CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

CONTENTS

SECTION A. General description of the small-scale project activity

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

Korea Water Resources Corporation (KOWACO) small-scale hydroelectric power plants project (the Andong-dam, the Seongnnam, the Jangheung-dam small-scale hydroelectric power plants construction project)

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

- Purpose of the project
Small-scale hydroelectric power plants construction by KOWACO generates electricity as well as socio-economical benefits in local and national level. Construction of above mentioned 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
KOWACO small-scale hydroelectric power plants project (the Andong-dam, the Seongnam, the Jangheung-dam small scale hydro power plant construction project) consists in 2.64 MW of facility capacity, and power generation of 15,473,000KWh per year for 7 years. Major project participant is KOWACO.

- 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 : 9,689 ton CO_2 eq/yr
  - SOx : 17 ton SOx /yr
  - NOx : 13 ton NOx /yr
  - Dust : 1 ton Dust /yr

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

A.3. Project participants:

<Table 1> Project participants of KOWACO small-scale hydroelectric power plants project (the Andong-dam, the Seongnam, the Jangheung-dam small scale hydroelectric power plants construction project)

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
KOREA (host)	• Public entity: Korea Water Resources Corporation (KOWACO) – major project participant	No

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

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

A.4.1.1. Host Party(ies):

Republic of Korea

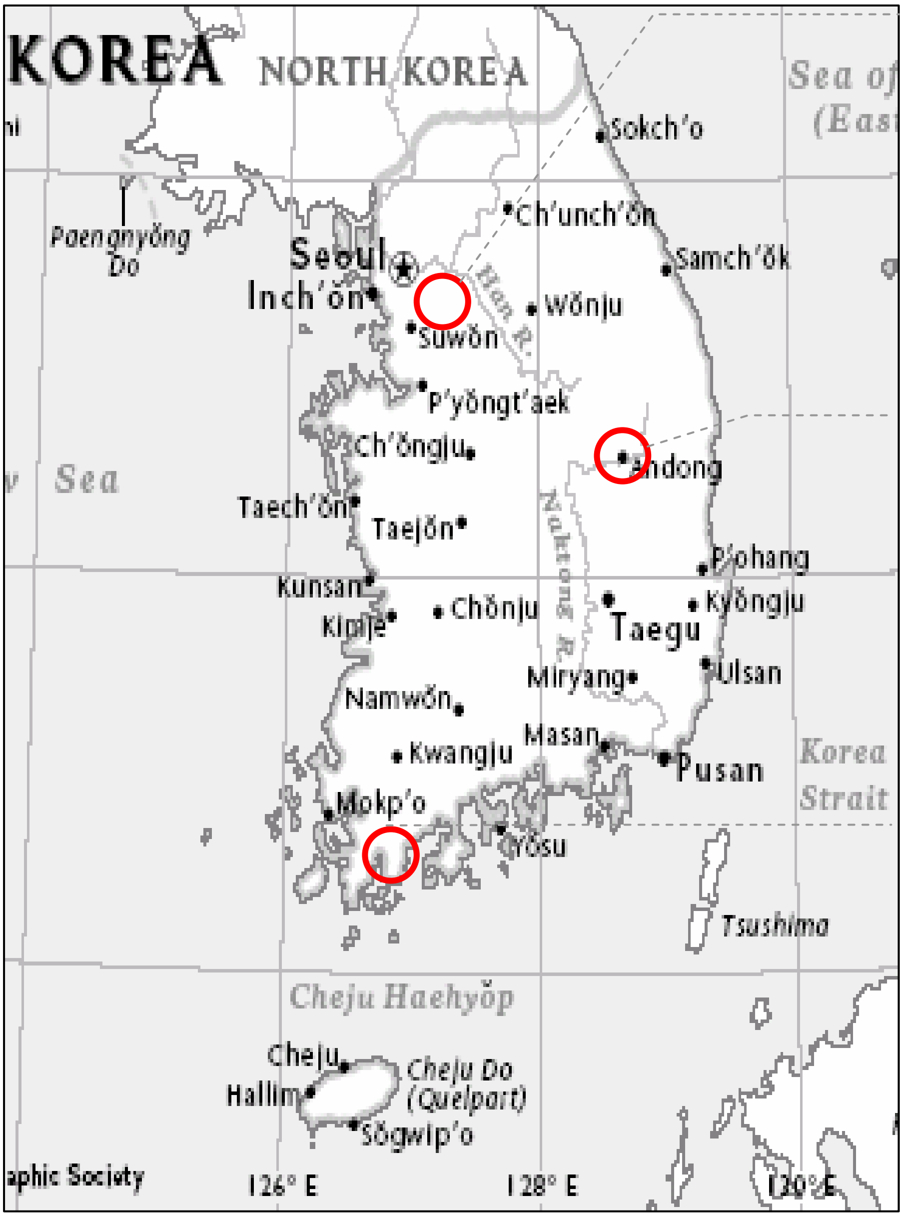
A.4.1.2. Region/State/Province etc.:

The Andong-dam small-scale hydroelectric power plant: Gyeongsangbuk-do
The Seongnam small-scale hydroelectric power plant: Gyeonggi-do
The Jangheung -dam small-scale hydroelectric power plant: Jeollanam-do

A.4.1.3. City/Town/Community etc:

The Andong-dam small-scale hydroelectric power plant: Andong city
The Seongnam small-scale hydroelectric power plant: Seongnam city
The Jangheung -dam small-scale hydroelectric power plant: Janheung-gun

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



The Seongnam ss-Hydroelectric power plant

Generator was built at the entrance of the Seongnam purification plant.

The Andong-dam ss-Hydroelectric power plant

Ss-hydroelectric power plant was built in the right side of the existing

The Jangheung -dam ss-Hydroelectric power plant

SS-hydroelectric power plant was built in the left lower part of the Jangheung -dam

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

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

Type : 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 KOWACO 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.

<Table2> Description of technology of the small-scale hydroelectric power plants

Classification		The Andong-dam small-scale hydroelectric	The Seongnam small-scale hydroelectric	The Jangheung -dam small-scale Hydroelectric
Wheel	Type	Propeller (Tubular)	Vertical Francis	Horizontal Francis
	Output power	493 KW	372 kW	800 kW
	Rotation	225 RPM	450 RPM	514 RPM
	Unit	3	1	1
Generator	Type	Concentrating induction	Three-phase induction (horizontal axis)	Three-phase induction (horizontal axis)
	Output power	500 KW	340 kW	800 kW
	Rotation	225 RPM	450 RPM	514 RPM
Transformer	Type	Mold type	Mold type	Mold type
	capacity	2,000 kVA	500 kVA	1,000 kVA
	Volatage	3.3 kV / 22.9 kV	380 V / 22.9 kV	3.3 kV / 22.9 kV
	Connection type	△-Y	△-Y	△-Y
	Unit	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.

Water turbine generator, which is the main equipment, is designed and made by Daeyang Co., Ltd.[1] Also the technology can be applied optimistically. Technology details are followed;

- Firstly, adopted technology to water turbine generator which is for this project, optimistically designed based on surrounded water resources, therefore, stable efficiency is guaranteed.
- Secondly, this is not the style of gear or belt connection but unified shaft which is directly related to water turbine generator. Therefore, components are simple style and operation & maintenance is easy. It has low probability of serious problem.
- Thirdly, operation and maintenance is smoothly performed, therefore, generation loss can be reduced.

A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

The main objective of the project is to develop and generate electricity by means of zero GHGs emitting renewable energy sources. Small-scale hydroelectric power plants project will reduce GHGs emissions by generating electricity with using hydroelectric power sources, and replace some portion of conventional energy sources.

This project activity will substitute the fossil fuel fired plants by generating 15,473 MWh, so it will bring in annually 9,689 tons of CO_2 emission reduction.

The Korean government has constructed power plants in order to meet the increased demand for electricity, however due to the financial and technological barriers, the Korean government chose to build fossil fuel fired power plants. These fossil fuel fired plants have been emitting GHGs when to generate electricity. 62.5% of the total electricity generation in Korea comes from fossil fuel fired power plants (Source: KEPCO 2004). Less than 5% of the electricity is coming out of the alternative energy sources such as hydroelectric power, wind power, or solar power.

This project will not only reduce GHGs emission but also work as effective driving forces to promote the electricity generation industries by means of renewable energy sources.

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

67,823 tons of CO_2 emission reduction is estimated for the 7-year period.

[1] Daeyang Co., Ltd . has researched about water turbine generator for 20 years since 1983. Based on international references and reports, they has being developed water turbine generator which can apply to Korean situation. From the developing technology and domestication of advanced international technology, most of water turbine generator is designed and made by themselves at the moment.

Years	Annual estimation of emission reductions in tonnes of CO_2 e
Year 1 (2007.1.1 ~ 2007.12.31)	9,689
Year 2 (2008.1.1 ~ 2008.12.31)	9,689
Year 3 (2009.1.1 ~ 2009.12.31)	9,689
Year 4 (2010.1.1 ~ 2010.12.31)	9,689
Year 5 (2011.1.1 ~ 2011.12.31)	9,689
Year 6 (2012.1.1 ~ 2012.12.31)	9,689
Year 7 (2013.1.1 ~ 2013.12.31)	9,689
Total estimated reductions (tonnes of CO_2 e)	67,823
Total number of crediting years	7
Annual average over the creditng period of estimated reductions (tonnes of CO_2 e)	9,689

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

No public funding is provided for this project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger 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. Bundled three small-scale hydroelectric power plants have 2.64 MW capacity. None of these three plants are part of a large project.

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.

KOWACO is firstly carrying out this small scale project, and therefore this project is not a debundled project.

SECTION B. Application of a baseline methodology:

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

Project activity I.D “Grid connected renewable electricity generation ”

Referred to small-scale project category of Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

B.2 Project category applicable to the small-scale project activity:

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 KOWACO 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.

The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO2eq/kWh) calculated in a transparent and conservative manner as:

(a) The average of the “approximate operating margin” and the “build margin”, where:

(i) The “approximate operating margin” is the weighted average emissions (in kg CO2equ/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

(ii) The “build margin” is the weighted average emissions (in kg CO2equ/kWh) of recent capacity additions to the system, 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 plant 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. Power plant capacity additions registered as CDM project activities should be excluded from the sample group *m*. If 20% falls on part capacity of a plant, that plant is included in the calculation.

OR,

(b) The weighted average emissions (in kg CO2equ/kWh) of the current generation mix.

(c) Approximate Operating Margin emission factor and the weighted average emission factor can be calculated using either of the two following data vintages for years(s) y:

- Option 1:
A 3-year average, based on the most recent statistics available at the time of PDD submission.

- Option 2:
The year in which project generation occurs, if emission factor is updated based on ex post monitoring.

(d) Build margin emission factor can be calculated using either of the following data vintages for years(s) y:

- Option 1
Most recent information available on plants already built at the time of PDD submission.

- Option 2
For the first crediting period, emission factor is updated based on ex-post monitoring. For subsequent crediting periods, Emission factor should be calculated ex-ante, as described in option 1 above.

(a), option 1 of (c) and option 1 of (d) are selected for this project as baseline for estimating GHG emission reduction with considering national grid-connect system and data acquisition.

<Table 3> 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 11>	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 7.>	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
Net Calorific Values at each power plant	Refer to <Table 8>, <Table 9>, <Table 10>	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
Approximate Operating Margin Emissions Factor (in kg CO_2 eq/kWh)	0.7807	Calculated
Build Margin Emissions Factor (in kg CO_2 eq/kWh)	0.4718	Calculated
Baseline Emissions Factor (in kg CO_2 eq/kWh)	0.6262	Calculated

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

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, the reason why small hydro power resources haven't be activated is economical efficiency is insufficient. The policy of Korea Government has supported various economical efficiencies for activating small hydro power generation plant. That is, a unit cost of fuel of oil heating power generation plant is adopted to small hydro power electricity from 1984 to 1994. Since 1995, small hydro electricity cost 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. From this government policy, small hydro power plant doesn't have economical efficiency without government aid.
Economical analysis has performed for expression of investment barrier as quantitatively through showing NPV of individual plant. 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 to small hydro power unit cost which is before the notice of official price.

<Table 4> result of economical analysis

Plant Name	Total Expenses (unit: one million won)	Operation& Maintenance Cost (unit: one million won /year)	Corporation Tax (unit: one million won /year)	Unit Cost of Purchase (unit: won/KWh)	Electricity (unit:KWh)	NPV (unit : one million won)
The Andong-dam small-scale hydroelectric	3,811.000	126.525	45.894	51.43	10,167,000	-421.625
The Seongnam small-scale hydroelectric	1,374.000	33.251	3.439	47.35	2,592,000	-478.667
The Jangheung -dam small-scale Hydroelectric	1437.620	56.928	0.445	47.35	2,713,853	-706.262
* Business life time is for 21 years except construction period. * Jangheung and Seongnam of discount rate is 7.5% and Andong is 8.0%. * 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 or can be resolved from governmental support.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the small-scale project activity:

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.

B.5. Details of the baseline and its development:

B.5.1. Specify the baseline for the proposed project activity using a methodology specified in the applicable project category for small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities:

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

- Option 1: *selected*

A 3-year average, based on the most recent statistics available at the time of PDD submission.

The "approximate operating margin" is calculated as follows, using 3-year average data.

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

$F_{i,j,y}$ 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 generation.
$COEF_{i,j,y}$ ($COEF\ i = NCV\ i \cdot EFco_2i \cdot OXID\ i$) is the CO_2 emission coefficient of fuel *i* (kg CO_2 eq/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 (KWh) delivered to the grid by source *j*.

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

Build margin emission factor is calculated as following data vintages for years(s) y:

- Option 1

Most recent information available on plants already built at the time of PDD submission.

Participants have to use the most recent data from the sample group that has already been built. Among the sample groups, the participants have to choose one that has a larger annual generation than the other.

- 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

The annual generation of "the five power plants that have been built most recently" was 1,209,000 MWh (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 70,401,000 MWh. Therefore, the latter was chosen as a lager figure than the other one.

<Table 5> 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	1,209,000 MWh	70,401,000 MWh	Total generation is 322,768,000 MWh 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 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 AOM 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[2] are excluded.)

B.5.2. Date of completing the final draft of this baseline section (DD/MM/YYYY):

17/03/2006.

[2] 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.

B.5.3. Name of person/entity determining the baseline:

Dr. Jaesu Jung(civilenvi@ecoeye.com) / Ecoeye Co., Ltd.

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

C.1.1. Starting date of the small-scale project activity:

Commercial operation starting dates are followed;

The Andong-dam small-scale hydroelectric power plant: 08/09/2003
The Seongnam small-scale hydroelectric power plant: 16/12/2004
The Jangheung -dam small-scale hydroelectric power plant: 30/11/2005

C.1.2. Expected operational lifetime of the small-scale project activity:

Expected lifetime of equipment is 30 years.

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

C.2.1. Renewable crediting period:

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

01/01/2007

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

C.2.2.2. Length:

SECTION D. Application of a monitoring methodology and plan:

D.1. Name and reference of approved monitoring methodology applied to the small-scale project activity:

Name: monitoring methodology for Project activity I.D "Grid connected renewable electricity generation "

Reference: Type I.D. Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

D.2. Justification of the choice of the methodology and why it is applicable to the small-scale project activity:

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.

The monitoring plan for emission factor for baseline and electricity generated is as fallows:

- Emission factor for baseline: As emission factor is calculated, so all the parameters and data used for calculation shall be transparent and credible. All the data shall be collected and calculated in the same way as D.3.

- Electricity used for the project activity: Electricity is defined as the grid connected electricity and the value of it is measured. Measurement shall be done by both project participant and Korea power exchange. The measured data by both entities shall be equal. Monitoring equipment for measurement shall fulfill step 1 of QA/QC in D.4.

D.3 Data to be monitored:

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ID number	Data type	Data variable	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long Is archived Data kept?	Comment
1. EGy*	Electricity quantity	Electricity supplied to the grid by the project	KWh	Directly measured	hourly measurement and monthly recording	100%	Electronic	During the crediting period and two years after	Data will be aggregated weekly, monthly and yearly Double checked against receipt of sales. Electricity transmission except Electricity consumed in the plant *
2. EFy	Emission factor	CO_2 emission factor of the Korea grid	kg CO_2 eq/kWh	C	Once at the time of PDD submission	100%	Electronic	During the crediting period and two years after	Data will be used of 3 year vintage data. Calculated as a weighted sum of the OM and BM emission factors.
3. $EF_{AOM, y}$	Emission factor	CO_2 AOM emission factor of the Korea grid	kg CO_2 eq/kWh	C	Once at the time of PDD submission	100%	Electronic	During the crediting period and two years after	Data will be used of 3 year vintage data. Calculated as indicated in the relevant AOM baseline method above.
4. $EF_{BM, y}$	Emission factor	CO_2 BM emission factor of the Korea grid	kg CO_2 eq/kWh	C	Once at the time of PDD submission	100%	Electronic	During the crediting period and two years after	Data will be used of a year vintage data. Calculated as [∑ i, m F i, m, y · COEF i, m]/ [∑ m GEN m, y] over recently built power plants defined in the baseline methodology.
5. $F_{i, y}$	Fuel quantity	Amount of each fossil fuel consumed by each power source / plant	Mass or volume	M	Once at the time of PDD submission	100%	Electronic	During the crediting period and two years after	Data will be used of 3 year vintage data. Obtained from the KEPCO.

6. $COEF_i$	Emission factor coefficient	CO_2 emission coefficient of each fuel type i	kg CO_2 eq/ mass or kg CO_2 eq/ volume	C	Once at the time of PDD submission	100%	Electronic	During the crediting period and two years after	Caculated as [NCVi · EF_{co2}i · OXIDi]. Data will be calculated by each energy source in accordance with IPCC 1996 default value..
7. NCVi (Local value)	Net Caloric Value	Net Caloric coefficient of each fuel type i to calculate $COEF_i$	Kcal/ Mass or Kcal/ volume	m	Once at the time of PDD submission	100%	Electronic	During the crediting period and two years after	NCVi (Local value) is obtained from the KEPCO.
8. GENy	Electricity quantity	Electricity generation of each power source / plant	KWh/ each plant	m	Once at the time of PDD submission	100%	Electronic	During the crediting period and two years after	Data will be used of 3 year vintage data. Obtained from the KEPCO.
9. AOM plant	Plant name	Identification of power source / plant for the AOM	text	e	Once at the time of PDD submission	100% of set of plants	Electronic	During the crediting period and two years after	Identification of plants to calculate Approximate Operating Margin emission factors.
10. BM plant	Plant name	Identification of power source / plant for the BM	text	e	Once at the time of PDD submission	100% of set of plants	Electronic	During the crediting period and two years after	Identification of plants to calculate Build Margin emission factors.

D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

All variables, except one related to off-site transportation, used to calculate project and baseline emissions are directly measured or are publicly available official data. 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 6> 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
1.EGy	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 data must be within ± 0.5%.
5. $F_{i,y}$	Low	QA/QC procedure for this are planned. The data will be obtained by KEPCO.
6.$COEF_i$	Low	QA/QC procedure for this are planned. Data will be checked against other sources.
Others	Low	QA/QC procedure for this are planned. All the data and grid statistics data will be used, and provided by KEPCO

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.

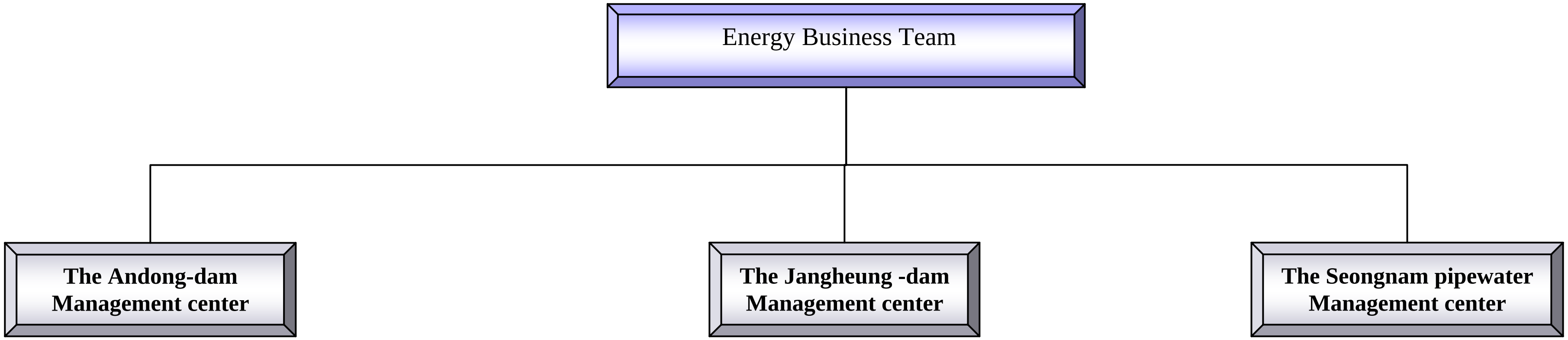
2-3. The collected data in article 2-2. shall be compared with those of Korea power Exchange.
2-4. If the two data compared in article 2-3. are different, the operation condition of electricity meters and other equipments shall be examined. In case meters are improperly operated equipments, internal 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 three times per 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.

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:



Department in charge of monitoring for the project and responsible department are as follows:
- Department in charge of monitoring: the Andong-dam management center, the Seongnnam area management center, the Jangheung -dam management center
- Responsible department: Energy Business Team

D.6. Name of person/entity determining the monitoring methodology:

Dr. Jaesu Jung(civilenvi@ecoeye.com) / Ecoeye Co., Ltd.
Contacted : +82-31-716-2108, ps@ecoeye.com

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

E.1.1 Selected formulae as provided in appendix B:

Not applicable

E.1.2 Description of formulae when not provided in appendix B:

Project emission reduction = BE(Baseline emissions) – PE(Project emissions)

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

GHGs emissions due to the project activity is not occurred.(For further information, refer to Section D.2)

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

Leakage due to the project activity is not occurred.(for more detailed information, refer to Section D.2)

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

Project activity emission is 0.

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

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

hydro, geothermal, wind, low-cost biomass, nuclear and solar generation power plants have to be deducted from the data to calculate AOM factor.

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

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

$F_{i,j,y}$ 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 generation.
$COEF_{i,j,y}$ ($COEF\ i = NCV\ i \cdot EFco_2 i \cdot OXID\ i$) is the CO_2 emission coefficient of fuel *i* (kg CO_2 eq/ 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 (KWh) delivered to the grid by source *j*.

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

<Table 7>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)
Anthracite	Yongdong	#1	155,792	242,312	227,405
		#2	406,756	422,327	332,746
	Donghae	#1	568,695	646,675	521,641
		#2	645,642	584,110	602,595
	Kunsan	#1	93,520	107,620	
	Socheon	#1	472,769	436,129	353,898
		#2	407,368	440,503	376,352
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
		#6	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	Yongdong	#1	61,610	60,999	60,981
		#2	94,104	99,181	76,841
	Donghae	#1			
		#2			
	Kunsan	#1	61,520	71,207	
	Seocheon	#1	80,333	83,374	82,817
		#2	93,068	85,375	77,913
	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	

Energy sources	Plant Name		Fuel consumption 2002 (kl)	Fuel consumption 2003 (kl)	Fuel consumption 2004 (kl)
		#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	Yongdong	#1	61	98	71
		#2	176	244	133
	Donghae	#1	1,887	1,460	906
		#2	976	1,834	775
	Kunsan	#1	125	97	
	Seocheon	#1	111	76	45
		#2	41	56	59
	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 8>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)
Yongdong	#1	4,508	10,073	9,040	
	#2	4,326	10,084	9,040	
Donghae	#1	4,614		8,986	
	#2	4,598		9,039	
Kunsan	#1	4,812	9,915	9,063	
Seocheon	#1	4,670	10,081	8,952	
	#2	4,646	10,078	8,947	
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 9>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)
Yongdong	#1	4,521	10,068	9,040	
	#2	4,491	10,073	9,040	
Donghae	#1	4,673		8,977	
	#2	4,662		8,968	
Kunsan	#1	4,787	9,917	9,071	
Seocheon	#1	4,621	10,013	8,784	
	#2	4,627	10,012	8,784	
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 10>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)
Yongdong	#1	4,697	10,096	9,040	
	#2	4,682	10,095	9,040	
Donghae	#1	4,703		8,993	
	#2	4,722		9,006	
Kunsan	#1				
Seocheon	#1	4,607	10,013	8,992	
	#2	4,655	10,018	8,848	
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 11>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
Yongdong	#1	462,001	589,528	572,449	1.0440	1.0832	1.0975
	#2	977,345	1,036,174	821,764	1.0377	1.0479	1.0676
Donghae	#1	1,019,142	1,172,082	932,870	1.0432	1.0430	1.0631
	#2	1,148,885	1,044,650	1,076,139	1.0442	1.0558	1.0681
Kunsan	#1	338,022	398,897		1.1165	1.0891	
Seocheon	#1	1,055,360	991,048	848,412	1.0898	1.0903	1.0884
	#2	990,740	1,044,245	879,256	1.0740	1.0914	1.0882
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		**169,890,091**	**173,147,648**	**192,644,738**	**0.7894**	**0.7920**	**0.7629**

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

<Table 12>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 AOM calculation formula and variables of above tables, AOM is 0.7807 Kg CO_2 eq/kWh.

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

Participants have to use the most recent data from the sample group that has already been built. Among the sample groups, the participants have to choose one that has a larger annual generation than the other.

- 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

<Table 13> 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	1,209,000 MWh	70,401,000 MWh	Total generation is 322,768 MWh 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 70,401 GWh. Therefore, the latter was chosen as a lager 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 14> Sample group 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	Result
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%	0.3991	0.0560356
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%	0.8802	0.0511
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), Current status of power generating facility(2005, Korea power exchange)

According to the BM calculation formula and variables of above tables, BM is 0.4718 Kg CO_2 eq/kWh

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

The average of AOM and BM factors calculated by step 1 and 2 is ***EF_y***, baseline emission factor.

$$EF_y = (EF_{AOM\,y} + EF_{BM,y})/2$$

According to Step 2. and Step 3, EF(Emission factor) is 0.6262 Kg CO_2 eq/kWh.

Step 4. – Calculation of the baseline emission

Baseline emission = Electricity transferred to a grid(KWh) x Baseline emission factor(Kg CO_2 eq/kWh)

<Table 15>Annual electricity generation and baseline emission at each SS hydro power plant

Category	Annual electricity generation
Andong SS hydropower	10,167,000 KWh/yr
Sengnam SS hydropower	2,592,000 KWh/yr
Jangheung -dam SS hydropower	2,714 ,000 KWh/yr
Project electricity generation	15,473,000 KWh/yr
Baseline emission factor	0.6262 Kg CO_2 eq/kWh
Baseline emission	9,689 CO_2 ton/yr

According to the formula above, baseline emission is 9,689 CO_2 ton/yr.

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

Total emission reduction due to the project activity during a crediting period is 67,823 CO_2 tons/7yrs.

E.2 Table providing values obtained when applying formulae above:

<Table 16>Estimated emission reductions by the project activity

Years	Estimated emission by the project activity (tonnes of CO_2 e)	Estimated baseline emission (tonnes of CO_2 e)	Estimated leakage (tonnes of CO_2 e)	Estimated emission reductions (tonnes of CO_2 e)
Year 1 (2007)	0	9,689	0	9,689
Year 2 (2008)	0	9,689	0	9,689
Year 3 (2009)	0	9,689	0	9,689
Year 4 (2010)	0	9,689	0	9,689
Year 5 (2011)	0	9,689	0	9,689
Year 6 (2012)	0	9,689	0	9,689
Year 7 (2013)	0	9,689	0	9,689
Total (tones of CO_2 e)	0	67,823	0	67,823

SECTION F.: Environmental impacts:

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

The project activity does not apply to environmental impact assessment.

SECTION G. Stakeholders' comments:

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

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 collected during approval process of electricity business, stream occupation, row-line construction for small hydro power plant construction. In order to get approval of electricity business, stream occupation, and row-line construction, the agreement should acquired from local community people, Korea Power Exchange, Korea Electricity Power Corporation, down stream residents of small hydro power plant, and related governmental office. Therefore, in order to collect stakeholders' comments, agreement from them was got from direct meeting and related governmental office confirmed. To get approval letters of electricity business, stream occupation, row-line construction for small hydro power plant construction, stakeholders' agreement should get and the same process has done for this project. As a result, these approval letters are issued and submitted to DOE.

G.2. Summary of the comments received:

As the project activity uses unaccounted outflows from the existing dams or purification plants and generates electricity, there are no severe environmental impacts. Since the project activity is not large in size, there are no duly accounted comments from stakeholders.

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

Not applicable

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding to constitute a diversion of official assistance, nor to count towards any financial obligation from Parties.