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# VALIDATION REPORT

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***YANGYANG RENEWABLE ENERGY  
PROJECT (3MW WIND POWER +  
1.4MW SMALL HYDROELECTRIC  
POWER)***  
(UNFCCC Registration Ref. No.0784)

REPORT No. 2013-12

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**KOREAN FOUNDATION FOR QUALITY**



## VALIDATION REPORT

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Client:  Korea Midland Power Corporation (KOMIPO)		Client ref.:  Mr. Dong-hun Oh	

### Summary:

**Project Title :** Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power)

**Annex I Country :** N/A

**Host Country :** Republic of Korea

**Project Participants :** Korea Midland Power Corporation (KOMIPO)

**Applied Methodology(ver) :** AMS-I.D (Version 17.0)

**Sectoral Scope :** 1-Energy Industries: Renewable Electricity Generation for a grid

**Technology/Measure to be employed :** 3MW Wind Power + 1.4MW Small Hydroelectric Power

**Crediting Period :** 7 years renewable crediting period

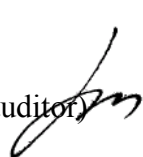

**Estimated ER :** 9,009 tCO<sub>2</sub>e/yr (5,539 tCO<sub>2</sub>e/yr for Wind Power and 3,470 tCO<sub>2</sub>e/yr for Small Hydroelectric Power)

**Project Size :** Small Scale

**Validation Report Status**

- ☐ CAR/CL Requested  
☐ Before DNA approval  
☐ Resolution of Outstanding issues  
☒ Validation opinion for renewal of crediting period

As the result of the validation for **Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power)** was based on the final PDD of 5 November 2013 (Version 5.2) meets all relevant UNFCCC requirements for the renewal of crediting period and all relevant host country criteria and correctly applies the baselines and monitoring methodology AMS-I.D (Version 17.0). KFQ thus requests the renewal of the crediting period for the project.

Work carried out by :  Pyung Hee JANG (Audit team Leader, GHG auditor)   Nam Hoon KIM (Audit team member, GHG auditor)	Work Verified by :  Yu Shim Jeong 
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## VALIDATION REPORT

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### Abbreviations

BM	Build Margin
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction
CL	Clarification request
CM	Combined Margin
CO <sub>2</sub>	Carbon dioxide
CO <sub>2</sub> e	Carbon dioxide Equivalent
DNA	Designated National Authority
EF	Emission Factor
GCV	Gross Calorific Value
GHG	Greenhouse gas(es)
KFQ	Korean Foundation for Quality
MoV	Means of verification
MP	Monitoring Plan
NCV	Net Calorific Value
NGO	Non-governmental Organisation
ODA	Official Development Assistance
OM	Operating Margin
PDD	Project Design Document
PP	Project Participant
UNFCCC	United Nations Framework Convention for Climate Change
VVS	Validation and Verification Standard

# VALIDATION REPORT

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# 1 INTRODUCTION

Korean Foundation for Quality (KFQ) has been engaged by Korea Midland Power Corporation (KOMIPO) to assess renewal of crediting period of registered CDM project, ‘Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power)’ (UNFCCC registration reference 0784) in Republic of Korea. This validation opinion summarizes the findings of the validation of renewal request for the project, performed on the basis of UNFCCC and host party’s criteria for CDM renewal, as well as criteria given to provide for consistent project operations, monitoring and reporting. UNFCCC criteria refer to Article 12 of the Kyoto Protocol, the CDM modalities and procedures and the subsequent decisions by the CDM Executive Board.

All the validation team’s conclusion and opinion on this project activity are made based on the PDD of version 5.2, 5 November 2013, as a basis of the final PDD has followed the structure and guidance in the latest relevant PDD template (F-CDM-PDD, Version 04.1) and the Guidelines for Completing the Project Design Document (Version 01.0).

The project is classified with sectoral scope 1- Energy Industries (Renewable Electricity: Generation for a grid). The wind power facility utilizes wind sources and hydropower plant utilizes water resources in Gongsujeonri, Seomyeon, Yangyang-gun, Gangwon Province. Total capacity of the project is 4.4MW (3MW wind power and 1.4MW small hydroelectric power), comprised of 2 sets of 1.5MW wind turbines on wind power and 2 units of 0.7MW hydroelectric turbines on hydropower. The expected annual electricity supply to the KEPCO Grid is 14,267MWh annually (8,463MWh for wind power and 5,804MWh for hydropower). Expected average CO<sub>2</sub> emission reduction is estimated to be 9,009 tCO<sub>2</sub>e per year and 63,063 tCO<sub>2</sub>e over the second 7 years crediting period.

## 1.1 Objective

The purpose of a validation is to have an independent third party assess for renewal of the project activity. In particular, the validity of the original baseline, estimated emission reductions, the monitoring plan (MP), and the project’s compliance with relevant UNFCCC and host countries criteria are validated in order to confirm that the updated baseline and monitoring plan is sound and reasonable and meets the stated requirements and identified criteria. Validation is a requirement for all CDM projects requesting for renewal and is seen as necessary to provide assurance to stakeholders of the quality of the project and its intended generation of certified emission reductions (CERs).

## 1.2 Scope

The validation scope is defined as an independent and objective review of the updated project design document (PDD), the validity of the original baseline scenario, estimated emission reductions, monitoring plan and other relevant documents. The information in these documents is reviewed against the criteria stated in section I of the Project Standard and the relevant decisions by the CDM Executive Board including the approved baseline and monitoring methodology. KFQ has, based on the recommendations in the Validation and Verification Standard (Version 04.0) employed a risk-based approach in the validation, focusing on the identification of significant risks for project implementation and the generation of CERs.

The validation is not meant to provide any consulting towards the client. However, stated requests for clarifications and/or corrective actions may provide input for improvement of the project design.

## 1.3 Description of the Project Activity

‘Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power)’ is a small-scale bundling project (wind power and small hydropower) in Gongsujeonri, Seomyeon, Yangyang-gun, Gangwon Province, Republic of Korea and the main objective of the project is to generate zero GHG emission electricity and contribute to sustainability of power generation of KEPCO Grid.

The physical components including the equipments for generating electricity and measuring generated electricity were confirmed as proposed in the PDD.

Project Title	Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power)
UNFCCC Registration Number	0784
Project Participant	- Korea Midland Power Corporation (KOMIPO)(Host party)
Location of the project	Gongsujeonri, Seomyeon, Yangyang-gun, Gangwon Province, Republic of Korea
Date of registration	10 February 2007
Crediting period	-Type: Renewable -First crediting period: 10 February 2007 ~ 9 February 2014

## 1.4 Validation Team

The validation team consisted as follows:

Pyung Hee JANG (Audit team Leader, GHG auditor)

Nam Hoon KIM (Audit team member, GHG auditor)

Technical review was implemented by a technical reviewer, Yu Shim Jeong.

The qualification of each individual verification team member and a technical reviewer are detailed in Appendix B and Appendix C to this report.

## 2 METHODOLOGY

The validation consists of the following three phases:

- I Desk review of the project design documents
- II On-site assessment and follow-up interviews with project stakeholders
- III The resolution of outstanding issues and the issuance of the final validation opinion.

Corrective Action Requests (CAR) are issued, where:

- i) mistakes have been made with a direct influence on project results;
- ii) applicable CDM requirements for renewal of crediting period have not been met; or
- iii) there is a risk that emission reductions cannot be monitored or calculated.

The term Clarification (CL) is issued where information is insufficient, unclear or not transparent enough to establish whether relevant requirement are met.

The validation team has assessed the proposed CAR/CL with a positive result and after closing the CAR/CL, the proponent has issued the final version of the PDD. On the basis of this, the final validation opinion was issued.

<i>Appendix A Table 1: Resolution of Corrective Action and Clarification Requests</i>			
<i>Corrective action requests and clarification requests</i>	<i>Relevant requirements</i>	<i>Summary of project owner response and validation team opinion</i>	<i>Validation conclusion</i>
<i>A Corrective Action Request or a Clarification Request, these should be listed in this section.</i>	<i>Relevant requirements, where the Corrective Action Request or Clarification Request are issued, are explained.</i>	<i>The responses given by the owner during the validation process and the opinion of validation team should be summarised in this section.</i>	<i>The conclusions should be included under "Final Conclusion".</i>

**Figure 1 Resolution of Corrective Action and Clarification Requests**

## 2.1 Desk review of the Documents

The Project Design Document (PDD) version 5.0 was submitted to the DOE on 29 August 2013 and was reviewed with additional background documents related to the project design including baseline and monitoring of the project. A complete list of all documents and proofs reviewed is in section 5, Reference, to this report.

Furthermore, main changes between the versions used for notification of renewal request intention and the final version submitted for renewal request are:

- Changes related to the CARs and CLs identified in the site visit
- Update Tool to calculate the emission factor for an electricity system from version 03.0.0 to version 04.0.0

## 2.2 On-site Assessment and Follow-up Interviews with Project Stakeholders

Issues identified by KFQ during the subsequent stages of the validation have been clarified through continuous communication with the project participants. The project participants have also provided underlying documentation for review by KFQ, confirming selected information and resolving issues identified during the validation activity.

In the period of 10 September 2013, KFQ performed interviews with project stakeholders to confirm selected information and to resolve issues identified in the document review. The main topics of the interviews are summarized in Table 1 below.

**Table 1 Interview topics**

Interviewed organisation	Interview topics
<ul style="list-style-type: none"> <li>▪ Korea Midland Power Corporation (KOMIPO)</li> <li>-Dong Hoon Oh</li> <li>-Jong Min Park</li> <li>-Gang Yong Seo</li> <li>-Eu Hoy Kim</li> <li>-Young Nam Yoon</li> <li>-Seok Joon Yoon</li> </ul>	<ul style="list-style-type: none"> <li>➤ <i>Application for renewal of the crediting period</i></li> <li>➤ <i>Project design</i></li> <li>➤ <i>Project operation, maintenance</i></li> <li>➤ <i>Monitoring status and monitoring plan</i></li> </ul>
<ul style="list-style-type: none"> <li>▪ Ecoeye Co., Ltd.</li> <li>- Jeong Hwan Lee</li> <li>- Da Jeong Jeong</li> </ul>	<ul style="list-style-type: none"> <li>➤ <i>Applicability of selected methodology</i></li> <li>➤ <i>Baseline validity</i></li> <li>➤ <i>Emission factor calculation</i></li> <li>➤ <i>Emission reductions calculation</i></li> </ul>

## 2.3 Resolution of Clarification and Corrective Action Requests

The objective of this phase of the validation is to resolve any outstanding issues which need to be clarified prior to KFQ's positive conclusion on the project design. In order to guarantee the



transparency of the validation process, the concerns raised by KFQ and responses provided by project participant are documented in table 1 of Appendix A.

For this project, two Corrective Action Requests (CARs) and one request for Clarifications (CLs) were issued. These requests were presented to the project participant in a CAR/CL report on 3 September 2013. The additional information provided by the project participant to address these requests and the final PDD of 5 November 2013 resolved all the Corrective Action Request and requests for Clarification to KFQ's entire satisfaction.

## **2.4 Internal Quality Control**

According to KFQ's Procedure for deciding whether to proceed request for renewal of crediting period, the final validation opinion underwent a technical review before being submitted to the UNFCCC. The technical review was performed by a technical reviewer qualified in accordance with KFQ's qualification scheme for CDM validation and verification.

# **3 VALIDATION FINDINGS**

## **3.1 Project participants and MoC**

The project participants are Korea Midland Power Corporation (KOMIPO) as the project owner (hereinafter, PP or Project owner) from the host Party, Republic of Korea. The party still meet the requirements to participate in the CDM.

The validation team checked the names of the project participants in the request for renewal of crediting period, Korea Midland Power Corporation (KOMIPO), is consistent with the names of the registered project participants for the project activity on the UNFCCC website<sup>1</sup> in accordance with para.305/VVS version 04.0.

## **3.2 Project Design**

Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power) is registered on 10 February 2007 with reference number of 0784. The project selected a renewable crediting period of 7 year and the first crediting period of the project is from 10 February 2007 to 9 February 2014. The project requests for renewal of the crediting period from 10 February 2014 to 9 February 2021.

The PO noticed the PO's intention to request for renewal of crediting period to UNFCCC secretariat through e-mail on 8 August 2013. The confirmation e-mail from the UNFCCC

secretariat to the PO was received on 9 August 2013. The validation team checked these e-mails from the PO and confirms that the notification was made in accordance with para. 244 of Clean Development Mechanism Project Cycle Procedure (Version 04.0).

The project has a total installed capacity of 4.4MW (3MW wind power and 1.4MW small hydroelectric power) and is expected to supply average 14,267MWh per year (8,463MWh for wind power and 5,804MWh for hydropower) for the second crediting period of 7 years. The expected CO<sub>2</sub> reduction is estimated to be 9,009 tCO<sub>2</sub>e per year and 63,063 tCO<sub>2</sub>e over the second 7 years crediting period.

The proposed project is not a debundled component of a large-scale project activity in accordance with the “Guidelines on assessment of debundling for SSC project activities (Ver. 03). The validation team confirmed following requirements through site visit inspection and document review as well as interview of the PO.

- (a) With the same project participants: No
- (b) In the same project category and technology/measure: No
- (c) Registered within the previous 2 years: No
- (d) Whose project boundary is within 1 km of the project boundary of the proposed small- scale activity at the closest point: No

The designed operational lifetime of the project is estimated as 20 years for wind power and 30 years for hydropower, which were confirmed through relevant document review for wind turbines and hydropower turbines & generators. The wind power project started operation from 28 June 2006 and the hydropower started from 22 August 2005. Accordingly, the lifetime of the project covers the second crediting period.

All descriptions of the project contained in the original and updated PDD were identified through objective evidences such as verification reports, and other relevant documents of the project activity as well as physical site visit.

The process undertaken to validate the accuracy and completeness of the project description includes document review and cross-check with the relevant approvals issued by local government. KFQ hereby is able to confirm that the project description in PDD is accurate and complete in all respects relevant to the renewal of crediting period.

### **3.3 Validity of Baseline**

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<sup>1</sup> <http://cdm.unfccc.int/Projects/DB/KFQ1141796981.11/view>

### 3.3.1 Applicability of the selected methodology to the project activity

‘Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power)’ in Gangwon Province of Korea applies the approved consolidated baseline methodology AMS-I.D “Grid connected renewable electricity generation (Version 17.0)”.

The validation team checked the final PDD against other reliable sources such as original PDD, the validation report, the monitoring reports, the verification reports, etc. And we confirmed that the methodology is applicable to the project as all relevant applicable conditions are met as follows.

The validation team confirms that the methodology is applicable to the project as all relevant applicable conditions are met as follows.

3MW Wind Power	1.4MW Small Hydroelectric Power
The project activity is a grid connected renewable power generation activity and is the installation of wind power plant that supplies electricity to a national grid (KEPCO grid). The project activity installed a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield project).	The project activity is a grid connected renewable power generation activity is the installation of hydro power plant that supplies electricity to a national grid (KEPCO grid). The project activity installed a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield project). This project consists under pumped storage power plant and reservoir is constructed for pumped storage power plant. Therefore if small hydropower plant was not constructed, this reservoir would be existed. As the project activity is implemented in the existing reservoir with no change in the volume of reservoir.
The installed capacity of the proposed project is 3MW, which is less than 15MW.	The installed capacity of the proposed project is 1.4MW, which is less than 15MW.
The project activity involves the utilisation of renewable wind resources.	The project activity involves the utilisation of renewable water resources.
The project activity does not involve switching from fossil fuels to renewable energy at the project site.	The project activity does not involve switching from fossil fuels to renewable energy at the project site.
The geographic and system boundaries of the national grid (KEPCO grid) are clearly identified and the relevant information of this	The geographic and system boundaries of the national grid (KEPCO grid) are clearly identified and the relevant information of this

grid is available.	grid is available.
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In addition, the methodology applied in the original PDD is AMS-I.D (Version 09) and the methodology applied in the monitoring plan revision is AMS-I.D (Version 17.0). The validation team confirms that the latest approved version of the methodology of AMS-I.D (Version 17.0) is correctly applied in the updated PDD on the basis of para.303/VVS (Version 04.0).

The validation team checked the registered PDD and conducted site-visit. And we confirmed that the methodology is applicable to the project as all relevant applicable conditions are met as follows.

In addition, the applicability conditions included in the tools applied and referred to above apply as follows:

**Table 2. The applicability conditions of the tools**

Tool	Applicability conditions	Applicability	Conclusion
Tool to calculate the emission factor for an electricity system (Version 04.0.0)	This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity, i.e. where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).	The proposed project activity is the installation of a wind power plant and hydropower plant supplying electricity to the Grid (KEPCO grid).	OK
	The tool is not applicable if the project electricity system is located partially or totally in an Annex-I country.	The project electricity system is located in a non-Annex I country.	OK

Based on thorough document review, interview and physical site-visit, KFQ concluded the applied baseline and monitoring methodology is applicable to the project activity.

### 3.3.2 Project boundary

According to the baseline and monitoring methodology AMS-I.D (version 17.0), the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the KEPCO Grid<sup>2</sup>. And selected sources/gases are also identified and described in the PDD correctly with valid justification for the project activity. For emission sources, which are not addressed by the applied methodology, and are expected to contribute more than 1% of the overall expected annual average emission reductions, have not been identified.

<sup>2</sup> Sole electricity grid system in Korea operated by KEPCO

**Table 3. The emission source of the project boundary**

Emissions	GHGs involved	Description
Baseline emissions	CO <sub>2</sub>	Main emission source in KEPCO Grid. The baseline emission factor for the project is determined ex-ante as a combined margin, consisting of combination of the operating margin (OM) and build margin (BM). The combined margin (CM) of the wind project is 0.6545 tCO <sub>2</sub> /MWh. The combined margin (CM) of the hydro project is 0.5980 tCO <sub>2</sub> /MWh.
Project emissions	N/A	Project emissions are regarded as zero as the project is wind and hydro power project in applying AMS-I.D (Version 17.0).
Leakage	N/A	No leakages need to be considered as per AMS-I.D (Version 17.0).

The identified boundary and selected sources and gases are justified for the project activity. The validation of the project activity did not reveal other greenhouse gas emissions occurring within the proposed CDM project activity boundary as a result of the implementation of the proposed project activity which are expected to contribute more than 1% of the overall expected average annual emission reduction, which are not addressed by AMS-I.D (Version 17.0).

### 3.3.3 Validity of the original baseline

As per the applied methodology, AMS-I.D (Version 17.0), the PP correctly addresses two issues required for methodology implementation in 2<sup>nd</sup> crediting periods:

- Assess the continued validity of the baseline; and
- Update the baseline

The validity of the baseline has been assessed using the methodological tool, “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period” (Version 03.0.1).

#### ***Step 1: Assess the validity of the current baseline for the next crediting period***

##### ***Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies***

Korean government has promoted some programs to propagate renewable energy system. There are “Act on the Promotion of the Development, Use and Diffusion of New and Renewable Energy” to promote the use of renewable energy. However, according to the guidance about E+/E-policies, the impacts of these policies can be excluded in establishing a baseline scenario if they have been implemented since the adoption of the Marrakesh Accords (11 November 2001). In accordance with the Accords, the policy which has been implemented to promote the use of

renewable energy in Korea can be regarded as if the policies did not exist because it was implemented since April 2010. Thus the validation team confirmed the current baseline complies with relevant mandatory nation and/or sectoral policies.

***Step 1.2: Assess the impact of circumstances***

The validation team assessed the existing circumstances, such as national regulations and policies, and confirmed that the existing circumstances do not impact on the current baseline emissions. The baseline scenario is identified as continuation of the current practice.

The conditions used to determine the baseline emissions in the first crediting period are still valid.

***Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.***

Not applicable. The project is a green field project.

***Step 1.4: Assessment of the validity of the data and parameters***

The data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period are not valid any more, such as IPCC default value in 1996 IPCC Guideline and emission factors. Thus, the data and parameters should be updated for the second crediting period.

Step 1 showed that the current baseline needs to be updated and thus, step 2 is applied in the PDD.

***Step 2: Update the current baseline and the data and parameters***

***Step 2.1: Update the current baseline***

The baseline emissions for the second crediting period have been updated in the B.6 of the PDD without reassessing the baseline scenario, based on the latest approved version of the methodology, AMS-I.D (Version 17.0), which is ‘*Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”*’.

***Step 2.2: Update the data and parameters***

The current baseline has been updated for the second crediting period according to the “Tool to calculate the emission factor for an electricity system (Version 04.0.0)” and is described in B.6.1 of the PDD.

The validation team confirms the validity of the data and parameters used for the proposed project. For detailed information, please refer to 3.3.4 Algorithms and/or formulae used to determine emission reductions of this validation report.

The validation team hereby confirms that baseline of the project is correctly defined according to AMS-I.D (Version 17.0) and “Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (Version 03.0.1)” and is the electricity delivered to the KEPCO Grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. The combined margin (CM) of wind power is correctly calculated applying  $W_{OM}$  0.75 and  $W_{BM}$  0.25 and hydro power is correctly applied as  $W_{OM}$  0.25 and  $W_{BM}$  0.75, which are correspondent with the “Tool to calculate the emission factor for an electricity system (Version 04.0.0)”.

The information presented in the PDD has been validated by KFQ through document review, interview and the site-visit. The sources referenced in the PDD have been quoted correctly and verified against credible sources such as tool, public websites and relevant national regulations.

The validation team checked the validity of the original baseline and its update are assessed on the basis of para.304/VVS version 04.0 as follows.

- The impact of new relevant national and/or sectoral policies and circumstances on the baseline taking into account relevant guidance from the Board with regard to renewal of the crediting period at the time of requesting renewal of crediting period;
- The correctness of the application of an approved baseline methodology for the determination of the continued validity of the baseline or its update, and the estimation of emission reductions for the applicable crediting period.

In conclusion, the validation team confirms the original baseline is valid and the baseline emission is reasonably updated and emission reduction is correctly estimated for the second crediting period.

### **3.3.4 Algorithms and/or formulae used to determine emission reductions**

According to AMS-I.D (Version 17.0), the baseline emissions are CO<sub>2</sub> emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The baseline emissions ( $BE_y$ ) are to be calculated as net electricity generation by the proposed project ( $EG_{PJ,y}$ ) multiplied by the grid emission factor ( $EF_{grid,CM,y}$ ). Therefore, electricity generation by proposed project activity and emission factor is assessed as follows:

### 1) Ex-ante calculation of net electricity generation supplied to the Grid ( $EG_{PJ,y}$ )

The net electricity generation for wind power and hydro power is calculated based on six year's historical net electricity generation (2007~2012) prior to the notification on renewal intention for the project activity to the secretariat (August 2013) and average range of fluctuation during this period. Thus the PO estimated the net electricity generation as 14,267MWh (8,463MWh for wind power and 5,804MWh for hydro power) which is same as the original PDD.

For wind power, the highest annual net electricity generation was 6,180.5MWh in 2010 and the average range of fluctuation during 6 years is about 51.7%, so, the PO estimated that the annual net electricity generation of the first crediting period can be generated in the second crediting period considering above results. Thus the PO decided same annual net electricity generation as 8,463MWh which is same as the PDD of the first crediting period for wind power.

In case of hydro power, the highest annual net electricity generation was 5,309MWh in 2007 (during 11 months from February to December) and the average range of fluctuation during 6 years is about 30.1%, thus the PO selected the annual output as 5,804MWh which is same as the PDD of the first crediting period for hydropower based on above circumstance.

The validation team checked actual historical electricity output through KPX invoice for exported electricity and KEPCO receipts for imported electricity together with the monitoring reports and the verification reports as well as site-visit inspection.

Thus, the validation team confirms that the net electricity generation supplied to the grid is reasonably estimated and valid.

Nevertheless, CL 1 was raised during the validation process and successfully closed (ref Annex A: Table 1).

### 2) Emission Factors ( $EF_{grid,CM,y}$ )

The project activity is the installation of a new grid-connected renewable power plant and thus, the combined margin emission factor is calculated according to “Tool to calculate the emission factor for an electricity system (Version 04.0.0)”.

#### *Step 1. Identify the relevant electricity systems*

The grid is determined as the KEPCO Grid. KEPCO grid is sole electricity grid system in Korea operated by KEPCO and the project is connected to KEPCO grid. Thus, the validation team confirms that the KEPCO grid is correctly identified as the relevant electricity system.

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

Option 1 is selected and only grid power plants are included in the calculation.



### ***Step 3. Select a method to determine the operating margin (OM)***

For the calculation of the OM emission factor, the simple OM method is selected because low cost/must-run plants constitute less than 50% of the total grid generation in average of the five most recent years (2007~2011).

Electricity generation data from 2007 to 2011 were analyzed in the excel spreadsheet and were confirmed to be the five most recent year data when the PO notified their renewal intention to the secretariat on 8 August 2013; the validation team confirms that low-cost/must run resources are correctly identified as hydro, geothermal, wind, low-cost biomass, solar, landfill gas, anthracite coal, nuclear power plants reflecting power plants status in Korea and are in line with “Tool to calculate the emission factor for an electricity system (Version 04.0.0)”; the validation team also confirms that the low-cost/must run generation identified in the excel spreadsheet is complete and correct and the average low-cost/must run generation is correctly calculated as 36.59% of the total grid generation.

Thus, the validation team confirms that low-cost/must-run resources constitute less than 50% of total grid generation and simple OM method (Option a) is appropriately selected in the PDD to determine the operating margin.

### ***Step 4. Calculate the operating margin emission factor according to the selected method***

Simple OM emission factor is calculated as the generation-weighted average CO<sub>2</sub> emissions per unit net electricity generation (tCO<sub>2</sub>/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

Under this option,  $EF_{grid,OM}$  was calculated using as per the following equation, which is confirmed from the excel spreadsheet..

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

Where,  $EF_{EL,m,y}$  was calculated using option A 1 as per the following equation.

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

The net quantity of electricity generated and delivered to the grid by power unit m in year y ( $EG_{m,y}$ ) and the amount of fuel type I consumed by power unit m in year y ( $FC_{i,m,y}$ ) are quoted from the Statistics of Electric Power in Korea (KEPCO, 2010~2012) and are correctly provided and calculated in the excel spreadsheet; gross calorific values (GCV) were derived from the Statistics of Electric Power in Korea (2010~2012) and the net calorific values ( $NCV_{i,y}$ ) are correctly calculated from GCV using conversion factor suggested in the 2006 Revised IPCC Guidelines; CO<sub>2</sub> emission factor of each fuel type i ( $EF_{CO2,i,y}$ ) are quoted from the lower emission factor of 2006 Revised IPCC Guidelines.

The validation team confirms that 2009~2011 data is the three most recent years from renewal intention notification on 8 August 2013 since Statistics published in June 2012 is the recent available resource.

Thus, the validation team confirms that emission factor of each power unit  $m$  ( $EF_{EL,m,y}$ ) is confirmed to be correctly calculated and provided in the excel spreadsheet.

Accordingly,  $EF_{grid,OM}$  is correctly calculated as 0.6828 tCO<sub>2</sub>/MWh.

#### ***Step5. Calculate the build margin (BM) emission factor***

Option 1 is chosen for calculating the build margin emission factor. Thus, the build margin emission factor is calculated ex-ante based as follows.

$SET_{5-units}$  and  $SET_{\geq 20 \text{ per cent}}$  are identified in the excel spreadsheet based on the Status of Generation Facility (KPX, 2012); the validation team confirms that the identified power units are complete and registered CDM projects to KEPCO grid are correctly excluded.

$SET_{sample}$  is correctly selected as  $SET_{\geq 20 \text{ per cent}}$  in that  $SET_{\geq 20 \text{ per cent}}$  comprises larger annual electricity generation than  $SET_{5-units}$ . Among the  $SET_{\geq 20 \text{ per cent}}$ , no power units started to supply electricity to the grid more than ten years ago. The validation team confirms that  $SET_{\geq 20 \text{ per cent}}$  is correctly identified in the excel spreadsheet.

Accordingly,  $EF_{grid,BM,y}$  is calculated using as per the following equation, which is confirmed from the excel spreadsheet..

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

$EF_{grid,BM,y}$  is correctly calculated as 0.5698 tCO<sub>2</sub>/MWh.

#### ***Step6. Calculate the combined emission factor***

The combined margin (CM) emission factor ( $EF_{grid,CM,y}$ ) is correctly calculated applying  $W_{OM}$  of 0.75 and  $W_{BM}$  of 0.25 for wind power project and  $W_{OM}$  of 0.25 and  $W_{BM}$  of 0.75 for hydro power project, which are correspondent with the “Tool to calculate the emission factor for an electricity system (Version 04.0.0)”.

##### Wind Power

$$\begin{aligned} EF_{grid,CM,y} &= EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM} \\ &= (0.6828 \times 0.75) + (0.5698 \times 0.25) = 0.6545 \text{ tCO}_2/\text{MWh} \end{aligned}$$

$EF_{grid,CM,y}$  is correctly calculated as 0.6545 tCO<sub>2</sub>/MWh.

##### Hydro Power

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

$$= (0.6828 \times 0.25) + (0.5698 \times 0.75) = 0.5980 \text{ tCO}_2/\text{MWh}$$

$EF_{grid,CM,y}$  is correctly calculated as 0.5980 tCO<sub>2</sub>/MWh.

The emission factor is fixed ex-ante for the entire crediting period and this emission factor which is not need to be monitored. The formulas and values selected for the calculation are listed in the PDD and excel spreadsheet. Formulas and values were verified by KFQ and found correct.

Nevertheless, CAR 1 was raised during the validation process and successfully closed (ref Annex A: Table 1).

### 3) Ex-ante calculation of emission reductions

With an expected annual net electricity generation of 14,267MWh (wind: 8,463MWh + hydro: 5,804MWh) to the grid, and the combined margin factor of 0.6545 tCO<sub>2</sub>/MWh for wind power and 0.5980 tCO<sub>2</sub>/MWh for hydro power, the annual baseline emissions are correctly calculated as 9,009 tCO<sub>2</sub>e (5,539 tCO<sub>2</sub>e for wind power and 3,470 tCO<sub>2</sub>e for hydro power) in the PDD, and this parameter will be determined ex-post. As greenhouse gases emission from the project can be considered to be zero and no leakage calculation is required according to AMS-I.D (Version 17.0), the emission reductions are equal to baseline emissions.

There is difference in estimated annual emission reductions between the PDD ver. 05 as 9,174 tCO<sub>2</sub>e/yr (5,539 tCO<sub>2</sub>e/yr for Wind Power and 3,635 tCO<sub>2</sub>e/yr for Small Hydroelectric Power) and ver. 05.2 as 9,009 tCO<sub>2</sub>e/yr (5,539 tCO<sub>2</sub>e/yr for Wind Power and 3,470 tCO<sub>2</sub>e/yr for Small Hydroelectric Power) due to correction of emission factor for small hydroelectric power.

KFQ assessed the calculations of the project emissions, baseline emissions, leakage, and emission reductions through relevant documents and calculation spreadsheets. The parameters and equations presented in the PDD, as well as other relevant documents, have been compared with the information, the latest requirements and other applicable tools.

The assumptions and data used to determine the emission reductions are listed in the PDD and all the sources have been checked. The data and sources used are affirmed to be correctly quoted and indicated in the PDD. The values in the PDD are considered reasonable based on the review of documentation and references as well as on the site-visit inspection.

The validation team hereby confirms that the emission reductions are appropriately worked out complying with relevant methodology and tools, and parameters and data for the calculations are sourced from proper data source according to para.99/VVS version 04.0 as follow.

- All assumptions and data used by the project participants are listed in the PDD, including their references and sources;
- All documentation used by project participants as the basis for assumptions and source of data is correctly quoted and interpreted in the PDD;
- All values used in the PDD are considered reasonable in the context of the proposed project activity;
- The baseline methodology and corresponding tool(s) have been applied correctly to calculate project emissions, baseline emissions, leakage and emission reductions;
- All estimates of the baseline emissions can be replicated using the data and parameter values provided in the PDD.

In conclusion, the validation team has confirmed that the application, discussion and determination of the chosen baseline methodology are transparent and reasonable and baseline for this project activity is reasonably determined by considering relevant national and/or sectoral policies and circumstances.

### **3.4 Additionality**

The proposed project demonstrated the additionality through technological barrier and prevailing practice according to “Attachment A to Annex B of the simplified modalities and procedures for CDM small-scale project activities” in the original PDD. The proposed project validated by DOE, KEMCO and registered on 10 February 2007. Even though the additionality was validated, the PO has demonstrated the additionality based on “Guidelines for demonstrating additionality of Microscale project activities (Ver.05)”.

According to the guideline, article 8, project activities up to five megawatts that employ renewable energy technology are additional if any one of the conditions (a)~(d), thus the PO demonstrate applying (d) as follow.

- (d) The project activity employs specific renewable energy technologies/measures recommended by the host country designated national authority (DNA) and approved by the Board to be additional in the host country. The following conditions shall apply for DNA recommendations:
- (i) “Specific renewable energy technologies/measures” refers to grid connected renewable energy technologies of installed capacity equal to or smaller than 5 MW
  - (ii) The ratio of installed capacity of the specific grid connected renewable energy technology in the total installed grid connected power generation capacity in the host country shall be equal to or less than three per cent
  - (iii) Most recent available data on the percentage of contributions of specific renewable

energy technologies shall be provided to demonstrate compliance with the three per cent threshold. In no case shall data older than three years from the date of submission be used

- (iv) Technologies/measures recommended by DNAs and approved by the Board to be additional in the host country remain valid for three years from the date of approval. However, additionality of eligible project activities applying the guidelines remains valid for the entire crediting period
- (v) DNA submissions shall include the specific grid connected renewable electricity generation technologies that are being recommended and provide the required data as indicated above (e.g. wind power, biomass power, geothermal power, hydropower).

According to “Procedure for submission and consideration of microscale renewable energy technologies for automatic additionality, version 01”, the DNA of Republic of Korea proposed specific renewable technologies/measures for automatic additionality by submitting the F-CDM-RRT form and the supporting documents on 5 Jan 2012<sup>3</sup>. The validation team reviewed the form and confirmed the additionality of the proposed project is complied with the “Guidelines for demonstrating additionality of Microscale project activities (Ver.05)”.

### 3.5 Monitoring Plan

Through assessment as below 3.4.1 and 3.4.2, the validation team concludes that the monitoring plan is in line with the approved monitoring methodology, AMS-I.D Version 17.0 – Grid connected renewable electricity generation. And it is expected that the monitoring arrangements described in the monitoring plan of the PDD are feasible with the project design and implement the monitoring plan.

In the case of wind power and hydro power projects, only baseline emissions need to be monitored. The project emissions are regarded as zero and leakage emissions do not need to be considered when using AMS-I.D Version 17.0.

#### 3.5.1 Parameters determined ex-ante

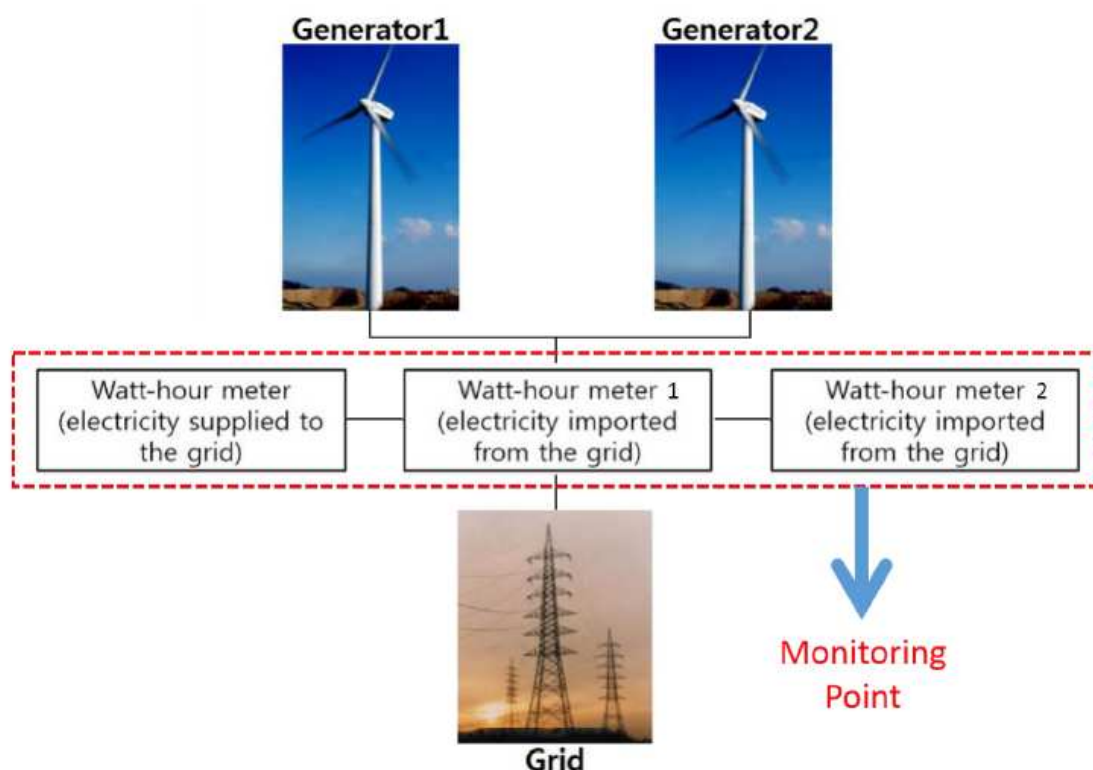
The emission factor of the KEPCO Grid is fixed ex-ante for the entire crediting period. The formulas and values selected for the calculation are listed in the PDD. All formulas and values ( $EF_{grid,CM,y}$ ,  $EF_{grid,OM,y}$ ,  $EF_{grid,BM,y}$ ,  $FC_{i,m,y}$ ,  $NCV_{i,y}$ ,  $EF_{CO2,i,y}$ ,  $EG_{m,y}$ ) in the PDD and excel spreadsheet were verified by KFQ and found correct. For detailed information, please refer to 3.3.4 Algorithms and/or formulae used to determine emission reductions.

### 3.5.2 Parameters monitored ex-post

#### Wind Power

The main data needed to be monitored ex-post is the net electricity supplied by the proposed project activity to the grid. The net electricity supplied to the grid ( $EG_{\text{facility}}$ ) will be measured as the gross electricity supplied to the grid ( $EG_{\text{export}, y}$ ) minus the electricity supplied to the project site from the grid ( $EG_{\text{import}, y}$ ).

$$\text{i.e., } EG_{\text{facility}, y} = (EG_{\text{export}, y} - EG_{\text{import}, y})$$



**Figure 2 The monitoring diagram of the wind power project**

The project owner will monitor exported electricity generation continuously, hourly measurement and at least monthly recording basis through Watt-hour meter (electricity supplied to the grid, accuracy of  $\pm 0.5\%$ ). The meter will be used to obtain the amount of electricity supplied to the grid from the project site. The meter will be calibrated at least once in 3 years and 6 months  $\pm$  6 months according to the relevant national regulation for electricity export, “Act on operation of electricity market”. The data of electricity supplied to the grid will be cross-checked with relevant sale records provided by KPX (Korea Power Exchange).

The project owner will monitor imported electricity continuously, hourly measurement and at least monthly recording basis through two Watt-hour meters (electricity supplied to the grid, accuracy of  $\pm 1.0\%$ ). These meters will be used to obtain the amount of electricity imported from

<sup>3</sup> <http://cdm.unfccc.int/DNA/submissions/index.html>

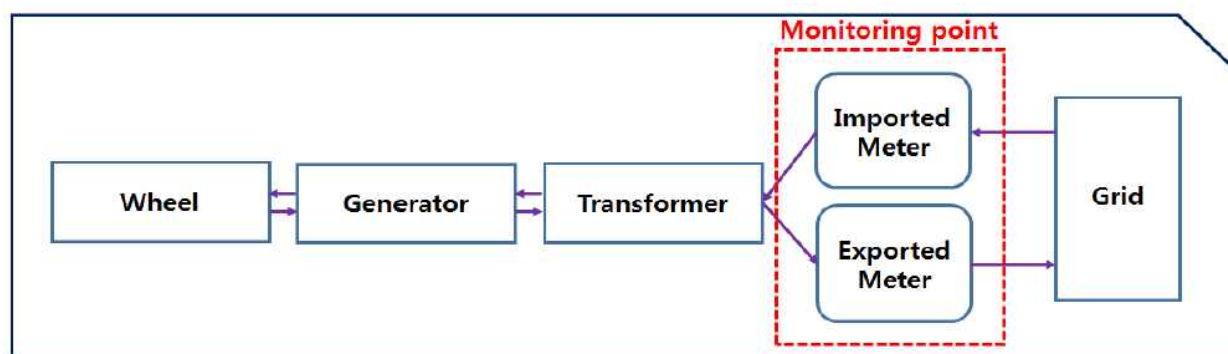
the grid to the project site. This meter will be managed by KEPCO and they will be calibrated at least once in 7 years in accordance with the relevant national regulation, “Law regarding measurement”. The data of electricity imported from the grid will be cross-checked with relevant receipts provided KEPCO.

Amount of electricity that has transmitted to the grid shall be measured automatically by established meters. The measured data are simultaneously transferred to the KPX (Korea Power Exchange). The electricity exported to grid and imported from grid will be continuously monitored, hourly measured, monthly record. The collected exported data shall be compared with sales records of KPX (Korea power Exchange) and the collected imported data shall be compared with receipts of KEPCO. If two data compared is different, the operation condition of electricity meters and other equipment shall be examined. In case meters are improperly operated, internal audits and correction procedure shall be implemented and be certified by the final decision-maker and KPX (Korea Power exchange) and KEPCO. All the data will be kept for 2 years after the end of the crediting period.

### **Small Hydroelectric Power**

The main data needed to be monitored ex-post is the net electricity supplied by the proposed project activity to the grid. The net electricity supplied to the grid ( $EG_{\text{facility}}$ ) will be measured as the gross electricity supplied to the grid ( $EG_{\text{export}, y}$ ) minus the electricity supplied to the project site from the grid ( $EG_{\text{import}, y}$ ).

$$\text{i.e., } EG_{\text{facility}, y} = (EG_{\text{export}, y} - EG_{\text{import}, y})$$



**Figure 3 The monitoring diagram of the hydro power project**

The project owner will monitor exported electricity generation continuously, hourly measurement and at least monthly recording basis through Exported meter (accuracy of  $\pm 0.5\%$ ). The meter will be used to obtain the amount of electricity supplied to the grid from the project site. The meter will be calibrated at least once in 3 years and 6 months  $\pm 6$  months according to the relevant national regulation for electricity export, “Act on operation of electricity market”. The data of electricity supplied to the grid will be cross-checked with relevant sale records provided by KPX (Korea Power Exchange).

The project owner will monitor imported electricity generation continuously, hourly measurement and at least monthly recording basis through Imported meter (accuracy of  $\pm 1.0\%$ ). This meter will be used to obtain the amount of electricity imported from the grid to the project site. This meter will be managed by KEPCO and it will be calibrated at least once in 7 years in accordance with the relevant national regulation, “Law regarding measurement”. The data of electricity imported from the grid will be cross-checked with relevant electricity bills provided KEPCO.

Amount of electricity that has transmitted to the grid shall be measured automatically by established meters. The measured data are simultaneously transferred to the KPX (Korea Power Exchange). The electricity exported to grid and imported from grid will be continuously monitored, hourly measured, monthly record. The collected exported data shall be compared with sales records of KPX (Korea power Exchange) and the collected imported data shall be compared with receipts of KEPCO. If two data compared is different, the operation condition of electricity meters and other equipment shall be examined. In case meters are improperly operated, internal audits and correction procedure shall be implemented and be certified by the final decision-maker and KPX (Korea Power exchange) and KEPCO. All the data will be kept for 2 years after the end of the crediting period. All the data will be kept for 2 years after the end of the crediting period.

### **Implementation of the plan**

#### **Wind power**

The PP, KOMIPO Headquarter (Head of the climate environment team) has the overall authority and responsibility for project operation. Also they get final approval of CDM monitoring activity.

KOMIPO Headquarter (Climate environment team) has responsibilities of overall monitoring procedure for the management of emission reduction and collecting the monitoring result. And they manage monitoring report and approval.

KOMIPO Seoul thermal plant branch (Electricity team & Mechanic team) will monitor installation management and the CDM project. They provide the monitoring result regularly to the Climate environment team of the Head office.

#### **Small Hydroelectric Power**

The PP, KOMIPO Headquarter (Head of the climate environment team) has the overall authority and responsibility for the project activity. Also they get final approval of CDM monitoring activity.

The PP, KOMIPO will outsource operation of the project activity by KHNP (Korea Hydro & Nuclear Power Co., Ltd.) and KHNP Headquarter (New renewable energy team) has



responsibilities of overall monitoring procedure for the management of emission reduction and collecting the monitoring result. And they manage monitoring report and approval.

KHNP Yangyan water plant branch (Foreign Cooperation team) will provide the monitoring result regularly to the New renewable energy team of KHNP headquarter.

KHNP Yangyan water plant branch (Power operation team & Electric generation team) will monitor installation management monitoring of the CDM project.

The validation team confirms that the designated staffs for monitoring of the project will be trained as per the monitoring plan and the monitoring manual, and it has been appropriately implemented.

Through reviewing the monitoring plan and the previous monitoring reports and interviewing with the PP, KFQ confirms that the monitoring arrangements described in the monitoring plan of the PDD in line with AMS-I.D requirements and are feasible with the project design and the PP is able to implement the monitoring plan<sup>4</sup>.

Nevertheless, CL 2 were raised during the validation process and successfully closed (ref Annex A: Table 1).

### 3.6 Calculation of GHG Emissions

According to AMS-I.D (Version 17.0), emission reduction is calculated as following equation:

$$ER_y = BE_y - PE_y$$

- $ER_y$  (t CO<sub>2</sub>e/yr): Emission reductions
- $BE_y$  (t CO<sub>2</sub>/yr): Baseline Emissions
- $PE_y$  (t CO<sub>2</sub>/yr): Project Emissions

- Project emissions can be considered as 0.

- As a result,

#### Wind Power

$$\begin{aligned} ER_y = BE_y &= EG_{PJ,y} \times EF_{grid,CM,y} = EG_{facility,y} \times EF_{grid,CM,y} \\ &= 8,463 \text{ MWh/yr} \times 0.6545 \text{ tCO}_2\text{e/MWh} \\ &= 5,539 \text{ tCO}_2\text{/yr} \end{aligned}$$

#### Hydro Power

$$ER_y = BE_y = EG_{PJ,y} \times EF_{grid,CM,y} = EG_{facility,y} \times EF_{grid,CM,y}$$

<sup>4</sup> In addition, the PP has been operating and monitoring the project activity in accordance with the registered PDD and the revised monitoring plan, which was approved on 13 December 2008, which is confirmed through interview with the PP and reviewing the previous verification reports.

$$= 5,804 \text{ MWh/yr} \times 0.5980 \text{ tCO}_2\text{e/MWh}$$

$$= 3,470 \text{ tCO}_2\text{/yr}$$

Total emission reduction of the project activity is 9,009 tCO<sub>2</sub>/yr

Emission reduction by this project activity is estimated to be 9,009 tCO<sub>2</sub>e per year and 63,063 tCO<sub>2</sub>e over second 7 year crediting period. The validation team concluded that the GHG calculation is transparent and the amount of estimated emission reduction is reasonable. Also validation team confirmed that all the assumptions and data used by PP are considered reasonable and the methodology has been applied correctly to calculate baseline emission and emission reduction.

Further to this, all estimates of the baseline emissions can be replicated using data and parameter values provided in the PDD.

#### 4. VALIDATION OPINION

*Korean Foundation for Quality (KFQ) has performed a validation of the renewal of crediting period for 'Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power)' (Ref. No. 0784) in Republic of Korea. The validation was performed on the basis of UNFCCC criteria for the Clean Development Mechanism and host country criteria, as well as criteria given to provide for consistent project operations, monitoring and reporting. UNFCCC criteria refer to Article 12 of the Kyoto Protocol, the CDM modalities procedures, and subsequent decision by the CDM Executive Board.*

*The validation is based on the information made available to us and the engagement conditions detailed in this report. The only purpose of this report is its use during the renewal process for the second crediting period of the proposed project. Hence, KFQ cannot be held liable by any party for decisions made or not made based on the validation opinion, which will go beyond that purpose. And it has provided KFQ with sufficient evidence to determine the fulfillment of stated criteria.*

*By displacing fossil fuel-based electricity with electricity generated from a renewable source, the project will continue to result in reductions of CO<sub>2</sub> emissions that are real, measurable and give long-term benefits to the mitigation of climate change. We can confirm that the indicated amount of emission reductions of 63,063 ton CO<sub>2</sub> over 7 years of second crediting period, resulting in a calculated annual average of 9,009 ton CO<sub>2</sub>, represents a reasonable estimation using the assumptions given by the project documents.*

*The responsibilities and authorities of monitoring and maintenance are clearly defined and a detailed monitoring plan has been developed. There is no need to monitor the grid CO<sub>2</sub> emission coefficient as it is fixed ex-ante for the renewable crediting period.*

*In our opinion, the 'Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power)' as described in the final PDD of 5 November 2013 (version 5.2), meets all relevant UNFCCC requirements for the CDM and all relevant host country criteria and correctly applies the baseline and monitoring methodology (AMS-I.D) Version 17.0. Thus the 'Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power)' will hence be recommended by KFQ for requesting for renewal of crediting period to UNFCCC.*

**Signed on behalf of the Korean Foundation for Quality**

Signature :



Name : Yu Shim JEONG

Date : 19 December 2013

## 5. References

Reference No.	Documentation and/or website	Remarks
1	Project Design Document for CDM project ‘Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power) ’ - Version 5.0: 6 August 2013 - Version 5.2: 5 November 2013	PDD
2	ER calculation sheet - Version 5.0: 6 August 2013 - Version 5.2: 5 November 2013	ER calculation sheet
2	AMS-I.D.: Grid connected renewable electricity generation (Version 17.0.0) Clean Development Mechanism Validation and Verification Standard (Version 04.0) Clean Development Mechanism Project Standard (Version 04.0) Clean Development Mechanism Project Cycle Procedure (Version 04.0) Guidelines for completing the project design document form for small-scale CDM project activities (Version 01.1) Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (Version 03.0.1) Glossary of CDM terms (Version 07.0) Tool to calculate the emission factor for an electricity system (Version 04.0.0) Guidelines on assessment of debundling for SSC project activities (Ver. 03) Guidelines for demonstrating additionality of Microscale project activities (Ver.05)	EB Guidance/Tool and Methodology
3	Notification e-mail on PO’s intention to request a renewal for renewal of crediting period to UNFCCC secretariat from the PO, 8 August 2013 Confirmation e-mail from UNFCCC secretariat to the PO, 9 August 2013	Request for renewal
4	Project Design Document for CDM project ‘Yangyang Renewable Energy Project (3MW Wind Power + 1.4MW Small Hydroelectric Power) ’ (Project 0784) (Version 04, 3 August 2006) Validation report (Revision 03, issued by KEMCO), Report No.: AT201-200601	Previous PDD
5	1 <sup>st</sup> Monitoring report, (10 February 2007~10 February 2010, Version 03., 8 July 2010)	Previous Monitoring Report
6	1 <sup>st</sup> Verification report, (Revision 2.1, 18 November 2010), issued by KFQ, Report No.: 2010-01	Previous Verification Report

7	Business license of PP Commercial operation start statements (Hydropower: 22 August 2005, Wind power: 28 June 2006)	Project operation
8	Original Law No. 10445, Alternative Energy Development Promotion Act, amended on March, 2002 Law No. 10445, Act on the Promotion of the Development, Use, and Diffusion of New and Renewable Energy, amended on December 2004  Current Law No. 10445, Act on the Promotion of the Development, Use, and Diffusion of New and Renewable Energy”, amended on 9 March 2011, effective as of 1 January 2012 Ordinance of Ministry of Knowledge Economy No. 271, Enforcement ordinance for promoting new energy and renewable energy development, use, and dissemination Ordinance of the President No. 23640, Enforcement regulation for promoting new energy and renewable energy development, use, and dissemination	National Law and regulation
9	Specification of wind turbines/ document for equipment control of hydropower turbine	Project life time
10	3MW Wind Power 1 <sup>st</sup> Monitoring report, (10 February 2007~10 February 2010, Version 03., 8 July 2010) KPX yearly report for monthly electricity export 2010~2012 Monthly electricity generation report 2010~2012 KEPCO yearly report for monthly electricity import 2010~2012  1.4MW Small Hydroelectric Power 1 <sup>st</sup> Monitoring report, (10 February 2007~10 February 2010, Version 03., 8 July 2010) KPX yearly report for monthly electricity export 2010~2012 Electricity generation record 2010~2012 KEPCO yearly report for monthly electricity import 2010~2012	Historical electricity generation
11	Monitoring map of 3MW Wind Power and 1.4MW Small Hydroelectric Power	Monitoring period
12	CDM Monitoring Manual (Ver.01, December 2011)	Monitoring manual
13	Training record and certificates - Internal training record on 3 July 2012 - External training certificates on 20~22 November 2012	Training

14	<p>Emission factor calculation</p> <ul style="list-style-type: none"><li>-2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2 Energy</li><li>- Statistics of Electric Power in Korea: KEPCO, 2010~2012</li><li>- Status of Generation Facility, KPX, June 2012</li><li>- UNFCCC website for projects registered in Korea <a href="http://cdm.unfccc.int/Projects/projsearch.html">http://cdm.unfccc.int/Projects/projsearch.html</a></li></ul>	Emission factor calculation
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**APPENDIX A**

**RESOLUTION OF CORRECTIVE ACTION AND CLARIFICATION REQUESTS**



**Table 1. Resolution of Corrective Action and Clarification Requests**

Corrective action requests and clarification requests by validation team	Relevant requirements	Summary of project owner response and validation team opinion	Validation team conclusion
<p><b>CAR 1:</b></p> <p>EF<sub>OM</sub> calculation for hydropower is not consistent with Tool to calculate the emission factor for an electricity system (Ver.03.0.0) which describes that all other project: W<sub>OM</sub>=0.25 and W<sub>BM</sub>=0.75 for the second and third crediting period.</p> <p>Furthermore, as per EF<sub>OM</sub> calculation in EF calculation sheet, net electricity generation and amount of fuel consumption in 2009 are not consistent with the references (Statistics of Electric Power in Korea and Status of Generation Facility, KPX</p>	<p>Tool to calculate the emission factor for an electricity system (04.0.0)</p>	<p>The PO provided relevant evidences and explained why the data is error as follow. Regarding net electricity generation in 2009 from the references, Power plant “Hamlim” has data of net electricity generation but fuel consumption is no data. Thus data of “Hamlim” is not included in EF calculation sheet. Based on above correction, the PO revised the PDD according to the latest requirement “Tool to calculate the emission factor for an electricity system (Version 04.0.0)” as below.</p> <p>The project activity is the installation of a new grid-connected renewable power plant and thus, the combined margin emission factor is calculated according to “Tool to calculate the emission factor for an electricity system (Version 04.0.0)”.</p> <p><b>Step 1. Identify the relevant electricity systems</b> The grid is determined as the KEPCO Grid. KEPCO grid is sole electricity grid system in Korea operated by KEPCO and the project is connected to KEPCO grid. Thus, the validation team confirms that the KEPCO grid is correctly identified as the relevant electricity system.</p> <p><b>Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)</b> Option 1 is selected and only grid power plants are included in the calculation.</p> <p><b>Step 3. Select a method to determine the operating margin (OM)</b></p> <p>For the calculation of the OM emission factor, the simple OM method is selected because low cost/must-run plants constitute less than 50% of the total grid generation in average of the five most recent years (2007~2011). Electricity generation data from 2007 to 2011 were analyzed in the excel spreadsheet and were confirmed to be the five most recent year data when the PO notified their renewal intention to the secretariat on 8 August 2013; the validation team confirms that low-cost/must run resources are correctly identified as hydro, geothermal, wind, low-cost biomass, solar, landfill gas, anthracite coal, nuclear power plants reflecting power plants status in Korea and are in line with “Tool to calculate the emission factor for an electricity system (Version 04.0.0)”; the validation team also confirms that the low-cost/must run generation identified in the excel spreadsheet is complete and correct and the average low-cost/must run generation is correctly calculated as 36.59% of the total grid generation. Thus, the validation team confirms that low-cost/must-run resources constitute less than 50%</p>	<p>CAR 1 is closed.</p>

		<p>of total grid generation and simple OM method (Option a) is appropriately selected in the PDD to determine the operating margin.</p> <p><b>Step 4. Calculate the operating margin emission factor according to the selected method</b></p> <p>Simple OM emission factor is calculated as the generation-weighted average CO<sub>2</sub> emissions per unit net electricity generation (tCO<sub>2</sub>/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.</p> <p>Under this option, EF<sub>grid,OM</sub> was calculated using as per the following equation, which is confirmed from the excel spreadsheet..</p> $EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$ <p>Where, EF<sub>EL,m,y</sub> was calculated using option A 1 as per the following equation.</p> $EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$ <p>The net quantity of electricity generated and delivered to the grid by power unit m in year y (EG<sub>m,y</sub>) and the amount of fuel type I consumed by power unit m in year y (FC<sub>i,m,y</sub>) are quoted from the Statistics of Electric Power in Korea (KEPCO, 2010~2012) and are correctly provided and calculated in the excel spreadsheet; gross calorific values (GCV) were derived from the Statistics of Electric Power in Korea (2010~2012) and the net calorific values (NCV<sub>i,y</sub>) are correctly calculated from GCV using conversion factor suggested in the 2006 Revised IPCC Guidelines; CO<sub>2</sub> emission factor of each fuel type i (EF<sub>CO2,i,y</sub>) are quoted from the lower emission factor of 2006 Revised IPCC Guidelines.</p> <p>The validation team confirms that 2009~2011 data is the three most recent years from renewal intention notification on 8 August 2013 since Statistics published in June 2012 is the recent available resource.</p> <p>Thus, the validation team confirms that emission factor of each power unit m (EF<sub>EL,m,y</sub>) is confirmed to be correctly calculated and provided in the excel spreadsheet.</p> <p>Accordingly, EF<sub>grid,OM</sub> is correctly calculated as 0.6828 tCO<sub>2</sub>/MWh.</p> <p><b>Step5. Calculate the build margin (BM) emission factor</b></p> <p>Option 1 is chosen for calculating the build margin emission factor. Thus, the build margin emission factor is calculated ex-ante based as follows.</p>	
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		<p>SET<sub>5-units</sub> and SET<sub>≥ 20 per cent</sub> are identified in the excel spreadsheet based on the Status of Generation Facility (KPX, 2012); the validation team confirms that the identified power units are complete and registered CDM projects to KEPCO grid are correctly excluded.</p> <p>SET<sub>sample</sub> is correctly selected as SET<sub>≥ 20 per cent</sub> in that SET<sub>≥ 20 per cent</sub> comprises larger annual electricity generation than SET<sub>5-units</sub>. Among the SET<sub>≥ 20 per cent</sub>, no power units started to supply electricity to the grid more than ten years ago. The validation team confirms that SET<sub>≥ 20 per cent</sub> is correctly identified in the excel spreadsheet.</p> <p>Accordingly, EF<sub>grid,BM,y</sub> is calculated using as per the following equation, which is confirmed from the excel spreadsheet..</p> $EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$ <p>EF<sub>grid,BM,y</sub> is correctly calculated as 0.5698 tCO<sub>2</sub>/MWh.</p> <p><b>Step6. Calculate the combined emission factor</b></p> <p>The combined margin (CM) emission factor (EF<sub>grid,CM,y</sub>) is correctly calculated applying W<sub>OM</sub> of 0.75 and W<sub>BM</sub> of 0.25 for wind power project and W<sub>OM</sub> of 0.25 and W<sub>BM</sub> of 0.75 for hydro power project, which are correspondent with the “Tool to calculate the emission factor for an electricity system (Version 04.0.0)”.</p> <p><u>Wind Power</u></p> $EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$ $= (0.6828 \times 0.75) + (0.5698 \times 0.25) = 0.6545 \text{ tCO}_2/\text{MWh}$ <p>EF<sub>grid,CM,y</sub> is correctly calculated as 0.6545 tCO<sub>2</sub>/MWh.</p> <p><u>Hydro Power</u></p> $EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$ $= (0.6828 \times 0.25) + (0.5698 \times 0.75) = 0.5980 \text{ tCO}_2/\text{MWh}$ <p>EF<sub>grid,CM,y</sub> is correctly calculated as 0.5980 tCO<sub>2</sub>/MWh.</p> <p>The emission factor is fixed ex-ante for the entire crediting period and this emission factor which is not need to be monitored. The formulas and values selected for the calculation are listed in the PDD and excel spreadsheet. Formulas and values were verified by KFQ and found correct.</p>	
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## APPENDIX A. KFQ VALIDATION PROTOCOL

<p><b>CL 1:</b></p> <p>Please clearly explain that why the same electricity generation from the registered PDD is suitable</p> <p>-Hydropower: 5,804 MWh/year</p> <p>-Wind power : 8,463 MWh/year</p>	<p>ACM0002 (13.0.0)</p>	<p>The PO explained suitability for estimation of net electricity generation as follow.</p> <p>The net electricity generation for wind power and hydro power is calculated based on six year's historical net electricity generation (2007~2012) prior to the notification on renewal intention for the project activity to the secretariat (August 2013) and average range of fluctuation during this period. Thus the PO estimated the net electricity generation as 14,267MWh (8,463MWh for wind power and 5,804MWh for hydro power) which is same as the original PDD.</p> <p>For wind power, the highest annual net electricity generation was 6,180.5MWh in 2010 and the average range of fluctuation during 6 years is about 51.7%, so, the PO estimated that the annual net electricity generation of the first crediting period can be generated in the second crediting period considering above results. Thus the PO decided same annual net electricity generation as 8,463MWh which is same as the PDD of the first crediting period for wind power.</p> <p>In case of hydro power, the highest annual net electricity generation was 5,309MWh in 2007 (during 11 months from February to December) and the average range of fluctuation during 6 years is about 30.1%, thus the PO selected the annual output as 5,804MWh which is same as the PDD of the first crediting period for hydropower based on above circumstance.</p> <p>The validation team checked actual historical electricity output through KPX invoice for exported electricity and KEPCO receipts for imported electricity together with the monitoring reports and the verification reports as well as site-visit inspection.</p> <p>Thus, the validation team confirms that the net electricity generation supplied to the grid is reasonably estimated and valid.</p>	<p>CL 1 is closed.</p>
<p><b>CL 2:</b></p> <p>Please clearly describe organization chart and their roles and responsibilities in the PDD.</p>	<p>ACM0002 (13.0.0)</p>	<p>The PP updated organization chart and their roles and responsibilities in the PDD as follow.</p> <p><b><u>Wind power</u></b></p> <p>The PP, KOMIPO Headquarter (Head of the climate environment team) has the overall authority and responsibility for project operation. Also they get final approval of CDM monitoring activity.</p> <p>KOMIPO Headquarter (Climate environment team) has responsibilities of overall monitoring procedure for the management of emission reduction and collecting the monitoring result. And they manage monitoring report and approval.</p> <p>KOMIPO Seoul thermal plant branch (Electricity team &amp; Mechanic team) will monitor installation management and the CDM project. They provide the monitoring result regularly to the Climate environment team of the Head office.</p>	<p>CL 2 is closed.</p>

		<p><b><u>Small Hydroelectric Power</u></b></p> <p>The PP, KOMIPO Headquater (Head of the climate enviroment team) has the overall authority and responsibility for the project activity. Also they get final approval of CDM monitoring activity.</p> <p>The PP, KOMIPO will outsource operation of the project activity by KHNP (Korea Hydro &amp; Nuclear Power Co., Ltd.) and KHNP Headquater (New renewable energy team) has responsibilities of overall monitoring proceudre for the management of emission reduction and collecting the monitoring result. And they manage monitoring report and approval.</p> <p>KHNP Yangyan water plant branch (Foreign Cooperation team) will provide the monitoring rsult regularly to the New renewable energy team of KHNP headquater.</p> <p>KHNP Yangyan water plant branch (Power operation team &amp; Electric generation team) will monitor installation management monitoring of the CDM project.</p> <p>Thus the validation team confirmed it's appropreately described in the PDD.</p>	
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Appendix B  
Qualification of Validation Team



## CERTIFICATE OF COMPETENCE

**Name:** Pyung-Hee JANG

**Qualification:**

	Validation	Verification
-Lead auditor	■	■
-Auditor	<input type="checkbox"/>	<input type="checkbox"/>
-Technical Expert	<input type="checkbox"/>	<input type="checkbox"/>
-Local Expert	<input type="checkbox"/>	<input type="checkbox"/>

**Scopes of Expertise:**

**Technical Area (TA)**

1.2 Energy generation from renewable energy sources

Approved by Qualification Committee of KFQ on 27 July 2011

Sustainability Management Institute  
Byung Yong LEE

A handwritten signature in black ink, appearing to read 'B Y Lee'.



## CERTIFICATE OF COMPETENCE

**Name:** Nam Hoon KIM

**Qualification:**

	Validation	Verification
-Lead auditor	■	■
-Auditor	<input type="checkbox"/>	<input type="checkbox"/>
-Technical Expert	<input type="checkbox"/>	<input type="checkbox"/>
-Local Expert	<input type="checkbox"/>	<input type="checkbox"/>

**Scopes of Expertise:**

**Technical Area (TA)**

1.2 Energy generation from renewable energy sources

Approved by Qualification Committee of KFQ on 28 February 2011

Sustainability Management Institute  
Byung Yong LEE

A handwritten signature in black ink, appearing to read 'B Y Lee'.



Appendix C  
Qualification of Technical Reviewer



## CERTIFICATE OF COMPETENCE

**Name:** Yu Shim JEONG

**Qualification:**

	Validation	Verification
-Lead auditor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
-Auditor	<input type="checkbox"/>	<input type="checkbox"/>
-Technical Expert	<input type="checkbox"/>	<input type="checkbox"/>
-Local Expert	<input type="checkbox"/>	<input type="checkbox"/>

**Scopes of Expertise:**

**Technical Area (TA)**

1.2 Energy generation from renewable energy sources

She is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 28 February 2011.  
Sustainability Management Institute  
Byung Yong LEE

A handwritten signature in black ink, appearing to read 'B Y Lee', is written over a faint horizontal line.