



**Project design document form for
CDM project activities
(Version 08.0)**

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Miaoli 49.8MW Wind Farm Project
Version number of the PDD	4.0
Completion date of the PDD	22/12/2017
Project participant(s)	Whitehelm Capital Limited ¹
Host Party	Taiwan
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	CDM Methodology: ACM0002, "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (version 17)
Sectoral scope(s) linked to the applied methodology(ies)	Sectoral Scope 1: Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	120,298 tCO ₂ e

¹ The original register is Macquarie International Infrastructure Fund Limited (MIIF) made the transfer of equity in 2016.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The Miaoli 49.8MW Wind Farm Project (hereinafter referred to as “the project”) includes the construction and operation of a 49.8MW Wind Farm located in Miaoli County, Taiwan. The project was developed by Miaoli Wind Co., Ltd (hereafter refer as “Miaoli Wind”) and is currently owned by Whitehelm Capital Limited² (hereafter refer as “Whitehelm Capital”) The Wind Farm is comprised of 25 wind turbines in two separate areas of Miaoli County, Houlung Township ‘named Dapong Site’ (21 turbines) and Chunan Township, named ‘Chunan Site’ (4 turbines), for a total feed output of 49.8MW. The proposed project started construction on 20 May 2005 and it started operation in 10 February 2006. The purpose of the project is to encourage the use of renewable energy in Taiwan. The project displaces part of the electricity supplied by the national grid, Taiwan power company grid (“TPCG”), which is currently dominated by fossil fuel-fired power plants, and thus reduces greenhouse gas emissions. The yearly net generated electricity delivered to the grid is estimated at 186,509 MWh, and the average annual emission reduction is 120,298 tCO₂e.

The scenario existing prior to the implementation of the project activity is electricity delivered to the grid by the project activity would have been generated by the operation of grid-connected power plants and by the addition of new generation sources of TPCG, as reflected in the combined margin (CM) calculations described in the latest “Tool to calculate the emission factor for an electricity system”. The baseline scenario is the same as the scenario existing prior to the implementation of the project activity.

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, renewable energy that contributes to alleviate the global warming;
- contribute to the development of the wind energy sector in Taiwan;
- provide clean electricity to the equivalent of 49,847 households³;
- create local employment both during the construction and operational phase;
- 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.

The project is not a CPA that has been excluded from a registered CDM PoA as a result of erroneous inclusion of CPAs.

² The original register is Macquarie International Infrastructure Fund Limited (MIIF) made the transfer of equity in 2016.

³ Taipower Statistic Data (2006-2010): Average household power usage is 311.8 kWh/month (3,741.6 kWh/year) http://www.taipower.com.tw/left_bar/jing_ying_ji_xiao/5year_effects.htm

A.2. Location of project activity**A.2.1. Host Party**

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Taiwan

A.2.2. Region/State/Province etc.

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Miaoli County

A.2.3. City/Town/Community etc.

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Houlong and Chunan Township

A.2.4. Physical/Geographical location

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The wind farm site is located in Taiwan's Miaoli district, directly off the coast of the Taiwan Strait. The area extends from south-west to north-east over a distance of nearly 10km along the coastline. The project consists of 21 turbines in Houlong, the main area located in the south and an additional 4 turbines in Chunan. The proposed project activities are distributed in these zones which are at the geographical position of 24°43'0.27"N, 120°51'48.60"E for the Chunan Site and 24°35'37.42"N, 120°42'58.68"E for the Dapong Site. The locations are depicted in the pictures shown below. Figure A-1 shows the geographic location of the project, Figure A-2 shows the locations of the wind turbines in Chunan, and Figure A-3 shows the location of the wind turbines in Dapong.



Fig.A-1 Geographic location of the project

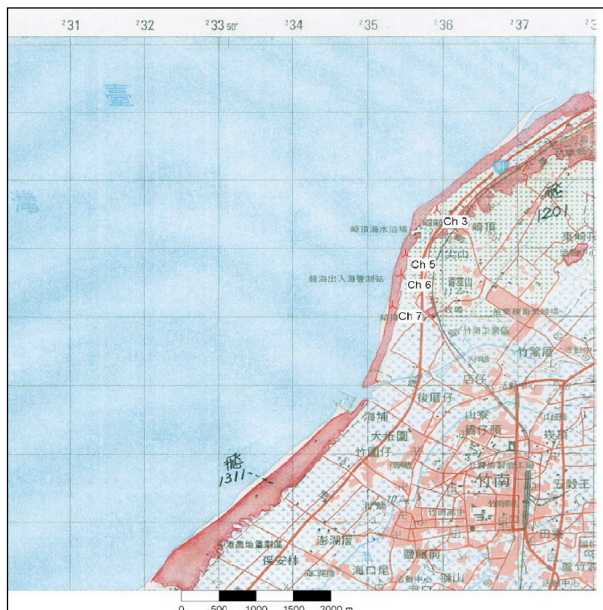


Fig.A-2: Map of Chunan Site

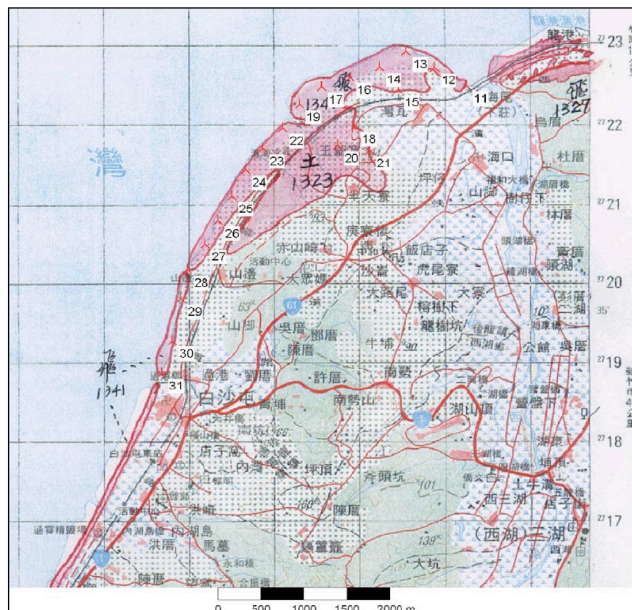


Fig.A-3: Map of Dapong site.

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 a 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 TPCG, and by the addition of new power sources to TPCG. The proposed wind power project activity therefore abates the amount of carbon dioxides (CO₂, 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 Chunan site comprises 3 sets of 2,000kW turbines and 1 set of 1,800kW turbine. The Dapong site comprises 21 sets of 2,000kW turbines. The turbines installed are imported from German wind turbine supplier, Enercon. Wind turbines type Enercon E-70 E4 are used, with 71m diameters and 64m hub heights. The turbines in Chunan site are directly connected to Taipower Grid at Shanjia substation through 22.8KV underground cables. The turbines in Dapong site are connected to the Tung-Ho Steel Substation through 22.8KV underground cables, then connected to the step-up transformer to 161 kV Taipower grid. Plant load factor is estimated at 42.75% with operating hours of 3,745 hrs/year⁴. The project utilizes 2 bi-directional electricity meters, which are located at Shanjia and Tung-Ho Steel Substations. Both are 3-phase/4-wire type electricity meter, with accuracy level 0.5.

The technical data of the turbine units of turbine type E-70 E4 is given in the table below.

Table 1. Characteristics of the wind turbines E-70 E4

Wind Turbines Type	E-70 E4	
Site	Chunan Site	Dapong Site

⁴ According to the final financial model 03/03/2005

Rated power	2,000 kW	1,800 kW ⁵	2,000 kW
Number of turbines	3	1	21
Total output	49.8MW		
Rotor diameter	71m		
Hub height	64m		
Generator	Direct-driven synchronous Enercon ring generator		
Grid feeding	ENERCON inverter		
Lifetime of equipment	20 years		

Source: Turbines Supply Contract Annex 5

The project owner provided capacity building for the local operational and maintenance staffs, so that it is no longer necessary to import the skilled foreign workers. However, the capacity building for staffs responsible for operation and maintenance were held only in the earlier development phase of the project; and there has not been any public seminars or workshop training program held by the project owner in Taiwan. In conclusion, although the project has contributed to technical skills development of its staffs, the project has no spill over effect on transferring the technical know-how of wind power, as it has not been involved in technology transfer at the broader national level in Taiwan.

A.4. Parties and project participants

Party involved (host) indicates 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)	Whitehelm Capital Limited (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 and standardized baseline

B.1. Reference of methodology and standardized baseline

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The approved consolidated baseline and monitoring methodology:

ACM0002 (version 17.0): "Large-scale consolidated methodology: Grid-connected electricity generation from renewable sources."

⁵ All turbines are the same Enercon E-70 E4 type, but one turbines in Chunan Site has an output capacity of 1.8MW

The methodology was applied with the following tools:

- Tool to calculate the emission factor for an electricity system (version 5.0)
- Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation
- Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period

Details are available at the following website:

<http://cdm.unfccc.int/methodologies/PAMethodologies/approved.html>

B.2. Applicability of methodology and standardized baseline

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The choice to use the ACM0002 (Version 17) methodology is applicable to the project because the project meets its applicability criteria:

No.	Technology/Measure	Project Activity	Applicability
1	This methodology is applicable to grid-connected renewable energy power generation project activities that: (a) Install a Greenfield power plant; (b) Involve a capacity addition to (an) existing plant(s); (c) Involve a retrofit of (an) existing operating plants/units; (d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or (e) Involve a replacement of (an) existing plant(s)/unit(s).	The project activity is a grid-connected renewable power generation project activity install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield plant)	Applicable
2	The methodology is applicable under the following conditions: (a) The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit; (b) In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion,	The project activity is a wind farm with 25 turbines, does not involve switching from fossil fuels to renewable energy source at the site of the project activity, also is not a biomass/biogas power plant, or hydro power plant that result in new reservoirs/increase in existing reservoirs, so this project is covered under paragraph (a).	Applicable

	retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.		
3	In case of hydro power plants, one of the following conditions shall apply: (a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or (b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3), is greater than 4 W/m^2; or (c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m^2; or (d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4 W/m^2, all of the following conditions shall apply: (i) The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m^2; (ii) Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; (iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m^2 shall be: a. Lower than or equal to 15 MW; and b. Less than 10 per cent of the total installed capacity of integrated hydro power project.	Not applicable, the project is a wind farm project and didn't install any hydro power plants.	N/A
4	In the case of integrated hydro power projects, project proponent shall: Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir	Not applicable, the Project is not a hydro power plant, so this condition does not need to be considered.	N/A

	and that collectively constitute to the generation capacity of the integrated hydro power project; or Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.		
5	The methodology is not applicable to: (a) Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; (b) Biomass fired power plants/units.	The project does not involve switching from fossil-fuels to renewable energy sources at the site of the project activity and also the project is not a biomass-fired power project.	Applicable
6	In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	Not applicable, the project is a wind power project.	N/A
7	In addition, the applicability conditions included in the tools referred to below apply	The project satisfies all the applicability conditions included in the tools applied.	N/A

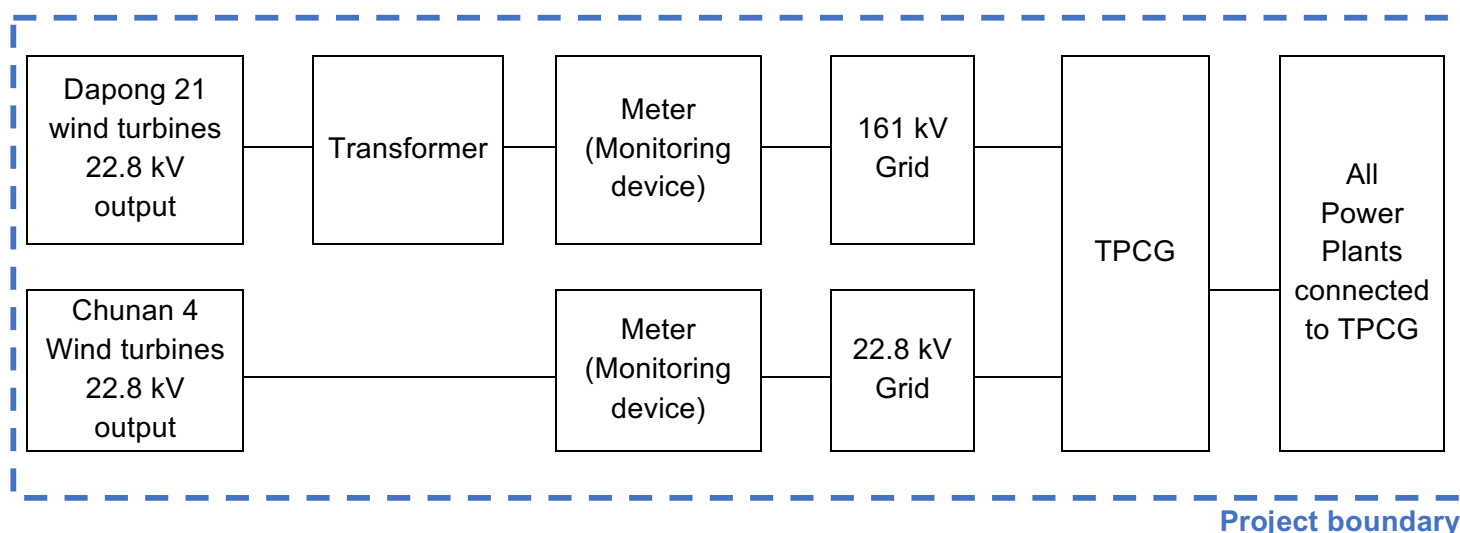
B.3. Project boundary

According to the methodology ACM0002 (version 17.0), since the proposed project is a grid connected wind power project, only CO₂ emission from fossil fuels power plants in baseline scenario need to be considered.

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in the following table.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	CO ₂ emission from electricity generation in fossil fuel fired power plant that is displaced due to the project activity. (Power Plants in TPCG)	CO ₂	Yes	Main emission source
		CH ₄	No	Minor emission source. Excluded for simplification. This conservative.
		N ₂ O	No	Minor emission source. Excluded for simplification. This is conservative.
Project scenario	Emission Sources of Project Activity (Miaoli 49.8MW Wind farm Project)	CO ₂	No	Excluded, as per ACM0002 version 17.
		CH ₄	No	Excluded, as per ACM0002 version 17.
		N ₂ O	No	Excluded, as per ACM0002 version 17.

Spatial extent of the grid is as defined in the “*Tool to calculate the emission factor for an electricity system (version 5.0)*”. 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 a single power grid with no cable connection with the continent. Thus, there is no other connected electricity system in Taiwan, besides TPCG. The spatial extent of the Project Boundary is defined as project power plant and all power plants connected physically to the electricity system that the project power plant is connected to. Namingly, the project boundary as described in flow chart below, is defined as the Miaoli wind power plant and the TPCG, and all power plants connected to TPCG.



B.4. Establishment and description of baseline scenario

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Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period (version 03.0.1)

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

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

There are no new national and/or sectoral policies that could affect the baseline scenario during the renewal of the crediting period. Although national policies favor the development of renewable energy sources, total renewable resource-based power generation accounts for 5.10%⁶ of total grid generating output in TPCG in 2016. Hence in the absence of the project activity, electricity would still have been generated in the existing fossil fuel power plants or by the addition of new fossil fuel power plants connected to the TPCG. Go to next step.

Step 1.2: Assess the impact of circumstances

The baseline scenario identified at the validation of the project activity was the continuation of the current practice without any investment. The investment environment or market characteristics especially the feed-in tariff, the policy in terms of market access permit, these circumstances continue during the second crediting period and therefore, do not have an impact on the current baseline emissions. Hence the current baseline does not need to be updated. Go to next step 1.3.

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

The project is a greenfield project with a lifetime of 20 years, with no baseline equipment(s) or an investment for the crediting period for which renewal is requested, this step is not applicable. Go to step 1.4.

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

Data and parameters that need to be updated are as follows:

$EF_{grid,CM,y}$: the baseline emission factor that determined once for the first crediting period at the time of validation, hence it has been updated using the latest version of “*Tool to calculate the emission factor for an electricity system*”. Please refer to section B.6 for details.

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

Step 2.1: Update the current baseline

As per the analysis in step 1 above, the current baseline does not need to be updated.

Step 2.2: Update the data and parameters

The updated baseline emission factor for the project ($EF_{grid,CM,y}$) is 0.645 tCO₂e/MWh.

B.5. Demonstration of additionality

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⁶ Taipower grid http://www.taipower.com.tw/content/new_info/new_info-b31.aspx?LinkID=8

The additionality of the project activity has been demonstrated in the registered PDD. No further demonstration is required for renewal of crediting period.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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The approved consolidated baseline and monitoring methodology ACM0002 (version 17.0) "Large-scale Consolidated Methodology: Grid-connected electricity generation from renewable sources" has been used.

The methodology was applied with the following tools:

- Tool to calculate the emission factor for an electricity system (version 05.0)
- Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 02.0)"

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 CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity, calculated as follows:

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

where:

$EF_{grid,CM,y}$ Combined Margin Emission Factor in year y

BE_y Baseline Emissions in year y (tCO₂/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)

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

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 (version 17), no need to consider.

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y	Emission reductions in year y (tCO ₂ e/yr)
BE_y	Baseline emissions in year y (tCO ₂ e/yr)
PE_y	Project emissions in year y (tCO ₂ e/yr)

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

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

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 (tCO ₂ e/MWh)
$EF_{grid,BM,y}$	Build margin emission factor (tCO ₂ e/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 0.702 tCO₂e/MWh and the build margin emission factor ($EF_{grid,BM,y}$) is 0.475 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 **0.645** tCO₂e/MWh. The calculations are presented in Annex 4

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO ₂ e/MWh
Description	Combined Emission factor
Source of data	Calculated
Value(s) applied	0.645
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 emission
Additional comment	The emission of the build and operating margin are calculated according to the ex-ante option.

Data / Parameter	EG_y
Unit	MWh
Description	The net electricity generation excluding the low-cost must-run (up until 2015)

Source of data	Energy Balances in Taiwan ⁶
Value(s) applied	See Table A2 in Annex 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	N/A

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 sheet in Taiwan
Value(s) applied	Step 4 Table A4 in Annex 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	N/A

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.6.0.2 – Environmental Protection Administration (EPA) Executive Yuan, Taiwan ⁷
Value(s) applied	Please refer to the table of GHG Emission Factor Inventory v.6.0.2
Choice of data or Measurement methods and procedures	Numbers are adopted from the reference document.
Purpose of data	Calculation of baseline emission
Additional comment	The Bureau of Energy (BOE) provides directly emission factor by unit of mass or volume in which is equal to the product of $NCV_{i,v}$ and $EF_{CO_2,i,y}$

Data / Parameter	$EF_{CO_2,i,y}$
Unit	kgCO ₂ /kg kgCO ₂ /L kgCO ₂ /M ³

⁶ http://www.moeaboe.gov.tw/ecw/populace/web_book/WebReports.aspx?book=B_CH&menu_id=145

⁷

<http://ghgregistry.epa.gov.tw/upload/Tools/%E6%BA%AB%E5%AE%A4%E6%B0%A3%E9%AB%94%E6%8E%92%E6%94%BE%E4%BF%82%E6%95%B8%E7%AE%A1%E7%90%86%E8%A1%A86.0.2%E7%89%88.rar>

Description	CO ₂ emission factor of fossil fuel type i in year y
Source of data	GHG emission factor table version 6.0.2 published by EPA
Value(s) applied	Table A1 in Annex 4
Choice of data or Measurement methods and procedures	Publicly available data from EPA
Purpose of data	Calculation of baseline emission
Additional comment	The BOE provides directly emission factor by unit of mass or volume 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	GHG emission factor table version 6.0.2 published by EPA
Value(s) applied	EF _{Coal,Adv} = 0.804 tCO ₂ /MWh EF _{Gas,Adv} = 0.367 tCO ₂ /MWh EF _{Oil,Adv} = 0.506 tCO ₂ /MWh Step 6 Substep 2 in Annex 4
Choice of data or Measurement methods and procedures	Publicly available data from EPA website
Purpose of data	Calculation of baseline emission
Additional comment	N/A

Data / Parameter	<i>CAP_{source,y}</i>
Unit	MW
Description	Installed capacity by different sources from 2000 till 2015 (MW)
Source of data	Statistic data of power generation capacity and total generation (available data of year 2000~2015) published by Bureau of Energy, Ministry of Economic Affairs
Value(s) applied	Step 6 Substep 2 in Annex 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 emission
Additional comment	N/A

B.6.3. Ex ante calculation of emission reductions

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Project Activity Emissions**GHG emissions by source**

In accordance to ACM0002, the project emission for most renewable energy (including wind farm) project activities are zero ($PE_y = 0$)

Leakage

Based on ACM0002, there is no need to consider LE_y .

Baseline Emission

Based on ACM0002, baseline emissions (BE_y) include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the proposed project activity, which is calculated as follows:

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

Where:

$EF_{grid,CM,y}$ Combined Margin Emission Factor in year y

BE_y Baseline Emissions in year y (tCO₂/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)

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

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

$$\begin{aligned} ER_y &= BE_y \\ &= EF_{grid,CM,y} \times EG_{facility,y} \\ &= 0.645 \text{ tCO}_2\text{e/MWh} \times 186,509 \text{ MWh/year} \\ &= 120,298 \text{ tCO}_2\text{e/year} \end{aligned}$$

The result of emission reduction:

Parameter	Description	Value	Unit
$EG_{PJ,y}$	Net electricity delivered annually to grid by the Project at full capacity	186,509	MWh/year
$EF_{grid,CM,y}$	Combined Emission Factor	0.645	tCO ₂ e/MWh
ER_y	Emission reduction annually	120,298	tCO ₂ e/year

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

Year	Baseline emissions (t CO ₂ e)	Project emissions (t CO ₂ e)	Emission reductions (t CO ₂ e)
12/12/2017 – 11/12/2018	120,298	0	120,298
12/12/2018 – 11/12/2019	120,298	0	120,298
12/12/2019 – 11/12/2020	120,298	0	120,298
12/12/2020 – 11/12/2021	120,298	0	120,298
12/12/2021 – 11/12/2022	120,298	0	120,298
12/12/2022 – 11/12/2023	120,298	0	120,298
12/12/2023 – 11/12/2024	120,298	0	120,298
Total	842,086	0	842,086
Total number of crediting years	7		
Annual average over the crediting period	120,298	0	120,298

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

Data / Parameter	EG _{e,y}
Unit	MWh
Description	Quantity of electricity generation supplied by the project plant/unit to the grid
Source of data	Electricity meter
Value(s) applied	186,509 MWh
Measurement methods and procedures	There are 2 bi-directional electricity meters applied in the project, one is located in the Shanjia Substation which measures power generation from Chunan site; while another meter is located in Tung-Ho Steel Substation, which measures power generation from Dapong site. Meters accuracy level are 0.5, and calibration frequency is 8 years, as regulated by CNMV 46 ⁸ . Data from the electricity meters will be collected and monitored by both, the project owner and Taipower. The confirmed electricity supplied to the grid is then recorded in the electricity receipts obtained from Taipower every month.
Monitoring frequency	Continuous measurement and at least recording.

⁸ www.bsmi.gov.tw/wSite/public/Attachment/f1224657229438.doc

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-year period. In addition, electricity receipt is kept for cross reference as per ACM0002.
Purpose of data	Calculation of baseline emission
Additional comment	N/A

Data / Parameter	$EG_{i,y}$
Unit	MWh
Description	Quantity of electricity consumption of the project plant/unit from the grid
Source of data	Electricity meter
Value(s) applied	0
Measurement methods and procedures	There are 2 bi-directional electricity meters applied in the project, one is located in the Shanjia Substation which measures power generation from Chunan site; while another meter is located in Tung-Ho Steel Substation, which measures power generation from Dapong site. Meters accuracy level are 0.5, and calibration frequency is 8 years, as regulated by CNMV 46. Data from the electricity meters will be collected and monitored by both, the project owner and Taipower. The confirmed electricity consumption is then recorded in the electricity receipts obtained from Taipower every month.
Monitoring frequency	Continuous measurement and at least recording.
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 in every 8-year period. In addition, electricity receipt is kept for cross reference as per ACM0002
Purpose of data	Calculation of baseline emission
Additional comment	N/A

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 $EG_{e,y} - EG_{i,y}$
Value(s) applied	186,509 MWh
Measurement methods and procedures	Calculated by the difference of $EG_{e,y}$ and EG_i which are measured continuously and at least monthly recording.
Monitoring frequency	Monthly
QA/QC procedures	Meter reading records of $EG_{e,y}$ and $EG_{i,y}$ will be crosschecked with the electricity receipts, and calculation will be double checked and verified.
Purpose of data	Calculation of baseline emissions

Additional comment	Determined as per “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 02.0)
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B.7.2. Sampling plan

>>

N/A

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:

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

Where:

ER_y Emission reduction in year y

$EF_{grid,CM,y}$ Combined Margin Emission Factor in year y

$EG_{facility,y}$ 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)

As the emission factor is fixed for the whole 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:

$$EG_{facility,y} = EG_{e,y} - EG_{i,y}$$

Where:

$EG_{facility,y}$ Quantity of net electricity generation supplied by the project plant/unit to the grid

$EG_{e,y}$ Quantity of electricity generation supplied by the project plant/unit to the grid

$EG_{i,y}$ Quantity of electricity consumption of the project plant/unit from the grid

(2) Electricity meters:**Electricity generation ($EG_{e,y}$)**

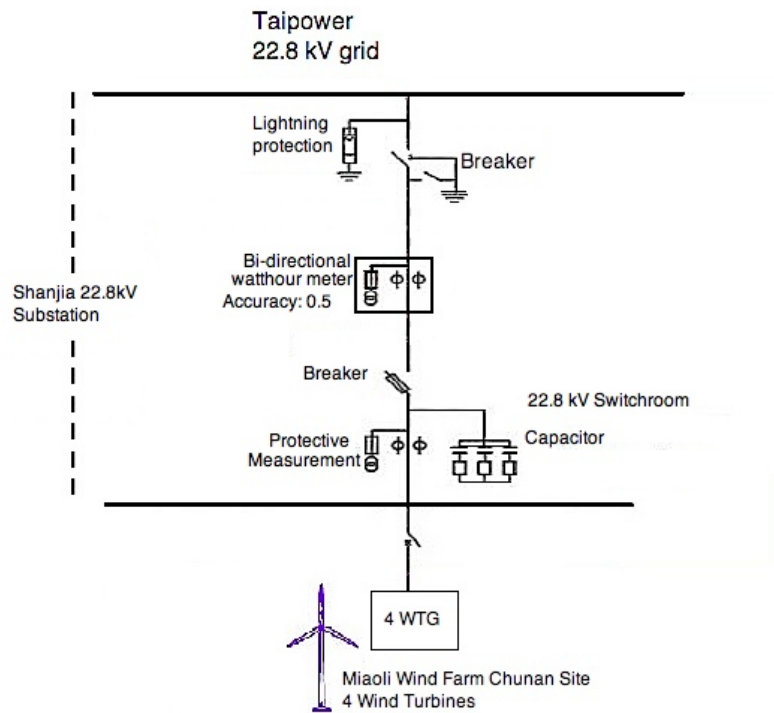
The electricity generated by the wind turbines are transmitted to Taipower's substation in which an electricity meter is installed to record the transmitted electricity. The project utilizes 2 bi-directional electricity meters, which are located at Shanjia Substation (Chunan Site) and Tung Ho Steel Substation (Dapong Site). Both are 3-phase/4-wire type electricity meter, with accuracy level 0.5.

Electricity consumption ($EG_{i,y}$)

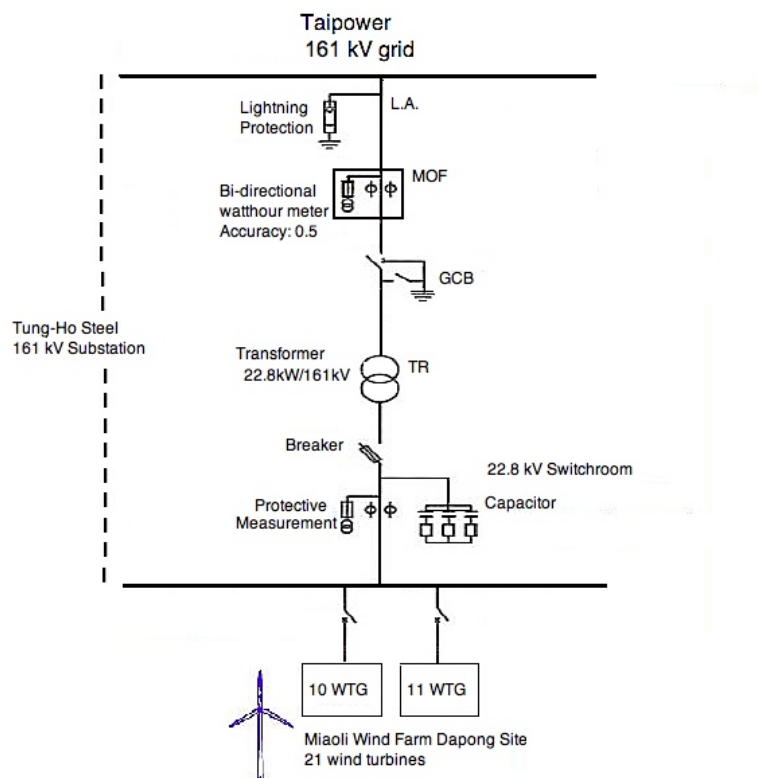
The wind farm needs to use electricity from grid during the turbines start up. Electricity consumptions are also recorded by Taipower. The project utilizes 2 bi-directional electricity meters,

which are located at Shanjia Substation (Chunan Site) and Tung Ho Steel Substation (Dapong Site). Both are 3-phase/4-wire type electricity meter, with accuracy level 0.5.

Chunan Wind Farm Schematic Diagram



Dapong Wind Farm Schematic Diagram



(3) Monitoring Management

Since the baseline methodology is based on ex ante determination of the baseline, there are 3 parameter that must be monitored, electricity generation supplied to the grid ($EG_{e,y}$), electricity consumption of the project plant from the grid ($EG_{i,y}$), and the net electricity supplied to the grid by the project ($EG_{facility,y}$). **Whitehelm Capital Limited** and Taipower ensure the availability and high quality of the necessary monitoring data. As accorded by the Gold Standard, all data necessary for emission reductions calculations will be kept by the project owner for at least two years after the end of crediting period. Data acquisition, management and quality assurance procedures are already in place; therefore, no additional procedures need to be established for the monitoring plan.

The operational and management structure of the project implemented by **Whitehelm Capital Limited** is as follows:

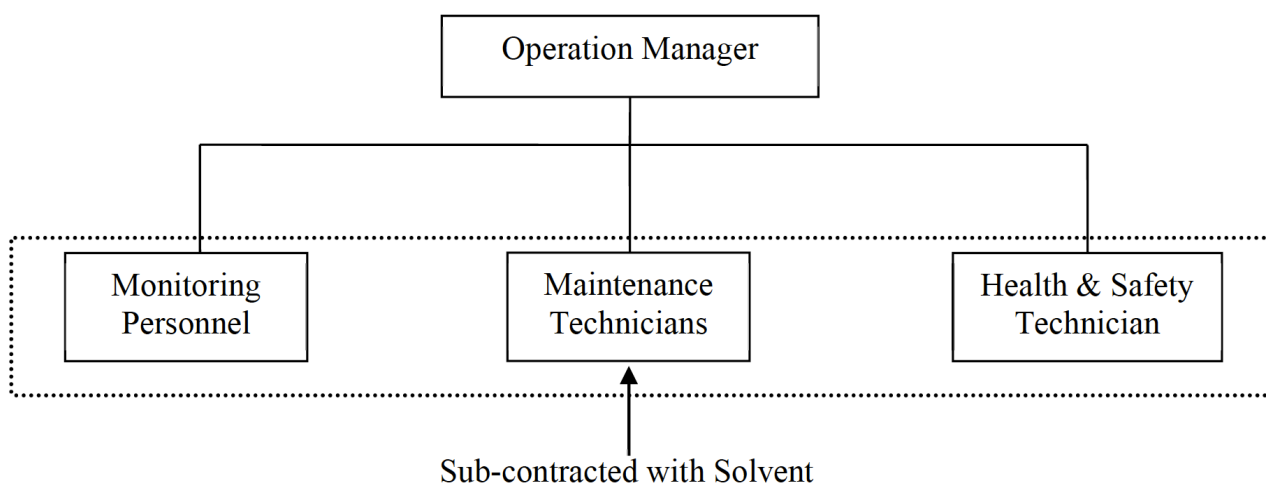


Fig. B-1 The operational and management structure of the project

As indicated in the above figure, the personnel responsible for Monitoring and Maintenance and Health & Safety are managed and trained by the sub-contracted company “Solvent”. 12 personnel from Solvent will be assigned to take charge of the monitoring and maintenance of the project. The job descriptions and the prescribed trainings are presented below in Table B-3.

Table B-3 Job descriptions and prescribed trainings

Job name	Job description	Prescribed trainings
Measurement Technician	- Measuring and recording the electricity generation through the proper methods and instruments - Data storing and reporting to Operational Manager	Trainings on measurement and recording by Solvent
Maintenance Technician	Marking periodical and failure maintenance programmes and activities	Electronical and Mechanical Maintenance Trainings by Solvent
Health & Safety Technician	- Fulfilling occupational safety and health responsibilities. - Monitoring Environmental issue.	Safety and health trainings by Solvent

Data management

Electricity data from the Meter of Facility (MOF) in Taipower's substation is recorded on paper and downloaded using the electronic device by Taipower's monitoring staff. The MOF measures both electricity generation and consumption, both data will be recorded in the monthly and annual report. Subsequent to meter reading sessions, Taipower sends separate confirmations to the project owner regarding amount of both generation and consumption. MOF data copies and the confirmation records will be archived for at least two years after the end of the crediting period by the project owner.

Quality assurance and quality control procedures

Internal audit will be carried out to check compliance with operational procedures outlined in this monitoring plan. This internal audit will also identify potential possible adjustments for operational procedures to improve monitoring and reporting in future years.

MOF specification complies with The Weight and Measures Act, Regulation no. CNMV 46, 'Technical Specification for Verification and Inspection of Electricity Meters'⁹. The accuracy class of the electricity meters used for the project activity is 0.5 (in line with the official standard error for electricity meter (MOF) at $\pm 0.5\%$ ¹⁰). 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 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.¹¹. Since Taipower is in charge of all electricity meter, in case of a performance failure, the handling procedures follows the Power Supply and Engineering Regulations. Taipower and the project owner will jointly recalculate the amount of electricity dispatched by the project based on Electricity Tariff Regulations.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>

Date of completion: 22/12/2017

The baseline calculation has been prepared by Nanjitan Asset Management Ltd.

Name and contact details of the person responsible for the baseline section:

Andrea Yu

Nanjitan Asset Management Ltd.

No.812, Taiwan Boulevard Section 4, Xitun District, Taichung city 40764, Taiwan

Phone: +886 4 2462 9218 / Fax: +886 4 2462 9219

ayu@nanjitan.com

⁹ 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

¹⁰ 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

¹¹ <http://www.bsmi.gov.tw/wSite/laws/review.jsp?lawId=8a8a85591c30ce08011c31d0b3860006&mp=1>

SECTION C. Duration and crediting period**C.1. Duration of project activity****C.1.1. Start date of project activity**

>>

03/03/2005¹²**C.1.2. Expected operational lifetime of project activity**

>>

20 years

C.2. Crediting period of project activity**C.2.1. Type of crediting period**

>>

1. Renewable
2. The second crediting period

C.2.2. Start date of crediting period

>>

12/12/2017

C.2.3. Length of crediting period

>>

7 years

SECTION D. Environmental impacts**D.1. Analysis of environmental impacts**

>>

According to the EIA regulations in Taiwan, for wind power projects with capacity below 50MW at a non-urban area, and below 25MW at an urban area, are exempted from EIA. Therefore, in the case of the Miaoli project, no EIA is necessary. The project is limited to a capacity of 49.8MW and is below the 50MW threshold for EIA approval¹³

¹² Turbines purchase contract came into effect

¹³ RULE NO. 5, ARTICLE 29, STANDARDS FOR DETERMINING SPECIFIC ITEMS AND SCOPE OF ENVIRONMENTAL IMPACT ASSESSMENTS FOR DEVELOPMENT ACTIVITIES (29/12/2004), REGULATED BY THE ENVIRONMENTAL PROTECTION ADMINISTRATION (EPA), EXECUTIVE YUAN – TAIWAN R.O.C.

D.2. Environmental impact assessment

>>

Not applicable

SECTION E. Local stakeholder consultation**E.1. Solicitation of comments from local stakeholders**

>>

This project didn't have any new installation or physical changes during last CP and the complementary stakeholder consultation is not mandatory for this renewal of the crediting period. However, we hold a newly consultation, so this is conservative.

The first-round stakeholder consultation meeting was held for the second crediting period of Miaoli Wind Farm Project, including Dapong site and Chunan site. The original copies of meeting minutes in local language are attached in Annex 5. The project has obtained an official feasibility assessment and construction permits from the central government via Bureau of Energy, and Ministry of Economic Affairs, Taiwan R.O.C. Furthermore, local government and resident representatives were invited through phone call and in person by the project owner to provide opinions and discuss community.

- Stakeholder consultation (first round) for Miaoli Wind Farm
 - Time: 16/03/2017
 - Location: Qing-Hai Temple, No. 114-1, Nangang Village, Houlong Township, Miaoli County, Taiwan.
 - Number of attendance: 43

E.2.**E.2. Summary of comments received**

>>

The summarized survey is listed in the below table:

Item	Options	Number of participants	Percent
Air quality	-	0	0.00%
	0	23	52.27%
	+	21	47.73%
Water	-	0	0.00%

<http://law.moj.gov.tw/lawclass/lawoldver.aspx?pcode=o0090012&lnndate=20021231&lser=001> "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 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 a 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 plants that are connected to the same substation. (2) total generation capacity of plants that are located in the same county (city) jurisdiction, within 2 kilometres radius range from the coastline to the highest density of wind turbines set "

	0	21	47.73%
	+	23	52.27%
Soil	-	0	0.00%
	0	20	45.45%
	+	24	54.55%
Other	-	0	0.00%
	0	22	50.00%
	+	22	50.00%
Biodiversity	-	0	0.00%
	0	19	43.18%
	+	25	56.82%
Quality	-	0	0.00%
	0	9	33.33%
	+	18	66.67%
Livelihood	-	0	0.00%
	0	9	33.33%
	+	18	66.67%
Access to affordable and clean energy services	-	0	0.00%
	0	6	22.22%
	+	21	77.78%
Human and institutional capacity	-	0	0.00%
	0	17	62.96%
	+	10	37.04%
Quantitative employment and income	-	0	0.00%
	0	8	29.63%
	+	19	70.37%
Balance of payments and investment	-	0	0.00%
	0	8	29.63%
	+	19	70.37%
Technology transfer and technological self-reliance	-	0	0.00%
	0	6	22.22%
	+	21	77.78%

E.3. Report on consideration of comments received

>>

According to the surveys, most of the people believe this project will put a positive effect on the environment. But some people were expressing their concerns about the project the incentive scheme, the project owner explained that they have made the subsequent donation to the village office who can decide how to use this donation, namely maintaining the public area and public facilities or sharing it with residents.

Therefore, there is no reason to modify the project activity due to comments. More information please refers to the submitted complementary LSC report for details.

SECTION F. Approval and authorization

>>

N/A

Annex 1 Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Whitehelm Capital Limited
Street/P.O. Box	23 Church Street
Building	#11-11 Capital Square
City	Singapore
State/Region	
Postcode	049481
Country	Singapore
Telephone	+65 6231 2765
Fax	+65 6438 7306
E-mail	Andrew.Yeoh@macquarie.com
Website	https://www.whitehelmcapital.com/au/
Contact person	Andrew Yeoh
Title	Mr.
Salutation	
Last name	Yeoh
Middle name	
First name	Andrew
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	Andrew.Yeoh@macquarie.com

Project participant and/or responsible person/ entity	☐ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Nanjitan Asset Management Ltd.
Street/P.O. Box	No.812, Taiwan Boulevard Section 4, Xitun District
Building	
City	Taichung City
State/Region	Taiwan
Postcode	40764
Country	Taiwan
Telephone	+886 4 2462 9218
Fax	+886 4 2462 9219
E-mail	jchuang@nanjitan.com
Website	www.nanjitan.com
Contact person	Jules CHUANG
Title	Mr.
Salutation	
Last name	CHUANG
Middle name	
First name	Jules
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	jchuang@nanjitan.com

Annex 1

Annex 1

Annex 1

Annex 2 Affirmation regarding public funding

The project does not involve any ODA financing. As confirmed with the GS¹⁴, 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. The DOE has confirmed that the project financing does not comprise ODA funding in the validated financial model and IRR analysis.

Annex 3 Applicability of methodology and standardized baseline

N/A

Annex 4 Further background information on ex ante calculation of emission reductions

$EF_{grid,CM,y}$ is calculated as per the latest version of “*Tool to calculate the emission factor for an electricity system*” (version 05.0). The baseline emission factor $EF_{grid,CM,y}$ is calculated ex ante and fixed for the 2nd crediting period. Detailed as follows:

Step 1. Identify the relevant electric power system

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-New Format (from the Bureau of Energy¹⁵), 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.

¹⁴ 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.

¹⁵ Energy Balances in Taiwan-New Format, http://www.moeaboe.gov.tw/opengovinfo/Plan/all/energy_balance/main/en/default.htm

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

According to the “Tool to calculate the emission factor for an electricity system (version 05)”, 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)

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

Table A1. Net Calorific Values (NCV_{i,y}) multiplied by (EF_{CO₂,i,y}) of fossil fuel used for OM and BM calculation

Fuel Type	Emission Factor	Unit
Bituminous Coal-Steam coal	2.34	KgCO ₂ /Kg
Sub-Bituminous Coal	2.29	KgCO ₂ /Kg
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	0.66	KgCO ₂ /Kg
Natural Gas	1.82	KgCO ₂ /M ³
Liquefied Petroleum Gases (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 run¹⁶. Thus, only nuclear, biomass, hydro geothermal electricity, solar photovoltaic and wind power plants are included as lowcost/ must-run resources, hereafter referred as lc-mr, which turns out to be between 21.17% and 19.16% of the total electricity generation on average during years 2011 and 2015.

Table A2. Gross and Net Electricity Generation (EG_y) in Taiwan

Item	Unit	2011	2012	2013	2014	2015
Total electricity generation	MWh	255,733,038	253,862,198	255,875,507	263,708,142	261,807,514
Total LCMR	MWh	54,138,650	54,090,959	55,750,472	55,561,692	50,158,818
Power Plant Own Use						
Total Power Plant Own Use	MWh	11,976,600	11,746,634	11,263,849	11,976,791	11,723,461
Total LCMR power Plant Own Use	MWh	1,666,640	1,602,603	1,617,922	1,842,829	1,549,123
Net generation excl. LCMR	MWh	191,284,428	189,627,208	190,479,108	198,012,488	201,474,358
share of LCMR	MWh	21.17%	21.31%	21.79%	21.07%	19.16%

Source: Energy Balance Sheet in Taiwan

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

- Simple OM; or
- Simple adjusted OM; or
- Dispatch data analysis OM; or
- Average OM

Since the average share of electricity generation by LC-MR plants 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 data vintages:

¹⁶ 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'.

- Ex-ante option, where a 3-year generation-weighted average based on the most recent data is used. Monitoring and recalculation of the emission factor 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 CO₂ emissions per unit net electricity generation of all generating power plants serving the system, excluding lc-mr sources using one of the following approaches;

- Option A: Based on data on fuel consumption and net electricity generation of each power plant/unit, or
- Option B: Based on data 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.

Complete plant-specific data required by Options A is unavailable, Taipower can furnish some plant specific data but only for the power plants they operate, these numbers do not comprise all IPP 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 lc-mr 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 1 in step 2 was chosen). According to the “Tool to calculate the emission factor for an electricity system version 2,” 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:

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

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$FC_{i,y}$	Amount of fossil fuel type <i>i</i> consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type <i>i</i> in year y (energy unit / mass or volume unit)
$EF_{CO2,i,y}$	CO ₂ emission factor of fossil fuel type <i>i</i> in year y (tCO ₂ /energy unit)
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>i</i>	All fossil fuel types combusted in power sources in the project electricity system in year y
<i>y</i>	the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation

Table A3. The total CO₂ emission by fuels of 2013, 2014 and 2015

Total Emission in 2013	tCO ₂	134,255,827
Total Emission in 2014	tCO ₂	139,902,988
Total Emission in 2015	tCO ₂	140,000,635

Thus, we have the results of Operating Margin:

EF _{grid,OM,y} 2013	tCO ₂ / MWh	0.705
EF _{grid,OM,y} 2014	tCO ₂ / MWh	0.707
EF _{grid,OM,y} 2015	tCO ₂ / MWh	0.695
Average EF_{grid,OM,y} (2013~2015)	tCO₂ / MWh	0.702

The result of Operating Margin is 0.702 tCO₂/MWh

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

In accordance to the calculation method proposed by the Chinese NDRC¹⁷ which was approved by CDM EB¹⁸, 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 CO₂ 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 recently¹⁹. In terms of vintage of data, *Option 1* is chosen: *For the second crediting period, the Build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE.*

Step 6. In accordance with STEP 5, BM emission factor of the grid is calculated as follows:

Sub-step 1:

¹⁷ 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.

¹⁸ 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/filestorage/6/P/O/6POIAMGYOEDOTKW25TA20EHEKPR4DM/Request%20for%20deviation%20for%20m.pdf?t=UTF8b2k1bzEzfDBhJDdpBWYTNx9G9vPYJtxm> This approach has been applied by many registered CDM projects using methodology ACM0002 so far.

¹⁹ Note: According to the Tool to calculate the emission factor for an electricity system (version 05) page23. "If 20% falls on part capacity of a unit, that unit is fully included in the calculation"

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 CO₂ emissions related to consumption of coal, oil and gas fuel used for power generation as compared to total CO₂ emissions from the total fossil fuelled electricity generation (sum of CO₂ emissions from coal, oil and gas).

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

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/m³ for gas fuels)

$EF_{CO2,i,j,y}$ the CO₂ emission coefficient of fuel i (tCO₂/GJ)

Coal, Oil and Gas stands for solid, liquid and gas fuels respectively

Table A4. The total CO₂ emissions by fuels of 2015 (FC_{i,y})

Fuel		Units	Emission (tCO ₂ e)	
Solid	Bituminous Coal-Steam Coal	t	71,268,366	71.54%
	Coke oven Gas	M ³	496,756	
	Blast Furnace Gas	M ³	5,599,431	
	Oxygen Steel Furnace Gas	M ³	1,058,399	
	Sub-bituminous coal	t	21,737,910	
	Sub-total		100,160,862	
Liquid	Diesel	L	360,035	6.02%
	Refinery gas	M ³	8,284	
	Petroleum Coke	t	550,786	
	Fuel oil	L	7,505,722	
	Sub-total		8,424,828	
Gas	Natural Gas	M ³	9,203	22.44%
	LNG	M ³	31,405,742	
	Sub-total		31,414,945	
Total			140,000,635	100.00%

Data Source: Energy Balances in Taiwan²⁰

Sub-step 2

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

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

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 factors 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 optional 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
Coal fire power plant	$EF_{Coal, Adv}$	0.804
Gas fired power plant	$EF_{Gas, Adv}$	0.367
Oil fired power plant	$EF_{Oil, Adv}$	0.506

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

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.

²⁰ Energy Energy Balances in Taiwan-New Format,
http://www.moeaboe.gov.tw/opengovinfo/Plan/all/energy_balance/main/en/default.htm

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

Type / Installed capacity (MW)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Newly added installed capacity from 2005 till 2015	Proportion against nearly added installed capacity
	A	B	C	D	E	F	G	H	I	J	K	L=K-A	Item / Total
Thermal power	32,809.04	34,564.42	35,284.32	35,691.92	37,168.42	37,923.82	37,631.52	37,062.52	37,285.40	36,650.40	36,638.58	3,829.54	69.12%
Hydro power	4,511.73	4,511.73	4,523.23	4,539.93	4,538.93	4,579.43	4,642.73	4,683.44	4,683.44	4,683.44	4,691.44	179.71	3.24%
Nuclear power	5,144.00	5,144.00	5,144.00	5,144.00	5,144.00	5,144.00	5,144.00	5,144.00	5,144.00	5,144.00	5,144.00	0.00	0.00%
Renewable Energy*	697.84	829.63	927.66	995.20	1,123.03	1,237.14	1,376.33	1,533.96	1,746.66	1,997.73	2,229.18	1,531.34	27.64%
Total	43,162.61	45,049.78	45,879.21	46,371.05	47,974.38	48,884.39	48,794.58	48,423.92	48,859.50	48,475.557	48,703.20	5,540.59	100.00%
Share in 2015 installed capacity	11.38%	7.50%	5.80%	4.79%	1.50%	-0.37%	-0.19%	0.57%	-0.32%	0.47%			

*Note: Renewable energy in this table refers to geothermal, solar, wind, biomass and waste.

The result of Build Margin is **0.48** tCO₂/MWh.

Step 7. Calculate the combined margin (CM) emission factor

The Baseline Emission Factor is calculated as a Combined Margin, using the weighted average of the Operating Margin and Build Margin.

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

The operating margin emission factor ($EF_{grid,OM,y}$) of Taiwan is 0.702 tCO₂e/MWh and the build margin emission factor ($EF_{grid,BM,y}$) is 0.475 tCO₂e/MWh. The default 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 0.645 tCO₂e/MWh.

Annex 5 Further background information on monitoring plan

Please refer to Section B.7

Annex 6 Summary of post registration changes

N/A