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	Korea Water Resources Corporation (Kwater [1]) small-scale hydroelectric power plants project II
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	Version 04.0
Completion date of the PDD	31/07/2017
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 9.0
Sectoral scopes linked to the applied methodologies	Sectoral scope : 1 - Energy industries (renewable / non-renewable sources)
Estimated amount of annual average GHG emission reductions	8,664 tCO_2e

[1] K-water is new name of KOWACO (Korea Water Resources Corporation).

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Purpose of the project

Small-scale hydroelectric power plants construction by K-water generates electricity as well as socio-economical benefits in local and national level. Construction of dams contributes to effective development of hydroelectric power through utilizing environmental friendly energy sources such as surplus hydroelectric power from the existing dams and waterworks, and also abates global warming**.** In addition, it will cope with the increasing demand to electricity and reduce fossil fuels imports in Korea.

Concept of the project

K-water small-scale hydroelectric power plants project (the SeongnamⅡ, the Dalbang-dam, the Juam-dam, Daecheong-dam small scale hydro power plant construction project) consists in 2,320 kW of facility capacity, and power generation of 13,944MWh per year. Major project participant is K-water.

Contribution to sustainable development

The project activity contributes to sustainable development 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 sources, small-scale hydroelectric power does not emit air pollutants or wastes.
- As a renewable energy source, hydroelectric power does not deplete natural resources and therefore it will be used as alternative energy sustainably by future generations.
- There are no Green House Gas (GHG) emissions.
- Construction of small-scale hydroelectricity power plants makes local people approach water for irrigation and household usage much easier and takes advantage of water resources more efficiently.
- Construction of the project and operation brings in reduction in below pollutants as much as the following:
  - CO_2 : 8,664 tons/yr
  - SOx : 16.0 tons/yr
  - NOx : 12.1 tons/yr
  - Dust : 0.8 tons/yr

Above mentioned emission reduction contributes to abatement of global warming as well as prevention of acidification and photochemical reaction.

A.2. Location of project activity

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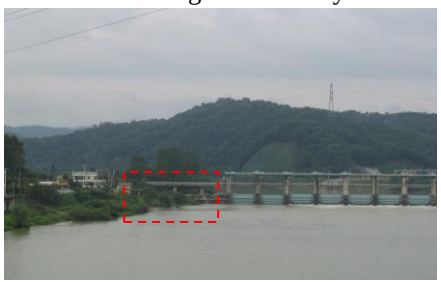
● The Seongnam Ⅱ SSC-hydroelectric power plant

The generator will be constructed on the site in the dotted red line.

● The Dalbang-dam SSC-hydroelectric power plant

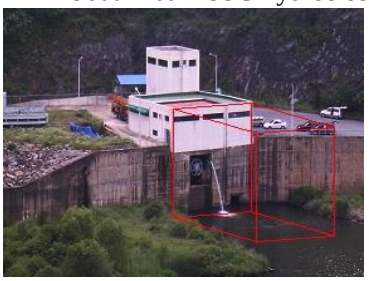
The generator will be constructed on the site in the dotted red line.

● The Daecheong-dam SSC-hydroelectric power plant



The generator will be constructed on the site in the dotted red line.

● The Juam-dam SSC-hydroelectric power plant



The generator will be constructed on the site in the red area.

<Figure A.1> Location of small-scale power plant and brief description

<Table A.1> The address of the power plant of each project site

Project sites	Address	Latitude	Longitude
Seongnam II	512, Sasong-dong, Sujeong-gu, Seongnam city, Gyeonggi-do, Republic of Korea	37.413333°N	127.108333°E
Dalbang-dam	854-20, Iro-dong, Donghae city, Gangwon-do, Republic of Korea	37.504444°N	129.038889°E
Juam-dam	564-11, Gwangcheon-ri, Juam-myeon, Suncheon city, Jeollanam-do, Republic of Korea	35.065000°N	127.236944°E
Daecheong-dam	461-3, Nosan-ri, Hyeondo-myeon, Seowon-gu, Cheongju city[2], Chungcheongbuk-do, Republic of Korea	36.450833°N	127.451944°E

[2] The administrative district was reorganized from Cheongwon-gun to Seowon-gu, Cheongju city since 01/07/2014

A.3. Technologies/measures

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

The project falls into 'Renewable energy project' of Type I of 'Appendix B of the simplified modalities and procedures for small-scale CDM project activities' in that K-water small-scale hydroelectric power plants project utilizes renewable energy source. Additionally, the project falls into 'Electricity generation of a grid' of category D, because electricity generated by renewable energy source is grid-connected.

<Table A.2> Description of technology of the small-scale hydroelectric power plants

Classification		The Seongnam Ⅱ small-scale hydroelectric	The Dalbang-dam small-scale hydroelectric	The Juam-dam small-scale Hydroelectric	The Daecheong-dam small-scale Hydroelectric
Wheel	Type	Horizontal Francis	Horizontal Francis	Horizontal Francis	Propeller (Tubular)
	Output power	382 KW	180 kW	537 kW	413 kW
	Rotation	400 RPM	900 RPM	720 RPM	225 RPM
	Unit	1	1	2	2
Generator	Type	Three-phase induction	Three-phase induction	Three-phase induction	Three-phase induction
	Output power	360 KW	170 kW	495 kW	400 kW
	Rotation	412 RPM	900 RPM	720 RPM	225 RPM
Transformer	Type	Mold type	Mold type	Mold type	Mold type
	capacity	500 kVA	250 kVA	1,500 kVA	1,500 kVA
	Voltage	380 V / 22.9 kV	380 V / 22.9 kV	480 V / 22.9kV	0.6 kV / 22.9 kV
	Connect-ion type	Δ-Y	Δ-Y	Δ-Y	Δ-Y
	Unit	1	1	1	1

As the project activity generates electricity with using unaccounted outflows from the existing dams or purification plants, there are no severe environmental impacts. Accordingly, technology adopted to this project is environmentally safe and sound. In addition, there is no conversion of equipment in this project because this project is new business.
Water turbine generator, which is the main equipment in this project, is designed and manufactured by Dae-yang Electric Machine Co.[3], which is Korean company. Also one of the best technologies of the world is applied to this project. Technology details are followed;

- Firstly, the water turbine generator applied to this project has the stable performance because the water turbine generator was custom-made with the water source conditions such as flow velocity and flow volume.

3 Dae-yang Electric Machine Co. has researched about water turbine generator for 20 years since 1983. Based on international references and reports, they have been developing water turbine generator which can apply to Korea situation. From the developing technology and domestication of advanced international technology, they have contributed much to facilities field of small-scale electricity generation.

- Secondly, this is not the style of gear or belt connection but unified shaft that the water turbine is directly related to the generator. Therefore, it has simple components and low probability of serious problem.
- Thirdly, operation and maintenance is smoothly performed and generation loss is reduced.

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
United Kingdom of Great Britain and Northern Ireland		
Switzerland		

A.5. Public funding of project activity

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No public funding is provided for this 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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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.
The contents of Appendix C for debundling project is as follows :

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 an application to register another small-scale CDM project activity:

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

Bundled four small-scale hydroelectric power plants have 2.320 MW capacity. None of these four plants are part of a large project. Therefore this project is not a debundled project.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

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Project activity I.D./Version9 "Grid connected renewable electricity generation."
http://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

Referred to small-scale project category of Appendix B of the simplified modalities and procedures for small-scale CDM project activities.
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 9.0) can be applied to the proposed project because the proposed project meets all the applicability criteria of the methodology as demonstrated as follows:

Applicability Conditions	Justification
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.
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 fuel, 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 2.32MW. 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.
Biomass combined heat and power (co-generation) systems that supply electricity to and/or displace electricity from a grid are included in this category. To qualify under this category, the sum of all forms of energy output shall not exceed 45 $MW_{thermal}$. E.g., for a biomass based co-generating system the rating for all the boilers combined shall not exceed 45 $MW_{thermal}$.	Not relevant : The proposed project is the generation of hydropower using renewable energy. There are no Biomass combined heat and power (co-generation) systems.
Project activities adding renewable energy capacity should consider the following cases: a) Adding new units; b) Replacing old units for more efficient units. To qualify as a small scale CDM project activity, the aggregate installed capacity after adding the new units (case a) or of the more efficient units (case b) should be lower than 15 MW.	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.
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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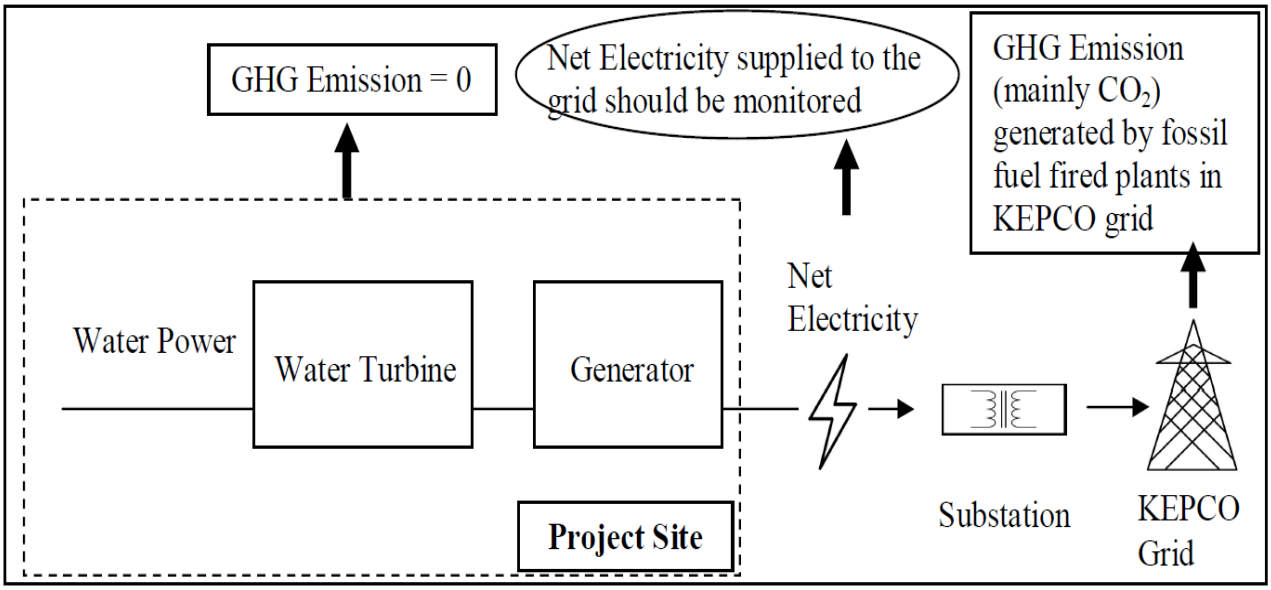
For the baseline determination, project boundary is related to CO_2 emissions from power generation in a fossil fuel power plant replaced by this project activity. The spatial extent of the project boundary includes the project sites and all the power plants connected physically to the electricity system of Korea Electric Power Corporation (KEPCO).

For calculation of baseline GHG emissions from the project boundary does not include 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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Project category is Type I.D-"Grid connected renewable electricity generation."

- The project falls into 'Renewable energy project' of Type I of 'Appendix B of the simplified modalities and procedures for small-scale CDM project activities' in that K-water small-scale hydroelectric power plants project utilizes renewable energy source. Additionally, the project falls into 'Electricity generation of a grid' of category D, because electricity generated by renewable energy source is grid-connected.

Facts for baseline to estimate emission reduction of the project is shown at 9th clause of Appendix B – Type I.D. of 'the simplified modalities and procedures for small-scale CDM project activities'. The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2 eq/kWh) and calculation should be transparent and conservative.

Baseline shown at 9th clause of Appendix B – Type I.D. of 'the simplified modalities and procedures for small-scale CDM project activities' is:

(a) A combined margin(CM), consisting of the combination of operating margin(OM) and build margin(BM) according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple Om and the Average OM calculations must be considered;

(b) The weighted average emissions (in kg CO2 eq/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

In the proposed project, the option (a) is used. Calculations must be based on data from an official source (where available) and made publicly available.

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

Parameter	Value	Source
the electricity delivered to the grid by source Coals, Heavy oil, Light Oil, LNG	Refer to <Table 13>	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
the amount of Coal, Heavy oil, Light Oil, LNG (in a mass or volume unit) consumed by relevant power)	Refer to <Table 9>	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
Net Calorific Values at each power plant	Refer to <Table 10>, <Table 11>, <Table 12>	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
Fuels Carbon Emission Factor (tC/TJ)	Coal : 25.8 heavy Oil : 21.1 Light Oil: 20.2 LNG : 15.3	IPCC 1996 Revised Guidelines
Fraction of Carbon Oxidised (OXID)	Coal : 0.98 Petroleum products : 0.99 LNG : 0.995	IPCC 1996 Revised Guidelines
Operating Margin Emissions Factor (in kg CO_2/kWh)	0.7710	Calculated
Build Margin Emissions Factor (in kg CO_2/kWh)	0.4718	Calculated
Baseline Emissions Factor (in kg CO_2/kWh)	0.6214	Calculated

Step 1. Calculation of the Operating Margin emission factor (OM)

As described in ACM0002, the OM 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. The OM is calculated as follows, using a 3 year average:

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

F i, j, y is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*, *j* refers to the power sources delivering electricity to the grid, not including hydro, geothermal, wind, low-cost biomass, nuclear and solar power plants,

COEF i, j, y (*COEF i = NCV i · EFco₂i · OXID i*) is the CO2 emission coefficient of fuel *i* (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*, and
GEN j, y is the electricity (MWh) delivered to the grid by source *j*.

Step 2. Calculation of the Build Margin (BM)
According to ACM0002, there are two options to choose in order to calculate the BM.
Option 1. Calculate the Build Margin emission factor $EF_{BM,y}$ ex ante based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group m consists of either

- 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

Option 2. For the first crediting period, the Build Margin emission factor $EF_{BM,y}$ must be updated annually ex post for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, $EF_{BM,y}$ should be calculated ex-ante, as described in option 1 above. The sample group m consists of either.

- 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

Project participants should use from these two options that sample group that comprises the larger annual generation. For this project, option1 was selected.

The calculation of *BM y* is as follows;

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Step 3. Calculation of the baseline emission factor (*EF y*)
The average of OM and BM factors calculated by step 1 and 2 is EF_y, baseline emission factor.

$$EF\ y = (EF_{OM\ y} + EF_{BM,y}) / 2$$

(In order to conservatively calculate emission factor, private power generation and community energy service facility[4] are excluded.)

Step 4. – Calculation of the baseline emission
Baseline emission = Electricity transferred to a grid(kWh) x Baseline emission factor($kgCO_2$ eq/kWh)

<Table B.2>Annual electricity generation and baseline emission at each SS hydro power plant

Category	Annual electricity generation
Seongnam Ⅱ small-scale hydropower	2,645 MWh/yr

4 Community energy Service: Community energy service is a facility that supplies energy from collectivized energy generating facility such as Steam Supply and Power Generation plant, Heat Only Boiler, and facility for resource recovery to multi-users of household, commercial, and industrial zones. All the generated power is not supplied to the grid, but surplus power supplied in community energy services and private power generation plants, for this reason CO2 emissions per KWh from power supplied to the grid is very high.

Dalbang-dam small-scale hydropower	1,102 MWh/yr
Juam-dam small-scale hydropower	4,934 MWh/yr
Daecheong-dam small-scale hydropower	5,263 MWh/yr
Project electricity generation	13,944 MWh/yr
Baseline emission factor	0.6214 CO_2 ton/MWh
Baseline emission	8,664 CO_2 ton/yr

According to the formula above, baseline emission is 8,664 CO_2 ton/yr.

B.5. Demonstration of additionality

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

The hugest barrier is investment barrier. As for the small hydro power resources, development of small hydro power resources haven't be activated because they are not economical. Korea Government has carried out the various policies to support the small scale hydrogen power generation economically in order to activate the small hydro power generation plant. That is, a unit cost of fuel of oil heating power generation plant was adopted to small hydro power electricity from 1984 to 1994. Since 1995, small hydro electricity cost was estimated excluding the electric supply cost, electric purchase cost, and electric supply loss cost of previous year's average price from Korea Electric Power Corporation. Since 2002, the policy to raise economical efficiency of small hydro power generation plant comes into effect, then the official price of small hydro power electricity is 73.69 Won/KWh. It is demonstrated from this government policy that small hydro power plant doesn't have economical efficiency without government support.
The result of NPV analysis of individual plant has been performed to show the difficulty of investment in this project. As for the economical analysis, EB 22 Meeting Report, based on Annex 3 "CLARIFICATIONS ON THE CONSIDERATION OF NATIONAL AND/OR SECTORAL POLICIES AND CIRCUMSTANCES IN BASELINE SCENARIOS", SMP price is adopted from small hydro power unit cost prior to the notice of official price.

<Table B.3> Result of Economical Analysis

Plant Name	Total Expenses (unit: one million won)	Operation & Maintenance Cost (unit: one million won /year)	Insurance and Tax (unit: one million won /year)	Unit Cost of Purchase (unit: won/KWh)	Purchased Electricity (unit :MWh)	NPV (unit : one million won)
Seongnam Ⅱ small scale hydroelectric	1,903.4	38.1	8.0	55.79	2,645	-461.0
Dalbang-dam small scale hydroelectric	1,010	20.2	4.2	55.79	1,102	-488.9
Juam-dam small scale hydroelectric	2,997.4	86.9	12.6	55.79	4,934	-575.4
Daecheong-dam small scale hydroelectric	3,071	61.4	12.9	55.79	5,263	-454.0

- Crediting period is for 21 years except construction period.
- The discount rate of Dalbang-dam, Juam-dam, Daecheong-dam is 4.25 and the discount rate of Seongnam Ⅱ is 4.0
- Insurance and Tax rate : 0.42% of total construction cost (from the design report of each project)
- O&M cost of Juam-dam is 2.9% of total construction cost and O&M cost of Seongnam, Dalbang-dam and Daecheong-dam is 2.0% (from the design report of each project)
- Discount rate and other variables are adopted from the execution design report of individual plant.
- Raw data (Excel file) for economical analysis is submitted to DOE (DNV).

As a result of economical analysis, NPV is lower than 0. It means, it doesn't have economical attraction.
In addition, there are risks of difficulty in retrieving the investment. Investment retrieval depends on when power plants operate and how much power is generated. Power generation depends on operation time of power plants. However, real operating time can change by virtue of below mentioned risk factors.

- Change of Real outflow from dams and amount of water supply from the planned facility capacity
- Interruption of power generation caused by water quality aggravation
- Interruption of power generation caused by construction of spillway and gate

The above mentioned risk factors act as obstacles against investment in small-scale hydroelectric projects. This investment barrier can be resolved after registration as the CDM project of governmental support.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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Project category is Type I.D-"Grid connected renewable electricity generation."ver9.0

The project generates electricity by utilizing small-scale hydroelectric power. The generated electricity is connected to the grid. Therefore the project is included in the category of I.D. The electricity connected to the grid replaces electricity generated by the existing fossil fuel power plants. Accordingly, the reduction of fossil fuel leads to the reduction of CO_2 emission.

To accurately estimate emission reduction by the project, it is necessary to decide which GHGs emit in the boundary and transboundary and how to monitor GHGs emission. Decision on GHGs emission in the boundary and transboundary is done in the following ways:

- Direct emission in the boundary: Small-scale hydroelectric power plant utilizes clean hydro potential energy with the view of generating power, and hence there is no direct emission in the boundary.

- Indirect emission in the boundary: Indirect emission results from electricity used inside the boundary. For the purpose of estimating emission reduction, electricity consumed in the plants is excluded.

- Direct transboundary emission: Fuel transportation in the process of power generation or fuel consumption outside the boundary is not detected in the project activity. There is no direct transboundary emission.

- Indirect transboundary emission: there is zero indirect transboundary emission in the project.

- Leakage: No leakage is associated with the project.

According to the result of defining GHG emission in the project, the amount of emitted GHGs is not important factor for estimating emission reduction. The important factors for estimating emission reduction are emission factor for baseline and electricity generated from the project activity.

As a result estimation of emission reductions is;
"BE(Baseline emissions) – PE(Project emissions) – LE(Leakage emissions)"

Baseline emissions

For all other systems, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2eq/kWh) calculated in a transparent and conservative manner as section "B.4 Establishment and description of baseline scenario".

Baseline emission = Electricity transferred to a grid(kWh) X Emission factor(kgCO_2 eq/kWh)

Project emissions

The project activity generates electricity by utilizing hydroelectric 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

Leakage due to the project activity is not occurred.

$LE_y = 0$

B.6.2. Data and parameters fixed ex ante

Data/Parameter	EF_y
Data unit	tCO_2e/MWh
Description	CO_2 emission factor of the Korea grid
Source of data	Calculated
Value(s) applied	0.6214 tCO_2e/MWh
Choice of data or measurement methods and procedures	This value was calculated according to the approved methodology ACM0002. The applied value was calculated by referring "Statistics of Electric Power in Korea" (2003, 2004, 2005) (KEPCO) and "Status of Generation Facility" (2005) (KPX).
Purpose of data	Calculation of baseline emissions
Additional comment	- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/Parameter	$EF_{OM,y}$
Data unit	tCO_2e/MWh
Description	Operating Margin emission factor
Source of data	Calculated
Value(s) applied	0.7710 tCO_2e/MWh
Choice of data or measurement methods and procedures	This value was calculated according to the approved methodology ACM0002. The applied value was calculated by referring "Statistics of Electric Power in Korea" (2003, 2004, 2005) (KEPCO) and "Status of Generation Facility" (2005) (KPX).
Purpose of data	Calculation of baseline emission
Additional comment	- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/Parameter	$EF_{BM,y}$
Data unit	tCO_2e/MWh
Description	Build Margin emission factor
Source of data	Calculated
Value(s) applied	0.4718 tCO_2e/MWh
Choice of data or measurement methods and procedures	This value was calculated according to the approved methodology ACM0002. The applied value was calculated by referring "Statistics of Electric Power in Korea" (2003, 2004, 2005) (KEPCO) and "Status of Generation Facility" (2005) (KPX).
Purpose of data	Calculation of baseline emission
Additional comment	- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/Parameter	$F_{i,y}$
Data unit	Mass or volume
Description	Amount of fuel *i* consumed by relevant power in year *y*
Source of data	Statistics of Electric Power in KOREA (2003) Statistics of Electric Power in KOREA (2004) Statistics of Electric Power in KOREA (2005)
Value(s) applied	See the Appendix 4
Choice of data or measurement methods and procedures	The applied value was calculated by referring "Statistics of Electric Power in Korea" (2003, 2004, 2005) (KEPCO)
Purpose of data	Calculation of baseline emissions
Additional comment	- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/Parameter	$COEF_{i,y}$
Data unit	tCO_2e/mass or tCO_2e/volume
Description	CO_2 emission coefficient of fuel *i* in year *y*
Source of data	Calculated
Value(s) applied	See the Appendix 4
Choice of data or measurement methods and procedures	This value was calculated according to the approved methodology ACM0002. The applied value was calculated by referring "IPCC Guidelines, 1996a".
Purpose of data	Calculation of baseline emission
Additional comment	- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/Parameter	$NCV_{i,y}$
Data unit	Kcal/Mass or Kcal/volume
Description	Net Caloric coefficient of each fuel type i in year *y*
Source of data	Statistics of Electric Power in KOREA (2003) Statistics of Electric Power in KOREA (2004) Statistics of Electric Power in KOREA (2005)
Value(s) applied	See the Appendix 4
Choice of data or measurement methods and procedures	The applied value was calculated by referring "Statistics of Electric Power in Korea" (2003, 2004, 2005) (KEPCO)
Purpose of data	Calculation of baseline emission
Additional comment	- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/Parameter	GEN_y
Data unit	MWh/each plant
Description	Electricity delivered to the grid in year *y*
Source of data	Statistics of Electric Power in KOREA (2003) Statistics of Electric Power in KOREA (2004) Statistics of Electric Power in KOREA (2005)
Value(s) applied	See the Appendix 4
Choice of data or measurement methods and procedures	The applied value was calculated by referring "Statistics of Electric Power in Korea" (2003, 2004, 2005) (KEPCO)
Purpose of data	Calculation of baseline emissions
Additional comment	- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/Parameter	OM plant
Data unit	text
Description	Identification of power source / plant for the OM
Source of data	Estimated
Value(s) applied	See the Appendix 4
Choice of data or measurement methods and procedures	The applied value was calculated by referring "Statistics of Electric Power in Korea" (2003, 2004, 2005) (KEPCO)
Purpose of data	Calculation of baseline emission
Additional comment	- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/Parameter	BM plant
Data unit	text
Description	Identification of power source / plant for the BM
Source of data	Estimated
Value(s) applied	See the Appendix 4
Choice of data or measurement methods and procedures	The applied value was calculated by referring "Statistics of Electric Power in Korea" (2003, 2004, 2005) (KEPCO)
Purpose of data	Calculation of baseline emission
Additional comment	- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

B.6.3. Ex ante calculation of emission reductions

>>

Baseline Emissions

According to the result of calculation presented in the 'Appendix 4' above, the combined emissions factor (EF_y) is *0.6214 tCO_2e/MWh*

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

$BE_y = EG_y \times EF_y$
$= 13{,}944\ MWh/yr \times 0.6214\ tCO_2e/MWh$
$= 8{,}664\ tCO_2e/yr$

Project emissions

$PE_y = 0$

Leakage

$LE_y = 0$

Estimation of Emission reductions

$ER_y = BE_y – PE_y – LE_y$
$= 8,664\ tCO_2e/yr – 0\ tCO_2e/yr – 0\ tCO_2e/yr$
$= 8,664\ tCO_2e/yr$

Total emission reduction due to the project activity during a crediting period is 60,648 CO_2 tons/7yrs.

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 (2008.06.01~ 2009.05.31)	8,664	0	0	8,664
Year 2 (2009.06.01~ 2010.05.31)	8,664	0	0	8,664
Year 3 (2010.06.01~ 2011.05.31)	8,664	0	0	8,664
Year 4 (2011.06.01~ 2012.05.31)	8,664	0	0	8,664
Year 5 (2012.06.01~ 2013.05.31)	8,664	0	0	8,664
Year 6 (2013.06.01~ 2014.05.31)	8,664	0	0	8,664
Year 7 (2014.06.01~ 2015.05.31)	8,664	0	0	8,664
Total	60,648	0	0	60,648
Total number of crediting years	7 years			
Annual average over the crediting period	8,664	0	0	8,664

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	**EGy**
Data unit	MWh
Description	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y
Source of data	Electricity meters
Value(s) applied	13,944 MWh/yr - $EG_{Seongnam\ II,y}$: 2,645 MWh/yr - $EG_{Dalbang\text{-}dam,y}$: 1,102 MWh/yr - $EG_{Juam\text{-}dam,y}$: 4,934 MWh/yr - $EG_{Daecheong\text{-}dam,y}$: 5,263 MWh/yr
Measurement methods and procedures	This parameter is calculated as difference between electricity supplied to the grid and electricity imported to the grid.
Monitoring frequency	Measuring : Continuously Recording : Monthly
QA/QC procedures	More detailed QA/QC procedures are described in the monitoring system in the “Section B.7.3. Other elements of monitoring plan”.
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

>>
Not applicable

B.7.3. Other elements of monitoring plan

>>
The objective of the monitoring plan is to assure the complete, consistent, clear, and accurate monitoring and calculation of the project emission reductions during the crediting period. To ensure the quality of the data, in particular the measured data are double-checked against commercial data. Measuring the quality control and quality assurance which were planned for the project are outlined in the following table.

<Table B.3> Data quality control

Data	Uncertainty of data (high/middle/low)	Explanation of planned QA/QC procedures for data or the reason that the procedures are not needed
EG_y	Low	QA/QC procedure for this are planned. The electricity output from each hydroelectric power plant to the grid will be monitored and recorded at the on-site control The allowable error of exported electricity data must be within ± 0.5%.

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

1. Monitoring equipment

1-1. Electricity measuring meters shall be set up transparently in accordance with "Law regarding measurement" and "Act on operation of electricity market" and shall be sealed after affirmation of Korea Power Exchange.
1-2. The meters shall be authorized through the due formal certifying process (the valid period for the authorized certification: 7 years.)
1-3. The meters shall be calibrated when they are installed, and re-calibrated every three years after installation.

2. The amount of electricity monitoring

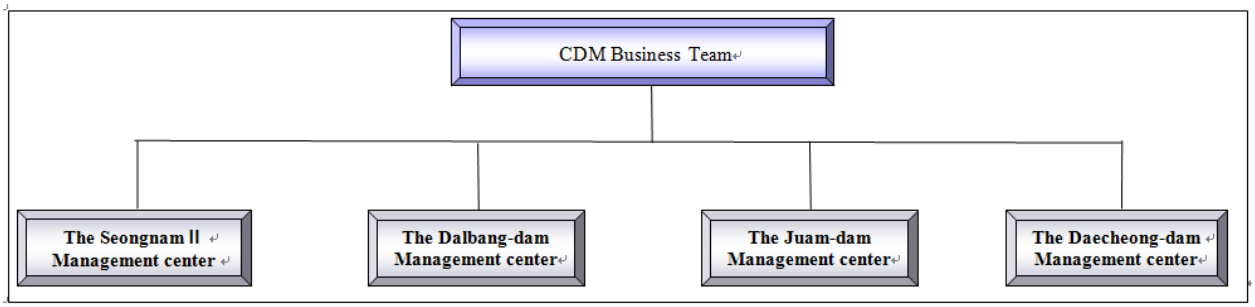
2-1. The amount of electricity transmitted to the grid shall be measured automatically by established meters. The measured data are simultaneously transferred to central control system of Small-Scale hydroelectric Power Plant and Korea Power Exchange.
2-2. The measured amount of electricity shall be collected daily, weekly, and monthly and shall be archived in electronic way.
2-3. The collected data in article 2-2. shall be compared with those of Korea Power Exchange.
2-4. If the two data compared in article 2-3. are different, the operation condition of electricity meters and other equipments shall be examined. In case meters are improperly operated equipments, internal investigation and correction procedure shall be followed and be certified by the final decision-maker and Korea Power exchange.

3. Management of monitoring and electricity safety

3-1. The person in charge of monitoring and electricity safety shall attend the following courses every year.
- Course on 'Law regarding measurement'
- Course on 'Act on operation of electricity market
- Course on Electricity safety

3-2. In case of absence of the responsible person, the second responsible person shall be selected.
3-3. If the responsibility for monitoring and electricity safety is transferred to another person, it is needed to be approved by the final decision-maker.

Monitoring organization



Department in charge of monitoring for the project and responsible department are as follows:

- Department in charge of monitoring: the Seongnam Ⅱ management center, Dalbang-dam management center, the Juam-dam management center, Daecheong-dam management center.
- Responsible department: Electric Business Team

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
Commercial start of plants is followed;

- The Seongnam Ⅱ small-scale hydroelectric power plant: 01/10/2008
- The Dalbang-dam small-scale hydroelectric power plant: 12/02/2007
- The Juam-dam small-scale hydroelectric power plant: 09/04/2007
- The Daecheong-dam small-scale hydroelectric power plant: 20/06/2008

C.2. Expected operational lifetime of project activity

>>
Expected lifetime of equipment is 30 years.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
Renewable type (1st crediting period)

C.3.2. Start date of crediting period

>>
01/06/2008

C.3.3. Duration of crediting period

>>
7 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
The project activity does not apply to environmental impact assessment.

D.2. Environmental impact assessment

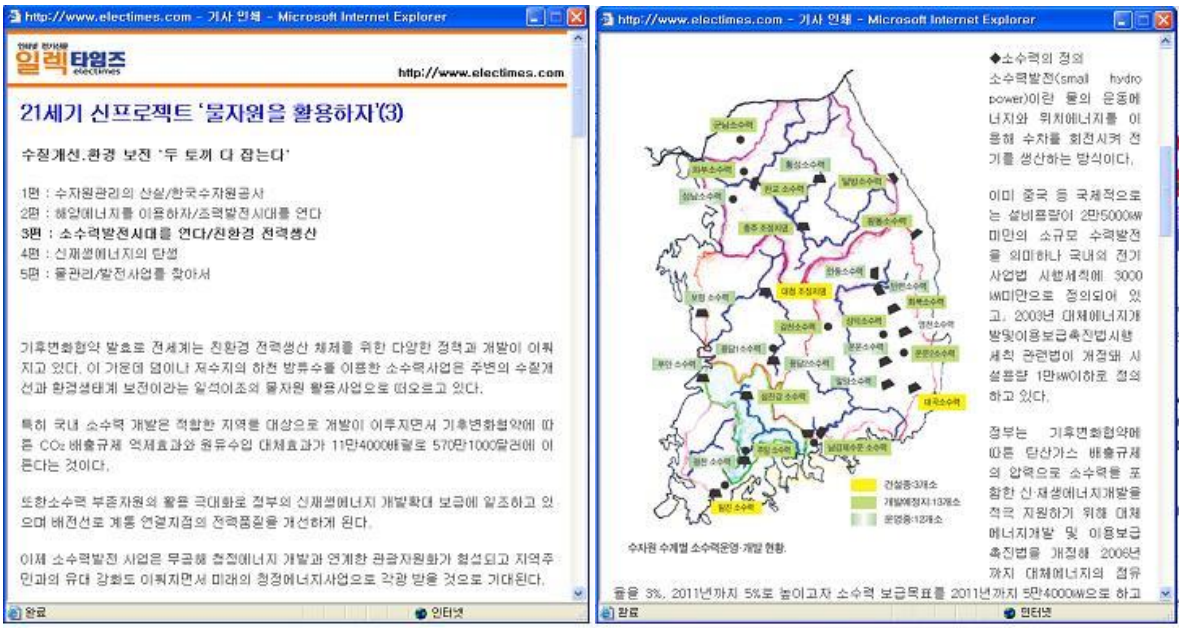
>>
Not applicable

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>
Comments from local stakeholders have been invited through the following channels:

A. Announcements in Korean newspapers.(09/06/2005)
The news about small hydro power plants was issued on The Electimes, which many electric-realational worker were prescribing, to notify them to local stakeholders. Small hydro power plant of Dalbang dam, Daecheong dam, Juam dam were mentioned on the newspaper.



<Figure E.1> The Electimes including contents about small hydro power plant of Dalbang dam, Daecheong dam and Juam dam

B. Announcements in the annual sustainable report of K-water in 2005
The sustainable report of K-water is issued annually and opened to the public. Small hydro power plant of Dalbang dam, Daecheong dam, Juam dam and Seongnam Ⅱ were mentioned on the 2005 sustainable report of K-water .

재생에너지 생산

소수력, 조력 등 재생에너지 개발을 자발적으로 추진하여
지구온난화 방지를 위한 유엔 기후변화협약 이행에 동참하고 있습니다.

수력에너지 생산

우리공사가 보유하고 있는 다목적댐 대수력 및 소수력발전소의 총 설비용량은 1,014.9MW로써 이는 2005년 현재 우리나라 전체 전력설비의 1.6%를 차지하며, 수력발전부문의 26.1%를 담당하고 있습니다. 2005년에는 국내 수력생산량의 47.4%인 2,457GWh의 수력에너지를 생산하였습니다.

재생에너지 개발

정부와 신재생에너지 공급협약(RPA,'05.7)을 체결하여 2008년까지 소수력, 풍력, 태양광 발전 등 전체 설비규모 8,730kW의 신재생에너지 개발사업에 총 328억원을 투자키로 하였으며, 수자원의 효율적 이용을 위한 소수력 개발은 2005년 대곡, 장흥 소수력발전소가 가동을 개시하여 총 설비용량은 13,074kW로 증가하였고 연간 발전량은 60,198MWh를 기록하였습니다.

소수력은 3,000kW이하 규모에 불과하지만 현실적인 청정에너지 개발자원으로 인정받고 있으며 2005년에 수행한 소수력개발 적지조사 결과를 토대로 소수력 개발 중장기계획을 수립하여 소수력발전소 건설을 지속적으로 확대해 나갈 계획입니다.

구분	사업명	시설용량(kW)	착공	준공
건설중	대청댐	800	2004	2007
	주암댐	1,000	2005	2007
	달방댐	170	2005	2007
	운문 II	700	2006	2007
	성남 II	360	2006	2007
계획중	주암역조정지	600	2007	2008
	소양강댐	800	2007	2008
	화북댐	400	2008	2009
	섬진강댐	1,400	2007	2008

소수력발전소 건설계획 ('04~'08, 대청댐 등 9개소 6,230kW)

2004년도에 착공한 세계 최대규모(254,000kW)의 시화조력발전소는 현재 2009년 상업발전을 목표로 기초공사와 발전설비에 대한 기술적 검토공정이 진행중으로 시화호 수질개선과 친환경 청정에너지 생산에 기여할 것입니다.

시화조력발전소 수차발전기 단면도

<Figure E.2> The 2005 K-water sustainable report including contents about small hydro power plant of Dalbang dam, Daecheong dam, Juam dam and Seongnam Ⅱ

C. The approval letters acquired from local community people, Korea Power Exchange, Korea Electricity Power Corporation, down stream residents of small hydro power plant and related governmental office

Stakeholders of this project are local community people, Korea Power Exchange, Korea Electricity Power Corporation, down stream residents of small hydro power plant, related governmental office. Stakeholders' comments were collected during approval process of electricity business, stream occupation and row-line construction for small hydro power plant construction

E.2. Summary of comments received

>>

- Announcements in Korean newspapers

There were no questions or opinions on the projects to K-water.

- Announcements in the annual sustainable report of K-water in 2005

There were no questions or opinions on the projects to K-water.

- The approval letters acquired from local community people, KPX, KEPCO, downstream residents of small hydro power plant and related governmental office

There were no comments received on the approval letter to K-water.

E.3. Consideration of comments received

>>

Not applicable

SECTION F. Approval and authorization

>>

In the proposed project, the K-water is the project participant and parties involved are the Republic of Korea, United Kingdom of Great Britain and Northern Ireland and Switzerland. PP has already obtained letter of approval from the DNA of Republic of Korea(14/09/2006), United Kingdom of Great Britain and Northern Ireland(29/03/2010), 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 to constitute a diversion of official assistance, nor to count towards any financial obligation from Parties.

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

Step 1. Calculation of the Operating Margin emission factor (OM)

Hydro, geothermal, wind, low-cost biomass, nuclear and solar plants have to be deducted from the data in the calculation of OM factor.

The OM is calculated as follows, using 3-year average data.

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y,
j refers to the power sources delivering electricity to the grid, not including hydro, geothermal, wind, low cost biomass, nuclear and solar power plants,
$COEF_{i,j,y}$ ($COEF\ i = NCV\ i \cdot EFco_2 i \cdot OXID\ i$) is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y, and
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j.

The data used for the formula and the result are as follows.

<Table 9> Data on fuel consumption for plants in the Operating Margin

Energy sources	Plant Name		Fuel consumption 2002 (ton)	Fuel consumption 2003 (ton)	Fuel consumption 2004 (ton)
Bituminous	Honam	#1	732,433	633,609	885,758
		#2	782,381	832,014	783,300
	Samchonpo	#1	1,570,717	1,535,849	1,624,500
		#2	1,478,115	1,680,305	1,564,986
		#3	1,546,947	1,634,224	1,467,177
		#4	1,468,736	1,710,195	1,538,768
		#5	1,296,193	1,430,182	1,707,777
		#6	1,492,369	1,436,503	1,734,977
	Boryeong	#1	1,522,646	1,263,072	1,599,557
		#2	1,488,547	1,311,401	1,555,055
		#3	1,240,289	1,478,200	1,427,263
		#4	1,485,354	1,355,767	1,560,014
		#5	1,336,613	1,468,153	1,397,343
		#6	1,488,931	1,343,310	1,559,785
	Taean	#1	1,203,424	1,466,761	1,438,094
		#2	1,342,878	1,333,563	1,509,379
		#3	1,290,663	1,459,118	1,415,585
		#4	1,381,903	1,358,587	1,539,502
		#5	1,375,995	1,243,228	1,547,217
		#5	979,172	1,335,853	1,531,751
	Hadong	#1	1,358,393	1,476,164	1,389,739
		#2	1,458,164	1,377,617	1,515,681
		#3	1,449,498	1,362,366	1,501,027

		#4	1,360,689	1,483,166	1,397,482
		#5	1,434,705	1,375,276	1,501,672
		#6	1,307,355	1,473,500	1,379,396
	Dangjin	#1	1,457,856	1,369,223	1,502,885
		#2	1,426,409	1,360,761	1,523,605
		#3	1,277,914	1,488,422	1,404,465
		#4	1,275,932	1,501,207	1,434,844
	Yonghung	#1			1,114,254
		#2			459,217
Energy sources	**Plant Name**		**Fuel consumption 2002 (kl)**	**Fuel consumption 2003 (kl)**	**Fuel consumption 2004 (kl)**
Heavy Oil	Honam	#1	3,619	3,528	606
		#2	3,264	641	1,714
	Ulsan	#1	169,437	113,103	73,408
		#2	160,954	104,734	65,316
		#3	174,584	109,039	71,305
		#4	424,713	361,447	420,739
		#5	340,975	484,842	513,497
		#6	407,525	327,005	527,083
	Youngnam	#1	168,139	250,280	347,107
		#2	131,462	223,269	248,049
	Yosu	#1	167,477	173,830	181,712
		#2	226,755	85,905	316,523
	Pyongtaek	#1	361,196	343,765	204,664
		#2	379,819	325,723	209,664
		#3	340,527	329,779	179,921
		#4	302,867	361,331	192,294
	Namjeju	#1	8,449	12,520	16,510
		#2	9,565	12,216	16,040
	Jeju	#1	7,508	10,363	15,306
		#2	123,477	107,856	118,473
		#3	111,071	124,954	124,160
	Incheon	#1	15,908	22,390	
		#2	18,368	22,656	
		#3	12,112	24,998	
		#4	12,286	23,774	
	Namjeju	D/P	55,233	56,401	57,808
Energy sources	**Plant Name**		**Fuel consumption 2002 (kl)**	**Fuel consumption 2003 (kl)**	**Fuel consumption 2004 (kl)**
Diesel Oil	Honam	#1	564	409	300
		#2	620	366	335
	Samchonpo	#1	994	1,144	1,674
		#2	960	657	744
		#3	734	838	814
		#4	675	299	785
		#5	1,291	2,118	230
		#6	840	1,570	652
	Boryeong	#1	308	968	311
		#2	552	934	616
		#3	372	59	574

		#4	174	307	179
		#5	781	152	422
		#6	113	356	350
	Taean	#1	918	319	999
		#2	401	730	310
		#3	235	193	390
		#4	152	628	254
		#5	1,633	994	329
		#6	6,021	1,011	230
	Hadong	#1	584	390	533
		#2	133	445	145
		#3	125	613	670
		#4	625	302	737
		#5	484	435	318
		#6	316	223	689
	Dangjin	#1	439	926	294
		#2	628	787	211
		#3	868	510	605
		#4	1,041	746	528
	Ulsan	#1	848	484	114
		#2	372	1,061	82
		#3	281	500	554
		#4	676	1,450	1,238
		#5	836	1,740	931
		#6	987	1,525	1,603
	Youngnam	#1	1,109	1,024	837
		#2	279	270	274
	Yosu	#1	436	370	571
		#2	163	86	436
	Pyongtaek	#1	364	167	247
		#2	289	195	232
		#3	460	111	240
		#4	384	123	225
	Namjeju	#1	22	20	6
		#2	21	24	13
	Jeju	#1	15	23	7
		#2	16	65	73
		#3	24		41
	Seoul	#4	11		1
		#5	9	4	3
	Incheon	#1	98	6	
		#2	97	6	
		#3	135	247	149
		#4	251	170	
	Pyongtaek C/C		43,827	96,032	21
	Ilsan	C/C	20,350	40,006	
	Bundang	C/C	66	-	
	Ulsan	C/C	20,902	63,295	
	Seoincheon	C/C	17,631	44,792	88
	Shinincheon	C/C	17,219	47,393	
	Boryeong	C/C	13,907	97,106	

	Hallim	C/C	26,967	16,286	28,796
	Anyang	C/C	-	-	
	Bucheon	C/C	-	-	
	K I E Co.	C/C	52,608	103,057	
	L G Bugog	C/C	5,370	67,273	
	Namjeju	D/P	75	84	80
	Busan			1,213	2,687
	Yonghung	#1			27,916
		#2			18,314
	Yulchon	C/C			596
	Jeju	G/T			2,232
Energy sources	**Plant Name**		**Fuel consumption 2002 (ton)**	**Fuel consumption 2003 (ton)**	**Fuel consumption 2004 (ton)**
LNG	Pyongtaek	#1	1,407	2,727	2,095
		#2	1,201	2,402	2,515
		#3	1,385	2,238	3,791
		#4	1,335	2,370	3,217
	Seoul	#4	23,145	32,670	22,409
		#5	175,058	126,211	117,908
	Incheon	#1	39,155	25,930	10,523
		#2	40,762	28,612	11,094
		#3	18,751	34,035	4,235
		#4	19,824	24,093	
	Pyongtaek C/C		99,363	76,012	98,846
	Ilsan	C/C	510,283	530,874	593,548
	Bundang	C/C	604,893	598,396	653,880
	Ulsan	C/C	255,078	189,997	347,076
	Seoincheon	C/C	1,086,293	1,012,670	1,209,806
	Shinincheon	C/C	1,416,960	1,405,724	1,587,638
	Boryeong	C/C	454,503	571,742	988,548
	Hallim	C/C	-		
	Anyang	C/C	338,303	325,207	270,559
	Bucheon	C/C	244,828	266,577	258,596
	K I E Co.	C/C	501,648	381,684	467,583
	L G Bugog	C/C	147,849	121,037	260,653
	Busan	C/C		234,533	1,298,418

Source : Statistics of Electric Power in KOREA (2003,2004,2005) (KEPCO)
Blank : not operated or not use relevant energy source

<Table 10>Caloric value (2002)

Plant Name		**Caloric value (by source in 2002)**			
		Coal (kcal/kg)	**Heavy oil (kcal/l)**	**Diesel oil (kcal/l)**	**L. N. G (kcal/kg)**
Honam	#1	5,465	9,896	8,871	-
	#2	5,473	9,922	8,870	-
Samchonpo	#1	5,943	-	9,000	-
	#2	5,925	-	8,999	-
	#3	5,941	-	9,001	-
	#4	5,928	-	9,002	-
	#5	5,781	-	9,000	-

	#6	5,764	-	9,000	-
Boryeong	#1	6,048	-	8,943	-
	#2	6,047	-	8,936	-
	#3	6,180	-	8,749	-
	#4	6,192	-	8,749	-
	#5	6,188	-	8,749	-
	#6	6,188	-	8,749	-
Taean	#1	6,299	-	9,013	-
	#2	6,310	-	9,013	-
	#3	6,307	-	9,013	-
	#4	6,314	-	9,013	-
	#5	6,344	-	9,013	-
	#6	6,340	-	9,013	-
Hadong	#1	6,260	-	9,002	-
	#2	6,262	-	8,975	-
	#3	6,261	-	8,983	-
	#4	6,262	-	8,993	-
	#5	6,261	-	8,983	-
	#6	6,262	-	8,983	-
Dangjin	#1	6,212	-	9,378	-
	#2	6,220	-	8,916	-
	#3	6,226	-	9,627	-
	#4	6,210	-	8,939	-
Ulsan	#1	-	9,838	9,120	-
	#2	-	9,881	9,120	-
	#3	-	9,805	9,120	-
	#4	-	9,967	9,123	-
	#5	-	9,948	9,123	-
	#6	-	9,966	9,123	-
Youngnam	#1	-	9,926	8,971	-
	#2	-	9,924	8,974	-
Yosu	#1	-	10,015	8,979	-
	#2	-	10,024	8,981	-
Pyongtaek	#1	-	9,907	9,095	12,949
	#2	-	9,907	9,102	12,939
	#3	-	9,908	9,101	12,945
	#4	-	9,905	9,081	12,956
Namjeju	#1	-	9,942	8,866	-
	#2	-	9,944	8,865	-
Jeju	#1	-	10,009	9,238	-
	#2	-	9,977	8,928	-
	#3	-	9,975	8,928	-
Seoul	#4	-	-	9,070	13,033
	#5	-	-	9,070	13,025
Incheon	#1	-	-	8,985	13,015
	#2	-	-	8,986	13,013
	#3	-	-	8,993	13,018
	#4	-	-	8,988	13,019
Pyongtaek	C/C	-	-	8,969	13,036
Ilsan	C/C	-	-	8,934	13,040

Bundang	C/C	-	-	8,970	13,044
Ulsan	C/C	-	-	9,049	13,029
Seoincheon	C/C	-	-	9,104	13,006
Shinincheon	C/C	-	-	9,096	13,007
Boryeong	C/C	-	-	9,101	13,034
Hallim	C/C	-	-	8,961	-
Anyang C/C	(Other co.)	-	-	-	13,052
Bucheon C/C	(")	-	-	-	13,018
K I E Co.	(")	-	-	9,081	13,029
L G Bugog	(")	-	-	9,027	13,042
Namjeju	D/P	-	9950	8867	-

Source : Statistics of Electric Power in KOREA (2003) (KEPCO)
Blank : not operated or not use relevant energy source

<Table 11> Caloric value (2003)

Plant Name		Caloric value (by source in 2003)			
		Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
Honam	#1	5,693	9,859	8,844	-
	#2	5,655	9,901	8,847	-
Samchonpo	#1	5,846	-	9,009	-
	#2	5,844	-	9,011	-
	#3	5,862	-	8,948	-
	#4	5,855	-	8,992	-
	#5	5,766	-	9,000	-
	#6	5,765	-	9,000	-
Boryeong	#1	6,066	-	8,942	-
	#2	6,075	-	8,944	-
	#3	6,254	-	8,749	-
	#4	6,254	-	8,777	-
	#5	6,254	-	8,749	-
	#6	6,239	-	8,749	-
Taean	#1	6,181	-	9,013	-
	#2	6,192	-	9,013	-
	#3	6,188	-	9,013	-
	#4	6,198	-	9,013	-
	#5	6,155	-	9,013	-
	#6	6,167	-	9,013	-
Hadong	#1	6,149	-	8,941	-
	#2	6,144	-	8,984	-
	#3	6,146	-	8,912	-
	#4	6,145	-	8,957	-
	#5	6,148	-	8,871	-
	#6	6,142	-	8,839	-
Dangjin	#1	6,102		8,892	-
	#2	6,121		8,904	-
	#3	6,129		8,889	-
	#4	6,118		8,893	-
Ulsan	#1	-	9,861	9,018	-
	#2	-	9,856	9,047	-

	#3	-	9,862	9,035	-
	#4	-	9,921	9,120	-
	#5	-	9,912	9,120	-
	#6	-	9,921	9,120	-
Youngnam	#1	-	9,196	8,997	-
	#2	-	9,043	8,993	-
Yosu	#1	-	9,979	8,975	-
	#2	-	9,983	8,970	-
Pyongtaek	#1	-	9,838	8,974	-
	#2	-	9,844	8,972	12,955
	#3	-	9,845	8,977	12,929
	#4	-	9,842	8,976	12,950
Namjeju	#1	-	9,852	8,900	-
	#2	-	9,853	8,958	-
Jeju	#1	-	10,009	9,238	-
	#2	-	9,945	8,928	-
	#3	-	9,943	8,928	-
Seoul	#4	-	-	9,070	13,013
	#5	-	-	7,515	13,003
Incheon	#1	-	9,828	7,526	13,018
	#2	-	9,833	8,986	13,018
	#3	-	9,822	8,993	13,017
	#4	-	9,830	8,988	13,015
Pyongtaek	C/C	-	-	8,926	13,026
Ilsan	C/C	-	-	8,966	13,021
Bundang	C/C	-	-	-	13,030
Ulsan	C/C	-	-	9,053	13,007
Seoincheon	C/C	-	-	9,151	12,999
Shinincheon	C/C	-	-	9,150	13,005
Boryeong	C/C	-	-	9,131	13,016
Busan	C/C	-	-	9,242	12,997
Hallim	C/C	-	-	8,964	-
Anyang C/C	(Other co.)	-	-	-	13,033
Bucheon C/C	(")	-	-	-	13,022
K I E Co.	(")	-	-	9,092	13,014
L G Bugog	(")	-	-	9,033	13,018
Namjeju	D/P	-	9,852	8,881	-

Source : Statistics of Electric Power in KOREA (2004) (KEPCO)
Blank : not operated or not use relevant energy source

<Table 12> Caloric value(2004)

Plant Name		Caloric value (by source in 2004)			
		Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
Honam	#1	5,493	9,814	8,848	
	#2	5,430	9,817	8,850	
Samchonpo	#1	5,527		9,012	
	#2	6,275		9,010	
	#3	6,530		9,006	
	#4	6,507		9,004	

	#5	4,829		9,000	
	#6	4,773		9,000	
Yonghung	#1	5,892		8,927	
	#2	5,852		8,720	
Boryeong	#1	5,924		8,770	
	#2	5,922		8,910	
	#3	5,943		8,749	
	#4	5,945		8,749	
	#5	5,931		8,749	
	#6	5,937		8,749	
Taean	#1	5,980		8,765	
	#2	5,977		8,699	
	#3	5,975		9,004	
	#4	5,967		8,721	
	#5	5,996		8,912	
	#6	5,996		8,804	
Hadong	#1	6,032		9,002	
	#2	6,025		8,975	
	#3	6,046		8,983	
	#4	6,097		8,993	
	#5	5,982		8,983	
	#6	5,935		8,983	
Dangjin	#1	6,011		8,880	
	#2	6,000		8,889	
	#3	5,976		8,897	
	#4	5,966		8,898	
Ulsan	#1		9,893	9,010	
	#2		9,901	9,010	
	#3		9,896	9,010	
	#4		9,972	9,120	
	#5		9,963	9,120	
	#6		9,959	9,120	
Youngnam	#1		7,432	8,865	
	#2		7,679	8,876	
Yosu	#1		10,011	8,924	
	#2		10,009	8,956	
Pyongtaek	#1		9,877	8,917	12,920
	#2		9,879	8,941	12,907
	#3		9,902	8,907	12,910
	#4		9,903	8,915	12,956
Namjeju	#1		9,900	9,333	
	#2		9,901	8,846	
Jeju	#1		9,897	8,961	
	#2		9,912	8,936	
	#3		9,919	8,928	
Namjeju	D/P		9,901		
Seoul	#4			9,070	13,011
	#5			9,070	13,014
Incheon	#1				13,038
	#2				13,039
	#3			8,951	13,038
Pyongtaek C/C				8,758	13,033

Ilsan	C/C			-	13,017
Bundang	C/C			-	13,026
Ulsan	C/C			-	12,920
Seoincheon	C/C			9,211	13,010
Shinincheon	C/C			-	13,017
Boryeong	C/C			-	13,025
Busan	C/C			-	13,004
Hallim	C/C			8,972	-
Anyang	C/C			-	13,025
Bucheon	C/C			-	13,013
K I E Co.	C/C			-	13,023
L G Bugog	C/C			-	13,028
Yulchon	C/C			11,731	13,014
Namjeju	D/P			8,867	-
Jeju	G/T			8,948	-

Source : Statistics of Electric Power in KOREA (2005) (KEPCO)
Blank : not operated or not use relevant energy source

<Table 13> Electricity power and CEF

Plant Name		MWh Produced in 2002	MWh Produced in 2003	MWh Produced in 2004	CEF (t CO2 / MWh) 2002	CEF (t CO2 / MWh) 2003	CEF (t CO2 / MWh) 2004
Honam	#1	1,508,303	1,372,873	1,855,554	1.0386	1.0286	1.0191
	#2	1,623,572	1,784,483	1,625,399	1.031	1.0249	1.0193
Samchonpo	#1	4,006,965	3,745,916	3,974,202	0.9047	0.931	0.8779
	#2	3,755,823	4,110,134	3,839,080	0.9056	0.9277	0.9932
	#3	3,976,257	4,051,427	3,652,769	0.8974	0.9183	1.0185
	#4	3,763,370	4,250,404	3,811,371	0.8984	0.9144	1.0201
	#5	3,320,736	3,606,167	4,147,957	0.8767	0.889	0.7716
	#6	3,814,588	3,609,696	4,185,213	0.8757	0.8915	0.7683
Boryeong	#1	3,905,038	3,237,526	4,014,109	0.9154	0.9192	0.9163
	#2	3,824,457	3,380,013	3,915,285	0.9138	0.9155	0.9132
	#3	3,390,363	4,090,927	3,746,265	0.8776	0.877	0.8791
	#4	4,069,374	3,754,883	4,097,489	0.8772	0.8765	0.8785
	#5	3,662,540	4,063,865	3,660,240	0.877	0.877	0.8791
	#6	4,076,351	3,709,092	4,093,207	0.8773	0.8771	0.8783
Taean	#1	3,335,520	3,995,111	3,780,097	0.8827	0.8808	0.8836
	#2	3,735,044	3,651,716	3,975,123	0.8808	0.8781	0.8809
	#3	3,586,755	3,994,351	3,732,363	0.881	0.8773	0.8797
	#4	3,857,072	3,708,360	4,048,258	0.8781	0.8816	0.8808
	#5	3,842,365	3,370,362	4,091,406	0.8828	0.882	0.8802
	#6	2,721,769	3,637,652	4,056,835	0.8912	0.8797	0.8787
Hadong	#1	3,763,669	3,995,331	3,688,313	0.8772	0.8819	0.8824
	#2	4,033,255	3,739,800	4,028,529	0.8787	0.8786	0.8797
	#3	3,995,847	3,694,945	3,997,064	0.8815	0.8798	0.8816
	#4	3,763,399	4,029,035	3,724,757	0.879	0.878	0.8882
	#5	3,976,839	3,733,243	4,013,845	0.8769	0.8793	0.8687
	#6	3,620,142	4,013,010	3,685,698	0.8779	0.8754	0.8626
Dangjin	#1	3,997,354	3,677,169	3,986,406	0.8795	0.8825	0.8797
	#2	3,923,487	3,685,913	4,038,457	0.8779	0.8776	0.8787
	#3	3,514,316	4,034,969	3,711,787	0.8793	0.8778	0.8779

	#4	3,519,919	4,096,642	3,801,495	0.8879	0.884	0.8742
Ulsan	#1	650,428	430,067	271,544	0.8254	0.8346	0.8587
	#2	621,740	404,834	244,246	0.8218	0.8248	0.8498
	#3	667,893	414,630	268,231	0.8229	0.8349	0.8491
	#4	1,778,566	1,507,363	1,759,376	0.7641	0.7654	0.7666
	#5	1,415,550	2,025,171	2,141,162	0.7699	0.7633	0.7673
	#6	1,698,585	1,363,879	2,196,344	0.7683	0.7658	0.7683
Youngnam	#1	664,185	890,011	973,872	0.8102	0.8323	0.8516
	#2	506,254	753,536	665,973	0.8278	0.8601	0.9182
Yosu Ⅱ	#1	686,062	703,557	723,968	0.7856	0.792	0.8078
(Yosu)	#2	878,464	328,981	1,304,109	0.8301	0.8365	0.7798
Pyongtaek	#1	1,535,696	1,465,460	850,533	0.7505	0.7402	0.7702
	#2	1,625,568	1,393,188	880,646	0.7449	0.7435	0.7634
	#3	1,434,408	1,400,056	751,633	0.7579	0.7485	0.7761
	#4	1,282,597	1,539,552	800,854	0.7539	0.7455	0.7753
Namjeju	#1	26,182	38,080	50,294	1.0309	1.04	1.0423
	#2	29,181	36,860	48,714	1.047	1.0488	1.0460
Jeju	#1	22,410	30,288	44,659	1.0771	1.1001	1.0881
	#2	506,993	439,474	486,401	0.7792	0.7829	0.7745
	#3	453,911	513,880	509,330	0.7828	0.7752	0.7755
Seoul	#4	96,233	132,599	90,322	0.7327	0.7492	0.7543
	#5	750,457	503,383	480,919	0.71	0.7618	0.7455
Incheon	#1	263,763	225,023	47,491	0.4525	0.6641	0.6750
	#2	279,809	242,806	49,144	0.4439	0.6527	0.6878
	#3	142,944	267,999	19,018	0.4016	0.6825	0.6999
	#4	150,246	214,153		0.406	0.6942	
Pyongtaek		792,480	863,292	596,001	0.5342	0.5728	0.5052
Ilsan		2,913,131	3,097,425	3,281,407	0.5529	0.557	0.5502
Bundang		3,392,511	3,344,852	3,650,122	0.5435	0.5447	0.5452
Ulsan		1,837,604	1,557,954	2,329,524	0.4542	0.4835	0.4498
Seoincheon		7,381,775	7,012,289	8,353,619	0.4539	0.4566	0.4403
Shinincheon		10,460,040	10,459,986	11,596,955	0.4163	0.4211	0.4164
Boryeong		3,055,340	4,436,234	6,979,928	0.4658	0.4533	0.4310
Busan			1,574,883	9,884,075		0.4544	0.3991
Hallim		97,221	55,044	96,435	0.7629	0.8141	0.8223
Anyang (Other co.)		1,909,128	1,793,725	1,506,070	0.5404	0.5521	0.5468
Bucheon (Other co.)		1,339,949	1,454,854	1,425,073	0.5558	0.5575	0.5518
K I E Co. (Other co.)		3,312,541	2,683,591	2,809,983	0.5053	0.5397	0.5063
LG Bugog (Other co.)		1,091,904	1,221,992	1,894,996	0.4262	0.4539	0.4187
Namjeju(D/P)		262,357	265,063	274,089	0.6724	0.673	0.6703
Yulchon	C/C			36,366			0.6768
Jeju	G/T			3,016			2.0328
Yonghung	#1			2,986,382			0.8787
	#2			1,172,450			0.9313
Total		**163,898,595**	**166,911,029**	**187,513,847**	**0.7794**	**0.7815**	**0.7542**

Source : Statistics of Electric Power in KOREA (2003,2004,2005) (KEPCO)
Blank : not operated

<Table 14> Fuel Carbon Emission Factor

Fuel	Carbon Emission Factor (tC/TJ)	Fuel	Carbon Emission Factor (tC/TJ)
Liquid Fossil		**Solid Fossil**	
Primary fuels		*Primary Fuels*	
Crude oil	20	Anthracite	26.8
Orimulsion	22	Coking coal	25.8
Natural gas liquids	17.2	Other bituminous coal	25.8
Secondary fuels/products		sub-bituminous coal	26.2
Gasoline	18.9	Lignite	27.6
Jet kerosene	19.5	Oil shale	29.1
Other Kerosene	19.6	Peat	28.9
Shale oil	20	*Secondary fuels/products*	
Gas/Diesel oil	20.2	BKB & Patent Fuel	25.8
Residual fuel oil	21.1	Coke Oven/Gas Coke	29.5
LPG	17.2	Coke gas oven	13
Ethane	16.8	Blast Furnace gas	66
Naphtha	20	**Gaseous Fossil**	
Bitumen	22	Natural gas (dry)	15.3
Lubricants	20	**Biomass**	
Petroleum coke	27.5	Solid Biomass	29.9
Refinery Feedstocks	20	Liquid Biomass	20
Refinery gas	18.2	Gas Biomass	30.6
Other oil	20		

Source : IPCC Guidelines, 1996a

According to the OM calculation equation and variables of above tables, OM is 0.7710 ton CO2 eq./MWh

Step 2. – Calculation of the Build Margin (BM)

According to ACM0002, there are two options to choose in order to calculate the BM.

Option 1. Calculate the Build Margin emission factor $EF_{BM,y}$ *ex ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of either

- the five power plants that have been built most recently, or
- 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.

Project participants should use from these two options that sample group that comprises the larger annual generation.

Option 2. For the first crediting period, the Build Margin emission factor EF_{BM},*y* must be updated annually *ex post* for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, $EF_{BM,y}$ should be calculated *ex-ante*, as described in option 1 above. The sample group *m* consists of either

- the five power plants that have been built most recently, or
- 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.

Project participants should use from these two options that sample group that comprises the larger annual generation.

For the this project, Option 1 was selected. To select the sample group *m*, "the five power plants that have been built most recently" and "the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) which have been built most recently" were compared and the results are as follows.

<Table 15> Sample Plant group (m) for determining Build margin Emission factor

Sample group(m) Classification	**"The five power plants that have been built most recently"**	**"The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently."**	**Comments**
Electricity quantity	1,209GWh	70,405 GWh	Total generation is 322,768 GWh in Korea (based on KEPCO's data of the year 2005)
Proportion (ratio to total generation in Korea)	0.37%	21.81%	
Selected Group		**O**	

The annual generation of "the five power plants that have been built most recently" was 1,209 GWh (0.37% of total generation of the grid system), and the annual generation of "the power plants capacity additions in the electricity system that comprise 21.81% of the system generation and that have been built most recently" was 70,405 GWh. Therefore, the latter was chosen as a larger figure than the other one.

The calculation of BM_y is as follows;

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

<Table 16> Sample group of plants used in the Build Margin calculation and Carbon Emission Factor of the Build Margin

Plant name		Technology	year operation	Fuel	MWh in 2004	% of total output	CEF	Results
Sungnam		small hydro power	2004.12	hydro	14	0.00%	0	0
Maebongsan-wind power		wind power	2004.12	wind power	42	0.00%	0	0
Yongheng	#2	steam	2004.11	bituminous coal	1,172,450	1.67%	0.9313	0.0155
new solar energy		solar power	2004.09	solar	11	0.00%	0	0
Yulchon	C/C	steam	2004.07	LNG	36,366	0.05%	0.6768	0.0003
Yongheng	#1	steam	2004.07	bituminous coal	2,986,382	4.24%	0.8787	0.0373
Ulchin	#5	nuclear power	2004.07	nuclear	4,656,890	6.61%	0	0
Hankyung-wind power		wind power	2004.02	wind power	10,577	0.02%	0	0
Chunsang		small hydro power	2004.01	hydro	54	0.00%	0	0
Cheongju LFG		steam by L.P.G	2004.01	LFG	9,958	0.01%	0	0
WunjeongLFG		steam by L.P.G	2003.12	LFG	13,733	0.02%	0	0
Daegwanryung-wind power		wind power	2003.11	wind power	3,713	0.01%	0	0
Daejon Geumgodong		steam by L.P.G	2003.06	LFG	10,048	0.01%	0	0
Hoicheon ENC		steam by L.P.G	2003.05	LFG	7,169	0.01%	0	0
Busan	C/C	combined cycle power	2003.05	LNG	9,884,075	14.04%	0.3992	0.056046
Andong		small hydro power	2003.08	hydro	8,250	0.01%	0	0
Muju		small hydro power	2003.04	hydro	695	0.00%	0	0
Seohee- ENC		steam by L.P.G	2003.04	LFG	30,262	0.04%	0	0
Yonggwang	#6	nuclear power	2002.12	nuclear	6,311,544	8.96%	0	0
Gunsan- filling		steam by L.P.G	2002.12	LFG	4,659	0.01%	0	0
Gunsan-wind power		wind power	2002.11	wind power	4,582	0.01%	0	0
Taean	#6	steam	2002.05	bituminous coal	4,056,835	5.76%	0.8787	0.0506
Yonggwang	#5	nuclear power	2002.05	nuclear	5,511,898	7.83%	0	0

Pohang-hodong		steam by L.P.G	2002.05	LFG	12,675	0.02%	0	0
Sangwon ENC		steam by L.P.G	2001.12	LFG	54,381	0.08%	0	0
Sanchong pumping #2		pumping	2001.11	hydro	287,832	0.41%	0	0
Milyang		small hydro power	2001.10	hydro	7,872	0.01%	0	0
Sanchong pumping #1		pumping	2001.09	hydro	290,531	0.41%	0	0
Yongdam		hydro	2001.09	hydro	166,759	0.24%	0	0
Yeongcheon		small hydro power	2001.08	hydro	3,332	0.00%	0	0
Hadong	#6	steam	2001.07	bituminous coal	3,685,698	5.23%	0.8626	0.0452
Dangjin	#4	steam	2001.03	bituminous coal	3,801,495	5.40%	0.8742	0.0472
Pohang-wind power		wind power	2001.02	wind power	576	0.00%	0	0
Taean	#5	steam	2001.01	bituminous coal	4,091,406	5.81%	0.8804	0.0512
Jeju	#3	steam	2000.12	heavy oil	509,330	0.72%	0.7755	0.0056
Dangjin	#3	steam	2000.09	bituminous coal	3,711,787	5.27%	0.8779	0.0463
Hoengseong		small hydro power	2000.08	hydro	5,004	0.01%	0	0
Hadong	#5	steam	2000.07	bituminous coal	4,013,845	5.70%	0.8687	0.0495
L G Bugog	C/C	combined cycle power	2000.07	LNG	1,894,996	2.69%	0.4187	0.0113
Jeju	#2	steam	2000.03	heavy oil	486,401	0.69%	0.7745	0.0054
Dangjin	#2	steam	1999.12	bituminous coal	4,038,457	5.74%	0.8787	0.0504
Ulchin	#4	nuclear power	1999.12	nuclear	8,623,075	12.25%	0	0
Total					70,405,658	100%	BM Factor	0.471834

Source : Statistics of Electric Power in KOREA (2005) (KEPCO), Status of Generation facility*(2005) (Korea Power Exchange)

According to the BM calculation equation and variables of above tables, BM is 0.4718 ton CO2 eq./MWh

Step 3. – Calculation of the baseline emission factor (EF_y)

Based on the results derived from Step 1, and Step 2, EF_y has been calculated using the following formula:

$$EF_y = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y}$$

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2/MWh.

Therefore,

<Table 17> $CEF_{electricity,y}$

$CEF_{electricity,y}$	$= (EF_{OM,y} + EF_{BM,y})/2$
0.6214	= (0.7710 + 0.4718) / 2

Step 4. – Calculation of the baseline emission
Baseline emission = Electricity transferred to a grid(kWh) x Baseline emission factor($kgCO_2$ eq/kWh)

<Table 18>Annual electricity generation and baseline emission at each SS hydro power plant

Category	Annual electricity generation
Seongnam Ⅱ small-scale hydropower	2,645 MWh/yr
Dalbang-dam small-scale hydropower	1,102 MWh/yr
Juam-dam small-scale hydropower	4,934 MWh/yr
Daecheong-dam small-scale hydropower	5,263 MWh/yr
Project electricity generation	13,944 MWh/yr
Baseline emission factor	0.6214 CO_2 ton/MWh
Baseline emission	8,664 CO_2 ton/yr

According to the formula above, baseline emission is 8,664 CO_2 ton/yr.

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

PDD version 3 (Completion date : 17/12/2009)

- Project participant corrected the PDD with respect to commercial operation date of all plants to reflect actual date.
- Project participant updated the generator output power of the Juam-dam from 500 kW to 495 kW.

PDD version 4 (Completion date : 31/07/2017)

- Project participant revised address of Daecheong-dam from Cheongwon-gun to Seowon-gu, Cheongju city due to reorganization of administrative district.
- Project participant revised the PDD with respect to specification of Seongnam Ⅱ according to installed wheel and generator.