



Monitoring report form (Version 03.1)

Monitoring report

Title of the project activity	Samdal Wind Power Project
Reference number of the project activity	4661
Version number of the monitoring report	1
Completion date of the monitoring report	25/07/ 2013
Registration date of the project activity	13/04/2011
Monitoring period number and duration of this monitoring period	1st monitoring 01/07/2011 ~ 30/06/2013
Project participant(s)	Hanshin Energy Co.,Ltd
Host Party(ies)	Republic of Korea
Sectoral scope(s) and applied methodology(ies)	- Sectoral scope: I Energy Industries(Renewable resource) - Methodology: ACM0002(Ver.11)
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	108,552 tCO ₂ e/2yr (This monitoring period is 2 years)
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	82,384tCO ₂ e/2yr (This monitoring period is 2 years)
Actual GHG emission reductions or net anthropogenic GHG removal by sinks achieved during the period up to 31 December 2012(if applicable)	58,516 tCO ₂ e
Actual GHG emission reductions or net anthropogenic GHG removal by sinks achieved during the period from 1 January 2013(if applicable)	23,868 tCO ₂ e

SECTION A. Description of project activity**A.1. Purpose and general description of project activity**

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- Purpose of the project activity and the measures taken for GHG emission reductions**

Samdal Wind Power Project is to build a wind power generating plant on Samdal-ri, Seongsan-eup, Seogwipo-si, Jeju Special self-governing province, the Republic of Korea. The project utilizes wind power which is generating no greenhouse gases emission into the atmosphere. The project is also supporting the government policy to promote new & renewable energy technology in Korea.

The capacity of each turbine is 3.0MW at max and the total capacity consisting of 11 turbines for the project is 33MW. The utilization rate of the turbine is 30.7%, so the annual power generation is estimated about 88,948MWh.

- Brief description of the installed technology and equipment**

Samdal wind power project consists of 11 wind turbines and total capacity is 33MW.

Item	Samdal
Unit	Vestas
Model	V90-3.0MW
Capacity (kW)	33MW

- Relevant dates for the project activity**

Item	Completion of Construction	Commissioning Date	Starting Date of Operation
Date	14/12/2009	21/09/2009 ~27/09/2009	27/09/2009

- Total emission reductions achieved in this monitoring period**

From 01 July 2011 to 30 June 2013, the net generated electricity by the project is 135,011.860MWh, corresponds to the emission reductions of 82,384 tCO_{2e}.

A.2. Location of project activity

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Samdal-ri, Seongsan-eup, Seogwipo-si, Jeju special self-governing province, Republic of Korea.
(33°22'N, 126°50'E).

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea (host)	Hanshin Energy Co.,Ltd	No

A.4. Reference of applied methodology

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- **The applied methodology(ies):** ACM0002 “ Consolidated methodology for grid-connected electricity generation from renewable sources” (Version 11)
- **Referred tools:** “Tool to calculate the emission factor for and electricity system” (Version 02)

A.5. Crediting period of project activity

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- **Type :** Fixed
- **Start date :** 01 July 2011
- **Length of the crediting period :** 01 July 2011 ~ 30 June 2021
- **1st monitoring period :** 01 July 2011 ~ 30 June 2013

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

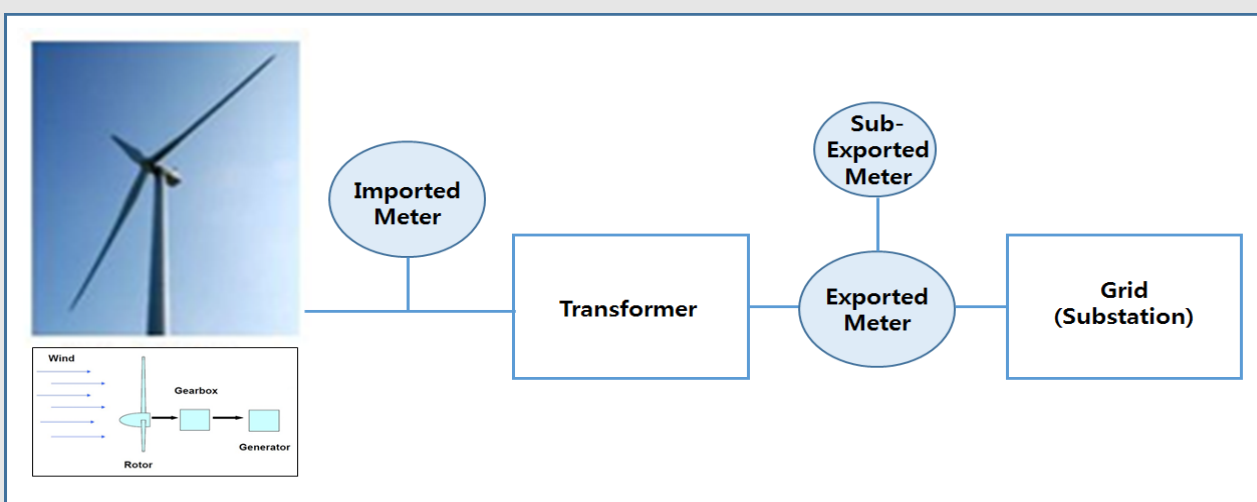
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- **Technical process**

Total installed capacity of this project is 33MW. The plant was installed total 11 wind turbines. Turbine Model are V90-3.0MW produced by Vestas. V90-3.0MW has 3 blades consisting of carbon fibre for the load-bearing spars, by which it is relatively lighter than similar V80 tower.

The amount of generated electricity is depends on daily weather condition, especially wind velocity. The voltage of generated electricity is increased by the transformer at the plant for decreasing transmission loss. And the high voltage electricity is transmitted to substation which is connected with the grid. All of generated electricity is transmitted to the substation, and electricity for internal use is imported separately. The amount of exported and imported electricity is checked by each watt-hour meter and technical process is monitored by computer system.

- **System diagram**



• Installed technology

<Table A-1. Turbine specifications>
Model No.



V90-3.0MW

Rotor	
Diameter	90m
Area swept	6,362m ²
Normal resolutions	16.1 rpm
Operational interval	8.6~18.4 rpm
Number of blade	3
Power regulation	Pitch/OptiSpeed
Air brake	Full blade pitch by three separate hydraulic pitch cylinders
Tower	
Hub height	80m
Operational Data	
Cut-in wind speed	4m/sec
Nominal wind speed (3000kW)	15m/sec
Stop wind speed	25m/sec
Generator	
Type	Asynchronous with OptiSpeed
Rated output	3,000kW
Operational data	60Hz, 1,000V
Gear Box	
Type	Two Planetary/helical three stages
Control	
Type	Microprocessor-based control of all the turbine functions with the option of remote monitoring. Output regulation and optimisation via OptiSpeed and OptiTip pitch regulation.
Weight (IEC)	
Hub height	80 m
Tower	160 t
Nacelle	70 t
Rotor	41 t
Total	271 t
t-metric ton	

• Information on the implementation and actual operation of the project activity

Item	Samdal	
Overhaul	- 2times	
	Date	details
	08/06/2012 ~ 20/08/2012	planned maintenance(#1 ~ #11)
	12/06/2013 ~ 28/06/2013	planned maintenance(#1 ~ #11)
Downtime	- 6times	
	Date	details
	28/09/2011 ~ 05/11/2011, 07/11/2011 ~ 26/11/2011	WTG blade inspection(#1 ~ #11) & repair(#1, #3, #6, #7, #9)
	24/11/2011 ~ 28/11/2011	Blade core sampling and inspection(#7)
	07/03/2012 ~ 16/03/2012	Gear box upgrade(#1 ~ #11)
	03/05/2012 ~ 25/05/2012	Repair of Gear box and hub connection(#1, #3, #4, #9)
	19/10/2012 ~ 09/11/2011	WTG upgrade work(#3, #5)
	01/05/2013 ~ 17/06/2013	WTG upgrade work(#1, #3, #5, #7, #8, #11)
Equipment exchange	- 4times	
	Date	details
	31/12/2011 ~ 17/01/2012	Generator bearing replacement and Exchange of rotor cable (#01)
	31/12/2011 ~ 17/01/2012	Generator bearing replacement(#11)
	21/03/2012 ~ 23/03/2012	Generator bearing replacement(#10)
	20/06/2013 ~ 23/06/2013	Generator bearing replacement(#5)

• Events or situations which may impact on the applicability of the methodology

There are no events or situations that occurred during the monitoring period that may impact the applicability of the applied methodology.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

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N/A

B.2.2. Corrections

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This table of EFy value is simple declared error when draw up the PDD

Refer to the PDD and validation report, EFy is applied in 0.6102 and it is used baseline emission calculation

Registered monitoring plan	
Data / Parameter:	EGy
Data unit:	tCO2/MWh
Description:	CO2 emission factor of the Jeju special self-governing province.
Source of data used:	This value was calculated according to "Tool to calculate the emission factor for an electricity system.(Ver.2)" Applied value was calculated by referring Statistics of Electric Power in 2005-2007, KEPCO 2006-2008

	and Status of Generation facility (2008) (Korea Power Exchange). When the OM EF is estimated which reflect the value of OM EF supplied to Jeju Special self-governing province by using a weight average of OM(inland). Electricity generation in Jeju special self-governing province is not enough to supply Jeju Special self-governing province, so interconnection tie from inland must be needed.
Value applied:	0.6351
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated
Any comment:	-The same value will be applied during the first crediting period without update. -For detail calculation method, refer to Annex 3.

changes

Data / Parameter:	EGy
Data unit:	tCO2/MWh
Description:	CO2 emission factor of the Jeju special self-governing province.
Source of data used:	This value was calculated according to "Tool to calculate the emission factor for an electricity system.(Ver.2)" Applied value was calculated by referring Statistics of Electric Power in 2005-2007, KEPCO 2006-2008 and Status of Generation facility (2008) (Korea Power Exchange). When the OM EF is estimated which reflect the value of OM EF supplied to Jeju Special self-governing province by using a weight average of OM(inland). Electricity generation in Jeju special self-governing province is not enough to supply Jeju Special self-governing province, so interconnection tie from inland must be needed.
Value applied:	0.6102
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated
Any comment:	-The same value will be applied during the first crediting period without update. -For detail calculation method, refer to Annex 3.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

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Based on local regulation "Measures Act", imported meter of allowable error applied in this project is not exist. Minimum allowable error is $\pm 0.5\%$ and it will be applied to the monitoring plan according to local regulations.

• Data and parameters monitored (Section B.7.1)

Registered monitoring plan	
Data / Parameter:	EG _{consumption,y}
Data unit:	MWh/yr

Description:	The Quantity of annual electricity purchased from the grid by the proposed project		
	Source of data to be used: Measure at Samdal wind power plants		
	Value of data applied for the purpose of calculating expected emission reductions in section B.5 0		
	Description of measurement methods and procedures to be applied: Data will be automatically measured and recorded monthly. Main meter is installed at substation. The allowable error of data must be within $\pm 0.2\%$.		
	QA/QC procedures to be applied: Uncertainty of data is low. QA/QC procedure for this is planned. The meter are bidirectional, which can record the import and export electricity generation		
	Any comment: -		
changes			
Data / Parameter:	EG _{consumption,y}		
	Data unit: MWh/yr		
	Description: The Quantity of annual electricity purchased from the grid by the proposed project		
	Source of data to be used: Measure at Samdal wind power plants		
	Value of data applied for the purpose of calculating expected emission reductions in section B.5 0		
	Description of measurement methods and procedures to be applied: Data will be automatically measured and recorded monthly. Main meter is installed at substation. The allowable error of data must be within $\pm 0.5\%$.		
	QA/QC procedures to be applied: Uncertainty of data is low. QA/QC procedure for this is planned.		
	Any comment: -		
• Description of the monitoring plan (1. Monitoring equipment)			
<table> <tr> <td>Registered monitoring plan</td><td>changes</td></tr> </table>		Registered monitoring plan	changes
Registered monitoring plan	changes		

1-3. The meters shall be calibrated when they are installed, and re-calibrated every three years after the installation. (Act on operation of electricity market 7.3.1, 2009.1.1)

1-3. The exported meters shall be calibrated when they are installed, and re-calibrated every three years after the installation. (Act on operation of electricity market 7.3.1, 2009.1.1)

The watt-hour meter for electricity imported from the grid is not within the control of project participants and calibration frequency of the watt-hour meter in national standard is once in 7 years.

1-5. Allowable error of the export and import meter is $\pm 0.2\%$.

1-5. Allowable error of the export meter is $\pm 0.2\%$ and imported meter is $\pm 0.5\%$.

B.2.4. Changes to project design of registered project activity

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N/A

B.2.5. Changes to start date of crediting period

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N/A

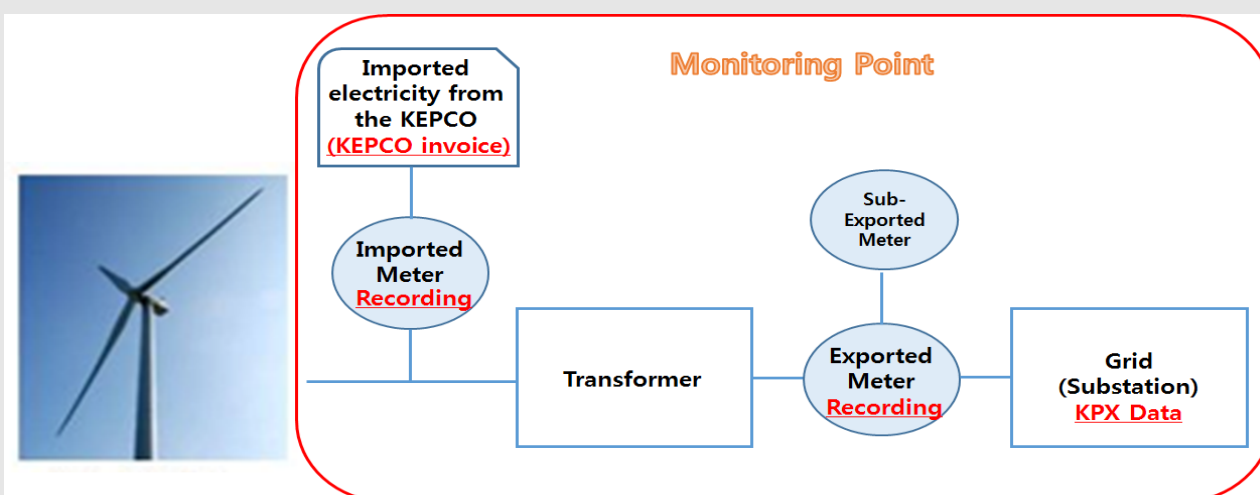
B.2.6. Types of changes specific to afforestation or reforestation project activity

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N/A

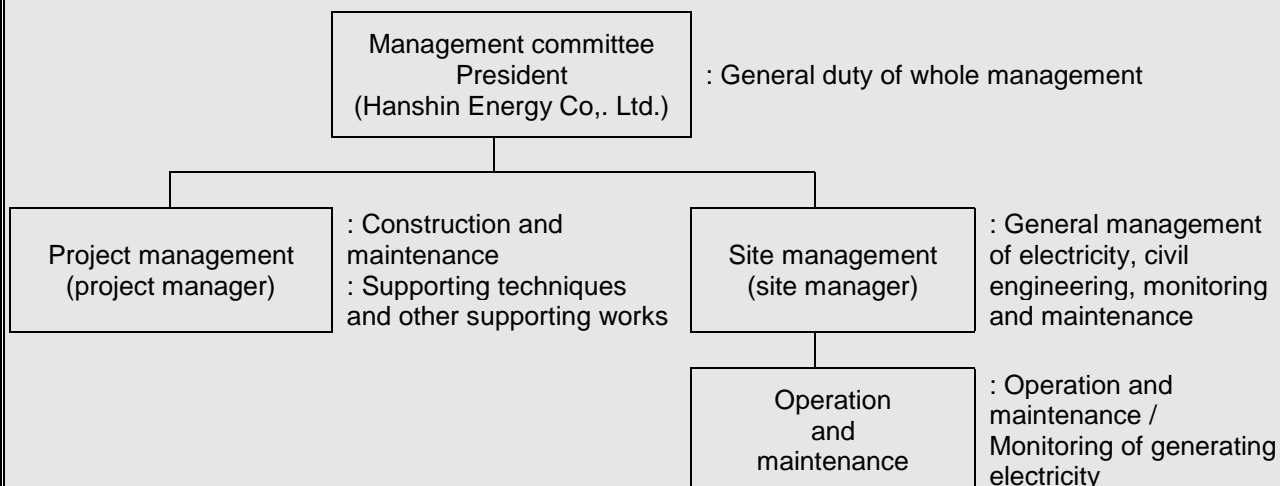
SECTION C. Description of monitoring system

• Data collection procedure and Monitoring Point for the project



- 1) Measurement of electricity meters established on the site
- 2) Aggregation of measured data
- 3) Recording of measured data
- 4) Transfer of measured data to KPX
- 5) Recording of KPX data and KEPCO data
- 6) Calculation of emission reduction

• **Operational and management structure**



• **Quality Control (QC) / Quality Assurance (QA) and Emergency procedure**

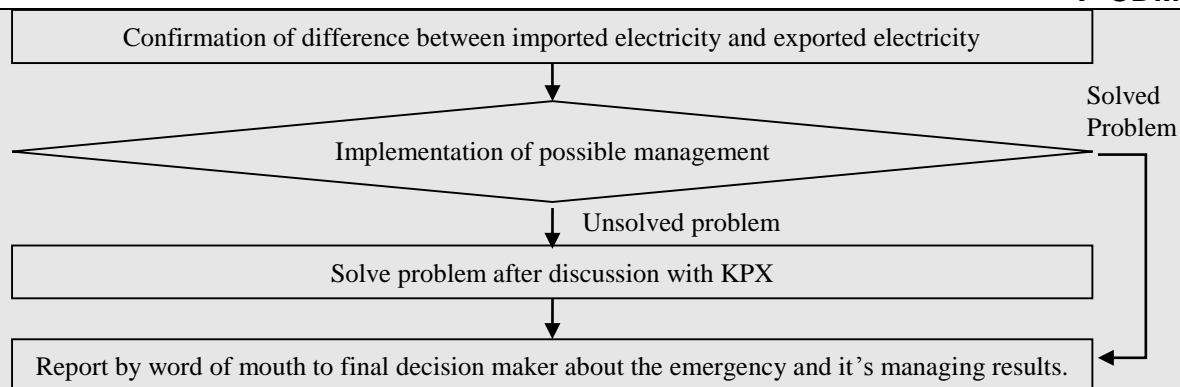
1. Monitoring equipment

- 1-1. Electricity measuring meters is 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 is authorized through the due formal certifying process (the valid period for the authorized certification: 7 years.) (Act on operation of electricity market 7.3.8, 2009.1.1)
- 1-3. The meters is calibrated when they are installed, and re-calibrated every three years after the installation. (Act on operation of electricity market 7.3.1, 2009.1.1). The watt-hour meter for electricity imported from the grid is not within the control of project participants and calibration frequency of the watt-hour meter in national standard is once in 7 years.
- 1-4. The metering equipment measuring point is installed and maintained. (Act on operation of electricity market 4.1.1, 2009.1.1)
- 1-5. Allowable error of the export meter is $\pm 0.2\%$ and imported meter is $\pm 0.5\%$.

2. Monitoring of amount of electricity

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

- Procedures for emergency preparedness:



3. Management of monitoring and electricity safety and training

- 3-1. The person in charge for monitoring and electricity safety is attend the monitoring courses regularly. Initial training for employees in site are provided by the equipment supplier. If there are additional employees or changes of operating manual, VESTAS is responsible for training them. VESTAS is undergo training for operation of monitoring system, emergency preparedness and management of data following operating manual. Training include an organized course of theoretical and practical components.
- 3-2. In case of absence of the responsible person, the second responsible person is selected.
- 3-3. If the responsibility for monitoring and electricity safety is transferred to another person, one is approval by the final decision-maker.
- 3-4. If metering equipment is properly maintained and checked according to the national or professional requirement by qualified third party designated if being out of work.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	EF _y
Unit:	tCO ₂ /MWh
Description:	CO ₂ emission factor of the Jeju special self-governing province.
Source of data:	This value was calculated according to “Tool to calculate the emission factor for an electricity system.(Ver.2)” Applied value was calculated by referring Statistics of Electric Power in 2005-2007, KEPCO 2006-2008 and Status of Generation facility (2008) (Korea Power Exchange). When the OM EF is estimated which reflect the value of OM EF supplied to Jeju Special self-governing province by using a weight average of OM(inland). Electricity generation in Jeju special self-governing province is not enough to supply Jeju Special self-governing province, so interconnection tie from inland must be needed.
Value(s) applied:	0.6102 tCO ₂ /MWh
Purpose of data:	Emission reduction calculation
Additional comment:	- The same value will be applied during the crediting period without updating. - For detail calculation method, refer to the PDD of this project.

D.2. Data and parameters monitored

Data / Parameter:	EG _{facility,y}
Unit:	MWh
Description:	The Quantity of net electricity generated supplied by the project plant to the grid in year y
Measured/ Calculated / Default:	Calculated
Source of data:	Measured by Watt-hour meters installed at the project site
Value(s) of monitored parameter:	<ul style="list-style-type: none"> Net electricity: 135,011.860 MWh Net electricity = Exported electricity - Imported electricity (135,022.987MWh=135,715.228 MWh - 703.368 MWh)
Monitoring equipment:	Watt-hour meters for exported and imported electricity
Measuring/ Reading/ Recording frequency:	<ul style="list-style-type: none"> Exported electricity: real-time measured and daily recorded Imported electricity: real-time measured and monthly recorded
Calculation method (if applicable):	Exported electricity – Imported electricity
QA/QC procedures:	<ul style="list-style-type: none"> Allowable error <ul style="list-style-type: none"> Exported electricity data: within $\pm 0.2\%$ Imported electricity data: within $\pm 0.5\%$
Purpose of data:	This value is used for baseline emission calculation
Additional comment:	

Data / Parameter:	EG _{export,y}
Unit:	MWh
Description:	The Quantity of annual electricity delivered to the grid by proposed project
Measured/ Calculated / Default:	Measured
Source of data:	Measured by Watt-hour meters installed at the project site
Value(s) of monitored parameter:	135,715.228 MWh
Monitoring equipment:	Measurement equipment: Watt-hour meter Accuracy: Allowable error range $\pm 0.2\%$ Serial number: PT-0905A097-01 (main meter) PT-0905A098-01 (Sub meter) Calibration information <ul style="list-style-type: none"> Number of meter: 2meter(main meter and sub meter) Calibration frequency: Within 3years Date of initial/previous calibration: 12/08/2009 Date of latest calibration: 26/09/2012 Validity period: 12/08/2009 ~ 11/08/2012 26/09/2012 ~ 25/09/2015
Measuring/ Reading/ Recording frequency:	Real-time measured and daily recorded
Calculation method (if applicable):	Not applicable
QA/QC procedures:	The allowable error of data is $\pm 0.2\%$
Purpose of data:	This value is used for baseline emission calculation

Additional comment:			
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Data / Parameter:	EG _{consumption,y}
Unit:	MWh
Description:	The Quantity of annual electricity purchased from the grid by proposed project
Measured/ Calculated / Default:	Measured
Source of data:	Measured by Watt-hour meter installed at the project site
Value(s) of monitored parameter:	703.368 MWh
Monitoring equipment:	Measurement equipment: Watt-hour meter Accuracy: Allowable error range $\pm 0.5\%$ Serial number: 9000062 Calibration information <ul style="list-style-type: none"> - Number of meter: 1meter - Calibration frequency: Within 7years - Date of initial/previous calibration: 11/04/2011 - Date of latest calibration: 27/09/2011 - Validity period: 27/09/2011 ~ 26/09/2018
Measuring/ Reading/ Recording frequency:	Real-time measured and monthly recorded
Calculation method (if applicable):	Not applicable
QA/QC procedures:	The allowable error of data is $\pm 0.5\%$
Purpose of data:	This value is used for baseline emission calculation
Additional comment:	

D.3. Implementation of sampling plan

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N/A

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

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$BE_y = EG_{\text{facility}} * EF_y$

Where:

BE_y: Baseline emissions (tCO₂)

EG_{facility}: Net electricity amounts supplied to the grid by the project (MWh)

EF_y: Baseline emission factor (tCO₂/MWh)

• **EG_{facility} – Net electricity amounts supplied to the grid by the project.**

Period	EG _{facility} (MWh)			Remarks
	EG _{export}	EG _{consumption}	EG _{facility}	

1 July 2011 ~ 30 June 2013	135,726.356	703.368	135,022.988	
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Applying the maximum permissible error 0.2% of exported electricity due to overdue calibration of exported electricity meter (for 12.08.2011 to 25.09.2011) – based on Annex 60 of EB52th meeting. (Guidelines for assessing compliance with the calibration frequency requirements-ver01)

Deduction 0.2% of monitored electricity due to overdue calibration of main electricity meter (for 12.08.2011 to 25.09.2011)

Period	EG _{facility} (MWh)			Remarks
	EG _{export}	EG _{consumption}	EG _{facility}	
1 July 2011 ~ 30 June 2013	135,715.228	703.368	135,011.860	

• **EF_y – Baseline emission factor.**

The Baseline emission factor is calculated ex-ante 0.6102 tCO₂/MWh in the registered PDD and will be fixed during the crediting period.

• **BE_y – Baseline emissions**

$$\begin{aligned}
 BE_y &= EG_{\text{facility}} * EF_y \\
 &= 135,011.860 \text{ MWh} * 0.6102 \text{ tCO}_2/\text{MWh} \\
 &= 82,384.24 \text{ tCO}_2 \\
 &\approx 82,384 \text{ tCO}_2
 \end{aligned}$$

E.2. Calculation of project emissions or actual net GHG removals by sinks

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$$PE_y = 0 \text{ tCO}_2$$

E.3. Calculation of leakage

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$$LE_y = 0 \text{ tCO}_2$$

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO ₂ e)	Project emissions or actual net GHG removals by sinks (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO ₂ e)
Total	82,384	0	0	82,384

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO ₂ e)	108,552 (54,276 × 2years)	82,384

E.6. Remarks on difference from estimated value in registered PDD

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The actual amount of emission reduction in this monitoring period(from 01 July 2011 to 30 June 2013) are 82,384 tCO₂, which are about 24.1% less than that estimated in the PDD(108,552 tCO₂). It is because efficiency of wind turbines are changeable depending on daily weather such as wind velocity. The expected utilization rate applied to registered PDD is 30.7%, however, real utilization rate in this monitoring period is about 23.5%.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO ₂ e)	58,516	23,868

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Document information

Version	Date	Description
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

Decision Class: Regulatory

Document Type: Form

Business Function: issuance

Keywords: monitoring report, performance monitoring