1000MW Capacity of base-load standard nuclear power plant
- Alternative 2-2. 1400MW Capacity of base-load next generation nuclear power plant
- Alternative 2-3. 500MW Capacity of base-load bituminous coal power plant
- Alternative 2-4. 800MW Capacity of base-load bituminous coal power plant

[7] Sihwa Tidal Power Plant will generate electricity once a day when the inflow of the tides comes in, which means that the plant will not be generating electricity all the time. The available time period to generate electricity is regularly changed little by little everyday with a 14.5 days' cycle. This is different from the regular grid-connected system, but the tidal plant has similar characteristics to the base-load power generation plant in that both plants produce electricity at regular intervals as average rate in a year.

Sub-step 1b. Compliance with applicable laws and regulations:

All proposed alternatives comply with the laws and regulatory requirements for electricity generation in Korea.

Step 2. Investment Analysis

Sub-step 2a. Determine appropriate analysis method

The comparison (Option Ⅱ) demonstrates that the tidal power plant was less financially attractive than any other alternatives.

Sub-step 2b. Option Ⅱ. Apply investment comparison analysis

The Sihwa Tidal Power - Net generation cost

The indicators that have been used for the net generation cost are as follows;

Table 3 Indicators for the net generation cost estimation

Indicator		Figure	Remark
Capacity	MW	254	25.4MW × 10
Possible generation (PG)	GWh/year	552.7	10 Turbines, 8 floodgates
Utilization rate	%	22.814	
Maintenance rate (f1)	%	6.28	Based on Lance Dam, France
In plant consumption rate (f2)	%	2.00	(Same as above)
Sales of Generated electricity (SG)	GWh/year	507.629	SG = PG ·(1-f1) ·(1-f2)
Construction cost per Unit	Thousand KRW/kW	1,566.5	Based on Facility Capacity 254MW
Life time of equipment	Year	30	Based on existing equipment in other plants
Discount rate	%	8	
CRF rate	%	8.883	
Corporation Tax Rate	%	0.018	
Operation maintenance rate	%	2.07	
Fixed rate	%	10.971	Based on CRF, Operating rate, Corporation Tax Rate

Source: Report on the plan for Sihwa tidal power plant design by K-water, 2005

The net generation cost was calculated based on Net generation cost formula from KEPCO.

$$\text{Generation Cost (Net)} = \frac{\text{Construction cost per unit (won/}kW\text{) x Fixed rate (\%)}}{\text{8760 x Utilization rate x (1- In plant consumption rate)}} + \frac{\text{Heat consumption rate (}kcal/kWh\text{) x Fuel cost per unit}}{\text{Calorific value (}kcal/kg\text{) x (1- In plant consumption rate)}}$$

The net generation cost of Sihwa Tidal Power Plant was calculated as 87.75 won/KWh.

Sub-step 2c. Calculation and comparison of financial indicators

For the comparison analysis with alternatives, following indicators were used.

Table 4 Indicators for the comparison analysis

Indicator	Alternative 1	Alternative 2-1	Alternative 2-2	Alternative 2-3	Alternative 2-4
Capacity	254,000 kw	1,000,000 kw	1,400,000 kw	500,000 kw	800,000 kw
Net construction cost per unit (Thousand Korean won/kw)	-	1,498	1,197	1,045	876
Construction term (Month)	54	64	68	44	52
Construction interest (won)		19.96	21.35	13.25	15.88
Total construction cost per unit (Thousand won/kw)	1,567	1,797	1,453	1,183	1,015
Operation maintenance cost (Thousand won/kw, month)		6.66	5.63	4.24	3.43
Life time of facility (year)	30	40	40	30	30
Capital return rate (%)	8.883%	8.386%	8.386%	8.883%	8.883%
Corporate tax rate (%)	0.018%	0.018%	0.018%	0.018%	0.018%
Operation maintenance rate (%)	2.070%	4.447%	4.651%	4.229%	4.055%
Fixed rate (%)	10.971%	12.851%	13.055%	13.130%	12.956%
Fuel purchasing cost (Won/kg, l)				37.157	37.157
Calorific value (kcal/kg,l)				5,780	5,780
Heat consumption rate (Kcal/kwh)		2,315	2,364	2,091	1,377
Calorific value cost per unit (Won/10^6kcal)				6,429	6,429
In plant consumption rate (%)	2.000%	4.700%	4.200%	4.400%	4.200%
Fuel cost (won/kwh)		4.38	4.49	14.06	13.27
R & D (won/kwh)		1.2	1.2		
Utilization rate (%)	22.8%	80.0%	80.0%	80.0%	80.0%

Source: status of power generation facility the year of 2003 by Korea Power Exchange(KPX)

Combined the indicators and the formula above, the each net generation cost was calculated as follows;

Table 5 Result of net generation cost estimation

Results	Alternative 1	Alternative 2-1	Alternative 2-2	Alternative 2-3	Alternative 2-4
Net generation cost (won/KWh)	**87.75**	34.58	28.25	37.25	28.83

As a result of the comparison analysis, the Alternative 1 shows the highest net generation cost. Therefore the Sihwa Tidal Power Plant was not financially attractive.

Sub-step 2d. Sensitivity analysis

The sensitivity analysis was carried out based on the results of Sub-step 2c, about the highly uncertain indicators.

- Net generation cost change based on fuel purchasing cost per unit 50% increase
- Net generation cost change based on fuel purchasing cost per unit 50% decrease
- Net generation cost change based on discount rate 6%, 7%, 8%
- Net generation cost change based on construction cost per unit 10% increase
- Net generation cost change based on construction cost per unit 10% decrease

The result of sensitivity analysis is as follows;

Table 6 Result of sensitivity analysis

	Alternative 1	Alternative 2-1	Alternative 2-2	Alternative 2-3	Alternative 2-4
Material cost per unit 50% increase	**87.75**	34.58	28.25	44.28	33.45
Material cost per unit 50% decrease	**87.75**	34.58	28.25	30.21	24.21
Discount rate 6%,	**70.53**	33.24	27.11	36.60	28.20
Discount rate 7%,	**78.81**	33.92	27.69	36.93	28.51
Discount rate 8%,	**87.75**	34.58	28.25	37.25	28.83
Construction cost per unit 10% increase	**96.52**	38.04	31.08	39.56	30.79
Construction cost per unit 10% decrease	**78.97**	31.12	25.43	34.93	26.87

As a result of the sensitivity analysis, the construction of Sihwa tidal power plant was less financially attractive than any other alternatives.

Step 4. Common Practice Analysis

Sub-step 4a. Other activities similar to the Sihwa Tidal Power Plant in Korea

There is no tidal power plant installed in Korea.

Sub-step 4b. Discuss any similar options that are occurring

There is no relevant data.

Step 5. Impact of CDM registration

The success of the construction and operation of the project will have big impact on Korea environmentally and financially. Environmentally, the project will contribute to decrease GHG emission by 293,760 tonnes of CO_2, as well as some amount of SOx, Nox, and dust. Financially, Sihwa tidal power plant IRR will be increased by 0.79% with the estimated carbon profits.

Table 7 Result of IRR estimation

	Without revenue from selling of CERs	With revenue from selling of CERs
IRR	1.39%	2.18%

*When IRR is caudated at Table 7, 'Alternative Energy Development Promotion Act amended on March, 2002[8].' is not considered.

By achieving this CDM registration, the incentives will give motivation to these kinds of renewable energy power developments that may not be financially attractive without CDM program. Furthermore, it will influence national energy generation policy so that the reduction of GHGs emission can be extended.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

>>
For the baseline determination, project boundary has been accounted CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to this project activity.

The spatial extent of the project boundary includes the project site and all the power plants connected physically to the electricity system of KEPCO.

In the calculation of GHG emissions from the plants included in Project Boundary, the emissions generated during the construction of future power plants, the emissions generated related to electricity transmission and distribution losses, the emissions related to fossil-fuel transportation, mining, water dumping, etc. have not been considered for the baseline.

B.6.2. Data and parameters fixed ex ante

Data / Parameter:	**$EF_{grid,CM,y}$**
Unit:	t CO_2/MWh
Description:	Combined margin CO_2 emission factor for the project electricity system in year y
Source of data:	2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018) (KEPCO) and "2017 Status of Generation Facility (2018)" (KPX).
Value(s) applied:	0.5197
Choice of data or Measurement methods and procedures:	This value was calculated according to the "Tool to calculate the emission factor for an electricity system" (version 06.0). The applied value was derived from "2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018)" (KEPCO) and "2017 Status of Generation Facility (2018)" (KPX).
Purpose of data:	Calculation of baseline emissions
Additional comment:	This value will be applied during the crediting period.

[8] Alternative Energy Development Promotion Act amended on March, 2002.' : Alternative Energy Development Promotion Act amended in March, 2002, the Ministry of Commerce, Industry and Energy (MOCIE) of Korean Government issued the Public Notice N0.2003-61 on 9 October, 2003 and its amendment No. 2004-104 on 19 October, 2004 which compensates the renewable energy electricity generation projects for the difference between the standard price applicable for the electricity generated using the alternative energy and the system marginal price of the grid to promote such kinds of electricity generation.

Data / Parameter:	**$EF_{grid,OM,y}$**
Unit:	t CO_2/MWh
Description:	Operating margin CO_2 emission factor for the project electricity system in year y
Source of data:	2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018) (KEPCO) and “2017 Status of Generation Facility (2018)” (KPX).
Value(s) applied:	0.7043
Choice of data or Measurement methods and procedures:	This value was calculated according to the “Tool to calculate the emission factor for an electricity system” (version 06.0). The applied value was derived from “2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018)” (KEPCO) and “2017 Status of Generation Facility (2018)” (KPX).
Purpose of data:	Calculation of baseline emissions
Additional comment:	This value will be applied during the crediting period.

Data / Parameter:	**$EF_{grid,BM,y}$**
Unit:	t CO_2/MWh
Description:	Build margin CO_2 emission factor for the project electricity system in year y
Source of data:	2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018) (KEPCO) and “2017 Status of Generation Facility (2018)” (KPX).
Value(s) applied:	0.4582
Choice of data or Measurement methods and procedures:	This value was calculated according to the “Tool to calculate the emission factor for an electricity system” (version 06.0). The applied value was derived from “2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018)” (KEPCO) and “2017 Status of Generation Facility (2018)” (KPX).
Purpose of data:	Calculation of baseline emissions
Additional comment:	This value will be applied during the crediting period.

Data / Parameter:	**$FC_{i,m,y}$**
Unit:	Mass: Anthracite, Bituminous, LNG Volume: Heavy oil, Diesel
Description:	Amount of fossil fuel type i consumed by power plant m in year y i : anthracite, bituminous, heavy oil, diesel, LNG m : sample group consisting of power plant capacity additions that comprises 20% of system generation and that have been built most recently. y : year
Source of data:	2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018) (KEPCO)
Value(s) applied:	See the Appendix 4
Choice of data or Measurement methods and procedures:	The applied value was derived from “2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018)” (KEPCO)
Purpose of data:	Calculation of baseline emissions
Additional comment:	This value will be applied during the crediting period.

Data / Parameter:	**$NCV_{i,y}$**
Unit:	kcal/ mass or volume unit
Description:	Net calorific value of fuel i : anthracite, bituminous, heavy oil, diesel oil, LNG y : year

Source of data:	"2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018)" (KEPCO)
Value(s) applied:	See the Appendix 4
Choice of data or Measurement methods and procedures:	The applied value was derived from "2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017,2018)" (KEPCO)
Purpose of data:	Calculation of baseline emissions
Additional comment:	This value will be applied during the crediting period.

Data / Parameter:	**$EF_{CO2,i,y}$**
Unit:	t CO_2/GJ
Description:	CO_2 emission factor of fuel i i : anthracite, bituminous, heavy oil, diesel oil, LNG y : year
Source of data:	Guideline for the greenhouse gas and energy target management operation in Korea (30.12.2016) attached table 22
Value(s) applied:	See the Appendix 4
Choice of data or Measurement methods and procedures:	Country-specific emission factor of fuel were used.
Purpose of data:	Calculation of baseline emissions
Additional comment:	This value is more accurate emission factor developed reflecting Korea's domestic energy source and equipment characteristics. This value will be applied during the crediting period.

Data / Parameter:	**$EG_{m,y}$**
Unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant m in year y
Source of data:	2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018) (KEPCO) and "2017 Status of Generation Facility (2018)" (KPX).
Value(s) applied:	See the Appendix 4
Choice of data or Measurement methods and procedures:	The applied value was derived from "2015, 2016, 2017 Statistics of Electric Power in Korea (2016, 2017, 2018)" (KEPCO), and "2017 Status of Generation Facility (2018)" (KPX).
Purpose of data:	Calculation of baseline emissions
Additional comment:	This value will be applied during the crediting period.

Data / Parameter:	**$\eta_{m,y}$**
Unit:	%
Description:	Average net energy conversion efficiency of power unit m or k in year y
Source of data:	TOOL09:"Determining the baseline efficiency of thermal or electric energy generation systems"
Value(s) applied:	See the Appendix 4
Choice of data or Measurement methods and procedures:	The applied value was derived from the default values provided in Table 2, Appendix of the above mentioned tool(if available).
Purpose of data:	Calculation of baseline emissions
Additional comment:	This value will be applied during the crediting period.

B.6.3. Ex ante calculation of emission reductions

Baseline emission

According to the methodology ACM0002 (Version 17.0), the baseline emissions (BE_y) are to be calculated as follows:

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

Where:
BE_y = Baseline emissions in year y (t CO_2e)
$EG_{PJ,y}$ = 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 (MWh)
$EF_{grid,y}$ = 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" y(t CO_2e/MWh) .

The capacity of the the project is 254MW and average power generation for last 6 years is 483,143 MWh per year.

Table 8. Historical data of last 6 years of the proposed project

item	2012	2013	2014	2015	2016	2017
Total Electricity exported to the grid (MWh)	465,924	483,777	492,172	496,354	495,456	489,466
Electricity imported from the grid(MWh)	4,090	3,942	4,001	4,145	4,094	4,017
Net electricity generation(MWh)	461,833	479,834	488,171	492,208	491,361	485,448
Average of net electricity generation(MWh)						483,143

The emission factor ($EF_{grid,y}$) is calculated according to the procedures prescribed in the "Tool to Calculate the Emission Factor for an Electricity System (Version 06.0)". As per the tool, the combined margin CO_2 emission factor ($EF_{grid,CM,y}$) is considered as CO_2 emission factor of the proposed project.

$EF_{grid,y} = EF_{grid,CM,y}$
The combined margin CO_2 emission factor ($EF_{grid,CM,y}$) is calculated as follows:
(For the specific calculation, refer to the section B.4.)
$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$

Where:
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor in year y (t CO_2e/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (t CO_2e/MWh)
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (t CO_2e/MWh)
w_{OM} = Weighting of operating margin emissions factor (25% for the second crediting period)
w_{BM} = Weighting of build margin emissions factor (75% for the second crediting period)

The combined emissions factor (EF grid,CM,y) is as follows:

$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$
= 0.7043 t CO2e/MWh × 0.25 + 0.4582 t CO2e/MWh × 0.75
= 0.5197 t CO2e/MWh

On the basis of the historical data and combined emissions factor (EF grid,CM,y) above, the baseline emissions are calculated as follows:

$BE_y = EG_{facility,y} \times EF_{grid,CM,y}$
$= 483{,}143$ MWh/yr $\times$ 0.5197 t CO_2e/MWh
$= 251{,}089$ t CO_2e/yr

Project emissions

The project activity generates electricity by utilizing tidal power and it means that there is no greenhouse gas emitted by performing this project activity. Therefore, the project emission is zero.

$PE_y = 0$

Leakage

According to the methodology of ACM0002,(Version 17.0), leakage is to be considered if the energy generating equipment is transferred from another activity. Therefore, leakage in the proposed project activity is zero.

$LE_y = 0$

Estimation of Emission reductions

The project emission reductions can be estimated by following equation.

$ER_y = BE_y - PE_y - LE_y$

Where:
ER_y = Emission reductions in year y (t CO_2e)
BE_y = Baseline emissions in year y (t CO_2e)
PE_y = Project emissions in year y (t CO_2e)
LE_y = Leakage in year y (t CO_2e)

The Emission reductions (ER y) are calculated as follows:
$ER_y = BE_y - PE_y - LE_y$
= 251,089 t CO_2e/yr – 0 t CO_2e/yr – 0 t CO_2e/yr
= 251,089 t CO_2e/yr

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 1	251,089	0	0	251,089
Year 2	251,089	251,089	251,089	251,089
Year 3	251,089	251,089	251,089	251,089
Year 4	251,089	251,089	251,089	251,089
Year 5	251,089	251,089	251,089	251,089
Year 6	251,089	251,089	251,089	251,089
Year 7	251,089	251,089	251,089	251,089
Total	1,757,623			1,757,623
Total number of crediting years	7			
Annual average over the crediting period	251,089	0	0	251,089

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

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

Data / Parameter	**$EG_{PJ,y}$**
Unit	MWh/yr
Description	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
Source of data	Electricity meters
Value(s) applied	483,143 MWh/y
Measurement methods and procedures	This parameter is calculated as difference between $EG_{export,y}$ and $EG_{import,y}$. **$EG_{export,y}$** - The watt-hour meter was installed according to the national standards of the “Measures Act” and the “Rules on the Operation of the Electricity Market”. - The measurement of watt-hour meter will be undertaken by experienced staff who belongs to the K-water. - The electricity supplied to the grid will be measured automatically with the installed meter and those measured data will be delivered to the KPX and K-water **$EG_{import,y}$** - The watt-hour meter was installed according to the national standards of the “Measures Act”. - The electricity imported from the grid will be measured continuously and recorded by K-water.
Monitoring frequency	Continuously measured and recorded monthly
QA/QC procedures	**$EG_{export,y}$** - The watt-hour meter will be calibrated properly in accordance with the “Measures Act” and “Rules on the Operation of the Electricity Market”. - The data of electricity supplied to the grid will be cross-checked by K-water and KPX. -The accuracy range of main watt-hour meters for SEND is ±0.2%. And accuracy range of the sub watt-hour meters is ±0.5%. - The person in charge of monitoring of the proposed project is responsible for all QA/QC procedures. **$EG_{import,y}$** - The watt-hour meter will be properly calibrated or replaced by KEPCO in accordance with the “Measures Act”. - The accuracy range of main watt-hour meters for RECEIVE is ±0.5%. - The person in charge of monitoring of the proposed project is responsible for all QA/QC procedures. - Measured data will be checked by receipt of KEPCO.
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be kept and archived electronically for 2 years after the end of the crediting period or the last issuance of CERs for the proposed project, whichever occurs later.

B.7.2. Sampling plan

>>

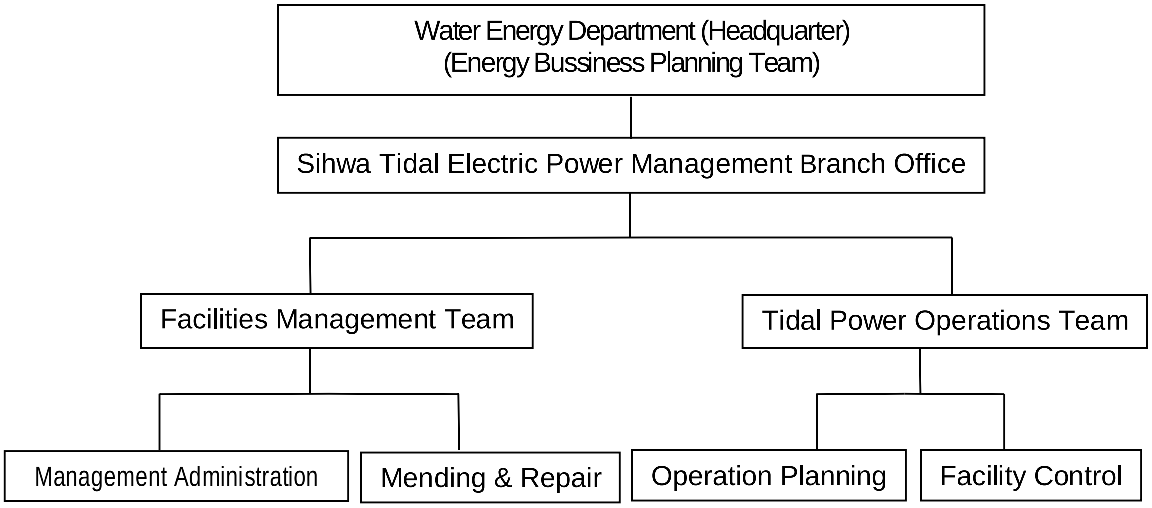
The data and parameters monitored above are not to be determined by a sampling approach. Therefore, sampling plan is not applicable to the proposed project.

B.7.3. Other elements of monitoring plan

>>

Operational and Management Structure

1. Monitoring organization structure, roles and responsibilities



<Figure 8.> Monitoring organization and responsibility

The role and responsibility of the respective monitoring departments and persons are as follows:

- R & R to measure the input-output electricity and maintain watt hour meters: Sihwa Tidal Power Plant Office and Tidal Power Operations Team Member
- R & R to collect and record electricity data and to confirm CM emission factor: The person in charge of CDM in New & Renewable Energy Department
- R & R to check and correct the transmitted electricity by comparing the data of K-water and KPX: The person in charge of adjustment of electricity trading in New & Renewable Energy Department.

* The name of department, team or position in charge can be changed according to reorganization in K-water.

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

- Measuring meter of electricity exported to the grid shall be set up transparently in accordance with “Measures act” and “Rules on the Operation of the Electric Utility Market” then sealed after affirmation of KPX.
- The meters for exported electricity shall be calibrated when they are produced or installed and those are supposed to be re-calibrated regularly in accordance with the “Measures Act” and “Rules on the Operation of the Electric Utility Market” after installation.
- The meters for imported electricity are under KEPCO’s control and calibrated or replaced with new one by KEPCO according to the “Measures act”.
- The data of sub meter are transferred to the “Renewable energy metering information system” at the head office through a modem. And when the watt hour meter is not operating well, the data of sub meter can be used.

(Monitoring of electricity amount)

- The amount of electricity exported to the grid is measured electronically by installed meters.
- The measured data is simultaneously transferred to “central control system of K-water” and KPX.
- The measured amount of electricity is collected daily and monthly and is archived in electronic way. The collected data of electricity exported to the grid are double checked with those of KPX.

(Management of monitoring and electricity safety)

- The person in charge of monitoring and electricity safety are appointed by the final decision-maker and in the case of absence of the responsible person, the second responsible person shall be selected.
- The person in charge of monitoring and electricity safety shall be educated properly according to the related national law and regulation.

(Emergency procedure)

- In case unexpected accident which affects Emission Reductions is occurred, the person in charge of monitoring should report to the responsible department(Energy Planning Team) and act according to the internal manual, namely, “Sihwa Tidal Power Plant Operation Manual in emergency”.
- In case measuring meters of the electricity exported to the grid are improperly operated or the transfer of data is in error, internal investigation and correction procedure shall be followed and certified by the final decision-maker of K-water’s New & Renewable Energy Department and KPX.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>

The starting date of the project activity begins in December 31, 2004.

C.2. Expected operational lifetime of project activity

>>

The estimated operational lifetime is approximately 30 years.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>

Renewable type (2nd crediting period)

C.3.2. Start date of crediting period

>>

01/07/2018 – Start date of 2nd crediting period

C.3.3. Duration of crediting period

>>

7 years – Length of 2nd crediting period

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

HYUNDAI ENGINEERING CO., LTD. (www.hec.co.kr) executed the feasibility study on the Sihwa Tidal Power Plant from the year 2002 to 2003 in accordance with the Impact Assessment Act regarding environment, traffic, and disaster. The consultative meetings for concerning matters over the construction of Sihwa Tidal Power Plant were held by Ministry of Environment and stakeholders, started on March, 2002 and completed on June, 2004.

Due to the incompatibility between the actual construction plan and the approved construction plan, the Ministry of Environment requested K-water to change or revise the items as the environmental impact assessment. In addition, because it became hard to keep track of all the records about

discussions and meetings, the construction plans and consultative meetings were advised to be managed and executed in one unified format. So the consultative meetings reports had to be changed and revised. The schedules of the important events about the EIA are as follows,

- May. 2002: Executed Environmental Impact Assessment.
- June. 2003: Advised from EIA experts on the Sihwa Tidal Power Plant construction.
- Oct. 2003. : Held conferences for the project description and collected opinions from related government departments and environmental NGOs.
- Nov. 2003. : Submitted the EIA report on Sihwa Tidal Power Plant construction.
- June. 2004: Completed the discussion on the EIA.
- March. 2005: Approved and Scheduled for the changed EIA consultative report.

The final EIA consultative report dealt with the issues on the various perspectives such as natural environment, residential environment, and socio-economic environment etc…while the report have the analysis on complicated inter-relationship between environmental impact elements and factors which can be caused by the Sihwa Tidal Power Plant construction.

(The related EIA report was submitted to DOE.)

D.2. Environmental impact assessment

>>

It is possibly expected to take place a landslide effect by the plant construction. Besides, some contaminants which exist in the lake can be diffused to the sea when the plant is operating, and it is expected that certain sediment erosion can be influential in the adjacent area. Therefore the strong measures were established and planned as follows;

1. Landslide reduction plan
   - Install the cofferdam before all the facilities’ construction.
   - Install the contamination-stop-filter that can protect the lake and the sea.
   - Install the provisional waterways and grit chamber.

2. Contaminants diffusion (by the operational discharge) reduction plan
   - Gradually increase the electricity generation when the plant starts operating.
   - Control the amount of discharge

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>

The EIA report was submitted in order to collect opinions and suggestions from government agencies concerned such as Ministry of Environment (ME), Ministry of Maritime Affairs & Fisheries (MMAF), Gyeonggi Province, Hwaseong-city, Ansan-city, and Siheung-city. In response to the EIA report, K-water received written opinions from the above government agencies. Also public opinions were reflected especially from citizens, who were living near the Sihwa Lake. To do this, the schedules of the public hearings and the EIA report displays were announced through newspapers and the internet as follows,

- Announcement dates of the information on the public display and hearing

- • 1. Dec, 2003. on the Hankyoreh Shinmun, the Gyeonggi Shinmun (Newspapers) and Ansan City Hall homepage (www.iansan.net)
- • 13. Dec, 2003. on the Kihoilbo (Newspaper) and Hwaseong City Hall homepage (www.hscity.net)

- Place for Public displays: 8 places were chosen where residents on that area can easily visit and look at the EIA report.
- Period for Public displays: 1. 12. 2003. ~ 9. 1. 2004.

<Figure 9.> Ansan City Hall homepage

2003년 12월1일 월요일

한겨레

THE HANKYOREH

안산시 공고 제 509호

환경영향평가서(초안) 공람 및 주민설명회 개최공고

한국수자원공사에서 시행하는 시화호조력발전건설사업 환경영향평가서(초안) 주민의견수렴을 위한 공람 및 주민설명회 개최일정을 환경·교통·재해등에관한영향평가법 제6조 및 같은법 시행령 제6조, 제7조, 제8조 규정에 의거 다음과 같이 공고합니다.

2003년 12월 1일

안 산 시 장

1. 사업개요
- 사 업 명 : 시화호 조력발전 건설사업
- 사업위치 : 경기도 안산시 대부동 시화방조제 일원
- 사업시행 : 한국수자원공사 사장
- 사업기간 : 2003년 ~ 2009년
- 시설용량 : 252천kw (552백만kwh/년)

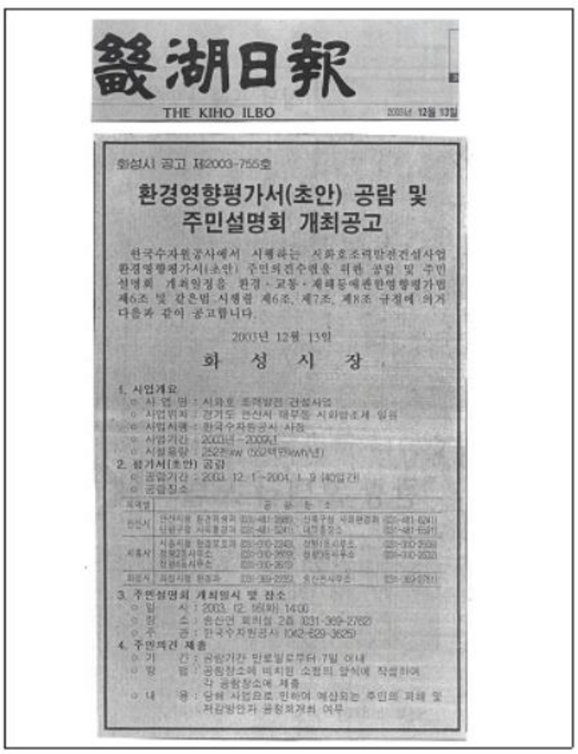
2. 평가서(초안) 공람
- 공람기간 : 2003. 12. 1 ~ 2004. 1. 9 (40일간)
- 공람장소

지역별	공 람 장 소
안산시	안산시청 환경보호과 (031-481-2888), 상록구청 시회환경과 (031-481-6241) 단원구청 사회환경과 (031-481-5241), 대부출장소 (031-481-6591)
시흥시	시흥시청 환경보호과 (031-310-2243), 정왕1동사무소 (031-310-2608) 정왕2동사무소 (031-310-2609), 정왕3동사무소 (031-310-2632) 정왕4동사무소 (031-310-2613)
화성시	화성시청 환경과 (031-369-2232), [illegible] (031-369-2761)

3. 주민설명회 개최일시 및 장소
- 일 시 : 2003. 12. 9(화) 10:00
- 장 소 : 안산시 여성복지회관 4층 강당 (031-481-2761)
- 주 관 : 한국수자원공사 (042-629-3625)

4. 주민의견 제출
- 기 간 : 공람기간 만료일로부터 7일 이내
- 방 법 : 공람장소에 비치된 소정의 양식에 작성하여 각 공람장소에 제출
- 내 용 : 당해 사업으로 인하여 예상되는 주민의 피해 및 저감방안과 공청회개최 여부

<Figure 10.>The Hankyoreh Shinmun,



畿湖日報

THE KIHO ILBO

화성시 공고 제2003-755호

환경영향평가서(초안) 공람 및 주민설명회 개최공고

한국수자원공사에서 시행하는 시화호조력발전건설사업 환경영향평가서(초안) 주민의견수렴을 위한 공람 및 주민설명회 개최일정을 환경·교통·재해등에관한영향평가법 제6조 및 같은법 시행령 제6조, 제7조, 제8조 규정에 의거 다음과 같이 공고합니다.

2003년 12월 13일

화 성 시 장

<Figure 11.> The Kihoilbo

2003년 12월 1일 월요일 제 447호

경기신문

환경영향평가서(초안) 공람 및 주민설명회 개최공고

2003년 12월 1일

안 산 시 장

<Figure 12.> The Gyeonggi Shinmun

The Public hearings to reflect opinions from local residents was held two different times as follows,

1. Date and time: 10:00AM. 9. 12. 2003. ~
   Place: Ansan Women Center Conference Hall
   Target audience: Residents from Ansan-city, Siheung-city, and Hwaseong-city
   Objective: To collect opinions from residents and reflect them to the project planning.

<Figure 13.> First Public hearing at the Ansan Women Center

2. Date and time: 14:00PM. 16. 12. 2003 ~
   Place: Hwaseong-city Songsan-myeon office
   Target audience: Hwaseong-city residents
   Objective: To collect opinions from residents and reflect them to the project planning.

<Figure 14.> Second Public hearing at the Songsan-myeon office

(Note: The report related to the lists of participants and presenters was submitted to DOE separately.)

E.2. Summary of comments received

The target audience to collect opinions for Sihwa Tidal Power plant was mainly the authorities concerns and the residents near that region, and summary of the comments received is as follows.

<Table 9> Summary of stakeholders' comments

	Opinions & Requests	Suggested by	Remark
1-Q	Present a thorough analysis of how sedimentary environment changes resulting from the turbine generators will affect organisms living on the sea floor (Benthos) during the actual operation.	- ME	- Written opinion
2-Q	Present an estimation of how the plant operation will affect the oceanic lives' movements as they pass through the turbine generators.	- ME	- Written opinion
3-Q	It is expected that the tidal plant may give off pollutants into the neighborhood sea area during its trial running. Suggest strong pollution-control measures.	- ME	- Written opinion
4-Q	Will the discharge facilities to reduce air-pollutants be installed during the power plant operation?	- ME	- Written opinion
5-Q	Suggest an established measurement to treat wastewater in case that it is caused by the plant.	- ME	- Written opinion
6-Q	Provide a study report examining on whether the plant causes noises and vibrations during the operation.	- ME	- Written opinion
7-Q	To conserve scenery around the tideland and to keep pedestrians and visitors from being overawed by the aerial power cable, the idea that the aerial power transmission cables are installed under ground or under water should be considered.	- ME - Gyeonggi Prov. - MMAF - Hwaseong-city residents	- Written opinion
8-Q	A port should be constructed in the future because the construction and operation of the tidal power plant may cause inconveniences in operating vessels.	- MMAF	- Written opinion

9-Q	According to the water quality improvement triggered by the tidal power generation, K-water should take measures to boost the local market economy for contributing to the fishery right restoration and the equal regional development.	- Gyeonggi Prov. - Hwaseong-city - Hwaseong-city residents	- Written opinion
10-Q	The escalation of the sea deposit triggered by the increasing amount of sea water flow into Sihwa Lake may cause the mud flat to contain pollutants, and this would critically contaminate the tideland ecosystem. Therefore, K-water should examine it thoroughly and prepare for it.	- Gyeonggi Prov. - MMAF - Hwaseong-city	- Written opinion
11-Q	It is expected to damage around that area because it is difficult to secure the irrigation water for the neighboring farmland during the dry season, so K-water should take proper measures.	- Gyeonggi Prov. - Hwaseong-city	- Written opinion
12-Q	K-water must consider the concerning issues that could cause bad effects on the local communities and the residents during the construction period, and have to provide ways to minimize them.	- Gyeonggi Prov. - Hwaseong-city residents	- Written opinion - Requested opinion at the public display
13-Q	Is it possible to provide free distribution of the electricity produced from the plant for the residents around the Sihwa Lake? Is there any way to return the profit from the plant operation to residents around that region?	- Hwaseong-city residents	- Public hearing
14-Q	How much would the speed change of a running fluid affect the movement of ships?	- Siheung-city	- Annexed paper
15-Q	A board which consists of residents, farmers, and fishermen should be operated and monitor the project if K-water follows the construction plans and the project activity improves the lake water quality.	- Siheung YMCA	- Public hearing

(Note: The full reports related to the written opinions from the government agencies and the public hearings were separately submitted to DOE.)

E.3. Report on consideration of comments received

>>

The results on how due account during the public hearing period was taken as follows.

<Table 10> Report on how to take due account of stakeholders' comments

	How the accounts were managed	Remark
1-A	Carried out the thorough examination of Benthos, and provided a report that expects the sedimentary environment changes based on the examination.	
2-A	Provided the result after examining the possible effects.	
3-A	To minimize undesirable influence on the open sea which would be caused during the trial running of the plant, a plan that the tidal power plant discharges into the open sea step by step was examined, and reflected to the construction plan.	
4-A	It is known that the tidal power plants don't emit the air-pollutants as they generate the electricity using tidal energy source, so there would be no other plans to reduce the air-pollutants.	
5-A	Estimated population when the plant starts operating and reflected measures to be taken and the method of treating wastewater that would occur under the circumstances.	

6-A	Plant facilities such as turbine generators and other systems will be constructed under the ground/water level, so there will be no known influences from noises and vibrations during the operation, and there was no noise effect had been reported in the international practice cases.	
7-A	Transmission lines will be planned to set up under the ground	
8-A	Matters in relation to a port construction should be set up after the port construction plan is completed, and K-water will have a thorough inspection about any inconveniences caused by the plant then.	
9-A	K-water completed the compensation on the fishery right as it will be extinguished by the construction of the plant, and K-water will discuss with relative authorities whether the fishery permit should be given or not after examining the improvement of water quality in Sihwa Lake. In addition, K-water will be in connection with the neighboring tourist attractions to contribute to a local economy's boost by attracting national and international tourists.	
10-A	As a result of a thorough study on the movement of the sea deposit, some degree of soil erosion and suspended solid are expected to occur. Therefore, K-water is planning to remove the sea deposits and reinforce the base of the plant and near the area in order to minimize the influences on tideland ecosystem.	
11-A	Although the plant is commercially operated, the water level of Sihwa Lake will be kept as high as the current water level (EL (-) 1.0m), so it is not expected to have the influences on securing the irrigation water.	
12-A	To minimize undesirable effects which may be caused during the plant construction phase, K-water reflected suggestions and opinions from case studies on practices and experts into the construction plans, and will collect and update the opinions and suggestions from the public and residents continuously.	
13-A	It is difficult to return the profit from the plant operation to residents directly around that area since there are no regulations and programs to support the suggestion, but K-water will discuss with the authorities concerned to make it possible to support the programs by revising the relevant regulations and laws.	
14-A	It is expected that the effect of the velocity of the flow on the movement of ships will be insignificance, but before starting the effluent from the tidal plant, K-water is planning to broadcast an announcement and install mark floats to guide ships and residents around the boundary.	
15-A	Currently 'Sihwa sustainable development conference group' (http://www.sihwa-sd.com) is managed by local residents, experts, and NGOs. They are also planning to monitor matters concerned such as water quality and other environmental, local issues when the plant is constructing and operating.	

(Note: The consultative reports about how due account was taken during public hearings and displays were submitted to DOE separately.)

SECTION F. Approval and authorization

>>

In connection with this project, the K-water is the project participant and parties involved are the Republic of Korea and Switzerland, and the LOAs from two DNA are already posted in CDM website.

Appendix 1. Contact information of project participants

Organization name	Korea Water Resources Corporation (K-water)
Country	Republic of Korea
Address	200, Sintanjin-ro, Daedeok-gu, Daejeon
Telephone	+82-42-629-2988
Fax	+82-42-629-2999
E-mail	kdj@kwater.or.kr
Website	http://english.kwater.or.kr
Contact person	Kim, Deog-je

Appendix 2. Affirmation regarding public funding

There is no public funding invested for this project.

Appendix 3. Applicability of methodologies and standardized baselines

Please refer to section “B.2. Applicability of methodologies and standardized baselines”.

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

<Simple Operating Magin (OM) calculation>

The simple OM method can be used where low cost/must run resources on constitute less than 50% of total grid generation in average of the five most recent years.

< Net generation of power plants groups (MWh)>

Source : 2013~2017 Statistics of Electric Power in Korea (KEPCO)

year	Low cost/must run					Total grid generation(B)	Off-grid		Low cost/must run ratio(A/B)
	Hydro	Nuclear	Alternative*	Group energy**	Subtotal(A)		private power generation	Internal combustion	
2013	8,314,816	132,465,304	10,138,909	14,403,169	165,322,198	494,802,648	1,654,353	227,603	33.41%
2014	7,757,995	149,164,916	14,665,276	18,871,788	190,459,975	500,926,758	561,813	225,264	38.02%
2015	5,759,133	157,161,254	17,286,242	21,940,106	202,146,735	503,505,376	576,355	227,179	40.15%
2016	6,377,606	154,195,147	18,833,841	32,462,140	211,868,734	518,478,254	220,419	237,297	40.86%
2017	6,948,836	141,278,284	23,679,934	36,111,536	208,018,590	531,305,955	304,506	212,507	39.15%
Average of five recent years	**7,031,677**	**146,852,981**	**16,920,840**	**24,757,748**	**195,563,246**	**509,803,798**	**663,489**	**225,970**	**38.36%**

☞ **LCMR share < 50% in recent 5 years → Simple OM**

*Alternative: Wind, Low-cost biomass, Solar, LFG, Tidal, Waste, Fuel cell, IGCC

** Group energy is Low-cost/must run power plants in Korea. Because electricity supplied to the grid by Group energy is preferentially purchased at the electricity market. ('Electric utility act' articale 31)

<u>Simple OM for the proposed project activity</u>

	Net Generation (EGm,y) (MWh)	CO_2 emisson (tCO2/yr)	Operating Margin
2015	301,358,638	213,031,427	0.7069
2016	306,609,522	214,127,940	0.6984
2017	323,287,371	228,718,418	0.7075
Sub total	931,255,531	655,877,785	0.7043
Average(2015~2017)	**0.7043**		

'15.1.1~12.31 OM FACTOR

Division / Power Plant			Net Generation (EG_y) (MWh)	Fuel consumption(Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑ iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
1	Honam	#1	906,485	161,404	267,117	-	1,220	-	977,736	1,375,895	-	11,427	-	5,755	4,893	-	8,898	-	435,557	521,536	-	3,368	-	960,461	1.0595	960,461
2		#2	1,304,091	225,651	362,721	-	1,459	-	1,407,477	1,873,559	-	13,620	-	5,926	4,907	-	8,868	-	626,997	710,176	-	4,014	-	1,341,187	1.0284	1,341,187
3	Donghae	#1	1,058,928	329,151	150,378	-	1,640	-	1,712,985	836,951	-	14,636	-	4,944	5,287	-	8,478	-	763,093	317,248	-	4,314	-	1,084,654	1.0243	1,084,654
4		#2	1,229,553	376,666	175,121	-	747	-	1,976,485	975,983	-	6,638	-	4,985	5,295	-	8,442	-	880,476	369,948	-	1,956	-	1,252,380	1.0186	1,252,380
5	Yeongdong	#1	1,140,872	511,121	-	23,040	25	-	3,005,869	-	231,934	223	-	5,587	-	9,563	8,474	-	1,339,041	-	69,649	66	-	1,408,756	1.2348	1,408,756
6		#2	1,142,230	521,493	-	22,957	39	-	3,047,604	-	231,119	347	-	5,552	-	9,564	8,453	-	1,357,633	-	69,405	102	-	1,427,140	1.2494	1,427,140
7	Seocheon	#1	1,688,376	-	841,477	609	177	-	-	4,708,776	6,075	1,591	-	-	5,316	9,477	8,539	-	-	1,784,871	1,824	469	-	1,787,164	1.0585	1,787,164
8		#2	1,737,375	-	854,350	692	136	-	-	4,806,452	6,903	1,222	-	-	5,345	9,477	8,536	-	-	1,821,895	2,073	360	-	1,824,328	1.0500	1,824,328
9	Samchonpo	#1	3,709,570	-	1,578,335	-	1,498	-	-	9,194,343	-	13,329	-	-	5,534	-	8,453	-	-	3,485,134	-	3,928	-	3,489,062	0.9406	3,489,062
10		#2	4,152,405	-	1,800,430	-	925	-	-	10,335,954	-	8,223	-	-	5,454	-	8,445	-	-	3,917,863	-	2,424	-	3,920,287	0.9441	3,920,287
11		#3	3,869,375	-	1,614,715	-	600	-	-	9,248,704	-	5,332	-	-	5,441	-	8,442	-	-	3,505,739	-	1,571	-	3,507,311	0.9064	3,507,311
12		#4	4,243,288	-	1,731,572	-	511	-	-	9,915,524	-	4,550	-	-	5,440	-	8,459	-	-	3,758,499	-	1,341	-	3,759,840	0.8861	3,759,840
13		#5	4,068,592	-	1,928,546	-	629	-	-	9,528,198	-	5,586	-	-	4,694	-	8,437	-	-	3,611,682	-	1,646	-	3,613,328	0.8881	3,613,328
14		#6	3,749,397	-	1,752,274	-	1,123	-	-	8,640,034	-	9,964	-	-	4,684	-	8,429	-	-	3,275,022	-	2,937	-	3,277,958	0.8743	3,277,958
15	Yeongheung	#1	6,135,677	-	2,470,705	-	3,166	-	-	14,170,453	-	28,409	-	-	5,449	-	8,524	-	-	5,371,338	-	8,373	-	5,379,711	0.8768	5,379,711
16		#2	5,783,422	-	2,339,901	-	2,217	-	-	13,432,968	-	20,476	-	-	5,454	-	8,774	-	-	5,091,793	-	6,035	-	5,097,827	0.8815	5,097,827
17		#3	6,110,441	-	2,401,369	-	1,432	-	-	13,869,654	-	12,862	-	-	5,487	-	8,533	-	-	5,257,319	-	3,791	-	5,261,110	0.8610	5,261,110
18		#4	6,904,319	-	2,716,761	-	1,615	-	-	15,652,576	-	14,735	-	-	5,473	-	8,668	-	-	5,933,379	-	4,343	-	5,937,482	0.8600	5,937,482
19		#5	5,827,850	-	2,474,561	-	2,044	-	-	13,406,932	-	18,841	-	-	5,147	-	8,757	-	-	5,081,924	-	5,553	-	5,087,477	0.8730	5,087,477
20		#6	6,582,437	-	2,787,403	-	916	-	-	15,073,764	-	8,442	-	-	5,137	-	8,755	-	-	5,713,739	-	2,488	-	5,716,228	0.8684	5,716,228
21	Boryeong	#1	3,580,172	-	1,525,824	-	-	-	-	8,660,180	-	-	-	-	5,392	-	-	-	-	3,282,658	-	-	-	3,282,658	0.9169	3,282,658
22		#2	3,516,268	-	1,522,888	-	-	-	-	8,647,829	-	-	-	-	5,395	-	-	-	-	3,277,976	-	-	-	3,277,976	0.9322	3,277,976
23		#3	4,230,944	-	1,737,851	-	-	-	-	9,849,716	-	-	-	-	5,384	-	-	-	-	3,733,554	-	-	-	3,733,554	0.8824	3,733,554
24		#4	3,616,303	-	1,483,207	-	-	-	-	8,406,989	-	-	-	-	5,385	-	-	-	-	3,186,685	-	-	-	3,186,685	0.8812	3,186,685
25		#5	4,172,641	-	1,721,782	-	-	-	-	9,756,227	-	-	-	-	5,383	-	-	-	-	3,698,117	-	-	-	3,698,117	0.8863	3,698,117
26		#6	3,743,948	-	1,496,974	-	-	-	-	8,472,853	-	-	-	-	5,377	-	-	-	-	3,211,651	-	-	-	3,211,651	0.8578	3,211,651
27		#7	3,857,812	-	1,516,753	-	-	-	-	8,602,416	6,033	-	-	-	5,388	-	-	-	-	3,260,762	-	-	-	3,260,762	0.8452	3,260,762
28		#8	3,900,960	-	1,538,039	-	-	-	-	8,728,363	7,041	-	-	-	5,391	-	-	-	-	3,308,503	-	-	-	3,308,503	0.8481	3,308,503
29	Taean	#1	3,398,146	-	1,392,906	-	-	-	-	7,761,289	-	2	-	-	5,293	-	-	-	-	2,941,932	-	-	-	2,941,932	0.8657	2,941,932
30		#2	4,061,915	-	1,695,266	-	-	-	-	9,441,230	-	-	-	-	5,291	-	-	-	-	3,578,717	-	-	-	3,578,717	0.8810	3,578,717

Power Plant	Division		Net Generation (EG_y) (MWh)	Fuel consumption(Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
31		#3	3,633,796	-	1,473,687	-	-	-	-	8,205,050	-	2	-	-	5,289	-	-	-	-	3,110,140	-	-	-	3,110,140	0.8559	3,110,140
32		#4	4,011,224	-	1,639,995	-	-	-	-	9,124,413	-	-	-	-	5,285	-	-	-	-	3,458,626	-	-	-	3,458,626	0.8622	3,458,626
33		#5	4,127,124	-	1,653,295	-	-	-	-	9,459,708	-	2	-	-	5,436	-	-	-	-	3,585,721	-	-	-	3,585,721	0.8688	3,585,721
34		#6	3,581,114	-	1,446,639	-	-	-	-	8,280,449	-	-	-	-	5,438	-	-	-	-	3,138,720	-	-	-	3,138,720	0.8765	3,138,720
35		#7	4,164,501	-	1,670,871	-	-		-	9,440,195	-	2	-	-	5,367	-	-	-	-	3,578,324	-	-	-	3,578,324	0.8592	3,578,324
36		#8	3,941,008	-	1,570,417	-	-	-	-	8,842,443	-	-	-	-	5,349	-	-	-	-	3,351,745	-	-	-	3,351,745	0.8505	3,351,745
37	Hadong	#1	4,037,054	-	1,659,375	-	174	-	-	9,249,902	-	1,618	-	-	5,296	-	8,834	-	-	3,506,193	-	477	-	3,506,670	0.8686	3,506,670
38		#2	3,462,818	-	1,442,810	-	543	-	-	8,056,073	-	4,907	-	-	5,304	-	8,585	-	-	3,053,670	-	1,446	-	3,055,116	0.8823	3,055,116
39		#3	3,560,413	-	1,489,020	-	1,162	-	-	8,301,718	-	10,838	-	-	5,297	-	8,861	-	-	3,146,782	-	3,194	-	3,149,977	0.8847	3,149,977
40		#4	4,010,264	-	1,666,240	-	504	-	-	9,280,202	-	4,611	-	-	5,291	-	8,691	-	-	3,517,679	-	1,359	-	3,519,038	0.8775	3,519,038
41		#5	3,807,043	-	1,560,483	-	445	-	-	8,675,828	-	4,156	-	-	5,282	-	8,872	-	-	3,288,589	-	1,225	-	3,289,814	0.8641	3,289,814
42		#6	4,126,912	-	1,692,087	-	185	-	-	9,426,919	-	1,693	-	-	5,293	-	8,694	-	-	3,573,292	-	499	-	3,573,791	0.8660	3,573,791
43		#7	3,730,255	-	1,477,286	-	291	-	-	8,457,749	-	2,693	-	-	5,439	-	8,792	-	-	3,205,926	-	794	-	3,206,720	0.8597	3,206,720
44		#8	3,730,343	-	1,470,557	-	271	-	-	8,427,761	-	2,447	-	-	5,444	-	8,578	-	-	3,194,559	-	721	-	3,195,280	0.8566	3,195,280
45	Dangjin	#1	4,192,649	-	1,722,505	-	17	-	-	9,683,494	-	149	-	-	5,341	-	8,326	-	-	3,670,547	-	44	-	3,670,591	0.8755	3,670,591
46		#2	4,053,931	-	1,665,737	-	471	-	-	9,448,547	-	4,172	-	-	5,389	-	8,415	-	-	3,581,490	-	1,230	-	3,582,720	0.8838	3,582,720
47		#3	3,930,199	-	1,619,006	-	497	-	-	9,122,747	-	4,430	-	-	5,353	-	8,468	-	-	3,457,995	-	1,306	-	3,459,301	0.8802	3,459,301
48		#4	3,496,634	-	1,438,707	-	351	-	-	8,096,242	-	3,098	-	-	5,346	-	8,385	-	-	3,068,896	-	913	-	3,069,809	0.8779	3,069,809
49		#5	3,277,775	-	1,325,563	-	1,252	-	-	7,626,964	-	11,060	-	-	5,466	-	8,392	-	-	2,891,015	-	3,260	-	2,894,275	0.8830	2,894,275
50		#6	3,400,564	-	1,365,971	-	699	-	-	7,747,654	-	6,219	-	-	5,388	-	8,452	-	-	2,936,763	-	1,833	-	2,938,596	0.8641	2,938,596
51		#7	3,913,468	-	1,567,830	-	175	-	-	8,882,062	-	1,558	-	-	5,382	-	8,458	-	-	3,366,763	-	459	-	3,367,222	0.8604	3,367,222
52		#8	3,961,658	-	1,584,815	-	856	-	-	8,993,862	-	7,588	-	-	5,391	-	8,421	-	-	3,409,141	-	2,236	-	3,411,377	0.8611	3,411,377
53		#9	1,121,151	-	497,975	-	10,815	-	-	2,942,331	-	96,790	-	-	5,613	-	8,502	-	-	1,115,296	-	28,527	-	1,143,823	1.0202	1,143,823
54	Yeosu	#2	1,716,958	-	852,558	-	2,587	-	-	4,266,134	-	23,043	-	-	4,754	-	8,462	-	-	1,617,086	-	6,791	-	1,623,878	0.9458	1,623,878
55	Ulsan	#4	674,409	-	-	157,336	580	-	-	-	1,590,806	5,524	-	-	-	9,605	9,048	-	-	-	477,716	1,628	-	479,344	0.7108	479,344
56		#5	972,938	-	-	236,909	455	-	-	-	2,398,123	4,336	-	-	-	9,616	9,053	-	-	-	720,152	1,278	-	721,430	0.7415	721,430
57		#6	1,270,521	-	-	287,458	897	-	-	-	2,883,302	8,513	-	-	-	9,529	9,016	-	-	-	865,850	2,509	-	868,360	0.6835	868,360
58	Pyongtaek	#1	721,375	-	-	164,206	-	1,330	-	-	1,647,665	-	17,383	-	-	9,532	-	11,763	-	-	494,791	-	3,675	498,466	0.6910	498,466
59		#2	913,724	-	-	203,406	-	1,853	-	-	2,036,533	-	24,208	-	-	9,512	-	11,758	-	-	611,567	-	5,117	616,685	0.6749	616,685
60		#3	808,072	-	-	183,376	-	1,304	-	-	1,836,768	-	17,043	-	-	9,516	-	11,763	-	-	551,578	-	3,603	555,181	0.6870	555,181
61		#4	1,006,489	-	-	226,599	-	1,689	-	-	2,257,768	-	22,056	-	-	9,466	-	11,753	-	-	678,004	-	4,662	682,666	0.6783	682,666
62	Namjeju	#1	583,499	-	-	493	225	-	-	-	5,011	1,694	-	-	-	9,656	7,152	-	-	-	1,505	499	-	2,004	0.0034	2,004
63		#2	655,643	-	-	167,381	49	-	-	-	1,678,315	428	-	-	-	9,526	8,298	-	-	-	503,995	126	-	504,121	0.7689	504,121
64	Jeju	#2	372,736	-	-	96,332	157	-	-	-	942,235	1,325	-	-		9,292	8,018	-	-	-	282,952	391	-	283,342	0.7602	283,342

No.	Power Plant (Division)		Net Generation (EG_y) (MWh)	Fuel consumption(Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
65		#3	366,954	-	-	-	106	-	-	-	-	979	-	-	-	-	8,774	-	-	-	-	289	-	289	0.0008	289
66	Seoul	#4	52,724	-	-	-	-	13,204	-	-	-	-	172,323	-	-	-	-	11,746	-	-	-	-	36,428	36,428	0.6909	36,428
67		#5	157,604	-	-	-	-	37,890	-	-	-	-	494,612	-	-	-	-	11,749	-	-	-	-	104,557	104,557	0.6634	104,557
68	Jeju	G/T	1,654	-	-	-	907	-	-	-	-	-	-	-	-	-	-	-						-	0.6351	1,050
69	Jeju	D/P	379,407	-	-	79,846	-	-	-	-	792,383	-	-	-	-	9,428	-	-	-	-	237,951	-	-	237,951	0.6272	237,951
70	Pyongtaek	C/C	5,298,786	-	-	-	-	681,330	-	-	-	-	8,903,528	-	-	-	-	11,761	-	-	-	-	1,882,130	1,882,130	0.3552	1,882,130
71	Ilsan	C/C	953,738	-	-	-	-	183,187	-	-	-	-	2,392,310	-	-	-	-	11,753	-	-	-	-	505,714	505,714	0.5302	505,714
72	Bundang	C/C	1,871,362	-	-	-	-	330,485	-	-	-	-	4,318,717	-	-	-	-	11,761	-	-	-	-	912,940	912,940	0.4878	912,940
73	Ulsan	C/C	5,762,787	-	-	-	-	765,331	-	-	-	-	9,925,650	-	-	-	-	11,672	-	-	-	-	2,098,198	2,098,198	0.3641	2,098,198
74	Seoincheon	C/C	3,641,719	-	-	-	23	527,135	-	-	-	208	6,894,766	-	-	-	8,591	11,772	-	-	-	61	1,457,495	1,457,556	0.4002	1,457,556
75	Shinincheon	C/C	5,705,029	-	-	-	-	803,274	-	-	-	-	10,490,578	-	-	-	-	11,754	-	-	-	-	2,217,619	2,217,619	0.3887	2,217,619
76	Boryeong	C/C	535,680	-	-	-	-	91,299	-	-	-	-	1,192,413	-	-	-	-	11,754	-	-	-	-	252,066	252,066	0.4706	252,066
77	Incheon	C/C	6,305,419	-	-	-	-	684,470	-	-	-	-	9,152,891	-	-	-	-	12,035	-	-	-	-	1,934,844	1,934,844	0.3069	1,934,844
78	Busan	C/C	5,901,602	-	-	-	60	806,398	-	-	-	535	10,528,827	-	-	-	8,471	11,751	-	-	-	158	2,225,705	2,225,863	0.3772	2,225,863
79	Hallim	C/C	64,179				∨																		0.4303	27,616
80	Andong	C/C	2,160,984	-	-	-	-	275,429	-	-	-	-	3,598,478	-	-	-	-	11,758	-	-	-	-	760,688	760,688	0.3520	760,688
81	Gunsan	C/C	2,705,418	-	-	-	-	381,542	-	-	-	-	4,984,792	-	-	-	-	11,758	-	-	-	-	1,053,743	1,053,743	0.3895	1,053,743
82	Yungwol	C/C	1,191,464	-	-	-	117	173,627	-	-	-	1,044	2,269,079	-	-	-	8,477	11,762	-	-	-	308	479,664	479,972	0.4028	479,972
83	GSPower	C/C	2,216,560	-	-	-	-	389,875	-	-	-	-	5,092,876	-	-	-	-	11,757	-	-	-	-	1,076,591	1,076,591	0.4857	1,076,591
84	POSCOPower	C/C	11,318,570	-	-	-	-	1,483,522	-	-	-	-	19,770,793	-	-	-	-	11,994	-	-	-	-	4,179,378	4,179,378	0.3692	4,179,378
85	GSEPS	C/C	4,327,855	-	-	-	-	544,755	-	-	-	-	7,272,222	-	-	-	-	12,015	-	-	-	-	1,537,286	1,537,286	0.3552	1,537,286
86	Yulchon	C/C	6,938,370	-	-	-	-	311,333	-	-	-	-	4,070,358	-	-	-	-	11,767	-	-	-	-	860,439	860,439	0.1240	860,439
87	Kwangyang	C/C	5,637,724					∨																	0.3257	1,836,207
88	MPCDaesan	C/C	6,493				∨																		0.4303	2,794
89	Osung	C/C	2,867,391					∨																	0.3257	933,909
90	Pochun	C/C	6,090,792					∨																	0.3257	1,983,771
91	Ansan	C/C	5,183,443					∨																	0.3257	1,688,247
92	Dongduchon	C/C	9,322,876					∨																	0.3257	3,036,461
			301,358,638	**2,125,486**	**79,432,655**	**1,850,640**	**46,990**	**8,490,262**	**12,128,156**	**445,412,259**	**18,558,014**	**416,117**	**111,605,903**	**32,748**	**276,349**	**142,758**	**410,451**	**259,355**	**5,402,797**	**168,834,380**	**5,569,013**	**122,640**	**23,592,543**	**203,521,372**		**213,031,427**

0.7069

Orange colored plants : Option A2 was used to calculate the emission factor of units that electricity generation and the fuel types used are available.

CO_2 Emission Factor of fossil fuel type i

fual type	$EF_{CO2,i,y}$ ($kgCO_2/TJ$)	$EF_{CO2,i,y}$ (tCO_2/GJ)
Bituminous	**95,300**	**0.095300**
Heavy Oil	**75,500**	**0.075500**
Diesel Oil	**74,100**	**0.074100**
LNG	**86,100**	**0.056100**
Anthracite	**112,000**	**0.112000**

*Source : Guideline for the greenhouse gas and energy target management operation(2016.12.30) attached table #22

Default efficiency for grid connected power plants

General Technology		Default efficiency factors for power plants(y≥2012)
coal	Subcritical	0.39
	Supercritical	0.45
	Ultra-supercritical	0.5
	IGCC	0.5
	FBS	-
	CFBS	0.4
	PFBS	0.45
oil/natural gas	Steam turbine	0.44
	Reciprocal gas engine	0.485
	Open cycle gas turbine	0.42
	Combined cycle gas turbine	0.62

*Source : Tool 09 Determining the baseline efficiency of thermal or electric generation systems

$$EF_{EL,m,y} = \frac{EF_{co2,m,i,y} \times 3.6}{\eta_{m,y}}$$

$EF_{EL,m,y}$ =	0.3257	LNG C/C
$EF_{EL,m,y}$ =	0.8797	Coal
$EF_{EL,m,y}$ =	0.4303	Oil C/C
$EF_{EL,m,y}$ =	0.6351	Oil G/T

'16.1.1~12.31 OM FACTOR

Division / Power Plant			Net Generation (EG_y) (MWh)	Fuel consumption(Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑ iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
1	Yeongdong	#1	603,750	275,780	-	-	1,075	-	1,519,508	-	-	9,943	-	5,234	-	-	8,787	-	676,904	-	-	2,930	-	679,834	1.1260	679,834
2		#2	1,357,488	613,369	-	-	3,524	-	3,377,684	-	-	31,407	-	5,231	-	-	8,467	-	1,504,676	-	-	9,257	-	1,513,932	1.1152	1,513,932
3	Donghae	#1	1,302,219	605,611	-	-	624	-	3,154,788	-	-	5,491	-	4,949	-	-	8,360	-	1,405,381	-	-	1,618	-	1,406,999	1.0805	1,406,999
4		#2	1,338,591	624,919	-	-	404	-	3,267,440	-	-	3,553	-	4,967	-	-	8,355	-	1,455,565	-	-	1,047	-	1,456,612	1.0882	1,456,612
5	Seocheon	#1	1,191,535	490,239	-	28,615	-	-	2,807,348	-	286,183	-	-	5,440	-	9,501	-	-	1,250,605	-	85,940	-	-	1,336,545	1.1217	1,336,545
6		#2	1,277,283	527,552	-	32,898	-	-	3,029,689	-	328,798	-	-	5,456	-	9,495	-	-	1,349,652	-	98,737	-	-	1,448,390	1.1340	1,448,390
7	Honam	#1	1,504,245	-	754,049	533	151	-	-	4,142,910	5,313	1,350	-	-	5,220	9,470	8,493	-	-	1,570,378	1,595	398	-	1,572,371	1.0453	1,572,371
8		#2	1,502,717	-	736,465	2,077	306	-	-	4,053,108	20,959	2,730	-	-	5,228	9,586	8,475	-	-	1,536,338	6,294	805	-	1,543,437	1.0271	1,543,437
9	Samchonpo	#1	4,223,845	-	1,855,404	-	1,111	-	-	10,494,244	-	9,896	-	-	5,373	-	8,462	-	-	3,977,864	-	2,917	-	3,980,780	0.9425	3,980,780
10		#2	3,556,142	-	1,539,387	-	1,046	-	-	8,689,281	-	9,326	-	-	5,362	-	8,470	-	-	3,293,689	-	2,749	-	3,296,437	0.9270	3,296,437
11		#3	4,324,190	-	1,805,947	-	557	-	-	10,234,993	-	4,941	-	-	5,384	-	8,427	-	-	3,879,594	-	1,456	-	3,881,050	0.8975	3,881,050
12		#4	3,953,108	-	1,669,147	-	476	-	-	9,459,751	-	4,238	-	-	5,384	-	8,458	-	-	3,585,737	-	1,249	-	3,586,986	0.9074	3,586,986
13		#5	3,535,856	-	1,648,244	-	3,094	-	-	8,085,132	-	27,584	-	-	4,660	-	8,470	-	-	3,064,685	-	8,130	-	3,072,815	0.8690	3,072,815
14		#6	3,937,195	-	1,877,745	-	1,826	-	-	9,209,317	-	17,001	-	-	4,659	-	8,845	-	-	3,490,809	-	5,011	-	3,495,820	0.8879	3,495,820
15	Yeongheung	#1	5,285,753	-	2,137,968	-	3,686	-	-	12,296,435	-	33,122	-	-	5,464	-	8,537	-	-	4,660,988	-	9,762	-	4,670,750	0.8836	4,670,750
16		#2	6,185,567	-	2,468,565	-	4,142	-	-	14,170,471	-	37,763	-	-	5,453	-	8,661	-	-	5,371,344	-	11,130	-	5,382,474	0.8702	5,382,474
17		#3	6,770,592	-	2,613,851	-	1,556	-	-	15,141,203	-	13,986	-	-	5,503	-	8,539	-	-	5,739,302	-	4,122	-	5,743,424	0.8483	5,743,424
18		#4	6,086,488	-	2,415,673	-	6,816	-	-	13,986,523	-	60,469	-	-	5,500	-	8,428	-	-	5,301,619	-	17,822	-	5,319,441	0.8740	5,319,441
19		#5	6,619,159	-	2,770,475	-	1,909	-	-	15,238,253	-	17,584	-	-	5,225	-	8,751	-	-	5,776,089	-	5,183	-	5,781,272	0.8734	5,781,272
20		#6	5,603,367	-	2,605,907	-	2,591	-	-	14,315,751	-	23,748	-	-	5,219	-	8,707	-	-	5,426,413	-	6,999	-	5,433,412	0.9697	5,433,412
21	Boryeong	#1	3,403,500	-	1,318,253	-	-	-	-	7,531,619	-	-	-	-	5,428	-	-	-	-	2,854,875	-	-	-	2,854,875	0.8388	2,854,875
22		#2	3,849,894	-	1,520,695	-	-	-	-	8,683,218	-	-	-	-	5,425	-	-	-	-	3,291,391	-	-	-	3,291,391	0.8549	3,291,391
23		#3	3,399,644	-	1,274,162	-	-	-	-	7,240,670	-	-	-	-	5,399	-	-	-	-	2,744,590	-	-	-	2,744,590	0.8073	2,744,590
24		#4	3,815,745	-	1,432,174	-	-	-	-	8,141,634	-	-	-	-	5,401	-	-	-	-	3,086,102	-	-	-	3,086,102	0.8088	3,086,102
25		#5	3,378,237	-	1,246,043	-	-	-	-	7,082,060	-	-	-	-	5,399	-	-	-	-	2,684,469	-	-	-	2,684,469	0.7946	2,684,469
26		#6	3,783,421	-	1,402,135	-	-	-	-	7,973,959	-	-	-	-	5,403	-	-	-	-	3,022,545	-	-	-	3,022,545	0.7989	3,022,545
27		#7	3,971,049	-	1,463,335	-	-	-	-	8,315,743	-	-	-	-	5,399	-	-	-	-	3,152,099	-	-	-	3,152,099	0.7938	3,152,099
28		#8	3,579,932	-	1,282,359	-	-	-	-	7,288,630	-	-	-	-	5,400	-	-	-	-	2,762,769	-	-	-	2,762,769	0.7717	2,762,769
29	Taean	#1	3,883,773	-	1,598,786	-	1	-	-	8,965,843	0	7	-	-	5,328	-	6,650	-	-	3,398,520	-	2	-	3,398,522	0.8751	3,398,522
30		#2	3,487,725	-	1,445,473	-	-	-	-	8,100,515	-	-	-	-	5,324	-	-	-	-	3,070,516	-	-	-	3,070,516	0.8804	3,070,516

No.	Division / Power Plant	Unit	Net Generation (EG_y) (MWh)	Fuel consumption(Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
31		#3	3,807,504	-	1,564,060	-	1	-	-	8,764,571	-	7	-	-	5,324	-	6,650	-	-	3,322,228	-	2	-	3,322,230	0.8725	3,322,230
32		#4	3,480,714	-	1,436,870	-	-	-	-	8,059,934	-	-	-	-	5,329	-	-	-	-	3,055,134	-	-	-	3,055,134	0.8777	3,055,134
33		#5	3,400,358	-	1,396,121	-	1	-	-	8,088,108	-	7	-	-	5,504	-	6,650	-	-	3,065,813	-	2	-	3,065,815	0.9016	3,065,815
34		#6	3,948,874	-	1,570,553	-	-	-	-	9,107,773	-	-	-	-	5,509	-	-	-	-	3,452,319	-	-	-	3,452,319	0.8743	3,452,319
35		#7	3,432,330	-	1,415,166	-	1	-	-	7,979,183	-		-	-	5,356	-	-	-	-	3,024,525	-	-	-	3,024,525	0.8812	3,024,525
36		#8	3,957,424	-	1,628,083	-	-	-	-	9,171,870	-	-	-	-	5,352	-	-	-	-	3,476,615	-	-	-	3,476,615	0.8785	3,476,615
37		#9	2,047,081	-	622,130	-	153	-	-	3,718,029	-		-	-	5,677	-	-	-	-	1,409,326	-	-	-	1,409,326	0.6885	1,409,326
38	Hadong	#1	3,546,375	-	1,485,278	-	552	-	-	8,256,517	-	4,836	-	-	5,281	-	8,323	-	-	3,129,649	-	1,425	-	3,131,074	0.8829	3,131,074
39		#2	3,835,288	-	1,640,734	-	314	-	-	9,115,074	-	2,750	-	-	5,278	-	8,320	-	-	3,455,086	-	811	-	3,455,897	0.9011	3,455,897
40		#3	3,945,377	-	1,656,316	-	331	-	-	9,194,684	-	2,915	-	-	5,274	-	8,366	-	-	3,485,263	-	859	-	3,486,122	0.8836	3,486,122
41		#4	3,599,141	-	1,519,087	-	306	-	-	8,440,621	-	2,718	-	-	5,279	-	8,438	-	-	3,199,434	-	801	-	3,200,235	0.8892	3,200,235
42		#5	3,956,730	-	1,635,920	-	393	-	-	9,084,794	-	3,461	-	-	5,276	-	8,366	-	-	3,443,609	-	1,020	-	3,444,629	0.8706	3,444,629
43		#6	3,557,892	-	1,473,365	-	481	-	-	8,190,427	-	4,216	-	-	5,281	-	8,327	-	-	3,104,597	-	1,243	-	3,105,840	0.8729	3,105,840
44		#7	3,655,507	-	1,463,866	-	585	-	-	8,378,458	-	5,177	-	-	5,437	-	8,407	-	-	3,175,871	-	1,526	-	3,177,397	0.8692	3,177,397
45		#8	3,964,606	-	1,579,353	-	405	-	-	9,040,995	-	3,566	-	-	5,438	-	8,365	-	-	3,427,007	-	1,051	-	3,428,058	0.8647	3,428,058
46	Dangjin	#1	3,108,361	-	1,296,517	-	1,414	-	-	7,265,428	-	14,230	-	-	5,324	-	9,560	-	-	2,753,975	-	4,194	-	2,758,169	0.8873	2,758,169
47		#2	3,330,182	-	1,393,436	-	665	-	-	7,797,302	-	7,248	-	-	5,316	-	10,354	-	-	2,955,582	-	2,136	-	2,957,719	0.8882	2,957,719
48		#3	2,662,324	-	1,119,385	-	1,824	-	-	6,270,438	-	17,522	-	-	5,322	-	9,126	-	-	2,376,822	-	5,164	-	2,381,986	0.8947	2,381,986
49		#4	3,364,706	-	1,432,914	-	575	-	-	8,000,212	-	5,821	-	-	5,304	-	9,617	-	-	3,032,496	-	1,716	-	3,034,211	0.9018	3,034,211
50		#5	3,391,252	-	1,403,942	-	609	-	-	7,864,783	-	5,971	-	-	5,322	-	9,314	-	-	2,981,161	-	1,760	-	2,982,921	0.8796	2,982,921
51		#6	3,467,762	-	1,422,079	-	230	-	-	7,973,283	-	2,014	-	-	5,326	-	8,319	-	-	3,022,288	-	594	-	3,022,882	0.8717	3,022,882
52		#7	2,729,495	-	1,131,048	-	1,554	-	-	6,356,840	-	15,081	-	-	5,339	-	9,219	-	-	2,409,573	-	4,445	-	2,414,017	0.8844	2,414,017
53		#8	2,928,326	-	1,215,067	-	659	-	-	6,809,731	-	6,639	-	-	5,324	-	9,571	-	-	2,581,242	-	1,957	-	2,583,198	0.8821	2,583,198
54		#9	2,422,475	-	1,028,968	-	5,983	-	-	5,810,978	-	52,680	-	-	5,365	-	8,365	-	-	2,202,662	-	15,526	-	2,218,189	0.9157	2,218,189
55		#10	3,459,601	-	709,235	-	340	-	-	3,836,630	-	2,957	-	-	5,139	-	8,262	-	-	1,454,282	-	872	-	1,455,154	0.4206	1,455,154
56	Yeosu	#1	1,252,560	-	471,192	-	2,299	-	-	1,936,693	-	64,679	-	-	3,905	-	26,727	-	-	734,107	-	19,063	-	753,170	0.6013	753,170
57	Yeosu	#2	2,076,173	-	1,132,224	-	994	-	-	5,435,826	-	8,617	-	-	4,561	-	8,236	-	-	2,060,460	-	2,540	-	2,063,000	0.9937	2,063,000
58	Samcheok Green Power		1,194,400	-	710,738	-	17,520		-	3,200,856	-	191,547	-	-	4,278	-	10,386	-	-	1,213,291	-	56,455	-	1,269,745	1.0631	1,269,745
59	shinboryeong	#1	602,154		∨																				0.8797	529,715
60	Bugpyeoung		1,287,995		∨																				0.8797	1,133,049
61	Ulsan	#4	2,013,459	-	-	486,701	474	-	-	-	4,680,076	4,618	-	-	-	9,135	9,255	-	-	-	1,405,419	1,361	-	1,406,780	0.6987	1,406,780
62		#5	1,531,871	-	-	378,492	791	-	-	-	3,822,354	7,597	-	-	-	9,594	9,124	-	-	-	1,147,846	2,239	-	1,150,085	0.7508	1,150,085
63		#6	1,822,724	-	-	431,011	384	-	-	-	3,815,750	3,637		-	-	8,410	8,998	-	-	-	1,145,863	1,072	-	1,146,935	0.6292	1,146,935
64	Pyongtaek	#1	1,198,181	-	-	275,033	32	3,524	-	-	2,754,407	303	46,072	-	-	9,514	8,995	11,766	-	-	827,144	89	9,739	836,972	0.6985	836,972

Division / Power Plant			Net Generation (EG_y) (MWh)	Fuel consumption(Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
65		#2	1,177,974	-	-	262,118	106	4,212	-	-	2,627,792	1,007	54,949	-	-	9,524	9,025	11,741	-	-	789,121	297	11,616	801,034	0.6800	801,034
66		#3	1,185,509	-	-	268,299	88	2,323	-	-	2,691,308	839	30,194	-	-	9,529	9,057	11,698	-	-	808,195	247	6,383	814,825	0.6873	814,825
67		#4	1,424,479	-	-	323,741	87	2,032	-	-	3,245,363	832	26,546	-	-	9,523	9,085	11,758	-	-	974,577	245	5,612	980,434	0.6883	980,434
68	Namjeju	#1	680,034	-	-	-	164	-	-	-	-	1,428	-	-	-	-	8,272	-	-	-	-	421	-	421	0.0006	421
69		#2	573,559	-	-	146,512	105	-	-	-	1,463,247	911	-	-	-	9,488	8,242	-	-	-	439,410	268	-	439,679	0.7666	439,679
70	Jeju	#2	321,786	-	-	75,378	127	-	-	-	747,781	489	-	-	-	9,424	3,658	-	-	-	224,557	144	-	224,701	0.6983	224,701
71		#3	411,669	-	-	12,706	44	-	-	-	110,460	179	-	-	-	8,259	3,865	-	-	-	33,171	53	-	33,224	0.0807	33,224
72	Seoul	#5	348,136	-	-	-	-	66,002	-	-	-	-	862,403	-	-	-	-	11,760	-	-	-	-	182,305	182,305	0.5237	182,305
73	Jeju	G/T	1,160				588																		0.6351	737
74	Jeju	D/P	295,913			59,405					589,678			-	-	9,430	-	-	-	-	177,079	-	-	177,079	0.5984	177,079
75	Seoincheon	C/C	3,883,815	-	-	-	10	561,693	-	-	-	87	7,335,011	-	-	-	8,265	11,753	-	-	-	26	1,550,559	1,550,585	0.3992	1,550,585
76	Shinincheon	C/C	4,926,902	-	-	-	-	728,226	-	-	-	-	9,512,499	-	-	-	-	11,756	-	-	-	-	2,010,862	2,010,862	0.4081	2,010,862
77	Bundang	C/C	2,159,293	-	-	-	-	415,024	-	-	-	-	5,429,502	-	-	-	-	11,774	-	-	-	-	1,147,751	1,147,751	0.5315	1,147,751
78	Ilsan	C/C	1,187,791	-	-	-	-	228,343	-	-	-	-	2,984,762	-	-	-	-	11,764	-	-	-	-	630,953	630,953	0.5312	630,953
79	Pyongtaek	C/C	4,960,093	-	-	-	-	644,446	-	-	-	-	8,423,265	-	-	-	-	11,763	-	-	-	-	1,780,607	1,780,607	0.3590	1,780,607
80	Boryeong	C/C	932,477	-	-	-	-	147,258	-	-	-	-	1,924,998	-	-	-	-	11,765	-	-	-	-	406,928	406,928	0.4364	406,928
81	Ulsan	C/C	5,921,085	-	-	-	-	796,176	-	-	-	-	10,349,426	-	-	-	-	11,699	-	-	-	-	2,187,781	2,187,781	0.3695	2,187,781
82	Hallim	C/C	60,200	-	-	-	12,545	-	-	-	-	111,193	-	-	-	-	8,420	-	-	-	-	32,772	-	32,772	0.5444	32,772
83	Busan	C/C	7,028,187	-	-	-	67	984,639	-	-	-	588	12,873,353	-	-	-	8,337	11,767	-	-	-	173	2,721,318	2,721,491	0.3872	2,721,491
84	Incheon	C/C	5,552,135	-	-	-	-	707,552	-	-	-	-	9,206,519	-	-	-	-	11,711	-	-	-	-	1,946,180	1,946,180	0.3505	1,946,180
85	Gunsan	C/C	2,636,894	-	-	-	-	385,562	-	-	-	-	5,040,389	-	-	-	-	11,766	-	-	-	-	1,065,496	1,065,496	0.4041	1,065,496
86	Yungwol	C/C	740,745	-	-	-	105	112,120	-	-	-	939	1,466,539	-	-	-	8,496	11,772	-	-	-	277	310,014	310,291	0.4189	310,291
87	Andong	C/C	2,631,583	-	-	-	-	337,755	-	-	-	-	4,415,514	-	-	-	-	11,766	-	-	-	-	933,402	933,402	0.3547	933,402
88	POSCO Power	C/C	10,885,790	-	-	-	-	1,094,374	-	-	-	-	14,308,759	-	-	-	-	11,767	-	-	-	-	3,024,750	3,024,750	0.2779	3,024,750
89	GS Power	C/C	2,420,727	-	-	-	-	180,712	-	-	-	-	5,631,287	-	-	-	-	28,045	-	-	-	-	1,190,406	1,190,406	0.4918	1,190,406
90	GS Bugog	C/C	4,621,706	-	-	-	-	598,974	-	-	-	-	7,941,693	-	-	-	-	11,933	-	-	-	-	1,678,807	1,678,807	0.3632	1,678,807
91	Yulchon	C/C	7,105,324	-	-	-	-	282,651	-	-	-	-	3,697,819	-	-	-	-	11,774	-	-	-	-	781,688	781,688	0.1100	781,688
92	Kwangyang	C/C	5,224,415					∨																	0.3257	1,701,592
93	Hyundai- Daesan	C/C	3,871				∨																		0.4303	1,666
94	Osung	C/C	1,999,052					∨																	0.3257	651,091
95	Pochun	C/C	5,531,466					∨																	0.3257	1,801,598
96	Ansan	C/C	4,802,492					∨																	0.3257	1,564,172
97	Dongducheon	C/C	10,186,295					∨																	0.3257	3,317,676

Division / Power Plant			Net Generation (EG_y) (MWh)	Fuel consumption(Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
98	Etc. C/C	C/C	95,753					∨																	0.3257	31,187
	total		**306,609,522**	**3,137,470**	**77,435,889**	**2,783,519**	**88,801**	**8,283,598**	**17,156,457**	**431,991,301**	**27,189,469**	**873,445**	**111,561,499**	**31,278**	**273,958**	**139,883**	**498,706**	**263,299**	**7,642,782**	**163,747,140**	**8,164,949**	**257,430**	**23,583,156**	**203,395,457**	**70.8230**	**214,127,940**

0.6984

Orange colored plants : Option A2 was used to calculate the emission factor of units that electricity generation and the fuel types used are available.

CO_2 Emission Factor of fossil fuel type i

fuel type	$EF_{CO2,i,y}$ ($kgCO_2/TJ$)	$EF_{CO2,i,y}$ (tCO_2/GJ)
Bituminous	**95,300**	**0.095300**
Heavy Oil	**75,500**	**0.075500**
Diesel Oil	**74,100**	**0.074100**
LNG	**86,100**	**0.056100**
Anthracite	**112,000**	**0.112000**

*Source : Guideline for the greenhouse gas and energy target management operation(2016.12.30) attached table #22

Default efficiency for grid connected power plants

General Technology		Default efficiency factors for power plants(y≥2012)
coal	Subcritical	0.39
	Supercritical	0.45
	Ultra-supercritical	0.5
	IGCC	0.5
	FBS	-
	CFBS	0.4
	PFBS	0.45
oil/natural gas	Steam turbine	0.44
	Reciprocal gas engine	0.485
	Open cycle gas turbine	0.42
	Combined cycle gas turbine	0.62

*Source : Tool 09 Determining the baseline efficiency of thermal or electric generation systems

$$EF_{EL,m,y} = \frac{EF_{co2,m,i,y} \times 3.6}{\eta_{m,y}}$$

$EF_{EL,m,y}$ =	0.3257	LNG C/C
$EF_{EL,m,y}$ =	0.8797	Coal
$EF_{EL,m,y}$ =	0.4303	Oil C/C
$EF_{EL,m,y}$ =	0.6351	Oil G/T

'17.1.1~12.31 OM FACTOR

Division / Power Plant			Net Generation (EG_y) (MWh)	Fuel consumption(Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑ iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
1	Yeongdong	#2	739,840	372,854			1,669		2,136,992		-	14,523		5,445	-	-	8,267	-	951,978	-	-	4,280	-	956,258	1.2925	956,258
2	Donghae	#1	1,247,949	592,264			915		3,028,982		-	8,011		4,859	-	-	8,317	-	1,349,337	-	-	2,361	-	1,351,698	1.0831	1,351,698
3		#2	1,038,740	497,546			616		2,520,000		-	5,388		4,812	-	-	8,309	-	1,122,598	-	-	1,588	-	1,124,186	1.0823	1,124,186
4	Seocheon	#1	490,608	208,957		15,099	-		1,194,501		149,362	-		5,431	-	9,398	-	-	532,121	-	44,853	-	-	576,974	1.1760	576,974
5		#2	501,773	219,533		14,546	-		1,248,057		143,802	-		5,401	-	9,392	-	-	555,979	-	43,183	-	-	599,162	1.1941	599,162
6	Dangjin	#1	3,715,995		1,585,298		502			8,866,621	-	4,399		-	5,313	-	8,325	-	-	3,360,910	-	1,297	-	3,362,206	0.9048	3,362,206
7		#2	3,063,079		1,311,799	341	940			7,308,078	-	8,299		-	5,292	-	8,387	-	-	2,770,141	-	2,446	-	2,772,587	0.9052	2,772,587
8		#3	2,410,510		1,047,890	109	989			5,832,008	-	8,675		-	5,287	-	8,333	-	-	2,210,634	-	2,557	-	2,213,191	0.9181	2,213,191
9		#4	2,274,240		965,085		1,165			5,382,731	-	10,181		-	5,299	-	8,302	-	-	2,040,335	-	3,001	-	2,043,335	0.8985	2,043,335
10		#5	2,543,293		1,084,705	31	741			6,002,279	-	6,480		-	5,257	-	8,308	-	-	2,275,175	-	1,910	-	2,277,085	0.8953	2,277,085
11		#6	2,429,487		1,023,355	88	1,120			5,647,975	-	9,813		-	5,243	-	8,324	-	-	2,140,876	-	2,892	-	2,143,768	0.8824	2,143,768
12		#7	2,663,703		1,146,298	85	839			6,329,720	-	7,367		-	5,246	-	8,342	-	-	2,399,293	-	2,171	-	2,401,464	0.9016	2,401,464
13		#8	2,875,461		1,220,053		373			6,738,739	-	3,258		-	5,247	-	8,298	-	-	2,554,332	-	960	-	2,555,292	0.8887	2,555,292
14		#9	6,152,494		2,444,331		926			13,501,648	-	8,078		-	5,247	-	8,287	-	-	5,117,826	-	2,381	-	5,120,207	0.8322	5,120,207
15		#10	5,248,772		2,104,127		2,834			11,655,733	-	24,753		-	5,262	-	8,298	-	-	4,418,128	-	7,295	-	4,425,424	0.8431	4,425,424
16	Boryeong	#1	3,472,194		1,496,051		-			8,491,928	-	-		-	5,392	-	-	-	-	3,218,882	-	-	-	3,218,882	0.9270	3,218,882
17		#2	3,155,453		1,391,754		-			7,827,471	-	-		-	5,343	-	-	-	-	2,967,018	-	-	-	2,967,018	0.9403	2,967,018
18		#3	3,743,486		1,536,383		-			8,733,935	-	-		-	5,401	-	-	-	-	3,310,615	-	-	-	3,310,615	0.8844	3,310,615
19		#4	3,555,622		1,464,074		-			8,308,569	-	-		-	5,391	-	-	-	-	3,149,379	-	-	-	3,149,379	0.8857	3,149,379
20		#5	3,575,516		1,456,859		-			8,283,753	-	-		-	5,402	-	-	-	-	3,139,973	-	-	-	3,139,973	0.8782	3,139,973
21		#6	3,460,331		1,398,349		-			7,973,212	-	-		-	5,417	-	-	-	-	3,022,261	-	-	-	3,022,261	0.8734	3,022,261
22		#7	3,505,437		1,410,211		-			7,978,277	-	-		-	5,375	-	-	-	-	3,024,181	-	-	-	3,024,181	0.8627	3,024,181
23		#8	3,904,445		1,547,655		-			8,781,062	-	-		-	5,390	-	-	-	-	3,328,479	-	-	-	3,328,479	0.8525	3,328,479
24	SamcheokGreenpower	#1	3,322,656		2,024,156		7,242			8,540,913	-	78,440		-	4,009	-	10,290	-	-	3,237,450	-	23,119	-	3,260,568	0.9813	3,260,568
25		#2	3,188,621		1,572,432		855			6,581,099	-	9,340		-	3,976	-	10,378	-	-	2,494,578	-	2,753	-	2,497,331	0.7832	2,497,331
26	Samchonpo	#1	3,118,945		1,333,205		2,012			7,439,955	-	17,530		-	5,301	-	8,277	-	-	2,820,129	-	5,167	-	2,825,296	0.9058	2,825,296
27		#2	3,627,441		1,562,154		1,953			8,697,094	-	17,048		-	5,289	-	8,293	-	-	3,296,650	-	5,025	-	3,301,675	0.9102	3,301,675
28		#3	3,409,246		1,429,991		1,936			8,032,468	-	16,865		-	5,336	-	8,276	-	-	3,044,723	-	4,971	-	3,049,693	0.8945	3,049,693
29		#4	4,235,875		1,769,296		825			9,882,777	-	7,218		-	5,306	-	8,312	-	-	3,746,086	-	2,127	-	3,748,213	0.8849	3,748,213
30		#5	3,935,172		1,851,566		1,012			8,969,620	-	8,846		-	4,602	-	8,304	-	-	3,399,952	-	2,607	-	3,402,559	0.8647	3,402,559

	Division / Power Plant		Net Generation (EG_y) (MWh)	Fuel consumption (Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
31		#6	3,305,075		1,554,991		2,362			7,511,780	-	20,612		-	4,589	-	8,290	-	-	2,847,355	-	6,075	-	2,853,430	0.8633	2,853,430
32	Sinboryeong	#1	5,779,858		2,080,951		4,965			10,648,367	-	43,323		-	4,861	-	8,289	-	-	4,036,284	-	12,769	-	4,049,053	0.7005	4,049,053
33		#2	4,367,686		1,517,218		11,223			9,687,376	-	97,879		-	6,066	-	8,285	-	-	3,672,019	-	28,848	-	3,700,867	0.8473	3,700,867
34	Yeosu	#1	2,101,908		1,268,346		1,911			5,466,699	-	16,678		-	4,095	-	8,291	-	-	2,072,163	-	4,916	-	2,077,078	0.9882	2,077,078
35		#2	1,963,827		1,072,573		1,106			4,942,220	-	9,612		-	4,377	-	8,256	-	-	1,873,358	-	2,833	-	1,876,191	0.9554	1,876,191
36	Yeongheung	#1	5,885,417		2,379,741		2,710			13,703,581	-	24,968		-	5,471	-	8,753	-	-	5,194,369	-	7,359	-	5,201,728	0.8838	5,201,728
37		#2	5,561,119		2,257,078		6,079			13,026,483	-	56,005		-	5,483	-	8,752	-	-	4,937,714	-	16,506	-	4,954,220	0.8909	4,954,220
38		#3	6,241,854		2,442,157		2,557			14,075,128	-	23,554		-	5,475	-	8,751	-	-	5,335,205	-	6,942	-	5,342,147	0.8559	5,342,147
39		#4	6,786,133		2,703,559		4,297			15,579,432	-	37,198		-	5,474	-	8,224	-	-	5,905,414	-	10,963	-	5,916,377	0.8718	5,916,377
40		#5	6,351,315		2,683,507		1,725			14,695,227	-	15,998		-	5,202	-	8,810	-	-	5,570,254	-	4,715	-	5,574,969	0.8778	5,574,969
41		#6	6,487,489		2,703,786		1,419			14,879,666	-	13,097		-	5,228	-	8,768	-	-	5,640,166	-	3,860	-	5,644,026	0.8700	5,644,026
42	Taean	#1	2,850,512		1,170,093		-			6,559,303	-	-		-	5,326	-	-	-	-	2,486,317	-	-	-	2,486,317	0.8722	2,486,317
43		#2	3,313,914		1,343,636		-			7,525,547	-	-		-	5,321	-	-	-	-	2,852,573	-	-	-	2,852,573	0.8608	2,852,573
44		#3	2,510,925		1,015,440		-			5,690,543	-	-		-	5,324	-	-	-	-	2,157,011	-	-	-	2,157,011	0.8591	2,157,011
45		#4	3,319,418		1,359,189		-			7,614,395	-	-		-	5,322	-	-	-	-	2,886,251	-	-	-	2,886,251	0.8695	2,886,251
46		#5	3,347,751		1,417,800		-			8,144,141	-	-		-	5,457	-	-	-	-	3,087,052	-	-	-	3,087,052	0.9221	3,087,052
47		#6	2,986,062		1,218,714		-			7,003,814	-	-		-	5,460	-	-	-	-	2,654,809	-	-	-	2,654,809	0.8891	2,654,809
48		#7	3,288,072		1,375,439		-			7,713,660	-	-		-	5,328	-	-	-	-	2,923,878	-	-	-	2,923,878	0.8892	2,923,878
49		#8	3,280,465		1,353,242		-			7,584,918	-	-		-	5,325	-	-	-	-	2,875,078	-	-	-	2,875,078	0.8764	2,875,078
50		#9	6,899,189		2,826,068		714			14,990,495	-	6,441		-	5,039	-	8,570	-	-	5,682,176	-	1,898	-	5,684,075	0.8239	5,684,075
51		#10	5,072,719		1,796,181		581			9,249,780	-	7,480		-	4,892	-	12,231	-	-	3,506,147	-	2,205	-	3,508,352	0.6916	3,508,352
52	Hadong	#1	3,829,976		1,592,923		193			8,865,612	-	1,695		-	5,287	-	8,343	-	-	3,360,527	-	500	-	3,361,027	0.8776	3,361,027
53		#2	3,348,011		1,417,181		204			7,883,256	-	1,814		-	5,285	-	8,448	-	-	2,988,163	-	535	-	2,988,698	0.8927	2,988,698
54		#3	3,414,733		1,431,715		242			7,978,600	-	2,126		-	5,294	-	8,346	-	-	3,024,304	-	627	-	3,024,930	0.8858	3,024,930
55		#4	3,884,999		1,627,856		160			9,060,896	-	1,409		-	5,288	-	8,366	-	-	3,434,550	-	415	-	3,434,965	0.8842	3,434,965
56		#5	3,606,004		1,502,410		312			8,351,619	-	2,919		-	5,281	-	8,888	-	-	3,165,697	-	860	-	3,166,558	0.8781	3,166,558
57		#6	3,809,100		1,567,058		462			8,717,008	-	4,192		-	5,285	-	8,620	-	-	3,304,199	-	1,236	-	3,305,434	0.8678	3,305,434
58		#7	3,842,465		1,532,177		1			8,695,704	-	10		-	5,392	-	9,500	-	-	3,296,123	-	3	-	3,296,126	0.8578	3,296,126
59		#8	3,689,607		1,457,792		1			8,271,547	-	12		-	5,390	-	11,400	-	-	3,135,346	-	4	-	3,135,349	0.8498	3,135,349
60	Honam	#1	1,569,678		791,772	412	112			4,379,169	4,390	982		-	5,254	10,123	8,329	-	-	1,659,932	1,318	289	-	1,661,540	1.0585	1,661,540
61		#2	1,548,142		767,332	707	146			4,233,172	7,528	1,279		-	5,241	10,115	8,322	-	-	1,604,592	2,261	377	-	1,607,230	1.0382	1,607,230
62	Bukpyeong	#1	2,931,168		∨																				0.6862	2,011,367
63		#2	1,768,922		∨																				0.6862	1,213,834
64	Namjeju	#1	585,931				128				-	1,112		-	-	-	8,253	-	-	-	-	328	-	328	0.0006	328

Division / Power Plant			Net Generation (EG_y) (MWh)	Fuel consumption (Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
65		#2	575,115			146,940	69				1,476,334	596		-	-	9,545	8,206	-	-	-	443,340	176	-	443,516	0.7712	443,516
66	Ulsan#4	#4	603,785			119,150	-				1,199,677	-		-	-	9,565	-	-	-	-	360,261	-	-	360,261	0.5967	360,261
67		#5	533,493			127,953	-				1,290,146	-		-	-	9,579	-	-	-	-	387,429	-	-	387,429	0.7262	387,429
68		#6	809,937			116,267	-				1,171,437	-		-	-	9,572	-	-	-	-	351,780	-	-	351,780	0.4343	351,780
69	Jeju	#1	396,012			30,566	32				300,265	-		-	-	9,332	-	-	-	-	90,169	-	-	90,169	0.2277	90,169
70		#2	347,178			63,652	90				634,284	510		-	-	9,467	5,383	-	-	-	190,474	150	-	190,625	0.5491	190,625
71	Pyeongtaek#1	#1	206,317			48,820	49	3,112			485,304	468	40,640	-	-	9,444	9,073	11,753	-	-	145,736	138	8,591	154,465	0.7487	154,465
72		#2	247,458			57,302	57	2,582			569,967	539	33,745	-	-	9,449	8,983	11,762	-	-	171,160	159	7,133	178,452	0.7211	178,452
73		#3	232,769			54,956	68	2,062			547,436	652	26,944	-	-	9,463	9,109	11,760	-	-	164,394	192	5,696	170,282	0.7315	170,282
74		#4	349,950			81,917	64	2,382			816,100	607	31,116	-	-	9,464	9,010	11,757	-	-	245,073	179	6,578	251,830	0.7196	251,830
75	Seoul	#5	209,245					51,224					669,712	-	-	-	-	11,767	-	-	-	-	141,571	141,571	0.6766	141,571
76	Jeju	G/T	2,359		-		1,019			-	-	7,928		-	-	-	7,391	-	-	-	-	2,337	-	2,337	0.9905	2,337
77	Jeju	D/P	229,627			48,946					485,642			-	-	9,426	-	-	-	-	145,837	-	-	145,837	0.6351	145,837
78	Gunsan	C/C	1,109,949				-	171,917				-	2,253,026	-	-	-	-	11,795	-	-	-	-	476,271	476,271	0.4291	476,271
79	Boryeong	C/C	722,011				-	114,348				-	1,499,585	-	-	-	-	11,803	-	-	-	-	317,000	317,000	0.4391	317,000
80	Busan	C/C	5,239,811				65	725,084				569	9,491,837	-	-	-	8,316	11,782	-	-	-	168	2,006,494	2,006,662	0.3830	2,006,662
81	Bundang	C/C	2,230,974				-	390,249				-	5,106,741	-	-	-	-	11,777	-	-	-	-	1,079,522	1,079,522	0.4839	1,079,522
82	Seoincheon	C/C	2,508,877				3	368,803				34	4,830,724	-	-	-	10,767	11,789	-	-	-	10	1,021,174	1,021,184	0.4070	1,021,184
83	Shinincheon	C/C	3,239,046				-	472,310				-	6,176,134	-	-	-	-	11,769	-	-	-	-	1,305,582	1,305,582	0.4031	1,305,582
84	Andong	C/C	1,397,174				-	183,056				-	2,399,061	-	-	-	-	11,795	-	-	-	-	507,141	507,141	0.3630	507,141
85	Yeongwol	C/C	556,957				76	81,335				680	1,065,363	-	-	-	8,500	11,789	-	-	-	200	225,209	225,409	0.4047	225,409
86	Ulsan	C/C	6,299,890				-	863,230				-	6,957,870	-	-	-	-	7,254	-	-	-	-	1,470,835	1,470,835	0.2335	1,470,835
87	Incheon	C/C	5,855,008				-	846,783				-	12,669,625	-	-	-	-	13,466	-	-	-	-	2,678,251	2,678,251	0.4574	2,678,251
88	Ilsan	C/C	1,057,483				-	203,931				-	1,064,033	-	-	-	-	4,696	-	-	-	-	224,928	224,928	0.2127	224,928
89	Pyeongtaek	C/C	2,864,529				-	385,319				-	5,040,585	-	-	-	-	11,773	-	-	-	-	1,065,537	1,065,537	0.3720	1,065,537
90	Hanlim	C/C	100,042				28,433	-				250,417		-	-	-	8,367	-	-	-	-	73,805	-	73,805	0.7377	73,805
91	Kwangyang	C/C	6,806,932					V																	0.3257	2,217,018
92	Dangjin	C/C	7,256,526					949,569					12,698,702	-	-	-	-	12,036	-	-	-	-	2,684,398	2,684,398	0.3699	2,684,398
93	Dongducheon	C/C	7,337,793					V																	0.3257	2,389,919
94	Busanjeonggwanenergy	C/C	11,061					V																	0.3257	3,603
95	Bucheon	C/C	961,838					179,044					2,341,560	-	-	-	-	11,770	-	-	-	-	494,986	494,986	0.5146	494,986
96	Ansan	C/C	4,452,409					V																	0.3257	1,450,150
97	Anyang	C/C	1,441,875					253,770					3,320,023	-	-	-	-	11,775	-	-	-	-	701,825	701,825	0.4867	701,825

Division / Power Plant			Net Generation (EG_y) (MWh)	Fuel consumption (Fi,y)					Calorific Consumption(106Kcal)					Net Calorific Value(NCVi,y)					FCi,y * NCVi,y * EFCO2,i,y					∑iFCi,y * NCVi,y * EFCO2,i,y (tCO2)	EFEL,m,y (tCO2/ MWh)	∑EGy * EFEL,y
				Anthracite coal(ton)	Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	L.N.G (t)	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G	Anthracite coal (kcal /kg)	Bituminous coal (kcal /kg)l	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	L.N.G (kcal /kg	Anthracite coal	Bituminous coal	Heavy oil	Diesel Oil	L.N.G			
98	Yeongnampower	C/C	885,601					V																	0.3257	288,440
99	Oseong	C/C	2,543,570					V																	0.3257	828,441
100	Yulchon	C/C	6,060,540					253,122					2,923,098	-	-	-	-	10,393	-	-	-	-	617,918	617,918	0.1020	617,918
101	Pajumunsan	C/C	10,255,511					V																	0.3257	3,340,220
102	POSCOenergy	C/C	9,392,145					1,239,922					19,639,592	-	-	-	-	14,255	-	-	-	-	4,151,643	4,151,643	0.4420	4,151,643
103	Pocheon	C/C	4,138,764					V																	0.3257	1,347,995
104	Pocheoncheonyeon	C/C	3,680,760					V																	0.3257	1,198,824
105	Daesan	C/C	1,222				V																		0.4303	526
	total		**323,287,371**	**1,891,154**	**88,405,002**	**927,887**	**103,099**	**7,743,154**	**10,128,532**	**484,516,803**	**9,281,674**	**927,907**	**100,279,716**	**25,946**	**291,735**	**143,333**	**474,417**	**250,516**	**4,512,013**	**183,657,033**	**2,787,270**	**273,482**	**21,198,283**			**228,718,418**

0.7075

Orange colored plants : Option A2 was used to calculate the emission factor of units that electricity generation and the fuel types used are available.

CO_2 Emission Factor of fossil fuel type i

fual type	$EF_{CO2,i,y}$ ($kgCO_2/TJ$)	$EF_{CO2,i,y}$ (tCO_2/GJ)
Bituminous	**95,300**	**0.095300**
Heavy Oil	**75,500**	**0.075500**
Diesel Oil	**74,100**	**0.074100**
LNG	**86,100**	**0.056100**
Anthracite	**112,000**	**0.112000**

*Source : Guideline for the greenhouse gas and energy target management operation(2016.12.30) attached table #22

Default efficiency for grid connected power plants

General Technology		Default efficiency factors for power plants(y≥2012)
coal	Subcritical	0.39
	Supercritical	0.45

$$EF_{EL,m,y} = \frac{EF_{co2,m,i,y} \times 3.6}{\eta_{m,y}}$$

$EF_{EL,m,y}$ =	0.3257	LNG C/C

	Ultra-supercritical	0.5
	IGCC	0.5
	FBS	-
	CFBS	0.4
	PFBS	0.45
oil/natural gas	Steam turbine	0.44
	Reciprocal gas engine	0.485
	Open cycle gas turbine	0.42
	Combined cycle gas turbine	0.62

*Source : Tool 09 Determining the baseline efficiency of thermal or electric generation systems

$EF_{EL,m,y}$ =	0.8797	Coal
$EF_{EL,m,y}$ =	0.4303	Oil C/C
$EF_{EL,m,y}$ =	0.6351	Oil G/T

<*Build Margin* (BM) calculation>

For the calculation of the Build Margin emission factor (BM) the sample group misselected according to Option1

2016NetGeneration(MWh)		Percentage		Remark
Grid total	531,305,955	100.00%		
Sample m-five plants	2,610,416	0.49%		
Sample m-SET>20%	106,549,362	20.05%		**Selected**

Grid generation	Net Generation (MWh)
Total generation	531,822,968
Total grid generation	531,305,955
Island group–Jejudo	212,507
Total island group(offgrid)	444,492
Jejudo(on-grid)	231,985
Non-utility generation	304,506

Carbon Emission Factor

CO2 Emission Factor of fossil fuel type i

fuel type	$EF_{CO2,i,y}$ ($kgCO_2$/TJ)	$EF_{CO2,i,y}$ (tCO_2/GJ)
Bituminous coal	**95,300**	**0.095300**
Heavy Oil	**75,500**	**0.075500**
Diesel Oil	**74,100**	**0.074100**
LNG	**56,100**	**0.056100**
Anthracite	**112,000**	**0.112000**

*Source: Guideline for the green house gas and energy target management operation(2016.12.30) attached table #22

2017 Plant utilization factor of new and renewable energy (applied the most conservative values)

Plants	Utilization factor		
	KEPCO Sub.	Other Co.	Total
Small hydro	32.2%	29.1%	30.0%
Solar	13.6%	14.1%	14.1%
Wind	17.3%	20.7%	20.3%
Biomass	53.1%	64.4%	60.2%
Landfill-gas	0.0%	41.9%	41.9%
Waste-burnup	44.9%	36.7%	37.1%
Fuel cell	67.1%	66.9%	66.9%

* Source : 2017 Statistics of Electric Power in Korea (KEPCO)

** Adoption of the largest between the respective energy resources utilization factor data for conservative calculation.

Default efficiency for grid connected power plants

General Technology		Default efficiency factors for power plants(y≥2012)
coal	Subcritical	0.39
	Supercritical	0.45
	Ultra-supercritical	0.5
	IGCC	0.5
	FBS	-
	CFBS	0.4
	PFBS	0.45
oil/natural gas	Steam turbine	0.44
	Reciprocal gas engine	0.485
	Open cycle gas turbine	0.42
	Combined cycle gas turbine	0.62
cogeneration	Steam turbine	0.835
	Gas turbine	0.788
	Reciprocal engine	0.888
	Mircoturbine	0.777

*Source : Tool 09 Determining the baseline efficiency of thermal or electric generation systems

$$EF_{EL,m,y} = \frac{EF_{co2,m,i,y} \times 3.6}{\eta_{m,y}}$$

LNG C/C	$EF_{EL,m,y}$ =	0.3257
Coal(Ultra-supercritical)	$EF_{EL,m,y}$ =	0.6862
Coal(IGCC)	$EF_{EL,m,y}$ =	0.6862
Cogeneration(LNG,Gas)	$EF_{EL,m,y}$ =	0.2563
Cogeneration(LNG,Steam)	$EF_{EL,m,y}$ =	0.2419
Cogeneration(Coal,Steam)	$EF_{EL,m,y}$ =	0.4109

BM Factor(2017)

	Plant(m)	Installed Capacity (MW)	Completion date	Fuel(i) type	*Net Generation(EGm,y) (MWh)	**Fuel consumption($F_{i,y}$)				***Calorific Consumption(10^6Kcal)				Net Calorific value($NCV_{i,y}$)				$F_{i,y}$*$NCV_{i,y}$*$EF_{CO2,i,y}$				$\sum F_{i,y}$*$CV_{i,y}$ * $EF_{CO2,i,y}$(tCO_2)	$EF_{EL,m,y}$ (tCO_2 /MWh)	$EG_{m,y}$ *$EF_{EL,m,y}$ (tCO_2)
						Bituminous coal(ton)	Heavy oil(kl)	Diesel Oil(kl)	LNG (ton)	Bituminous coal	Heavy oil	Diesel Oil	LNG	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)			
2017	SolarTotal	1,346	2017.12	Solar	1,662,513																			
	Dongtan#1,2 Cogeneration	757	2017.12	thermal	944,019				V														0.2513	237,203
	Dongbongni-wind	2.00	2017.12	Wind	302																			
	Dusan-wind	3.00	2017.12	Wind	453																			
	Gyeongju#2-wind	21	2017.12	Wind	3,128																			
	Daecheongdaem#2-smallhydro	0.90	2017.12	Small hydro	212																			
	Geumgwang-smallhydro	0.36	2017.12	Small hydro	85																			
	Hapcheon#2-smallhydro	1.80	2017.12	Small hydro	423																			
	Jejuchuksan#2-bio	0.19	2017.11	Biomass	179																			
	Sinboryeong-fuelcell	7.48	2017.11	fuelcell	7,328																			
	Daewoo-waste	0.91	2017.11	waste-burnup	596																			
	Yeongnampo werC/C	443	2017.10	thermal	885,601				V														0.3257	288,440
	Hajang#3-wind	4.60	2017.10	Wind	2,085																			
	Yeongyangmuchang-wind	24	2017.10	Wind	10,948																			
	Eungdori-wind	0.02	2017.10	Wind	9																			
	Myogokjigu-smallhydro	0.25	2017.10	Small hydro	176																			
	Gwangmyeonggreen-fuelcell	2.64	2017.10	fuelcell	3,879																			
	UlsanSRF-waste	1.80	2017.10	waste-burnup	1,770																			
	Sinboryeong#2	926	2017.09	thermal	4,367,686	1,517,218		11,223		9,687,376	-	97,879		6,066	-	8,285	-	3,672,019	-	28,848	-	3,700,867	0.8473	3,700,867
	Yangguri-wind	76	2017.09	Wind	45,877																			
	Dodeuram-bio	0.25	2017.09	Biomass	470																			
	Yuilsaneop-fuelcell	0.42	2017.09	fuelcell	823																			
	Seongnim#1-waste	9.10	2017.09	waste-burnup	11,931																			
	Bukpyeong#2	595	2017.08	thermal	1,768,922	V																	0.6862	1,213,834
	Daegi#1-wind	2.35	2017.08	Wind	1,776																			
	Daegi#2-wind	2.35	2017.08	Wind	1,776																			
	SamcheokGreenpower-smallhydro	2.75	2017.08	Small hydro	3,074																			
	Gimhae#2-bio	0.50	2017.08	Biomass	1,164																			
	Gwangjujeonnam-waste	22	2017.08	waste-burnup	36,038																			
	BusanjeonggwanenergyC/C	46	2017.07	thermal	11,061				V														0.3257	3,603

Plant(m)	Installed Capacity (MW)	Completion date	Fuel(i) type	*Net Generation(EGm,y) (MWh)	**Fuel consumption($F_{i,y}$)				***Calorific Consumption(10^6Kcal)				Net Calorific value($NCV_{i,y}$)				$F_{i,y}$*$NCV_{i,y}$*$EF_{CO2,i,y}$				$\sum F_{i,y}$*$CV_{i,y}$ * $EF_{CO2,i,y}$(tCO_2)	$EF_{EL,m,y}$ (tCO_2/MWh)	$EG_{m,y}$ *$EF_{EL,m,y}$ (tCO_2)
					Bituminous coal(ton)	Heavy oil(kl)	Diesel Oil(kl)	LNG (ton)	Bituminous coal	Heavy oil	Diesel Oil	LNG	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)			
Daegwallyeong#1-wind	3.30	2017.07	Wind	2,992																			
Yuryangmori Seouljungnang#3-smallhydro	0.01	2017.07	Small hydro	11																			
Yuryangmori Seouljungnang#4-smallhydro	0.01	2017.07	Small hydro	11																			
Cheongyang#2-bio	0.40	2017.07	Biomass	1,128																			
Pocheon-fuelcell	0.44	2017.07	fuelcell	1,293																			
ESsejong-waste	0.80	2017.07	waste-burnup	1,573																			
Sinboryeong#1	926	2017.06	thermal	5,779,858	2,080,951		4,965		10,648,367	-	43,323		4,861		8,289		4,036,284	-	12,769	-	4,049,053	0.7005	4,049,053
Taean#10	1,050	2017.06	thermal	5,072,719	1,796,181		581		9,249,780	-	7,480		4,892		12,231		3,506,147	-	2,205	-	3,508,352	0.6916	3,508,352
SamcheokGreenpower#2	1,022	2017.06	thermal	3,188,621	1,572,432		855		6,581,099	-	9,340		3,976		10,378		2,494,578	-	2,753	-	2,497,331	0.7832	2,497,331
IlsanPurificationPlant-smallhydro	0.25	2017.06	Small hydro	411																			
Gimhae#1-bio	0.99	2017.06	Biomass	3,258																			
ChuncheonCogeneration	431	2017.05	thermal	1,925,299				V														0.2515	484,214
Gunjang#5Cogeneration	29	2017.04	thermal	201,213	V																	0.4109	82,679
WiryeCogeneration	413	2017.04	thermal	2,531,391				V														0.2513	636,205
DangjinC/C	846	2017.04	thermal	2,245,709				293,867				3,929,924	-	-	-	12,036	-	-	-	830,753	830,753	0.3699	830,753
Moktongcarbonzero-smallhydro	0.10	2017.04	Small hydro	209																			
Jeju-stockraising-bio	0.10	2017.04	Biomass	372																			
Yeongdong#1-bio	125	2017.04	Biomass	502,745																			
Seonchang-bio	3.30	2017.04	Biomass	12,411																			
Namhae-environment-bio	0.48	2017.04	waste-burnup	1,416																			
PocheoncheonyeonC/C	874	2017.03	thermal	3,680,760				V														0.3257	1,198,824
Bukpyeong#1	595	2017.03	thermal	2,931,168	V																	0.6862	2,011,367
BusanGreen#2-fuelcell	15	2017.03	fuelcell	75,434																			
SiheungbaegotBoosterStation-fuelcell	6.00	2017.03	fuelcell	29,390																			
Tuium-bio	0.45	2017.02	Biomass	2,327																			
DonguALT-bio	1.10	2017.02	Biomass	5,688																			
PajumunsanC/C	1,695	2017.02	thermal	10,255,511				V														0.3257	3,340,220
Gangneungdaegiri#1-wind	14	2017.01	Wind	25,386																			
Gangneungdaegiri#2-wind	12	2017.01	Wind	21,760																			
Eogok-wind	2.08	2017.01	Wind	3,772																			

	Plant(m)	Installed Capacity (MW)	Completion date	Fuel(i) type	*Net Generation(EGm,y) (MWh)	**Fuel consumption($F_{i,y}$)				***Calorific Consumption(10^6Kcal)				Net Calorific value($NCV_{i,y}$)				$F_{i,y}$*$NCV_{i,y}$*$EF_{CO2,i,y}$				$\sum_i F_{i,y}$*$CV_{i,y}$*$EF_{CO2,i,y}$(tCO_2)	$EF_{EL,m,y}$ (tCO_2/MWh)	$EG_{m,y}$*$EF_{EL,m,y}$ (tCO_2)
						Bituminous coal(ton)	Heavy oil(kl)	Diesel Oil(kl)	LNG (ton)	Bituminous coal	Heavy oil	Diesel Oil	LNG	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)			
	Organicwaste	1.05	2017.01	Biomass	5,924																			
	Vinotec-waste	2.57	2017.01	waste-burnup	10,089																			
	SolarTotal	1,179	2016.12	Solar	1,456,107																			
	Shin-Gori#3	1,400	2016.12	Nuclear	12,405,607																	-	-	-
	SamcheokGreenpower#1	1,022	2016.12	thermal	3,322,656	2,024,156	-	7,242	-	8,540,913	-	78,440	-	4,009	-	10,290	-	3,237,450	-	23,119	-	3,260,568	0.9813	3,260,568
	Jeonjupower-bio	32	2016.12	Biomass	182,557																			
	Bakdalsewagetreatmentplant-bio	2.66	2016.12	Biomass	15,029																			
	Jinrofermentation-bio	2.90	2016.12	Biomass	16,360																			
	Moktongcarbonzero-wind	0.01	2016.12	Wind	11																			
	Yaksu-wind	20	2016.11	Wind	35,904																			
	Windsystemassessmentcenter-wind	3.00	2016.11	Wind	5,440																			
	Hajang#2-wind	3.00	2016.11	Wind	5,440																			
	Gangdong-wind	7.05	2016.11	Wind	12,784																			
	Noeulgreen-fuelcell	20	2016.11	fuelcell	117,559																			
	Busangreen#1-fuelcell	15	2016.11	fuelcell	90,521																			
2016	Hamyang-gun-waste	0.14	2016.11	waste-burnup	551																			
	Taean-thermal#9	1,050	2016.10	thermal	6,899,189	2,826,068		714	-	14,990,495	-	6,441	-	5,039	-	8,570	-	5,682,176	-	1,898	-	5,684,075	0.8239	5,684,075
	Cheonbuk-wind	7.05	2016.10	Wind	12,784																			
	Cheonsa-wind	42	2016.10	Wind	76,159																			
	SinBoryeong-smallhydro	5.00	2016.10	Small hydro	12,127																			
	Recycling-bio	1.75	2016.10	Biomass	9,873																			
	Reduce-dio	0.70	2016.10	Biomass	3,949																			
	Nonsangyeryong-bio	0.60	2016.10	Biomass	3,385																			
	KFenergy-bio	0.10	2016.10	Biomass	536																			
	Dangjin-thermal#10	930	2016.09	thermal	5,248,772	2,104,127		2,834	-	11,655,733	-	24,753	-	5,262	-	8,298	-	4,418,128	-	7,295	-	4,425,424	0.8431	4,425,424
	Tamna#1ocean-wind	18	2016.09	Wind	32,640																			
	Tamna#25ocean-wind	12	2016.09	Wind	21,760																			
	Changnyeong-smallhydro	0.08	2016.09	Small hydro	226																			
	Seongmun#1-bio	39	2016.09	Biomass	219,452																			
	Yeosu-thermal#1	340	2016.08	thermal	2,101,908	1,268,346		1,911	-	5,466,699	-	16,678	-	4,095	-	8,291	-	2,072,163	-	4,916	-	2,077,078	0.9882	2,077,078
	TaeanIGCCST#9	346	2016.08	thermal(IGCC)	961,604	V																	0.6862	659,853

	Plant(m)	Installed Capacity (MW)	Completion date	Fuel(i) type	*Net Generation(EGm,y) (MWh)	**Fuel consumption($F_{i,y}$)				***Calorific Consumption(10^6Kcal)				Net Calorific value($NCV_{i,y}$)				$F_{i,y}$*$NCV_{i,y}$*$EF_{CO2,i,y}$				$\sum F_{i,y}$*$CV_{i,y}$ * $EF_{CO2,i,y}$(tCO2)	$EF_{EL,m,y}$ (tCO2 /MWh)	$EG_{m,y}$ *$EF_{EL,m,y}$ (tCO2)
						Bituminous coal(ton)	Heavy oil(kl)	Diesel Oil(kl)	LNG (ton)	Bituminous coal	Heavy oil	Diesel Oil	LNG	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)			
	Hongseongmosando-wind	2.00	2016.08	Wind	3,627																			
	Yeongjudam-smallhydro	5.00	2016.08	Small hydro	14,104																			
	Juwol-smallhydro	0.05	2016.08	Small hydro	141																			
	Janggun-bio	5.00	2016.08	Biomass	28,207																			
	Dangjin-thermal#9	930	2016.07	thermal	6,152,494	2,444,331		926	-	13,501,648	-	8,078	-	5,247	-	8,287	-	5,117,826	-	2,381	-	5,120,207	0.8322	5,120,207
	Jejusangmyeong-wind	21	2016.07	Wind	38,080																			
	Yongdamgosan-smallhydro	0.80	2016.07	Small hydro	2,257																			
	Seomjingangdaem-smallhydro	1.65	2016.07	Small hydro	4,654																			
	Heungmaeum-bio	0.82	2016.07	Biomass	4,626																			
	Budang#3-fuelcell	3.38	2016.07	fuelcell	33,622																			
	Gowon-wind	18	2016.06	Wind	32,640																			
	Geumseong-wind	3.05	2016.06	Wind	5,531																			
	YongyeonPurificationPlant-smallhydro	0.76	2016.06	Small hydro	2,144																			
	Bocheong-smallhydro	0.35	2016.05	Small hydro	987																			
	Daewongreen-waste	2.90	2016.05	waste-burnup	11,406																			
	Boryeonggreen-waste	0.44	2016.05	waste-burnup	1,731																			
	Gunjang#4Cogeneration	250	2016.04	thermal	2,353,371	V																	0.4109	967,000
	Uiryeong-wind	19	2016.04	Wind	34,000																			
	Maengdong-wind	0.36	2016.04	Small hydro	1,015																		-	
	Oneeco-waste	2.80	2016.04	waste-burnup	11,013																			
	Anseong-bio	1.05	2016.04	Biomass	5,924																			
	Cheonil-bio	0.20	2016.04	Biomass	1,128																			
	MyeongpumosanCogeneration	436	2016.02	thermal	3,254,887				V														0.2514	818,415
	GumhoyeosuCogeneration	145	2016.02	thermal	868,976	V																	0.4109	357,062
	Bukpyeong-ocean-smallhydro	5.00	2016.01	Small hydro	14,104																			
2015	SolarTotal	745	2015.12	Solar	920,472																			
	Geochang-wind	14	2015.12	Wind	25,386																			
	Samyangsaulsan-wate	3.70	2015.12	waste-burnup	14,553																			
	Seogwangsaneop-bio	2.40	2015.12	Biomass	13,539																			
	Saeman-geum#1,2Cogeneration	303	2015.11	thermal	2,095,994	V																	0.4109	861,244

Plant(m)	Installed Capacity (MW)	Completion date	Fuel(i) type	*Net Generation(EGm,y) (MWh)	**Fuel consumption($F_{i,y}$)				***Calorific Consumption(10^6Kcal)				Net Calorific value($NCV_{i,y}$)				$F_{i,y}$*$NCV_{i,y}$*$EF_{CO2,i,y}$				$\sum_i F_{i,y}$*$CV_{i,y}$* $EF_{CO2,i,y}$(tCO_2)	$EF_{EL,m,y}$ (tCO_2/MWh)	$EG_{m,y}$ *$EF_{EL,m,y}$ (tCO_2)
					Bituminous coal(ton)	Heavy oil(kl)	Diesel Oil(kl)	LNG (ton)	Bituminous coal	Heavy oil	Diesel Oil	LNG	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)			
Hwasun-wind	16	2015.11	Wind	29,013																			
DNI-wind	1.65	2015.11	Wind	2,992																	-	-	
Hajang-wind	3.00	2015.11	Wind	5,440																			
HanamCogeneration	364	2015.10	thermal	2,012,403				V														0.2514	505,955
DonghwaPurificationPlant-smallhydro	0.12	2015.10	Small hydro	338																			
KHpower-fuelcell	1.00	2015.10	fuelcell	5,878																	-	-	
Cheongju-bio	0.50	2015.10	Biomass	2,793																			
CGN#3-fuelcell	5.00	2015.10	fuelcell	29,390																			
Taebaengmaebong#2-wind	2.00	2015.09	Wind	3,627																			
BioDH#2-bio	0.15	2015.09	Biomass	846																			
NET-waste	1.80	2015.08	waste-burnup	7,080																			
Sinwolsong#2	1,000	2015.07	Nuclear	6,234,194																			
Gunsansandan-wind	4.95	2015.07	Wind	8,976																			
Genesisenergy-wind	0.10	2015.07	Wind	180																			
Sejong-waste	2.45	2015.07	waste-burnup	9,636																			
Gyeongsaneco#1-waste	1.88	2015.06	waste-burnup	7,375																			
GSYeongyang-wind	59	2015.06	Wind	107,711																			
Donghwa1#1-smallhydro	0.60	2015.06	Small hydro	1,692																			
GSDangjin-biomass	100	2015.05	Biomass	564,144																			
			$\Sigma_m EG_{m,y}$=	106,549,362																		$\sum_m EG_{m,y}$*$EF_{EL,m,y}$=	48,819,823

*,**,*** Source : 2017 Statistics of Electric Power in Korea (KEPCO, 2018.6), 2017 Status of Generation facility(KPX, 2018.7)

0.4582

1) The power units registered as CDM project activities are not included.

2) The power units whose amount of net generation was missing in the "2017 Statistics of Electric Power in Korea" were calculated by plant capacity and plant utilization factor of each units. (plant capacity ; 2017 Status of Generation facility(KPX, 2018.7.), plant utilization factor ; 2017 Statistics of Electric Power in Korea(KEPCO, 2018.6.))

Orange colored plants : Option A2 was used to calculate the emission factor of units that electricity generation and the fuel types used are available.

Appendix 5. Further background information on monitoring plan

Please refer to section “B.7. Monitoring plan”.

Appendix 6. Summary report of comments received from local stakeholders

Please refer to section “E.2. Summary of comments received”

Appendix 7. Summary of post-registration changes

1) Nov 23rd 2012(PRC-0349-001)
   (a) Korea Water Resources Corporation, which is the project participant, has made corrections of the project participant(s) as a result of withdrawal of Ecoeye Co. Ltd from the project participant(s) on 22nd Aug, 2009. After the withdrawal, the project participant is only Korea Water Resources Corporation.
   (b) The abbreviation of Korea Water Resources Corporation was changed from KOWACO to K-water.
   (c) The project participant changed build margin emission factor as referring to Statistics of Electric Power in Korea by KEPCO in recent years.

2) May 3rd 2013(PRC-0349-002)
   (a) GPS information described in the approved revised PDD has been changed.

3) Oct 30th 2014(PRC-0349-003)
   (a) Project participant’s short name have been changed from “KOWACO” to “K-water” and reflected the relevant parts through the revised PDD.
   (b) Operational and management structure at section D.4 of registered PDD have been changed as belows;
   1. “Electric Power Business Department & Water Resources Operation Center in headquarter” is added as a main body at <Figure 5> in the registered PDD.
   2. Responsible department and person for monitoring are revised considering the actual situation as following table

4) Feb 9th 2018(request renewal of CP)
   (a) The monitoring frequency of watt hour meter for electricity in B.7.1 was changed to calibrate the meter according to the national law.
   (b) K-water’s monitoring department name was updated as per the latest reorganization.

Document information

Version	Date	Description
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.

Version	*Date*	*Description*

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