CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

The Gangwon Wind Park Project (GaWiP).

A.2. Description of the project activity:

The 98MW Gangwon Wind Park Project (GaWiP) is the largest wind park project ever planned in the Republic of Korea. The first phase has the capacity of 28MW comprised of 14 units of wind turbine generators to be put into operation in 2005, and the second and third phases with 70MW comprised of 35 units which are planned to be put into operation in 2006.

This wind park site is located in the Samyang farmland, Gangwon Province along the Taegwallyong ridge easterly to Maebong Mountain as well as in the neighbouring area of the Hanil farm. The project will be interconnected at the Hoenggye substation, approximately 11km from the project site. The investigation of the electrical grid situation indicates that the wind power plant causes no adverse bus bar conditions, and the transmission system has sufficient capacity to carry all the planned generated electricity to the various load centers in the electricity transmission and distribution system of the Korea Electrical Power Company (KEPCO).

The annual wind speeds for the site are in the range of 7.65 m/s at 60m above the ground (Source: **PB Power**[1]). The turbines will be connected via underground 22.9kV waterproof copper conductor XLPE insulated cables to the wind farm substation on the project site where the voltage is increased to 154kV. A new 154kV transmission line will connect the project substation to the KEPCO substation in Hoenggye.

Republic of Korea is the world's forth-largest oil importing country. Korea is importing more than 97% of fossil fuels from other countries to produce energy (solely from the Arab world: 73%). The GaWiP project addresses this situation by reducing the reliance on imported energy sources as well as contributes to the GHGs reduction by using the renewable energy source.

The project will support the following of the Republic of Korea Government objectives;

- Cultivate, support and promote the research and development of new renewable energy sources, with one of the key renewable technologies listed being wind.
- Minimize dependence on fossil fuel imports and create domestic power resources, which will have added economic benefits.

The project contributes to sustainable development in the following ways:

- Renewable energy sources present many environmental benefits. Compared to other energy sources, processing wind energy does not release pollutants into the air, nor does it emit residuals that can give harmful impacts on soil, water etc.

[1] PB Power : Parsons Brinckerhoff Associate Ltd.

- Renewable energy sources provide future generations with environmentally friendly fuel alternatives that protect the environment.
- This project will cut GHGs and other emissions such as sulphur dioxide, nitrogen oxide, and particulates.
- An assessment of the environmental effects on Korea demonstrates that GHGs and emissions of air pollutants from this kind of renewable energy power plants would be cut by approximately 149,536 metric tons of CO_2, 284 tons of SOx, 215 tons of NOx, and 15 tons of dust per year, if the 98MW wind power plant in Taegwallyong was built. (The value of CO2 was estimated in accordance with the methodology of ACM0002 and each value of SOx, NOx, and dust was estimated by using national Database for LCI(Source: Data of MOCIE[1] of the year 1998).
- The GaWiP project will create jobs in the local area during the initial phase (see Table 1 in detail). Infrastructure, such as, access roads, power lines, and communication cables for constructions will benefit the local economy.

The project will transfer the advance technology and knowledge regarding wind power plant as follows:

- While Engineers dispatched from Vestas will stay in the plant and monitor the operation and management of the plant for five years , and transfer the knowledge and technology to the local people (source: Vestas consortium)
- After five year training, the local engineers will manage and operate the plant.

<Table 1> Employment state in GaWiP

Time	Area	
Under construction	Construction workers: 80	Electrician: 150
Management	Technician: 5	Manager: 5

A.3. Project participants:

The Republic of Korea:
UNISON Co., Ltd. (Developer, Investor, EPC Contractor and O&M Contractor of the Project)
Gangwon Wind Power Co., Ltd. (The project company)
ecoeye Co., Ltd. (CDM Consultant retained for CDM Project Activity)

Japan:
Marubeni Corporation (Investor)
Eurus Energy Japan Corporation (Investor)

[1] MOCIE : Ministry of Commerce, Industry, and Energy is a state administration authority which is responsible for trading, industry, technology, energy, resource in Korea .

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Republic of Korea

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

The project is located at Gangwon Province

A.4.1.3. City/Town/Community etc:

The project is located at Pyeongchang-Gun

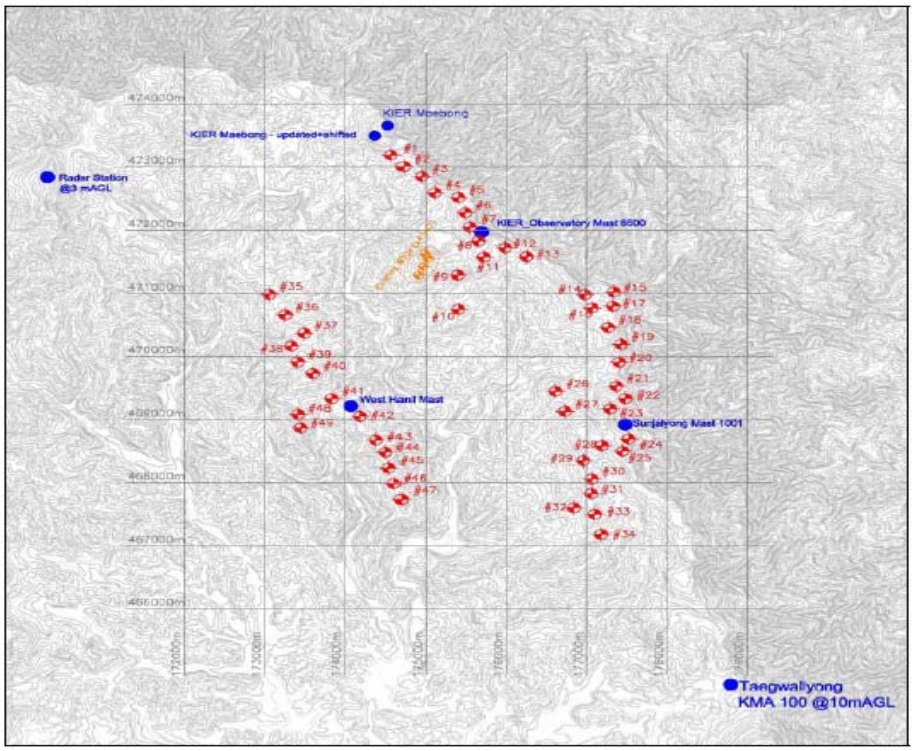
A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

This wind park site is located in the Samyang farmland (128° 42′ longitude and 37° 42′ latitude) and the Gangwon Province along the Taegwallyong ridge easterly to Maebong Mountain as well as in the neighbouring land of the Hanil farm.

The Gangwon Province is located at the mid-eastern part of the Korean peninsula, which is the eastern tip of the Asian continent. Gangwon is in the same latitude of Tokyo, Athens or Washington D.C.

<Figure 1> Map of the location of GaWiP

The Taegwallyong area is located in the eastern part of the Pyeongchang-Gun, which is part of the Gangwon Province. With an average altitude of 700m the terrain of Pyeongchang-Gun is rather mountainous. 65.2% of the whole area is highland and there are 23 places that reach up to an altitude of 1,000m or more. Because of the location, the Site has nearly five months of long winter and heavy snow fall yearly. This site is well developed with highland vegetables, and with Odae Mountain national park, ski resorts and golf courses. Also Pyeongchang-Gun is the starting point of Namhan river.



<Figure 2> Locations of Gangwon wind farm (red) and surrounding long-term reference sites and monitoring towers (blue)

A.4.2. Category(ies) of project activity:

Renewable Electricity Generation for a Grid

A.4.3. Technology to be employed by the project activity:

The project with an installed capacity of 98MW will use the turbine technology asynchronous with OptiSpeed ™ [1] and OptiTip® [2] technology and is estimated to generate 244,400MWh per year. In addition, the Gangwon Wind Power plant was designed by Lahmeyer International, a German company, and the generator facilities will be imported from Denmark, which are not available in Korea in terms of building, operating, and maintaining this kind of wind power plant.

[1] OptiSpeed™ is, also named Vestas Converter System(VCS), allows variable speed operation in a range of approx. 60% of nominal RPM, for more information, visit http://www.vestas.com.

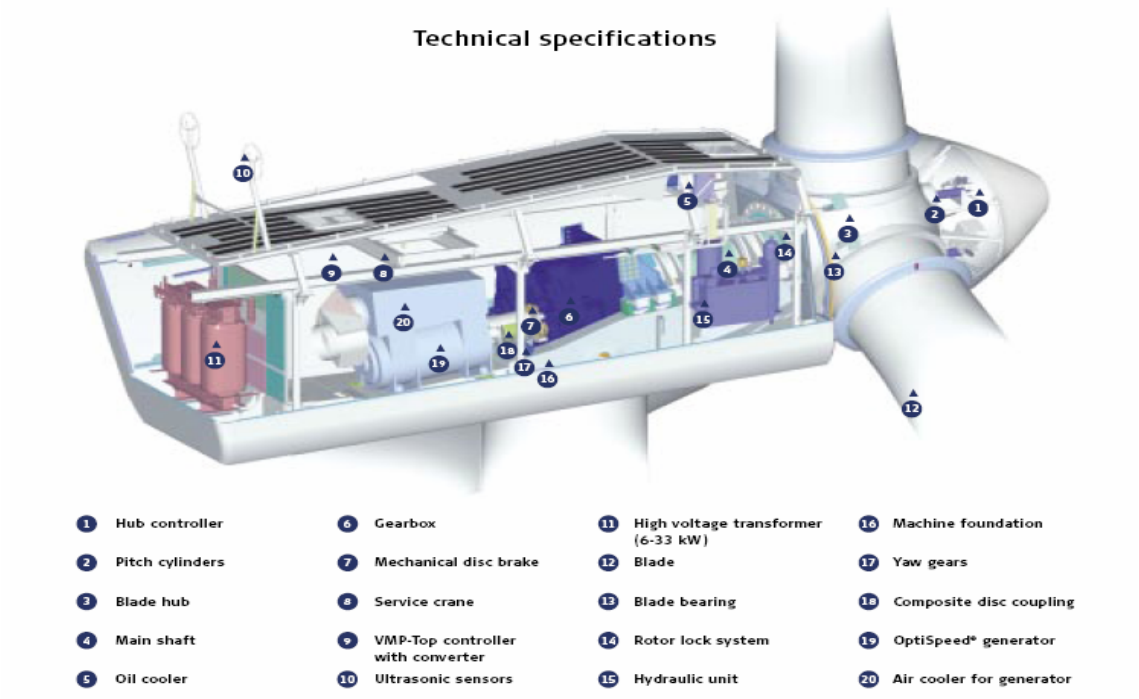
[2] OptiTip® is a pitch regulation system of blades, for more information, visit http://www.vestas.com.

The design features of the wind turbine enable the rotor to operate with variable speed (RPM) to fit the various local wind conditions. At higher wind speeds, the OptiSpeed™ and the pitch regulating system keep the power at nominal speed, regardless of the air temperature and density. At lower wind speeds, the OptiTip® system and the OptiSpeed ™ optimize the power output by selecting the optimal RPM and pitch angle.

All functions of the wind turbine are monitored and controlled by microprocessor-based control units. This control system – including the transformer – is placed in the nacelle. The wind turbine is designed for ambient temperatures ranging from -20 ℃ ~ to +30 ℃. Special precautions must be taken outside these temperatures. The generator model is the V80 with a rated power of 2MW respectively. This type of generator has been chosen due to its large capacity. The V80 is made by Vestas Wind Systems.

For the time being the following installation plan with a total capacity of 98MW for the Gangwon wind farm is considered:

- 49×2MW – V80 wind turbine
- Frequency – 60Hz
- Rotor diameter – 80 meter
- Tip angle – Pitch regulated
- IEC Class – IIa



<Figure 3> Vestas V80 technical specifications

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

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

The main objective of the project is to produce and use electricity generated by renewable energy sources without releasing any GHG emissions. The 98MW GaWiP project represents 0.179% of the total grid-electricity system in Korea and will generate 244,400MWh of electricity per year which is 0.081% of total electricity generated in Korea in 2003. The success of GaWiP project will have a significant impact on Korea as a start point of developing renewable energy sources.

This project is for constructing the wind power plant which uses a renewable and clean energy source, and subsequently the plant will not result in any GHG emissions. Therefore, the wind electricity generation plant will displace other electricity generation plants that use fossil fuels.

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

Due to the economical efficiency, Korea government preferred to build fossil fuel fired power plants and nuclear plants over the past years instead of building renewable resourced power plants. And the fossil fuel fired power plants and nuclear power plants have caused enormous environmental destruction when they processed those kinds of resources for electricity generation.

Compared to above electricity generation plants, wind power plants barely cause environmental problems. Even hydro power plants damage the geological shapes and relevant ecosystem. One of the advantages in using wind power source is that the environmental destruction can be minimized when the facilities are built, operated, and maintained.

In spite of these environmental advantages of the wind power plants, for Korea, as a developing country, the low rate and long term of ROI (Return on investment) was an obstacle to building them. Moreover, the Korean government is spending a large portion of its GNP on imported fossil fuels. Including hydro power plants, various renewable energy sourced power plants need to be developed in order to diversify the resources for energy generation and contribute to the GHG reduction. That is why this GaWiP project has a significant meaning not only for Korea, but also for Unison Co., Ltd., the official construction company for this project.
Unison Co., Ltd. gathered all the elements to build the wind power plant in Korea from 1) procuring foreign investment and advanced technology for the wind power system construction to 2) seeking cooperation from the relevant stakeholders with the support from Gangwon Province.

This GaWiP project will carry out the biggest wind power capacity ever so far in Korea – 98MW, and this plant will produce clean electricity and it is connected to grid system to distribute electricity without the GHG emission. Only after the realization of this project, would it be possible to build more power plants which use renewable resources in Korea, replacing fossil fuel fired power plants.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

It has been estimated that 1,495,363 tons of CO_2 will be reduced over 10 years of the crediting period (For calculations see section E).

A.4.5. Public funding of the project activity:

This CDM project is not funded by official development assistance or other sources counted towards the financial obligations of Parties included in Annex I.

SECTION B. Application of a baseline methodology

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

ACM0002. – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources."

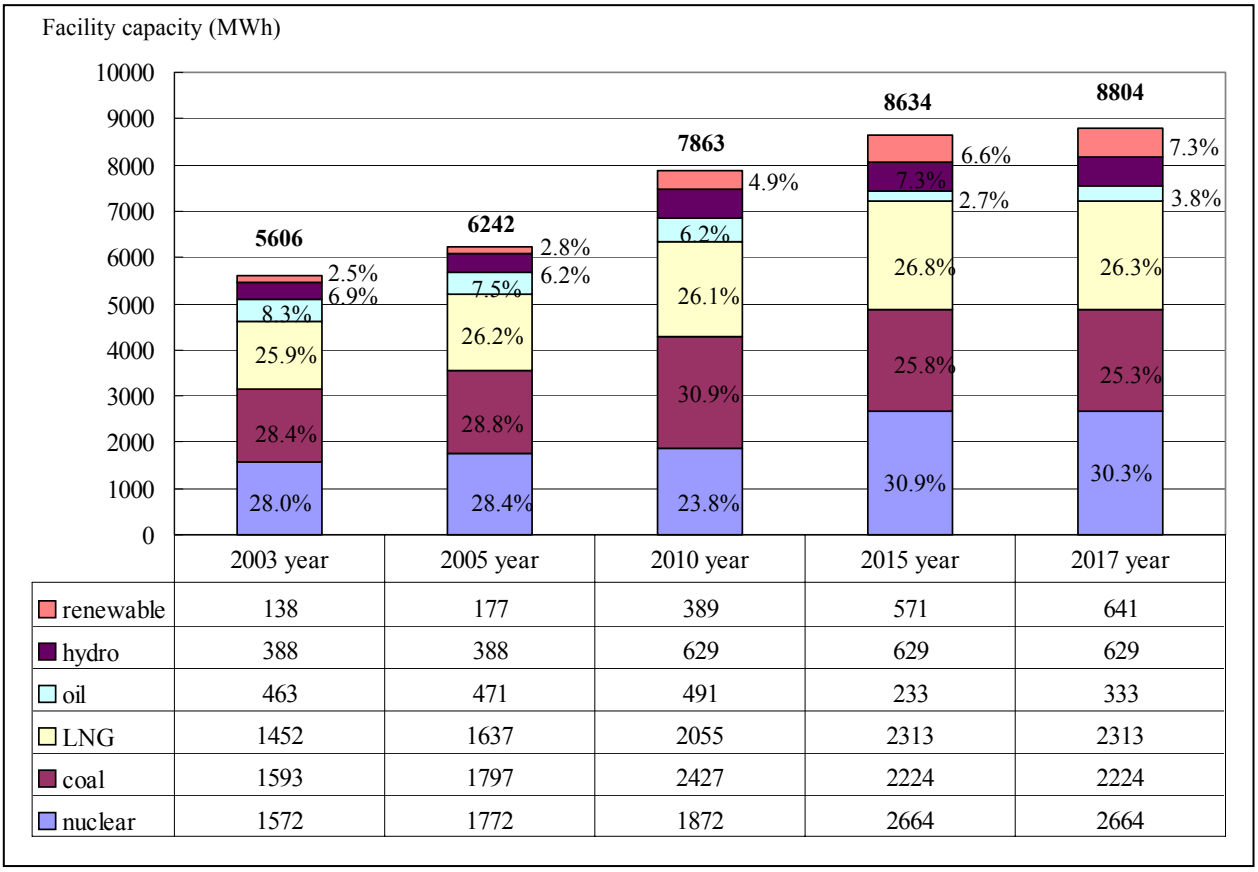
B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

The methodology applied to calculate baseline in this project is the approved consolidated baseline methodology (ACM0002) that can calculate a reduction of GHGs emission from the power plant that uses wind power – one of the renewable energy sources replacing fossil fuel fired power plants.

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

B.2. Description of how the methodology is applied in the context of the project activity:

According to ACM0002, baseline was calculated as the following steps in order to calculate the reduction of GHG emission.
The baseline scenario is as follows: electricity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.



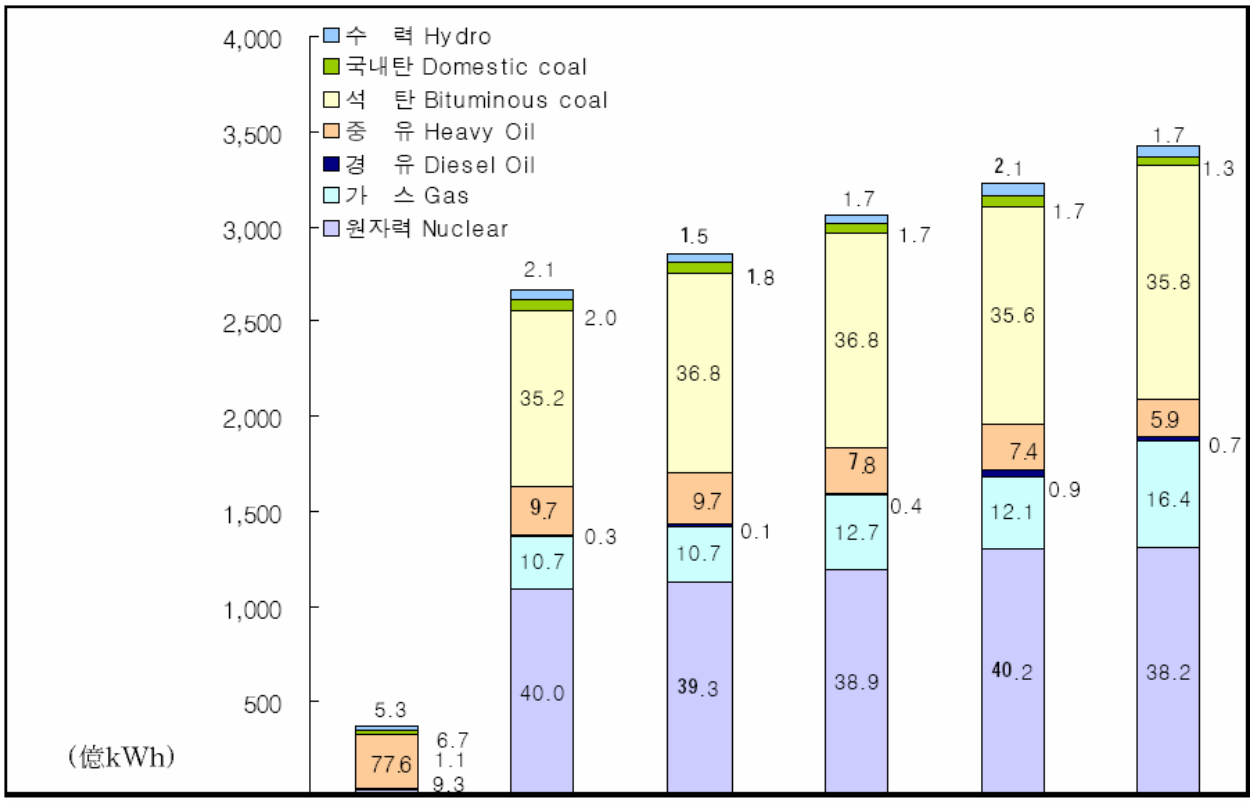
	2003 year	2005 year	2010 year	2015 year	2017 year
renewable	138	177	389	571	641
hydro	388	388	629	629	629
oil	463	471	491	233	333
LNG	1452	1637	2055	2313	2313
coal	1593	1797	2427	2224	2224
nuclear	1572	1772	1872	2664	2664

<Figure 4> Forecast for the Electricity Composition based on the Source of Energy (Source: the 2nd demand-supply program of electricity from 2004 to 2017, December 2004, MOCIE)

OM (Operating Margin) and BM (Build Margin) are calculated by using data from existing power plants that provide electricity to the current grid-connected electricity generation, and with this result, the EF $_y$ (Emission Factor) can be calculated. The steps for the Baseline calculation methodology is as follows;

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

The rate of low cost/must run electricity generation does not exceed 50% of the total grid (the most recent 5-year (2000~2005) average data shows that the rate of low cost/must run is 42.84%) referred to the host country's gross electricity generation rate by energy sources (Source: KEPCO), and an hourly dispatched data is not available at this point of time. Therefore, Option (a) (Simple OM) has been chosen.



(単位 Unit : 百萬kWh million kWh)

區分 Item \ 年度 Year		1980	2000	2001	2002	2003	2004
水 力 Hydro		1,984	5,610	4,151	5,311	6,887	5,744
火 力 Thermal	國內炭Coal(Dom.)	2,481	5,285	5,235	5,144	5,398	4,603
	石 炭Coal(Bitum.)	-	92,253	105,098	112,877	114,878	122,556
	重油 Oil(Heavy)	28,876	25,485	27,770	23,940	23,656	20,099
	輕油 Oil(Diesel)	421	657	386	1,155	2,870	2,433
	가 스 Gas	-	28,146	30,451	38,943	39,091	55,999
原子力 Nuclear		3,477	108,964	112,133	119,103	129,672	130,715
計 Total		37,239	266,400	285,224	306,474	322,452	342,148

<Figure 5> Yearly proportion of the Generation of Electricity based on the Source of Energy (Source: Electricity statistics on Electricity quantity from Korea Electric Power Corporation, 2005)

As described in ACM0002, the OM is calculated as the generation-weighed emissions per electricity unit of all generating units serving the system, excluding low-operating cost and must-run power plants. Low-operating cost and must run power plants include hydro, nuclear, low cost biomass, geothermal and domestic coal. The OM is calculated as follows, using a 3-year average:

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

$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y,
j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid,
$COEF_{i,j,y}$ ($COEFi = NCVi \cdot EFco2i \cdot OXIDi$) is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y, and
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j.

The detailed information used in the calculation is presented in Annex 3.

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

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

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

- the five power plants that have been built most recently, or
- the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

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

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

- the five power plants that have been built most recently, or
- the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use from these two options that sample group that comprises the larger annual generation.
For GaWiP, Option 1 was selected.

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

<Table 2> 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	1,585GWh	60,221 GWh	Total generation is 303,347 GWh in Korea (based on KEPCO's data of the year 2003)
Proportion (ratio to total generation in Korea)	0.52%	20%	
Selected option		**O**	

The result of the calculation of "the five power plants that have been built most recently," was 1,585GWh which is comprised of 0.52% of the total system generation (303,347 GWh based on KEPCO's 2003 data). While, the result of the calculation was 60,221 GWh which is comprised of app. 20.06% of the total system generation based on "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 result of the calculation of "the power plants capacity additions in the electricity system that comprises 20% of the system generation (in MWh) which have been built most recently" was selected because the bigger result has to be chosen comparing one to another. The detailed data used in the calculation are presented in Annex 3.

The calculation of BM $_y$ is as follows;

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

where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method above for plants *m*.

The detailed information used in the calculation is presented in Annex 3.

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

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

$$EF = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$

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

The emission factors of the OM and BM in GaWiP have been weighted equally, each 50%. Sections E.4 and E.6 below provide details of the calculation and results.

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 CDM project activity:

The determination of the Additionality is done by using the Tool for the demonstration and assessment of Additionality, as published in Annex 1 of the sixteenth meeting of the Executive Board (EB-16). The CDM consolidated tool for demonstration of Additionality, includes the following steps:

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

The construction work of the project started in May, 2005, and the financial closing for the project was in May, 2005.

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

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

The proposed alternatives are as follows,

Alternative 1. The construction of Gangwon Wind power plant which will generate electricity and be connected to a grid of KEPCO

Alternative 2. The construction of business-as-usual power plant which will be connected to a grid of KEPCO

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

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

According to the EB 16th meeting Report, Annex 3, 1 page 'Clarifications on the treatment of national and/or Sectoral policies and regulations (paragraph 45 (e) of the CDM Modalities and Procedures) in determining a baseline scenario', which is *'"Type E-"national and/or Sectoral policies or regulations that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) may not be taken into account in developing a baseline scenario (i.e. the baseline scenario should refer to a hypothetical situation without the national and/or Sectoral policies or regulations being in place)'*, this analysis is performed based on this hypothetical situation without regarding the 'Alternative Energy Development Promotion Act amended on March, 2002[1].' (See more information at http://cdm.unfccc.int/EB/Meetings/016/eb16repan3.pdf)
According to the above decision, purchase price of electricity which excludes subsidy through compensation for difference between generation costs by MOCIE was used for the investment analysis.

Step 2. Investment Analysis

Sub-step 2a. Determine appropriate analysis method

To prove the Additionality of this project, we have chosen the option 2 among three options of the investment analysis from "Tool for the demonstration and assessment of Additionality" described by Annex 1 of the sixteenth meeting of the Executive Board (EB-16). This CDM project will have Carbon credit profit along with the profit from selling electricity generated by the plant, and that is why option 1 cannot be chosen. In addition, there are not enough benchmark information and data to apply option 3.

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

Unit cost of electricity generation was selected to conduct comparison of financial indicators with alternatives. For the calculation of unit cost of electricity generation the following variables were used.
In alternative 2, BAU power plants include nuclear, fissile fuel fired, and hydraulic power plants.

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

<Table 3> Comparison between unit cost of electricity generation of each business-as-usual power plant

	GaWiP	Nuclear	Coal (bituminous)	Domestic coal (anthracite)	heavy oil	LNG	Pumping
	98 MW	1000 MW	500 MW	200 MW	100 MW	450 MW	400 MW
Total unit cost of Construction (1000Won/kw)	**1,614**	2,350	1,099	1,775*	1,690	580*	934
Facility life time (year)	**20**	40	30	30	30	30	55
Discount rate (%)	**8**	8	8	8	8	8	8
CRF (%)	**10.185**	8.386	8.883	8.883	8.883	8.883	8.118
Corporation tax / Total cost of construction (%)	**0.018**	0.018	0.018	0.018	0.018	0.018	0.018
Operation & Maintenance rate (%)	**2.117**	4.447	4.229	3.449	4.126	7.51	2.246
Fixed rate (%)	**12.320**	12.852	13.200	12.350	13.027	16.411	10.382
Unit price of Fuel purchase (Won/kg, l)	**0**	0	37.157	71.100	208.000	434.188	0
Unit price of Fuel purchase (Won/KWh)	**0**	4.38	14.06	36.94	46.08	53.70	0
Caloric value (kcal/kg,l)	**0**	0	5,780	4,882	9,831	13,042	0
Heat consumption rate (kcal/kwh)	**0**	2,315	2,091	2,270	2,091	1,592	0
Unit price of calorie (Won/10^6kcal)	**0**	0	6,429	14,564	21,158	33,292	0
Electricity consumption Rate in the plant (%)	**0.8**	4.7	4.4	10.5	4.0	1.3	0.4
Coefficient of Utilization [1] (%)	**28%**	91.3%	79.1%	64.2%	48.7%	12.4%	11.6%

Baseline price : '04. constant price
* : '01.1 constant is used because data has been absented since 2002.
Source: Generation facility state in 2003, Korea Power Exchange Demand & Supply plan

[1] Coefficient of Utilization refers to the average Coefficient of Utilization of 2001~2003. (See PB POWER Report for Coefficient of Utilization of GaWiP.)

Sub-step 2c. Calculation of financial indicators

The unit cost of electricity generation was calculated based on unit cost of electricity generation formula from KEPCO.

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

According to the result of the comparison between unit cost of electricity generation., GaWiP is not the most financially attractive.

<Table 4> Result of comparison between unit cost of electricity generation at each business-as-usual power plant

	GaWiP	Nuclear	Coal (bituminous)	Domestic coal (anthracite)	heavy oil	LNG	Pumping
	98 MW	1000 MW	500 MW	200 MW	100 MW	450 MW	400 MW
Unit cost of electricity generation (Won/KWh)	**80.52**	43.99	35.94	80.48	**99.83**	**142.62**	**95.81**

Sub-step 2d. Sensitivity analysis

The basis of sensitivity analysis is as follows:

- Result in accordance with the fluctuations of fuel price
- Result in accordance with the fluctuations of discount rate
- Result in accordance with the fluctuations of construction cost
- Result in accordance with the fluctuations of Coefficient of Utilization

<Table 5> Results of Sensitivity analysis

	GaWiP	Nuclear	Coal (bituminous)	Domestic coal (anthracite)	heavy oil	LNG	Pumping
	98 MW	1000 MW	500 MW	200 MW	100 MW	450 MW	400 MW
Unit cost of electricity generation in case of 10% increase of fuel price (Won/KWh)	**80.52**	44.42	37.23	**84.17**	**104.44**	**147.99**	**95.81**

Unit cost of electricity generation in case of 10% decrease of fuel price (Won/KWh)	**80.52**	43.54	34.42	76.78	**95.22**	**137.25**	**95.81**
When Discount rate is 7% Unit cost of electricity generation (Won/KWh)	**75.64**	41.26	34.46	**77.57**	**96.43**	**138.15**	**87.10**
when discount rate is 9% Unit cost of electricity generation (Won/KWh)	**85.54**	46.79	37.24	83.48	**103.34**	**147.23**	**104.69**
Unit cost of electricity generation in case of 10% increase of construction cost (Won/KWh)	**88.57**	47.94	38.00	84.83	**105.21**	**151.51**	**105.39**
Unit cost of electricity generation in case of 10% decrease of construction cost (Won/KWh)	**72.46**	40.02	33.65	**76.12**	**94.46**	**133.73**	**86.23**
Unit cost of electricity generation in case of 5% increase of Coefficient of Utilization	**68.47**	41.93	34.53	**77.33**	**94.83**	**117.04**	66.95
Unit cost of electricity generation in case of 5% decrease of Coefficient of Utilization	**97.71**	46.28	37.29	84.15	**105.98**	**202.86**	**168.43**

As the result of sensitivity analysis shows, GaWiP project is not the most financially attractive.

Step 4. Common Practice Analysis

Sub-step 4a. Other activities similar to the GaWiP in Korea.

From the end of year 2003, wind power plants were started to be established and operated by the government promotion act of the spread of the technology. According to the data from Korea Energy Management Corporation, in 2003 current operating state of wind power plants was total capacity of 18,690.8 kW with 115 generators and net generation was 20,863 MWh.

Sub-step 4b. Discussion of similar options that occur

In Korea, there is no wind power plant similar to GaWiP in terms of the capacity. However, Yeongdeok Wind Power Plant is the most similar project to GaWiP in Korea as a commercial wind power plant. It has established in December, 2004 with a capacity of 39.6MW. Yeongdeok Wind Power Plant developed by Unison Co., Ltd, the same company who promoted GaWiP. In Yeongdeok's case, Unison and the international investor for the project has considered the CDM for their investment in the project. Unison is now preparing for application of Yeongdeok Wind Power Plant as CDM project. Currently Yeongdeok Wind Power Plant is under validation as a CDM project by Korean Foundation for Quality (AE).

Step 5. Impact of CDM registration

If this project is successfully built and operated, it will contribute to reduce CO_2 emission by 149,536ton/year.

In addition, the equity IRR will be increased by 2.06% with the sales proceeds of CERs which will make the project financially attractive for the international and domestic investors. In fact, Unison has considered applying for a CDM project from the very beginning of the initial stage of this project, and CDM is one of factors which were considered by the foreign investors in their decision making process of the investment in a positive way. Moreover, through the approval of this GaWiP project, other investors and developers would be attracted to the similar kind of renewable energy power plant in Korea, where the ratio of all renewable sourced power plants such as wind power plants is far less than 5% of the total energy generation system. For Korea, the introduction of advanced technology and capital to build these facilities will bring potential benefits not only economically but also environmentally. By achieving CDM registration, the incentives will give motivation to these kinds of renewable energy power developments which may not be financially attractive without CDM program. Furthermore, it will influence national energy generation policy so that the reduction of GHGs emission can be extended**.**

<Table 6> Result of Economic Analysis

	Without Carbon	With Carbon
Equity IRR	Negative (- 3.80%)	Negative (-1.74%)

Applied data to calculate IRR are described as follows.

<Table 7> Items used for Economic Analysis

The proposed project scenario		Remark
Installed Capacity	98 MW	
Sales	244,400 MWh	

Items	Without Carbon	With Carbon	Remark
Years of Operating Period (years)	20	20	
First year of analysis	2005	2005	
Last year of analysis	2026	2026	
Carbon emission reduction Amount (ton/yr)		149,536	
Crediting Period (years)		10	
Prices of Carbon (Euro)		5.5	
Exchange Rate (KRW / Euro)	1289.52	1289.52	(2005-05-03)
Exchange Rate (KRW / USD)	1002.50	1002.50	(2005-05-03)

Electricity sales price (KRW /KWh)	57.79	57.79	Applied average SMP (System Marginal Price) the year 2004. Source : Korea Power Exchange
Income Tax Rate (below 100 million KRW)	14.30%	14.30%	
Income Tax Rate (above 100 million KRW)	27.50%	27.50%	

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

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

The spatial extent of the project boundary includes the project site and all the power plants connected physically to the electricity system of Korea Electric Power Corporation (KEPCO). And electricity system of Korea Electric Power Corporation (KEPCO) does not import or export electricity.

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

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

The entity determining the baseline and participating in the project as the consultant is ecoeye Co.,Ltd. (www.ecoeye.com). Dr. Jae-su Jung determined the baseline for the project in February 1, 2005(civilenvi@ecoeye.com).

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

Construction for the project started in May 2005.

C.1.2. Expected operational lifetime of the project activity:

Approximately 20 years of operational lifetime is estimated.

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

C.2.1. Renewable crediting period

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

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

A crediting period of 10 years has been selected for the project.

C.2.2.1. Starting date:

31/12/2006

C.2.2.2. Length:

10 years and 0 month

SECTION D. Application of a monitoring methodology and plan

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

Approved Monitoring Methodology ACM0002, which is the consolidated monitoring methodology for zero emissions grid-connected electricity generation from renewable sources.

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

This monitoring methodology is used in conjunction with the approved baseline methodology ACM0002 (consolidated baseline methodology for grid-connected electricity generation from renewable sources.) and applies to electricity capacity additions from wind energy sources. The geographic and system boundaries for the relevant electricity grid can be clearly identified, and information on the characteristics of the grid is available and data to calculate project emission is also obtainable.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

No emissions from the project activity are identified.

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Not applicable								

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

No emissions from the project activity are identified.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

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	MWh	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	tCO_2/ MWh	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. $EF_{OM, y}$	Emission factor	CO_2 OM emission factor of the Korea grid	tCO_2/ MWh	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 OM baseline method above.

4. $EF_{BM, y}$	Emission factor	CO_2 BM emission factor of the Korea grid	tCO_2/ MWh	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 $[\sum_{i, m} F_{i, m, y} \cdot COEF_{i, m}]/ [\sum_{m} GEN_{m, y}]$ 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	t CO_2/ mass or t CO_2/ volume	c	Once at the time of PDD submission	100%	Electronic	During the crediting period and two years after	Caculated as [NCVi · EFco2i · 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. Data will be calculated by each energy source in accordance with IPCC 1996 default value.
8. GENy	Electricity quantity	Electricity generation of each power source / plant	MWh/ 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. OM plant	Plant name	Identification of power source / plant for the OM	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 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.

* According to the regulation on the electricity measurement equipment, the equipment must use the main metering equipment that has allowable error of ± 0.2%, and the sub-metering equipment that has allowable error of ± 0.5%. This equipment shall be sealed by the authorised person from the connected substation right after the installation of the equipment. Also, electricity generation will be checked every 5 minutes, and the data will be kept for two years after CERs are issued
* The amount of electricity consumed in the plant and electricity transmission to a grid will be measured by bidirectional meter. EGy means a net amount of electricity transmitted to the grid excluding electricity consumed in the plant.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

$BEy = EFy \times EGy$

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Option 2 is not selected as it is not appropriated to ACM0002 Baseline methodology for small grid-connected zero-emission renewable electricity generation.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Option 2 is not selected.

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

$ER_y = BE_y - PE_y - L_y$

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

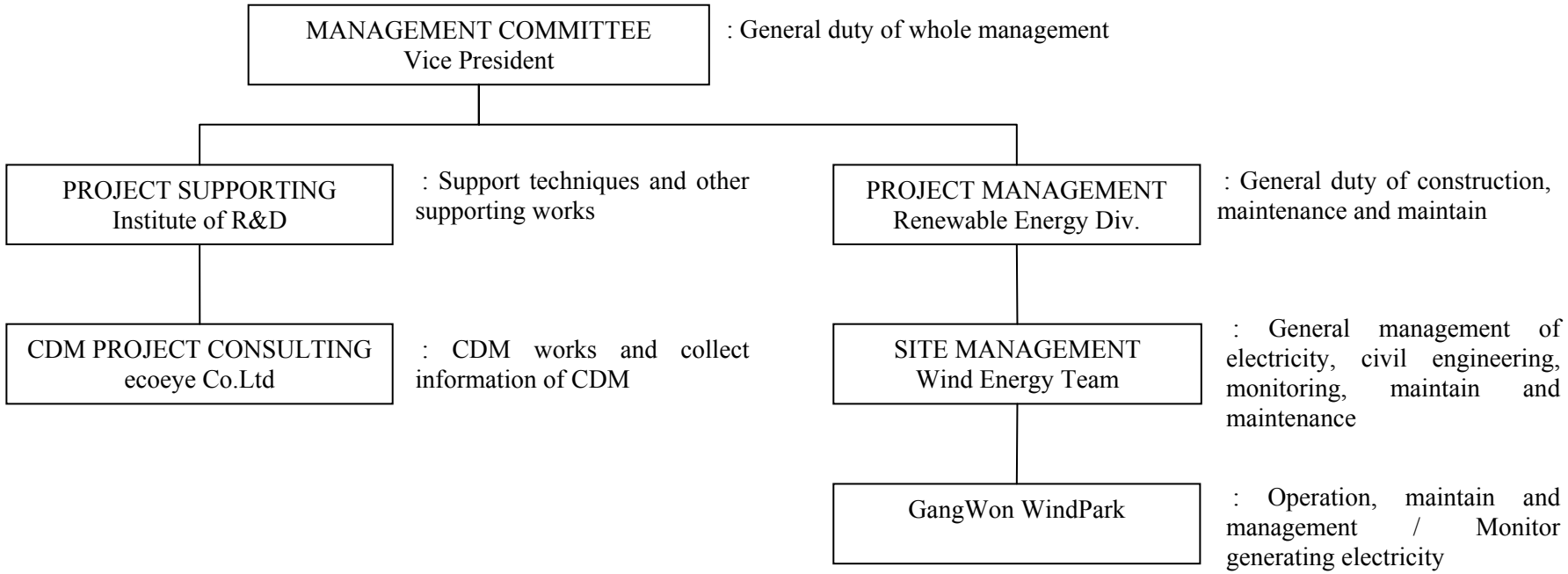
All variables, except one related to off-site transportation, used to calculate project and baseline emissions are directly measured or are publicly available official data. To ensure the quality of the data, in particular those that are measured, the data are double-checked against commercial data. The quality control and quality assurance measures planned for the Project are outlined in the following table.

Data	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1.EGy	Low	QA/QC procedure for this are planned. The electricity output from each wind turbine to the grid will be monitored and recorded at the on-site control The allowable error of data must be within ± 0.2%.
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

See Annex 4 about detail of QA/QC

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

This figure describes the operational and management structure that will monitor emissions reductions generated by the project activity.



<Figure 6> operational and management structure

D.5 Name of person/entity determining the monitoring methodology:

This monitoring methodology is determined and planned by Dr. Jae-su Jung, ecoeye Co.,Ltd (Korea, see Annex1) on February 1, 2005.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

The direct GHGs emission from renewable energy sourced power plants using wind power is zero. In addition, the GHGs emission from activities such as constructing facilities and operating certain equipment to build the plant in the project site is not included in the project boundary. Therefore, the direct GHGs emissions from this project are zero.

E.2. Estimated leakage:

No leakage is estimated at this point of time.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

The total sum of the project emissions and the leakage is zero emissions.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

The equation for calculating emissions in the baseline (BE_y) is:

$$BE_y = EG_y * EF_y$$

Where:
BE: Baseline emissions (t CO_2e)
EG: Annual electricity supplied by the project to the grid (MWh)
EF: baseline emission factor (t CO_2e / MWh)
y: refers to a given year

The baseline emission factor calculations will be based on the combined margin using the "Simple Operating Margin," option (a) of the ACM0002.

$$EF = w_{OM} * EF\_OM_y + w_{BM} * EF\_BM_y$$

Where:
EF: baseline emission factor (t CO_2e / MWh)
w_{OM}: Operation Margin weight, which is 0.5 by default
w_{BM}: Build Margin weight, which is 0.5 by default
EF_OM: Operational Margin emission factor (t CO_2e / MWh)
EF_BM: Build Margin emission factor (t CO_2e / MWh)
y: refers to a given year

The emission factor (EF_OM y) of operating margin is calculated using the following equation:

$$EF\_OM_y\ (tCO2e / MWh) = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Where:
$F_{i,j,y}$ is the amount of fuel i (in GJ) consumed by power source j in year y;
j is the set of plants delivering electricity to the grid, not including low-cost or must-run plants and carbon financed plants;
$COEF_{i,j,y}$ is the carbon coefficient of fuel i (t CO_2/GJ);
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j.

The emission factor (EF_OM y) of Build margin is calculated using the following equation:

$$EF\_BM_y\ (tCO2e / MWh) = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Where:
$F_{i,m,y}$ is the amount of fuel i (in GJ) consumed by power source m in year y;
m is the power plants that comprise 20% of the system generation and that have been built most recently.
$COEFi_{i,m,y}$ is the carbon coefficient of fuel i (t CO_2/GJ);
$GEN_{m,y}$ is the electricity (MWh) delivered to the grid by source m.

Korea does not import/export electricity from/to other countries. The data for the calculation of the OM emission factor and BM emission factor including the total electricity produced are used based on the years 2001, 2002 and 2003 data from KEPCO. See also Annex 3 below. According to the above method, the reduction of GHG emission from the project will be calculated as **149,536** ton/year. Therefore, from this project activity, the baseline emissions will be approximately **1,495,363** ton CO_2e for the entire 10-years project duration.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

Given that E.3 is equal to zero, the emission reductions of project activity are equal to E.4.

E.6. Table providing values obtained when applying formulae above:

<Table 8> Estimated GHGs emission reduction during the crediting period for the project

	Per Year	Total Crediting Period (10years)
Operating Margin Emissions Factor(in t CO_2/MWh) 2001	0.7946	
Operating Margin Emissions Factor(in t CO_2/MWh) 2002	0.7794	
Operating Margin Emissions Factor(in t CO_2/MWh) 2003	0.7815	
Operating Margin Emissions Factor (in t CO_2/MWh) 2001~2003	0.7849	
Build Margin Emissions Factor (in t CO_2/MWh)	0.4388	
Baseline Emissions Factor (EF y in t CO_2/MWh)	0.6119	
Electricity Generated by Project (EG MWh)	244,400	
Baseline Emissions (BE t CO_2)	149,536	1,495,360
Project Emissions (PE t CO_2)	0	0
Emissions reduction from electricity Generation (t CO_2/year)	149,536	1,495,360

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

According to the provisions of Enforcement Decree of the Act on Assessment of Impacts of Works on Environment, Traffic, Disasters, etc, any plant facility whose power source is solar power, wind power or fuel cell is more than 100,000kW shall be carried out EIA (revised 24 February 2001). As GaWiP whose facility capacity is 98MW, it is not required to be performed EIA. Instead Prior Environmental Review (PER) approved by the Korean Government was performed by an environmental impact assessment agency, Taeil Co., Ltd (President Changho Cho, tienv@chollian.net, Tel. 82-2-489-5747).

The PER was processed in two stages as follows,

Stage 1. : First PER completed on the turbines of 26 units in August, 2002.
Stage 2. : Second PER completed on the turbines of 23 units and the power transmission lines in October, 2003.

The PER covers the sectors of natural environment, residential environment, and social/economical environment as follows,

- Natural environment: Weather, Topography, Geology, Fauna, and Flora
- Residential environment: Land utilization, Air quality, Water quality, Soil, Waste, Noise, Vibration, Recreation, Scenery, and Radio interference
- Social/economical environment: Industries, Traffics, and Cultural assets

**Note: In order to evaluate environmental impact caused by of the project and to minimize the influence, Preliminary Agreement Report (November 2001) as well as Prior Environmental Review (PER) was carried out. All the reports regarding PER and Preliminary Agreement Report were submitted to Korea Energy Management Corporation as an Applicant Entity to validate.*

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The completed PER reports were submitted to ME (Ministry of Environment), and MOCIE (Ministry of Commerce, Industry, and Energy) and proceeded as follows,

Phase 1. : Consultation period (2002.10.10~2002.10.17)

Subjects :

- To inspect the environmental impact to be caused by the project, an environmental impact monitoring & inspection committee will be established consulting with Wonju Regional Environmental Office

- From the point of starting the construction work and the actual operation of the project, PER monitoring will be carried out for two years. The period can be extended by the committee.
- The damaged vegetation from the construction work should be restored as original vegetation.
- The colour of the wind power generators should be harmonized with the surrounding of the site and near city.
- The wind power facility should not be seen from the east coast of the Republic of Korea.
- The construction work including soil excavation and digging should be executed avoiding Monsoon season. Sandy soil from the construction works should be handled and managed carefully and thoroughly.

Phase 2. : Consultation period (2003.12.15~2003.12.23)

Subjects :

- To inspect the environmental impact to be caused by the project an environmental impact monitoring & inspection committee shall be formed consisting of Gangwon Province, Wonju Regional Environmental Office, experts on assessment and analysis, and activists from civil environmental movement groups.
- All vehicles & motors may use the existing road but the damage should be minimized.
- The wind power plant facility should be constructed over 30 meters' distance from a ridgeline of the Great Baekdu Mountain Range (The main line of the Korean mountain range).

GaWiP is planning to form the environment assessing committee for the continuous assessment, analysis, and inspection on the environmental impact on the project site. In order to exercise this process, the environmental monitoring & inspection committee was established, consulting with the Wonju Regional Environmental Office for the impact on the project site for the actual operation. Gangwon Wind power plant Co., Ltd will inspect thoroughly when there is a possible sign of undesirable environmental impact against the Korean government's environmental standards by identifying the origin which causes the problems, and take strong measures on the problems in order to minimize a harmful influence that may be caused by the wind power plant. In addition to that, the monitoring committee was established for the inspection on the activities of the environment monitoring & inspection committee

SECTION G. Stakeholders' comments

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

As described in the tables below, local/international stakeholders' comments from various sources have been invited and compiled.

<Table 9> Process of the collection of stakeholders' comments

1)

Title	Great Baekdu Mountain Range Protection Measure's Scheme Plan (The Great Baekdu Mountain Range's Environmental Protection Study)
Date & Time	2000. 10. ~ 2001. 4.
Place	Gangwon Province
Management Organization /Department	Ministry of Environment
Host Organization /Department	Nature Conservation Bureau
Commenter /Presenter	Various Government Departments and NGOs

2)

Title	Feasibility Study for the Construction Wind Farms in Gangwon Province
Date & Time	2000. 6. ~ 2001. 8.
Place	Gangwon Province
ıagement Organization /Department	Gangwon Province
Host Organization /Department	Korea Institute of Energy Research
Remark	Inspection of the feasibility study for the construction wind farms in Gangwon Province by a third party.

3)

Title	Open Forum for the legislature improvement of the Alternative Energy Use and Diffusion Promotion
Date & Time	2001. 7. 20. 14:00 ~ 17:00
Place	Korea Energy Economics Institute
Management Organization /Department	Ministry of Commerce, Industry and Energy, Korea Energy Management Corporation

Host Organization /Department	Korea Energy Economics Institute
Commenter /Presenter	Unison Co., Ltd. Various Government Departments NGOs (Including Korean Federation for Environmental Movement) Universities' Research Centers Companies related to new and renewable energy sources and anyone who wants to give his/her opinions

4)

Title	**Conference for the reasonable price settings and technology development policies for the promotion of the energy alternatives**
Date & Time	2001. 11. 22. 10:00 ~ 12:00
Place	Sejong Center Conference Room
Management Organization /Department	Citizens' Movement for Environmental Justice
Host Organization /Department	Korea NGO's Energy Network
Commenter /Presenter	Korea Environment Institute Korea Energy Economics Institute Korea Energy Management Corporation Incheon University Korea University

5)

Title	**Energy System's Switchover and New & Renewable Energy (The National Assembly Environment Economy Study Society's Policy Symposium)**
Date & Time	2002. 2. 1. 14:00 ~ 17:00
Place	The National Assembly Center Conference Room
Host Organization /Department	The National Assembly Environment Economy Study Society Centre for Energy Alternative at Korean Federation for Environmental Movement
Commenter /Presenter	Centre for Energy Alternative The National Assembly Unison Co., Ltd. Various government departments

6)

Title	**Forum - Environmental Impact and Feasibility Study of the Wind Park Construction in Great Baekdu Mountain Range**
Date & Time	2002. 1. 29. 14:00 ~ 17:00
Place	Jongro Catholic Cathedral Conference Hall

Host Organization /Department	Green Korea United Center for Energy Alternative Korea NGO's Energy Network
Commenter /Presenter	Unison Co., Ltd. Sangji University Center for Energy Alternative Green Korea United Ministry of Environment Korea Forest Service Ministry of Commerce, Industry and Energy

G.2. Summary of the comments received:

Along with Prior Environmental Review (PER) in section F, a number of researches, forums, and conferences were held by various governmental/non-governmental organizations to collect/reflect public opinions and concerns on this CDM project. The subjects that were dealt with in those researches, forums, and conferences were as follows,

- The Great Baekdu Mountain Range(the biggest Korean Mountain range) environmental protection;
- The impact of constructing the wind farms;
- Wind energy as a new & renewable energy source;
- The reasonable price setting for grid connected electricity from new and renewable energy;
- Energy system transformation in Korea.
- The impact on aviation opeation
- The impact on a military facility

The PER was conducted to assess the impacts on environment, aviation opeartion and militaty facility in the project region. There were no serious impacts.

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

Stakeholders accepted the measures taken by GaWiP and had no objection to the development of new & renewable energy which is environmentally friendly and sustainable. However, the following matters had been discussed extensively from the beginning of the plan of construction.

At first, the comment to the Great Baekdu Mountain Range was the most serious one among the stakeholders' comments. To solve the issue, GaWiP took the following measures. First of all, Unison diminished the number of the turbine generators (At the 1st stage, 14 generators of 2000KW will be constructed instead of the planned 75 generators of 750KW capacity, and in the 2nd stage, the plan of construction of 28 generators of 1500KW capacity will be changed to 35 generators of 2000KW capacity and shifted the generators to most suitable place). Secondly, GaWiP agreed to monitor environmental impact regularly under the committee composed of NGOs, experts, governmental officers and a representative person from GaWiP to the period from 2005 to 2008.

At second, restoration of the ecosystem in the vicinity after the completion of construction was discussed. Right after the construction completion, GaWiP will restore the ecosystem.

There are no other serious concerns.

**Note: all the related document of researches, forums, and conferences is submitted to Korea Energy Management Coperation as an Applicant Entity to validate.*

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	UNISON
Street/P.O.Box:	803
Building:	
City:	Cheonan
State/Region:	Jangsan – Ri, Soosin-Myun, Choongnam
Postfix/ZIP:	330-882
Country:	The republic of KOREA
Telephone:	+82-41-620-3456
FAX:	+82-41-552-7416
E-Mail:	
URL:	Http://www.unison.co.kr
Represented by:	
Title:	CEO
Salutation:	Mr
Last Name:	Lee
Middle Name:	
First Name:	Tae - Hwa
Department:	Unison
Mobile:	
Direct FAX:	+82-41-620-3456
Direct tel:	+82-41-552-7416
Personal E-Mail:	leekc@unison.co.kr

Organization:	Gangwon Wind Power co., Ltd
Street/P.O.Box:	14-209
Building:	
City:	
State/Region:	Hoenggye-Ri, Do-am, Gangwon – do
Postfix/ZIP:	232-950
Country:	The republic of KOREA
Telephone:	+82-33-335-8777
FAX:	+82-33-335-4321
E-Mail:	
URL:	
Represented by:	
Title:	CEO
Salutation:	Mr
Last Name:	Lee
Middle Name:	
First Name:	Gun–woo
Department:	
Mobile:	+82-11-9098-1880
Direct FAX:	+82-2-553-6415
Direct tel:	+82-2-528-8777
Personal E-Mail:	gwlee@unison.co.kr

Organization:	ecoeye. Co., Ltd.
Street/P.O.Box:	153
Building:	Lordland EZ Building #607
City:	Seongnam
State/Region:	Gu-mi dong
Postfix/ZIP:	463-810
Country:	Republic of KOREA
Telephone:	+82-31-716-2108
FAX:	+82-31-716-1848
E-Mail:	
URL:	Http://www.ecoeye.com
Represented by:	
Title:	CEO
Salutation:	Dr.
Last Name:	Jung
Middle Name:	
First Name:	Jae-su
Department:	
Mobile:	+82-19-331-1675
Direct FAX:	+82-31-716-1848
Direct tel:	+82-31-716-1648
Personal E-Mail:	civilenvi@ecoeye.com

Organization:	Marubeni Corporation
Street/P.O.Box:	4-2, Ohtemachi 1Chome, Chiyoda-ku
Building:	
City:	Tokyo
State/Region:	
Postfix/ZIP:	100-8088
Country:	Japan
Telephone:	+81-3-3282-2111
FAX:	
E-Mail:	
URL:	http://www.marubeni.com/index.html
Represented by:	
Title:	Assistant General Manager
Salutation:	
Last Name:	Fukuda
Middle Name:	
First Name:	Tomofumi
Department:	Overseas Power Project Department -II
Mobile:	
Direct FAX:	+81-3-3286-9128
Direct tel:	+81-3-3286-9139
Personal E-Mail:	Fukuda-t@mpdc.marubeni.co.jp

Organization:	Eurus Energy Japan Corporation
Street/P.O.Box:	11-30, Akasaka 1-Chome, Mitato-ku
Building:	5F Akasaka 1-Chome Center Building,
City:	Tokyo
State/Region:	
Postfix/ZIP:	107-0052
Country:	Japan
Telephone:	+81-3-5561-6245
FAX:	+81-3-5561-6247
E-Mail:	
URL:	http://www.euruw-energy.com
Represented by:	
Title:	Assistant Manager
Salutation:	Mr
Last Name:	Ito
Middle Name:	
First Name:	Takeshi
Department:	Business Development Department
Mobile:	+81-90-4952-5284
Direct FAX:	+81-3-5561-6247
Direct tel:	+81-3-5561-6245
Personal E-Mail:	takeshi.ito@eurus-energy.com

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 included in Annex I.

Annex 3
BASELINE INFORMATION

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

Energy sources	Plant Name		Fuel consumption 2001 (ton)	Fuel consumption 2002 (ton)	Fuel consumption 2003 (ton)
bituminous	Honam	#1	813,044	732,433	633,609
		#2	569,859	782,381	832,014
	Samchonpo	#1	1,595,498	1,570,717	1,535,849
		#2	1,688,414	1,478,115	1,680,305
		#3	1,646,890	1,546,947	1,634,224
		#4	1,410,390	1,468,736	1,710,195
		#5	1,451,065	1,296,193	1,430,182
		#6	1,443,882	1,492,369	1,436,503
	Boryeong	#1	1,300,071	1,522,646	1,263,072
		#2	1,339,767	1,488,547	1,311,401
		#3	1,449,739	1,240,289	1,478,200
		#4	1,282,594	1,485,354	1,355,767
		#5	1,455,110	1,336,613	1,468,153
		#6	1,316,335	1,488,931	1,343,310
	Taean	#1	1,402,055	1,203,424	1,466,761
		#2	1,435,608	1,342,878	1,333,563
		#3	1,401,825	1,290,663	1,459,118
		#4	1,294,811	1,381,903	1,358,587
		#5	382,489	1,375,995	1,243,228
		#6		979,172	1,335,853
	Hadong	#1	1,412,653	1,358,393	1,476,164
		#2	1,306,611	1,458,164	1,377,617
		#3	1,309,524	1,449,498	1,362,366
		#4	1,416,125	1,360,689	1,483,166
		#5	1,263,113	1,434,705	1,375,276
		#6	990,916	1,307,355	1,473,500
	Dangjin	#1	1,513,159	1,457,856	1,369,223
		#2	1,342,419	1,426,409	1,360,761
		#3	1,479,074	1,277,914	1,488,422
		#4	1,206,326	1,275,932	1,501,207

Energy sources	Plant Name		Fuel consumption 2001 (kl)	Fuel consumption 2002 (kl)	Fuel consumption 2003 (kl)
	Yongdong	#1	59,000	61,610	60,999
		#2	104,948	94,104	99,181
	Kunsan		52,151	61,520	71,207
	Seocheon	#1	97,351	80,333	83,374
		#2	93,107	93,068	85,375
	Honam	#1	3,524	3,619	3,528
		#2	9,905	3,264	641
		#1	137,610	169,437	113,103

		#2	168,541	160,954	104,734
		#3	136,520	174,584	109,039
		#4	545,552	424,713	361,447
		#5	453,209	340,975	484,842
		#6	456,791	407,525	327,005
	Youngnam	#1	181,259	168,139	250,280
		#2	149,377	131,462	223,269
	Yosu Ⅱ (Yosu)	#1	174,007	167,477	173,830
		#2	300,864	226,755	85,905
	Pyongtaek	#1	467,148	361,196	343,765
		#2	462,488	379,819	325,723
		#3	541,159	340,527	329,779
		#4	541,043	302,867	361,331
	Seoul	#4	1,051		
		#5	4,219		
	Incheon	#1		15,908	22,390
		#2		18,368	22,656
		#3		12,112	24,998
		#4		12,286	23,774
	Namjeju	#1	8,983	8,449	12,520
		#2	9,109	9,565	12,216
	Jeju	#1	9,221	7,508	10,363
		#2	110,806	123,477	107,856
		#3	121,402	111,071	124,954
	Namjeju	D/P	50,054	55,233	56,401
Diesel Oil	Yongdong	#1	92	61	98
		#2	151	176	244
	Donghae	#1	2,216	1,887	1,460
		#2	2,006	976	1,834
	Kunsan		171	125	97
	Seocheon	#1	63	111	76
		#2	56	41	56
	Honam	#1	851	564	409
		#2	1,096	620	366
	Samchonpo	#1	709	994	1,144
		#2	521	960	657
		#3	377	734	838
		#4	828	675	299
		#5	945	1,291	2,118
		#6	898	840	1,570
	Yonghung	#1			1,636
	Boryeong	#1	787	308	968
		#2	776	552	934
		#3	267	372	59
		#4	587	174	307
		#5	158	781	152
		#6	751	113	356
	Taean	#1	455	918	319
		#2	122	401	730

		#3	249	235	193
		#4	343	152	628
		#5	5,777	1,633	994
		#6		6,021	1,011
	Hadong	#1	818	584	390
		#2	565	133	445
		#3	818	125	613
		#4	558	625	302
		#5	786	484	435
		#6	1,806	316	223
	Dangjin	#1	312	439	926
		#2	583	628	787
		#3	470	868	510
		#4	1,977	1,041	746
	Ulsan	#1	121	848	484
		#2	612	372	1,061
		#3	199	281	500
		#4	714	676	1,450
		#5	1,215	836	1,740
		#6	918	987	1,525
	Youngnam	#1	1,093	1,109	1,024
		#2	364	279	270
	Yosu Ⅱ (Yosu)	#1	462	436	370
		#2	425	163	86
	Pyongtaek	#1	1,178	364	167
		#2	1,160	289	195
		#3	1,324	460	111
		#4	814	384	123
	Seoul	#4	24	11	
		#5	5	9	4
	Incheon	#1	118	98	6
		#2	303	97	6
		#3	632	135	247
		#4	336	251	170
	Pyongtaek	C/C	3,577	43,827	96,032
	Ilsan	C/C		20,350	40,006
	Bundang	C/C		66	
	Ulsan	C/C	2,191	20,902	63,295
	Seoincheon	C/C	147	17,631	44,792
	Shinincheon	C/C		17,219	47,393
	Boryeong	C/C		13,907	97,106
	Busan	C/C			1,213
	Hallim	C/C	12,398	26,967	16,286
	K I E Co.	(")		52,608	103,057
	L G Bugog	(")	4,905	5,370	67,273
	Namjeju	D/P	139	75	84
	Namjeju	#1	14	22	20
		#2	13	21	24
	Jeju	#1	8	15	23

		#2	68	16	65
		#3	11	24	-

Energy sources	Plant Name		Fuel consumption 2001 (ton)	Fuel consumption 2002 (ton)	Fuel consumption 2003 (ton)
LNG	Pyongtaek	#1		1,407	2,727
		#2	2	1,201	2,402
		#3	363	1,385	2,238
		#4	62	1,335	2,370
	Seoul	#4	80,791	23,145	32,670
		#5	147,032	175,058	126,211
	Incheon	#1	35,943	39,155	25,930
		#2	9,957	40,762	28,612
		#3	26,705	18,751	34,035
		#4	28,363	19,824	24,093
	Pyongtaek	C/C	86,678	99,363	76,012
	Ilsan	C/C	470,825	510,283	530,874
	Bundang	C/C	612,789	604,893	598,396
	Ulsan	C/C	286,427	255,078	189,997
	Seoincheon	C/C	790,415	1,086,293	1,012,670
	Shinincheon	C/C	1,294,685	1,416,960	1,405,724
	Boryeong	C/C		454,503	571,742
	Busan	C/C			234,533
	Anyang C/C	(Other co.)	253,641	338,303	325,207
	Bucheon C/C	(")	222,616	244,828	266,577
	K I E Co.	(")	322,693	501,648	381,684
	L G Bugog	(")	120,680	147,849	121,037

Source: KEPCO, 2004

<Table 2> CEF Calculation for the Operating Margin in 2001, 2002, 2003

Plant Name		MWh Produced in 2001	MWh Produced in 2002	MWh Produced in 2003	CEF ($t CO_2$ / MWh) 2001	CEF ($t CO_2$ / MWh) 2002	CEF ($t CO_2$ / MWh) 2003
Honam	#1	1,654,238	1,508,303	1,372,873	1.0293	1.0386	1.0286
	#2	1,166,318	1,623,572	1,784,483	1.0319	1.0310	1.0249
Samchonpo	#1	3,956,496	4,006,965	3,745,916	0.9057	0.9047	0.9310
	#2	4,182,559	3,755,823	4,110,134	0.9053	0.9056	0.9277
	#3	4,128,627	3,976,257	4,051,427	0.8984	0.8974	0.9183
	#4	3,547,485	3,763,370	4,250,404	0.8987	0.8984	0.9144
	#5	3,557,295	3,320,736	3,606,167	0.8749	0.8767	0.8890
	#6	3,533,879	3,814,588	3,609,696	0.8742	0.8757	0.8915
Boryeong	#1	3,324,720	3,905,038	3,237,526	0.9193	0.9154	0.9192
	#2	3,433,238	3,824,457	3,380,013	0.9162	0.9138	0.9155
	#3	3,988,774	3,390,363	4,090,927	0.8781	0.8776	0.8770
	#4	3,535,359	4,069,374	3,754,883	0.8780	0.8772	0.8765
	#5	4,003,616	3,662,540	4,063,865	0.8771	0.8770	0.8770
	#6	3,617,331	4,076,351	3,709,092	0.8774	0.8773	0.8771
Taean	#1	3,902,127	3,335,520	3,995,111	0.8808	0.8827	0.8808
	#2	3,992,430	3,735,044	3,651,716	0.8812	0.8808	0.8781
	#3	3,899,517	3,586,755	3,994,351	0.8805	0.8810	0.8773
	#4	3,611,486	3,857,072	3,708,360	0.8795	0.8781	0.8816
	#5	1,078,217	3,842,365	3,370,362	0.8936	0.8828	0.8820
	#6		2,721,769	3,637,652		0.8912	0.8797
Hadong	#1	3,916,473	3,763,669	3,995,331	0.8788	0.8772	0.8819
	#2	3,624,182	4,033,255	3,739,800	0.8780	0.8787	0.8786
	#3	3,632,118	3,995,847	3,694,945	0.8799	0.8815	0.8798
	#4	3,919,211	3,763,399	4,029,035	0.8794	0.8790	0.8780
	#5	3,505,571	3,976,839	3,733,243	0.8779	0.8769	0.8793
	#6	2,740,236	3,620,142	4,013,010	0.8829	0.8779	0.8754
Dangjin	#1	4,075,491	3,997,354	3,677,169	0.8817	0.8795	0.8825
	#2	3,637,873	3,923,487	3,685,913	0.8788	0.8779	0.8776
	#3	3,994,426	3,514,316	4,034,969	0.8789	0.8793	0.8778
	#4	3,300,912	3,519,919	4,096,642	0.8786	0.8744	0.8706

Ulsan	#1	518,504	650,428	430,067	0.8319	0.8254	0.8346
	#2	636,366	621,740	404,834	0.8313	0.8218	0.8248
	#3	512,060	667,893	414,630	0.8349	0.8229	0.8349
	#4	2,269,846	1,778,566	1,507,363	0.7610	0.7641	0.7654
	#5	1,878,656	1,415,550	2,025,171	0.7655	0.7699	0.7633
	#6	1,894,110	1,698,585	1,363,879	0.7648	0.7683	0.7658
Youngnam	#1	695,075	664,185	890,011	0.8367	0.8102	0.8323
	#2	567,843	506,254	753,536	0.8419	0.8278	0.8601
Yosu Ⅱ (Yosu)	#1	704,390	686,062	703,557	0.7943	0.7856	0.7920
	#2	1,139,975	878,464	328,981	0.8507	0.8301	0.8365
Pyongtaek	#1	2,007,440	1,535,696	1,465,460	0.7398	0.7505	0.7402
	#2	1,985,214	1,625,568	1,393,188	0.7406	0.7449	0.7435
	#3	2,304,541	1,434,408	1,400,056	0.7462	0.7579	0.7485
	#4	2,310,073	1,282,597	1,539,552	0.7433	0.7539	0.7455
Namjeju	#1	27,069	26,182	38,080	1.0604	1.0309	1.0400
	#2	27,364	29,181	36,860	1.0635	1.0470	1.0488
Jeju	#1	26,936	22,410	30,288	1.0876	1.0771	1.1001
	#2	446,333	506,993	439,474	0.7887	0.7792	0.7829
	#3	487,696	453,911	513,880	0.7905	0.7828	0.7752
Seoul	#4	344,809	96,233	132,599	0.7224	0.7327	0.7492
	#5	632,944	750,457	503,383	0.7278	0.7100	0.7618
Incheon	#1	178,216	263,763	225,023	0.6159	0.4525	0.6641
	#2	45,481	279,809	242,806	0.6843	0.4439	0.6527
	#3	127,560	142,944	267,999	0.6508	0.4016	0.6825
	#4	139,932	150,246	214,153	0.6236	0.4060	0.6942
Pyongtaek		531,905	792,480	863,292	0.5150	0.5342	0.5728
Ilsan		2,590,534	2,913,131	3,097,425	0.5547	0.5529	0.5570
Bundang		3,402,745	3,392,511	3,344,852	0.5488	0.5435	0.5447
Ulsan		1,950,726	1,837,604	1,557,954	0.4500	0.4542	0.4835
Seoincheon		5,126,411	7,381,775	7,012,289	0.4691	0.4539	0.4566
Shinincheon		9,446,610	10,460,040	10,459,986	0.4169	0.4163	0.4211
Boryeong			3,055,340	4,436,234		0.4658	0.4533
Busan				1,574,883			0.4544
Hallim		37,911	97,221	55,044	0.9042	0.7629	0.8141

Anyang (Other co.)	1,393,923	1,909,128	1,793,725	0.5542	0.5404	0.5521
Bucheon (Other co.)	1,207,903	1,339,949	1,454,854	0.5598	0.5558	0.5575
K I E Co. (Other co.)	1,845,928	3,312,541	2,683,591	0.5318	0.5053	0.5397
LG Bugog (Other co.)	874,368	1,091,904	1,221,992	0.4360	0.4262	0.4539
Namjeju(D/P)	237,523	262,357	265,063	0.6744	0.6724	0.6730
Total	**151,015,125**	**163,898,596**	**166,911,025**	**0.7946**	**0.7794**	**0.7815**

Source: KEPCO, 2004

<Table 3> Sample group plants used in the Build Margin calculation and Carbon Emission Factor of the Build Margin.

Plant Name	Technology	year operational	Fuel	MWh Produced in 2003	% of total output	CEF	Weighted average CEF ($t CO_2 / MWh$)
Wunjeong LFG	steam by LFG	2003	LFG	802	1.33E-03	0	0
Andong(small)	small hydro power	2003	hydro	798	1.32E-03	0	0
Daejon Geumgodong	steam by LFG	2003	LFG	2,838	4.71E-03	0	0
Busan C/C	combined cycle power	2003	L.N.G/Diesel oil	1,574,883	2.62E+00	0.4544	0.0119
Hoicheon ENC	steam by LFG	2003	LFG	5,655	9.39E-03	0	0
Seohee- ENC	steam by LFG	2003	LFG	21,895	3.64E-02	0	0
Muju	small hydro power	2003	hydro	827	1.37E-03	0	0
Sangwon ENC	steam by LFG	2003	LFG	43,773	7.27E-02	0	0
Yonggwang #6	nuclear power	2002	Uranium	7,656,278	1.27E+01	0	0
Taean #6	steam	2002	bituminous coal	3,637,652	6.04E+00	0.8797	0.0531
Yonggwang #5	nuclear power	2002	Uranium	6,689,440	1.11E+01	0	0
Sanchong	small hydro power	2001	hydro	0	0.00E+00	0	0
Sanchong pumping #2	pumping	2001	hydro	333,619	5.54E-01	0	0
Milyang	small hydro power	2001	hydro	8,271	1.37E-02	0	0
Taean #5	steam	2001	bituminous coal	3,370,362	5.60E+00	0.8820	0.0494
Sanchong pumping #1	pumping	2001	hydro	354,988	5.89E-01	0	0
Yongdam	hydro	2001	hydro	142,739	2.37E-01	0	0

Yeongcheon	small hydro power	2001	hydro	5,263	8.74E-03	0	0
Hadong #6	steam	2001	bituminous coal	4,013,010	6.66E+00	0.8754	0.0583
L G Bugog	G/T & S/T	2000~2001	L.N.G/Diesel oil	1,221,992	2.03E+00	0.4539	0.0092
Dangjin #4	steam	2001	bituminous coal	4,096,642	6.80E+00	0.8706	0.0592
Jeju #3	steam	2000	heavy oil	513,880	8.53E-01	0.7752	0.0066
Dangjin #3	steam	2000	bituminous coal	4,034,969	6.70E+00	0.8778	0.0588
Hoengseong	small hydro power	2000	hydro	6,331	1.05E-02	0	0
Hadong #5	steam	2000	bituminous coal	3,733,243	6.20E+00	0.8793	0.0545
Imgi	small hydro power	2000	hydro	5,338	8.86E-03	0	0
Jeju #2	steam	2000	heavy oil	439,474	7.30E-01	0.7829	0.0057
Ulchin #4	nuclear power	1999	Uranium	7,922,455	1.32E+01	0	0
Dangjin #2	steam	1999	bituminous coal	3,685,913	6.12E+00	0.8776	0.0537
Wolsong #4	nuclear power	1999	Uranium	5,646,819	9.38E+00	0	0
Donghae #2	steam	1999	anthracite coal	1,044,650	1.73E+00	1.0556	0.0183
Seongju	small hydro power	1999	hydro	6,987	1.16E-02	0	0
Total				**60,221,784**	**100**		**0.4388**

Source : KEPCO, 2004

The total electricity generation provided to the grid in the year of 2003 is 303,347GWh, and for the BM calculation, the sample plants' generation provided to the grid in the year of 2003 is 60,221GWh as 20% of the total. The sample group plants are selected based on "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" from ACM0002.

<Table 4> Fuels Carbon Emission Factor (tC/TJ)

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

<Table 5> Net Calorific Values by Power Plant in 2001

Plant Name		Caloric values (by source in 2001)			
		Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
Honam	#1	5,354	9,886	8,979	-
	#2	5,287	9,885	8,966	-
Samchonpo	#1	5,784	-	8,994	-
	#2	5,776	-	8,996	-
	#3	5,802	-	8,987	-
	#4	5,821	-	8,998	-
	#5	5,522	-	8,999	-
	#6	5,509	-	9,002	-
Boryeong	#1	6,054	-	8,989	-
	#2	6,046	-	8,996	-
	#3	6,225	-	8,993	-
	#4	6,233	-	8,903	-
	#5	6,218	-	8,968	-
	#6	6,209	-	9,004	-
Taean	#1	6,314	-	9,022	-
	#2	6,314	-	9,016	-
	#3	6,310	-	7,398	-
	#4	6,319	-	10,192	-
	#5	6,383	-	9,013	-
	#6				
Hadong	#1	6,274	-	8,949	-
	#2	6,272	-	8,924	-
	#3	6,284	-	8,941	-
	#4	6,268	-	8,937	-
	#5	6,274	-	8,957	-
	#6	6,279	-	8,937	-
Dangjin	#1	6,118	-	8,872	-
	#2	6,134	-	8,928	-
	#3	6,114	-	8,913	-
	#4	6,183	-	8,931	-
Ulsan	#1	-	9,769	9,157	-
	#2	-	9,758	9,118	-
	#3	-	9,755	9,136	-
	#4	-	9,865	9,123	-
	#5	-	9,873	9,125	-
	#6	-	9,874	9,120	-
Youngnam	#1	-	9,955	8,993	-

	#2	-	9,961	8,997	-
Yosu	#1	-	10,005	8,946	-
	#2	-	10,041	8,976	-
Pyongtaek	#1	-	9,893	9,149	-
	#2	-	9,893	9,144	15,000
	#3	-	9,884	9,147	13,017
	#4	-	9,885	9,149	12,952
Namjeju	#1	-	9,953	8,643	-
	#2	-	9,952	9,077	-
Jeju	#1	-	9,902	9,125	-
	#2	-	9,904	8,897	-
	#3	-	9,904	8,727	-
Seoul	#4	-	9,713	9,208	13,018
	#5	-	9,711	9,400	13,026
Incheon	#1	-	-	9,025	13,031
	#2	-	-	9,010	13,016
	#3	-	-	9,011	13,024
	#4	-	-	9,027	13,027
Pyongtaek	C/C	-	-	9,238	13,024
Ilsan	C/C	-	-	-	13,062
Bundang	C/C	-	-	-	13,041
Ulsan	C/C	-	-	9,189	13,025
Seoincheon	C/C	-	-	9,082	13,018
Shinincheon	C/C	-	-	-	13,019
Hallim	C/C	-	-	9,008	-
Anyang C/C	(Other co.)	-	-	-	13,035
Bucheon C/C	(")	-	-	-	13,000
K I E Co.	(")	-	-	-	13,020
L G Bugog	(")	-	-	9,100	13,033
Namjeju	D/P	-	9,958	8,906	-

Source: KEPCO, 2004

<Table 6> Net Calorific Values by Power Plant in 2002

Plant Name		Caloric value (by source in 2002)			
		Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
Honam	#1	5,465	9,896	8,871	-
	#2	5,473	9,922	8,870	-
Samchonpo	#1	5,943	-	9,000	-
	#2	5,925	-	8,999	-
	#3	5,941	-	9,001	-
	#4	5,928	-	9,002	-
	#5	5,781	-	9,000	-
	#6	5,764	-	9,000	-
Boryeong	#1	6,048	-	8,943	-
	#2	6,047	-	8,936	-
	#3	6,180	-	8,749	-
	#4	6,192	-	8,749	-
	#5	6,188	-	8,749	-
	#6	6,188	-	8,749	-
Taean	#1	6,299	-	9,013	-
	#2	6,310	-	9,013	-
	#3	6,307	-	9,013	-
	#4	6,314	-	9,013	-
	#5	6,344	-	9,013	-
	#6	6,340	-	9,013	-
Hadong	#1	6,260	-	9,002	-
	#2	6,262	-	8,975	-
	#3	6,261	-	8,983	-
	#4	6,262	-	8,993	-
	#5	6,261	-	8,983	-
	#6	6,262	-	8,983	-
Dangjin	#1	6,212	-	9,378	-
	#2	6,220	-	8,916	-
	#3	6,226	-	9,627	-
	#4	6,210	-	8,939	-
Ulsan	#1	-	9,838	9,120	-
	#2	-	9,881	9,120	-
	#3	-	9,805	9,120	-
	#4	-	9,967	9,123	-
	#5	-	9,948	9,123	-
	#6	-	9,966	9,123	-
Youngnam	#1	-	9,926	8,971	-
	#2	-	9,924	8,974	-

Yosu	#1	-	10,015	8,979	-
	#2	-	10,024	8,981	-
Pyongtaek	#1	-	9,907	9,095	12,949
	#2	-	9,907	9,102	12,939
	#3	-	9,908	9,101	12,945
	#4	-	9,905	9,081	12,956
Namjeju	#1	-	9,942	8,866	-
	#2	-	9,944	8,865	-
Jeju	#1	-	10,009	9,238	-
	#2	-	9,977	8,928	-
	#3	-	9,975	8,928	-
Seoul	#4	-	-	9,070	13,033
	#5	-	-	9,070	13,025
Incheon	#1	-	-	8,985	13,015
	#2	-	-	8,986	13,013
	#3	-	-	8,993	13,018
	#4	-	-	8,988	13,019
Pyongtaek	C/C	-	-	8,969	13,036
Ilsan	C/C	-	-	8,934	13,040
Bundang	C/C	-	-	8,970	13,044
Ulsan	C/C	-	-	9,049	13,029
Seoincheon	C/C	-	-	9,104	13,006
Shinincheon	C/C	-	-	9,096	13,007
Boryeong	C/C	-	-	9,101	13,034
Hallim	C/C	-	-	8,961	-
Anyang C/C	(Other co.)	-	-	-	13,052
Bucheon C/C	(")	-	-	-	13,018
K I E Co.	(")	-	-	9,081	13,029
L G Bugog	(")	-	-	9,027	13,042
Namjeju	D/P	-	9950	8867	-

Source: KEPCO, 2004

<Table 7> Net Calorific Values by Power Plant in 2003

Plant Name		Caloric value (by source in 2003)			
		Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
Honam	#1	5,693	9,859	8,844	-
	#2	5,655	9,901	8,847	-
Samchonpo	#1	5,846	-	9,009	-
	#2	5,844	-	9,011	-
	#3	5,862	-	8,948	-
	#4	5,855	-	8,992	-
	#5	5,766	-	9,000	-
	#6	5,765	-	9,000	-
Boryeong	#1	6,066	-	8,942	-
	#2	6,075	-	8,944	-
	#3	6,254	-	8,749	-
	#4	6,254	-	8,777	-
	#5	6,254	-	8,749	-
	#6	6,239	-	8,749	-
Taean	#1	6,181	-	9,013	-
	#2	6,192	-	9,013	-
	#3	6,188	-	9,013	-
	#4	6,198	-	9,013	-
	#5	6,155	-	9,013	-
	#6	6,167	-	9,013	-
Hadong	#1	6,149	-	8,941	-
	#2	6,144	-	8,984	-
	#3	6,146	-	8,912	-
	#4	6,145	-	8,957	-
	#5	6,148	-	8,871	-
	#6	6,142	-	8,839	-
Dangjin	#1	6,102		8,892	-
	#2	6,121		8,904	-
	#3	6,129		8,889	-
	#4	6,118		8,893	-
Ulsan	#1	-	9,861	9,018	-
	#2	-	9,856	9,047	-
	#3	-	9,862	9,035	-
	#4	-	9,921	9,120	-
	#5	-	9,912	9,120	-
	#6	-	9,921	9,120	-
Youngnam	#1	-	9,196	8,997	-
	#2	-	9,043	8,993	-

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

Source: KEPCO, 2004

<Table 8> Results of CO_2 emission reductions

	Annual Emissions in tones of CO_2	Total over 10 years in tones of CO_2
Emission reduction	**149,536**	**1,495,363**

Annex 4

MONITORING PLAN

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 two years after the installation.

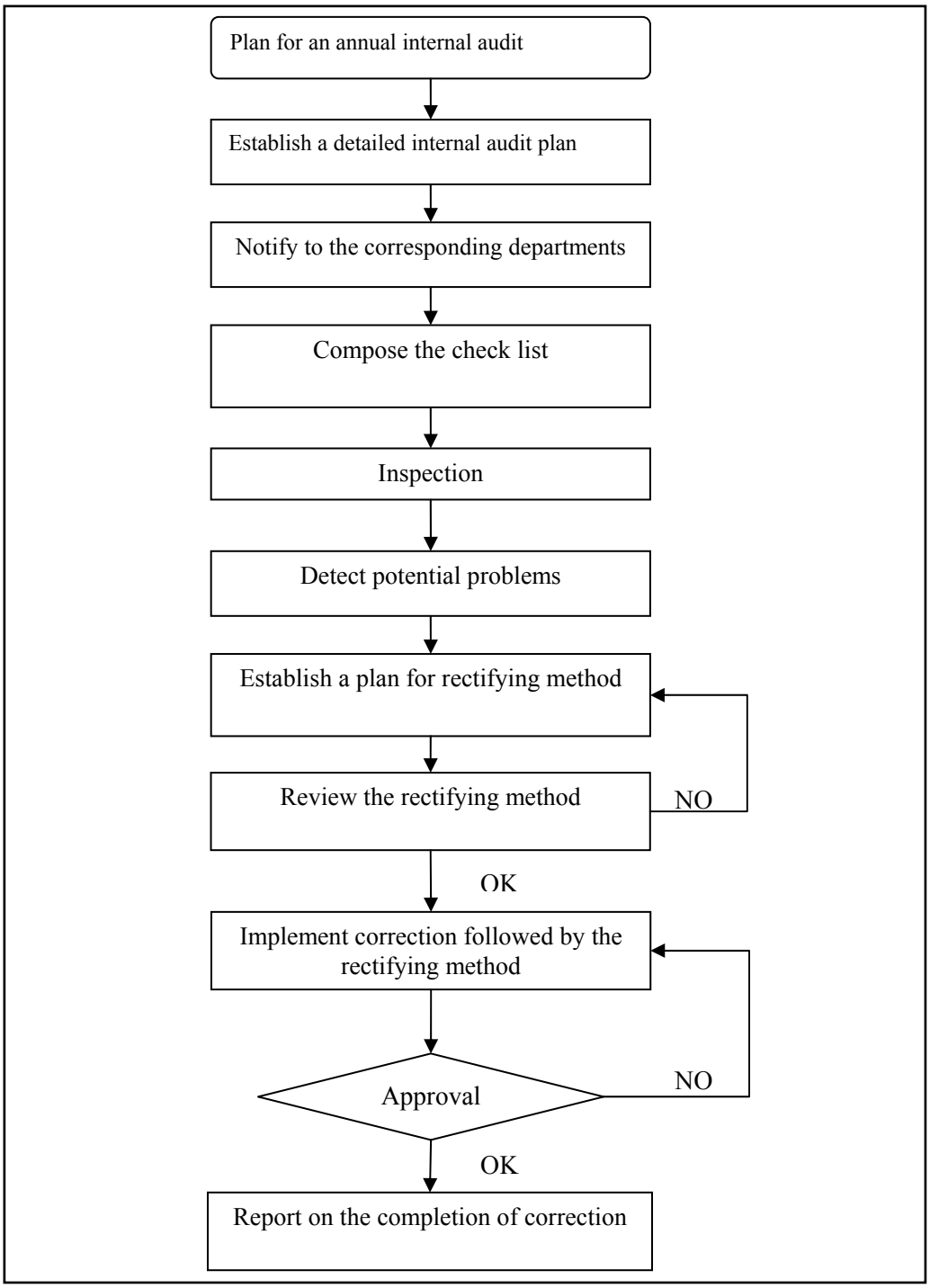
2. Monitoring of amount of electricity

2-1. The amount of electricity transmitted to the grid shall be measured automatically by the established meters. The measured variables are simultaneously transferred to GaWiP central control system.
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 variables in article 2-2. shall be compared with those of Korea power Exchange.
2-4. If the two variables compared in article 2-3. are different, the operation condition of electricity meters and other equipments shall be examined. In case meaters are improperly operated equipment, 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 once a 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, one shall be approved by the final decision-maker.



<Figure 7> Flowchart of internal investigation and correction procedure for Monitoring the Project Activity