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	K-water 0.96MW bundle small-scale hydroelectric power plants project
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	Version 05.0
Completion date of the PDD	14/09/2017
Project participants	Korea Water Resources Corporation(K-water)
Host Party	Republic of Korea (host)
Applied methodologies and standardized baselines	AMS.I.D. Grid connected renewable electricity generation, version 13.0
Sectoral scopes linked to the applied methodologies	Sectoral scope : 1 - Energy industries (renewable / non-renewable sources)
Estimated amount of annual average GHG emission reductions	2,987 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Description of the project

This bundle project consists of two projects which are 0.56MW Gosan and 0.40MW Pangyo small-scale hydroelectric power plants in Daegu metropolitan city and Gyonggi-do. Expected electricity produced by this project is 5,557MWh/yr and estimated GHG reduction is 2,987tCO_2/yr.
The purpose of the project is contributes to the international effort to prevent global warming by using renewable energy. This small-scale hydroelectric power plant generates electricity utilizing potential energy of water which emits zero greenhouse gas (GHG) into the atmosphere or water system without any natural resources depletion. The project supports the government policy which promotes development of renewable energy technology in Republic of Korea. The project also contributes to decrease dependence on electricity generated by thermal power plants using fossil fuel which takes 63.1% of electricity generation in Korea (Source: Statistics of Electric Power in 2007, KEPCO 2008).

■ **Gosan small-scale hydroelectric power plant**

Gosan small-scale hydroelectric power plant is located in front of the settling pond in the Gosan Water Purification plant using water supply pipeline of Woonmoon Dam. This project generates electricity using the difference in elevation between Woonmoon Dam and Gosan Water Purification plant. For the details refer to below <Table A.1>.
Gosan Water Purification plant can be abundantly supplied with water in the dry season and supplied more water in the wet season. Besides the generator's output power and water quantity can be variable with water quantity of the consumer.

■ **Pangyo small-scale hydroelectric power plant**

Inflow from Paldang water intake pumping station is provided to Pyoung-teak water distribution system by putting pressure on it. Some of the water that is exceeding the capacity of inline pump facility is stored in the control reservoirs, and thereafter provided into Suji purification plant and factories at Hwaseong industrial complex. In this process, electricity generation takes place utilizing waste pressure at the intake of the control reservoir which would be otherwise not used. For the details refer to below <Table A.1>.

<Table A.1> Description of the project

Classification	The Gosan small-scale hydroelectric power plant	The Pangyo small-scale hydroelectric power plant	Total
Installed capacity (MW)	0.56	0.40	**0.96**
Expected electricity produced by project (MWh/yr)	3,562	1,995	**5,557**
Estimated CO_2 reduction (tonCO_2/yr)	1,915	1,072	**2,987**
Crediting period (year)	10	10	**10**
Total Estimated CO_2 reduction (tonCO_2/yr)	19,146	10,723	**29,869**
Life time of the project (year)	30	30	**30**

Classification	The Gosan small-scale hydroelectric power plant	The Pangyo small-scale hydroelectric power plant	Total
Total investment cost (million won)	2,448	1,639	**4,087**

Contribution to sustainable development

By using renewable local source of energy, the project will contribute to sustainable development in Republic of Korea as follows:

- Power generation from small-scale hydroelectric power plants reduces consumption of fossil fuels, decreases imports of fossil fuel, and hence brings in national profits.
- As an alternative energy source, small-scale hydroelectric power does not emit air pollutants or wastes.
- As the renewable energy source, hydroelectric power does not deplete natural resources and therefore it will be used as alternative energy sustainable by future generations.
- There are no Green House Gas (GHG) emissions.
- Demonstrate replicable clean energy technology.

A.2. Location of project activity

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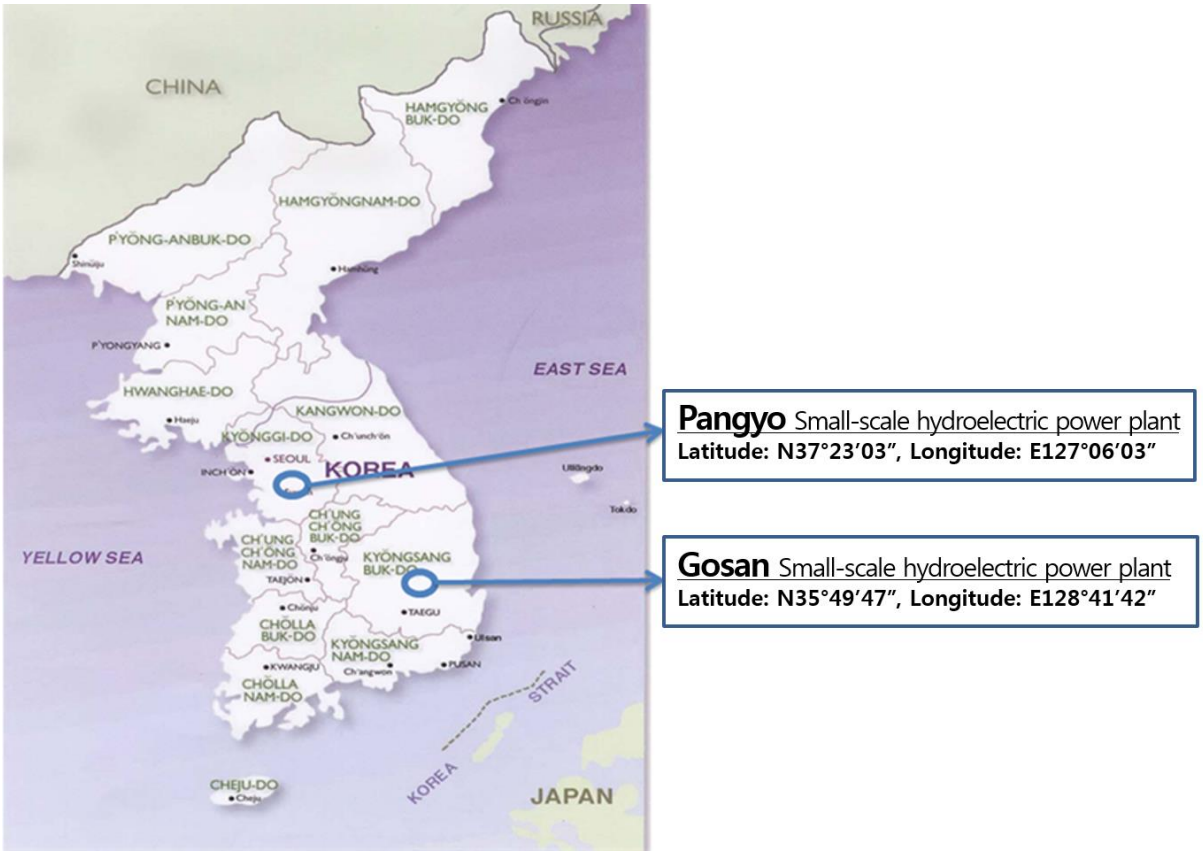
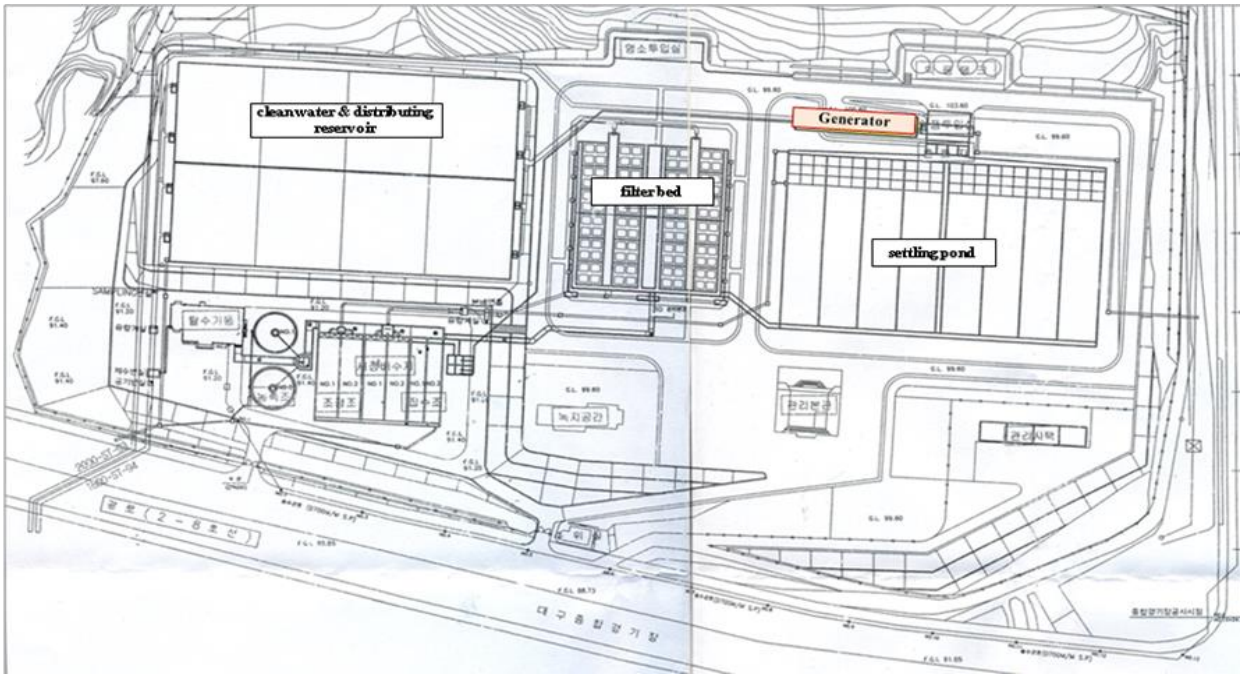
Gosan small-scale hydroelectric power plant is located in the latitude N35°49’47”, longitude E128°41’42”. There is Taedok Mountain, 600m in elevation, on the southwest and the hilly area on the south. Oksu brook flows from east side of the Gosan purification plant to Geumho River.

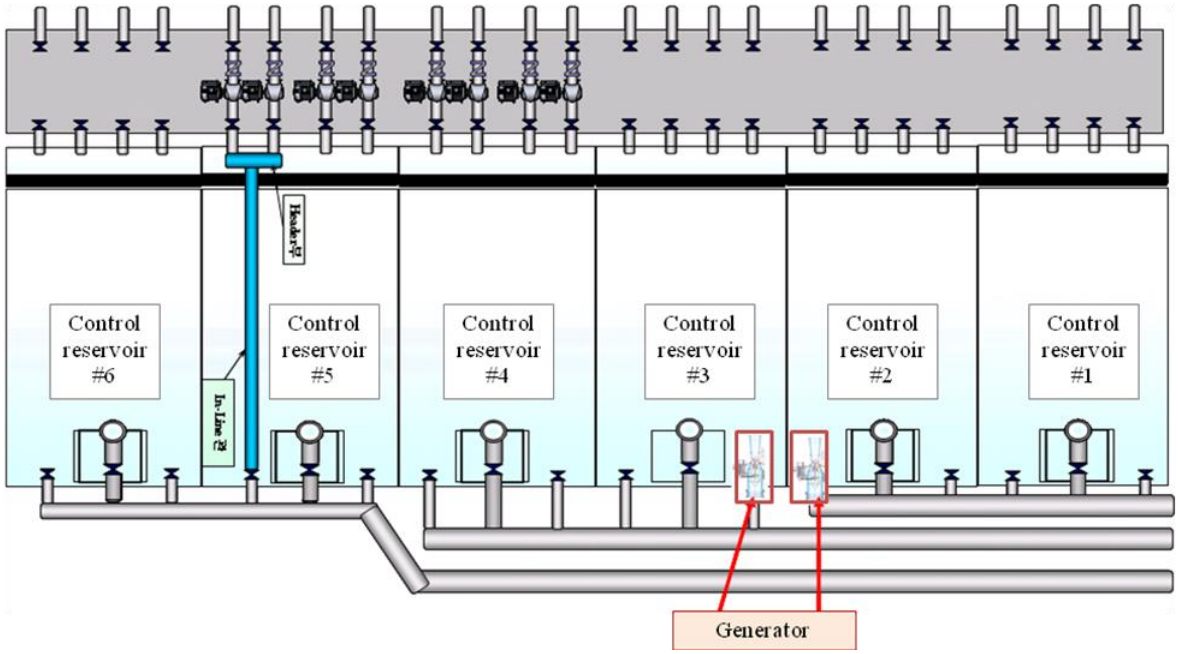
Pangyo small-scale hydroelectric power plant is located in the latitude N37°23’03”, longitude E127°06’03”.



<Figure A.1> The location of the project



<Figure A.2> Plane figure of the Gosan Water Purification Plant



<Figure A.3> Generator location in Pangyo water control reservoir

<Table A.2> The address of the power plant of each project site

Project sites	Address	Latitude	Longitude
Gosan	422-5, Nobyeon-Dong, Suseong-Gu, Daegu metropolitan city, Republic of Korea	N35°49’47”,	E128°41’42”
Pangyo	655, Pangyo-Dong, Bundang-Gu, Seongnam City, Gyeonggi-do, Republic of Korea.	N37°23’03”	E127°06’03”

A.3. Technologies/measures

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- Type: I – Renewable energy projects
- Category: I.D – Grid connected renewable electricity generation

The project type, as defined in UNFCCC's Appendix B of "the simplified modalities and procedures for small-scale CDM project activities", is I.D: Renewable energy projects; Grid connected renewable electricity generation.

This project generates electricity utilizing renewable energy, hydro power, and supplies the electricity to the grid. Furthermore, the total capacity of the power plant is 0.96MW which is less than 15MW. Therefore, the methodology AMS I.D. is eligible for this project activity.

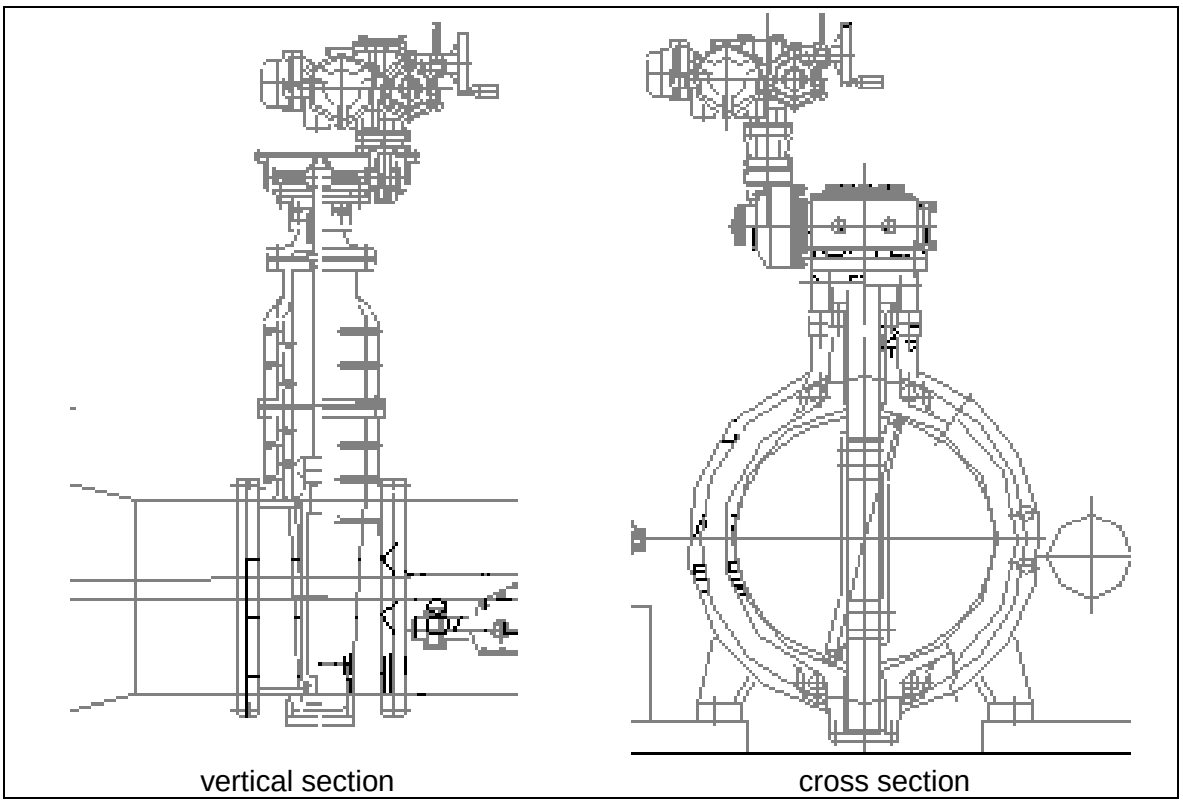
The Gosan small-scale hydroelectric power plant's installed capacity is 0.56MW, rated water quantity is 2.60m^3/sec and rated available head is 25.4m. It will apply the vertical shaft Francis wheel which can reduce noise vibration harshness and extent of the structure. And the three-phase Induction generator will apply considering safety in work operations and economy. Dependable turbines Ltd. performed design of wheel and system. It is manufacturers specialized in wheel production and has 30 years of experience in the development, design, engineering, sales, manufacturing and operation of small hydropower plants. And IlJin electric Co., Ltd. makes a wheel and generator including A/S. It is heavy electric equipment maker.

The Pangyo small-scale hydroelectric power plant's installed capacity is 0.40MW, rated water quantity is 3.54m^3/sec and rated available head is 16.0m. It will apply the horizontal shaft Kaplan Tubular wheel considering rated available head, rated water quantity, output power of the wheel, etc. And the three-phase Induction generator will apply considering same reason as Gosan project. It is applied technologies of GUGLER Water Turbines GmbH. It has 35 years of experience in the development, design, engineering, sales, manufacturing and operation of small hydropower plants.

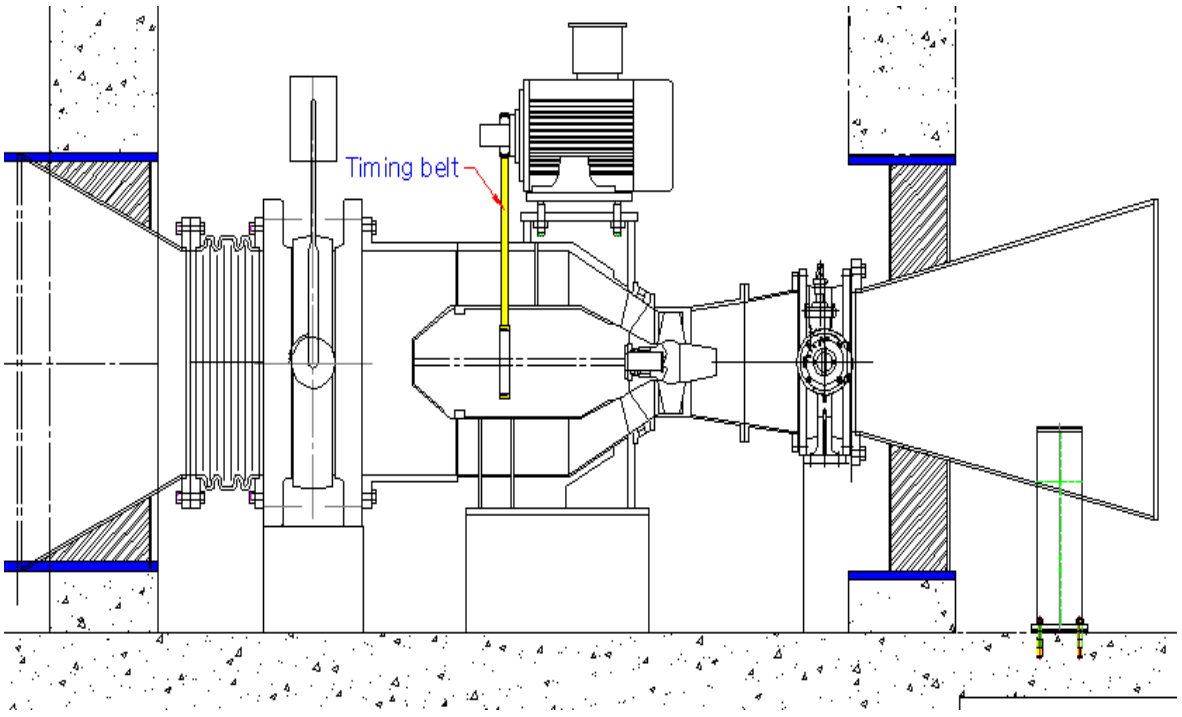
For the details of the project, refers to the following table.

<Table A.3> Description of applied technology at this project

Classification		**The Gosan small-scale hydroelectric power plant**	**The Pangyo small-scale hydroelectric power plant**
Wheel	Type	vertical shaft Francis	horizontal shaft Kaplan Tubular
	Output power	596 kW	292 kW
	Rotation	720 RPM	1,885 RPM
	efficiency	85%	80%
	Unit	1	2
Generator	Type	Three-phase induction	Three-phase induction
	Output power	560 kW	200 kW
	efficiency	94%	90%
	Unit	1	2
Transformer	Type	Mold type	Mold type
	capacity	850 kVA	500 kVA
	Voltage	22.9 kV/3.3 kV	22.9 kV/0.38 kV
	Connect-ion type	∆-Y	∆-Y
	Unit	1	1



<Figure A.4> Turbine-generator layout (Gosan)



<Figure A.5> Turbine-generator layout (Pangyo)

A.4. Parties and project participants

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

A.5. Public funding of project activity

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Public funding is not involved in this bundled project activity.

A.6. History of project activity

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- The proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA).
- 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

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This project is not a part of any large scale project activity.
According to Appendix C of the simplified modalities and procedures for small-scale CDM project activities, debundling is defined as the fragmentation of a large project activity into smaller parts.
A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or another small-scale CDM project activity requested for registration which has the conditions as follows;

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

This project does not belong in above 4 things. Therefore, this is not a debundled part of large-scale project activities.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

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AMS-I.D. version 13 (14 Dec 2007)
http://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

"Grid connected renewable electricity generation." as outlined in Annex B of the simplified modalities and procedures for small-scale CDM project activities. ("SSC M&P")
http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=52

B.2. Applicability of methodologies and standardized baselines

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The methodology AMS-I.D. (Version 13.0) can be applied to the proposed project because the proposed project meets all the applicability criteria of the methodology as demonstrated as follows:

No.	Applicability Conditions	Justification
1	This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit.	Applicable : The proposed project is the generation of hydropower using renewable energy that will be supplied to Korea Electric Power Corporation (hereinafter referred to as 'KEPCO') grid.
2	If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel1, the capacity of the entire unit shall not exceed the limit of 15MW.	Applicable : The total capacities of hydroelectric power plants in a bundle are 0.96MW. It is not greater than the maximum limited capacity of 15 MW for a small scale CDM project. And the project will remain under the 15MW limits over the crediting period.
3	Combined heat and power (co-generation) systems are not eligible under this category.	Not relevant : The proposed project is the generation of hydropower using renewable energy. There are no co-generation systems.
4	In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not relevant : The proposed project is new installation of hydroelectric power plants, not addition of generation units. And the proposed project does not involve replacement of generation units.
5	Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small-scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15 MW.	Not relevant : The proposed project is new installation of hydroelectric power plants, not involve retrofit.

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

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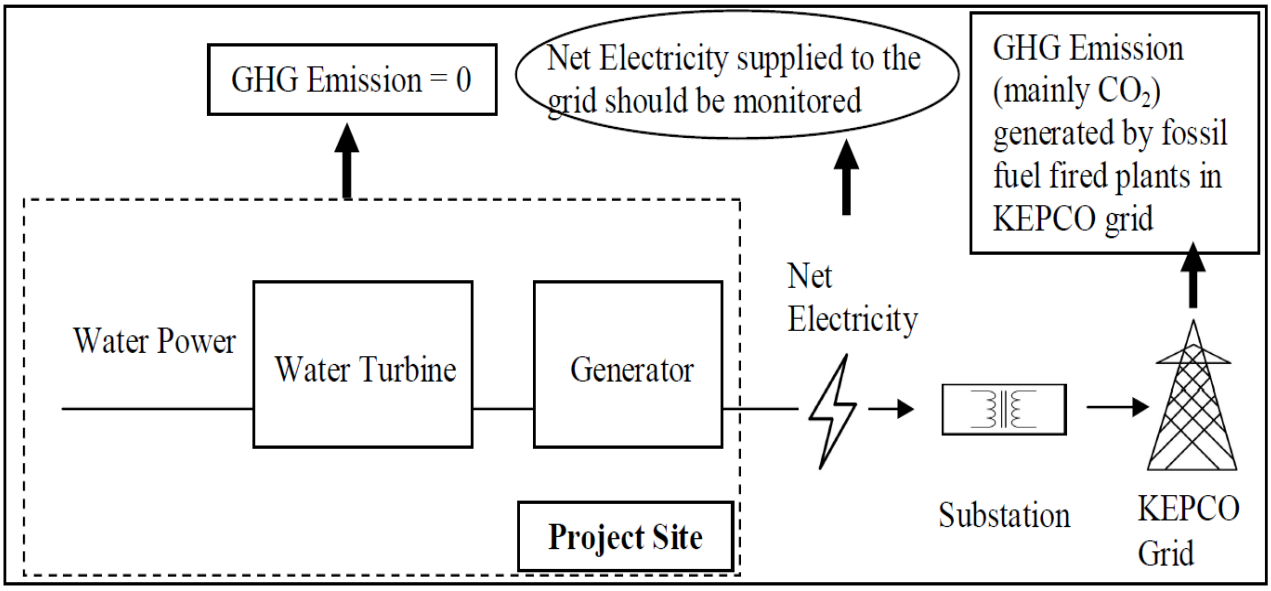
As referred to in Appendix B for small-scale project activities, the project boundary for a small scale hydropower project that provides electricity to a grid encompasses the physical, geographical site of the renewable generation source.

For the baseline determination, project boundary is related to CO_2 emissions from power generation in a fossil fuel power plant replaced by this project activity. The spatial extent of the project boundary includes the project sites and all the power plants connected physically to the electricity system of Korea Electric Power Corporation (KEPCO).

For calculation of baseline GHG emissions from the project boundary are not included emissions during plant construction, leakage from electricity transfer, and emission from transportation, mining, and pumping.

	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	According to AMS-I.D., Main emission source
		CH_4	No	According to AMS-I.D., Minor emission source
		N_2O	No	According to AMS-I.D., Minor emission source
Project activity	The proposed project	CO_2	No	According to AMS-I.D., project emissions are zero.
		CH_4	No	
		N_2O	No	



<Figure B.1> Project boundary

B.4. Establishment and description of baseline scenario

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According to clause 9 of AMS I.D version 13, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/kWh) calculated in a transparent and conservative manner as:

(a) A combined margin(CM), consisting of the combination of operating margin(OM) and build margin(BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system".

OR

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

Therefore the baseline for this project was calculated according to "Tool to calculate the emission factor for an electricity system(version 01.1)", on the authority of (a) as mentioned above. The baseline emission factor (EF_y) was calculated as a combined margin (CM), consisting of the combination of operating margin(OM) and build margin(BM) factors according to the following six steps. In calculating this combined margin(CM), the data originated from existing power plants were applied. Here, these data were collected from the Statistics of Electric Power published at the most recent 3-years (KEPCO 2006-2008), and should be proper because the host country of this project, Republic of Korea, does not import/export electricity from/to other countries.

STEP 1. Identify the relevant electric power system
For the purpose of determining the electricity emission factors, a **project electricity system** is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

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

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

- In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of more than 5 percent between the systems during 60 percent or more of the hours of the year.
- The transmission line is operated at 90% or more of its rated capacity during 90% percent or more of the hours of the year.

In this sense, it is clear that the project electric power system is connected with the whole Korean national grid system. Because all power plants-including proposed bundle small-scale hydroelectric power plant-are physically connected to each other through transmission and distribution lines constituting the grid. Therefore the Korean national grid has been chosen as relevant electricity power system for purpose of determining the electricity emission factors.

<Figure B.1> Electric Power Grid Nationwide in Republic of Korea

Source: 2008 Annual Report (KEPCO)

STEP 2. Select an operating margin (OM) method

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

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

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

Referring to the gross electricity generation rate by energy sources of the host country, Republic of Korea, the rate of low cost/must run power generation does not exceed 50% of the total grid. Actually, the most recent 5-year(2003~2007) average data shows that the rate of low cost/must run is 41.49%. (Source: Statistics of Electric Power in 2007, KEPCO 2008)
Therefore, for this project case, "Option (a) Simple OM" is available. <Table B.1> shows the yearly proportion of the generation of electricity based on the source of energy. (Source: Statistics of Electric Power in 2007, KEPCO 2008)

<Table B.1> Gross generation by energy sources

(Unit: million kWh)

Item \ Year		2003	2004	2005	2006	2007
Hydro*		6,887	5,861	5,189	5,219	5,042
Thermal	Domestic Coal*	5,398	4,603	4,484	4,312	4,470
	Bituminous Coal	114,878	122,556	129,174	134,894	150,204
	Heavy Oil	23,656	21,591	20,079	18,596	20,769
	Diesel Oil	2,870	474	412	599	446
	Gas	39,091	55,999	58,118	68,302	78,427
Nuclear*		129,672	130,715	146,779	148,749	142,937
Alternative*		-	350	404	511	829
Total		322,452	342,148	364,683	381,181	403,124
The rate of low cost/must run power generation (%)		44.02%	41.36%	43.02%	41.66%	38.02%
		41.49				

Source: Statistics of Electric Power in 2007, KEPCO 2008(* low-operating cost and must-run power plants)

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

- Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period, or

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

On this PDD, *ex-ante* data were applied. The Simple OM emission factor is calculated as following step 3.

STEP 3. Calculate the Operating Margin emission factor ($EF_{grid,OM,y}$)

The simple OM emission factor is calculated as the generation-weighed emissions per electricity unit of all generating units serving the system, excluding low-operating cost and must-run power plants. Low-operating cost and must run power plants include hydro, nuclear, low cost biomass, geothermal and domestic coal. And it is calculated based on data on fuel consumption and net electricity generation of each power plant /unit (Option A) as follows:

$$EF_{grid,OMSimple,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_{m} EG_{m,y}} \quad \textbf{(1)}$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type i consumed by power plant / unit m in year y (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
$EG_{m,y}$	=	Net electricity generated and delivered to the grid by power plant / unit m in year y (MWh)
m	=	All power plants / units serving the grid in year y except low-cost / must-run power plants / units
i	=	All fossil fuel types combusted in power plant / unit m in year y
y	=	Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

In case of this project, the applied parameters are presented for estimation of Operating Margin emission factor ($EF_{grid,OM,y}$) at <Table Annex-1, 2, 3> in Appendix4.

STEP 4. Identify the cohort of power units to be included in the Build Margin emission factor ($EF_{grid,BM,y}$)

The sample group of power unit m used to calculate the build margin consists of either:

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

Project participants should use the set of power units that comprises the larger annual generation.
As a general guidance, a power unit is considered to have been built at the date when it started to supply electricity to the grid.
Power plant registered as CDM project activities should be excluded from the sample group m. However, If group of power units, not registered as CDM project activity, identified for estimating the build margin emission factor includes power unit(s) that is(are) built more than 10 years ago then:

(i) exclude power unit(s) that is (are) built more than 10 years ago from the group; and
(ii) include grid connected power projects registered as CDM project activities, which are dispatched by dispatching authority to the electricity system.

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

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

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

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

described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

For this project case, *Option* 1 is taken to calculate the Build Margin emission factor, $EF_{grid,BM,y}$ *ex-ante*, and it is estimated as <Table B.2> according to each regulation to compose proper sample group(*m*) that the electricity quantity of candidate sample groups and in ratio to total generation in Korea.

<Table B.2> Sample Plant group(m) for determining Build margin Emission factor

Sample group(m) Classification	Regulation 1	Regulation 2	Comments
	"The five power plants that have been built most recently"	**"The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently."**	
Electricity quantity	33 MWh	84,736,759 MWh	Total generation is 385,990,619MWh in Korea (Source: Statistics of Electric Power in 2007, KEPCO 2008) CDM registered Power plants generation is 376,177MWh.
Proportion (ratio to total generation in Korea)	0.00001%	21.953%	
Selected Group		**O**	

The annual generation of "the five power plants that have been built most recently" was 33MWh (0.00001% of total generation of the grid system), and the annual generation of "the power plants capacity additions in the electricity system that comprise 21.953% of the system generation and that have been built most recently" was 84,736,759MWh. Therefore, the latter was chosen for this project as a lager figure than the other one. It is presented at <Table Annex-4> in Appendix 4 that the sample group of plants used in the Build Margin emission factor ($EF_{grid,BM,y}$).

STEP 5. Calculate the build margin emission factor ($EF_{grid,BM,y}$)

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

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

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_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 (tCO_2/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which power generation data is available

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

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

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

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)

- Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods.
- All other projects: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

Alternative weights can be proposed, as long as $w_{OM} + w_{BM} = 1$, for consideration by the Executive Board, taking into account the guidance as described below. The values for $w_{OM} + w_{BM}$ applied by project participants should be fixed for a crediting period and may be revised at the renewal of the crediting period.

Depending on AMS I.D (Version13), baseline emissions should be obtained by the below equation

$$BE_y = (EG_y - EG_{baseline}) \cdot EF_y \quad (4)$$

Where:
BE_y is the baseline emissions (in tCO_2)
EG_y is the electricity supplied by the project activity to the grid (in MWh)
$EG_{baseline}$ is the baseline electricity supplied to the grid in the case of modified or retrofit facilities (in MWh)
EF_y is the baseline emissions factor (in tCO_2/MWh)

However $EG_{baseline}$ is zero because there are no modified or retrofit facilities in this project. Therefore the baseline emissions (BE_y) can be calculated as follows;

$$BE_y = EG_y \cdot EF_y \quad (5)$$

The key information and data used for calculation of baseline emission by this project activity have been taken from following sources.

<Table B.3> Key information and data used to determine the baseline scenario

Parameter	Value	Source
$EG_{m,y}$ **(MWh)** is the electricity delivered to the grid by source *j*.	Refer to <Table Annex-3>	Statistics of Electric Power in 2005-2007, KEPCO 2006-2008
$FC_{i,m,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*, *m* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid	Refer to <Table Annex-1>	Statistics of Electric Power in 2005-2007, KEPCO 2006-2008
Net Calorific Values by Power Plant	Refer to <Table Annex-2>	Caloric value sourced from Statistics of Electric Power in 2005-2007, KEPCO 2006-2008 (net caloric value = Caloric value* net caloric value conversion factor)
Net Caloric Values Conversion Factor	Solid/Liquid fuel : 0.95 Gaseous fuel : 0.90	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Fuels CO_2 Emission Factor ($EF_{CO2,i,i}$)	Refer to <Table Annex-5>	2006 IPCC Guidelines for National Greenhouse Gas Inventories 1.21
$EF_{grid,OM\ y}$ Operating Margin Emissions Factor (in ton CO_2/MWh) 2005~2007	0.6817	Calculated
$EF_{grid,BM,\ y}$ Build Margin Emissions Factor (in ton CO_2/MWh)	0.3933	Calculated
$EF_{grid,CM,y}$ Baseline Emissions Factor (in ton CO_2/MWh)	0.5375	Calculated

B.5. Demonstration of additionality

>>

Investment barrier

To prove additionality of the project, attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities was referred. According to this, project participants shall provide an explain to show that the project activity would not have occurred anyway due to at least one of barriers such as investment barrier, technological barrier, barrier due to prevailing practice or other barriers.

The biggest barrier of the project is investment barrier because small-scale hydroelectric power project requires high investment cost, but expectation of capital return is low. Due to these reasons, these hydroelectric power plants are not attractive alternative as power generation. It can be explained by calculating IRR (Internal Rate of Return). IRR is discount rate which makes present value of income flow and present value of cost flow is same.

Benchmark rate of this project is **7.00%** based on the latest report of the Ministry of Knowledge Economy (March. 2006). It is the discount rate of small hydroelectric power project.

The Unit price of electricity sales of the project is 73.25won/kWh which is 3-year average value, based on the most recent data (2005-2007).

Detail financial parameter and calculated IRRs of the each small-scale hydroelectric power plant has been described in the below tables.

<Table B.4> Investment analysis data of the Gosan small-scale hydroelectric power plant

Content	Value	Remark
Total Investment Cost (Million won)	2,448	Feasibility Study Report, 2008. 2
Expected electricity produced by this plant (MWh/year)	3,562	Feasibility Study Report, 2008. 2
Unit price of electricity sales (won/kWh)	73.25	Average Price in 2005~2007 source from Electric Power Statistics Information System (www.kpx.or.kr/epsis/)
Operation & Maintenance Cost (Million won/yr)	73	3.00% < The report published by the Ministry of Knowledge Economy, 2006. 3>
Corporate Tax. (Million won/yr)	14	Corporate Tax Act. - if the taxable standard price is less than hundred million: 13%, in case of taxable standard price is exceeding hundred million: 13million won + surplus ×25%
Life time (year)	30	

<Table B.5> Sensitivity analysis of the Gosan small-sale hydroelectric power plant

Increasing rate of unit price of electricity sale(%)	Unit price of electricity sales (won/kWh)	IRR (%)
-	73.25	5.75
5	76.91	6.26
10	80.58	6.76
Decreasing rate of Total Investment Cost(%)	**Total Investment Cost (million won)**	**IRR (%)**
-	2,448	5.75
5	2,325	6.32
10	2,203	6.94

IRR of the Gosan small-scale hydroelectric power is **5.75%** which is lower than the Benchmark rate, 7.00%. And it is still lower than the Benchmark rate when the Unit price of electricity sales has increased up to

+10%. In case of decreasing total investment cost up to -10%, IRR is lower than the Benchmark rate, too. Therefore this project is not attractive as business.
IRR considering CERs benefit is **6.62%** which has increased 0.87% compared with the project IRR, 5.75%.

<Table B.6> Investment analysis data of the Pangyo small-scale hydroelectric power plant

Content	Value	Remark
Total Investment Cost (Million won)	1,639	Feasibility Study Report, 2008. 6
Expected electricity produced by this plant (MWh/year)	1,995	Feasibility Study Report, 2008. 6
Unit price of electricity sales (won/kWh)	73.25	Average Price in 2005~2007 source from Electric Power Statistics Information System (www.kpx.or.kr/epsis/)
Operation & Maintenance Cost (Million won/yr)	49	3.00% < The report published by the Ministry of Knowledge Economy, 2006. 3>
Corporate Tax. (Million won/yr)	6	Corporate Tax Act. - if the taxable standard price is less than hundred million: 13%, in case of taxable standard price is exceeding hundred million: 13million won + surplus ×25%
Life time (year)	30	

<Table B.7> Sensitivity analysis of the Pangyo small-sale hydroelectric power plant

Increasing rate of unit price of electricity sale(%)	Unit price of electricity sales (won/kWh)	IRR (%)
-	73.25	3.71
5	76.91	4.26
10	80.58	4.80
Decreasing rate of Total Investment Cost(%)	**Total Investment Cost (million won)**	**IRR (%)**
-	1,639	3.71
5	1,557	4.29
10	1,475	4.91

IRR of the Pangyo small-scale hydroelectric power is **3.71%** which is lower than the Benchmark rate, 7.00%. And it is still lower than the Benchmark rate when the Unit price of electricity sales has increased up to +10%. In case of decreasing total investment cost up to -10%, IRR is lower than the Benchmark rate, too. Therefore this project is not attractive as business.
IRR considering CERs benefit is **4.53%** which has increased 0.82% compared with the project IRR, 3.71%.

In Republic of Korea, government gives subsidy to the new and renewable sources of energy project developers as "Act on the Promotion of the Development and Use of New and Renewable Sources of Energy" from after 26.Sep. 2002. That law encourages investments in renewable energy projects by providing for high price within the feed-in tariff policy. In spite of these benefits, this project is still not attractive due to Unit price of electricity sales is higher than Standard price of electricity sales.

According to decision of 22nd CDM EB meeting (Annex 3 – Clarifications on the consideration of national and/or sectoral policies and circumstances in baseline scenarios, ver.02), this law first established in 2002 to

promote renewable energy policy need not be taken into account in developing a baseline scenario. Thus the law will not be considered in this baseline calculation. Therefore this project does not included subsidy in electricity price in the investment analysis.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

>>

Calculation of Baseline Emission

Depending on "Tool to calculate the emission factor for an electricity system (Version01.1)", baseline emissions should be obtained by the below equation (4)

$$BEy = (EGy - EG_{baseline}) \cdot EFy \quad (4)$$

Where,

BE_y : Baseline emissions (in tCO_2)
EG_y : Electricity supplied by the project activity to the grid (in MWh)
$EG_{baseline}$: Baseline electricity supplied to the grid in the case of modified or retrofit facilities (in MWh)
EF_y : Baseline emissions factor (in tCO_2/MWh)
y : Refers to a given year

However $EG_{baseline}$ is zero because there are no modified or retrofit facilities in this project. Therefore the baseline emissions (BE_y) can be calculated as follows;

$$BE_y = EG_y \cdot EF_y \quad (5)$$

The baseline emission factor (EF_y) calculations will be based on the "Tool to calculate the emission factor for an electricity system (Version01.1)".

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

Where,

$EF_{grid,CM,y}$: Baseline emission factor (tCO_2/ MWh)
w_{OM} : Operation Margin weight, which is 0. 5 by default
w_{BM} : Build Margin weight, which is 0.5 by default
$EF_{grid,OM,y}$: Operational Margin emission factor (tCO_2 / MWh)
$EF_{grid,BM\,,y}$: Build Margin emission factor (tCO_2 / MWh)
Y : Refers to a given year

Operational Margin emission factor ($EF_{grid,OM,y}$) is obtained based on 'Simple OM method'. Build Margin emission factor ($EF_{grid,BM\,,y}$) is estimated as *Option* 1 ($EF_{BM,y}$ *ex-ante*).

The OM emission factors is calculated as follows,

$$EF_{grid\,,OMSimple\,,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_{m} EG_{m,y}} \quad (1)$$

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power plant / unit m in year y (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)

$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
$EG_{m,y}$	=	Net electricity generated and delivered to the grid by power plant / unit m in year y (MWh)
m	=	All power plants / units serving the grid in year y except low-cost / must-run power plants / units
i	=	All fossil fuel types combusted in power plant / unit m in year y
y	=	Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

The emission factor of Build margin is calculated using the following equation:

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

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_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 (tCO_2/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which power generation data is available

Project emission

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

Leakage

GHGs emissions due to leakage are not estimated at this point of time from hydroelectric power generation.

Estimation of Emission reduction

Project emission reduction can be estimated by following equation (6)

$$\boldsymbol{ER_y = BE_y - PE_y - L_y} \quad \textbf{(6)}$$

Where
ER_y : The emission reductions by the project activity during a given year *y*
BE_y : Baseline emissions
PE_y : Project emissions
L_y : Emissions due to leakage

B.6.2. Data and parameters fixed ex ante

Data/Parameter	EF_y
Data unit	tCO_2e/MWh
Description	CO_2 emissions intensity of the electricity displaced
Source of data	Calculated
Value(s) applied	0.5375 tCO_2/MWh
Choice of data or measurement methods and procedures	This value was calculated according to "Tool to calculate the emission factor for an electricity system (version 01.1)." Applied value was calculated by referring Statistics of Electric Power in 2005-2007, KEPCO 2006-2008 and Status of Generation facility (2008) (Korea Power Exchange).
Purpose of data	Calculation of baseline emissions
Additional comment	- The same value will be applied during the first crediting period without updating. - For detail information to calculate this value, refer to Appendix 4.

Data/Parameter	$EF_{OM,y}$
Data unit	tCO_2e/MWh
Description	Operating Margin emission factor
Source of data	Calculated
Value(s) applied	0.6817 tCO_2/MWh
Choice of data or measurement methods and procedures	This value was calculated according to "Tool to calculate the emission factor for an electricity system (version 01.1)." Applied value was calculated by referring Statistics of Electric Power in 2005-2007, KEPCO 2006-2008 and Status of Generation facility (2008) (Korea Power Exchange).
Purpose of data	Calculation of baseline emissions
Additional comment	- This value is ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period without updating.

Data/Parameter	$EF_{BM,y}$
Data unit	tCO_2e/MWh
Description	Build Margin emission factor
Source of data	Calculated
Value(s) applied	0.3933 tCO_2/MWh
Choice of data or measurement methods and procedures	This value was calculated according to "Tool to calculate the emission factor for an electricity system (version 01.1)." Applied value was calculated by referring Statistics of Electric Power in 2005-2007, KEPCO 2006-2008 and Status of Generation facility (2008) (Korea Power Exchange).
Purpose of data	Calculation of baseline emissions
Additional comment	- This value is ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period without update.

Data/Parameter	$FC_{i,m,y}$
Data unit	mass or volume unit
Description	Amount of fossil fuel type i consumed by power plant / unit m in year y
Source of data	Statistics of Electric Power in 2005-2007, KEPCO 2006-2008
Value(s) applied	See the <Table Annex-1> in Appendix 4
Choice of data or measurement methods and procedures	Applied value was referred Statistics of Electric Power in 2005-2007, KEPCO 2006-2008.
Purpose of data	Calculation of baseline emissions
Additional comment	- The same value will be applied during the first crediting period without updating.

Data/Parameter	$NCV_{i,y}$
Data unit	kcal/mass or volume unit
Description	Net calorific value of fossil fuel type i consumed by power plant / unit m in year y
Source of data	Statistics of Electric Power in 2005-2007, KEPCO 2006-2008
Value(s) applied	See the <Table Annex-2> in Appendix 4
Choice of data or measurement methods and procedures	Applied value refers to Statistics of Electric Power in 2005-2007, KEPCO 2006-2008.
Purpose of data	Calculation of baseline emissions
Additional comment	- $NCV_{i,y}$ is the $GCV_{i,y}$ multiplied the Net caloric values conversion factor. - $GCV_{i,y}$ value refers to Statistics of Electric Power in 2005-2007, KEPCO 2006-2008 and Net caloric values conversion factor was referred 2006 IPCC Guidelines for National Greenhouse Gas Inventories. - The same value will be applied during the first crediting period without updating.

Data/Parameter	$EF_{CO2,i,y}$
Data unit	tCO_2/TJ
Description	CO_2 emission factor of fossil fuel type i in year y
Source of data	2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	See the <Table Annex-5> in Appendix 4
Choice of data or measurement methods and procedures	IPCC default values at the lower limit of the uncertainty at 95% confidence interval as provided in table 1.4 of Chpter1 of Vol.2(Energy)
Purpose of data	Calculation of baseline emissions
Additional comment	- The same value will be applied during the first crediting period without updating.

The calculation of the OM and BM emission factors were submitted to DOE as an excel file. It's including following information:

- Information to clearly identify the plant
- The date of commissioning
- The fuel type(s) used
- The quantity of net electricity generation in the relevant year(s)
- The fuel consumption of each fuel type in the relevant year(s)
- Information of a low-cost/must-run plant

B.6.3. Ex ante calculation of emission reductions

>>

Baseline emission

The capacity of **the Gosan small-scale hydroelectric power plant** is 0.56MW and coefficient of utilization is about 72.6%. Therefore, expected electricity produced by the project is 3,562MWh per year.

- Expected electricity generation= 0.56MW × 365day× 24hr× 72.6%= 3,562MWh/year
- Baseline emission$_{Gosan}$ = electricity generation × emission factor (EF_y)
  = 3,562MWh/yr × 0.5375tCO_2/MWh
  = 1,915tonCO_2/yr

The capacity of **the Pangyo small-scale hydroelectric power plant** is 0.40MW and coefficient of utilization is about 56.9%. Therefore, expected electricity produced by the project is 1,995MWh per year.

- Expected electricity generation= 0.40MW × 365day× 24hr× 56.9%= 1,995MWh/year
- Baseline emission$_{Pangyo}$ = electricity generation × emission factor (EF_y)
  = 1,995MWh/yr × 0.5375tCO_2/MWh
  = 1,072tonCO_2/yr

Project emission

Project emission is zero

Leakage

Emission due to leakage is zero

Ex-ante emission reduction

Emission reduction = Baseline emission - Project emission - Leakage
= (1,915 + 1,072) = 2,987 tonCO_2/yr

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

< Total(Gosan and Pangyo) small-scale hydroelectric power plant>

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Jun 2010~May 2011	2,987	0	0	2,987
Jun 2011~May 2012	2,987	0	0	2,987
Jun 2012~May 2013	2,987	0	0	2,987
Jun 2013~May 2014	2,987	0	0	2,987
Jun 2014~May 2015	2,987	0	0	2,987
Jun 2015~May 2016	2,987	0	0	2,987
Jun 2016~May 2017	2,987	0	0	2,987
Jun 2017~May 2018	2,987	0	0	2,987
Jun 2018~May 2019	2,987	0	0	2,987
Jun 2019~May 2020	2,987	0	0	2,987
Total	29,869	0	0	29,869
Total number of crediting years	10 years			
Annual average over the crediting period	2,987	0	0	2,987

<Gosan small-scale hydroelectric power plant>

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)

Jun 2010~May 2011	1,915	0	0	1,915
Jun 2011~May 2012	1,915	0	0	1,915
Jun 2012~May 2013	1,915	0	0	1,915
Jun 2013~May 2014	1,915	0	0	1,915
Jun 2014~May 2015	1,915	0	0	1,915
Jun 2015~May 2016	1,915	0	0	1,915
Jun 2016~May 2017	1,915	0	0	1,915
Jun 2017~May 2018	1,915	0	0	1,915
Jun 2018~May 2019	1,915	0	0	1,915
Jun 2019~May 2020	1,915	0	0	1,915
Total	19,146	0	0	19,146
Total number of crediting years	10 years			
Annual average over the crediting period	1,915	0	0	1,915

<Pangyo small-scale hydroelectric power plant>

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Jun 2010~May 2011	1,072	0	0	1,072
Jun 2011~May 2012	1,072	0	0	1,072
Jun 2012~May 2013	1,072	0	0	1,072
Jun 2013~May 2014	1,072	0	0	1,072
Jun 2014~May 2015	1,072	0	0	1,072
Jun 2015~May 2016	1,072	0	0	1,072
Jun 2016~May 2017	1,072	0	0	1,072
Jun 2017~May 2018	1,072	0	0	1,072
Jun 2018~May 2019	1,072	0	0	1,072
Jun 2019~May 2020	1,072	0	0	1,072
Total	10,723	0	0	10,723
Total number of crediting years	10 years			
Annual average over the crediting period	1,072	0	0	1,072

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$EGy_{,Gosan}$/ $EGy_{,Pangyo}$
Data unit	MWh
Description	Electricity supplied to the grid by the project
Source of data	Measured
Value(s) applied	3,562MWh/yr / 1,995MWh/yr
Measurement methods and procedures	Read from watt-hour meter.
Monitoring frequency	Measuring : Continuously Recording : Monthly

QA/QC procedures	***1. Measuring equipment*** 1-1. Electricity measuring meters shall be set up transparently in accordance with "Law regarding measurement" and "Act on operation of electricity market" and shall be sealed after affirmation of Korea Power Exchange. 1-2. The meters shall be approved through the certified official process as the Managerial regulations of electricity markets. (the valid period for the authorized certification: 7 years.) 1-3. The meters shall be calibrated when they are installed, and recalibrated every 3 years after installation regularly. 1-4. In accordance with "Act on operation of electricity market", the allowable error of data to the meter for electricity exported to the grid must be within ± 0.5%. And in compliance with "Rules and Rates for Electric Service", the allowable error of data to the meter for electricity imported from the grid must be within ± 2.0%. ***2. Data Archive*** 2-1. The daily amount of electricity transmitted to the grid shall be transferred to Korea Power Exchange. 2-2. The monitor archives the amount of electricity transmitted to the grid from the Korea Power Exchange monthly. ***3. Calibration and Recalibration*** 3-1. Calibration: "Korea Power Exchange" or "Meter and Petrochemical Testing and Research Institute" 3-2. Recalibration: "Meter and Petrochemical Testing and Research Institute"
Purpose of data	Calculation of baseline emissions
Additional comment	- Data will be kept for 2 years after the last issuance of CERs from this project activity. - This data is electricity generated except electricity consumed in the plant. - Person in Green Business Department will check up in real-time data and compare KPX with PEMS D/B. - The archived data in KPX shall be reported to the Emission trading person in K-water on request for issuance of CERs.

B.7.2. Sampling plan

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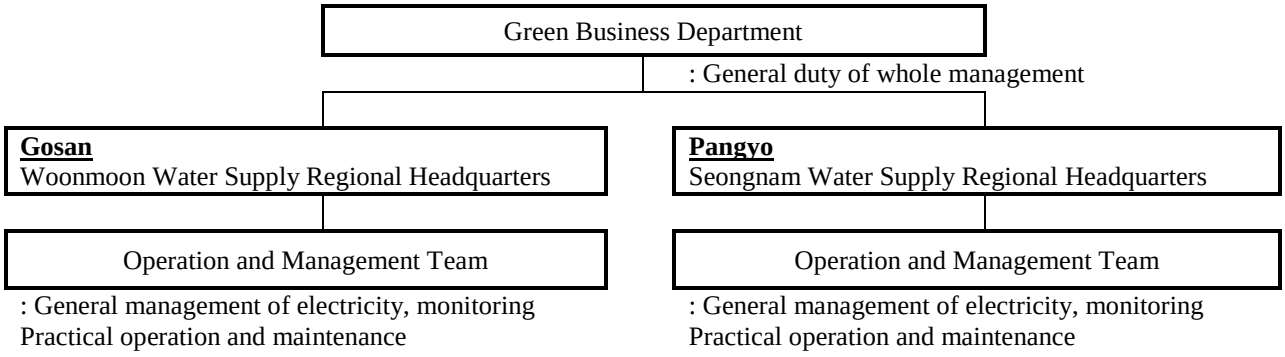
Not applicable

B.7.3. Other elements of monitoring plan

>>

Applied monitoring methodology for the project is AMS I.D. and electricity produced will be monitored. Also, related facility including watt-meter will be managed properly. Operational and management structure is as follows.



<Figure B.2> The operational and management structure

※ Title of the Dept., Regional and Team can be changed from a reorganization plan

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
It is the contract date for manufacturing and purchasing of hydroelectric power generating facilities.

- Gosan small-scale hydroelectric power plant: 18/Aug/2008
- Pangyo small-scale hydroelectric power plant: 30/Jan/2009

C.2. Expected operational lifetime of project activity

>>
The expected operational lifetime of the small hydroelectric power plant activity is 30 years

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
Fixed type (10 years)

C.3.2. Start date of crediting period

>>
01/Jun/2010 or Registration date whatever is later

C.3.3. Duration of crediting period

>>
10 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

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According to the "Environmental Impact Assessment Act", one of the laws in Korea, the proposed bundled project activity does not need to environmental impact assessment.

Businesses of power generation that environmental impact assessment must be done by "Environmental Impact Assessment Act" are following.

- Business of power generation has the design capacity over than 10,000 kW
- If the dam and reservoir construct simultaneously, business of power generation has the design capacity over than 3,000 kW
- The case of equipped with self-power generation equipment in the factory site, business of power generation has the design capacity over than 30,000 kW
- Any power plant using solar, wind or fuel cell as a power has the design capacity over than 100,000 kW

In this bundle project case, the total design capacity of generators is planned as just 960kW, which is much less amount than the lowest limit capacity, 3,000kW. Therefore, it is not necessary for this project to perform obligatory "Environmental Impacts Assessment (EIA)" in conformity with the legal restriction.

D.2. Environmental impact assessment

>>
Not applicable

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

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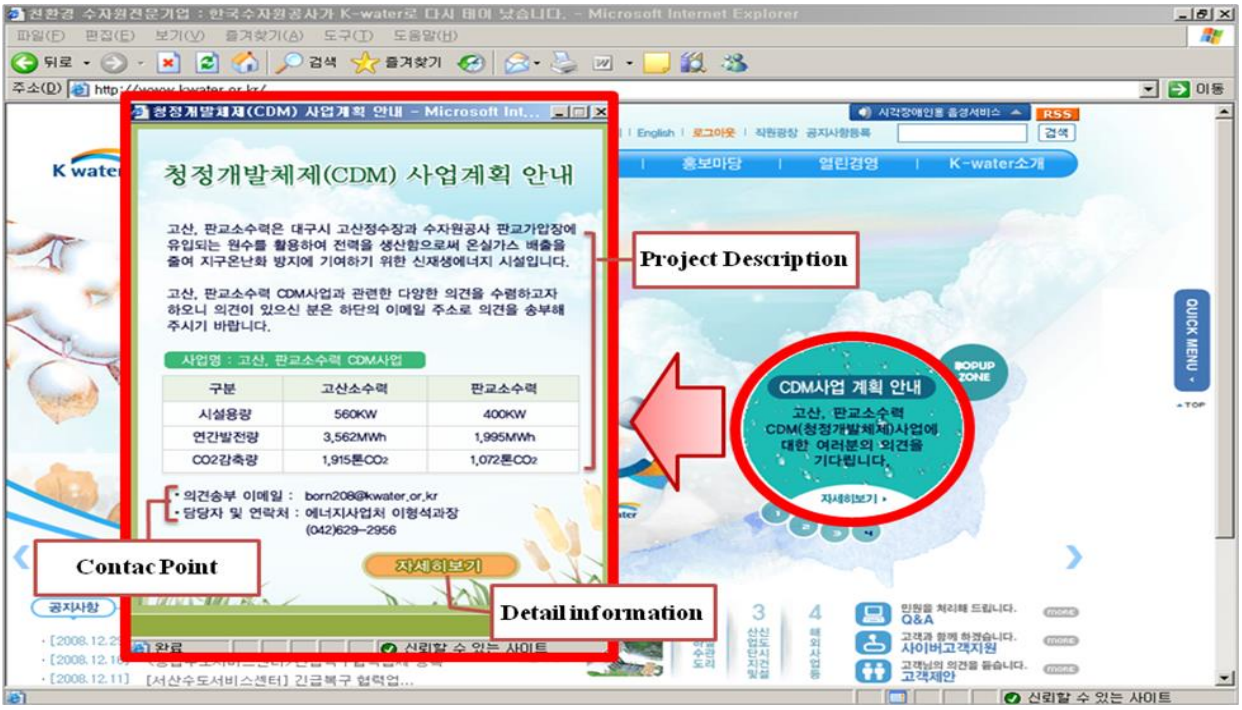
Activities for inviting stakeholders' comments

project	stakeholder	How to invite and compile comments
Gosan	Daegu metropolitan city government (institute that have authority to permit electricity generation business)	Invite comment and requests through procedure for electricity business permit. (20/03/2008) Invite comment and requests through notified "Management Plane of Areas of Restricted Development Amendment" to the local resident. (01/05/2008-14/05/2008)
Pangyo	Gyonggi-do province government (institute that have authority to permit electricity generation business)	Invite comment and requests through procedure for electricity business permit. (10/09/2008)
Both	Domestic stakeholders	Invite comment and requests through pop-up on website. (http://www.kwater.or.kr/) Period for Comments: 05/01/2009~20/01/2009



<Figure E.1> pop-up on website (http://www.kwater.or.kr) for inviting public comments

※ Residents near project site are excluded because this project activity occurred only within water purification plant that is owned and operated by project participant K-Water. This project activity only utilizes waste energy. There is no factor to affect municipal water supply.

E.2. Summary of comments received

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project	stakeholder	How to invite and compile comments
Gosan	Daegu metropolitan city government	Condition for issue of "the permit of the Electricity Enterprise" 1. Must observe "Electricity Enterprises Act". 2. Must observe the reviewing for small-scale hydro power development by the panel on KOREA HYDRO & NUCLEAR POWER CO., LTD.
Pangyo	Gyonggi-do province government	Condition for issue of "the permit of the Electricity Enterprise" 1. Must observe the reviewing for small-scale hydro power development by the panel on KOREA HYDRO & NUCLEAR POWER CO., LTD. 2. Must submit the notice of the construction plan to the Gyonggi-do province government before the construction. 3. Must submit the notice of the starting of generation to the Gyonggi-do province government after the completion of the construction. 4. Take precautionary measures on the expected environmental impacts on the water pollution, air pollution, waste disposal, and noise vibration harshness, etc. 5. Make a contract with KEPCO on joining the grid system.
Both	Domestic stakeholders	There are no special comments.

E.3. Consideration of comments received

>>

Due Accounts for Comments

- **Gosan**

Stakeholder	Comments	Due account
Daegu metropolitan city government	1. Must observe "Electricity Enterprises Act".	We have been observed "Electricity Enterprises Act".
	2. Must observe the reviewing for small-scale hydro power development by the panel on KOREA HYDRO & NUCLEAR POWER CO., LTD.	We've acknowledged it is must be got right as reviewing for small-scale hydro power development by the panel on KOREA HYDRO & NUCLEAR POWER CO., LTD.

■ **Pangyo**

Stakeholder	Comments	Due account
Gyonggi-do province government	1. Must observe the reviewing for small-scale hydro power development by the panel on KOREA HYDRO & NUCLEAR POWER CO., LTD.	We've acknowledged it is must be got right as reviewing for small-scale hydro power development by the panel on KOREA HYDRO & NUCLEAR POWER CO., LTD.
	2. Must submit the notice of the construction plan to the Gyonggi-do province government before the construction.	We will do act as comments.
	3. Must submit the notice of the starting of generation to the Gyonggi-do province government after the completion of the construction.	We will do act as comments.
	4. Take precautionary measures on the expected environmental impacts on the water pollution, air pollution, waste disposal, and noise vibration harshness, etc.	There is no expected impact. Refer to Section D.2
	5. Make a contract with KEPCO on joining the grid system.	We will do act as comments.

Procedure of collection and address of stakeholder's appeals during project activity

Korea Water Resources Corporation has operating VOC (Voice of Customer) system which is collecting public opinion regularly through the interview, call, and homepage. The stakeholders' comments are managed efficiently by the VOC.

<Table E.1> The process of the VOC

procedure	charge of person	duties
application	customer	- VOC record
Selection of Department	Management renovation department Customer center	- VOC acceptance and selection of control department - monitoring of the control progress
Selection of person in charge	person in charge of file + division supervisor	- selection of person in charge, observe handling period, an attitude of address, etc. general management
answer	person in charge	- answer a stakeholders question meeting the customers' needs in duty period
	team manager	- VOC monitoring of the relevant business - selection of second person in charge when the absent of person in charge

procedure	charge of person	duties
Customer confirmation	customer	- conformation of VOC answer
Post management	Management renovation department	- VOC analysis and feedback

<Figure E.2> Screen capture of the VOC system

SECTION F. Approval and authorization

>>

In the proposed project, the K-water is the project participant and parties involved are the Republic of Korea and Switzerland. PP has already obtained letter of approval from the DNA of Republic of Korea(27/05/2009) and Switzerland(27/04/2012).

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 bundle 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

BASELINE INFORMATION

<Table Annex-1> Data on fuel consumption for plants in the Operating Margin

Year	Plant		Amount of fossil fuel($FC_{i,m,y}$)			
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
2005	Honam	#1	870,214	961	278	-
		#2	912,497	338	185	-
	Samchonpo	#1	1,534,223	-	1,220	-
		#2	1,731,265	-	626	-
		#3	1,723,152	-	377	-
		#4	1,632,334	-	1,029	-
		#5	1,516,654	-	1,415	-
		#6	1,546,663	-	1,001	-
	Yonghung	#1	2,081,972	-	4,541	-
		#2	1,761,395	-	2,903	-
	Boryeong	#1	1,440,343	-	761	-
		#2	1,388,532	-	551	-
		#3	1,589,150	-	90	-
		#4	1,421,343	-	603	-
		#5	1,587,999	-	156	-
		#6	1,260,305	-	627	-
	Taean	#1	1,508,570	-	621	-
		#2	1,323,078	-	395	-
		#3	1,494,175	-	650	-
		#4	1,383,297	-	365	-
		#5	1,411,398	-	742	-
		#5	1,504,962	-	417	-
	Hadong	#1	1,513,930	-	284	-
		#2	1,410,099	-	792	-
		#3	1,422,196	-	472	-
		#4	1,511,054	-	567	-
		#5	1,345,648	-	614	-
		#6	1,520,774	-	331	-
	Dangjin	#1	1,438,702	-	637	-
		#2	1,437,473	-	632	-
		#3	1,549,041	-	141	-
		#4	1,544,010	-	134	-
		#5	499,714	-	5,701	-
		#6	38,671	-	1,779	-
	Ulsan	#1	-	70,183	750	-
		#2	-	67,296	585	-
		#3	-	53,085	662	-
		#4	-	375,417	1,971	-
		#5	-	363,992	1,676	-
		#6	-	352,776	1,708	-
	Youngnam	#1	-	359,910	844	-
		#2	-	190,085	584	-
	Yosu	#1	-	106,919	434	-
		#2	-	218,356	346	-
	Pyongtaek	#1	-	293,214	118	3,553
		#2	-	321,188	140	2,641
		#3	-	308,042	132	1,784
		#4	-	311,245	138	2,047
	Namjeju	#1	-	14,628	15	-
		#2	-	15,031	12	-

Year	Plant		Amount of fossil fuel($FC_{i,m,y}$)			
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
	Jeju	#1	-	12,564	12	-
		#2	-	129,516	-	-
		#3	-	122,866	48	-
	Seoul	#4	-	-	-	49,143
		#5	-	-	1	108,761
	Incheon	#1	-	-	-	4,365
		#2	-	-	-	8,505
		#3	-	-	372	746
		#4	-	-	400	6,620
	Pyongtaek C/C	C/C	-	-	1	110,953
	Ilsan	C/C	-	-	-	533,188
	Bundang	C/C	-	-	-	671,944
	Ulsan	C/C	-	-	-	470,131
	Seoincheon	C/C	-	-	335	989,645
	Shinincheon	C/C	-	-	-	1,458,763
	Boryeong	C/C	-	-	-	1,161,510
	Incheon	C/C	-	-	-	281,813
	Busan	C/C	-	-	-	1,211,144
	Hallim	C/C	-	-	29,686	-
	Anyang	C/C	-	-	-	261,202
	Bucheon	C/C	-	-	-	261,705
	POSCO POWER	C/C	-	-	-	445,253
	G S Bugog	C/C	-	-	-	297,976
	Yulchon	C/C	-	-	159	194,534
	Namjeju	D/P	-	56,727	37	-
	Jeju	G/T	-	-	2,869	-
	Jeju	D/P	-	31,808	72	-
2005 Total			**47,854,833**	**3,776,147**	**75,744**	**8,537,927**
2006	Honam	#1	781,139	1,113	279	
		#2	859,736	1,251	359	
	Samchonpo	#1	1,696,271		860	
		#2	1,508,082		1,362	
		#3	1,519,385		457	
		#4	1,521,263		1,818	
		#5	1,665,339		977	
		#6	1,770,348		428	
	Yonghung	#1	2,004,193		2,548	
		#2	2,129,118		2,545	
	Boryeong	#1	1,638,140		306	
		#2	1,389,425		1,137	
		#3	1,323,779		514	
		#4	1,610,928		82	
		#5	1,296,455		541	
		#6	1,553,273		518	
	Taean	#1	1,354,832		514	
		#2	1,532,209		162	
		#3	1,338,967		575	
		#4	1,548,909		133	
		#5	1,542,775		544	
		#6	1,294,577		1,113	
		#7	61,910		4,799	
	Hadong	#1	1,373,049		515	
		#2	1,543,074		293	
		#3	1,549,094		153	
		#4	1,376,612		796	
		#5	1,554,524		242	
		#6	1,371,801		690	
	Dangjin	#1	1,380,527		966	

Year	Plant		Amount of fossil fuel($FC_{i,m,y}$)			
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
		#2	1,570,077		161	
		#3	1,402,916		433	
		#4	1,386,317		1,549	
		#5	1,456,458		745	
		#6	1,216,582		3,051	
		#7	1,008		505	
	Ulsan	#1		72,243	605	
		#2		80,187	469	
		#3		96,459	518	
		#4		360,919	3,729	
		#5		375,985	3,678	
		#6		378,331	3,694	
	Youngnam	#1		107,090	1,016	
		#2		95,127	1,494	
	Yosu	#1		99,129	281	
		#2		215,957	291	
	Pyongtaek	#1		261,458	141	3,997
		#2		277,025	166	5,687
		#3		303,858	134	3,891
		#4		245,602	103	3,473
	Namjeju	#1		11,406	17	
		#2		9,772	14	
		#3		46,504	2,509	
	Jeju	#1		8,603	23	
		#2		113,679	64	
		#3		117,464	67	
	Seoul	#4			1	69,383
		#5			1	152,891
	Incheon	#1				6,945
		#2				5,223
		#3			311	15,426
		#4			311	12,454
	Pyongtaek C/C	C/C			45	84,054
	Ilsan	C/C			1,384	556,504
	Bundang	C/C				720,381
	Ulsan	C/C				536,196
	Seoincheon	C/C			1,066	1,199,196
	Shinincheon	C/C				1,641,038
	Boryeong	C/C				998,683
	Incheon	C/C				484,606
	Busan	C/C				1,396,417
	Hallim	C/C			48,475	
	Anyang	C/C				230,969
	Bucheon	C/C			215	225,713
	POSCO POWER	C/C				408,018
	G S Bugog	C/C				389,811
	Yulchon	C/C				315,132
	Namjeju	D/P		51,347	111	
	Jeju	G/T			8,264	
	Jeju	D/P		52,907		
2006 Total			**50,123,092**	**3,383,417**	**111,869**	**9,466,086**
2007	Honam	#1	866,853	889	281	
		#2	846,931	811	262	
	Samchonpo	#1	1,631,706		296	
		#2	1,804,695		384	
		#3	1,755,374		434	
		#4	1,543,140		677	
		#5	1,850,764		315	

Year	Plant		Amount of fossil fuel($FC_{i,m,y}$)			
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
		#6	1,714,320		619	
	Yonghung	#1	1,902,557		3,320	
		#2	2,296,289		1,779	
		#3	119,883		3,964	
		#4				
	Boryeong	#1	1,466,761		811	
		#2	1,655,488		169	
		#3	1,648,008		187	
		#4	1,347,303		646	
		#5	1,629,904		195	
		#6	1,490,809		387	
	Taean	#1	1,524,391		410	
		#2	1,434,221		374	
		#3	1,521,349		350	
		#4	1,320,380		422	
		#5	1,342,358		676	
		#6	1,535,931		491	
		#7	1,430,171		2,321	
		#8	919,055		3,636	
	Hadong	#1	1,582,726		178	
		#2	1,396,830		637	
		#3	1,424,033		375	
		#4	1,572,409		292	
		#5	1,486,776		452	
		#6	1,585,307		109	
	Dangjin	#1	1,512,904		269	
		#2	1,358,316		543	
		#3	1,516,065		119	
		#4	1,519,231		342	
		#5	1,279,796		1,038	
		#6	1,281,318		878	
		#7	1,059,612		6,681	
		#8	467,807		4,873	
	Ulsan	#1		107,844	406	
		#2		108,381	483	
		#3		120,571	576	
		#4		341,170	3,525	
		#5		370,712	4,711	
		#6		216,409	3,021	
	Youngnam	#1		174,082	1,232	
		#2		122,249	796	
	Yosu	#1		121,572	332	
		#2		257,420	367	
	Pyongtaek	#1		269,284	114	3,316
		#2		359,870	140	6,339
		#3		349,481	157	4,874
		#4		255,443	117	4,047
	Namjeju	#1				
		#2				
		#3		124,559	225	
		#4		127,900	341	
	Jeju	#1		1,049	4	
		#2		70,122	112	
		#3		98,846	34	
	Seoul	#4			1	75,080
		#5			1	206,908
	Incheon	#1				30,402
		#2				31,528

Year	Plant		Amount of fossil fuel($FC_{i,m,y}$)			
			Coal (t)	**Heavy oil (kl)**	**Diesel oil (kl)**	**L. N. G (t)**
		#3			354	41,270
		#4			201	18,892
	Pyongtaek C/C	C/C			67	151,414
	Ilsan	C/C				635,260
	Bundang	C/C			3	660,899
	Ulsan	C/C				649,494
	Seoincheon	C/C				1,495,687
	Shinincheon	C/C				1,761,001
	Boryeong	C/C				1,121,251
	Incheon	C/C				494,690
	Busan	C/C				1,552,997
	Hallim	C/C			17,753	
	Anyang	C/C				289,384
	Bucheon	C/C				269,651
	POSCO POWER	C/C				660,445
	G S Bugog	C/C				371,586
	Yulchon	C/C				292,336
	Namjeju	D/P		35,297	238	
	Jeju	G/T			850	
	Jeju	D/P		49,613		
2007 Total			**55,641,771**	**3,683,575**	**76,359**	**10,829,064**

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

<Table Annex-2> Net Caloric Value

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
2005	Honam	#1	5,122	9,343	8,368	
		#2	5,107	9,362	8,364	
	Samchonpo	#1	5,618		8,399	
		#2	5,628		8,439	
		#3	5,602		8,550	
		#4	5,603		8,496	
		#5	5,079		8,183	
		#6	5,107		8,550	
	Yonghung	#1	5,824		8,488	
		#2	5,750		8,500	
	Boryeong	#1	5,539		8,496	
		#2	5,525		8,496	
		#3	5,588		8,303	
		#4	5,596		8,311	
		#5	5,588		8,312	
		#6	5,606		8,312	
	Taean	#1	5,700		8,257	
		#2	5,708		8,249	
		#3	5,707		8,242	
		#4	5,699		8,270	
		#5	5,730		8,242	
		#5	5,716		8,256	
	Hadong	#1	5,703		8,493	
		#2	5,697		8,481	
		#3	5,698		8,533	
		#4	5,699		8,491	
		#5	5,695		8,526	
		#6	5,695		8,481	
	Dangjin	#1	5,664		8,392	
		#2	5,664		8,469	
		#3	5,638		8,402	
		#4	5,644		8,387	
		#5	5,809		8,458	
		#6	5,910		10,540	
	Ulsan	#1		9,405	8,660	
		#2		9,408	8,657	
		#3		9,413	8,663	
		#4		9,501	8,666	
		#5		9,494	8,666	
		#6		9,480	8,662	
	Youngnam	#1		7,108	8,495	
		#2		7,342	8,496	
	Yosu	#1		9,462	8,442	
		#2		9,447	8,441	
	Pyongtaek	#1		9,407	8,496	11,608
		#2		9,409	8,513	11,585
		#3		9,412	8,502	11,647
		#4		9,413	8,502	11,604
	Namjeju	#1		9,384	8,853	
		#2		9,385	8,842	
	Jeju	#1		9,435	8,441	
		#2		9,433		
		#3		9,429	8,491	
	Seoul	#4				11,702
		#5			8,617	11,707
	Incheon	#1				11,729
		#2				11,723
		#3			8,516	11,727
		#4			8,506	11,723
	Pyongtaek C/C	C/C			8,503	11,727
	Ilsan	C/C				11,710
	Bundang	C/C				11,723

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	**Heavy oil (kcal/l)**	**Diesel oil (kcal/l)**	**L. N. G (kcal/kg)**
	Ulsan	C/C				11,475
	Seoincheon	C/C			8,740	11,709
	Shinincheon	C/C				11,712
	Boryeong	C/C				11,727
	Incheon	C/C				11,711
	Busan	C/C				11,700
	Hallim	C/C			8,524	
	Anyang	C/C				11,723
	Bucheon	C/C				11,702
	POSCO POWER	C/C				11,721
	G S Bugog	C/C				12,381
	Yulchon	C/C			10,384	11,721
	Namjeju	D/P		9,383	8,526	
	Jeju	G/T			8,473	
	Jeju	D/P		9,435	8,506	
2005 Total			**190,659**	**212,292**	**529,516**	**281,195**
2006	Honam	#1	5,164	9,318	8,472	
		#2	5,137	9,332	8,426	
	Samchonpo	#1	5,640		8,373	
		#2	5,645		8,373	
		#3	5,565		8,373	
		#4	5,568		8,363	
		#5	4,974		8,550	
		#6	4,993		8,550	
	Yonghung	#1	5,768		8,447	
		#2	5,782		8,454	
	Boryeong	#1	5,479		8,412	
		#2	5,478		8,496	
		#3	5,552		8,496	
		#4	5,533		8,496	
		#5	5,552		8,312	
		#6	5,542		8,312	
	Taean	#1	5,683		8,312	
		#2	5,679		7,952	
		#3	5,684		8,216	
		#4	5,680		8,232	
		#5	5,638		8,232	
		#6	5,662		8,232	
		#7	5,667		8,130	
	Hadong	#1	5,670		8,396	
		#2	5,662		8,482	
		#3	5,660		8,481	
		#4	5,671		8,384	
		#5	5,665		8,466	
		#6	5,669		8,456	
	Dangjin	#1	5,588		8,526	
		#2	5,611		8,529	
		#3	5,592		8,556	
		#4	5,581		8,564	
		#5	5,743		8,507	
		#6	5,814		8,450	
		#7	5,527		8,535	
	Ulsan	#1		9,419	8,664	
		#2		9,427	8,664	
		#3		9,423	8,664	
		#4		9,529	8,664	
		#5		9,531	8,664	
		#6		9,533	8,664	
	Youngnam	#1		9,631	8,403	
		#2		9,605	8,419	
	Yosu	#1		9,465	8,358	

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	**Heavy oil (kcal/l)**	**Diesel oil (kcal/l)**	**L. N. G (kcal/kg)**
		#2		9,456	8,356	
	Pyongtaek	#1		9,222	8,496	11,647
		#2		9,233	8,496	11,647
		#3		9,260	8,501	11,573
		#4		9,208	8,501	11,667
	Namjeju	#1		9,413	8,525	
		#2		9,412	8,504	
		#3		9,403	8,491	
	Jeju	#1		9,377	8,429	
		#2		9,454	8,524	
		#3		9,455	8,524	
	Seoul	#4			8,617	11,716
		#5			8,617	11,594
	Incheon	#1				11,733
		#2				11,725
		#3			8,533	11,716
		#4			8,532	11,722
	Pyongtaek C/C	C/C			8,503	11,727
	Ilsan	C/C			8,540	11,715
	Bundang	C/C				11,723
	Ulsan	C/C				11,381
	Seoincheon	C/C			8,740	11,723
	Shinincheon	C/C				11,723
	Boryeong	C/C				11,730
	Incheon	C/C				11,698
	Busan	C/C				11,716
	Hallim	C/C			8,506	
	Anyang	C/C				11,726
	Bucheon	C/C			10,381	11,711
	POSCO POWER	C/C				11,728
	G S Bugog	C/C				11,727
	Yulchon	C/C				12,039
	Namjeju	D/P		9,734	8,462	
	Jeju	G/T			8,352	
	Jeju	D/P		9,136		
2006 Total			**200,520**	**225,976**	**568,837**	**280,804**
2007	Honam	#1	5,186	9,311	8,497	
		#2	5,190	9,311	8,493	
	Samchonpo	#1	5,545		8,373	
		#2	5,537		8,373	
		#3	5,525		8,349	
		#4	5,540		8,349	
		#5	4,865		8,550	
		#6	4,864		8,550	
	Yonghung	#1	5,745		8,391	
		#2	5,739		8,457	
		#3	5,822		7,878	
		#4				
	Boryeong	#1	5,519		8,496	
		#2	5,515		8,496	
		#3	5,518		8,655	
		#4	5,513		8,944	
		#5	5,520		8,655	
		#6	5,518		8,655	
	Taean	#1	5,733		8,174	
		#2	5,733		8,387	
		#3	5,734		8,388	
		#4	5,727		7,963	
		#5	5,686		8,361	
		#6	5,695		8,347	

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
		#7	5,717		8,044	
		#8	5,722		7,256	
	Hadong	#1	5,647		8,492	
		#2	5,645		8,456	
		#3	5,627		8,469	
		#4	5,639		8,519	
		#5	5,652		8,492	
		#6	5,640		8,495	
	Dangjin	#1	5,660		8,610	
		#2	5,663		8,606	
		#3	5,657		8,617	
		#4	5,659		8,635	
		#5	5,713		8,620	
		#6	5,737		8,613	
		#7	5,725		8,621	
		#8	5,742		8,596	
	Ulsan	#1		9,413	8,664	
		#2		9,420	8,664	
		#3		9,360	8,664	
		#4		9,508	8,664	
		#5		9,511	8,664	
		#6		9,502	8,664	
	Youngnam	#1		9,643	8,402	
		#2		9,643	8,403	
	Yosu	#1		9,464	8,368	
		#2		9,462	8,370	
	Pyongtaek	#1		9,445	8,534	11,650
		#2		9,448	8,530	11,653
		#3		9,447	8,518	11,650
		#4		9,460	8,517	11,651
	Namjeju	#1				
		#2				
		#3		9,411	8,201	
		#4		9,410	8,515	
	Jeju	#1		9,412	8,458	
		#2		9,420	7,906	
		#3		9,419	8,490	
	Seoul	#4			7,411	11,727
		#5			8,617	11,727
	Incheon	#1				11,727
		#2				11,730
		#3			8,514	11,730
		#4			8,483	11,730
	Bundang fuel cell					11,673
	Pyongtaek C/C	C/C			8,503	11,739
	Ilsan	C/C				11,725
	Bundang	C/C			8,716	11,728
	Ulsan	C/C				11,610
	Seoincheon	C/C				11,739
	Shinincheon	C/C				11,735
	Boryeong	C/C				11,735
	Incheon	C/C				11,726
	Busan	C/C				11,727
	Hallim	C/C			8,533	
	Anyang	C/C				11,741
	Bucheon	C/C				11,898
	POSCO POWER	C/C				11,756
	G S Bugog	C/C				11,734
	Yulchon	C/C				11,732
	Kwangyang	C/C				-

year	Plant		Net Caloric value($NCV_{i,y}$)			
			Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
	Namjeju	D/P		9,419	8,323	
	Jeju	G/T			8,447	
	Jeju	D/P		9,396		
2007 Total			**217,814**	**217,234**	**565,661**	**292,975**

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

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

Year	Plant		Net electricity generated $EG_{m,y}$ (MWh)	EF for each plant ($tonCO_2/MWh$)
2005	Honam	#1	1,787,715	0.9363
		#2	1,875,790	0.9318
	Samchonpo	#1	3,810,079	0.8484
		#2	4,323,618	0.8448
		#3	4,343,666	0.8330
		#4	4,112,297	0.8341
		#5	3,542,728	0.8158
		#6	3,643,969	0.8130
	Yonghung	#1	5,623,299	0.8101
		#2	4,658,862	0.8163
	Boryeong	#1	3,547,140	0.8433
		#2	3,433,608	0.8377
		#3	4,124,745	0.8068
		#4	3,698,705	0.8061
		#5	4,121,314	0.8069
		#6	3,283,477	0.8068
	Taean	#1	3,992,112	0.8075
		#2	3,484,251	0.8126
		#3	3,957,054	0.8079
		#4	3,653,534	0.8088
		#5	3,744,413	0.8099
		#5	3,999,847	0.8062
	Hadong	#1	3,997,914	0.8094
		#2	3,732,583	0.8070
		#3	3,769,077	0.8060
		#4	3,989,315	0.8092
		#5	3,553,901	0.8085
		#6	4,037,763	0.8040
	Dangjin	#1	3,797,307	0.8045
		#2	3,798,078	0.8037
		#3	4,081,017	0.8020
		#4	4,079,557	0.8005
		#5	1,318,670	0.8360
		#6	96,365	0.9478
	Ulsan	#1	262,393	0.8027
		#2	255,812	0.7883
		#3	200,518	0.7964
		#4	1,549,091	0.7312
		#5	1,500,935	0.7307
		#6	1,454,644	0.7299
	Youngnam	#1	1,022,470	0.7931
		#2	531,006	0.8337
	Yosu	#1	430,310	0.7458
		#2	904,597	0.7218
	Pyongtaek	#1	1,258,662	0.7004
		#2	1,376,342	0.6994
		#3	1,321,167	0.6975
		#4	1,338,204	0.6964

Year	Plant		Net electricity generated $EG_{m,y}$ (MWh)	EF for each plant ($tonCO_2/MWh$)
	Namjeju	#1	44,602	0.9738
		#2	44,654	0.9994
	Jeju	#1	36,266	1.0341
		#2	532,700	0.7249
		#3	502,189	0.7294
	Seoul	#4	207,498	0.6301
		#5	444,324	0.6515
	Incheon	#1	16,450	0.7075
		#2	37,727	0.6008
		#3	-	-
		#4	29,202	0.6396
	Pyongtaek C/C	C/C	659,932	0.4482
	Ilsan	C/C	2,873,958	0.4939
	Bundang	C/C	3,742,073	0.4785
	Ulsan	C/C	3,131,075	0.3917
	Seoincheon	C/C	7,001,031	0.3764
	Shinincheon	C/C	10,543,280	0.3684
	Boryeong	C/C	8,221,926	0.3766
	Incheon	C/C	2,055,016	0.3651
	Busan	C/C	9,076,327	0.3549
	Hallim	C/C	100,346	0.7665
	Anyang	C/C	1,433,978	0.4854
	Bucheon	C/C	1,404,160	0.4959
	POSCO POWER	C/C	2,571,095	0.4615
	G S Bugog	C/C	2,189,808	0.3830
	Yulchon	C/C	1,300,627	0.3989
	Namjeju	D/P	268,073	0.6280
	Jeju	G/T	5,069	1.4577
	Jeju	D/P	151,759	-
2005 Total			**195,045,065**	**0.6891**
2006	Honam	#1	1,622,639	0.9340
		#2	1,782,016	0.9313
	Samchonpo	#1	4,161,219	0.8620
		#2	3,703,880	0.8622
		#3	3,779,585	0.8387
		#4	3,816,997	0.8328
		#5	3,761,205	0.8259
		#6	4,065,091	0.8150
	Yonghung	#1	5,337,432	0.8129
		#2	5,727,937	0.8065
	Boryeong	#1	3,988,848	0.8434
		#2	3,423,101	0.8341
		#3	3,409,486	0.8082
		#4	4,133,946	0.8080
		#5	3,364,148	0.8022
		#6	3,987,488	0.8093
	Taean	#1	3,556,797	0.8116
		#2	4,035,753	0.8081
		#3	3,528,613	0.8086
		#4	4,069,820	0.8101
		#5	4,013,235	0.8125
		#6	3,381,867	0.8131
		#7	159,677	0.8976
	Hadong	#1	3,607,063	0.8092
		#2	4,068,036	0.8049
		#3	4,079,158	0.8056
		#4	3,631,374	0.8061
		#5	4,092,625	0.8065
		#6	3,610,222	0.8077

Year	Plant		Net electricity generated $EG_{m,y}$ (MWh)	EF for each plant ($tonCO_2/MWh$)
	Dangjin	#1	3,598,820	0.8040
		#2	4,115,891	0.8021
		#3	3,666,490	0.8020
		#4	3,610,984	0.8041
		#5	3,946,931	0.7947
		#6	3,392,395	0.7836
		#7	1,474	2.3058
	Ulsan	#1	275,016	0.7879
		#2	306,668	0.7832
		#3	376,132	0.7675
		#4	1,511,557	0.7257
		#5	1,583,846	0.7213
		#6	1,589,838	0.7232
	Youngnam	#1	359,205	0.9149
		#2	323,595	0.9043
	Yosu	#1	403,547	0.7367
		#2	906,849	0.7126
	Pyongtaek	#1	1,123,948	0.6879
		#2	1,198,620	0.6875
		#3	1,304,568	0.6899
		#4	1,052,228	0.6884
	Namjeju	#1	34,448	0.9864
		#2	28,686	1.0148
		#3	179,033	0.8082
	Jeju	#1	24,748	1.0328
		#2	462,023	0.7357
		#3	479,676	0.7323
	Seoul	#4	306,558	0.6028
		#5	685,011	0.5883
	Incheon	#1	32,932	0.5625
		#2	24,366	0.5714
		#3	78,669	0.5325
		#4	62,414	0.5446
	Pyongtaek C/C	C/C	497,441	0.4507
	Ilsan	C/C	3,038,165	0.4890
	Bundang	C/C	4,059,300	0.4730
	Ulsan	C/C	3,608,435	0.3845
	Seoincheon	C/C	8,726,521	0.3666
	Shinincheon	C/C	11,797,500	0.3707
	Boryeong	C/C	7,089,662	0.3757
	Incheon	C/C	3,648,288	0.3533
	Busan	C/C	10,455,401	0.3557
	Hallim	C/C	175,356	0.7147
	Anyang	C/C	1,286,480	0.4786
	Bucheon	C/C	1,241,795	0.4845
	POSCO POWER	C/C	2,338,128	0.4653
	G S Bugog	C/C	2,911,683	0.3569
	Yulchon	C/C	2,276,276	-
	Namjeju	D/P	239,690	0.6603
	Jeju	G/T	15,986	1.3123
	Jeju	D/P	252,764	0.6045
2006 Total			**206,605,293**	**0.6791**
2007	Honam	#1	1,806,765	0.9343
		#2	1,773,852	0.9303
	Samchonpo	#1	3,903,591	0.8687
		#2	4,398,382	0.8515
		#3	4,311,704	0.8431
		#4	3,840,729	0.8345
		#5	4,074,103	0.8284

Year	Plant		Net electricity generated $EG_{m,y}$ (MWh)	EF for each plant ($tonCO_2/MWh$)
		#6	3,823,174	0.8177
	Yonghung	#1	5,020,901	0.8174
		#2	6,081,490	0.8128
		#3	320,502	0.8457
		#4		
	Boryeong	#1	3,604,642	0.8421
		#2	4,120,511	0.8303
		#3	4,214,892	0.8086
		#4	3,438,773	0.8099
		#5	4,162,530	0.8101
		#6	3,817,024	0.8078
	Taean	#1	4,055,394	0.8078
		#2	3,796,670	0.8118
		#3	4,039,811	0.8094
		#4	3,504,214	0.8089
		#5	3,523,988	0.8121
		#6	4,036,733	0.8123
		#7	3,868,817	0.7934
		#8	2,528,587	0.7824
	Hadong	#1	4,140,667	0.8089
		#2	3,681,670	0.8030
		#3	3,727,907	0.8056
		#4	4,115,014	0.8075
		#5	3,905,190	0.8067
		#6	4,158,792	0.8057
	Dangjin	#1	3,968,103	0.8088
		#2	3,595,927	0.8019
		#3	4,010,715	0.8014
		#4	4,009,178	0.8037
		#5	3,443,482	0.7965
		#6	3,497,359	0.7882
		#7	2,904,680	0.7886
		#8	1,297,925	0.7853
	Ulsan	#1	406,685	0.7916
		#2	407,321	0.7955
		#3	458,584	0.7812
		#4	1,418,034	0.7296
		#5	1,540,400	0.7316
		#6	899,604	0.7314
	Youngnam	#1	688,935	0.7748
		#2	474,475	0.7896
	Yosu	#1	497,053	0.7334
		#2	1,071,405	0.7195
	Pyongtaek	#1	1,147,515	0.7085
		#2	1,553,162	0.7031
		#3	1,502,099	0.7037
		#4	1,095,986	0.7070
	Namjeju	#1	-	
		#2	-	
		#3	484,459	0.7661
		#4	500,222	0.7623
	Jeju	#1	3,019	1.0379
		#2	280,454	0.7455
		#3	396,186	0.7430
	Seoul	#4	357,572	0.5598
		#5	962,861	0.5729
	Incheon	#1	148,821	0.5446
		#2	157,042	0.5354
		#3	205,530	0.5399

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

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

<Table Annex-4> Sample group plants used in the Build Margin calculation and CO_2 Emission Factor of the Build Margin

Year	No.	Plant name		Technology	Type of Fossile Fue	year operation	Net electricity generated (EGm,y)	CO_2 emission factor ($EF_{EL,m,y}$)	Results
							MWh in 2007	tCO2/MWh	EF for each plant (tonCO2eq./MWh)
	1	Hanbit Sungsan the second solar		solar		2007.12	-		
	2	Taein gangjin solar		solar		2007.12	6		
	3	Suni gangjin solar		solar		2007.12	11		
	4	Korea yeongcheon solar		solar		2007.12	17		
	5	Solar yungam solar		solar		2007.12	-		
	6	Changwhan yeongduk solar		solar		2007.12	5		
	7	Samsung jindo		solar		2007.12	9		
	9	Hwaseong heat & power		combined		2007.12			
	10	Dangjin	#8	steam power	Bituminous coal	2007.12	1,297,925	0.7853	0.0120
	11	SP solar yonggwang		solar		2007.11	38		
	12	Dongyang energy sinan		solar		2007.11	268		
	13	Ef yungam solar		solar		2007.11	40		
	14	Dongwon gangjin solar		solar		2007.11	214		
	15	Solec yonggwang solar		solar		2007.11	120		
	16	Solar jungeub solar		solar		2007.11	92		
	17	Sinbuk yungam solar		solar		2007.11	178		
	18	Hyein haenam solar		solar		2007.11	364		
	19	Samlangjin solar		solar		2007.11	646		
2	20	Hyosung daegi-wind power		wind		2007.11	42		
	19	Nonhyun heat & power		combined		2007.10			
	20	Wuriyungam solar		solar		2007.08	267		
0	21	Hwasung solar		solar		2007.08	309		
	22	Yeongju the first solar		solar		2007.08	230		
	23	Muan solar		solar		2007.08	622		
0	24	Jangheung solar		solar		2007.08	125		
	25	Gomun		small hydro power		2007.08	2,996		
	26	Taean	#8	steam power	Bituminous coal	2007.08	2,528,587	0.7824	0.0233
7	27	Dangjin	#7	steam power	Bituminous coal	2007.06	2,904,680	0.7886	0.0270
	28	Munkyung solar		solar		2007.06	2,563		
	29	Younggwang solar park		solar		2007.06	853		
	30	Yungam Solar		solar		2007.06	770		
	31	Wonjungsu		small hydro power		2007.05			
	32	baegok		small hydro power		2007.05	1,001		
	33	damyangho		small hydro power		2007.05	1,771		
	34	Juam		small hydro power		2007.05			
	35	Namjeju	#4	thermal	heavy oil	2007.03	500,222	0.7623	0.0045
	36	Eco energy		solar		2007.03	231,029		
	37	hapcheon		small hydro power		2007.02	6,777		
	38	Jeonju-resource recovery facility				2007.02	13,059		
	39	Seoul Marin(suncheon)		solar		2007.02	1,223		
	40	Mirae energy		solar		2007.02	165		
	41	Seomjingang		small hydro power		2007.02			
	42	samcheonpo		small hydro power		2007.02			
	43	dalbang		small hydro power		2007.02			
	44	Taean	#7	steam power	Bituminous coal	2007.02	3,868,817	0.7934	0.0362
	45	Yeongju the second solar		solar		2007.01	646		
	46	Hyundaedaesan		combined		2007.01			

	1	Cheongsong pumping	#2	pumping		2006.12	145,042		
	2	S&P Solar		solar		2006.10	995		
	3	Bundang fuel cell		fuel cell	LNG	2006.10	1,959	0.4243	0
	4	Yonnggwang Solar park		solar		2006.10	853		
	5	Namhae Solar		solar		2006.10	1,462		
	6	HanlaJeunggong Solar		solar		2006.10	1,292		
2	7	Yungam Solar		solar		2006.09	770		
	8	Enepark		solar		2006.09	416		
	9	Yongheng solar		solar		2006.09	1,214		
0	10	Cheongsong pumping	#1	pumping		2006.09	164,069		
	11	Namjeju	#3	thermal	heavy oil	2006.09	484,459	0.7661	0.0044
	12	yangyang(pumping)	#4	pumping		2006.08	91,270		
0	13	Donghae solar		solar		2006.08	1,118		
	14	Kangwon-wind power		wind		2006.07			
	15	yangyang pump windpower		wind		2006.06			
6	16	Hadongho		small hydro power		2006.06	1,832		
	17	yangyang (pumping)	#3	pumping		2006.06	56,495		
	18	Goheung Solar		solar		2006.06	1,233		
	19	Jangseong		small hydro power		2006.05	648		
	20	yangyang (pumping)	#2	pumping		2006.04	103,698		
	21	Dangjin	#6	thermal	Bituminous coal	2006.04	3,497,359	0.7882	0.0325
	22	Sinchang-wind power		wind		2006.03	3,572		
	23	yangyang (pumping)	#1	pumping		2006.02	106,973		

	1	Janghengdam		small hydro power		2005.12			
	2	Suncheon Solar		solar		2005.12	1,259		
	3	Samcheonpo solar energy		solar		2005.12	131		
	4	Dangjin	#5	steam power	Bituminous coal	2005.10	3,443,482	0.7965	0.0324
	5	yangyang pump small hydro		small hydro power		2005.10			
	6	Taean solar energy		solar		2005.10	118		
	7	Jeju DP		internal combustion	heavy oil	2005.07	235,626	0.6254	0.0017
	8	WunjeongLFG		internal combustion	LFG	2005.07	11,415		
	9	Yulchon		combined	LNG	2005.07	2,083,451	0.3743	0.0092
	10	Incheon		combined	LNG	2005.07	3,696,784	0.3567	0.0156
	11	Daegok		small hydro power		2005.07	1,278		
	12	Donghwa		small hydro power		2005.07	2,481		
2	13	Ulchin	#6	nuclear		2005.04	7,911,305		
	14	Hanrye		LFG	LFG	2005.04	5,102		
	15	Busan Bio-gas		internal combustion	LFG	2005.03	1,551		
	16	Sungnam		small hydro power		2004.12			
0	17	Yungduk-wind power		wind		2004.12			
	18	Yongdam		small hydro power		2004.12	24,928		
	19	Maebongsan-wind power		wind		2004.12	11,058		
0	20	Daegwanryung-wind power		wind		2004.12	4,288		
	21	Yongheng	#2	steam power	Bituminous coal	2004.11	6,081,490	0.8128	0.0583
	22	new solar energy		solar		2004.11	224		
	23	Yongheng	#1	steam power	Bituminous coal	2004.07	5,020,901	0.8174	0.0484
5	24	Ulchin	#5	nuclear		2004.07	8,025,928		
	25	Busan		combined combustion	LNG	2003.05/2004.03	11,616,221	0.3564	0.0489
	26	Chunsang		small hydro power		2004.02	240		
	27	Cheongju LFG		internal combustion		2004.02	5,808		
	28	Daejon Geumgodong		internal combustion		2003.06	9,160		
	29	Hoicheon ENC		internal combustion		2003.05	2,826		
	30	Andong		small hydro power		2003.09			
	31	Gunsan-wind power		wind		2002.11/2003.09	7,958		
	32	Sangwon ENC		internal combustion		2001.12/2003.03/2003.06			
	33	Muju		small hydro power		2003.04	637		
	34	Yonggwang	#6	nuclear		2002.12	7,859,224		
	35	Taean	#6	steam power	Bituminous coal	2002.05	4,036,733	0.8123	0.0387
	36	Yonggwang	#5	nuclear		2002.05	8,601,736		
Total							**84,736,759**		**0.3933**

Source: Statistics of Electric Power in 2005-2007, KEPCO 2006-2008, Current status of power generating facility (Korea power exchange)

<Table Annex-5> Fuels CO_2 Emission factor

Fuel Type	$EF_{CO2,i,y}$ (tCO2/TJ)
Gasoline	**67.5**
Diesel oil	**72.6**
residual fuel oil	**75.5**
LNG	**54.3**
bituminous coal	**89.5**
Anthracite	**94.6**

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

Appendix 5. Further background information on monitoring plan

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

Appendix 6. Summary report of comments received from local stakeholders

Please refer to section “E.1. Modalities for local stakeholder consultation”.

Appendix 7. Summary of post-registration changes

- Project participant revised the geo coordination of the Gosan power plant.
- Project participant revised the PDD with respect to specification of wheel information of Pangyo power plant according to installed turbine.
- Project participant revised the PDD with respect to information of allowable error of the watt-hour meters for electricity exported to the grid and imported from the grid.