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

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	San Antonio El Sitio Wind Power Project
Version number of the PDD	1
Completion date of the PDD	24/04/2012
Project participant(s)	Eólico San Antonio El Sitio, S.A. (Private Entity)
Host Party(ies)	Guatemala
Sectoral scope and selected methodology(ies)	Sectoral Scope: Energy Industries - Renewable Sources ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 12.3.0)
Estimated amount of annual average GHG emission reductions	85,986

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

The San Antonio El Sitio Wind Power Project (the “Project”) consists of installing sixteen 3 megawatt (“MW”) Vestas V112 wind turbine generators (“WTG”), for a total capacity of 48 MW. San Antonio El Sitio is expected to provide 122,382 GWh per year to the Guatemalan National Interconnected System.

The Project will be located in Guatemala, in Los Llanos village of the municipality of Villa Canales, in an area considered appropriate for wind energy generation. The Project is a Greenfield development, in an area where no other electricity generating plant has been previously sited.

The San Antonio El Sitio Wind Power Project will contain the basic elements of a wind farm: wind turbines, wind measuring stations, an operations building and an electrical substation. A WMP6000 control system will be used to supervise, monitor and control all relevant project components.

Wind energy technologies are considered environmentally safe; there are no greenhouse gases or other emissions due to the direct operation of these projects. Similarly the San Antonio El Sitio Wind Project will have no greenhouse gases (“GHG”) or other harmful emissions related to its operation, and will displace carbon dioxide emissions from electricity generation derived from fossil fuelled power plants.

Around 47% of generation in the Guatemalan grid (namely, National Interconnected System, “NIS”) is provided by fossil fuels including fuel oil, diesel and coal[1]. Therefore in the absence of the project activity, its electricity would be provided by the operation of grid-connected power plants (as well as by the addition of new generation sources), which in Guatemala have an estimated Combined Margin Emission Factor of 0.7026 tCO_2/MWh, as described below in Section B.6. This is the baseline scenario corresponding to this project activity. By providing 122,382 MWh/yr, the project is expected to annually displace 85,986 tCO_2. This will occur since the wind energy will displace generation that would otherwise be derived from carbon-intensive power plants.

The San Antonio El Sitio Wind Power Project is an initiative of the private enterprise Eólico San Antonio El Sitio, S.A.

Contribution to sustainable development

The San Antonio El Sitio Wind Power Project will produce significant benefits to Guatemala. These include:

- Increase in power supply in the country: The San Antonio El Sitio Wind Project will have an installed capacity of 48 megawatts, which will increase the supply of electricity and contribute to satisfy the growing demand for electricity.

- Reduction in electricity costs: The project will generate electricity from a clean, inexpensive (i.e. zero marginal cost) source of energy as compared with thermal power plants that require expensive fossil fuels to operate.

- Employment generation: employment opportunities will increase, especially during the construction phase, but also in the longer term during the operational phase of the wind Project.

- GHG emissions reduction: the Project activity will be generating electricity from a clean energy source, displacing generation from carbon-intensive technologies on the grid; therefore it contributes to the mitigation of climate change.

[1] Source: AMM Statistics (see baseline spreadsheet attached).

- Technology transfer: clean, state-of-the-art technology will be transferred from developed countries (as no local suppliers of wind turbines are available). The project also involves investment flows into the country and will demonstrate the use of replicable, clean energy technologies. Local workers hired during the construction and the operational phase of the Project will acquire important skills, supporting sustainable development in the country.

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

Guatemala.

A.2.2. Region/State/Province etc.

Guatemala.

A.2.3. City/Town/Community etc.

Los Llanos village, municipality of Villa Canales.

A.2.4. Physical/Geographical location

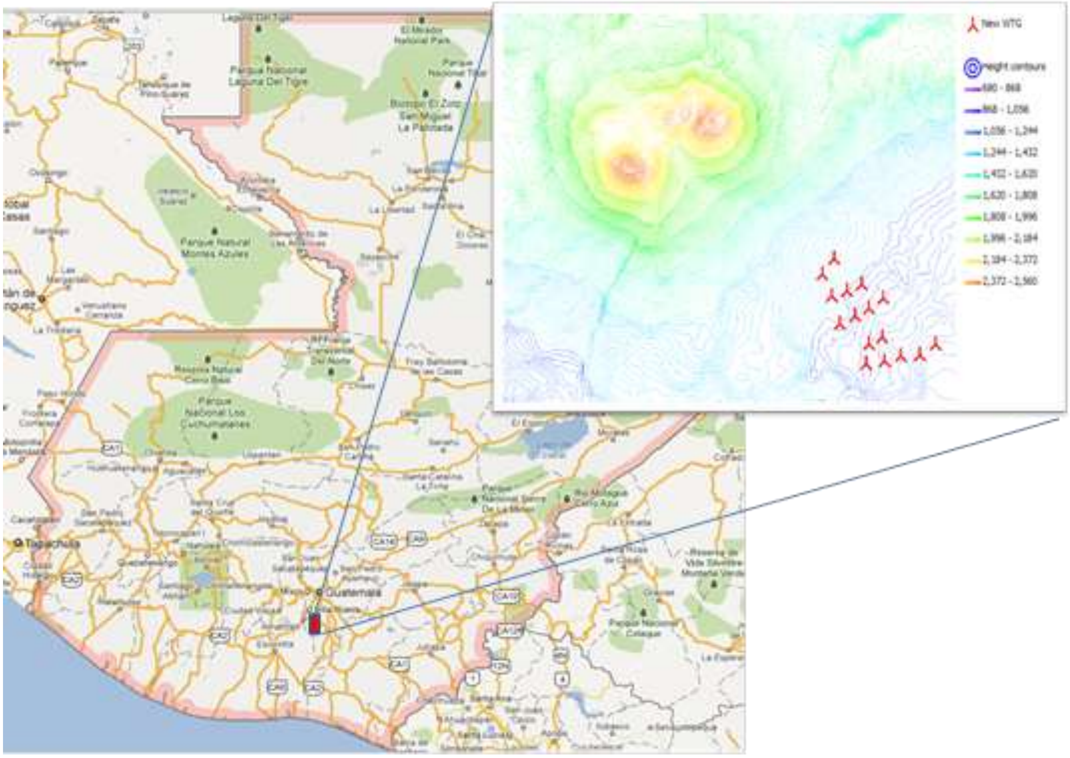
The Project will be located in Los Llanos village, on the highway from Santa Elena Barillas to Dolores, km 43, Villa Canales, Guatemala; on the farms of San Antonio El Sitio and Aras Independientes.

The area for the implementation of the wind farm is centered at the geographical coordinates (UTM): N 14°22´32.4” and W 90°34´35.6”. Table 1shows the wind turbine coordinates.

Table 1 - Wind Turbine Coordinates

WTG ID	Eastings UTM WGS84	Northing UTM WGS84	WTG ID	Eastings UTM WGS84	Northing UTM WGS84
T1	764116	1587112	T9	764031	1588755
T2	762947	1588785	T10	765140	1587812
T3	763263	1588900	T11	764014	1587943
T4	763571	1589032	T12	763682	1587401
T5	762738	1589230	T13	764666	1587573
T6	763117	1588222	T14	764198	1587530
T7	763441	1588381	T15	762983	1589550
T8	763732	1588546	T16	763735	1587804

Figure 1 - Project Location



A.3. Technologies and/or measures

The San Antonio El Sitio Wind Power Project involves installing a wind farm with sixteen 3 MW Vestas V112 wind turbine generators to produce energy and supply it to the NIS. This technology produces electricity without emitting GHGs, with emissions from wind projects defined as zero according to the methodology used ACM0002[2] (version 12.3), and with low direct impacts on the environment. Therefore it´s considered an environmentally safe and sound technology.

The Project will result in significant technology transfer in terms of its construction and operation, as this type of renewable energy projects does not exist in the country, thus it will create local "know-how" related to the installation and operation of the wind farm. Experience and training to local workers will be provided during construction, operation and maintenance.

Before the installation of the Project, no other technology for electricity generation has been employed at the site. The wind Project will be located in an area mainly dedicated to agriculture and livestock. For example: cultivating pineapple, coffee and pastures.

The baseline scenario for Grid Connected Renewables is defined by ACM0002 (version 12.3) as: "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 (version 02.2.1)". As shown in B.6 below, the Combined Margin Emission Factor in Guatemala for this baseline scenario is 0.7026 tCO_2/MWh.

[2] Section B.3 of this document

Activities to be implemented by the Project

The functional layout of the San Antonio El Sitio Wind Power Project location consists of all the main elements of a wind farm: wind turbines, wind measuring stations, an operations building (with metering equipment), internal roads between turbines and an electrical substation.

After collecting wind data for 13 months, an assessment of the resource was conducted by WindLogics, at the site identified for the installation of the wind project. The equipment primarily used for wind mapping was from NRG Symphonie with speed sensors calibrated and measurement towers installed that meet international standards.

The long-term average speed of the wind calculated across all the towers in the park is estimated to be on the order of 7.57 meters per second.

The Wind Turbine Generator ("WTG") chosen for the Project activity is the Vestas 112, which is 84 meters high. This generator has a generating capacity of 3 MW and 16 units will be installed, to provide a total capacity of 48 megawatt. The Project will have a net energy production of 122,382 MWh per year.

Vestas has operated in the field of wind power for more than 30 years. Having installations in 69 countries, Vestas is by far the most global wind turbine manufacturer. After installing over 43,000 wind turbines throughout the world, Vestas has a huge amount of expertise in these areas[3].

A VMP6000 (Vestas Multi Processor) control system will supervise, monitor and control all equipment in the wind farm (i.e. WTGs, meteorological masts, and electrical substation, among others). The control system functions in real time to operate individual turbines continuously, and is designed to react to variable wind speed to maximize power output and minimize loads and noise.

The equipment has been developed and tested with regard to the following main standards:

- Load Assumptions according to IEC 61400-22, Class IIA
- Safety System of Machinery, Safety – related Parts of Control Systems. IEC 13849-1
- Safety System of Machinery – Electrical Equipment of Machines, IEC 60204-1
- Rotor Blade diameter 112.0 m
- Machinery Components 50/60 Hz
- Tubular Steel Tower, Hub Heights at 84, 94, 119 meters, IEC 64100-1 Edition 3
- Lightning protection IEC 62305-1: 2006, IEC 62305-3: 2006, IEC 62305-4: 2006; IEC/TR 61400-24:2002
- Nacelle Cover and Hub IEC 64100-1 Edition 3 and EN 50308
- Design life time 20 years

The power curve used for the calculation of the annual production of energy corresponds with the power curve furnished in the WindLogics wind study for the Project. Vestas has reviewed power curves of the potential WTG for the site and forecasted the P50 Net Capacity Factor to be 129,402 MWh per year. This value is adjusted for 97% availability and 2.5% electrical losses, for a net production of 122,382.

The energy produced by each of the turbines will be delivered to the collector substation through 34.5 kV underground circuit cables. The collector substation consists of a building that will house the system of medium voltage, control equipment, protection and communications associated with substations. This substation will raise the voltage from 34.5 kV to 230 kV.

[3] http://www.vestas.com/

Net energy delivered to the grid will be measured at the 34.5/230 kV substation, which includes bi-directional meters capable of measuring energy exports and imports in both sides (i.e. the 34.5 kV and the 230 kV side). Electrical losses to the 230 kV point of interconnection are estimated at 2.5%. Details on the monitoring equipment are presented on Section B.7 below.

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)
Guatemala (host)	Private entity Eólico San Antonio El Sitio, S.A	No

A.5. Public funding of project activity

There are no public funds involved in this project.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

Approved baseline and monitoring methodology applied:

- ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 12.3.0)

The following tools were applied together with the methodology:

- "Tool for the demonstration and assessment of additionality" (Version 06.0.0)
- "Guidelines on the assessment of investment analysis" (Version 05)
- "Tool to calculate the emission factor for an electricity system" (Version 02.2.1)

B.2. Applicability of methodology

The consolidated baseline methodology for grid-connected electricity generation from renewable sources is applicable as the Project consists of the installation of a new wind power plant at a site where no renewable power plant was operated prior to the implementation of the Project activity (Greenfield plant). The relevant ACM0002 (version 12.3) applicability criteria are set out and discussed below.

Table 2 - Applicability conditions

Applicability Conditions	***Description of applicability condition as per ACM0002 (version 12.3)***	***Justification***
Condition 1	The project activity is the installation, capacity addition, retrofit or replacement of power plant/unit of one of the following types: hydro power plant/ unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.	The project activity involves installation of a wind farm with an installed capacity of 48 MW
Condition 2	In case the capacity additions, retrofits or replacements: (except for wind, solar, wave or tidal power capacity addition projects which use Option 2 to calculate the parameter $EG_{PJ,y}$): the existing plant 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 or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	The project activity is not a retrofit or modification of an existing power plant.
Condition 3	In case of hydro power plants: • The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of reservoirs. • The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per definitions given in the project Emissions section, is greater than 4 W/m2 after the implementation of the project activity. • The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per definitions given in the project Emissions section, is greater than 4 W/m^2 after the implementation of the project activity.	The project activity is not a hydro power plant.
Condition 4	The methodology is not applicable to the following: • 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; • Biomass fired power plants; • Hydro power plants that result in new single reservoir or in the increase in an existing single reservoir where the power density of the power plant is less than 4 W/m^2.	The project activity does not involve switching from fossil fuels to renewable energy at the site of the project activity; it is neither a biomass fired power plant nor a hydro plant.

B.3. Project boundary

As stated in ACM0002 (version 12.3), renewable energy projects shall only account for the amount of CO_2 emissions from electricity generation derived from fossil fuelled power plants that are displaced due to the project activity.

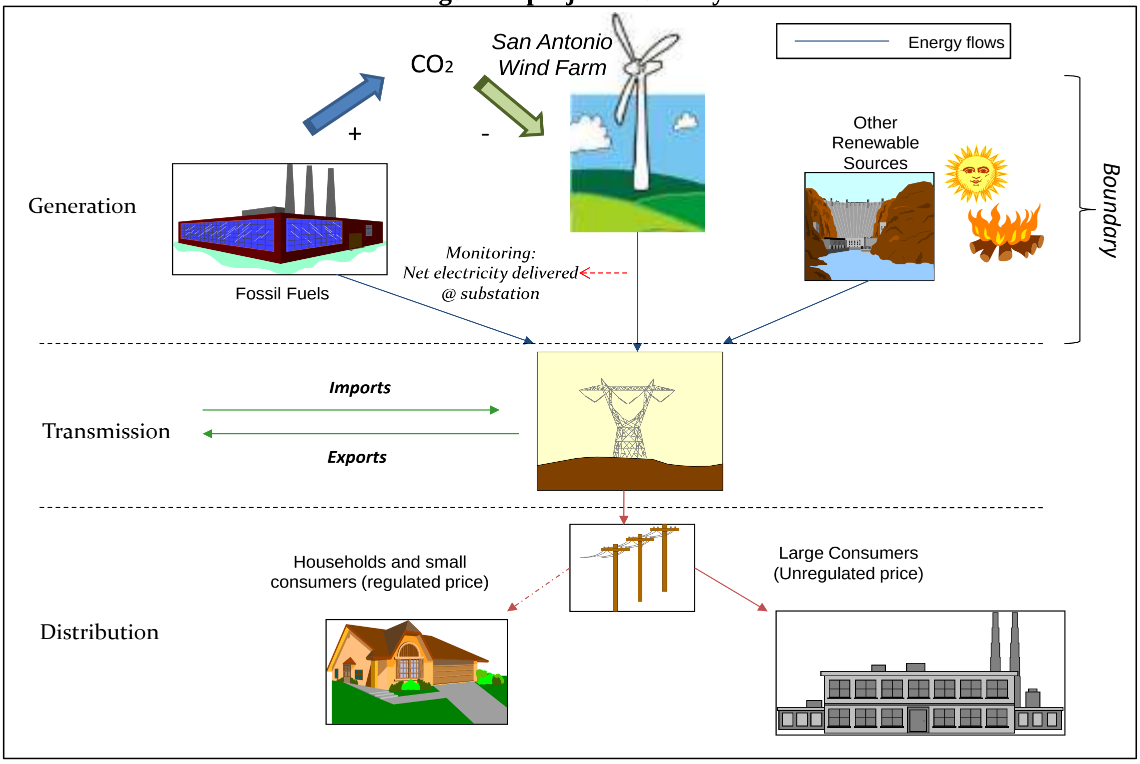
The following table reflects the greenhouse gases and emissions sources considered for baseline and project emissions as per the methodology:

Table 3 - Emissions sources in the project boundary

	Source	GHGs	Included?	Justification/Explanation
Baseline scenario	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
project scenario	No emissions foreseen for wind power projects in ACM0002.	CO_2	No	No CO2 emissions for wind power plants
		CH_4	No	No CH_4 emissions for wind power plants
		N_2O	No	No N_2O emissions for wind power plants

For the proposed project, the spatial extent of the project boundary includes the power plant and all power plants connected physically to the electricity system the proposed project will be connected to, i.e. Guatemala's National Interconnected System (NIS). A diagram of the latter is shown in Figure 2 below.

Figure 2- project boundary



B.4. Establishment and description of baseline scenario

As the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario specified in the methodology 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 (version 02.2.1)*".

In line with the previous definition, the baseline consists of a combination of i) other plants currently in the grid, and ii) new additions to the system. The information provided herein, and set out in section B.6.3, is based upon official statistics published by AMM (Wholesale Market Administrator) on its website[4].

In Guatemala, the National Interconnected System is a clearly defined grid that runs throughout most of the country. According to the latest data available at the time of furnishing this PDD, the grid's overall capacity is 2,454.34 MW (corresponding to January 2011, as published by AMM).

During the 80s and beginnings of the 90s, the electricity sub-sector consisted of a monopolistic market structure type, with vertical integration in the following activities: generation, transmission and distribution of electricity. The Market Agents at the time were: the National Institute of Electrification (INDE), attending especially the electrification of departmental rural areas and the Guatemala Electrical Company (EEGSA) covering the central urban area.

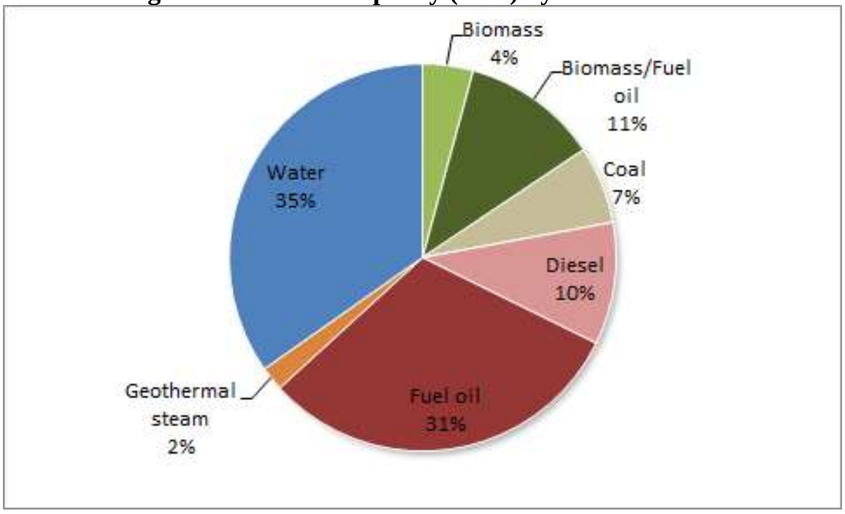
In the 90s, a reform process was initiated to modernize the sub-sector, resulting in the enactment of the General Electricity Law, Decree 93-96 of Congress in November 1996. It established a competitive market model. This modernization process established a new legal and regulatory framework for the electricity industry. This law regulates the activities of generation, transmission, distribution and marketing, and defined as the highest authority and governing body of the energy sector the Ministry of Energy and Mines (MEM). Furthermore, the Act mandates the creation of the regulator, the National Electric Energy Commission (CNEE) as a technical body of the MEM, and states that the Wholesale Market Administrator (AMM) is the administrator of the Market and dispatch.

Since the introduction of these reforms, distribution, generation and transmission are all open to participation by private actors, as well as by state run entities. Transmission and distribution prices, however, are regulated.

In 2010, the overall capacity of the Guatemalan grid was 2,454.34 MW. The composition of the grid (Figure 3) was: 31% fuel oil, 10% diesel and 7% coal; 35% hydro, 15% biomass (most of which also depends on fuel oil) and 2% geothermal. Fossil fuel power plants are the dominant technology in the Guatemalan grid.

[4] All the calculations, graphs and data sources can be found in the baseline spreadsheet submitted with this PDD (a summary of the latter is presented on Annex 3).

Figure 3 - Installed capacity (MW) by source in 2010



B.5. Demonstration of additionality

To demonstrate that the proposed project activity is not a part of the above mentioned baseline scenario (i.e. to demonstrate that the project is additional), the "*Tool for the demonstration and assessment of additionality*" (version 6) will be followed.

Implementation schedule and CDM consideration

The owner group is aware of CDM incentives, as carbon credits have been critical for the development of Amayo Phases 1&2 (Nicaragua). Said wind farms were developed by representatives from Arctas Capital Group and Centrans Energy Services, which are also two of the three project sponsors for the San Antonio project, along with Victoria Corp. the major landowner. Arctas Capital Group also developed the Eolo project in Nicaragua.

Implementation of the project is expected to take place as per Table 4 below. The project participants presented a proposal for the international public bid process PEG-1-2010 summoned by the National Commission of Electric Energy (CNEE) for the provision of a total of 800 MW of Guaranteed Power Capacity for the Guatemalan distribution utilities (namely, Distribuidora de Electricidad de Occidente SA, Distribuidora Eléctrica de Oriente SA and Empresa Eléctrica de Guatemala SA). Only two wind power projects (San Antonio and Viento Blanco) submitted bids, which in case of being awarded will become the first two wind power plants in Guatemala. Both projects are seeking CDM status.

The project start date corresponds to the one on which the project participant commits to expenditures related to the implementation or related to the construction of the project activity[5]. In this case, said milestone is represented by the Engineering, Procurement and Construction (EPC) contract, targeted for September, 2012, in anticipation of the CNEE bid being awarded and the PPA with the distributors being signed.

[5] Glossary of CDM Terms, Version 5, page 28.

Table 4 - Implementation schedule

Milestone	Conclusion expected by
1. CNEE Bid and Execute PPAs	11/2012
2. Environmental Study	01/2012
3. Select Turbine and Sign EPC	09/2012
4. Financial Due Diligence and Closing	12/2012
5. Issue Notice to Proceed	01/2013
6. Civil Works/Foundations	08/2013
7. Turbines Ship, in Transit	07/2013
8. Turbine Erection	10/2013
9. Electrical Substation Construction	09/2013
10. Transmission Line Construction	08/2013
11. Testing and Commissioning	11/2013
12. Commercial Operations Date	11/2013

According to the Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM, notification of prior consideration to the DNA and UNFCCC is "*not necessary if a project design document (PDD) has been published for global stakeholder consultation or a new methodology proposed to the Executive Board for the specific project before the project activity start date*"[6]. As global stakeholder consultation for the San Antonio wind farm is expected to take place before August 2012 (i.e. before the project start date), no notification letters are mandatory for this project. Nonetheless, the project participants issued notification letters to both the DNA and UNFCCC (available upon request).

Additionality

Although provided with an important wind potential, no wind power plants have been commissioned to date in Guatemala[7] and thus the San Antonio project comprises the first effort in this direction.

A project is said to be additional if it can be transparently demonstrated that it would not take place in a hypothetical situation where no carbon credits existed to support clean projects. A project activity of such characteristics is said to be *additional* to the baseline scenario. According to the additionality tool, the following definitions are relevant in the context of first-of-its-kind projects:

[6] EB 62, Annex 13, paragraph 2.

[7] As of December 2011, no wind power plants have been commissioned. See for example: http://www.amm.org.gt/pdfs/2011/generacion/Generacion_2011_WEB.pdf

Table 5 – Definitions relevant for "first-of-its-kind" projects in the additionality tool

Applicable geographical area for the analysis: *the entire host country as a default; if the technology applied in the project is not country specific, then the applicable geographical area should be extended to other countries. project participants may provide justification that the applicable geographical area is smaller than the host country for technologies that vary considerably from location to location depending on local conditions*	The applicable geographical area for the project is the Republic of Guatemala, as legislations governing the energy sector are the same throughout the entire territory of the country and differ when considering different countries.
Measures (for emission reduction activities) *include fuel and feedstock switch, switch of technology with or without change of energy source (including energy efficiency improvement), methane destruction and methane formation avoidance.*	The project involves the introduction of a new energy source into the Guatemalan grid, which is now mainly dominated by power plants that rely on fossil fuels and hydro power to operate.
Relevant outputs: *goods or services with comparable quality, properties, and application areas.*	The relevant output in this case is electricity. Thus, all the electricity generators will be included in the analysis.
Different technologies: *technologies that deliver the same output and differ by at least one of the stipulated aspects (energy source/fuel, feed stock, scale) mentioned in the methodology.*	No power plants of any scale currently use wind resources to generate electricity in Guatemala. The first wind power plants expected to enter the grid are San Antonio (expected commissioning date: November 2013) and Viento Blanco (expected commissioning date: May 2013[8]). Thus, all the currently existing power plants in Guatemala rely on different technologies.

According to the guidelines, a proposed project activity identified as the first-of-its-kind project activity <u>is automatically deemed additional</u>. A proposed project activity is the first-of-its-kind in the applicable geographical area if:

> (a) The project is the first in the applicable geographical area that applies a technology that is different from any other technologies able to deliver the same output and that have started commercial operation in the applicable geographical area before the start date of the project; and
>
> (b) project participants selected a crediting period of a maximum of 10 years with no option of renewal.

The project start date of the San Antonio El Sitio Wind Power project is scheduled for September 2012. As no other wind farm will be commissioned prior to (at least) May 2013, we may conclude that the proposed project fits within the definition of "first of its kind" activity. The project developer chooses a fixed, 10 year crediting period instead of the renewable alternative (3 periods of up to 7 years each).

[8] Viento Blanco PDD (page 2) submitted to validation, available at:
http://cdm.unfccc.int/Projects/Validation/DB/3SAFMM9BB5XGGBYPQJ5WFIUP9YEGPG/view.html

B.6. Emission reductions
B.6.1. Explanation of methodological choices

In general terms, emission reductions are given by:

(1) $$ER_y = BE_y - PE_y - LE_y$$

where:

ER_y = Emission reductions in period y (tCO_2e/yr)
BE_y = Baseline emissions in period y (tCO_2e/yr)
PE_y = project emissions in period y (tCO_2e/yr)
LE_y = Leakage emissions in period y (tCO_2e/yr)

As both project emissions (PE_y) and leakage emissions (LE_y) are zero for wind projects as per ACM0002 version 12.3, baseline emissions (BE_y) will determine the amount of emission reductions (ER_y) attributable to the project activity.

Baseline emissions include only CO_2 emissions from electricity generation from fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

(2) $$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$$

Where:
BE_y = Baseline emissions in period 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 period y (MWh/yr)
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in period y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system (version 02.2.1)" (tCO_2/MWh)

For the specific case of greenfield projects, the methodology uses the notation $EG_{PJ,y} = EG_{facility,y}$, i.e. quantity of net electricity generation supplied by the project plant to the grid in period y.

The combined margin emission factor consists of a weighted average between two emission factors: the "Operating Margin" (which focuses on existing fossil fuelled plants affected by the project) and the "Build Margin" (which aims to capture the project's effect on the incorporation of new plants to the grid).

The relevant Tool to calculate the emission factor for an electricity system (version 02.2.1) applies six steps for the calculation of $EF_{grid,CM,y:}$

Step 1. Identify the relevant electricity systems

For determining the electricity emission factors, 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. As

described earlier in this document, in Guatemala the relevant electric power system for the project is the National Interconnected System[9] (NIS), the only grid in the country.

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

project participants are allowed to choose between the following two options to calculate operating margin and build margin emission factors:

- 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.

As the NIS represents most of the national generation in Guatemala, and considering the fact that the project will be delivering its output to the national grid, only grid connected plants will be included in the calculations (i.e. 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 Guatemala, low cost/must-run resources are comprised solely by renewable energies. The latter constitute more than 50% of the total grid generation, as seen in Table 6 below. Thus, option (b) (Simple adjusted OM) will be used in the context of this project activity.

Table 6 - Low cost/Must-run generation in the 2006-2010 period

Type	2008	2009	2010
Low cost/Must-run	60%	53%	63%
Fossil Fuels	40%	47%	37%
Total	100%	100%	100%

Source: Author's elaboration based on AMM statistics (see baseline spread-sheet attached)

Finally, the data vintage chosen for the estimation of the simple OM is the *ex-ante* option, i.e. the emission factor is determined once at validation stage, which implies that no monitoring and recalculation of the factor during the crediting period will be required; three years of most recent data available will be used in the calculations.

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

The simple adjusted operating margin emission factor ($EF_{grid,OM\text{-}adj,y}$) is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

[9] The original name in Spanish is: "*Sistema Nacional Interconectado*"

(3) $$EF_{grid,OM-adj,y} = (1-\lambda_y)\cdot\frac{\sum_m EG_{m,y}\cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y\cdot\frac{\sum_k EG_{k,y}\cdot EF_{El,k,y}}{\sum_k EG_{k,y}}$$

where:

$EF_{grid,OM-adj,y}$ = Simple adjusted operating margin CO_2 emission factor in year y (tCO_2/MWh)
λ_y = Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year *y*
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year *y* (MWh)
$EG_{k,y}$ = Net quantity of electricity generated and delivered to the grid by power unit k in year *y* (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$EF_{EL,k,y}$ = CO_2 emission factor of power unit k in year y (tCO_2/MWh); = 0 as in Guatemala only renewable energies are considered as low cost/must-run units.
m = All grid power units serving the grid in year *y* except low-cost/must-run power units
k = All low-cost/must run grid power units serving the grid in year *y*
y = The relevant year as per the data vintage chosen in Step 3

As fuel consumption data is unavailable, option A.2 in the "Tool to calculate the emission factor for an electricity system" (version 02.2.1) is followed and thus the emission factor of each plant is determined according to:

(4) $$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y}\cdot 3.6}{\eta_{m,y}}$$

Where:
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$ = Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$ = Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
m = All power units serving the grid in year *y* except low-cost/must-run power units
y = The relevant year as per the data vintage chosen in Step 3

$EF_{EL,k,y}$ is calculated in an analogous way replacing the *m* for the *k* units.

Lastly, the λ_y factor is calculated as follows[10]:

(5) $$\lambda_y = \frac{\textit{number of hours low-cost/must-run sources are on margin in year y}}{\textit{8760 hours per year}}$$

Step (i) Plot a load duration curve. Collect chronological load data (typically in MW) for each hour of the year *y*, and sort the load data from the highest to the lowest MW level. Plot MW against 8760 hours in the year, in descending order.

Step (ii) Collect electricity generation data from each power plant/unit. Calculate the total annual generation (in MWh) from low-cost/must-run power plants/units (i.e. $\Sigma_k EG_{k,y}$).

[10] Load duration curves needed to obtain the Lambda factors are presented on Annex 3.

Step (iii) Fill the load duration curve. Plot a horizontal line across the load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/ must-run power plants/units (i.e. $\Sigma_k EG_{k,y}$).

Step (iv) Determine the "Number of hours for which low-cost/must-run sources are on the margin in year y". First, locate the intersection of the horizontal line plotted in Step (iii) and the load duration curve plotted in Step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero.

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

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor *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. 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. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available.

Option 1 (*ex ante* build margin) is chosen for this project activity.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above[11]:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-}units}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh); according to the latest information available in Guatemala, the last 5 power units to enter the grid were Panan, Los Cerros, Covadonga, Jesbon Maravillas and El Prado. Their overall generation was $AEG_{SET\text{-}5\text{-}units}$ = 5,101 MWh.

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh; in Guatemala, in 2010: AEG_{total} = 7,146,520 MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} ($SET_{\geq 20\%}$ - if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) and determine their annual electricity generation ($AEG_{SET\geq 20\%}$, in MWh); in our data, the set goes from Panan (commissioned in 2010) to the Arizona power plant (commissioned in 2003), with $AEG_{SET\geq 20\%}$ = 1,679,082 MWh.

[11] The calculations presented in this sub-section can be reproduced from the baseline spread sheet attached to the PDD (see the BM sheet).

(c) From $SET_{5\text{-}units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}); thus, according to AMM data, $SET_{sample} = SET_{\geq 20\%}$.

Identify the date when the power units in SET_{sample} started to supply electricity to the grid (shown on Table 7). If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In our case, the eldest unit in the set (Arizona) was commissioned in 2003, which is less than 10 years ago and thus SET_{sample} will be used to calculate the BM.

Table 7 - Determination of the set of plants included in the BM w/o CDM projects

Plant / unit	Starting date	Fuel	Generation 2010 [MWh]	Cumm. respect overall 2010 generation[12]
Panan	2010	Water	34	0.0%
Los Cerros	2010	Water	2,794	0.0%
Covadonga	2010	Water	1,268	0.1%
Jesbon Maravillas	2010	Water	950	0.1%
El Prado	2010	Water	55	0.1%
Oscana	2010	Water	5	0.1%
La Union 2	2009	Biomass	1,784	0.1%
Trinidad	2009	Biomass	38,299	0.6%
Kaplan Chapina	2009	Water	569	0.6%
Cuevamaría	2009	Water	8,703	0.8%
Magdalena 3 (Unit B5)	2008	Biomass	168,448	3.1%
La Libertad	2008	Coal	93,078	4.4%
Arizona Vapor 1	2008	Fuel oil	7,797	4.5%
Gecsa 2	2008	Fuel oil	48,847	5.2%
Coenesa	2008	Fuel oil	136	5.2%
Santa Elena	2008	Water	768	5.2%
El Recreo	2007	Water	140,819	7.2%
Gecsa	2007	Fuel oil	8,906	7.3%
Poza Verde	2005	Water	35,213	7.8%
Palin Ii	2005	Water	0	7.8%
Pantaleon 2	2005	Biomass	39,777	8.4%
Magdalena 2 (Unit B4)	2005	Biomass	99,910	9.8%
Electrocristal Bunker	2005	Fuel oil	25,984	10.1%
Renace	2004	Water	310,536	14.5%
San Diego	2004	Biomass	1,386	14.5%
Darsa	2004	Biomass	0	14.5%
Arizona	2003	Fuel oil	643,014	23.5%
Total			**1,679,082**	**23.5%**

Source: Author's elaboration based on AMM statistics (see baseline spreadsheet attached)

[12] Total grid generation in 2010 (excluding CDM projects) was 7,146,520 MWh.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

(6)
$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh) (as per eq. (4))
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

Step 6. Calculate the combined margin (CM) emissions factor

Once the operating and build margin emission rates are obtained, the *combined margin* (CM) is based in the option (a) "Weighted average CM" and is calculated according to the following expression:

(7)
$$EF_{grid,CM,y} = EF_{grid,OM-adj,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM}$$

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 (%)

w_{OM} and w_{BM} are the weights given respectively to the operating margin emission factor and the build margin emission factor (i.e. $w_{OM} + w_{BM} = 1$). For wind projects, $w_{OM} = 0.75$ and $w_{BM} = 0.25$ are the default values for the first crediting period and are thus used in the context of this project activity.

Emission reductions

The emission factor will remain fixed (i.e. $EF_{grid,CM,y} = EF_{grid,CM}$) throughout the monitoring period assuming the value obtained in section B.6.3 below. Replacing our results back into (1), we arrive to the following expression, which will be used throughout the first crediting period:

(8)
$$ER_y = EG_{facility,y} \cdot EF_{grid,CM}$$

Section B.7.3 indicates the actual procedures used to determine $EG_{facility,y}$ in the specific context of the project's monitoring plan (and in line with the provisions of the methodology).

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/TJ
Description	CO_2 emission factor
Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National Greenhouse Gas Inventories. Available at: http://www.ipccnggip.iges.or.jp/public/2006gl/index.html
Value(s) applied	Fuel Oil: 75.5 tCO_2/TJ Diesel: 72.6 tCO_2/TJ Coal: 0.0946 tCO_2/TJ
Choice of data or Measurement methods and procedures	No other data is publicly available. IPCC guidelines have been used in a conservative manner.
Purpose of data	Estimation of combined margin emission factor.
Additional comment	

Data / Parameter	$EG_{m,y}$
Unit	MWh
Description	Annual electricity generation of each power plant in the grid
Source of data	AMM
Value(s) applied	Data for the 2008-2010 period is shown on **Table 8 (operating margin) and Table 10(build margin).**
Choice of data or Measurement methods and procedures	Data is obtained from official sources (AMM)
Purpose of data	Estimation of combined margin emission factor.
Additional comment	Annual data is available at: http://www.amm.org.gt/ (option “Generación” on the left column) Hourly generation data necessary for the lambda coefficients obtained from: https://oas.amm.org.gt/epronergy/KE/jsp/KE001000.jsp (availability of both websites was consulted on 24/04/2012)

Data / Parameter	$\eta_{m,y}$
Unit	%
Description	Average net energy conversion efficiency of power unit *m* in year *y*
Source of data	"Tool to calculate the emission factor for an electricity system" (Version 2.2.1), Annex 1.
Value(s) applied	(see table below) New units correspond to equipment commissioned after 2000.
Choice of data or Measurement methods and procedures	Default values used as no consumption data was available.
Purpose of data	Estimation of combined margin emission factor.
Additional comment	

Technology		η_i (%)	
		Old units	New Units
Coal	Subcritical ST	37.0%	39.0%
Coal	Supercritical ST		45.0%
Oil	Steam Turbines	37.5%	39.0%
Oil	Open cycle	30.0%	39.5%
Oil	Combined cycle	46.0%	46.0%

New units correspond to equipment commissioned after 2000.

B.6.3. Ex ante calculation of emission reductions

Equation (8) is used to estimate the number of emissions displaced by the proposed project's activity; equations (3) to (7) are used in order to estimate the ex-ante emission factor.

Table 8 below presents a summary of generation by the plants included in the operating margin group, which in the period under consideration (2008-2010) includes all thermal power plants consuming either fuel oil, coal or diesel[13]. The emission factors calculated for each year are then adjusted using the λ coefficients, as indicated in equation (3) and shown in Table 9.

Table 10 presents the list of units that comprise the group of plants included in the build margin emission factor calculation, as per Step 5 of the guidance for estimating the grid's emission factor described in Section B.6.1 above; equation (6) is then applied to obtain the build margin emission factor.

[13] Specific links to information publicly available on the internet are provided on Annex 3. Said annex also includes a summary of the load duration curves calculated to estimate λ_y.

Table 8 - Operating margin emission factor calculation

Thermal Power Plants	Power Generation ($EG_{m,y}$) MWh			Fuel type (i)	EFi (tCO_2/GJ)	η_i	$EF_{EL,m}$ (tCO_2/MWh) (as per equation (4))
	2008	2009	2010				
La libertad	30,932	89,766	93,078	Coal	0.0946	0.3900	0.8732
Arizona vapor 1	10,573	17,443	7,797	Fuel oil	0.0774	0.3900	0.7145
Gecsa 2	1,071	98,942	48,847	Fuel oil	0.0774	0.3950	0.7054
Coenesa	103	191	136	Fuel oil	0.0774	0.3950	0.7054
Gecsa	92,275	35,036	8,906	Fuel oil	0.0774	0.3950	0.7054
Electrocristal bunker	0	30,308	25,984	Fuel oil	0.0774	0.3950	0.7054
Arizona	748,613	1023,810	643,014	Fuel oil	0.0774	0.3950	0.7054
Electrogeneración	21,709	42,998	32,383	Fuel oil	0.0774	0.3950	0.7054
San jose	1016,626	588,717	942,539	Coal	0.0946	0.3700	0.9204
La esperanza (poliwatt)	532,694	704,304	454,749	Fuel oil	0.0774	0.3000	0.9288
Las palmas 1	30,001	73,039	63,995	Fuel oil	0.0774	0.3000	0.9288
Las palmas 2	56,085	75,697	67,843	Fuel oil	0.0774	0.3000	0.9288
Las palmas 3	54,753	69,688	41,134	Fuel oil	0.0774	0.3000	0.9288
Las palmas 4	56,542	78,774	24,723	Fuel oil	0.0774	0.3000	0.9288
Las palmas 5	15,730	28,744	14,286	Fuel oil	0.0774	0.3000	0.9288
Genor	192,341	208,366	215,690	Fuel oil	0.0774	0.3000	0.9288
Textiles b1 (lagotex)	32,920	70,061	23,400	Fuel oil	0.0774	0.3000	0.9288
Textiles b2 (amatex)	48,064	77,504	63,967	Fuel oil	0.0774	0.3000	0.9288
Textiles b3 (amatex)	2,982	19,074	42,800	Fuel oil	0.0774	0.3000	0.9288
Sidegua	41,050	56,265	22,692	Fuel oil	0.0774	0.3000	0.9288
Tampa	11,294	25,990	2,026	Diesel	0.0741	0.3000	0.8892
Stewart & stevenson	1,500	3,111	844	Diesel	0.0741	0.3000	0.8892
Puerto quetzal power	107,481	244,189	40,223	Fuel oil	0.0774	0.3000	0.9288
Generadora progreso	48,496	69,171	27,108	Fuel oil	0.0774	0.3000	0.9288
Esc.gas no.5	789	1,482	155	Diesel	0.0741	0.3000	0.8892
Laguna gas 2	1,047	992	226	Diesel	0.0741	0.3000	0.8892
Laguna gas 1	636	419	162	Diesel	0.0741	0.3000	0.8892
Esc.gas no.3	0	1,888	120	Diesel	0.0741	0.3000	0.8892
Imports	875	32,405	354,062	-	**0**	-	**0**
Total Thermal	**3,157,182**	**3,768,374**	**3,262,892**	-	-	-	-

Source: Author's elaboration based on AMM statistics (see baseline spread sheet attached)

Table 9 – Generation weighted average, adjusted OM emission factor

Year (y)	Unadjusted (tCO2/MWh) $\frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$	λ_y	Adjusted (tCO2/MWh) $EF_{grid,OM\text{-}adj,y}$ as per eq. (3)	Generation (MWh) $\sum_m EG_{m,y}$
2008	0.8633	0.0217	0.8445	3,157,182
2009	0.8438	0.0011	0.8429	3,768,374
2010	0.7715	0.0110	0.7630	3,262,892
Generation weighted average: $EF_{grid,OM-adj,2008\text{-}2010}$			**0.8178**	

Source: Author's elaboration based on AMM statistics (see baseline spread-sheet attached)

Table 10 - Build margin emission factor calculation

Company (*m* units included in the BM)	**Generation 2010 [MWh]**	**Cumm. respect overall 2010 generation(*)**	**Fossil Fuel type (*i*)**	**Emissions (tCO_2)**		
	($EG_{m,2010}$)			**$EF_{EL,m}$ (tCO_2/MWh)**	**10^3 tCO_2 (2010)**	**tCO_2/MWh (2010)**
Panan	34	0.0%	Water	-	-	-
Los cerros	2,794	0.0%	Water	-	-	-
Covadonga	1,268	0.1%	Water	-	-	-
Jesbon maravillas	950	0.1%	Water	-	-	-
El prado	55	0.1%	Water	-	-	-
Oscana	5	0.1%	Water	-	-	-
La union 2	1,784	0.1%	Biomass	-	-	-
Trinidad	38,299	0.6%	Biomass	-	-	-
Kaplan chapina	569	0.6%	Water	-	-	-
Cuevamaría	8,703	0.8%	Water	-	-	-
Magdalena 3 (unit b5)	168,448	3.1%	Biomass	-	-	-
La libertad	93,078	4.4%	Coal	0.8732	81,279	0.0484
Arizona vapor 1	7,797	4.5%	Fuel oil	0.7145	5,571	0.0033
Gecsa 2	48,847	5.2%	Fuel oil	0.7054	34,458	0.0205
Coenesa	136	5.2%	Fuel oil	0.7054	96	0.0001
Santa elena	768	5.2%	Water	-	-	-
El recreo	140,819	7.2%	Water	-	-	-
Gecsa	8,906	7.3%	Fuel oil	0.7054	6,283	0.0037
Poza verde	35,213	7.8%	Water	-	-	-
Palin ii	-	7.8%	Water	-	-	-
Pantaleon 2	39,777	8.4%	Biomass	-	-	-
Magdalena 2 (unit b4)	99,910	9.8%	Biomass	-	-	-
Electrocristal bunker	25,984	10.1%	Fuel oil	0.7054	18,329	0.0109
Renace	310,536	14.5%	Water	-	-	-
San diego	1,386	14.5%	Biomass	-	-	-
Darsa	-	14.5%	Biomass	-	-	-
Arizona	643,014	23.5%	Fuel oil	0.7054	453,593	0.2701
Total	**1,679,082**	**23.5%**		***$EF_{grid,BM,2010}$ (eq. (6))***	**599,609**	**0.3571**

Source: Author's elaboration based on AMM statistics (see baseline spread-sheet attached)

The default weights for wind projects are used to obtain the combined margin emission factor according to equation (7):

Table 11 - Combined margin emission factor

EFgrid,OM-adj,2008-2010	0.8178
ω_{OM}	0.75
EFgrid,BM,2010	0.3571
ω_{BM}	0.25
$EF_{grid,CM}$	**0.7026**

Source: Author's calculation

The calculations show $EF_{grid,CM}$ = 0.7026 tCO_2/MWh. This is the ex-ante grid emission factor that will be used throughout the first crediting period (i.e. this value will not be recalculated in every monitoring period).

For the purpose of this *ex-ante* estimation of emission reductions, $EG_{facility,ex-ante}$ = 122,382 MWh, which is the expected annual generation allowed by the project. Thus, according to equation (8) our annual emission reduction estimate is given by $ER_{ex-ante}$ = 122,382 MWh * 0.7026 tCO_2/MWh = 85,986 tCO_2 per year (after rounding down).

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

Table 12 - Summary of expected emission reductions

Year	Baseline emissions (t CO_2e)	project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
29/09/2013-28/09/2014	85,986	0	0	85,986
29/09/2014 -28/09/2015	85,986	0	0	85,986
29/09/2015 - 28/08/2016	85,986	0	0	85,986
29/09/2016 - 28/08/2017	85,986	0	0	85,986
29/09/2017 - 28/08/2018	85,986	0	0	85,986
29/09/2018 - 28/08/2019	85,986	0	0	85,986
29/09/2019 - 28/08/2020	85,986	0	0	85,986
29/09/2020 - 28/08/2021	85,986	0	0	85,986
29/09/2021 - 28/08/2022	85,986	0	0	85,986
29/09/2022 - 28/08/2023	85,986	0	0	85,986
Total	859,860	0	0	859,860
Total number of crediting years	10			
Annual average over the crediting period	85,986	0	0	85,986

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{facility,y}$
Unit	MWh in period *y*
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in period *y*
Source of data	On-site metering system
Value(s) applied	122,382 MWh/year
Measurement methods and procedures	Data will be continuously metered; generation data will be aggregated monthly for billing purposes. Electricity consumption from the grid (for start-up or auxiliary purposes) will be deducted from gross exports to the latter in order to obtain *net* electricity supplied to the NIS.
Monitoring frequency	
QA/QC procedures	Meters have an accuracy rating of +/- 0.2% and will be calibrated periodically as by entities authorized by the CNEE. Data can be cross-checked with the receipts of sales.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be archived by means of electronic and paper backup for the full crediting period, plus two year years after the end of the crediting period or the last issuance of CERs, whichever occurs later.

B.7.2. Sampling plan

No sampling will take place in the context of this monitoring plan.

B.7.3. Other elements of monitoring plan

Determination of net electricity delivered to the grid ($EG_{facility,y}$)

The San Antonio El Sitio Wind Power project will deliver its output to a dedicated collection substation that is connected through a main 34,5/230 kV transformer and a 230 kV. The bi-directional meters required for determining the plant's net generation will be installed. Figure 4 shows a metering scheme: electricity is determined at the 230 kV substation Meters (both for energy delivered to and consumed from the Grid).

The parameter $EG_{facility,y}$ will be determined according to:

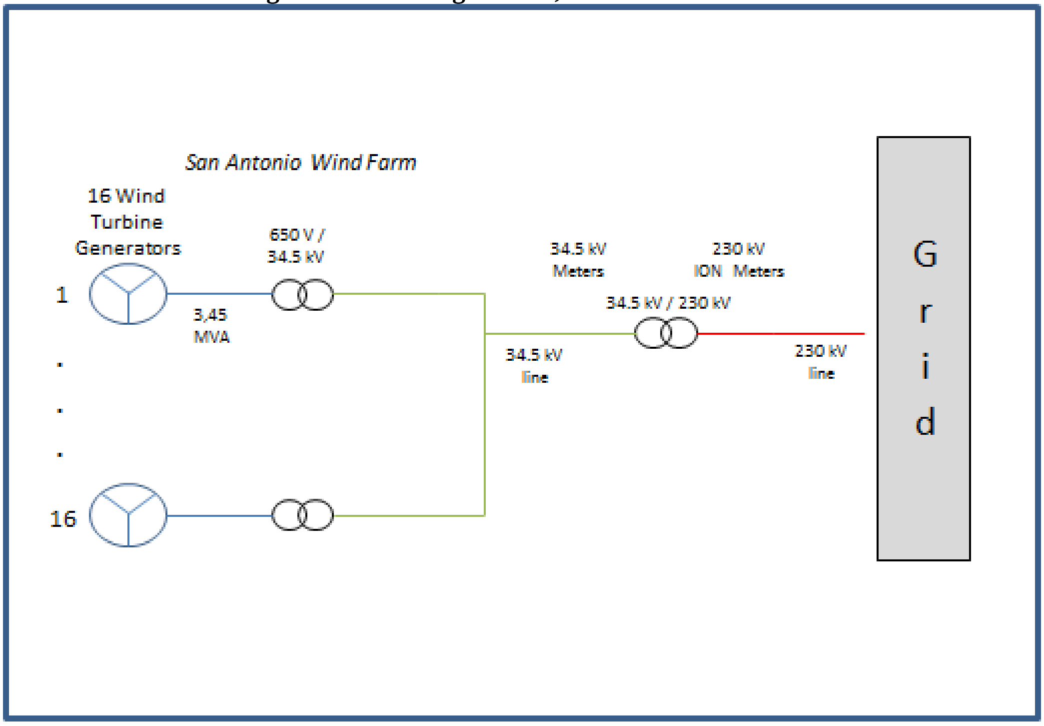
(9) $$EG_{facility,y} = EG_{230kV,y} - EC_{230kV,y}$$

where:

$EG_{230kV,y}$ = Gross electricity delivered to the grid (as measured by the 230 kV meter) in period *y*.

$EC_{230kV,y}$ = Electricity consumption from the grid (as measured by the 230 kV meter) in period *y*.

Figure 4 - Metering scheme, dedicated substation



Emergency procedures
Although main and backup meters will be installed in the substation, onsite meters at the 34.5 kV side (of at least +/- 0.5 accuracy level) are available in case both 230 kV meters at the substation are out. In this case, historical records will be used to account for transmission losses of the transmission line. The average difference between the readings from the 34.5 kV and the 230 kV meters of the last 3 months will be deducted from the readings obtained from the 34.5 kV meters. Notice, however, that due to the proximity of both set of meters, it is likely that said difference will be negligible.

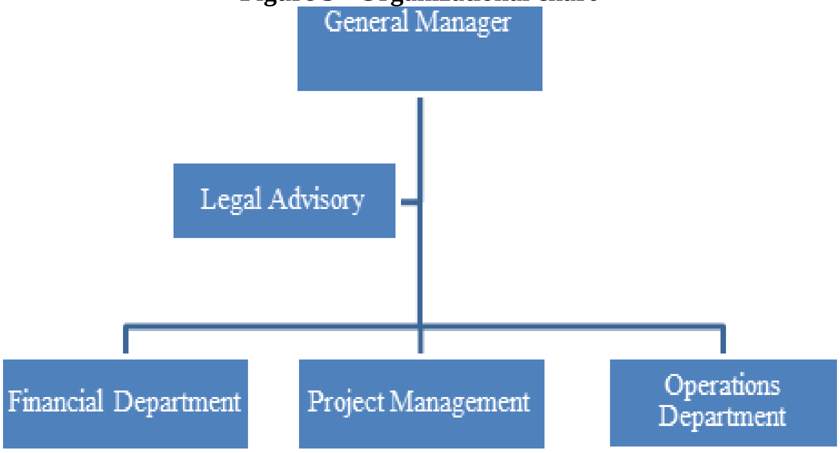
As the 230 kV meters are the official ones used for billing purposes, any events affecting the latter should be reflected in audit reports prepared by the grid operator (*Administrador del Mercado Mayorista, AMM*). If a different method for determining net electricity is used in these audit reports, the most conservative values will be chosen.

CDM management
Since the project Participants have chosen to use *ex-ante* emission factors, there is no need to recalculate each of the latter during the crediting period. Thus, the main variable that requires monitoring is the net amount of electricity that the project delivers to the grid, that is, the amount exported by the project after deducting any electricity imports from the grid that the project uses for auxiliary consumption or plant start-up.

The project Participants will implement a management structure where monitoring responsibilities will be explicitly defined. The Plant Manager will be responsible for ERs monitoring, record keeping and the implementation of proper QA procedures. All the information from this department will be consistent and easily verifiable with all the relevant data from other departments in case an external audit should require it.

All O&M procedures will be adapted to include the carbon monitoring component and the adequate accounting of the emission reductions.The organizational chart is provided below:

Figure 5 - Organizational chart



The Operations Department (which reports directly to the General Manager) will have a person in charge of the carbon credits monitoring according to the following responsibilities matrix:

Table 13 - Responsibilities matrix

	Plant Manager	Environmental Coordinator	Operations Manager	GME – CDM coordinator
Collect data				
Power delivered to grid	R	E		I
Ensure calibrations and data quality	R	I	E	I
Process data				
Input of raw data in spreadsheet		R	E	
Cross check data and correct		R	E	
Calculate emission reductions		R	E	I
Quality check calculated emission reductions	R/E	I	R/E	I
Reporting and archiving				
Report data gaps and errors	I	R	E	I
Report emission reductions to date	R/E	I	R/E	I
Archiving of procedures and certificates		R	E	
Archiving of data	R	E	E	I

E = Execute; R = Responsible; I = To be informed

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

27/09/2012 is the project start date. According to Version 05 of the Glossary of CDM Terms, "*the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity*[14]". In the context of the proposed project this date corresponds to the date when the EPC/Wind Turbine supply agreement with Vestas is signed. Said date is expected to take place on 27/09/2012.

C.1.2. Expected operational lifetime of project activity

The equipment has an expected lifetime of 20 years according to Vestas.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Fixed crediting period

C.2.2. Start date of crediting period

29/09/2013 or registration date (whichever is later).

C.2.3. Length of crediting period

10 (ten) years, 0 (cero) months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

An Environmental Impact Assessment was conducted in accordance with Law of Protection and Improvement of the Environment (Government Agreement No. 68-86) and Assessment, Environmental Monitoring and Control Regulation (Government Agreement No. 431-2007) and its amendments, on the basis of the content recommended in the Guide Terms of Reference for the Development of Studies for Environmental Impact Assessment from the Ministry of Environment and Natural Resources.

The preparation, submission and approval of the Environmental Impact Assessment (EIA) complied with the provisions of Article-8 of the Law on Protection and Improvement of the Environment, (amended by Congressional Decree No. 1-93). For all projects, industry or any other activity which by its nature can cause deterioration to renewable natural resources or the environment, or introduce harmful or noticeable changes to the landscape and cultural resources of the national heritage, it will be necessary to conduct a study of environmental impact assessment conducted by experts in the field and approved by the commission of the Environment prior to development.

The following is the list of the areas covered in the study with a brief summary of the environmental action plan that will be implemented throughout the different stages of the proposed project to mitigate the latter´s negative impacts:

- **Landscape:** a proper selection of the paint colour to be applied on the wind turbines will be done to reduce the effects caused by incident sunlight on the wind turbines (such as brightness and the flicker that influence or attract the eye of the observer), and to minimize visual intrusion of the turbines with the natural environment.

[14] Glossary of CDM Terms, Version 5, page 28

- **Earthquakes:** the project is located in an area of seismic intensity IV; therefore, the project should consider designing the plant and building it taking into account the seismic conditions of the area.

- **Soil:** to reduce the impact on the Land Morphology of the project, existing access roads shall be used. Also, for the preparation of the main and secondary paths, the embankments are to be filled with material cut from other zones, so that the digging and filling volumes are offset to the extent possible. In addition, to mitigate the erosion of the rock the construction activities will avoid as much as possible coinciding with periods of heavy rainfall, and slopes, embankments and bare surfaces will be replanted with vegetation.

  The following measures will be taken to avoid possible soil contamination from spills of fuels and lubricants used in heavy machinery of construction work: the transportation of daily storage tanks of hydrocarbons will be carried out preferably in tank trucks; the containers of fuels and lubricants will have clear signs indicating its contents and precautions; metal trays will be used for inevitable spills or leaks during the transfer operation, and if in the removal of the oil tank from its base it is found that the soil is contaminated with oil, then the contaminated soil (hazardous waste) must be removed and taken to a landfill for safe disposal.

- **Water drainage:** for the runoff effect, the structures and access roads must be located in the higher areas and preferably at watersheds. In addition, in areas where access roads and facilities are to be built and prevent the natural evacuation of rain water, a drainage system must be implemented and maintained.

  Also, runoff water can drag inert material from soil erosion by construction works, introducing turbidity to the water, once this material is placed in the plane of the dry forest it will affect the soil´s quality used as support for trees and shrubs. To reduce or prevent this effect, channelling works of runoff and retention of fine materials must be provided, which will be separated, removed and deposited in areas that won´t affect the quality of the soil.

- **Air**: Water will be poured on the dirt roads surrounding the project area so as to prevent the suspension of dust particles in the air.

- **Noise:** to prevent the influence of noisy construction activities they will be limited to a schedule, also the machines and tools to be used must have low emission of noise, besides being in good maintenance conditions.

- **Flora:** to avoid impacts on the flora of the area during the preparation of the ground for the access roads and other facilities, the measure to be implemented is to transfer plants not affected to other areas, especially young species. In the case of the other species that are unable to be transferred, it will be necessary to perform a reforestation in another area with twice the amount of species of trees and shrubs cleared in order to preserve the landscape of the project area.

- **Bird and Land fauna:** to mitigate possible effects on the terrestrial fauna, an attempt of clearing a radius of up to about 300 meters of the site from the presence of animals will be done. Furthermore, noise bursts might produce fright or fear reactions in birds during construction. It is most likely the birds will go away for a while, but then return to their usual places.

The aforementioned assessment determines that the San Antonio El Sitio Wind Power project is environmentally viable. The negative impacts are temporary and reversible. The main activities with potential affects to the environment include site preparation and access roads, civil works and operation of tools and machines. Therefore these impacts can be mitigated with the application of the Environmental Management Plan. The corrective actions are aimed at reforestation and infrastructure

integration with the landscape and the reduction of noise emissions. On the other hand there is a positive impact as to job creation due to the hiring of equipment, personnel and services.

D.2. Environmental impact assessment

The aforementioned assessment determines that the San Antonio El Sitio Wind Power project is environmentally viable. The negative impacts are temporary and reversible. The main activities with potential affects to the environment include site preparation and access roads, civil works and operation of tools and machines. Therefore these impacts can be mitigated with the application of the Environmental Management Plan. The corrective actions are aimed at reforestation and infrastructure integration with the landscape and the reduction of noise emissions. On the other hand there is a positive impact as to job creation due to the hiring of equipment, personnel and services.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

The stakeholder consultation of the project activity has been conducted in two distinct ways including: a formal survey of opinions in surrounding communities and a public meeting that took place on April 18th, 2012.

The objectives of both consultations were: (a) to inform the local stakeholders of the project activity and its characteristics as a CDM project; (b) to present the socio-economical benefits of the project for the country and the municipality of Villa Canales; and (c) to gain insights on local concerns and opinions regarding the project activity.

Activities in preparation for the events are described below:

- **Formal survey**

For the execution of the formal survey it was necessary to calculate the size of the sample given the characteristics of the population: random, finite and having a list of the entire target population (based on the 2002 census of the INE) this was done by selecting a sampling method: "Simple Random Sampling Design". This method indicated that 88 surveys were required, divided equally in the following four communities: Santa Elena Barillas, Los Positos, Los Llanos and Los Dolores.

However, the project participants increased the number of surveys in each of the four communities: Santa Elena Barillas (25), Los Positos (27), Los Llanos (22) and Los Dolores (25), for total of 99 surveys.

- **Public meeting**

A preliminary research and selection for invitees was carried out by Eólico San Antonio El Sitio, S.A. The selected stakeholders were: the local government, NGO´s, and neighbours from the project's surroundings (which consist of landowners and workers from the farms). After selection of the organizations and people, Eólico San Antonio El Sitio delivered personalized invitations on site.

Also Eólico San Antonio El Sitio emailed personalized invitation cards to several institutions of the national government in the capitol of Guatemala City.

Moreover, Eólico San Antonio El Sitio announced the stakeholder presentation in one of the newspaper in Guatemala "Siglo 21" on April 14th, 2012.[15]

[15] A respective copy of the announcement can be presented upon request.

More than 38 participants attended the stakeholder consultation representing a total of approximately 4 organizations and institutions, located around the project site and some others around the country[16].

Phases of the stakeholder presentation:

At the entrance of the conference room the registration process was conducted and a paper form was handed out in which the attendees could write their questions and/or comments related to the project.

The public consultation started with a Power Point presentation that explained the project's features regarding its objectives, location, technology, operations, benefits of the project, mitigation measures and Clean Development Mechanism aspects. Hence during the consultancy, the project participants described the project activity in a clear and complete manner[17], which allowed the local stakeholders to understand the project activity.

After the presentation a period of time was given to all participants to submit their questions in written form to the project developer and give comments. Each question received satisfactory and comprehensive answers by the project developer. A video of the entire stakeholder presentation is available and can be submitted upon request. A complete summary of the questions and comments can be found in section E.2.

Once the consultation was held, a coffee break was enjoyed by all participants.

Location of the stakeholder consultation

Attendee registration process

Explanation of the project

Attendees

[16] A list of the participants can be presented upon request.
[17] The consultation and its presentations were in Spanish (Guatemala´s official language)

E.2. Summary of comments received

At the end of both consultations, the comments and questions by the stakeholders were compiled and shared by the project Participants. The main topics brought up are summarized below:

- **Formal survey**

Approximately 85% of the respondents thought that a project which used wind to produce energy was good, and 89% agreed with the development of the San Antonio Wind Power project. This demonstrates that the majority of the people have a positive opinion regarding the project. In addition 81% of the polled considered that the project wouldn´t cause discomfort to the communities.

Main concerns were related to the pollution that the project could produce to the communities, and that this should be avoided. The activities due to the project should be done with precaution to avoid harming the environment.

The participants asked for benefits that the project could give to the communities related to employment taking into account local labour, improvements to road infrastructure, among others such as expectation that the cost of electricity will decrease.

Another concern from stakeholders is that the presence of the project could cause traffic in the city or communities. Some participants requested that the municipality be notified about the activities to be executed.

- **Public meeting**

Main questions during the public meeting were regarding the Environmental Impact Assessment and its impact related to noise, landscape, road access, infrastructure improvements, and accidents; beginning date of the construction and its construction period; and employment opportunities for locals. Other questions /comments included:

- These kinds of projects in developed countries are very profitable; will the project have the same profitability as other projects in those countries?

- What is the monthly average wind speed in the region? Is it constant during the year?

- What does Technology Transfer mean in relation to wind farms? Does the project cause thunderstorms?

- Will the electricity produced join the one we actually have? Will the transmission lines installed be affected by the new project?

- Will this project be part of the monopoly in energy generation of Guatemala?

- Which is the land area considered for the project? Does it include neighbours' properties? Have you contacted civil aviation because of the height of the turbines?

- Have the project developers considered an expansion of the capacity. Will the introduction of the project be in combination with other projects? How much is the potential capacity for wind energy in Guatemala?

- Will there be an office for consults and comments related to the project?

Main comments were congratulating the project developers. They have a good perspective related to the project as in emission reductions and employment opportunities. The Ministry of Energy and Mines supports the development of these projects given that they contribute to the transformation of the energy matrix.

E.3. Report on consideration of comments received

Eólico San Antonio El Sitio clarified all stakeholders' concerns by providing relevant data and answered all questions to the satisfaction of the participants. Detailed minutes of the meeting delineating the above questions and Eólico San Antonio El Sitio´s responses have been recorded and written down. These are available upon request.

Eólico San Antonio El Sitio also informed the stakeholders that the project activity would contribute to the sustainable development of the region and country by facilitating and catalysing local and regional opportunities, thereby creating sustainable economic, social and environmental value.

On the other hand, as no major environmental concerns were raised during the entire stakeholder consultation processes, which were not already addressed by the Environmental Impact Assessment, it was not necessary to make any changes to the project design or incorporate any additional measures to limit or avoid negative environmental impacts. The same applies to socio-economic concerns.

The proponents will also address the concerns related to employment. They will have an office when the project is executed to attend and answer any questions or comments from the community.

It is evident from the stakeholder consultation process, that the project is perceived as a positive example for the renewable energy sector in Guatemala and that it contributes to sustainable development of the region.

Finally, it's important to emphasize that residents and the local government are all very supportive of the proposed project activity.

SECTION F. Approval and authorization

The letter of approval is pending at the time of submitting this PDD to the DOE for validation.

Appendix 1: Contact information of project participants

Organization name	Eólico San Antonio El Sitio, S.A.
Street/P.O. Box	Ruta 3, 2-16 Zona 4
Building	Edificio Altamira # 500
City	Cuidad de Guatemala
State/Region	Guatemala
Postcode	
Country	Guatemala, C.A.
Telephone	(502) 2205-4545
Fax	(502) 2334-7950
E-mail	jorgesini@grupoenerg.com
Website	
Contact person	Jorge Eduardo Sinibaldi Radi
Title	Legal Representative
Salutation	Mr.
Last name	Sinibaldi
Middle name	Eduardo
First name	Jorge
Department	
Mobile	(502) 5511-5915
Direct fax	(502) 2334-7950
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Personal e-mail	jorgesini@grupoenerg.com

Appendix 2: Affirmation regarding public funding

Appendix 3: Applicability of selected methodology

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

1. Determination of lambda coefficients

Figure 6 - Lambda 2008

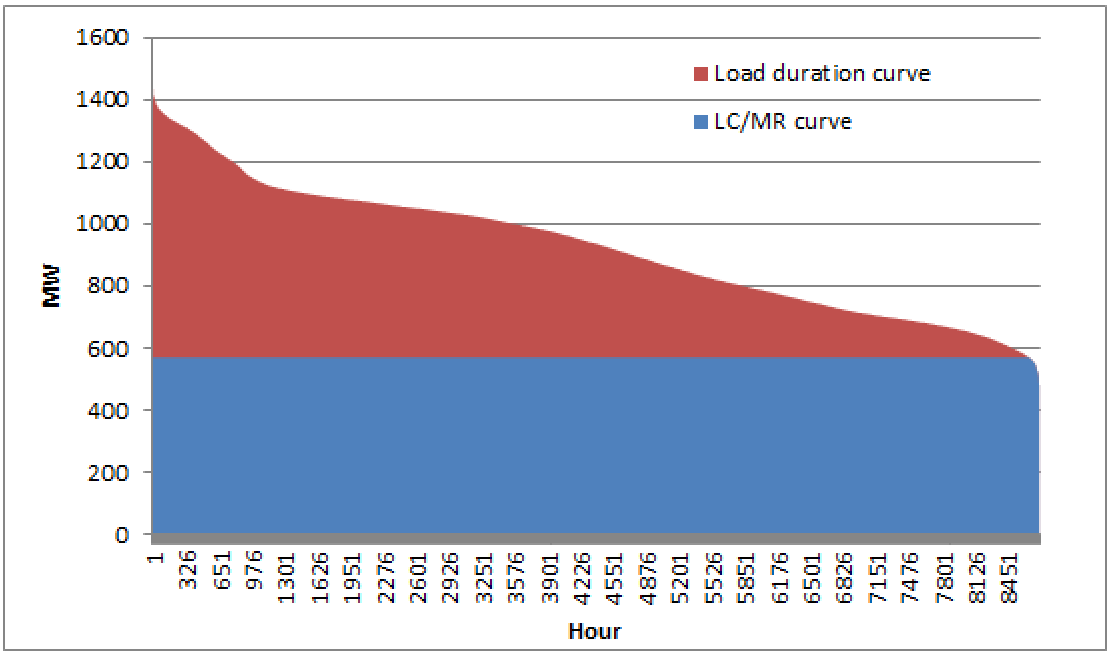

Table 14 - Lambda 2008

x	191
Hours / Year	8784
λ	0.0217
1- λ	0.9783

Figure 7 - Lambda 2009

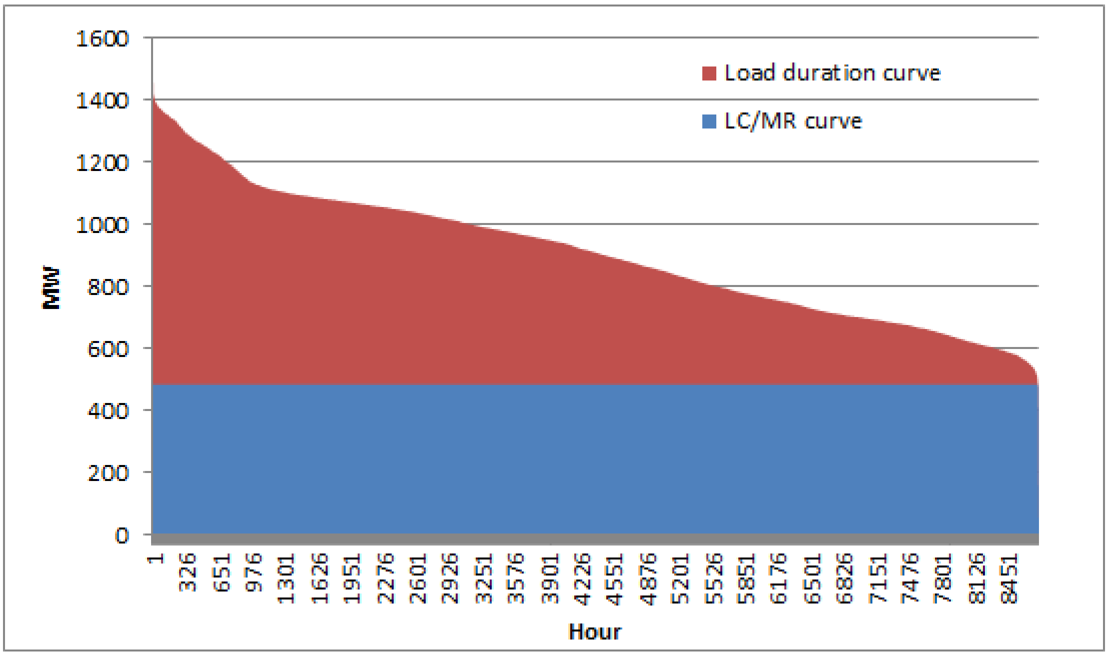

Table 15 - Lambda 2009

x	10
Hours / Year	8760
λ	0.0011
1- λ	0.9989

Figure 8 - - Lambda 2010

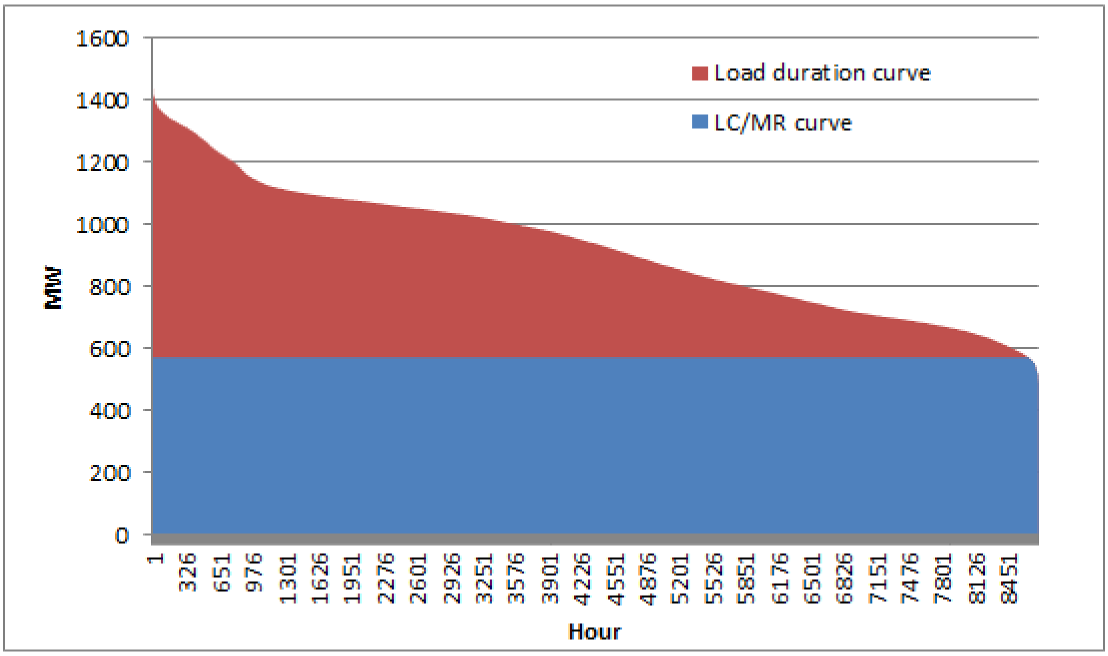

Table 16 - Lambda 2010

x	96
Hours / Year	8760
λ	0.0110
1- λ	0.9890

Appendix 5: Further background information on monitoring plan

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Appendix 6: Summary of post registration changes

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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.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		