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	SHPs Albano Machado and Rio dos Índios CDM Project (JUN1115)	
UNFCCC reference number of the project activity	6465	
Version number of the PDD applicable to this monitoring report	4	
Version number of this monitoring report	1	
Completion date of this monitoring report	28/01/2020	
Monitoring period number	First Monitoring Period	
Duration of this monitoring period	02/07/2012 – 01/07/2019	
Monitoring report number for this monitoring period	1	
Project participants	Rio do Lobo Energia Ltda ; Casa de Pedra Energia S.A ; Carbotrader Assessoria e Consultoria em Energia EIRELI	
Host Party	Brazil	
Applied methodologies and standardized baselines	AMS-I.D. ver. 17 - Grid connected renewable electricity generation	
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
	2,910 tCO_2e	97,227 tCO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	110,865 tCO_2e	

SECTION A. Description of project activity

A.1. General description of project activity

The project activity consists in the construction of the renewable energy generation Albano Machado (3.06 MW installed power) and Rio dos Índios (8.10 MW installed power) Small Hydro Power plants (SHP`s) located in Trindade do Sul and Nonoai cities in Rio Grande do Sul State, Brazil.

The purpose of the project activity is to provide electricity energy from renewable source to the Brazilian National Interconnected System (from the portuguese "*Sistema Interconectado Nacional – SIN*"), offsetting the fossil fuelled thermal generation and helping to attend the rising energy demand in Brazil.

The project activity reduces emissions of greenhouse gases (GHG) and the global warming, avoiding the use of fossil fuel that would be burned in thermoelectric generating units interconnected to the grid. This initiative helps Brazil to meet its goals of promoting sustainable development. Renewable energy generation has priority operation over non renewable energy.

For project participants the project activity is a sustainable alternative for electricity generation. Taking in consideration that the project activity consists of 2 Small Hydropower Plants with small reservoir, so they have low environmental impacts, almost zero, even compared to large hydroelectric plants.

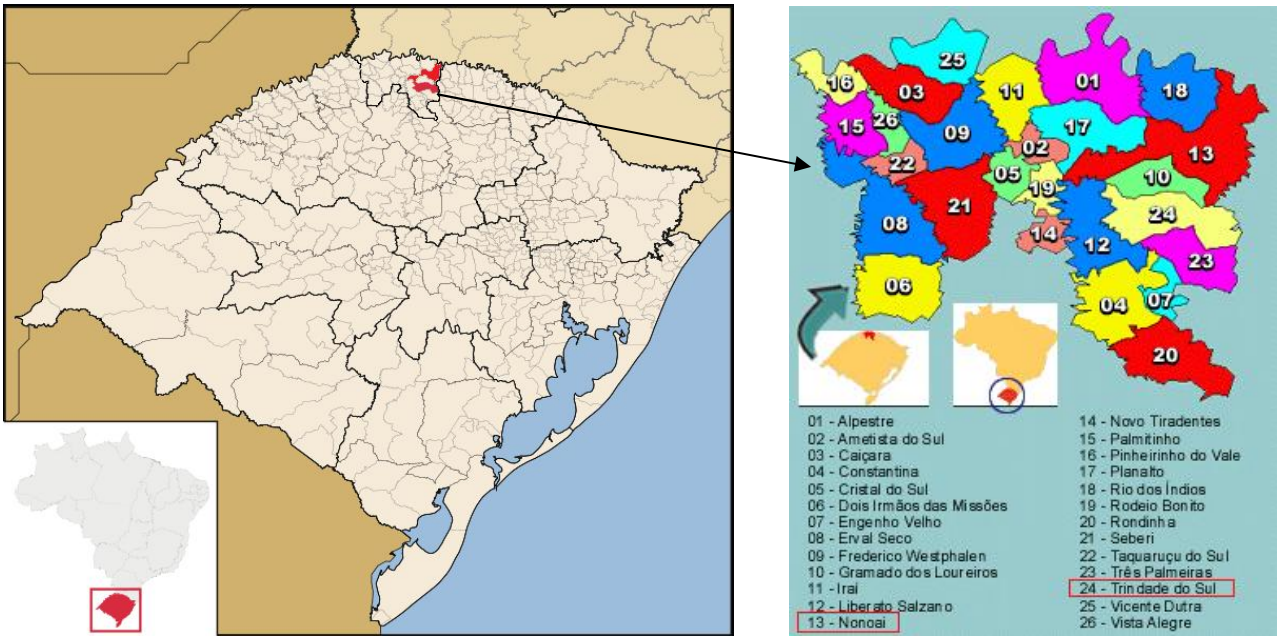
Also the project activity contributes to sustainable development, because:

- It reduces the fossil fuel (non-renewable source) use. Thus the project contributes to natural resources better utilization and makes use of clean and efficient technologies;
- It contributes to better working conditions and increases employment opportunities in the area where the project is located (rural areas in small cities);
- It contributes to the better conditions for the local economy, mainly in the rural areas from the cities involved.

A.2. Location of project activity

The SHP Albano Machado is located at the Lajeado do Lobo river, coordinates 27º 29'48'' S and 52º 48' 13'' W (Dam), between Trindade do Sul and Nonoai cities, Rio Grande do Sul State, south region, Brazil.
The SHP Rio dos Índios is located at the Rio dos Índios river, coordinates 27°16'30"S and 50°47'38"W, in Nonoai city, Rio Grande do Sul State, south region of Brazil.

Figure 1: Trindade do Sul and Nonoai cities



Sources: Wikipedia - pt.wikipedia.org and City Brazil - www.citybrazil.com.br

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 (host Party)	Rio do Lobo Energia Ltda (private entity)	No
	Casa de Pedra Energia S.A (private entity)	
	Carbotrader Assessoria e Consultoria em Energia EIRELI (private entity)	

A.4. References to applied methodologies and standardized baselines

Methodology AMS-I.D. version 17 – "Grid connected renewable electricity generation"
Link: https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

This one already contains the standardized baseline.

And:

TOOL07: Tool to calculate the emission factor for an electricity system (version 7.0)[1]

A.5. Crediting period type and duration

02/07/2012 until 01/07/2019 (Renewable)

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

The project activity consists in the use of water directly from the river to generate electricity. The potential gravitational energy of the water is used to move the turbines, and doing so, it generates electricity. It is a source of clean and renewable energy, which presents minimal impact on the environment.
The technology and equipment utilized in project activity was developed and manufactured in Brazil and the transfer of know-how or technology to host country was not established.

The Albano Machado and Rio dos Índios plants were interconnected with the national interconnected grid system (SIN) and supply energy to this electric system. The commercial operation start was:

SHP Albano Machado - 11/02/2011[2]
SHP Rio dos Índios - 04/05/2013[3]

The Small Hydropower Plants (SHPs) are enterprises classified as Small Hydropower Plants because according to Resolution #652 of 09/12/2003, from National Electric Energy Agency (ANEEL) entity, to be considered a small hydroelectric central, the area of the reservoir must be less than 3 km^2 (300 ha) and the generation capacity must be between 1 MW to 30 MW. These enterprises are also called "**run of river**" plants, which does not include significant water "stocks" area.

The SHPs characteristics are specified below:

[1] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

[2] ANEEL Dispatch #516 of 10/02/2011

[3] ANEEL Dispatch #1,359 of 03/05/2013

Table 1: Main data from the SHPs

SHP	Albano Machado	Rio dos Índios
Installed Power Capacity (MW)[4]	3.06	8.10
Reservoir Area (Km^2) [5]	0.0893	0.2526
Power Density (W/m^2)	34.26	32.06
Energy Assured (MWaverage)	1.66	4.336
Operation Start	11/02/2011	04/05/2013
Turbines Type	Francis	Francis
Turbines Quantity	2	2
Unit Nominal Power (kW)	1,566	4,125
Flow Rate (m^3/s)	1.86	1.96
Synchronous Speed (rpm)	900	720
Generators		
Generators Quantity	2	2
Nominal Power (kVA)	1,800	4,500
Effective Power (kW)	1,530	4,005
Power's Factor	0.85	0.9
Frequency (Hz)	60	60

Also follow below the Table 2 and 3 with the calibration data for metering equipments:

Table 2: Calibration data SHP Albano Machado

Nº	METERS IDENTIFICATION		DATE OF ISSUE	VALIDITY
1	Number: 458485 Manufacturer: Landis+Gyr Model: SAGA1000/1681	Main meter	11/08/2010	5 years
2	Number: 458486 Manufacturer: Landis+Gyr Model:: SAGA1000/1681	Backup meter	11/08/2010	5 years
3	Number: 458485 Manufacturer: Landis+Gyr Model: SAGA1000/1681	Main meter	25/09/2015	5 years
4	Number: 458486 Manufacturer: Landis+Gyr Model:: SAGA1000/1681	Backup meter	05/03/2015	5 years

[4] From the PDD: "According to the ANEEL Resolution no. 407/2000 the SHP capacity can vary from the planned power capacity and the implemented one in +- 5% without affect the legal documents already issued (shouldn´t be formally declared and justified to the ANEEL for regularization)."

[5] Based on the Environmental Licenses issued in 2010. The areas remains the same as forecasted in PDD.

5	Number: 458485 Manufacturer: Landis+Gyr Model: SAGA1000/1681	Main meter	06/02/2019	5 years
6	Number: 458486 Manufacturer: Landis+Gyr Model:: SAGA1000/1681	Backup meter	06/02/2019	5 years

Table 3: Calibration data SHP Rio dos Índios

Nº	METERS IDENTIFICATION		DATE OF ISSUE	VALIDITY
1	Number: 1076060 Manufacturer: Landis+Gyr Model: SAGA1000	Main meter	02/07/2012	5 years
2	Number: 1076061 Manufacturer: Landis+Gyr Model:: SAGA1000	Backup meter	03/07/2012	5 years
3	Number: 1076060 Manufacturer: Landis+Gyr Model: SAGA1000	Main meter	05/03/2015	5 years
4	Number: 1076061 Manufacturer: Landis+Gyr Model:: SAGA1000	Backup meter	05/03/2015	5 years
5	Number: 1076060 Manufacturer: Landis+Gyr Model: SAGA1000	Main meter	01/03/2019	5 years
6	Number: 1076061 Manufacturer: Landis+Gyr Model:: SAGA1000	Backup meter	01/03/2019	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

Not Applicable

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

Not Applicable

B.2.4. Inclusion of monitoring plan

Not Applicable

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

Not Applicable

B.2.6. Changes to project design

Not Applicable

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

Not Applicable

SECTION C. Description of monitoring system

The monitoring system for the project activity is based on the methodology AMS I.D.

1) Power generation:

General characteristics of the measurement system:

The procedures designed for monitoring electricity generation by the project activity follow the parameters and regulations of the Brazilian energy sector. The National Grid Operator (ONS) and the Electric Power Commercialisation Chamber (CCEE) are the entitiesorgans responsible for technical specification requirements of energy measurement system for billing, which evaluate and approve projects for accurate accounting of energy.

The agent responsible for the measurement system for billing (SMF) develop the project in accordance with the technical specifications of the measurements for billing, which should include the location of measurement points, panels of measurement, meters and systems for local and remote measurement.

The measurement system makes the measure and records the energy. This is installed in the panels of measurement, which are generally located in the control room or cabins of measurement. For this system is guaranteed the inviolability of data, which are placed stamps and seals or seals with electronic passwords.

Should be installed metering panels with two meters (the main and the backup).

The measurement system contains also a communication system that has the function to send the data of electricity dispatched for the grid to the CCEE.

Data monitoring:

The readings of meters are used for calculating the emission reductions when the Meter is in normal operation state. The monitoring steps are as follows:

(1) The data are measured hourly and recorded monthly;
(2) The power output settlement sheet from CCEE is used to cross check the monitored data.
(3) The project owner provides DOE with readings recorded from the meters and also access to the CCEE data measured (Main and Backup Meters of SHPs Albano Machado and Rio dos Índios)

Quality control:

(1) Calibration of meters

The calibration of meters conducted by qualified organization must comply with national standards and industrial regulations to ensure the accuracy. The meters must be sealed for safety after calibration. The calibration records must be archived together with other monitoring records.
The class of accuracy in the equipment that will be used in the project activity is under the national standards (NBR 14519 from Associação Brasileira de Normas Técnicas – Brazilian Association of Technical Standards). It can be viewed in the Grid Procedures from the National Grid Operator: Module 12, Sub-module12.2 Installation of the Measurement System for Billing in the link:
http://www.ons.org.br/download/procedimentos/modulos/Modulo_12/Submodulo%2012.2_Rev_1.0.pdf

(2) Emergency treatment

In case of impracticability of measures from any point of measurement, due to maintenance, commissioning or for any other reason, will be used the methodology to estimate data as the item 14.3 of the Procedure of Energy Commercialization PdC ME.01[6]

Data Management:

All the project activity issues regarding the SHPs are treated by the SPEs (Special Purpose Entities) Rio do Lobo Energia Ltda and Casa de Pedra Energia S.A board and the Management Sector responsible.

An operational structure for the plants was assigned and trained before commercial operation start.

The data are annually filed (electronic archive) and should be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Training Procedures:

All the training necessary for the plant operational team were provided during the plant construction and during the plant commercial operation. Also a plant operation manual was created in order to provide assured instructions.

Furthermore, operation, maintenance and calibration procedures shall follow the national guidelines set by the National Grid Operator.

Emission Factors:

The Emission Factor related to this project activity ($EF_{grid,CM,y}$, $EF_{gris,OM-DD,y}$ and $EF_{grid,BM,y}$) as mentioned previously, are available by the Brazilian DNA and it can be viewed at its website (www.mct.gov.br/clima).

Thus, the monitoring of such data was done ex-post through periodic access to data provided by DNA.

The Area of the reservoir (A_{PJ}) was measured annually through the topographical surveys, maps, satellite pictures, etc.
The facility capacity ($Cap_{PJ,y}$) was measured annually through the technical specifications on the installed equipments.

Regard the grid connection points, the electricity from the SHP Albano Machado is dispatched to RGE'substation (Rio Grande Energia – local energy distributor in the interconnected grid) located in Entre Rios city (RS) being this the interconnection point.
The SHP Rio dos Índios electricity is dispatched to CELESC Distribuição S.A substation (local energy distributor in the interconnected grid) located near of Chapecó City (SC) being this is the interconnection point.

The diagram below presents the project main equipments for each SHP (related to monitoring points)[7]:

SHP AM (renewable electricity) → Entre Rios Substation (from RGE) – Meters: #458485 (Main) and #458486 (Backup)

SHP RDI (renewable electricity) → Chapecó II Substation (from CELESC) – Meters: #1076060 (main) and #1076061 (Backup)

6 http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=67778d3ef9a3c010VgnVCM1000005e01010aRCRD

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

All data and parameters used in the baseline emission calculation were monitored.

D.2. Data and parameters monitored

Data/Parameter	$EG_{Albano\ Machado,y}$
Unit	MWh/year
Description	Net electricity of the SHP Albano Machado delivered to the grid in year y
Measured/calculated/ default	Measured
Source of data	Energy Meters
Value(s) of monitored parameter	2012 = 7,539.72 2013 = 18,344.09 2014 = 10,283.24 2015 = 15,160.70 2016 = 11,551.30 2017 = 16,495.53 2018 = 10,803.96 2019 = 8,853.18
Monitoring equipment	Meters: #458485 (Main) and #458486 (Backup)
Measuring/reading/recording frequency	Hourly measuring and reading, Monthly Recording.
Calculation method (if applicable)	Not applicable.
QA/QC procedures	The meter must comply with national standards and industrial regulations to ensure the accuracy (Class 0.2). The meters must be sealed for safety after calibration. The net electricity delivered to the grid will be checked through the energy metering. The data from the energy meters will be cross checked with the CCEE data bank (Electric Power Commercialization Chamber in Brazil).
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	$EG_{Rio\ dos\ Indios,y}$
Unit	MWh/year
Description	Net electricity of the SHP Rio dos Indios delivered to the grid in year y
Measured/calculated/ default	Measured
Source of data	Energy Meters
Value(s) of monitored parameter	2012 = 0,00 2013 = 7,501.93 2014 = 25,679.73 2015 = 26,633.53 2016 = 22,844.74 2017 = 33,339.78 2018 = 30,224.14 2019 = 22,055.62
Monitoring equipment	Meters: #1076060 (main) and #1076061 (Backup)
Measuring/reading/recording frequency	Hourly measuring and reading, Monthly Recording.
Calculation method (if applicable)	Not applicable.

QA/QC procedures	The meter must comply with national standards and industrial regulations to ensure the accuracy. The meters must be sealed for safety after calibration. The net electricity delivered to the grid will be checked through the energy metering. The data from the energy meters will be cross checked with the CCEE data bank (Electric Power Commercialization Chamber in Brazil) or with invoice of energy sales in the way to verify the coherency of the data.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	

Data/Parameter	$EF_{CO2,grid,,y}$
Unit	tCO_2e/MWh
Description	CO_2 emission factor of the grid electricity 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	For SHP Albano Machado: 2012 = 0.3860 2013 = 0.4319 2014 = 0.4399 2015 = 0.4070 2016 = 0.3905 2017 = 0.3756 2018 = 0.3298 2019 = 0.3664 For SHP Rio dos Índios: 2012 = 0 2013 = 0.4286 2014 = 0.4384 2015 = 0.4088 2016 = 0.3926 2017 = 0.2980 2018 = 0.3005 2019 = 0.3517
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} and w_{BM} default 0.5 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	$EF_{grid,OM-DD,y}$
Unit	tCO_2/MWh
Description	CO_2 Operating Margin emission factor of the grid, in a year *y*
Measured/calculated/ default	Data provided by DNA to the year *y*
Source of data	This data is available on the web-site: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

Value(s) of monitored parameter	For SHP Albano Machado: 2012 = 0.5710 2013 = 0.5924 2014 = 0.5835 2015 = 0.5587 2016 = 0.6228 2017 = 0.5931 2018 = 0.5014 2019 = 0.5746 For SHP Rio dos Índios: 2012 = na 2013 = 0.5859 2014 = 0.5805 2015 = 0.5624 2016 = 0.6270 2017 = 0.5932 2018 = 0.4640 2019 = 0.5665
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	

Data/Parameter	$EF_{grid,BM,y}$
Unit	tCO2/MWh
Description	CO2 Build Margin emission factor of the grid, in a year *y*
Measured/calculated/ default	Data provided by DNA to the year *y*.
Source of data	This data is available on the web-site: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html
Value(s) of monitored parameter	2012 = 0.2010 2013 = 0.2713 2014 = 0.2963 2015 = 0.2553 2016 = 0.1581 2017 = 0.0028 2018 = 0.1370 2019 = 0.1370
Monitoring equipment	This data will be applied in *ex-post* for the calculation of the Emission Factor. The data will be annually filed (electronic archive) should be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later
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	

Data/Parameter	$Cap_{Albano\ Machado\ ,y}$
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Measured/calculated/ default	Default
Source of data	Technical specifications on the installed equipments.
Value(s) of monitored parameter	3,060,000
Monitoring equipment	
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Not applicable
QA/QC procedures	
Purpose of data/parameter	This data will be applied for the Power Density calculation.
Additional comments	

Data/Parameter	$Cap_{Rio\ dos\ Índios,y}$
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Measured/calculated/ default	Default
Source of data	Technical specifications on the installed equipments.
Value(s) of monitored parameter	8,100,000
Monitoring equipment	
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Not applicable
QA/QC procedures	
Purpose of data/parameter	This data will be applied for the Power Density calculation.
Additional comments	

Data/Parameter	$A_{Albano\ Machado,y}$
Unit	m^2
Description	Area of the reservoir measured in the water surface, after the implementation of the project activity, when the reservoir is full.
Measured/calculated/ default	Measured
Source of data	Measured from topographical surveys, maps, satellite pictures, etc.
Value(s) of monitored parameter	89,300
Monitoring equipment	
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Not applicable

QA/QC procedures	
Purpose of data/parameter	This data will be applied for the Power Density calculation
Additional comments	

Data/Parameter	$A_{Rio\ dos\ índios,y}$
Unit	m^2
Description	Area of the reservoir measured in the water surface, after the implementation of the project activity, when the reservoir is full.
Measured/calculated/ default	Measured
Source of data	Measured from topographical surveys, maps, satellite pictures, etc.
Value(s) of monitored parameter	252,600
Monitoring equipment	
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Not applicable
QA/QC procedures	
Purpose of data/parameter	This data will be applied for the Power Density calculation
Additional comments	

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 spreadsheets "*CERs 1st MR_AM_rev1.xls*" and "*CERs 1st MR_RDI_rev1.xls*", tabs "Hourly 2012", "Hourly 2013" "Hourly 2014", "Hourly 2015" "Hourly 2016 , "Hourly 2017", "Hourly 2018", "Hourly 2019".

The $EF_{grid,OM,2018}$ was used in the SHPs Albano Machado and Rio dos Índios calculations for the year 2019, because it is the most recent value available in the DNA website.

Below, follow a summary of $EF_{OM,y}$:

	SHP Albano Machado	**SHP Rio dos Índios**
$EF_{grid,OM,2012}$ (tCO2/MWh)	0.5710	nd
$EF_{grid,OM,2013}$ (tCO2/MWh)	0.5924	0.5859
$EF_{grid,OM,2014}$ (tCO2/MWh)	0.5835	0.5805
$EF_{grid,OM,2015}$ (tCO2/MWh)	0.5587	0.5624
$EF_{grid,OM,2016}$ (tCO2/MWh)	0.6228	0.6270
$EF_{grid,OM,2017}$ (tCO2/MWh)	0.5931	0.5932
$EF_{grid,OM,2018}$ (tCO2/MWh)	0.5014	0.4640
$EF_{grid,OM,2019}$ (tCO2/MWh)	0.5746	0.5665

"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[8]. The last available data is for 2018 year.

$EF_{grid,BM,2012}$ = 0.2010 tCO_2/MWh

$EF_{grid,BM,2013}$ = 0.2713 tCO_2/MWh

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

$EF_{grid,BM,2015}$ = 0.2553 tCO_2/MWh

$EF_{grid,BM,2016}$= 0.1581 tCO_2/MWh

$EF_{grid,BM,2017}$ = 0.0028 tCO_2/MWh

$EF_{grid,BM,2018}$ = 0.1370 tCO_2/MWh

$EF_{grid,BM,2019}$ = 0.1370 tCO_2/MWh

"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 $EF_{OM,,}y$ and the $EF_{BM,,}y$ weighted 50% each, by definition, that gives:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * 0.5 + EF_{grid,BM,y} * 0.5 \ (tCO_2/MWh)$$

SHP Albano Machado	$EF_{grid,OM,y}$ (tCO2/MWh)	$EF_{grid,BM,y}$ (tCO2/MWh)	$EF_{grid,CM,y}$ (tCO2/MWh)
2012	0.5710	0.2010	0.3860
2013	0.5924	0.2713	0.4319
2014	0.5835	0.2963	0.4399
2015	0.5587	0.2553	0.4070
2016	0.6228	0.1581	0.3905
2017	0.5931	0.0028	0.3756

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

2018	0.5014	0.1370	0.3298
2019	0.5746	0.1370	0.3664

SHP Rio dos Índios	$EF_{grid,OM,y}$ (tCO2/MWh)	$EF_{grid,BM,y}$ (tCO2/MWh)	$EF_{grid,CM,y}$ (tCO2/MWh)
2012	0	0	0
2013	0.5859	0.2713	0.4286
2014	0.5805	0.2963	0.4384
2015	0.5624	0.2553	0.4088
2016	0.6270	0.1581	0.3926
2017	0.5932	0.0028	0.2980
2018	0.4640	0.1370	0.3005
2019	0.5665	0.1370	0.3517

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:

$\boldsymbol{L_y = 0}$

And also the project emission is zero:

$\boldsymbol{PEy = 0}$

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).

$$BE_y = EF_{grid,CM,y}. EG_y$$

Then:

SHP Albano Machado	$EF_{grid,CM,y}$ (tCO2/MWh)	EG_{PJ} (MWh)	ERs (tCO_2e)
2012	0.3860	7,539.72	2,910
2013	0.4319	18,344.09	7,922
2014	0.4399	10,283.24	4,523
2015	0.4070	15,160.70	6,170
2016	0.3905	11,551.30	4,510
2017	0.3756	16,495.53	6,195
2018	0.3298	10,803.96	3,562
2019	0.3664	8,853.18	3,243

SHP Rio dos Índios	$EF_{grid,CM,y}$ (tCO2/MWh)	EG_{PJ} (MWh)	ERs (tCO_2e)
2012	0	0,00	0
2013	0.4286	7,501.93	3,215
2014	0.4384	25,679.73	11,257
2015	0.4088	26,633.53	10,888
2016	0.3926	22,844.74	8,967
2017	0.2980	33,339.78	9,935

2018	0.3005	30,224.14	9,083
2019	0.3517	22,055.62	7,757

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	100,137	0	0	2,910	97,227	100,137

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)
100,137	110,865

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, like a good estimation to $EF_{grid,OM-DD,y}$ value, the arithmetic average of the 12 last monthly emission factors published by the DNA (**ultimate data available** - http://www.mct.gov.br/index.php/content/view/307492.html)

Average Monthly Factor (tCO_2/MWh)												
year	2010											
month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EF	0.2111	0.2798	0.2428	0.2379	0.3405	0.4809	0.4347	0.6848	0,7306	0,7320	0,7341	0,6348

So the Operation Margin Emission Factor is:

$$EF_{grid,OM\text{-}DD,y} = 0.4787$$

"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 the 2009 year value published by the DNA (ultimate data available).

$EF_{grid,BM,y}$ = 0.1404

"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:

$$EF_{grid,CM,y} = 0.4787 \cdot 0.5 + 0.1404 \cdot 0.5 = 0.30955 \quad (tCO_2/MWh)$$

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

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.

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

The electricity energy generated by the SHPs Albano Machado and Rio dos Índios ($EG_{BL,y}$) in the year *y* was estimated in 52,525 MWh/year.

So the baseline emissions are:

BE_y = 52,525 . 0.30955 = **16,258 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 = 16,258 – 0 – 0 = **16,258 tCO_2e/year**

E.6. Remarks on increase in achieved emission reductions

Not applicable.

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

The combined scale of the activities belonging to the same small-scale project type (Type I) remained under the limit of 15 MW every year during the crediting period. Since the Installed capacity of both SHPs are 11.07 MW (for more details see section D.2).

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.

Version	Date	Description

Decision Class: Regulatory
Document Type: Form
Business Function: Issuance
Keywords: monitoring report