CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Orosí Wind Power Project
Version 3
Date: 14/06/2012

A.2. Description of the project activity:

The Orosí Wind Power Project (the "Project") consists of installing twenty-five 2 megawatt ("MW") Gamesa series G80 (also known as G8X) wind turbine generators (WTG), for a total capacity of 50 MW. Orosí is expected to provide 216.4 GWh per year to the *Instituto Costarricense de Electricidad* ("Costa Rican Electricity Institute" or "ICE"), which is the national grid's authority in Costa Rica.

The Project will be located in Costa Rica, in the community of Quebrada Grande, Municipality of Liberia, in Guanacaste Province. In an area considered appropriate for wind energy generation. The Project is a Greenfield development, on dairy pasture land in an area where no other electricity generating plant has been previously sited. The Project will contain the basic elements of a wind farm: wind turbines, wind measuring stations, an operations building and an electrical substation. A SCADA control system will be used to supervise, monitor and control all relevant Project components. The Project´s substation will be connected to the existing Pailas Substation (property of ICE) to allow a connection to the National Grid.

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 Orosí Project will have no greenhouse gases or other harmful emissions during its operation, and will displace carbon dioxide emissions from electricity generation derived from fossil fuelled power plants.

The Costa Rican grid (namely, the National Electric System or "NES" consists mainly of hydro power plants. In recent years there has been an increased contribution into the NES from fossil fuelled generation sources as the supply of energy has attempted to keep pace with the increase in demand. In 2010, the composition of the grid was: 30.3% fossil fuel (bunker and diesel) and the remaining 69.8% being derived from various renewable energy sources: 58.6% hydro, 1.4% biomass, 6.3% geothermal and 3.5% wind[1]. Therefore in the absence of the project activity the electricity that will be 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 Section B.6. This is the baseline scenario corresponding to this project activity.

The NES has an estimated emission factor of 0.3528 tCO_2e per megawatt hour, which implies that the Project will displace more than 76,000 tonnes of carbon dioxide per year. This will occur since the wind energy generated by the Project will displace generation required from more carbon intensive plants.

The Orosí Wind Power Project is an initiative of Inversiones Eólicas de Orosí Dos, S.A. (IEDO), a Costa Rica legal entity and a subsidiary of Globeleq Mesoamerica Energy, S.A. (GME).

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[1] Source: ARESEP Statistics

Contribution to sustainable development

The Project will produce significant benefits to Costa Rica. These include:

- Increase in power supply in the country: The Project will have an installed capacity of 50 megawatts, which will increase the supply of electricity and contribute to satisfy the country's growing demand for electricity.

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

- 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.

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

- 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.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Costa Rica (Host Party)	Inversiones Eólicas de Orosí Dos, S.A. (IEDO) (Private Entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

The project is located in the community of Quebrada Grande, Municipality of Liberia, in the Guanacaste Province, approximately 110 km north of San Jose.

A.4.1.1. Host Party(ies):

Costa Rica

A.4.1.2. Region/State/Province etc.:

Guanacaste

A.4.1.3. City/Town/Community etc.:

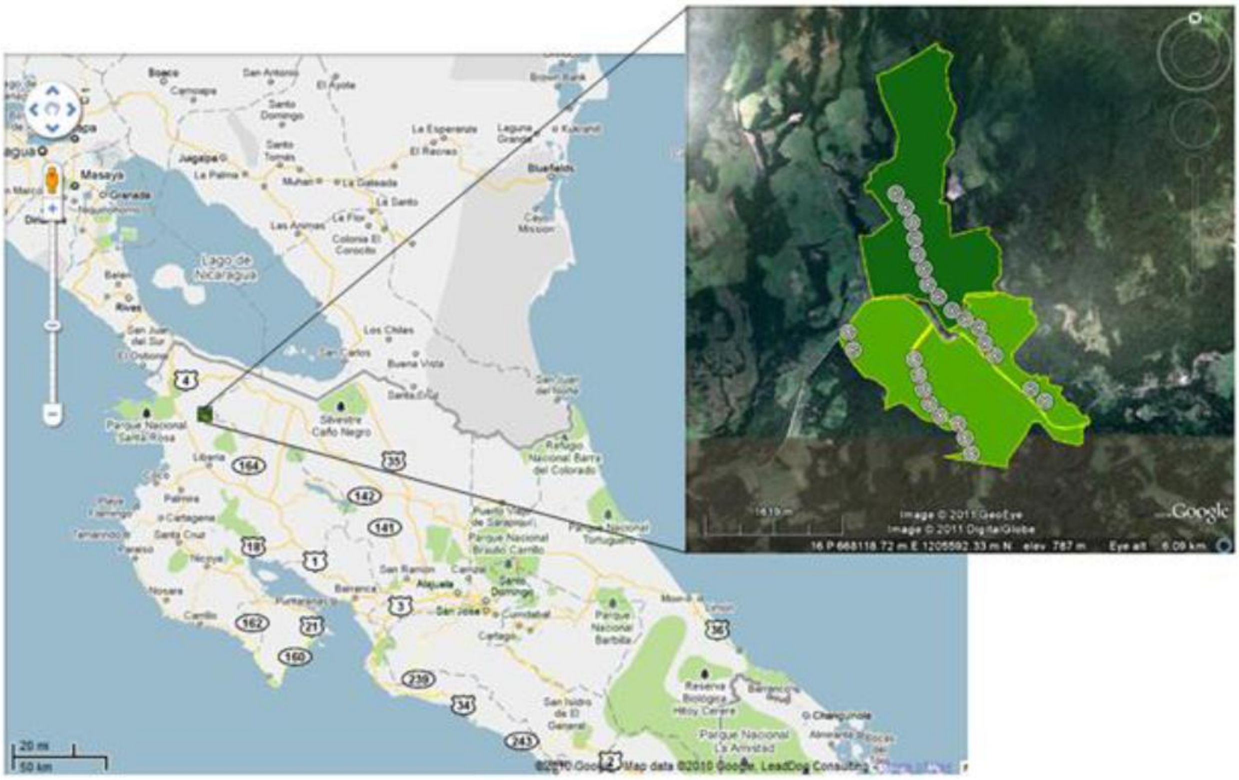
Community of Quebrada Grande, Municipality of Liberia

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The Project is located on the Los Angeles and La Frescura farms, in the community of Quebrada Grande. The geographic coordinates of the proposed location of the Project are 10º52´23.26” N, 85º26´53.88” W, DATUM WGS84.

Its geographical location makes the Project suitable for wind energy generation, as its located in the natural wind canyon created by the Orosí volcano and the volcano Rincon de la Vieja. Because of this wind canyon effect, winds from the Caribbean slope accelerate and make this an attractive location for wind generation.

Figure 1 - Project Location



Site access is via the North Interamerican highway, taking the road to Quebrada Grande at the junction known as Potrerillos. The access to the site is mostly on paved roads, except the last 2 miles are a busy dirt road all year.

A.4.2. Category(ies) of project activity:

The Orosí Wind Power Project falls into:

Scope number: 1

Sectoral Scope: Energy Industries - Renewable Sources

A.4.3. Technology to be employed by the project activity:

The Project involves installing a wind farm with twenty-five 2MW Gamesa G8X wind turbine generators to produce energy and supply it to the NES. This technology produces electricity without emitting greenhouse gases, with emissions from wind projects defined as zero according to the methodology used ACM0002 (version 12.3)[2], and with a low direct impact on the environment. Therefore it is considered an environmentally safe and sound technology.

[2] Section B.3 of this document

The Project will result in significant technology transfer in terms of its construction and operation. As this type of renewable energy projects is not common in the country, 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 Project will be located in an area mainly dedicated to dairy farming; the tracts of land used to host turbine towers being pasture.

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)"

The overall capacity of the Costa Rican grid (NES) in 2010 was 2,614 MW. The composition of the grid was: 58.6% hydro, 30.3% fossil fuel, 6.3% geothermal, 1.4% biomass and 3.5% wind. Hydro power plants are the dominant technology in the Costa Rican grid[3]. However, in recent years, the share of fossil fuelled generation increased to allow the supply of energy to grow at pace with the demand.

Activities to be implemented by the project

The functional layout of the Orosí 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 the interconnection to an existing electrical substation ("Las Pailas").

After collecting wind data for 3 years, an assessment of the resource was conducted by GL Garrad Hassan upon which the two host farms were identified for the installation of a wind project. The equipment primarily used for wind mapping was from NRG Symphonie with speed sensors calibrated and measurement towers and installation that meet international standards.

The long-term average speed of the wind calculated across all the towers in the park is estimated to be in the order of 10.4 meters per second.

The Wind Turbine Generator ("WTG") chosen for the Project activity is the Gamesa G80, which is 78 meters high. This generator has a generating capacity of 2 MW and 25 units will be installed, to provide a total capacity of 50 megawatt. The Project will have a net energy production of 216.4 GWh per year.

Gamesa is one of the world leaders in the market for design, manufacture, installation and maintenance of wind turbines, with about 23,000 MW installed in 30 countries and nearly 15,000 MW in maintenance. In

[3] Source: ARESEP Statistics

addition, Gamesa is also a world leader in the development, construction and sale of wind farms, having installed over 4,100 MW and having a portfolio of 24,500 MW in Europe, America and Asia.[4]

A SCADA control system will supervise, monitor and control all equipment in the wind farm (i.e. WTGs, meteorological masts, and electrical substation, among others) via a PLC (Programmable Logic Controller). 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.

Germanischer Lloyd, a renowned international independent engineering firm, has certified the system design, the Implementation of the requirements in Production and Erection (IPE), the prototype testing and the manufacturer´s quality system. Germanischer Lloyd attested compliance concerning the design in respect to the following:

- Load Assumptions according to IEC 61400-1, Class IIA
- Safety System and Manuals 50/60 Hz.
- Rotor Blade Gamesa Eólica 39.0 m
- Machinery Components 50/60 Hz
- Tubular Steel Tower, Hub Heights at 78 meters (Class IA)
- Electrical installations and lightning protection 50/60 Hz
- Commissioning
- Nacelle Cover and Spinner
- 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 Garrad Hassan wind study for the Project. Garrad Hassan has reviewed power curves of the potential WTG for the site and forecasted the P50 Net Capacity Factor to be 49.4% for Gamesa.

The energy produced by each of the turbines will be delivered to the substation through 34.5 kV circuit collectors. The collector substation consists of a building that will house the system of medium voltage (Metal-Clad), ancillary services and control panels of the medium voltage substation.

The connecting line to the NES has an operating voltage of 230 kV in a single-circuit using the conductor 795 MCM ACSR Drake Code, which has a length of 20 km approximately. The line connects the plant to an input line module in the 230 kV substation “Las Pailas” property of ICE, according to the approved connection point for the project. The bi-directional meters used to determine net electricity provided to the grid will be located at the substation[5].

The Operations and Maintenance building will be near the Project’s substation. This structure will house the equipment necessary for daily operations of the Project.

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[4] http://www.gamesa.es

[5] Metering scheme is further discussed on section B.7.2.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

The Project is expected to generate 216,416MWh of electricity per year. As the grid's combined margin emission factor is 0.3528 tCO_2/MWh, the number of displaced emissions will be of approximately 76,352 tCO_2e per year.

Table 1 - Estimated amount of emission reductions during the First Crediting Period

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2014	76,352
2015	76,352
2016	76,352
2017	76,352
2018	76,352
2019	76,352
2020	76,352
Total estimated reductions (tonnes of CO_2 e)	**534,461**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	76,352

A.4.5. Public funding of the project activity:

There are no public funds involved in this project.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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. Justification of the choice of the methodology and why it is applicable to the project activity:

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.

No fossil fuels or biomass will be used for this project.

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.	Project activity involves installation of a wind farm with an installed capacity of 50MW
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/m^2 after the implementation of the project activity. • The project activity results in new single or multiple reservoirs and the power density of	The Project activity is not a hydro power plant

Applicability Conditions	*Description of applicability condition as per ACM0002 (version 12.3)*	*Justification*
	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	
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. Description of the sources and gases included in the 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:

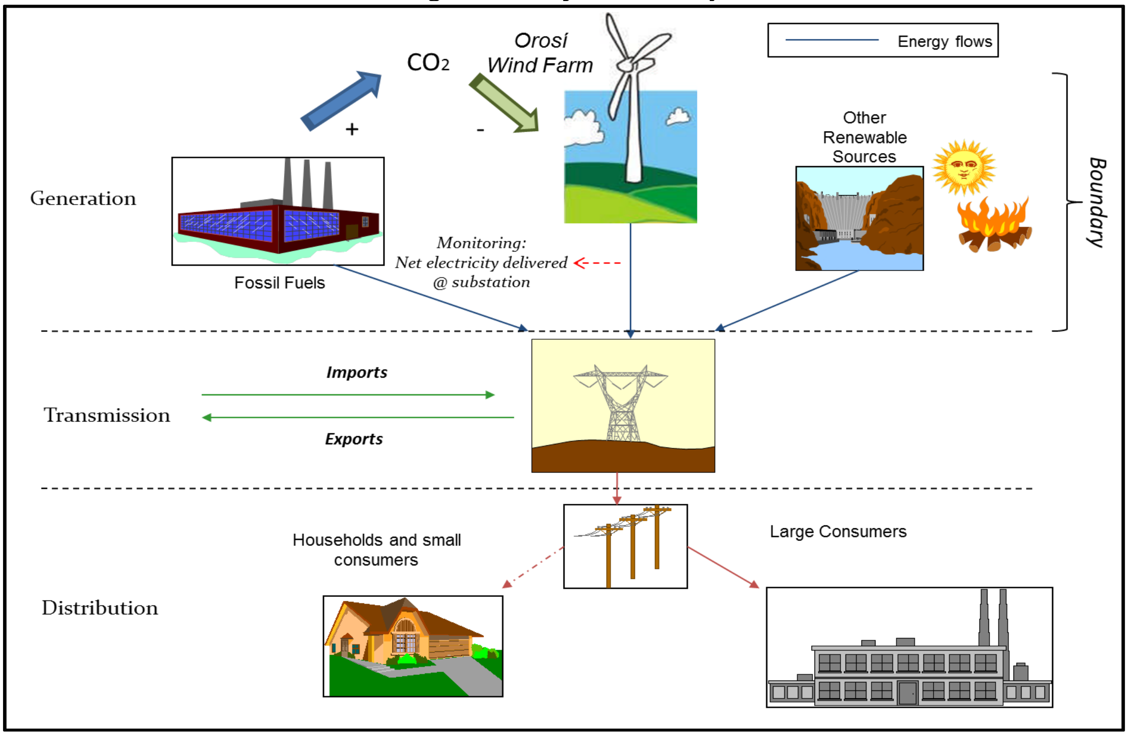
Table 2 - Emission Sources (as per ACM0002, v.12.3)

Source		Gas	Included ?	Justification / Explanation
Baseline	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 activity	Wind Power Generation	CO_2	No	No CO_2 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. The latter

will be the Costa Rican National Electric System (NES). A diagram of the latter is shown in Figure 2 below.

Figure 2 - Project boundary



B.4. Description of how the baseline scenario is identified and description of the identified 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 ARESEP (Public Services' Regulatory Agency) and the CNFL ("National Light and Power Company", a subsidiary of ICE, see below) on their respective websites. Information from the DSE (Energy Sector Management) and the ICE (Costa Rican Electricity Institute) provided by the respective entities to the project developer has also been used. All the calculations, graphs and data sources can be found in the baseline spreadsheet submitted with this PDD; detailed data source is presented on Annex 3.

ICE (a governmental agency) plays the central role in the national electric energy market. It is the only entity allowed to buy and sell electricity, the sole provider of transmission services and the single most important generator[6].

Law Number 7200 (modified by Law Number 7508) determines the provisions for private generation, in one of two ways:

> - Chapter one of the law allows for the installation by private sector generators of plants of up to 20 MW, as long as the overall capacity additions to the grid under this category do not collectively exceed 15% of the grid's total capacity. Likewise, 35% of the private generator's ownership structure must be owned by Costa Rican citizens/institutions. The plants under this category receive a price determined by the regulatory body (ARESEP)[7].
>
> - Chapter two of the law allows private construction and operation of plants of up to 50 MW, again as long as the collective private capacity under this category does not exceed 15% of the overall national capacity and at least 35% of the project's equity is under Costa Rican ownership. ICE is authorized to purchase energy from projects under this category of generating plants (and as long as these projects are authorized by ARESEP) by means of a BOT ("Build, Operate, Transfer") contract.

As it can be seen, the current regulations place very stringent requirements on private development. Likewise, the centralized structure of the electricity market –in which the ICE is the only authorized buyer of electricity, and the sole entity capable of subscribing export-import contracts- directly, translates into perceived risks by potential investors[8]. This is one causal factor in the relatively low level of private sector participation in the Costa Rican grid, and is depicted in Figure 3 which shows private participation is currently below 15% of total installed capacity.

Although, as shown in Figure 4 below, most of the capacity of the NES comes from hydro resources, though recent years have seen an increased participation of fossil fuelled projects in order to allow the supply of energy to grow at a similar pace with the increasing demand. This result –which would be more pronounced if we excluded from the analysis the renewable projects registered within the CDM- is mainly the consequence of the shorter lead time required to develop thermal plants in comparison with their renewable counterparts.

With thermal and hydro generation dominating the Costa Rican grid (with 88.9% of the generating mix between them), it can be seen that wind has yet to significantly penetrate into the Costa Rican generation mix. Only 3.5% (91.20 MW) of the total NES capacity is based on wind resources, of which the totality are either registered CDM projects (the Tejona and Guanacaste wind farms; 19.8 and 25.2 MW of

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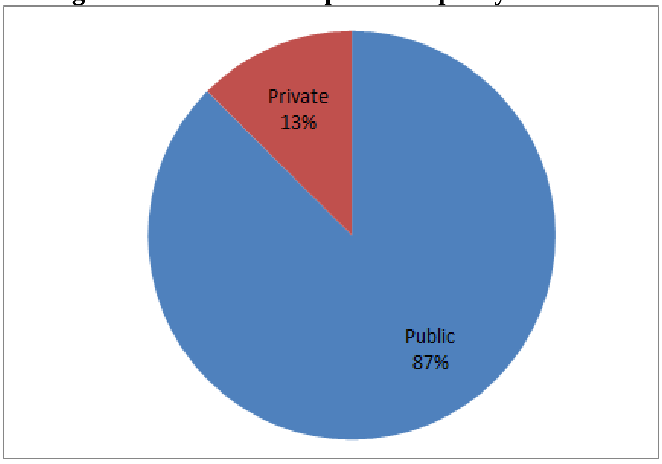
[6] Although with a significantly smaller contribution to Costa Rica's generation mix, other public organisations such as CNFL ("*Compañía Nacional de Luz y Fuerza*", majority owned by the ICE) are also involved in generation.

[7] In practice, however, this scheme is no longer being applied as the ARESEP is currently developing their price policy applicable to energy projects. For more on this topic, please refer to page 27 and page 31 on "*Análisis del Mercado Costarricense de Energía Renovable*" (BCIE, 2009 – Spanish edition available at www.proyectoareca.org) A copy of this document is available to the DOE.

[8] For more details on the limitations faced by private developers in Costa Rica refer to pages 29-30 on "*Análisis del Mercado Costarricense de Energía Renovable*" (BCIE, 2009)

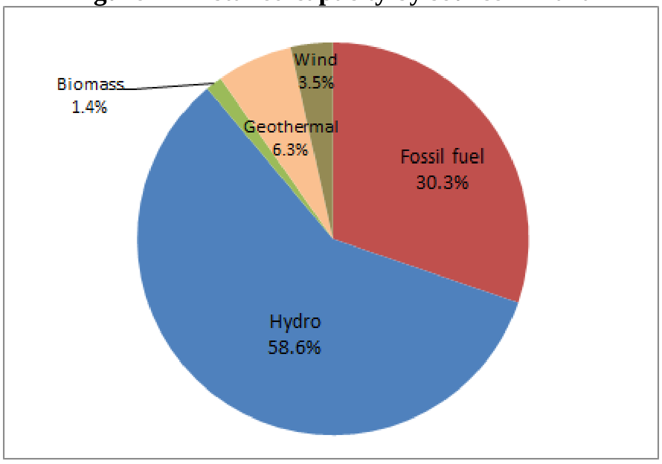
installed capacity respectively[9]) or Activities Implemented Jointly (Tilarán/Plantas Eólicas S.A, Aeroenergía and MOVASA/"Tierras Morenas"; 19.8, 6.4 and 20 MW respectively[10]). This shows that wind projects are not only scarce (and not yet common practice) but also dependent on financial support mechanisms such as the CDM.

Figure 3 - Public versus private capacity in 2010[11]



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

Figure 4 - Installed capacity by source in 2010



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

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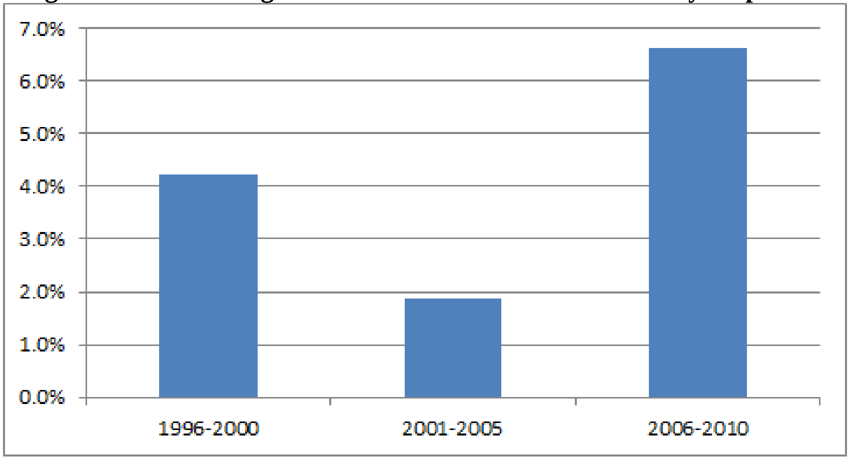
[9] Tejona CDM reference number is 0824; Guanacaste CDM reference number is 4147. ARESEP data for 2010 reflects the initial installed capacity of the Guanacaste project (25.2 MW); the remaining 24.3 MW had already been commissioned at the time of furnishing this PDD; thus, the total capacity of the Guanacaste project is 49.5 MW, as indicated in the corresponding PDD.

[10] *Source:* http://unfccc.int/kyoto_mechanisms/aij/activities_implemented_jointly/items/2013.php (accessed on January 2012)

[11] Total installed capacity in 2010 totals 2,614 MW.

Figure 5 - Fossil fuel generation share in the most recent 5 year periods



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

Section B.6.3 presents a quantitative estimate of the carbon emissions arising from the two aspects of the current scenario presented above. Emissions arising from existing plants are captured by the "operating margin" emission factor, whereas emissions from the recent additions are captured by the "build margin[12]" emission factor. The "combined margin" emission factor results from the weighted average of the operating margin and the build margin. This estimate is known as the grid's *emission factor*.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and 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 latest version of the "*Tool for the demonstration and assessment of additionality (version 06.0.0)*" and the "*Guidelines on the assessment of investment analysis*" are followed.

Project milestones and CDM consideration

Inversiones Eólicas de Orosí Dos S.A. (IEDO)'s parent company is Globeleq-Mesoamerica Energy, S.A. (GME). GME are active in several other CDM projects globally, and as such are well aware of the requirements and benefits of the CDM.

IEDO has been assessing the wind resource in the area of Quebrada Grande in Liberia, Guanacaste since April 2008, installing a total of three 80m tall measurement towers on two farms, namely, Los Angeles and La Frescura, with whom the developers have arrived at a purchase agreement for the properties.

[12] The build margin aims to capture the amount of GHG emissions arising from "future" additions to the grid, which in turn are estimated according to the units that were most recently built.

On September 13th 2010, ICE opened a public tender (2010LI-000020-PROV) for the purchase of 50 MW of power and its corresponding energy under the BOT (Build, Operate and Transfer) modality[13], originally open until March 2011 but the closing was subsequently postponed until September 9th of the same year. Considering that the development of the project was mature enough, IEDO decided to participate. Permission to interconnect to the national grid at Las Pailas substation was requested by IEDO and granted by ICE in October 2010.

Requests for Proposals (RFP) were submitted to Vestas, Gamesa, Siemens and Juwi in November 2010; a contract with GL Garrad Hassan for the assessment of the expected capacity factor was signed in January 2011. Deloitte was appointed to undertake a revision of the investment analysis developed by IEDO in April, 2011; their report was issued on June of the same year. That same month, a non-binding Agreement Letter (renewed on September 1st, before the second round of bids) was signed with Gamesa, which would supply the equipment if IEDO were to be awarded the generation bid promoted by ICE. After an initial round of offers in June, the final round took place in September 9th 2011; this second and last round considered an additional discount in the offered price; CDM revenues were considered ever since the first proposal submitted to ICE. A few days earlier, on September 5th, CDG Environmental Advisors S.A. was contracted for the project's environmental and social impact assessment. Mr. Justin Guest (GME's advisor on other CDM projects) was formally appointed as CDM Technical Advisor in October 2011 after discussions in September 2011.

Although IEDO was not awarded the bid, the proposed price was the second best by a slight difference and hence the ICE's Executive Board decided to allow the project developers to present a proposal for a direct contract, under the same price awarded to the winner of the bid (this was officially authorized on November 16th 2011); in October 2011 discussion began with various DOEs and potential CDM PDD consultants to begin preparing formal CDM documentation, as it was apparent that a revised bid would be made and was likely to be accepted by ICE. For this purpose, IEDO contracted Geo Ingeniería as their CDM consultant in November of the same year. A formal proposal to present an offer was issued by the ICE and submitted to IEDO on December 8th, 2011

Approval of the interconnection to the grid was obtained in January 2012. The updated proposal to ICE was presented on February 24th, 2012.

Expected schedule and project start date

The updated proposal presented to ICE is expected to be approved in April 2012.At this point IEDO will have an obligation to post a performance bond (guarantee) with ICE, hence the date of payment of the latter will be considered the project start date. Other relevant future milestones include the signature of the EPC with Gamesa the approval of the EIA, the signature of the PPA and financial closure, all of which are expected to occur in August 2012. The notice to proceed with construction will be issued in September 2012. By December 2013 the project will begin commercial full operations, after a period of phased commissioning of individual turbines. As a conservative assumption, the crediting period will start from January 1st 2014, or after registration date (whichever is latest).

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[13] Institutional framework applicable in Costa Rica is further discussed in Section B.4

Summary of main milestones

Table 3 - Past milestones

Date	*Milestone*
April 2008	Wind resource assessment.
13/09/2010	ICE opens public tender for the purchase of 50 MW.
October 2010	Interconnection permission requested and granted by ICE to IEDO.
November 2010	Request for proposal (RFP) submitted to various wind turbine manufacturers.
January 2011	GL Garrad Hassan appointed for estimation of expected generation.
05/04/2011	Deloitte appointed to undertake revision of financial analysis (report issued in June 2011).
02/06/2011	Non-binding agreement letter with Gamesa (WTG manufacturer) for the provision of the equipment in case IEDO was awarded the ICE bid.
09/06/2011	IEDO presents first proposal to ICE, which considers CDM revenues.
01/09/2011	Renewal of non-binding agreement letter with Gamesa
05/09/2011	CDG Environmental Advisors S.A. contracted for EIA.
09/09/2011	IEDO presents second and final proposal to ICE with a discount in the price.
October 2011	Mr. Justin Guest appointed as CDM advisor.
	Discussions with various DOEs and potential CDM PDD consultants to begin preparing formal CDM documentation.
14/11/2011	Geo Ingeniería is appointed to develop the PDD.
16/11/2011	ICE board issues authorization to sign a direct contract with IEDO.
08/12/2011	ICE submits proposal request to IEDO.
10/02/2012	Global stakeholder consultation / Beginning of validation
24/02/2012	Formal presentation of IEDO's proposal to ICE.

Table 4 - Expected milestones as of September 2011

Date	*Milestone*
April 2012	Acceptance by ICE of IEDO's proposal and concession agreement awarded to the project (*project start date* as IEDO has an obligation to post a performance bond with ICE).
August 2012	EIA approval.
	Signature of PPA.
	Financial closure.
	Signature of the EPC
September 2012	Notice to Proceed (Beginning of construction works).
December 2013	Begin of commercial operations.

Additionality assessment

The Tool for the demonstration and assessment of additionality (version 06.0.0) consists of a series of steps, as stated below:

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

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

Being a private initiative, the alternatives for the project developers are mainly to:

1. Pursue the proposed project *without* CDM incentives;

2. Cease to pursue the proposed project, i.e. continuation of the current baseline. This would imply that electricity would be generated by the operation of grid-connected power plants and new capacity additions. This business-as-usual scenario is described on Section B.4 above, in which no CO_2 emission reductions would take place.

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

Regulatory framework relevant for the proposed project involves the following set of norms[14]:

- *Ley No. 7593 (August 1996), "Law for the creation of the ruling authority of public services (ARESEP)" and Executive Decree No. 25,903 (February 1997):"Regulatory*

[14] Other regulations that are not specific for the alternatives listed were excluded for simplicity; these include Law No. 217 ("General Law for the Environment and Natural Resources") Decree No. 45 ("Regulation for Environmental Impact Assessments and Permits"), among others. All the alternatives listed are in compliance with these norms.

decree for Law No. 7593". Article 9 of this law states that ARESEP is the entity responsible for issuing the generation licenses for private-owned power plants.

- *Ley No. 7200 (October 1990), as modified by Law No. 7508 (May 1995): "Law for autonomous (i.e. private) generation"*. This law determines the contracting scheme applicable for privately owned power plants.

The first alternative depicted in *Sub-step 1a* consists of the proposed project activity undertaken without the CDM. From the perspective of national regulations, this is the same as the proposed project in its present CDM state, which is in compliance with all national regulations. In particular, the Orosí project comprises a 50 MW power plant that will enter the NES by means of a BOT ("Build, Operate and Transfer") contract with the ICE, who will automatically take ownership of the facility at the end of the 20 year BOT period (the 20 year period beginning from the point the concession is awarded).

The second alternative in *Sub-step 1a* consists of no project activity, i.e. the continuation of the business-as-usual scenario. It is assumed that all the existing generating facilities –as well as those to enter the grid in the future- are in compliance with all the national regulations.

- Step 2: Investment analysis

The purpose of this section is to determine whether the proposed project activity is *not*:

(a) The most economically or financially attractive; or
(b) Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).

As the relevant alternatives in the context of this project involve either to develop the project without CDM incentives or not pursuing the project at all, we will assess whether the project is economically or financially feasible without CDM incentives.

- Sub-step 2a: Determine appropriate analysis method
In order to demonstrate that the project is not economically attractive, a benchmark analysis will be undertaken. As stated in the "*Guidelines on the Assessment of Investment Analysis*":

"*If the proposed baseline scenario leaves the project participant no other choice than to make an investment to supply the same (or substitute) products or services, a benchmark analysis is not appropriate and an investment comparison analysis shall be used. If the alternative to the project activity is the supply of electricity from a grid this is not to be considered an investment and a benchmark approach is considered appropriate*" (paragraph 19).

In this case, the project participant is not forced to make an investment in the same or similar products or services.

The guidance further states that:

"*The benchmark approach is therefore suited to circumstances where the baseline does not require investment or is outside the direct control of the project developer, i.e. cases where the choice of the developer is to invest or not to invest*" (paragraph 19).

As this is clearly the case for a private facility in general, and for this project in particular, this justifies the choice of Option III: Benchmark analysis.

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

The Internal Rate of Return (IRR) is one of the most widely accepted financial indicators for project evaluation. In this case, equity IRR will be estimated (after tax, considering financial leverage). As per paragraph 12 of the Guidelines on the Assessment of Investment Analysis, required/expected returns on equity are appropriate benchmarks for equity IRRs; therefore this benchmark will be used. Furthermore, the Appendix to these Guidelines provides default benchmark values for the expected return on equity; thus, the 12% reference value for scope 1 activities in Costa Rica will be used. Please note that this default benchmark is more conservative in comparison to the discount rate that was actually considered by the project developers in the appraisal of the project (which was 14%, as seen on the financial model submitted during the public bid).

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

The version of the financial model considered herein contains the latest information available at September 2011 (second and last round of the public bid), after which ICE decided to request a direct contract proposal with IEDO. As the final proposal that will be submitted to ICE in February 2012 is not expected to differ significantly from the one submitted in September (with the sole exception of the electricity price, which has to revised downwards in order to at least match the price from the winning bid[15]), 09/09/2011 is considered the date in which the decision to invest was undertaken. All assumptions are expected to remain valid until the project start date, which is targeted to occur in April 2012, once the proposal submitted in February is accepted by the ICE. Therefore, the model discussed herein is the same one submitted to ICE, i.e. all the assumptions below are the same ones included in the proposal reviewed by ICE officials. The model submitted to ICE on the first round is the same one assessed by Deloitte.

The cash flow is based upon the following assumptions:

- Overall investment cost for the wind project will be 127.65 million USD.
- Orosí Project will provide an annual generation of 216,416 MWh, obtained using a 49.41% plant factor. The capacity factor was estimated by the independent third party Garrad Hassan[16], one of the world's largest renewable energy consulting firms.
- Project operational life is set at 18 years after which the ownership of the plant is transferred to the ICE as a result of the BOT contract. No compensation will be paid to IEDO.
- Offered monomic energy price is 84.67 USD/MWh.
- Operation and maintenance is expected to be a total of 3.17 million USD per year.

[15] The original price considered in the September submission to ICE is nevertheless considered as this value is more conservative than the price that will actually be agreed.

[16] http://www.gl-garradhassan.com/en/aboutus.php

- The expected capital structure of this project is 75% debt, 25% equity. Two loans are considered for this project: the first loan is expected to be provided by the Central American Bank for Economic Integration (CABEI, also known as BCIE), considering a variable interest rate[17] and a maturity of 15 years. The second loan is expected to be provided by a Export-Import Bank of the United States. For this second loan, a fixed 6.40% interest rate and 18-year maturity is assumed.

The equity IRR for the project is 9.55%, below the 12% benchmark, which demonstrates that the Orosí Wind Power Project cannot be considered a financially attractive option, i.e. that the project is additional to the baseline scenario.

- Sub-step 2d: Sensitivity analysis

According to the investment guidelines, only variables that constitute more than 20% of either total project costs or total project revenues should be included in the sensitivity analysis. Thus, the following parameters have been considered:

Table 5 - Parameters included in the sensitivity analysis

Parameter	% of total investment	% of annual revenues	Included?
Revenues (price/generation).		100.0%	Yes
investment cost	100.0%		Yes
O&M		22.2%	Yes
Interest		23.5%	Yes

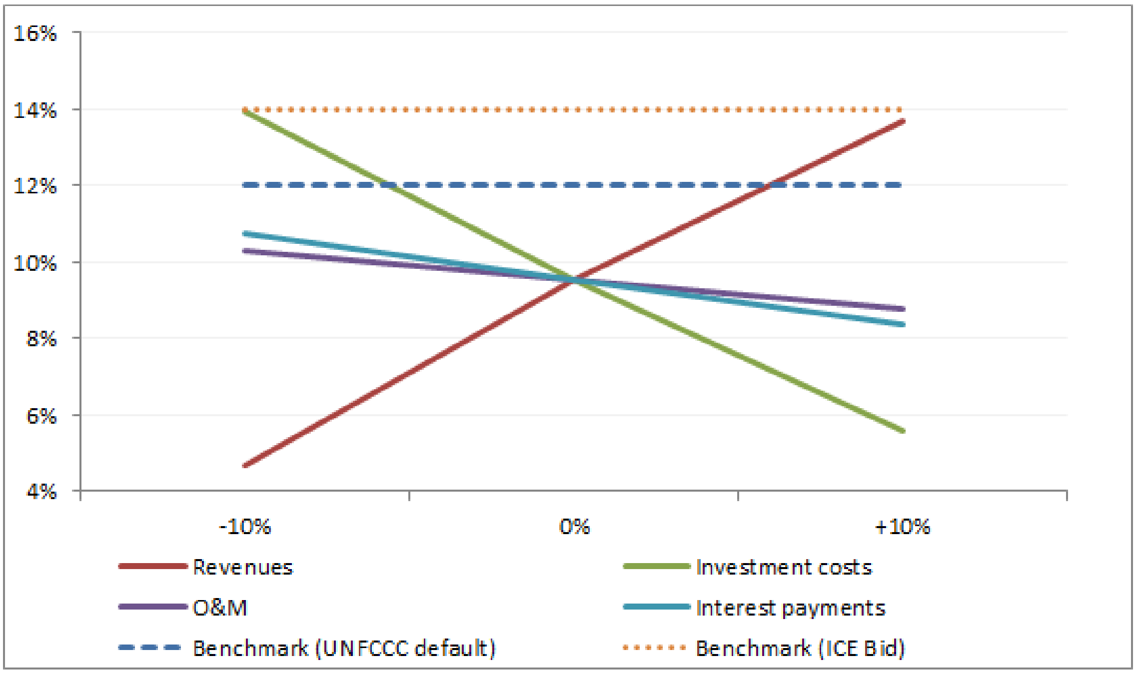
Default +/- 10% variations are considered for each of the parameters. The results are shown in Table 6 and Figure 6 below.

Table 6 – Sensitivity analysis results

	-10%	0%	+10%
Benchmark	**12.00%**	**12.00%**	**12.00%**
Revenues	4.67%	9.55%	13.68%
Investment costs	13.94%	9.55%	5.58%
O&M	10.29%	9.55%	8.79%
Interest	10.76%	9.55%	8.35%

[17] Interest rate swaps will be used to convert the variable interest rate into its fixed-rate equivalent.

Figure 6 - Sensitivity analysis results



Note that the project reaches the minimum default benchmark (12%) under very unlikely scenarios, whereas the actual benchmark considered at the time of the original ICE bid in 2001 (14%) is not reached under any sensitivity scenario. Moreover, it is important to emphasize the following considerations:

- **Generation estimate:**
  - Although generation may suffer inter-annual variation, it is unlikely that the project will benefit from a *permanent* increased electricity production. The capacity factor considered in the base scenario of our analysis (49.41%) is already higher than is observed in all the other wind power plants that are operational in Costa Rica. For example, the 5-year average effective capacity factor of plants with available data ranges from 36.5% to 47.8% (calculations can be found on the "wind projects performance" tab within the baseline spreadsheet). Therefore, a permanent upwards shift in generation is felt to be unlikely. A permanent 10% increase in revenue would imply a capacity factor in the order of 54.5%
  - The project uses annual generation/PLF that are already very conservative values. A P50 estimate for the generation/capacity factor was considered, whereas P75 estimates are common practice for wind power projects[18]. The latter link indicates that: "*The base case has been calculated assuming a Probability of Exceedance of 75% (P75). For the scenario analysis two further cases have been considered: Best Case: Probability of Exceedance of 50% (P50); Worst Case: Probability of*

[18] See e.g. http://www.greenrhinoenergy.com/finance/modelling/revenue_uncertainties.php and https://energypedia.info/index.php/Economic_analyses_of_wind_energy_projects

Exceedance of 90 % (P90)", showing that the P50 is actually considered as a "best case" scenario in the economic analysis of wind energy projects. The P75 generation estimate for Orosí is 206.2 GWh/yr (Garrad Hassan wind study, page 25), almost 5% *below* the P50 estimate considered as our base scenario (i.e. 216.4 GWh/yr).

- Available data suggests how wind projects perform globally. One possible indicator could be the data compiled by UNEP Risoe showing issuance success of CDM wind projects, as issuance success is directly related to wind generation performance. Latest data indicates that the average wind farm underperforms the PDD estimates of CER production (and by implication wind generation) by around 15%[19]. Similar results are observed in projects in Central America, like Amayo Phase I and Phase II (Nicaragua, CDM ref. #2315 and #5305)[20].

- **Inflationary Indexation & Benchmark Choice:**
  - There is limited indexation upside available. The price received by the project on the revenue side will be fixed in the contract that will be signed with ICE: only 20% of the base price is subject to indexation by means of the US producer price index, as shown in evidence available, whereas no such cap exists for costs. The latter are prone to variation according to US inflation in some cases (e.g. spare parts of WTGs) and in terms of local currency in others (e.g. salaries, etc.). In past years (2003-2011), local inflation has ranged from 9.10% to 13.80% /year[21]. Moreover, although inflation indexation may take place to the extent discussed above, increments in tariff will only take place after the developer can justify that raises in costs make the indexation necessary. Therefore, the prospect of inflation adjustments does not make the project any more attractive. On the contrary, price indexation of public services tends to be sluggish, occurring only *after* significant impact on costs has already taken place.
  - In close relation to the previous item, it is important to stress that the use of a *real* instead of a *nominal* benchmark is highly conservative as revenues cannot be freely indexed. A model that reasonably accounts for inflation would require an upwards revision of the benchmark (see e.g. paragraph 7 to the Appendix on EB62 Annex 5), the project revenues and the corresponding expenditures. However, as inflation would impact directly on costs and only in a limited way in revenues, the base IRR would be even further below the benchmark.
  - Lastly, the benchmark chosen is conservative when the project's capital structure is considered. Although this non-inflation adjusted 12% benchmark derived from UNFCCC's default values was chosen for simplicity, the actual benchmark targeted by the developer was 14%, as can be observed in the original model submitted to ICE (see cell F69 on the "No. III-5 tab"; this value is used to estimate the project's net present value to equity holders); said benchmark is not crossed even in the most

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[19] http://www.cdmpipeline.org/publications/CDMPipeline.xlsx (see Table 2 on the "Analysis" tab, which shows an 85% issuance success for CDM wind projects, spreadsheet consulted is dated: 01/04/2012).

[20] This is pointed out on page 27 of the validation report for project #5305. These projects are relevant due to their proximity (some 90 km from Quebrada Grande, Guanacaste, where the Orosí project is located) and the fact that they are the most recent wind projects in the region with performance data already available.

[21] See e.g. http://www.indexmundi.com/es/costa_rica/tasa_de_inflacion_(precios_al_consumidor).html

optimistic scenarios analysed in our sensitivity analysis. According to paragraph 18 of the guidelines, a 50% debt / 50% equity ratio is assumed by default whereas the proposed project considers a significantly higher amount of leverage (debt comprises 75% of the project's total capital structure). As debt holders have priority over equity holders, an increase in the debt-to-equity ratio will necessarily increase the risk born by stockholders, which should be reflected in a higher expected return (i.e. a higher equity-benchmark)[22]. The relation between the debt/equity ratio and equity's expected return is widely documented on technical literature such as Brealey-Myers' "Principles of corporate finance", 7th edition (see e.g. figures 19.1 and 19.2)[23]. Conversely, note that if the default 50% share for senior debt is assumed in the financial model, then the base scenario IRR would be 7.43%; this fall would equally translate into all the scenarios analysed in the sensitivity analysis. This can be confirmed by simply replacing the original 25% value in cell C27 of the "Inputs" tab of the investment spreadsheet by 50%.

- **Variation in Investment Costs**
  - A decrease in investment expenditures is also not likely as underestimation of large scale power projects rarely takes place. For example, reports[24] of the Guanacaste wind power project (the latest wind power plant commissioned in Costa Rica at the time of developing this PDD) indicate a 32% increase in actual investment costs as compared to the original estimates. While this percentage increase in investment costs is lower when comparing the expected investment costs as set out in the registered PDD (95.5 million USD) versus the final investment costs, the actual cost was still more than 15% higher than originally expected.
  - Likewise, notice that a downwards variation of investment expenditures is limited by the fact that the EPC contract would lock most of the project expenditures. EPC costs account for 89.7 MM USD out of 127.7 MM USD of the project's overall costs; thus, the portion of costs that is subject to variation is only 38.0 MM. Given the fixed nature of the EPC price, the +/- 10% variations would only apply to the part that is not included within the EPC contract. As for the latter, the price offered by Gamesa in their third and last proposal is the same as the one already included in their second one (i.e. the one considered herein) and thus no further discounts seem plausible. Moreover, other expenses (such as land rights), are fixed, whereas –after the investment decision (i.e. after the model date)- some of the development costs have already been spent.

This discussion has aimed to highlight several key points in relation to the investment analysis:

- The benchmark considered is implicitly conservative, as it ignores the impacts of inflation on costs and diminishes the impacts of different capital structure, with a commensurately lower benchmark as a result. That the prospects for the project to consistently outperform by 10%

[22] The actual benchmark considered by the developer was 14%, as can be observed in the original model submitted to ICE.

[23] Brealey-Myers corporate finance 7th edition-extrcat.docx is available to the DOE.

[24] See e.g. http://www.lawea.org/newsletter/esp/0915/noticia01.html

are limited given the choice of a P50 value as opposed to P75. A choice of a P75 value would see a reduction in the equilibrium IRR for the project. The practice of using P75 estimates in the region is supported by available data on actual wind farm performance both on a global and a regional level. Moreover, underperforming is a special concern for investors/potential lenders especially during the first years of operation, as these are the years in which the debt has to be repaid. Lastly, notice that should the project *underperform by 10%* the project IRR will fall as low as 4.7%.

- The prospects for the investment costs of the project to be 10% lower than is currently expected are extremely remote given the fixed nature of much of these costs (EPC, land acquisition etc). This would imply that the non-fixed components of the project costs would have to outperform their expected costs by significantly higher than 10%.

In both cases, if the benchmark were more realistic, and a less optimistic generation/ capacity factor would have been used, the gap between the IRR and the benchmark observed in the base scenario would widen further, reducing the potential that any sensitivity would breach the benchmark. These results provide a strong argument in favour of the project's additionality since they consistently support the conclusion that *the project activity is unlikely to be financially attractive.*

- Step 3. Barrier analysis

Skipped as a detailed investment analysis was presented

- Step 4. Common practice analysis

Activities listed under paragraph 6 of the Tool for the demonstration and assessment of additionality (version 06.0.0) (in which renewable energies are included) must follow paragraph 47 regarding the common practice analysis. The following sub-steps must be applied:

Sub-step 1. Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

For this project, said range includes projects within 25-75 MW of installed capacity.

Sub-step 2: In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Sub-step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}. Registered CDM project activities and projects activities undergoing validation shall not be included in this step.

The list of projects within the range from the previous step is presented below:

Table 7 - Plants included in the +/- 50% range of the common practice analysis (N_{all} = 12)

Plant name	Capacity (KW)	Technology
1. Garita (1,2)	37,360	Hydro (public)
2. Sandillal	31,978	Hydro (public)
3. Toro 2	65,736	Hydro (public)
4. Peñas Blancas	38,172	Hydro (public)
5. Moín Pistón	32,000	Thermal (public)
6. San Antonio	44,299	Thermal (public)
7. Barranca	53,280	Thermal (public)
8. Miravalles I	55,080	Geotherm. (public)
9. Miravalles II	55,080	Geotherm. (public)
10. Coopelesca	28,000	Hydro (coop.)
11. San Lorenzo-Pocosol	39,700	Hydro (coop.)
12. Miravalles III	27,500	Geotherm. (private)

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

Sub-step 3: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff}.

There are no power plants similar in technology (i.e. wind power projects) in the group of plants within similar (i.e. +/-50%) range. Thus, N_{diff} = 12.

Sub-step 4: Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity. The proposed project activity is a common practice within a sector in the applicable geographical area if both the following conditions are fulfilled:

(a) The factor F is greater than 0.2, and
(b) $N_{all}-N_{diff}$ is greater than 3.

As for the proposed project F = 0, the Orosí Wind Power Project may not be considered common practice in Costa Rica.

This concludes the additionality argument for the Orosí Wind Power Project.

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 Costa Rica the relevant electric power system for the project is the National Electric System[25] (NES), 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 NES represents most of the national generation in Costa Rica, 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 Costa Rica, 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 8 below. Thus, option (b) (Simple adjusted OM) will be used in the context of this project activity.

Table 8 - Low cost/Must-run generation in the 2006-2010 period

Type	2006	2007	2008	2009	2010
Renewables	94%	92%	93%	95%	93%
Fossil fuels	6%	8%	7%	5%	7%
Total	100%	100%	100%	100%	100%

Source: Author's elaboration based on ARESEP statistics (see baseline spreadsheet 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.

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

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:

(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:

$EF_{grid,OM\text{-}adj,y}$ = 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 Costa Rica 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 and electricity generation is available, option A.1 of the “Tool to calculate the emission factor for an electricity system” (version 02.2.1) is used:

(4) $$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y}\cdot NCV_{i,y}\cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power unit m in year *y* (Mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m = All power units serving the grid in year *y* except low-cost/must-run power units
i = All fossil fuel types combusted in power unit m in year *y*
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.

Whenever fuel consumption data is unavailable[26], 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:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}} \quad (5)$$

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

Lastly, the λ_y factor is calculated as follows[27]:

$$\lambda_y = \frac{\text{number of hours low-cost/must-run sources are on margin in year } y}{\text{8760 hours per year}} \quad (6)$$

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. $\Sigma_k EG_{k,y}$).

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.

[26] In our data set, only consumption unavailable is the one corresponding to Guápiles/Orotina units in 2008.

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

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[28]:

(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 Costa Rica, the last 5 power units to enter the grid were Garabito, El Encanto, Coneléctrica, Coopeguanacaste and Barranca. Their overall generation was $AEG_{SET\text{-}5\text{-}units}$ = 494,074 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 Costa Rica in 2010: AEG_{total} = 9,080,323 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} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\geq 20\%}$, in MWh); in our data, the set goes from Garabito (commissioned in 2010) to the Angostura (commissioned in 2000), with $AEG_{SET\geq 20\%}$ = 2,413,739 MWh.

(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 INE 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 9). 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

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

(Angostura) was commissioned in 2000, which is more than 10 years ago and thus sub-step (d) must be followed.

Table 9 - 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[29]
Garabito	2010	Fossil fuel	24,717	0.27%
El Encanto (CNFL)	2009	Hydro	52,000	0.84%
Coneléctrica	2009	Hydro	188,698	2.92%
Coopeguanacaste (CH Canalete)	2008	Hydro	64,722	3.64%
Barranca	2008	Fossil fuel	163,937	5.44%
San Antonio	2008	Fossil fuel	97,804	6.52%
Cariblanco	2007	Hydro	288,959	9.70%
El General	2006	Hydro	192,697	11.82%
Guápiles / Orotina	2006	Fossil Fuel	83,449	12.74%
Ingenios (Taboga)	2004	Bagasse	35,970	13.14%
Miravalles V	2003	Geothermal	115,992	14.42%
Moín CNFL	2003	Fossil fuel	43,796	14.90%
Peñas Blancas	2002	Hydro	158,862	16.65%
Angostura	2000	Hydro	902,137	26.58%
Total			**2,413,739.22**	26.58%

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

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system to the extent possible. CDM units are displayed in Table 10. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh). This is shown on Table 11.

Table 10 - Generation from CDM power projects in Costa Rica

Project	Ref. #	Starting date	MWh in 2010
Guanacaste	4147	2009	150,977
La Joya	0541	2006	244,201
Río Azul	0037	2004	70
Cote	0251	2003	13,000
Tejona	0824	2001	415

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

[29] Total grid generation in 2010 (excluding CDM projects) was 9,080,323 MWh.

Table 11 - Determination of the set of plants included in the BM including CDM projects

Company	Starting date	Fuel	Generation 2010 [MWh]	Cumm. respect overall 2010 generation
Garabito	2010	Thermal	24,717	0.27%
El Encanto -CNFL	2009	Hydro	52,000	0.84%
Coneléctrica	2009	Hydro	188,698	2.92%
Guanacaste **(CDM)**	2009	Wind	150,977	4.59%
Coopeguanacaste (CH Canalete)	2008	Hydro	64,722	5.30%
Barranca	2008	Fossil fuel	163,937	7.10%
San Antonio	2008	Fossil fuel	97,804	8.18%
Cariblanco	2007	Hydro	288,959	11.36%
El General	2006	Hydro	192,697	13.49%
Guápiles / Orotina	2006	Fossil Fuel	83,449	14.40%
La Joya **(CDM)**	2006	Hydro	244,201	17.09%
Ingenios (Taboga)	2004	Bagasse	35,970	17.49%
Río Azul **(CDM)**	2004	Biogas	70	17.49%
Miravalles V	2003	Geothermal	115,992	18.77%
Moín CNFL	2003	Fossil fuel	43,796	19.25%
Cote **(CDM)**	2003	Hydro	13,000	19.39%
Peñas Blancas	2002	Hydro	158,862	21.14%
Total			**1,919,851.23**	21.14%

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

If the annual electricity generation of that set comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin and ignore steps (e) and (f). As this is our case, $SET_{sample\text{-}CDM}$ will be the group of plants used for the build margin.

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:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (7)$$

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) was based in the option (a) “Weighted average CM” and is calculated according to the following expression:

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

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:

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

Section B.7.2 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 that are available at validation:

Data / Parameter:	***$NCV_{i,y}$***
Data unit:	$TJ/10^3$ m^3
Description:	Net calorific value (energy content) per volume unit of fuel *i*
Source of data used:	"*Factores para el cálculo de emisiones de gases de efecto invernadero del sistema eléctrico nacional y su aplicación a un inventario del año 2010*" (spanish for "Considerations for the estimation of GHG emissions from the SEN in 2010"; ICE, 2011, page 21).
Value applied:	Fuel Oil: 39.35 Diesel: 36.46
Justification of the choice of data or description of measurement methods and procedures actually applied:	Local data from official sources used.
Any comment:	

Data / Parameter:	***$EF_{CO2,i,y}$***
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor
Source of data used:	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 applied:	Fuel Oil: 75.5 tCO_2/TJ Diesel: 72.6 tCO_2/TJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	No other data is publicly available. IPCC guidelines have been used in a conservative manner.
Any comment:	

Data / Parameter:	***$FC_{i,m,y}$***
Data unit:	Litres
Description:	Amount of each fossil fuel consumed by each power plant/unit
Source of data used:	ARESEP
Value applied:	Data for the 2008-2010 period is available on Table 12.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is obtained from official sources.
Any comment:	

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Annual electricity generation of each power plant in the grid
Source of data used:	ARESEP, DSE and CNFL
Value applied:	Data for the 2008-2010 period is shown on Table 12(OM) and **Table 14** (BM).
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is obtained from official sources
Any comment:	Information published by ARESEP aggregates generation data from ICE plants (i.e. no individual plant data for the ICE stations is available in ARESEP statistics); hence, DSE information is used in order to analyse data collected on a plant-by-plant basis. In the same manner, CNFL's plant's generation was derived from their website. Specific links to information publicly available are included in the spreadsheet with emission reductions calculations. Information from the DSE is publicly available upon request.

Data / Parameter:	$\eta_{m,y}$
Data unit:	%
Description:	Average net energy conversion efficiency of power unit *m* in year *y*
Source of data used:	"Tool to calculate the emission factor for an electricity system" (Version 2.2.1), Annex 1.
Value applied:	**46% (value for combined cycle, oil power plant commissioned after 2000)**
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value used when no consumption data was available.
Any comment:	Only used with the Guápiles/Orotina power units in 2008. Most conservative technology (i.e. combined cycle) assumed as no details of the technology used by these units was available.

B.6.3. Ex-ante calculation of emission reductions:

Equation (9) is used to estimate the number of emissions displaced by the proposed project's activity; equations (3) to (8) are used in order to estimate the ex-ante emission factor.

Table 12 below presents a summary of fuel consumptions and 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 or diesel[30]. The emission factors calculated for each year are then adjusted using the λ coefficients, as indicated on equation (3) and shown on Table 13.

Table 14 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 (7) is then applied to obtain the build margin emission factor.

Table 12 - Operating margin emission factor calculation

Thermal Power Plants	**Power Generation ($EG_{m,y}$)**			**Fuel type (i)**	**Fuel consumed ($FC_{i,m,y}$)**			**Emissions**					
	MWh				**Thousand liters**			**tCO2 ($FC_{i,m,y}$ * $NCV_{i,y}$ * $EF_{CO2,i,y}$)**			**tCO2/MWh ($EF_{EL,m,y}$ as per equation (4))**		
	2008	**2009**	**2010**		**2008**	**2009**	**2010**	**2008**	**2009**	**2010**	**2008**	**2009**	**2010**
Colima	12,399	9,108	8,335	bunker	3,528	2,656	2,396	10,482	7,890	7,119	0.85	0.87	0.85
San Antonio	23,350	5,877	7,348	diesel	9,333	2,465	3,088	24,707	6,526	8,174	1.06	1.11	1.11
Moín CNFL	135,592	84,536	43,796	diesel	46,151	28,653	15,240	122,168	75,849	40,342	0.90	0.90	0.92
Barranca	17,518	5,323	6,883	diesel	7,475	2,252	2,927	19,788	5,960	7,747	1.13	1.12	1.13
Moín Pistón	8,305	8,510	14,343	bunker	2,214	2,072	3,525	6,579	6,157	10,474	0.79	0.72	0.73
Moín Gas	187,937	85,046	190,563	diesel	64,412	29,428	66,785	170,508	77,901	176,790	0.91	0.92	0.93
Guápiles / Orotina	88,188	67,475	83,449	bunker	n.a.	15,118	18,932	52,108	44,920	56,252	0.59	0.67	0.67
Barranca Alq.	59,876	81,869	163,937	diesel	16,856	23,399	47,390	44,621	61,940	125,447	0.75	0.76	0.77
San Antonio Alq.	143,395	103,466	97,804	diesel	44,150	31,200	29,943	116,871	82,590	79,264	0.82	0.80	0.81
Garabito	0	0	24,717	bunker	-	0	6,396	0	0	19,005			0.77
Total Thermal	**676,560**	**451,209**	**641,175**					**567,831**	**369,733**	**530,615**	**0.8393**	**0.8194**	**0.8276**

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

[30] 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 13 – 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	0.8393	0.4649	0.4491	676,560
2009	0.8194	0.5471	0.3711	451,209
2010	0.8276	0.5050	0.4096	641,175
Generation weighted average: $EF_{grid,OM-adj,2008\text{-}2010}$			**0.4149**	

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

Table 14 - Build margin emission factor calculation

Company (m units included in the BM)	Generation 2010 [MWh] ($EG_{m,2010}$)	Cumm. respect overall 2010 generation(*)	Fossil Fuel type (i)	Fossil fuel consumption (10^3 lts) ($FC_{i,m,y}$)	Emissions (tCO_2) ($FC_{i,m,y}$ * $NCV_{i,y}$ * $EF_{CO2,i,y}$)	tCO_2/MWh ($EF_{EL,m,y}$ as per eq. (4))
Garabito	24,717	0.27%	Bunker	6,396	19,005	0.77
El Encanto (CNFL)	52,000	0.84%	None			-
Coneléctrica	188,698	2.92%	None			-
Guanacaste	150,977	4.59%	None			-
Coopeguanacaste (CH Canalete)	64,722	5.30%	None			
Barranca Alq.	163,937	7.10%	Diesel	47,390	125,447	0.77
San Antonio Alq.	97,804	8.18%	Diesel	29,943	79,264	0.81
Cariblanco	288,959	11.36%	None			-
El General	192,697	13.49%	None			-
Guápiles / Orotina	83,449	14.40%	Bunker	18,932	56,252	0.67
La Joya	244,201	17.09%	None			
Ingenios (Taboga)	35,970	17.49%	None			-
Río Azul	70	17.49%	None			
Miravalles V	115,992	18.77%	None			-
Moín CNFL	43,796	19.25%	Diesel	15,240	40,342	0.93
Cote	13,000	19.39%	None			
Peñas Blancas	158,862	21.14%	None			-
Total	**1,919,851.23**	21.14%	$EF_{grid,BM,2010}$ *(eq. (7))*		**320,311**	**0.1668**

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

The default weights for wind projects are used to obtain the combined margin emission factor according to equation (8):

Table 15 - Combined margin emission factor

$EFgrid,OM\text{-}adj,2008\text{-}2010$	0.4149
ωOM	0.75
$EFgrid,BM,2010$	0.1668
ω_{BM}	0.25
$EF_{grid,CM}$	**0.3528**

Source: Author's calculation

The calculations show in $EF_{grid,CM}$ = 0.3528 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, $EG_{facility,ex\text{-}ante}$ = 216,416 MWh, which is the expected annual generation allowed by the project. Thus, according to equation (9) our annual emission reduction estimate is given by $ER_{ex\text{-}ante}$ = 216,416 MWh * 0.3528 tCO_2/MWh = 76,352 tCO_2 per year (after rounding down).

B.6.4 Summary of the ex-ante estimation of emission reductions:

A summary of the results from previous sections is presented below:

Table 16 - Summary of emission reductions estimate

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2014	0	76,352	0	76,352
2015	0	76,352	0	76,352
2016	0	76,352	0	76,352
2017	0	76,352	0	76,352
2018	0	76,352	0	76,352
2019	0	76,352	0	76,352
2020	0	76,352	0	76,352
Total (tonnes of CO2 e)	0	534,461	0	534,461

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	***$EG_{facility,y}$***
Data 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 to be used:	On-site metering system
Value of data applied for the purpose of calculating expected emission reductions in section B.5	216,416 MWh/year
Description of measurement methods and procedures to be applied:	Two bi-directional meters (main and backup) will be installed at the ICE's substation (ST Pailas) for determining the plant's net generation. Hence, electricity will be determined at the 230 kV Pailas substation Revenue Meters (both for energy delivered to and consumed from the Grid). 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 NES.
QA/QC procedures to be applied:	Meters have an accuracy rating of +/- 0.2% and will be calibrated periodically as by entities authorized by the ICE. Data can be cross-checked with the receipts of sales.
Any 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. Description of the monitoring plan:

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

The Orosí Wind Power Project will deliver its output to a dedicated collection substation (Orosí Substation) that is connected through a main 34,5/230 kV transformer and a 230 kV, 19 km transmission line to an existing substation (ST Pailas, 230 kV) owned by the Utility (ICE). The bi-directional meters required for determining the plant's net generation will be installed at the ICE's substation. Figure 7 shows a metering scheme: electricity is determined at the 230 kV Pailas substation Revenue Meters (both for energy delivered to and consumed from the Grid).

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

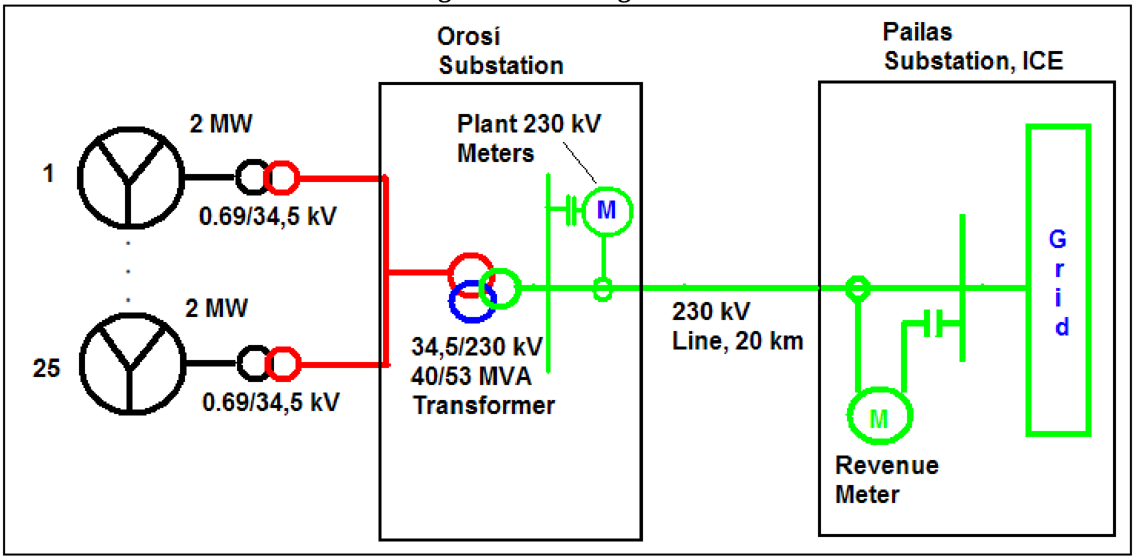
(10) $$EG_{facility,y} = EG_{230kV,y} - EC_{230kV,y}$$

where:

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

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

Figure 7- Metering scheme



Emergency procedures
Although main and backup meters will be installed at the Pailas substation, onsite meters of at least +/- 0.5 accuracy level at the 230 kV side are available in case both meters at the Pailas 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 230 kV meters located at the Orosí substation and the 230 kV meters of the Pailas substation of last 3 months will be conservatively deducted/added from the readings obtained from the 230 kV meters at Orosí Substation.

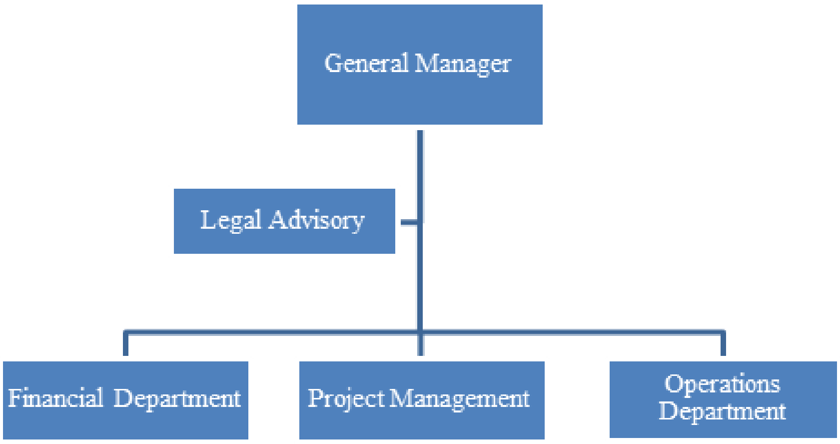
As the 230 kV meters located at Pailas substation are the official ones used for billing purposes, any events affecting the latter should be reflected in audit reports prepared by the grid operator (*Centro Nacional de Control de Energía, CENCE*). If a different method for determining net electricity 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 8 - 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 17 - 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

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

This baseline and monitoring methodology application study was completed on 02/01/2012 by Geo Ingeniería Ingenieros Consultores S.A., San José - Costa Rica.

- Phone: + (506) 2290 4656 / Fax: + (506) 2290 5297
- E-mail: scastro@geoingenieria.co.cr

The entity above is not considered a project participant.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

30/04/2012 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*[31]". In the context of the proposed project this date corresponds to the date when ICE is expected to approve the proposal made by IEDO and award a concession agreement to the project. At this point IEDO has an obligation to post a performance bond with ICE. Said date is expected to take place on 30/04/2012.

C.1.2. Expected operational lifetime of the project activity:

The project activity has an expected operational lifetime of 18 years as per the BOT[32] contract with ICE.

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

01/01/2014 or registration date (whichever is later).

C.2.1.2. Length of the first crediting period:

7 (seven) years, 0 months.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Since a renewable period was chosen, this section is not applicable.

C.2.2.2. Length:

Since a renewable period was chosen, this section is not applicable.

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

[32] BOT has a duration of 20 years (2 years of construction phase and 18 years of operational lifetime)

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

As stipulated in the Autonomous Generation Law, No. 7200 and Law No. 7508, all projects with electricity generation under this law must perform an Environmental Impact Assessment[33].

For the proposed Project Activity, a preliminary environmental evaluation was conducted by the independent consultants CDG Environmental Advisors. The evaluation was carried out by the consultant's multidisciplinary team as part of the Feasibility Study presented in the Bid to ICE. However, it was established that if the project was chosen as winner of the procurement process, it would proceed with the complete Environmental Impact Assessment (EIA) process established by the national environmental authority SETENA (Secretaría Técnica Nacional Ambiental, in English: National Environmental Technical Secretariat).

The same consultants, CDG Environmental Advisors, were retained by IEDO in September 2011 to conduct the Environmental Impact Assessment and environmental permitting process.

The preliminary environmental evaluation concluded that the Project is environmentally viable since the Project's benefits will compensate for its minor impact on the environment and the nearby community (which is Quebrada Grande, approximately 7 km away from the Project area).

For the preliminary environmental evaluation and final EIA, public consultations were held in the community. The first public meeting was held on March 2nd, 2011, and a community workshop was held on January 6, 2012 as part of the final EIA. To date, the opinion of community members and local organizations towards the Project is positive, the majority believing that it would be "good" or "advantageous" for the area.

IEDO submitted the final EIA for SETENA´s approval in February 24th, 2012.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The following is the list of the areas covered in the preliminary environmental evaluation 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:

Air quality: during construction in particular, to mitigate the suspension of dust particles and vehicle exhaust containing pollutants, water will be misted to moisten the roads and appropriate maintenance will be given to vehicles. Vehicles will also be appropriately maintained during operation and maintenance.

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[33] "*Guidelines for the development of renewable energy projects in Costa Rica*". Central American Bank for Economic Integration, 2010).

Noise: based on initial, basic measurements, the existing background noise (without the project) is relatively high due to the wind, which does not currently affect the nearest population. The location of the turbines away from nearby communities will not dramatically change this sound. The use of next-generation wind turbines further helps to decrease noise.

Waste management: It is anticipated that the main types of waste to be generated are construction debris and operational oils and greases, among other domestic waste. All waste will be collected and stored in appropriate containers and disposed of at the appropriate disposal centers.

Bird and bat fauna: The preliminary findings of the environmental evaluation suggest that there are no migratory bird routes that pass over the project area, though there may be some species listed under CITES as threatened or endangered. Though not yet directly required by SETENA or ICE, IEDO has contracted a one-year, full season Avian and Bat Study separate from the EIA given its length and focus. This study is being conducted by the same consultants responsible for the EIA, and preliminary reports from this Study will be integrated into the final EIA.

Ultimately the project will contribute to sustainable development for the local and national area, and the project is expected to have an overall positive impact on the local and global environment. All negative environmental impacts are subject to mitigations measures and monitoring as described above.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

The stakeholder consultation of the project activity took place on Thursday January 19th, 2012, at 2:00 p.m. in Quebrada Grande High School, located in Quebrada Grande, Liberia.

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

Activities in preparation for the event are described below:

Preliminary research and selection of invitees was carried out by IEDO. The selected stakeholders were: the local Municipality (Mayor and Environment Unit), Ministry of Environment, Energy and Telecommunications (MINAET), at national and local level, including the Regional Office of the National System of Protected Areas, schools, ASADAs (Community Administered Aqueducts), neighbours from the project's surroundings (which consist of landowners and workers of the farms), and key representatives and residents from different towns and communities in the project's surroundings.

After selection of the organizations and people, IEDO delivered personalized invitations to the event on site and via email.

Moreover, IEDO announced the stakeholder consultation in one of the most popular newspapers in Costa Rica, "Al DIA", on January 14th, 2012, approximately one week before the event[34]. Furthermore IEDO broadcast the announcement in "Guanaventas" (channel 36 of Guanacaste) and in "Cabletica" (Channel 5) from January 12 – 19th, 2012. The event was also announced by means of "YouTube", on the internet. On January 6th, 2012, representative of IEDO was interviewed by the local channel 36, and the latter was presented in the local news.

More than 29 participants attended the stakeholder consultation mainly coming from the communities located around the project site[35], such as Quebrada Grande, Los Angeles, Las Lilas, and San Antonio, among others. IEDO hired two private buses to transport the people from the nearby communities to the stakeholder consultation.

Phases of the stakeholder presentation:

Registration process. Registration of the invitees was done at the entrance of the conference area, and a flyer with specific information on the Orosí project was handed out as well as a paper form in which the attendees could write their questions and/or comments related to the project.

Video and presentation. To initiate the event, a video was played showing the experience of the Project Participants in order to introduce the attendees to the generalities of the Project Activity. The video was followed by a Power Point presentation that explained the project's features in terms of its objectives, location, technology, operations, benefits and the Clean Development Mechanism aspects. Hence during the consultation, the Project Participants described the Project Activity in a clear and complete manner[36], which allowed the local stakeholders to understand the Project Activity.

Questions-and-answers session. After the presentation, a period of time was designated for all attendees to submit their questions and comments in written form to the Project Participants. The Project Participants responded to each question with satisfactory and comprehensive answers. A video of the entire stakeholder presentation was recorded and is available upon request. A summary of the questions and comments can be found in section E.2.

At the end of the consultation, coffee and snacks were distributed to all attendees.

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

[35] A list of the participants can be presented upon request.

[36] The consultation and its presentations were in Spanish (Costa Rica official language)

Location of the stakeholder consultation


Attendee registration process


Explanation of the project


Attendees

E.2. Summary of the comments received:

At the end of the stakeholder presentation, the comments and questions by the attendees were compiled and shared by the Project Participants. The main topics brought up are summarized below:

- Main questions were regarding the duration of the Project and the lifespan of the wind turbines, considering acid rain and volcanic eruptions.
- What, if any, damage a blade could produce if it falls down, in case a hurricane occurs.
- What possibility is there of community participation in the Project from an economic point of view, and how the community could share in the revenues of the Project.
- What strategy or plan will be used to avoid damaging the biodiversity in the project area. Regarding environmental impact, a participant asked, what is the relationship of the bats with the sound of the blades.
- Which infrastructure improvements need to be carried out in order to develop the project, for example fixing bridges, roads, among others.

- What are the benefits of the project to the people and community around the project site. Together with employment, what other benefits will local people obtain, and if the social benefits will be only at the beginning of the project or constantly during its lifetime.

E.3. Report on how due account was taken of any comments received:

IEDO clarified all of the stakeholder's concerns by providing relevant data and answered all questions to the satisfaction of the attendees. Detailed minutes of meeting outlining the above questions and IEDO´s responses have been recorded, written down and are available upon request.

IEDO also informed the stakeholders that they are eager to continue receiving suggestions and comments regarding the Project, and to get to know the needs and strength of the communities. IEDO will be available to attend to any person with questions and doubts regarding the project.

IEDO explained to the attendees that they foresee that this project activity would contribute to the development of the communities and region 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 process, which were not already addressed in the Environmental Evaluation, 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 proponents will also address the concerns related to social welfare. They will create programs or activities that will have positive impacts on 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 Costa Rica and that it contributes to the sustainable development of the region.

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

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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URL:	
Represented by:	
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Salutation:	Mr.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Sources of information

Although most of the information required for the estimation of the grid's emission factor is indeed publicly available, many of the sources are disperse. The following table summarises the exact sources consulted for the provision of each one of the inputs used in the determination of the combined margin emission factor.

Table 18 - Data sources used for determination of baseline emission factor

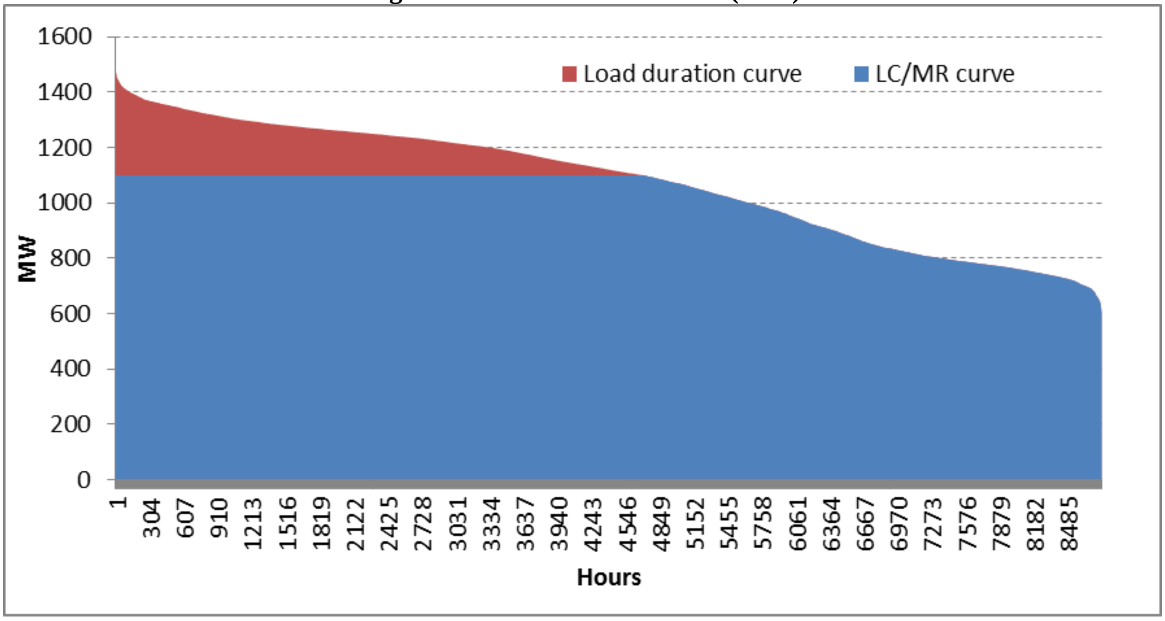
Data	Source	Publicly available	Comments[37]
Annual generation and fuel consumption from thermal power plants using fossil fuels.	ARESEP	Yes	http://www.aresep.go.cr/docs/GENERAC_TERMICA_2010.xls
Annual generation from private plants	ARESEP	Yes	http://www.aresep.go.cr/docs/GEN_PRIVADA_2010.xls
Annual generation from CNFL's power plants	CNFL	Yes	http://www.cnfl.go.cr/portal/page?_pageid=35,43166,35_463621&_dad=portal&_schema=PORTAL
Annual generation from Coneléctrica and Coopeguanacaste power plants	ARESEP	Yes	http://www.aresep.go.cr/docs/GENxFUENTE_1996-2010.xls
Annual generation from ICE power plants Cariblanco, Miravalles V and Peñas Blancas	DSE	Upon request	http://www.dse.go.cr
Hourly generation for load duration curve	ICE	Upon request	Data was requested to ICE through the Costa Rican DNA's office.
Grid capacity per technology and ownership type (1996-2010)	ARESEP	Yes	http://www.aresep.go.cr/docs/CAPACIDADXFUENTE_1996-2010.xls (see "CAPXFUENTE" tab)
Grid capacity per power plant (2010)	ARESEP	Yes	http://www.aresep.go.cr/docs/CAPACIDADXFUENTE_1996-2010.xls (see "CEPAL" tab)

[37] All links provided herein were checked on 02/02/2012.

Lambda calculation

Load duration curves were derived from hourly data provided by the ICE. Summary of each year's results are available below; full spreadsheet with calculations are available to the DOE.

Figure 9 – Load duration curve (2008)

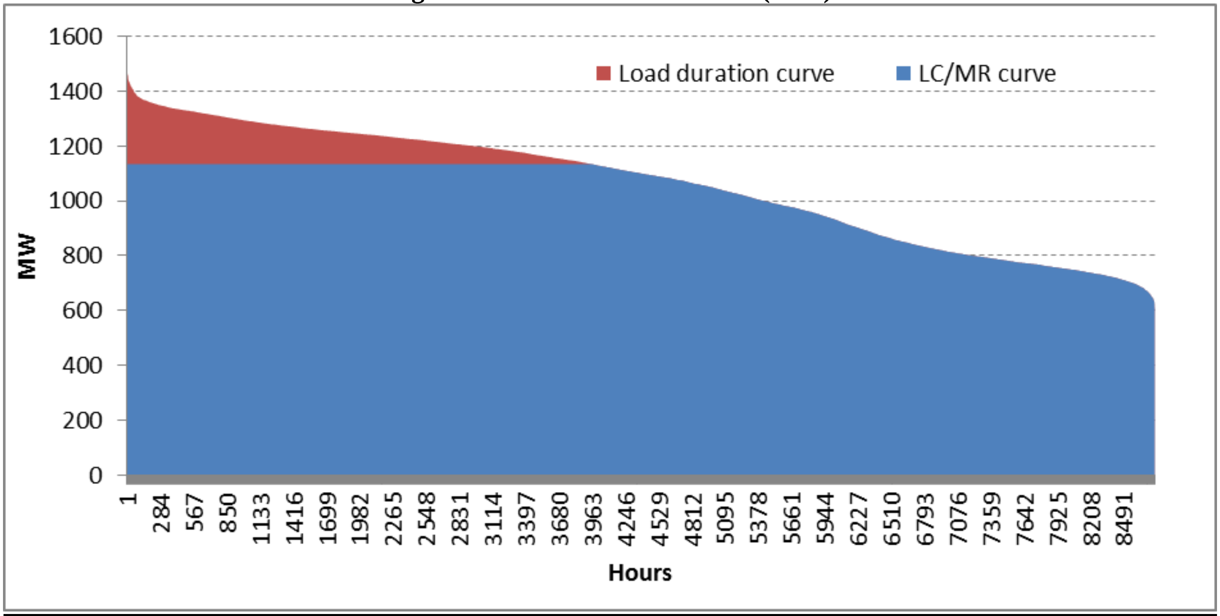


Source: Author's elaboration based on ICE hourly data

Table 19 – Calculation of λ_{2008}

x	4084
Hours / Year	8784
λ_{2008}	0.4649
1- λ_{2008}	0.5351

Figure 10 - Load duration curve (2009)

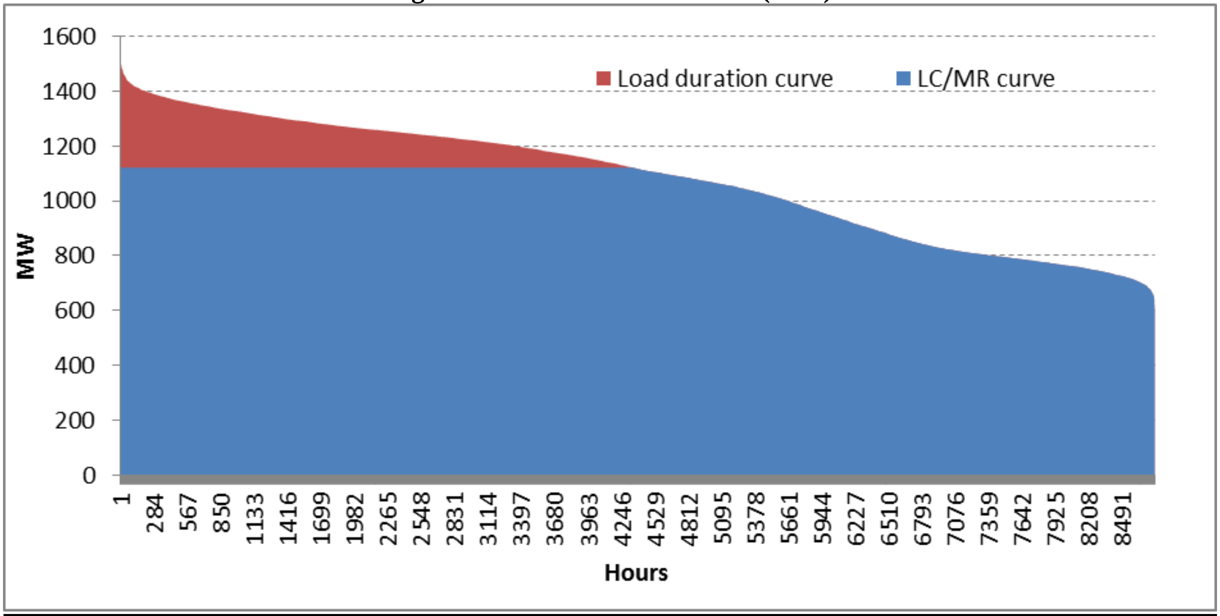


Source: Author's elaboration based on ICE hourly data

Table 20 - Calculation of λ_{2009}

x	4793
Hours / Year	8760
λ_{2009}	0.5471
1- λ_{2009}	0.4529

Figure 11 - Load duration curve (2010)



Source: Author's elaboration based on ICE hourly data

Table 21 - Calculation of λ_{2010}

x	4424
Hours / Year	8760
λ_{2010}	0.5050
1- λ_{2010}	0.4950

Annex 4

MONITORING INFORMATION

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