PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	SHPs Poço Fundo and Providência CDM Project (JUN1133), Brazil
Version number of the PDD	3.~~1~~2
Completion date of the PDD	~~30~~17/~~07~~12/~~2013~~07/03/2014
Project participant(s)	Poço Fundo Energia S.A. and Providência Energia S.A..
Host Party(ies)	Brazil
Sectoral scope and selected methodology(ies)	1 - Energy Industries (renewable/non-renewable sources), Methodology ACM0002, version 1~~3~~4.0.0
Estimated amount of annual GHG emission reductions	31,316 tCO_2

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SECTION A. Description of project activity
A.1. Purpose and general description of project activity

The project activity will consist in the construction of the **Poço Fundo Small Hydropower Plant** (SHP) with final installed capacity of 14.44 MW and **Providência Small Hydropower Plant** (SHP) with final installed capacity of 5.0 MW.

The **Poço Fundo SHP** will be located on the Preto River, River Eastern Atlantic Basin, in the municipality of São José do Vale do Rio Preto – Rio de Janeiro State, Brazil. It will have a small reservoir with 0.19 Km^2. The SHP will be managed by the Poço Fundo Energia S.A., special purpose entity responsible for the power plant construction and operation.

The **Providência SHP** will be located on the Preto River, River Eastern Atlantic Basin, in the municipality of Teresópolis – Rio de Janeiro State, Brazil. It will have a small reservoir with 0.0926 Km^2. The SHP will be managed by the Providência Energia S.A., special purpose entity responsible for the power plant construction and operation.

The project activity purpose is to provide electric power to the National Interconnected System - SIN (from Portuguese – Sistema Interligado Nacional), replacing fossil fuels thermal generation presented in the system by renewable energy generation .

SHPs construction helps to meet the growing energy demand in Brazil, to decrease the external energy dependency and contributes to environmental sustainability, as it increases the renewable energy share in relation to total electricity consumption in the country.

The scenario existing prior to the project activity implementation is the electricity being generated for other grid-connected power plants, which includes fossil fuel power plants (more details about the Brazilian National Interconnected Grid - SIN in B.5. Step 4). The baseline scenario is the same as the scenario existing prior to the project activity implementation start.

In regard to project contribution for mitigating Greenhouse Gas emissions (GHG), the project activity will reduce these gases avoiding fossil fuelled thermoelectric plants operation. The main emission source will be the CO_2 emission from electricity generation in fossil fuel fired power plants that will be replaced due to the project activity, as described in details at B.3 item. The estimated annual average GHG emission reductions is 31,316 tCO_2. The total credits estimated for the first period of seven years is 219,212tCO_2. In absence of the project activity (baseline scenario), fossil fuels would be burned in thermoelectric plants connected to the grid to supply the electrical demand of the country.

In the point of view of the Project Participants, the project activity will help Brazil to reach its sustainable development and also~~.~~, ~~B~~besides, it is aligned with the specific requirements of the CDM (Clean Development Mechanism) for the host country, because:

- It will contribute to environmental sustainability reducing the use of fossil energy (non-renewable sources). Thus the project will contribute to best use of natural resources and will make use of clean and efficient technologies.
- It will increase the employment opportunity in areas where the projects will be located.
- It will contribute to local economy better conditions , reducing the pollution released to atmosphere and social costs related to it.

- It will contribute to Brazilian biodiversity conservation through the investment on Conservation Units (protected areas) required by the mechanisms described on federal law number 9.985/2000 (link http://www.planalto.gov.br/ccivil_03/leis/l9985.htm) that created the Conservation Units National System - *SNUC* (from Portuguese *Sistema Nacional de Unidades de Conservação*).

Moreover, the project will help to diversify the electricity generation sources and decentralize energy generation bringing specific benefits such as:

- Increase of reliability, with shorter and less extensive interruptions;
- Fewer demands related to reserve margin;
- Minor losses in transmission and distribution lines;
- Reactive energy control;
- Mitigation in transmission and distribution congestion.

A.2. Location of project activity
A.2.1. Host Party(ies)
Brazil.

A.2.2. Region/State/Province etc.
Southeast Region - Rio de Janeiro State (RJ)

A.2.3. City/Town/Community etc.
- SHP Poço Fundo – City of São José do Vale do Rio Preto
- SHP Providência – City of Teresópolis

A.2.4. Physical/Geographical location

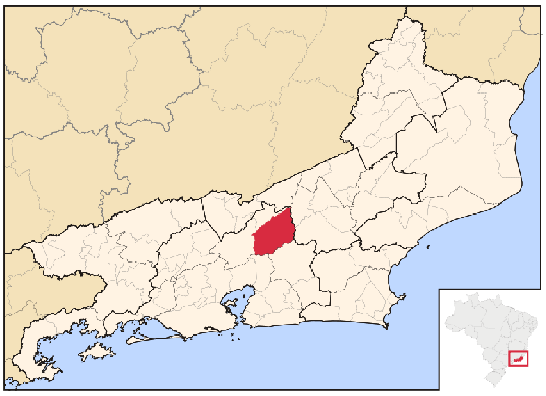
The Poço Fundo SHP will be located on the Preto river, with geographical coordinates 22°11'20" S and 48°53'29"W, or, in decimal coordinates -22,188889 latitude and -48,891389 longitude, in São José do Vale do Rio Preto city, Rio de Janeiro State, southeast region, Brazil.

The Providência SHP will be located on the Preto river, with geographical coordinates 22º15´ S and 42º54'W, or, in decimal coordinates -22,25 latitude and -42,9 longitude, in Teresópolis city, Rio de Janeiro State, southeast region, Brazil.

Figure 1: Localization of Rio de Janeiro State

Figure 2: Localization of São José do Vale do Rio Preto municipality

Figure 3: Localization of Teresópolis municipality



A.3. Technologies and/or measures

Sectoral Scope: 1
The project activity is the construction of two greenfield run-of-river hydropower plants (sectoral scope: Energy industries – renewable/now renewable sources).

Prior to implementation of the proposed project, the electricity has been generated by the operational brazilian power plant grid (which has strong participation of fossil fuel power plants). The project activity baseline scenario is the same as the scenario existing prior to the project activity implementation start .

The project activity will reduce GHGs emissions avoiding the operation entrance of thermoelectric power plants connected to the grid, that make use of fossil fuel as energy source (the renewable energy power plants have priority over non renewable thermal generation, because, in general, the thermoelectric power plants start to work when the other clean sources of energy cannot supply the demand). In absence of the project activity, those plants would operate in order to supply the country

electrical demand. Part of this demand, by now supplied by thermoelectric power plants, will start to be supplied by the project activity power plants.

The technology that will be used in the enterprise is the use of Preto River to electrical energy generation. The gravitational energy of water will be used to move turbines and doing this, trigger generators that will enable electricity generation. It will be a clean and renewable energy source that will present minimal environment impact.

The project activity is composed by ventures classified as Small Hydro Power Plant, because according to the Brazilian Resolution number 652, in 09/12/2003, issued by ANEEL (link http://www.aneel.gov.br/cedoc/res2003652.pdf), to be considered a SHP the reservoir area must be less than 3 Km^2 (300 ha) and the total installed capacity must be between 1 MW to 30 MW. As can be checked at the tables 1 and 2, the two power plants meet these requirements.

The SHP Poço Fundo will dispatch generated energy to the National Interconnected Grid through the Ponte Nova Substation (owned by AMPLA) located 11 km far from the substation of SHP Poço Fundo. The SHP Providência will dispatch generated energy to the National Interconnected Grid through the Ponte Nova Substation (owned by AMPLA) located 2 km far from the substation of SHP Providência. The exclusive transmission line from each SHP's substation until Ampla's substation will operate in 34.5kV for both SHPs.

The technology and equipments that will be used in the project activity will be developed and manufactured in Brazil and is not expected know-how or technology transfer to the host country. The emissions sources and GHGs involved are CO_2 emissions from electricity generation with fossil fuel fired power plants and emissions of CH_4 from the new large hydropower plants' reservoirs that would be implanted to complement the energy availability in the country (in case of additional energy input by the project activity will not occur).

The equipments' technical characteristics that will be implemented in SHPs can be seen in tables below:

Table 1: Main equipments´ technical characteristics to be installed at SHP Poço Fundo

Generator	Characteristics
Type	Synchronous
Quantity	2
Power (kW)	2 x 7,220
Nominal Power (kVA)	2 x 7,800
Power Factor	0.925
Voltage (kV)	6.9
Frequency (Hz)	60
Turbines	**Characteristics**
Type	Francis
Quantity	2

Power (kW)	2 x 7,220
Nominal Flow (m^3/s)	11.27
Water head (m)	69.4
Other Information	**Characteristics**
Efficiency of Turbine-Generator Set (%)	90.6
Reservoir Area (Km²)	0.19
Power Density (W / m²)	76.00

Table 2: Main equipment's technical characteristics to be installed at SHP Providência.

Generator	**Characteristics**
Type	Synchronous
Quantity	2
Power (kW)	2 x 2,502
Nominal Power (kVA)	2 x 2,780
Power factor	0.9
Voltage (kV)	6.9
Frequency (Hz)	60
Turbines	**Characteristics**
Type	Francis
Quantity	2
Power (kW)	2 x 5,000
Nominal Flow (m^3/s)	11.27
Water head (m)	46.7
Other Information	**Characteristics**
Efficiency of Turbine-Generator Set (%)	90.0
Reservoir Area (Km²)	0.0926
Power Density (W / m²)	54.00

All the equipments should be new since they are greenfield power plants. The forecasted lifetime to the generator and turbines shall be more than 30 years. The civil construction lifetime is more than 50 years. The measurement system for each SHP shall be done through at minimum two meters (one main and one backup) located in a panel inside the powerhouse or directly in the Substation where will be the grid connection point. More details in the section B.7.3.

The baseline scenario to the project activity is the same as the scenario existing prior to the project activity implementation start.

The energy and mass flows and balances of the systems and equipment relevant to the project activity are described in the Section B.3.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (Host Country)	**Poço Fundo Energia S.A. (private entity)**	**No**
	Providência Energia S.A. (private entity)	

A.5. Public funding of project activity
There is no public funding provided by Annex I parts, so the carbon credits revenue are the option chosen.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology

The Project uses the approved consolidated baseline and monitoring methodology ACM0002: "Grid-connected electricity generation from renewable sources ~~*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*~~" - version 1~~3~~4.0.0 (valid from ~~11~~4 October ~~May~~ 201~~2~~3 onwards).

The ACM0002 version 1~~3~~4.0.0 also refers to the following tools:

- Tool to calculate the emission factor for an electricity system (version 0~~3~~4.0.0);
- Tool for the demonstration and assessment of additionality (version 07.0.0);
- Guidelines on the assessment of investment analysis (version 05)

B.2. Applicability of methodology

As per UNFCCC`s (United Nations Framework Convention on Climate Change) definitions, the project activity is according to the sectoral scope 1 that refers to energy industries (renewable or non renewable sources). The ACM0002 version 1~~3~~4.0.0 methodology is applicable to grid-connected renewable power generation project activities that:

(a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant);

(b) involve a capacity addition;
(c) involve a retrofit of (an) existing plant(s); or
(d) involve a replacement of (an) existing plant(s).

In the case of this project activity, the alternative (a) is the applicable: (a) the installation of new power plants at sites where no renewable power plants were operated prior to the implementation of the project activity (Greenfield plants)

The ACM0002 version 1~~3~~4.0.0 methodology is applicable to grid-connected renewable power generation project activities under following conditions:

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

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

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

Not applicable to the project activity because it consists of new hydro power plants.

In case of hydro power plants, at least one of the following conditions must apply:

• *The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or*

Not applicable to the project activity.

• *The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir the project activity, as per the definitions given in the Project Emissions section, is greater than 4* W/m^2*; or*

Not applicable to the project activity.

• *The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per the definitions given in the Project Emissions section, is greater than 4 W/m2.*

The project activity results in new reservoirs and the power densities are above 4W/m^2**, as described in the calculations in section B.6.**

In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m2 all the following conditions must apply:

• *The power density calculated for the entire project activity using equation 5 is greater than 4 W/m2;*

• *Multiple reservoirs and hydro power plants are located at the same river and were designed together to function as an integrated project that collectively constitutes the generation capacity of the combined power plant;*
• *Water flow between the multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity;*
• *Total installed capacity of the power units, which are driven using water from the reservoirs with power density lower than 4 W/m2, is lower than 15 MW;*
• *Total installed capacity of the power units, which are driven using water from reservoirs with a power density lower than 4 W/m2, is less than 10 per cent% of the total installed capacity of the project activity from multiple reservoirs.*

Not applicable to this project activity (not are multiple reservoirs)

The methodology is not applicable to the following:

• *Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site* **(not applicable);**
• *Biomass fired power plants* **(not applicable);**
• *Hydro power plants that result in the creation of a new single reservoir or in the increase in an existing single reservoir where the power density of the power plant is less than 4 W/m2* **(not applicable).**

So, the small hydro power plants Poço Fundo and Providência are considered electric generation by renewable source with new reservoirs, which have power densities of 76.00 W/m^2 and 54.00 W/m^2 respectively. As the sum of installed capacity of the two plants is 19.44 MW, greater than 15 MW, thus the project activity is included in the large scale project category considering the CDM standards.

So the ACM0002 version 134.0.0 methodology is applicable.

B.3. Project boundary

According to ACM0002 version 134.0.0 the space extension of the project's boundaries includes the project activity power plants and all power plants connected physically to the electricity system that the CDM project power plants are connected. In this case, the SHPs Poço Fundo and Providência will be connected with SIN.

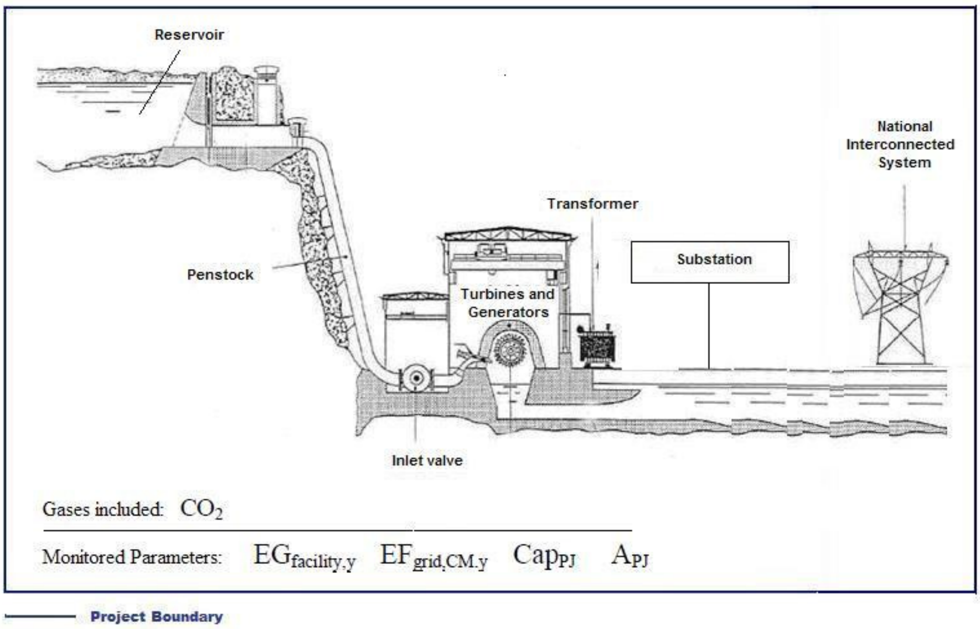
The greenhouse gases included in or excluded from the project boundary are shown in the table below:

Table 3: Description of the sources and gases included in or excluded from the project boundaries:

Source		GHGs	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.
	For hydro power plants, emissions of	CO_2	No	Minor emission source.

	CH_4 from the reservoir.	CH_4	No	Considering that the power density of the SHP Poço Fundo is 76.00 W/m^2 and of the SHP Providência is 54.00 W/m^2, so greater than 10 W/m^2, the emissions from reservoir are not considered.
		N_2O	No	Minor emission source.

The diagram below shows the project boundary, main equipments, monitored parameters and included gases (per SHP)[1]:



B.4. Establishment and description of baseline scenario

According to the methodology ACM0002 version 1~~3~~4.0.0, if the project activity is the "installation of a new grid-connected renewable power plant/unit", 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 generating sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system"*.

Then, the baseline emissions are the kWh produced by the renewable power unit multiplied by an emission coefficient (quantified in tCO_2e/MWh), calculated in a conservative and transparent manner.

[1] It is forecasted to deliver the electricity from the SHPs Poço Fundo and Providência through the **Ponte Nova Substation** (that belongs to the AMPLA company - http://www.ampla.com) with transmission lines far 11 and 2km respectively in 34.5 kV.

In the project activity absence (baseline scenario), the electricity would be generated for other grid-connected power plants, included fossil fuel based power plants (more details about the baseline scenario and Brazilian National Interconnected Grid - SIN in B.5. Steps 1a and 4 respectively).

The electricity generation from SHPs Poço Fundo and Providência will provide the necessary MWh to the calculation of baseline GHGs.

Also, the project activity will use as source for the Emission Factor calculation of SIN the operating margin and build margin, the coefficients provided by the Designated National Authority (DNA) of this host country (publicly available).

The CO_2 Emission Factor resulting from the electric energy generation verified in the SIN in Brazil will be calculated based on generating records from plants centrally operated by the National Electric System Operator (from Portuguese *Operador Nacional do Sistema - ONS*).

The method used to make this calculation will be the dispatch analysis method. These information are needed for renewable energy projects connected to the electric grid and implanted in Brazil under the CDM.

The data resultant from the work of the ONS, Ministry of Mines and Energy and Ministry of Science and Technology, are available to the CDM project proponents. Thus, they can be applied in calculating ex-ante emissions avoided by the project activity, where the emission reduction will be calculated ex-post.

Further details of the development of the project baseline can be viewed through the link: http://www.mct.gov.br/index.php/content/view/307492.html .

B.5. Demonstration of additionality

This item was elaborated based on the version 134.0.0 of "ACM0002 - Consolidated baseline methodology for grid connected electricity generation from renewable sources", and of the "Tool for the demonstration and assessment of additionality" prevailing the Methodology since this supersedes the Tool. To investment analysis was used the "Guidelines on the assessment of investment analysis".

Step 0: Demonstration whether the proposed project activity is the first-of-its-kind

Not used, the proposed project activity isn´t the first of kind in Brazil.

Step 1: Identification of alternatives to the project activity consistent with current laws and Regulations

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

The Project is the installation of a new grid connected hydro power plant, the baseline scenario, according to the methodology ACM0002version 134.0.0 , 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 described in the Tool to calculate the emission factor for an electricity system".

The selected methodology ACM0002 version 1~~3~~4.0.0 prescribes the baseline scenario, thus, alternatives to the Project is not required to be further identified as per paragraph 115 of Clean Development Mechanism Validation and Verification Standard (VVS) version 0~~3~~5.0.

Outcome of Sub-step 1a: Not necessary to identify realistic and credible alternative scenario(s) to the project activity

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

The SHPs Poço Fundo and Providência installation is in compliance with all regulations of the following entities: National Electric System Operator – *ONS* (from Portuguese *Operador Nacional do Sistema Elétrico*), National Electricity Regulatory Agency – *ANEEL* (from Portuguese *Agência Nacional de Energia Elétrica*), Environmental Institute of Rio de Janeiro State – *INEA (*from Portuguese - *Instituto Estadual do Ambiente)*, and CDM Executive Board, For more details, the section B.7.3 explain the necessary requirements for SHPs monitoring. The Previous license and Section D.2 detail the Environmental Plans and ANEEL's documents detail the laws referent to the SHPs. The SHPs operational procedures will follow all requirements defined by these three Brazilian organs and the CDM Executive Board.

ONS – Agency responsible for operation coordination and control of the electrical energy generation and transmission in SIN (National Interconnected System).

ANEEL – Regulating Agency, tied with Ministry of Mines and Energy, with headquarters and office in Federal District, with the purpose of regulating and fiscalizing the generation, transmission and commercialization of electrical energy, in compliance with Federal Government Politics.

INEA – It is an agency created to protect, conserve and recoup the environment and to sustainable development promotion.

In the current and future stages of the proposed project activity (until commercial operation) the most important steps to be assessed are:

Issuance by the ANEEL of **SHP Project Design acceptance Dispatch** and/or **Authorizations**[2] for the power plants (this has already been done, more details in section D.1).

Issuance of Environmental licenses[3] by the INEA according to the project phase; this has already been done for SHP Poço Fundo - at the actual stage the **Previous License** was issued and the next step shall be the **Installation License** issuance that is under progress - and shall be issued for SHP Providência the **Previous License**, more details in section D.1).

ONS authorization to SIN electricity dispatch shall occur when finalizing the SHPs construction. During this phase, the measurement system grid procedures shall be followed (see section B.7.3 for more details).

[2] Through the **ANEEL Dispatch** that accepts the SHPs project design and also though **ANEEL Authoritative Resolution**

[3] There are 3 Licenses, the Previous (ok for the exploitation), Installation (ok for the construction) and Operation (ok for the SHP operation).

Outcome of Sub-step 1b: The project activity is in compliance with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

Step 2: Investment analysis

The investment analysis shall be performed in order to determine whether the proposed project activity is not:

(a) The most economically or financially attractive; or
(b) Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).

For the proposed project activity, the investment analysis determinates if the proposed project activity is not economically or financially feasible without the revenues from the Certified Emission Reductions (CERs).

Sub-step 2a: Determine appropriate analysis method
In order to determine the appropriate analysis method, the following options are available to be used in the additionality analysis:

- Option I - Apply simple cost analysis,
- Option II - Apply investment comparison analysis,
- Option III - Apply benchmark analysis

According to the "Tool for the demonstration and assessment of additionality" version 07.0.0, if the CDM project activity and the alternatives identified in Step 1 generate financial or economic benefits other than CDM related income, then the investment comparison analysis (Option II) or the benchmark analysis (Option III) must be used. The Option II must be applied when there are credible alternative scenarios for the project activity. As there aren´t alternative to compare with the project's indicators (Internal Rate of Return) the Option III is the most appropriate.

Therefore, the Option III was chosen.

Sub-step 2b – Option III: Apply benchmark analysis
The financial indicator most appropriate for this type of project is the Internal Rate of Return (Equity IRRs), because it is the compound rate of return annualized effective that can be obtained on invested capital.

The financial/economic indicator analysis is based on parameters that are standard in the energy market in Brazil and around the world, considering the specific characteristics of the project type – investments in energy projects.

The benchmark analysis is performed comparing the equity IRR with a benchmark. The established benchmark for this comparison is the Cost of Equity (K_e), based on the Capital Asset Pricing Model, in line with the accountable rules generally accepted. The details are described below:

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

K_e – Cost of Equity

The cost of equity was calculated in line with the "Guidelines on the assessment of investment analysis" published in 62 meeting of the CDM Executive Board (Annex 5) making use of reliable sources and the

Equity IRR can be comparable with Cost of Equity because required/expected returns on equity are appropriate benchmarks for equity IRR, as described in item 12 of this Guideline.

Cost of Equity calculation

The cost of equity was calculated as follows:

K_e = Rf + Beta * (US Premium + Country ERP)[4]

Where:

K_e = Cost of equity (also referred as Equity Return);
Rf = Risk free rate;
US Premium = United States risk premium;
Country ERP = Brazilian Equity Risk Premium;
Beta = adjustment factor to reflect the risk of projects, this value is the average of energy companies in Brazil, leveraged to the capital structure of the project activity

In our case the risk free rate of return is the average rate of American Treasury Bonds (T-Bond) corresponding to the years 2003 to 2012[5] . Value to be applied 3.22[6]%.

US Premium and also the Country ERP (for Brazil) are available in the A. Damodaran reference available in http://www.stern.nyu.edu/~adamodar/pc/datasets/ctryprem.xls. Values Applied 5.80% and 1.75% respectively.

For Beta establishment was made use of the A. Damodaran reference available for Brazilian Companies (average Betas from Power Industry[7] levered for the proposed project activity capital structure[8]). Value applied 2.155.

It is important to observe that this project activity make use of the reliable and also conservative sources for the benchmark calculation in accordance with the references presented in the "*Guidelines on the assessment of investment analysis*".

Therefore:

K_e = 3.22% + 2.155 * (5.80% + 1.75%)

So

K_e = 19.49%[9]

[4] A. Damodaran on presentation "Estimating Discounting Rates"
[5] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histret.html
[6] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histret.html Average rate of return of T-Bonds = 5.64% - 2.42% (to be in real terms is discounted the projected inflation rate based on CPI index ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt) from the page: http://pages.stern.nyu.edu/~adamodar/New_Home_Page/data.html
[7] http://www.stern.nyu.edu/~adamodar/pc/archives/emergcompfirm11.xls (Country: Brazil, Industry: Power) **results in 0.849** - from the page: http://pages.stern.nyu.edu/~adamodar/New_Home_Page/data.html
[8] Beta $_{unlevered}$ = Beta $_{levered}$ / 1+D/E (1-T) where D= Debt, E = Equity, T = Interest and Taxes - so 2.155= 0.849 * 1 + 70% / 30% (1-34%) source: BNDES, Camacho
[9] Please, check the worksheet “Ke POF_PRV_v2_1” provided to more details about the calculation performed.

Below, the table 4 summarizes the reference values to the equity IRR and the equity value used as benchmark.

Table 4: Comparative between equity IRRs and the Benchmark

Benchmark Cost of Equity	Equity IRR SHP Poço Fundo	Equity IRR SHP Providência
19.49%	**6.58%**	**4.65%**

The cash-flow was elaborated for 20 years operation[10]
As the project activity´s cash flow is considered confidential information, this will be integrally presented for the validation entities in a separated worksheet. In the worksheet are also identified all the reference sources for the applied values.

The cash flow has as main input values the following:

Table 5: Main Input Values of cash flow

Parameter	SHP Poço Fundo	SHP Providência
Investment (R$)	69,564,515.18[11]	28,823,950.00[12]
Assured Energy (MWaverage)	7.2	2.75
Energy Price (R$/MWh)	135.00	135.00
Annual O&M, Insurance, Administration, Environment (R$)	913,294.00	497,161.00

The equity's IRRs have stayed below the project proponent`s equity value. The analysis shows that the projects are destroying capital of the investor considering the parameters that compose the calculation of equity of Poço Fundo Energia S.A. and Providência Energia S.A., facing therefore investment barriers because there are more attractive alternatives.

The CERs are highly significant instruments for entrepreneurs in overcoming barriers, improving investment quality and hence stimulating future investments in clean energy generation.

Sub-step 2d: Sensitivity analysis

To better understand the investment barrier was also performed a **sensitivity analysis** in which were varied the following parameters: (1) Investment, (2) Assured Energy, (3) Energy Price and (4) Annual O&M, Insurance, Administration and Environment costs, in order to check the financial impact of these on the project.

A **Breakeven Point Analysis** was performed in order to discuss the likelihood of occurrence of these scenarios.

[10] As per *Applicability of the "Guidelines on the assessment of investment analysis" version 0~~1~~5.0* since technical lifetime of the CDM project activity is more than 20 years
[11] Document "OPE - PCH-PFD-B-GEOR-0001-dezembro de 2011 rev1"
[12] Document "Providencia - OPE FINAL Alternativa 3.pps" of July 2010

The tables 6.1 and 6.2 present the main results of the analysis[13].

Table 6.1: SHP Poço Fundo breakeven analysis.

Parameter	Original Value	Equity IRR (Parameter +- 10%)	Breakeven point	% of deviation
Investment (R$)	69,564,515.18[14]	8.64%	41,523,059.11	- 40.31%
Assured Energy (MWaverage)	7.20	8.59%	11.26	+56.44%
Energy Price (R$/MWh)	135.00	8.75%	205.81	+ 52.45%
Annual O&M, Insurance, Administration, Environment (R$)	913,294.00	6.83%	Not sensible enough to reach the benchmark	-100%

Table 6.2: SHP Providência breakeven analysis.

Parameter	Original Value	Equity IRR (Parameter +- 10%)	Breakeven point	% of deviation
Investment (R$)	28,823,950.00[15]	6.45%	15,123,926.57	- 47.53%
Assured Energy (MWaverage)	2.75	6.40%	4.62	+ 67.87%
Energy Price (R$/MWh)	135.00	6.54%	225.54	+ 67.07%
Annual O&M, Insurance, Administration, Environment (R$)	497,161.00	4.96%	Not sensible enough to reach the benchmark	- 100%

Facing the above described, it is possible to verify that for all analyzed parameters the variation margin of 10% determined by CDM as sensitivity indicator do not lead the SHPs' Equity IRRs to reach the benchmark in 19.49% (in fact to reach the benchmark value the parameters variations should be above 40.31%). Therefore, fluctuations of this amplitude would not lead the IRR of project activity to reach or overcome the considered benchmark.
The project activity has taken in consideration the revenues of CERs sales for the implantation. These financial benefits generated in strong currency (euro or dollar) bring to the project a better security against monetary depreciations.
Facing the explanations, information and evidences provided by the PPs, the project activity IRRs are below than the established benchmark (cost of equity), evidencing that project activity is destroying capital, not being therefore the most financially attractive investment option. The CDM benefits were the key point to go ahead and to implement the project activity, improving its financial attractiveness.

Therefore, the project activity is financially additional.

Outcome of Step 2: After the sensitivity analysis it is concluded that the proposed CDM project activity is unlikely to be financially/economically attractive (as per Step 2c).

Step 3: Barrier analysis

Not necessary. As concluded in the sensitivity analysis the project activity is not financially attractive.

Step 4: Common practice analysis

[13] The value used in the conversion is an average that result in USD 1.00 = R$2.029, got in the site of Brazilian Central Bank, link: http://www4.bcb.gov.br/pec/conversao/Resultado.asp?idpai=convmoeda, as described in the files "IRR_POF_v2_1.xls" and "IRR_PRV_v2_1.xls"
[14] Document "OPE - PCH-PFD-B-GEOR-0001-dezembro de 2011 rev1"
[15] Document "Providencia - OPE FINAL Alternativa 3.pps" of July 2010

The following stepwise approach clearly demonstrates the project activity does not represent the common practice.

The list of plants operating in the country is made available by ANEEL[16].

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

The projects to be considered in the analyses must have installed capacity between 9.72 MW (50% below the proposed project activity with 19.44 MW of total installed capacity) and 29.16 MW (50% above).

STEP 2: Identify similar projects (both CDM and non-CDM) which fulfill all of the following conditions:

(a) The projects are located in the applicable geographical area;
(b) The projects apply the same measure as the proposed project activity;
(c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;
(d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g. clinker) as the proposed project plant;
(e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;
(f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

The similar projects are listed below:

Table 7: similar projects (both CDM and non-CDM)

[16] http://www.aneel.gov.br/area.cfm?idArea=37&idPerfil=2 , file "**Resumo Geral dos Novos Empreendimentos de Geração**"

Name	State	Type	Difference	MW
Faxinal II	MT	Hydro	CDM	10
Furnas do Segredo	RS	Hydro	CDM	9.8
Ivan Botelho III	MG	Hydro	CDM	24.4
Ombreiras	MT	Hydro	CDM	26
Salto Corgão	MT	Hydro	CDM	27
Canoa Quebrada	MT	Hydro	CDM	28
Santa Edwiges I	GO	Hydro	CDM	10.1
Santa Edwiges II	GO	Hydro	CDM	13
Braço Norte IV	MT	Hydro	CDM	14
Primavera	RO	Hydro	CDM	18.2
Salto	MT	Hydro	CDM	19
São João (Castelo)	ES	Hydro	CDM	25
Alto Benedito Novo I	SC	Hydro	CDM	15
Cachoeirão	MG	Hydro	CDM	27
Graça Bernnand (Terra Santa)	MT	Hydro	CDM	27.4
Paranatinga II	MT	Hydro	CDM	29.01
Porto das Pedras	MS	Hydro	CDM	28.03
Salto Buriti	PA	Hydro	CDM	10
Salto Curuá	PA	Hydro	CDM	22.5
Eng. Ernesto Jorge Dreher	RS	Hydro	CDM	17.9
Ouro	RS	Hydro	CDM	16
Pampeana	MT	Hydro	CDM	27.99
Pedra do Garrafão	ES/RJ	Hydro	CDM	19
Pirapetinga	RJ/ES	Hydro	CDM	20
Planalto	GO/MS	Hydro	CDM	17
Rodeio Bonito	SC	Hydro	CDM	14.68
Santa Edwiges III	GO	Hydro	CDM	11.6
Santa Gabriela	MT/MS	Hydro	CDM	26
São Domingos II	GO	Hydro	CDM	24.3
Angelina	SC	Hydro	CDM	26.27
Anhanguera	SP	Hydro	CDM	22.68
Arvoredo	SC	Hydro	CDM	13
Criúva	RS	Hydro	CDM	23.949
Goiandira	GO	Hydro	CDM	27
Ibirama	SC	Hydro	CDM	21
Malagone	MG	Hydro	CDM	19
Paiol	MG	Hydro	CDM	20
Palanquinho	RS	Hydro	CDM	24.165
Piedade	MG	Hydro	CDM	21.69
Pipoca (UG1)	MG	Hydro	CDM	20
São Francisco	PR	Hydro	CDM	14
São Gonçalo	MG	Hydro	CDM	11
Sítio Grande	BA	Hydro	CDM	25
Ninho da Águia	MG	Hydro	CDM	10
Braço	RJ	Hydro	CDM	11.52
Corrente Grande	MG	Hydro	CDM	14
Barra da Paciência	MG	Hydro	CDM	23
Eng. Henrique Kotzian	RS	Hydro	CDM	13
Caju	RJ	Hydro	CDM	10
Marco Baldo	RS	Hydro	CDM	16
São Sebastião do Alto	RJ	Hydro	CDM	13.2
Moinho	RS	Hydro	CDM	13.7
Boa Fé	RS	Hydro	CDM	24
Divisa	MT	Hydro	CDM	10.8
Autódromo	RS	Hydro	CDM	24
Victor Baptista Adami	SC	Hydro	CDM	25
Santana I	MT	Hydro	CDM	14.758
São Paulo	RS	Hydro	CDM	16
Paracambi	RJ	Hydro	CDM	25
Pezzi	RS	Hydro	CDM	19
Galheiros	GO	Hydro	CDM	12.06
São Sebastião	SC	Hydro	CDM	9.9
Salto Góes	SC	Hydro	CDM	20
Barra do Rio Chapéu	SC	Hydro	CDM	15.15
Serra dos Cavalinhos II	RS	Hydro	CDM	29
Pardos	SC	Hydro	CDM	10
Segredo	MT	Hydro	CDM	26.12
Salto Três de Maio	PA	Hydro		20
Nova Aurora	GO	Hydro		21
Santa Luzia Alto	SC	Hydro		28.5
Palmeiras	SP	Hydro		16.5
Indaiá Grande	MS	Hydro		19.98
Unaí Baixo	MG	Hydro		26
Esmeralda	RS	Hydro	Proinfa	22.2
Piranhas	GO	Hydro	Proinfa	18
Flor do Sertão	SC	Hydro	Proinfa	16.5
José Gelásio da Rocha	MT	Hydro	Proinfa	23.7
Rondonópolis	MT	Hydro	Proinfa	26.6
Alto Irani	SC	Hydro	Proinfa	21
Alto Sucuriú	MS	Hydro	Proinfa	29
Boa Sorte	TO	Hydro	Proinfa	16
Bonfante	MG/RJ	Hydro	Proinfa	19
Caçador	RS	Hydro	Proinfa	22.5
Calheiros	RJ/ES	Hydro	Proinfa	19
Colino II	BA	Hydro	Proinfa	16
Cotiporã	RS	Hydro	Proinfa	19.5
Da Ilha	RS	Hydro	Proinfa	26
Funil	MG	Hydro	Proinfa	22.5
Jararaca	RS	Hydro	Proinfa	28
Lagoa Grande	TO	Hydro	Proinfa	25.6
Plano Alto	SC	Hydro	Proinfa	16
São Joaquim	ES	Hydro	Proinfa	21
Linha Emília	RS	Hydro	Proinfa	19.5
Monte Serrat	RJ/MG	Hydro	Proinfa	25
Retiro Velho	GO	Hydro	Proinfa	18
Santa Fé	ES	Hydro	Proinfa	29
São Lourenço	MT	Hydro	Proinfa	29.1
São Simão	ES	Hydro	Proinfa	27
Areia Branca	MG	Hydro	Proinfa	19.8
Figueirópolis	MT	Hydro	Proinfa	19.41
São Tadeu I	MT	Hydro	Proinfa	18
Sete Quedas Alta	MT	Hydro	Proinfa	22
Novo Horizonte	PR	Hydro	Proinfa	23
Sapezal	MT	Hydro	Proinfa	16
Cidezal	MT	Hydro	Proinfa	17
Parecis	MT	Hydro	Proinfa	15.4
Porto Góes	SP	Hydro	Small Size	14.3
São Bernardo	RS	Hydro	Small Size	15

Ponte Alta	MS	Hydro	Small Size	13
Santa Laura	SC	Hydro	Small Size	15
Cachoeira da Lixa	BA	Hydro	Small Size	14.8
Carangola	MG	Hydro	Small Size	15
Colino I	BA	Hydro	Small Size	11
Mambaí II	GO	Hydro	Small Size	12
Cocais Grande	MG	Hydro	Small Size	10
Água Limpa	TO	Hydro	Small Size	14
Areia	TO	Hydro	Small Size	11.4
Rondon	MT	Hydro	Small Size	13
Pontal do Prata	GO	Hydro	Small Size	13.744
Indaiazinho	MS	Hydro	Small Size	12.5
Toca do Tigre	RS	Hydro	Small Size	11.84
Campo Florido	MG	Thermoelectric	Energy Source/Fuel	12
Miguel Forte	PR	Thermoelectric	Energy Source/Fuel	10
Caeté	AL	Thermoelectric	Energy Source/Fuel	16.8
Contagem	MG	Thermoelectric	Energy Source/Fuel	19.3
Agrovale	BA	Thermoelectric	Energy Source/Fuel	10
Água Bonita	SP	Thermoelectric	Energy Source/Fuel	17
Coruripe	AL	Thermoelectric	Energy Source/Fuel	16
Fartura	SP	Thermoelectric	Energy Source/Fuel	17.4
Giasa II	PB	Thermoelectric	Energy Source/Fuel	20
Ruette	SP	Thermoelectric	Energy Source/Fuel	28
Winimport	PR	Thermoelectric	Energy Source/Fuel	11.5
Thermal REFAP	RS	Thermoelectric	Energy Source/Fuel	27.12
Bunge Araxá	MG	Thermoelectric	Energy Source/Fuel	11.5
Alunorte	PA	Thermoelectric	Energy Source/Fuel	27.8
Fartura	SP	Thermoelectric	Energy Source/Fuel	22
Jitituba Santo Antônio	AL	Thermoelectric	Energy Source/Fuel	15
CNT	GO	Thermoelectric	Energy Source/Fuel	20
Cidade Nova	AM	Thermoelectric	Energy Source/Fuel	11.2
Gusa Nordeste	MA	Thermoelectric	Energy Source/Fuel	10
Serra do Navio	AP	Thermoelectric	Energy Source/Fuel	21.6
São João Biogás	SP	Thermoelectric	Energy Source/Fuel	21.6
São José	PE	Thermoelectric	Energy Source/Fuel	18
Pitangueiras	SP	Thermoelectric	Energy Source/Fuel	10
Santa Cruz AB	SP	Thermoelectric	Energy Source/Fuel	25
Carneirinho	MG	Thermoelectric	Energy Source/Fuel	24
Pirapama	PE	Thermoelectric	Energy Source/Fuel	25
Ecoluz	PR	Thermoelectric	Energy Source/Fuel	12.33
REFAP	RS	Thermoelectric	Energy Source/Fuel	26
Ripasa	SP	Thermoelectric	Energy Source/Fuel	16.6
Monte Alegre	MG	Thermoelectric	Energy Source/Fuel	16
Guariroba	SP	Thermoelectric	Energy Source/Fuel	12
Rigesa	SC	Thermoelectric	Energy Source/Fuel	25
Frutal	MG	Thermoelectric	Energy Source/Fuel	16.09
Vale do Ivaí	PR	Thermoelectric	Energy Source/Fuel	16
Tropical Bioenergia	GO	Thermoelectric	Energy Source/Fuel	15
Cerradão	MG	Thermoelectric	Energy Source/Fuel	25
Alcoa Beneficiamento	PA	Thermoelectric	Energy Source/Fuel	9.83
Cocamar Maringá	PR	Thermoelectric	Energy Source/Fuel	13
Biolins	SP	Thermoelectric	Energy Source/Fuel	28
Marituba	AL	Thermoelectric	Energy Source/Fuel	12
Berneck	PR	Thermoelectric	Energy Source/Fuel	12
Iacanga	SP	Thermoelectric	Energy Source/Fuel	19
Total	MG	Thermoelectric	Energy Source/Fuel	25
Maracaju	MS	Thermoelectric	Energy Source/Fuel	10.4
São Francisco	SP	Thermoelectric	Energy Source/Fuel	21.8
Monteverde	SP	Thermoelectric	Energy Source/Fuel	20
São Miguel	AL	Thermoelectric	Energy Source/Fuel	13.2
Monções	SP	Thermoelectric	Energy Source/Fuel	20
Petribu	PE	Thermoelectric	Energy Source/Fuel	22
DVPA	MG	Thermoelectric	Energy Source/Fuel	28
Salvador	BA	Thermoelectric	Energy Source/Fuel	19.73
CENPES	RJ	Thermoelectric	Energy Source/Fuel	16.06
Vale do Paracatu - BEVAP	MG	Thermoelectric	Energy Source/Fuel	25
Selecta	MG	Thermoelectric	Energy Source/Fuel	11.4
Lwarcel	SP	Thermoelectric	Energy Source/Fuel	16.3
Citrovita Catanduva	SP	Thermoelectric	Energy Source/Fuel	15
Eldorado	MS	Thermoelectric	Energy Source/Fuel	24
Santa Teresa	PE	Thermoelectric	Energy Source/Fuel	10
S.A Usina Coruripe	MG	Thermoelectric	Energy Source/Fuel	20
Rio Pardo	SP	Thermoelectric	Energy Source/Fuel	25
Cargill Uberlândia	MG	Thermoelectric	Energy Source/Fuel	25
São Borja	RS	Thermoelectric	Energy Source/Fuel	12.5
RECAP	SP	Thermoelectric	Energy Source/Fuel	13.6
Bunge nº 1 Cubatão	SP	Thermoelectric	Energy Source/Fuel	11.5
Ipê	SP	Thermoelectric	Energy Source/Fuel	25
LDC Bioenergia Lagoa da Prata	MG	Thermoelectric	Energy Source/Fuel	20
CEM	GO	Thermoelectric	Energy Source/Fuel	12
Millennium	PB	Wind	Energy Source/Fuel	10.2
Parque Eólico de Beberibe	CE	Wind	Energy Source/Fuel	25.6
Taíba Albatroz	CE	Wind	Energy Source/Fuel	16.5
Paracuru (SIIF Énergies)	CE	Wind	Energy Source/Fuel	21.4
Canoa Quebrada (RV)	CE	Wind	Energy Source/Fuel	10.5
Pedra do Sal	PI	Wind	Energy Source/Fuel	21.3
Foz do Rio Choró	CE	Wind	Energy Source/Fuel	25.2
Praias de Parajuru	CE	Wind	Energy Source/Fuel	28.8
Praia do Morgado	CE	Wind	Energy Source/Fuel	28.8
Gargaú	RJ	Wind	Energy Source/Fuel	28.05
Cerro Chato II	RS	Wind	Energy Source/Fuel	28
Mangue Seco 3	RN	Wind	Energy Source/Fuel	26
Mangue Seco 2	RN	Wind	Energy Source/Fuel	26
Mangue Seco 1	RN	Wind	Energy Source/Fuel	26
Mangue Seco 5	RN	Wind	Energy Source/Fuel	26
Campo Belo	SC	Wind	Energy Source/Fuel	10.5
Miassaba II	RN	Wind	Energy Source/Fuel	14.4
Amparo	SC	Wind	Energy Source/Fuel	22.5
Aratuá I	RN	Wind	Energy Source/Fuel	14.4
Cabeço Preto	RN	Wind	Energy Source/Fuel	19.8
Cabeço Preto IV	RN	Wind	Energy Source/Fuel	19.8
Sangradouro 3	RS	Wind	Energy Source/Fuel	24
Sangradouro 2	RS	Wind	Energy Source/Fuel	26
Osório 2	RS	Wind	Energy Source/Fuel	24
Quixaba	SE	Wind	Energy Source/Fuel	25.5
Mel 2	RN	Wind	Energy Source/Fuel	20
Osório 3	RS	Wind	Energy Source/Fuel	26
Fazenda Rosário 2	RS	Wind	Energy Source/Fuel	20

STEP 3: Within plants identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation.

The power plants that are neither registered CDM nor undergoing validation are:

Name	State	Type	Difference	MW
Salto Três de Maio	PA	Hydro		20
Nova Aurora	GO	Hydro		21
Santa Luzia Alto	SC	Hydro		28.5
Palmeiras	SP	Hydro		16.5
Indaiá Grande	MS	Hydro		19.98
Unaí Baixo	MG	Hydro		26
Esmeralda	RS	Hydro	Proinfa	22.2
Piranhas	GO	Hydro	Proinfa	18
Flor do Sertão	SC	Hydro	Proinfa	16.5
José Gelásio da Rocha	MT	Hydro	Proinfa	23.7
Rondonópolis	MT	Hydro	Proinfa	26.6
Alto Irani	SC	Hydro	Proinfa	21
Alto Sucuriú	MS	Hydro	Proinfa	29
Boa Sorte	TO	Hydro	Proinfa	16
Bonfante	MG/RJ	Hydro	Proinfa	19
Caçador	RS	Hydro	Proinfa	22.5
Calheiros	RJ/ES	Hydro	Proinfa	19
Colino II	BA	Hydro	Proinfa	16
Cotiporã	RS	Hydro	Proinfa	19.5
Da Ilha	RS	Hydro	Proinfa	26
Funil	MG	Hydro	Proinfa	22.5
Jararaca	RS	Hydro	Proinfa	28
Lagoa Grande	TO	Hydro	Proinfa	25.6
Plano Alto	SC	Hydro	Proinfa	16
São Joaquim	ES	Hydro	Proinfa	21
Linha Emília	RS	Hydro	Proinfa	19.5
Monte Serrat	RJ/MG	Hydro	Proinfa	25
Retiro Velho	GO	Hydro	Proinfa	18
Santa Fé	ES	Hydro	Proinfa	29
São Lourenço	MT	Hydro	Proinfa	29.1
São Simão	ES	Hydro	Proinfa	27
Areia Branca	MG	Hydro	Proinfa	19.8
Figueirópolis	MT	Hydro	Proinfa	19.41
São Tadeu I	MT	Hydro	Proinfa	18
Sete Quedas Alta	MT	Hydro	Proinfa	22
Novo Horizonte	PR	Hydro	Proinfa	23
Sapezal	MT	Hydro	Proinfa	16
Cidezal	MT	Hydro	Proinfa	17
Parecis	MT	Hydro	Proinfa	15.4
Porto Góes	SP	Hydro	Small Size	14.3
São Bernardo	RS	Hydro	Small Size	15
Ponte Alta	MS	Hydro	Small Size	13
Santa Laura	SC	Hydro	Small Size	15
Cachoeira da Lixa	BA	Hydro	Small Size	14.8
Carangola	MG	Hydro	Small Size	15
Colino I	BA	Hydro	Small Size	11
Mambaí II	GO	Hydro	Small Size	12
Cocais Grande	MG	Hydro	Small Size	10
Água Limpa	TO	Hydro	Small Size	14
Areia	TO	Hydro	Small Size	11.4
Rondon	MT	Hydro	Small Size	13
Pontal do Prata	GO	Hydro	Small Size	13.744
Indaiazinho	MS	Hydro	Small Size	12.5
Toca do Tigre	RS	Hydro	Small Size	11.84
Campo Florido	MG	Thermoelectric	Energy Source/Fuel	12
Miguel Forte	PR	Thermoelectric	Energy Source/Fuel	10
Caeté	AL	Thermoelectric	Energy Source/Fuel	16.8
Contagem	MG	Thermoelectric	Energy Source/Fuel	19.3
Agrovale	BA	Thermoelectric	Energy Source/Fuel	10
Água Bonita	SP	Thermoelectric	Energy Source/Fuel	17
Coruripe	AL	Thermoelectric	Energy Source/Fuel	16
Fartura	SP	Thermoelectric	Energy Source/Fuel	17.4
Giasa II	PB	Thermoelectric	Energy Source/Fuel	20
Ruette	SP	Thermoelectric	Energy Source/Fuel	28
Winimport	PR	Thermoelectric	Energy Source/Fuel	11.5
Thermal REFAP	RS	Thermoelectric	Energy Source/Fuel	27.12
Bunge Araxá	MG	Thermoelectric	Energy Source/Fuel	11.5
Alunorte	PA	Thermoelectric	Energy Source/Fuel	27.8
Fartura	SP	Thermoelectric	Energy Source/Fuel	22
Jitituba Santo Antônio	AL	Thermoelectric	Energy Source/Fuel	15
CNT	GO	Thermoelectric	Energy Source/Fuel	20
Cidade Nova	AM	Thermoelectric	Energy Source/Fuel	11.2
Gusa Nordeste	MA	Thermoelectric	Energy Source/Fuel	10
Serra do Navio	AP	Thermoelectric	Energy Source/Fuel	21.6
São João Biogás	SP	Thermoelectric	Energy Source/Fuel	21.6

São José	PE	Thermoelectric	Energy Source/Fuel	18
Pitangueiras	SP	Thermoelectric	Energy Source/Fuel	10
Santa Cruz AB	SP	Thermoelectric	Energy Source/Fuel	25
Carneirinho	MG	Thermoelectric	Energy Source/Fuel	24
Pirapama	PE	Thermoelectric	Energy Source/Fuel	25
Ecoluz	PR	Thermoelectric	Energy Source/Fuel	12.33
REFAP	RS	Thermoelectric	Energy Source/Fuel	26
Ripasa	SP	Thermoelectric	Energy Source/Fuel	16.6
Monte Alegre	MG	Thermoelectric	Energy Source/Fuel	16
Guariroba	SP	Thermoelectric	Energy Source/Fuel	12
Rigesa	SC	Thermoelectric	Energy Source/Fuel	25
Frutal	MG	Thermoelectric	Energy Source/Fuel	16.09
Vale do Ivaí	PR	Thermoelectric	Energy Source/Fuel	16
Tropical Bioenergia	GO	Thermoelectric	Energy Source/Fuel	15
Cerradão	MG	Thermoelectric	Energy Source/Fuel	25
Alcoa Beneficiamento	PA	Thermoelectric	Energy Source/Fuel	9.83
Cocamar Maringá	PR	Thermoelectric	Energy Source/Fuel	13
Biolins	SP	Thermoelectric	Energy Source/Fuel	28
Marituba	AL	Thermoelectric	Energy Source/Fuel	12
Berneck	PR	Thermoelectric	Energy Source/Fuel	12
Iacanga	SP	Thermoelectric	Energy Source/Fuel	19
Total	MG	Thermoelectric	Energy Source/Fuel	25
Maracaju	MS	Thermoelectric	Energy Source/Fuel	10.4
São Francisco	SP	Thermoelectric	Energy Source/Fuel	21.8
Monteverde	SP	Thermoelectric	Energy Source/Fuel	20
São Miguel	AL	Thermoelectric	Energy Source/Fuel	13.2
Monções	SP	Thermoelectric	Energy Source/Fuel	20
Petribu	PE	Thermoelectric	Energy Source/Fuel	22
DVPA	MG	Thermoelectric	Energy Source/Fuel	28
Salvador	BA	Thermoelectric	Energy Source/Fuel	19.73
CENPES	RJ	Thermoelectric	Energy Source/Fuel	16.06
Vale do Paracatu - BEVAP	MG	Thermoelectric	Energy Source/Fuel	25
Selecta	MG	Thermoelectric	Energy Source/Fuel	11.4
Lwarcel	SP	Thermoelectric	Energy Source/Fuel	16.3
Citrovita Catanduva	SP	Thermoelectric	Energy Source/Fuel	15
Eldorado	MS	Thermoelectric	Energy Source/Fuel	24
Santa Teresa	PE	Thermoelectric	Energy Source/Fuel	10
S.A Usina Coruripe	MG	Thermoelectric	Energy Source/Fuel	20
Rio Pardo	SP	Thermoelectric	Energy Source/Fuel	25
Cargill Uberlândia	MG	Thermoelectric	Energy Source/Fuel	25
São Borja	RS	Thermoelectric	Energy Source/Fuel	12.5
RECAP	SP	Thermoelectric	Energy Source/Fuel	13.6
Bunge nº 1 Cubatão	SP	Thermoelectric	Energy Source/Fuel	11.5
Ipê	SP	Thermoelectric	Energy Source/Fuel	25
LDC Bioenergia Lagoa da Prata	MG	Thermoelectric	Energy Source/Fuel	20
CEM	GO	Thermoelectric	Energy Source/Fuel	12
Millennium	PB	Wind	Energy Source/Fuel	10.2
Parque Eólico de Beberibe	CE	Wind	Energy Source/Fuel	25.6
Taíba Albatroz	CE	Wind	Energy Source/Fuel	16.5
Paracuru (SIIF Énergies)	CE	Wind	Energy Source/Fuel	21.4
Canoa Quebrada (RV)	CE	Wind	Energy Source/Fuel	10.5
Pedra do Sal	PI	Wind	Energy Source/Fuel	21.3
Foz do Rio Choró	CE	Wind	Energy Source/Fuel	25.2
Praias de Parajuru	CE	Wind	Energy Source/Fuel	28.8
Praia do Morgado	CE	Wind	Energy Source/Fuel	28.8
Gargaú	RJ	Wind	Energy Source/Fuel	28.05
Cerro Chato II	RS	Wind	Energy Source/Fuel	28
Mangue Seco 3	RN	Wind	Energy Source/Fuel	26
Mangue Seco 2	RN	Wind	Energy Source/Fuel	26
Mangue Seco 1	RN	Wind	Energy Source/Fuel	26
Mangue Seco 5	RN	Wind	Energy Source/Fuel	26
Campo Belo	SC	Wind	Energy Source/Fuel	10.5
Miassaba II	RN	Wind	Energy Source/Fuel	14.4
Amparo	SC	Wind	Energy Source/Fuel	22.5
Aratuá I	RN	Wind	Energy Source/Fuel	14.4
Cabeço Preto	RN	Wind	Energy Source/Fuel	19.8
Cabeço Preto IV	RN	Wind	Energy Source/Fuel	19.8
Sangradouro 3	RS	Wind	Energy Source/Fuel	24
Sangradouro 2	RS	Wind	Energy Source/Fuel	26
Osório 2	RS	Wind	Energy Source/Fuel	24
Quixaba	SE	Wind	Energy Source/Fuel	25.5
Mel 2	RN	Wind	Energy Source/Fuel	20
Osório 3	RS	Wind	Energy Source/Fuel	26
Fazenda Rosário 2	RS	Wind	Energy Source/Fuel	20

So, N_{all} = 149

STEP 4: Within similar projects identified in Step 3, identify those that apply technologies that are different to the technology applied in the proposed project activity.

To the common practice analysis, it was done a survey about the activities which became operational between July 2004 (when the New Model of Brazilian Electric Sector started to operate) and May 2013 (last data available before project activity publication for global stakeholders), in order to establish a range of projects that could be considered similar to the project activity, as the definition in the latest version of *"Guidelines on Common Practice"*, version 02.0.

Were considered in the analysis the similar project activities as Poço Fundo and Providência SHPs that had or not financial incentives. To the investment climate in the investment decision date, must be considered: Subsidies or other financial flows, Promotional Policies and Legal regulations.

Subsidies or other financial flows and promotional policies

It is important to consider that, in the incentive and investment matters, Brazil has two main foment lines to renewable energy projects: the Clean Development Mechanism (CDM), established by the Kyoto Protocol, and the Alternative Electrical Energy Sources Incentive Program (PROINFA), established for the Decree nº 5,025/2004[17].

The PROINFA is a governmental program of incentives which was implemented to increase the participation of renewable energy in the SIN. Its target is to diversify the Brazilian Electrical Matrix, creating alternatives to improve the security in the electrical energy supply and to allow the appreciation of local and regional characteristics and potentialities.

The Ministry of Mines and Energy (MME) is the responsible to define the rules, elaborates the Program planning and defines the economical value of each source. The Eletrobrás (Electrical Brazilian Centrals - from Portuguese *Centrais Elétricas Brasileiras S.A.*) is the executor agent, with the mission to close the Power Purchase Contracts (from Portuguese *Contratos de Compra e Venda de Energia – CCVE)*[18] or, in English, Power Purchase Agreements – PPA.

In PROINFA, the financial incentives provided by the Federal Government are based on differentiated lines of finance, guarantees of minimal revenues through of the PPAs (CCVEs) to be firmed with entrepreneur and Eletrobrás, which assures to the entrepreneur a minimal revenue through the purchase of 70% of the generated energy during the financing period. The PROINFA gives also protection against the risks of exposure in the short-term market besides other benefits of adhesion in the program.

Projects qualified by the PROINFA are eligible to participate in the CDM, agreeing to the decision of the UNFCCC regarding eligibility of project derived from public policies. The legislation that created the PROINFA considered the possible CDM revenues to implement the program.

In Brazil regulatory environments, all the projects of generation, transmission, distribution and commercialization of electric energy are supervised and regulated by ANEEL in compliance with the law 9,427 of 26 of December of 1996, guaranteeing, then, the same regulatory requirements to the project activities similar to the proposed project activity.

[17] Decree 5,025 de 2004 that establishes the PROINFA http://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2004/Decreto/D5025.htm

[18] Definition available in the MME page http://www.mme.gov.br/programas/proinfa

In the light of the SHPs performance was considered also the parameter small size of installation[19] for the hydroelectric within the similar projects, since the proposed project activity is related to greenfield power plants only and also large size. Excluded also the thermoelectric and wind power plants since they are different technology not comparable to the technology proposed in this project activity - hydro as energy source or feedstock.

From the power plants listed in the Step 3, considering the explanation above and the "Guidelines on Common Practice" which states that CDM project activities are not be included in the analysis, from July 2004 to May 2013.

N_{diff} = 33 (are Proinfa) + 67 (are Thermal) + 28 (are Wind) +15 (are Small)

N_{diff} = 143

STEP 5: Calculate factor F=1-Ndiff/Nall 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.

According the requirements of the version 02.0 of "Guidelines on Common Practice", the factor F that represents "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" must be calculated as follows:

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

$$F=1- 143/149$$

$$F = 0.04027$$

and

$$N_{all} - N_{diff} = 149 - 143 = 6$$

In the light of all the explanation provided above and considering the values of factor "F" and "N_{all} - N_{diff}", it is possible to conclude that the implantation of hydropower plants similar to the project activity is not a common practice in Brazil, because it satisfies a condition and not another, being therefore eligible to CDM according its requirements.

Outcome of Step 4: The proposed project activity is not regarded as "common practice", then the proposed project activity is additional

Table 8: Timeline of SHP Poço Fundo implantation events.

28/01/2011	LP IN015599	Previous License
04/05/2011	Dispatch 1914	Approves the basic project
27/05/2011	Prior Consideration	Prior Consideration
12/07/2011	Resolution 3.004	Authorizes the Poço Fundo Energia S.A.

[19] as defined in paragraph 28 of decision 1/CMP.2

		to establish itself as PIE (Independent Power Producer) because of the exploitation of the SHP Poço Fundo.
01/08/2011	Directive 29	Set the assured energy of SHP Poço Fundo
March 2013	Bids of DOEs	Bids of DOEs
April 2013	Forecast of Installation License	Installation License
June 2013	Contract with DOE	Contract with DOE
January 2016	SHP construction forecasted start	Starting date– Document "PoçoFundo_Cronograma.pdf"
January 2018	Commercial operation forecasted start	Document "PoçoFundo_Cronograma.pdf"

Table 9: Timeline of SHP Providência implantation events.

14/02/2011	Dispatch 541	Accept the basic project
27/05/2011	Prior Consideration	Prior Consideration
March 2013	Bids of DOEs	Bids of DOEs
June 2013	Contract with DOE	Contract with DOE
January 2016	SHP construction forecasted start	Starting date - Document "Providencia_Cronograma.pdf"
January 2018	Commercial operation forecasted start	Document "Providencia_Cronograma.pdf"

B.6. Emission reductions
B.6.1. Explanation of methodological choices

The emission reductions of project activity (ER_y) are quantified through the subtraction of project emissions (PE_y) from baseline emissions (BE_y).

$$ER_y = BE_y - PE_y$$

Where:
ER_y = Emission reduction in year y (tCO_2e/y~~ea~~r);
BE_y = Baseline emissions in year y (tCO_2e/y~~ea~~r);
PE_y = Project emissions~~ from water reservoirs for hydro power plants~~ in year y (tCO_2e/y~~ea~~r)

Project emissions ($PE_{HP,y}$)

According to the methodology ACM0002 version 1~~3~~4.0.0, for hydro power project activities that result in new reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoir, estimated as follows:

~~a)~~ If the power density of the single or multiple reservoirs (PD) is great~~high~~er than 4W/m² and less~~ower~~ than or equal to 10W/m²

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$$PE_{HP,y} = \frac{EF_{Res} \cdot TEG_y}{1000}$$

Where:

$PE_{HP,y}$ Emission from water reservoirs (tCO_2e/yr);

EF_{Res} Default emission factor for emissions from reservoirs of hydro power plants in year y (kgCO2e/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 the power density of the project activity is greater than 10 W/m²:

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$PE_{HP,y} = 0$

The power densities of the project activity ~~are~~(PD) is calculated as follows:

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

Where:

PD Power density of the project activity~~, in~~ (W/m²)~~.~~
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 (m²).
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 (m²). For new reservoirs, this value is zero.

$$PD_{\text{Poço Fundo}} = \frac{14{,}440{,}000 - 0}{190{,}000 - 0} = 76.00\ \text{W/m}^2$$

$$PD_{\text{Providência}} = \frac{5{,}000{,}000 - 0}{92{,}600 - 0} = 54.00\ \text{W/m}^2$$

Therefore, the reservoir project emissions are zero to the SHPs Poço Fundo and Providência because their Power Densities are higher than 10 W/m².

Baseline Emissions (BE_y)

Baseline emissions (BE_y in tCO_2) are the product of the baseline emissions factor ($EF_{grid,CM,y}$ in tCO_2/MWh) multiplied by the electricity supplied by the project activity to the grid ($EG_{PJ,y}$ in MWh), as follows:

$$BE_y = EF_{grid,CM,y} \cdot EG_{PJ,y}$$

Where:
BE_y Baseline emissions in year y (tCO_2e/yr);
$EG_{PJ,y}$ Quantity of electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr);

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

Energy Generated ($EG_{PJ,y}$)

The project activity is the installation of two new grid-connected renewable power plants/units at sites where no renewable power plants were operated prior to the implementation of the project activity, thus classified as Greenfield renewable energy power plants.

The $EG_{PJ,y}$ is based on the estimative of energy to be inputted annually into the grid by the Project activity, which considers the assured energy of the plants, information provided by ANEEL and the Brazilian Mines and Energy Ministry. Then:

$$EG_{PJ,y} = EG_{facilitiy,y}$$

Where:
$EG_{PJ,y}$ Quantity of 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 electricity generation supplied by the project plants/units to the grid in year y (MWh/yr).

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$Cap_{BLPoço\ Fundo}$
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Project site.
Value(s) applied	0
Choice of data or Measurement methods and procedures	Not applicable.
Purpose of data	Calculation of project emissions.
Additional comment	

Data / Parameter	$A_{BLPoço\ Fundo}$
Unit	m^2
Description	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.
Source of data	Project site.
Value(s) applied	0
Choice of data or Measurement methods and procedures	Not applicable.
Purpose of data	Calculation of project emissions.
Additional comment	

Data / Parameter	$Cap_{BLProvidência}$
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Project site.
Value(s) applied	0
Choice of data or Measurement methods and procedures	Not applicable.
Purpose of data	Calculation of project emissions.
Additional comment	

Data / Parameter	$A_{BLProvidência}$
Unit	m^2
Description	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.
Source of data	Project site.
Value(s) applied	0
Choice of data or Measurement methods and procedures	Not applicable.
Purpose of data	Calculation of project emissions.
Additional comment	

B.6.3. Ex ante calculation of emission reductions

The baseline methodology considers the determination of the emissions factor of the grid which the project activity is connected to as the core data to be determined in the baseline scenario. In Brazil, the grid is interconnected by SIN in a single system[20].

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

For calculation of the baseline emission factor, the six steps below should be followed:

STEP 1. Identify the relevant electricity system.

Considering the stated by the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh), and the fact that Brazilian DNA has published the Resolution nº 8 issued on May 26th, 2008, which defines Brazilian Interconnected Grid as a single system that covers all five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest), boundaries of Brazilian electricity system are clearly defined.

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

Since Brazilian DNA has made available emission factor calculation based on information of the grid power plants only, the off-grid power plants are not considered.

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

The method adopted to calculate the operating margin is "Dispatch data analysis OM". The calculation is performed by the Brazilian DNA and made publicly available.

The Dispatch Data emission factor (OM), is summarized as follows:

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

Where:

$EF_{grid,OM-DD,y}$ = Dispatch data analysis operating margin CO_2 emission factor in year y (tCO_2/MWh);
$EG_{PJ,h}$ = Electricity displaced by the project activity in hour h of year y (MWh);
$EF_{EL,DD,h}$ = CO_2 emission factor for grid 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 (h)
y = Year in which the project activity is displacing grid electricity

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

For effect of ex-ante estimation to $EF_{grid,OM-DD,y}$ value, was calculated the arithmetic average of the 12 months emission factors of operating margin, published by the DNA (data available to year 2012)[21].

[20] http://www.mct.gov.br/upd_blob/0024/24562.pdf
[21] http://www.mct.gov.br/index.php/content/view/338047.html#ancora

Table 10: Operating Margin Emission Factor for year 2012

OPERATING MARGIN												
Average Emission Factor (tCO_2 / MWh)												
2012	MONTH											
	January	February	March	April	May	June	July	August	September	October	November	December
	0.2935	0.3218	0.4050	0.6236	0.5943	0.5056	0.3942	0.4490	0.6433	0.6573	0.6641	0.6597

Thus, the Emission Factor of Operating Margin is:

$$EF_{grid,OM\text{-}DD,y} = 0.5176 \ tCO_2/MWh$$

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

The power units included in the build margin are defined by the Brazilian DNA who is responsible for the operating margin and build margin calculations. The results are made publicly available in its web site.

According to the methodology, the build margin emission factor (BM) is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{i,m} EG_{m,y} . EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

For the build margin emission factor $EF_{grid,BM,y}$, will be adopted also 2012 year values published by the DNA (ultimate data available)[22].

Table 11: Brazilian DNA latest data for Build Margin Emission Factor (2012)

BUILD MARGIN	
Average Emission Factor (tCO_2 /MWh) – **ANNUAL**	
2012	
	0.2010

So, we have that the Build Margin Emission Factor is:

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

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

[22] http://www.mct.gov.br/index.php/content/view/338047.html#ancora

For the combined margin emission factor calculation (operation and build margins combination) is used a weighted-average formula, considering both w_{OM} and w_{BM} = 0.5. As a conservative approach, is presented below the emission factor calculated using four decimal places, rounded down. Thus, the result is:

$$EF_{grid,CM,y} = 0.5176 \cdot 0.5 + 0.2010 \cdot 0.5 = 0.3593 \text{ (tCO}_2\text{/MWh)}$$

The baseline emissions would be then proportional to the electricity delivered to the grid throughout the project's lifetime. Are calculated multiplying the electricity baseline emissions factor ($EF_{grid,CM,y}$) by the electricity generation of the project activity.

$$BE_y = EG_{PJ,y} * EF_{grid,CM,y}$$

The values of $EG_{PJ,y}$ are in the item B.7.1.

$BE_{y,\text{ Poço Fundo}}$ = 63,072 * 0.3593 = 22,661 tCO_2/yr

$BE_{y,\text{ Providência}}$ = 24,090 * 0.3593 = 8,655 tCO_2/yr

Moving back to the emission reductions of project activity (*ER*), we have the annual ex-ante estimated CO_2 reductions as:

$$ER_y = BE_y - PE_y$$

$$ER_y = (22,661+8,655) - 0 = 31,316 \text{ (tCO}_2\text{)}$$

Leakage

According methodology ACM0002 version 1~~3~~4.0.0, no leakage emissions are considered.[23]

B.6.4. Summary of ex ante estimates of emission reductions

Table 12: Summary of emission reductions *ex-ante* estimated

[23] 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, transport). These emissions sources are neglected.

Year	Baseline emissions ($t CO_2e$)	Project emissions ($t CO_2e$)	Leakage ($t CO_2e$)	Emission reductions ($t CO_2e$)
2018	31,316	0	0	31,316
2019	31,316	0	0	31,316
2020	31,316	0	0	31,316
2021	31,316	0	0	31,316
2022	31,316	0	0	31,316
2023	31,316	0	0	31,316
2024	31,316	0	0	31,316
Total	219,212	0	0	219,212
Total number of crediting years	7 years, renewable for more 2 periods of 7 years each one.			
Annual average over the crediting period	31,316	0	0	31,316

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{Poço\ Fundo,y}$
Unit	MWh/yr
Description	Quantity of electricity generation supplied by the SHP to the grid (SIN) in year y.
Source of data	Project site - Energy Meters (one main and one backup that shall be located in a panel inside the powerhouse or inside the Ampla substation)
Value(s) applied	63,072 (calculated in the file "CERs JUN1133_v3.xls")
Measurement methods and procedures	The electricity delivered to the grid will be checked through the electricity meters (one main and one back-up). Also the electricity delivered from the grid shall be checked through the same meters since they are bidirectionals. For safety, the meters will be sealed after calibration.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	The meters must comply with national standards stated by ONS module 12.2 (which can be viewed through the link http://extranet.ons.org.br/operacao/prdocme.nsf/principalPRedeweb?openframeset), and industry regulation to ensure the accuracy. These data will be used to calculate the emission reductions. The data will be archived monthly (electronic) and kept archived during the credit period and two years after. The data from the energy meters will be cross checked with the CCEE databank in order to verify the coherency of the data. The periodicity of the calibration will follow the Procedure 12.3 of ONS[24].
Purpose of data	Calculation of baseline emissions.
Additional comment	PP is responsible for the measurements (check and/or cross check readings)

[24] http://extranet.ons.org.br/operacao/prdocme.nsf/principalPRedeweb?openframeset

Data / Parameter	$EG_{Providência,y}$
Unit	MWh/yr
Description	Quantity of electricity generation supplied by the SHP to the grid (SIN) in year y.
Source of data	Project site - Energy Meters (one main and one backup that shall be located in a panel inside the powerhouse or inside the Ampla substation)
Value(s) applied	24,090 (calculated in the file "CERs JUN1133_v3.xls")
Measurement methods and procedures	The electricity delivered to the grid will be checked through the electricity meters (one main and one back-up). Also the electricity delivered from the grid shall be checked through the same meters since they are bidirectionals. For safety, the meters will be sealed after calibration.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	The meters must comply with national standards stated by ONS module 12.2 (which can be viewed through the link http://extranet.ons.org.br/operacao/prdocme.nsf/principalPRedeweb?openframeset), and industry regulation to ensure the accuracy. These data will be used to calculate the emission reductions. The data will be archived monthly (electronic) and kept archived during the credit period and two years after. The data from the energy meters will be cross checked with the CCEE databank in order to verify the coherency of the data. The periodicity of the calibration will follow the Procedure 12.3 of ONS[25].
Purpose of data	Calculation of baseline emissions.
Additional comment	PP is responsible for the measurements (check and/or cross check readings)

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO_2e/MWh
Description	Combined Margin CO_2 emission factor for grid connected power generation, in the year y, calculated using the latest version of the "Tool to calculate the emission factor for an electricity system".
Source of data	Based on data provided by DNA (Designated National Authority).
Value(s) applied	0.3593
Measurement methods and procedures	The Combined Margin is calculated through a weighted-average formula, considering the $EF_{grid,OM-DD,y}$ and the $EF_{grid,BM,y}$ and the weights w_{OM} and w_{BM} default 0.5. As per the "Tool to calculate the emission factor for an electricity system".
Monitoring frequency	Annually.
QA/QC procedures	As per the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions.
Additional comment	To the emission reductions *ex-ante* estimative, were used data related to the year 2012 (ultimate available data). Source: http://www.mct.gov.br/index.php/content/view/338047.html#ancora

[25] http://extranet.ons.org.br/operacao/prdocme.nsf/principalPRedeweb?openframeset

Data / Parameter	$EF_{grid,OM-DD,y}$
Unit	tCO_2e/MWh
Description	CO_2 Operating Margin emission factor of the grid, in a year y
Source of data	Data provided by DNA (Designated National Authority) to the year y.
Value(s) applied	0.5176
Measurement methods and procedures	According procedures established by the most recent version of "Tool to calculate the emission factor for an electricity system".
Monitoring frequency	Monthly.
QA/QC procedures	This data will be annually updated to be applied in ex-post calculation of the Emission Factor of Combined Margin.
Purpose of data	Calculation of baseline emissions.
Additional comment	To the emission reductions *ex-ante* estimative, were used data related to the year 2012 (ultimate available data). Source: http://www.mct.gov.br/index.php/content/view/338047.html#ancora

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2e/MWh
Description	CO_2 Build Margin emission factor of the grid, in a year *y*
Source of data	Data provided by DNA (Designated National Authority) to the year *y*.
Value(s) applied	0.2010
Measurement methods and procedures	According procedures established by the most recent version of "Tool to calculate the emission factor for an electricity system".
Monitoring frequency	Annually.
QA/QC procedures	This data will be annually updated to be applied in ex-post calculation of the Emission Factor of Combined Margin.
Purpose of data	Calculation of baseline emissions.
Additional comment	To the emission reductions *ex-ante* estimative, were used data related to the year 2012 (ultimate available data). Source: http://www.mct.gov.br/index.php/content/view/338047.html#ancora

Data / Parameter	$Cap_{Poço\ Fundo}$
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	Equipments' plaques
Value(s) applied	14,440,000
Measurement methods and procedures	Technical specifications on the installed equipments.
Monitoring frequency	Annually.
QA/QC procedures	Determined based on recognized standards. This data will be applied for the Power Density calculation.
Purpose of data	Calculation of project emissions.
Additional comment	To emission reductions *ex-ante* estimative were used data of ANEEL Authorizing Resolution No. 3,004, issued on 12 July, 2011 (link http://www.aneel.gov.br/cedoc/rea20113004.pdf)

Data / Parameter	$Cap_{Providência}$
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	Equipment plaques
Value(s) applied	5,000,000
Measurement methods and procedures	Technical specifications on the installed equipments.
Monitoring frequency	Annually.
QA/QC procedures	Determined based on recognized standards. This data will be applied for the Power Density calculation.
Purpose of data	Calculation of project emissions.
Additional comment	To *ex-ante* emission reductions estimative were used data of Summary Sheet ANEEL

Data / Parameter	$A_{Poço\ Fundo}$
Unit	m^2
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).
Source of data	Dispatch ANEEL No. 1,914 of 4 May 2011(link http://www.aneel.gov.br/cedoc/dsp20111914.pdf)
Value(s) applied	190,000
Measurement methods and procedures	The own personal or a third part company will be hired for the development of topographic surveys and/or satellite image processing.
Monitoring frequency	Annually.
QA/QC procedures	
Purpose of data	Calculation of project emissions.
Additional comment	This data is applied for the Power Density calculation.

Data / Parameter	$A_{Providência}$
Unit	m^2
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).
Source of data	Summary Sheet ANEEL
Value(s) applied	92,600
Measurement methods and procedures	The own personal or a third part company will be hired for the development of topographic surveys and/or satellite image processing.
Monitoring frequency	Annually.
QA/QC procedures	
Purpose of data	Calculation of project emissions.
Additional comment	This data is applied for the Power Density calculation.

B.7.2. Sampling plan

The data and parameters monitored in section B.7.1 above are not determined by a sampling approach. The data are effectively measured.

B.7.3. Other elements of monitoring plan

The monitoring plan for the project activity is based on the methodology ACM0002 version 1~~3~~4.0.0 and consists of monitoring of the electricity generation from the project activity and CO_2 emission factors.

1) **Power generation and measurement system – $EG_{facility,y}$:**

General characteristics of the Measurement System:

The procedures designed for the monitoring electricity generation by the project activity follow the Brazilian energy sector parameters and regulations. The National Grid Operator (ONS) and Electric

Power Commercialization Chamber (from Portuguese *Câmara de Comercialização de Energia Elétrica - CCEE)* are the responsible for the energy measurement system for billing technical requirements.

The agent responsible for measurement system for billing (from the Portuguese, *Sistema de Medição para Faturamento - SMF*) will develop the project in accordance with the measurements for billing technical specifications, which must include the measurement points location, measurement panels, meters and systems for local and remote measurement. The measurement system for each SHP shall be done through at minimum two meters (one main and one backup) located in a panel inside the powerhouse or directly in the Substation where will be the grid connection point. The meters will be bidirectional and the accuracy class will be 0.2.

As stated by the sub-module 12.1 of Grid Procedures[26], the SMF is a system composed of main and back-up meters, instrument transformers, communication channels between the agents and CCEE and also billing measures data collecting systems.

The measurement system will measure and record the energy values delivered in the grid. The SHPs Poço Fundo and Providência measurement system will be installed in measurement panels. After the calibration, the panels will be physically sealed, guaranteeing the data measured inviolability.

The data recorded in the meters will also be collected by the Collect Energy Data System (from Portuguese - *Sistema de Coleta de Dados de Energia – SCDE*) from CCEE, remote and automatically, using the two meters that will be installed for each SHP (one main and one backup).

Then, besides electricity measurements performed by the project owners, all the energy generated by SHPs Poço Fundo and Providência will also be online monitored by the CCEE. The CCEE´s measurement system has a communication system that has the function of sending the data from dispatched energy to the grid to the CCEE. The CCEE is responsible for monthly readings and keeping the energy dispatched data records.

Data monitoring:

The meters readings are used to calculate the emission reductions. The monitoring steps are as follow:

(1) The data will be measured hourly and recorded monthly;
(2) Spreadsheets containing the electricity delivered to the grid will be generated; the CCEE datas measured will be used to calculate the emission reductions;
(3) Poço Fundo Energia S.A. and Providência Energia S.A. will provide Carbotrader the monitored datas from its meters and the CCEE datas measured;
(4) The emission reductions will be managed by the responsible project manager at Carbotrader;

Other details, regarding to the parameters to be monitored can be found in sections B.7.1, and Appendix 5. The monitoring plan can be consulted annex (Document "Plano de Monitoramento.doc").

Quality control:

(1) Calibration of meters:

The calibration of meters will be conducted by a qualified organization that must comply with national standards and industrial regulations to ensure the system accuracy. The periodicity of the calibration will

[26] http://extranet.ons.org.br/operacao/prdocme.nsf/principalPRedeweb?openframeset from http://www.ons.org.br/procedimentos/index.aspx

follow the Procedure 12.3[27] of ONS. After calibration, the meters must be sealed for safety and the calibration certificates must be recorded with other monitoring records. The class of accuracy of the equipment that will be used in the project activity is under the national standards (NBR 14519 from Associação Brasileira de Normas Técnicas – Brazilian Association of Technical Standards).It can be viewed in the Procedure 12.2[28] of ONS.

(2) Emergency treatment

In case of unavailability of measures from any point of measurement, due to maintenance, commissioning or for any other reason, will be used the methodology to estimate data as the item 7.1 of the Procedure of Energy Commercialization PdC ME.01–[29], Module 2.

Data Management:

All the issues regarding the SHP will be treated by the responsible Manager of the SHPs Poço Fundo and Providência.

All the datas got in the monitoring period will be electronically filed and kept for at least 2 years after the last crediting period. The crediting to be generated will be calculated regularly by the project proponents and kept for the verification phase.

Training Procedures:

Poço Fundo Energia S.A. and Providência Energia S.A. will provide the training for the team responsible for the maintenance and operation of SHPs Poço Fundo and Providência.

2) **Emission Factors - $EF_{grid,CM,y}$, $EF_{grid,OM\text{-}DD,y}$ and $EF_{grid,BM,y}$:**

The CO_2 emission factors related to this project activity ($EF_{grid,CM,y}$, $EF_{grid,OM\text{-}DD,y}$ and $EF_{grid,BM,y}$) as mentioned previously, are made public available by the Brazilian DNA and it can be viewed at its website (http://www.mct.gov.br/index.php/content/view/307492.html). Thus, the monitoring of this data will be ex-post through periodic access to data provided by DNA.

3) **Installed capacity – Cap_{PJ}:**

In Brazil, the installed capacity of hydropower plants is determined and authorized by the competent regulatory agency. Furthermore, any modification must also be authorized and made available to the public. Thus, any new authorization to increase the installed capacity of the plants will be monitored.

It is also important to highlight that according the ANEEL resolution number 407 (link http://www.aneel.gov.br/cedoc/res2000407.pdf), issued on 19th October 2000[30], if the present/real installed capacity is greater than +/- 5 % of the authorized (granted) capacity, a revision of the authorized installed capacity should be requested. It must be considered after the total capacity of the plant was installed.

Authority and Responsibility

Poço Fundo Energia S.A. and Providência Energia S.A. are responsible for the monitoring equipments maintenance and calibration, operational requirements and corrective actions compliance related to the

[27] http://extranet.ons.org.br/operacao/prdocme.nsf/principalPRedeweb?openframeset
[28] http://extranet.ons.org.br/operacao/prdocme.nsf/principalPRedeweb?openframeset
[29] http://www.ccee.org.br/portal/wcm/idc/groups/regrasprocedlegis/documents/conteudoccee/ccee_058269.pdf
[30] http://www.aneel.gov.br/cedoc/res2000407.pdf

project activity functionality. Moreover, the companies have authority and responsibility for registration, monitoring, measurements as well as managing all the issues related to the project activity.

The baseline project emissions and the emissions reductions calculations will be performed by Carbotrader Assessoria e Consultoria em Energia Eireli which will report the results in a proper way to the entities related with the CDM process.

SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity

01/01/2016

Earliest date at which the implementation of the project activity begins, the project proponent has forecasted to start the construction of the SHPs, as described in the timeline file named "PoçoFundo_Cronograma.pdf" and "Providencia_Cronograma.pdf" (project schedules).

C.1.2. Expected operational lifetime of project activity
30 years and 0 months.

C.2. Crediting period of project activity
C.2.1. Type of crediting period

Renewable being:

01/01/2018 until 31/12/2024	the First crediting Period.
01/01/2025 until 31/12/2031	the Second crediting Period.
01/01/2032 until 31/12/2038	the Third crediting Period.

C.2.2. Start date of crediting period
The starting date of the first crediting period of the project activity is 01/01/2018 (date forecasted in the timelines "PoçoFundo_Cronograma.pdf" and "Providencia_Cronograma.pdf" when both SHPs will be in commercial operation with the two generation units); or in the CDM registration date, whichever occur later.

C.2.3. Length of crediting period
7 years and 0 months renewable for more 2 periods of 7 years and 0 months.

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts

Regarding the regulatory permits, the **SHP Poço Fundo** has the following authorizations issued by the ANEEL:

• Directive # 29 (link http://www.aneel.gov.br/cedoc/prt2011029spde.pdf), dated 1st August 2011, set the security of assured energy of SHP Poço Fundo.

• Dispatch # 1,914 (link http://www.aneel.gov.br/cedoc/dsp20111914.pdf), dated 04th May 2011, that approves the basic project presented by Poço Fundo Energia S.A., regarding to the Poço Fundo SHP, in "Preto River", São José do Vale do Rio Preto city (Rio de Janeiro).

• Authoritative Resolution # 3,004 (link http://www.aneel.gov.br/cedoc/rea20113004.pdf), dated 12th July 2011 – authorizes Poço Fundo Energia S.A. to establish as an independent electric energy generator through the use of the hydro potential called Poço Fundo SHP, located in "Preto River", São José do Vale do Rio Preto city, Rio de Janeiro state.

To the **SHP Providência** the following authorizations were issued by the ANEEL.

• Dispatch # 541 (link http://www.aneel.gov.br/cedoc/dsp2011541.pdf), dated 14th February 2011, that accepts the basic project presented by Providência Energia S.A., regarding to the Providência SHP, in "Preto River", Teresópolis city (Rio de Janeiro).

Environmental Licenses

• Previous License # IN015599, issued by State Environmental Institute - INEA, dated 28th January 2011, that authorizes the Poço Fundo Energia S.A. to develop the studies to install the Poço Fundo hydroelectric plant in "Preto River", municipality of São José do Vale do Rio Preto.

Environmental licenses were requested from the environmental agency, as confirmed by the documents "Protocolo LI POF.pdf" and "Protocolo LP PRV.pdf".
The document "Protocolo LI POF.pdf" is the protocol request of solicitation of the SHP Poço Fundo Installation License, asked the INEA in 28/09/2011.
The document "Protocolo LP PRV.pdf" is the protocol request of solicitation of the SHP Providência Previous License, asked the INEA in 29/06/2012.
The environmental impacts caused by the SHP are not considered significant by the project proponent. More details are described in the section D.2.

D.2. Environmental impact assessment

The Small Hydro Power plants (SHPs) are considered an alternative for the Brazilian electric matrix diversification. One of their characteristics are to present low negative environmental impacts to the place of its installation, when compared with business as usual in Brazil – large Hydro Power Plants, due mainly to the fact of dismiss the inundation of big areas.

The environmental impacts caused by the SHP are not considered significant by the project proponent. Otherwise, several environmental and social action plans for quality improvement and impacts reduction are under implementation and/or will be implemented.

Studies related to the impact of SHP Poço Fundo were made. A Basic Environmental Plan (PBA), an Environmental Impact Assessment (EIA, from Portuguese Estudo de Impacto Ambiental) and an Environmental Impact Report (RIMA, from Portuguese Relatório de Impacto Ambiental) were elaborated by a third company named Sigma Pesquisas & Projetos. These studies have a full environmental assessment of the area of influence of the projects and also, have a set of activities and programs that aim to minimize the negative effects and monitor the resulting changes in water systems installations.

With a view to reducing, mitigating or compensating for impacts, the SHP Poço Fundo has several activities to be implemented:

• Environmental Management Plan
• Management Plan for the reservoir and flow Reduced Excerpt
• Program for Recovery of Degraded Areas
• Population Health Program Linked to Work
• Environmental Education Program Population Linked to Work

• Program for Solid Waste Management
• Plan to Dismantle Rock
• Hydro geological Monitoring Program
• Monitoring Program Erosive Processes in the surroundings Reservoir
• Reforestation Program
• Preservation Program Endangered Species of Flora Extinction
• Monitoring Program Herpetofauna
• Monitoring Program Avifauna
• Monitoring Program Mastofauna
• Fauna Rescue Program
• Consolidation Program Conservation Unit
• Hydrological Monitoring Programme
• Monitoring Program Nascentes
• Limnological Monitoring Program, Water Quality and Sediments
• Program Monitoring and Control of macrophytes
• Monitoring Program Ichthyofauna
• Rescue Program Ichthyofauna
• Monitoring Programme Implementation Mechanism
• Social Communication Program
• Program Monitoring of mining activities
• Environmental Education Program
• Compensation Program of Affected Population
• Program Monitoring and Archaeological Prospection
• Heritage Education Program For Material Culture and Heritage Intangible

The programs described above aim to mitigate or compensate for adverse environmental impacts that could be caused. The size of the business, the characteristics of the region and the environmental studies made, show us that the SHP Poço Fundo has a set of characteristics that demonstrate that the project is environmentally feasible

Regarding the SHP Providence, should complete its environmental studies until June 2014.

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders

In accordance to Ruling nº.1, dated 11 September 2003 and Ruling nº7, of the Inter-Ministry Commission on Global Climate Change (CIMGC), any CDM projects shall send a letter describing the project and request commentaries by local interested parties.

The project activity applies to only one state of the federation, thus, the invitations of comments should be addressed to the following actors involved and affected by the project activities:

- City Hall and City Councils;
- State environmental body and Municipal environmental bodies;
- Brazilian Forum of NGOs and Environmental and Development Social Movements[31];
- Community associations;
- State Prosecutors Office;
- National Prosecutors Office.

[31] http://www.fboms.org.br

In order to satisfy and comply with this ruling the project proponents sent invitation letters describing the project, and requested commentaries by the following interested parties:

a) City Hall of São José do Vale do Rio Preto
b) City Hall of Teresópolis
c) City Council of São José do Vale do Rio Preto
d) City Council of Teresópolis
e) Environmental Agency of São José do Vale do Rio Preto
f) Environmental Agency of Teresópolis
g) Community Association Rural Industrial and Commercial Association of São José do Vale do Rio Preto (from Portuguese *"Associação Comercial Industrial e Rural de São José do Vale do Rio Preto"*)
h) Community Association ACIAT - Commerce, Industry and Agriculture of Teresopolis (from Portuguese *"ACIAT - Associação Comercial, Industrial e Agrícola de Teresópolis"*)
i) Environmental Agency of the Rio de Janeiro State (INEA – Instituto Estadual do Ambiente)
j) Brazilian Forum of NGOs and Environmental and Development Social Movements – FBOMS;
k) Federal Public Attorney
l) State Public Attorney of the Rio de Janeiro State

E.2. Summary of comments received
The stakeholder State Public Attorney of the Rio de Janeiro State spoke, by phone, that they could not speak about the project for carbon credits, since the SHP Providence is still under the same analysis regarding the environmental process.
The stakeholders City Hall of São José do Vale do Rio Preto and the Community Association ACIAT - Associação Comercial, Industrial e Agrícola de Teresópolis have expressed their support to the project.

E.3. Report on consideration of comments received
Not applicable due to the item E.2.

SECTION F. Approval and authorization
The Letter of Approval shall be obtained after the DOE´s Final Validation Report issuance and before the CDM Executive Board project request for registration.

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Appendix 1: Contact information of project participants

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Website	---
Contact person	Tarcísio de Meira Lins Filho
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Appendix 2: Affirmation regarding public funding

There is no Kyoto Protocol Annex 1 country public fund financing this project activity

Appendix 3: Applicability of selected methodology

No further information.

Appendix 4: Further background information on ex ante calculation of emission reductions

The CO_2 emission factors resulting from the generation of electricity verified in Brazilian National Interconnected System (SIN) are calculated from the power plants generation records issued centrally by the National Grid Operator, especially in thermoelectric plants. This information is necessary to renewable energy projects connected to the national grid and implemented in Brazil under the Kyoto Protocol's Clean Development Mechanism (CDM).

The ex ante emission reductions are calculated according to the "**Tool to calculate the emission factor for an electricity system**". With this methodology the National Grid Operator (ONS) is tasked with explaining the SIN (National Interconnected System) operational practices regulated by the ANEEL (Brazilian Electricity Regulatory Agency) to the work group made up by the Ministry of Science and Technology (MCT) and Ministry of Mines and Energy (MME). According to this system, the CO2 Emission Factors applicable to the project activity will be calculated by the National Grid Operator (ONS) for the single system since 27th May 2008.

The latest available data of the Brazilian grid emission factor used on emissions reductions calculations is available in the link: http://www.mct.gov.br/index.php/content/view/338047.html#ancora.

Appendix 5: Further background information on monitoring plan

The monitoring of the project activity is based on the baseline methodology and monitoring applicable to this project and, as described in items B.-7.1 and B.-7.3., the metering equipments of generated energy is used for verification of renewable energy generated by the project activity.

After energy generation data has been collected, there will be a reconciliation of this data with the reports/data issued by the CCEE. We emphasize that the energy data from CCEE is a passes by auditing and must not contain errors. This procedure will be adopted in order to give consistency to the data.

It should be noted that all collected data in the monitoring scope will be electronically filed and kept for at least 2 years after the last credit period or the last issuance of CERs for this project activity, whichever occurs later.

This monitoring plan is based on version 134.0.0 of Large Scale Methodology ACM0002 – **"Consolidated baseline methodology for grid-connected electricity generation from renewable sources"**, as well as on the latest version of "**Tool to calculate the emission factor for an electricity system".**

Appendix 6: Summary of post registration changes

Not applicable.

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required ensuring consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
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