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	Electricity generation from renewable sources - Windfarms Santa Clara I, Santa Clara II, Santa Clara III, Santa Clara IV, Santa Clara V, Santa Clara VI and Eurus VI	
UNFCCC reference number of the project activity	5495	
Version number of the PDD applicable to this monitoring report	4	
Version number of this monitoring report	1	
Completion date of this monitoring report	01/07/2020	
Monitoring period number	first monitoring period	
Duration of this monitoring period	01/03/2014 to 31/12/2014	
Monitoring report number for this monitoring period	1	
Project participants	CPFL Geração de Energia S/A	
Host Party	Brazil	
Applied methodologies and standardized baselines	ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 12.1.0.	
Sectoral scopes	Sectoral Scope 1 – Energy Industries (Renewable / Non-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 tCO_2e	256,027 tCO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	125,199 tCO_2e	

SECTION A. Description of project activity

A.1. General description of project activity

>> The proposed project activity consists in the implementation and operation of seven new wind electricity generation facilities, Santa Clara I, II, III, IV, V, VI and Eurus VI, located in Parazinho, in the Rio Grande do Norte state, Brazil. The project activity will employ 94 horizontal-axis aerogenerators (model: Enercon E82 E2), each with 2.0 MW (total nominal capacity: 188 MW). Santa Clara I, II, III, IV, V, VI will use 15 aerogenerators each, whereas Eurus VI will use the remaining 4 aerogenerators..

Table 1. Basic information about each electricity generation facilities

Unit Name	Numbers of aerogenerators	Model	Installed Capacity	PLF
Santa Clara I	15	Enercon E82 E2	30 MW	44.83%
Santa Clara II	15	Enercon E82 E2	30 MW	43.08%
Santa Clara III	15	Enercon E82 E2	30 MW	42.52%
Santa Clara IV	15	Enercon E82 E2	30 MW	41.79%
Santa Clara V	15	Enercon E82 E2	30 MW	42.43%
Santa Clara VI	15	Enercon E82 E2	30 MW	42.18%
Eurus VI	4	Enercon E82 E2	8 MW	42.13%

The project activity is forecasted to deliver 726,712 MWh/year of renewable electricity to the National Interconnected System (*Sistema Interligado Nacional* - SIN). In the baseline[1], electricity delivered to the grid by the project activity would have been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations. Hence, the project activity will promote GHG emissions reductions by displacing **fossil fuel-based electricity generation** that would otherwise occur.

Wobben, the aerogenerator supplier to the project activity, belongs to the Enercon GmbH group, which is one of the world's largest manufacturers of wind turbines. Wobben/Enercon was the first manufacturer of large-scale (800 – 3,000 kW) wind turbines in South America, being installed in Brazil since 1995. Its manufacturing facilities are located in Germany, Sweden, Brazil, Turkey and Portugal. By March 2010, Enercon was responsible for over 16,000 installed wind turbines and 20 GW across the world.

The aerogenerator "E82 E2" is designed for medium wind speed regime and for a lifetime of 20 years. It is a wind turbine with a three-blade rotor, active blade adjustment (adjustment of pitch) and variable speed operation with a nominal power of 2,000 kW. Its diameter of 82 m and hub height of 78-108 m allows E82 E2 to effectively use the existing wind conditions for electricity generation.

The rotating component of the generator and the rotor consist in a single unit. These two parts are connected directly to the hub so they can spin at the same low speed. Once the gearbox and other rotating parts do not exist, the energy losses between the rotor and generator, noise emissions, the use of oil in the gearbox and mechanical wear are reduced drastically.

The first plant to be installed by Wobben is in operation since December 1998 (Taíba, Ceará, 5 MW), hence wind-power electricity generation technologies developed by Wobben are all well known in the wind power industry and have proven themselves over the time.

The overview of the technical characteristics of the E82 E2 aerogenerator is provided in Table 2.

Table 2: ENERCON E82 E2 technical overview

Operational data	
Rated power	2.0 MW
Cut-in wind speed	2.5 m/s
Cut-out wind speed	28-34 m/s
50 years gust wind speed	59.5 m/s
Wind class*	IEC IIA
Rotational speed	6 to18 rpm
Rotor	
Power Control	Pitch
Diameter	82 m
Swept area	5,281 m^2
Blade material type	Epoxy-bounded fibreglass
Generator	
Type	ENERCON direct-drive synchronous annular generator
Rated power	2,000 kW
Protection	IP 23
Braking system	
Aerodynamical brake	- 3 independent systems with blade pitching mechanism - Rotor Brake - Rotor Lock
Certification*	Compliance with IEC 61400-1: Wind turbines – Part 1: Design requirements, 3rd Edition 2005-08 – Wind Turbine Class II A

Source: ENERCON E-82 E2 2MW – Aerogenerator Characteristics (*Características do Aerogerador)*. *Type Certificate TC 100201, Rev. 0

The project boundary includes CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. Project and leakage emissions are not expected.

A flow diagram of the project boundary, physically delineating the project activity, representing emissions sources and gases included in the project boundary and the monitoring variables, is depicted in Figure 1 below.

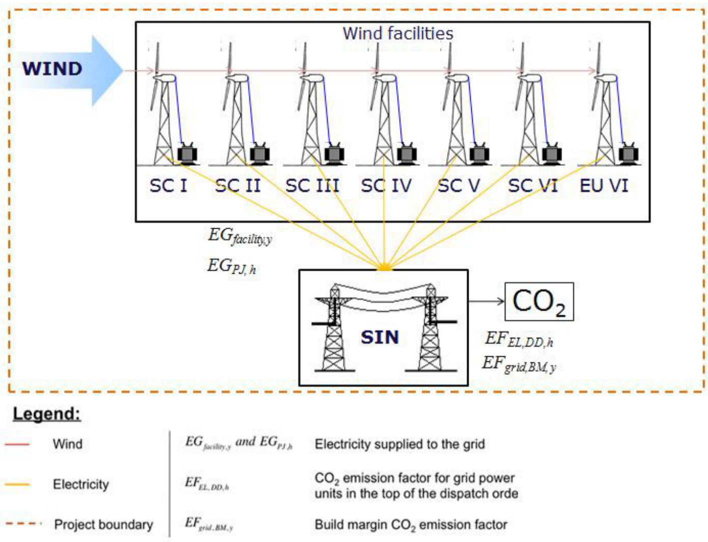

Figure 1: Project boundary. Monitored variables are depicted. Baseline emissions consist of CO_2 emissions from fossil fuel combustion for the generation of electricity by the plants connected to SIN as reflected in its combined margin.

The project activity contributes to the host country's sustainable development in the following ways:

- Contribution to local environmental sustainability: The project activity will produce renewable electricity from low environmental impact wind power plants;
- Contribution to the net workplace generation: New job posts will be created by the project activity, especially during project implementation;
- Contribution towards the diversification of the electric mix and towards energetic security: The period when there is the greatest abundance of wind resources is coincident with the period of the smallest hydraulic availability, in Brazil. Hence, wind-based electricity generation is complementary to hydroelectricity, which contributes to the security of renewable electricity supply throughout the year and, hence, to the diminishment of the dependence upon fossil fuels during the dry season[1].
- Contribution to technological learning and technological development: This type of project can stimulate similar initiatives inside the Brazilian energy sector and encourage the development of modern and more efficient renewable energy units throughout Brazil.

A.2. Location of project activity

>> The project activity is located in Parazinho city, Rio Grande do Norte State, Brazil.

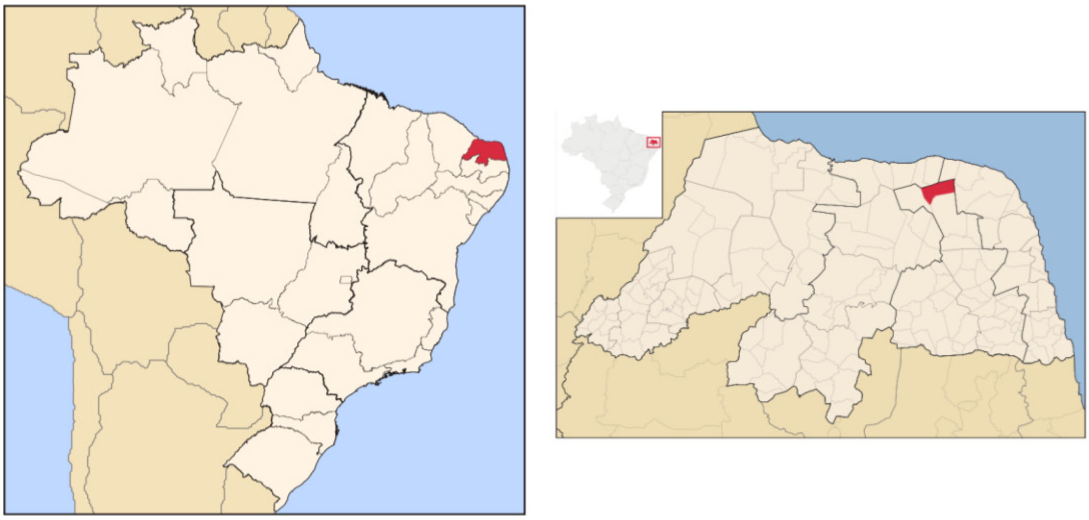

Figure 2: Geographic location of the project activity. Left panel: the localization of the Rio Grande do Norte state within Brazil is depicted in red. Right Panel: the localization of the municipality of Parazinho in the Rio Grande do Norte state is depicted in red.

The reference geographic coordinates of the units of the project activity are depicted in Table 3.

Table 3: Reference geographic coordinates of the project units

Unit Name	Latitude	Longitude
Santa Clara I	- 5.2611	- 35.8982
Santa Clara II	- 5.2529	- 35.9091
Santa Clara III	- 5.2716	- 35.9129
Santa Clara IV	- 5.2393	- 35.9077
Santa Clara V	- 5.2647	- 35.9270
Santa Clara VI	- 5.2374	- 35.9160
Eurus VI	- 5.2352	- 35.9368

[1] Brasil, Agência Nacional de Energia Elétrica, Atlas de Energia Elétrica do Brasil (Brasília, DF: ANEEL) <http://www.aneel.gov.br/aplicacoes/Atlas/download.htm>.

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil	CPFL Geração de Energia S/A (Private entity)	No

A.4. References to applied methodologies and standardized baselines

>> Approved consolidated baseline and monitoring methodology **ACM0002** – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 12.1.0.
Link: https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG

This methodology also refers to the latest approved versions of the following tools:

TOOL 05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" – version 03.0
Link: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

TOOL 07: "Tool to calculate the emission factor for an electricity system", version 07.0
Link: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

A.5. Crediting period type and duration

>> 01/03/2014 – 28/02/2014 (Fixed)

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

>> The proposed project activity consists in the implementation and operation of seven new wind electricity generation facilities, Santa Clara I, II, III, IV, V, VI and Eurus VI, located in Parazinho, in the Rio Grande do Norte state, Brazil. The project activity makes use of 94 horizontal-axis aerogenerators (model: Enercon E82 E2), each with 2.0 MW (total nominal capacity: 188 MW). Santa Clara I, II, III, IV, V, VI will use 15 aerogenerators each, whereas Eurus VI will use the remaining 4 aerogenerators.

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[2] As per document ANEEL Dispatch # 500, of 28/02/2014.

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Wind class*	IEC IIA
Rotational speed	6 to18 rpm
Rotor	
Power Control	Pitch
Diameter	82 m
Swept area	5,281 m^2
Blade material type	Epoxy-bounded fibreglass
Generator	
Type	ENERCON direct-drive synchronous annular generator
Rated power	2,000 kW
Protection	IP 23
Braking system	
Aerodynamical brake	- 3 independent systems with blade pitching mechanism - Rotor Brake - Rotor Lock
Certification*	Compliance with IEC 61400-1: Wind turbines – Part 1: Design requirements, 3rd Edition 2005-08 – Wind Turbine Class II A

Source: ENERCON E-82 E2 2MW – Aerogenerator Characteristics (*Características do Aerogerador)*. *Type Certificate TC 100201, Rev. 0

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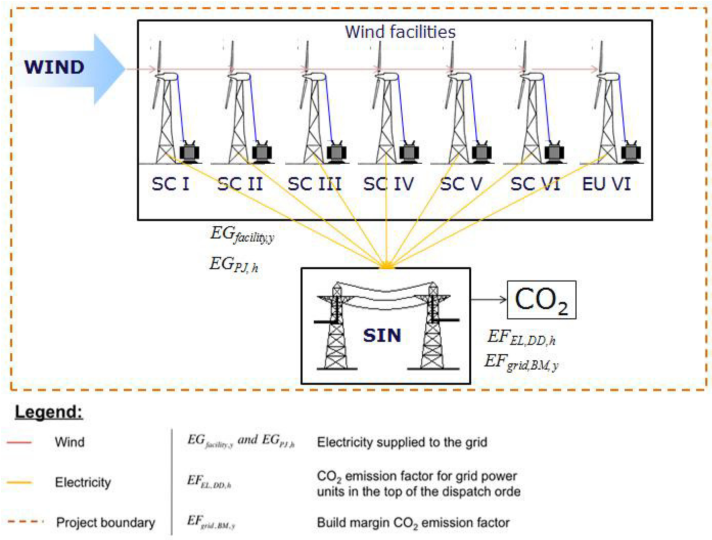

Figure 3: Project boundary. Monitored variables are depicted. Baseline emissions consist of CO_2 emissions from fossil fuel combustion for the generation of electricity by the plants connected to SIN as reflected in its combined margin.

Table 6: Metering Calibration datas

Nº	METERS IDENTIFICATION		DATE OF ISSUE	VALIDITY
1	Number: MN-1206A056-0 Manufacturer: Schneider Electric Model: ION8800C	Main meter Line 1	07/08/2015	5 years
2	Number: MN-1206A053-01 Manufacturer: Schneider Electric Model: ION8800C	Backup meter Line 1	07/08/2015	5 years
3	Number: MN-1206A054-01 Manufacturer: Schneider Electric Model: ION8800C	Main meter Line 2	07/08/2015	5 years
4	Number: MN-1206A055-01 Manufacturer: Schneider Electric Model: ION8800C	Backup meter Line 2	07/08/2015	5 years

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

>> Corrections were made on a new revised PDD (version 4 of 03/04/2020) for:

- PP contact details;
- Grid emission factor update for years 2014 to 2019 (provided by DNA);
- Information about current operational licenses and Letter of Approval was included.

See PRC-5495-001 approved on 31/05/2020 (link: https://cdm.unfccc.int/PRCContainer/DB/prcp730572257/view).

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

>> The start date of the crediting period was changed from 01 Jul 12 - 30 Jun 22 to 01 Mar 14 - 28 Feb 24 (fixed) as per PRC-5495-001 approved on 31/05/2020 (link: https://cdm.unfccc.int/PRCContainer/DB/prcp730572257/view).

B.2.4. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

>> Not Applicable

B.2.5. Changes to project design

>> Not Applicable

B.2.6. Changes specific to afforestation or reforestation project activity

>> Not Applicable

SECTION C. Description of monitoring system

>>

1 - General Considerations:

The monitoring plan is to ensure the complete, consistent, clear, and accurate monitoring and calculation of the emissions reductions achieved by the project activity during the whole crediting period. The project operator (CPFL Geração de Energia S/A) is responsible for the implementation of the monitoring plan on which is based in monitoring the net electricity dispatched to the grid and the emission factor of the electricity grid.

2 - Data and Parameters monitored:

Net electricity dispatched to the grid – $EG_{facility,y}$

Monitoring consists of metering the net electricity generated by the project activity (meters located in João Câmara substation). Measurement results will be crosschecked with the data provided in the Electric Energy Commercialization Chamber (*Câmara de Comercialização de Energia Elétrica* – CCEE SINERCOM) databank. Data will be measured continuously and will be consolidated hourly and monthly. Records pertaining to the meters used in the project activity (type, model and calibration reports) shall be kept accordingly.

The Operator of National Electric System (*Operador Nacional do Sistema Elétrico* - ONS) regulates, by means of its Grid Procedures (*Procedimentos de Rede*), inter alia, the measurements of electricity production for invoicing (12nd module). Information related to this module are necessary to maintain the Measurement for Invoicing System (*Sistema de Medição para Faturamento* – SMF) according to the standard specified in the document Technical Specifications of Measurement for Invoicing (*Especificação Técnica das Medições para Faturamento*) to assure not only the control of energy accounting process by CCEE, but also the determination of demands by ONS.

Generally, SMF is a system composed of the main and backup measurers, by the potential and current transformers, the channels of communication between energy agent/project participant and CCEE, and the system for data collection and measurement for invoicing. In this PA there are 2 electricity lines connecting

the WPPs with João Câmara Substation. For each line there are 2 meters (main and backup). So 4 meters on total.

According to the ONS Grid Procedures – Submodule 12.1, the SMF should be installed in the connection of the plants with the energy network to measure the net generation of these plants, which will be used for accounting and settlement of electricity in the CCEE.

Data stored on the meters is collected by the System of Energy Data Collection (*Sistema de Coleta de Dados de Energia* – SCDE) of CCEE, remotely and automatically through direct access to the meters of the project participant. These collected data are processed in SCDE for electricity accounting by CCEE and are available to all energy market participants to control their respective incomes.

The energy meters are: multi-phase, 3 elements, 4 wire (for 4 wire systems), of system rated frequency, rated current according to the secondary of current transformer, nominal voltage according to the secondary of potential transformer. The meters have independence of elements and sequence of phases, ensuring the same performance in monophasic and three-phasic testing.

The measurement systems are designed and implemented in accordance with the standards of the Brazilian Association of Technical Standards (*Associação Brasileira de Normas Técnicas* – ABNT) or International Electrotechnical Commission - IEC, ensuring the quality of the system. In addition, the meters have certificate of conformity of design approved and issued by the National Institute of Metrology Standardization and Industrial Quality (*Instituto Nacional de Metrologia, Normalização e Qualidade Industrial* – INMETRO).

Regarding the class of accuracy of energy meters, they meet all relevant metrological requirements prescribed in Metrological Technical Regulation (*Regulamento Técnico Metrológico* – RMT) for Class 0.2 of energy meters, approved by INMETRO. Class 0.2 of energy meter, also identified as index D energy meters admits error in measurements of up to + / - 0.2%.

The energy meters possess mass memory capable of storing the data of active, reactive and demand energy in a bidirectional manner, voltages and currents at intervals of integration programmable from 5 to 60 minutes during the minimum period of 32 days. These meters are equipped with a system of preservation and salvage of records in case of power loss, storing data in non-volatile memory for at least 100 hours. In addition, they possess at least two independent communication ports with concurrent access or that allow the prioritization of one of them. One is for the exclusive use of the CCEE and the other for access of agents involved in the measurement point. The CCEE communication port will be coupled to a stable and good performance internet channel, which will be established under a VPN tunnel (Virtual Private Network) between the meter and the CCEE. The meters will be able to manage concurrent access to its communications ports in order to allow full time access to mass memory records of meters via CCEE communication port.

Besides electricity measurements are performed by the project owners, all the electricity dispatched to the grid by the project activity is monitored online by CCEE. This entity is responsible for the monthly readings and keeping the records of the energy generated. If any problem happens at the local meter level, the reading lecture corresponding to the amount of energy during the time of the problem will not be lost due to online reading performed by CCEE. As mentioned before, in order to assure the quality of data used in the emission reductions calculation, the project proponents will provide access to the DOE the records of CCEE databank, because the data from this entity will serve to crosscheck the electricity dispatched to the grid.

Backup meters are equal or equivalent to the main meters, installed on the same panel, with the same information for current and voltage and under the same technical standards.

In order to ensure the effectiveness operation of SMF, preventive maintenance must be carried out and, where necessary, also corrective maintenance. Inspections are also conducted in order to verify the correct operation of meters.

The calibration of meters has being conducted by a qualified organization that must comply with national standards and industrial regulations to ensure the accuracy. After calibration, the meters must be sealed to assure the safety and the calibration certificates must be archived with the other monitoring records. The deadline for meter's calibration follows, therefore, the "Grid Procedures" from the ONS Module 12, Sub-module 12.3. By the time of completion of this document, the frequency of calibration is a maximum of five years, but in the case of any changes occurred in the ONS Grid Procedures, the project owners shall follow the rules from the relevant sector organizations (e.g. ONS, ANEEL, CCEE, etc).

All the meters installed were tested and calibrated in accordance with regulations provided by CCEE where all the requirements were fulfilled. Moreover if any errors are detected in the measuring device, it will be immediately replaced by the backup meter that will be previously calibrated. The damaged measuring device will be repair, recalibrate and will return to the monitoring system.

Emission Factor: $EF_{grid,OM,y}$, $EF_{grid,BM,y}$ and $EF_{grid,CM,y}$

The monitoring plan also includes parameters such as the operating margin CO_2 emission factor for power units in the top of the dispatch order ($EF_{grid,OM,y}$), the build margin CO_2 emission factor ($EF_{grid,BM,y}$) of SIN and the combined margin CO_2 emission factor ($EF_{grid,CM,y}$),). These parameters will be obtained from the Brazilian Interministerial Commission for Climate Change, which calculates and publishes $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ according to the most recent version of the "Tool to calculate the emission factor for an electricity system". These published parameters, along with the records of the net electricity supplied to SIN by the project activity, will be used for the calculation of the yearly combined margin ($EF_{grid,CM,y}$) and, ultimately, for the calculation of the emission reductions achieved by the project activity.

All data collected as part of monitoring will be archived and kept at least for 2 years after the end of the crediting period or 2 years after the last issuance of CER for this project activity, whichever occurs later.

3 - Monitoring Structure

The monitoring of the data from the project activity will be done centrally at the *Centro de Operação da Geração* – COG, situated at the CPFL Energia headquarters, in Campinas – São Paulo. The COG account with the support of a data remote reading system known as ZFA, manufactured by the German company ITF / EDV. This system is able to communicate with protocols and systems simultaneously, performing the collection, transport and availability of measurement data. The ZFA has a database and a communication server, integrated with the meters used in the monitoring plan.

The generation data are stored, and the system allows the reporting within the daily, weekly, monthly or yearly periodicity, according to user request. The query to the server can be made online by CPFL and CCEE, which accesses in the real-time the gross and the net electricity generation by the seven units of the project activity. The monitoring routine is already a common practice for the project proponent, since CPFL has other projects in operation inside the Clean Development Mechanism – CDM.

The operational and management structure that the project operator implemented in order to monitor emission reductions achieved by the project activity is given in the flowchart below:

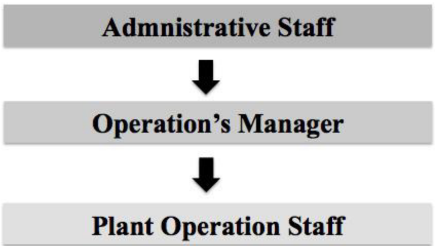

Figure 4: Operational and management structure that the project operator will implement in order to monitor emission reductions achieved by the project activity.

The roles and responsibilities within the structure outlined in are described in detail in the paragraphs below.

Administrative Staff: Responsible for go along with the auditor during the verification visit and provide all necessary documents related to the records of the net electricity supply to the grid. If applicable, at the time of verification by DOE, the Administrative Staff will provide access to the records of CCEE databank in order to demonstrate that electricity generation data is consistent and accurate. The Administrative Staff will forward all electronic media-based information to the CDM Consultancy Company at a minimum bimonthly frequency.

Operation`s Manager: Responsible for the general supervision of the COG (*Centro de Operação da Geração*) and for the record keeping and indexing of the data pertaining to the net electricity supply to the grid. Its attributions also include ensuring that the monitored data pertaining to the net electricity generation

is continuously sent (online) to the Electric Energy Commercialization Chamber (CCEE – *Câmara de Comercialização de Energia Elétrica*).

Plant Operation Staff: Responsible for the general supervision of the plant operation and for the supervision of the metering. Its attributions also include ensuring that meters included in the present monitoring plan are calibrated and undergo maintenance as per the applicable regulations and manufactures' recommendations. Any meter calibration procedures will be reported to the Administrative Staff.

4 - Compilation of Monitoring Reports

Monitored data will be forwarded to the CDM Consultancy Company at a minimum bimonthly basis. Besides being responsible for collecting the information pertaining to the calculation of the grid emission factor ($EF_{grid,OM,y}$ and $EF_{grid,BM,y}$), the CDM consultancy company will compile monitoring reports and is responsible for the calculation of the emission reductions achieved by the project activity.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	w_{OM}
Unit	%
Description	Operating Margin weight
Source of data	Tool to calculate the emission factor for an electricity system
Value(s) applied	75
Choice of data or measurement methods and procedures	Deafult
Purpose of data/parameter	Emission factor calculation.
Additional comments	

Data/Parameter	w_{BM}
Unit	%
Description	Building Margin weight
Source of data	Tool to calculate the emission factor for an electricity system
Value(s) applied	25
Choice of data or measurement methods and procedures	Default
Purpose of data/parameter	Emission factor calculation.
Additional comments	

D.2. Data and parameters monitored

Data/Parameter	$EG_{facility,y}$
Unit	MWh
Description	Quantity of net electricity generation supplied by the project plant to the grid in year y
Measured/calculated/ default	Measured.
Source of data	Electricity meters (main and backup) located in João Câmara Substation

Value(s) of monitored parameter	2014= 499,374.64
Monitoring equipment	Four meters type ION8800C (two main and two back-up) installed in 2 metering panels, which is in João Câmara substation. The main meters have serial numbers MN-1206A056-0 and MN-1206A054-01. The back-up meters have serial numbers MN-1206A053-01 and MN-1206A055-01. Both have accuracy class 0.2.
Measuring/reading/recording frequency	Hourly measuring and reading, Monthly Recording.
Calculation method (if applicable)	Not applicable.
QA/QC procedures	The measurement of the energy generated and delivered to the grid will be done by two three-phases four wire electronic redundant meters per line which send data to the grid through a gateway. If the main meter fails the back-up meter starts reading and the information is not lost. The calibration of the meters is done complying with the National System Operator (*Operador Nacional do Sistema* – ONS) regulations.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	Value of 499,374.64 (minus 0.2%) adjusted due to meters calibration delay

Data/Parameter	$EF_{grid,CM,y}$
Unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for the project electricity system in year y
Measured/calculated/ default	Calculated.
Source of data	Based on data provided by the DNA (Designated National Authority).
Value(s) of monitored parameter	2014= 0.5118
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency	Annually.
Calculation method (if applicable)	The Combined Margin is calculated through a weighted-average formula, considering the $EF_{grid,OM-DD,y}$ and the $EF_{grid,BM,y}$ and the weights w_{OM}=0.75 and w_{BM}=0.25 as defined in the latest version of "Tool to calculate the emission factor for an electricity system".
QA/QC procedures	Data will be archived electronically up to two years after the completion of the crediting period.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	

Data/Parameter	$EF_{grid,OM,y}$
Unit	tCO_2/MWh
Description	CO_2 Operating Margin emission factor of the grid, in a year *y*
Measured/calculated/ default	Calculated.
Source of data	Data provided by the DNA (Designated National Authority) monthly.
Value(s) of monitored parameter	2014= 0.5837
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency	Monthly.

Calculation method (if applicable)	As defined in the “Tool to calculate the emission factor for an electricity system”.
QA/QC procedures	Data will be archived electronically up to two years after the completion of the crediting period.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	This data is available on the web-site: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

Data/Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	CO_2 Build Margin emission factor of the grid, in a year *y*
Measured/calculated/ default	Calculated.
Source of data	Data provided by DNA (Designated National Authority) to the year *y*.
Value(s) of monitored parameter	2014= 0.2963
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency	Annually.
Calculation method (if applicable)	As defined in the “Tool to calculate the emission factor for an electricity system”
QA/QC procedures	Data will be archived electronically up to two years after the completion of the crediting period.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	This data is available on the web-site: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

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

>> The baseline methodology considers the determination of the emissions factor to the grid which the project activity is connected as the core data to be determined in the baseline scenario. In Brazil, the grid is interconnected by the National Interconnected System (SIN) in a single system.

“Operating Margin *OM* Emission Factor” calculation (*$EF_{grid,OM,y}$*)

The Emission Factor (OM) calculated by the Dispatch Data Analysis is summarized as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where:

$EF_{grid,OM-DD,y}$	Dispatch data analysis operating margin CO_2 emission factor in year y (tCO_2/MWh));
$EG_{PJ,h}$	Electricity displaced by the project activity in hour h of year y (MWh);
$EF_{EL,DD,h}$	CO_2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO_2/MWh);
$EG_{PJ,y}$	Total electricity displaced by the project activity in year y (MWh);
h	Hours in year y in which the project activity is displacing grid electricity;
y	Year in which the project activity is displacing grid electricity.

The calculation of the $EF_{grid,OM-DD,y}$ was done using the formula above and the datas from the spreadsheet "***CERs_5495_2014_rev1.xls***" tab "2014".

Below, the summarized value of $EF_{grid,OM,y}$:

$EF_{grid,OM,2014}$ (tCO_2/MWh)	0.5837

"Building Margin *BM* Emission Factor" ($EF_{grid,BM,y}$)

The $EF_{grid,BM,y}$ also is published by the Brazilian DNA annually and it is available in its website[3].

$EF_{grid,BM,2014}$ (tCO_2/MWh)	0.2963

"Baseline Emission Factor" calculation ($EF_{grid,CM,y}$)

The baseline emission factor ($EF_{grid,CM,y}$) is calculated through a weighted-average formula, considering the $EF_{OM,,}y$ = 75% and the $EF_{BM,,}y$ = 20% weighted each, by definition, that gives:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times 0.75 + EF_{grid,BM,y} \times 0.25 \ (tCO_2/MWh)$$

Year	$EF_{grid,OM,y}$ **(tCO2/MWh)**	$EF_{grid,BM,y}$ **(tCO2/MWh)**	$EF_{grid,CM,y}$ **(tCO2/MWh)**
2014	0.5837	0.2963	0.5118

Emission Reduction

The emissions reduction (**ER**) of this project activity is:

$$ER = BE_y - (L_y + PE_y)$$

Since to this project leakages is not considered, thus:

$L_y = 0$

And also the project emission is zero:

$PEy = 0$

So

$$ER = BE_y$$

The baseline emissions (BE_y) would be then proportional to the electricity delivered to the grid throughout the project's lifetime. Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor ($EF_{grid,CM,y}$) with the electricity generation of the project activity (EG_y).

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

[3] http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

Then:

Year	$EF_{grid,CM,y}$ (tCO2/MWh)	EG_y (MWh)	BE_y (tCO_2e)
2014	0.5118	499,374.64	256,027

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

>> According to the project category and the corresponding methodology, project emissions are zero

E.3. Calculation of leakage emissions

>> There is no leakage associated with this project activity

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	256,027	0	0	0	256,027	256,027

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)
256,027	125,199

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

>> The baseline considered in PDD was the determination of the emissions factor to the grid which the project activity is connected as the core data to be determined in the baseline scenario. In Brazil, the grid is interconnected by the National Interconnected System (SIN) in a single system.

"Operating Margin Emission Factor (OM)" calculation ($EF_{grid,OM-DD,y}$)

The Dispatch Data emission factor (OM), is summarized as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where:

$EF_{grid,OM-DD,y}$	Dispatch data analysis operating margin CO_2 emission factor in year y (tCO_2/MWh));
$EG_{PJ,h}$	Electricity displaced by the project activity in hour h of year y (MWh);
$EF_{EL,DD,h}$	CO_2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO_2/MWh);
$EG_{PJ,y}$	Total electricity displaced by the project activity in year y (MWh);
h	Hours in year y in which the project activity is displacing grid electricity;
y	Year in which the project activity is displacing grid electricity.

For effect of *ex-ante* operation margin emission factor calculation was used the 12 last monthly emission factors published by the DNA
(**2009 year:** http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html)

Average Monthly Factor (tCO_2/MWh)												
year	2009											
month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EF	0.2813	0.2531	0.2639	0.2451	0.4051	0.3664	0.2407	0.1988	0.1622	0.1792	0.181	0.194

So the average Operation Margin Emission Factor is:

$EF_{grid,OM\text{-}DD,y}$ **= 0.2476**

"Build Margin Emission Factor (BM)" calculation ($EF_{grid,BM,y}$)

According to the used methodology, the build margin emission factor (BM) also needs to be calculated:

$$EF_{grid,BM,y} = \frac{\sum_{i,m} EG_{m,y}.EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year *y* (tCO_2/MWh);

$EG_{m,y}$ Net quantity of electricity generated and delivered to the grid by power unit m in year *y* (MWh);

$EF_{EL,m,y}$ CO_2 emission factor of power unit m in year *y* (tCO_2/MWh);

m Power units included in the build margin.

For the build margin emission factor $EF_{grid,BM,y}$ was adopted also the 2009 year value published by the DNA.

$EF_{grid,BM,y}$ **= 0.0794**

"Baseline Emission Factor" calculation ($EF_{grid,CM,y}$)

Finally, the baseline emission factor (*EFy*) is calculated through a weighted-average formula, considering both the EF_{OMy} and the EF_{BMy} that gives:

$EF_{grid,CM,y}$= 0.2476 x 0.75+0.0794 x 0.25 = 0.2055 (tCO_2/MWh)

$EF_{grid,CM,y} = EF_{CO2,grid,y}$

The Emission Reductions for this project activity are:

$$ER = BE_y - L_y - PE_y$$

The baseline emissions would be then proportional to the electricity delivered to the grid throughout the project's lifetime. Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor ($EF_{grid,CM,y}$) for the electricity generated by the project activity.

$$BE_y = EG_{BL,y} \times EF_{CO2,grid,y}$$

The electricity energy generated by the project activity ($EG_{BL,y}$) in the year *y* was estimated in 609,243.55 MWh/year.

So the baseline emissions are:

BE_y = 609,243.55 x 0.2055 = **125,199 tCO_2e/year**

To this project the leakage aren´t considered, so:

***L_y* = 0**.

As mentioned the (PE_y) is zero:

***PE_y* =0**

Thus all this, the Emission Reductions (ER) from the project activity are:

ER = 125,199 – 0 – 0 = **125,199 tCO_2e/year**

E.6. Remarks on increase in achieved emission reductions

>> The amount estimated ex-ante for this monitoring period (same period) in PDD was **125,199** tCO_2e but was achieved **256,027** tCO_2e (increase of 104%).

The increase is due to the difference between the emissions factors used in PDD, *ex-ante*, versus the ones *ex-posts*, see the differences in the table below:

Year	$EF_{CO2,grid,y}$ *ex-ante*	$EF_{CO2,grid,y}$ *ex-post*	Difference (%)
2014	0.2055	0.5118	149%

The electricity generation was below than forecasted in PDD, see table below:

Year	$EG_{facility,y}$ *ex-ante*	$EG_{facility,y}$ *ex-post*	Difference (%)
2014	609.243,55	499,374.64	-18%

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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