Monitoring report form
(Version 04.0)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT	
Title of the project activity	Ibirama Small Hydropower Plant – a Brennand CDM Project Activity.
Reference number of the project activity	6208
Version number of the monitoring report	4
Completion date of the monitoring report	20/08/2014
Registration date of the project activity	25/07/2012
Monitoring period number and duration of this monitoring period	1st verification: 25/07/2012 – 31/12/2013
Project participant(s)	Ibirama Energética S.A. Ecopart Assessoria em Negócios Empresariais Ltda
Host Party(ies)	Brazil
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Sectoral scope 1 : Energy industries (renewable - / non-renewable sources). ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 12.1.0).
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	40,796 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	67,817 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	16,608 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	51,209 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The primary objective of Ibirama Small Hydropower Plant Project Activity (Ibirama SHPP) is to help 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 by increasing the share of renewable energy in total electricity consumption for Brazil

The project consists of the construction of a small hydropower plant ("PCH", from the Portuguese Pequena Central Hidrelétrica) with 21 MW of installed capacity and a reservoir area of 0.13 km^2. The plant is located in the Ibirama municipality, State of Santa Catarina, Brazil's Southern region.

As described in the registered PDD, the Construction Permit for Ibirama SHPP was issued on February 18th, 2009[1] and, then, construction started on July 1st, 2009[2]. The 3 (three) Francis turbines and 3 (three) syncronos generators started commissioning on December 1st, 2010[3] and operation startup on December 21st, 2010[4].

Ibirama Energética S.A., the company that controls Ibirama Small Hydropower Plant, is owned by Empreendimentos Energéticos e Participações Ltda. and MM Energia Ltda. Empreendimentos Energéticos e Participações Ltda. is the major shareholder of Ibirama Energética S.A. and is owned by the Brennand Group.

The Brennand Group has another 3 (three) project activities registered under CDM: ARAPUtanga Centrais Elétricas S. A. - ARAPUCEL - Small Hydroelectric Power Plants Project (Ref. 0530), Pampeana and Terra Santa Small Hydropower Plants Project Activity (Ref. 4996) and Ouro Small Hydropower Plant – Brennand CDM Project Activity (Ref. 4936).

Prior to the implementation of the project activity no small hydropower plant was operational in the location where the Ibirama project is implemented. The project activity reduces emissions of GHG by avoiding electricity generation from fossil fuel sources, which would be generated (and emitted) in the absence of the project and, thus, it contributes to environmental sustainability. In conclusion, the baseline scenario and the scenario without the project activity are the same.

This first verification comprises the period from 25/07/2012 to 31/12/2013; the GHG emission reductions achieved up to 31/12/2012 are 16,608 tCO_2e. From 01/01/2013 to 31/12/2013, the project activity reduced 51,209 tCO_2e. Therefore, the Ibirama SHPP reduced 67,817 tCO_2e during this first monitoring period.

A.2. Location of project activity

The project activity is located in Ibirama, State of Santa Catarina, Southern region of Brazil under the following geographical coordinates:

Table 1 – Geographical coordinates of Ibirama project activity[5]

Latitude	Longitude
27° 02' 15.9" South	49° 34' 9.8" West

[1] Construction License # 0013/09 issued on February 18th, 2009 by the Environmental Agency of Santa Catarina (Fundação do Meio Ambiente – FATMA).

[2] Public information available in the ANEEL's report Acompanhamento das Pequenas Centrais Hidrelétricas com Licença de Instalação, dated December 15th, 2009. ANEEL's website: <http://www.aneel.gov.br/>.

[3] ANEEL Ordinance # 3,643 issued on November 30th, 2010. Available at ANEEL's website:

<http://www.aneel.gov.br/cedoc/dsp20103643.pdf>.

[4] ANEEL Ordinance nr. 3,961 dated December 20th, 2010. Available at: <http://www.aneel.gov.br/cedoc/dsp20103961.pdf>.

[5] See the Construction License of the project issued on February 18th, 2009.

A.3. Parties and project participant(s)

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)	Ibirama Energética S.A.	No
	Ecopart Assessoria em Negócios Empresariais Ltda	

A.4. Reference of applied methodology and standardized baseline

The project activity applies ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 12.1.0).

ACM0002 refers to the latest approved versions of the following tools:

- Tool to calculate the emission factor for an electricity system (Version 2.2.0);
- Tool for the demonstration and assessment of additionality (Version 5.2);
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 2).
- Combined tool to identify the baseline scenario and demonstrate additionality (version 3.0.0).

A.5. Crediting period of project activity

The starting date of the crediting period of the project activity is from 25/07/2012 to 24/07/2019 (renewable).

A.6. Contact information of responsible persons/ entities

Contact information of responsible person / entity:

Name: A. Ricardo J. Esparta

Company: Ecopart Assessoria em Negócios Empresariais Ltda.

E-mail: ricardo.esparta@eqao.com.br

Tel: +55 (11) 3063-9068

Ecopart Assessoria em Negócios Empresariais Ltda. is the entity responsible for the CDM-MR-FORM form and is also the Project Participant.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The project activity was implemented as described in the registered PDD. The 3 (three) generating units started-up on December 20th, 2010, through ANEEL Ordinance nr. 3,961/2012.

During this monitoring period, the project operated according to the registered Monitoring Plan as described in section C of this Monitoring Report.

Table 2 – Technical configuration of Ibirama project activity

Turbine[6]	Type	Francis
	Quantity	3
	Nominal power (MW)	7.250[7]
	Speed (rpm)	400
	Grid frequency (Hz)	60
	Manufacturer	Voith Siemens
Generator[8]	Type	Syncronos
	Quantity	3
	Nominal power (kVA)	7,780
	Frequency (rpm)	400
	Power factor	0.9
	Nominal tension (V)	6,900
	Manufacturer	Gevisa S/A

B.2. Post registration changes

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

Not applicable.

B.2.2. Corrections

Not applicable.

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

Not applicable.

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

Not applicable.

[6] Information available in the design data sheet issued by the turbines manufacturer dated October 1st, 2007.

[7] The sum of the nominal power of the three turbines was considered as the project installed capacity. Detailed information is presented in CL 14 of Validation Protocol.

[8] Information available in the technical data record issued by the generators manufacturer Gevisa S/A in July 2009.

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

The project activity proceeded according to the "Approved consolidated monitoring methodology ACM0002" – "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources". According to this methodology and as presented in the registered PDD, the parameters to be monitored for Ibirama project are as follows:

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

(ii) Installed capacity of the hydro power plant after the implementation of the project activity (Cap_{PJ});

(iii) Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ});

(iv) Parameters used for the calculation of the 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" ($EF_{grid,CM,y}$).

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

The electricity monitoring consists of using a meter equipment projected to register and verify bidirectionally the energy generated by the facility. This energy measurement is fundamental to verify and monitor the baseline emissions.

There are 6 (six) energy meters involved in the project activity: 3 (three) located in each generator, 1 (one) meter (which writes up the total sum of generator meters) and 2 (two) at the substation (principal and backup). Energy meters have by legal requirements extremely low level of uncertainty. See meters specifications in Table 3.

Measurements are controlled in real time by the Operation and Management Center (from the Portuguese *Centro de Operação de Geração – COG*) in Cuiabá, capital of Mato Grosso State. For emission reductions, monthly recording from the local power utility or Chamber of Electric Energy Commercialization (from the Portuguese Câmara Comercializadora de Energia Elétrica – CCEE) can be used.

Meters located at the plant measure the gross electricity and meters located at the substation measure the net electricity of Ibirama project. The net measurement is used for invoicing and, also, for emission reduction purposes. The gross measurements are only for internal control and cross-checking data, in case of large discrepancies (losses share).

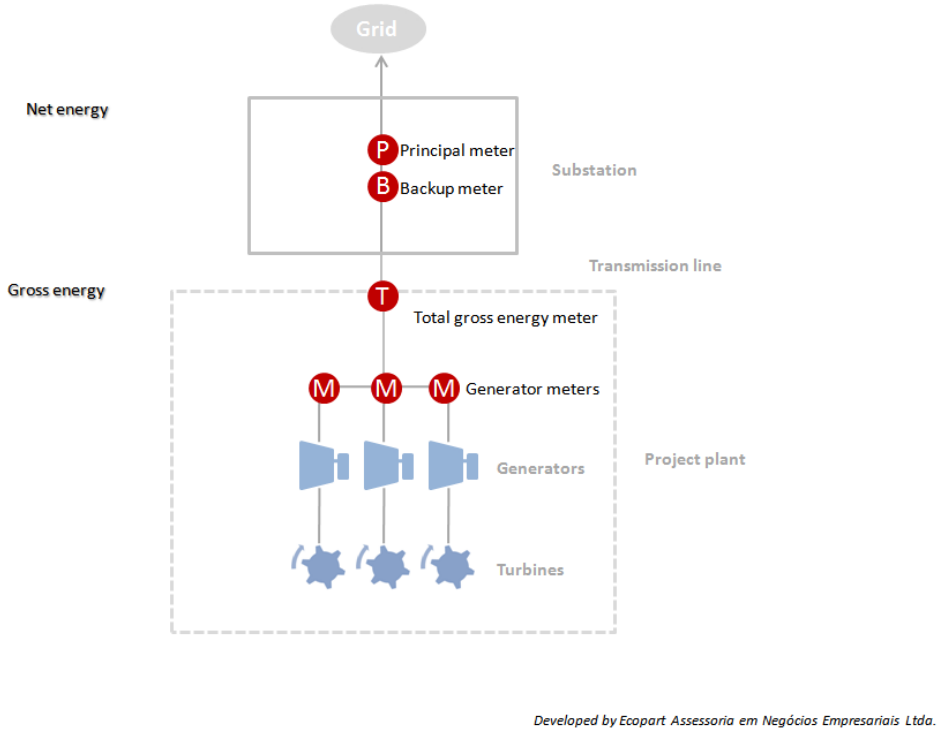

Figure 1 – Meters diagram involved in the project activity

It is important to mention that meters located in the substation have to be the ones specified by the Chamber of Electric Energy Commercialization (from the Portuguese *Câmara de Comercialização de Energia Elétrica - CCEE*). CCEE makes feasible and regulates the electricity energy commercialization. Before the operation startup, CCEE demands that these meters are calibrated by an entity with Rede Brasileira de Calibração (RBC) credential. In addition, CCEE has online access to the measurement data from the meters located at the substation.

Table 3 – Meters specifications

Type	SAGA 1000[9]	IDM144[10]
Class	0.2	0.25 - 0.5
Frequency	50/60 Hz	50/60 Hz
Manufacturer	Landis+Gyr Equipamentos de Medição Ltda.	ABB Ltda.
Location	Principal and backup meters at the substation (P/B)	At the generators and power plant (T, M)

The table below presents the dates when energy meters located at the substations were calibrated.

[9] As mentioned above, meters located at the substation have to be the ones specified by CCEE. Therefore, SAGA1000 meter has the necessary requirements to be used in the Ibirama project as presented at the CCEE's website: <http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=ca4da5c1de88a010VgnVCM100000aa01a8c0RCRD>. Specifications of SAGA1000 meter can be checked in the manufacturer's manual dated April 20th, 2006, as presented to the DOE during validation.

[10] Specifications of IDM144 meter can be checked in the manufacturer's manual dated 2000, as presented to the DOE during validation.

Table 4 - Calibration dates of the energy meters located at the substation – SAGA 1000

Type	*Serial Number*	*Certificate nr.*	*Last Calibration Date*	*Previous Calibration Date*
Main meter	458489	CCR 081/13	29/01/2013	20/07/2010
Backup meter	458490	CCR 082/13	29/01/2013	20/07/2010

Centrais Elétricas de Santa Catarina S/A (CELESC) is responsible for the calibration each 2 years of meters located at the substation, following the ONS procedures (procedure 12.3)[11].

Since there was a delay in the calibration of net energy meters as presented in Table 4, the PPs applied the discount following §283 of the CDM Validation and Verification Standard. Results are presented in sections D.2 and E of this Monitoring Report.

(ii) Installed capacity of the hydro power plant after the implementation of the project activity (Cap_{PJ})

Installed capacity of the power plant can be checked by DOE during on-site visit at every verification (estimated to happen yearly) and cross-checked with official documents, *e.g.* new ANEEL resolutions/authorization or new licenses issued by the environmental agency of Santa Catarina State.

Since power plants are only authorized to export electricity based on the installed capacities approved by the Brazilian Power Regulatory Agency (ANEEL) and the environmental agencies of the states, changes in the installed capacity of the project can be clearly identified (low level of uncertainty).

(iii) **Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ})**

The Brazilian government does not require the reservoir area monitoring; the reservoir area of a small or large hydropower plant in Brazil is determined once at the time of the project design/conception.

In spite of the information above, the reservoir area of the project is monitored through topographical studies (made once at the time of the project design) and water reservoir levels, which are monitored monthly by the project sponsors (plant operator) following ACM0002 methodology.

(iv) Parameters used for the calculation of the 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" ($EF_{grid,CM,y}$)

The Brazilian DNA made publicly available the build margin ($EF_{grid.BM.y}$) and operating margin ($EF_{grid.OM.y}$) emission factors yearly. Then, these values were used in this verification.

Brennand Group is responsible for the project management, as well as for organizing and training the staff in the appropriate monitoring, measurement and reporting techniques. In addition, it is responsible for the maintenance of the monitoring equipment, for dealing with possible monitoring data adjustments and uncertainties, for review of reported results/data, for internal audits of GHG project compliance with operational requirements and for corrective actions.

[11] ONS procedure 12.3. Maintenance of the metering system for invoicing. Grid procedures. Version 1. Valid since August 5th, 2009. Available at: <http://www.ons.org.br/download/procedimentos/modulos/Modulo_12/Submodulo%2012.3_Rev_1.0.pdf>.

Brennand Group, the company that controls Ibirama Energética S.A., has hired expert companies to execute their environmental programs. After the beginning of commercial operations, renovation of degraded areas and of permanent preservation areas were done according to the regulations of the environmental agencies, through a team of environmental experts, that monitor the compliance with the environmental agencies' regulations. Studies done during the design phase of the project activities have shown the environmental impacts and the interference on the social development in the region of the plant, indicating the mitigation measures to be adopted during the construction phase. These measures are being taken rigorously. Data about environmental impact are being archived by the SHPPs and the environmental agencies.

Data monitored and required for verification and issuance will 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.

SECTION D. Data and parameters

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

Data / Parameter:	Cap_{BL}
Unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity.
Source of data:	Project site
Value(s) applied):	0
Purpose of data:	Baseline and project emissions.
Additional comment:	The methodology that this value shall be applied for new hydro power plants.

Data / Parameter:	A_{BL}
Unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity.
Source of data:	Project site
Value(s) applied):	0
Purpose of data:	Project emissions
Additional comment:	The methodology that this value shall be applied for new hydro power plants.

D.2. Data and parameters monitored

<table>
<tr><td>Data / Parameter:</td><td>$EG_{facility,y}$</td></tr>
<tr><td>Unit:</td><td>MWh/yr</td></tr>
<tr><td>Description:</td><td>Electricity generation of the Project delivered to grid.</td></tr>
<tr><td>Measured/
Calculated /
Default:</td><td>Measured</td></tr>
<tr><td>Source of data:</td><td>Project activity site.</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>
<table>
<tr><th>Year</th><th>$EG_{facility,y}$</th></tr>
<tr><td>2012</td><td>42,430 MWh</td></tr>
<tr><td>2013</td><td>118,662 MWh</td></tr>
<tr><td>Total</td><td>161,092 MWh</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment:</td><td>Electricity meters. Description of the net electricity is presented below:
<table>
<tr><td>Quantity</td><td>2 (main and backup)</td></tr>
<tr><td>Type</td><td>SAGA 1000</td></tr>
<tr><td>Accuracy class</td><td>0.2%</td></tr>
<tr><td>Serial number</td><td>458489 / 458490</td></tr>
<tr><td>Calibration frequency</td><td>Each 2 years</td></tr>
<tr><td>Date of the latest calibrations</td><td>20/07/2010 / 29/01/2013</td></tr>
<tr><td>Validity</td><td>19/07/2012 / 28/01/2015</td></tr>
</table>
</td></tr>
<tr><td>Measuring/
Reading/
Recording frequency:</td><td>Continuously measurement and monthly recording.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>-</td></tr>
<tr><td>QA/QC procedures:</td><td>Double checked by internal control and sales receipt or by documents from the Chamber of Electric Energy Commercialization (from the Portuguese Câmara Comercializadora de Energia Elétrica – CCEE).

Equipments used have by legal requirements extremely low level of uncertainty).</td></tr>
<tr><td>Purpose of data:</td><td>Baseline emissions</td></tr>
<tr><td>Additional comment:</td><td>Electronically archived. Detailed information regarding electricity meters is presented in section C of the Monitoring Report.</td></tr>
</table>

Data / Parameter:	Cap_{PJ}
Unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity.
Measured/ Calculated / Default:	-
Source of data:	Project site.
Value(s) of monitored parameter:	21,006,000 W
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Installed capacity of the power plant will be checked by DOE during verification on-site visit. TAG's equipment and licenses issued by the Environmental Agency of the State will be available at that time.
Calculation method (if applicable):	-
QA/QC procedures:	-
Purpose of data:	Baseline and project emissions
Additional comment:	Electronically archived.

Data / Parameter:	A_{PJ}
Unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full
Measured/ Calculated / Default:	Measured
Source of data:	Construction License nr. 0013/09 (issued on 18/02/2009).
Value(s) of monitored parameter:	130,000 m^2
Monitoring equipment:	The reservoir are will be monitored through topographical data in the location of the project activity (made once at the time of the project design) and the reservoir level, which will yearly monitored by project sponsor.
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	-
QA/QC procedures:	-

Purpose of data:	Baseline and project emissions
Additional comment:	Electronically archived.

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*
Measured/ Calculated / Default:	Calculated
Source of data:	The Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value(s) of monitored parameter:	**Year** / $EF_{grid.CM.y}$ 2012 / 0.3914 tCO_2/MWh 2013 / 0.4316 tCO_2/MWh
Monitoring equipment:	Calculated based on Operating and Build margin emission factors.
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system" applying the numbers published by the Brazilian DNA.
QA/QC procedures:	Official source of data.
Purpose of data:	Baseline emissions
Additional comment:	Electronically archived.

Data / Parameter:	$EF_{grid.OM.y}$
Unit:	tCO_2/MWh
Description:	Operating margin CO_2 emission factor for grid connected power generation in year *y*
Measured/ Calculated / Default:	Calculated

Source of data:	The Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value(s) of monitored parameter:	<table><tr><th>Year</th><th>$EF_{grid.OM.y}$</th></tr><tr><td>2012</td><td>0.5818 tCO_2/MWh</td></tr><tr><td>2013</td><td>0.5918 tCO_2/MWh</td></tr></table>
Monitoring equipment:	The selected option to calculate the operating margin was the dispatch analysis which does not permit the vintage of *ex-ante* calculation of the emission factor. Therefore. the chosen option was ***ex-post*** calculation. This parameter will be annually up-dated applying the numbers provided by the Brazilian DNA. Electronically archived.
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system" applying the numbers published by the Brazilian DNA.
QA/QC procedures:	Official source of data.
Purpose of data:	Baseline emissions
Additional comment:	-

Data / Parameter:	$EF_{grid.BM.y}$
Unit:	tCO_2/MWh
Description:	Build margin CO_2 emission factor for grid connected power generation in year *y*
Measured/ Calculated / Default:	Calculated
Source of data:	The Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value(s) of monitored parameter:	<table><tr><th>Year</th><th>$EF_{grid.BM.y}$</th></tr><tr><td>2012</td><td>0.2010 tCO_2/MWh</td></tr><tr><td>2013</td><td>0.2713 tCO_2/MWh</td></tr></table>

Monitoring equipment:	Option 2 of the tool was chosen. Hence. this parameter will be ***ex-post*** up-dated applying the numbers provided by the Brazilian DNA. Electronically archived.
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system" applying the numbers published by the Brazilian DNA.
QA/QC procedures:	Official source of data.
Purpose of data:	Baseline emissions
Additional comment:	-

Data / Parameter:	***$FC_{i,m,y}$, $FC_{i,y}$, $FC_{i,j,y}$, $FC_{i,k,y}$, $FC_{i,n,y}$ and $FC_{i,n,h}$***
Unit:	Mass or volume unit
Description:	Amount of fossil fuel type i consumed by power plant / unit *m, j, k* or *n* (or in the project electricity system in case of $FC_{i,y}$) in year *y* or hour *h*
Measured/ Calculated / Default:	Calculated
Source of data:	The Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value(s) of monitored parameter:	The parameters $EF_{grid,BM,y}$, as well as $FE_{EL,DD,h}$ used for the $EF_{grid,OM,y}$ calculation, are calculated and made available by the Brazilian DNA. These figures are used for the $EF_{grid.BM.y}$ calculation.
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures:	Official source of data.
Purpose of data:	Baseline emissions
Additional comment:	-

Data / Parameter:	***$NCV_{i,y}$***
Unit:	GJ/ mass or volume unit

Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Measured/ Calculated / Default:	Calculated
Source of data:	The Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value(s) of monitored parameter:	The parameters $EF_{grid,BM,y}$, as well as $FE_{EL,DD,h}$ used for the $EF_{grid,OM,y}$ calaculation, are calculated and made available by the Brazilian DNA. These figures are used for the $EF_{grid.BM.y}$ calculation.
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures:	Official source of data.
Purpose of data:	Baseline emissions
Additional comment:	-

Data / Parameter:	***$EF_{CO2i,y}$ and $EF_{CO2m,i,y}$***
Unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Measured/ Calculated / Default:	Calculated
Source of data:	The Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value(s) of monitored parameter:	The parameters $EF_{grid,BM,y}$, as well as $FE_{EL,DD,h}$ used for the $EF_{grid,OM,y}$ calaculation, are calculated and made available by the Brazilian DNA. These figures are used for the $EF_{grid.BM.y}$ calculation.
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures:	Official source of data.
Purpose of data:	Baseline emissions

Additional comment:	-

Data / Parameter:	$EG_{m,y}$, EG_y, $EG_{j,y}$, $EG_{k,y}$ and $EG_{n,h}$
Unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant / unit *m, j, k* or *n* (or in the project electricity system in case of EG_y) in year *y* or hour *h*
Measured/ Calculated / Default:	Calculated
Source of data:	The Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value(s) of monitored parameter:	The parameters $EF_{grid,BM,y}$, as well as $FE_{EL,DD,h}$ used for the $EF_{grid,OM,y}$ calculation, are calculated and made available by the Brazilian DNA. These figures are used for the $EF_{grid.BM.y}$ calculation.
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Hourly
Calculation method (if applicable):	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures:	Official source of data.
Purpose of data:	Baseline emissions
Additional comment:	-

Data / Parameter:	$EG_{PJ,h}$
Unit:	MWh
Description:	Electricity displaced by the project activity in hour *h* of year *y*
Measured/ Calculated / Default:	Calculated
Source of data:	The Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value(s) of monitored parameter:	Massive amount of data. Please refer to the CER spreadsheet attached to this Monitoring Report.

Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Hourly
Calculation method (if applicable):	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures:	Official source of data.
Purpose of data:	Baseline emissions
Additional comment:	-

Data / Parameter:	$\eta_{m,y}$
Unit:	-
Description:	Average net energy conversion efficiency of power unit m in year *y*
Measured/ Calculated / Default:	Calculated
Source of data:	The Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value(s) of monitored parameter:	The parameters $EF_{grid,BM,y}$, as well as $FE_{EL,DD,h}$ used for the $EF_{grid,OM,y}$ calaculation, are calculated and made available by the Brazilian DNA. These figures are used for the $EF_{grid.BM.y}$ calculation.
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures:	Official source of data.
Purpose of data:	Baseline emissions
Additional comment:	-

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

According to ACM0002, the baseline emissions (BE_y) during a given year *y* are achieved through the equation below:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \qquad \textbf{Equation 1}$$

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/yr);

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh).

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

According to the selected approved methodology (ACM0002, 2009), the baseline emission factor (EF_y) is calculated using the methodological tool "Tool to calculate the emission factor for an electricity system". According to this tool PPs shall apply the following six steps to the baseline calculation:

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 - Calculate the build margin (BM) emission factor.

STEP 6 - 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 has published the Resolution # 8 issued on 26th May, 2008, which 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.

The Brazilian DNA made available the emission factor calculation based on information of the grid power plants only – option (i) – following the "*Tool to calculate the emission factor for an electricity system*". More information of the methods applied can be obtained in the DNA's website (http://www.mct.gov.br/index.php/content/view/4016.html).

- **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.

The Brazilian DNA made available the operating margin emission factor calculated following the "Tool to calculate the emission factor for an electricity system", approved by the CDM Executive Board. The calculation uses option c – Dispatch data analysis OM. This option does not permit the vintage of *ex-ante* calculation of the emission factor. Therefore, the chosen option was ***ex-post*** calculation. This parameter is annually up-dated applying the numbers provided by the Brazilian DNA. More information of the methods applied can be obtained in the DNA's website (http://www.mct.gov.br/index.php/content/view/4016.html).

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

The dispatch data analysis OM emission factor ($EF_{grid,OM\text{-}DD,y}$) 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 $EF_{grid,OM\text{-}DD,y}$.

It will be calculated using the below formulae:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \qquad \textbf{Equation 2}$$

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.

As mentioned above, the host country's DNA will provide $EF_{EL,DD,h}$ in order for PPs to calculate the operating margin emission factor. Hence, this data was updated applying the numbers provided by the Brazilian DNA as follows:

Table 5 – $EF_{grid,OM,y}$ based on data from the Brazilian DNA (2012 – 2013)

Year	$EF_{grid,OM,y}$
2012	0.5818 tCO_2/MWh
2013	0.5918 tCO_2/MWh*

- **STEP 5** - Calculate the build margin (BM) emission factor

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, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$ **Equation 3**

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;

y = Most recent historical year for which power generation data is available.

The Brazilian DNA made available the build margin emission factor calculated following the "Tool to calculate the emission factor for an electricity system", approved by the CDM Executive Board. This parameter shall be annually up-dated applying the numbers provided by the Brazilian DNA.

Table 6 – $EF_{grid,BM,y}$ made available by the Brazilian DNA (2012 – 2013)

Year	$EF_{grid,OM,y}$
2012	0.2010 tCO_2/MWh
2013	0.2713 tCO_2/MWh*

- **STEP 6** – Calculate the combined margin (CM) emissions factor.

  The combined margin is calculated as follows:

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$ **Equation 4**

Where:

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

$EF_{OM\,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh);

w_{BM} = weighting of build margin emissions factor (%);

$EF_{BM,\,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh).

Weights are determined by the emission factor calculation tool. Alternative weights can be proposed for consideration by the Executive Board, as long as $w_{OM} + w_{BM} = 1$, and the values applied by PPs should be fixed for a crediting period and may be revised at the renewal of the crediting period.

Table 7 – $EF_{grid,CM,y}$ based on data from the Brazilian DNA and weights from determined by the EF tool (2012 – 2013)

Year	$EF_{grid,OM,y}$	w_{OM}	$EF_{grid,BM,y}$	W_{BM}	$EF_{grid,CM,y}$
2012	0.5818	0.5	0.2010	0.5	0.3914
2013	0.5918		0.2713		0.4316

Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity ($EG_{PJ,y}$)

According to ACM0002, the calculation of $EG_{PJ,y}$ is different depending on the case of the project as follows:

(a) Greenfield plants (installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity);

(b) Retrofits and replacements of an existing renewable energy power plant;

(c) Capacity addition to an existing renewable energy power plant.

Since Ibirama project is a new hydropower plant connected to the grid where no renewable power plant was operated prior to the project, Ibirama applies option (a). In this case, $EG_{PJ,y}$ is calculated as follows:

$$EG_{PJ,y} = EG_{facility,y} \qquad \textbf{Equation 5}$$

Where:

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

Since the calibration of energy meters have been delayed, the Project Participants applied the maximum permissible error of the energy meters (0.2%) for the period not covered by calibration, *i.e*. from 25 July 2012 to 28 January 2013, in accordance with §283 of the CDM Validation and Verification Standard. Error was applied in the net electricity generated by the project activity and the results are presented in the table below.

Table 8 – Net electricity generated by the project activity during 25/07/2012 – 31/12/2013 applying the maximum permissible error of equipment

Month	Year	
	2012	2013
January	-	10,370
February	-	8,311
March	-	9,072
April	-	6,124
May	-	2,895
June	-	9,457
July	3,363	13,157
August	10,621	14,652
September	5,096	13,485
October	9,243	14,319
November	7,330	8,740
December	6,777	8,080

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

The proposed project activity may involve project emissions that can be significant. In this sense, according to the selected CDM methodology these emissions shall be accounted for as project emissions by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad \text{Equation 6}$$

Where:

PE_y = Project emissions in year *y* (tCO_2e/yr);

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year *y* (tCO_2/yr);

$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e/yr);

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e/yr).

Emissions from fossil fuel combustion ($PE_{FF,y}$)

Considering that there is no fossil fuel combustion in the proposed project activity, $PE_{FF,y}$ = 0 tCO_2/year.

Emissions from the operation of geothermal power plants due to the release of non-condensable gases ($PE_{GP,y}$)

Considering that the proposed project activity consists on the construction of a small hydropower plant, there are no emissions of non-condensable gases from the operation of geothermal power plants. Therefore, $PE_{GP,y}$ = 0 tCO_2/year.

Emissions from water reservoirs of hydro power plants ($PE_{HP,y}$)

According to ACM0002, new hydropower projects with reservoirs, shall account for project emissions, estimated as follows:

a) If the power density (*PD*) of power plant is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_y = \frac{EF_{\text{Res}} \times TEG_y}{1000} \quad \text{Equation 7}$$

Where:

PEy = Emission from reservoir expressed as tCO_2e/year;

EF_{Res} = is the default emission factor for emissions from reservoirs, and the default value as perEB23 is 90 Kg CO_2e/MWh;

TEG_y = Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh).

b) If power density (*PD*) of the project is greater than $10W/m^2$, PE_y = 0. The power density of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad \text{Equation 8}$$

Where:

PD = Power density of the project activity, in W/m^2;

Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W);

Cap_{BL} = Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero;

A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2);

A_{BL} = Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

During the monitored period, Cap_{PJ} and A_{PJ} parameters remained the same from the registered PDD, *i.e.* Cap_{PJ} = 21,006,000 W and A_{PJ} = 130,000 m^2. Therefore, there are no project emissions involved in the project activity, since the power density is 161.6 W/m^2.

E.3. Calculation of leakage

Indirect emissions can result from project construction, transportation of materials and fuel and other upstream activities. Nevertheless, no significant net leakage from these activities was identified.

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	67,817	0.00	0.00	67,817

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)	40,796	67,817

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

As presented in section E.5 above, the emission reductions estimated in the registered PDD for the period of July 25th, 2012 to December 31st, 2013 are 40,796 tCO_2e and the actual emission reductions are 67,817 tCO_2e. Therefore, there was an increase of 66.2% of emission reductions when comparing to the registered PDD.

Considering the 66.2% increase in the emission reductions of the project activity during the monitored period when comparing to the estimated ones, the Project Participants analyzed the monitored parameters that may have impacted the emission reductions of the project activity.

→ **Electricity generation of the project delivered to grid ($EG_{facility,y}$)**

While analyzing the net electricity generated by Ibirama small hydropower plant in the monitoring period, it can be observed that, in reality, there was a reduction of electricity in comparison to the registered PDD.

From July 25th, 2012 to December 31st, 2013, 175,118 MWh was estimated in the registered PDD and 161,092 MWh was monitored. Therefore, there was a reduction of 8.0% of electricity dispatched to the grid when comparing to the estimation presented in the registered PDD. Estimated and monitored electricity dispatched to the grid are presented in the figures below.

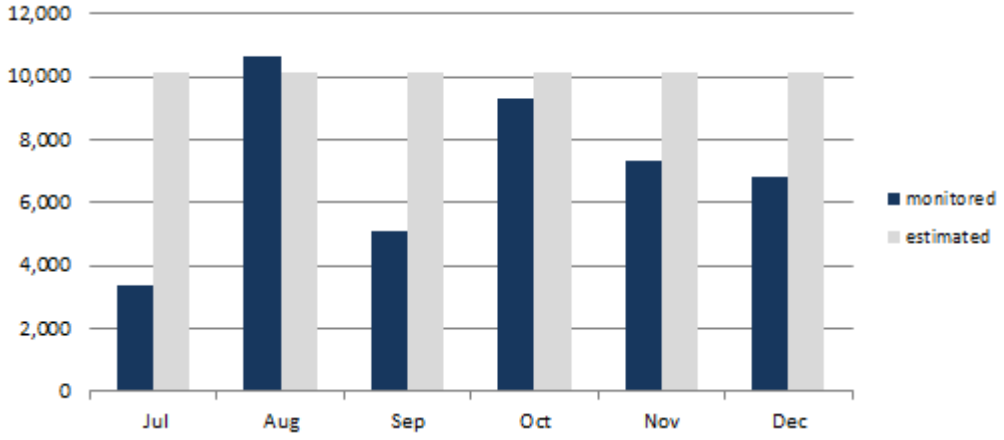

Figure 2 – Estimated and monitored electricity dispatched to the grid by the project activity from 25/07/2012 to 31/12/2012 in MWh

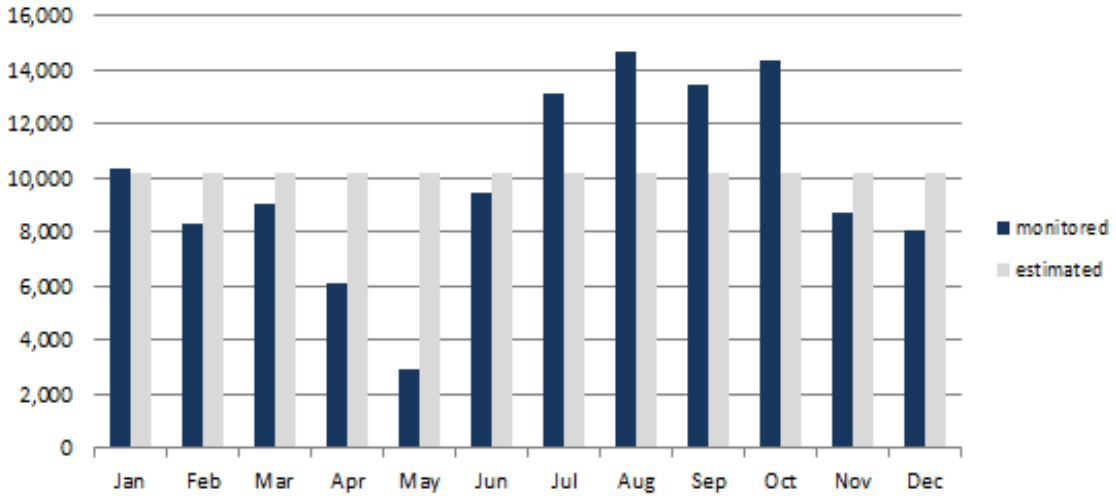

Figure 3 – Estimated and monitored electricity dispatched to the grid by the project activity from 01/01/2013 to 31/12/2013 in MWh

Considering explanations above, the increase of emission reductions in comparison to the values presented in the registered PDD was not caused by an increase of electricity generation, since there was a reduction of 8.0% during the monitored period.

→ **Combined margin CO_2 emission factor for grid connected power generation ($EF_{grid,CM,y}$)**

The estimated CO_2 emission factor of the grid considered for estimative proposes in the registered PDD was 0.2326 tCO_2/MWh based on the values published by the Brazilian DNA for the year of 2006 to 2008. This value is very low while comparing to the values of 2012 and 2013 years as presented in the table below.

Table 9 – Estimated and monitored CO_2 emission factor of the grid from 07/2012 to 12/2013 in tCO_2/MWh

Estimated (tCO_2/MWh)	Monitored (tCO_2/MWh)	Difference
0.2326	Year 2012: 0.3914	68.3%
0.2326	Year 2013: 0.4316	85.5%

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 year of 2012 and in 2013, when the calculated emission factor was significantly higher when compared to those for 2006 to 2008.

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.

Conclusion

Considering the discussion presented above, the parameter that increase the emission reductions of the project activity in comparison to the estimated value presented in the registered PDD is the combined margin CO_2 emission factor of the grid ($EF_{grid,CM,y}$).

Although the net electricity generation of the project activity has reduced during the monitoring period, it was not sufficient to compensate the significantly increase in the CO_2 emission factor of the grid for the years of 2012 and 2013, which resulted in 68.3% and 85.5% increase, respectively. Therefore, this increase impacted the baseline emissions/emission reductions of the project activity. For this reason, it can be concluded that the increase in the emission reductions of the project activity is due to the increase in the CO_2 emission factor of the grid.

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)	16,608	51,209

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Ibirama Energética S.A.
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Document information

Version	*Date*	*Description*
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.

Version	*Date*	*Description*
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).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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