



**Monitoring report form for CDM programme of activities
(Version 03.0)**

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

MONITORING REPORT

Title of the PoA	Brazilian PoA for NAMA incentivized NCRE Projects	
UNFCCC reference number of the PoA	PoA 10286	
Version numbers of the PoA-DD applicable to this monitoring report	04.1	
Version number of this monitoring report	2.2	
Completion date of this monitoring report	03/09/2020	
Monitoring period number	1 st	
Duration of this monitoring period	01/01/2017 – 31/12/2019	
Monitoring report number for this monitoring period	1	
Coordinating/managing entity	ENGIE Brasil Energia S.A.	
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)
	Brazil	Yes
	-	-
Applied methodologies and standardized baselines	ACM0002 ver. 16 - Grid-connected electricity generation from renewable sources	
Sectoral scopes	1 : Energy industries (renewable - / non-renewable sources)	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	234,859
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs covered in this monitoring report	400,951	

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

The objective of the Brazilian Programme of Activities for Nationally Appropriate Mitigation Actions incentivized Non-Conventional Renewable Energy Projects (or by simplification “*Brazilian PoA for NAMA incentivized NCRE Projects*”) is to contribute to environmental, social and economic sustainability by promoting the development of NCRE sources as an alternative to the dispatch of electricity from existing fossil fuel thermal power plants and the development of new power plants based on GHG intensive generation.

The Component Project Activities (CPAs) included in the PoA are implemented within the Brazilian national territory and connected to the Brazilian Interconnected System (from the Portuguese Sistema Interligado Nacional – SIN) and consist of new (Greenfield) solar, wind, small hydro (up to 30 MW), geothermal, wave and tidal power plants. The CPAs included in the PoA reduce greenhouse gas (GHG) emissions by displacing electricity that would have otherwise been generated by the operation of power plants and by the addition of new generation sources connected to the SIN.

The PoA fosters the implementation of multiple NCRE projects, providing an important contribution to renewable and clean non-conventional alternatives for electricity generation and achievement of the country’s voluntary climate change mitigation goals. The PoA also sustainably develop regional economies and consequently increase the quality of life in local communities.

A.1.1. Corresponding generic component project activities (CPAs)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Method for Wind, Solar, Wave and Tidal Projects	04.1	01	ACM0002 “Grid-connected electricity generation from renewable sources”; version 16.0

A.1.2. CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
10286-P1-0001-CP1: Santa Mônica Wind Complex	04.1	Method for Wind, Solar, Wave and Tidal Projects	Renewable: 01/01/17 - 31/12/23	NO
10286-P1-0002-CP1: Assú V Solar Power Plant	04.1	Method for Wind, Solar, Wave and Tidal Projects	Renewable: 01/01/18 - 31/12/24	NO
10286-P1-0003-CP1: Floresta Solar Power Complex	04.1	Method for Wind, Solar, Wave and Tidal Projects	Renewable: 01/01/18 - 31/12/24	YES
10286-P1-0004-CP1: Paracatu Solar Power Complex	04.1	Method for Wind, Solar, Wave and Tidal Projects	Renewable: 01/01/19 - 31/12/25	YES
10286-P1-0005-CP1: Campo Largo Wind Complex (Phase 1)	04.1	Method for Wind, Solar, Wave and Tidal Projects	Renewable: 01/01/19 - 31/12/25	NO
10286-P1-0006-CP1: Umburanas Wind	04.1	Method for Wind, Solar, Wave and Tidal Projects	Renewable: 01/01/19 - 31/12/25	NO

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
Complex (Phase 1)				
10286-P1-0007-CP1: Campo Largo Wind Complex (Phase 2)	04.1	Method for Wind, Solar, Wave and Tidal Projects	Renewable: 21/11/20 - 20/11/27	NO

A.2. Coordinating/managing entity

ENGIE Brasil Energia S.A.

SECTION B. Implementation of PoA

B.1. Description of implemented PoA

The PoA fosters the implementation of multiple NCRE projects, providing an important contribution to renewable and clean non-conventional alternatives for electricity generation and achievement of the country's voluntary climate change mitigation goals. The PoA also sustainably develop regional economies and consequently increase the quality of life in local communities.

All CPAs included in the PoA are implemented within Brazil's geographical boundary and are connected to the National Interconnected System (SIN).

B.2. Post-registration changes to PoA

B.2.1. Corrections

☐ Applicable / ☒ Not applicable

Justification: No corrections have occurred.

B.2.2. Inclusion of monitoring plan

☐ Applicable / ☒ Not applicable

Justification: There is/was no post-registration change to include a monitoring plan into the PoA-DD, for which the delayed submission of the monitoring plan was chosen by the coordinating/managing entity at the time of the registration of the PoA.

B.2.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

☐ Applicable / ☒ Not applicable

Justification: No permanent changes from registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents have occurred.

B.2.4. Changes to programme design

☐ Applicable / ☒ Not applicable

Justification: No changes to programme design have occurred.

B.2.5. Changes specific to afforestation or reforestation activities

☐ Applicable / ☒ Not applicable

Justification: The CPAs included in the PoA do not involve afforestation or reforestation activities.

PART II Monitoring of CPAs

This Monitoring Report covers the first monitoring period of the PoA, from 01/01/2017 to 31/12/2019, for the following CPAs:

CPA Ref. Number	CPA Title	Inclusion Date	Crediting Period Start and End Dates
10286-P1-0003-CP1	Floresta Solar Power Complex	27/10/2017	01/01/2018 – 31/12/2024
10286-P1-0004-CP1	Paracatu Solar Power Complex	27/10/2017	01/01/2019 – 31/12/2025

SECTION C. Implementation of CPAs**C.1. Description of implemented CPAs****CPA 10286-P1-0003-CP1: Floresta Solar Power Complex**

The Floresta Solar Power Complex (hereinafter referred to as the CPA Floresta) consists of the installation of greenfield PV power plants located in the municipality of Areia Branca, state of Rio Grande do Norte (RN), North-eastern region of Brazil. The power plants are connected to the National Interconnected System (from the Portuguese “Sistema Interligado Nacional - SIN”).

The CPA Floresta consists of three solar power plants (Floresta I, Floresta II and Floresta III), totalling 86 MW installed capacity and 221,386 MWh/year estimated net energy generation on a P50 basis¹. The beginning of the testing phase started in November 2017 and the operation start-up occurred in December 2017. The estimated average emissions reductions to be generated by the project in the first crediting period are 119,805 tCO₂e/year.

The CPA is a greenfield grid-connected PV power plants. It consists of the installation of 317,160 PV modules with 320 Wp each and 86 inverters with 1,000 kW, totalling 86 MW installed capacity.

¹ Solarimetric Certificates # 16MJBRD287, # 16MJBRD288 and # 16MJBRD289, issued by MegaJoule on 07/11/2016.

P50 is the energy that the power plant is 50% likely to produce, given the uncertainties in the measurement, analysis and equipment operation. The adoption of the P50 is used in Energy Auctions promoted by the Brazilian Government as presented in EPE-DEE-RE-065/2013-r2. The use of P50 meets the requirements required by the document "Guidelines for the reporting and validation of plant load factors" (version 1) from the CDM Executive Board (Annex 11, EB48).

The main technical parameters of the power plants are presented in the following table according to the solarimetric certificates²:

Table 1 – Main technical specifications of the CPA

GENERAL	Floresta I	Floresta II	Floresta III
Electricity generation – P50 basis	86,014 MWh/yr	86,117 MWh/yr	59,032 MWh/yr
Net electricity generation – P50 basis	82,376 MWh/yr	82,474 MWh/yr	56,536 MWh/yr
Installed capacity	32 MW	32 MW	22 MW
PV MODULES			
Manufacturer	BYD	BYD	BYD
Quantity	118,080	118,080	81,000
Average nominal power	320 Wp	320 Wp	320 Wp
Short-circuit current	9.15 A	9.15 A	9.15 A
Maximum Power Current	8.70 A	8.70 A	8.70 A
Maximum Power Voltage	36.78 V	36.78 V	36.78 V
Dimension (W x H x D)	985 x 1,961 x 29 mm	985 x 1,961 x 29 mm	985 x 1,961 x 40 mm
Nr. Cells	72	72	72
Lifetime	25 years	25 years	25 years
INVERTERS			
Manufacturer	GE	GE	GE
Quantity	32	32	22
Nominal power	1,000 kW	1,000 kW	1,000 kW
Maximum tension	1,500 V	1,500 V	1,500 V
Maximum power point tracking tension range	835 - 1,300 V	835 - 1,300 V	835 - 1,300 V
Maximum Output Current	1,200 A	1,200 A	1,200 A
Dimension (W x H x D)	180 x 200 x 60 cm	180 x 200 x 60 cm	180 x 200 x 60 cm
Lifetime	25 years	25 years	25 years

The electricity generated by Floresta Solar Complex is dispatched to the grid via Areia Branca substation (“SE”). The connection to SIN occurs through around 58 km transmission line connecting Areia Branca SE to Mossoró II SE.

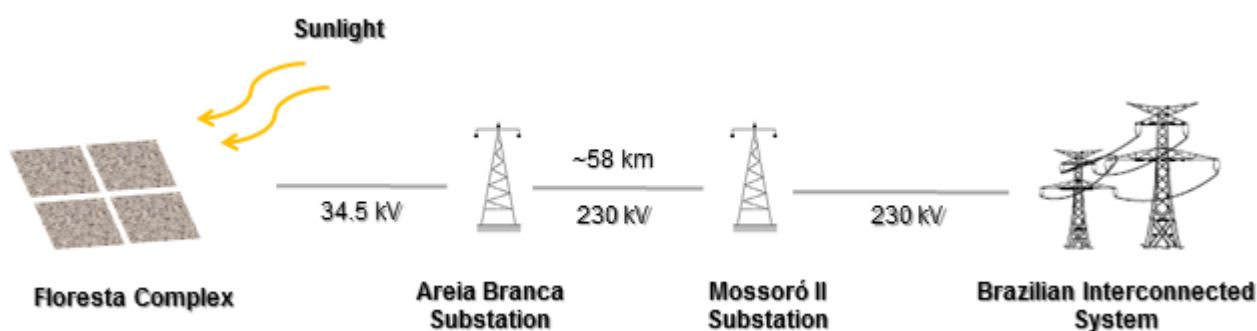


Figure 1 – Simplified diagram of the CPA and its connection to the grid

² Solarimetric Certificates issued by MegaJoule on 07/11/2016 # 16MJBRD287, # 16MJBRD288 and # 16MJBRD289.

The schematic representation of the energy flow and balance of the system and equipment included in the CPA is presented in Section D further below.

CPA 10286-P1-0004-CP1: Paracatu Solar Power Complex

The Paracatu Solar Power Complex (hereinafter referred to as the CPA Paracatu) consists of the installation of greenfield PV power plants located in the municipality of Paracatu, state of Minas Gerais (MG), Southeast-eastern region of Brazil. The power plants are connected to the National Interconnected System (from the Portuguese “Sistema Interligado Nacional – SIN”).

The CPA Paracatu consists of four solar power plants (Paracatu I, Paracatu II, Paracatu III and Paracatu IV), totalling 132 MW installed capacity and 298,138 MWh/year estimated net energy generation on a P50 basis. The beginning of the testing phase started in November 2018 and the operation start-up occurred in January 2019. The estimated average emissions reductions to be generated by the project in the first crediting period are 161,341 tCO₂e/year.

The CPA is a greenfield grid-connected PV power plants. It consists of the installation of 487,080 PV modules with 325 Wp each and 132 inverters with 1,000 kW, totalling 132 MW installed capacity.

The main technical parameters of the power plants are presented in the following table according to the solarimetric certificates³:

Table 2 – Main technical specifications of the CPA

GENERAL	Paracatu I	Paracatu II	Paracatu III	Paracatu IV
Electricity generation – P50 basis	78,407 MWh/yr	77,890 MWh/yr	78,309 MWh/yr	78,137MWh/yr
Net electricity generation – P50 basis	74,745 MWh/yr	74,252 MWh/yr	74,652 MWh/yr	74,489 MWh/yr
Installed capacity	33 MW	33 MW	33 MW	33 MW
PV MODULES				
Manufacturer	BYD	BYD	BYD	BYD
Quantity	121,770	121,770	121,770	121,770
Average nominal power	325 Wp	325 Wp	325 Wp	325 Wp
Short-circuit current	9.23 A	9.23 A	9.23 A	9.23 A
Maximum Power Current	8.79 A	8.79 A	8.79 A	8.79 A
Maximum Power Voltage	36.98 V	36.98 V	36.98 V	36.98 V
Dimension (W x H x D)	98.5 x 196.1 x 2.9 cm	98.5 x 196.1 x 2.9 cm	98.5 x 196.1 x 2.9 cm	98.5 x 196.1 x 2.9 cm
Nr. cells	72	72	72	72
Lifetime	25 years	25 years	25 years	25 years
INVERTERS				
Manufacturer	GE	GE	GE	GE
Quantity	33	33	33	33
Nominal power	1,000 kW	1,000 kW	1,000 kW	1,000 kW
Maximum tension	1,500 V	1,500 V	1,500 V	1,500 V
Maximum power point tracking tension range	835 - 1,300 V	835 - 1,300 V	835 - 1,300 V	835 - 1,300 V

³ Solarimetric Certificates # 1 #17MJBRD013, # #17MJBRD014, # #17MJBRD015 and # #17MJBRD016, issued by MegaJoule on 28/03/2017.

Maximum Output Current	1,250 A	1,250 A	1,250 A	1,250 A
Dimension (W x H x D)	236 x 289 x 72.4 cm	236 x 289 x 72.4 cm	236 x 289 x 72.4 cm	236 x 289 x 72.4 cm
Lifetime	25 years	25 years	25 years	25 years

The electricity generated by Paracatu Solar Complex is dispatched to the grid via UFV Paracatu substation (“SE”). The connection to SIN occurs through around 22 km transmission line connecting UFV Paracatu SE to Paracatu IV SE.

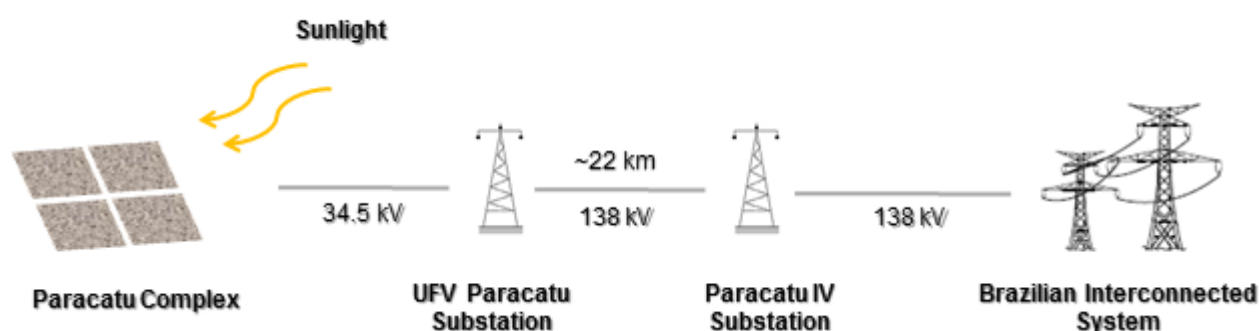


Figure 2 – Simplified diagram of the CPA and its connection to the grid

The schematic representation of the energy flow and balance of the system and equipment included in the CPA is presented in Section D further below.

C.2. Location of CPAs

CPA 10286-P1-0003-CP1: Floresta Solar Power Complex

The CPA Floresta is located in the municipality of Areia Branca, state of Rio Grande do Norte, Northeastern region of Brazil. The GPS coordinates of the PV power plant sites are as follows:

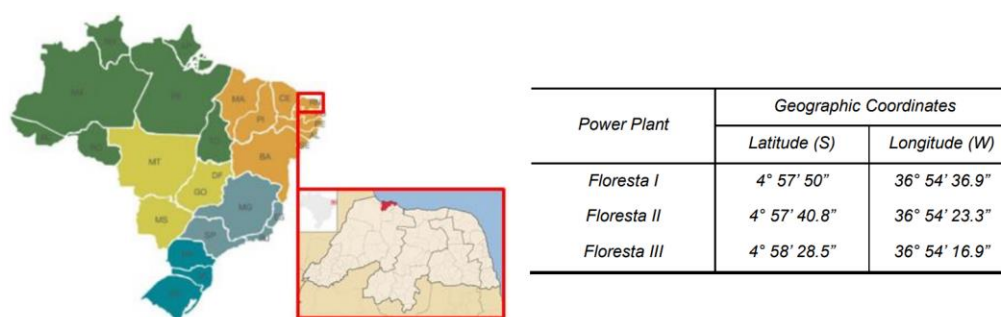


Figure 3: Location of Floresta PV power plant under the PoA boundary
Source: IDEMA (2017)⁴

⁴ IDEMA. Construction Licenses issued for Floresta I, Floresta II and Floresta III on 02/05/2017. All official source related to the CPA (licenses, ANEEL ordinances and solarimetric certificates) presents the project location coordinates in UTM. Therefore, coordinates from Construction License were converted to GMS, while applying SAD69, Z24, South.

CPA 10286-P1-0004-CP1: Paracatu Solar Power Complex

The CPA Paracatu is located in the municipality of Paracatu, state of Minas Gerais, Southeast-eastern region of Brazil. The GPS coordinates of the PV power plant sites are as follows:

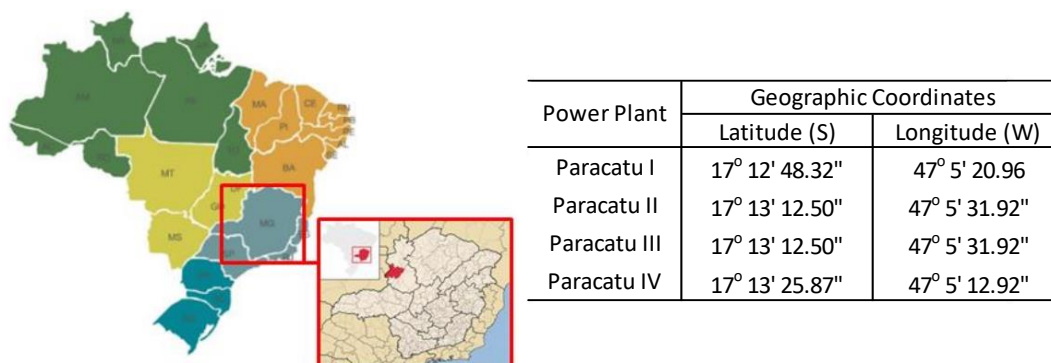


Figure 4: Location of Paracatu PV power plant under the PoA boundary
Source: Minister of State of Mines and Energy⁵

C.3. Post-registration changes to CPAs**C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies, standardized baselines or other methodological regulatory documents**

☐ Applicable / ☒ Not applicable

Justification: No temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies, standardized baselines or other methodological regulatory documents have occurred.

C.3.2. Corrections

☐ Applicable / ☒ Not applicable

Justification: No corrections have occurred.

C.3.3. Changes to the start date of the crediting period

☐ Applicable / ☒ Not applicable

Justification: No changes to the start date of the crediting period have occurred.

C.3.4. Inclusion of monitoring plan

☐ Applicable / ☒ Not applicable

⁵ Minister of State of Mines and Energy. Geographical coordinates were extracted and converted from the following official documents: Ordinance N° 125, of April 26, 2016 (Paracatu I); Ordinance N° 198, of May 25, 2016 (Paracatu II); Ordinance N° 197, of May 25, 2016 (Paracatu III); and Ordinance N° 260, of June 17, 2016 (Paracatu IV).

Justification: There is/was no post-registration change to include a monitoring plan into the CPA-DDs, for which the delayed submission of the monitoring plan was chosen by the coordinating/managing entity at the time of the inclusion of the CPAs, for the CPAs covered in this monitoring report.

C.3.5. Permanent changes to the included monitoring plans, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

☐ Applicable / ☒ Not applicable

Justification: No permanent changes from registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents have occurred.

C.3.6. Changes to project design

☐ Applicable / ☒ Not applicable

Justification: No changes to project designs have occurred.

C.3.7. Changes specific to afforestation or reforestation CPA

☐ Applicable / ☒ Not applicable

Justification: The CPAs included in the PoA do not involve afforestation or reforestation activities.

SECTION D. Description of monitoring system of CPAs

The Monitoring System described below is valid for both CPAs (Floresta and Paracatu), except when their differences are specified.

1. Management Structure and Responsibilities

Overall responsibility for the monitoring activities of the Measurement System for Invoicing Purposes (MSIP) ("*Sistema de Medição para Faturamento - SMF*") lies within the Solaredirect Brasil's Technical Team and O&M Department ("*Departamento de Operação e Manutenção - DOM*") jointly with the CME.

The team is involved with the CPAs daily operation, supervision of the collection, storage, review and reporting of measured project data and other monitoring activities, such as maintenance and follow-up of calibration procedures. The main duties and responsibilities of the staff allocated for conducting monitoring activities will be:

- Data Collection: measurements of the energy generated and delivered to the grid follow Module 12 of the Grid Procedures from ONS (Measurement for Invoicing). This module provides technical specifications for measuring all electricity generated, transmitted and consumed to/from the National Interconnected Grid System (SIN).

The Measurement System for Invoicing Purposes – MSIP (“*Sistema de Medição para Faturamento – SMF*”) comprises two meters (the main meter and the backup one), transformers for instruments (TI’s), communication channels between the Project Developer and the Electric Power Commercialization Chamber (from Portuguese “*CCEE – Câmara de Comercialização de Energia Elétrica*”) and data collection systems. Minimum standards for the main and backup meters are also established by the Module 12 (Sub-Module 12.2, Annex 1).

Data from MSIP (SMF) are stored in database and are available to the Power Plant Supervision Room, which can be extracted in spreadsheet format. As the MSIP was conceived with the clear purpose of assuring high quality and accurate standards for determining the amount of energy produced by the generators connected to the grid, the project data can be also obtained by accessing the CCEE database. As determined by the Module 12 of the Grid Procedures from ONS (Sub-Module 12.1, paragraph 1.7), data that are stored in the meters are remotely and automatically collected by the “Energy Data Collection System - EDCS” of CCEE, through a direct access to the agent’s installed meters or through the “Measurement Collection Unit” used by the agent. The data collected by EDCS are the basis for quantifying and invoicing the energy produced by the component project activity (CPA).

Therefore, the adoption of Module 12 allows for a proper recording and archiving of measured data and assures that all the data generated throughout the crediting period is maintained in at least two databases (project developer’s and CCEE). For the emission reductions calculation purposes, data from CCEE are used as the main source of information for determining the net amount of electricity dispatched to the grid by the component project activity (CPA).

This means that the amount of net electricity dispatched by the CPA to the national grid (SIN) is constantly monitored by the power meters which are monitored online and regularly checked by the CCEE. Such practice is warranted because CCEE has free access to the information stored in the power meters installed at the point in which the component project activity is connected to the Interconnected Grid System (SIN) and thus net electricity is dispatched to the national grid (SIN). The information collected in the power meters is stored in CCEE database.

By accessing the CCEE database, it is possible to obtain different kind of electricity generation reports. CCEE is responsible for the commercialization of electric power within the National Interconnected System, for both Regulated and Free Contracting Environments and for the spot market. Moreover, CCEE is in charge of financial settlement for the spot market transactions. These activities form the Energy Accounting and Financial Settlement Process, which is entirely audited by external auditors, pursuant ANEEL’s Normative Resolution NR. 109, dated 26 October 2004 (Electric Power Commercialization Convention). The Commercialization Rules and Procedures that govern the activities performed by CCEE are defined and approved by ANEEL⁶. Therefore, the quantity of net electricity generation supplied by the project plant/unit to the grid shall be checked through the CCEE (Electric Power Commercialization Chamber) database, which is the official and the most credible source of information for this purpose.

Thus, for the emission reductions calculation purposes, data from CCEE are used as the main source of information for determining the net amount of electricity dispatched to the grid by the component project activity.

⁶ Available at: <https://www.ccee.org.br/portal/faces/pages_publico/quem-somos/estrutura_e_pessoas/governanca?_afzLoop=871069021251743#%40%3F_afzLoop%3D871069021251743%26_adf.ctrl-state%3Dn1yzqtnxx_17>. Accessed on 01/06/2017.

Electricity invoices and/or sales receipts are not suitable for cross-checking purposes, as these documents refer to the values established in the electricity supply contracts or PPAs (Power Purchase Agreements), with a fiscal balance or correction that usually happens after the end of each year as a matter of compensate possible divergences or differences between the amount of electricity contracted and the effective amount of electricity delivered. Hence, the electricity invoices and/or sales receipts may not reflect as accurately the amount of electricity dispatched to the grid by the component project activity as data from CCEE.

This information is kept and archived by the project developer and made available to the DOE. Other physical documents such as paper-based maps, diagrams and environmental assessments are collected in a central place, together with this monitoring plan. All paper-based information is stored by the project owner and all data including calibration records is kept until 2 years after the end of the total crediting period of the CDM project.

- **Calibration:** Calibration of energy meters is regulated by the National Interconnected Power System Operator (ONS) and are conducted by a qualified organization in compliance with national standards and industrial regulations to ensure accuracy. By the time of completion of the CPAs, ONS procedure “Maintenance of the measurement system for billing” (Sub-module 12.3) v2016.12 dated 16/12/2016, establishes a 5-year meters calibration. In case of any update in the ONS Grid Procedures, the project developer will follow the rules from the relevant sector organizations (e.g. ONS, ANEEL, CCEE).

- **Data Report:** Internally, data recorded are consolidated on a monthly basis and are checked for quality control purposes by the appointed staff in the project developer’s head office. The consolidated data are sent to the CME CDM team member(s) of the PoA or any other person indicated as responsible for assessing the correct monitoring of the CPAs.

- **Data Archives:** Generation data are electronically stored in the CME corporative database. In order to assure that relevant generation is appropriately and securely stored, the Information Technology Area conducts an insurance backup for all company’s data through a Data Server backup.

Following these procedures, the CME assures that all relevant data is kept at least 2 years after the end of the crediting period or the last issuance of CERs, whichever occurs later.

2. Quality Assurance and Quality Control

As mentioned above, the meters used for determining the energy supplied to the grid are high accuracy measurement devices and meet all relevant metrological requirements prescribed in Metrological Technical Regulation (*Regulamento Técnico Metrológico – RMT*) for Class 0.2 of energy meters, approved by the National Institute of Metrology, Quality and Technology (INMETRO)⁷.

⁷ From the Portuguese *Instituto Nacional de Metrologia, Qualidade e Tecnologia – INMETRO*.

Procedures for maintenance of the monitoring equipment are conducted in accordance with national procedures and standards.

In addition, the accuracy of the field measurements is assured by coordinated work between the project developer and the CCEE. In this regard, the generation data collected and recorded by the project developer are monthly cross-checked with the energy readings performed by the CCEE. Reports of CCEE provide information of “gross electricity”, losses until the delivery point and net electricity supplied to the grid.

Readings of the electricity generated by the plant are remotely obtained via telemetering. In case of lack of data transmission, electricity generation data can be sent when the system is re-established. If the system does not work, a technical professional shall be sent to the site and data shall be obtained directly from the meters.

3. Training of Monitoring Personnel

Designated people that participate in the monitoring process received proper training, in order to assure the correct application of the monitoring plan of the project.

4. Monitoring Diagrams

4.1. Floresta Monitoring Diagram

Mossoró II SE (*Mossoró Substation*) is operated by CHESF⁸ and it is the CPA's delivery point to the SIN, where there are two energy meters (main and backup). In order to connect to Mossoró II SE, Floresta Complex shares Areia Branca SE (*Areia Branca Substation*) and transmission line infrastructure with 2 (two) operational wind power plants – *Mar e Terra* and *Areia Branca* – through a consortium firm between the Solairedirect and Cubico Brasil S/A.

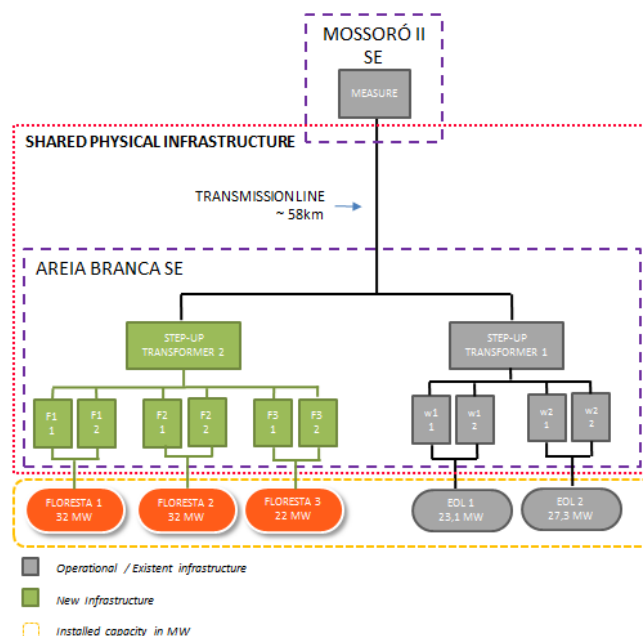


Figure 5: Monitoring infrastructure involved in the CPA Floresta

⁸ CHESF - Companhia Hidro Elétrica do São Francisco. Available at: <https://www.chesf.gov.br>.

In order to monitor electricity generated by Floresta Complex, each solar plant has 2 (two) circuits, each one of them with 2 (two) electricity meters (main and backup meters) located at the 34,5 kV sector of Areia Branca SE (“collector substation”). At the high voltage sector of this substation, there are 2 (two) meters (main and backup) measuring electricity from the 3 (three) solar plants. The same scheme is used at the wind farms, as demonstrated in the figure below. Moreover, there is a circuit in the connection bay at Mossoró II SE (CPA’s delivery point to the SIN), that counts with another pair of meters.

The diagram below illustrates the transmission lines and connection points involved in the CPA Floresta.

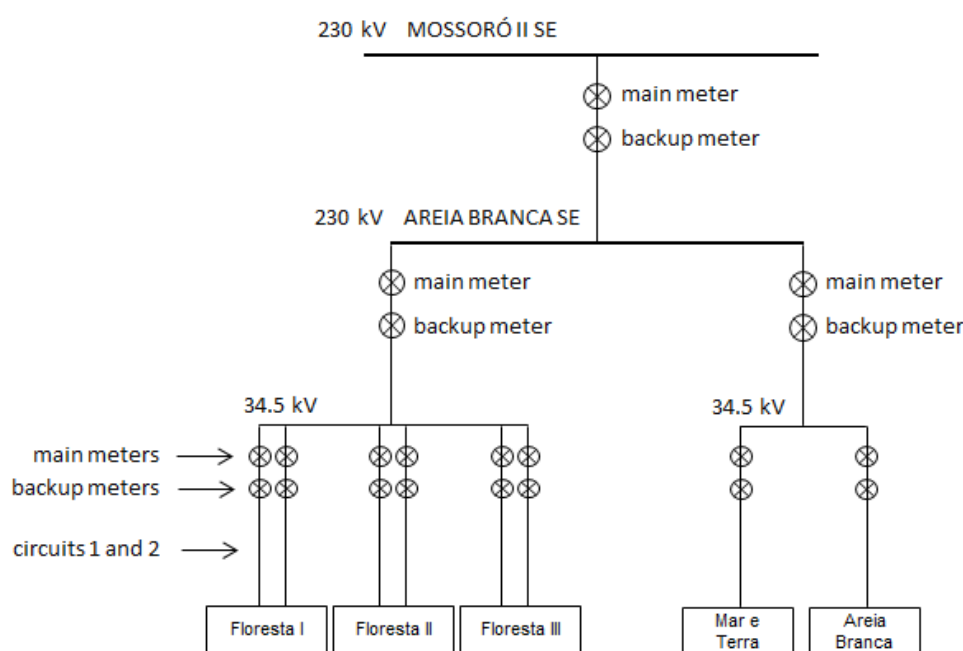


Figure 6: Meters diagram involved in the CPA boundary

Meters located at Areia Branca SE measure the gross electricity generated by Floresta Complex and Mar e Terra and Areia Branca wind power plants. Meters located at Mossoró II SE measure the net electricity while applying losses share applicable to each power plant (EG_y) based on individual meters and readings from meters located at Areia Branca SE. Areia Branca SE is called “the collector substation” and Mossoró II SE is the “delivery point to the SIN”. Although there are energy meters in each power plant and Areia Branca SE, the net electricity produced by the power plants is the one measured at the “delivery point to SIN” and readings from individual power plants and from collector meters serve to calculate losses that are shared among the power plants.

Sharing the infrastructure of transmission use is not uncommon and it is allowed and predicted by the ONS Grid Procedures, established by the Electric System National Operator (from Portuguese “Operador Nacional do Sistema - ONS”). Methodology for accounting electricity generation losses and net electricity dispatch to the grid from power plants sharing the same transmission line are established by ONS “Submodule 12.2 - Installation of the measurement system for invoicing” (in a free translation from the Portuguese “Instalação do Sistema de Medição para Faturamento”).

4.1. Paracatu Monitoring Diagram

Both substations involved in Paracatu Complex – Paracatu SE and Paracatu IV SE – have two energy meters (main and backup). Paracatu SE is the “collector substation” and Paracatu IV SE is the CPA’s delivery point to the SIN, as demonstrated in the figure below.

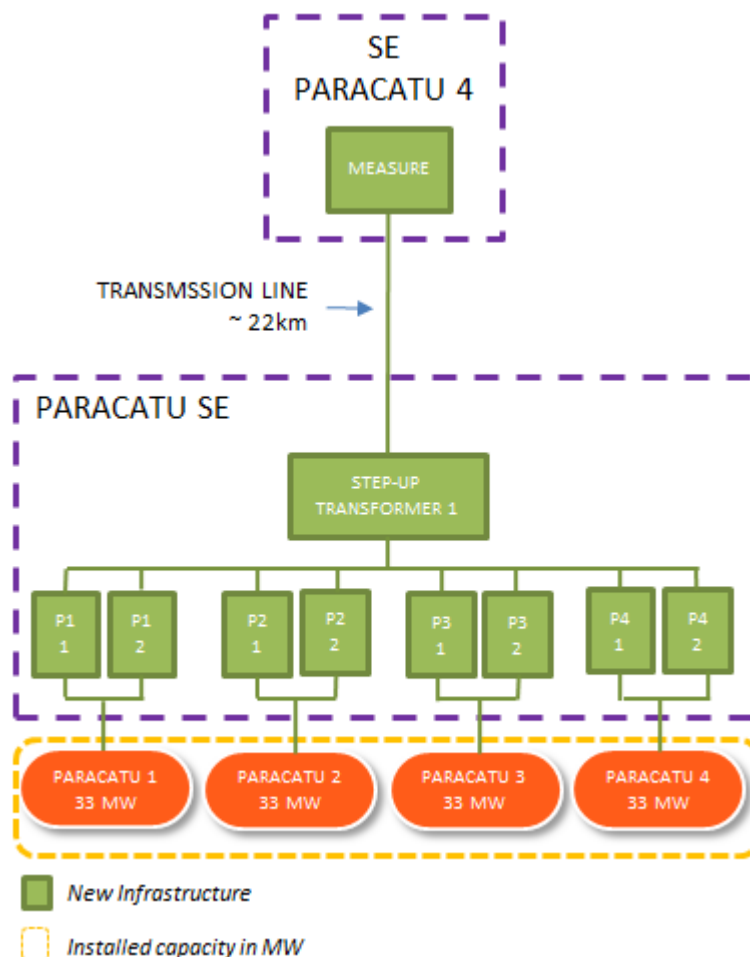


Figure 7: Monitoring infrastructure involved in the CPA Paracatu

In order to monitor electricity generated by Paracatu Complex, each solar plant has 2 (two) circuits, each one of them with 2 (two) electricity meters (main and backup meters) located at the 34,5 kV sector of Paracatu SE (“collector substation”). At the high voltage sector of this substation, there are 2 (two) meters (main and backup) measuring electricity from the 4 (four) solar plants. Moreover, there is a circuit in the connection bay at Paracatu IV SE (CPA’s delivery point to the SIN), that counts with another pair of meters.

The net electricity produced by the power plants is the one measured at the “delivery point to the SIN” and readings from individual power plants and from collector meters serve to calculate losses that are shared among the power plants.

The diagram below illustrates the transmission lines and connection points involved in the CPA Paracatu.

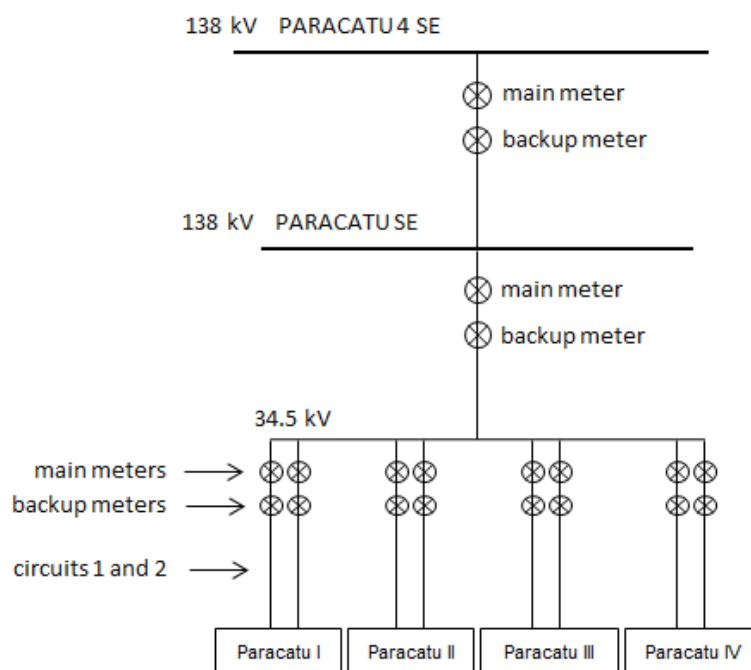


Figure 8: Meters diagram involved in the CPA boundary

In the case of this CPA, all electricity generated by the power plants is dispatched to the same transmission line that connects the collector substation with the concessionaire substation. In case of future power plants are implemented, the transmission line and substation infrastructure can be shared among power plants following requirements established by Electric System National Operator (from Portuguese “*Operador Nacional do Sistema - ONS*”).

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

Data/Parameter	EF _{grid, BM, 2014}
Unit	tCO ₂ /MWh
Description	Build margin CO ₂ emission factor for the project electricity system in year y
Source of data	Brazilian DNA BM emission factor for the year 2014.
Value(s) applied	0.2963
Choice of data or measurement methods and procedures	<p>The Build Margin (BM) emission factor of the Brazilian electricity grid system is calculated by the Brazilian DNA by applying all steps, data and variables required by the latest version of the “Tool to calculate the emission factor for an electricity system”.</p> <p>This data will be archived electronically and according to internal procedures, until 2 years after the end of the crediting period.</p>
Purpose of data/parameter	<p>As per the Attachment “Instructions for completing this form” of the CDM-PoA-MR-FORM (version 03.0), one of the following options has to be chosen:</p> <p><input checked="" type="checkbox"/> (a) Calculation of baseline emissions or baseline net GHG removals by sinks;</p> <p><input type="checkbox"/> (b) Calculation of project emissions or actual net GHG removals by sinks;</p> <p><input type="checkbox"/> (c) Calculation of leakage.</p>

Additional comments	<p>This value is used for the first crediting period of this CPA.</p> <p>The build margin emission factor is based on data from the year 2014 and it has been defined as <i>ex-ante</i> by the project participants.</p>
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E.2. Data and parameters monitored

Data/Parameter	EF _{grid, OM,y}																																																																																																																																																												
Unit	tCO ₂ /MWh																																																																																																																																																												
Description	Operation margin emission factor in year y																																																																																																																																																												
Measured/calculated/default	<input type="checkbox"/> Measured; <input checked="" type="checkbox"/> Calculated; <input type="checkbox"/> Default:																																																																																																																																																												
Source of data	The Brazilian DNA.																																																																																																																																																												
Value(s) of monitored parameter	<p>The values of the monitored parameter “<i>Operating margin emission factor of the Brazilian grid</i>” ($EF_{grid,OM,y}$) are calculated by the Brazilian DNA and made public available at its website, through the following link: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emis_sao_despacho.html.</p> <p>The OM values for the years between 2017 and 2019, used for this monitoring period (covering the period from 01 Jan 2017 to 31 Dec 2019), are provided below. However, the OM values to be considered for the CPAs of Floresta and Paracatu cover the period from 01 Jan 2018 to 31 Dec 2019.</p> <table><tr><th colspan="13">OPERATIONAL MARGIN</th></tr><tr><th colspan="13">Average Emission Factor (tCO₂/MWh) - MONTHLY</th></tr><tr><th>2017</th><th>January</th><th>February</th><th>March</th><th>April</th><th>May</th><th>June</th><th>July</th><th>August</th><th>September</th><th>October</th><th>November</th><th>December</th></tr><tr><td></td><td>0,5419</td><td>0,5148</td><td>0,5867</td><td>0,5905</td><td>0,6086</td><td>0,5846</td><td>0,6052</td><td>0,6102</td><td>0,6060</td><td>0,5997</td><td>0,6019</td><td>0,6078</td></tr></table> <table><tr><th colspan="13">OPERATIONAL MARGIN</th></tr><tr><th colspan="13">Average Emission Factor (tCO₂/MWh) - MONTHLY</th></tr><tr><th>2018</th><th>January</th><th>February</th><th>March</th><th>April</th><th>May</th><th>June</th><th>July</th><th>August</th><th>September</th><th>October</th><th>November</th><th>December</th></tr><tr><td></td><td>0,5652</td><td>0,5559</td><td>0,5750</td><td>0,5058</td><td>0,5461</td><td>0,6691</td><td>0,5989</td><td>0,5948</td><td>0,5718</td><td>0,5782</td><td>0,3654</td><td>0,3423</td></tr></table> <table><tr><th colspan="13">OPERATIONAL MARGIN</th></tr><tr><th colspan="13">Average Emission Factor (tCO₂/MWh) - MONTHLY</th></tr><tr><th>2019</th><th>January</th><th>February</th><th>March</th><th>April</th><th>May</th><th>June</th><th>July</th><th>August</th><th>September</th><th>October</th><th>November</th><th>December</th></tr><tr><td></td><td>0,3540</td><td>0,5573</td><td>0,5075</td><td>0,5095</td><td>0,4794</td><td>0,4175</td><td>0,5914</td><td>0,5312</td><td>0,5606</td><td>0,5370</td><td>0,5720</td><td>0,5997</td></tr></table>	OPERATIONAL MARGIN													Average Emission Factor (tCO ₂ /MWh) - MONTHLY													2017	January	February	March	April	May	June	July	August	September	October	November	December		0,5419	0,5148	0,5867	0,5905	0,6086	0,5846	0,6052	0,6102	0,6060	0,5997	0,6019	0,6078	OPERATIONAL MARGIN													Average Emission Factor (tCO ₂ /MWh) - MONTHLY													2018	January	February	March	April	May	June	July	August	September	October	November	December		0,5652	0,5559	0,5750	0,5058	0,5461	0,6691	0,5989	0,5948	0,5718	0,5782	0,3654	0,3423	OPERATIONAL MARGIN													Average Emission Factor (tCO ₂ /MWh) - MONTHLY													2019	January	February	March	April	May	June	July	August	September	October	November	December		0,3540	0,5573	0,5075	0,5095	0,4794	0,4175	0,5914	0,5312	0,5606	0,5370	0,5720	0,5997
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Monitoring equipment	Not applicable. Values are made public available at the Brazilian DNA website.																																																																																																																																																												
Measuring/reading/recording frequency	Published by the Brazilian DNA on a regular basis.																																																																																																																																																												
Calculation method (if applicable)	Calculation as per the “Tool to calculate the emission factor for an electricity system”.																																																																																																																																																												
QA/QC procedures	Official source of data																																																																																																																																																												
Purpose of data/parameter	As per the Attachment “Instructions for completing this form“ of the CDM-PoA-MR-FORM (version 03.0), one of the following options has to be chosen: <input checked="" type="checkbox"/> (a) Calculation of baseline emissions or baseline net GHG removals by sinks; <input type="checkbox"/> (b) Calculation of project emissions or actual net GHG removals by sinks; <input type="checkbox"/> (c) Calculation of leakage.																																																																																																																																																												
Additional comments	The Operating Margin emission factor shall be used as ex-post during the verifications. This data/information is used for the emission reductions calculation.																																																																																																																																																												

Data/Parameter	EF _{grid, CM,y}																																																																																																				
Unit	tCO ₂ /MWh																																																																																																				
Description	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".																																																																																																				
Measured/calculated/Default	<input type="checkbox"/> Measured; <input checked="" type="checkbox"/> Calculated; <input type="checkbox"/> Default.																																																																																																				
Source of data	Brazilian DNA.																																																																																																				
Value(s) of monitored parameter	<p>The values of the monitored parameter "<i>Combined margin CO₂ emission factor</i>" ($EF_{grid,CM,y}$) are calculated using the "Build margin emission factor" ($EF_{grid,BM,2014}$), which was defined as ex-ante for the whole 1st crediting period of the CPAs (based on data from the year 2014) and the "<i>Operating margin emission factor of the Brazilian grid</i>" ($EF_{grid,OM,y}$), both calculated by the Brazilian DNA and made public available at its website: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html.</p> <p>The Combined Margin (CM) is calculated in the last column of the table below by the sum of the Operating Margin (OM) and Build Margin (BM) multiplied by their respective weighting values ($W_{BM} = 0.25$ and $W_{OM} = 0.75$) as demonstrated below.</p> <table border="1"> <thead> <tr> <th>PERIOD</th><th>BM</th><th>OM</th><th>CM (BM*25%+OM*75%)</th></tr> </thead> <tbody> <tr><td>Jan/18</td><td>0.2963</td><td>0.5652</td><td>0.4980</td></tr> <tr><td>Feb/18</td><td>0.2963</td><td>0.5559</td><td>0.4910</td></tr> <tr><td>Mar/18</td><td>0.2963</td><td>0.5750</td><td>0.5053</td></tr> <tr><td>Apr/18</td><td>0.2963</td><td>0.5058</td><td>0.4534</td></tr> <tr><td>May/18</td><td>0.2963</td><td>0.5461</td><td>0.4837</td></tr> <tr><td>Jun/18</td><td>0.2963</td><td>0.6691</td><td>0.5759</td></tr> <tr><td>Jul/18</td><td>0.2963</td><td>0.5989</td><td>0.5233</td></tr> <tr><td>Aug/18</td><td>0.2963</td><td>0.5948</td><td>0.5202</td></tr> <tr><td>Sep/18</td><td>0.2963</td><td>0.5718</td><td>0.5029</td></tr> <tr><td>Oct/18</td><td>0.2963</td><td>0.5782</td><td>0.5077</td></tr> <tr><td>Nov/18</td><td>0.2963</td><td>0.3654</td><td>0.3481</td></tr> <tr><td>Dec/18</td><td>0.2963</td><td>0.3423</td><td>0.3308</td></tr> <tr><td>Jan/19</td><td>0.2963</td><td>0.3540</td><td>0.3396</td></tr> <tr><td>Feb/19</td><td>0.2963</td><td>0.5573</td><td>0.4921</td></tr> <tr><td>Mar/19</td><td>0.2963</td><td>0.5075</td><td>0.4547</td></tr> <tr><td>Apr/19</td><td>0.2963</td><td>0.5095</td><td>0.4562</td></tr> <tr><td>May/19</td><td>0.2963</td><td>0.4794</td><td>0.4336</td></tr> <tr><td>Jun/19</td><td>0.2963</td><td>0.4175</td><td>0.3872</td></tr> <tr><td>Jul/19</td><td>0.2963</td><td>0.5914</td><td>0.5176</td></tr> <tr><td>Aug/19</td><td>0.2963</td><td>0.5312</td><td>0.4725</td></tr> <tr><td>Sep/19</td><td>0.2963</td><td>0.5606</td><td>0.4945</td></tr> <tr><td>Oct/19</td><td>0.2963</td><td>0.5370</td><td>0.4768</td></tr> <tr><td>Nov/19</td><td>0.2963</td><td>0.5720</td><td>0.5031</td></tr> <tr><td>Dec/19</td><td>0.2963</td><td>0.5997</td><td>0.5239</td></tr> </tbody> </table>	PERIOD	BM	OM	CM (BM*25%+OM*75%)	Jan/18	0.2963	0.5652	0.4980	Feb/18	0.2963	0.5559	0.4910	Mar/18	0.2963	0.5750	0.5053	Apr/18	0.2963	0.5058	0.4534	May/18	0.2963	0.5461	0.4837	Jun/18	0.2963	0.6691	0.5759	Jul/18	0.2963	0.5989	0.5233	Aug/18	0.2963	0.5948	0.5202	Sep/18	0.2963	0.5718	0.5029	Oct/18	0.2963	0.5782	0.5077	Nov/18	0.2963	0.3654	0.3481	Dec/18	0.2963	0.3423	0.3308	Jan/19	0.2963	0.3540	0.3396	Feb/19	0.2963	0.5573	0.4921	Mar/19	0.2963	0.5075	0.4547	Apr/19	0.2963	0.5095	0.4562	May/19	0.2963	0.4794	0.4336	Jun/19	0.2963	0.4175	0.3872	Jul/19	0.2963	0.5914	0.5176	Aug/19	0.2963	0.5312	0.4725	Sep/19	0.2963	0.5606	0.4945	Oct/19	0.2963	0.5370	0.4768	Nov/19	0.2963	0.5720	0.5031	Dec/19	0.2963	0.5997	0.5239
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Monitoring equipment	Not applicable. Calculated based on data provided by Brazilian DNA website.																																																																																																				

Measuring/reading/recording frequency	Calculated using data published by the Brazilian DNA on a monthly basis.
Calculation method (if applicable)	Calculation as per the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures	-
Purpose of data/parameter	As per the Attachment "Instructions for completing this form" of the CDM-PoA-MR-FORM (version 03.0), one of the following options has to be chosen: <input checked="" type="checkbox"/> (a) Calculation of baseline emissions or baseline net GHG removals by sinks; <input type="checkbox"/> (b) Calculation of project emissions or actual net GHG removals by sinks; <input type="checkbox"/> (c) Calculation of leakage.
Additional comments	<p>Values applied have been calculated based on the Build Margin (BM), which is determined as fixed (ex-ante) for the first crediting period according to the registered PoA, and the Operating Margin (OM) from 2017 to 2019. Both BM and OM values are provided by the Brazilian DNA. Although the Build Margin (BM) is determined as fixed (ex-ante) for the first crediting period, the Operating Margin (OM) and the resulting Combined Margin (CM) shall be updated annually during the crediting period.</p> <p>These values are used to calculate the emission reductions achieved by the CPAs during the monitoring and crediting periods.</p> <p>In case the Brazilian DNA discontinues the publication of the $EF_{grid,OM,y}$ during the crediting periods, the CME may choose, for each monitoring period to be verified, the option between: a) to make use of the latest available official data and information as calculated and published by the Brazilian DNA; or b) to conduct the calculations based on data from ONS.</p>

Data/Parameter	EG _{facility,y} (or EG _{PJ,y})				
Unit	MWh/yr				
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y				
Measured/calculated/default	<input checked="" type="checkbox"/> Measured; <input checked="" type="checkbox"/> Calculated; <input type="checkbox"/> Default.				
Source of data	Electricity meters				
Value(s) of monitored parameter	CPA 10286-P1-0003-CP1: Floresta Solar Power Complex				
	FLORESTA	NET ELECTRICITY DISPATCHED TO THE GRID (MOSSORÓ II SE)			
	PERIOD	Floresta I	Floresta II	Floresta III	TOTAL
	Jan/18	3,139.16	1,806.34	995.96	5,941.46
	Feb/18	5,268.67	3,941.57	2,257.95	11,468.19
	Mar/18	5,363.24	4,649.74	2,853.60	12,866.58
	Apr/18	1,341.89	1,106.76	1,101.50	3,550.16
	May/18	3,717.42	2,581.36	2,819.67	9,118.45
	Jun/18	3,680.95	3,748.54	2,519.80	9,949.30
	Jul/18	2,945.37	3,805.32	2,110.17	8,860.86
	Aug/18	2,747.29	4,496.72	1,447.97	8,691.99
	Sep/18	2,115.96	6,562.38	1,455.12	10,133.47
	Oct/18	4,065.71	6,530.46	964.54	11,560.71
	Nov/18	4,938.62	3,504.04	653.44	9,096.10
	Dec/18	4,654.32	2,038.97	347.28	7,040.57
	Jan/19	3,843.08	3,725.60	1,773.24	9,341.91

	Feb/19	2,573.55	4,331.89	1,710.39	8,615.82	
	Mar/19	4,463.80	4,811.15	2,094.74	11,369.68	
	Apr/19	3,795.78	2,615.11	1,302.48	7,713.37	
	May/19	4,287.60	5,134.07	2,861.04	12,282.70	
	Jun/19	4,206.28	4,612.58	2,670.63	11,489.50	
	Jul/19	4,797.07	5,276.42	3,240.73	13,314.23	
	Aug/19	6,016.64	6,181.88	3,580.42	15,778.94	
	Sep/19	6,252.18	6,027.79	3,707.33	15,987.31	
	Oct/19	5,940.77	6,471.55	3,635.30	16,047.61	
	Nov/19	5,914.34	6,090.39	3,225.66	15,230.38	
	Dec/19	6,604.55	5,846.77	3,596.39	16,047.71	
	TOTAL	102,674.24	105,897.40	52,925.33	261,496.97	
	CPA 10286-P1-0004-CP1: Paracatu Solar Power Complex					
	PARACATU	NET ELECTRICITY DISPATCHED TO THE GRID (PARACATU 4 SE)				
	PERIOD	PARACATU I	PARACATU II	PARACATU III	PARACATU IV	TOTAL
	Jan/19	5,758.63	3,041.23	5,932.18	4,937.09	19,669.12
	Feb/19	4,504.97	3,879.24	4,401.28	4,362.47	17,147.96
	Mar/19	4,564.59	4,281.51	4,514.80	4,512.46	17,873.36
	Apr/19	4,119.29	3,697.93	4,052.66	4,115.73	15,985.62
	May/19	4,174.55	4,070.51	3,988.55	4,015.78	16,249.39
	Jun/19	4,352.30	4,225.65	3,738.00	3,970.46	16,286.42
	Jul/19	4,539.83	4,155.74	3,961.81	4,041.59	16,698.97
	Aug/19	5,564.31	4,244.67	5,463.06	4,222.13	19,494.17
	Sep/19	6,549.70	5,003.41	6,975.28	5,780.83	24,309.22
	Oct/19	7,204.26	7,058.98	7,292.01	7,198.95	28,754.20
	Nov/19	4,964.71	4,861.67	5,057.88	4,947.88	19,832.14
	Dec/19	6,267.14	6,103.72	6,273.08	6,360.25	25,004.18
	TOTAL	62,564.27	54,624.26	61,650.61	58,465.62	237,304.76
Monitoring equipment	All electricity meters are model ION 8650, “bi-directional” type, possess an accuracy level of 0.2% or higher and are calibrated or verified with a frequency or interval of up to 5 years. Key information on net electricity meters is summarized below.					
	<u>CPA 10286-P1-0003-CP1: Floresta Solar Power Complex</u>					
	UFV	Power Meter	Descr.	Serial Number	Date of Last Calibration	Validity
	FLORESTA I	M1P	Circuit 1	MW-1703A610-02	12/05/2017	11/05/2022
	FLORESTA I	M1R	Circuit 1	MW-1703A613-02	11/05/2017	10/05/2022
	FLORESTA I	M2P	Circuit 2	MW-1703A595-02	12/05/2017	11/05/2022
	FLORESTA I	M2R	Circuit 2	MW-1703A791-02	12/05/2017	11/05/2022
	FLORESTA II	M3P	Circuit 1	MW-1703A607-02	12/05/2017	11/05/2022
	FLORESTA II	M3R	Circuit 1	MW-1704A038-02	16/05/2017	15/05/2022
	FLORESTA II	M4P	Circuit 2	MW-1703A597-02	12/05/2017	11/05/2022
	FLORESTA II	M4R	Circuit 2	MW-1703A609-02	11/05/2017	10/05/2022

	FLORESTA III	M1P	Circuit 1	MW-1703A603-02	12/05/2017	11/05/2022
	FLORESTA III	M1R	Circuit 1	MW-1703A796-02	12/05/2017	11/05/2022
	FLORESTA III	M2P	Circuit 2	MW-1703A601-02	12/05/2017	11/05/2022
	FLORESTA III	M2R	Circuit 2	MW-1703A799-02	12/05/2017	11/05/2022
	TRAFO T1	MF-T1-P	SMF-T1	MW-1706A061-02	10/07/2017	09/07/2022
	TRAFO T1	MF-T1-R	SMF-T1	MW-1705B681-02	12/07/2017	11/07/2022
	TRAFO T2	MF-T2-P	SMF-T2	MW-1706A008-02	10/07/2017	09/07/2022
	TRAFO T2	MF-T2-P	SMF-T2	MW-1706A048-02	10/07/2017	09/07/2022
	<i>CPA 10286-P1-0004-CP1: Paracatu Solar Power Complex</i>					
	UFV	Power Meter	Descr.	Serial Number	Date of Last Calibration	Validity
	PARACATU I	M1P	Circuit C1	MW-1710B259-02	22/01/2018	21/01/2023
	PARACATU I	M1R	Circuit C1	MW-1711A522-02	17/01/2018	16/01/2023
	PARACATU I	M2P	Circuit C2	MW-1710A303-02	26/01/2018	25/01/2023
	PARACATU I	M2P	Circuit C2	MW-1710B258-02	25/01/2018	24/01/2023
	PARACATU II	M3P	Circuit C1	MW-1709A917-02	20/01/2018	19/01/2023
	PARACATU II	M3R	Circuit C1	MW-1710A709-02	20/01/2018	19/01/2023
	PARACATU II	M4P	Circuit C2	MW-1710A006-02	18/01/2018	17/01/2023
	PARACATU II	M4R	Circuit C2	MW-1707A816-02	22/01/2018	21/01/2023
	PARACATU III	M1P	Circuit C1	MW-1709A825-02	25/01/2018	24/01/2023
	PARACATU III	M1R	Circuit C1	MW-1710B169-02	20/01/2018	19/01/2023
	PARACATU III	M2P	Circuit C2	MW-1707A196-02	24/01/2018	23/01/2023
	PARACATU III	M2P	Circuit C2	MW-1709A904-02	20/01/2018	19/01/2023
	PARACATU IV	M3P	Circuit C1	MW-1707A238-02	20/01/2018	19/01/2023
	PARACATU IV	M3R	Circuit C1	MW-1709A840-02	22/01/2018	21/01/2023
	PARACATU IV	M4P	Circuit C2	MW-1707A785-02	20/01/2018	19/01/2023
	PARACATU IV	M4R	Circuit C2	MW-1707A779-02	20/01/2018	19/01/2023
	PARACATU IV BAY 138KV	M1	-	MW-1709A064-02	17/11/2017	16/11/2022
	PARACATU IV BAY 138KV	M2	-	MW-1709A089-02	18/11/2017	17/11/2022
<p>Notes:</p> <p>Initial calibration has been performed by the power meters' manufacturer (Schneider Electric) through an accredited entity (3C Services) and according to applicable Brazilian Norms (ABNT NBR ISO/IEC 17025).</p> <p>All power meters were duly calibrated before their installation and before the project's transmission lines started to operate.</p> <p>The CPA implementers can confirm that the power meters were properly calibrated covering this monitoring period as per the monitoring plan contained in the registered CPAs.</p> <p>All calibration certificates are made available to the verification team of the DOE.</p>						
Measuring/reading/recording frequency	Continuous measurements and monthly aggregated.					
Calculation method (if applicable)	This parameter is monitored using bi-directional energy meters Class 0.2S in					

	<p>accordance with the established Grid Procedures defined by the National Electric System Operator (ONS)⁹ and Commercialization Procedures by the CCEE (Electric Power Commercialization Chamber)¹⁰.</p> <p><u>CPA 10286-P1-0003-CP1: Floresta Solar Power Complex</u></p> <p>Each solar plant of Floresta Complex has two circuits, each one of them with two electricity meters (main and backup meters) located at the 34,5 kV sector of Areia Branca SE ("collector substation"). At the high voltage sector of this substation, there are 2 (two) meters (main and backup) measuring electricity from the 3 (three) solar plants.</p> <p>The connection with the SIN occurs through Mossoró II SE (the CPA's delivery point to SIN), where there are two more meters (main and backup). In order to connect to the SIN, Floresta Complex shares the same transmission line with two operational wind power plants – <i>Mar e Terra</i> and <i>Areia Branca</i> power plants.</p> <p>Meters located in Mossoró II SE measure the net electricity generated by the CPA, while losses are shared among the power plants based on individual meters and readings from meters located at Areia Branca SE.</p> <p><u>CPA 10286-P1-0004-CP1: Paracatu Solar Power Complex</u></p> <p>Each solar plant of Paracatu Complex has two circuits, each one of them with two electricity meters (main and backup meters) located at the 34,5 kV sector of Paracatu SE ("collector substation"). At the high voltage sector of this substation, there are 2 (two) meters (main and backup) measuring electricity from the 4 (four) solar plants.</p> <p>The connection with the SIN occurs through Paracatu IV SE (the CPA's delivery point to the SIN), where there are two more electricity meters (main and backup).</p> <p>Meters located in Paracatu IV SE measure the net electricity generated by the CPA, while losses are shared among the power plants based on individual meters and readings from meters located at Paracatu SE.</p>
QA/QC procedures	<p>Meters calibration are performed according to the ONS Grid Procedures.</p> <p>Data collected from the project meter has low uncertainty levels and to guarantee its accuracy it can be confronted with information of generation provided by CCEE.</p> <p>In case of failure of the main meter, the backup energy meter can be used.</p>
Purpose of data/parameter	<p>As per the Attachment "Instructions for completing this form" of the CDM-PoA-MR-FORM (version 03.0), one of the following options has to be chosen:</p> <p><input checked="" type="checkbox"/> (a) Calculation of baseline emissions or baseline net GHG removals by sinks;</p> <p><input type="checkbox"/> (b) Calculation of project emissions or actual net GHG removals by sinks;</p> <p><input type="checkbox"/> (c) Calculation of leakage.</p>
Additional comments	Data is archived at least for two years after crediting period.

E.3. Implementation of sampling plan

☐ Applicable / ☒ Not applicable

⁹ Installation of measurement system for billing (Submodule 12.2); ONS; v2016.12; 16/12/2016. Available at:

<[http://extranet.ons.org.br/operacao/prdocme.nsf/videntificadorlogico/FE8DB116CE0F4F8583258098006C26AB/\\$file/Su%20bm%C3%B3dulo%2012.2.pdf?openelement](http://extranet.ons.org.br/operacao/prdocme.nsf/videntificadorlogico/FE8DB116CE0F4F8583258098006C26AB/$file/Su%20bm%C3%B3dulo%2012.2.pdf?openelement)>. Accessed on: 21/08/2017.

¹⁰ From Portuguese "Câmara de Comercialização de Energia Elétrica – CCEE". Available at: <http://www.ccee.org.br/portal/faces/pages_publico/o-que-fazemos?_adf.ctrlstate=97nwq4566_45&_afLoop=307374146798100>. Accessed on: 01/06/2017.

Justification: No sampling plan is applied.

SECTION F. Calculation of emission reductions or net anthropogenic removals

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

Baseline emissions include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the CPA. The methodology assumes that all project electricity generation 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:

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

Where,

BE_y = Baseline emissions in year y (tCO₂);

$EG_{PJ,y}$ = 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);

$EF_{grid,CM,y}$ = Combined margin CO₂ 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” (tCO₂/MWh).

Calculation of $EG_{PJ,y}$

As the CPA consists of the installation of a greenfield power complex, then:

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

Where:

$EG_{PJ,y}$ = 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);

$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh).

Calculation of the combined margin CO₂ emission factor for grid connected power generation in year y ($EF_{grid,CM,y}$)

The Combined Margin (CM) emission factor is calculated from the generation record of all plants connected to the SIN and centrally dispatched by the Electric System National Operator (*Operador Nacional do Sistema - ONS*). Based on this generation data as provided by the ONS, the Brazilian Designated National Authority (DNA) calculates the SIN's Operating Margin (OM) and Build Margin

(BM) emission factors by the dispatch analysis method according to the “Tool to calculate the emission factor for an electricity system” and makes them available to the public¹¹.

Therefore, to calculate $EF_{grid,CM,y}$ the publicly available data on the SIN operating margin and build margin emission factors provided by the Brazilian DNA are used.

The combined margin is calculated as a weighted average as follows:

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

Where,

$EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (tCO₂/MWh);

$EF_{grid,OM,y}$ = Operating margin CO₂ emission factor in year y (tCO₂/MWh);

w_{OM} = Weighting of operating margin emissions factor (%);

w_{BM} = Weighting of build margin emissions factor (%).

The Brazilian DNA is responsible for calculating the OM and BM emission factors in Brazil.

For calculating the Operating Margin (OM) emission factor, the Brazilian DNA uses the method (c) Dispatch data analysis OM. For the dispatch data analysis OM ($EF_{grid,OM-DD,y}$), it is necessary to use the year in which each project activity (in this case, each CPA) displaces grid electricity and to update the emission factor annually during monitoring period. For verification purposes, the OM emission factor is calculated *ex-post* and annually updated.

For calculating the Build Margin (BM) emission factor, the Option 1 (*ex-ante*) has been chosen in the PoA and thus, it is consistently applied in the present CPA as it is connected to the SIN. The Build Margin emission factor for 2014, as published by the Brazilian DNA¹², is used and fixed for the first crediting period of the present CPAs.

Although the Build Margin (BM) is fixed (*ex-ante*), the Operating Margin (OM) and the resulting Combined Margin (CM) are yearly updated based on data and calculations provided by the Brazilian DNA.

In case the Brazilian DNA discontinues the publication of these data during the monitoring period, ENGIE Brasil Energia S.A. may choose, for each monitoring period to be verified, the option between: a) to make use of the latest available official data and information as calculated and published by the Brazilian DNA; or b) to conduct the calculations based on data from ONS.

The following table provides the key information and data used to determine the baseline emissions and the emission reductions achieved by the 2 CPAs (Floresta and Paracatu):

¹¹ Available at: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html.

¹² Brazilian DNA: Build Margin emission factor for the year 2014 ($EF_{grid,BM,2014} = 0.2963$ tCO₂/MWh). Available at: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html.

CPA 10286-P1-0003-CP1: Floresta Solar Power Complex

FLORESTA	NET ELECTRICITY DISPATCHED TO THE GRID (MOSSORÓ II SE)				Grid Emission Factors (tCO ₂ e/MWh)			CERs Calculation			
PERIOD	Floresta I	Floresta II	Floresta III	TOTAL	BM (25%)	OM (75%)	CM	Floresta I	Floresta II	Floresta III	TOTAL
Jan/18	3,139.16	1,806.34	995.96	5,941.46	0.2963	0.5652	0.4980	1,563	900	496	2,959
Feb/18	5,268.67	3,941.57	2,257.95	11,468.19	0.2963	0.5559	0.4910	2,587	1,935	1,109	5,631
Mar/18	5,363.24	4,649.74	2,853.60	12,866.58	0.2963	0.5750	0.5053	2,710	2,350	1,442	6,502
Apr/18	1,341.89	1,106.76	1,101.50	3,550.16	0.2963	0.5058	0.4534	608	502	499	1,610
May/18	3,717.42	2,581.36	2,819.67	9,118.45	0.2963	0.5461	0.4837	1,798	1,248	1,364	4,410
Jun/18	3,680.95	3,748.54	2,519.80	9,949.30	0.2963	0.6691	0.5759	2,120	2,159	1,451	5,730
Jul/18	2,945.37	3,805.32	2,110.17	8,860.86	0.2963	0.5989	0.5233	1,541	1,991	1,104	4,636
Aug/18	2,747.29	4,496.72	1,447.97	8,691.99	0.2963	0.5948	0.5202	1,429	2,339	753	4,521
Sep/18	2,115.96	6,562.38	1,455.12	10,133.47	0.2963	0.5718	0.5029	1,064	3,300	732	5,096
Oct/18	4,065.71	6,530.46	964.54	11,560.71	0.2963	0.5782	0.5077	2,064	3,316	490	5,870
Nov/18	4,938.62	3,504.04	653.44	9,096.10	0.2963	0.3654	0.3481	1,719	1,220	227	3,167
Dec/18	4,654.32	2,038.97	347.28	7,040.57	0.2963	0.3423	0.3308	1,540	674	115	2,329
Jan/19	3,843.08	3,725.60	1,773.24	9,341.91	0.2963	0.3540	0.3396	1,305	1,265	602	3,172
Feb/19	2,573.55	4,331.89	1,710.39	8,615.82	0.2963	0.5573	0.4921	1,266	2,132	842	4,239
Mar/19	4,463.80	4,811.15	2,094.74	11,369.68	0.2963	0.5075	0.4547	2,030	2,188	952	5,170
Apr/19	3,795.78	2,615.11	1,302.48	7,713.37	0.2963	0.5095	0.4562	1,732	1,193	594	3,519
May/19	4,287.60	5,134.07	2,861.04	12,282.70	0.2963	0.4794	0.4336	1,859	2,226	1,241	5,326
Jun/19	4,206.28	4,612.58	2,670.63	11,489.50	0.2963	0.4175	0.3872	1,629	1,786	1,034	4,449
Jul/19	4,797.07	5,276.42	3,240.73	13,314.23	0.2963	0.5914	0.5176	2,483	2,731	1,677	6,892
Aug/19	6,016.64	6,181.88	3,580.42	15,778.94	0.2963	0.5312	0.4725	2,843	2,921	1,692	7,455
Sep/19	6,252.18	6,027.79	3,707.33	15,987.31	0.2963	0.5606	0.4945	3,092	2,981	1,833	7,906
Oct/19	5,940.77	6,471.55	3,635.30	16,047.61	0.2963	0.5370	0.4768	2,833	3,086	1,733	7,652
Nov/19	5,914.34	6,090.39	3,225.66	15,230.38	0.2963	0.5720	0.5031	2,975	3,064	1,623	7,662
Dec/19	6,604.55	5,846.77	3,596.39	16,047.71	0.2963	0.5997	0.5239	3,460	3,063	1,884	8,407
TOTAL	102,674.24	105,897.40	52,925.33	261,496.97				48,250	50,569	25,490	124,309

CPA 10286-P1-0004-CP1: Paracatu Solar Power Complex

PARACATU	NET ELECTRICITY DISPATCHED TO THE GRID (PARACATU 4 SE)					Grid Emission Factors (tCO2e/MWh)			CERs Calculation				
PERIOD	PARACATU I	PARACATU II	PARACATU III	PARACATU IV	TOTAL	BM (25%)	OM (75%)	CM	Paracatu I	Paracatu II	Paracatu III	Paracatu IV	TOTAL
Jan/19	5,758.63	3,041.23	5,932.18	4,937.09	19,669.12	0.2963	0.3540	0.3396	1,955	1,033	2,014	1,677	6,679
Feb/19	4,504.97	3,879.24	4,401.28	4,362.47	17,147.96	0.2963	0.5573	0.4921	2,217	1,909	2,166	2,147	8,438
Mar/19	4,564.59	4,281.51	4,514.80	4,512.46	17,873.36	0.2963	0.5075	0.4547	2,076	1,947	2,053	2,052	8,127
Apr/19	4,119.29	3,697.93	4,052.66	4,115.73	15,985.62	0.2963	0.5095	0.4562	1,879	1,687	1,849	1,878	7,293
May/19	4,174.55	4,070.51	3,988.55	4,015.78	16,249.39	0.2963	0.4794	0.4336	1,810	1,765	1,730	1,741	7,046
Jun/19	4,352.30	4,225.65	3,738.00	3,970.46	16,286.42	0.2963	0.4175	0.3872	1,685	1,636	1,447	1,537	6,306
Jul/19	4,539.83	4,155.74	3,961.81	4,041.59	16,698.97	0.2963	0.5914	0.5176	2,350	2,151	2,051	2,092	8,644
Aug/19	5,564.31	4,244.67	5,463.06	4,222.13	19,494.17	0.2963	0.5312	0.4725	2,629	2,006	2,581	1,995	9,211
Sep/19	6,549.70	5,003.41	6,975.28	5,780.83	24,309.22	0.2963	0.5606	0.4945	3,239	2,474	3,449	2,859	12,022
Oct/19	7,204.26	7,058.98	7,292.01	7,198.95	28,754.20	0.2963	0.5370	0.4768	3,435	3,366	3,477	3,433	13,711
Nov/19	4,964.71	4,861.67	5,057.88	4,947.88	19,832.14	0.2963	0.5720	0.5031	2,498	2,446	2,544	2,489	9,977
Dec/19	6,267.14	6,103.72	6,273.08	6,360.25	25,004.18	0.2963	0.5997	0.5239	3,283	3,197	3,286	3,332	13,098
TOTAL	62,564.27	54,624.26	61,650.61	58,465.62	237,304.76				29,056	25,617	28,648	27,230	110,550

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

According to the methodology, project emissions (PE_y) for wind, solar, wave or tidal projects that do not use fossil fuels for electricity generation are zero.

Therefore: PE_y = 0

F.3. Calculation of leakage emissions

According to the methodology ACM0002 (version 16.0), the following is stated:

"No leakage emissions are considered. The emissions potentially arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport) are neglected".

Therefore, $L_y = 0$.

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

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
CPA 10286-P1-0003-CP1 (Floresta)	124,309	0	0	0	124,309	124,309
CPA 10286-P1-0004-CP1 (Paracatu)	110,550	0	0	0	110,550	110,550
Total	234,859	0	0	0	234,859	234,859

F.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the included CPA-DDs

CPA UNFCCC reference number	Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante for this monitoring period in the CPA-DD (t CO ₂ e)
CPA 10286-P1-0003-CP1 (Floresta)	124,309	239,610
CPA 10286-P1-0004-CP1 (Paracatu)	110,550	161,341
Total	234,859	400,951

F.5.1. Explanation of calculation of “amount estimated ex ante for this monitoring period in the CPA-DD”

The “amount estimated ex ante for this monitoring period in the CPA-DD” was calculated as follows:

- For the CPA 10286-P1-0003-CP1 (Floresta): Calculated as the sum of emission reductions estimates for the period 01 Jan 2018 – 31 Dec 2019, i.e. 119,805 tCO₂e in 2018 plus 119,805 tCO₂e in 2019, as per the registered CPA, totalling 239.610 tCO₂e.
- For the CPA 10286-P1-0004-CP1 (Paracatu): Calculated as the emission reductions estimates for the period 01 Jan 2019 – 31 Dec 2019, i.e. 161.341 tCO₂e, as per the registered CPA.

As a result, it can be observed that the amount of emission reductions achieved during this monitoring period was -48.1% in the case of CPA 10286-P1-0003-CP1 (Floresta) and -31.5% in the case of CPA 10286-P1-0004-CP1 (Paracatu).

F.6. Remarks on increase in achieved emission reductions

☐ Applicable / ☒ Not applicable

Justification: As per the CDM Project Standard for Programmes of Activities (Version 02.0), paragraph 271 states the following: “For any included CPA, except for A/R CPA, the coordinating/managing entity shall explain the cause of any increase in the actual GHG emission reductions achieved during the monitoring period (e.g. higher water availability, higher plant load factor), including all information (i.e. data and/or parameters) that is different from that stated in the

uploaded CPA-DD". However, this is not applicable since the volume of GHG emission reductions achieved in this first monitoring period is lower than estimated in the registered CPAs [CPA 10286-P1-0003-CP1 (Floresta) and CPA 10286-P1-0004-CP1 (Paracatu)]. Therefore, no increase in the actual GHG emission reductions has been achieved or observed during the current monitoring period for both CPAs (Floresta and Paracatu).

F.7. Remarks on scale of small-scale CPAs

☐ Applicable / ☒ Not applicable

Justification: The CPA covered in this Monitoring Report is not a small-scale CPA.

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
03.0	31 May 2019	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 02.0 of the “CDM project standard for programmes of activities” (CDM-EB93-A07-STAN); • Add a section on remarks on the observance of the scale limit of small-scale CPAs during the crediting periods; • Add "changes specific to afforestation or reforestation activities/CPA" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R PoAs between two commitment periods; • Make structural and editorial improvements.
02.0	7 June 2017	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 01.0 of the “CDM project standard for programmes of activities (CDM-EB93-A07-STAN); • Make editorial improvements.
01.0	1 April 2015	Initial publication.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report, programme of activities		