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:

Title of the project activity: Pipoca Small Hydropower Plant Project Activity.

Version number: 5.

Date of completion (DD/MM/YYYY): 13/01/2012.

A.2. Description of the project activity:

The primary objective of Pipoca Small Hydropower Plants Project Activity ("PCH", from the Portuguese *Pequena Central Hidrelétrica*) 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 the share of renewable energy in total electricity consumption for Brazil (and for the region of Latin America and the Caribbean).

Countries in the Latin America and the Caribbean region have expressed their commitment towards achieving a target of 10% renewable energy for total energy use in the region. Through an initiative from the Ministers of the Environment in 2002 (UNEP-LAC, 2002), a preliminary meeting of the World Summit for Sustainable Development (WSSD) was held in Johannesburg in 2002. In the WSSD final Plan of Implementation no specific targets or timeframes were stated, however, their importance was recognized for achieving sustainability in accordance with the Millennium Development Goals[1].

The privatization process initiated in 1995 commenced with the expectation of adequate tariffs (fewer subsidies) and better prices for generators. It drew the attention of investors to possible alternatives not available in the centrally planned electricity market. Unfortunately, the Brazilian energy market lacked a consistent expansion plan; the current expansion plan contains major problems such as political and regulatory uncertainties. In the late 1990's a strong increase in demand in contrast with a less-than-average increase in installed capacity caused the outbreak of the supply crisis/rationing in 2001/2002. One of the solutions the government provided was flexible legislation favoring smaller independent energy producers[2]. Furthermore, the possible eligibility under the Clean Development Mechanism of the Kyoto Protocol drew the attention of investors to small power projects, especially small hydropower projects.

Pipoca Small Hydropower Plant Project consists of the construction of a small hydropower plant with an installed capacity of 20.45 MW and a reservoir area of 0.855 km^2 (power density of 24.06 W/m^2). It is located between the municipalities of Caratinga and Ipanema, state of Minas Gerais, Southeastern region of Brazil, and it is estimated to become operational in April 2010.

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[1] WSSD Plan of Implementation, Paragraph 19 (e): "*Diversify energy supply by developing advanced, cleaner, more efficient, affordable and cost-effective energy technologies, including fossil fuel technologies and renewable energy technologies, hydro included, and their transfer to developing countries on concessional terms as mutually agreed. With a sense of urgency, substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply, recognizing the role of national and voluntary regional targets as well as initiatives, where they exist, and ensuring that energy policies are supportive to developing countries' efforts to eradicate poverty, and regularly evaluate available data to review progress to this end.*"

[2] (LANDI, 2006) Describes the implementation of the new energy market regulation (page 106), and the specific incentives provided to Small Independent energy producer (page 140).

The Project is owned by Hidrelétrica Pipoca S.A., which is a consortium formed by the following shareholders:

- CEMIG Geração e Transmissão S.A.: 49%;
- OMEGA Energia Renovável S.A.: 51%.

Income distribution will be derived from this project due to job creation, employees' salaries and benefit packages such as social security and life insurance. Also, lower expenditure is achieved due to the fact that money will no longer be spent in the same amount to "import" electricity from other regions in the country through the grid. This money would stay in the region and may be used for providing better services for the community which would improve the availability of basic needs. This surplus of capital could be translated into investments in education and health that would directly benefit the local population and indirectly in a more equitable income distribution.

It is important mentioning that prior to the implementation of the project activity no small hydropower plant or other project activity was operational in the location where Pipoca project is being built. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation from fossil fuel sources (and CO_2 emissions), which would be generated (and emitted) in the absence of the project. In conclusion, the baseline scenario and the scenario without the project activity are the same.

Although Pipoca small hydropower plant does not have alone a major impact in the host country given its electricity system size, it is undoubtedly part of a greater idea. The project activity contributes to sustainable development since it meets the present needs without compromising the ability of future generations to meet their own needs, as defined by the Brundtland Commission (1987). In other words, the implementation of small hydroelectric power plants ensures renewable energy generation, reduces the national electric system demand, avoids negative social and environmental impact caused by the construction of large hydros with large reservoirs and fossil fuel thermo power plants, and drives the regional economy, increasing quality of life in local communities.

Therefore, indisputably the project has reduced negative environmental impacts and has developed the regional economy, resulting, consequently, in better quality of life. In other words, environmental sustainability combined with social and economic justice, undeniably contribute to the host country's sustainable development.

A.3. Project participants:

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

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 wishes to be considered as project participant (Yes/No)

Brazil (host)	Hidrelétrica Pipoca S.A. (Private entity)	No
	Ecopart Assessoria em Negócios Empresariais Ltda. (Private entity)	No
(*) 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.		

A.4. Technical description of the project activity:

By legal definition of the Brazilian Power Regulatory Agency (in a free translation from the Portuguese *Agência Nacional de Energia Elétrica - ANEEL*), Resolution # 652, issued on December 9th, 2003[3], small hydropower plant must have installed capacity between 1 MW and 30 MW, and have a reservoir area smaller than 3 km², which is the case of Pipoca Project.

According to ACM0002 – "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*", Pipoca Small Hydropower Plant is classified as new hydroelectric project with new reservoir and with power density greater than 4 W/m², which results in a minimum environmental impact:

Installed capacity: 20.45 MW

Reservoir area: 0.855 km²

Power density: 24.06 MW/km² or W/m²

More information about the power density calculation is presented in section B.6.3.

Additionally, because of its small reservoir the plant is considered a run-of-river project which are those that do not include significant water storage, and must therefore make complete use of the water flow. A typical run-of-river scheme involves a low-level diversion dam and is usually located on swift flows (Figure 1).

[3] *Agência Nacional de Energia Elétrica – ANEEL*. Resolution # 652 dated December 9th, 2003. Available at: <http://www.aneel.gov.br/cedoc/res2003652.pdf>.

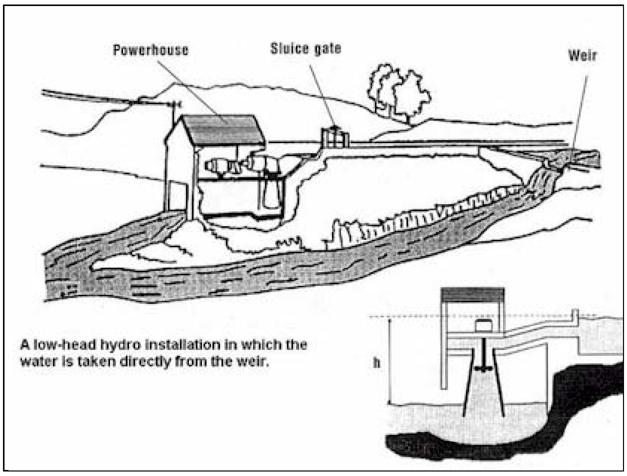

Figure 1 - Schematic view of run-of-river power plant

The World Commission of Dams (WCD, 2000) establishes that **Run-of-river dams** creates a hydraulic head in the river to divert some portion of the river flows. They have no storage reservoir or limited daily poundage. Within these general classifications there is considerable diversity in scale, design, operation and potential for adverse impacts.

To determine the days of poundage at maximum volume of the reservoir, data about the annual average of the river flow rate and the maximum volume of the reservoir from ANEEL technical summary are used.

Table 2 – Munhuaçu River monthly average flow at the project location from 1931 to 1998

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average (m^3/s)	69.7	58.1	49.4	38.1	28.8	24.2	21.1	18.4	17.4	21.7	36.9	57.6

Considering the table above, the annual average of the river flow rate is 36.8 m^3/s, therefore:

- Volume of the reservoir: 8,186,000 m^3
- River average flow rate: 36.8 m^3/s
- Days of poundage: 2.6 days

According to ANEEL technical summary, the residence time of water in reservoir is three days, which is equal to the days of poundage calculated above. Then, to the understanding or the project participants, the Pipoca Small Hydro Power Plant can be considered a run-of-river power plant according to the presented criteria.

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

South-eastern region of Brazil.

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

State of Minas Gerais.

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

Municipalities of Caratinga and Ipanema.

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

The project is located in the Southeast of Brazil, State of Minas Gerais, between the municipalities of Caratinga and Ipanema (Figure 2), and uses the hydro potential of Manhuaçu River. PCH Pipoca geographic coordinates are as follows according to ANEEL technical summary:

Dam: 19º46’10,2’’ S and 41º 47’20,3’’ W[4];

Power house: 19º 45’ S and 41º 46’ W.

Figure 2 - Political division of Brazil presenting the municipalities of Caratinga and Ipanema in the state of Minas Gerais

Source: Google Earth, 2009

Caratinga has 81,731 inhabitants, 1,251 km^2 (IBGE, 2009) and is distant 295 km from Belo Horizonte[5], capital of the state of Minas Gerais. Ipanema has 17,128 inhabitants, 459 km^2 (IBGE, 2009) and is distant 356 km from Belo Horizonte[6].

[4] As described by the ANEEL´s Dispach #1695 issued on 14/06/2010.

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

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

Category: Renewable electricity generation for a grid.

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

The Francis turbines, used in Pipoca Small Hydro Power Plant Project Activity, are the most widely used among water turbines (Figure 3). Francis turbine is a type of hydraulic reaction turbine in which the flow exits the turbine blades in the radial direction. They are common in electricity generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through a spiral tank and is directed onto the blades. The low momentum water then exits the turbine through a ducting known as suction tube. In the model, water flow is supplied by a variable speed centrifugal pump. A load is applied to the turbine by means of a magnetic brake, and torque is measured by observing the deflection of calibrated springs. The performance is calculated by comparing the output energy to the energy supplied.

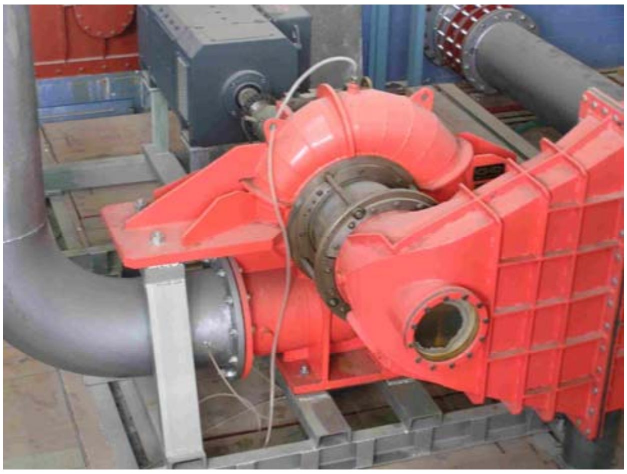

Figure 3 - Example of a Francis Turbine

Source: NTUA, 2009

The equipment and technology utilized by Pipoca Small Hydro Power Plant Project Activity have been successfully applied to similar projects in Brazil and around the world. Technical description of the facility is as follows:

Table 3 – Technical configuration of PCH Pipoca

Description	PCH Pipoca

[5] Available at Férias.tur.br website: http://www.ferias.tur.br/informacoes/2885/caratinga-mg.html . Accessed on August 05th, 2009.

[6] Available at Férias.tur.br website: http://www.ferias.tur.br/informacoes/3228/ipanema-mg.html . Accessed on August 05th, 2009.

PCH	Installed capacity (MW)	20.45
	Reservoir area (km^2)	0.855
	Estimated energy generated (MWh/year)	104,244
Turbines	Type	Francis – horizontal axis
	Quantity	3
	Nominal power (MW)	7.03
	Total Power (MW)	21.09
	Manufacturer	Andritz Hydro Brasil Ltda
Generators	Type	Triphasic, BRUSHLESS
	Quantity	3
	Nominal power (MVA)	7.41
	Load Factor	0.92
	Total Power (MW)	(7.41 * 0.92 * 3) = 20.45
	Nominal voltage (kV)	6.8172
	Manufacturer	GE Motors

As mentioned earlier on section A.2., prior to the implementation of the project activity there was no small hydropower plant or other project activity operational in the same location of Pipoca Project. In the absence of the project activity all the energy would be supplied by the interconnected grid. Hence, the baseline scenario and the scenario without the project activity are the same.

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

The emission factor estimated from the data published by the Brazilian DNA and used to estimate the Emission Reductions by the plant is equal to 0.1635 tCO_2e/MWh. Please refer to Annex 3 for details on the calculation of the emission factor used in the *ex-ante* estimative. The results are presented in the table below.

Table 4 – Estimated emission reductions of Pipoca Small Hydro Power Plant Project.

Years	Annual estimation of emission reductions in tonnes of CO_2e
2012*	8,592
2013	17,044
2014	17,044
2015	17,044

2016	17,091
2017	17,044
2018	17,044
2019**	8,452
Total estimated reductions (tonnes of CO_2e)	119,354
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	17,051

* from 1-7-2012 to 31-12-2012

** from 1-1-2019 to 30-6-2019

A.4.5. Public funding of the 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, EB 65).

- Tool to calculate the emission factor for an electricity system[7];
- Tool for the demonstration and assessment of additionality[8];
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion[9].
- Combined tool to identify the baseline scenario and demonstrate additionality[10];

The *Combined tool to identify the baseline scenario and demonstrate additionality* and the *Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion* are not applicable to the project activity, and therefore are not used.

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[7] Tool to calculate the emission factor for an electricity system (version 2.2.1). UNFCCC, CDM Executive Board 63th Meeting Report, 29 September 2011, Annex 19. Web-site: http://cdm.unfccc.int/

[8] Tool for the demonstration and assessment of additionality (version 06.0.0). UNFCCC, CDM Executive Board 65th Meeting Report, 21-25 November 2011, Annex 21. Web-site: http://cdm.unfccc.int/

[9] Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 2). UNFCCC, CDM Executive Board 41st Meeting Report, 30 July '- 02 August 2008, Annex 11. Web-site: http://cdm.unfccc.int/

[10] Combined tool to identify the baseline scenario and demonstrate additionality (version 3.0.1). UNFCCC, CDM Executive Board 60th Meeting Report, 11 - 15 April 2011, Annex 7. Web-site: http://cdm.unfccc.int/

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

The methodology ACM0002 is applicable to projects consisting of "*the installation or modification/retrofit 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*".

Moreover, for hydro power plants that result in new single or multiple reservoirs, the power density of the power plant shall be greater than 4 W/m^2.

Considering the applicability above, Pipoca Small Hydropower Plant Project meets all the criteria established by the ACM0002, being a Greenfield small hydro project interconnected to the electricity grid with new single reservoir and with power density greater than 4 W/m^2 as can be seen in section B.6.3.

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

According to ACM0002 "*the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system which the CDM project power plant is connected to*". On May 26th, 2008, the Brazilian Designated Authority published the Resolution # 8[11] that defines a single system for the Brazilian Interconnected Grid, covering all the five geographical regions of the country (North, Northeast, South, Southeast and Midwest).

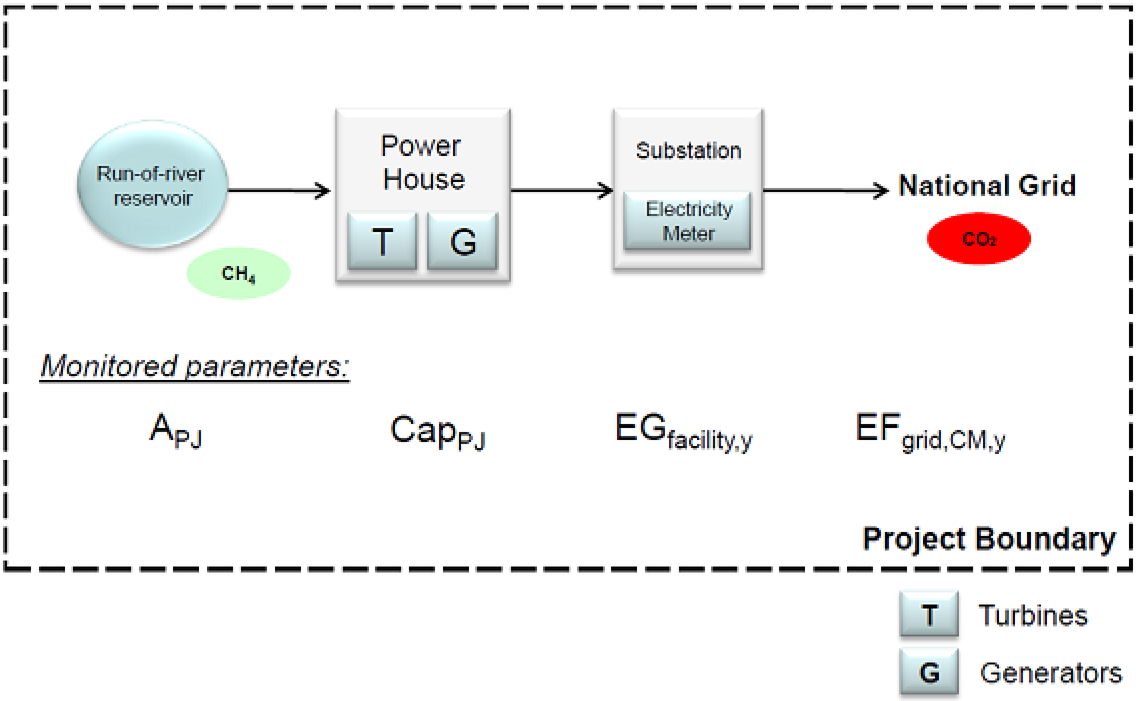

Figure 4 - Project boundary

[11] 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 5 – Sources and gases included in the project boundary

	Source	Gas	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	For geothermal power plants, fugitive emissions of CH4 and CO2 from non-condensable gases contained in geothermal steam	CO_2	No	Not applicable.
		CH_4	No	Not applicable.
		N_2O	No	Not applicable.
	CO2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	Not applicable.
		CH_4	No	Not applicable.
		N_2O	No	Not applicable.
	For hydro power plants, emissions of CH4 from the reservoir	CO_2	No	Minor emission source.
		CH_4	No	Considering that Pipoca power density is 24.06 W/m^2, and therefore, greater than 10 W/m^2, there are no project emissions from the reservoir involved in the project activity.
		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 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".

In the absence of the project activity, all the energy would be obtained from the interconnected grid. Hence, the baseline scenario is identified as the continuation of the current (previous) situation of electricity supplied by the grid, in which large quantities of carbon dioxide (CO_2) would be emitted to the atmosphere.

According to ANEEL (2010), 69.20 % of the Brazil's installed capacity is composed by large hydropower plants which on average present large reservoirs and 25.20 % by thermal power stations (see step 04, section B.5) [12].

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):

Project Participants held a timeline of the project with dates of actions for the project implementation:

Table 6 – Project starting date

Dates	Actions
14/11/2005	Letter of intent signed between Hydro Partners and CEMIG
13/04/2007	Construction License issuance
05/10/2007	EPC[13] contract signed (conditioned to the Service Order issuance, until 15/04/2008)
29/11/2007	CEMIG Board's meeting held to decide the feasibility of Pipoca project implementation considering carbon credits commercialization.
15/04/2008	The service order was not issued, and the EPC contract had to be renegotiated.
20/05/2008	CEMIG Geração e Transmissão S/A bought 49% share of Pipoca project from Hydro Partners do Brasil Empreendimentos e Participações Ltda.
30/06/2008	Omega Energia Renovável S/A bought 51% share of Pipoca project from Hydro Partners do Brasil Empreendimentos e Participações Ltda.
27/08/2008	CEMIG Board's meeting held to decide the feasibility of Pipoca project implementation considering changes in the project investments and IRR. A second IRR was presented with the inclusion of carbon credits commercialization
20/10/2008	EPCrenegotiated contract signature
14/04/2009	PPA signature

[12] Available at: < http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp>. Accessed on August 04th, 2010.

[13] Engineering, procurement and construction contract.

14/09/2009	Financing contract signature

Due to Pipoca´s high investment requirement and low rate of return, the project could not be implemented until 2008 when a joint venture with CEMIGs occurred. The company´s expertise[14] associated with the carbon credits revenues that the project could overcome the economical feasibility barrier.

The first EPC contract signed by Pipoca S.A. had as a necessary condition to its execution, the Service Order issuance. For its part the Service Order issuance depended on CEMIG´s entrances into the project, which occurred only on 20/05/2008, a month after the contract´s deadline (15/04/2008) determined by the first EPC, once the contract lost its validity, a contract renegotiation became necessary, and a new contract had to be signed. Before CEMIG´s entrance on Pipoca S.A. a meeting was held to decide the feasibility of the project implementation considering carbon credits commercialization. The project´s valuation culminated with the purchase of 49% share of Pipoca by CEMIG Geração e Transmissão S/A on May 20th, 2008.

Then all implementation conditions were only fully attended (on 20/05/2008) with Pipoca S.A.´s subscription agreement, which included CEMIG as a shareholder, who comprised the initial investment to the projects implementation begin as previously agreed. Therefore, since the EPC contract could only became viable after CEMIG´s entrance, it is clear, that CEMIG´s subscription agreement in which CEMIG´s paid up R$ 3.632 million in order to start Pipoca S.A. implementation is the most appropriate event which better complies with the starting date definition in "Glossary of CDM terms".

> "*The start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. This, for example, can be the date on which contracts have been signed for equipment or construction/operation services required for the project activity.*

Considering information above and in accordance with EB62 Annex 13, the Project Participants considered the project starting date as the date in which project sponsors committed expenditures, i.e., the date in which Pipoca project's share was bought by CEMIG on May 20th, 2008. All documents related to the dates mentioned above are available with Project Participants and will be presented to DOE during validation.

According to the Guidelines on the Demonstration and assessment of Prior Consideration of the CDM version 04 (Annex 13, EB 62):

> "*Proposed project activities with a start date before 2 August 2008, for which the start date is prior to the date of publication of the PDD for global stakeholder consultation, are required to demonstrate that the CDM was seriously considered in the decision to implement the project activity*".

The consideration of CDM incentives are dated November 29th, 2007, when CEMIG Board's meeting was held to decide the feasibility of Pipoca project implementation considering carbon credits commercialization. Furthermore, the CEMIG Board's meeting held on August 27th, 2008 also considered

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[14] CEMIG: Companhia Energética de Minas Gerais (Minas Gerais Electric Company, S.A.) It is a major brazilian energy company that operates in electricity generation and distribution. With a presence in 15 Brazilian states and in Chile among the five biggest energy producer in the country and responsible for 12% of the national distribution.

the CDM revenues. Project Participants held a timeline containing the summary of actions demonstrating CDM consideration for the project:

Table 7 - Summary of actions for CDM consideration of the Project Activity

Dates	Actions
17/03/2006	EcoInvest sent a CDM advisory proposal regarding SHPP Pipoca
29/11/2007	CEMIG Board's meeting held to decide the feasibility of Pipoca project implementation considering carbon credits commercialization
27/08/2008	CEMIG Board's meeting held to decide the feasibility of Pipoca project implementation considering changes in the project investments and IRR. A second IRR was presented with the inclusion of carbon credits commercialization
02/09/2008	Issuance of the first Ecopart's advisory proposal to develop the CDM process for Pipoca project
18/02/2009	Issuance of the second Ecopart's advisory proposal to develop the CDM process for Pipoca project
26/06/2009	Signature of the contract between Hidrelétrica Pipoca S/A and Ecopart Assessoria em Negócios Empresariais Ltda.
10/08/2009	Ecopart sent letters to local stakeholders for the CDM project consultation as requested by the Brazilian DNA

For the demonstration of additionality, the proposed baseline methodology refers to the Additionality Tool (version 06.0.0 is the most recent one at the time PDD is being developed) approved by the Executive Board. The tool considers some important steps necessary to determine whether the project activity is additional and to demonstrate how the emission reductions would not occur in the absence of Pipoca Project. The application of the above mentioned tool is described in the next paragraphs.

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

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

As described in the methodology ACM0002, version 12.2.0, the project activity fits the category of installation of a new grid-connected renewable power plant/unit, the baseline scenario is the electricity delivered to the grid by the project activity that 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 described in the "Tool to calculate the emission factor for an electricity system".

In spite of the fact that the baseline scenario is already defined, to assess and demonstrate the additionality of the project activity the "Tool for the demonstration and assessment of additionality" prescribes the following:

> *"16. Identify realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed CDM project activity. These alternatives are to include:*
>
> > *(f) Other realistic and credible alternative scenario(s) to the proposed CDM project activity scenario that deliver outputs services (e.g., cement) or services (e.g. electricity, heat) with comparable quality, properties and application areas, taking into account, where relevant, examples of scenarios identified in the underlying methodology*

Therefore, the following scenarios are identified:

Scenario 1: The alternative to the project activity is the continuation of the current (previous) situation of electricity supplied by the existing power plants from the interconnected system.

Scenario 2: The proposed project activity undertaken without being registered as a CDM project activity.

Since no other realistic and credible alternative scenario to the proposed CDM project activity, taken by the project proponent that delivers services with comparable quality, properties and application areas was not identified, both mentioned scenarios were considered.

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

Both alternatives, the project activity and the alternative scenarios are in compliance with all regulations according the following entities:

- National Electric System Operator (in a free translation from the Portuguese *Operador Nacional do Sistema Elétrico – ONS*);
- Electricity Regulatory Agency (in a free translation from the Portuguese *Agência Nacional de Energia Elétrica – ANEEL*);
- Mines and Energy Ministry (in a free translation from the Portuguese *Ministério de Minas e Energia – MME*);
- Chamber of Electrical Energy Commercialization (in a free translation from the Portuguese *Câmara de Comercialização de Energia Elétrica – CCEE*);
- Environmental Agency of the state of Minas Gerais (in a free translation from the Portuguese *Fundação Estadual do Meio Ambiente – FEAM*).

SATISFIED/PASS – Proceed to Step 2

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method:

Once the project activity generates other financial benefit other than CDM related income (sale of energy) Option I could not be chosen. Option III is more appropriate when compared to Option II because there are no other options of investment from the project owner perspective. Therefore, additionality is demonstrated through an investment benchmark analysis (option III).

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

The financial indicator identified for Pipoca project is the equity IRR. The IRR here presented is compared to the appropriate benchmark of the electric sector, which is the Cost of Equity – Ke calculated according the Capital Asset Pricing Model (CAPM).

Benchmark calculation

The Capital Asset Pricing Model (CAPM) is one of the most widely accepted models used to determine the required rate of return on equity. The CAPM calculates a newly introduced asset's non-diversifiable risk. CAPM takes into account the asset's sensitivity to non-diversifiable risk, better referred to as beta (β). Embedded in the model is also the market premium which can be tracked using historical data from the local or relevant equity market.

The rate which should be charged for the equity component of a project is calculated through the formula: **Ke = [(1+Rf)/(1+π)-1] + β*Rm + Rc** where **Ke** represent the suggested rate of return for equity investments. **Rf** stands for the risk free rate and beta, or **β,** stands for the average sensitivity of comparable companies in that industry to movements in the underlying market.

Rm represents the market premium, or higher return, expected by market participants in light of historical spreads attained from investing in equities versus risk free assets such as the US treasury.

The risk-free rate used for Ke calculation was based on the US Treasury bond, which are long term titles of a mature market. Over this rate, Brazilian country risk (Rc) have been considered and resulted in the risk-free rate applied to the calculation.

β derives from the correlation between returns of US companies from the sector and the performance of the returns of the US market. β have been adjusted to the leverage of Brazilian companies in the sector, reflecting both structural and financial risks. β adjusts the market premium to the sector.

The market premium is estimated based on the historical difference between the S&P 500 returns and the long term US bonds returns. The spread over the risk-free rate is the average of the difference between those returns.

Cost of Equity (Ke)	
(Rf) 20-year U.S. Treasury Coupon Bond Yield[15]	4.82
(π) US expected inflation	2.57

[15] Risk-free rate value according to Yahoo Finance available at: <http://finance.yahoo.com/q/hp?s=%5ETNX>. For the risk-free rate calculation, US expected inflation (10-year US Treasury minus 10-year US TIPS) was used based on the US Federal Reserve information available at: <http://www.federalreserve.gov/econresdata/researchdata.htm>.

(Rm) S&P500 vs 10-year T.Bond Yield[16]	5.92
(Rc) EMBI+Brazil[17]	6.78
(ß) Average Beta US electric-generation re-levered to Brazilian leverage[18]	1.55
Cost of Equity (BRL)	18.13

Considering calculation above, the cost of equity is 18.13%.

Each assumption made and all data used to estimate the Ke through CAPM will be presented to the DOE during validation. The spreadsheet used for calculation of the Ke will be also provided to the DOE.

Financial Indicator, Internal rate of return (IRR)

As mentioned above, the financial indicator identified for PCH Pipoca is the equity Internal Rate of Return (IRR). Pipoca cash flow over its lifetime of 35 years shows that the equity IRR is 14.30%.

The table below presents the more significant values considered in the project cash flow as well as the reference documentation:

Table 8 – Parameters reference documentation of the project cash flow

Parameter	Value	Reference documentation
Investment	BRL 100,361,000	CEMIG's Board meeting – 29/11/2007
O&M costs	BRL 6.90/MWh	Technical proposal received by the construction consortium of the SHPP.
Energy price	BRL 144.20 /MWh Energy sold at spot market (PLD) BRL 68.96 /MWh	CEMIG's Board meeting – 29/11/2007. Price was estimated on third new energy auction, considering the Marginal Price Auction (the highest price of the audiction) adjusted by the Inflation targeting in Brazil (4,5%). According to historical price of The Spot Price, also called Settlement Price for the

[16] Available at Damodaran website: <http://pages.stern.nyu.edu/~adamodar/>.
[17] Available at JP Morgan website: <www.morganmarkets.com>.
[18] Available at Damodaran website: < http://pages.stern.nyu.edu/~adamodar/>.

		Differences (translation for Preço de Liquidação das Diferenças - PLD)
Amount of electricity dispatched to the grid per year	104,244 MWh/year	Based on the energy assured established by ANEEL Resolution # 65, dated May 25th, 2004. Available at ANEEL's website: <http://www.aneel.gov.br/>.
Taxes based on total revenues	0.65% + 3% + 18%	Employees' Profit Participation Program (in a free translation from the Portuguese *Program de Integração Social – PIS*) Tax for social security financing (in a free translation from the Portuguese *Contribuição para o Financiamento da Seguridade Social – COFINS*) ICMS – Tax for movement of goods and services (in a free translation of "Imposto sobre circulação de mercadorias e prestação de serviços")

For more details, see the equity IRR calculation spreadsheet of the project. All documents used for the equity IRR calculation are available with the project participants and will be presented to DOE at the time of validation.

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

The cash flow of the project activity, containing the calculation of the equity 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 *Guidance on the Assessment of Investment Analysis,* EB62 Annex 5..

The equity IRR, as presented above, is 14.30%. This number shows that the IRR of the project without considering CERs revenues is lower than the Ke of the sector – 18.13% - the benchmark. Hence, it is evident that the project activity without the incentives from the CDM is not financially attractive to the investor.

PCH	IRR (%)	Benchmark (%)
Pipoca	14.30	18.13

Sub-step 2d: Sensitivity analysis

The sensitivity analysis, as established by the "*Guidance 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. Hence, the sensitivity analysis considered the variation of the following parameters:

- For project revenues: An increase in the project revenues can be obtained when energy generation by the plant is higher than the expected or the energy price increases over the forecasted in the investment analysis. However, an increase in energy generation is not expected to happen because the estimated electricity generation is based on the assured energy which is established by ANEEL and it is based on hydrological data of the river, considering several years. Also, energy price considered in the project cash flow is a reasonable price considering the latest energy auctions. See discussion of the scenarios below.
- For running costs: An increase in the project costs can be obtained through a reduction in the operation costs of the plant or investments. However, project costs and investments are defined under contracts and, therefore, are not expected to be reduced. See discussion of the scenarios below.

Also according to the guidance, "*variations in the sensitivity analysis should at least cover a range of +10% and -10%, unless this is not deemed appropriate in the context of the specific project circumstances*". Therefore, financial analyses were performed altering each of these parameters by 10%, although such variation is clearly not expected, and assessing what the impact on the project IRR would be. Results of the sensitivity analysis are shown in the below table.

Table 9 – Sensitivity analysis

Parameter	IRR (%)	Benchmark (%)
Original Project's IRR	**14.30**	**18.13**
Increase in energy price	**17.04**	
Increase in the energy generation/ plant load factor	**16.89**	
Reduction in operation cost	**14.57**	
Reduction in project investments	**16.33**	

As it can be seen, the equity IRR remains below the benchmark in cases in which parameters change in favor of the project.

According to the Guidance on the Assessment of Investment Analysis version 5, whenever a scenario results in an IRR higher than the benchmark, an assessment on the probability of the respective occurrence shall be presented. Although none of the scenarios above the IRR surpasses the benchmark, an analysis of the probability of the occurrence of these scenarios is presented below:

1. Revenues

a) 10% increase in the energy price

The energy price considered for the project cash flow is BRL 144,20/MWh. For reference, the energy price required for the equity IRR to meet the benchmark (18.13%) is BRL 162.87/MWh. However, the latest government's energy auctions for new projects (in a free translation from Portuguese *Leilão de Energia Nova*) indicates that the price of BRL 162.87/MWh would not be reasonable. It is worth mentioning that energy auctions promoted by the government are an official reference for the energy prices analysis by energy players in Brazil. Official information regarding electric energy auctions are publicly available and can be obtained at the Chamber of Electric Energy Commercialization's website: <http://www.ccee.org.br/>.

Table 10 – Energy price commercialized in the Brazilian energy auction for new projects (10th energy auction carried out on 30/07/2010)

Project	Agreed Price (BRL/MWh)
Ferreira Gomes	69.78
Colider	103.40
Pirapora	154.49
Canaa	153.98
Jamari	154.23
Santa Cruz de Monte Negro	153.73
Garibaldi	107.98
Average Price	128.2

Table 11 – Energy price commercialized in the Brazilian energy auction for new projects (11th energy auction carried out on 17/12/2010)

Project	Agreed Price (BRL/MWh)
Santo Antonio Jari	104.00
Teles Pires	58.35
Average Price	81.2

As per the average energy prices indicated above, it is very unlikely that energy prices would surpass BRL 162.87/MWh – for an IRR above benchmark. The highest energy price in the energy auctions carried out in 2010 was BRL 154.49/MWh, in the 10th energy auctions for new projects.

As indicated in the table above, the average energy price at the auction was BRL 137.62/MWh (considering all the 18 participating projects). If we consider only small hydropower plants, the highest price paid was BRL 135.00/MWh.

It should be added that Pipoca participates in the Energy Reallocation Mechanism (directly translation from the Portuguese *Mecanismo de Realocação de Energia – MRE*). The Energy Relocation Mechanism was created through Decree # 2,655 dated July 2nd, 1998 and was regulated by the Resolution # 169, dated May 3rd, 2001.

MRE is based on the energy assured of power plants and acts as a balancing pool, mitigating the hydrologic risks for all power producers' participants considering the geographic diversification, territory length and different hydrological regions of Brazil.

This mechanism transfers the energy from the producers who have excess generation compared to their assured energy to the producers who generated below their energy assured. The energy generated in excess, i.e. above the assured energy, is reallocated to other project and cannot be sold in the SPOT market. This energy shall be sold/acquired amongst MRE participants for a symbolic price established by Superintendence of Energy Generation Services Regulation (in a free translation from the Portuguese *Superintendência de Regulação dos Serviços de Geração – SRG*), which is much lower than that established in the project PPA. For 2009 year, the energy price established by Superintendence of Energy Generation Services Regulation is of BRL 8.18 /MWh[19] (less than 10% or the PPA price).

Considering information above, in case projects generate above or below the energy assured, such event will in the long term have no significant impact in the project's revenue.

Therefore, an increase in the market energy price to BRL 154,87/MWh (energy price required to meet the benchmark) is very unlikely to occur and if this occurred, it would not have a significant impact in the project's revenue.

b) Increase in the energy generation/plant load factor

As previously explained all excess generation from Pipoca´s is reallocated to MRE and cannot be sold in the SPOT market. Therefore no increase in the energy generation/plant load factor would make the IRR reaches the benchmark.

2. Costs

a) Reduction in the O&M costs

The Operational costs variation would not make the IRR reaches the benchmark, even if no costs were considered.

[19] Available at:
http://www.aneel.gov.br/aplicacoes/noticias_boletim/?fuseaction=boletim.detalharNoticia&idNoticia=196>.

b) Reduction in the project investments

Project sponsor executes turnkey EPC contracts for Pipoca project, in which costs are fixed and will not vary even if project's investments increase for an unexpected reason. Therefore, a reduction of 10% in investments is very unlikely and not expected to occur, even more unlikely a reduction of 17.3% (the necessary value to projects IRR equals the benchmark).

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It is important to mention that real investments in developing countries are usually higher than the original estimative. This may be evidenced from the estimation of construction costs and schedules in developing countries. Using a sample of 125 projects (59 thermal and 66 hydropower) Bacon and Besant-Jones (1998)[20] indicates that although the ratio of actual to estimated cost can be smaller than one (indicating actual investment smaller than estimated), less than 10% of the analyzed projects had investments lower than those forecasted. One of the conclusions is that "the estimated values were significantly based below actual values".

Further confirmation on that is provided by Brazilian Association for the Small and Medium Electrical Energy Producers (in a free translation form Portuguese "Associação Brasileira dos Pequenos e Médios Produtores de Energia Elétrica" APMPE,), retained by PPs in order to attain an expert opinion. APMPE's work concludes that the likelihood of higher investments then those previously estimated is probable. In line with the statement of APMPE's president the "Guidance for Small Hydropower Plants Studies and Projects"[21] (in a free translation from the Portuguese *Diretrizes para Estudos e Projetos de Pequenas Centrais Hidrelétricas*) prepared by the a power utility controlled by Brazil federal government (Eletrobrás - Centrais Eletricas Brasileiras S.A.) recommends in its Annex 3 to add 5% on above estimated for unforeseen expenses. PPs state that the estimated costs presented for the project activity do not include any cost for unforeseen expenses.

In summary, values used in the project cash flow are reasonable considering that they are based on project sponsor's experience and, generally, actual investments are higher than estimated. Therefore, a 10% reduction in project investments is not expected to occur.

All information used in this sensitivity analysis is based on official data and will be presented to DOE at the time of validation.

Outcome: The IRR of the project activity without being registered as a CDM project is below the benchmark, evidencing that project activity is not financially attractive. The knowledge of the CDM registering benefits was the key point in decision-making to implement the project activity.

SATISFIED/PASS – Proceed to Step 3

Step 3. Barrier analysis

Not applicable.

[20] R. W. Bacon and J. E. Besant Jones (1998). Estimating construction costs and schedules – Experience with electricity generation projects in developing countries. Energy Policy, vol. 26, no 4, pp 317-333.

[21]Available at http://www.eletrobras.gov.br/EM_Atuacao_Manuais/default.asp (site accessed on August 5th, 2009).

Step 4. Common practice analysis

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

According to the additionality tool, "*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*". Thus, stepwise approach proposed in the "*Guidelines on Common Practice*" (Annex 12, EB63) is used.

Considering the definitions provided by the above mentioned guidelines as well as the project specific characteristics, the following criteria are considered while assessing the common practice:

i. ***Applicable geographical region:*** Brazil has an extension of 8,514,876.599 square kilometres[22] (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[23]. 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 5 and Figure 6).

   These varieties of climate obviously have strong influence in the technical aspects related to a small hydropower plant implementation.

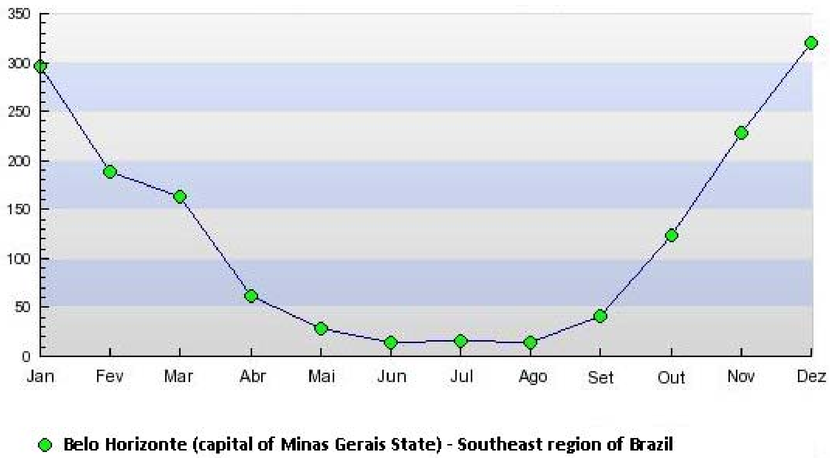

Figure 5 - Average of precipitation (mm) in Belo Horizonte (Southeast region of Brazil) from 1961 to 1990

[22] Available at: http://www.ibge.gov.br/english/geociencias/cartografia/default_territ_area.shtm.

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

Source: INMET (2009)[24]

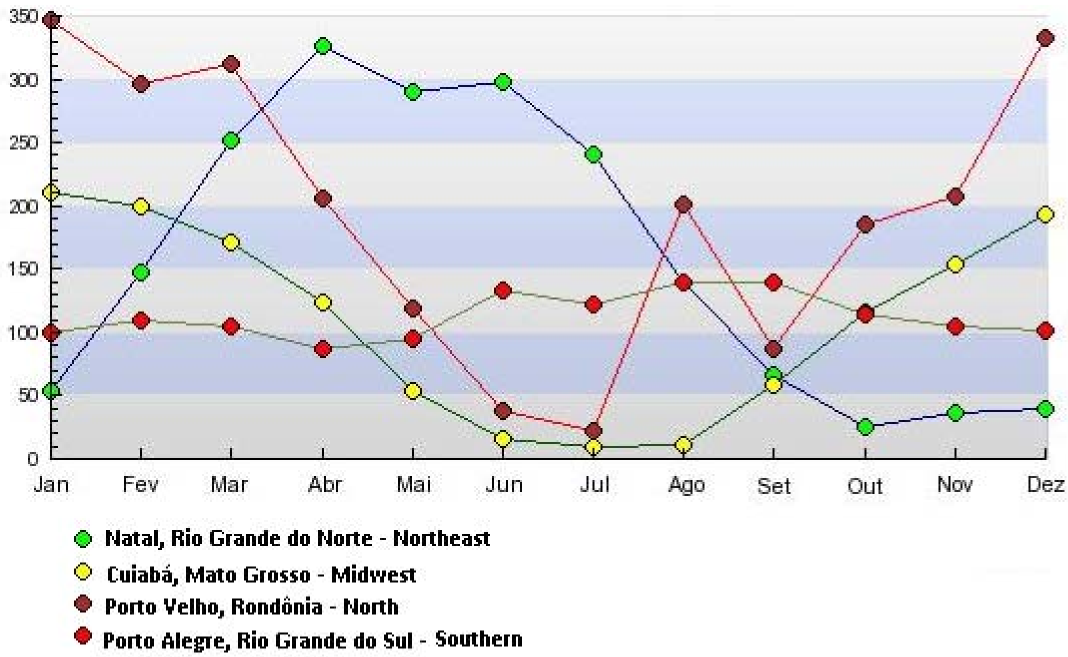

Figure 6 - Average of precipitation (mm) in the regions of Brazil (except the Southeast region of Brazil) from 1961 to 1990

Source: INMET (2009)[25]

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 frequently not reasonable to compare different hydropower potential and plants. Moreover, hydro-power plants cannot always 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 Pipoca project is located – Minas Gerais State –, it has an extension of 586,528.293 square kilometres (IBGE, 2009). For reference, the average of European country areas is 565,679 square kilometres[26]; 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 Minas Gerais State is

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[24] Available at: <http://www.inmet.gov.br/html/clima/graficos/plotGraf.php?chklist=2%2C&capita=belohorizonte%2C&peri=99%2C&per6190=99&precipitacao=2&belohorizonte=15&Enviar=Visualizar>.

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

[26] 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/>.

considered large and differences can influence the implementation of small hydropower plants. However, project participants decided to analyze projects located in Minas Gerais State for conservativeness reasons.

ii. ***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.

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

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

- ***Same environment with respect to regulatory framework*****:** 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 between the 1990's and 2003; however it 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 the 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 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[27]. Given the new *regulatory framework and investment climate PP* included only projects starting after March of 2004 in the analysis.
- ***Same environment with respect to investment climate, access to technology and financing*****:** As mentioned in the item "country/region" above, depending on the project location, differences related to the technical aspects of a small hydropower plant project, even if small hydro projects are located in the same region. These technical differences obviously have an influence in the investment/financing of a project. Also, it has to be taken into account that project sponsors have different investment capacity. Then, financial information should be considered when small hydro projects were analyzed. However, Project Participants decided to do their upmost in making a reasonable comparison for the purpose of common practice analysis even without investment information available.

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

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

Considering information above, Project Participants applied the steps provided by Annex 12, EB 63 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.

As mentioned in section A, according to Brazilian regulations, small scale hydropower plants are defined as plants with an installed capacity within 1 and 30MW[28]. Therefore, no large scale hydropower plants (installed capacity over 30MW) were considered. Furthermore, only plants with installed capacity 50% lower and 50% higher than Pipoca (20.45 MW) project were analyzed (i.e. between 10 and 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 shall not be included in this step.

Considering information above, Project Participants researched about the generating units of small hydro power plants in Brazil that started operations from April 2004 to December 2010 in Southeast and Center-west Regions in Brazil, that consist the electrical submarket where Pipoca is located and comprise *Espírito Santo, São Paulo, Rio de Janeiro, Minas Gerais, Mato Grosso, Mato Grosso do Sul* and *Goiás* states. Also, small hydros that received some kind of incentive (PROINFA[29] and/or CDM) were identified.

Table 11 – Operations start of PCHs from April 2004 to December 2010

Small Hydropower Plant	Installed Capacity (MW)	State	CDM	Proinfa	Operation Starting
Alto Sucuriú	29	MS		X	2008
Anhanguera	22.68	SP	X		2010
Areia Branca	19.8	MG	X		2010
Bocaiúva	30	MT	X		2010
Bonfante	19	MG		X	2008
Braço Norte III	14.16	MT	X		2003

[28] *ANEEL – Agência Nacional de Energia Elétrica. Resolution # 652, issued on December 9th, 2003.*

[29] Alternative Electricity Sources Incentive Program (in a free translation from the Portuguese *Programa de Incentivo às Fontes Alternativas de Energia Elétrica – PROINFA*), created through the Law # 10,438 dated April 26th, 2002. Among others, one of the initiative's goals is 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, 20041, 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.

Braço Norte IV	14	MT	X		2007
Buriti	30	MS	X	X	2007
Cachoeirão	27	MG	X		2009
Calheiros	19	ES		X	2008
Canoa Quebrada	28	MT	X	X	2006
Carangola	15	MG		X	2007
Cocais Grande	10	MG		X	2007
Engº José Gelásio da Rocha	24.435	MT		X	2007
Faxinal II	10	MT	X		2005
Figueirópolis	19.41	MT		X	2010
Francisco Gross (Ex.Santa Fé)	29	ES	X	X	2009
Funil	22.5	MG		X	2008
Garganta da Jararaca	29.3	MT	X		2006
Goiandira	27	GO	X		2010
Graça Brennand (Ex.Terra Santa)	18.266	MT	X		2008
Irara	30	GO		X	2008
Ivan Botelho III (Ex-Triunfo)	24.4	MG	X		2005
Jataí	30	GO		X	2008
Malagone	19	MG	X		2010
Mambaí II	12	GO		X	2008
Monte Serrat	25	MG		X	2009
Mosquitão	30	GO		X	2006
Ombreiras	26	MT	X		2005
Paiol	20	MG	X		2010
Pampeana	27.99	MT	X		2009
Paraíso I	21.6	MS	X		2004
Paranatinga II	29.02	MT	X		2008
Pedra do Garrafão	19	ES	X		2009
Piedade	21.69	MG	X		2010
Piranhas	18	GO		X	2006
Pirapetinga	20	ES	X		2009
Planalto	17	MS	X		2009
Ponte Alta	13	MS		X	2007
Porto das Pedras	28.03	MS	X		2008
Retiro Velho	18	GO		X	2009
Riachão (Ex-Santa Edwiges	11.2	GO	X		2006

I)					
Rondonópolis	26.6	MT		X	2007
Sacre 2	30	MT	X		2006
Salto	19	MT	X	X	2007
Salto Corgão	27	MT	X		2005
Santa Edwiges II	13	GO	X		2006
Santa Edwiges III	11.6	GO	X		2009
Santa Fé I	30	MG	X	X	2008
Santa Gabriela	24	MS	X		2009
Santa Rosa II	30	RJ		X	2008
São Domingos II	24.3	GO	X		2009
São Gonçalo (Ex-Santa Bárbara)	11	MG	X		2007
São João	25	ES	X		2007
São Joaquim	21	ES		X	2008
São Lourenço (Ex.Zé Fernando)	29.1	MT		X	2009
São Pedro	30	ES		X	2009
São Simão	27.42	ES		X	2009
São Tadeu I	18	MT		X	2010
Sete Quedas Alta	22	MT		X	2010

From the above list, the comparable plants not using CDM incentive sum 24 plants.

N_{all} = 24 plants

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

Amongst the plants identified in the previous step within the described ranges, the number of plants that apply different technologies than the one applied in the proposed project activity is 24 small hydro power plants have received incentives from PROINFA (identified as a promotional policy, as explained above). Therefore, $\boldsymbol{N_{diff} = 24}$.

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.

$F = 1 - N_{diff}/N_{all}$

$F = 1 – 24/24$

$F = 0$

$N_{all} - N_{diff} = 24 – 24 = 0$

Outcome: The proposed project activity would be 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. Therefore, the project activity is not common practice in the applicable geographical area.

Thus, considering research above, all similar projects were implemented receiving some kind of incentive from CDM and/or PROINFA. It is important to mention that the first phase of PROINFA was conducted in 2004, through two public calls for projects selection on April 6th and October 5th, and there is no indication when the second phase will be conducted.

This result demonstrates that risks related to this type of project are higher, as discussed in Step 2 – Investment Analysis and that a strong incentive is required to promote the construction of renewable energy projects in Brazil, where it includes the small hydropower plants.

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.

It is worth mentioning that 69. 20 % of Brazil's installed capacity is composed of large hydro with large reservoirs and 25.20 % of thermal power stations. Only 2.89 % of Brazil's installed capacity comes from small hydro power sources (3.2 GW out of a total of 110 GW).

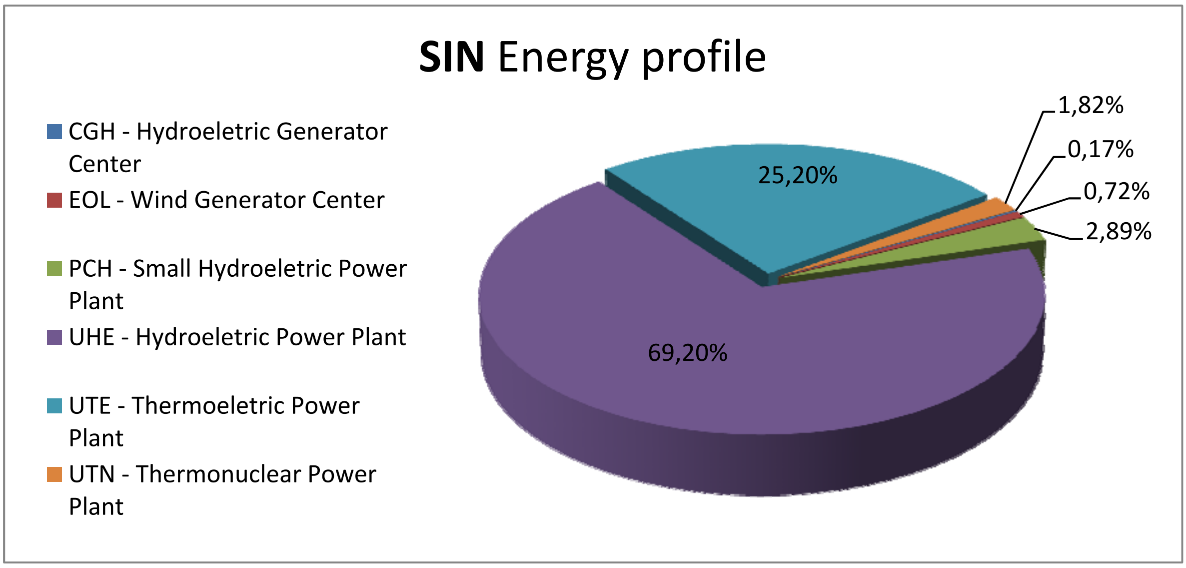

Figure 7 - Share of installed capacity

Source: ANEEL, 2010[30]

Moreover, in the most recent energy auctions, which took place between 2005 and 2007 from the total of 9,594 MW sold, 5,888 MW (61.3%) will come from fossil fuel fired thermal power plants, from which

[30] Available at: < http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp>. Accessed on August 04th, 2010.

2,152 MW come from natural gas and 2,514 MW fuel oil fired thermal power plants, i.e., 22.4% and 26.2% of the total sold respectively (Esparta, 2008).

SATISFIED/PASS – Project is ADDITIONAL

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Emission reductions calculation (ER_y)

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

$$ER_y = BE_y - PE_y \qquad \textbf{Equation 1}$$

Where:

ER_y = Emission reductions in year y (tCO_2e/yr);

BE_y = Baseline emissions in year y (tCO_2e/yr);

PE_y = Project emissions in year y (tCO_2
e/yr).

Baseline calculation (BE_y)

Baseline emissions are calculated using the annual electricity dispatched to the grid (EG_y) times the CO_2 baseline emission factor (EF_y), as follows:

$$BE_y = EG_{\mathrm{PJ,y}} \cdot EF_{grid,CM,y} \qquad \textbf{Equation 2}$$

Where:

BE_y = Baseline emissions in year y (tCO_2/yr);

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

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

For Greenfield projects installed at a site where no electricity generation occurred previously, as it is the case of the proposed project activity, the calculation of $EG_{PJ,y}$ is as follows:

$$EG_{PJ,y} = EG_{facility,y}$$ **Equation 3**

Where:

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr);

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

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

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

STEP 1 - Identify the relevant electric power systems

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

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

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

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

STEP 6 – Calculate the combined margin (CM) emission factor .

- **STEP 1 -** Identify the relevant electric power systems.

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

Brazilian DNA has published the Resolution # 8 issued on May 26th, 2008, which defines the Brazilian Interconnected Grid as a single system that covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest). Hence, this figure is 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 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 following the "Tool to calculate the emission factor for an electricity system", approved by the CDM Executive Board. The calculation uses option c – Dispatch data analysis OM. This option does not permit the vintage of *ex-ante* calculation of the emission factor and, thus, the chosen option was ***ex-post*** calculation. This parameter will be annually up-dated applying the numbers provided by the Brazilian DNA. More information of the methods applied can be obtained in the DNA's website (http://www.mct.gov.br/index.php/content/view/4016.html).

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

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

It will be calculated using the below formulae:

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$ **Equation 4**

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:

$$EF_{EL,DD,y} = \frac{\sum_{i,n} FC_{i,n,h} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_{n} EG_{n,h}}$$ **Equation 5**

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 6**

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 7**

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) emission factor ($EF_{grid,CM,y}$)

The combined margin is calculated as follows:

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

Equation 8

Where:

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

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

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

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

According to the emission factor tool, wind and solar electricity generation project activities shall use the default values of w_{OM} = 0.75 and w_{BM} = 0.25 for the first crediting period and for subsequent crediting periods. All other projects shall use the default values of w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

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

Estimated quantity of net electricity generation supplied by the project plant/unit to the grid is presented in section B.6.3 below.

Project emissions calculation (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 9**

Where:

PE_y = Project emissions in year *y* (tCO2e/yr);

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year *y* (tCO2/yr);

$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO2e/yr);

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year *y* (tCO2e/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 ($PE_{HP,y}$)

New hydro electric power projects resulting in new single or multiple reservoirs, shall account for CH_4 and CO_2 emissions from reservoirs, estimated as follows:

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

$$PE_y = \frac{EF_{Res} \times TEG_y}{1000}$$ **Equation 10**

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 per EB23 is 90 Kg CO_2e/MWh;

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

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

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$ **Equation 11**

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 single or multiple reservoirs 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 single or multiple reservoirs 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 calculation (LE_y)

According to the methodology, "*no leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transport). These emissions sources are neglected*". Therefore, leakage of PCH Pipoca is 0 tCO_2/year.

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

Data / Parameter:	Cap_{BL}
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity.
Source of data used:	PCH Pipoca site.
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually	The methodology states that this value shall be applied for new hydro power plants.

applied :	
Any comment:	

Data / Parameter:	A_{BL}
Data unit:	m^2
Description:	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity.
Source of data used:	PCH Pipoca site.
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied:	The methodology states that this value shall be applied for new hydro power plants.
Any comment:	

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

Baseline emissions (BE_y)

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

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

For estimative purpose, the latest available value of the operating margin was used.. When applying the estimate figures in the formula presented in step 3 of section B.6.1., the $EF_{grid,OM,y}$ obtained is:

$$EF_{grid,OM,\ 2009} = 0.2476\ tCO_2e/MWh.$$

The average building margin for the considered years is:

$$EF_{grid,BM,\ 2009} = 0.0794\ tCO_2e/MWh.$$

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

$$EF_{CM,2009} = 0.5 \times 0.2476 + 0.5 \times 0.0794$$

$$EF_{CM,2009} = 0.1635\ tCO_2e/MWh.$$

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

Net electricity produced by the project activity (EG_y) is based on the energy assured of PCH Pipoca established by ANEEL Resolution #65, dated May 25th, 2004. Future electricity supplied by the project to the grid (EG_y) is estimated based on the energy assured with the discount of electricity supplied for internal loads. Baseline emissions calculation is presented in the emission reduction spreadsheet, which will be presented to the DOE at the time of validation.

Table 12 – Estimated energy generated, exported to the grid and baseline

Year	Days	Net Energy Generated (EG) in MWh	BE (tCO_2e)
2012*	184	52,550	8,592
2013	365	104,244	17,044
2014	365	104,244	17,044
2015	365	104,244	17,044
2016	366	104,530	17,091
2017	365	104,244	17,044
2018	365	104,244	17,044
2019**	181	51,694	8,452
TOTAL	**2,556**	**729,994**	**119,354**
Annual average over the crediting period of estimated reductions (tonnes of CO2e)			17,051

* from 1-7-2012 to 31-12-2012

** from 1-1-2019 to 30-6-2019

Project emissions calculation (PE_y)

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 single or multiple reservoirs shall account for related project emissions based on the calculation of their power density. Applying the installed capacity of PCH Pipoca (20.45 MW) and its single reservoir area (0.855 km^2) in the equation 7, the result is:

$$PD = \frac{20.45MW - 0}{0.855km^2 - 0} = 24.06MW / km^2$$

Since the project's power density is above 10W/m^2, $PE_{HP,y}$ = 0 tCO_2/year.

Leakage emissions (LE_y)

As explained above in section B.6.1. no leakage is to be considered. Hence, LE_y = 0 tCO_2/year.

Emission reductions calculation (ER_y)

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

$$ER_y = BE_y - PE_y$$

Summary of the ex-ante estimation of emission reductions is presented in section B.6.4 below.

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

Table 13 – Summary of the ex-ante estimation of emission reductions of PCH Pipoca

Years	**Estimation of project activity emissions** (tonnes of CO_2e)	**Estimation of baseline emissions** (tonnes of CO_2e)	**Estimation of leakage** (tonnes of CO_2e)	**Estimation of overall emission reductions** (tonnes of CO_2e)
Year 1 - (2012*)	0	8,592	0	8,592
Year 2 - (2013)	0	17,044	0	17,044
Year 3 - (2014)	0	17,044	0	17,044
Year 4 - (2015)	0	17,044	0	17,044
Year 5 - (2016)	0	17,091	0	17,091
Year 6 - (2017)	0	17,044	0	17,044
Year 7 - (2018)	0	17,044	0	17,044
Year 8 - (2019**)	0	8,452	0	8,452
Total (tonnes of CO_2e)	**0**	**119,354**	**0**	**119,354**

* from 1-7-2012 to 31-12-2012

** from 1-1-2019 to 30-6-2019

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

B.7.1 Data and parameters monitored:

Data monitored and required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter:	$EG_{facility,y}$
Data unit:	MWh/year
Description:	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*.
Source of data to be used:	Project site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2012: 52,550 2013: 104,244 2014: 104,244 2015: 104,244 2016: 104,530 2017: 104,244 2018: 104,244 2019: 51,694
Description of measurement methods and procedures to be applied:	Electricity supplied by the project activity to the grid. Double checked by Project Sponsors internal control and sales receipt or evidences from Câmara Comercializadora de Energia Elétrica – CCEE, a Brazilian government entity which monitors the electricity on the national interconnected grid. Hourly measurement and monthly recording.
QA/QC procedures to be applied:	Energy metering QA/QC procedures are explained in section B.7.2 (the equipments used have by legal requirements extremely low level of uncertainty).
Any comment:	-

Data / Parameter:	Cap_{PJ}
Data unit:	MW
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	20.45

section B.5	
Description of measurement methods and procedures to be applied:	Yearly.
QA/QC procedures to be applied:	Determine the installed capacity based on recognized standards.
Any comment:	-

Data / Parameter:	A_{PJ}
Data unit:	km^2
Description:	Area of the single or multiple reservoirs 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	0.855
Description of measurement methods and procedures to be applied:	Yearly.
QA/QC procedures to be applied:	Measured from topographical surveys, maps, satellite pictures, etc.
Any comment:	-

Data / Parameter:	$EF_{grid.CM.y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for grid connected electricity 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:	Calculated following the steps provided by the "*Tool to calculate the emission factor for an electricity system*" applying the numbers published by the Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value of data applied for the purpose of	0.1635

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Calculated based on the latest available value of the Operating and Build margin emission factors. Once option C) for the calculation of the operating margin was chosen by the DNA, this value will be up-dated annually following the prescription of the tool.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$EF_{grid.OM.y}$
Data unit:	tCO_2/MWh
Description:	Operating Margin CO_2 emission factor for grid connected electricity 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:	Calculated following the steps provided by the "*Tool to calculate the emission factor for an electricity system*" applying the numbers published by the Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
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:	Option C) was chosen to calculate the operating margin. This option does not permit the *ex-ante* vintage for the calculation of the emission factor. Therefore, the emission factor will be calculated ***ex-post*** applying the numbers provided by the Brazilian DNA. For estimative purpose, the latest available value of the operating margin was used.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$EF_{grid.BM.y}$
Data unit:	tCO_2/MWh
Description:	Build margin CO_2 emission factor for grid connected electricity 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	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system" applying the numbers published by the Brazilian

used:	DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0794
Description of measurement methods and procedures to be applied:	Numbers provided by the Brazilian DNA will be applied. For estimative purpose, the latest available value of the operating margin was used.
QA/QC procedures to be applied:	
Any comment:	

B.7.2. Description of the monitoring plan:

As of the procedures set out by the "Approved consolidated monitoring methodology ACM0002" – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", the project monitoring consists in using a meter equipment projected to registry and verifies the energy dispatched to the grid by the facility. This energy measurement is fundamental to verify and monitor the GHG emission reductions. The Monitoring Plan permits the calculation of GHG emissions generated by the project activity in a straightforward manner, applying the baseline emission factor.

The project will proceed with the necessary measures for the power control and monitoring. With the information produced by CCEE, the local power utility and the project sponsors, it will be possible to monitor the electricity generation of the project and the grid power mix. Information about electricity generation can be checked with the project sponsors and energy supplied to the grid is controlled by CCEE. CCEE makes feasible and regulates the electricity energy commercialization.

There will be energy meters[31] (principal and backup) specified by ONS that will be installed in the control room of Hidroelétrica Pipoca´s substation. Before the operations start, ONS demands that these meters are calibrated by an entity with *Rede Brasileira de Calibração* (RBC) credential. Also, according to CCEE's recommendation, these meters shall have to be calibrated every two years after operation starts. Hidrelétrica Pipoca S.A. will be responsible for these calibrations.

The meters measures continuously the electricity dispatched to the grid, CCEE has remote access to energy information. The energy generated by the plants will be checked by CCEE, which will generate an official report with the checked information. The compiled data will be used to certify the energy generation reported produced by the Project Participant (PP). Along the quantity of net electricity generation supplied by the plant, PP will monitor yearly: the build and operating margin CO_2 emission factor for grid connected power; The area of the reservoir measured in the surface of the water; and the installed capacity of the hydro power plant after the implementation of the project activity.

[31] The meters are owned by the Hidrelétrica Pipoca S.A. and are directly linked with CCEE, which is able to access all measured data remotely at any time. The meters are sealed and are submitted to periodic survey and recalibration procedures.

The meter´s recalibration are scheduled to occur every two years, the recalibration procedures will be executed by a specialized metrology company that will be hired to this specific purpose. Pipoca will be responsible for the maintenance of the equipments' monitoring, for dealing with possible monitoring data adjustments and uncertainties, for review of reported results/data, for internal audits of GHG project compliance with operational requirements and for corrective actions. Yet, it is also responsible for the project management, as well as for organising and training of the staff in the appropriate monitoring, measurement and reporting techniques.The personal training programs will be implemented by Enex O&M, the company responsible for the Pipoca´s operations and maintenance. Enex O&M will capacitate the operators about the, operational, safety and emergency procedures. The training course includes: ISO standards and technical reports elaboration procedures.

At the time of PCH Pipoca verification, all the necessary documents will be provided. As mentioned in section B.7.1, all data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period.

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 completion of the application of the baseline study and monitoring methodology: 19/09/2011.

Name of the responsible person(s)/entity(ies):

Company:	Ecopart Assessoria em Negócios Empresariais Ltda.
Address:	Rua Padre João Manoel, 222
Zip code + city:	01411-000 São Paulo, SP
Country:	Brazil
Contact person:	Adriana Jacintho Berti
Telephone number:	+55 (11) 3063-9068
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E-mail:	*adriana.berti*@eqao.com.br; info@eqao.com.br

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

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:

20/05/2008.

Following to the "Glossary of CDM terms", the project start date is May 20th, 2008. This date corresponds to the date when Pipoca project was bought by CEMIG Geração e Transmissão S/A. Detailed information is presented in section B.5.

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

35y-0m[32]

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 on the date of registration of the CDM project activity.

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 (National Environmental Council Resolution, in a free translation from the Portuguese *Conselho Nacional do Meio Ambiente – CONAMA*, # 237/97):

- The preliminary license (*Licença Prévia* or LP),
- The construction license (*Licença de Instalação* or LI); and

[32] It is predicted in *Eletrobrás* Guidelines for SHPP Projects, Chapter 6 – Basic Studies; Lifetime of the plant (to be considered in the financial analysis.)

- 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 # 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 Indians lands and historical areas of slavery – 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 Impact 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 (from the Portuguese *Projeto Básico Ambiental – PBA*), 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.

The plant possesses the Construction License # 302/2000/002/2004, issued by Minas Gerais Environmental Agency on April 13th, 2007, the license period was renewed and extended being valid until 20/01/2011[33], the project also possess an Operational License issued on 28/07/2010 by COPAM. Considering this, the project does not imply in any negative transboundary environmental impacts; the license would not have otherwise been issued if negative transboundary environmental impacts existed for the project implementation.

[33] All related document were provided to the DOE assessment.

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 no different; environmental rules and licensing process policy are very demanding in line with the best international practices.

All environmental plans and programs to be implemented given the project construction were approved by Regional Superintendence for Environment and Sustainable Development (Superintendência Regional de Meio Ambiente e Desenvolvimento Sustentável – SUPRAM), Environmental Agency of Minas Gerais State (*Fundação Estadual do Meio Ambiente – FEAM)* and Environmental Politic State Council (Conselho Estadual de Política Ambiental – COPAM).

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*", requests comments from local stakeholders, and the validation report issued by an authorized DOE according to the Resolution # 7, issued on March 5th, 2008, in order to provide the letter of approval.

The Resolution determines that copies of the invitations for comments sent by the project proponents at least to the following agents involved in and affected by project activities:

- Government and state assembly of the project;
- State and federal governments;
- Brazilian Forum of NGOs and Social Movements for Environment and Development;
- National entities with objectives related to the project activity;
- Community associations;
- Federal State Attorney for the Public Interest.

Invitation letters were sent to the following agents (copies of the letters and post office confirmation of receipt communication are available upon request):

- City Hall of Caratinga and Ipanema;
- Municipal Assembly of Caratinga and Ipanema;
- Environmental Agency of Caratinga and Ipanema;
- Environmental Agency of Minas Gerais state;

- Comunitarian Association of Caratinga and Ipanema;
- Federal/State Attorney for the Public Interest of Minas Gerais state;
- Brazilian Forum of NGOs and Social Movements for the Development and Environment (in a free translation from the Portuguese *Fórum Brasileiro de ONGs e Movimentos Sociais para o Desenvolvimento e Meio Ambiente*).

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

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Represented by:	Mr. Gustavo Bastos Mattos
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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.

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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>,

MARGEM DE CONSTRUÇÃO	
	Fator de Emissão Médio (tCO_2/MWh) - **ANUAL**
2009	
	0,0794

MARGEM DE OPERAÇÃO												
	Fator de Emissão Médio (tCO_2/MWh) - **MENSAL**											
2009	MÊS											
	Janeiro	Fevereiro	Março	Abril	Maio	Junho	Julho	Agosto	Setembro	Outubro	Novembro	Dezembro
	0,2813	0,2531	0,2639	0,2451	0,4051	0,3664	0,2407	0,1988	0,1622	0,1792	0,1810	0,1940

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Annex 4

MONITORING INFORMATION

Pipoca Small Hydro Power Plant Project Activity monitoring plan will proceed according to the "Approved consolidated monitoring methodology ACM0002" – "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*". Information details are described in Section B.7.2.

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Annex 5

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