CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Project title: Energisa Rio Grande SHPPs.

PDD version number: 03.

Date (DD/MM/YYYY): 01/03/2012

A.2. Description of the project activity:

The primary objective of Energisa Rio Grande SHPPS is to help meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy's share of the total Brazilian electricity consumption.

The project consists of 31.6 MW divided into three small hydroelectric power plants (SHPP), Caju SHPP, Santo Antônio SHPP, and São Sebastião do Alto SHPP, all of them in the state of Rio de Janeiro, Southeast region of Brazil.

The three facilities (sub-projects) description is as follows:

- SHPP Caju, located on the city of São Sebastião do Alto and Santa Maria Madalena (Rio Grande river), Rio de Janeiro,with 9.97 MW total installed capacity.
- SHPP Santo Antônio, located on the city of Bom Jardim (Rio Grande river), Rio de Janeiro, with 8.27 MW total installed capacity.
- SHPP São Sebastião do Alto, located on the city of São Sebastião do Alto e Santa Maria Madalena (Rio Grande river), Rio de Janeiro, with 13.36 MW total installed capacity.

According to ANEEL's Resolutions nr. 1.452[1], 1.454[2] and 1.453[3] issued on July, 8th 2008, all the three plants were expected to become operational until March, 2010. However, a storm occurred at the region where the SHPPs are located in January, 2011 caused a delay in the expected schedule defined by ANEEL. At that time, the SHPPs were damaged due to the rain, especially Santo Antônio SHPP, the civil works stopped and a delay in the scheduled activities happened. Consequently, ANEEL defines a new date for the SHPPs commercial operation. They are as follows:

- Caju SHPP: the first and second generating units started the commercial operation on March, 17th 2011 as defined by ANEEL Dispatch nr. 1.170[4], issued on March, 16th 2011;

- Santo Antônio SHPP: the SHPP was the most damaged and had to be re-built due to the rain that occurred at the region in the beginning of 2011. The rain caused a delay in the construction and in the

[1] Caju SHPP schedule. Available at: http://www.aneel.gov.br/cedoc/rea20081452.pdf.
[2] Santo Antônio SHPP schedule. Available at: http://www.aneel.gov.br/cedoc/rea20081454.pdf .
[3] São Sebastião do Alto SHPP schedule. Available at: http://www.aneel.gov.br/cedoc/rea20081453.pdf .
[4] Available at: http://www.aneel.gov.br/cedoc/dsp20111170.pdf

beginning of the commercial operation was longer when compared to the other two small hydropower plants. ANEEL authorized Santo Antônio SHPP to start its commercial operation from February, 4th 2012 through the Dispatch nr. 399, dated February, 3rd 2012.

- São Sebastião do Alto SHPP: the first generating unit started the commercial operation on September, 1st 2011 as stated by ANEEL Dispatch nr. 3.548[5] issued on August, 31st 2011 and the second unit started the commercial operation on August, 19th 2011 as stated by the ANEEL Dispatch nr. 3.395[6] issued on August, 18th 2011.

This indigenous and cleaner source of electricity will also have an important contribution to environmental sustainability by reducing carbon dioxide emissions that would have occurred otherwise in the absence of the project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation by fossil fuel sources (and CO_2 emissions), which would be generating (and emitting) in the absence of the project. Energisa Rio Grande SHPPS improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. These small scale projects provide site-specific reliability and transmission and distribution benefits including:

- increased reliability, shorter and less extensive outages;
- lower reserve margin requirements;
- improved power quality;
- reduced lines losses;
- reactive power control;
- mitigation of transmission and distribution congestion, and;
- increased system capacity with reduced T&D investment.

It can be said that fair income distribution is achieved from job creation and an increase in people's wages, however better income distribution in the region where the project is located is obtained from less expenditures and more income in the local municipalities. The surplus of capital that these municipalities will have could be translated into investments in education and health which will directly benefit the local population and indirectly impact a more equitable income distribution. This money would stay in the region and be used for providing the population better services which would improve the availability of basic needs. A greater income comes from the local investment on the local economy, and a greater tax payment, which will benefit the local population.

Therefore, indisputably the project will reduce negative environmental impacts and will contribute to the regional development economically and socially, resulting in a better quality of life. In other words, environmental sustainability combined with social and economic justice, definitely, contributes to the host country's sustainable development.

[5] Available at: http://www.aneel.gov.br/cedoc/dsp20113548.pdf
[6] Available at: http://www.aneel.gov.br/cedoc/dsp20113395.pdf

Energisa Geração Rio Grande S.A., owners of Energisa Rio Grande SHPPS, belongs to Energisa Soluções S.A., which was founded in 2004. It operates and maintains hydroelectric power plants for other companies, constructs and refurbishes generators, manages construction work projects, assembles and supplies electromechanical and hydromechanical equipment, and provides civil construction and engineering services. The company belongs to Energisa Group's which has as core activity the distribution of electric power. It has five electricity distributors in Brazil, three of which are located in the northeast of Brazil, one in Zona da Mata in Minas Gerais state and one in Nova Friburgo, in Rio de Janeiro state, covering an area of 91,180 Km². In total there are approximately 2.2 million consumers and a population of roughly 6.5 million in 352 municipalities.

Founded in 1905, Energisa Minas Gerais - Distribuidora de Energia S/A (the new Companhia Força e Luz Cataguazes-Leopoldina - CFLCL) is the company which gave rise to the Energisa Group and which until February 2007 was the operating holding company. Following the conclusion of the de-verticalization process, Energisa S/A became the new parent company of all the Group's companies.

A.3. Project participants:

Table 1 - Party(ies) and private/public entities involved in the project activity

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) Project participants (*) (as applicable)	Kindly indicate if the Party involved whishs to be considered as project participant (Yes/No)
Brazil (host)	Energisa Geração Rio Grande S.A.	No
	Ecopart Assessoria em Negócios Empresariais Ltda.	
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Detailed contact information on party(ies) and private/public entities involved in the project activity is listed in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil.

A.4.1.2. Region/State/Province etc.:

State of Rio de Janeiro, Southeast of Brazil.

A.4.1.3. City/Town/Community etc.:

Caju SHPP – Town of Santa Maria Madalena and São Sebastião do Alto;

Santo Antonio SHPP – Town of Bom Jardim;

São Sebastião do Alto SHPP – Town of Santa Maria Madelena and São Sebastião do Alto.

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

All three SHPP are at Rio Grande River, both SHPP Caju and SHPP São Sebastião do Alto are located in the town of São Sebastião do Alto and Santa Maria Madalena, and the SHPP Santo Antonio is located in the town of Bom Jardim (Figure 1). The geographical coordinates of the three SHPP are:

- Caju SHPP: **Latitude (S):** -21.8967/ **Longitude (W)** -42.0789;
- Santo Antônio SHPP: **Latitude (S):** -22.1367/ **Longitude (W):** - -42.3481;
- São Sebastião do Alto SHPP: **Latitude (S):** -21.9358/ **Latitude (W):** -42.0883.

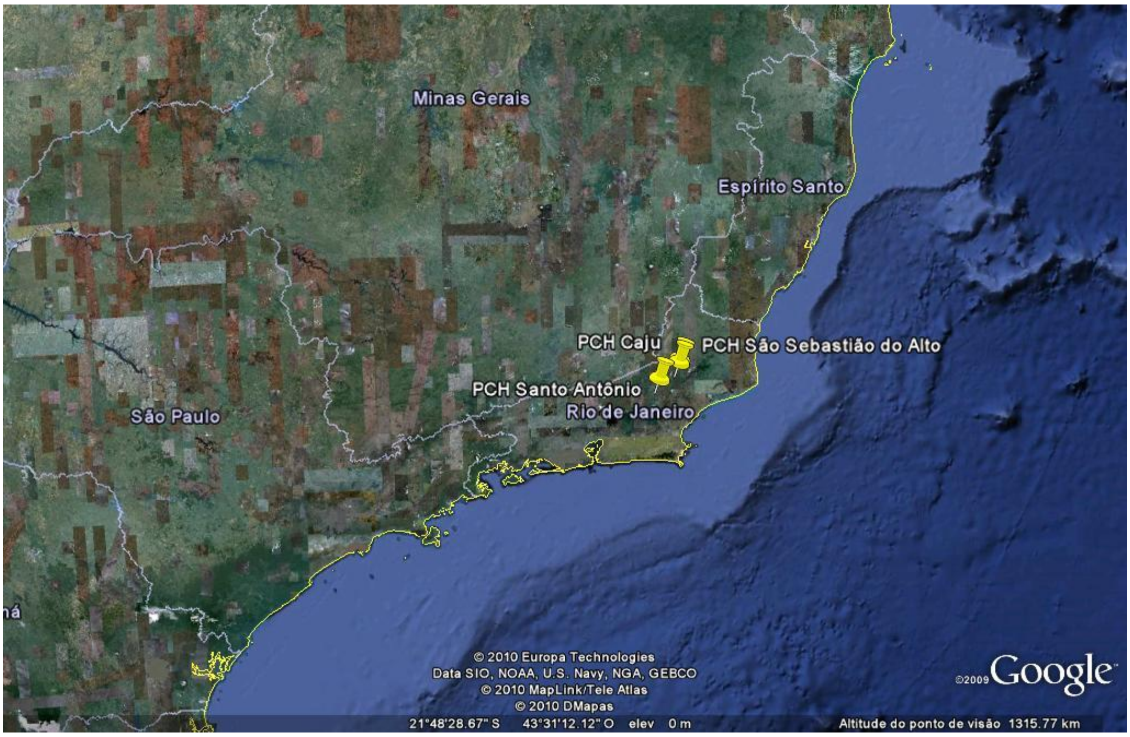

Figure 1 – Location of the SHPPs at the State of Rio de Janeiro

(Source: Google Earth, 2010[7])

[7] Available at: <www.googleearth.com>. Accessed on May 04th, 2010.

A.4.2. Category(ies) of project activity:

Type: Energy and Power.

Sectoral Scope: 1 – Energy industries (renewable - / non-renewable sources).

A.4.3. Technology to be employed by the project activity:

By legal definition of the Brazilian power regulatory agency (ANEEL – *Agência Nacional de Energia Elétrica*), Resolution nr. 652, issued on December 9th, 2003, small hydro must have installed capacity greater than 1 MW, but not more than 30 MW, and have a reservoir area less than 3 km².

All three plants are classified as Greenfield plants and considered Small hydro power plants. The reservoir area of SHPP Caju, SHPP Santo Antônio, and SHPP São Sebastião do Alto are respectively 1.13 km^2; 1.00 km^2; 2.70 km^2 and the installed capacity of all three plants is below 30 MW and superior to 1 MW.

SHPP are considered to one of the most cost effective power plants in Brazil, given the possibility to generate distributed power and to supply small urban areas, rural regions and remote areas of the country. Generally, they consist of a hydro electric power project with small reservoir.

The technology employed at the project is established in the energy sector, Kaplan turbines are widely used among hydro power plants (Figure 2). They are well suited to situations in which there is a low head and a large amount of discharge. The adjustable runner blades enable high efficiency even in the range of partial load, and there is little drop in efficiency due to head variation or load [8].

Figure 2 - Example of a Kaplan turbine[9]

Table 2 – Technical configuration of the SHPPs

[8] Source: The Worlds of David Darling, 2009 (http://www.daviddarling.info/, accessed on 09/04/2010).
[9] Source: Ossberger Water Power Engineering (http://www.waterpower-engineering.co.uk/ossberger.html,).

Project Name	CAJU	STO ANTONIO	SÃO SEBASTIÃO DO ALTO
Installed capacity (MW)[10]	9.97	8.27	13.36
Net energy generation estimative (MW)[11]	5.86	4.81	7.15
Total energy generation estimative (MW) [12]	5.98	4.91	7.29
Reservoir area (km2)	1.13	1	2.7
Technical Description			
Turbines			
Type	Kaplan S	Kaplan S	Kaplan S
Quantity	2	2	2
Nominal power (MW)	5.15	4.3	6.9
Rotation (rpm)	360	450	400
Generators			
Type	SPA 1250	SPA 1120	SPA 1400
Frenquency (Hz)	60	60	60
Quantity	2	2	2
Nominal power (MVA)	5.42	4.492	7.26
Power Factor	0.92	0.92	0.92
Nominal Power (MW)	4.986	4.133	6.679

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

The chosen crediting period for this project is the renewable crediting period of 7 years. The estimated amount of emission reductions for the second crediting period of the project can be seen at (Table 3).

Table 3 - Project Emission Reduction Estimation.

Years	Annual estimation of emission reductions in tCO_2e
2012*	5,641
2013	11,189
2014	11,189
2015	11,189
2016	11,189
2017	11,189

[10] As per paragraph 4a of EB 59, Annex 9, the determination of the rated/installed capacity is based on the installed/rated capacity of generator.

[11] As established by ANEEL resolution #1 issued on 14/01/2010

[12] As established by ANEEL resolution #1 issued on 14/01/2010 plus 2% of internal loads and transmission losses.

2018	11,189
2019**	5,549
Total estimated reduction (tCO_2e)	**78,324**
Total number of crediting years	7
Annual average over the crediting period of estimated reduction (tCO_2e)	11,189

* Starting on July 1st 2012
** Until June, 30th 2019

A.4.5. Public funding of the project activity:

There is no recourse to any public funding by the PPs in the proposed project activity. The project proponents hereby confirm that there is no divergence of Official Development Assistance (ODA) to the proposed project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

ACM0002 - "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*" (Version 12.2.0).

- *"Tool to calculate the emission factor for an electricity system"* (version 2.2.1);
- *"Tool for the demonstration and assessment of additionality"* (version 6.0.0);

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The applicability conditions of ACM0002 (version 12.2.0) are all fulfilled by the proposed project activity as further detailed below.

According to this methodology, it *is applicable to grid-connected renewable power generation project activities that (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).*

The proposed project activity comprises three Greenfield plants corresponding to option (a).

The methodology also provides the following conditions:

– *The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;*

The proposed project activity is the installation of three new hydro power plants.

– *In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2: on page 10 to calculate the parameter* $EG_{PJ,y}$*): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;*

Not applicable. The proposed project activity does not correspond to a capacity addition, retrofit or replacement.

– *In case of hydro power plants, one of the following conditions must apply:*

- *The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of reservoirs; or*
- *The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per definitions given in the Project Emissions section, is greater than 4 W/m2; or*
- *The project activity results in new single or multiple reservoirs and the power density of teach reservoir, as per definitions given in the Project Emissions section, is greater than 4* W/m^2.

The implementation of the proposed project activity will result in a new reservoir for each small hydropower plant which the power density is greater than $4W/m^2$.

– *In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4* W/m^2*all the following conditions must apply:*

- *The power density calculated for the entire project activity using equation 5 is greater than 4* W/m^2*;*
- *Multiple reservoirs and hydro power plants located at the same river and where are designed together to function as an integrated project1 that collectively constitute the generation capacity of the combined power plant;*
- *Water flow between multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity;*
- *Total installed capacity of the power units, which are driven using water from the reservoirs with power density lower than 4* W/m^2*, is lower than 15MW;*

- *Total installed capacity of the power units, which are driven using water from reservoirs with power density lower than 4 W/m², is less than 10% of the total installed capacity of the project activity from multiple reservoirs.*

Not applicable. The proposed project activity does not correspond to hydro power plants with power density lower than 4W/m²

Finally, the methodology has the following restrictions – *i.e.* project activities may not be applicable in the following cases:

– *Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;*

– *Biomass fired power plants;*

– *Hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m2.*

The project is still applicable for the use of ACM0002 (version 12.2.0) since it does not correspond to any of the restrictions listed above.

B.3. Description of the sources and gases included in the project boundary:

The project boundary is defined by the emissions targeted or directly affected by the project activities, construction and operation. It encompasses the physical, geographical site of the hydropower generation source, which is represented by the respective river basin of the project close to the power plant facility, as well as the interconnected grid (Figure 3). On May 26th, 2008, the Brazilian Designated Authority published Resolution nr 8 defining the Brazilian Interconnected Grid as a single system comprising the fifth regions of the country[13].

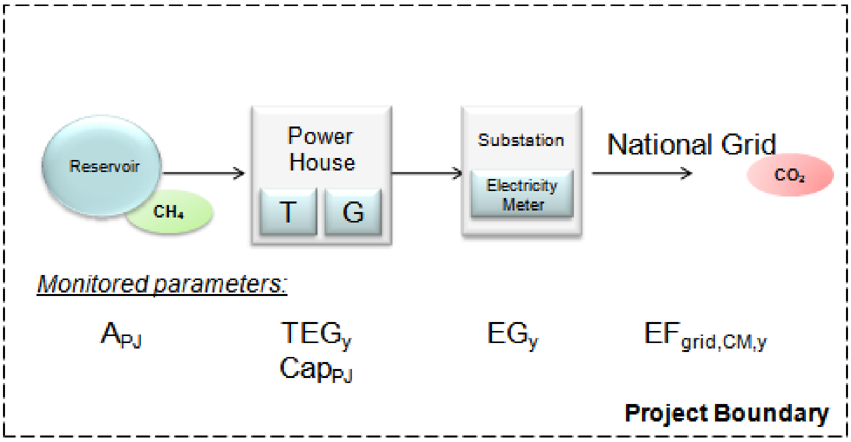

Figure 3 - Project Boundary of the project activity

[13] CIMGC's Resolution nr 8 from May 26th, 2008 available at: <http://www.mct.gov.br/upd_blob/0024/24719.pdf>.

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in the below table.

Table 4 - Emission sources and gases related to the project activity

Source		Gás	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the Project Activity.	CO_2	Yes	Main emission source.
		CH_4	No	Minor emission source.
		N_2O	No	Minor emission source.
Project Activity	Emission of CH_4 from the reservoir.	CO_2	No	Minor emission source.
		CH_4	Yes	Main emission source. Emissions from reservoir are accounted as project emissions once power density of the plant is between 4 and 10 W/m^2.
		N_2O	No	Minor emission source.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The project activity does not modify or retrofit an existing electricity generation facility. Hence, according to ACM0002 the baseline scenario in the case is the following:

"Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations as described in the "Tool to calculate the emission factor for an electricity system".

Thus in the absence of the project activity, all the energy would be imported from the interconnected grid. Hence, the baseline scenario is identified as the continuation of the current (previous) situation of electricity supplied by a mix of electricity generation in the Brazilian interconnected grid, which includes fossil fuel in its energy matrix.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

Considering the "Glossary of CDM terms", the start date of a CDM project activity is: "*the earliest date at which either the implementation or construction or real action of a project activity begins*". In addition, the "Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM" (Annex 46, EB 41) "*project activities with a start date on or after 2 August 2008, the project participants* *must inform a Host Party DNA and/or the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status. Such notification must be made within six months of the project activity start date and shall contain the precise geographical location and a brief description of the proposed project activity.*"

Then, Project Participants held a timeline of the project with dates of actions for the project implementation:Table 5 –Project activity´s milestones

Dates			Actions
Caju	Santo Antonio	São Sebastião do Alto	
03/08/2007	03/08/2007	06/03/2007	Construction permit issued (installation license)[14]
20/12/2007	20/12/2007	20/12/2007	First letter was sent to BNDES requesting a finance to the project implementation
21/02/2008	21/02/2008	2102/2008	BNDES recognizes Energisa´s project credit eligibility
28/03/2008	28/03/2008	28/03/2008	Suppliers are quoted
18/04/2008	18/04/2008	18/04/2008	BNDES´s protocol is emitted, confirming the receipt of the financial request
08/07/2008	08/07/2008	08/07/2008	ANEEL authorizes Energisa S/A to explore the hydro potential of the SHPP Caju, SHPP Santo Antonio, and SHPP São Sebastião do Alto
17/07/2008	17/07/2008	17/07/2008	Energisa Soluções S/A Board's meeting held on 17/07/2008 in order to approve the implementation of SHPP Caju, São Sebastião do Alto, and Santo Antônio.
18/08/2008	18/08/2008	18/08/2008	First PPA signature
24/10/2008	24/10/2008	24/10/2008	EPC[15] contract signature
16/09/2009	16/09/2009	16/09/2009	Financing contract signature
03/03/2009	03/03/2009	03/03/2009	Start of construction

All documents related to the dates presented in the timeline above are available with the PPs.

The earliest event that indicates the project implementation´s start is the EPC contract signature on October, 24th 2008. However, the EPC contract presents a safeguard related to the beginning of the contract validity which states that the contract validity starts when the Financing Contract is firmed between *Energisa* and *BNDES*. Thus, the project starting date is considering September, 16th 2009 date in which Energisa Soluções´s Board and Brazilian Development Bank (from the Portuguese *Banco Nacional de Desenvolvimento Econômico e Social – BNDES*) signed the Financing Contract.

[14] Construction License # N° FE013124 (SHPP Caju) /N° FE013122 (SHPP Santo Antônio)/N° FE012406 (SHPP São Sebastião do Alto), all permits were issued by FEEMA (from Portuguese "Fundação Estadual de Engenharia do Meio Ambiente", Rio de Janeiro´s Environmental Agency), which were replaced by INEA (from Portuguese Instituto estadual do Ambiente)
[15] Engineering, procurement and construction contract.

Once the project´s starting date is after August, 2nd 2008, as required by the Executive Board, Project Participants must inform the Host Party DNA and the UNFCCC in writing of the commencement of the project activity and of their intention to seek CDM status. Therefore, Project Participants have forwarded the Prior Consideration of the CDM Form (F-CDM-Prior Consideration) both for the Brazilian Designated National Authority and to the UNFCCC secretariat on September, 2nd 2009[16].

For the purpose of assessing the additionality of the project activity, ACM0002 methodology includes a "*Tool for the demonstration and assessment of additionality*" agreed by the CDM Executive Board, which is available on the UNFCCC CDM web site.

Following are the necessary steps for the demonstration and assessment of Energisa Rio Grande SHPPS additionality.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulation

Sub-step 1a. Define alternatives to the project activity

- The alternative to the project activity is the continuation of the current (previous) situation of electricity supplied by the grid.
- The implementation of the project without incentives from the CDM.

Sub-step 1b. Consistency with mandatory laws and regulations

Both the project activity and the alternatives scenarios are in compliance with all regulations according the following entities: National Electric System Operator (ONS from the Portuguese *Operador Nacional do Sistema Elétrico*), Electricity Regulatory Agency (ANEEL from the Portuguese *Agência Nacional de Energia Elétrica*), The Chamber of Electrical Energy Commercialization (CCEE from the Portuguese *Câmara de Comercialização de Energia Elétrica*), Rio de Janeiro Environmental Agency (from the Portuguese *Instituto Estadual do Ambiente* - *INEA* previously named *Fundação Estadual de Engenharia do Meio Ambiente* - FEEMA) and the CDM Executive Board.

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[16] Available at: <http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html>.

SATISFIED/PASS – Proceed to Step 2

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

Additionality is demonstrated through an investment benchmark analysis; option III of the Additionality Tool. Options I and II are not applicable to the proposed project activity. All evidence supporting the discussion presented below was supplied to the DOE.

Sub-step 2b. Option III – Apply benchmark analysis

The financial indicator identified for Energisa Rio Grande SHPPs CDM Project Activity is the project IRR. The IRR here presented is compared to the appropriate benchmark of the energy sector, which is the Weighted Average Cost of Capital – WACC.

Weighted Average Cost of Capital (WACC)

The weighted-average cost of capital (WACC) is a rate used to discount business cash flows and takes into consideration the cost of debt and the cost of equity of a typical investor in the sector of the project activity. The benchmark can be applied to the cash flow of the project as a discount rate when calculating the net present value (NPV) of the same, or simply by comparing its value to the internal rate of return (IRR) of the project. The WACC considers that shareholders expect compensation towards the projected risk of investing resources in a specific sector or industry in a particular country.

The WACC calculation is based on parameters that are standard in the market, considers the specific characteristics of the project type, and is not linked to the subjective profitability expectation or risk profile of this particular project developer. The WACC of the sector as of the project's financial analysis decision date (2008) was of 15.86%.

Each assumption made and all data used to estimate the benchmark have been presented to the DOE. The spreadsheet used for the calculation of the WACC was conducted considering the nominal value of the data assumptions, i.e., considering the inflation through the years.

$$WACC = Wd \times Kd + We \times Ke$$

We and **Wd** are, respectively, the weights of equity and debt typically observed at the sector. **We** is of 35%, and **Wd** of 65%. These numbers derive from the typical leverage of similar projects in the sector in Brazil, based on the rules for available long term loans from Brazilian Development Bank (from the Portuguese *Banco Nacional de Desenvolvimento Econômico e Social – BNDES*)[17]. BNDES is the major provider of long-term loans in the country; it supplies the financing for small to large scale projects. Long-term loans are scarcely provided by commercial banks, and in general, these entities do not have competitive rates compared to the BNDES. **Kd** and **Ke** are, respectively, the cost of debt and cost of equity. Detailed explanations related to both calculations are presented below.

Kd is the cost of debt, which is observed in the market related to the project activity, and which already accounts for the tax benefits of contracting debts. **Kd** derives from long term loans applied to the sector in Brazil, and therefore is based on BNDES financing endeavour credit line's interest rates. **Kd** is calculated using the data and the equation presented in the table below:

Table 6 - Cost of debt (Kd) calculation

Cost of Debt (Kd) = (a + b + c) x (1 - t)]	
(a) Financial cost[18]	9.06%
(b) BNDES fee[19]	1.00%
(c) Credit risk rate[20]	2.50%
(a+b+c) Pre-Cost of Debt	12.56%
(t) Marginal tax rate	0.00%
(d) Inflation forecast[21]	4.50%
After tax Cost of Debt - nominal	12.56%p.a.

Therefore, **Kd** is of 12.56%.

Ke is the cost of equity, estimated through the Capital Asset Pricing Model (CAPM). **Ke** derives from a risk free rate plus the market risk premium adjusted to the sector through Beta. The risk-free rate, the market risk premium, and the Beta have been calculated based on publicly available data and presented to the DOE. The data and formulae used to calculate **Ke** is determined below:

Table 7 - Cost of Equity (Ke) calculation

Cost of Equity – CAPM (Capital Asset Pricing Model) = $[(1+Rf)/(1+\pi_{us})*(1+\pi_{br})-1] + \beta*Rm + Rc$

18 BNDES. Available at: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Custos_Financeiros/Taxa_de_Juros_de_Longo_Prazo_TJLP/index.html

19 BNDES. Available at: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Custos_Financeiros/Taxa_de_Juros_de_Longo_Prazo_TJLP/index.html

20 BNDES. Available at: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Custos_Financeiros/Taxa_de_Juros_de_Longo_Prazo_TJLP/index.html

21 http://www.bcb.gov.br/pec/metas/InflationTargetingTable.pdf

(Rf) Risk-free rate[22]	4.72%
(Rm) Equity risk premium[23]	6.20%
(Rc) Estimated country risk premium[24]	3.91%
(β) Adjusted Industry Beta[25]	1.81%
(I) US expected inflation[26]	2.39%
Cost of Equity - nominal	21.99%p.a.

Ke is of 21.99%.

Finally, plugging these numbers into WACC formulae:

$$WACC = 65\% \times 12.56\% + 35\% \times 21.99\% = 15.86\%$$

Sub-step 2c - Calculation and comparison of financial indicators

The cash flow of the project activity, containing the calculation of the project IRR of the project activity was provided to the DOE in a separate annex to this CDM-PDD. The relevant assumptions made are in accordance with the *Guidelines on the Assessment of Investment Analysis* (EB 62, Annex 5).

The project IRR of each SHPP, as presented to the DOE, is shown at Table 8. This number shows that the IRR of the project is lower than the WACC of the sector – 15.86% – the benchmark. Hence, it is evident that the project activity is not financially attractive to the investor..

Table 8 - Comparison between Project's IRR and WACC of the sector

Project	IRR (%)	WACC (%)
Caju SHPP	11.32	15.86%
Santo Antônio SHPP	10.67	
São Sebastião do Alto SHPP	8.58	

The table presented below provides a summary of the main input values used in the investment analysis and a brief justification for their use. As observed in the cash flows presented for each SHPP, the inputs used in the investment analysis consider the inflation through the years, which characterizes a nominal cash flow. Also, it is important to mention that the project investment decision year is 2008, and in accordance with paragraph 6 of the "*Guidelines on the assessment of investment analysis*", the "*Input*

[22] Damodaran website. Available at: http://pages.stern.nyu.edu/~adamodar/
[23] Damodaran website. Available at: http://pages.stern.nyu.edu/~adamodar/
[24] JP Morgan. Available at: http://www.cbonds.info/all/eng/index/index_detail/group_id/1/
[25] Damodaran website. Available at: http://pages.stern.nyu.edu/~adamodar/
[26] Federal Reserve. Available at: http://www.federalreserve.gov/econresdata/researchdata.htm

values used in all investment analysis should be valid and applicable at the time of the investment decision". Therefore the values presented in the table below concerns the year of 2008. Furthermore, it is important to mention that some inputs presented in the table below were changed and for conservativeness reasons, they were used in the sensitivity analysis, in order to prove that the project activity remains additional. Documents evidencing all input values mentioned below which were used to estimate the IRR, were supplied to the DOE.

Table 9 - Data used in the investment analysis and the justification of their use.

Parameter	Caju SHPP	Santo Antônio SHPP	São Sebastião do Alto SHPP	Justification/source of information used
Installed Capacity (MW)	9.97	8.27	13.36	Based on the nameplate of the generators checked during the site visit.
Assured Energy (MW_{med})	5.86	4.81	7.15	The assured energy of the small hydropower plants are defined by the ANEEL Resolution nr. 1, issued on January, 14th 2010. The estimative is based on the historical average river flow of Rio Grande River.
Plant Load Factor	58.78%	58.16%	53.52%	Determined dividing the assured energy of the small hydropower plant by its installed capacity. This parameter is used to estimate the electricity generated by the small hydropower plants.
Electricity tariff (R$/MWh)	224.80	224.80	224.80	The price of the electricity was based on the negotiated electricity until the time of the project decision (2008) through the Power Purchase Agreement (PPA) firmed between *Energisa* and *EATON* considering the *ICMS*. The amount of the negotiated electricity under this PPA corresponds to 50% of the total electricity generated by the SHPPs until the year of 2020.
	206.67	206.67	206.67	The price of electricity estimated by project participants for the electricity not negotiated until the time of the investment decision (2008) which correspond to 50% and also applied for the subsequent years, from 2021 until 2031.
TUSD (BRL/kW.month)	100% of 4.36	100% of 4.36	100% of 4.36	The value of the tariff is determined for generators connected to the local distribution network as per ANEEL Ordinance #617/2008[27]. In Brazil, electricity producers

[27] Available at: http://www.aneel.gov.br/cedoc/reh2008617.pdf

				using renewable sources receive a 50% discount in the Tariff for the Use of the Distribution System - TUSD fee (from the Portuguese *Tarifa de Uso do Sistema de Distribuição*). This discount aims at boost investments in renewable energy projects and shall be considered as a Type E- policy as defined by Annex 3, EB 22. Additionally, according to this clarification, type E-policies[28] do not need to be considered in the development of the baseline scenario if implemented after 11 November 2001. The reduction in the TUSD fee was regulated by the Law10 438, dated 26/04/2002[29]. Therefore, the discount is not going to be taken into account.
Connection Costs (BRL/kW)	0.52	0.52	0.52	The value of the Connection Costs is in accordance with the Contract signed between *Zona da Mata Geração* and *CFLCL* in March, 2007.
ANNEL Fee (BRL/kW)	303,78	303,78	303,78	It corresponds to the value fixed by ANEEL regarding the Supervision Tax on Electricity Power Services (from the Portuguese *Taxa de Ficalização de Serviços de Energia Elétrica – TFSEE)* implemented by the Law nr. 9,427, dated December, 12th 1996 and regulated by the Decree nr. 2,410 issued on November, 28th 1997. The TFSEE aims to compose the ANEEL revenue in order to cover its administrative and operational costs. The Dispatch nr. 3,731, dated December, 27th 2007 was used to estimate the ANEEL fee of the SHPPs for the year of 2008.

[28] From paragraph 6.b) of Annex 3, EB 22 Type E- policies are *National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs).*

[29] Available in Portuguese at <http://www.aneel.gov.br/cedoc/lei200210438.pdf>. Accessed on 28/04/2011.

Revenue Deductions (BRL)	2,871,059	2,822,743	1,473,711	The revenue deductions concerns to the Integration Social Program (from the Portuguese *Programa de Integração Social – PIS*), the Contribution to the Social Security Financing (from the Portuguese *Contribuição para o Financiamento da Seguridade Social - COFINS*) and the Tax on Goods and Services from the Portuguese *Imposto sobre Circulação de Mercadorias e Prestação de Serviços – ICMS*[30])
Income Tax and Social Contribution (BRL)	308,651	303,457	158,430	The Income Tax percentage is determined by the Decree nr. 3,000[31], dated March, 26th 1999, in its Article #518. The Social Contribution percentage is given by the Law 11,727[32], dated June, 23rd 2008 in its Article #17.
O&M(BRL)	592,257	582,290	814,242	The O&M Costs is based on an estimative made by project participants at the time of project decision. Also, the O&M Costs is included in the Total Costs of the SHPP considered in the sensitivity analysis below.
Investment (BRL)	64,211,157	52,823,644	99,495,418	The investment is based on an estimative made by project participants at the time of project decision. Nevertheless, the sensitivity analysis was conducted also considering the quotation defined in the EPC contract and the amendments from each small hydropower plant.
IRR (%)	11.32	10.67	8.58	Calculated in the attached spreadsheets.

Sub-step 2d: Sensitivity analysis

[30] Available at: http://alerjln1.alerj.rj.gov.br/contlei.nsf/f25edae7e64db53b032564fe005262ef/4d52dca0a0d8d58b8325785a00659855?OpenDocument

[31] Available at: http://www.planalto.gov.br/ccivil_03/decreto/d3000.htm

[32] Available at: http://www.receita.fazenda.gov.br/Legislacao/Leis/2008/lei11727.htm#Art. 17.

The sensitivity analysis, as established by the "*Guidelines on the Assessment of Investment Analysis*" (EB 62, Annex 5), is to be conducted considering variables that constitute more than 20% of either total project costs or total project revenues, including initial investment costs. Hence, variations will be done increasing project's revenues (sale of electricity and plant load factor), reducing investment expenses, and reducing operation and maintenance costs.

The results are presented below.

Table 10 - Results of the sensitivity analysis - Caju SHPP.

Caju SHPP	Variation	IRR	WACC (%)
Original IRR	-	11.32	15.86%
Electricity tariff increase	+10%	12.61	
Plant load factor increase	+10%	12.50	
Total cost reduction	-10%	12.10	
Investment reduction	-10%	12.50	

Table 11 - Results of the sensitivity analysis – Santo Antônio SHPP.

Santo Antônio SHPP	Variation	IRR	WACC (%)
Original IRR	-	10.67	15.86%
Electricity tariff increase	+10%	11.84	
Plant load factor increase	+10%	11.74	
Total cost reduction	-10%	11.38	
Investment reduction	-10%	11.73	

Table 12 - Results of the sensitivity analysis – São Sebastião do Alto SHPP.

São Sebastião do Alto SHPP	Variation	IRR	WACC (%)
Original IRR	-	8.58	15.86%
Electricity tariff increase	+10%	9.67	
Plant load factor increase	+10%	9.57	
Total cost reduction	-10%	9.25	
Investment reduction	-10%	9.56	

A typical investor of the sector would not be attracted in investing in the projects since the IRR is lower than the benchmark of the sector. That would be the case even when a positive variation of 10% would occur in energy tariff and in the plant load factor or a negative variation of 10% would occur in total costs and in total investments of the project, as presented in the table above. Yet, a simulation was conducted in order to verify possible scenarios where the IRR of each SHPP would be equal the benchmark. The results for the small hydropower plants are presented in the tables below.

Table 13 - Scenarios when IRR of the project equals the benchmark (15.86%) – Caju SHPP

	IRR %	*ELECTRICITY TARIFF (BRL/MWh)*	*PLANT LOAD FACTOR (%)*	*INVESTMENT (BRL/MWh)*	*TOTAL COSTS (BRL/MWh)*	*Variation (%)*
Original	11.32	224.80	58.78	64,211,157	4,046,575	N/A
Electricity Tariff	15.86	308.65	58.78	64,211,157	4,046,575	37.30
Plant Load Factor	15.86	224.80	82.82	64,211,157	4,046,575	40.90
Investment	15.86	224.80	58.78	44,145,171	4,046,575	31.25
Total Costs	15.86	224.80	58.78	64,211,157	1,521,512	62.40

Table 14 - Scenarios when IRR of the project equals the benchmark (15.86%) – Santo Antônio SHPP

	IRR %	*ELECTRICITY TARIFF (BRL/MWh)*	*PLANT LOAD FACTOR (%)*	*INVESTMENT (BRL/MWh)*	*TOTAL COSTS (BRL/MWh)*	*Variation (%)*
Original	10.67	224.80	58.16	52,823,644	4,020,006	N/A
Electricity Tariff	15.86	335.85	58.16	52,823,644	4,020,006	49.40
Plant Load Factor	15.86	224.80	89.63	52,823,644	4,020,006	54.10
Investment	15.86	224.80	58.16	30,426,419	4,020,006	42.40
Total Costs	15.86	224.80	58.16	52,823,644	711,541	82.30

Table 15 - Scenarios when IRR of the project equals the benchmark (15.86%) – São Sebastião do Alto SHPP

	IRR %	*ELECTRICITY TARIFF (BRL/MWh)*	*PLANT LOAD FACTOR (%)*	*INVESTMENT (BRL/MWh)*	*TOTAL COSTS (BRL/MWh)*	*Variation (%)*
Original	8.58	224.80	53.52	99,495,418	2,646,137	N/A
Electricity Tariff	15.86	399.92	53.52	99,495,418	2,646,137	77.90
Plant Load Factor	15.86	224.80	99.22	99,495,418	2,646,137	85.40
Investment	15.86	224.80	53.52	50,603,369	2,646,137	49.14
Total Costs	15.86	224.80	53.52	99,495,418	-714,457	127.00

The price used in the investment analysis (R$ 224.80) corresponds to an estimative adopted by Project Participants at the time of the project implementation decision. Considering the sensitivity analysis conducted above in which aims that IRR achieves the benchmark (15.86%), the electricity tariff would be R$ 308.65, R$ 335.85 and R$ 399.92 for *Caju*, *Santo Antônio* and *São Sebastião do Alto* SHPPs, respectively. However, the electricity generation by the small hydropower plants was negotiated in the free market (in a free translation from the Portuguese *Mercado Livre*) and the prices vary between R$ 150.00 and R$ 192.00. Therefore, considering the tariff established by the Power Purchase Agreements (PPAs), the projects IRR would be lower than the one presented in the calculation spreadsheet. The table below compares the projects IRR taking into account the price considered at the time of the project implementation decision and the price determined in the PPA.

Table 16 – Projects IRR considering the price established at the Power Purchase Agreement.

Small Hydropower Plants	***Caju***		***Santo Antônio***		***São Sebastião do Alto***	
Estimated Tariff (BRL)	224.80		224.80		224.80	
IRR*	11.32%		10.67%		8.58%	
Tariff at the PPA (BRL)	150.00	192.00	150.00	192.00	150.00	192.00
IRR**	9.81%	10.65%	9.42%	10.12%	7.46%	8.09%

* Project IRR considering the tariff estimated by Project Participants at the time of the project implementation decision.

** Project IRR considering the tariff established at the Power Purchase Agreement negotiated between *Energisa* and the free costumers (in a free translation from the Portuguese *Consumidores Livres*)

Hence, an increase in the project IRR due to an increase in the electricity tariff would not occur.

The plant load factor of the small hydropower plants is based on the installed capacity and the assured energy of the project. The total installed capacity and the assured energy is not determined by project sponsors, but established by ANEEL, considering at least 30 years of historical data regarding the project's river and other rivers, such as river flow data, downstream and upstream levels, unavailability (compulsory and planned). For the small hydropower plants described in this project activity, the assured energy is established by ANEEL's Resolution nr.1, issued on January, 14th 2010. In addition, according to the Brazilian legislation[33], the project concession shall be based on the maximum installed power and energy generation of the power plant (the project cannot be inefficient, should be implemented as effectively as possible). Therefore, the presented increases in the energy generation are not reasonable in the project context and are not expected to occur. Furthermore, according to the sensitivity analysis conducted above, in which intended the projects IRR reach the benchmark, it was observed that *São Sebastião do Alto* SHPP, should be almost 100% of the installed capacity, which evidences that is not reasonable such increase to happen.

The total investment necessary to build the plants as it is presented in the cash flow corresponds to the estimated investment cost made by the project owner at the time of the project implementation decision.

[33] MME Decree # 5,163, dated July 30th, 2004.

For this project activity the project owner signed an EPC contract. This type of contract fixes the price to build the small hydropower plants and therefore there is no possibility in occur any variation in the price established by the contract. Nevertheless, as described above in Section A.2, the rain that occurred in the region where the SHPPs are located causing a great damage at the civil works, especially at Santo Antônio SHPP which have to be re-built. Due to the new works conducted at the SHPPs, an amendment was signed between *Energisa* and the suppliers concerning the extra work performed at the SHPPs and then, the investment costs varied. Even a variation was observed at the total investment costs, the projects IRR will not achieve the benchmark. The table below shows the projects IRR considering the costs determined at the EPC Contract and its amendments even when apply the sensitivity analysis do not surpass the benchmark.

Table 17 - Projects IRR considering the investment costs established at the EPC Contract and the amendments.

Small Hydropower Plants	***Caju***	***Santo Antônio***	***São Sebastião do Alto***
Estimated Investment (R$)	64,211,157	52,823,644	99,495,418
IRR*	11.32%	10.67%	8.58%
Investment as per the EPC Contract and amendments (R$)	55,834,537.87	75,399,037.78	59,478,267.78
IRR**	12.90%	7.47%	13.89%
Variation	Approximately a Decrease 13.05%	Approximately an Increase 42.50%	Approximately a Decrease 40.22%

* Project IRR considering the investment estimated by Project Participants at the time of the project implementation decision.

** Project IRR considering the investment established at the EPC Contract and its amendments;

The total costs related to the small hydropower plants can be summarized in the ones calculated determined based on the plants installed capacity as of O&M costs, ANEEL Inspection Fee (from the Portuguese *Taxa de Fiscalização de Serviços de Energia Elétrica – TFSEE*), Connection Fee and the Tariff for the Use of the Distribution System - *TUSD* fee (from the Portuguese *Tarifa de Uso do Sistema de Distribuição*) and the taxes deducted from the project revenues: the Integration Social Program (in a free translation form the Portuguese *Programa de Integração Social - PIS*), the Contribution to the Social Security Financing (in a free translation from the Portuguese *Contribuição para o Financiamento da Seguridade Social – COFINS*) and the Tax on Goods and Services (in a free translation from the Portuguese *Imposto sobre Circulação de Mercadorias e Prestação de Serviços - ICMS*). Thus, as described above, there is no variation at the small hydropower plants installed capacity and at the assured energy which is used to calculate the projects revenue. Therefore, no variation concerning the total costs are expected to occur and consequently the IRR remains the same.

Outcome

The IRR of the small hydropower plants projects without being registered as a CDM project is significantly below the sector benchmark, evidencing that project activity is not financially attractive to investor. Then, scenario 1 would be the most plausible alternative to the project activity, *i.e.* the continuation of the current situation with additional electricity supplied by the Brazilian Interconnected Grid.

SATISFIED/PASS – Proceed to Step 3

Step 3. Barrier analysis

Not applicable.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

According to the additionality tool (version 6.0.0), "*projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc*". Also, the stepwise approach proposed by the new version of the additionality tool is used in order to choose the projects that are similar to Energisa projects:

- ***Applicable geographical region:*** Brazil has an extension of 8,514,876.599 square kilometres[i] (with over 4,000 km distance in the north-south as well as in the east-west axis) and 6 distinct climate regions: sub-tropical, semi-arid, equatorial, tropical, highland-tropical and Atlantic-tropical (humid tropical). These varieties of climate obviously have strong influence in the technical aspects related to a small hydropower plant implementation.

  Considering the distinct climate conditions, precipitation varies from 500 to more than 3,000 mm/year[34]. Making a comparison of the monthly precipitation (mm) among the Brazilian regions, it can be clearly demonstrated the differences related to the region where the project activity is located (Southeast) and other regions (North, Northeast, Midwest and South) (Figure 4 and Figure 5).

[34] Public information available at *Instituto Nacional de Metereologia – INMET*'s website. Gráfico de normais climatológicas (1961-1990): <http://www.inmet.gov.br/>.

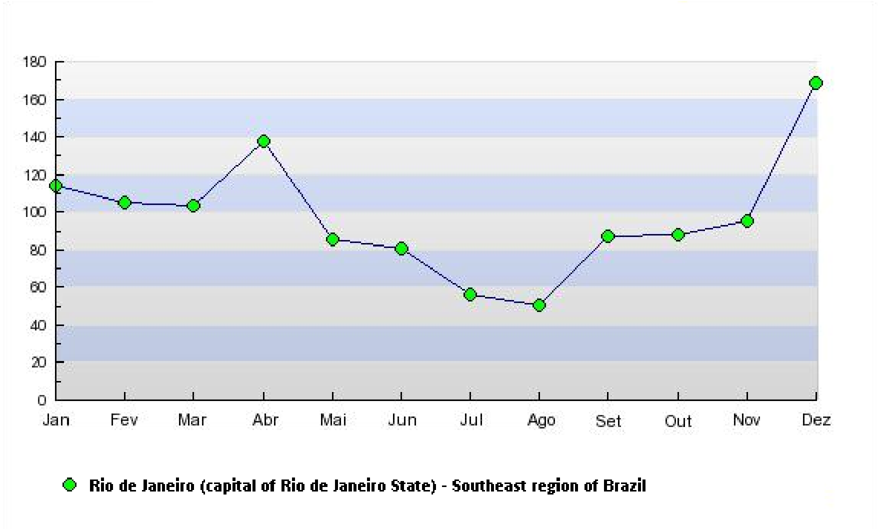

Figure 4 - Average of precipitation (mm) in Rio de Janeiro (Southeast region of Brazil) from 1961 to 1990

Source: INMET (2009)[35]

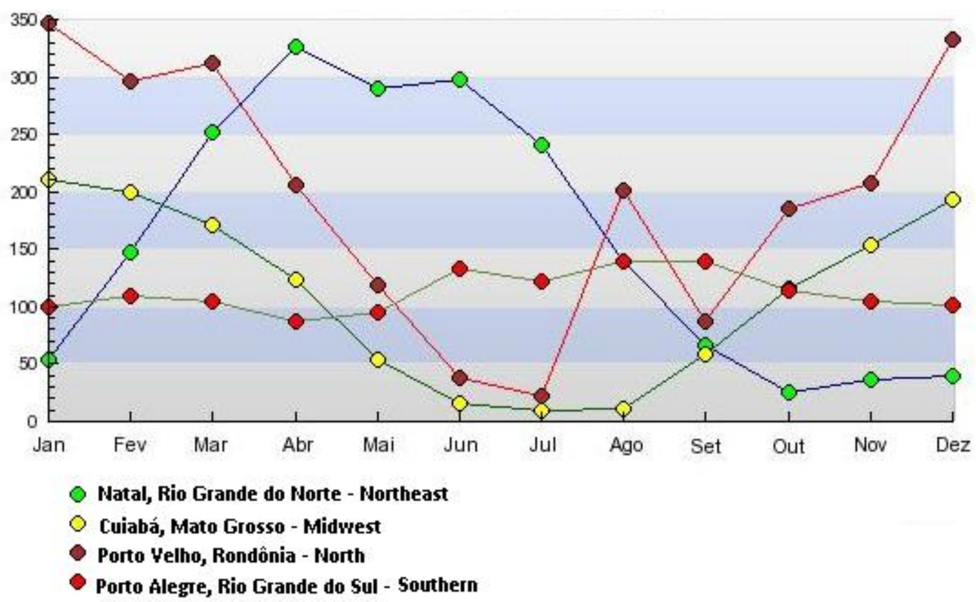

Figure 5 - Average of precipitation (mm) in the regions of Brazil (except the Southeast region of Brazil) from 1961 to 1990

Source: INMET (2009)[36]

[35] Available at: http://www.inmet.gov.br/html/clima/graficos/plotGraf.php?chklist=2%2C&capita=portoalegre%2C&peri=99%2C&per6190=99&precipitacao=2&portoalegre=30&Enviar=Visualizar.

[36] Public information available at *Instituto Nacional de Metereologia – INMET*'s website. Gráfico de normais climatológicas (1961-1990): <http://www.inmet.gov.br/>.

In addition, hydroelectric projects can differ significantly from each other considering the region to be implemented, climate, topography, availability of transmissions lines, river flow regularity, etc. For those reasons alone it is extremely difficult and not reasonable to compare different hydropower potential and plants. Moreover, hydro-power plants cannot be optimally placed (close to load centers and transmission lines) and easily transferred (moved to a new region where a better tariff is offered) as, for example, modular fossil-fuel-fired (diesel, natural gas) power plants. Differences may be even larger if no big water storage is possible, as in the case of small hydropower plants.

Considering the region where Energisa projects are located – Rio de Janeiro State – it has an extension of 43,696.054 square kilometres[37]. For reference, the average of European countries areas is 565,679 square kilometres[38]; this result is considering Russian Federation area (which has 17,075,400 square kilometres). If Russian Federation is not considered, the average of European country areas is 163,003 square kilometres. This demonstrates that Rio de Janeiro State is considered large and differences can influence the implementation of small hydropower plants.

- ***Measure:*** The assessment will be done consistently with the purpose of the proposed project activity and its alternative baseline scenario, corresponding to item b) switch of technology with change of energy source. In other words, the electricity generation by hydro power plants will displace electricity generated by other sources connected to the grid.

- ***Output:*** Only the grid connected power plants producing are going to be considered.

- ***Different technologies:*** Within this criteria, the following aspects are going to be taken into consideration while conducting the common practice analysis:

  - *Energy source:* given the particularities of small hydropower generation, only small hydropower plants are going to be considered;

  - *Legal regulations:* Until the beginning of the 1990's, the energy sector was composed almost exclusively of state-owned companies. From 1995 onwards, due to the increase in international interest rates and the lack of state investment capacity, the government started the privatization process. However, by the end of 2000 results were still modest. Further initiatives, aiming to improve electric generation in the country, were taken from the late 1990's to 2003; however they did not attract new investment to the sector. In 2003 the recently elected government decided to fully review the electricity market institutional framework in order to boost investments in the electric energy sector. The market rules were changed and new institutions were created such as Energetic Research Company (in a free translation from

[37] Available at: < http://www.ibge.gov.br/estadosat/perfil.php?sigla=rj>.

[38] Data collected from United Nations Economic Commission for Europe (UNECE) – UNECE member countries in figures: country overview y indicator, country and year. Available at: <http://www.unece.org/>.

the Portuguese Empresa de Pesquisa Energética – EPE) – an institution that would become responsible for the long term planning of the electricity sector with the role of evaluating, on a perennial basis, the safety of the supply of electric power – and Chamber for the Commercialization of Electric Power (CCEE) – an institution to manage the commercialization of electric power within the interconnected system. This new structure was approved by the House of Representatives and published in March of 2004[39]. Given the new regulatory framework and investment climate only projects starting after March of 2004 will be considered similar to the proposed project activity;

o *Promotional Policies:* The Brazilian Federal Government has provided important incentives for small hydropower electricity generation. One of the most recognized ones is the Alternative Electricity Sources Incentive Program (in a free translation from the Portuguese *Programa de Incentivo às Fontes Alternativas de Energia Elétrica – PROINFA*). The *PROINFA* was created through the Law # 10,438 dated April 26th, 2002. Among others, one of the initiative's goals was to increase the renewable energy sources share in the Brazilian electricity market, thus contributing to a greater environmental sustainability. In order to achieve such goals, the Brazilian government has designated the federal state-owned power utility *Eletrobrás* (*Centrais Elétricas Brasileiras S/A*) to act as the primary off-taker of electric energy generated by alternative energy facilities in Brazil, by entering into long-term Power Purchase Agreements with alternative energy power producers, at a guaranteed price of at least 80% of the average energy supply tariff charged to ultimate consumers. Also, the Brazilian Decree # 5,025 dated March 30th, 2004[1], which regulates the Law # 10,438, states that *PROINFA* aims for the reduction of greenhouse gases as established by the United Nations Framework Convention on Climate Change (UNFCCC) under Kyoto Protocol, contributing to the sustainable development. Therefore, the program is clearly a "Type E-" policy.

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Sub-step 4b. Discuss any similar options that are occurring:

Considering information above, Project Participants applied the steps provided by the "*Guidelines on common practice*" (EB 63, Annex 12) also included in the new version of the "*Tool for the demonstration and assessment of additionality*" (EB 65, Annex 21) to perform the common practice analysis, as further detailed below.

Step 1: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

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[39] http://www.planalto.gov.br/CCIVIL/_Ato2004-2006/2004/Lei/L10.848.htm.

Only plants with installed capacity from 50% lower to 50% higher[40] than the small hydropower plants installed capacity considered in this CDM Project Activity will be analyzed. The project encompasses three small hydropower plants: *Caju*, *Santo Antônio* and *São Sebastião do Alto* SHPPs which present 9.97, 8.27 and 13.36 MW of installed capacity. Therefore, projects between 4.13 and 20.04 MW of installed capacity are going to be taken into consideration. Finally, the three plants together sum 31.6 MW of installed capacity. For conservative reasons, the analysis comprising projects between 15.8 and 47.40 MW of installed capacity will also be conducted. However, considering the explanation given above "*(iv) Different technologies – (a) Energy source*" large scale hydropower plant, *i.e.*, with total installed capacity over 30MW, will not be considered. Hence, the range applied when considered the three small hydropower plants is from 15.8 to 30 MW;

Step 2: In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Registered CDM project activities and projects activities undergoing validation shall not be included in this step.

The ANEEL database was checked[41] and the result is that 6 small hydropower plants considering the range between 4.13 and 30 MW identified in Step 1, have started commercial operations before the project starting date, *i.e.*, before September, 16th 2009. Also, registered CDM project activities and CDM project activities at validation shall not be included, thus, *Pirapetinga* small hydropower plant small hydropower plants will not be considered in this analysis. Hence, N_{all} **= 5**.

Spreadsheet with complete research of the common practice analysis is available with the Project Participants and was presented to DOE during validation.

Step 3: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity.

Within the plants identified in the Step 2, considering the range between 4.13 and 30 MW of installed capacity, four small hydro power plants received incentives from PROINFA (identified as a promotional policy, as explained above). They are: *Bonfante*, *Monte Serrat*, *Santa Rosa II* and *Calheiros* small hydropower plants; therefore, it can be concluded that these small power plants apply different technologies when compared to the proposed CDM project Activity. Hence, N_{diff} **= 4**.

Step 4: Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.

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[41] ANEEL (2011b). Fiscalização dos serviços de geração. Acompanhamento da expansão da oferta de geração de energia elétrica. Resumo geral do acompanhamento das usinas de geração elétrica – Version dated December 2011. Available at: http://www.aneel.gov.br/area.cfm?idArea=37&idPerfil=2. Accessed on December, 23rd 2011

The factor is ***F = 1- 4/5 = 0.2***. This factor represents the share of plants using a similar technology to the one used by the proposed project activity.

The proposed project activity is a "common practice" within a sector in the applicable geographical area if the factor F is greater than 0.2 and N_{all}-N_{diff} is greater than 3.

Outcome: The factor determined above in ***Step 4*** is not greater than 0.2. Also $N_{all} - N_{diff}$ is not greater than 3. Hence, the proposed project activity cannot be considered a common practice in the applicable geographical area.

In summary, this project activity is clearly not common practice, because no similar project started operation during the above mentioned period without some kind of incentive. With the financial benefit derived from the CERs, it is anticipated that other project developers will benefit from this new source of revenue and further will decide to develop such projects. CDM has made it possible for investors to set up their small hydro plants and sell their electricity to the grid.

SATISFIED/PASS – Project is ADDITIONAL

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

<u>*Baseline Emissions*</u>

Baseline emissions are calculated using the annual generation (project annual electricity dispatched to the grid) times the CO_2 average emission rate of the estimated baseline and correspond to the CO_2 emissions that are displaced as a consequence of the project activity, calculated as follows:

$$BE_y = EG_y * EF_{grid,CM,y} \qquad \textbf{Equation 1}$$

Where,

BE_y = Baseline emissions in year *y* (tCO2/yr)

$EG_{facility,y}$ = Electricity supplied by the project activity to the grid (MWh)

$EF_{grid,CM,y}$ = Combined margin CO2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "*Tool to calculate the emission factor for an electricity system*".

According to the methodological tool "*Tool to calculate the emission factor for an electricity system*" (version 2.2.1). The following seven steps to the baseline calculation:

STEP 1 - Identify the relevant electric power system.

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) emission factor.

- **STEP 1 -** Identify the relevant electric power system

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*".

Brazilian DNA has 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 will be 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).

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.

Project participants choose to follow Option I (Only grid power plants are included in the calculation).

- **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 using option c – Dispatch data analysis OM. This option does not permit the vintage of *ex-ante* calculation of the emission factor and, thus, the chosen option was ***ex-post*** calculation. Detailed information on the methods and data applied can be obtained in the DNA's website[42].

- **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 $EF_{grid,OM\text{-}DD,y}$. As consequence it will be calculated ex-post. Only for the purpose of estimative, the numbers of the most recent years will be used.

The $EF_{grid,OM\text{-}DD,y}$ 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.

The CO_2 emission factor for power units in the top of the dispatched order ($EF_{EL,DD,h}$) parameter can be obtained through hourly fuel consumption or hourly emission factor calculated based on the energy efficiency of power units and fuel types. As checked by DOEs, the $EF_{EL,DD,h}$ is calculated by the Brazilian DNA through the hourly fuel consumption according to the following equation:

[42] Site accessed on March 2009 http://www.mct.gov.br/index.php/content/view/4016.html

$$EF_{EL,DD,y} = \frac{\sum_{i,n} FC_{i,n,h} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_{n} EG_{n,h}}$$ **Equation 3**

Where:

$EF_{EL,DD,h}$ = CO_2 emission factor for power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/MWh);

$FC_{i,n,h}$ = Amount of fossil fuel type *i* consumed by power unit *n* in hour *h* (Mass or volume unit);

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit);

$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ);

$EG_{n,h}$ = Electricity generated and delivered to the grid by power unit *n* in hour *h* (MWh);

n = Power units in the top of the dispatch (as defined below);

i = Fossil fuel types combusted in power unit *n* in year *y*;

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.

To determine the set of power units *n* that are in the top of the dispatch, it shall be obtained from a national dispatch centre:

- The grid system dispatch order of operation for each power unit of the system including power units from which electricity is imported; and
- The amount of power (MWh) that is dispatched from all power units in the system during each hour *h* that the project activity is displacing electricity.

At each hour *h*, stack each power unit's generation using the merit order. The group of power units *n* in the dispatch margin includes the units in the top x% of total electricity dispatched in the hour *h*, where x% is equal to the greater of either:

(a) 10%; or

(b) The quantity of electricity displaced by the project activity during hour *h* divided by the total electricity generation in the grid during that hour *h*.

According to information provided by DOEs, the option used by the Brazilian DNA in order to obtain the units in the top x% is (a) 10%. As mentioned above, the host country's DNA will provide

$EF_{EL,DD,h}$ in order to Project Participants calculate the operating margin emission factor. Hence, this data will be updated annually applying the number published by the Brazilian DNA. For estimation purposes, the average of the most recent years available in the DNA website is used. 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 5** – Calculate the build margin (BM) emission factor

Option 2 (ex-post) was chosen, where for the first crediting period, the build margin emission factor shall be updated annually 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 (ex-ante). For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. 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 comprise 20% of the system generation (in MWh) and that have been built most recently.

The build margin will also be calculated by the DNA. The number is published on the website and for estimation purposes the average for the most recent years is used.

The build margin emission factor is the weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which electricity 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 4

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 electricity generation data is available.

The CO_2 emission factor of power unit m in year *y* ($EF_{EL,m,y}$) parameter is calculated as determined as per the guidance in step 3 (a) for the simple OM, option B1, using for *y* the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin.

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Equation 5

Where:

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

$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit);

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit);

$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ);

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

m = All power units serving the grid in year y except low-cost / must-run power units;

i = All fossil fuel types combusted in power unit m in year *y*;

y = Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2.

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. This parameter will be annually up-dated applying the numbers provided by the Brazilian DNA. The number is published on the website and for estimation purposes the average of the most recent years is used.

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

The combined margin is calculated as follows:

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$ **Equation 6**

Where the weights w_{OM} and w_{BM}, for the first crediting period, by default, are w_{BM} = 0.5 and w_{OM} = 0.5.

Project emissions (PE_y)

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:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$ **Equation 7**

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, Version 12, new hydro electric power 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:

$$PE_y = \frac{EF_{\mathrm{Res}} \times TEG_y}{1000}$$ **Equation 8**

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, PEy = 0.

The power density of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$ **Equation 9**

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.

Leakage emissions (LE_y)

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.

Emission reductions (ER_y)

According the selected approved methodology ACM0002, Version 12, emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$ **Equation 10**

Where:

ER_y = Emission reductions in year y (t CO_2e/yr);

BE_y = Baseline emissions in year y (t CO_2e/yr);

PE_y = Project emissions in year y (t CO_2e/yr);

LE_y = Leakage emissions in year y (t CO_2e/yr).

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	***GWP_{CH4}***
Data unit:	tCO_2/tCH_4
Description:	Global Warming Potential of methane valid for the commitment period.
Source of data used:	IPCC
Value applied:	For the first commitment period: 21tCO_2/tCH_4.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Not applicable.
Any comment:	-

Data / Parameter:	***EF_{RES}***
Data unit:	kg/CO_2e/MWh
Description:	Default emission factor for emissions from reservoirs.
Source of data used:	Decision by EB 23.
Value applied:	90
Justification of the choice of data or description of measurement methods and procedures actually applied :	Not applicable.
Any comment:	-

Data / Parameter:	***Cap_{BL}***
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data used:	Project site.
Value applied:	0
Justification of the	Determination of the installed capacity based on recognized standards.

choice of data or description of measurement methods and procedures actually applied :	
Any comment:	-

Data / Parameter:	$\boldsymbol{A_{BL}}$
Data unit:	m^2
Description:	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).
Source of data used:	Project site.
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Measured from topographical surveys, maps, satellite, pictures, etc.
Any comment:	-

B.6.3. Ex-ante calculation of emission reductions:

Baseline calculation

As described in section B.6.1, baseline emissions (BE_y) are calculated directly from electricity supplied by the project to the grid ($EG_{facility,y}$) multiplied by the emission factor ($EF_{grid,CM,y}$).

Future electricity supplied by the project to the grid is estimated based on the energy assured of the hydropower plant as established in ANEEL resolutions.

For estimation purposes, data provided by the Brazilian DNA for the year 2009 were applied in the calculation of the emission factor. When applying the published numbers in the formula presented in step 3 of section B.6.1., the $EF_{grid,OM\text{-}DD,y}$ obtained was:

$$EF_{grid,OM\text{-}DD,\,2009} = 0.2476 \text{ tCO}_2\text{e/MWh.}$$

The building margin for the year of 2009 published by the DNA is:

$$EF_{BM,2009} = 0.0794 \text{ tCO}_2\text{e/MWh.}$$

With these numbers, applying in the formula presented in step 6 of section B.6.1., we have:

$$EF_y = 0.50 \times 0.2476 + 0.50 \times 0.0794$$

EF_y = 0.1635 tCO_2e/MWh.

The total electric energy generation (TEG_y) and the net energy generation estimative are the following:

	CAJU	SANTO ANTONIO	SÃO SEBASTIÃO DO ALTO
Total Energy Generated (TEG_y) [MWh]	52,385	43,012	63,860
Net Energy Generated ($EG_{facility,y}$) [MWh]	51,334	42,136	62,634

Substituting the numbers described above in the equation presented at section B.6.1 we have:

$BE_{y,Caju}$ = 51,334*0.1635 = 8,393 tCO_2e/year

$BE_{y,Santo\ Antônio}$ = 42,136*0.1635 = 6,889 tCO_2e/year

$BE_{y,Ormeo\ Junqueira\ Botelho}$ = 62,634*0.1635 = 10,241 tCO_2e/year

Project Emissions

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 hydro electric power projects with new reservoirs shall account for related project emissions based on the calculation of their power density. Applying the installed capacity of each SHPP and its reservoir area in the equation 7 (described in section B.6.1), the result is:

SHPPs	Installed Capacity (MW)	Reservoir Area (km^2)	Power Density (MW/km^2)
Caju	9.97	1.13	8.82
Santo Antônio	8.27	1.0	8.27
São Sebastião do Alto	13.36	2.7	4.95

Considering that the power density of all SHPP are greater than 4 W/m² and less than or equal to 10 W/m² the project emissions must be calculated through Equation 5 considering the default emission factor for emission from reservoirs (90 kg CO_2e/MWh).

Caju		Santo Antônio		São Sebastião do Alto		Total
TEG_y [MWh]	PE_y [tonCO_2e]	TEG_y [MWh]	PE_y [tonCO_2e]	TEG_y [MWh]	PE_y [tonCO_2e]	PE_y [tonCO_2e]
52,385	4,715	43012	3,871	63,860	5,747	14,333

Leakage Emissions

As described above in section B.6.1., there are no leakage emissions associated with the implementation of the proposed CDM project activity. Hence, $\boxed{LE_y = 0}$.

Emission Reductions

When applying the results presented above in Equation 7 of section B.6.1 we have:

$$\boxed{ER_y = 25{,}522 - 14{,}333 - 0 = 11{,}189\ tCO_2e/year}$$

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Baseline emissions (BE_y) ton CO_2e	Estimation of project activity emissions (PE_y) ton CO_2e	Estimation of leakage (L_y)ton CO_2e	Estimation of overall emission reductions (ER_y) ton CO_2e
Year 1 - (2012)*	12,866	7,225	0	5,641

Year 2 - (2013)	25,522	14,333	0	11,189
Year 3 - (2014)	25,522	14,333	0	11,189
Year 4 - (2015)	25,522	14,333	0	11,189
Year 5 - (2016)	25,522	14,333	0	11,189
Year 6 - (2017)	25,522	14,333	0	11,189
Year 7 - (2018)	25,522	14,333	0	11,189
Year 8 - (2019)**	12,656	7,107	0	5,549
TOTAL (tonnes of CO_2e)	**178,654**	**100,330**	**0**	**78,324**

* Starting on July, 1st 2012

** Until June, 30th 2019

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

All the monitored information listed in this section will be archived for two years following the end of the crediting period. Data will be recorded electronically and/or in paper.

Data / Parameter:	TEG_y
Data unit:	MWh/yr
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y*.
Source of data to be used:	Project activity site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	SHPP Caju: 52,385 SHPP Santo Antônio: 43,012 SHPP São Sebastião do Alto: 63,860
Description of measurement methods and procedures to be applied:	Electricity meters[43].
QA/QC procedures to be applied:	-
Any comment:	Applicable to hydropower project activities with a power density of the project activity (PD) greater than 4 W/m^2 and less than or equal to 10 W/m^2.

[43] Consolidated in internal monthly reports, based on the plant´s automation system that continuously measure the plant´s total electricity generation.

Data / Parameter:	***$EG_{facility,y}$***
Data unit:	MWh
Description:	Electricity supplied by the project activity to the grid.
Source of data to be used:	Project activity site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	SHPP Caju: 51,334
Description of measurement methods and procedures to be applied:	There are two electricity meters (principal and back-up) which continuously monitor the electricity generated by the plant and delivered to the grid. As per the information presented above, they are calibrated every two years following the recommendations of the System National Operator.
QA/QC procedures to be applied:	The official reports issued by CCEE can be crosschecked the company´s internal generation reports (the equipments used have by legal requirements extremely low level of uncertainty, precision class of 0.2%.).
Any comment:	-

Data / Parameter:	***$EG_{facility,y}$***
Data unit:	MWh
Description:	Electricity supplied by the project activity to the grid.
Source of data to be used:	Project activity site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	SHPP Santo Antônio: 42,136
Description of measurement methods and procedures to be applied:	There are two electricity meters (principal and back-up) which continuously monitor the electricity generated by the plant and delivered to the grid. As per the information presented above, they are calibrated every two years following the recommendations of the System National Operator.
QA/QC procedures to be applied:	The official reports issued by CCEE can be crosschecked the company´s internal generation reports (the equipments used have by legal requirements extremely low level of uncertainty, precision class of 0.2%.).
Any comment:	-

Data / Parameter:	***$EG_{facility,y}$***
Data unit:	MWh
Description:	Electricity supplied by the project activity to the grid.
Source of data to be used:	Project activity site.
Value of data applied for the purpose of calculating expected emission reductions in	SHPP São Sebastião do Alto: 62,634

section B.5	
Description of measurement methods and procedures to be applied:	There are two electricity meters (principal and back-up) which continuously monitor the electricity generated by the plant and delivered to the grid. As per the information presented above, they are calibrated every two years following the recommendations of the System National Operator.
QA/QC procedures to be applied:	The official reports issued by CCEE can be crosschecked the company´s internal generation reports (the equipments used have by legal requirements extremely low level of uncertainty, precision class of 0.2%.).
Any comment:	-

Data / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2/MWh
Description:	Operating 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”.
Source of data to be used:	Brazilian DNA website, based on 2009 data published, the most recent publicly available at: http://www.mct.gov.br/index.php/content/view/72764.html. Based on 2009 data published
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.2476
Description of measurement methods and procedures to be applied:	The emission factor is calculated by and published by the Brazilian DNA as a combined margin (CM), consisting of operating margin (OM) and build margin (BM) according to procedures prescribed in the “*Tool to calculate the emission factor for an electricity system*”.
QA/QC procedures to be applied:	This parameter is publically available and it is proposed by the Brazilian Ministry of Science and Technology.
Any comment:	-

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	Build 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”.
Source of data to be used:	Brazilian DNA website, based on 2009 data published, the most recent publicly available at: http://www.mct.gov.br/index.php/content/view/72764.html. Based on 2009 data published
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0794
Description of measurement methods	The emission factor is calculated by and published by the Brazilian DNA as a combined margin (CM), consisting of operating margin (OM) and huild margin

and procedures to be applied:	(BM) according to procedures prescribed in the "*Tool to calculate the emission factor for an electricity system*".
QA/QC procedures to be applied:	This parameter is publically available and it is proposed by the Brazilian Ministry of Science and Technology.
Any comment:	As per the "Tool to calculate the emission factor for an electricity system".

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system".
Source of data to be used:	As per the "Tool to calculate the emission factor for an electricity system".
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1635
Description of measurement methods and procedures to be applied:	As per the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures to be applied:	As per the "Tool to calculate the emission factor for an electricity system".
Any comment:	As per the "Tool to calculate the emission factor for an electricity system".

Data / Parameter:	CAP_{PJ}
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data to be used:	Project site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	SHPP Caju: $9.97 *10^6$ SHPP Santo Antônio: $8.27*10^6$ SHPP São Sebastião do Alto: $4.95*10^6$
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	A_{PJ}

Data 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.
Source of data to be used:	Project site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	SHPP Caju: 1,130,000 SHPP Santo Antônio: 1,000,000 SHPP São Sebastião do Alto: 2,700,000
Description of measurement methods and procedures to be applied:	Measured from topographical surveys, maps, satellite pictures, etc.
QA/QC procedures to be applied:	-
Any comment:	-

B.7.2. Description of the monitoring plan:

The monitoring plan of the emission reductions by the project activity is in accordance with the procedures set by the methodology ACM0002 - "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*".

The Monitoring Plan will be based on amount of electricity delivered to the grid ($EG_{facility,y}$) by the project activity and the Project Participants will proceed the necessary monitoring measures as established by *ONS*, *ANEEL* and *CCEE*. standards.

The ONS is the entity responsible for coordinating and controlling the operation of generation and transmission facilities in the National interconnected Power System (NIPS) under supervision and regulation of ANEEL[44] which is the regulatory agency providing favourable conditions for the electric power market to develop a balance between the agents and the benefit of society[45]. CCEE is a not-for-profit, private, civil organization company that is in charge of carrying out the wholesale transactions and commercialization of electric power within the NIPS, for both Regulated and Free Contracting Environments and for the spot market[46].

The total electricity exported to the grid will be monitored following the procedures and requirements established by ONS which defines the technical characteristics and precision class (0.2% of maximum

[44] Information available at <http://www.ons.org.br/institucional/modelo_setorial.aspx?lang=en>.

[45] Information available at <http://www.aneel.gov.br/>.

[46] Information available at <http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=25afa5c1de88a010VgnVCM100000aa01a8c0RCRD>.

permissible error) of the electricity meters to be used[47]. In addition, ONS also rules about the electricity meter calibration requirements (every two years)[48].

The amount of electricity dispatched will be monitored by the project owner, as well as by the Chamber of Electrical Energy Commercialization (from the Portuguese *Câmara de Comercialização de Energia Elétrica* - CCEE) that controls all electricity provided to the grid and contractually assures, for the buyer, that the electricity sold will be properly delivered. Once energy losses are accounted and the data consistency is verified, CCEE issues an official report that indicate, per week, the amount of electricity dispatched during a certain month, in which will be based the GHG emission reductions.

From what is established in the relevant regulation of the energy sector in Brazil, all the plants delivering electricity to the grid have to implement a *Measurement System for Invoicing (from the Portuguese, Sistema de Medição e Faturamento - SMF)* in accordance with the specifications set by CCEE. Model and type of energy meters installed are in accordance with CCEE´s standards. Such configuration is in accordance with ONS´s grid procedures, "Module 12: Measurement for Invoicing".

There will be two energy meters, a principal and back up meter, specified by *CCEE*, that will monitor the electricity delivered to the grid ($EG_{facility,y}$) generated by *Caju* and *São Sebastião do Alto* SHPPs. Those meters will provide to CCEE the amount of electricity dispatched to the grid, they will be calibrated every two years by an entity with Rede Brasileira de Calibração (RBC) credential. The meters are located at *Coletora* substation and present the following characteristics:

- **Principal meter:**
  - Type: ION
  - Serial number: PT-1008A533-01
  - Accuracy class: 0.2%
  - Calibration frequency: each 2 years according to ONS recommendations
  - Date of the last calibration: 24/09/2010
- **Backup meter:**
  - Type: ION
  - Serial number: PT-1008A512-01
  - Accuracy class: 0.2%
  - Calibration frequency: each 2 years according to ONS recommendations
  - Date of the last calibration: 24/09/2010

The measurement of the electricity delivered to the grid by *Santo Antônio* SHPP will be made at *Bom Jardim* substation. As explained above, the meters located at *Bom Jardim* substation will also provide to CCEE the amount of electricity dispatched to the grid, andwill be calibrated every two years

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[47] ONS – Operador Nacional do Sistema. **Procedimentos de Rede – Módulo 12: medição para faturamento / Submódulo 12.2: Instalação do sistema de medição para faturamento.** Available at http://www.ons.org.br/procedimentos/modulo_12.aspx.

[48] ONS – Operador Nacional do Sistema. **Procedimentos de Rede – Módulo 12: medição para faturamento / Submódulo 12.3: Manutenção do sistema de medição para faturamento.** Available at http://www.ons.org.br/procedimentos/modulo_12.aspx.

by an entity with Rede Brasileira de Calibração (RBC) credential. The meters specifications are detailed below:

- **Principal meter:**
  - Type: ION 8600C
  - Serial number: PT-1011A033-01
  - Accuracy class: 0.2%
  - Calibration frequency: each 2 years according to ONS recommendations
  - Date of the last calibration: 04/11/2011
- **Backup meter:**
  - Type: ION 8600C
  - Serial number: PT-1011A042-01
  - Accuracy class: 0.2%
  - Calibration frequency: each 2 years according to ONS recommendations
  - Date of the last calibration: 03/01/2011

The total power generation (TEG_y) will be monitored through the plant´s supervisory system. Each SHPP presents a principal and a backup meter located at the exit of the SHPP which are integrated to the plant ´s supervisory system, the meters measurements will be remotely accessed by the operations center, so that it can record the total electricity produced. The gross electricity meters specifications are presented in the table below and the calibration frequency are in accordance with the *ONS* recommendations:

Table 18 - Gross electricity meters' specifications.

Location	Meter	Serial number	Manufacturer	Type/Model	Accuracy class
Caju SHPP	Principal	PT-0910A473-01	Schneider Electric Brasil Ltda.	ION 8600A	0.2
	Backup	PT-1008A611-01	Schneider Electric Brasil Ltda.	ION 8600C	0.2
São Sebastião do Alto SHP	Principal	PT-1010A0638-01	Schneider Electric Brasil Ltda.	ION 8600C	0.2
	Backup	PT-1009A917-01	Schneider Electric Brasil Ltda.	ION 8600C	0.2
Santo Antônio	Principal	PT-1102A168-01	Schneider Electric Brasil	ION 8600C	0.2

SHPP			Ltda.		
	Backup	PT-1102A178-01	Schneider Electric Brasil Ltda.	ION 8600C	0.2

The data storage will be done, and will be electronically stored. The installed capacity of the power plant will be checked by DOE during on-site visit every verification and the reservoir area will be monitored through ANEEL's Geo-referenced Information Systems. This information will be available at the time of the project verification.

Energisa is responsible for ensuring the meter´s calibration (each two years), according to the procedures established by the ONS[49], and maintenance of the monitoring equipments. The company is also responsible for the project management, as well as for organising and training the staff in the appropriate monitoring procedures. The plant is subject to ANEEL inspection in which the agency assesses the compliance with legal requirements as per official procedures and standards.

All data required for verification and issuance will be monitored and archived electronically and 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.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Date of completing the final draft of this baseline section and the monitoring methodology (DD/MM/YYYY): 26/07/2010.

Name of person/entity determining the baseline:

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Ecopart Assessoria em Negócios Empresariais Ltda. is Project Advisor and Project Participant.

[49] Please refer to the document "*Módulo 12 do ONS, Submódulo 12.3 – Manutenção do sistema de medição para faturamento*". Available at: http://www.ons.org.br/download/procedimentos/Submodulo%2012.3_v10.0.pdf.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

The starting date of the project activity is 16/09/2009, date in which *Energisa Soluções´s* Board and Brazilian Development Bank (from the Portuguese *Banco Nacional de Desenvolvimento Econômico e Social – BNDES*) signed the Financing Contract.

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C.1.2. Expected operational lifetime of the project activity:

30y-0m.

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

01/07/2012 or on the date of registration of the CDM project activity, whichever is later.

C.2.1.2. Length of the first crediting period:

7y-0m.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

In Brazil, the sponsor of any project that involves construction, installation, expansion or operation of any polluting or potentially polluting activity or any other capable to cause environmental degradation is obliged to secure a series of permits from the relevant environmental agency (federal and/or local, depending on the project).

Although small hydro projects have reduced environmental impacts given the smaller dams and reservoir size, project sponsors have to obtain all licenses required by the Brazilian environmental regulation (Resolution CONAMA - *Conselho Nacional do Meio Ambiente* (National Environmental Council) nr. 237/97):

- The preliminary license (*Licença Prévia* or LP);
- The construction license (*Licença de Instalação* or LI); and
- The operating license (*Licenca de Operação* or LO).

The environmental permit process has an administrative nature and was implemented by the National Environmental Policy, established by the Law nr. 6938 dated on October 31st, 1981. Additionally, other norms and laws were issued by CONAMA and local state agencies.

In order to obtain all environmental licenses every small hydro projects shall mitigate the following impacts:

- Inundation of indigenous peoples' lands and slaves historical areas – the authorization for that depends on National Congress decision;
- Inundation of environmental preservation areas, legally formed as National Parks and Conservation Units;
- Inundation of urban areas or country communities;
- Reservoirs where there will be urban expansion in the future;
- Elimination of natural patrimony;
- Expressive losses for other water uses;
- Inundation of protected historic areas; and
- Inundation of cemeteries and other sacred places.

The process starts with a previous analysis (preliminary studies) by the local environmental department. After that, if the project is considered environmentally feasible, the sponsors have to prepare the Environmental Assessment, which is basically composed of the following information:

- Reasons for project implementation;
- Project description, including information regarding the reservoir;
- Preliminary Environmental Diagnosis, mentioning main biotic, and anthropic aspects;
- Preliminary estimation of project impacts; and
- Possible mitigating measures and environmental programs.

The result of those assessments is the Preliminary License (LP), which reflects the environmental local agency positive understanding about the environmental project concepts.

In order to obtain the Construction License (LI) it is necessary to present (a) additional information about previous assessment; (b) a newly simplified assessment; or (c) the Environmental Basic Project, according to the environmental agency decision informed at the LP.

The Operation License (LO) is a result of pre-operational tests during the construction phase to verify if all exigencies made by environmental local agency were completed.

All the plants possess the Preliminary, Construction and Operation licenses, issued by the Rio de Janeiro Environmental Agency (*INEA – Instituto Estadual do Ambiente* previously named as *FEEMA - Fundação Estadual de Engenharia do Meio Ambiente*). The LO number as well as the issuance date is described below:

- Caju SHPP: LO nr. IN003282, issued on November, 26th 2010;
- Santo Antônio SHPP: LO nr. IN018481, issued December, 19th 2011;
- São Sebastião do Alto SHPP: LO nr. IN003281, issued on November, 26th 2010.

Given this, the project does not imply in any negative transboundary environmental impacts; the licenses would not have been issued if the project had negative transboundary environmental impacts existed.

Other guideline was used in order to evaluate the project contribution in achieve the host country's environmental sustainability called *Anexo III*, required by the Brazilian DNA in order to obtain the Letter of Approval. Anexo III includes an analysis of the project contribution related to: local environmental sustainability, quantity and quality development of jobs, fair income distribution, technological development and capacity building, regional integration and relationships among other sectors.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The growing global concern on sustainable use of resources is driving the requirement for more sensitive environmental management practices. Increasingly this is being reflected in countries' policies and legislation. In Brazil the situation is not different; environmental rules and licensing process policy are very demanding in line with the best international practices.

For the issuance of the Construction License, the Rio de Janeiro Environmental Agency requested the fulfillment of the following programs for project, also mentioned in the Environmental and Social Programs Plan (from the Portuguese *Plano Básico Ambiental – PBA*) of the Project:

- Social communication;
- Ictiofauna monitoring;
- Reforestation;
- Quality of water monitoring;
- Degraded area recuperation;

- Environmental education;
- Historic and cultural heritage conservation;
- Hiring Manpower Program;
- Indemnification of Land and Improvements Program;
- Relocation of local Population Program;
- Support Conservation Units Program.

As mentioned above, the project does not imply any significant negative transboundary environmental impacts, on the contrary the licenses would not be issued. All documents related to operational and environmental licensing are public and can be obtained at the state environmental agency (*INEA* previously named *FEEMA*) and with the project participants.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

Brazilian Designated National Authority "*Comissão Interministerial de Mudanças Globais do Clima*", request comments for local stakeholders, and the validation report issued by an authorized DOE according to the Resolution nr. 1, issued on September 11th, 2003, in order to provide the letter of approval.

The Resolution determines the direct invitation for comments sent by the project proponents at least to the following agents involved in and affected by project activities and at least 15 days before the Global Stakeholder Process (GSP):

- Municipal governments and City Councils;
- State and Municipal Environmental Agencies;
- Brazilian Forum of NGOs and Social Movements for Environment and Development;
- Community associations;
- State Attorney for the Public Interest (state and federal).

The same resolution also requires that at the time these letters are sent, a version of the PDD in the local language and a declaration stating how the project contributes to the sustainable development of the country, must be made available to these stakeholders at least 15 days previous to the starting of the Global Stakeholder Process (GSP). Taking into account that the invitation letters were sent to the following agents – by postal – 12/08/2010 and the e Portuguese version of the PDD was published at the internet website < https://sites.google.com/site/consultadcp/Inicio/projetos-pchs-energisa> on 06/10/2010:

- City Hall of Bom Jardim and São Sebastião do Alto (Prefeitura Municipal de Bom Jardim e

São Sebastião do Alto);

- Municipal Assembly of Bom Jardim and São Sebastião do Alto (Câmara Municipal de Bom Jardim e São Sebastião do Alto);
- Environmental Agency of Bom Jardim and São Sebastião do Alto (Secretaria Municipal de Meio Ambiente e Turismo);
- Communitarian Association of Bom Jardim and São Sebastião do Alto (Associação Comunitária de Bom Jardim e São Sebastião do Alto);
- Environmental Agency of Rio de Janeiro (*INEA – Instituto Estadual do Ambiente* previously named *FEEMA – Fundação Estadual de Engenharia do Meio Ambiente*);
- State Attorneys for the Public Interest of Brazil and Rio de Janeiro state (Ministério Público Federal e Ministério Público do Estado do Rio de Janeiro);
- Brazilian Forum of NGOs and Social Movements for the Development and Environment (Fórum Brasileiro de ONGs e Movimentos Sociais para o Desenvolvimento e Meio Ambiente).

Copies of the letters and post office confirmation of receipt are available upon request and will be submitted to the DOE during the validation of the Project Activity.

E.2. Summary of the comments received:

No comments were received.

E.3. Report on how due account was taken of any comments received:

No comments were received.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the present project.
This project is not a diverted ODA from an Annex 1 country.

Annex 3

BASELINE INFORMATION

The Brazilian electricity system, for the purpose of CDM activities, was delineated as a single interconnected system comprehending the five geographical regions of the country (North, Northeast, South, Southeast and Midwest). This was determined by the Brazilian DNA through its Resolution nr. 8 dated 26th May, 2008.

More information on how the Interconnected System is delineated and the emission factor values is available at the Brazilian DNA's website <http://www.mct.gov.br/index.php/content/view/317399.html#ancora>,

BUILD MARGIN	
	Average Emission Factor (tCO_2/MWh) - **ANNUAL**
2009	
	To be published in the beginning of 2010

OPERATING MARGIN												
	Average Emission Factor (tCO_2/MWh) - **MONTHLY**											
2009	MONTH											
	January	February	March	April	May	June	July	August	September	October	November	December
	0.2813	0.2531	0.2639	0.2451	0.4051	0.3664	0.2407	0.1988	0.1622	0.1792	0.1810	0.1940

Annex 4

Energisa Rio Grande SHPPs Project Activity monitoring plan will proceed according to the "Approved consolidated monitoring methodology ACM0002" – "*Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources*". Information details are described in Section B.7.2.

Annex 5

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