Monitoring report form for CDM project activity (Version 07.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	Orosi Wind Power Project	
UNFCCC reference number of the project activity	6652	
Version number of the PDD applicable to this monitoring report	5	
Version number of this monitoring report	3.0	
Completion date of this monitoring report	09/02/2021	
Monitoring period number	3rd monitoring period	
Duration of this monitoring period	01/01/2017 to 31/12/2019	
Monitoring report number for this monitoring period	N/A	
Project participants	Inversiones Eólicas de Orosí Dos, S.A. (IEDO) (Private Entity)	
Host Party	Costa Rica	
Applied methodologies and standardized baselines	ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 12.3.0)	
Sectoral scopes	Energy Industries - Renewable Sources	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	255,626 tCO_2e (3 years)
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	79,787 tCO_2e per year (239,361 tCO_2e for a period of 3 years)	

SECTION A. Description of project activity

A.1. General description of project activity

The Orosí Wind Power Project (the "Project") involves using renewable wind power to provide affordable electrical energy to the Costa Rican grid. The Project is located in Costa Rica, in the community of Quebrada Grande, Municipality of Liberia, in Guanacaste Province.

The main purpose of the Project is to provide electricity to the growing requirement in Costa Rica, using a sustainable and competitive resource: the wind. The Project consists on the installation of twenty-five 2 megawatt ("MW") Gamesa series G87s (also known as G9X) wind turbine generators (WTG), for a total capacity of 50 MW. Orosí is expected to provide 226.2 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 National Electric System has an estimated emission factor of 0.3528 tCO_2e per megawatt hour, which implies that the Project will displace almost 80 thousand 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 following table summarizes the Project's main milestones:

Milestones	Date
EPC Agreement signing	**22/11/2013**
Construction Works start date	**11/12/2013**
Partial Commercial operations start date (24 WTGs)[1]	**07/09/2015**
Commercial operations start date (25 WTGs)	**02/10/2015**

The total amount of emission reductions achieved in this monitoring period is summarized in the table below:

Monitoring period	Net electricity production	Total emission reductions
01/01/2017 to 31/12/2019	**725,045**	**255,626 tCO_{2eq}**

A.2. Location of project activity

Costa Rica
Guanacaste
Community of Quebrada Grande, Municipality of Liberia
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.

[1] Partial Commercial Operation with 48 MW (24 WTGs). The AEG-14 was pending to start commercial operations (Note 2015-09-10 - PEO61100-252-2015).

Figure 1 - Project Location

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Costa Rica (host)	Inversiones Eólicas de Orosí Dos, S.A. (IEDO) (Private Entity)	No

A.4. References to applied methodologies and standardized baselines

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)

Reference to the UNFCCC CDM web site:
http://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN

A.5. Crediting period type and duration

Type: 7 years renewable crediting period.
The crediting period of the project activity is from 15/01/15 – 14/01/22
Current monitoring period: 01/01/2017 to 31/12/2019

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

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), and internal roads between turbines and the interconnection to an existing electrical substation ("Las Pailas").

The Project signed a PPA with ICE on August 1st, 2013. On November 22, 2013, an EPC agreement was signed with GAMESA WIND LLC. Later on, construction works began in December of 2013 and the Project started partial commercial operations in September 7th, 2015 and commercial operations with a 100% of the contracting energy on October 2nd, 2015. The Project Activity was registered as a CDM Project on 14/10/2012 under reference number 6652.

The Wind Turbine Generator ("WTG") chosen for the Project activity was the Gamesa G87s, which is 78 meters high. This generator has a generating capacity of 2 MW and 25 units were installed, to provide a total capacity of 50 megawatt. The Project has a net energy production of approx. 226.2 GWh per year.

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.

The specific Project data is shown in the following table:

Table 1. Project Data

Project Features	**Total Nominal Capacity**	**50 MW**
Turbine Features	**Brand**	**GAMESA**
	Model	**G87s**
	Rotor Blade	**Gamesa Eólica 42.5 m**
	Capacity	**2.0 MW**
Other Data	**Machinery Components**	**50/60 Hz**
	Load Assumptions according to	**IEC 61400-1, Class S**
	Tubular Steel Tower	**Hub Heights at 78 meters**
	Electrical Installations and Lightning Protection	**50/60 Hz**
	Design Life	**20 years**

During this monitoring period (01/01/2017 to 31/12/2019), the net electricity supply by the Project to the utility was 725,045 MWh. The monitoring in the Project is carried out as established in the Monitoring Plan by continuous metering of the received and delivered energy.

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 (National Electric System) 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.

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.

Regarding events that may impact the GHG emission reductions during the monitoring period, the following are mentioned:

Table 2. Event Log

Time and date start	Time and date end	Time	Cause of Event
APRIL 2017			
24/4/2017 06:36	1/5/2017 00:00	17:24:00	Interconnection works of Vientos de Miramar and Vientos de la Perla (Alisios)
may-17			
1/5/2017 00:00	14/5/2017 09:06	09:06:00	Interconnection of Vientos de Miramar and Vientos de la Perla
20/5/2017 09:53	20/5/2017 13:07	03:14:00	Over Voltage
July 2017			
1/7/2017 13:01	1/7/2017 18:55	05:54:00	There is a blackout in Nicaragua and there is a disconnection with Panama, so we are not allowed to enter immediately due to frequency problems in the network
September 2017			
7/9/2017 05:17	8/9/2017 14:56	09:39:00	Annual Maintenance Substation Orosi
13/9/2017 16:14	13/9/2017 20:26	04:12:00	Breaker opening 152T
14/9/2017 03:19	14/9/2017 16:59	13:40:00	
March 2018			
7/3/2018 05:59	7/3/2018 14:53	08:54:00	Change of differential relay 87 T
jun-18			
7/6/2018 08:42	7/6/2018 18:20	09:38:00	Line Out, MT Terminal Placement in AEG 07
8/6/2018 12:46	8/6/2018 13:31	00:45:00	Line Out, MT Terminal Placement in AEG 07
9/6/2018 00:33	9/6/2018 07:43	07:10:00	Failure SE 34.5 kV Orosi
jul-18			
4/7/2018 05:51	5/7/2018 00:00	18:09:00	Annual Maintenance Substation Orosi
5/7/2018 00:00	5/7/2018 16:58	16:58:00	
oct-18			
3/10/2018 06:01	3/10/2018 17:42	11:41:00	Maintenance in transmission line Orosi-Pailas
4/10/2018 06:04	4/10/2018 14:23	08:19:00	
ene-19			
11/1/2019 08:53	11/1/2019 09:31	00:38:00	Switch Opening 652 T
abr-19			
1/4/2019 00:13	1/4/2019 03:24	03:11:00	Switch Opening 652 T
5/4/2019 16:40	5/4/2019 21:46	05:06:00	Switch Opening 652 T
TOTAL			
oct-19			
8/10/2019 05:06	9/10/2019 00:00	18:54:00	Annual Maintenance of ST 230 KV Orosi-Pailas
9/10/2019 00:00	9/10/2019 18:41	18:41:00	Annual Maintenance of ST 230 KV Orosi-Pailas
TOTAL			

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

Not Applicable

B.2.2. Corrections

The parameter EFgrid, CM, 2008, 2009, 2010 was added in section B.6.2 of the revised PDD (version 5 completed in 25.01.2021) as it was a parameter that was determined before the registration of the project activity and remain fixed throughout the crediting period.

B.2.3. Changes to the start date of the crediting period

Not Applicable

B.2.4. Inclusion of monitoring plan

Not Applicable

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

There is a change to the registered monitoring plan, as new wind power plants were added to the same substation and transmission line where the project is connected. Hence a new procedure for calculating the electricity generation was established in the Addenda No.4 of the PPA (Annex 11).

The category of the change is the following:

c) Changes that are being submitted with this monitoring report as part of the request for issuance (post-registration change - issuance track) as applicable from this monitoring period.

The revised PDD has a completion date of 25/01/2021, version number 5.

The DOE´s validation report is in process.

B.2.6. Changes to project design

Not Applicable

B.2.7. Changes specific to afforestation or reforestation project activity

Not Applicable

SECTION C. Description of monitoring system

Determination of net electricity delivered to the grid ($EG_{facility,y}$) from 01/01/2017 until 30/04/2017

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 2 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:

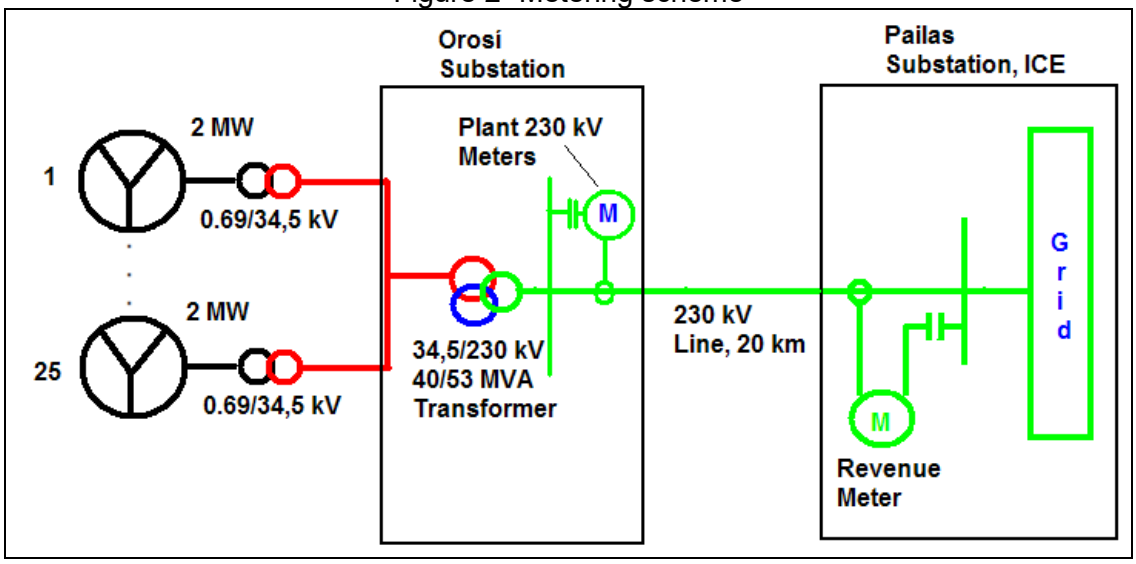
(1) $$EG_{facility,y} = EG_{230kV,y} - EC_{230kV,y}$$

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 2- Metering scheme



The main meter used during the period 01/01/2017 to 30/04/2017 was the MJ-1402A922-04 (Model ION 7650) and the backup meter used was MJ-1402A920-04 (Model ION 7650). The latter explanation is described in the table below:

Table 3: Meters (main and back-up)

PERIOD	MAIN METER *(MMED1)*	BACKUP METER *(MMED2)*
01/01/2017 to 30/04/2017	Part N.: M7650A0E0B6F1A0F Serial Number: MJ-1402A922-04 Model: ION 7650	Part N.: M7650A0E0B6F1A0F Serial Number: MJ-1402A920-04 Model: ION 7650

On the table below the dates of different processes of calibration is shown:

Table 4: Calibration/verification information

METER	LOCATION	1. VERIFICATION PERFORMED BY A CERTIFIED THIRD PARTY	VERFICATION VALIDITY	2. VERIFICATION PERFORMED BY A CERTIFIED THIRD PARTY	VERIFICATION VALIDITY
MAIN MJ-1402A922-04	Substation Las Pailas	22/04/2015	21/04/2016	17/05/2016	16/05/2017
BACKUP MJ-1402A920-04	Substation Las Pailas	22/04/2015	21/04/2016	17/05/2016	16/05/2017

As shown in the table above, both meters were calibrated on time during the required period. The verification report from ICE Certificate of 17/05/2016 is ICE-UVE-2016-0183.

Determination of net electricity delivered to the grid ($EG_{facility,y}$) from May 1st 2017 onwards:

After the the installation of other plants to the Orosí´s transmission Line "Orosi-Pailas", the parameter $EG_{facility,y}$ will be determined according to ADENDA No.4 of the PPA (Annex No. 11) where the following equation is established:

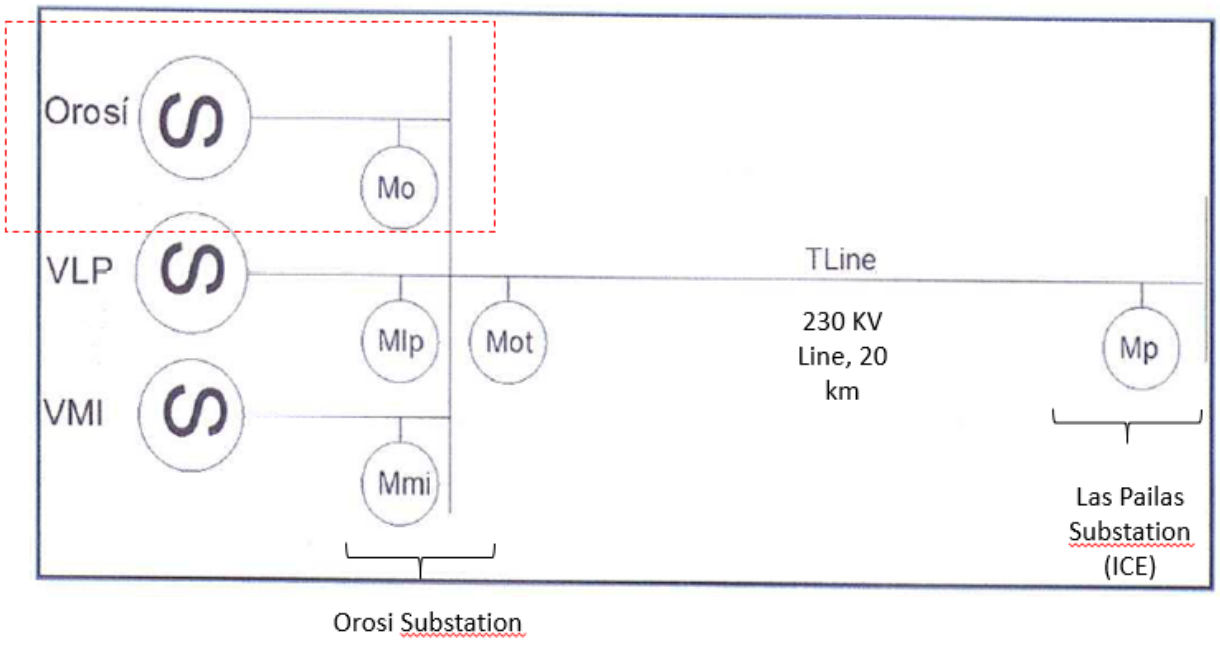
$$(2)\quad \boldsymbol{EG_{facility,y}} = M_{O,y} - ((M_{OT,y} - M_{P,y})\, M_{O,y} / M_{OT,y})$$

where:

- $M_{O,y}$ = Quantity of gross electricity generation that is produced by each plant in year y and is measured at the Orosi Substation (MWh/yr).
- $M_{OT,y}$ = Quantity of total gross electricity generation that is produced by all plants connected to the Orosi substation, in year *y* (MWh/yr)
- $M_{P,y}$ = Quantity of net electricity generation that is produced by all plants and fed into the grid in year *y* as measured at the Las Pailas substation (MWh/yr). Note that these are the same plants that deliver to the Orosi substation, but measure at a later point.

Figure 2 shows the new metering scheme:

Figure 3- Metering scheme after the installation of other plants to the substation and transmission line



The meter information is shown in the following tables:

Table 5: Meter Information Mo monitoring period (01/05/2017-31/12/2019)

	METER Model: ION 7650	Location	1. Calibration date from factory	2. Verification performed by a certified third party	Calibration Validity	3. Verification performed by a certified third party	Calibration Validity
Mo – Orosi gross energy	MAIN MJ-1604A324-05	Orosi Substation	15/04/2016	16/05/2018	15/05/2019	10/05/2019	09/05/2020
	BACK-UP MJ-1604A323-05	Orosi Substation	15/04/2016	16/05/2018	15/05/2019	10/05/2019	09/05/2020
M_{OT} – Total Gross Energy	MAIN MJ-1604A326-05	Orosi Substation	14/04/2016	15/05/2018	14/05/2019	09/05/2019	08/05/2020
	BACK-UP MJ-1604A325-05	Orosi Substation	14/04/2016	15/05/2018	14/05/2019	09/05/2019	08/05/2020

The metering system (Mo - Orosi gross energy) that calculates the Orosi´s gross energy, was installed from April 15th 2016 until July 13th, 2016, however was not part of the commercial electricity calculation. It became part of the procedure for calculating the energy generation since May 2017, when the installation of Las Perlas and Miramar Wind Power Projects were interconnected to Orosi´s substation and transmission line “OROSI-PERLAS”.

The meters (M_{OT} – Total Gross Energy) were installed in the Orosí substation at the same time of Mo (July 13th, 2016), but were also not used until May 2017 where the energy procedure calculation changed, as explained before.

Hence the verification for both Mo and M_{OT} was done one year after the meters started to functioned as part of the commercial electricity calculation of the project, complying with the PPA. However, since the meter installation was in July 13th, 2016 and even though the meters were not used until May 2017, an adjustment in the electricity generation readings has been applied since May 2017 until May 2018 in order to be conservative.

Both verifications reports from ICE Certificate (M_{OT} =15/05/2018 /OI-2018-079) and (Mo = 16/05/2018 / OI-2018-078), shows a maximum error for the main electricity meters of less than ±0.2%, however in accordance with the Clean Development Mechanism Validation and Verification Standard (Version 02.0, paragraph 366) the maximum permissible error of the meters of ±0.2% was applied for the period, as it’s the highest value.

Table 6: Meter Information monitoring period (01/05/2017-31/12/2019)

	METER Model: ION 7650	Location	1. Verification performed by a certified third party	Calibration Validity	2. Verification performed by a certified third party	Calibration Validity	3. Verification performed by a certified third party	Calibration Validity
M_P Net Energy	MAIN: MJ-1402A922-04 22-04-2015	Las Pailas Substation	02/05/2017	01/05/2018	17/05/2018	16/05/2019	22/05/2019	21/05/2020
	BACK-UP MJ-1402A920-04 22-04-2015	Las Pailas Substation	02/05/2017	01/05/2018	17/05/2018	16/05/2019	22/05/2019	21/05/2020

Regarding the meters in Las Pailas, also had a delayed calibration in the month of May 2018 and May 2019, hence an adjustment in the electricity generation readings has been applied to the months of May 2018 and 2019 in order to be conservative. The maximum permissible error of the meters of ±0.2% was applied for the period, as it's the highest value.

Emergency procedures

Although main and backup meters are 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 have implemented a management structure where monitoring responsibilities are explicitly defined. The Plant Manager is responsible for ERs monitoring, record keeping and the implementation of proper QA procedures. All the information from this department is consistent and easily verifiable with all the relevant data from other departments in case an external audit is required.

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

Information Flow

Figure 4 - Information Flow

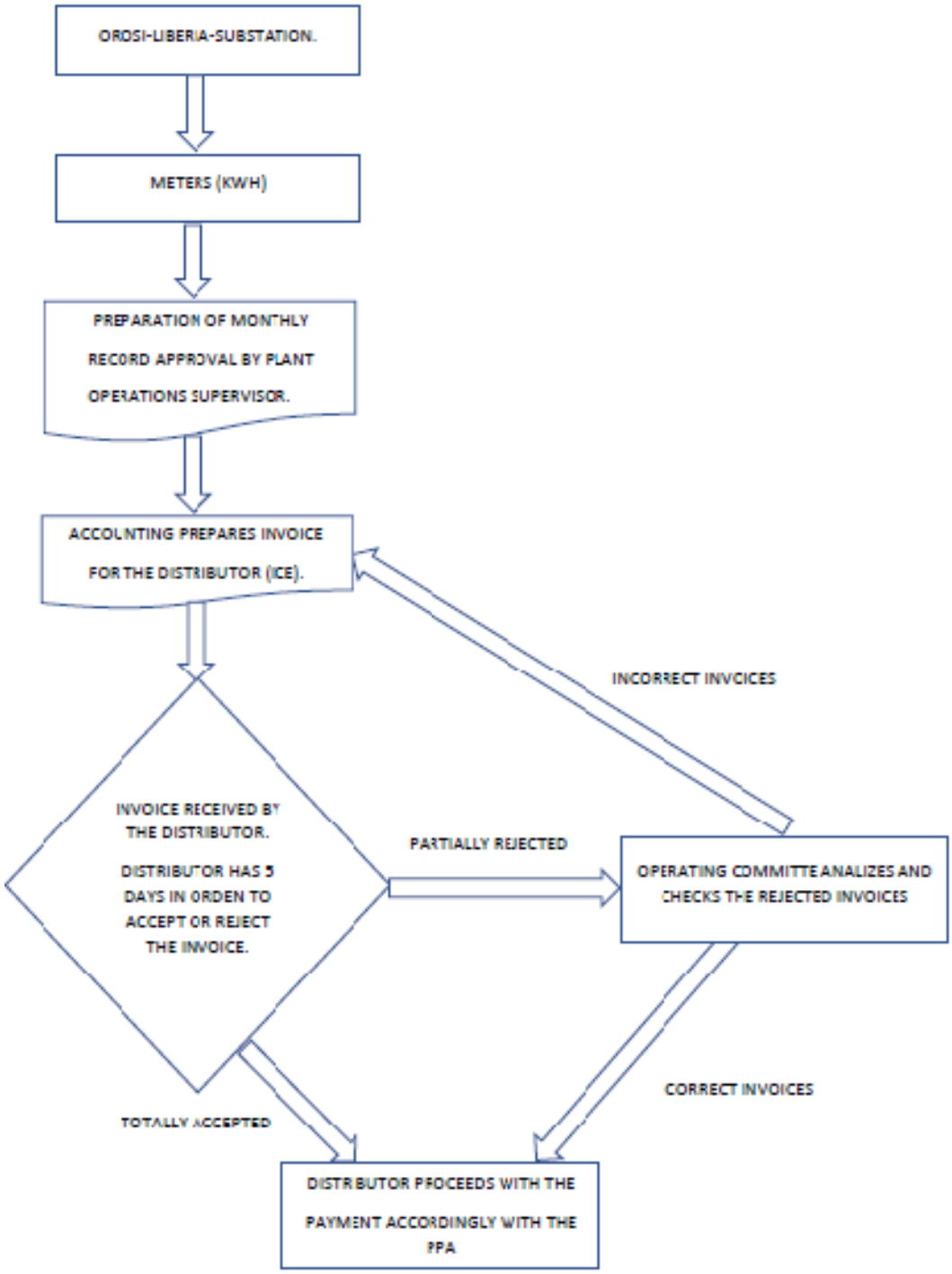
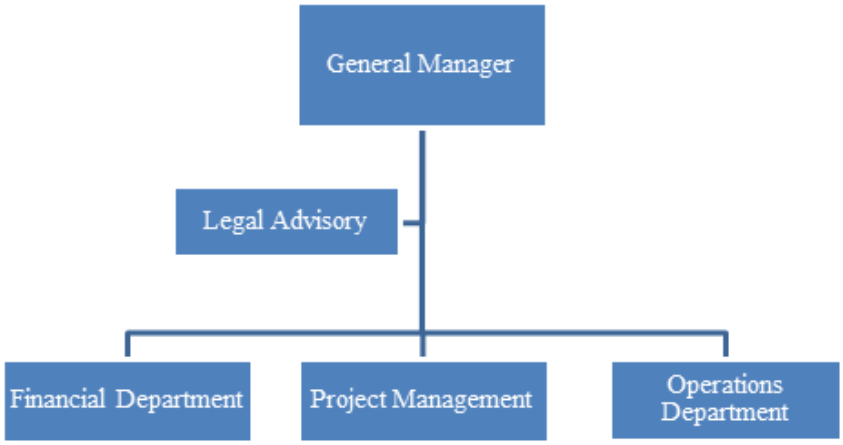


Figure 5 - Organizational chart



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

Table 7 - 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

Calibration of Meters and Metering

Meters must be calibrated and tested to verify their precision every year, as per the Costa Rican legislation that regulates the energy exchange, as established in the PPA (Section 7.2.4). ICE will cover the testing costs of their meters, presenting the Project copy of the Calibration Reports.

If any anomaly is detected, the cost of the auditing will be assumed by the Project.

The energy meters should have a precision no more than 0.2%, hence should be at least 0.2 class.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	**EFgrid, CM, 2008, 2009, 2010**
Unit	tCO_2/MWh
Description	Combined Margin Emission Factor of the Grid Calculated with the latest published official statistical data, using the default weights for wind projects w_{OM} = 0.75 and w_{BM} = 0.25
Source of data	Determined in the registered PDD
Value(s) applied	0.3528
Choice of data or measurement methods and procedures	Local data from official sources used.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	This parameter is fixed for the whole crediting period

Data / Parameter	$NCV_{i,y}$
Unit	$TJ/10^3\ m^3$
Description	Net calorific value (energy content) per volume unit of fuel *i*
Source of data	"*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 "Factors for the estimation of GHG emissions from the National Eletric System (SEN) and its application in a 2010 inventory") ICE, 2011, page 21.
Value(s) applied	Fuel Oil: 39.35 Diesel: 36.46
Choice of data or Measurement methods and procedures	Local data from official sources used.
Purpose of data	Calculation of baseline emissions in the PDD.
Additional comment	

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/TJ
Description	CO_2 emission factor

Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National Greenhouse Gas Inventories. Available at: http://www.ipccnggip.iges.or.jp/public/2006gl/index.html
Value(s) applied	Fuel Oil: 75.5 tCO_2/TJ Diesel: 72.6 tCO_2/TJ
Choice of data or Measurement methods and procedures	No other data is publicly available. IPCC guidelines have been used in a conservative manner.
Purpose of data	Calculation of baseline emissions in the PDD
Additional comment	

Data / Parameter	$FC_{i,m,y}$
Unit	Litres
Description	Amount of each fossil fuel consumed by each power plant/unit
Source of data	ARESEP
Value(s) applied	Data for the 2008-2010 period
Choice of data or Measurement methods and procedures	Data is obtained from official sources.
Purpose of data	Calculation of baseline emissions in the PDD
Additional comment	

Data / Parameter	$EG_{m,y}$
Unit	MWh
Description	Annual electricity generation of each power plant in the grid
Source of data	ARESEP, DSE and CNFL
Value(s) applied	Data for the 2008-2010 period
Choice of data or Measurement methods and procedures	Data is obtained from official sources
Purpose of data	Calculation of baseline emissions in the PDD
Additional 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	$\eta_{m,y}$
Unit	%
Description	Average net energy conversion efficiency of power unit m in year y
Source of data	"Tool to calculate the emission factor for an electricity system" (Version 2.2.1), Annex 1.
Value(s) applied	46% (value for combined cycle, oil power plant commissioned after 2000)

Choice of data or Measurement methods and procedures	Default value used when no consumption data was available.
Purpose of data	Calculation of baseline emissions in the PDD
Additional 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.

D.2. Data and parameters monitored

Calculation procedure used from 01/01/2017 until 30/04/2017

Data/Parameter	$EG_{facility,y}$
Unit	MWh in period *y*
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in period *y*
Measured/calculated/ default	Measured
Source of data	On-site metering system
Value(s) of monitored parameter	89,470.4 MWh/year (4 months)
Monitoring equipment	The energy is continuously metered at the Delivery Point by two electronic line meters. The MJ-1402A922-04 (ION 7650) meter served as the main meter and the MJ-1402A920-0 (ION 7650) as the backup meter Period from 01/01/2017 to 30/04/2017: - Main (MMED1) - Series: MJ-1402A922-04 - Brand: ION, Model: 7650 - Verification date: 17/05/2016, valid until 16/05/2017 - Power Accuracy: 0.2% - Date of meter installation to the plant: 20/04/2015 - Back Up (MMED2) - Series: MJ-1402A920-04 - Brand: ION, Model: 7650 - Verification date: 17/05/2016, valid until 16/05/2017 - Power Accuracy: 0.2% - Date of meter installation to the plant: 20/04/2015 Calibration frequency of the meters: at least once every year as per the Costa Rican legislation for the energy exchange, as established in the PPA (Section 7.2.4).
Measuring/reading/recording frequency	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). 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. Data will be continuously metered; generation data will be aggregated monthly for billing purposes.

Calculation method (if applicable)	N/A
QA/QC procedures	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. Data will be archived by means of electronic and paper backup for the full crediting period, plus two years after the end of the crediting period or the last issuance of CERs, whichever occurs later.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	

Calculation procedure used from 01/05/2017 – 31/12/2019

Data/Parameter	$EG_{facility,y}$
Unit	MWh in period *y*
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in period *y*
Measured/calculated/ default	Calculated
Source of data	On-site metering system
Value(s) of monitored parameter	109,142.4 (2017) + 262,443.9 (2018) + 263,988.2 (2019)
Monitoring equipment	From May 1st 2017 onwards, the Orosí Project will share the transmission line with other projects. Generation will be first delivered to the Orosí substation, where the apportioning is made, after which the electricity is delivered to the final metering point at Las Pailas Substation. Due to that, the procedure to measure the net energy is the following: • Orosí will have two bi-directional meters (main and backup), described as MO, installed at the Orosí substation (high voltage bus). This meter will be used to measure gross electricity generated by the Plant. • Another pair of meters (main and backup), described as MOT, will be installed also in the Orosí Substation that will measure the total incoming energy from all the plants delivering to the substation. • The Metering Point used for billing purposes will be located in Las Pailas Substation (ST Las Pailas), property of ICE, where another pair of meters, main and a back-up will be installed (MP). These meters will measure the total net energy coming from the Orosi Substation. The energy loses in the transmission line between the two substations will be distributed proportionally according to the energy delivered by each power plant as measured at the Orosi substation. The meters shall be advanced electronic socket meters, with an error no greater than 0.2 per cent (0.2%), with remote and real time communication facilities.
Measuring/reading/recording frequency	Data will be continuously metered; generation data will be aggregated monthly for billing purposes.

Calculation method (if applicable)	The following equation shows how the delivered energy of the Project will be determined in a common period: $EG_{facility,y} = M_{O,y} – ((M_{OT,y} - M_{P,y}) M_{O,y}/ M_{OT,y})$ $M_{O,y}$ = Quantity of gross electricity generation that is produced by Orosí Project in year *y* and is measured at the Orosi Substation (MWh/yr). $M_{OT,y}$ = Quantity of total gross electricity generation that is produced by all plants connected to the Orosi substation, in year *y* (MWh/yr) $M_{P,y}$ = Quantity of net electricity generation that is produced by all plants and fed into the grid in year *y* as measured at the Las Pailas substation (MWh/yr). Note that these are the same plants that deliver to the Orosi substation, but measured at a later point. The bidirectional meters (main and backup) at Las Pailas will measure both electricity generated that is being exported to the grid and the electricity that is consumed by the plants (imports). The data will be read primarily from the main meter. If an anomaly is detected in the data of the main meter, the data of the back-up meter will be used instead. The metering arrangements and the required quality control procedures to ensure accuracy are defined within the PPA between each relevant project instance and ICE
QA/QC procedures	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.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Data will be archived by means of electronic and paper backup for the full crediting period, plus two years after the end of the crediting period or the last issuance of CERs, whichever occurs later.

Data/Parameter	$M_{O,y}$
Unit	MWh in period *y*
Description	Quantity of gross electricity generation that is produced by the plant in year *y* and is measured at the Orosi Substation (MWh/yr).
Measured/calculated/ default	Measured
Source of data	Electricity meter reading
Value(s) of monitored parameter	109,447.8 (2017) + 263,098.3 (2018) + 264,673.7 (2019)

Monitoring equipment	The energy is continuously metered at the Delivery Point (ST OROSI) by two electronic line meters. The MJ-1604A338-05 (ION 7650) meter served as the main meter and the MJ-1604A337-05 (ION 7650) as the backup meter Period from 01/05/2017-31/12/2019 - Main (MMED1) - Series: MJ-1604A324-05 - Brand: Power Logic, Model: ION 7650 - Calibration date: 15/04/2016 - Verification date: 16/05/2018, valid until 15/05/2019 - Verification date: 10/05/2019, valid until 09/05/2020 - Power Accuracy: 0.2% - Date of meter installation to the plant: 13/07/2016 - Back Up (MMED2) - Series: MJ-1604A323-05 - Brand: Power Logic Model: ION 7650 - Calibration date: 15/04/2016 - Verification date: 16/05/2018, valid until 15/05/2019 - Verification date: 10/05/2019, valid until 09/05/2020 - Power Accuracy: 0.2% - Date of meter installation to the plant: 13/07/2016 Calibration frequency of the meters: at least once every year as per the Costa Rican legislation for the energy exchange, as established in the PPA (Section 7.2.4).
Measuring/reading/recording frequency	Monthly basis, recording continuously.
Calculation method (if applicable)	The data/parameter will be read directly from the meters.
QA/QC procedures	Meter readings will be checked for completeness on a monthly basis.
Purpose of data/parameter	Calculation of the $EG_{facility,y}$
Additional comments	Data will be archived by means of electronic and paper backup for the full crediting period, plus two years after the end of the Crediting period or the last issuance of CERs, whichever occurs later. During October 2019, the meter readings used in the calculation of ER were obtained directly from ICE´s readings, as the computer where the SCADA was located suffered a damage in the hard drive and readings were not accurate.

Data/Parameter	$M_{OT,y}$
Unit	MWh
Description	Quantity of total gross electricity generation that is produced by all plants connected to the Orosi substation, in year *y* (MWh/yr)
Measured/calculated/ default	Measured
Source of data	Electricity meter reading
Value(s) of monitored parameter	199,006.7 (2017) + 479,546 (2018) + 469,549.5 (2019)

Monitoring equipment	The energy is continuously metered at the Delivery Point (ST OROSI) by two electronic line meters. The MJ-1604A326-05 (ION 7650) meter served as the main meter and the MJ-1604A325-05 (ION 7650) as the backup meter. Period from 01/05/2017-31/12/2019 - Main (MMED1) - Series: MJ-1604A326-05 - Brand: ION, Model: 7650 - Calibration date: 14/04/2016 - Verification date: 15/05/2018, valid until 14/05/2019 - Verification date: 09/05/2019, valid until 08/05/2020 - Power Accuracy: 0.2% - Date of meter installation to the plant: 13/07/2016 - Back Up (MMED2) - Series: MJ-1604A325-05 - Brand: ION, Model: 7650 - Calibration date: 14/04/2016 - Verification date: 15/05/2018, valid until 14/05/2020 - Verification date: 09/05/2019, valid until 08/05/2020 - Power Accuracy: 0.2% - Date of meter installation to the plant: 13/07/2016
Measuring/reading/recording frequency	Monthly basis, recording continuously.
Calculation method (if applicable)	The data/parameter will be read directly from the meters.
QA/QC procedures	Meter readings will be checked for completeness on a monthly basis.
Purpose of data/parameter	Calculation of the $EG_{facility,y}$
Additional comments	Data will be archived by means of electronic and paper backup for the full crediting period, plus two years after the end of the Crediting period or the last issuance of CERs, whichever occurs later. During October 2019, the meter readings used in the calculation of ER were obtained directly from ICE´s readings, as the computer where the SCADA was located suffered a damage in the hard drive and readings were not accurate.

Data/Parameter	$M_{P,y}$
Unit	MWh
Description	Quantity of net electricity generation that is produced by all plants and fed into the grid in year *y* as measured at the Las Pailas substation (MWh/yr).
Measured/calculated/ default	Measured
Source of data	Electricity meter reading
Value(s) of monitored parameter	198,451.8 (2017) + 478,354.6 (2018) + 468,333.7 (2019)

Monitoring equipment	The energy is continuously metered at the Delivery Point (ST LAS PAILAS) by two electronic line meters. The MJ-1402A922-04 (ION 7650) meter served as the main meter and the MJ-1402A920-04 (ION 7650) as the backup meter. Period from 01/05/2017-31/12/2019 - Main (MMED1) - Series: MJ-1402A922-04 - Brand: ION, Model: 7650 - Verification date: 02/05/2017, valid until 01/05/2018 - Verification date: 17/05/2018, valid until 16/05/2019 - Verification fate: 22/05/2019, valid until 21/05/2020 - Power Accuracy: 0.2% - Date of meter installation to the plant: 22/04/2015 - Back Up (MMED2) - Series: MJ-1402A920-04 - Brand: ION, Model: 7650 - Verification date: 02/05/2017, valid until 01/05/2018 - Verification date: 17/05/2018, valid until 16/05/2019 - Verification fate: 22/05/2019, valid until 21/05/2020 - - Power Accuracy: 0.2% - Date of meter installation to the plant: 22/04/2015
Measuring/reading/recording frequency	Monthly basis, recording continuously.
Calculation method (if applicable)	The data/parameter will be read directly from the meters.
QA/QC procedures	Meter readings will be checked for completeness on a monthly basis.
Purpose of data/parameter	Calculation of the $EG_{facility,y}$
Additional comments	Data will be archived by means of electronic and paper backup for the full crediting period, plus two years after the end of the Crediting period or the last issuance of CERs, whichever occurs later. During October 2019, the meter readings used in the calculation of ER were obtained directly from ICE´s readings, as the computer where the SCADA was located suffered a damage in the hard drive and readings were not accurate.

D.3. Implementation of sampling plan

Not Applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

According to ACM0002, the baseline emissions of the project are equal to:

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

Where:

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

y	$EG_{PJ,y}$ (MWh)	$EF_{grid,CM,y}$ (tCO2 / MWh)	BE_y (tCO_2e)
2017	198,612.8	0.3528	69,993
2018	262,443.9	0.3528	92,505
2019	263,988.2	0.3528	93,128
Total	**725,045**		**255,626**

E.2. Calculation of project emissions or actual net removals

There are no project emissions attributable to wind projects. Consequently $PE_y = 0$

E.3. Calculation of leakage emissions

There is no leakage attributable to wind projects. Consequently $L_y = 0$.

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals ($t CO_2e$)	Project GHG emissions or actual net GHG removals ($t CO_2e$)	Leakage GHG emissions ($t CO_2e$)	GHG emission reductions or net anthropogenic GHG removals ($t CO_2e$)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	**255,626**	0	0	0	**255,626**	**255,626**

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period ($t CO_2e$)	Amount estimated ex ante for this monitoring period in the PDD ($t CO_2e$)
Year 2017: 69,993 Year 2018: 92,505 Year 2019: 93,128 **Total: 255,626**	79,787 tCO_2 / year **239,361** tCO_2 / 2017, 2018 and 2019

E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

The calculations in the PDD shows a $EF_{grid,CM}$ = 0.3528 tCO_2/MWh. This is the ex-ante grid emission factor that was used throughout the first crediting period (i.e. this value was recalculated in every monitoring period).

For the purpose of the *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 0:

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

The annual emission reduction estimate is given by $ER_{ex\text{-}ante}$ = 226,153 MWh * 0.3528 tCO_2/MWh = 79,787 tCO_2 per year (after rounding down).

For this monitoring period 2017, 2018 and 2019 the amount estimated was **239,361** tCO_2.

E.6. Remarks on increase in achieved emission reductions

The actual values of emission reductions achieved during the period 2018 are 92,505 tCO2e and during 2019 93,128 tCO2e; 16% and 17% higher (respectively) than the values estimated ex ante in the registered PDD for an equivalent amount of time (79,787 tCO2e). This is a direct consequence of an equally higher electricity generation, as compared to the estimate used in the PDD (i.e. 226,200 MWh versus 262,443 and 263,988MWh for an equivalent amount of time).

Production at wind farms varies greatly from year to year due to changes in weather patterns and frequency distribution of wind speeds. This was the case of year 2018 and 2019, where wind power generation was greatly affected in Costa Rica by means of the transition from the “Fenómeno de la Niña to the Fenómeno del Niño, which was reflected mainly in disorder of the rainy season and the behaviour of the temperature and wind. Because of “El Niño”, the dry season from 2018-2019 was longer, which generated an increase in wind speeds compared to the estimated for that year.

Figures with the wind behaviour and monthly generation of the Orosí Project, are available to the DOE.

E.7. Remarks on scale of small-scale project activity

Not applicable

Document information

Version	*Date*	*Description*
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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