PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	InfraVest Taiwan Wind Farms Bundled Project 2011
Version number of the PDD	1
Completion date of the PDD	29/10/2012
Project participant(s)	South Pole Carbon Asset Management Ltd. (private entity) InfraVest Wind Power Group (private entity)
Host Party(ies)	Taiwan
Sectoral scope and selected methodology(ies)	Sectoral Scope 1: Energy industries (Renewable source) ACM0002 (Version 13.0.0)
Estimated amount of annual average GHG emission reductions	171,559 tCO_2e

SECTION A. Description of project activity
A.1. Purpose and general description of project activity
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The InfraVest Taiwan Wind Farms Bundled Project 2011 (hereinafter referred to as "the proposed project") is a bundled project of four wind farms projects:

- InfraVest Fongwei Wind Farm Project, Taiwan: a 13.8 MW onshore wind farm located in Hsinfong Township (therefore also called Hsinfong Wind Farm), Hsinchu County, which comprises 6 wind turbines (hereafter: **Fongwei Wind Farm**)
- InfraVest Longwei Wind Farm Project, Taiwan: a 44.1 MW (18x2.3 MW + 3x0.9 MW) onshore wind farm located in Houlong Township (therefore also called Houlong Wind Farm), Miaoli County, which comprises 21 wind turbines (hereafter: **Longwei Wind Farm**)
- InfraVest Chungwei Wind Farm Project, Taiwan: a 29.9 MW onshore wind farm located in Dajia and Da-An Townships, Taichung County, which covers Taichung phases I and III, and Dafong sites, and which comprises 13 wind turbines (hereafter: **Chungwei Wind Farm**)
- InfraVest Tauwei Wind Farm Project, Taiwan: a 4.6 MW onshore wind farm located in Guanyin Township (also called Hsinwu Wind Farm), in Taoyuan County, which comprises 2 wind turbines (hereafter: **Tauwei Wind Farm**)

Wind Farm Name	Unit Capacity (MW)	Numbers of units	Overall installed Capacity (MW)	Estimated Electricity generation (MWh)	Operation start date
Fongwei	2.3	6	13.8	33,810	26/09/2011
Longwei	2.3	18	41.4	99,360	27/04/2012
	0.9	3	2.7	6,480	
Chungwei	2.3	3	6.9	17,250	31/10/2011
	2.3	9	20.7	51,750	
	2.3	1	2.3	5,520	
Tauwei	2.3	2	4.6	11,270	04/07/2011
Total	-	42	92.4	225,440	-

The above-mentioned four wind farms are constructed and operated by InfraVest Wind Power Group (hereafter refer as "InfraVest"), which is a subsidiary of Germany based VWind AG. The project in total comprises 42 wind turbines and the total installed capacity of the proposed bundled project is 92.4 MW. At full capacity, the aggregated output of the project is expected to be of 225,440 MWh/year, which is to be delivered to the state-owned power grid, Taipower grid ("TPG"), displacing part of the electricity supplied by the power grid currently dominated by fossil fuel-fired power plants. Accordingly, the project will lead to carbon dioxide emission reduction. The annual emission reductions are estimated as 171,559 tCO_2e/year, and the total emission reductions for the first crediting period of 7 years are estimated as 1,200,913 tCO_2e.

Prior to implementation of the proposed project, electricity demand in local society is supplied by the TPG dominated by the thermal power. The baseline scenario to the project activity is the same as the scenario existing prior to the start of implementation of the project activity. The purpose of the project activity is to produce electricity with clean and renewable wind sources and to displace part of the electricity from fossil fuel-fired power plants connected to the TPG. Thus, greenhouse gas (GHG) emission reductions can be achieved.

Contribution to sustainable development:
The project contributes significantly to the region's sustainable development. The specific goals for the project are to:

- reduce the greenhouse gas emissions in Taiwan by replacing fossil fuel based power generation;

- produce clean and renewable energy that contributes to alleviate the global warming;
- contribute the development of the wind energy sector in Taiwan;
- provide clean electricity to households;
- create local employment both during the construction and operational phases;
- technology and know-how transfer as the employees are trained by German wind turbine manufacturer Enercon on maintenance, safety and operational issues;
- contribute to the reduction of pollutants such as sulphur dioxide, nitrogen oxides and particles resulting from the electricity generation from fossil fuels in Taiwan;
- contribute to Taiwan's energy sustainability and security by reducing the dependency on fossil fuel imports.

A.2. Location of project activity
A.2.1. Host Party(ies)
>>
Taiwan

A.2.2. Region/State/Province etc.
>>
Hsinchu County, Miaoli County, Taichung County and Taoyuan County

A.2.3. City/Town/Community etc.
>>
Hsinfong Township, Houlong Township, Dajia and Da-An Townships, and Guanyin Township

A.2.4. Physical/Geographical location
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The locations of the wind farms are all in West Taiwan. Fongwei Wind Farm is located at the coastal land of Hsinfong Township, Hsinchu County. Hsinchu County is located in northwestern Taiwan, and is connected with Taoyuan County in north, Miaoli County in south, Taiwan Strait in the west and the Snow Mountains (Dabajian Mountain) in the east. Hsinchu County is surrounded by mountains on three sides.

Longwei Wind Farm is located in the west coastal land of Houlong Township, Miaoli County. Miaoli County is located in mountainous and hilly areas of central and northern Taiwan.

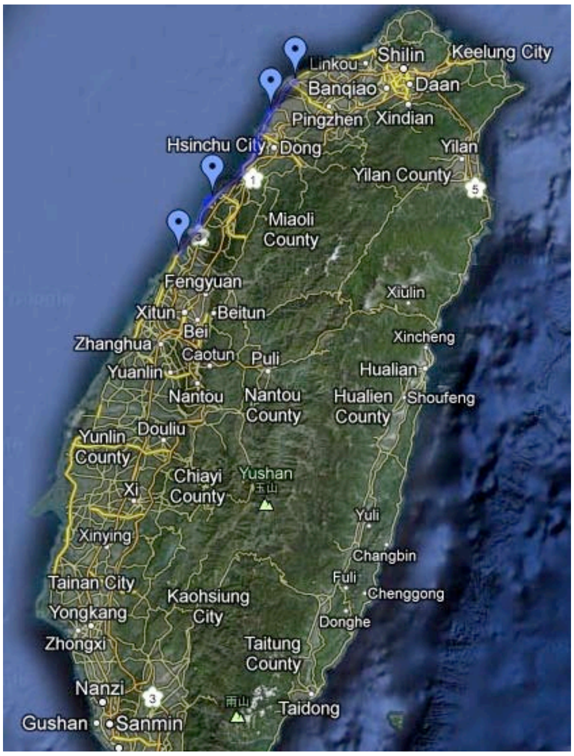
Chungwei Wind Farm is located in the coastal land of Dajia and Da-An Townships, Taichung County. Dajia and Da-An Townships are in the northwest of Taichung County and connected with Taiwan Strait in the west.

Tauwei Wind Farm is located in the west coastal land of Guanyin Townships, Taoyuan County. Taoyuan County is located in north-western Taiwan, close to the Taipei metropolitan area; with the majority of terrains are the hill terraces.

The proposed project activities are distributed in these zones, which are at the geographical positions of:

Wind Farm Name	Coordinates
Tauwei Wind Farm	25º02'43"N, 121º04'21"E
Fongwei Wind Farm	24º55'48"N, 120º58'40"E
Longwei Wind Farm	24º36'41"N, 120º44'13"E
Chungwei Wind Farm	24º24'21"N, 120º35'59"E

Figure A-1 shows the geographical locations of the project.



A.3. Technologies and/or measures

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The proposed project activity is a greenfield project which generates electricity by utilizing the renewable wind resources, providing clean electricity, thus does not produce GHG emissions. The scenario prior to the project activity implementation is the same as the baseline scenario defined in section B.4, where the equivalent amount of electricity would have otherwise been generated by power plants connected to the TPG (Taipower Grid), and by the addition of new power sources to TPG. The proposed wind power project activity therefore abates the amount of carbon dioxides (CO_2, please refer to section B.3) that would have been otherwise emitted given the grid composition that comprises mainly fossil fuel based power generation.

The project in total comprises 39 Enercon E-70 wind turbines with the unit capacity of 2.3 MW and 3 Enercon E-44 wind turbines with the unit capacity of 0.9 MW. The turbines installed are imported from German wind turbine supplier, Enercon. Wind turbines type Enercon E-70 is used, with 71 m diameters and 64 m – 113 m hub heights; and wind turbines type Enercon E-44 is used, with 44 m diameters and 55 m hub heights. The turbines in Fongwei wind farm site are connected to Taipower grid at SongLin Substation through 11.4 kV transmission line. In Longwei wind farm site, part of the turbines are connected to Taipower 11.4 kV grid through Houlong Substation and part of the turbines are connected to Taipower 69 kV grid through the Gongguan-Miaozi 69 kV line. The turbines in Chungwei wind farm site are connected to Taipower 69 kV grid through 22.8kV/69kV transformer. The turbines in Tauwei wind farm site are connected to Taipower 161 kV grid through Tangwei Substation. Each wind farm utilizes bi-directional watthour meters measuring electricity supplied to Taipower grid.

The technical data of the turbine units of turbine type E-70 and E-44 are given in the tables below.

Table 1. Characteristics of the wind turbine E-70

Wind Turbine Type:	E-70			
Site:	Fongwei	Longwei	Chungwei	Tauwei
Rated Power:	2300 kW			
Number of turbines	6	18	13	2
Rotor diameter:	71 m			
Hub Height:	64 m-113 m			
Generator:	Enercon direct-drive synchronous annular generator			
Grid feeding:	ENERCON converter			
Technical lifetime	20 years			

Table 2. Characteristics of the wind turbine E-44

Wind Turbine Type:	E-44
Site:	Longwei
Rated Power:	900 kW
Number of turbines	3
Rotor diameter:	44 m
Hub Height:	55 m
Generator:	Enercon direct-drive synchronous annular generator
Grid feeding:	ENERCON converter
Technical lifetime	20 years

According to the "Tool to determine the remaining lifetime of equipment" (Version 01), option (a) "Use manufacturer's information on the technical lifetime of equipment" is chosen for identifying the technical lifetime of the wind turbines in the proposed project activity.

A.4. Parties and project participants

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)
Taiwan (host)	InfraVest Wind Power Group (Private entity)	No
Switzerland	South Pole Carbon Asset Management Ltd. (Private entity)	No

A.5. Public funding of project activity

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There is no public funding from Annex I countries involved in the project activity.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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The approved consolidated baseline and monitoring methodology ACM0002 (version 13.0.0) "Consolidated baseline methodology for grid-connected electricity generation from renewable sources – Version 13.0.0" has been used.

The methodology was applied with the following tools:

- Tool for the demonstration and assessment of additionality (Version 07.0.0)
- Tool to calculate the emission factor for an electricity system (Version 03.0.0)

Details are available at the following website:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved

B.2. Applicability of methodology
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The choice to use the ACM0002 (Version 13.0.0) methodology is applicable to the project because the project meets its applicability criteria:

- The project activity is a grid-connected renewable power generation project activity installing new power plants at sites where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant)
- The project activity is the installation of four power plants of wind power plants
- The project does not involve switching from fossil fuels to renewable energy source at the site of the project activity, the project is not a biomass power plant, or hydro power plant that result in new reservoirs/increase in existing reservoirs

The choice to use the "Tool to calculate the emission factor for an electricity system" (Version 03.0.0) is applicable to the project because the proposed project activity supplies electricity to the grid and substitutes the grid electricity.

B.3. Project boundary

Source		GHGs	Included?	Justification/Explanation
Baseline	Source 1 CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. (Power plants in TPG)	CO_2	Yes	Main emission source.
		CH_4	No	Minor emission source. Excluded for simplification. This is conservative.
		N_2O	No	Minor emission source. Excluded for simplification. This is conservative.
Project activity	Source 1 Emission Sources of Project Activity (InfraVest Taiwan Wind Farms Bundled Project 2011)	CO_2	N/A	Excluded, as per ACM0002 Version 13.0.0
		CH_4	N/A	Excluded, as per ACM0002 Version 13.0.0
		N_2O	N/A	Excluded, as per ACM0002 Version 13.0.0

According to the methodology ACM0002 (Version 13.0.0), the spatial extent of the project boundary includes project power plant and all power plants connected physically to the electricity system that the project power plant is connected to. Taiwan is an island with a single power grid with no cable connection with the continent. Thus there is no other connected electricity system in Taiwan, besides Taipower Grid (TPG). Therefore, the project boundary as described in flow chart below, is defined as the InfraVest Fongwei, Longwei, Chungwei and Tauwei wind farms power plants and the Taipower grid, and all power plants connected to Taipower grid.

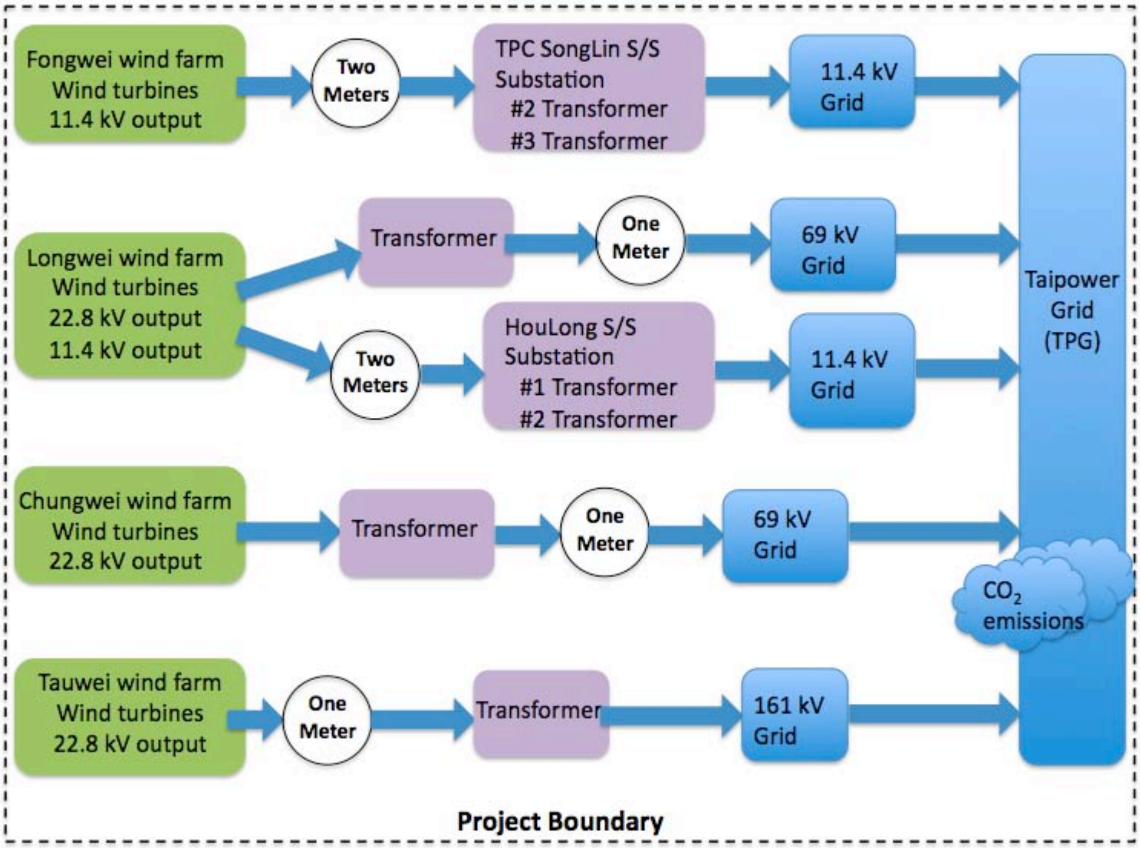

Figure B-1 Project boundary

B.4. Establishment and description of baseline scenario
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The methodology ACM0002 determines the baseline scenario through the following:
If the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

> *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".*

Because the project is connected to TPG, the baseline scenario is the emissions generated by the operation of the power plants currently connected to TPG and the emissions generated by the addition of new power sources to TPG. This is estimated ex-ante by using the Combined Margin (CM) calculation, which is the CM of TPG multiplied by the electricity delivered to TPG by the project.

The operating margin emission factor ($EF_{grid,OM,y}$) of Taiwan is 0.795 tCO_2e/MWh and the build margin emission factor ($EF_{grid,BM,y}$) is 0.662 tCO_2e/MWh. The defaults weights for wind power are used as specified in the emission factor tool: w_{OM}=0.75; w_{BM}=0.25. Thus the result of the Baseline Emission Factor ($EF_{grid,CM,y}$) calculation is **0.761** tCO_2e/MWh. The calculations are presented in Appendix 4.

B.5. Demonstration of additionality
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There was no public announcement of the project going ahead without the VER for the proposed project.

Project timeline:

Fongwei Wind Farm:

Date	Event	Supporting document
December 2001 ~ December 2002	InfraVest was already aware of carbon credit financing support and had approached several interested buyers for its future CDM and VER wind projects in China and in Taiwan	Emails
September 2006 ~ May 2007	InfraVest contacts with several potential carbon buyers for its upcoming VER wind projects in Taiwan	Emails
07/12/2007	Cooperation agreement between South Pole and InfraVest is signed	Cooperation Agreement
July 2008	South Pole and InfraVest signed ERPA for InfraVest's other wind farm projects in Taiwan[1]	ERPA for another project
10/12/2009	Board decision to seek for additional financial support from voluntary carbon trading scheme for Fongwei Wind Farm – *prior VER consideration*	Fongwei Board Decision
29/12/2009	Equipment Contract - Fongwei	Fongwei first equipment contract
30/07/2010	Construction Contract signed - Fongwei	Fongwei construction contract
27/09/2010	Email communication between South Pole and InfraVest on issues of documents preparation, LSC date and ERPA relevant for all four wind farms	Email
17/12/2010	South Pole started inviting stakeholders to attend the Local Stakeholder Consultation meeting for the proposed project	Invitation email
21/12/2010	EPRA Contract signed between South Pole and InfraVest for the proposed project	ERPA
03/01/2011	Local stakeholder consultation meeting held	LSC Report
28/01/2011	Submission to the Gold Standard LSC Report Project ID: GS1001	LSC Report Feedback
13/05/2011	Construction start time - Fongwei	Daily Report
26/09/2011	Commission start time - Fongwei	
04/09/2012	DOE Contract	DOE Contract
10/09/2012	Received from the Gold Standard the LSC Report Feedback; the project is listed in Gold Standard database	LSC Report Feedback
	PDD submitted to DOE	
	Validation review and site visit	

Longwei Wind Farm:

Date	Event	Supporting document
December 2001 ~ December 2002	InfraVest was already aware of carbon credit financing support and had approached several interested buyers for its future CDM and VER wind projects in China and in Taiwan	Emails

[1] InfraVest Changbin and Taichung bundled Wind Farms Project – Taiwan (GS472)

September 2006 ~ May 2007	InfraVest contacts with several potential carbon buyers for its upcoming VER wind projects in Taiwan	Emails
07/12/2007	Cooperation agreement between South Pole and InfraVest is signed	Cooperation Agreement
July 2008	South Pole and InfraVest signed ERPA for InfraVest's other wind farm projects in Taiwan[2]	ERPA for another project
23/12/2009	Board decision to seek for additional financial support from voluntary carbon trading scheme for Longwei Wind Farm – *prior VER consideration*	Longwei Board decision
29/12/2009	Equipment Contract - Longwei	Longwei equipment contract
30/07/2010	Construction Contract signed – Fongwei, Longwei, Chungwei	Longwei construction contract
27/09/2010	Email communication between South Pole and InfraVest on issues of documents preparation, LSC date and ERPA relevant for all four wind farms	Email
17/12/2010	South Pole started inviting stakeholders to attend the Local Stakeholder Consultation meeting for the proposed project	Invitation email
21/12/2010	EPRA Contract signed between South Pole and InfraVest for the proposed project	ERPA
03/01/2011	Local stakeholder consultation meeting held	LSC Report
28/01/2011	Submission to the Gold Standard LSC Report Project ID: GS1001	LSC Report Feedback
21/03/2011	Construction start time - Longwei	Daily Report
27/04/2012	Commission start time - Longwei	
04/09/2012	DOE Contract	DOE Contract
10/09/2012	Received from the Gold Standard the LSC Report Feedback; the project is listed in Gold Standard database	LSC Report Feedback
	PDD submitted to DOE	
	Validation review and site visit	

Chungwei Wind Farm:

Date	Event	Supporting document
December 2001 ~ December 2002	InfraVest was already aware of carbon credit financing support and had approached several interested buyers for its future CDM and VER wind projects in China and in Taiwan	Emails
September 2006 ~ May 2007	InfraVest contacts with several potential carbon buyers for its upcoming VER wind projects in Taiwan	Emails
07/12/2007	Cooperation agreement between South Pole and InfraVest is signed	Cooperation Agreement
July 2008	South Pole and InfraVest signed ERPA for InfraVest's other wind farm projects in Taiwan[3]	ERPA for another project

[2] InfraVest Changbin and Taichung bundled Wind Farms Project – Taiwan (GS472)
[3] InfraVest Changbin and Taichung bundled Wind Farms Project – Taiwan (GS472)

22/05/2009	Board decision to seek for additional financial support from voluntary carbon trading scheme for Chungwei – *prior VER consideration*	Chungwei Board decision
27/12/2009	Equipment Contract - Chungwei	Chungwei equipment contract
30/07/2010	Construction Contract signed –Chungwei	Chungwei construction contract
27/09/2010	Email communication between South Pole and InfraVest on issues of documents preparation, LSC date and ERPA relevant for all four wind farms	Email
17/12/2010	South Pole started inviting stakeholders to attend the Local Stakeholder Consultation meeting for the proposed project	Invitation email
21/12/2010	EPRA Contract signed between South Pole and InfraVest for the proposed project	ERPA
03/01/2011	Local stakeholder consultation meeting held	LSC Report
28/01/2011	Submission to the Gold Standard LSC Report Project ID: GS1001	LSC Report Feedback
15/02/2011	Construction start time - Chungwei	Daily Report
31/10/2011	Commission start time - Chungwei	
04/09/2012	DOE Contract	DOE Contract
10/09/2012	Received from the Gold Standard the LSC Report Feedback; the project is listed in Gold Standard database	LSC Report Feedback
	PDD submitted to DOE	
	Validation review and site visit	

Tauwei Wind Farm:

Date	Event	Supporting document
December 2001 ~ December 2002	InfraVest was already aware of carbon credit financing support and had approached several interested buyers for its future CDM and VER wind projects in China and in Taiwan	Emails
September 2006 ~ May 2007	InfraVest contacts with several potential carbon buyers for its upcoming VER wind projects in Taiwan	Emails
07/12/2007	Cooperation agreement between South Pole and InfraVest is signed	Cooperation Agreement
July 2008	South Pole and InfraVest signed ERPA for InfraVest's other wind farm projects in Taiwan[4]	ERPA for another project
10/12/2009	Board decision to seek for additional financial support from voluntary carbon trading scheme for Tauwei Wind Farm– *prior VER consideration*	Tauwei Board decision
27/09/2010	Email communication between South Pole and InfraVest on issues of documents preparation, LSC date and ERPA relevant for all four wind farms	Email
17/12/2010	South Pole started inviting stakeholders to attend	Invitation email

[4] InfraVest Changbin and Taichung bundled Wind Farms Project – Taiwan (GS472)

	the Local Stakeholder Consultation meeting for the proposed project	
21/12/2010	EPRA Contract signed between South Pole and InfraVest for the proposed project	ERPA
30/12/2010	Equipment Contract - Tauwei	Tauwei equipment contract
30/12/2010	Construction Contract signed - Tauwei	Tauwei construction contract
03/01/2011	Local stakeholder consultation meeting held	LSC Report
28/01/2011	Submission to the Gold Standard LSC Report Project ID: GS1001	LSC Report Feedback
10/02/2011	Construction start time - Tauwei	Daily Report
04/07/2011	Commission start time - Tauwei	
04/09/2012	DOE Contract	DOE Contract
10/09/2012	Received from the Gold Standard the LSC Report Feedback; the project is listed in Gold Standard database	LSC Report Feedback
	PDD submitted to DOE	
	Validation review and site visit	

InfraVest Taiwan wind farms bundled project 2011 is owned by InfraVest Group. Due to high investment cost and low feed-in tariff for wind projects in Taiwan, additional revenues from carbon credits were essential for the viability of the project. Given the circumstances, InfraVest was seeking for VER revenues comprehensively in the early stage of project development. The table above provides the different steps of the project development, showing all milestones and when and how InfraVest considered the VER revenues. The following elements will be disclosed to the DOE to prove early consideration, during project validation:

Since year 2001, the project owner of the proposed project, InfraVest has been considering the potential of carbon credits for financing its wind power projects and been in discussion actively with carbon consultants and buyers. Copies of mail exchange between InfraVest and several carbon consultants and buyers (which shall remain in private confidentiality)[5] during 2001 ~ 2002 and 2006 ~ 2007 dealing about the VER development in Taiwan will be provided to the DOE at validation. In fact, prior to the proposed bundled project, there are already 2 wind projects owned by project owner registered at Gold Standard, which are the *InfraVest Changbin and Taichung bundled Wind Farms Project – Taiwan*, the first GS registered project (GS472) in Taiwan, with total capacity of 142.6 MW and emission reduction estimated at 373,543 tCO_2e, and *InfraVest Guanyin Wind Farm Project – Taiwan* (GS612) with total capacity of 43.7 MW, and expected emission reduction of 110,293 tCO_2e. Therefore, it could be seen that the carbon credits financing has been always seriously considered by InfraVest as a mean to better compensate the low investment return for its wind farms.

In the beginning of September 2006, InfraVest started to look actively for carbon consultants that would be able to assist in developing VER projects in Taiwan and several brokers including Natsource, DEG, KfW were contacted.

In July 2007, the draft cooperation agreement was drafted between InfraVest and South Pole Carbon in Taiwan. In December 2007, South Pole Carbon finally signed the cooperation agreement with InfraVest, for InfraVest's wind projects in Taiwan (including the four wind farms under this proposed bundle project). The first ERPA between South Pole and InfraVest was signed in July 2008 for Changbin and

[5] Emails correspondence records between InfraVest and NREL, Natsource, DEG, KfW for its wind projects in China and in Taiwan.

Taichung wind farms (GS472), which is the first GS registered project in Taiwan. The ERPA for the proposed bundled project was signed in December 2010. Copies of correspondence between InfraVest and South Pole (which shall remain strictly confidential) about the VER development for wind projects in Taiwan are provided to the DOE at validation.

As discussed above, it is clear that:

- InfraVest is fully aware of carbon trading scheme, and has always sought actively and continuously for carbon consultants and buyers before the project start date;
- All InfraVest's previous projects in Taiwan have sought for carbon revenues; otherwise they would not have been financially attractive.

Demonstration of additionality

As prescribed by the Gold Standard, the projects' additionality is demonstrated through use of the Tool for the demonstration and assessment of additionality.

The approved methodological tool "*Tool for the demonstration and assessment of additionalit*y" (Version 07.0.0) provides a step-wise approach to demonstrate project additionality and is applied to determine whether the project is additional following the steps below:
(a) Step 0 Demonstration whether the proposed project activity is the first-of-its-kind;
(b) Step 1 Identification of alternatives to the project activity consistent with current laws and regulations;
(c) Step 2 Investment analysis to determine whether the proposed project activity is not:
1) The most economically or financially attractive; or
2) Economically or financially feasible, without the revenue from the sale of certified emission reduction (CERs);
(d) Step 3 Barriers analysis; and
(e) Step 4 Common practice analysis.

Step 0: Demonstration whether the proposed project activity is the first-of-its-kind

The proposed project activity is obviously not the first-of-its-kind. Prior to the proposed bundled project, there are already two wind projects owned by the same project owner, already registered at Gold Standard as GS VER projects (*InfraVest Changbin and Taichung bundled Wind Farms Project – Taiwan*, GS472, and *InfraVest Guanyin Wind Farm Project – Taiwan*, GS612).

Outcome of Step 0: the proposed project is not the first-of-its-kind.

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

This step involves the definition of realistic and credible alternatives to the project activity through the following Sub-steps:

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

As per paragraph 8 of the "Tool for the demonstration and assessment of additionality" (Version 07.0.0), project activities that apply this tool in context of approved consolidated methodology ACM0002, only need to identify that there is at least one credible and feasible alternative that would be more attractive than the proposed activity.
The project owner of the proposed project (InfraVest) is an independent power producer (IPP)[6] investing

[6] http://en.wikipedia.org/wiki/Independent_Power_Producer

solely in wind energy[7].

Outcome of Step 1a: Since the aim of the proposed project activity is to produce electricity by utilizing wind energy, therefore alternatives available for the project include:

> ***Alternative A*** *InfraVest Wind Farm Bundle Project without VER revenue*
> ***Alternative B*** *Continuation of the current situation (provision of the equivalent amount of project's annual power output by the grid)*

Sub-step 1b: Consistency with mandatory laws and regulations:

The mandatory preliminary permits have been obtained for the project activity, showing that it is in compliance with the current laws and regulations.

- Renewable Energy Development Act[8]
- Taipower Company renewable energy power acquisition operating points[9]
- The Electricity Act[10]
- Electricity registration rules[11]

Outcome of Step 1b: All the alternatives to the project outlined in Step 1a above are in compliance with applicable laws and regulations.

For the demonstration of additionality, both UNFCCC and Gold Standard guidelines allow to conduct an investment analysis or a barrier analysis, we choose to conduct an investment analysis.

Step 2: Investment analysis

The main purpose of carrying out investment analysis is to determine whether the proposed project activity is not: (a) the most economically or financially attractive; or (b) economically or financially feasible, without the revenue from the sale of VERs. All steps followed in this analysis are according to *"Tool for the demonstration and assessment of additionality"*.

Sub-step 2a: Determine appropriate analysis method

The project activity and the alternatives identified in Step 1 do have related financial benefits other than VER, therefore, simple cost analysis (Option I) is not applicable for all alternatives. As alternative B is not an investment project, therefore investment comparison (Option II) is not applicable. Hence, benchmark analysis (option III) will be applied to alternative A to demonstrate that it is not economically feasible.

Sub-step 2b: Option III. Apply benchmark analysis

For a private project developer, the most suitable economic indicator for the project type and decision context is the project's internal rate of return (IRR). Therefore, the benchmark analysis using an Equity IRR as financial indicator is applied to the proposed project.

Five options can be used to derive the benchmark of IRR:

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[7] http://www.infra-vest.com/english/index.html
[8]http://web3.moeaboe.gov.tw/ECW/main/content/wHandEditorFile.ashx?file_id=546
[9]http://www.taipower.com.tw/TaipowerWeb//upload/files/14/recycle_energy.pdf
[10]http://law.moj.gov.tw/LawClass/LawContent.aspx?PCODE=J0030011
[11]http://law.moj.gov.tw/LawClass/LawContent.aspx?PCODE=J0030012

(a) Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data;
(b) Estimates of the cost of financing and required return on capital (e.g. commercial lending rates and guarantees required for the country and the type of project activity concerned), based on bankers views and private equity investors/funds' required return on comparable projects;
(c) A company internal benchmark (weighted average capital cost of the company), only in the particular case referred to above in paragraph 5. The project developers shall demonstrate that this benchmark has been consistently used in the past, i.e. that project activities under similar conditions developed by the same company used the same benchmark;
(d) Government/official approved benchmark where such benchmarks are used for investment decisions;
(e) Any other indicators, if the project participants can demonstrate that the above Options are not applicable and their indicator is appropriately justified.

Since there is no officially approved benchmark for investment decisions in Taiwan, in this case, the option (a) is chosen to determine the benchmark of equity IRR. According to Professor Aswath Damodaran at Stern School of Business at New York University[12], a fairly simple alternative is to assume that a company's exposure to country risk is proportional to its exposure to all other market risk, which is measured by the beta. Prof. Damodaran's approach has been widely used in VER projects and the same approach was validated and accepted by the Gold Standard through the previous InfraVest's wind project in Taiwan (*InfraVest Changbin and Taichung bundled Wind Farms Project – Taiwan* GS472*)*. The cost of equity is determined by using Damodaran's Capital Asset Pricing Model (CAPM). For a firm in an emerging market[13], the cost of equity is determined as follows:

*Cost of equity = Risk free rate[14] + Beta[15] * (Mature Market Premium + Country Risk Premium)[16]*

This approach calculates the risk premium associated with the specific risk involved in a particular project type. The riskiness is calculated by means of the beta that measures the relative riskiness of the particular project type in the market. This approach assesses risks at a market level and not by looking at an individual's risk preferences. Therefore, the cost of equity is defined by analyzing governmental bond rates (risk free rate), increased by a suitable risk premium to reflect private investment.

The risk free rate is taken as the average of US treasury 10 years bond rates in the period of 3 years (22/05/2006 – 22/05/2009) prior to the earliest investment decision time of all the four wind farms, which is 22 May 2009 (Chungwei Wind Farm Board Decision) under this bundled proposed project (4.12%[17]). The total risk premium is calculated as beta of stock multiplied by the sum of the long-term risk premium for the country under consideration and the risk premium for a mature equity market. The risk premium for a mature equity market was 4.79% (represents the equity market risk for countries with zero risk); and the country risk premium of Taiwan is 0.90%. This results in a risk premium of 5.69%. The average beta of stocks for power sector in the same year is 1.56.

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[12] Aswath Damodaran, "Measuring Company Exposure to Country Risk: Theory and Practice," Stern School of Business Working paper, September 2003 http://people.stern.nyu.edu/adamodar/pdfiles/papers/CountryRisk.pdf
[13] http://en.wikipedia.org/wiki/Emerging_markets
[14] http://research.stlouisfed.org/fred2/graph/?g=5SD
[15] The beta value has been taken as the average beta for the power sector referring to the values provided by Prof. A. Damodaran online http://people.stern.nyu.edu/adamodar/pc/archives/betas04.xls, 2006-01-30. The list of companies included in the beta calculation is available here: http://people.stern.nyu.edu/adamodar/pc/archives/compfirm04.xls
[16] The total equity risk premium (*Mature Market Premium + Country Risk Premium)* has been sourced from Prof. A. Damodaran, http://people.stern.nyu.edu/adamodar/pc/archives/ctryprem07.xls, 2009-01-12.
[17] http://research.stlouisfed.org/fred2/graph/?g=5SD

The benchmark IRR estimation for the whole electricity generation sector in Taiwan is 4.12% + 1.56 * (4.79% + 0.90%) = **12.980%**.

Sub-step 2c: Calculation and comparison of financial indicators

The basic financial parameters of the proposed project are listed in the following table:

Fongwei Wind Farm:

Parameter	Unit	Value (6 x 2.3MW)	Source
Total Investment	EUR	20,698,800	InfraVest
Operation Cost	EUR/year	517,470	InfraVest
Loan/equity ratio	%	82/18	InfraVest
Loan interest	-	5.5%	InfraVest
Electricity generation	MWh/year	33,810	InfraVest
Emission reduction	tCO_2/year	25,729	Calculated
Project lifetime	Years	20	InfraVest
Income tax rate	%	17	InfraVest
Depreciation period	Years	20	InfraVest
Exchange rate	NTD/EUR	38.42	InfraVest
Electricity Price	NTD/MWh	2.6138	PPA

Longwei Wind Farm:

Parameter	Unit	Value (18 x 2.3MW)	Value (3 x 0.9MW)	Source
Total Investment	EUR	61,717,105	4,221,321	InfraVest
Operation Cost	EUR/year	1,542,928	105,533	InfraVest
Loan/equity ratio	%	82/18	82/18	InfraVest
Loan interest	-	5.5%	5.5%	InfraVest
Electricity generation	MWh/year	99,360	6,480	InfraVest
Emission reduction	tCO_2/year	75,612	4,931	Calculated
Project lifetime	Years	20	20	InfraVest
Income tax rate	%	17	17	InfraVest
Depreciation period	Years	20	20	InfraVest
Exchange rate	NTD/EUR	38.42	38.42	InfraVest
Electricity Price	NTD/kWh	2.6138 (for 17 units)	2.6574	PPA
Electricity Price	NTD/kWh	2.6574 (for 1 unit)	-	PPA

Chungwei Wind Farm:

Parameter	Unit	Value (3 x 2.3MW)	Value (9 x 2.3MW)	Value (1 x 2.3MW)	Source
Total Investment	EUR	10,349,987	31,049,940	3,647,000	InfraVest
Operation Cost	EUR/year	258,750	776,249	91,175	InfraVest
Loan/equity ratio	%	82/18	82/18	82/18	InfraVest
Loan interest	-	5.5%	5.5%	5.5%	InfraVest
Electricity generation	MWh/year	17,250	51,750	5,520	InfraVest
Emission reduction	tCO_2/year	13,127	39,381	4,200	Calculated
Project lifetime	Years	20	20	20	InfraVest
Income tax rate	%	17	17	17	InfraVest
Depreciation period	Years	20	20	20	InfraVest
Exchange rate	NTD/EUR	38.42	38.42	38.42	InfraVest

Electricity Price	NTD/kWh	2.6138	2.6138	2.6427	PPA

Tauwei Wind Farm:

Parameter	Unit	Value (2 x 2.3MW)	Source
Total Investment	EUR	6,900,000	InfraVest
Operation Cost	EUR/year	172,500	InfraVest
Loan/equity ratio	%	82/18	InfraVest
Loan interest	-	5.5%	InfraVest
Electricity generation	MWh/year	11,270	InfraVest
Emission reduction	tCO_2/year	8,576	Calculated
Project lifetime	Years	20	InfraVest
Income tax rate	%	17	InfraVest
Depreciation period	Years	20	InfraVest
Exchange rate	NTD/EUR	38.42	InfraVest
Electricity Price	NTD/MWh	2.6138	PPA

The table below shows the financial analysis for the project activity:

Wind Farm	Equity IRR
	IRR (without VERs)
Fongwei	5.47%
Longwei	4.99%
	3.87%
Chungwei	6.21%
	6.21%
	3.20%
Tauwei	5.47%

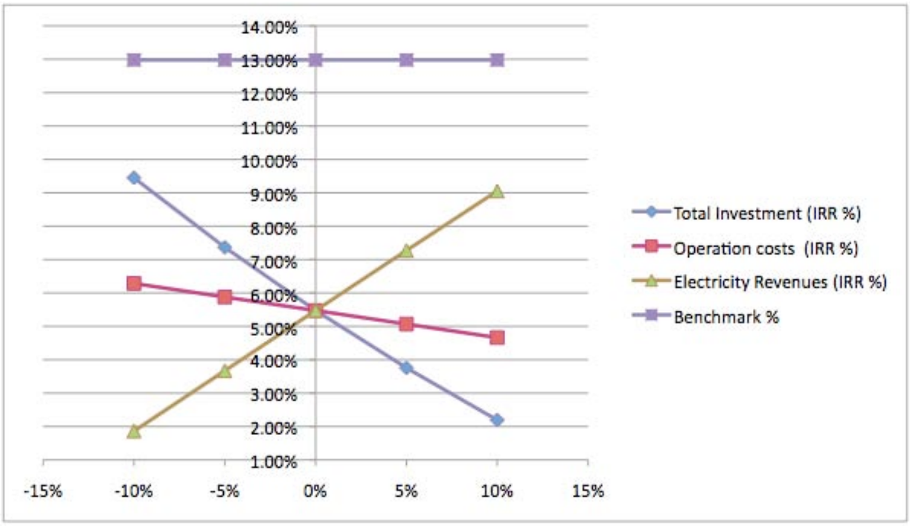
Without carbon revenue, Equity IRRs of the four wind farms in the proposed project are all lower than the benchmark. Thus, the proposed project is not financially attractive.

Sub-step 2d: Sensitivity analysis

Purpose of sensitivity analysis is to show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The variables chosen for sensitivity analysis are operation cost, total investment, and annual electricity revenues (derived from the fluctuation in total generation). The sensitivity of this analysis is tested by considering an increase and a decrease of up to 10% of each variable, as summarized in the following tables:

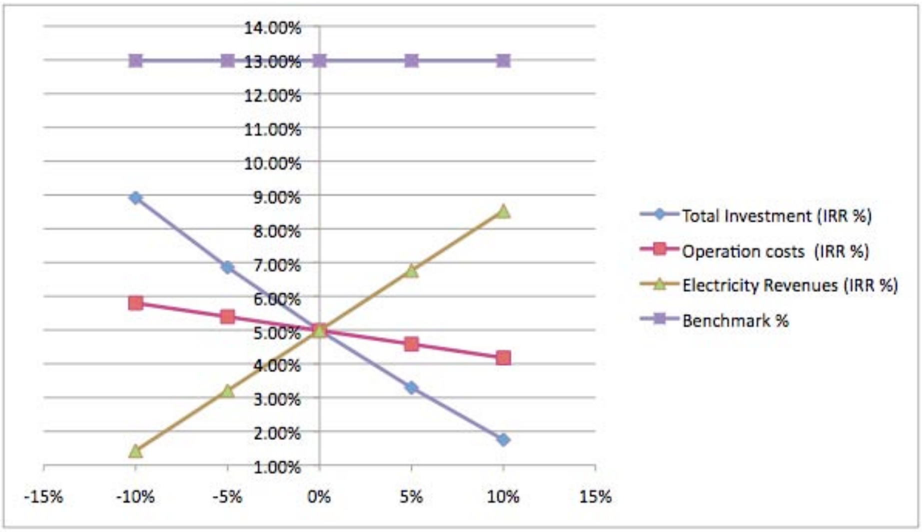
Fongwei sensitivity analysis (6 x 2.3MW):

Variation	Total Investment	Operation Cost	Electricity Revenues
-10%	9.45%	6.28%	1.86%
-5%	7.37%	5.88%	3.67%
0%	5.47%	5.47%	5.47%
5%	3.76%	5.07%	7.27%
10%	2.19%	4.66%	9.05%



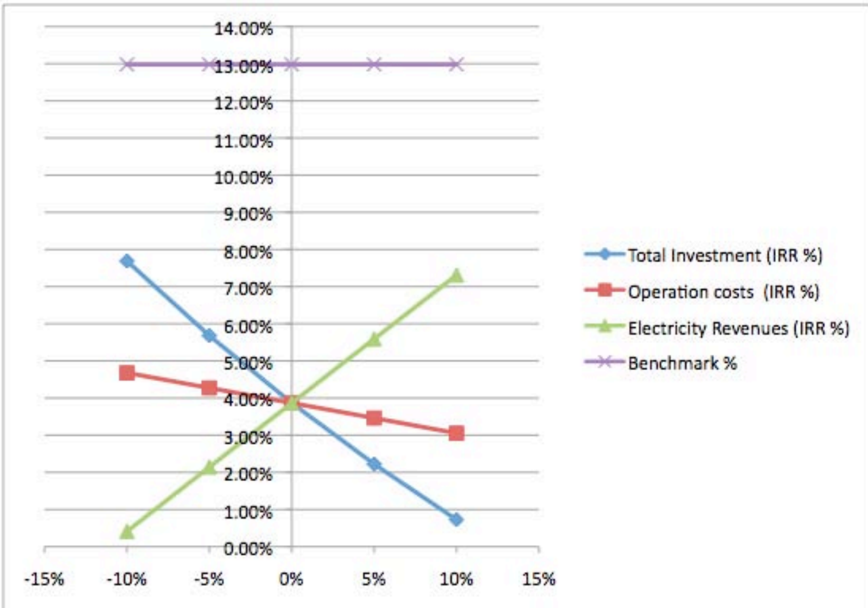
Longwei sensitivity analysis (18 x 2.3MW):

Variation	Total Investment	Operation Cost	Electricity Revenues
-10%	8.92%	5.80%	1.42%
-5%	6.86%	5.39%	3.21%
0%	4.99%	4.99%	4.99%
5%	3.29%	4.58%	6.76%
10%	1.75%	4.18%	8.53%



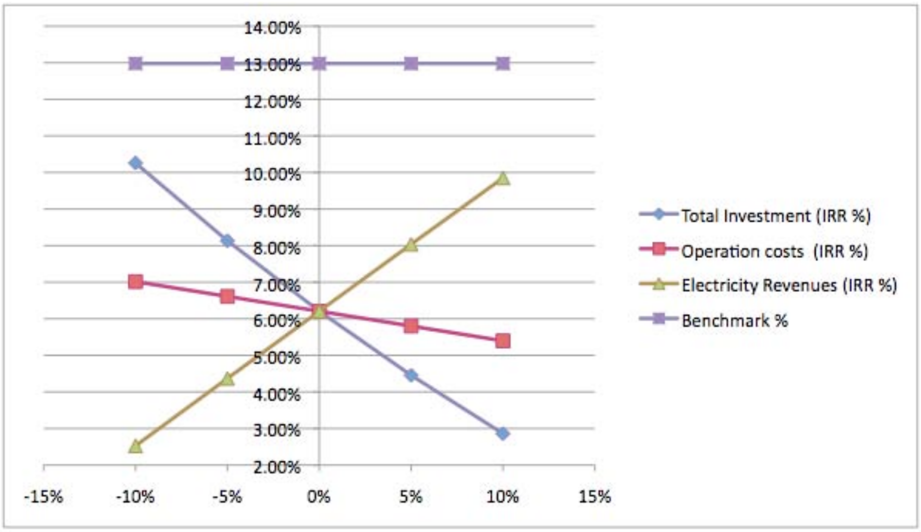
Longwei sensitivity analysis (3 x 0.9MW):

Variation	Total Investment	Operation Cost	Electricity Revenues
-10%	7.69%	4.68%	0.41%
-5%	5.68%	4.27%	2.14%
0%	3.87%	3.87%	3.87%
5%	2.22%	3.46%	5.59%
10%	0.73%	3.05%	7.31%



Chungwei sensitivity analysis (3 x 2.3MW):

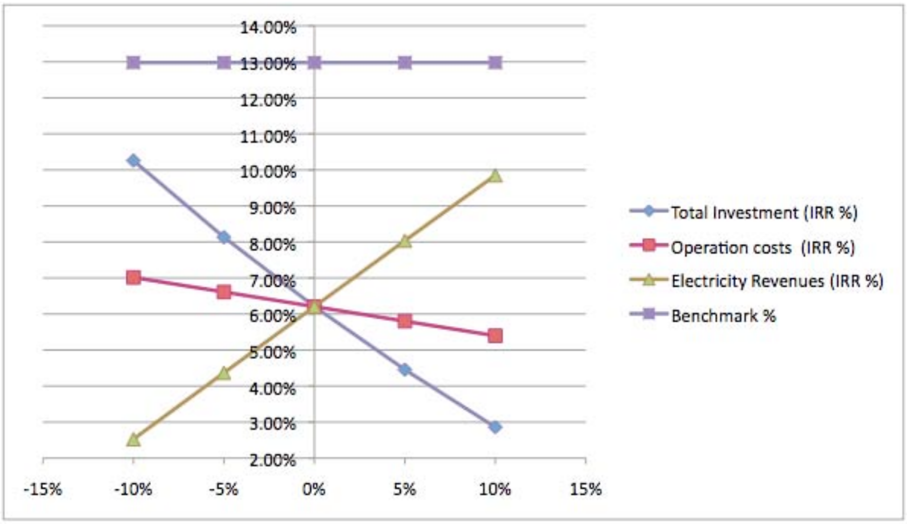
Variation	Total Investment	Operation Cost	Electricity Revenues
-10%	10.26%	7.01%	2.53%
-5%	8.13%	6.61%	4.37%
0%	6.21%	6.21%	6.21%
5%	4.46%	5.80%	8.04%
10%	2.86%	5.40%	9.85%



Chungwei sensitivity analysis (9 x 2.3MW):

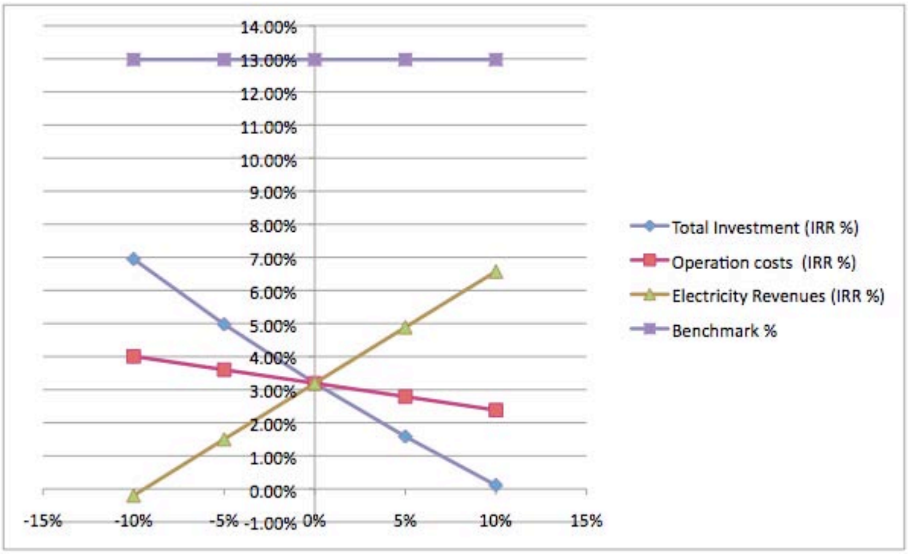
Variation	Total Investment	Operation Cost	Electricity Revenues
-10%	10.26%	7.01%	2.53%
-5%	8.13%	6.61%	4.37%
0%	6.21%	6.21%	6.21%
5%	4.46%	5.80%	8.04%

10%	2.86%	5.40%	9.85%



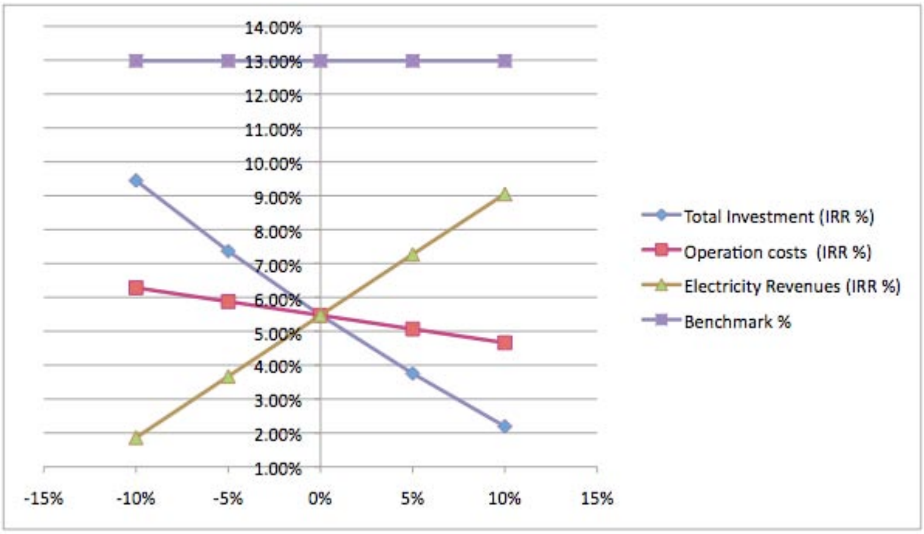
Chungwei sensitivity analysis (1 x 2.3MW):

Variation	Total Investment	Operation Cost	Electricity Revenues
-10%	6.95%	4.01%	-0.20%
-5%	4.97%	3.60%	1.50%
0%	3.20%	3.20%	3.20%
5%	1.58%	2.79%	4.89%
10%	0.11%	2.38%	6.57%



Tauwei sensitivity analysis (2 x 2.3MW):

Variation	Total Investment	Operation Cost	Electricity Revenues
-10%	9.45%	6.28%	1.86%
-5%	7.37%	5.88%	3.67%
0%	5.47%	5.47%	5.47%
5%	3.75%	5.07%	7.27%
10%	2.19%	4.66%	9.05%



The above analyses show that the IRR is more sensitive to the total investment and electricity revenues, while it is less elastic to operation cost. The sensitivity analyses result in the equity IRRs mostly below the benchmark.

A critical point analysis is further carried out towards the main financial parameters: total investment, operation costs, and electricity revenues. Outcomes of the calculation are presented as follows:

Benchmark Equity IRR	Critical Point		
12.98%	Total Investment	Operation Cost	Electricity Revenues
Fongwei	-17.24%	-92.58%	20.83%
Longwei	-18.35%	-98.55%	22.48%
	-20.92%	-112.35%	26.45%
Chungwei	-15.56%	-83.58%	18.42%
	-15.56%	-83.58%	18.42%
	-22.47%	-120.70%	28.97%
Tauwei	-17.42%	-92.58%	20.83%

The above results show that equity IRRs would reach the benchmark if the total investment decreased by 15.56% ~ 22.47%, operation cost decreased by 83.58% ~ 120.70%, or the electricity revenues increased by 18.42% ~ 28.97%. These conditions are impossible to occur for the following reasons:

1. Total investment: when the total investment decreases by 15.56% ~ 22.47% in the critical point scenario, the equity IRR would reach the benchmark. But the investment cannot be decreased by 15.56% or above. According to the Records Abstracts of the Draft Renewable Energy Electricity Purchase Rate Calculation Formula Hearings (year 2009, second meeting)[18], the actual experiences from the local wind energy developers in Taiwan are that the unit installation investment cost of land-based wind power projects in Taiwan have already reached 7.2 x 10^4 NTD/kW or above for wind IPP. However, The estimated unit investment cost for the proposed project is already highly conservative (estimated unit investment cost is around NTD 5.7 ~ 7.2 x 10^4 per kWh due to fluctuations of exchange rate). Therefore, the total investment is already conservatively estimated and is impossible to decrease by 15.56% or above.
2. Operation costs: The equity IRR would only reach the benchmark if operation costs decreases by 83.58% ~ 120.70%, but the operation costs can never be decreased by 83% or above. Based on the

[18] http://web3.moeaboe.gov.tw/ECW/renewable/content/wHandMenuFile.ashx?menu_id=1235

actual operation experiences from the local wind energy developers in Taiwan, the operation cost of the land-based wind power is 4% ~ 5% of the total investment for wind IPP[19]. However, The estimated operation cost for the proposed project is already highly conservative (estimated operation cost is 2.5% of the total investment). Therefore, the operation cost is impossible to decrease by 83% or above.

3. Electricity Revenues: The equity IRR would reach the benchmark if electricity tariff or electricity generation increased by around 18%. The electricity tariffs adopted in the IRR calculation are from the Power Purchase Agreements (PPAs), which are signed between the project owner and Taipower Company based on Taipower Purchase Renewable Electricity Price Directives[20] issued in 2011. Since the government controls the tariff, only small fluctuations are expected. In fact, according to the newly issued Taipower Purchase Renewable Electricity Price Directive in 2012[21], the electricity tariff for land-based wind power electricity with installed capacity above 10 MW is fixed at 2.60 NTD/kWh, 0.05% lower than that in 2011. Therefore, it is impossible for the electricity tariff to increase by 18%; and at current price level, without VERs revenues, the IRRs of the four wind farms are not higher than the benchmark.

   As to the electricity generation, the estimated operation hours of the wind farms under the proposed project are already below or equal to the average operation hours for Taiwan wind power generation (2,500 hours based on research by Industrial Technology Research Institute in Taiwan[22]). Moreover, according to the Energy Statistics Handbook 2011[23] and the Electricity Generation Installed Capacity and Total Generation Statistic Data (Year 1995-2010)[24], the 11-year (from 2001 to 2011) average operation hours for all Taiwan wind power are also around 2,500 hours and the 10-year average operation hours for wind power from IPPs in Taiwan are only 2,270 hours. Therefore, for the proposed project activity whose project owner is an IPP, it is impossible for the operation hours to increase by 20% to reach 3,000 hours.

Outcome of Step 2: In conclusion, the project shows equity IRR below benchmark when variation is applied to the chosen parameters in the sensitivity analysis. Critical point analysis further shows that the project equity IRR is impossible to reach the benchmark IRR. The conclusion that the proposed project is not financially attractive is therefore robust.

Step 4: Common practice analysis

According to the Tool for the demonstration and assessment of additionality (version 07.0.0), the measure of the proposed project belongs to **Measure** (ii): "Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies (example: energy efficiency improvements, power generation based on renewable energy)". Thus, Sub-step 4a is adopted to take the common practice analysis.

Sub-step 4a: The proposed project activity applies measure(s) that are listed in the definitions section above

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[19] http://web3.moeaboe.gov.tw/ECW/renewable/content/wHandMenuFile.ashx?menu_id=1235

[20] http://www.taipower.com.tw/TaipowerWeb//upload/files/14/main_3_1_9_2.pdf
http://www.esdtaiwan.edu.tw/upload/%7BEE832687-2AD7-4D05-B91D-83CC2D3508F8%7D/%E4%B8%AD%E8%8F%AF%E6%B0%91%E5%9C%8B100%E5%B9%B4%E5%BA%A6%E5%86%8D%E7%94%9F%E8%83%BD%E6%BA%90%E9%9B%BB%E8%83%BD%E8%BA%89%E8%B3%BC%E8%B2%BB%E7%8E%87%E5%8F%8A%E5%85%B6%E8%A8%88%E7%AE%97%E5%85%AC%E5%BC%8F.pdf

[21] http://solarcity.tainan.gov.tw/news_detail.php?nid=201

[22] http://www.fjinfo.gov.cn/kejiguan/txyjbg/201208.pdf

[23] http://web3.moeaboe.gov.tw/ECW/populace/content/wHandMenuFile.ashx?menu_id=681
Page 83, 14. Installed Capacity (by Fuel) (1) and Page 87, 16. Power Generation (by Fuel) (1)

[24] http://web3.moeaboe.gov.tw/ECW/populace/content/wHandMenuFile.ashx?menu_id=931

According to the “Guidelines on common practice” (Version 02.0), stepwise approach for common practice analysis is applied:

Step 1: calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.

The design capacities of the wind farms under the proposed project activity are between 4.6 MW to 44.1 MW. Therefore, the applicable capacity range is from 2.3 MW to 66.15 MW.

Step 2: identify similar projects (both CDM and non-CDM) which fulfil all of the following conditions:

(a) The projects are located in the applicable geographical area;
(b) The projects apply the same measure as the proposed project activity;
(c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
(d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
(e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
(f) The project started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

Applicable geographical area

Taiwan is selected as the applicable geographical area for the common practice, and the reasons are detailed as below:

- Taiwan is an island with a single power grid with no cable connection with the continent. Thus there is no other connected electricity system in Taiwan, besides Taipower Grid (TPG). The unique geological conditions in Taiwan results in the different wind resources, compared to wind plants in other regions or countries;
- The investment environments are different among regions and countries. This is due to a number of factors including the economic development level, the industrial structure, and the fundamental infrastructure, the development strategy and the policy framework. These can all affect the final investment decision;
- Finally, a number of other key economic factors vary from region to region, including tariff of products, the cost of materials, and other utilities such as water, the cost of labour and services and the types of loan that can be obtained. These all vary between regions. The electricity tariff of every region is different. This is the most important factor influencing the revenue from wind power generation, and hence affects the investment analysis of the projects. Wind power companies within the same region are therefore selected for the common practice analysis.

Similar projects

The applicable conditions for the similar projects are summarized as below:

- Applicable geographical area: Taiwan
- Applicable measure and technology: wind power projects (same energy source)
- Applicable output or capacity: 2.3 MW ~ 66.15 MW
- Applicable date of commercial operation: started before the start date of the project (27/12/2009)

Based on the Energy Statistics Hand Book 2011, published by Bureau of Energy, Ministry of Economics Affairs[25], Gold Standard database and other public available information, the similar projects are identified and listed in the table below:

Wind Farm Name	Total Capacity (MW)	Earliest commissioning start date	Project Owner	Turbine unit capacity / Turbine Number		Seeking for VER revenues
Penghu Wind Project	4.8	Sep 2001	Taipower Company	0.6	8	No
Shimen Wind Project	3.96	Oct 2004	Taipower Company	0.66	6	No
Hengchun Wind Project	4.5	Nov 2004	Taipower Company	1.5	3	No
Datan Wind Project	4.5	Jun 2005	Taipower Company	1.5	3	No
Guangyuan Wind Project	30	May 2006	Taipower Company	1.5	20	No
Zhonghuo Wind Project	8	Apr 2007	Taipower Company	2.0	4	No
Zhonggang Wind Project	8 16 10	Apr 2007 Dec 2007 Jan 2009	Taipower Company	2.0 2.0 2.0	4 8	No
Zhanggong Wind Project	46	Apr 2007	Taipower Company	2.0	23	No
Xinzhu Xiangshan Wind Project	4 8	Dec 2007 Jan 2009	Taipower Company	2.0 2.0	2 4	No
Mailiao Wind Project	30	Jan 2009	Taipower Company	2.0	15	No
Miaoli Chunan Wind Farm (*Miaoli 49.8MW Wind Farm Project*)	7.8	Feb 2006	Macquarie International Infrastructure Fund (MIIF)[26] (The wind farm is previously owned by InfraVest Group)	2.0 1.8	3 1	Yes (GS931)
Miaoli Dapong Wind Farm (*Miaoli 49.8MW Wind Farm Project*)	42	Apr 2006	Macquarie International Infrastructure Fund (MIIF) (The wind farm is previously owned by InfraVest Group)	2.0	21	Yes (GS931)
Changbin Wind Farm (*InfraVest Changbin and Taichung bundled Wind Farms Project - Taiwan*)	41.4 2.3 11.5	Jan 2008 Nov 2008 Dec 2009	InfraVest	2.3 2.3 2.3	18 1 5	Yes (GS472)
Lugang Wind	9.2	Jan 2008	InfraVest	2.3	4	Yes

[25] http://web3.moeaboe.gov.tw/ECW/populace/content/wHandMenuFile.ashx?menu_id=681 Page 111 and Page 112, 1. Hydro and Renewable Energy Power Plants (Cont.)

[26] http://www.macquarie.com/mgl/miif#

Farm (*InfraVest Changbin and Taichung bundled Wind Farms Project - Taiwan*)	9.2 2.3 6.9 11.5	Apr 2008 Oct 2008 May 2009 Dec 2009		2.3 2.3 2.3 2.3	4 1 3 5	(GS472)
Ta-an Wind Farm (Taichung) (*InfraVest Changbin and Taichung bundled Wind Farms Project - Taiwan*)	27.6 18.4	Jan 2009 Apr 2009	InfraVest	2.3 2.3	12 8	Yes (GS472)
Mailiao Wind Power Demonstration System	2.64	Dec 2000 (http://www.fengtay.org.tw/paper.asp?page=2006&num=311&num2=76)	Formosa Heavy Industries Corp. (http://www.fhi.com.tw/english/wind.htm)	0.66	4	No
Chunfeng Wind Power Demonstration System	3.5	Oct 2002 (http://www.fengtay.org.tw/paper.asp?page=2006&num=311&num2=76)	Chengloong Corp. (http://www.clc.com.tw/htmltest/community/community_adante.asp)	1.75	2	No

Step 3: within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all}.

Within the 17 similar projects identified in Step 2, 5 projects have already been registered as GS VER projects (see table above), which shall not be included in this common practice analysis; and the remaining 12 projects had not sought for VER revenue.

Therefore, $N_{all} = 12$

Step 4: within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity. Note their number N_{diff}.

As shown in the table above, 10 of all the 12 similar projects identified in Step 3 are owned by Taipower Company; and InfraVest is the main active, foreign wind farm developer and wind IPP in Taiwan. As the only state-owned grid company and largest power provider in Taiwan, Taipower does not face similar level of difficulty in terms of bank loan and financial closure as opposed to a private company like InfraVest. Moreover, two other private-owned projects can also be identified (Mailiao and Chunfeng Wind Power Demonstration Systems), but they were subsidized[27] by the government, and therefore do not face significant access to financial barriers.

According to the "Guidelines on Common Practice" (Version 02.0), different technologies are technologies that deliver the same output and differ by at least one of the following (as appropriate in the context of the measure applied in the proposed project activity and applicable geographical area):

[27] http://www.fhi.com.tw/english/wind.htm
http://old.npf.org.tw/PUBLICATION/SD/092/SD-C-092-086.htm

(a) Energy source/fuel;

(b) Feed stock;

(c) Size of installation (power capacity)/energy savings:

(i) Micro;

(ii) Small;

(iii) Large;

(d) Investment climate on the date of the investment decision, inter alia:

(i) Access to technology;

(ii) Subsidies or other financial flows;

(iii) Promotional policies;

(iv) Legal regulations;

(e) Other features, inter alia:

(i) Nature of the investment (example: unit cost of capacity or output is considered different if the costs differ by at least 20%).

Based on the principles mentioned above, the 10 Taipower's projects and the two other private-owned projects (Mailiao and Chunfeng Wind Power Demonstration Systems) are incomparable to the proposed project due to different technologies applied compared with that applied in the proposed project activity (investment climate on the date of the investment decision).

Therefore, $N_{diff} = 12$

Step 5: calculate factor $F=1-N_{diff}/N_{all}$ representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

$N_{all} - N_{diff} = 12 – 12 = 0$
$F = 1 - N_{diff}/N_{all} = 1 - 12/12 = 0$

According to the Guideline on common practice (version 02.0), if the factor F is greater than 0.2 and N_{all}-N_{diff} is greater than 3, the project activity would be a "common practice".
For the proposed project, $F = 0 < 0.2$ and $N_{all} - N_{diff} = 0 < 3$, therefore, the proposed project is not common practice.

From this analysis, it is clear that under the normal circumstances without carbon revenues, wind power projects are generally unattractive for investors in Taiwan, due to the high investment costs and relatively low feed-in tariff. In a broader perspective, based on *Energy Statistics Handbook, 2011 –* ***16.Power Generation (by Fuel) (2)***[28], wind power generation amounted to only 0.59% of total grid generation. Therefore, wind power generation cannot be considered as common practice in the region.

[28]Bureau of Energy, Ministry of Economic Affairs, Energy Statistics Handbook 2011, 16. Power Generation (by Fuel) (2).
http://web3.moeaboe.gov.tw/ECW/populace/content/wHandMenuFile.ashx?menu_id=681
http://web3.moeaboe.gov.tw/ECW/populace/content/ContentLink2.aspx?menu_id=380,

Outcome of Step 4: In a conclusion, the proposed project activity is not a common practice in the region, and it had obtained mandatory operational permits as in accordance with applicable laws in Taiwan R.O.C. As demonstrated above, the proposed wind farms bundled project faces significant financial barrier and requires carbon revenue in order to improve its financial status and future risks. Therefore, the emission reductions are additional to baseline scenario of the project activity.

B.6. Emission reductions
B.6.1. Explanation of methodological choices
>>
The approved consolidated baseline and monitoring methodology ACM0002 (version 13.0.0) "Consolidated baseline methodology for grid-connected electricity generation from renewable sources – Version 13.0.0" has been used.

The methodology was applied with the following tools:
- Tool for the demonstration and assessment of additionality (Version 07.0.0)
- Tool to calculate the emission factor for an electricity system (Version 03.0.0)

1. Project Emission
As per ACM0002, the project emission for most renewable energy (including wind farm) project activities is zero ($PE_y = 0$).

2. Baseline Emission
As per ACM0002, baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity, calculated as follows:

$$BE_y = EG_{PJ,y} * EF_{grid,CM,y}$$

Where:
BE_y = Baseline emissions in year y (tCO_2/yr)
$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

As per ACM0002, the project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, so:

$$EG_{PJ,y} = EG_{facility,y}$$

Where:
$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)

3. Leakage
For the leakage, according to ACM0002, no leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected.

Therefore, the leakage in this project is zero as well ($LE_y = 0$).

4. Emission reductions

Emission reductions of the project are calculated as follows:

$ER_y = BE_y – PE_y$

Where:
ER_y = Emission reductions in year y (tCO_2e/yr)
BE_y = Baseline emissions in year y (tCO_2/yr)
PE_y = Project emissions in year y (tCO_2e/yr)

After simplification, the final result for calculating this project's emission reduction is the following:

$ER_y = EG_{facility,y} * EF_{grid,CM,y}$

Emission Factor

The Baseline Emission Factor is calculated as a Combined Margin, using the weighted average of the operating margin and build margin.

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

$EF_{grid,OM,y}$ Operating Margin Emission Factor (tCO2e/MWh)
$EF_{grid,BM,y}$ Build margin emission factor (tCO2e/MWh)
w_{OM} Weighting of operating margin emissions factor
w_{BM} Weighting of build margin emissions factor

Based on above equation, the operating margin emission factor ($EF_{grid,OM,y}$) of Taiwan is 0.795 tCO2e/MWh and the build margin emission factor ($EF_{grid,BM,y}$) is 0.662 tCO2e/MWh. The defaults weights for wind power are used as specified in the emission factor tool: $w_{OM} = 0.75$; $w_{BM} = 0.25$.

The result of the Baseline Emission Factor ($EF_{grid,CM,y}$) calculation is **0.761 tCO2e/MWh**. The calculations are presented in Appendix 4 (The most recent 3-year data available (2008, 2009 and 2010) are used for calculating $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$. Until the first time of submission of PDD to DOE, data of year 2008, 2009 and 2010 have been the available most recent data for calculating the emission factor, and there were still some data of 2011 not available).

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**EG_y**
Unit	MWh
Description	The net electricity generation excluding the low-cost must-run (up until 2010)
Source of data	Energy Balances in Taiwan
Value(s) applied	See Table A4-2 in Appendix 4
Choice of data or Measurement methods and procedures	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	**$FC_{i,y}$**
Unit	Ton, litre or 1000 m^3
Description	Total amount of fossil fuel type i consumed by power plants/units in year y
Source of data	Energy Balances in Taiwan
Value(s) applied	Step 4 Table A4-3 in Appendix 4
Choice of data or Measurement methods and procedures	Fuel consumption breakdown by power plant/unit is unavailable, total consumption amounts are published annually.
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	**$NCV_{i,y}$**
Unit	TJ/KL, TJ/kt or TJ/million m^3
Description	Net calorific value of fossil fuel type i in year y
Source of data	GHG Emission Factor Inventory v.6.0. – Industrial Development Bureau, Ministry of Economic Affairs, Taiwan R.O.C.[29]
Value(s) applied	Please refer to the table of GHG Emission Factor Inventory v.6.0.
Choice of data or Measurement methods and procedures	Numbers are adopted from the reference document.
Purpose of data	Calculation of baseline emissions
Additional comment	The BoE provides directly emission factor by unit of mass or volume in which is equal to the product of $NCV_{i,y}$ and $EF_{CO2,i,y}$

[29] http://proj.moeaidb.gov.tw/ghg/page3-4.asp
GHG Emission Factor Inventory v.6.0. http://proj.moeaidb.gov.tw/ghg/files/A/ 溫室氣體排放係數管理表6.0版.xls

Data / Parameter	$EF_{CO2,i,y}$
Unit	$kgCO_2/kg$ $kgCO_2/L$ $kgCO_2/M^3$
Description	CO_2 emission factor of fossil fuel type i in year y
Source of data	GHG emission factor inventory version 6.0. published by Bureau of Energy, Ministry of Economic Affairs
Value(s) applied	Please refer to the table of GHG Emission Factor Inventory v.6.0.
Choice of data or Measurement methods and procedures	Publicly available data from Bureau of Energy, Ministry of Economic Affairs
Purpose of data	Calculation of baseline emissions
Additional comment	The BoE provides directly emission factor by unit of mass or volume in which is equal to the product of $NCV_{i,y}$ and $EF_{CO2,i,y}$

Data / Parameter	$EF_{Coal,Adv}$ $EF_{Gas,Adv}$ $EF_{Oil,Adv}$
Unit	tCO_2/MWh
Description	Emission factor of commercialized coal-fired, oil-fired and gas-fired power plant
Source of data	Equipment energy efficiency benchmark from Energy Information Network by Industrial Technology Research Institute, Bureau of Energy, Ministry of Economic Affairs
Value(s) applied	$EF_{Coal,Adv}$= 0.792 tCO_2/MWh $EF_{Gas,Adv}$= 0.367 tCO_2/MWh $EF_{Oil,Adv}$= 0.506 tCO_2/MWh Step 5 Substep 2 in Appendix 4
Choice of data or Measurement methods and procedures	Publicly available data from Bureau of Energy, Ministry of Economic Affairs
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	$CAP_{source,y}$
Unit	MW
Description	Installed capacity by different sources from 2002 till 2010 (MW)
Source of data	Statistic data of power generation capacity and total generation (available data of year 1995 ~ 2010) published by Bureau of Energy, Ministry of Economic Affairs
Value(s) applied	Step 5 Substep 2 in Appendix 4
Choice of data or Measurement methods and procedures	Publicly available data from Bureau of Energy, Ministry of Economic Affairs
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO_2e/MWh
Description	Combined Emission factor
Source of data	Calculated
Value(s) applied	0.761
Choice of data or Measurement methods and procedures	The Baseline Emission Factor is calculated as a Combined Margin, using the weighted average of the Operating Margin and Build Margin.
Purpose of data	Calculation of baseline emissions
Additional comment	

B.6.3. Ex ante calculation of emission reductions
>>
Project Emissions
In accordance to ACM0002, the project emission for most renewable energy (including wind farm) project activities is zero ($PE_y = 0$).

Leakage
Based on ACM0002, there is no need of leakage calculation or monitoring for this kind of activity, thus leakage is considered to be zero (0 tCO_2e).

Baseline Emissions
Based on ACM0002, baseline emissions (BE_y) include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the proposed project activity, which is calculated as follows:

$$BE_y = EG_{PJ,y} * EF_{grid,CM,y}$$

Where:
BE_y = Baseline emissions in year y (tCO_2/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

According to Section B.6.1, the final result for calculating this project's emission reduction is the following:

$$\mathbf{ER_y = EG_{facility,y} * EF_{grid,CM,y}}$$

The result of emission reduction:

$EG_{facility,y}$	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y	225,440	MWh/year
$EF_{grid,CM,y}$	Combined margin CO_2 emission factor	0.761	tCO_2e/MWh
ER_y	Baseline emission reductions annually	171,559	tCO_2e/year

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 1	171,559	0	0	171,559
Year 2	171,559	0	0	171,559
Year 3	171,559	0	0	171,559
Year 4	171,559	0	0	171,559
Year 5	171,559	0	0	171,559
Year 6	171,559	0	0	171,559
Year 7	171,559	0	0	171,559
Total	**1,200,913**	**0**	**0**	**1,200,913**
Total number of crediting years	7			
Annual average over the crediting period	171,559	0	0	171,559

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	**$EG_{Export,y}$**
Unit	MWh
Description	Quantity of electricity generation supplied by the project plant/unit to the grid
Source of data	Electricity meters
Value(s) applied	225,440 MWh
Measurement methods and procedures	Continuous measurement and at least monthly recording. Bi-directional electricity meters are applied in the project for all wind farms. Data from the electricity meters will be recorded remotely and digitally at the Taipower office. Taipower's personnel download the electronic data from the meters, and subsequent to meter reading sessions, the meters data are then incorporated in the monthly electricity receipts, which are then sent to the project owner by Taipower for confirmation on the amount of both electricity exported and imported. After confirmation from the project owner, the confirmed electricity exported to the grid is then considered as the basis on which Taipower conducts the payment to the project owner for purchasing electricity generated by the proposed project and the project owner sends the invoice to Taipower.
Monitoring frequency	Continuously
QA/QC procedures	Meter reading records will be crosschecked with the electricity receipts. The electricity meters will undergo maintenance/calibration according to Taiwan national standards (based on The Weight and Measures Act, Regulation no. CNMV 46, 'Technical Specification for Verification and Inspection of Electricity Meters') Accordingly, meter calibration is conducted every 8 years period.
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	$EG_{Import,y}$
Unit	MWh
Description	Quantity of electricity consumption of the project plant/unit from the grid
Source of data	Electricity meters
Value(s) applied	N/A
Measurement methods and procedures	Continuous measurement and at least monthly recording. Bi-directional electricity meters are applied in the project for all wind farms. Data from the electricity meters will be recorded remotely and digitally at the Taipower office. Taipower's personnel download the electronic data from the meters, and subsequent to meter reading sessions, the meters data are then incorporated in the monthly electricity receipts, which are then sent to the project owner by Taipower for confirmation on the amount of both electricity exported and imported. After confirmation from the project owner, the confirmed electricity imported is then considered as the basis on which the project owner conducts the payment to Taipower for electricity imported from Taipower by the proposed project and Taipower sends the invoice to the project owner.
Monitoring frequency	Continuously
QA/QC procedures	Meter reading records will be crosschecked with the electricity receipts. The electricity meters will undergo maintenance/calibration according to Taiwan national standards (based on The Weight and Measures Act, Regulation no. CNMV 46, 'Technical Specification for Verification and Inspection of Electricity Meters') Accordingly, meter calibration is conducted every 8 years period.
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	$EG_{facility,y}$
Unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid
Source of data	Calculated by the difference of $EG_{Export,y} – EG_{Import,y}$
Value(s) applied	225,440 MWh
Measurement methods and procedures	Calculated by the difference of $EG_{Export,y}$ and $EG_{Import,y}$ which are measured continuously and at least monthly recording.
Monitoring frequency	N/A
QA/QC procedures	Meter reading records of $EG_{Export,y}$ and $EG_{Import,y}$ will be crosschecked with the electricity receipts, and calculation will be double checked and verified.
Purpose of data	Calculation of baseline emissions
Additional comment	

B.7.2. Sampling plan

>>

Not applicable.

B.7.3. Other elements of monitoring plan

>>

1. Monitoring Objectives:

As per ACM0002, the emission reductions achieved by the project activity will be determined ex-post through direct measurement of the amount net electricity supplied to the grid multiplied by the combined margin emission factor:

$BE_y = EG_{facility,y} * EF_{grid,CM,y}$

Where:
BE_y = Baseline emissions in year y (tCO_2/yr)
$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

As the emission factor is fixed for the first crediting period, the aim of the monitoring is therefore only to monitor the net electricity generated using energy meters. The project proponent may use electricity from the grid for start up purpose so both electricity consumption and generation will be monitored:

$EG_{facility,y} = EG_{Export,y} – EG_{Import,y}$

$EG_{facility,y}$ Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)
$EG_{Export,y}$ Quantity of electricity generation supplied by the project plant/unit to the grid (MWh/y)
$EG_{Import,y}$ Quantity of electricity consumption of the project plant/unit from the grid (MWh/y)

2. Electricity meters:

Electricity generation ($EG_{Export,y}$) and consumption ($EG_{Import,y}$) are measured continuously by bi-directional meters installed at the wind farms switchrooms or Taipower substations, which are owned and supervised by Taipower. The accuracy for meters is equal to or higher than 0.5. The indicative meters locations and numbers of meters used for each wind farm are listed as below[30]:

Fongwei Wind Farm:
Two bi-directional electricity meters are located in Fongwei wind farm 11.4 kV Switchroom, before the generated electricity is transmitted to SongLin S/S Substation.

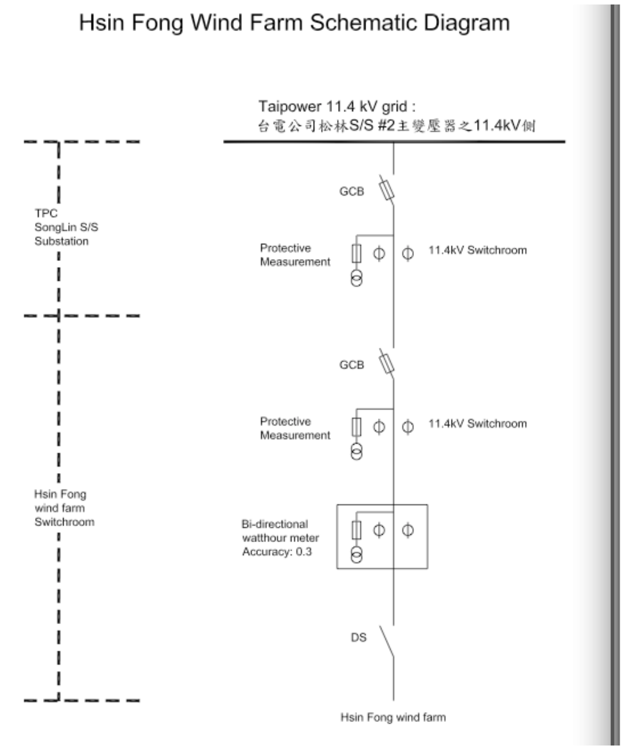
Longwei Wind Farm:
Three bi-directional electricity meters are used. One meter is located in Longwei wind farm 22.8 kV Switchroom, after the 22.8kV/69kV Transformer; and the other two meters are located in Longwei wind farm 11.4 kV Switchroom, before the generated electricity is transmitted to HouLong Substation.

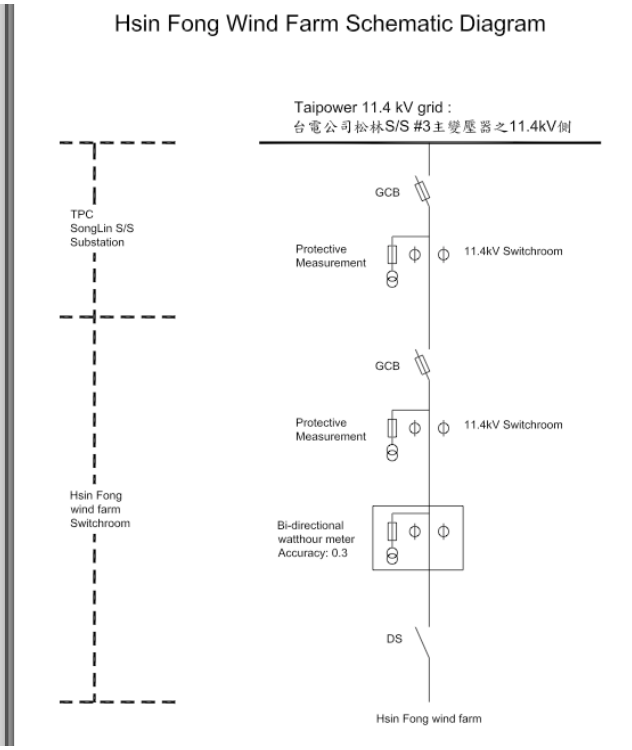
Chungwei Wind Farm:
One bi-directional electricity meter is located in Chungwei wind farm 22.8 kV Switchroom, after the 22.8kV/69kV Transformer.

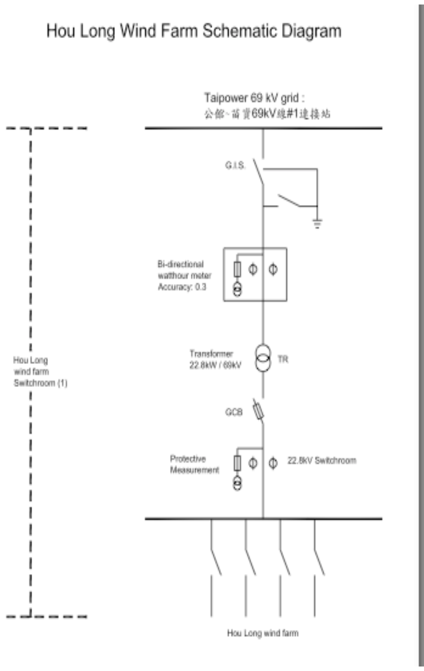
Tauwei Wind Farm:
One bi-directional electricity meter is located in Tauwei wind farm switchroom, before the electricity generated by Tauwei is connected with Guanyin wind farm.

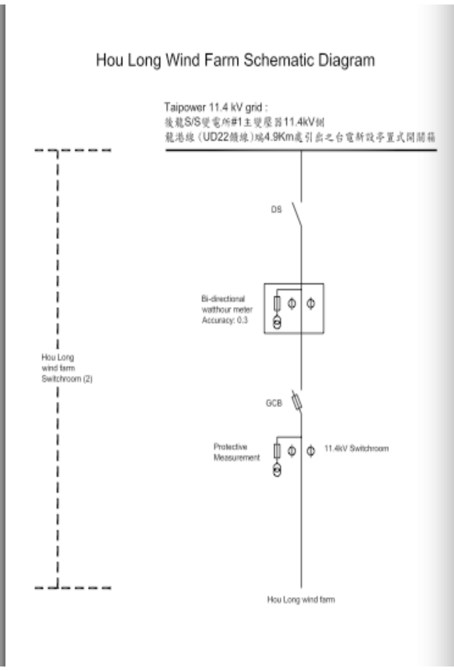
[30] Since the project construction has not been fully completed, the line diagram may be subject to future changes.

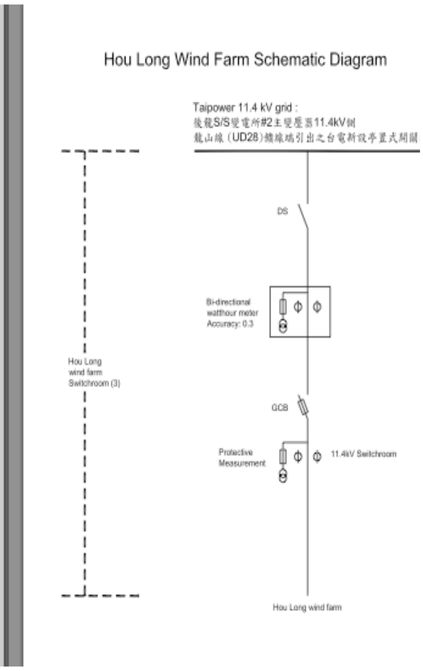
The turbines in Fongwei wind farm site are connected to Taipower grid at SongLin S/S Substation through 11.4 kV transmission line. In Longwei wind farm site, part of the turbines are connected to Taipower 11.4 kV grid through Houlong Substation and part of the turbines are connected to Taipower 69 kV grid through the Gongguan-Miaozi 69 kV line, then to Taipower grid. The turbines in Chungwei wind farm site are connected to Taipower 69 kV grid through 22.8kV/69kV transformer. The turbines in Tauwei wind farm site are connected to Taipower 161 kV grid through Tangwei Substation. Electricity Connection Diagram with meters locations for each wind farm is attached as below:



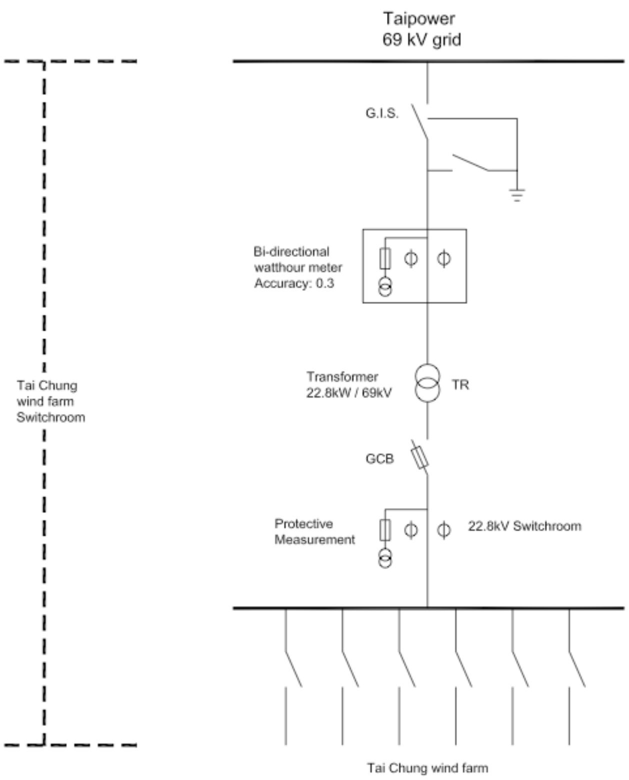




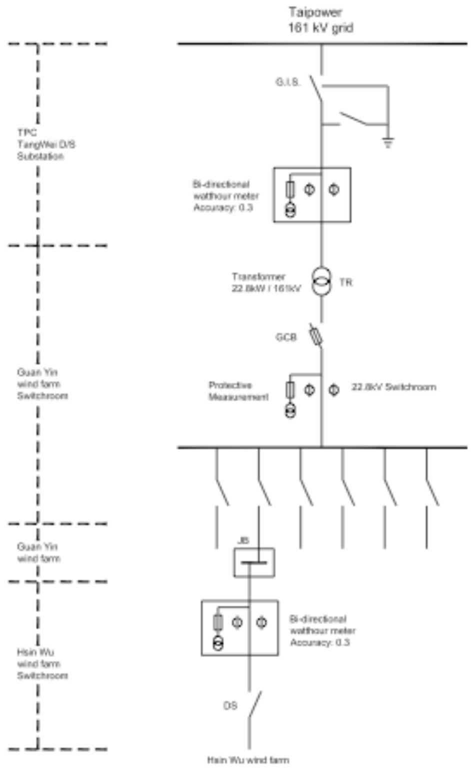




Tai Chung Wind Farm Schematic Diagram



Hsin Wu Wind Farm Schematic Diagram



3. Responsibility of Parties

Two parties are involved: InfraVest (project owner), Taipower (grid company).

InfraVest is in charge of overall wind projects operation & maintenance.

Taipower is in charge of monitoring.

4. Data Monitoring & Management Procedures:

The monitoring is done according to the following procedures:

1. Data from electricity meters are recorded remotely and digitally at the Taipower office. Taipower's personnel download the electric data.

2. Taipower incorporated the downloaded electric data into the monthly electricity receipts and send to InfraVest for confirmation on the amount of both electricity export and import;

3. InfraVest confirms the electricity amount on the receipts.

4. Taipower pays the money to InfraVest for the confirmed export amount and receives export invoices from InfraVest. InfraVest pays to Taipower for the confirmed import amount and receives import invoices from Taipower.

GS VER monitoring training for the staffs will be provided.

5. Quality assurance and quality control procedures
The meter specification complies with The Weight and Measures Act, Regulation no. CNMV 46, 'Technical Specification for Verification and Inspection of Electricity Meters'[31]. The accuracy class of the electricity meters used for the project activity would be at least 0.5, in line with the official standard error for electricity meter (MOF) at ±0.5%[32].

The official period of validity for the *electronic electricity meter* in this project is determined as 8 years. Request for calibration, error check and adjustment can be made by the project owner at its own expense. Taipower's calibration procedures are in accordance to and governed by the Bureau of Standards, Metrology and Inspection, Ministry of Economic Affairs, Taiwan R.O.C. All the calibration records will be documented by the project owner and provided to the DOE during verification.

All emergency and disputes management procedures related to the electricity meter are regulated by Bureau of Standards, Metrology and Inspection, M.O.E.A., R.O.C[33]. In case of meter performance failure or malfunction, Taipower and the project owner would follow the Power Purchase Agreement (PPA) clause 6: Taipower and the project owner will jointly recalculate the amount of electricity dispatched by the project during the malfunction period based on the electricity dispatched during the same period last year or on the average electricity dispatched normally during the previous three periods for electricity purchasing and sales.[34]

SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity
>>
27/12/2009 (First equipment contract was signed for Chungwei Wind Farm; this is the earliest date of equipment contracts of four wind farms)

C.1.2. Expected operational lifetime of project activity
>>
20 years and 0 months

C.2. Crediting period of project activity
C.2.1. Type of crediting period
>>
Renewable crediting period.
This is the first crediting period.

C.2.2. Start date of crediting period
>>
04/07/2011 (The date of start of operation or a maximum of two years prior to Gold Standard registration, whichever occurs later.)

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[31] The Weight and Measures Act www.bsmi.gov.tw/wSite/public/Attachment/f1224657229438.doc
Technical Specification for Verification and Inspection of Electricity Meters
http://www.bsmi.gov.tw/wSite/public/Attachment/f1224657229438.doc Clause 3.9.3
[32] The Weight and Measures Act www.bsmi.gov.tw/wSite/public/Attachment/f1224657229438.doc
Technical Specification for Verification and Inspection of Electricity Meters
http://www.bsmi.gov.tw/wSite/public/Attachment/f1224657229438.doc Clause 3.3.4 Table 4
[33] http://www.bsmi.gov.tw/wSite/laws/review.jsp?lawId=8a8a85591c30ce08011c31d0b3860006&mp=1
[34] Please refer to the Power Purchase Agreement (PPA) of the proposed project activity.

C.2.3. Length of crediting period

First crediting period: 7 years and 0 months
Total: 7 x 3 years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts
>>
The Environmental Impacts Assessment (EIA) of the project activity was carried out by InfraVest and was supervised by the Environmental Protection Agency (EPA). As every requirement set by the EPA was completed for the project, the project activity will start to take place.

Copy of the EIA reports will be provided to the DOE during validation upon request.

D.2. Environmental impact assessment
>>
Requirements and main conclusions of the EIA

Requirement of the EIA		Conclusion
Physics and Chemical Environment Assessment	1. Terrain, Geology and Earth	No negative effects result from the wind farms construction and operation.
	2. Water Quality	No negative effects are reported. The project is not in the water quality protection areas and is in a safe distance of any source of drinking water.
	3. Waste from projects	Wind farms produce few wastes during their activities. Therefore, the impact is considered negligible.
	4. Noise and Vibration	Wind turbines produce low frequency noises; the measured values are below the standard requirements[35]. No vibration takes place during the activity. The impact is thus considered very limited and can be negligible.
	5. Weather and Air Quality	Impact on weather is very limited. Concerns over dust that might fly in the air during the construction phase are raised. InfraVest responded that they will water the land (dust is emitted when moisture content of land is insufficient) during construction to minimize the impact on the air quality. Thus the impact on air quality is limited.
Ecology Environment	6. Animals	The construction areas are not located in any protected and sensitive regions. Thus construction activities do not increase the burden of environment for animals. Concerns regarding the impact of the wind farm on birds' activity is raised, but the turbines' height are

[35] Please refer to the EIA, Chapter 7, Section 7.1.4. The estimated noise level of the proposed project activity during the construction and operation phases will be below the requirements of the Environmental Sound Level Standard (http://ivy5.epa.gov.tw/epalaw/docfile/050100.pdf) and the Noise Control Standard (http://ivy5.epa.gov.tw/epalaw/docfile/050025.pdf).

		below the birds' migration (flying) altitude. During landing, birds will dodge these wind turbines. Thus, bird's issues are considered very limited.
	7. Plants	No protected or rare plants are found in the construction areas. And the wind turbines and blades are higher that the plants, they will not impede the growth of plants. Therefore, the impacts on the plants can be negligible.
Sociology and Economy	8. Residents Characteristics	The project activity will make the second industry (manufacturing) and third industry (services) more prosperous by bringing more job opportunities.
	9. Economic Environment	Job opportunities are increased and the service industry and income of the local residents will be promoted as well.
	10. Industry Structure	The wind-farm is expected to promote tourist activities in the area and increase opportunities to the local industries. Farming will not be influenced by the project activity.
	11. Usage of Land	Concerns over the usage of land arise from Taiwan's mountainous geographical characteristic, which limites the human's activity space and agrarian lands. However, the project is to develop in terms of dots not facets, meaning the distance between Each turbine is considered significant and there is plenty of room for other purpose of land, if any. Basically there will be no severe impact on the usage of land. Furthermore, the turbines are built on public land, managed by the government, and it is not dedicated for agrarian or residential purposes.
	12. Infrastructure	No extra infrastructure is expected.
	13. Transportation: overview and traffic analysis	Impact on traffic depends on the service quality of the road during the transportation of staff, machine and materials. However, the construction period is short and the transportation will avoid the heavy hours in such extent that generally the overall impact on traffic is very limited.
Tourism Impact	14. Scenery Study and Entertainment Study	The locations of these wind turbines are far from the residential areas. No any specific scenery is sited around or within these locations. Thus the impacts on the scenery and entertainment places are very limited.
Cultural Environment	15. Excavation	No excavation found.
	16. Ancient Buildings	No ancient buildings in the designated sites have been reported.
	17. Cultural Customs and Religions	No impact on close cultural customs and religions activities.

There is no significant impact deriving from the project activity, to the surrounding environment.

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders
>>
In concern of the interests of the local stakeholders, the project owner collected opinions from the local residents during the EIA review process, and in various occasions and forms, including:

1. Public Consultation in EIA

In Environment Impact Assessment (EIA) process, public hearings with the local residences are necessary before the constructions started (see Environment Impact Assessment Act, Article 8[36]). The public hearing was arranged on January 6th, 2006 for wind farms in Guanyin Township (including Tauwei Wind Farm), on March 24th, 2008 for Longwei Wind Farm and on August 19th, 2008 for wind farms in Dajia and Da-An Townships (including Chungwei Wind Farm). According to the EIA regulations in Taiwan, for wind power projects with capacity below 50 MW at a non-urban area, and below 25 MW at an urban area, are exempted from EIA. Therefore, in case of the Fongwei Wind Farm, no EIA is necessary. Fongwei Wind Farm only installs a capacity of 13.8 MW and is below the threshold for EIA approval[37].

EIAs copy will be provided to the DOE during validation upon request.

2. Local Stakeholder Consultation (was conducted on 3rd January 2011)

South Pole Carbon Asset Management Co., Ltd. invited international stakeholders through email on December 17th, 2010 to attend the local stakeholder consultation meeting for the proposed project. Recipients of invitation included Gold Standard, local supporters of Gold Standard, HELIO International, REEEP, Mercy Crops, Greenpeace and WWF International. The local community were involved in the consultation process of the proposed project through inviting the local residents and the community representatives to the stakeholder consultation meeting. Invitations were sent out to all villages and counties that might be impacted by the project bundle, including areas of the four wind farms. Most of the invitations were delivered in person to the village heads and community representatives; this is aimed to encourage them to gather the residents (men and women) in their community to join the meeting. This approach is considered more effective to invite the local people as compared to putting announcements through media or at local offices. With 20 invitations delivered to the local representatives, around 60 stakeholders, from different villages and counties where the four wind farms located, including the Township Mayor, local residents, community representatives, village heads, county/township officers attended the stakeholder consultation meeting, among which 25 were women.

The local NGO invited to the stakeholder consultation is NEAT Taiwan (New Energy Association of

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[36] http://law.moj.gov.tw/Eng/LawClass/LawAll.aspx?PCode=O0090001
[37] Rule No. 5, Article 29, Standards for Determining Specific Items and Scope of Environmental Impact Assessments for Development Activities (2007.12.28), Regulated by the Environmental Protection Administration (EPA).
http://law.moj.gov.tw/lawclass/LawOldVer.aspx?Pcode=o0090012&LNNDATE=20071228&LSER=001 "Offshore wind power project, or wind power project, with one of the following conditions, is required to conduct EIA: (1) the first or second subparagraph of the second paragraph (*located in a national conservation park, or wildlife protection areas - or important habitat areas*) (2) if located in urban area: the cumulative generating capacity of project construction/expansion within the area is 25,000 kW or more. (3) if located in an non-urban area, the cumulative generating capacity of the construction/expansion within the area is 50,000 kW or more. The calculation of 'cumulative generating capacity within one area' includes the following circumstances: (1) total generating capacity of all other wind turbines within the circle radius of 20 km range with any wind turbine as the center."
Letter issued by Environmental Protection Administration Executive Yuan, Taiwan for illustration of EIA exempt for Longwei wind farm can also be referred as supporting evidence.

Taiwan), which is an independent local NGO focusing on the climate sustainability, and the development of the clean, efficient energy technologies in the region. This NGO has a touch-base experience in the renewable energies cultivation than other NGOs in the region. Given the organization's background, it was expected to present an objective perspective regarding the proposed project development.

The list of the recipients is shown below:

Organisation (if relevant)	**Name of invitee**	**Way of invitation**	**Date of invitation**	**Confirmation received? Y/N**
Taichung City Counselor	Li, Rong-Hong	Delivered in person	20-12-2010	Y
Guike Village Head	Hong, Zheng-Yi	Delivered in person	17-12-2010	Y
Haiqian Village Head	Wang, Sheng-Zong	Delivered in person	17-12-2010	Y
Zhongzhuang Village Head	Zhuang, Ming-Yao	Delivered in person	17-12-2010	Y
Nanpu Village Head	Lin, Gong	Delivered in person	17-12-2010	Y
Jianxing Village Head	Cai, Ming-He	Delivered in person	17-12-2010	Y
Tongan Village Head	Lin, Yu-Sheng	Delivered in person	20-12-2010	Y
Fude Village Head	Mou, Yan-Qing	Delivered in person	20-12-2010	Y
Houlong Village Head	Zheng, Jia-Ding	Delivered in person	20-12-2010	Y
Chairman of Houlong Town Residents Representatives Commission	Zhu, Qiu-Long	Delivered in person	19-12-2010	Y
Miaoli County Counselor	Zheng, Qiu-Feng	Delivered in person	20-12-2010	Y
Miaoli County Counselor	Li, Wen-Bin	Delivered in person	20-12-2010	Y
Haibao Village Head	Chen, Bao-Yu	Delivered in person	20-12-2010	Y
Dashan Village Head	Guo, Mei-Hua	Delivered in person	20-12-2010	Y
Shuiwei Village Head	Hong, Jin-Tong	Delivered in person	20-12-2010	Y
Houlong Town Residents Representative	Chen, Guo-Zhong	Delivered in person	20-12-2010	Y
Hsinfeng Township Mayor	Xu, Mao-Gan	Sent via Post	18-12-2010	Y
Chairman of Hsinfong Township Residents Representatives	Xu, Qiu-Ze	Delivered in person	17-12-2010	Y

Commission				
Hsinchu County Counselor	Zheng, Qing-Han	Sent via Post	18-12-2010	Y
Potou Village Head	Lin, Qing-Liu	Sent via Post	20-12-2010	Y
Fengkeng Village Head	Jiang, Jin-Tian	Sent via Post	20-12-2010	Y
Guanyin Township Mayor	Ou, Bing-Chen	Delivered in person	17-12-2010	Y
Chairman of Guanyin Township Residents Representatives Commission	Chen, Jiang-Po	Delivered in person	17-12-2010	Y
Taoyuan County Counselor	Wu, Zong-Xian	Delivered in person	17-12-2010	Y
Baosheng Village Head	Huang, Xiu-Yun	Delivered in person	17-12-2010	Y
Datan Village Head	Peng, Zhen-Tian	Sent via Post	18-12-2010	Y
New Energy Association of Taiwan		Sent via Post	17-12-2010	Y
Gold Standard	Leon Wang	Email	17-12-2010	Y
Green Peace		Email	17-12-2010	N
Mercy Corps	Dorothy McIntosh	Email	17-12-2010	Y
Helio International	Helene Connor	Email	17-12-2010	N
REEEP	Marianne Osterkorn	Email	17-12-2010	Y
WWF	Roscher Bella	Email	17-12-2010	Y

The Local Stakeholder Consultation meeting was held on January 3rd, 2011, introduction of the project was made and comments were collected. The list of attendants is below:

Date/Time: January 3rd, 2011/11:00 am (GMT +08:00)
Location: 131-8, Haipu Village 8th Lane, Houlong Township, Miaoli County, Taiwan R.O.C.
List of Attendants:

Name participant	**Category Code**	**Job/position in the community**	**M/F**	**Organisation (if relevant)**
Guan, Shao-Dong	A	Local resident	M	Guanyin Haipu Village
Peng, Zhen-Tian	A	Local resident, Village Head	M	Datan Village
Su, Zhi-Yin	A	Local Resident	M	Guanyin Township Office Head of Planning Department
Zhan, Sen-Yan	A	Local Resident	M	Guanyin Township Office Member of Agriculture and Economic Division

Lin, Jia-Ling	A	Local Resident	F	Guanyin Township Office Member of Administration Division
Guo, Wen-Liang	A	Local Resident	M	Jianxing Village
Lin, Jia-Zhu	A	Local Resident	M	Jianxing Village
Zheng, Da-Cheng	A	Local Resident	M	Jianxing Village
Zhang, Jian-Yi	A	Local Resident	M	Jianxing Village
Huang, Qing-Yuan	A	Local Resident	M	Jianxing Village
Guo, Tian-Fu	A	Local Resident	M	Jianxing Village
Wang, Xi-Mei	A	Local Resident	F	Jianxing Village
Yang, Qing-Shan	A	Local Resident	M	Jianxing Village
Ye, Li-Yun	A	Local Resident	F	
Zheng, Qian	A	Local Resident	M	
Qiu, Su-Si	A	Local Resident	F	
Geng, A-Min	A	Local Resident	F	
Lin, Jin-Zhen	A	Local Resident	F	
Liang, Yi-Yuan	A	Local Resident	M	
Qiu, Shu-Zi	A	Local Resident	F	
Huo, Yue-Zhao	A	Local Resident	F	
Xu, Huang	A	Local Resident, Haibao Village Head	M	Haibao Village
Huang, Han-Ji	A	Local Resident, Chairman	M	Haibao Village
Xie, Hai-Shan	A	Local Resident, Village Head	M	Dazhuang Village
Zhu, Han-Long	A	Local Resident, Chairman of Residents Representatives Commission	M	Beilong Village Residents Representatives Commission
Liu, Wen-Guo	A	Local Resident,	M	Xinmin Village
Guo, Mei-Hua	A	Dashan Village Head	F	Dashan Village
Yang, Qing-Lan	A	Local Resident	F	Jianxing Village
Shao Li, Cai-Tou	A	Local Resident	F	Jianxing Village
Zheng, Cai-Feng	A	Local Resident	F	Jianxing Village
Yang, Chen-Zhuan	A	Local Resident	M	Jianxing Village
Zheng, Jin-Ying	A	Local Resident	F	Jianxing Village
Lin Zhu, Yu-Feng	A	Local Resident	F	
Guo, Jin-Lai	A	Local Resident	M	
Guo, Rong-Fu	A	Local Resident	M	
Zheng, Yue-Xia	A	Local Resident	F	
Luo, Si-Xiu	A	Local Resident	F	
Yang, Fang-San	A	Local Resident	M	
Yang, Sheng-Fang	A	Local Resident	M	
Zheng, Si-An	A	Local Resident	F	
Liu, Mei-Jin	A	Local Resident	F	
Lu, Ting-Zheng	A	Head Office	M	Nanya Electric
Geng, Mei-Zu	A	Local Resident	F	
Zou, Su-Zhen	A	Local Resident	F	
Lu, Ting-Ju	A	Local Resident	M	
Lu, Mei-Jun	A	Local Resident	F	

Zou, Zhu-Ying	A	Local Resident	F	
Lu, Chao-Zun	A	Local Resident	M	
Hong, Ya-Hui	A	Local Resident	F	
Cai, Ming-He	A	Local Resident, Village Head	M	Jianxing Village
Mou, Yan-Qing	A	Local Resident, Village Head	M	Fude Village
Zhuang, Ming-Yao	A	Local Resident, Village Head	M	Zhongzhuang Village
Huang, Yuan-Ri	A	Local Resident, Representative Chairman	M	Guanyin Township Residents Representatives Commission
Liu, Hong-Chang	A	Local Resident	M	Guanyin Township Office
Huang, Xiu-Yun	A	Local Resident, Village Head	F	Baosheng Village
Xie, Chun-Wen	A	Local Resident, Office Secretary	M	Guanyin Township Office
Lin, Qing-Jing	A	Local Resident, Chief Office Secretary	F	Guanyin Township Office
Chen, Jiang-Shun	A	Local resident, Chairman of Residents Representatives Commission	M	Guanyin Township Residents Representatives Commission
Ou, Bing-Zhen	B	Local resident, Mayor	M	Guanyin Township Office
Xu, Geng-Sheng	A	Local resident	M	Guanyin Township Office

The original copies of meeting minutes in local language can be referred to LSC Report.

E.2. Summary of comments received
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1. Public Consultation in EIA

Public hearings were held during Environment Impact Assessment (EIA) process. The goal of the public hearings is to communicate with the local residence and to solve their concerns over the project. Since the original opinions are Chinese in EIA reports, we present here only a short summary in English:

The general outcome was positive; the stakeholders are in favour of the project. The key concerns and responses addressed in the public hearings can be summarized as following:

Key concerns raised	Response
The impact of noise generated by the wind turbines on surrounding residents	In terms of noise impact, the project owner responded that turbines are erected in areas far from the factory and residence district; and from the regulatory point of view, noise level of the wind turbines is within the acceptable range and complies with the noise requirements state regulations.
The job opportunities to the locals created by the project	The project owner stated that it is their will to have the locals hired for the construction, operation and maintenance in the hope to bring this area to a prosperous future and also to reduce the company cost of

	staff accommodation.
The possibility of developing the wind farms as tourist spots	The project owner is willing to cooperate with local governments on tourist spots development.
Sand dust may be caused when the wind turbines blades start operation	The end of the fan blades of the project is 30 meters from the ground, according to the already set up and operated wind turbines of wind farms in Taiwan, no sand dust problem has been raised by local residents. For the project, the project owner already considered conducting green vegetation after completion of construction of this project, thus avoiding the sand dust phenomenon.
The impact of running blades on birds	There are many reasons for the birds deaths, for example, glass curtain buildings, transportation and high-voltage wires, which affect birds' visual and can cause the death due to collision with the engine, it is estimated that the number of bird deaths each year in the United States due to human behaviours is about 1 billion, but the rate of birds deaths due to hitting the running blades is less than 0.01%
The feedback program of the wind farm projects	The project owner promise to conduct the annual repayment based on reasonable proportions to the local townships and local counties after the wind farms start profiting.

2. Local Stakeholder Consultation

In the meeting, at first the project owner representative provided a brief introduction of the background of InfraVest Wind Farm Group and its various records in wind farm constructions. The general information of each wind farm in the proposed project was provided as well such as locations and technical parameters. Then the possible impacts and mitigation measures were explained to the attendants.

After the explanation, the meeting went to Q&A section and a few concerns were raised by the stakeholders. The following table summarizes the concerns and the response made by the project owner:

Concerns raised	Response
Noise problem might occur for some of the residents in nearby area within 200 m from a wind turbine	In terms of the noise problem, the project owner responded that the noise level of the wind turbines is within the acceptable range. However, the project owner promised to minimize the impact of wind farm operation towards the local residents. Hence, for the neighbouring residents who feel affected by the noise, the project owner offers to install airtight windows to significantly reduce noise level in the houses.
Embellishing turbines' appearance	The project owner plans to greening the area surrounding the wind turbines.
A local resident who works in a landscaping industry pointed out that he could provide service in greening in the wind farm	The project owner will consider the resident's suggestions and will contact him in case needed.

After Q& A section, following GS standard procedure, Blind Sustainable Development Exercise was performed by the attendants (please refer to LSC report for completed Blind Sustainable Development Matrix). The attendants didn't rate any of the aspects negative. All aspects of the matrix were rated either "positive" or "neutral".

After Blind Sustainable Development Exercise, open discussion was held. The attendants felt satisfied and did not express any other inquiries or concerns.

Finally, the evaluation form was asked to be filled by the attendants. The summary of comments in the filled forms are summarized as below:

Name	
What is your impression of the meeting?	The meeting helps locals understanding more about the planning and ideals of the wind farm project. Some of the stakeholders pointed out that the project owner explained in detail about the importance of wind power to the environment and the renewable energy development. One of the stakeholders expressed that the meeting improves local people's knowledge about carbon reduction.
What do you like about the project?	It is concluded that the project positively contributes to a sustainable environment: it uses renewable energy (wind) to generate clean electricity. One of the stakeholders wrote that a wind farm adds a scenery attraction to the area and it reduces air pollution. Another stakeholder expressed, "by developing wind energy resource, it creates a new alternative to the carbon reduction efforts"
What do you not like about the project?	Not indicated. The stakeholders do not think that the project would lead to any negative effects. They are quite supportive towards the renewable energy development in their area.

E.3. Report on consideration of comments received
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According to the stakeholder consultation processes, it is clear that the stakeholders are in favour of the development of the proposed project. Some minor questions such as noise impact were raised; however these are minor issues and mitigation measures had already been planned in the earliest stage of project design.

Besides these, no comments received up to the date of the completion of this PDD.

SECTION F. Approval and authorization
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N/A

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Appendix 1: Contact information of project participants

Organization name	InfraVest Wind Power Group
Street/P.O. Box	10-2F, No. 9, Sec. 2, Roosevelt Rd.,
Building	
City	Taipei
State/Region	
Postcode	100
Country	Taiwan
Telephone	+886 2 2395 4886
Fax	+886 2 2395 1580
E-mail	info@infra-vest.com
Website	http://www.infra-vest.com/
Contact person	Karl Eugen Feifel
Title	President
Salutation	Dr.
Last name	Feifel
Middle name	Eugen
First name	Karl
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	feifel@infra-vest.com

Organization name	South Pole Carbon Asset Management Ltd.
Street/P.O. Box	Technoparkstrasse 1
Building	
City	Zurich
State/Region	Zurich
Postcode	8005
Country	Switzerland
Telephone	+41 43 501 35 50
Fax	+41 43 501 35 99
E-mail	info@southpolecarbon.com
Website	www.southpolecarbon.com
Contact person	Renat Heuberger
Title	
Salutation	Mr.
Last name	Heuberger
Middle name	
First name	Renat
Department	
Mobile	
Direct fax	+41 43 501 35 99
Direct tel.	+41 43 501 35 99
Personal e-mail	r.heuberger@southpolecarbon.com

Appendix 2: Affirmation regarding public funding

The project does not involve any ODA financing. As confirmed with the GS[38], GS projects in Taiwan have been exempted from ODA declaration. Taiwan is not an OECD member, and it is not included in the DAC list of ODA recipients. Taiwanese projects are therefore not eligible for receiving ODA funding.

There is no public funding from Annex I countries involved in the project activity.

Appendix 3: Applicability of selected methodology

N/A

[38] Email correspondence with Leon Wang, GS Regional Manager of China and East Asia Region, dated October 19, 2011. Please also refer to the GS Passport of Registered Project #GS612 – InfraVest Guanyin Wind Farm Project – Taiwan. The email has been provided.

Appendix 4: Further background information on ex ante calculation of emission reductions

According to the “Tool to calculate the emission factor for an electricity system” (Version 03.0.0), six steps shall be applied for calculating the emission factor:

STEP 1. Identify the relevant electric systems

A project electricity system is defined by the *spatial extent* of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints.

A national connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system. Taiwan is an island with no cable connection with the continent. Thus there is not any connected electricity system in Taiwan. The spatial extent of the Project Boundary is defined as the insular electricity grid of Taiwan operated by Taipower.

The source of data used in calculation of OM and BM is publicly available in Taiwan:

- Energy Balances in Taiwan (from the Bureau of Energy[39]), which give access to electricity production and fossil fuel consumption in Taiwan by sectors.

As it will be explained below, the data will be used for calculating the operating margin and the build margin.

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

According to “Tool to calculate the emission factor for an electricity system (Version 03.0.0)”, project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

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

Since option II requires collecting data on off-grid power generation, while such data is not publicly available in the region, thus the off-grid power plants are excluded from the calculation and option I is chosen.

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

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

In order to calculate the Operating Margin, the emission factors of fossil fuels are listed in the following table:

Table A4-1 Net Calorific Values ($NCV_{i,y}$) multiplied by $EF_{CO2,i,y}$ of fossil fuel used for OM and BM calculation

Fuel Type	$EF_{CO2,i,y}$ * $NCV_{i,y}$[40]	Unit

[39] Energy Balances in Taiwan, http://web3.moeaboe.gov.tw/ECW/populace/web_book/WebReports.aspx?book=B_CH&menu_id=145

Bituminous Coal-Steam Coal	2.34	tCO_2/t
Sub-bituminous	2.29	tCO_2/t
Coke oven gas	0.66	$KgCO_2/M^3$
Blast Furnace Gas	0.71	$KgCO_2/M^3$
Oxygen Steel Furnace Gas	1.13	$KgCO_2/M^3$
Diesel	2.55	$KgCO_2/L$
Fuel oil	3.03	$KgCO_2/L$
LNG	2.20	$KgCO_2/M^3$
Petroleum Coke	2.85	$KgCO_2/Kg$
Natural Gas	1.82	$KgCO_2/M^3$
LPG	1.71	$KgCO_2/L$
Refinery Gas	1.82	$KgCO_2/M^3$

According to the experts, coal should not be considered as low cost/must run[41]. Thus only nuclear, biomass, hydro geothermal electricity, solar photovoltaic and wind power plants are included as low-cost/must-run resources, which turns out to be between 21.37% and 22.66% of the total electricity generation on average during years 2008 and 2010:

Table A4-2 Gross and Net Electricity Generation (EG_y) in Taiwan[42]

	Unit	2006	2007	2008	2009	2010
Total electricity generation	MWh	238,809,573	246,821,688	241,815,712	233,107,221	250,696,699
Total low-cost/must-run	MWh	51,493,182	53,037,007	52,694,371	52,832,479	53,583,346
Total power plants own use	MWh	10,505,429	10,949,893	10,420,879	10,191,768	10,784,661
Total low-cost/must-run power plants own use	MWh	1,587,321	1,615,139	1,604,647	1,634,110	1,646,302
Net	MWh	178,398,283	184,449,927	180,305,109	171,717,084	187,974,994

[40] http://ghgregistry.epa.gov.tw/Tool/tools.aspx

[41] According to Dr. Chung-Huang Huang (黃宗煌教授), a professor at Department of Economics, National Tsing Hua University, coal power plants are not 'low-cost' in calculation of Operating Margin because when evaluating the total costs of the electricity generation technologies, the external costs also have to be taken into account besides the internal costs (such as the operational cost, construction cost, etc). With the external costs included in the calculation, the total social cost (internal cost + external cost) of coal power plants is proved to be higher than that of renewable power generation. Furthermore, when the grid was going to reduce power plant operation during the lower load demand period, the coal-fired power plants are prioritized to undertake such function. Thus, coal cannot be considered as 'low-cost / must-run'.

According to Dr. Chien-Ming Lee (李堅明教授), a professor at Graduate Institute of Natural Resources Management, National Taipei University, coal power plants are not 'low-cost' since the operational cost is higher than that of the renewable power generation during the operation phase.

When the grid was going to reduce power plant operation during the lower load demand period, the coal-fired power plants are prioritized to undertake such function. Thus, coal cannot be considered as 'low-cost / must-run'.

[42] Extracted from the "Energy Balances Sheet in Taiwan" Bureau of energy, MOEA, http://web3.moeaboe.gov.tw/ECW/populace/web_book/WebReports.aspx?book=B_CH&menu_id=145

generation excl. low-cost/must-run						
Share of low-cost/must-run	MWh	21.56%	21.49%	21.79%	22.66%	21.37%

Since the average share of electricity generation by low-cost/must-run resources for five most recent years is found to be less than 50%, option (a) is chosen. The simple OM emission factor can be calculated using either of the two following data vintages:

- *Ex-ant option*, where a 3-year generation-weighted average based on the most recent data available is used. Monitoring and recalculation of the emission factor during the crediting period is not required, or
- *Ex-post option*, where the data of the year is used, in which the project activity displaces grid electricity. Yearly update of the emission factor is required.

The *ex-ante option* is selected to carry out the baseline methodology for the Project.

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

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

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

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

Option B can only be used if:
(a) The necessary data for Option A is not available; and
(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation (i.e. if Option I has been chosen in Step 2).

Complete plant-specific data required by Option A is unavailable, Taipower can furnish some plant specific data but only for the power plants they operate, these numbers do not comprise all independent power producers for which plant specific statistics are not available.
Option B is adopted since the necessary data for option A is not available; only renewable sources and nuclear are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and the off-grid power plants are not included in the calculation (Option I in step 2 was chosen). According to the "*Tool to calculate the emission factor for an electricity system version 03.0.0*," under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y}$$

Where:
$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$FC_{i,y}$ = Amount of fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)
EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
i = All fuel types combusted in power sources in the project electricity system in year *y*
y = The relevant year as per the data vintage chosen in Step 3

Table A4-3 The total CO_2 emissions by fuels of 2008, 2009 and 2010

Total Emission in 2008	tCO_2	146,780,278
Total Emission in 2009	tCO_2	137,751,653
Total Emission in 2010	tCO_2	144,936,301

Thus, the results of Operating Margin are:

$EG_{grid,OM,y}$ (2008)	tCO_2/MWh	0.814
$EG_{grid,OM,y}$ (2009)	tCO_2/MWh	0.802
$EG_{grid,OM,y}$ (2010)	tCO_2/MWh	0.771
Average $EG_{grid,OM,y}$ (2008~2010)	tCO_2/MWh	0.795

The result of Operating Margin is **0.795** tCO_2e/MWh.

STEP 5. Calculate the build margin (BM) emission factor

In accordance to the calculation method proposed by the Chinese NDRC[43] which was approved by CDM EB[44], since it is impossible to separate the different generation technology capacities based on coal, oil or gas fuel etc from the generic term "thermal power" in the present energy statistics, the following calculation measures is taken:
First, according to the energy statistics of the selected period in which approximately 20% capacity has been added to the grid, the ratio of CO_2 emissions produced by solid, liquid, and gas fuel consumption for power generation is determined; then this ratio is multiplied by the respective emission factors based on commercially available best practice technology in terms of efficiency. Finally, this emission factor for thermal power is multiplied with the ratio of thermal power identified within the approximation for the latest 20% (close but not lower than 20%) of installed capacity addition to the grid. The result is the BM emission factor of the grid. The sample group of power units chosen to calculate the build margin is therefore the set of power capacity additions in the electricity system that comprise 20% of the system capacity (in MW) that have been built most recently[45]. In terms of vintage of data, Option 1 is chosen:

[43] The build margin calculations is derived from the "Bulletin on the baseline emission factor of the Chinese Electricity Grid", which has been published by the Chinese DNA (Office of National Coordination Committee on Climate Change) on 20/10/2011.
[44] This is in accordance with the request for guidance: Application of AM0005 and AMS-I.D in China, a letter from DNV to the Executive Board, dated 07/10/2005, available online at: http://cdm.unfccc.int/UserManagement/FileStorage/6POIAMGYOEDOTKW25TA20EHEKPR4DM. This approach has been applied by many registered CDM projects using methodology ACM0002 so far.
[45] Note: According to the Tool to calculate the emission factor for an electricity system (version 03.0.0) "If 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation."

Build margin emission factor is calculated ex ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation.

BM emission factor of the grid is calculated as follows:

Sub-step 1
All emission factors of fossil fuels used in calculation of the emissions of fossil fuels are referred to the table "the emission factors of fossil fuels in Taiwan" in Step 2.

Calculate the proportion of CO_2 emissions related to consumption of coal, oil and gas fuel used for power generation as compared to total CO_2 emissions from the total fossil fuelled electricity generation (sum of CO_2 emissions from coal, oil and gas).

$$\lambda_{Coal,y} = \frac{\sum_{i \in COAL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}$$

$$\lambda_{Oil,y} = \frac{\sum_{i \in OIL,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}$$

$$\lambda_{Gas,y} = \frac{\sum_{i \in GAS,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}{\sum_{i,j} F_{i,j,y} \times NCV_{i,y} \times EF_{CO2,i,j,y}}$$

Where:
$F_{i,j,y}$ the amount of fuel *i* (in a mass or volume unit) consumed by power sources j in year(s) y,
$NCV_{i,y}$ the net calorific value of fuel *i* in year y (GJ/t for solid and liquid fuels, GJ/m^3 for gas fuels)
$EF_{CO2,i,j,y}$ the CO_2 emission coefficient of fuel *i* (tCO_2/GJ)
Coal, *Oil* and *Gas* stands for solid, liquid and gas fuels respectively.

Table A4-4 The total CO_2 emissions by fuel of 2010 ($FC_{i,y}$)

	Fuel	Units	Emission (tCO_2e)	λ
Solid	Bituminous Coal-Steam Coal	t	96,203,314	-
	Coke oven Gas	M^3	275,195	-
	Blast Furnace Gas	M^3	3,472,771	
	Oxygen Steel Furnace Gas	M^3	364,144	-
	Sub-bituminous coal	t	9,752,243	-
	Sub-total	-	110,067,667	75.94%
Liquid	Diesel	L	171,805	-
	Refinery gas	M^3	34,484	-
	Petroleum Coke	t	1,481,040	
	Fuel oil	L	7,641,144	-
	Sub-total	-	9,328,473	6.44%
Gas	Natural Gas	M^3	10,189	
	LNG	M^3	25,529,971	-
	Sub-total	-	25,540,161	17.62%
Total		-	144,936,301	100%

Data Source: Energy Balances in Taiwan by Taiwan's Bureau of Energy[46]

Table A4-5 The total CO_2 emissions by fuel of 2009 ($FC_{i,y}$)

	Fuel	Units	Emission (tCO_2e)	λ
Solid	Bituminous Coal-Steam Coal	t	93,957,241	-
	Coke oven Gas	M^3	150,062	-
	Blast Furnace Gas	M^3	2,018,277	
	Oxygen Steel Furnace Gas	M^3	309,022	-
	Sub-bituminous coal	t	13,878,958	-
	Sub-total	-	110,313,559	80.08%
Liquid	Diesel	L	173,220	-
	Refinery gas	M^3	41,549	-
	Petroleum Coke	t	1,439,005	
	Fuel oil	L	6,032,973	-
	Sub-total	-	7,686,746	5.58%
Gas	Natural Gas	M^3	10,258	
	LNG	M^3	19,741,090	-
	Sub-total	-	19,751,348	14.34%
Total		-	137,751,653	100%

Data Source: Energy Balances in Taiwan by Taiwan's Bureau of Energy[47]

Table A4-6 The total CO_2 emissions by fuel of 2008 ($FC_{i,y}$)

	Fuel	Units	Emission (tCO_2e)	λ
Solid	Bituminous Coal-Steam Coal	t	97,279,729	-
	Coke oven Gas	M^3	159,167	-
	Blast Furnace Gas	M^3	2,737,836	
	Oxygen Steel Furnace Gas	M^3	425,812	-
	Sub-bituminous coal	t	13,514,549	-
	Sub-total	-	114,117,093	77.75%
Liquid	Diesel	L	367,652	-
	Refinery gas	M^3	58,990	-
	Petroleum Coke	t	1,510,482	
	Fuel oil	L	9,783,251	-
	Sub-total	-	11,720,375	7.98%
Gas	Natural Gas	M^3	10,213	
	LNG	M^3	20,932,597	-
	Sub-total	-	20,942,810	14.27%
Total		-	146,780,278	100%

Data Source: Energy Balances in Taiwan by Taiwan's Bureau of Energy[48]

Sub-step 2

Calculate the operating margin emission factor of fuel-based generation.

$$EF_{Thermal,y} = \lambda_{Coal,y} \times EF_{Coal,Adv,y} + \lambda_{Oil,y} \times EF_{Oil,Adv,y} + \lambda_{Gas,y} \times EF_{Gas,Adv,y}$$

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[46] Energy Balances in Taiwan, http://web3.moeaboe.gov.tw/ECW/populace/web_book/WebReports.aspx?book=B_CH&menu_id=145

[47] Energy Balances in Taiwan, http://web3.moeaboe.gov.tw/ECW/populace/web_book/WebReports.aspx?book=B_CH&menu_id=145

[48] Energy Balances in Taiwan, http://web3.moeaboe.gov.tw/ECW/populace/web_book/WebReports.aspx?book=B_CH&menu_id=145

Where,
$EF_{Thermal,y}$ the weighted emissions factor of thermal power generation with the efficiency level of the best commercially available technology in Taiwan in the previous three years.
$EF_{Coal,Adv}$, $EF_{Oil,Adv}$, $EF_{Gas,Adv}$ the emission factor of coal, oil and gas-fired power generation with efficiency levels of the optimal commercially available technology in Taiwan in the previous three years.

The optimal efficiency and emission factors of commercialized coal-fired, oil-fired and gas-fired power plant are shown as below:

Type of power plant	Variables	Emission factor (tCO_2e/MWh)
Coal fired power plant	$EF_{Coal,Adv}$	0.792
Gas fired power plant	$EF_{Gas,Adv}$	0.367
Oil fired power plant	$EF_{Oil,Adv}$	0.506

$$EF_{grid,BM,y} = \frac{CAP_{Thermal,y}}{CAP_{Total,y}} \times EF_{Thermal,y}$$

Where,
CAP_{Total} the total capacity addition of the selected period in which close but not lower to 20% capacity has been added to the grid,
$CAP_{Thermal}$ the total thermal power capacity addition of the selected period in which approximately 20% capacity has been added to the grid.

The below is shown the Installed Capacity of Taiwan Power Grid:

	Installed capacity in 2002	Installed capacity in 2003	Installed capacity in 2004	Installed capacity in 2005	Installed capacity in 2006	Installed capacity in 2007	Installed capacity in 2008	Installed capacity in 2009	Installed capacity in 2010	Newly added installed capacity from 2002 till 2010	Proportion against newly added installed capacity
	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	
	A	B	C	D	E	F	G	H	I	J=I-A	$I_{THERMAL}/I_{TOTAL}$
Thermal power	28,432.0	30,442.1	32,292.8	33,481.9	35,290.6	36,023.5	36,431.1	37,907.6	38,663.0	10,231.0	94.86%
Hydro power	4,510.8	4,510.8	4,511.7	4,511.7	4,511.7	4,523.2	4,539.9	4,538.9	4,579.4	68.6	0.64%
Nuclear power	5,144.0	5,144.0	5,144.0	5,144.0	5,144.0	5,144.0	5,144.0	5,144.0	5,144.0	0.0	0.00%
Wind power and others	8.9	9.0	9.1	25.0	105.2	190.2	257.7	385.6	495.1	486.2	4.51%
Total	38,095.6	40,105.9	41,957.6	43,162.6	45,051.5	45,880.9	46,372.7	47,976.1	48,881.5	10,785.9	100.00%

Source: Electricity Generation Installed Capacity and Total Generation Statistic Data (Year 1995-2010)[49]

The result of Build Margin is **0.662** tCO_2e/MWh.

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

[49] http://web3.moeaboe.gov.tw/ECW/populace/content/wHandMenuFile.ashx?menu_id=931

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is using the weighted average of the Operating margin and build margin.

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

Where:
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)

The operating margin emission factor ($EF_{grid,OM,y}$) of Taiwan is 0.795 tCO_2e/MWh and the build margin emission factor ($EF_{grid,BM,y}$) is 0.662 tCO_2e/MWh. The defaults weights for wind power are used as specified in the emission factor tool: w_{OM} = 0.75 and w_{BM} = 0.25

The result of the Baseline Emission Factor ($EF_{grid,CM,y}$) calculation is **0.761** tCO_2e/MWh.

Appendix 5: Further background information on monitoring plan

Please refer to Section B.7.

Appendix 6: Summary of post registration changes

N/A

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
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