Monitoring report form
(Version 03.2)

Monitoring report

Title of the project activity	Central Energética do Rio Pardo Cogeneration Project (CERPA)
Reference number of the project activity	0209
Version number of the monitoring report	1
Completion date of the monitoring report	16/12/2013
Registration date of the project activity	09/03/2006 (renewal of the crediting period on 28/08/2011)
Monitoring period number and duration of this monitoring period	First verification of the 2nd crediting period: 01/05/2010 – 30/11/2013
Project participant(s)	• CERPA – Central Energética Rio Pardo Ltda. • Ecopart Assesoria em Negocios Empresariais Ltda. • BHP Billiton Marketing AG • CM Capital Markets Holding S.A.
Host Party(ies)	Brazil
Sectoral scope(s) and applied methodology(ies)	Sectoral scope 1 : Energy industries (renewable - / non-renewable sources) ACM0006 ver. 10 - Consolidated methodology for electricity generation from biomass residues ACM0002 ver. 12 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	38,875 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	48,212 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	35,053 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	13,159 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

Usina da Pedra is a sugar mill located in Serrana, state of São Paulo, Brazil. The company is owned by Pedra Agroindustrial S/A, which is one of the most traditional producers in the sugar industry in Brazil. Pedra Agroindustrial S/A owns three other sugarcane mills (Ibirá Mill, Ipê Mill and Buriti Mill). Usina da Pedra produces sugar, anhydrous and hydrated alcohol.

Figure 1 – Usina da Pedra view[1]

In May 2003, CERPA – the thermoelectric plant of Usina da Pedra –, sold its first MWh to the local power utility CPFL (Companhia Paulista de Força e Luz). Currently, there is a PPA signed with CPFL, valid until 2013, to commercialize 18 MW during the season.

In 2003, CERPA upgraded its equipment, installing a new boiler and two new turbogenerators, using bagasse more efficiently to cogenerate electricity (Table 1). It is important that all existent equipment is under operation.

Table 1 – Description of new equipment in the project activity scenario

Boiler (brand/model)	Capacity (ton/h)	Pressure (Kgf/Cm^2)	Efficiency (%) LHV	Date of constructio n	Date of start of operation
Equipálcool sistemas /150-V-2-S	150	65	86	2002	2003

Steam Turbine (brand/mode l)	Model	Installed power (KW)	Inlet pressure (kgf/cm²)	Outlet pressure (kgf/cm²)	Extraction pressure (kgf/cm²)	Date of construction	Date of start of operation
NG Metalurgica ltda.	H3/630 S	17,300	66	0.19	2.5	2002	2003
NG Metalurgica ltda.	H3/630 S	17,00	63	1.5	-	2002	2003

[1] Source: Pedra Agroindustrial S/A website: <http://www.pedraagroindustrial.com.br/unidadesprodutoras.php>.

Generator (brand/model)	Installed power (kVA)	Power factor	Date of construction	Date of start of operation
Toshiba/RCC	18,750	0.8	2002	2003
Toshiba/RCC	18,750	0.8	2002	2003

A more efficient cogeneration of renewable fuel allows Usina da Pedra to sell a surplus of electricity to the grid and creates competitive advantage. The electricity sold to the grid diversifies income to the mill and it helps meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to environmental, social and economic sustainability.

This indigenous and cleaner source of electricity will also have an important contribution to environmental sustainability by reducing carbon dioxide emissions that would have otherwise occurred in the absence of the project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation from fossil fuel sources (and CO_2 emissions), which would be generated (and emitted) in the absence of the project.

This first verification of the second crediting period comprises the period from 01/05/2010 to 30/11/2013, resulting in 48,212 tCO_2e reduced. Up to 31/12/2012, the GHG emission reductions are 35,053 tCO_2e; and during 2013, the project activity reduced 13,159 tCO_2e.

A.2. Location of project activity

The project activity is located in Serrana, state of São Paulo, Southeastern region of Brazil under the following geographical coordinates:

Latitude	Longitude
21º10'29.51" S	47º37'47.21" W

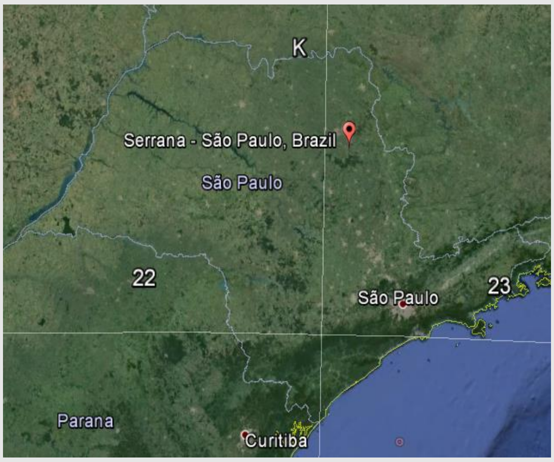

Figure 2 - Geographical position of São Paulo state and Serrana municipality[2]

A.3. Parties and project participant(s)

[2] Source: City Brazil (2008), available at: <www.citybrazil.com.br>, accessed on November 24th, 2008 and Google Earth (2013), available at: <earth.google.com>, accessed on December 6th, 2013.

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	CERPA – Central Energética Rio Pardo Ltda.	No
Netherlands	BHP Billiton Marketing AG	No
United Kingdom of Great Britain and Northern Ireland	Ecopart Assesoria em Negocios Empresariais Ltda.	No
Switzerland	CM Capital Markets Holding S.A.	No

A.4. Reference of applied methodology

For this project activity the following methodologies and tools were used:

- ACM0006 – “Consolidated baseline and monitoring methodology for electricity grid-connected electricity generation from biomass residues”, version 10.1, EB55;
- ACM0002 - “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”, version 12.1.0, EB 58;
- “Tool to calculate the emission factor for an electricity system” version 02.1, EB60;
- “Combined tool to identify the baseline scenario and demonstrate additionality”, version 3.0, EB60;
- “Tool to assess the validity of the original/current baseline and to update the baseline at the renewal of a crediting period”, EB46, Annex 1.

A.5. Crediting period of project activity

The project activity applies a renewable crediting period from 01/05/2010 to 30/04/2017. The starting date of the project is 01/05/2003 as described in the registered PDD.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

As stated in the registered PDD, some process equipment would be modified in 2012 due to the consortium held between CPFL Bio Pedra S/A and Pedra Agroindustrial S/A. These changes included modifications in milling starters, reducers, electrical distribution system and turbo pumps (electrical motors) for waste water treatment, factory, distillery and spray.

During the monitored period, the project activity operated according to the Monitoring Plan of the registered PDD, and the modifications mentioned above have no impact on the primary configuration of heat and power of the project activity.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

Not applicable.

B.2.2. Corrections

Not applicable.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

Not applicable.

B.2.4. Changes to project design of registered project activity

Not applicable.

B.2.5. Changes to start date of crediting period

Not applicable.

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable.

SECTION C. Description of monitoring system

As per the procedures set by the approved monitoring methodology ACM0006 and the registered PDD, the following parameters shall be monitored:

- Net quantity of electricity generated by the project plant ($EG_{project\ plant,y}$);
- Quantity of bagasse combusted in the project plant ($BF_{bagasse,y}$);
- Net calorific value of bagasse (NCV_k);
- Percentage of water content (%);
- CO_2 emission factor of the grid ($EF_{grid,y}$).

Data related to the CO_2 emission factor of the grid is made available by the Brazilian DNA and, it is used for the calculation of emission reductions. Data related to the electricity generated by the project plant and bagasse related parameters are monitored by the project sponsor.

The project sponsor has been proceed with the necessary measures for the power control and monitoring following the National Electric System Operator ("ONS" from the Portuguese Operador do Sistema Elétrico Nacional). Electricity exported to the grid will be done by two energy meters standardized by the Chamber of Electric Energy Commercialization ("CCEE" from the Portuguese Câmara de Comercialização de Energia Elétrica). Since the system is redundant, if there is any problem with the main meter which is used to collect data for energy sales invoice, measurements are taken from the backup meter. In addition, CCEE has remote control of data from these energy meters through SINERCOM system.

In case of any failure from these both meters, CERPA has additional meters installed at the project site, which is used for internal control purposes.

The calibration of energy meters are made according to the regulations of the Brazilian Power

Regulatory Agency ("ANEEL" from the Portuguese Agência Nacional de Energia Elétrica). Detailed description is presented in "Procedimentos de Distribuição de Energia Elétrica no Sistema Elétrico Nacional – PRODIST – Módulo 5 – Sistemas de Medição", document PND1A-DE8-0550, dated October 20th, 2005 (http://www.aneel.gov.br).

All energy monitored information is archived in the system named "Supervisório", which generates excel reports in order to control the entire energy operation of the plant.

Regarding bagasse, since the amount of burned bagasse is calculated analytically, the instruments used for laboratory analysis are all calibrated by CERPA, what can be checked on-site. For this measurement, Sampling and Analysis Plan for each sector in the plant is elaborated. There are specific Methods of Tests, Operational Standards and Norms of procedures for each parameter in order to calculate the amount of bagasse (such as daily analysis of BRIX – soluble solids percent by weight of broth, POL - sucrose content apparent percent by weight of broth, fiber content, purity). These methods are defined by Copersucar – Brazilian Cooperative of Sugar and Alcohol through the "Industrial efficiency and losses of sugar in the process" Manual, Manual of chemical control for the manufacture of sugar by CTC and CONSECANA - Council of Producers of Sugar Cane, Sugar and Alcohol of the State of São Paulo - manual.

Measurement of bagasse NCV will be done by independent laboratories (such as UNESP and IPT) every six months through compost sample, so that CERPA is not responsible for their calibration.

All the information related to the bagasse and sugarcane are archived and calculated in electronic format through GAtec system in the plant.

The methodology considers monitoring emissions reductions generated from cogeneration projects using sugarcane bagasse. The monitoring plan, for emissions reductions occurring within the project boundary, is based on monitoring the amount of electricity supplied to the grid. The electricity baseline emission factor will be determined ex-post. The value used in this PDD was determined ex-ante only for estimation purposes.

CERPA is responsible for the project management, monitoring and reporting as well as for organising and training of the staff in the appropriate monitoring, data collection, measurement, archiving and reporting techniques. The person in charge for the project monitoring and reporting is Mr. Eduardo Brondi.

General maintenance and maintenance of equipment/installations will be done yearly, according to the internal procedures of CERPA and the manufacturers' recommendations. The established procedures reflect good monitoring and reporting practices.

CERPA promotes training with local staff yearly focusing on the following issues:

- NR 10: Technical instruction for electric installation and services;
- NR 13: Technical instruction for boilers and pressure vessels;
- Boiler combustion (in accordance with the equipment supplier).

The operation and maintenance of the facility are administered by the sugar mill. The activities are divided in:

- Special predictive maintenance: vibration analysis (monthly), thermo inspections (twice during the season), analysis of the transformer's insolating oil (once during the season);
- Standard predictive maintenance: according ISO 9001.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	$\varepsilon_{el,\ reference\ plant}$

Unit:	MWhel / MWhbiomass
Description:	Average net energy efficiency of electricity generation in in the reference plant that would be installed in the absence of the CDM project activity
Source of data:	The Brazilian Sugarcane Industry Association (“UNICA” from the Portuguese União da Indústria da Cana-de-Açúcar) The Brazilian Power Regulatory Agency (“ANEEL” from the Portuguese Agência Nacional de Energia Elétrica).
Value(s) applied):	0.0363
Purpose of data:	Baseline emissions.
Additional comment:	-

D.2. Data and parameters monitored

Data / Parameter:	**$EG_{project\ plant,y}$**
Unit:	MWh
Description:	Net quantity of electricity generated in the project plant during the year y
Measured/ Calculated / Default:	Measured
Source of data:	Readings of the energy metering connected to the project plant
Value(s) of monitored parameter:	see table below
Monitoring equipment:	Electricity meters. CERPA will measure the quantity of exported electricity, the quantity of electricity consumed internally and the quantity of electricity consumed by the auxiliary systems.
Measuring/ Reading/ Recording frequency:	Continuously
Calculation method (if applicable):	-

Value(s) of monitored parameter:

Year	**$EG_{project\ plant,y}$**
2010	84,351
2011	53,753
2012	49,653
2013	55,755
Total	243,514

QA/QC procedures:	The consistency of metered net electricity generation should be cross-checked with receipts from electricity sales and/or a declaration from buyer of the amount of purchased electricity and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years).
Purpose of data:	Baseline emissions.
Additional comment:	-

Data / Parameter:	**EG_y**
Unit:	MWh
Description:	Net quantity of increased electricity generation as a result of the project activity during the year y
Measured/ Calculated / Default:	Calculated
Source of data:	Readings of the energy metering connected to the project plant calculated according to ACM0006.
Value(s) of monitored parameter:	see table below
Monitoring equipment:	Electricity meters. CERPA will measure the quantity of exported electricity, the quantity of electricity consumed internally. This data will be monitored by the project proponent through a kWh-meter and double checked by CCEE registration and reports of generated energy. Data will be archived during the crediting period and two years after.
Measuring/ Reading/ Recording frequency:	Continuously
Calculation method (if applicable):	-

Value(s) of monitored parameter:

Year	**EG_y**
2010	68,978
2011	42,232
2012	39,137
2013	44,329
Total	194,676

QA/QC procedures:	The consistency of metered net electricity generation should be cross-checked with receipts from electricity sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years). This measurement is supervised by internal procedures of Quality Department.
Purpose of data:	Baseline emissions.
Additional comment:	-

Data / Parameter:	$\mathbf{BF_{bagasse,y}}$
Unit:	Metric tones
Description:	Quantity of bagasse combusted in the project plant during the year *y*
Measured/ Calculated / Default:	Measured
Source of data:	On-site indirect measurements, based on the percentage of fibre in cane and of bagasse in fibre.
Value(s) of monitored parameter:	**Year** / $\mathbf{BF_{bagasse,y}}$: 2010 – 215,560; 2011 – 157,449; 2012 – 145,985; 2013 – 171,708; Total – 690,702
Monitoring equipment:	Monitored continuously through an annual energy balance. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be crosschecked with the quantity of electricity (and heat) generated and any fuel purchase receipts (if available). Data will be archived during the crediting period and two years after.
Measuring/ Reading/ Recording frequency:	Continuously
Calculation method (if applicable):	-
QA/QC procedures:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes.
Purpose of data:	Baseline emissions.
Additional comment:	-

Values of monitored parameter:

Year	$\mathbf{BF_{bagasse,y}}$
2010	215,560
2011	157,449
2012	145,985
2013	171,708
Total	690,702

Data / Parameter:	NCV_k
Unit:	GJ/ton
Description:	Net calorific value of bagasse
Measured/ Calculated / Default:	Measured
Source of data:	Measurements.from reputed laboratories.
Value(s) of monitored parameter:	(see table below)
Monitoring equipment:	Measurements were carried out at reputed laboratories and according to relevant international standards based on dry biomass.
Measuring/ Reading/ Recording frequency:	Every six months, taking at least three samples for each measurement.
Calculation method (if applicable):	-
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass.
Purpose of data:	Baseline emissions.
Additional comment:	-

Year	NCV_k	
	1st semester	2nd semester
2010	7.08	7.06
2011	7.26	7.26
2012	7.23	7.06
2013	6.60	6.60
Average	7.04	6.70

Data / Parameter:	Moisture content of the biomass residues
Unit:	% Water content
Description:	Moisture content of bagasse

Measured/ Calculated / Default:	Measured
Source of data:	On-site measurements
Value(s) of monitored parameter:	*(see table below)*
Monitoring equipment:	The moisture content will be monitored for each batch of biomass of homogeneous quality. The weighted average will be calculated for each monitoring period and used in the calculations.
Measuring/ Reading/ Recording frequency:	Continuously, mean values calculated at least annually.
Calculation method (if applicable):	-
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass.
Purpose of data:	Baseline emissions.
Additional comment:	This data is archived daily in CERPA electronic system.

Value(s) of monitored parameter:

Year	Percentage of water content	
	1st semester	2nd semester
2010	52.33	52.55
2011	50.97	50.53
2012	51.32	52.07
2013	52.00	52.00
Average	51.66	51.79

D.3. Implementation of sampling plan

Not applicable.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

The chosen methodology (ACM0006) is applicable to biomass-based cogeneration projects connected to the grid. The methodology considers emission reductions generated from cogeneration projects

using sugarcane bagasse. The equations to calculate the emission reductions are the following:

$$ER_y = ER_{heat,y} + ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y$$ **Equation 1**

Where:

ER_y	=	are the emission reductions of the project activity during year *y*
$ER_{heat,y}$	=	are the emissions reductions due to displacement of heat during the year *y*
$ER_{electricity,y}$	=	are the emissions reductions due to displacement of electricity in year *y*
$BE_{biomass,y}$	=	Baseline emissions due to natural decay or burning of anthropogenic sources of biomass residues during the year *y* (tCO_2e/yr)
PE_y	=	are project emissions in year *y* (zero for this project activity)
L_y	=	are the leakage emissions in year *y* (zero for this project activity)

Emissions reductions due to the displacement of heat:

According to ACM0006, the project participants may either:

- Demonstrate that the thermal efficiency in the project plant is larger or similar compared with the thermal efficiency of the plant considered in baseline scenario and then assume $ER_{heat,y} = 0$, or, if this is not the case;
- Account for any increases in CO_2 emissions.

In the registered PDD, the project participants demonstrated that the thermal efficiency of the project plant is higher than the plant considered in the baseline scenarios. Therefore, emissions reductions due to the displacement of heat are considered zero, $ER_{heat,y} = 0$.

Emissions reductions due to the displacement of electricity:

According to ACM0006, the emission reductions due to the displacement of electricity is calculated as follows:

$$EG_{electricity,y} = EG_y \times EF_{electricity,y}$$ **Equation 2**

Where:

$ER_{electricity,y}$	=	Emission reductions due to displacement of electricity during the year y (tCO_2/yr)
EG_y	=	Net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year y (MWh)
$EF_{electricity,y}$	=	CO_2 emission factor for the electricity displaced due to the project activity during the year y (tCO_2/MWh)

The amount of electricity to be considered for the displacement of power from the grid is calculated using the equation below. This equation corresponds to the chosen scenario #18 of the ACM0006 methodology:

$$EG_y = EG_{project plant,y} * \left(1 - \frac{\varepsilon_{el,baseline plant}}{\varepsilon_{el,project plant,y}}\right)$$ **Equation 2**

EG_y is determined based on the average net efficiency of electricity generation in the reference plant that would be installed in the absence of the project activity and that would have a lower efficiency of electric generation than the project plant ($\varepsilon_{el,baseline\ plant} = \varepsilon_{el,reference\ plant}$), and the average net efficiency of electricity generation in the project plant after project implementation, $\varepsilon_{el,project\ plant,y}$, shown in Equation 2, where:

EG_y	=	is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* in MWh
$EG_{project\ plant,y}$	=	is the net quantity of electricity generated in the project plant during the year *y* in MWh
$\varepsilon_{el,baseline\ plant}$	=	is the average efficiency of electricity generation in the baseline plant ($MWh_{el}/MWh_{biomass}$)
$\varepsilon_{el,project\ plant,y}$	=	is the average net energy efficiency of electricity generation in the project plant, expressed in $MWh_{el}/MWh_{biomass}$.

The average net energy efficiency of electricity generation in the project plant (**$\varepsilon_{el,project\ plant,y}$**) is determined by dividing the electricity generation during the year *y* by the sum of all fuels (biomass residue types *k* and fossil fuel types *i*), expressed in energy units, as follows:

$$\varepsilon_{el,project\ plant,y} = \frac{EG_{project\ plant,y}}{\sum_k NCV_k \cdot BF_{k,y} + \sum_i NCV_i \cdot FF_{project\ plant,i,y}}$$ **Equation 3**

Where:

$\varepsilon_{el,project\ plant,y}$	=	Average net energy efficiency of electricity generation in the project plant
$EG_{project\ plant,y}$	=	Net quantity of electricity generated in the project plant during the year *y* (MWh)
$BF_{k,y}$	=	Quantity of biomass residue type *k* combusted in the project plant during the year *y* (tonnes of dry matter or liter)
NCV_k	=	Net calorific value of the biomass residue type *k* (GJ/t of dry matter or GJ/liter)
NCV_i	=	Net calorific value of fossil fuel type *i* (GJ / mass or volume unit)
$FF_{project\ plant,i,y}$	=	Quantity of fossil fuel type *i* combusted in the project plant during the year *y* (mass or volume unit per year)

The average efficiency of electricity generation ($\varepsilon_{el,baseline\ plant}$) was validated in the registered PDD and shall not be change during the crediting period. Thus, $\varepsilon_{el,baseline\ plant}$ = 0.0363. Results of other parameters used in the emission reduction calculation during the monitored period are presented in Table 2 and Table 3:

Table 2 – Electricity parameters monitored during 01/05/2010 to 30/11/2013

Year	$EG_{project\ plant,y}$	EG_y	$\varepsilon_{el,project\ plant,y}$
2010	84,351	68,978	0.1992
2011	53,753	42,232	0.1694
2012	49,653	39,137	0.1714
2013	55,755	44,32	0.1771
Total	243,514	194,676	0.1793

Table 3 – Bagasse parameters monitored during 01/05/2010 to 30/11/2013

Year	$BF_{bagasse,y}$	NCV_k		% Water content	
		1st semester	2nd semester	1st semester	2nd semester
2010	215,560	7.08	7.06	52.33	52.55
2011	157,449	7.26	7.26	50.97	50.53
2012	145,985	7.23	7.06	51.32	52.07
2013	171,708	6.60	6.60	52.00	52.00
Total	690,702	7.04	6.70	51.66	51.79

Regarding CO_2 emission factor for the electricity displaced due to the project activity CO_2 emission factor of the grid ($EF_{electricity,y}$), ACM0006 determines the grid CO2 emisison factor ($EF_{grid,y}$), which shall be determined as follows:

- If the power generation capacity of the project plant is more than 15 MW, $EF_{grid,y}$ should be calculated as a combined margin (CM), following the guidance in the section "Baselines" in the Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);
- If the power generation capacity of the project plant is less or equal to 15 MW, project participants may alternatively use the average CO_2 emission factor of the electricity system, as referred to in Option (d) in Step 1 of the baseline determination in ACM0002.

Since the project activity has power generation capacity higher than 15 MW, the first option was used as described in the PDD. According to ACM0002, the following 7 (seven) steps shall be followed:

STEP 1 - Identify the relevant electricity systems.

STEP 2 – Choose whether to include off-grid power plants in the project electricity system (optional).

STEP 3 - Select a method to determine the operating margin (OM).

STEP 4 - Calculate the operating margin emission factor according to the selected method.

STEP 5 - Identify the group of power units to be included in the build margin (BM).

STEP 6 - Calculate the build margin emission factor.

STEP 7 - Calculate the combined margin (CM) emissions factor.

- **STEP 1** - Identify the relevant electricity systems

According to the tool, "*If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. If such delineations are not available, project participants should define the project electricity system and any connected electricity system and justify and document their assumptions in the CDM-PDD*".

The Brazilian DNA published the Resolution nr. 8 issued on 26th May, 2008 that defines the Brazilian

Interconnected Grid as a single system that covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest). Hence, this figure was used to calculate the baseline emission factor of the grid.

- **STEP 2 -** Choose whether to include off-grid power plants in the project electricity system (optional).

The project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

As described in the registered PDD, the project participants chose Option I above.

- **STEP 3** - Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

Since the Brazilian DNA made available the operating margin emission factor calculated using option c – Dispatch data analysis OM, this option was chosen by the project participants as described in the registered PDD.

Detailed information on the methods and data applied can be obtained at the DNA's website: <http://www.mct.gov.br/index.php/content/view/74689.html>.

- **STEP 4** - Calculate the operating margin emission factor according to the selected method

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the power units that are actually dispatched at the margin during each hour *h* where the project is displacing electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DD,y}$.

The $EF_{grid,OM-DD,y}$ shall be calculated using the formula below:

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$ **Equation 6**

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 the 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.

Based on hourly data published by the Brazilian ($FE_{EL,DD,h}$) and monitored data of the project activity ($EG_{PJ,h}$ and $EG_{PJ,y}$), it was possible to calculate the $EF_{grid,OM-DD,y}$. Results are presented below:

Tabela 1 – $EF_{grid,OM-DD,y}$ based on data from the Brazilian DNA and the project activity (2010 - 2013)

$EF_{grid,OM-DD,2010}$	0.5914
$EF_{grid,OM-DD,2011}$	0.3098
$EF_{grid,OM-DD,2012}$	0.5187
$EF_{grid,OM-DD,2013}$	0.5844*

*The OM emission factors of October and November of 2013 are not available yet. Thus, data of September 2013 was used. However, OM emission factors of these months will be updated during verification.

- **STEP 5** - Identify the group of power units to be included in the build margin (BM)

The sample group of power units *m* used to calculate the build margin consists of either:

(a) The set of five power units that have been built most recently; or

(b) The set of power capacity additions in the electricity system that comprises 20% of the system generation (in MWh) and that have been built most recently.

The build margin is also calculated by the Brazilian DNA. Therefore, the project participants used values published by the Brazilian DNA as stated in the registered PDD. The option (b) presented above was chosen by the Brazilian DNA. The number is published at the website: <http://www.mct.gov.br/index.php/content/view/74689.html>.

Tabela 2 – $EF_{grid,BM,y}$ based on data from the Brazilian DNA (2010 - 2013)

$EF_{grid,BM,2010}$	0.1404
$EF_{grid,BM,2011}$	0.1056
$EF_{grid,BM,2012}$	0.2010
$EF_{grid,BM,2013}$	0.2010*

*The BM emission factor for the year of 2013 is not available yet. Thus, 2012 data was used for the monitored period and it will be updated during verification.

Regarding data vintage, project participants can choose between one of the following two options of the “Tool to calculate the emission factor for an electricity system”:

Option 1: For the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex ante, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

According to the registered PDD, the project participants chose Option 2 above.

- **STEP 6** – Calculate the build margin emission factor (BM)

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available.

As stated in the registered PDD, data published by the Brazilian DNA shall be used in the project activity. The number is published at the website: http://www.mct.gov.br/index.php/content/view/74689.html.

- **STEP 7** – Calculate the combined margin (CM) emissions factor

The combined margin is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$ **Equation 3**

Where:

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

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

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

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

According to the "Tool to calculate the emission factor for an electricity system", project activities shall use the wOM = 0.25 and wBM = 0.75 for the second crediting period, except for wind and solar power generation project activities.

Tabela 3 – $EF_{grid,CM,y}$ from 2010 to 2013

Year	$EF_{grid,OM,y}$	w_{OM}	$EF_{grid,BM,y}$	w_{BM}	$EF_{grid,CM,y}$
2010	0.5914	0.25	0.1404	0.75	0.2531
2011	0.3098		0.1056		0.1567
2012	0.5187		0.2010		0.2804
2013	0.5844		0.2010		0.2968

Biomass baseline emissions:

According to ACM0006, baseline emissions due to uncontrolled burning or decay are only applicable to scenarios 2, 3, 7, 10, 15, 16, 17, 20 and 21. Since the scenario #18 is applied in the context of the project activity, biomass baseline emissions are zero, $BE_{biomass,y} = 0$.

E.2. Calculation of project emissions or actual net GHG removals by sinks

According to ACM0006, the project emissions are calculated as follows:

$$PE_y = PET_y + PEFF_y + PE_{EC,y} + GWP_{CH4} * (PE_{Biomass,CH4,y} + PE_{WW,CH4,y})$$ **Equation 4**

Where:

PET_y	=	CO_2 emissions during the year y due to transport of the biomass residues to the project plant (tCO_2/yr)
$PEFF_y$	=	CO_2 emissions during the year y due to fossil fuels co-fired by the generation facility or other fossil fuel consumption at the project site that is attributable to the project activity (tCO_2/yr)
PE_{ECy}	=	CO_2 emissions during the year y due to electricity consumption at the project site that is attributable to the project activity (tCO_2/yr)
GWP_{CH4}	=	Global Warming Potential for methane valid for the relevant commitment period.
$PE_{Biomass,CH4,y}$		CH_4 emissions from the combustion of biomass residues during the year y (tCH_4/yr)
$PE_{WWCH4,y}$		CH_4 emissions from waste water generated from the treatment of biomass residues in year y (tCH_4/yr)

In the present project activity is not identified any GHG emission as:

- CO_2 emissions from transportation of biomass residues to the project site since the biomass is produce inside the project boundary.
- CO_2 emissions from on-site consumption of fossil fuels due to the project activity:

  Sugar mills in Brazil do not use fossil fuels either for power or heat generation. This can be checked at the site of *Unica*. This is cited from the site (http://www.unica.com.br/content/show.asp?cntCode={0C8534A8-74A7-4952-8280-C5F6FB9276B7, accessed on 10 June 2010):

  > "*Auto-suficiência Energética: toda energia utilizada no processo industrial da produção de etanol e açúcar no Brasil é gerada dentro das próprias usinas a partir da queima do bagaço da cana"*. That means "Energy self-sufficiency: all the energy used in the industrial process of ethanol and sugar production in Brazil is generated inside the mills, through the burning of sugar cane bagasse".

- CO_2 emissions from consumption of electricity from the grid are not observed in ethanol and sugar production in Brazil. In the same reference above, it is mentioned that these units in Brazil are Energy self-sufficiency, where all the energy used in the industrial process of ethanol and sugar production in Brazil is generated inside the mills, through the burning of sugar cane bagasse
- Where this emission source is included in the project boundary and relevant: CH_4 emissions from the combustion of biomass residues. It is determined in the version 10.1 of ACM0006 that this emission source must be included if CH_4 emissions from uncontrolled burning or decay of biomass residues in the baseline scenario are included. Since in Brazil there is no burning or decay of the cane bagasse yet it is used to generate steam to the process, this emission source is not accounted.
- Where waste water from the treatment of biomass residues degrades under anaerobic conditions: CH_4 emissions from waste water. The cane bagasse suffers no treatment with water and therefore there is no waste water in the project boundary.

Therefore, no estimation of project emissions is necessary. The project emissions are zero, $PE_y = 0$.

E.3. Calculation of leakage

The main source of leakages in the ACM0006 methodology is considered to be the increase of fossil fuel consumption due to the diversion of the biomass. No diversion of biomass occurs, therefore no leakages

are present. For the reasons explained, leakages are considered zero, $L_y = 0$.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks ($t\ CO_2e$)	Project emissions or actual net GHG removals by sinks ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions or net anthropogenic GHG removals by sinks ($t\ CO_2e$)
Total	48,212	0.00	0.00	48,212

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks ($t\ CO_2e$)	38,875	48,212

E.6. Remarks on difference from estimated value in registered PDD

During the monitoring period from May 1st, 2010 to November 30th, 2013, the project activity generated 48,212 tCO_2e emission reductions. Thus, there was an increase of 24.0% from the estimative presented in the registered PDD of 38,875.

In order to analyze reasons for the increase of emission reductions, an analysis of the monitored parameters were held as presented in Table 4.

Table 4 – Estimated and monitored parameters for the monitored period (01/05/2010 – 30/11/2013)

Parameter	Estimative of the monitored period as presented in the registered PDD	Monitored data during 01/05/ 2010 to 30/11/2013	Difference (%)
$EG_{project\ plant,y}$ (MWh)	405,408	243,514	- 39.9
EG_y (MWh)	320,121	194,676	- 39.2
$BF_{bagasse,y}$ (tonnes)	1,151,697	690,702	- 40.0
NCV_k (MWh/tonnes)	2.04	1.95	- 4.4
Percentage of water content (%)	51.00	52.42	+ 2.8
$EF_{grid,2010}$ (tCO_2/MWh)	0.1214	0.2531	+ 108.5
$EF_{grid,2011}$ (tCO_2/MWh)	0.1214	0.1567	+ 29.0
$EF_{grid,2012}$ (tCO_2/MWh)	0.1214	0.2804	+ 130.9

$EF_{grid,2013}$ (tCO_2/MWh)	0.1214	0.2968	+ 144.4

As can be seen in the table above, the electricity generated by the project activity is 39.9% lower than the estimated figure in the registered PDD. This difference is directly associated to the reduction of bagasse consumption of 40.0%, passing from 1,151,697 tonnes of bagasse (considering an average of 337,082 tonnes of bagasse per year estimated in the registered PDD) to 690,702 tonnes consumed during the monitored period. This reduction of bagasse is associated with the decrease of milling and exportation during the monitored period, as well as downtimes required by Da Pedra mill, a power plant located near Usina da Pedra, which is owned by CPFL Bio Pedra S/A. It is important to mention that the implementation of this power plant does not impact the project activity boundary as mentioned in the registered PDD. Additionally to the reduction bagasse, the percentage of water content in biomass has increased from 51% estimated in the registered PDD to 52.42% during the monitored period; the increase of humidity in biomass impacted in milling and bagasse burn.

In spite of the reduction of bagasse consumption, the CO_2 emission factor of the grid presented a 103.2% average increase. The estimated CO_2 emission factor of the grid considered for estimative proposes in the registered PDD was 0.1214 tCO_2/MWh based on the values published by the Brazilian DNA for the year of 2009. This value is very low while comparing to the values of 2010 to 2013 years.

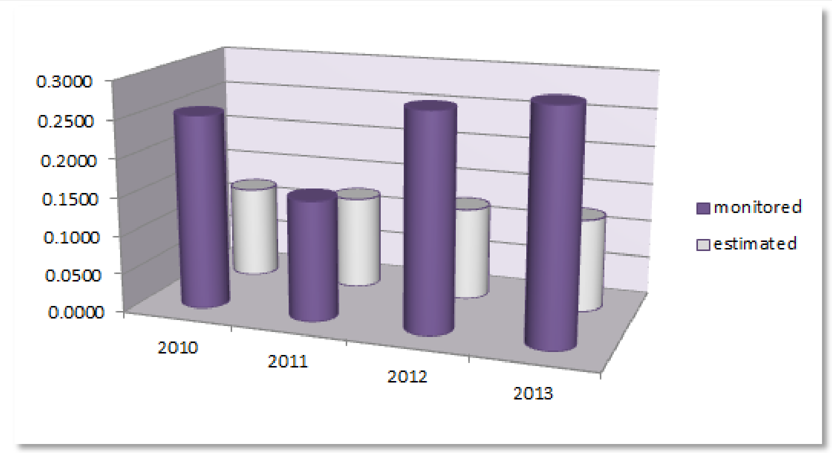

Figure 3 – CO_2 emission factor of the grid: estimated Vs. monitored (2010 – 2013)

Brazil possesses a large share of hydroelectricity and, for this reason, it presents a low CO_2 emission factor of the grid when comparing to other Latin American countries. However, during the years when an atypical short rainy season is observed, the generation of electricity by the thermal power plants fuelled with fossil fuels rises. This can be observed, for instance, in the years of 2010, 2012 and 2013, when the calculated CO_2 emission factors were significantly higher when compared to those for 2011.

Considering the explanations above, there was a significantly increase in the CO_2 emission factor of the grid during the monitored period when compared to the estimated value and, therefore, this increase undeniable impacted the emission reductions generated by the project activity.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	35,053	13,159

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Document information

Version	*Date*	*Description*
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 anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, 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).
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