CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAM ACTIVITY DESIGN DOCUMENT FORM (CDM-SSC-CPA-DD)
Version 01

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NOTE:

(i) This form is for submission of CPAs that apply a small scale approved methodology using the provision of the proposed small scale CDM PoA.

(ii) The coordinating/managing entity shall prepare a CDM Small Scale Programme Activity Design Document (CDM-SSC-CPA-DD)[1,2] that is specified to the proposed PoA by using the provisions stated in the SSC PoA DD. At the time of requesting registration the SSC PoA DD must be accompanied by a CDM-SSC CPA-DD form that has been specified for the proposed SSC PoA, as well as by one completed CDM-SSC CPA-DD (using a real case). After the first CPA, every CPA that is added over time to the SSC PoA must submit a completed CDM-SSC CPA-DD.

[1] The latest version of the template form CDM-CPA-DD is available on the UNFCCC CDM web site in the reference/document section.

[2] At the time of requesting validation/registration, the coordinating managing entity is required to submit a completed CDM-POA-DD, the PoA specific CDM-CPA-DD, as well as one of such CDM-CPA-DD completed (using a real case).

SECTION A. General description of small scale CDM programme activity (CPA)

A.1. Title of the small-scale CPA:

>>

Title : SH Corporation Solar photovoltaic housing complex programme in Republic of Korea-CPA<number>

Current version number and the date:

Ver 01	<should be filled>
Ver 02	<should be filled>
Ver 03	<should be filled>

Completion date PoA-DD: 00/ 00 /0000

A.2. Description of the small-scale CPA:

>>

<General description of SSC-CPA should be filled>

<Table A.1>Specific data of CPA<number>

No.	Place name	Capacity(kW)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

A.3. Entity/individual responsible for the small-scale CPA:

>>

The entity responsible of the proposed CPA is (<should be filled>).

A.4. Technical description of the small-scale CPA:

A.4.1. Identification of the small-scale CPA:

>>

SH Corporation Solar photovoltaic housing complex programme in Republic of Korea – CPA<number>

A.4.1.1. Host Party:

>>

Name of Party involved (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)
Republic of Korea(host)	<should be filled>	<should be filled>

A.4.1.2. Geographic reference or other means of identification allowing the unique identification of the small-scale CPA (maximum one page):

The installations enrolled in this CPA are stationary and geographically restricted to within the boundaries of the metropolis of Seoul. This area is clearly defined in *Figure A.1* below and comprises installations within the same isolation zone.

<Geographical figure should be filled>

<Figure A.1> Geographical boundary of CPA<number>

<Table A.2>Geographical reference of CPA<number>

No	Place name	Geographic Reference	
		Latitude	Longitude

A.4.2. Duration of the small-scale CPA:

A.4.2.1. Starting date of the small-scale CPA:

<Starting date of the CPA should be filled>

The start date of the proposed CPA<number> is no earlier than the date of commencement of PoA validation.

A.4.2.2. Expected operational lifetime of the small-scale CPA:

20 years

A.4.3. Choice of the crediting period and related information:

Fixed crediting period

A.4.3.1. Starting date of the crediting period:

<Starting date of the crediting period should be filled>

The starting date of crediting period would be a date of the two:

(i) the date of inclusion of the SSC-CPA in the registered PoA; or

(ii) the date of operating the solar PV in the SSC-CPA.

A.4.3.2. Length of the crediting period, first crediting period if the choice is renewable CP:

10years (fixed)

The duration of crediting period of All CPA shall be limited to the end date of the PoA regardless of when the CPA was added.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

<Table A.3>Estimated amount of emission reductions

Years	Estimation of annual emissions reductions (tCO_2e)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total estimated reductions (tCO_2e)	
Total Number of crediting years	
Annual average of estimated reductions over the crediting period (tCO_2e)	

A.4.5. Public funding of the CPA:

The CPA<number> will not involve any public funding.

A.4.6. Information to confirm that the proposed small-scale CPA is not a de-bundled component

<CPA implementer> checks the occurrence of de-bundling in each SSC-CPA according to the guidance for determining the occurrence of de-bundling under a PoA (EB 54, Annex 13).

1. For the purposes of registration of a Programme of Activities(PoA) a proposed small-scale CPA of a PoA shall be deemed to be a de-bundled component of a large scale activity if there is already an activity, which:

   (a) Has the same activity implementer as the proposed small scale CPA or has a coordinating or managing entity, which also manages a large scale PoA of the same sectoral scope, and;

   (b) The boundary is within 1km of the boundary of the proposed small-scale CPA, at the closest point.

<De-bundling check should be described>

A.4.7. Confirmation that small-scale CPAis neither registered as an individual CDM project activity or is part of another Registered PoA:

CPA <number> is not registered as other CDM project activities or part of other PoA.

SECTION B. Eligibility of small-scale CPA and Estimation of emissions reductions

B.1. Title and reference of the Registered PoA to which small-scale CPA is added:

SH Corporation Solar photovoltaic housing complex programme in Republic of Korea

B.2. Justification of the why the small-scale CPA is eligible to be included in the Registered PoA :

According to "Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities (Version 01, Annex3, EB 65)", the eligibility criteria for inclusion of CPA in the PoA:

A SSC-CPA to be included in the PoA should result all assessment as "yes"

No	Eligibility criteria	Self Assessment
1	**The geographical boundary of the CPA including any time-induced boundary consistent with the geographical boundary set in the PoA;**	
1.1	A CPA is performed within the territory of the metropolis of Seoul.	□ Yes □ No
1.2	A CPA is available identified its location from GPS location.	□ Yes □ No
2	**Conditions that avoid double counting of emission reductions like unique identifications of product and end-user locations (e.g. programme logo);**	
2.1	A CPA is a new project which is not registered large scale CDM or SSC-CPA in the other PoA or other carbon off-set program.	□ Yes □ No
2.2	There is unique identification of a PV and BIPV or end-user location.	□ Yes □ No

3	**The specifications of technology/measure including the level and type of service, performance specifications including compliance with testing/certifications;**	
3.1	Is it possible to submit specification of technology/measure when the DOE validates or verify?	□ Yes □ No
3.2	Solar PV (module) has a Certification from an officially approved institute. And BIPV (module) shall obtain a certification of test from an officially approved institute to confirm the output.	□ Yes □ No
4	**Conditions to check the start date of the CPA through documentary evidence;**	
4.1	Confirmation that the start date of a CPA is not, or will not be, prior to the commencement of validation of the PoA.	□ Yes □ No
5	**Conditions that ensure compliance with applicability and other requirements of single or multiple methodologies applied by CPAs**	
5.1	Does a CPA meet the applicability of AMS-I.F as described in PoA-DD section E.2?	□ Yes □ No
5.1.1	A CPA comprises photovoltaic generation units that supply electricity to user(s). A CPA will displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit i.e. in the absence of the project activity, the users would have been supplied electricity from the grid;	□ Yes □ No
5.1.2	A CPA meets the situation described as follows: Project displaces grid electricity consumption at the user end.	□ Yes □ No
5.1.3	A CPAs Installs a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant).	□ Yes □ No
5.1.4	If electricity and/or steam/heat produced by a CPA is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered that ensures that there is no double counting of emission reductions.	□ Yes □ No
6	**The conditions that ensure that CPAs meet the requirements pertaining to the demonstration of additionality**	

6.1	A CPA is a voluntary project which is not related to the mandatory policy or regulation by the Government of the Republic of Korea.	□ Yes □ No
6.2	A CPA employs solar energy technology. And total capacity of a CPA is less than five megawatts.	□ Yes □ No
6.3	Each independent subsystem/measures in the SSC-CPA is smaller or equal to 1,500 kW installed capacity.	□ Yes □ No
6.4	A CPA is designed for distributed energy generation (not connected to a national or regional grid).	□ Yes □ No
6.5	The end users of electricity produced by each independent activity are households, communities or SMEs.	□ Yes □ No
7	**The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis**	
7.1	Confirmation that a CPA performs local stakeholder consultation before the inclusion of SSC-CPA.	□ Yes □ No
7.2	Confirmation that a CPA does not need to performs the environmental impacts analysis according to the regulation of the Republic of Korea.	□ Yes □ No
8	**Conditions to provide an affirmation that funding from Annex I parties, if any, does not result in a diversion of official development assistance**	
8.1	A CPA uses own capitals or government subsidies that are not public funding.	□ Yes □ No
9	**Where applicable, target group (e.g. domestic/commercial/industrial, rural/urban, grid-connected/off-grid) and distribution mechanisms (e.g. direct installation)**	
9.1	The target group of a CPA is households.	□ Yes □ No
9.2	PV Power generation system is newly installed at housing complex and the generated electricity is supplied for households.	□ Yes □ No
10	**Where applicable, the conditions related to sampling requirements for a PoA in accordance with the approved guidelines/standard from the Board pertaining to sampling and surveys**	
10.1	A CPA measures all monitoring parameters without sampling or survey method. (Except the parameter for electricity imported from grid. It could be calculated in accordance with B.6.1 of the PoA)	□ Yes □ No

11	**Where applicable, the conditions that ensure that every CPA in aggregate meets the small-scale or microscale threshold criteria and remains within those thresholds throughout the crediting period of the CPA**	
11.1	A CPA remains within the thresholds of Paragraph 2 of the "Guidelines for demonstrating additionality of microscale project activities" (Version 04) during the crediting period.	□ Yes □ No
12	**Where applicable, the requirements for the debundling check, in case CPA belong to small-scale(SSC) or microscale project categories**	
12.1	Is a CPA confirmed to a single project which is not a de-bundled component of another large-scale CPA or CDM project activity as per the latest guidance given in CDM EB?	□ Yes □ No
13	**Etc.**	
13.1	Confirmation that the crediting period of a CPA shall not exceed the end date of the PoA.	□ Yes □ No
13.2	Can a CPA be checked the monitoring parameters and requirement of the PoA?	□ Yes □ No
13.3	An agreement between a CPA implementer and CME is made by a written agreement.	□ Yes □ No

B.3. Assessment and demonstration of additionality of the small-scale CPA , as per eligibility criteria listed in the Registered PoA:

The additionality of the proposed CPA Number is demonstrated by "Guidelines for demonstrating additionality of Microscale project activities (version 4)".

Paragraph 2 of the guideline reads as follows:

Project activities up to five megawatts that employ renewable energy technology are additional if any one of the conditions below is satisfied:

(c) The project activity is designed for distributed energy generation (not connected to a national or regional grid) with both conditions satisfied;

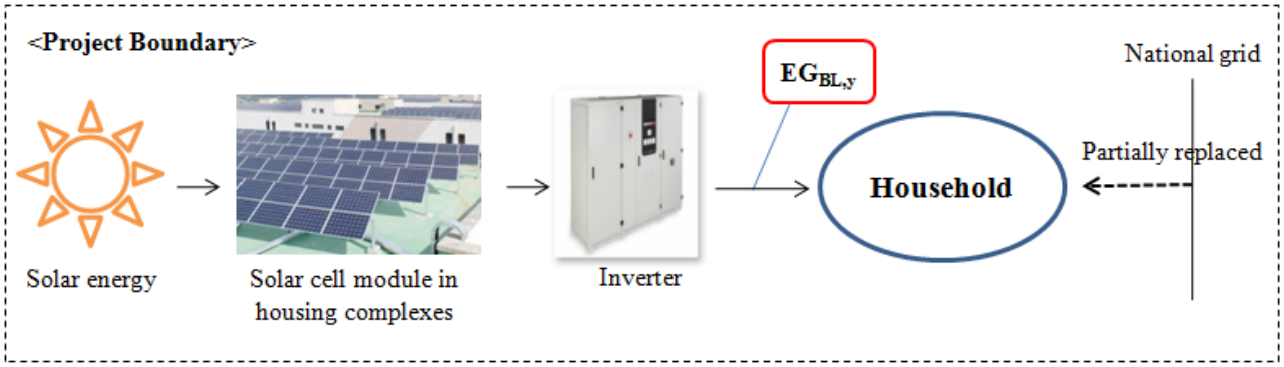
- (Each of the independent subsystems/measures in the project activity is smaller than or equal to 1500kW electrical installed capacity;
- End users of the subsystems or measures are households/communities/small and medium enterprises (SMEs).

<Justification shall be filled>

B.4. Description of the sources and gases included in the project boundary and proof that the small-scale CPA is located within the geographical boundary of the registered PoA.

The spatial extent of the project boundary includes industrial, commercial facilities consuming energy generated by the system. In the case of electricity generated and supplied to distributed users (e.g. residential users), the project boundary may be confined to physical, geographical site of solar generating units. The boundary also extends to the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

Source		Gas	Included	Justification
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Included	Major source of emissions in the baseline
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	Electricity generation from solar energy sources	CO_2	Excluded	Power generation utilizing solar energy results in zero emission
		CH_4	Excluded	Power generation utilizing solar energy results in zero emission
		N_2O	Excluded	Power generation utilizing solar energy results in zero emission



B.5. Emission reductions:

B.5.1. Data and parameters that are available at validation:

Data / Parameter:	**$EF_{CO2,y}$**
Data unit:	tCO_2/MWh
Description:	CO_2 emissions factor for the project electricity system in year y
Source of data used:	Calculated
Value applied:	0.6789 tCO_2e/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value was calculated according to "Tool to calculate the emission factor for an electricity system (version 02.2.1)." The applied value was calculated by referring Statistics of Electric Power in Korea (2009, 2010, 2011) (KEPCO) and Status of Generation facility (2011) (Korea Power Exchange).
Any comment:	- The ex-ante grid emission factor will be fixed during the crediting period of the proposed CPA<number>. - For details about the calculation method, refer to Annex 3.

Data / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2/MWh
Description:	Operating Margin CO_2 emissions factor for the project electricity system in year y
Source of data used:	Calculated
Value applied:	0.6933 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value was calculated according to "Tool to calculate the emission factor for an electricity system (version 02.2.1)." The applied value was calculated by referring Statistics of Electric Power in Korea (2009, 2010, 2011) (KEPCO) and Status of Generation facility (2011) (Korea Power Exchange).
Any comment:	- The ex-ante value will be fixed during the crediting period of the proposed CPA<number>. - For details about the calculation method, refer to Annex 3.

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	Build Margin CO_2 emissions factor for the project electricity system in year y
Source of data used:	Calculated
Value applied:	0.6357 tCO_2e/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value was calculated according to "Tool to calculate the emission factor for an electricity system (version 02.2.1)." The applied value was calculated by referring Statistics of Electric Power in Korea (2009, 2010, 2011) (KEPCO) and Status of Generation facility (2011) (Korea Power Exchange).
Any comment:	- The ex-ante value will be fixed during the crediting period of the proposed CPA<number>. - For details about the calculation method, refer to Annex 3.

Data / Parameter:	**$FC_{i,m,y}$**
Data unit:	Mass: Bituminous, LNG Volume: Heavy oil, Diesel
Description:	Amount of fossil fuel type i consumed by power plant m in year y $_i$: bituminous, heavy oil, diesel, LNG $_m$: all power units serving the grid in year y except low-cost/must-run power units. $_y$: the relevant year.
Source of data used:	2010 Statistics of Electric Power in Korea 2009 Statistics of Electric Power in Korea 2008 Statistics of Electric Power in Korea
Value applied:	See the Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	The applied value was calculated by referring Statistics of Electric Power in Korea (2009, 2010, 2011) (KEPCO)
Any comment:	- The ex-ante value will be fixed during the crediting period of the proposed CPA<number>.

Data / Parameter:	**$NCV_{i\,y}$**
Data unit:	kJ/ mass or volume unit
Description:	Net calorific value of fuel *i* : bituminous, heavy oil, diesel oil, LNG
Source of data used:	2010 Statistics of Electric Power in Korea 2009 Statistics of Electric Power in Korea 2008 Statistics of Electric Power in Korea
Value applied:	See the Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	The applied value was calculated by referring Statistics of Electric Power in Korea (2009, 2010, 2011) (KEPCO)
Any comment:	- The ex-ante value will be fixed during the crediting period of the proposed CPA<number>.

Data / Parameter:	**$EF_{co2,i,y}$**
Data unit:	tCO_2 /GJ
Description:	CO_2 emission factor of fuel *i* *i* : bituminous, heavy oil, diesel oil, LNG
Source of data used:	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	See the Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default values at the lower limit of the uncertainty at 95% confidence interval as provided in table 1.4 of Chpter1 of Vol.2(Energy)
Any comment:	- The ex-ante value will be fixed during the crediting period of the proposed CPA<number>.

Data / Parameter:	**$EG_{m,y}$**
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant/unit *m,j,k* or *n* in year *y* or hour *h*
Source of data used:	2010 Statistics of Electric Power in Korea 2009 Statistics of Electric Power in Korea 2008 Statistics of Electric Power in Korea
Value applied:	See the Annex3
Justification of the choice of data or description of measurement methods and procedures actually applied :	The applied value was calculated by referring Statistics of Electric Power in Korea (2009, 2010, 2011) (KEPCO)
Any comment:	- The ex-ante value will be fixed during the crediting period of the proposed CPA<number>.

Data / Parameter:	**C**
Data unit:	MW
Description:	Capacity of PV or BIPV system
Source of data used:	<shall be filled>
Value applied:	<shall be filled>
Justification of the choice of data or description of measurement methods and procedures actually applied :	<shall be filled>
Any comment:	- The value is just used to estimate emission reduction.

Data / Parameter:	H
Data unit:	Hr
Description:	Hours in a year
Source of data used:	Calculated(24hr * 365 days)
Value applied:	8760hr
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	- The value is just used to estimate emission reduction.

Data / Parameter:	U
Data unit:	%
Description:	Coefficient of utilization for PV and BIPV system
Source of data used:	<shall be filled>
Value applied:	<shall be filled>
Justification of the choice of data or description of measurement methods and procedures actually applied :	<shall be filled>
Any comment:	- The value is just used to estimate emission reduction.

B.5.2. Ex-ante calculation of emission reductions:

1. Determining Baseline Emission Factor

According to AMS-I.F (version 02), Emission factor of a grid shall be calculated as per the procedures provided in AMS-I.D. Thus, baseline emission factor is calculated by "Tool to calculate the emission factor for an electricity system (ver. 02.2.1) as per the procedures provided in AMS-I.D.

Baseline emission factor is calculated by combined margin (CM), which is weighted average of operating margin (OM) and build margin (BM).

Baseline emissions will be calculated using the following 6 steps.

STEP 1. Identify the relevant electric power system.

STEP 2. Choose whether to include off-grid power plants in the project electricity system.

STEP 3. Select a method to determine the operating margin (OM).

STEP 4. Calculate the operating margin emission factor according to the selected method.

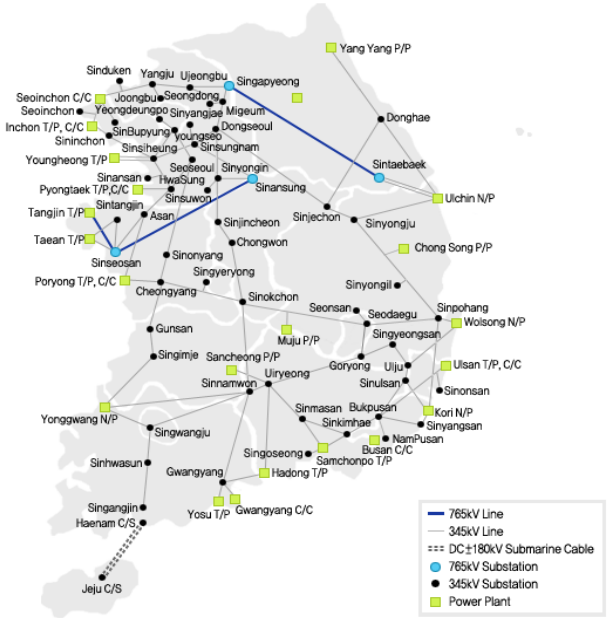
STEP 5. Calculate the build margin emission factor.

STEP 6. Calculate the combined margin (CM) emissions factor.

STEP 1. Identify the relevant electric power system

For determining the electricity emission factors, identify the relevant project electricity system. Similarly, identify any connected electricity system.

It is clear that the project electric power system is connected with the whole Korea national grid system. Because all power plants are physically connected to each other through transmission and distribution lines constituting the grid. Therefore the Korea national grid has been chosen as relevant electricity power system for purpose of determining the electricity emission factors.



<Figure B.2>. Power Grid Nationwide in Republic of Korea

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional).

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I : Only grid power plants are included in the calculation.

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

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

STEP 3. Select a method to determine the Operating Margin (OM)

The calculation of the Operating Margin emission factor ($EF_{grid,OM,y}$) is based on one of the four following methods, which are described under Step 4:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch Data Analysis OM, or

(d) Average OM.

For the simple OM, the simple adjusted OM and the average OM, the emissions factor can be calculated using either of the two following data vintages:

- *Ex ante* option: If the *ex ante* option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the five 5 most recent calendar years prior to the time of submission of the CDM-PDD for validation.
- *Ex post* option: If the *ex post* option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year *y* is usually only available later than six months after the end of year *y*, alternatively the emission factor of the previous year *y-1* may be used. If the data is usually only available 18 months after the end of year *y*, the emission factor of the year proceeding the previous year *y-2* may be used. The same data vintage (*y*, *y-1* or *y-2*) should be used

throughout all crediting periods.

Ex ante option is chosen. Thus, the emission factor is determined once at the validation stage and no monitoring and recalculation of the emissions factor during the crediting period is required.

Among the above options, the simple OM method can be used where low cost/must run resources constitute less than 50% of total grid generation average of the five most recent years.
During the 5 year period (2006 ~ 2010), the average low-cost/must run generation holds 39.43% of total KPX grid generation. (See Annex 3)[3]. Thus the Simple OM method is employed in order to calculate the OM emission factor. The Simple OM emission factor ($EF_{OM,simple,y}$) is calculated using a 3-year generation-weighted average(ex-ante) of all generating power plants serving the system, based on the most recent data available at the time of submission of the PDD.

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

According to the "Tool to calculate the emission factor for an electricity system (Version 02.2.1)", the Simple OM emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating power plants serving the system, not including low-operating cost and must-run power plants/units.

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

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

As the data on fuel consumption and net electricity generation of each power plant is available in Korea, the proposed CPA<number> can employ Option A. Where Option A is used, the simple OM emission factor is calculated as follows:

[3] As the anthracite was used as must-run resource, it was excluded from the set of plants for calculating Operating margin. And the bituminous coal was included in OM calculation.

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

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

m = All power units serving the grid in year *y* except low-cost / must-run power units

y = The relevant year as per the data vintage chosen in Step 3

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

The emission factor of each power unit m should be determined as follows:

- Option A1. : If for a power unit m data on fuel consumption and electricity generation is available.
- Option A2. : If for a power unit *m* only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit
- Option A3. : If for a power unit *m* only data on electricity generation is available, an emission factor of 0 tCO_2/MWh can be assumed as a simple and conservative approach.

As the data on fuel consumption and net electricity generation is available in Korea, the proposed CPA<number> can employ Option A1.

The emission factor of each power unit *m* should be determined as follows:

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

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power plant m in year y(mass or volume unit)

$NCV_{i,y}$ = Net calorific value of fossil fuel type i in year y(GJ / mass or volume unit)

$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power plant m in year y (MWh)

m = All power plants serving the grid in year y except low-cost / must-run power plants

i = All fossil fuel types combusted in power plant m in year y

y = The relevant year as per the data vintage chosen in Step 3

For the proposed CPA<number>, $NCV_{i,y}$ provided by official data source of Korea is used.
IPCC default value is used as CO_2 emission factor of fuel. Simple OM factor during 3 years (2008~ 2010) is 0.6933 tCO_2/MWh and this value is fixed along the credit period.
Detailed baseline information used in the calculation is presented in Annex 3.

STEP 5. Calculate the build margin emission factor

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

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

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

And here, option 1 was chosen for the proposed CPA<number>. As Option 1 is chosen to calculate BM emission factor, the emission factor won't be updated annually. Instead, it was calculated ex-ante based on the most recent information for the crediting period and will be fixed and used during the crediting period.

According to "Tool to calculate the emission factor for an electricity system (Version 02.2.1)", the sample group of power unit *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

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

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

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin.

In the project, as the annual generation of "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" was 92,307,706 MWh on 2010 and the annual generation of "the five power plants that have been built most recently" in 2010 was 1,281,700 MWh. Therefore, the former is a larger figure than the latter; $AEG_{SET\geq 20\%}$ is selected as SET_{sample}.
Additionally, none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago. Therefore, SET_{sample} is used to calculate the build margin.

The detailed data used in the calculation are presented in Annex 3.

According to the "Tool to calculate the emission factors for electricity system (Version 02.2.1)", the build margin emissions factor is the generation-weighted average emission factor (t CO_2/MWh) of all power units *m* during the most recent year y for which electricity generation data is available, calculate as follows:

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

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year y (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year y (tCO_2/MWh)

m = Power units included in the build margin

y = Most recent historical year for which electricity generation data is available

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

(For the proposed CPA<number> step 4 (a) Simple OM, option A1 was chosen)

For BM emission factor, $EF_{EL,m,y}$ was calculated by multiplying $FC_{i,m,y}$ by $NCV_{i,y}$* $EF_{CO2,i,y}$ and divide it by power generation of each plant.

And then $EF_{EL,m,y}$ was multiplied by power generation of each plant and finally it was divided by total power generation.(2006 IPCC Guidelines on National GHG Inventories Table 1.2, Table 1.4)

BM emission factor is 0.6357 tCO_2e/ MWh. And further information on the calculation for the BM emission factor is shown in Annex 3.

STEP 6. Calculate the combined emission factor

According to the tool to calculate the emission factor for electricity system (Version 02.2.1), the combined emissions factor is calculated as follows:

$EF_{grid, CM, y}$ = . $EF_{grid, OM, y}$.*W_{OM} .+$EF_{grid, BM, y}$.*W_{BM}

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (t CO_2 /MWh)

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (t CO_2 /MWh)

W_{OM} = Weighting of operating margin emissions factor (75% for PV power project)

W_{BM} = Weighting of build margin emissions factor (25% for PV power project)

$EF_{grid,CM,y}$ = 0.6933 * 0.75 + 0.6357 * 0.25 = 0.6789 (tCO_2e/MWh)

2. Baseline Emissions

According to AMS-I.F (version2) methodology, baseline emissions are the product of amount electricity displaced with the electricity produced by the renewable generating unit and an emission factor.

$BE_y = EG_{BL,y} * EF_{CO2,y}$

Where:

$BE_{,y}$ = Baseline emissions in year *y* (t CO_2)

$EG_{BL, y}$ = Quantity of net electricity displaced as a result of the implementation of the CDM project activity in year *y* (MWh)

$EF_{CO2,y}$ = Emission factor (tCO_2/MWh)

- Emission factor of a grid shall be calculated as per the procedures provided in AMS-I.D;

Ex-ante calculation for $\boldsymbol{EG_{BL,y}}$ is calculated as below:

$EG_{BL,y} = C * H * U$

Where:

C = Capacity of PV and/or BIPV system (MW)

H = Hours in a year (hr)

U = Coefficient of utilization for PV and/or BIPV system (%)

Therefore, $EG_{BL,y}$ is :

$EG_{BL,y}$(Total) =<project value>

Therefore, BEy_y is :

BE_y = <project value>

3. Project Activity Emissions

For most renewable energy project activities, $PE_y = 0$.
The proposed CPAs <number> will install <technology applied> and no use fossil fuel. Thus, project emission is 0. However, the proposed CPA<number> consumes electricity to operate the facility. It will be deducted from gross electricity generation.

4. Leakage

If the energy generating equipment is transferred from another activity, leakage is to be considered. However, CPA <number> does not use equipments transferred from another activity. Thus, leakage is not considered.

5. Emission Reductions

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y =Emission reductions in year y (tCO_2e/y)

BE_y =Baseline emissions in year y tCO_2/y)

PE_y =Project emissions in year y (tCO_2/y)

LE_y = Leakage emissions in year y (tCO_2/y)

ERy = <project value>

Therefore the ex-ante estimate of emission reductions is, on average over the first crediting period, <project value>tCO_2e/year.

B.5.3. Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tonnes of CO_2)	Estimation of baseline emissions (tonnes of CO_2)	Estimation of leakage (tonnes of CO_2)	Estimation of overall emission reductions (tonnes of CO_2 e)
Total (tonnes of CO_2 e)				

B.6. Application of the monitoring methodology and description of the monitoring plan:

B.6.1. Description of the monitoring plan:

Data / Parameter:	**$EG_{BL,y}$**
Data unit:	MWh
Description:	Quantity of net electricity displaced as a result of the implementation of the CDM project activity in year y
Source of data used:	Measured by meters.
Value applied:	<project value>
Justification of the choice of data or description of measurement methods and procedures actually applied :	-Data will be measured by measuring device. -Data will be continuously monitored and - hourly measured - recorded monthly -100% of data will be monitored and archived at least for 2years after the end of the last crediting period.
Any comment:	The Measurement will be in compliance with the National Guidelines and requirement for accuracy and reliability. The calibration will be carried out in accordance with the General guideline to SSC CDM methodologies. $EG_{BL,y}$ means a net amount of electricity supplied to user(s) excluding electricity consumed by the project and received from grid. If the auxiliary electricity consumption cannot be measured, the auxiliary electricity consumption should conservatively be calculated.(e.g. Equation : The auxiliary electricity consumption = Standby power[4] (of connector bands and inverters) * Numbers * Hours)

[4] Standby power is the electric power consumed by electronic appliances while they are switched off or in a standby mode and is based on the letter (or evidence) from manufacturers.

Monitoring will be implemented at the CPA level. For each CPA, all parameters will be monitored by CPA implementers according to the procedures and monitoring frame work under the PoA and will be submitted to E. Energy team of SH Corporation monthly.

<Description of specific monitoring plan of SSC-CPA>

C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

☒ Please tick if this information is provided at the PoA level. In this case, sections C.2. and C.3. need not be completed in this form.

Environmental analysis is provided at the PoA level. The government of Korea does not require any documentation of the environmental impacts and prior examination of environmental nature of the project activity about installation of solar photovoltaic system under 100MW.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The negative environmental impacts of small-scale solar photovoltaic electrical system are not considered significant. Because the CPA<Number> is to install small-scale solar PV and/or BIPV at housing complexes, damages to forest on sites are also not considered. The positive impacts include:

- Decreased air pollution linked to the use of fossil fuels
- Displacement of fossil fuels and GHG emission reductions
- Decrease dependency on fossil fuels.

C.3. Please state whether an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA), in accordance with the host Party laws/regulations:

As the capacity of CPA<number> is less than 100,000kW, CPA<number> is excluded from the scope of businesses subject to environmental impact assessment according to the "Environmental Impact Assessment Act". The solar energy system does not have a serious impact on the environment. Therefore the environmental impact is not considered significantly.

SECTION D. Stakeholders' comments

>>

D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

☐ Please tick if this information is provided at the PoA level. In this case, sections D.2. to D.4. need not be completed in this form.

Stakeholder comments are invited at CPA level.

<Related description will be filled>

D.2. Brief description how comments by local stakeholders have been invited and compiled:

<Related description will be filled>

D.3. Summary of the comments received:

<Related description will be filled>

D.4. Report on how due account was taken of any comments received:

<Related description will be filled>

Annex 1

CONTACT INFORMATION ON ENTITY/INDIVIDUAL RESPONSIBLE FOR THE SMALL-SCALE CPA

Organization:	
Street/P.O.Box:	
Building:	
City:	
State/Region:	
Postfix/ZIP:	
Country:	
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	
Salutation:	
Last Name:	
Middle Name:	
First Name:	
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project will not receive any public funding.

Annex 3

BASELINE INFORMATION

Simple OM calculation

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

< Generation of power plants groups (MWh, Gross)>

year	Low cost/must run					Total grid generation	Low cost/must run ratio
	Hydro	Coal (Anthracite)	Nuclear	Alternative*	Subtotal		
2006	5,219	4,312	148,749	511	158,791	365,153	43.49%
2007	5,042	4,470	142,937	829	153,278	386,367	39.67%
2008	5,563	5,010	150,958	1,092	162,623	404,813	40.17%
2009	5,641	5,559	147,771	1,791	160,762	415,170	38.72%
2010	6,472	4,613	148,596	3,984	163,665	455,096	35.96%
Average of five recent years	**5,587**	**4,793**	**147,802**	**1,641**	**159,824**	**405,319**	**39.43%**

*Alternative: Geothermal, Wind, Low-cost biomass, Solar, LFG

Source: 2010 KEPCO in Brief (2011.03)

Carbon Emission Factor

CO_2 Emission Factor of fossil fuel type i (unit: tCO_2/GJ) ($EF_{CO2,i,y}$)

Bituminous coal	0.089500
Heavy Oil	0.075500
Diesel Oil	0.072600
LNG	0.054300

*Source:: IPCC 2006

IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 of 2006 IPCC Guidance.

Simple OM for the proposed project activity

	Net Generation (EGm,y) (MWh)	**CO2emisson (tCO2/yr)**	**Operating Margin**
2008	237,888,671	163,529,778	0.6874
2009	247,072,945	175,832,796	0.7117
2010	279,038,210	190,305,764	0.6820
Sub total	763,999,826	529,668,388	
Average(2008-2010)	0.6933		

Operating Margin for 2010(continued)

Power plant (m)		Fuel (i) Type	*Net Generation ($EG_{m,y}$)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption (10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)	
Honam	#1	Coal-thermal	1,321,140	661,468	1,855	301	0	3,491,212	18,200	2,680	0	5,014	9,321	8,458	0	1,242,811	5,465	774	0	1,249,050
	#2	Coal-thermal	1,462,407	722,994	897	305	0	3,848,285	8,802	3,125	0	5,057	9,322	9,734	0	1,369,923	2,643	902	0	1,373,468
Samchonpo	#1	Coal-thermal	4,433,574	1,899,819	0	518	0	10,768,455	0	4,616	0	5,385	0	8,466	0	3,833,383	0	1,333	0	3,834,716
	#2	Coal-thermal	4,418,264	1,891,944	0	421	0	10,729,632	0	3,748	0	5,388	0	8,457	0	3,819,563	0	1,082	0	3,820,645
	#3	Coal-thermal	3,766,380	1,581,512	0	1,261	0	8,944,193	0	11,254	0	5,373	0	8,478	0	3,183,978	0	3,250	0	3,187,227
	#4	Coal-thermal	4,544,757	1,909,672	0	369	0	10,771,131	0	3,291	0	5,358	0	8,473	0	3,834,336	0	950	0	3,835,286
	#5	Coal-thermal	4,174,333	1,949,826	0	293	0	9,674,524	0	2,641	0	4,714	0	8,563	0	3,443,963	0	763	0	3,444,726
	#6	Coal-thermal	3,767,928	1,758,651	0	573	0	8,734,467	0	5,161	0	4,718	0	8,557	0	3,109,319	0	1,490	0	3,110,809
Yongheng	#1	Coal-thermal	5,558,681	2,201,446	0	2,189	0	12,587,273	0	19,325	0	5,432	0	8,387	0	4,480,851	0	5,580	0	4,486,431
	#2	Coal-thermal	5,627,774	2,264,564	0	1,531	0	12,951,441	0	13,507	0	5,433	0	8,381	0	4,610,489	0	3,900	0	4,614,389
	#3	Coal-thermal	6,887,344	2,778,041	0	739	0	15,751,410	0	6,527	0	5,386	0	8,391	0	5,607,229	0	1,885	0	5,609,114
	#4	Coal-thermal	6,943,045	2,821,533	0	663	0	15,975,433	0	5,849	0	5,379	0	8,381	0	5,686,977	0	1,689	0	5,688,666
Boryeong	#1	Coal-thermal	4,012,817	1,771,953	0	732	0	9,654,223	0	6,474	0	5,176	0	8,402	0	3,436,736	0	1,869	0	3,438,606
	#2	Coal-thermal	3,706,927	1,635,347	0	1,068	0	8,908,047	0	9,390	0	5,175	0	8,353	0	3,171,110	0	2,711	0	3,173,822
	#3	Coal-thermal	3,855,846	1,618,460	0	464	0	8,869,119	0	4,064	0	5,206	0	8,321	0	3,157,253	0	1,174	0	3,158,426
	#4	Coal-thermal	4,232,288	1,775,851	0	289	0	9,732,109	0	2,540	0	5,206	0	8,349	0	3,464,462	0	733	0	3,465,196
	#5	Coal-thermal	3,817,181	1,604,934	0	911	0	8,786,324	0	7,972	0	5,201	0	8,313	0	3,127,779	0	2,302	0	3,130,081
	#6	Coal-thermal	4,226,837	1,778,254	0	359	0	9,737,206	0	3,143	0	5,202	0	8,317	0	3,466,277	0	908	0	3,467,184
	#7	Coal-thermal	4,189,558	1,670,727	0	662	0	9,221,913	0	5,799	0	5,244	0	8,322	0	3,282,841	0	1,675	0	3,284,516
	#8	Coal-thermal	3,787,312	1,493,422	0	439	0	8,260,560	0	3,843	0	5,255	0	8,316	0	2,940,616	0	1,110	0	2,941,726
Taean	#1	Coal-thermal	3,817,336	1,512,930	0	865	0	8,692,027	0	7,674	0	5,458	0	8,428	0	3,094,211	0	2,216	0	3,096,427
	#2	Coal-thermal	4,058,392	1,626,596	0	518	0	9,291,872	0	4,596	0	5,427	0	8,429	0	3,307,745	0	1,327	0	3,309,073
	#3	Coal-thermal	3,776,949	1,506,479	0	476	0	8,614,930	0	4,227	0	5,433	0	8,436	0	3,066,766	0	1,221	0	3,067,986
	#4	Coal-thermal	4,165,579	1,656,710	0	296	0	9,514,987	0	2,624	0	5,456	0	8,422	0	3,387,170	0	758	0	3,387,928
	#5	Coal-thermal	3,657,234	1,450,465	0	680	0	8,384,441	0	6,039	0	5,491	0	8,437	0	2,984,716	0	1,744	0	2,986,460
	#6	Coal-thermal	3,339,271	1,319,263	0	1,094	0	7,618,266	0	9,705	0	5,486	0	8,428	0	2,711,971	0	2,802	0	2,714,773
	#7	Coal-thermal	3,940,580	1,521,262	0	879	0	8,758,319	0	7,800	0	5,469	0	8,430	0	3,117,810	0	2,252	0	3,120,062
	#8	Coal-thermal	4,335,230	1,674,579	0	240	0	9,617,658	0	2,130	0	5,456	0	8,431	0	3,423,720	0	615	0	3,424,335
Hadong	#1	Coal-thermal	3,948,643	1,651,998	0	386	0	9,151,952	0	3,072	0	5,263	0	7,561	0	3,257,936	0	887	0	3,258,823
	#2	Coal-thermal	4,181,012	1,758,216	0	133	0	9,738,153	0	1,179	0	5,262	0	8,421	0	3,466,614	0	340	0	3,466,954
	#3	Coal-thermal	4,229,016	1,760,793	0	94	0	9,755,957	0	858	0	5,264	0	8,671	0	3,472,952	0	248	0	3,473,199
	#4	Coal-thermal	3,877,595	1,623,350	0	610	0	8,987,558	0	5,404	0	5,260	0	8,416	0	3,199,415	0	1,560	0	3,200,975
	#5	Coal-thermal	4,210,179	1,762,407	0	369	0	9,756,069	0	3,357	0	5,259	0	8,643	0	3,472,991	0	969	0	3,473,961
	#6	Coal-thermal	3,972,047	1,642,064	0	367	0	9,096,744	0	3,254	0	5,263	0	8,423	0	3,238,283	0	940	0	3,239,223
	#7	Coal-thermal	3,497,189	1,314,119	0	674	0	7,647,412	0	6,012	0	5,528	0	8,474	0	2,722,346	0	1,736	0	2,724,082
	#8	Coal-thermal	4,221,464	1,586,695	0	34	0	9,228,319	0	307	0	5,525	0	8,578	0	3,285,122	0	89	0	3,285,210

*, **, ***: 2010Statistics of Electric Power in Korea, KEPCO, 2011.5.

Operating Margin for 2010(continued)

Power plant (m)		Fuel (i) Type	*Net Generation ($EG_{m,y}$)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption (10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)	
Dangjin	#1	Coal-thermal	4,240,235	1,802,866	0	89	0	9,755,269	0	777	0	5,140	0	8,294	0	3,472,707	0	224	0	3,472,931
	#2	Coal-thermal	4,271,208	1,812,592	0	168	0	9,793,117	0	1,507	0	5,133	0	8,522	0	3,486,180	0	435	0	3,486,615
	#3	Coal-thermal	3,924,887	1,660,911	0	430	0	8,985,559	0	3,862	0	5,140	0	8,532	0	3,198,703	0	1,115	0	3,199,818
	#4	Coal-thermal	3,757,184	1,593,667	0	974	0	8,613,065	0	8,683	0	5,134	0	8,469	0	3,066,102	0	2,507	0	3,068,609
	#5	Coal-thermal	4,133,329	1,676,374	0	332	0	9,172,326	0	2,982	0	5,198	0	8,533	0	3,265,189	0	861	0	3,266,050
	#6	Coal-thermal	4,242,960	1,722,658	0	157	0	9,419,756	0	1,408	0	5,195	0	8,520	0	3,353,270	0	407	0	3,353,676
	#7	Coal-thermal	3,870,155	1,572,939	0	347	0	8,621,062	0	3,117	0	5,207	0	8,534	0	3,068,949	0	900	0	3,069,849
	#8	Coal-thermal	4,272,886	1,729,056	0	90	0	9,447,782	0	805	0	5,191	0	8,497	0	3,363,247	0	232	0	3,363,479
Ulsan	#1	Heavy oil-therm	220,710	0	59,593	278	0	0	590,930	2,449	0	0	9,420	8,369	0	0	177,455	707	0	178,162
	#2	Heavy oil-therm	185,534	0	50,627	249	0	0	502,173	2,197	0	0	9,423	8,382	0	0	150,802	634	0	151,436
	#3	Heavy oil-therm	261,312	0	70,519	286	0	0	694,236	2,517	0	0	9,352	8,361	0	0	208,478	727	0	209,205
	#4	Heavy oil-therm	927,792	0	229,069	4,116	0	0	2,293,236	36,179	0	0	9,511	8,350	0	0	688,655	10,447	0	699,102
	#5	Heavy oil-therm	823,717	0	204,124	4,395	0	0	2,046,788	38,631	0	0	9,526	8,350	0	0	614,647	11,155	0	625,802
	#6	Heavy oil-therm	887,331	0	217,795	3,058	0	0	2,179,304	26,877	0	0	9,506	8,350	0	0	654,441	7,761	0	662,202
Youngnam	#1	Heavy oil-therm	354,224	0	91,050	1,170	0	0	930,156	10,820	0	0	9,705	8,785	0	0	279,324	3,124	0	282,449
	#2	Heavy oil-therm	304,146	0	80,387	786	0	0	820,950	7,195	0	0	9,702	8,696	0	0	246,530	2,078	0	248,607
Yosu	#1	Heavy oil-therm	481,530	0	118,289	370	0	0	1,187,687	3,252	0	0	9,539	8,350	0	0	356,660	939	0	357,599
	#2	Heavy oil-therm	956,556	0	236,662	278	0	0	2,377,287	2,442	0	0	9,543	8,345	0	0	713,895	705	0	714,600
Pyongtaek	#1	Heavy oil-therm	794,103	0	188,829	121	3,409	0	1,875,419	1,088	44,291	0	9,435	8,542	11,693	0	563,185	314	9,062	572,562
	#2	Heavy oil-therm	742,439	0	172,352	102	6,484	0	1,710,891	911	84,224	0	9,430	8,485	11,691	0	513,778	263	17,233	531,274
	#3	Heavy oil-therm	830,437	0	194,662	115	4,814	0	1,934,896	1,031	62,594	0	9,443	8,517	11,702	0	581,046	298	12,807	594,151
	#4	Heavy oil-therm	669,443	0	158,042	91	3,646	0	1,570,954	818	47,199	0	9,443	8,540	11,651	0	471,755	236	9,657	481,648
Namjeju	#1	Heavy oil-therm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	#2	Heavy oil-therm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	#3	Heavy oil-therm	594,537	0	151,950	105	0	0	1,505,154	940	0	0	9,410	8,505	0	0	451,995	271	0	452,267
	#4	Heavy oil-therm	580,342	0	146,544	134	0	0	1,451,580	1,195	0	0	9,410	8,472	0	0	435,907	345	0	436,252
Jeju	#1	Heavy oil-therm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	#2	Heavy oil-therm	298,469	0	76706	78	0	0	757,327	693	0	0	9,379	8,440	0	0	227,424	200	0	227,624
	#3	Heavy oil-therm	344,920	0	89373	82	0	0	882,369	733	0	0	9,379	8,492	0	0	264,974	212	0	265,186
Seoul	#4	Gas-thermal	356,493	0	0	0	77,219	0	0	0	1,007,818	0	0	0	11,746	0	0	0	206,209	206,209
	#5	Gas-thermal	815,062	0	0	1	169,145	0	0	7	2,207,592	0	0	6,650	11,746	0	0	2	451,693	451,695

*, **, ***: 2010Statistics of Electric Power in Korea, KEPCO, 2011.5.

Operating Margin for 2010

Power plant (m)		Fuel (i) Type	*Net Generation ($EG_{m,y}$)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption (10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)	
Incheon	#1	Gas-thermal	477,252	0	0	0	95,108	0	0	0	1,241,344	0	0	0	11,747	0	0	0	253,990	253,990
	#2	Gas-thermal	544,351	0	0	0	105,649	0	0	0	1,379,128	0	0	0	11,748	0	0	0	282,182	282,182
	#3	Gas-thermal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Namjeju D/P		Internal combusti	91,340	0	20,334	369	0	0	200,885	3,299	0	0	9,385	8,493	0	0	60,325	953	0	61,278
Jeju G/T		Internal combusti	1,115	0	0	697	0	0	0	6,273	0	0	0	8,550	0	0	0	1,811	0	1,811
Jeju D/P		Internal combusti	405,634	0	85,093	0	0	0	839,393	0	0	0	9,371	0	0	0	252,068	0	0	252,068
Pyongtaek C/C		Combined cycl	1,472,808	0	0	0	237,805	0	0	0	3,088,971	0	0	0	11,691	0	0	0	632,031	632,031
Ilsan C/C		Combined cycl	4,306,850	0	0	0	755,305	0	0	0	9,856,823	0	0	0	11,745	0	0	0	2,016,794	2,016,794
Bundang C/C		Combined cycl	4,311,466	0	0	0	725,097	0	0	0	9,464,132	0	0	0	11,747	0	0	0	1,936,446	1,936,446
Ulsan C/C		Combined cycl	5,709,782	0	0	0	846,672	0	0	0	10,889,910	0	0	0	11,576	0	0	0	2,228,173	2,228,173
Seoincheon C/C		Combined cycl	11,756,041	0	0	76	1,633,316	0	0	700	21,315,161	0	0	8,750	11,745	0	0	202	4,361,272	4,361,474
Shinincheon C/C		Combined cycl	9,595,856	0	0	0	1,349,902	0	0	0	17,618,873	0	0	0	11,747	0	0	0	3,604,979	3,604,979
Boryeong C/C		Combined cycl	7,053,566	0	0	0	1,016,783	0	0	0	13,271,568	0	0	0	11,747	0	0	0	2,715,481	2,715,481
Incheon C/C		Combined cycl	7,789,931	0	0	0	1,035,486	0	0	0	13,513,313	0	0	0	11,745	0	0	0	2,764,944	2,764,944
Busan C/C		Combined cycl	12,489,596	0	0	12	1,666,675	0	0	54	21,755,416	0	0	4,275	11,748	0	0	16	4,451,352	4,451,368
Hallim C/C		Combined cycl	45,450	0	0	12,737	0	0	0	114,447	0	0	0	8,536	0	0	0	33,048	0	33,048
GS Anyang C/C		Combined cycl	1,824,654	0	0	0	308,918	0	0	0	4,272,462	0	0	0	12,447	0	0	0	874,184	874,184
GS Bucheon C/C		Combined cycl	1,806,919	0	0	263	303,789	0	0	0	4,206,893	0	0	0	12,463	0	0	0	860,768	860,768
POSCO Power		Combined cycl	4,297,788	0	0	0	809,100	0	0	0	10,258,780	0	0	0	11,411	0	0	0	2,099,038	2,099,038
GS EPS Bugog #1		Combined cycl	3,026,986	0	0	0	428,568	0	0	0	5,363,434	0	0	0	11,263	0	0	0	1,097,406	1,097,406
GS EPS Bugog #2		Combined cycl	3,026,986	0	0	0	378,514	0	0	0	5,178,813	0	0	0	12,314	0	0	0	1,059,631	1,059,631
Gunsan C/C		Combined cycl	2,937,873	0	0	0	398,151	0	0	0	5,196,105	0	0	0	11,746	0	0	0	1,063,169	1,063,169
Yeongwol C/C		Combined cycl	1,281,206	0	0	263	182,365	0	0	2,353	2,380,779	0	0	8,499	11,750	0	0	679	487,129	487,808
Yulchon C/C		Combined cycl	2,680,710	0	0	0	372,560	0	0	0	4,863,307	0	0	0	11,748	0	0	0	995,076	995,076
		$\Sigma_m EG_{m,y}$=	**279,038,210**																$\sum_{i,m} FC_{i,m,y} \cdot CV_{i,y} \cdot EF_{CO2,i,y}$=	**190,305,764**

*, **, ***: 2010Statistics of Electric Power in Korea, KEPCO, 2011.5.

$EF_{grid,OMsimple,y}=\Sigma_{i,m}FC_{i,m,y}*CV_{i,y}*EF_{CO2,i,y} / \Sigma_m EG_{m,y}=$ **0.6820**

Operating Margin for 2009(continued)

Power plant (m)		Fuel (i) Type	*Net Generation ($EG_{m,y}$)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption (10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)	
Honam	#1	Coal-thermal	1,843,823	923,895	471	167	0	4,874,229	4,622	1,496	0	5,012	9,323	8,510	0	1,735,141	1,388	432	0	1,736,961
	#2	Coal-thermal	1,696,597	853,508	818	201	0	4,476,187	8,020	1,800	0	4,982	9,314	8,507	0	1,593,445	2,408	520	0	1,596,373
Samchonpo	#1	Coal-thermal	3,881,067	1,611,736	0	299	0	9,470,960	0	2,674	0	5,582	0	8,496	0	3,371,498	0	772	0	3,372,270
	#2	Coal-thermal	3,869,863	1,596,153	0	447	0	9,313,471	0	3,974	0	5,543	0	8,446	0	3,315,434	0	1,148	0	3,316,582
	#3	Coal-thermal	4,494,850	1,818,061	0	110	0	10,611,118	0	983	0	5,545	0	8,490	0	3,777,374	0	284	0	3,777,658
	#4	Coal-thermal	3,873,780	1,552,530	0	486	0	9,082,296	0	4,289	0	5,557	0	8,384	0	3,233,140	0	1,239	0	3,234,378
	#5	Coal-thermal	4,225,306	1,909,143	0	151	0	9,747,607	0	1,357	0	4,850	0	8,537	0	3,469,979	0	392	0	3,470,371
	#6	Coal-thermal	3,902,690	1,765,537	0	576	0	9,020,441	0	5,188	0	4,854	0	8,557	0	3,211,121	0	1,498	0	3,212,619
Yeongheung	#1	Coal-thermal	6,121,660	2,316,758	0	1,996	0	13,855,162	0	17,745	0	5,681	0	8,446	0	4,932,198	0	5,124	0	4,937,322
	#2	Coal-thermal	6,309,794	2,437,083	0	1,632	0	14,505,767	0	14,117	0	5,654	0	8,218	0	5,163,802	0	4,076	0	5,167,878
	#3	Coal-thermal	6,711,338	2,533,024	0	966	0	15,043,737	0	8,612	0	5,642	0	8,469	0	5,355,310	0	2,487	0	5,357,796
	#4	Coal-thermal	7,183,514	2,740,096	0	117	0	16,286,850	0	833	0	5,647	0	6,764	0	5,797,836	0	241	0	5,798,077
Boryeong	#1	Coal-thermal	2,076,329	896,958	0	1,982	0	4,965,573	0	17,726	0	5,259	0	8,496	0	1,767,658	0	5,119	0	1,772,777
	#2	Coal-thermal	3,148,655	1,361,908	0	5,689	0	7,586,023	0	50,212	0	5,292	0	8,385	0	2,700,493	0	14,499	0	2,714,992
	#3	Coal-thermal	4,153,516	1,686,579	0	180	0	9,521,590	0	1,606	0	5,363	0	8,476	0	3,389,521	0	464	0	3,389,985
	#4	Coal-thermal	3,823,603	1,554,579	0	672	0	8,734,064	0	6,049	0	5,337	0	8,551	0	3,109,175	0	1,747	0	3,110,922
	#5	Coal-thermal	4,136,937	1,681,591	0	516	0	9,477,969	0	4,576	0	5,354	0	8,425	0	3,373,993	0	1,321	0	3,375,314
	#6	Coal-thermal	3,802,516	1,538,187	0	935	0	8,707,900	0	8,231	0	5,378	0	8,363	0	3,099,861	0	2,377	0	3,102,238
	#7	Coal-thermal	3,720,811	1,438,768	0	568	0	8,163,761	0	4,974	0	5,390	0	8,319	0	2,906,157	0	1,436	0	2,907,594
	#8	Coal-thermal	4,417,673	1,701,650	0	341	0	9,643,209	0	3,109	0	5,384	0	8,661	0	3,432,815	0	898	0	3,433,713
Taean	#1	Coal-thermal	4,087,057	1,561,372	0	348	0	9,280,102	0	3,077	0	5,646	0	8,400	0	3,303,555	0	889	0	3,304,444
	#2	Coal-thermal	3,858,541	1,483,233	0	22	0	8,822,160	0	191	0	5,651	0	8,248	0	3,140,536	0	55	0	3,140,591
	#3	Coal-thermal	4,041,441	1,550,278	0	209	0	9,220,322	0	1,832	0	5,650	0	8,327	0	3,282,275	0	529	0	3,282,804
	#4	Coal-thermal	3,843,816	1,471,251	0	410	0	8,736,374	0	3,604	0	5,641	0	8,351	0	3,109,998	0	1,041	0	3,111,038
	#5	Coal-thermal	3,689,068	1,409,802	0	978	0	8,417,006	0	8,616	0	5,672	0	8,369	0	2,996,308	0	2,488	0	2,998,796
	#6	Coal-thermal	4,064,658	1,548,690	0	285	0	9,272,248	0	2,518	0	5,688	0	8,393	0	3,300,760	0	727	0	3,301,487
	#7	Coal-thermal	4,232,409	1,576,347	0	394	0	9,414,450	0	3,499	0	5,674	0	8,437	0	3,351,381	0	1,010	0	3,352,391
	#8	Coal-thermal	3,730,433	1,382,469	0	1,397	0	8,259,637	0	12,330	0	5,676	0	8,385	0	2,940,288	0	3,560	0	2,943,848
Hadong	#1	Coal-thermal	4,064,233	1,647,434	0	341	0	9,484,607	0	3,021	0	5,469	0	8,416	0	3,376,356	0	872	0	3,377,228
	#2	Coal-thermal	3,799,030	1,551,648	0	648	0	8,866,100	0	5,768	0	5,428	0	8,456	0	3,156,178	0	1,666	0	3,157,844
	#3	Coal-thermal	3,862,769	1,554,931	0	473	0	8,940,527	0	4,203	0	5,462	0	8,442	0	3,182,673	0	1,214	0	3,183,886
	#4	Coal-thermal	4,049,790	1,634,941	0	226	0	9,404,544	0	2,008	0	5,465	0	8,441	0	3,347,855	0	580	0	3,348,435
	#5	Coal-thermal	3,848,711	1,543,027	0	547	0	8,880,220	0	4,856	0	5,467	0	8,434	0	3,161,204	0	1,402	0	3,162,607
	#6	Coal-thermal	4,085,588	1,637,877	0	286	0	9,422,188	0	2,531	0	5,465	0	8,407	0	3,354,136	0	731	0	3,354,867
	#7	Coal-thermal	4,068,510	1,500,309	0	72	0	8,865,413	0	644	0	5,614	0	8,497	0	3,155,933	0	186	0	3,156,119
	#8	Coal-thermal	3,153,402	1,169,132	0	692	0	6,922,269	0	5,575	0	5,625	0	7,654	0	2,464,208	0	1,610	0	2,465,818

*, **, ***: 2009Statistics of Electric Power in Korea, KEPCO, 2010.5.

Operating Margin for 2009(continued)

Power plant (m)		Fuel (i) Type	*Net Generation ($EG_{m,y}$)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption (10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)	
Dangjin	#1	Coal-thermal	4,025,605	1,601,422	0	677	0	9,145,775	0	6,130	0	5,425	0	8,602	0	3,255,737	0	1,770	0	3,257,508
	#2	Coal-thermal	3,964,389	1,572,097	0	291	0	8,973,906	0	2,618	0	5,423	0	8,547	0	3,194,555	0	756	0	3,195,311
	#3	Coal-thermal	4,232,358	1,669,969	0	155	0	9,546,744	0	1,399	0	5,431	0	8,575	0	3,398,475	0	404	0	3,398,879
	#4	Coal-thermal	4,195,301	1,658,923	0	110	0	9,486,178	0	994	0	5,432	0	8,585	0	3,376,915	0	287	0	3,377,202
	#5	Coal-thermal	3,400,082	1,324,949	0	582	0	7,594,529	0	5,240	0	5,445	0	8,553	0	2,703,521	0	1,513	0	2,705,034
	#6	Coal-thermal	3,471,850	1,330,803	0	517	0	7,659,364	0	4,642	0	5,468	0	8,530	0	2,726,601	0	1,340	0	2,727,941
	#7	Coal-thermal	4,172,321	1,609,342	0	133	0	9,279,492	0	1,199	0	5,478	0	8,564	0	3,303,338	0	346	0	3,303,685
	#8	Coal-thermal	3,531,321	1,334,679	0	625	0	7,745,212	0	5,625	0	5,513	0	8,550	0	2,757,161	0	1,624	0	2,758,786
Yeongnam	#1	Heavy oil-therma	437,034	0	108,767	764	0	0	1,108,426	6,962	0	0	9,681	8,657	0	0	332,858	2,010	0	334,869
	#2	Heavy oil-therma	415,404	0	104,675	647	0	0	1,067,038	5,931	0	0	9,684	8,709	0	0	320,430	1,713	0	322,142
Yeosu	#1	Heavy oil-therma	466,519	0	113,633	187	0	0	1,126,663	1,645	0	0	9,419	8,357	0	0	338,335	475	0	338,810
	#2	Heavy oil-therma	805,262	0	193,394	203	0	0	1,919,142	1,665	0	0	9,427	7,792	0	0	576,315	481	0	576,796
Pyeongtaek	#1	Heavy oil-therma	251,576	0	56,671	354	2922	0	564,068	4,354	37,162	0	9,456	11,684	11,446	0	169,389	1,257	7,604	178,250
	#2	Heavy oil-therma	1,211,425	0	280,922	696	4203	0	2,776,916	8,718	53,611	0	9,391	11,900	11,480	0	833,903	2,517	10,969	847,390
	#3	Heavy oil-therma	1,225,561	0	282,894	581	4046	0	2,792,640	7,091	52,138	0	9,378	11,595	11,598	0	838,625	2,048	10,668	851,340
	#4	Heavy oil-therma	834,285	0	192,380	545	3838	0	1,903,402	6,092	49,541	0	9,399	10,619	11,617	0	571,588	1,759	10,137	583,484
Namjeju	#1	Heavy oil-therma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	#2	Heavy oil-therma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	#3	Heavy oil-therma	550,851	0	140,564	143	0	0	1,388,934	1,281	0	0	9,387	8,510	0	0	417,094	370	0	417,464
	#4	Heavy oil-therma	603,417	0	153,841	89	0	0	1,519,731	799	0	0	9,385	8,529	0	0	456,373	231	0	456,603
Ulsan	#1	Heavy oil-therma	116,425	0	30,963	35	0	0	306,856	323	0	0	9,415	8,767	0	0	92,148	93	0	92,242
	#2	Heavy oil-therma	104,292	0	27,250	41	0	0	270,082	375	0	0	9,416	8,689	0	0	81,105	108	0	81,213
	#3	Heavy oil-therma	*26,061*	0	7139	35	0	0	70,629	318	0	0	9,399	8,631	0	0	21,210	92	0	21,302
	#4	Heavy oil-therma	*1,058,708*	0	253330	2,938	0	0	2,529,556	26,341	0	0	9,486	8,517	0	0	759,621	7,606	0	767,228
	#5	Heavy oil-therma	1,318,789	0	313,474	2,805	0	0	3,130,855	25,448	0	0	9,488	8,619	0	0	940,190	7,348	0	947,539
	#6	Heavy oil-therma	1,215,616	0	288,842	2,460	0	0	2,885,571	22,272	0	0	9,491	8,601	0	0	866,532	6,431	0	872,963
Jeju	#1	Heavy oil-therma	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	#2	Heavy oil-therma	324,784	0	82,010	103	0	0	807,998	921	0	0	9,360	8,495	0	0	242,640	266	0	242,906
	#3	Heavy oil-therma	356,297	0	91,221	72	0	0	897,589	647	0	0	9,348	8,537	0	0	269,544	187	0	269,731
Seoul	#4	Gas-thermal	157,606	0	0	0	36,893	0	0	1	481,444	0	0	0	11,745	0	0	0	98,508	98,508
	#5	Gas-thermal	412,265	0	0	0	91,258	0	0	4	1,190,441	0	0	0	11,740	0	0	0	243,575	243,575

*, **, ***: 2009Statistics of Electric Power in Korea, KEPCO, 2010.5.

Operating Margin for 2009

Power plant (m)	Fuel (i) Type	*Net Generation ($EG_{m,y}$)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption (10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)
			Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)	
Incheon #1	Gas-thermal	72,854	0	0	0	15,168	0	0	0	197,826	0	0	0	11,738	0	0	0	40,477	40,477
#2	Gas-thermal	76,672	0	0	0	15,317	0	0	0	199,785	0	0	0	11,739	0	0	0	40,878	40,878
#3	Gas-thermal	11,865	0	0	47	2,411	0	0	423	31,486	0	0	8,550	11,753	0	0	122	6,442	6,564
#4	Gas-thermal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Namjeju D/P	Internal combusti	136,189	0	29,527	275	0	0	292,384	2,460	0	0	9,407	8,498	0	0	87,802	710	0	88,513
Jeju G/T	Internal combusti	842	0	0	626	0	0	241,244	5,603	0	0	0	8,503	0	0	0	1,618	0	1,618
Jeju D/P	Internal combusti	345,163	0	72,724	0	0	0	465,558	0	0	0	6,082	0	0	0	139,806	0	0	139,806
Pyeongtaek C/C	Combined cycle	483,959	0	0	0	80,050	0	0	0	1,044,172	0	0	0	11,740	0	0	0	213,647	213,647
Ilsan C/C	Combined cycle	3,270,241	0	0	0	595,190	0	0	0	7,761,613	0	0	0	11,737	0	0	0	1,588,095	1,588,095
Bundang C/C	Combined cycle	3,108,338	0	0	13,142	541,739	0	0	0	6,946,110	0	0	0	11,540	0	0	33,755	1,421,236	1,454,991
Ulsan C/C	Combined cycle	3,299,104	0	0	0	489,946	0	0	0	6,291,965	0	0	0	11,558	0	0	0	1,287,392	1,287,392
Seoincheon C/C	Combined cycle	7,503,395	0	0	0	1,061,332	0	0	0	13,844,165	0	0	0	11,740	0	0	0	2,832,640	2,832,640
Shinincheon C/C	Combined cycle	9,901,080	0	0	0	1,394,939	0	0	0	18,194,688	0	0	0	11,739	0	0	0	3,722,795	3,722,795
Boryeong C/C	Combined cycle	3,655,848	0	0	86	543,342	0	0	0	7,079,157	0	0	0	11,726	0	0	221	1,448,459	1,448,680
Incheon C/C	Combined cycle	6,075,599	0	0	0	806,154	0	0		10,555,663	0	0	0	11,784	0	0	0	2,159,783	2,159,783
Busan C/C	Combined cycle	9,268,113	0	0	0	1,247,488	0	0	0	16,282,354	0	0	0	11,747	0	0	0	3,331,515	3,331,515
Hallim C/C	Combined cycle	47,256	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GS Anyang C/C	Combined cycle	1,301,286	0	0	0	202,108	0	0	0	3,162,717	0	0	0	14,084	0	0	0	647,120	647,120
GS Bucheon C/C	Combined cycle	1,556,502	0	0	0	230,085	0	0	0	3,638,371	0	0	0	14,232	0	0	0	744,443	744,443
POSCO Power	Combined cycle	1,859,273	0	0	0	342,724	0	0	0	4,470,090	0	0	0	11,739	0	0	0	914,620	914,620
GS EPS Bugog #1	Combined cycle	2,172,135	0	0	0	343,063	0	0	0	4,968,103	0	0	0	13,033	0	0	0	1,016,518	1,016,518
GS EPS Bugog #2	Combined cycle	2,172,135				260,169	0	0	0	3,431,600	0	0	0	11,871	0	0	0	702,136	702,136
Yulchon C/C	Combined cycle	1,995,914	0	0	0	282,344	0	0	0	3,684,310	0	0	0	11,744	0	0	0	753,843	753,843
	$\Sigma_m EG_{m,y}$= 247,072,945																**$\Sigma_{i,m} FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ = 175,832,796**		

*, **, ***: 2009Statistics of Electric Power in Korea, KEPCO, 2010.

CO_2 Emission Factor of fossil fuel type i (unit: tCO_2/GJ) ($EF_{CO2,i,y}$) 2172135.5

$EF_{grid,OMsimple,y}=\Sigma_{i,m}FC_{i,m,y}*CV_{i,y}*EF_{CO2,i,y} / \Sigma_m EG_{m,y}$= 0.7117

Operating Margin for 2008(continued)

Power plant (m)		Fuel (i) Type	*Net Generation ($EG_{m,y}$) (MWh)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption (10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)	
Honam	#1	Coal-thermal	1,614,014	793,048	808	177	0	4,248,578	7,918	1,577	0	5,089	9,310	8,464	0	1,512,420	2,378	455	0	1,515,253
	#2	Coal-thermal	1,816,464	887,772	1,225	167	0	4,770,388	12,004	1,489	0	5,105	9,309	8,470	0	1,698,175	3,605	430	0	1,702,210
Samchonpo	#1	Coal-thermal	4,230,470	1,759,936	0	137	0	10,233,477	0	661	0	5,524	0	4,584	0	3,642,940	0	191	0	3,643,131
	#2	Coal-thermal	3,931,527	1,628,693	0	1,065	0	9,439,903	0	9,383	0	5,506	0	8,370	0	3,360,442	0	2,709	0	3,363,151
	#3	Coal-thermal	4,024,666	1,635,809	0	614	0	9,479,978	0	5,395	0	5,506	0	8,347	0	3,374,708	0	1,558	0	3,376,266
	#4	Coal-thermal	4,118,892	1,662,981	0	726	0	9,669,501	0	6,383	0	5,524	0	8,352	0	3,442,175	0	1,843	0	3,444,018
	#5	Coal-thermal	3,779,114	1,718,759	0	874	0	8,754,713	0	7,864	0	4,839	0	8,548	0	3,116,526	0	2,271	0	3,118,797
	#6	Coal-thermal	4,071,070	1,844,647	0	448	0	9,389,450	0	4,033	0	4,836	0	8,552	0	3,342,481	0	1,165	0	3,343,646
Yeongheung	#1	Coal-thermal	5,137,490	1,894,596	0	5,594	0	11,709,558	0	48,556	0	5,871	0	8,246	0	4,168,400	0	14,021	0	4,182,421
	#2	Coal-thermal	5,112,704	1,881,013	0	3,033	0	11,622,058	0	26,963	0	5,870	0	8,445	0	4,137,251	0	7,786	0	4,145,037
	#3	Coal-thermal	4,535,951	1,694,625	0	2,173	0	10,286,804	0	21,874	0	5,767	0	9,563	0	3,661,924	0	6,316	0	3,668,240
	#4	Coal-thermal	3,193,481	1,217,547	0	769	0	7,396,690	0	6,811	0	5,771	0	8,414	0	2,633,093	0	1,967	0	2,635,060
Boryeong	#1	Coal-thermal	4,017,302	1,697,622	0	566	0	9,653,929	0	5,060	0	5,402	0	8,493	0	3,436,631	0	1,461	0	3,438,093
	#2	Coal-thermal	3,247,137	1,328,646	0	196	0	7,611,359	0	1,753	0	5,442	0	8,497	0	2,709,512	0	506	0	2,710,018
	#3	Coal-thermal	3,733,602	1,528,112	0	223	0	8,649,383	0	2,666	0	5,377	0	11,357	0	3,079,030	0	770	0	3,079,800
	#4	Coal-thermal	4,162,971	1,694,212	0	339	0	9,606,801	0	3,052	0	5,387	0	8,553	0	3,419,855	0	881	0	3,420,736
	#5	Coal-thermal	3,677,963	1,503,611	0	642	0	8,515,176	0	6,224	0	5,380	0	9,210	0	3,031,255	0	1,797	0	3,033,052
	#6	Coal-thermal	4,170,094	1,704,157	0	301	0	9,661,509	0	2,746	0	5,386	0	8,667	0	3,439,330	0	793	0	3,440,123
	#7	Coal-thermal	2,878,738	1,102,498	0	2,696	0	6,326,499	0	23,097	0	5,451	0	8,139	0	2,252,124	0	6,670	0	2,258,794
	#8	Coal-thermal	748,005	227,312	0	1,060	0	1,292,365	0	5,383	0	5,401	0	4,824	0	460,060	0	1,554	0	461,614
Taean	#1	Coal-thermal	3,894,659	1,493,418	0	589	0	8,860,505	0	5,188	0	5,636	0	8,368	0	3,154,186	0	1,498	0	3,155,684
	#2	Coal-thermal	4,093,884	1,570,393	0	146	0	9,320,865	0	1,294	0	5,639	0	8,420	0	3,318,066	0	374	0	3,318,440
	#3	Coal-thermal	3,763,910	1,442,632	0	551	0	8,551,775	0	4,870	0	5,632	0	8,397	0	3,044,284	0	1,406	0	3,045,690
	#4	Coal-thermal	4,119,808	1,582,461	0	122	0	9,391,296	0	1,056	0	5,638	0	8,223	0	3,343,139	0	305	0	3,343,444
	#5	Coal-thermal	4,089,287	1,566,721	0	363	0	9,333,755	0	3,144	0	5,660	0	8,228	0	3,322,655	0	908	0	3,323,563
	#6	Coal-thermal	3,711,227	1,419,495	0	626	0	8,460,054	0	5,494	0	5,662	0	8,338	0	3,011,633	0	1,586	0	3,013,219
	#7	Coal-thermal	3,482,731	1,285,747	0	1,224	0	7,714,591	0	10,763	0	5,700	0	8,354	0	2,746,261	0	3,108	0	2,749,369
	#8	Coal-thermal	4,186,293	1,553,992	0	635	0	9,267,809	0	5,612	0	5,666	0	8,396	0	3,299,179	0	1,621	0	3,300,800
Hadong	#1	Coal-thermal	3,827,102	1,478,000	0	355	0	8,680,226	0	3,131	0	5,579	0	8,379	0	3,090,010	0	904	0	3,090,914
	#2	Coal-thermal	4,012,667	1,551,832	0	311	0	9,096,751	0	2,731	0	5,569	0	8,342	0	3,238,286	0	789	0	3,239,074
	#3	Coal-thermal	4,074,310	1,573,892	0	474	0	9,236,752	0	4,231	0	5,575	0	8,480	0	3,288,124	0	1,222	0	3,289,345
	#4	Coal-thermal	3,804,790	1,469,828	0	495	0	8,620,218	0	4,409	0	5,572	0	8,462	0	3,068,648	0	1,273	0	3,069,921
	#5	Coal-thermal	4,114,218	1,592,246	0	256	0	9,340,613	0	2,288	0	5,573	0	8,491	0	3,325,096	0	661	0	3,325,757
	#6	Coal-thermal	3,953,083	1,525,471		521	0	8,948,019	0	4,614	0	5,572	0	8,413	0	3,185,340	0	1,332	0	3,186,672
	#7	Coal-thermal	870,781	310,138	0	2,900	0	1,892,701	0	23,033	0	5,798	0	7,545	0	673,769	0	6,651	0	680,420

*, **, ***: 2008Statistics of Electric Power in Korea, KEPCO, 2009.5.

Operating Margin for 2008(continued)

Power plant (m)		Fuel (i) Type	*Net Generation ($EG_{m,y}$) (MWh)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption (10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)	
Dangjin	#1	Coal-thermal	3,991,074	1,559,086	0	60	0	9,058,810	0	545	0	5,520	0	8,629	0	3,224,779	0	157	0	3,224,937
	#2	Coal-thermal	4,162,369	1,621,753	0	136	0	9,390,115	0	1,222	0	5,501	0	8,536	0	3,342,718	0	353	0	3,343,071
	#3	Coal-thermal	3,800,792	1,474,550	0	751	0	8,557,506	0	6,758	0	5,513	0	8,549	0	3,046,324	0	1,951	0	3,048,275
	#4	Coal-thermal	3,737,406	1,457,994	0	771	0	8,445,848	0	6,872	0	5,503	0	8,467	0	3,006,576	0	1,984	0	3,008,560
	#5	Coal-thermal	3,908,658	1,490,658	0	250	0	8,739,255	0	2,267	0	5,570	0	8,615	0	3,111,023	0	655	0	3,111,678
	#6	Coal-thermal	4,006,307	1,509,171	0	132	0	8,836,168	0	1,187	0	5,562	0	8,543	0	3,145,523	0	343	0	3,145,865
	#7	Coal-thermal	3,336,619	1,264,913	0	645	0	7,430,976	0	5,211	0	5,581	0	7,675	0	2,645,299	0	1,505	0	2,646,803
	#8	Coal-thermal	3,992,732	1,494,311	0	314	0	8,754,372	0	2,826	0	5,566	0	8,550	0	3,116,405	0	816	0	3,117,221
Ulsan	#1	Heavy oil-thermal	114,753	0	30,689	565	0	0	304,937	5,140	0	0	9,440	8,642	0	0	91,572	1,484	0	93,056
	#2	Heavy oil-thermal	108,931	0	29,228	562	0	0	290,548	5,127	0	0	9,444	8,667	0	0	87,251	1,480	0	88,732
	#3	Heavy oil-thermal	123,706	0	32,541	480	0	0	323,370	4,381	0	0	9,440	8,671	0	0	97,107	1,265	0	98,373
	#4	Heavy oil-thermal	945,479	0	228,138	4,016	0	0	2,285,115	36,616	0	0	9,516	8,662	0	0	686,216	10,573	0	696,789
	#5	Heavy oil-thermal	678,426	0	163,748	2,956	0	0	1,642,627	27,034		0	9,530	8,688	0	0	493,278	7,806	0	501,084
	#6	Heavy oil-thermal	937,531	0	225,645	3,757	0	0	2,259,541	34,253		0	9,513	8,661	0	0	678,536	9,891	0	688,427
Yeongnam	#1	Heavy oil-thermal	229,316	0	59,763	1,476	0	0	608,600	13,123		0	9,674	8,446	0	0	182,762	3,789	0	186,551
	#2	Heavy oil-thermal	149,357	0	40,030	802	0	0	407,726	7,137		0	9,676	8,454	0	0	122,439	2,061	0	124,500
Yeosu	#1	Heavy oil-thermal	130,854	0	32,576	202	0	0	324,018	1,780		0	9,449	8,371	0	0	97,302	514	0	97,816
	#2	Heavy oil-thermal	454,052	0	111,854	341	0	0	1,112,340	2,998		0	9,447	8,352	0	0	334,034	866	0	334,899
Pyeongtaek	#1	Heavy oil-thermal	386,361	0	91,937	77	2,562	0	911,951	691	32,996	0	9,423	8,525	11,591	0	273,857	200	6,751	280,808
	#2	Heavy oil-thermal	534,121	0	125,789	90	4,744	0	1,248,562	808	61,481	0	9,430	8,529	11,664	0	374,941	233	12,580	387,754
	#3	Heavy oil-thermal	576,432	0	135,720	145	4,232	0	1,346,657	1,286	54,613	0	9,426	8,426	11,614	0	404,399	371	11,174	415,944
	#4	Heavy oil-thermal	365,269	0	86,454	100	3,020	0	857,048	894	39,129	0	9,418	8,493	11,661	0	257,370	258	8,006	265,634
Namjeju	#1	Heavy oil-thermal	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	#2	Heavy oil-thermal	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	#3	Heavy oil-thermal	559,817	0	132,984	146	0	0	1,317,986	1,313	0	0	9,415	8,543	0	0	395,789	379	0	396,168
	#4	Heavy oil-thermal	517,866	0	119,301	127	0	0	1,174,897	1,148	0	0	9,356	8,587	0	0	352,819	332	0	353,151
Jeju	#1	Heavy oil-thermal	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	#2	Heavy oil-thermal	336,676	0	84,258	81	0	0	835,778	724	0	0	9,423	8,491	0	0	250,983	209	0	251,192
	#3	Heavy oil-thermal	357,666	0	89,652	101	0	0	889,078	899	0	0	9,421	8,456	0	0	266,989	260	0	267,248
Seoul	#4	Gas-thermal	258,052	0	0	1	55,095	0	0	7	718,601	0	0	6,650	11,739	0	0	2	147,032	147,034
	#5	Gas-thermal	596,641	0	0	0	138,068	0		2	1,800,108	0	0	0	11,734	0	0	0	368,318	368,318

*, **, ***: 2008Statistics of Electric Power in Korea, KEPCO, 2009.5.

Operating Margin for 2008

Power plant (m)	Fuel (i) Type	*Net Generation ($EG_{m,y}$) (MWh)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption (10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} * NCV_{i,y} * EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)
			Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)	
Incheon #1	Gas-thermal	141,085	0	0	0	28,582	0		0	372,705	0	0	0	11,736	0	0	0	76,259	76,259
#2	Gas-thermal	152,576	0	0	0	30,186	0		0	393,650	0	0	0	11,737	0	0	0	80,544	80,544
#3	Gas-thermal	162,092	0	0	292	32,472	0		2,606	423,524	0	0	8,478	11,738	0	0	753	86,657	87,409
#4	Gas-thermal	139,637	0	0	238	27,637	0	0	2,119	360,318	0	0	8,458	11,734	0	0	612	73,724	74,336
Namjeju D/P	Internal combustion	93,201	0	19,875	482	0	0	196,494	4,337	0	0	9,392	8,548	0	0	59,007	1,252	0	60,259
Jeju G/T	Internal combustion	643	0	0	503	0	0	0	4,478	0	0	0	8,457	0	0	0	1,293	0	1,293
Jeju D/P	Internal combustion	223,630	0	46,728	0	0	0	462,719	0	0	0	9,407	0	0	0	138,954	0	0	138,954
Pyeongtaek C/C	Combined cycle	903,201	0	0	0	150,276	0	0		1,960,964	0	0	0	11,744	0	0	0	401,231	401,231
Ilsan C/C	Combined cycle	3,491,175	0	0	0	636,633	0	0		8,298,558	0	0	0	11,732	0	0	0	1,697,959	1,697,959
Bundang C/C	Combined cycle	3,748,232	0	0	0	651,005	0	0		8,489,943	0	0	0	11,737	0	0	0	1,737,118	1,737,118
Ulsan C/C	Combined cycle	4,454,326	0	0	0	655,938	0	0		8,489,348	0	0	0	11,648	0	0	0	1,736,996	1,736,996
Seoincheon C/C	Combined cycle	10,308,626	0	0	721	1,436,788	0	0		18,741,071	0	0	0	11,739	0	0	0	3,834,590	3,834,590
Shinincheon C/C	Combined cycle	11,531,252	0	0	0	1,607,180	0	0		20,962,220	0	0	0	11,739	0	0	0	4,289,057	4,289,057
Boryeong C/C	Combined cycle	6,126,641	0	0	0	894,790	0	0		11,664,738	0	0	0	11,733	0	0	0	2,386,709	2,386,709
Incheon C/C	Combined cycle	3,420,631	0	0	0	459,923	0	0		5,977,405	0	0	0	11,697	0	0	0	1,223,030	1,223,030
Busan C/C	Combined cycle	10,848,484	0	0	0	1,456,370	0	0	0	18,981,134	0	0	0	11,730	0	0	0	3,883,709	3,883,709
Hallim C/C	Combined cycle	23,547	0	0	6,883	0	0	0	61,841	0	0	0	8,535	0	0	0	17,857	0	17,857
GS Anyang C/C	Combined cycle	1,638,638	0	0	0	292,931	0	0	0	3,845,837	0	0	0	11,816	0	0	0	786,893	786,893
GS Bucheon C/C	Combined cycle	1,657,898	0	0	0	302,746	0	0	0	3,764,533	0	0	0	11,191	0	0	0	770,257	770,257
POSCO Power	Combined cycle	3,328,129	0	0	0	587,956	0	0	0	7,669,589	0	0	0	11,740	0	0	0	1,569,266	1,569,266
GS EPS Bugog #1	Combined cycle	2,754,546	0	0	0	433,004	0	0	0	5,476,761	0	0	0	11,383	0	0	0	1,120,594	1,120,594
GS EPS Bugog #2	Combined cycle	2,754,546				276,112	0	0	0	4,044,539	0	0	0	13,183	0	0	0	827,549	827,549
Yulchon C/C	Combined cycle	2,488,267	0	0	0	347,123	0	0	0	4,526,895	0	0	0	11,737	0	0	0	926,243	926,243
$\Sigma_m EG_{m,y}$= 237,888,671																		**$\Sigma_{i,m} FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ =**	**163,529,778**

*, **, ***: 2008 Statistics of Electric Power in Korea, KEPCO, 2009.5.

CO_2 Emission Factor of fossil fuel type i (unit: tCO_2/GJ) ($EF_{CO2,i,y}$)

$EF_{grid,OMsimple,y}=\Sigma_{i,m}FC_{i,m,y}*CV_{i,y}*EF_{CO2,i,y} / \Sigma_m EG_{m,y}$= 0.6874

Build Margin (BM) calculation

For the calculation of the Build Margin emission factor ($EF_{grid,BM,y}$), the sample group *m* is selected according to Option 1.

2010 Net Generation (MWh)		Percentage	Remark
Grid total	455,095,515	100.00%	
Sample group m - five plants	1,281,700	0.28%	
Sample group m - 20% plants	92,307,706	20.28%	Selected

Carbon Emission Factor

CO_2 Emission Factor of fossil fuel type i (unit: tCO_2/GJ) ($EF_{CO2,i,y}$)

Bituminous coal	0.089500
Heavy Oil	0.075500
Diesel Oil	0.072600
LNG	0.054300

*Source:: IPCC 2006

IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 of 2006 IPCC Guidance.

BM for the proposed project activity

Build margin for 2010: 0.6357 tCO_2/MWh

$$EF_{grid,BM,y} = 0.6357\ tCO_2/MWh$$

Build Margin for 2010(continued)

Plant (m)		Fuel (i) type	Net Generation ($EG_{m,y}$) (MWh)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption(10^6 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)	$EF_{EL,m,y}$ (tCO_2/MWh)	$EG_{m,y} * EF_{EL,m,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)			
Haengwon hydro	2010.12	hydro	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Gunwi hydro	2010.11	small hydro	228	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Haengwon solar	2010.11	solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Dangjin solar	2010.10	solar	265	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Yeongwol	2010.10	Combined	1,281,206	0	0	263	182,365	0	0	2,353	2,380,779	0	0	8,499	11,750	0	0	679	487,129	487,808	0.381	487,808
Yecheon solar	2010.10	solar	5,057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Seolibo hydro	2010.08	hydro	108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
singori	2010.08	Nuclear	1,121,956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Yeongheung wind	2010.05	Wind	2,238		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Gunsan	2010.05	Combined	2,937,873	0	0	0	398,151	0	0	0	5,196,105	0	0	0	11,746	0	0	0	1,063,169	1,063,169	0.362	1,063,169
Pangweo	2010.02	small hydro	2,154	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Dangjin hydro	2010.01	hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Gosan	2009.12	small hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Ilsan fuel cell	2009. 09	fuel cell	18,492	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Boryeong#1	2009.07	small hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Wooldolmok	2009.05	small hydro	1,039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Seongju	2009	small hydro	4,171	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Boseong	2009	small hydro	3,973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Hadong #8	2009. 06	Coal-thermal	4,221,464	1,586,695	0	34	0	9,228,319	0	307	0	5,525	0	8,578	0	3,285,122	0	89	0	3,285,210	0.778	3,285,210
Seongsan-wind	2009. 04	Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Daehanboryeong	2009	small hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Yeongwol solar	2009	solar	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Hadong #7	2008.12	Coal-thermal	3,497,189	1,572,939	0	347	0	7,647,412	0	6,012	0	4,619	0	16,459	0	2,722,346	0	1,736	0	2,724,082	0.779	2,724,082
Boryeong # 8	2008.12	Coal-thermal	3,787,312	1,493,422	0	439	0	8,260,560	0	3,843	0	5,255	0	8,316	0	2,940,616	0	1,110	0	2,941,726	0.777	2,941,726
Yeongheung #4	2008.12	Coal-thermal	6,943,045	2,821,533	0	663	0	15,975,433	0	5,849	0	5,379	0	8,381	0	5,686,977	0	1,689	0	5,688,666	0.819	5,688,666
Seongnam2	2008.10	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Jeju Solar	2008.09	Solar	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Boryeong fuel cell	2008.09	fuel cell	1,999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Busan C/C solar	2008.07	Solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Hadong solar	2008.07	Solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Yeongheung #3	2008.06	Coal-thermal	6,887,344	2,778,041	0	739	0	15,751,410	0	6,527	0	5,386	0	8,391	0	5,607,229	0	1,885	0	5,609,114	0.814	5,609,114
Boryeong #7	2008.06	Coal-thermal	4,189,558	1,670,727	0	662	0	9,221,913	0	5,799	0	5,244	0	8,322	0	3,282,841	0	1,675	0	3,284,516	0.784	3,284,516
Boryeong 2	2008.06	Hydro	1,338	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Taean	2008.06	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Hongikdongjin	2008.06	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Deacheongdaem	2008.06	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
kori-wind power	2008.05	Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Samlangjin solar	2008.04	solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Boryeong solar	2008.04	Solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Boryeong	2008.03	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Yeongheung	2008.03	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Yeonggwang solar park	2008.03	solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Yulhyeon	2008.02	Hydro	1,248	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Hangyeong wind	2008.02	Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Daecheong dam	2008.02	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Kyeongcheon	2008.02	Hydro	1,214	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Seocheon solar	2008.01	Solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-

Build Margin for 2010

Plant (m)		Fuel (i) type	*Net Generation ($EG_{m,y}$)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption((10⁴ Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)	$EF_{EL,m,y}$ (tCO_2/MWh)	$EG_{m,y} * EF_{EL,m,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)			
Dangjin #8	2007.12	Coal-thermal	4,272,866	1,729,056	0	90	0	9,447,782	0	805	0	5,191	0	8,497	0	3,363,247	0	232	0	3,363,479	0.787	3,363,479
Gomun	2007.08	hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Taean #8	2007.08	Coal-thermal	4,335,230	1,674,579	0	240	0	9,617,658	0	2,130	0	5,456	0	8,431	0	3,423,720	0	615	0	3,424,335	0.790	3,424,335
Dangjin #7	2007.06	Coal-thermal	3,870,155	1,572,939	0	347	0	8,621,062	0	3,117	0	5,207	0	8,534	0	3,068,949	0	900	0	3,069,849	0.793	3,069,849
Yonggwang solar park	2007.06	solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Wonjungsu	2007.05	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Baekgok	2007.05	Hydro	1,144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Damyang	2007.05	Hydro	1,727	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Juam	2007.05	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Namjeju #4	2007.03	Heavy oil-thermal	580,342	0	146,544	134	0	0	1,451,580	1,195	0	0	9,410	8,472	0	0	435,907	345	0	436,252	0.752	436,252
Samcheonpo	2007.02	hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Dalbang	2007.02	hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Hapcheon	2007.02	Hydro	7,472	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Taean #7	2007.02	Coal-thermal	3,940,580	1,521,262	0	879	0	8,758,319	0	7,800	0	5,469	0	8,430	0	3,117,810	0	2,252	0	3,120,062	0.792	3,120,062
Cheongsong pumping #2	2006.12	pumping	305,821	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Bundang fuel cell	2006.10	fuel cell	1,769	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Namjeju #3	2006.09	thermal	594,537	0	151,950	105	0	0	1,505,154	940	0	0	9,410	8,505	0	0	451,995	271	0	452,267	0.761	452,267
Cheongsong pumping #1	2006.09	pumping	301,551	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Yongheung solar	2006.09	solar	1,160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Yangyang pumping #4	2006.08	pumping	204,280	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Donghae solar	2006.08	solar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Gangwon wind power	2006.07	Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Yangyang	2006.06	Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Yangyang pumping #3	2006.06	pumping	194,083	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Hadongho	2006.06	small hydro power	2,923	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Jangseong	2006.05	small hydro power	2,056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Dangjin #6	2006.04	thermal	4,242,960	1,722,658	0	157	0	9,419,756	0	1,408	0	5,195	0	8,520	0	3,353,270	0	407	0	3,353,676	0.790	3,353,676
Yangyang pumping #2	2006.04	pumping	194,653	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Yangyang pumping #1	2006.02	Hydro-pumping	122,320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Samcheonpo solar	2005.12	Solar	1,129	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Janghengdam	2005.12	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Dangjin #5	2005.11	Coal-thermal	4,133,329	1,676,374	0	332	0	9,172,326	0	2,982	0	5,198	0	8,533	0	3,265,189	0	861	0	3,266,050	0.790	3,266,050
Yangyang	2005.10	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Taean solar	2005.10	Solar	116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Jeju D/P	2005.07	Internal combustion	405,634	0	85,093	0	0	0	839,393	0	0	0	9,371	0	0	0	252,068	0	0	252,068	0.621	252,068
Yulchon C/C	2005.07	Combined cycle	2,680,710	0	0	0	372,560	0	0	0	4,863,307	0	0	0	11,748	0	0	0	995,076	995,076	0.371	995,076
Daegok	2005.07	Hydro	1,038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Donghwa	2005.07	Hydro	3,289	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0
Incheon C/C	2005.07	Combined cycle	7,789,931	0	0	0	1,035,456	0	0	0	13,513,313	0	0	0	11,745	0	0	0	2,764,944	2,764,944	0.355	2,764,944
Ulchin #6	2005.04	Nuclear	7,991,038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-

Build Margin for 2010

Plant (m)		Fuel (i) type	*Net Generation ($EG_{m,y}$)	**Fuel consumption ($FC_{i,m,y}$)				***Calorific Consumption(10^3 Kcal)				Net Calorific value ($NCV_{i,y}$)				$FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}$				$\sum_i FC_{i,m,y} * CV_{i,y} * EF_{CO2,i,y}$ (tCO_2)	$EF_{EL,m,y}$ (tCO_2/MWh)	$EG_{m,y} * EF_{EL,m,y}$ (tCO_2)
				Bituminous coal (ton)	Heavy oil (kl)	Diesel Oil (kl)	LNG (ton)	Bituminous coal (kcal/kg)	Heavy oil (kcal/l)	Diesel Oil (kcal/l)	LNG (kcal/kg)	Bituminous coal (kJ/kg)	Heavy oil (kJ/l)	Diesel Oil (kJ/l)	LNG (kJ/kg)	Bituminous coal (tCO_2)	Heavy oil (tCO_2)	Diesel Oil (tCO_2)	LNG (tCO_2)			
Sungnam	2004.12	Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Yungduk-wind power	2004.12	Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Yongdam	2004.12	Hydro	26,825	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	-
Yeongheung #2	2004.11	Coal-thermal	5,627,774	2,264,564	0	1,531	0	12,951,441	0	13,507	0	5,433	0	8,381	0	4,610,459	0	3,900	0	4,614,359	0.820	4,614,389
Yeongheung #1	2004.07	Coal-thermal	5,558,681	2,201,446	0	2,189	0	12,587,273	0	19,325	0	5,432	0	8,387	0	4,480,851	0	5,580	0	4,486,431	0.807	4,486,431
		$\Sigma_{i,m} EG_{m,y}$ =	92,307,706																	$\sum m EGm,y * EFEL,m,y$ =		58,683,170

*, **, ***: 2010Statistics of Electric Power in Korea, KEPCO, 2011.5.

*, **, ***: 2010 Staus of Generation facility, KPX, 2011.5.

$EF_{grid,BM,y} = \Sigma_m EG_{m,y} * EF_{EL,m,y} / \Sigma_m EG_{m,y}$ = **0.6357**

Annex 4

MONITORING INFORMATION

Please refer to section B.6

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