Project design document form
(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Maracanã Small Hydropower Project
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	2.1
Completion date of the PDD	24/08/2020
Project participants	Maracanã Energética S.A. Carbon do Brasil Consultoria Empresarial Ltda.
Host Party	Brazil
Applied methodologies and standardized baselines	Methodology: AMS-I.D “Grid connected renewable electricity generation” - version 18.0
Sectoral scopes	Sectoral scope: 1 - Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	14,161 $tCO2$

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

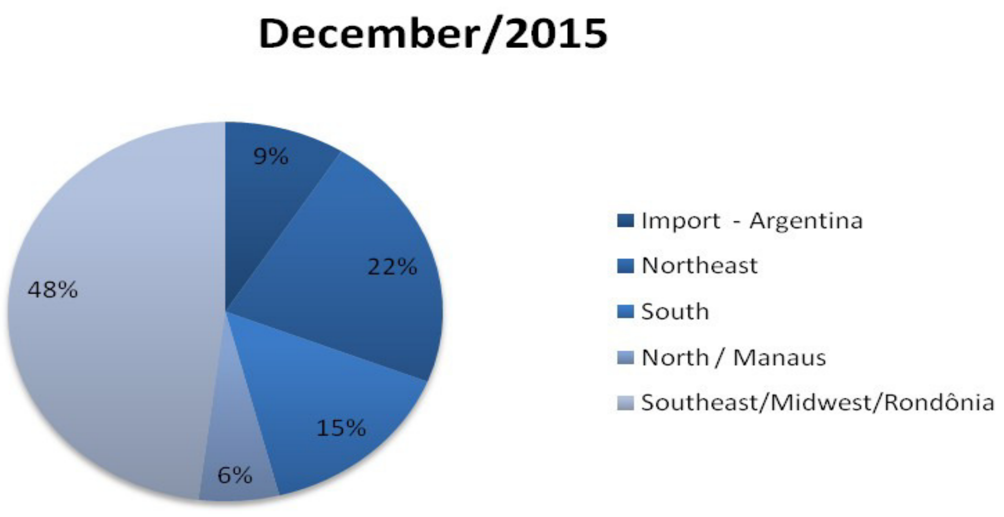
>> The Maracanã Small Hydropower Project (hereinafter referred to as “SHPP Maracanã”) will explore the renewable hydrological potential of the Maracanã stream, located in the municipality of Nova Marilândia, on the State of Mato Grosso, Midwest region of Brazil. The region’s main economic activities are agriculture of soy, rice, corn and beans, as well as coffee and citrus. The beef cattle industry has a herd of over 231,000 heads and a dairy herd of 30,000 heads.

The Project has an installed capacity of 10.656 MW and, with an assured energy of 6.96 MW and in the time when the additionality was verified it was expected to generate an average of 60,969 MWh per year, considering two Francis turbines, with horizontal axis, and two generator units. The project will be connected to the Brazilian National Interconnected System – SIN, the national grid managed by the National System Operator (ONS) through the sub-station of Tangará da Serra, by a double circuit transmission line of 34.5 kV[1].

The proposed project activity reduces greenhouse gas emissions (GHG) that would have occurred otherwise in the absence of the project activity by avoiding electricity generation by fossil fuel sources in the grid and in the time when the additionality was verified, it was expected to reduce an average of 14,161 tCO_2 per year. It is important to highlight that future scenario estimations show an increase in the consumption of fossil fuels, mainly natural gas, based on the Brazilian government’s intention of diversifying the energy supply as presented on its latest studies.

According to the Brazilian Decennial Plan for Electric Energy Expansion (2006-2015), developed by the Ministry of Mines and Energy, there were seven thermoelectric plants in operation in the country and, until 2009, two more would be constructed and ready to operate. As of when the study was conducted, there were also five new thermoelectric plants projects to be approved.

The Decennial Plan also predicts in its reference scenario that there will be an increase of 69% on the thermal generation supply between 2006 and 2015, against a 40% increase on hydro generation in the same period. As of 12/2015, the predicted thermoelectric power supply provided for the Southeast- Midwest region will be 48% of the Brazilian grid, as shown in the figure below.



[1] http://www.aneel.gov.br/cedoc/rea20092144.pdf

Figure 1 – Thermal Installed Capacity Participation per Subsystem – Reference Scenario

Source: Brazilian Decennial Plan for Electric Energy Expansion (2006-2015)

As defined in Section B.4, the project's baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources.

Environmental sustainability

The primary objective of the proposed project is to help meet Brazil's rising demand for energy due to its economic growth and to improve the supply of electricity, while contributing to the environmental, social (job creation in the construction phase, and infrastructure enhancements in surrounding municipalities) and economic sustainability by increasing renewable energy's share on the Brazilian electricity consumption.

The Project activity improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development.

This renewable and cleaner source of electricity will also have an important contribution to environmental sustainability by reducing carbon dioxide emissions that would occur otherwise in the absence of the project. The project activity reduces emissions of greenhouse gases (GHG) by avoiding electricity generation by fossil fuel plants connected to grid.

Economic development

The project will contribute to improve the local economy conditions due to the use of renewable electricity, which reduces our dependence on fossil fuels, thus reducing the amount of pollution and the associated social costs related to it. It also contributes towards better working conditions and increases employment direct and indirect opportunities in the area where the project is located. The project will generate 300 new jobs in the region.

Social development

Employment opportunities will increase in the area where the project is located, for construction as well as ongoing operation and maintenance of the plants. It will contribute to better working conditions and consequently will increase the revenue distribution and electricity purchasing of local population. It will also create new economic opportunities for the region, improving the electricity supplying conditions and the financial resources of the public administration of the city.

A.2. Location of project activity

>> The SHPP Maracanã is located on the Maracanã stream, on the municipality of Nova Marilândia, on the state of Mato Grosso. The location of Nova Marilândia is describe in Figure 2. The geographical coordinates of the project activity dam and power house are longitude -57.6191 W and -57.6155 W and latitude -14.3388 S and -14.3538 S, respectively. The project's geographical location is described in Figure 3. The access to the project activity site can be done through the highway BR-163/364 (Cuiabá/Santarém) and vicinal roads.

Figure 2 – Nova Marilândia Geographical Location
Source: http://pt.wikipedia.org/wiki/Nova_Maril%C3%A2ndia

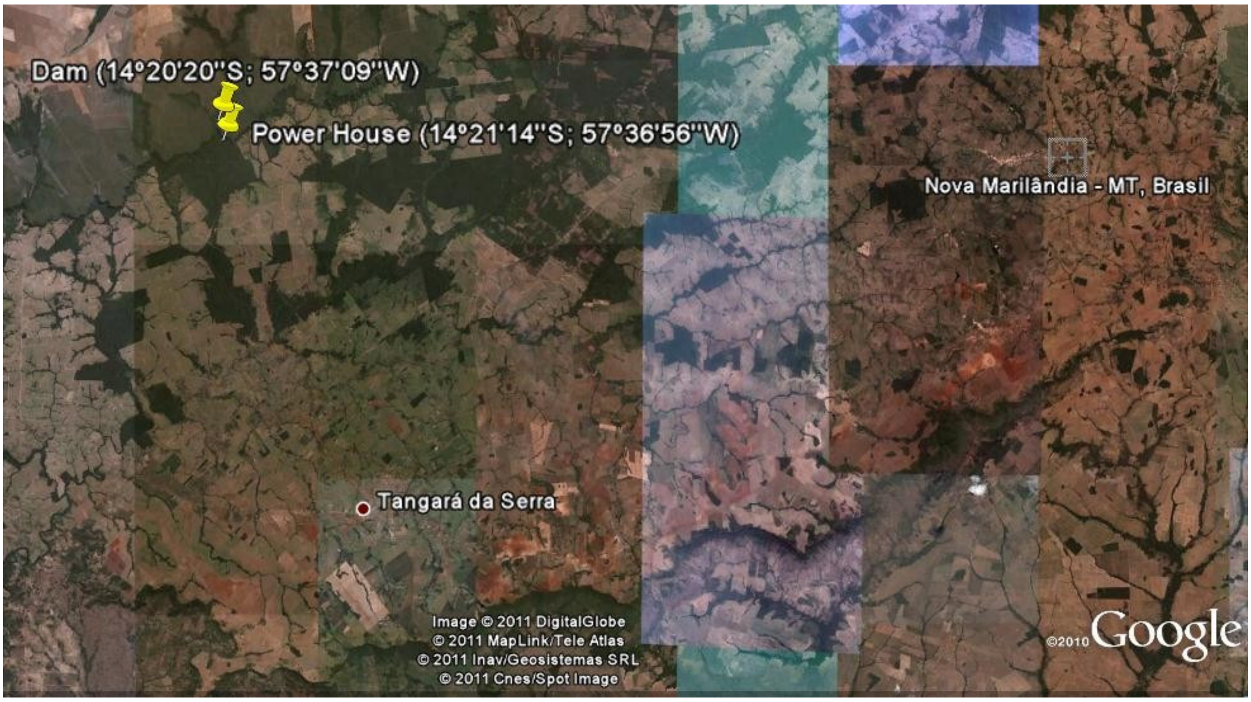


Figure 3 – Project's Dam and Power House Geographical Location
Source: Google Earth

A.3. Technologies/measures

>> The SHPP Maracanã has an installed capacity of 10.656 MW, well below the eligibility limit of 15 MW for small scale projects, and it will be introduced in its regional context as a low environmental impact plant, as it is a run-of-river plant.

Run-of-river designs do not include significant water storage and must therefore make complete use of the water flow. According to Eletrobrás[2], run-of-river projects are defined as "the projects where the river's dry season flow rate is the same or higher than the minimum required for the turbines".

The equipment and technology to be used in the SHPP Maracanã has been successfully applied to similar projects in Brazil and around the world. As of now, there are no turbines and generators contracts signed yet. The general arrangement of the SHPP Maracanã is shown is Figure 4.

Equipment installed on the project site:

- Turbines: 2 (two) Francis, horizontal axis of 5.528 MW each;
- Generators: 2 (two) Synchronous, horizontal axis of 5.328 MW each.

According with ANEEL Ordinance 36[3], of 03/02/2015:

- Installed Capacity: 10.656 MW

According with As-built from SHPP Maracanã, document "*FichaResumo PB PCH Maracanã-.pdf*", reservoir area equal 0.318 km².

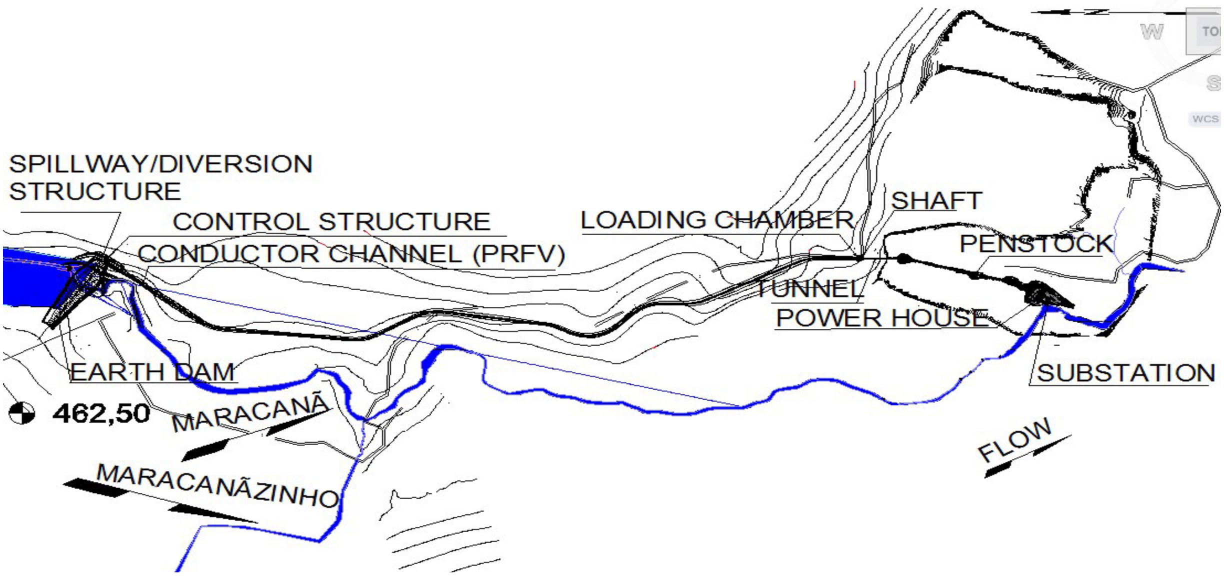


Figure 4 – General Arrangement of SHPP Maracanã

According to the general arrangement of the SHPP Maracanã, the plant will be built immediately upstream of a waterfall succeeded by rapids and small waterfalls which are located in a narrow valley with a high degree in canyon carving, resulting in a gap of 185m.

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[2] www.eletrobras.gov.br

[3] http://www.aneel.gov.br/cedoc/prt2015036spde.pdf

The hydraulic generation circuit will be placed on the left margin of the Maracanã stream and consists of a water intake, adduction canal, and penstock with a length of 620.00m and 1.4m diameter, followed by a sheltered powerhouse.

The dam consists of a concrete dam close to the spillway, with 53.60m in length, and two earth dams. The earth dam on the left margin is 91.95m long, while the dam on the right margin is 69.70m long. The diversion system consists of a Diversion Canal of 180.00m in length.

The SHPP Maracanã will be connected to the national grid by a double circuit transmission line with 42 km length at 34.5 kV through the substation Tangará da Serra, owned by CEMAT – Centrais Elétricas Matogrossenses S.A.[4]

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host Party)	Maracanã Energética S.A. (Private entity)	No
	Carbon do Brasil Consultoria Empresarial Ltda. (Private entity)	

A.5. Public funding of project activity

>> This Project Activity did not/will not receive any public funding from Parties included in Annex 1

A.6. History of project activity

>> This PDD refers to a renewal of the crediting period (second) for this project. Using this rationale:

- The proposed CDM project activity, at the time of its first submission for registration, was neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA).
- The proposed CDM project activity, at the time of its first submission for registration, was not a project activity that has been deregistered.
- The proposed CDM project activity, at the time of its first submission for registration, was not a CPA that has been excluded from a registered CDM PoA.

A registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project), at the time of its first submission for registration, did not exist in the same geographical location as the proposed CDM project activity.

A.7. Debundling

>> Based on the information provided in Appendix C of the simplified modalities and procedures for small scale CDM activities, this small-scale renewable energy project is not part of a larger emission-reduction project, i.e., is not a debundled component of a larger project or program. It is a unique CDM project proposed by the project developer. The project participants have not registered or operated (are not therefore engaged in any way) in any other small-scale CDM project activities in hydropower or by using any other technologies within the project boundary, and surrounding the project boundary.

[4] http://www.redenergia.com/concessionarias/cemat.aspx

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

>> Approved baseline and monitoring methodology:

AMS-I.D – "Grid connected renewable electricity generation" -Version 18
Link: https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

Additionally, the following tools and methodology are also applied to the second crediting period of the project activity:

- TOOL 07: "Tool to calculate the emission factor for an electricity system", version 07.0
Link: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf

- TOOL 11: "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period", version 03.0.1
Link: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf

- ACM0002 – "Grid-connected electricity generation from renewable sources", version 20.0 (for power density calculation)
Link: https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG

B.2. Applicability of methodologies and standardized baselines

>> In accordance to the list of sector scopes available on the UNFCCC website, the category in which the project is classified belongs to the Sector Scope I - Energy Industries (renewable/non-renewable sources).

The project activity is applicable to type I of small-scale projects (renewable energy), methodology I.D. – Grid connected renewable electricity generation – since it is classified in applicability requirements necessary for this category.
This category encompasses renewable sources, as hydro, which supplies electricity to a national or a regional grid, with power lower than 15 MW and reservoirs that satisfies at least one of the following conditions:
• The project activity is implemented in an existing reservoir with no change in the volume of reservoir;
• The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m^2;
• The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2.

The project activity will supply electricity to the Brazilian National Interconnected System. The total power capacity is 10.656 MW so below 15 MW, then they can be classified as Greenfield power plants. A new reservoir was created with the Power Density (PD) greater than 4 W/m^2 (33.51 W/m^2).

2. This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:

(a) Supplying electricity to a national or a regional grid; or
(b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.

Applicable, the proposed project activity comprises renewable energy generation units (hydro).

To summarize see below the applicability based on the methodology requirements:

4. This methodology is applicable to project activities that:
(a) Install a Greenfield plant;
(b) Involve a capacity addition in (an) existing plant(s);
(c) Involve a retrofit of (an) existing plant(s);
(d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or
(e) Involve a replacement of (an) existing plant(s).

Applicable, since install a new power plant at sites where there were no renewable energy power plants operating prior to the implementation of the project activity (Greenfield plants – item a).

5. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:
(a) The project activity is implemented in an existing reservoir with no change in the volume of reservoir;
(b) The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m^2;
(c) The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m^2.

Applicable, since the project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m^2.

6. If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.

Not applicable, has not renewable and non-renewable components.

7. Combined heat and power (co-generation) systems are not eligible under this category.

Not applicable, has not combined heat and power.

8. In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct1 from the existing units.

Not Applicable, the proposed project activity doesn´t involve addition of renewable energy generation units at an existing renewable power generation facility.

9. In the case of retrofit, rehabilitation or replacement, to qualify as a small-scale project, the total output of the retrofitted, rehabilitated or replacement power plant/unit shall not exceed the limit of 15 MW.

Not Applicable, the proposed project activity isn´t retrofit or replacement.

10. In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as “AMS-I.C.: Thermal energy production with or without electricity” shall be explored.

Not applicable to the project activity, since it does not involve landfill gas, wastewater treatment and agro-industries projects methane recovery.

11. In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply.

Not applicable. The project does not involve dedicated plantations to be used as fuel.

B.3. Project boundary, sources and greenhouse gases (GHGs)

>> According to the AMS I.D the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

Thus, the project boundary is the area where the project is located which includes the reservoirs, dams, powerhouses included the turbines, generators, substations, metering systems and the National Interconnected Grid.

The spatial extent of the project boundary is depicted in the figure below:

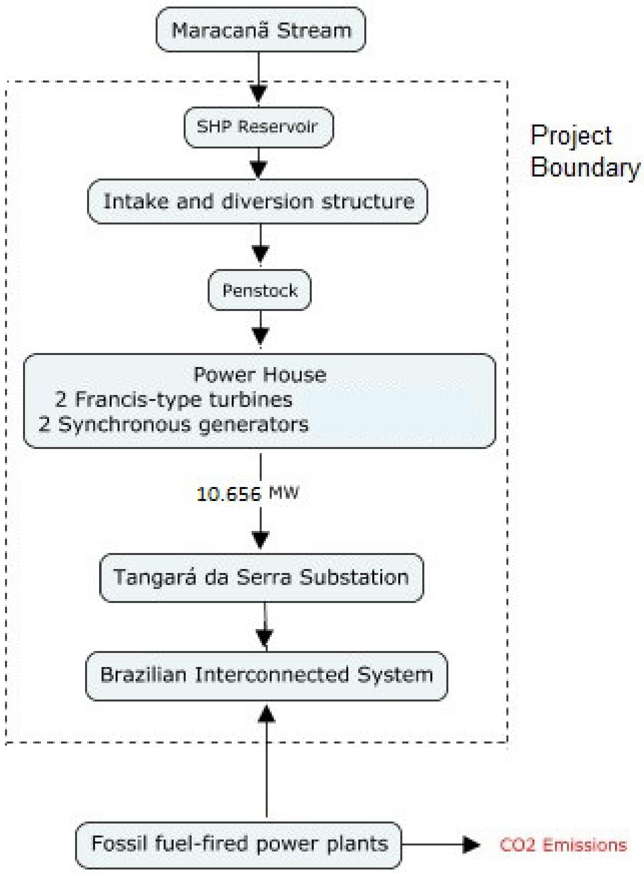

Figure 5 – Project boundary

As shown in the figure above, the project boundary is the area where the project is located, which contains the area of the reservoir and its dam, the powerhouse which includes the main equipments such as turbines and generators, the hydropower substation and its connection with the grid.

It must be noted that the Brazilian Designated National Authority, the Interministerial Global Climate Change Comission (*Comissão Interministerial de Mudança Global do Clima* - CIMGC) has adopted a single electric system, the Brazilian National Interconnected System (*Sistema*

Interligado Nacional - SIN) through the Resolution nº 8, of 26/05/2008[5], under which it was established that the SIN emission factor shall be regularly determined and published by the CIMGC.

More details on Section A.1. above.

	Source	GHG	Included?	Justification/Explanation
Baseline	Source 1: CO_2 emissions from electricity generation in fossil fuel fired power plants that is displaced due to the project activity.	CO_2	Yes	Main emission source.
		CH_4	No	Minor emission source.
		N_2O	No	Minor emission source.

Project activity	Source 1: For hydro power plants, emissions of CH_4 from reservoirs	CO_2	No	Minor emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source

B.4. Establishment and description of baseline scenario

>> According to the TOOL 11: "https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf" a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period is necessary.
The tool consists of two steps. The first step provides an approach to evaluate whether the current baseline is still valid for the next crediting period. The second step provides an approach to update the baseline in case that the current baseline is not valid anymore for the next crediting period.

Step 1: Assess the validity of the current baseline for the next crediting period

The validity of the current baseline is assessed using the following Sub-steps:

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies If the current baseline complies with all relevant mandatory national and/or sectoral policies which have come into effect after the submission of the project activity for validation or the submission of the previous request for renewal of the crediting period and are applicable at the time of requesting renewal of the crediting period, go to Step 1.2.

If the current baseline does not comply with relevant mandatory national and/or sectoral policies, then assess based on the examination of current practice in the country or region in which the policies apply, whether those policies are systematically not enforced and that non-compliance with those requirements is widespread in the country or region.

If the current baseline is not in compliance with the relevant mandatory national and/or sectoral policies or if it cannot be shown that the policies are systematically not enforced and that non-compliance with those policies is widespread in the country or region, then the current baseline needs to be updated for the subsequent crediting period.

The validity of the current baseline doesn´t need to be updated since still valid and in compliance with relevant mandatory brazilian policies.

- Brazilian Resolution #652 of 09/12/2003 from National Electric Energy Agency (ANEEL) for Small Hydro Power Plant;

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[5] http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/cimgc/Comissao_Interministerial_de_Mudanca_Global_do_Clima__CIMGC.html

- ONS (*Operador Nacional do Sistema Elétrico*) module 12 rules/requirements. More details on Section B.7.3;
- CCEE SINERCOM Databank (electricity dispatched to the Grid). More details on Section B.7.3.

Step 1.2: Assess the impact of circumstances

Assess the impact of circumstances existing at the time of requesting renewal of the crediting period on the current baseline emissions, without reassessing the baseline scenario.
In the situation where the baseline scenario identified at the validation of the project activity was the continuation of the current practice without any investment, an assessment of the changes in market characteristics is required for the renewal of the crediting period.
Evaluate whether the conditions used to determine the baseline emissions in the previous crediting period are still valid. Assess the availability of new fuels or raw materials and the impact of electricity or fuel prices in the identification of the current practice for the baseline emissions;

If the new circumstances make a continued validity of the current baseline not plausible, then the current baseline needs to be updated for the subsequent crediting period.

The circumstances at the time of requesting renewal of the crediting period are the same described for the first crediting period as described just after the TOOL 11 evaluation on this section.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

This sub-step should only be applied if the baseline scenario identified at the validation of the project activity was the continuation of use of the current equipment(s) without any investment and, the projects proponents or third party (or parties) would undertake an investment later due, for example, to the end of the technical lifetime of the equipment(s) before the end of the crediting period or the availability of a new technology.
Assess whether the remaining technical lifetime of the equipment that would have continued to be used in the absence of the project activity, as determined in the CDM-PDD or CDM-PDD-REN, exceeds the crediting period for which renewal is requested.
Take into consideration the market penetration of different technologies. Evaluate the penetration rate of different technologies that are available in the market and evaluate how they could affect the baseline.

If the baseline scenario of the project activity is the continuation of use of the current equipment(s) without any investment and the projects proponents or third party(ies) will undertake an investment later, but before the end of a crediting period, then the current baseline needs to be updated for that crediting period or the crediting of emission reductions should be limited to the period before the baseline equipment would cease its operation.

Not applicable since this is a Greenfield project activity.

Step 1.4: Assessment of the validity of the data and parameters

Assess whether data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period are still valid or whether they should be updated.

Updates should be undertaken in the following cases:

• Where IPCC default values are used, the values should be updated if any new default values have been adopted and published by the IPCC, for example, in guidelines for national GHG inventories, IPCC assessment report or special reports by the IPCC;
• Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project activity prior to the

implementation of the project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity.

The parameters that were only determined at the start of the crediting period and not monitored during the crediting period are still valid. And due to TOOL 7 requirements was included as fixed parameter at the start of the second crediting period the parameter EF_{BM}.

Step 2: Update the current baseline and the data and parameters

This step is only applicable if any of the Steps 1.1, 1.2, 1.3 and/or 1.4 showed that the current baseline needs to be updated.

Step 2.1: Update the current baseline

Update the current baseline emissions for the subsequent crediting period, without reassessing the baseline scenario, based on the latest approved version of the methodology applicable to the project activity. The procedure should be applied in the context of the sectoral policies and circumstances that are applicable at the time of request for renewal of the crediting period.

Applicable, the current baseline emissions were updated for the subsequent crediting period, without reassessing the baseline scenario, based on the latest approved version of the methodology AMS-I-D.

Step 2.2: Update the data and parameters

If the application of Step 1.4 showed that the data and/or parameter(s) that were only determined at the start of the crediting period and not monitored during the crediting period are not valid anymore, project participants should update all applicable data and parameters, following the guidance in Step 1.4.

Applicable, the data and parameters shall be updated as described below and on Section B.6.3.

According to the methodology AMS.I.D. the baseline scenario is that the 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 into the grid.

The electricity generation from the SHPP will provide the necessary electricity delivered to the grid by the project activity in MWh (calculation of baseline GHGs).

Also, the project activity uses as source for the Emission Factor calculation of SIN the operating margin and build margin 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 is calculated based on generating records from plants centrally operated by the National Electric System Operator (from Portuguese *Operador Nacional do Sistema Elétrico* - ONS).

The method used to make this calculation is the dispatch analysis method. These informations are necessary for renewable energy projects connected to electric grid and implanted in Brazil under the CDM.

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

Further details of the project baseline development can be viewed through the link:

http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

More technical details on Section A.1. above.
More baseline facilities details on Section B.5. below.

B.5. Demonstration of additionality

>> As per the Glossary of CDM Terms, the starting date of a CDM project activity is the earliest date in which either the implementation, construction or real action of a project activity begins. The project's starting date is 05/12/2011, date in which the Construction Consortium contract was signed.

The CDM benefits were seriously considered in the decision to proceed with the project activity. The timeline prepared for the DOE to assess the serious consideration given to the CDM in the project's decision making process and implementation can be verified on Annex 5 - Timeline of the SHPP Maracanã Project activity.

Additionality

The project's additionality was demonstrated according to the "Tool for the demonstration and assessment of additionality", version 6, which provides a step-wise approach to demonstrate and assess additionality, including the following:

- Identification of alternatives to the project activity;
- Investment analysis to determine that the proposed project activity is either: 1) not the most economically or financially attractive, or 2) not economically or financially feasible;
- Barriers analysis; and
- Common practice analysis.

Also, the Tool's Annex "Guidelines on the Assessment of Investment Analysis" was used.

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 consists in a new electricity generation facility that will supply electricity to the grid. The identification of alternative baseline scenarios only considered two alternatives since project's owner only develop hydroelectric projects like SHPP Maracanã. As said before, MARACANÃ ENERGÉTICA's core business is to invest in renewable energy generation, with low environmental impacts and GHG emissions.

Two scenarios were identified as potential alternatives to the proposed project activity:

- **Alternative 1: The project activity not undertaken as a CDM project activity**

This option is in compliance with the Brazilian legislation and is not prevented by any technical barriers. However, according to the Investment Analysis in section B.5, this alternative is not financially attractive and cannot be considered as a feasible baseline scenario.

- **Alternative 2: Continuation of the current situation (no project activity or other alternatives undertaken)**

The electricity would continue to be generated by the present generators operating for the grid.

There is no technical or economic barrier to achieve this scenario, which is allowed by Brazilian laws and regulations. Therefore, the only realistic alternative to the Project and hence the baseline is this option.

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

All scenarios identified in Sub-step 1a comply with existing legal framework.

As per the "Tool for the demonstration and assessment of additionality", project participants may choose to proceed with Step 2: Investment analysis or Step 3: Barrier analysis.

The main barrier identified by project participants for the proposed project activity is the investment barrier. A benchmark analysis was performed to demonstrate the project additionality in accordance with the latest "Tool for Demonstration and Assessment of Additionality" version 6, and it's Annex "Guidance on the Assessment of Investment Analysis" as described below.

OUTCOME OF STEP 1: Two different scenarios were identified as plausible alternative baseline scenarios to the project activity and both of them comply with existing legal framework.

Step 2: Investment Analysis

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).

Sub-step 2a: Determine appropriate analysis method

1) Determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis (Sub-step 2b). If the CDM project activity and the alternatives identified in Step 1 generate no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III).

The alternatives identified on section B.4 generate financial/economic benefits other than CDM related income, since project's main revenue comes from electricity generation. A benchmark analysis (Option III) was selected to perform the investment analysis in order to assess and demonstrate project's additionality.

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

In order to analyze investment barriers, the Weighted Average Capital Cost was calculated as a benchmark to be compared with the project's financial indicator, the project Internal Rate of Return (IRR).

WACC (Weighted Average Capital Cost) description

According to the Brazilian National Electricity Agency (ANEEL) Technical Note nº 68/2007-SRE/ANEEL, 21/05/2007:

Among the standard methods for determining the rate of return for an enterprise, the greater consensus is to calculate the Weighted Average Cost of Capital (WACC) in combination with Capital Asset Pricing Model (CAPM). According to this model, the rate of return of an enterprise is a weighted average cost of various types of capital, with weights equal to the share of each

type of capital in total value of the assets of the enterprise. In other words, the best approach is to use the WACC to define the minimum rate of return, in conjunction with the CAPM model to define the cost of equity.

The definition of the rate of return for a project should consider the different financing sources, the expected returns for each source (based on the risk incurred by the different stakeholders, wether they are creditors or shareholders), the relative proportion of each source of funds and their respective fiscal and tax impacts. The WACC method is the classic and consolidated form to calculate these considerations and it can be calculated as follows[6]:

$$WACC = We * Ke + Wd * Kd * (1 - t)$$

Where:

We = Percentage of Equity;
Wd = Percentage of Debt;
Ke = Cost of Equity;
Kd = Cost of Debt;
t = Tax rate on profit

Regardless the simplicity to calculate the WACC, there are some precautions to be considered and decisions to be made in order to define each of the variables above. Project participants used the WACC calculated by the Getúlio Vargas Foundation (FGV) in the study "Cost of Capital to Small Hydroelectric Power Plants (SHPPs) in the Clean Development Mechanism Context", published in 11/2010. On this study, the above mentioned definitions reflect the reality of hydroelectric power generation projects in SHPs and Hydro Power Plants (HPPs) with an installed capacity up to 50 MW for the Brazilian market, and each variable was validated before it was used in the WACC equation indicated above in order to calculate an appropriate rate of return.

Percentage of Equity (We) and Debt (Wd)

According to FGV's study, one of the important decisions to be made when evaluating projects is the definition of the percentages of third party resources (debt) and equity (investor/shareholder money) to be used. In the Brazilian market, especially in the case of power generation projects, these percentages, for the most part, are controlled by the parameters defined by the National Bank of Economic and Social Development (BNDES), the primary source of funds for investment projects in the country.

Cost of Equity (Ke)

The FGV study also highlights that determining the cost of Equity depends on correctly assessing the risk associated with generation projects for SHPs and HPPs with an installed capacity up to 50 MW in Brazil. The tool that is generally accepted by academics and companies to define the risk associated with an investment, and consequently to define the appropriate equity earnings, is the CAPM, which assesses the minimum return that an asset should offer the investor, based on the non-diversified (or systematic) risk associated with it.

The cost of Equity (Ke) calculated using CAPM is as follows:

$$Ke = Rf + \beta * (Rm - Rf)$$

Where:

[6] Fundação Getúlio Vargas – FGV. **Cost of Capital to Small Hydroelectric Power Plants (SHPPs) in the Clean Development Mechanism Context.** 11/2010. Available at: http://www.abce.org.br/downloads/portugueswacc.pdf

Rf = Risk Free Rate;

B = Investment risk compared to the market;

(Rm – Rf) = Market Risk Premium

According to CAPM, the required return on Equity (Ke) equals the rate on a risk-free asset (Rf) plus a premium based on the risk associated with the asset [β * (Rm – Rf)].

The risk of an asset, identified as Beta (β), is calculated using covariance between the returns of the asset in relation to the historical returns of a market portfolio. Therefore, to obtain Beta, historical data regarding market portfolio and industry returns are required in order to calculate the covariance between them.

Cost of Debt (Kd)

The FGV study states that, unlike other markets where most companies obtain financing from private lenders, the main sources of financing for Brazilian companies who invest in the infrastructure sector are lines of credit from BNDES which gives the Cost of Debt (Kd) in Brazil some specific characteristics.

BNDES is a federal government company and the main supplier of long term financing in Brazil. The Brazilian market offers very few alternate sources of long term financing which are not branches of government entities, since long term financing is rarely offered by commercial banks and, when it is, the rates are not competitive in comparison to those offered by BNDES. The financing for projects by BNDES is supplied through lines of credit called FINEM (Financing for Business Ventures) in a Project Finance model. This type of operation can be conducted directly with BNDES (direct operations) or through accredited financial institutions (indirect operations).

For direct operations, the transaction cost is comprised of the Financial Cost, BNDES Fee and the Credit Risk Rate. In the cases of indirect transactions, the total cost is comprised of the Financial Cost, BNDES Fee, Financial Negotiation Fee and the Accredited Financial Institution Fee. In the study conducted by FGV, all operations were considered direct, implying that the project would receive financing from BNDES at the lowest cost possible. In reality, many entrepreneurs receive loans through intermediary banks, however, for greater CDM conservatism, the study used direct operations as the standard.

The conditions offered by BNDES for financing this type of project enables the companies to use the FINEM/Project Finance resources up to the maximum limit allowed by the Bank. This situation has resulted in highly levered capital structures, with a major share of financing. Generally speaking, power generation projects rely on 60% to 70% of debt and, as consequence, 40% to 30% of funding from the investors.

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III)

The use of the WACC calculated by FGV as a comparison benchmark against the IRR for investments must, as conservative measure, be performed by its average within a certain time period. The WACC rate for the year of 2009 was 11.88%[7].

[7] Appendix 1 – Based Spreadsheets of the FGV **Cost of Capital to Small Hydroelectric Power Plants (SHPPs) in the Clean Development Mechanism Context** study. Available at: http://www.abce.org.br/downloads/portugueswacc.pdf.

The basic parameters for the financial indicators calculation of the project activity and the project's cash flow are presented below. The original spreadsheets which contain sensitive information are being available to the DOE, DNA and EB/CDM.

Table 1 – Project's basic financial parameters

Parameter	Project data
Installed capacity (MW)	10.5
Annual On-grid Supply (MWh)	61,583
Project lifetime (years)	30
PPA Price (R$)	141.93
Total investment (R$)	62,926,239.44
Project IRR (%)	10.38

The project IRR (Internal Rate of Return) of the project activity, without the benefit from the CERs sale, was lower than the WACC rate for the period. Therefore, the SHPP Maracanã project activity is not the most financially attractive option, once its IRR is 10.38%, which is lower than the selected benchmark WACC of 11.88%. The project's IRR considering the benefits from CDM is slightly below the WACC:11.56%.

As per the "Tool for Demonstration and Assessment of Additionality", if Option III (benchmark analysis) is used and if the CDM project activity has a less favorable indicator (e.g. lower IRR) than the benchmark, then the CDM project activity cannot be considered as financially attractive.

Sub-step 2d: Sensitivity analysis (only applicable to Options II and III)

The sensitivity analysis was conducted in two lines: varying critical parameters in ±10% and ±20% and stressing the parameter until project IRR equals the benchmark. The following table shows the variation, the highlights in red indicate the variation necessary so the project's IRR equals the benchmark:

Table 2 – Sensitivity analysis

Investmen		
Variation	IRR	R$
-20%	13.48%	50,340,991.55
-10.61%	11.88	56,249,765.44
-10%	11.78%	56,633,615.50
-5%	11.05%	59,779,927.47
0%	10.38%	62,926,239.44
5%	10.31%	66,072,551.41
10%	9.73%	69,218,863.39
20%	8.69%	75,511,487.33

Fixed		
Variation	IRR	R$/MWh

[8] The actual (post registration) Intalled Capacity is 10.656 MW. See section B.7 for more details.

[9] In the Sub-step 2b it was done a Sensitive Analyse that shows that only a variantion equal or bigger than10.29% could bring the Project to the benchmark. The changes ocurred post registration (from 61,583 to 60,970 MWh/year) do not affect the original Demonstration of aditionality since this parameter is smaller than the forecated at the time of the investment decision.

-100%	10.46	-
-20%	10.40%	346,147.45
-10%	10.39%	389,415.88
-5%	10.38%	411,050.10
0%	10.38%	432,684.31
5%	10.38%	454,318.53
10%	10.37%	475,952.74
20%	10.36%	519,221.17

Variable Costs		
Variation	IRR	R$/MWh
-100%	10.67	-
-20%	10.44%	335,838.72
-10%	10.41%	377,818.56
-5%	10.39%	398,808.48
0%	10.38%	419,798.40
5%	10.37%	440,788.32
10%	10.35%	461,778.24
20%	10.32%	503,758.08

PPA		
Variation	IRR	R$/MWh
-20%	7.29%	113.54
-10%	8.87%	127.74
-5%	9.63%	134.83
0%	10.38%	141.93
5%	11.12%	149.03
10%	11.84%	156.12
10.29%	11.88	156.53
20%	13.26%	170.32

Electricity Generation		
Variation	IRR	MWh
-20%	7.29%	49,266.24
-10%	8.87%	55,424.52
-5%	9.63%	58,503.66
0%	10.38%	61,582.80
5%	11.12%	64,661.94
10%	11.84%	67,741.08
10.29%	11.88	67,919.67
20%	13.26%	73,899.36

Investment reduction: When examining investment, a 20% reduction leads to an IRR only 1.60% above the WACC. An investment reduction of this magnitude is unlikely: it would be necessary a decrease of almost R$13 million. Further, the actual investment of the project activity has already exceeded the one previously estimated.

Fixed Costs: When examining the fixed costs analysis, a 20% reduction leads to an IRR that is still below the WACC. Even if these costs had a 100% reduction, the project's IRR would still be under the benchmark. The impact of this parameter is therefore insignificant.

Variable Costs: When examining the project's variable costs in this analysis, a 20% reduction leads to an IRR below the WACC. Even if these costs had a

100% reduction, the project's IRR would still be under the benchmark. The impact of this parameter is therefore insignificant.

PPA: The 2nd Alternative Energy Auction price is R$141.93/MWh. By adding another 20% to this price raises it to R$170.32/MWh and the IRR becomes only 1.38% above the benchmark.

There are two public sources of electricity sales prices in Brazil that support the argument that this increased price is unlikely:

a. Energy auctions carried out by the national electricity market regulator, CCEE, where utilities must buy their future demand. The table below shows the average price resulting in each auction and all prices are below R$150/MWh.

Table 3 – Energy auction prices
Source: http://www.epe.gov.br/leiloes/Paginas/default.aspx?CategoriaID=6801

Auction	New Energy		Auction Adjustment		Renewable Energy	
	Auction Date	R$/MWh	Auction Date	R$/MWh	Auction Date	R$/MWh
1	16/12/2005	139.00	-	-	-	-
2	29/06/2006	134.42	01/06/2006	Postponed	-	-
3	10/10/2006	138.00	29/09/2006	No deals	-	-
4	26/07/2007	136.00	29/03/2007	No deals	-	-
5	16/10/2007	131.49	28/06/2007	No prices	01/06/2007	137.32
6	17/09/2008	131.44	27/09/2007	138.25	-	-
7	30/09/2008	146.00	19/06/2008	141.78	-	-
8	27/08/2009	-	23/09/2008	145.67	-	-
9	21/12/2009	Cancelled	20/02/2009	-	-	-
10	30/07/2010	99.48	-	-	-	-
11	-	-	-	-	26/08/2010	133.56
12	17/12/2010	67.31	-	-	-	-
13	-	-	-	-	18/08/2011	99.61
14	17/08/2011	102.07	-	-	-	-
15	-	-	-	-	20/12/2011	102.18

b. Spot prices also registered by CCEE are shown in the graph below. Except for a short period in the end of 2007 when a prolonged draught drove prices up, the remaining prices are also under R$150/MWh.

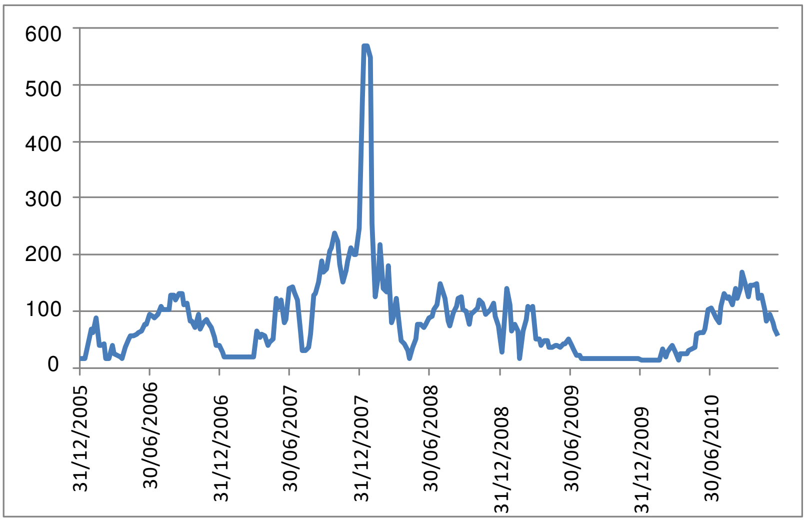

Figure 6 – Electricity spot prices

Energy Generated: With a 20% increase in energy generation, the IRR is only 1.38% higher than the benchmark. Such an increase is technically improbable once the estimated electricity generation of the SHPP Maracanã is based on the project's assured energy, defined as 7.03 MW. An increase in this energy is unlikely to happen once the plant load factor is determined in accordance with historical inflow series including critical periods in hydrological terms.

The sensitivity analysis confirms that the SHPP of Maracanã Energética is not financially attractive. Therefore, it can be concluded that the project is financially unattractive without the CERs revenues. The project thus faces significant financial barriers without CDM support.

Sub-step 2.d is satisfied.

OUTCOME OF STEP 2: As demonstrated throughout step 2, the project's IRR without the benefit of the CDM is lower than the selected benchmark. The sensitivity analysis also shows that the project is unlikely to become feasible without the benefit of the CDM as well. Therefore, the SHPP Maracanã project activity is not financially attractive and faces significant financial barriers without CDM support.

Step 3: Barrier analysis

Not evaluated.

Step 4. Common practice analysis

This step requires the analysis of any other activities that are operational and that are similar to the proposed project activity. According to the "Tool for the demonstration and assessment of additionality", projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.

Other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in this analysis. It should be provided documented evidence and, where relevant, quantitative information. On the basis of that analysis, it should be described whether and to which extent similar activities have already diffused in the relevant region.

The following steps are used as per the "Tool" to define similar power plants to the proposed project activity:

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

The SHPP Maracanã has an installed capacity of 10.656 MW and, thus, the power plants were only considered if they have a capacity ranging between -50% and +50% regarding the project's installed capacity (between 5.33 MW and 15.98 MW).

- **STEP 2:** In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}.

Registered CDM project activities and projects activities undergoing validation shall not be included in this step.

As defined in the "Tool", the applicable geographical area to be analyzed in the common practice analysis covers the entire host country as a default. All the operating power plants in Brazil that were considered in the common practice analysis can be verified in ANEEL's Generation Data Base, available at: http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp.

By the time this analysis was developed, there were 2,616 power plants operating in the country[10] that were analyzed in this step, as follows:

Table 4 - Current Brazilian operating power plants
Source: http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp

Type	Quantity	Total capacity (MW)	%
CGH	376	223.68	0.19
EOL	75	1,615.33	1.29
PCH	428	4,059.64	3.38
UFV	8	5.49	0
UHE	182	81,943.06	66.71
UTE	1,545	32,947.27	26.72
UTN	2	1,990.00	1.71
Total	**2,616**	**122,784.50**	**100**

The SHPP Maracanã project activity starting date is 05/12/2011, date in which the construction consortium was signed. Therefore the power plants analyzed were only considered similar to the project activity if they started their commercial operation before 05/12/2011.

The commercial operation starting date of all power plants analyzed in this step were verified in ANEEL's website, available at the following link: http://www.aneel.gov.br/area.cfm?idArea=37 (please, open the files in the "ACOMPANHAMENTO DA EXPANSÃO DA OFERTA DE GERAÇÃO DE ENERGIA ELÉTRICA" title).

Also, as will be addressed below, the analysis only considered those power plants operating as Independent Energy Producers (PIE – *Produtor Independente de Energia*), such as SHPP Maracanã.

Thus, the power plants that were found similar within the criteria mentioned above are presented in the following table, in which N_{all} = 98:

Table 5 – Similar power plants within the criteria established in Steps 1 and 2

Type	Quantity	Total capacity (MW)	%
EOL	8	97.7	9.48
PCH	25	251.6	24.41
UTE	65	681.46	66.11
Total	**98**	**1,030.76**	**100**

[10] Access in 08/05/2012.

The original spreadsheet with all power plants analyzed is available to the DOE.

- **STEP 3:** Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff}.

As defined in paragraph 9 of the "Tool", different technologies in the context of common practice are technologies that deliver the same output and differ by at least one of the following (as appropriate in the context of the measure applied in the proposed CDM project and applicable geographical area):

(a) Energy source/fuel

SHPP Maracanã generates renewable energy through hydroelectricity. Therefore, the eolic and thermal power plants identified in table 5 are not considered similar to the project activity, since their main energy sources are wind, biomass and fossil fuels.

(b) Feed stock; not applicable;

(c) Size of the installation (power capacity): micro; small; and large

All power plants presented in table 5 are within the range of the project's installed capacity and all SHPP of the table are defined as small power plants as per ANEEL's definition[11].

(d) Investment climate in the date of the investment decision, inter alia:

i. Access to technology;

The SHPPs that are considered similar to the project (presented in table 5) have the same conditions to access to technology and, therefore, this criteria was not used to establish any differences between them.

ii. Subsidies or other financial flows;

The Brazilian National Development Bank (*Banco Nacional de Desenvolvimento Econômico e Social* - BNDES) is the major provider of long-term loans in the country; it supplies the financing for projects of all sizes. Unlike other countries, long-term loans are scarcely provided by commercial banks, and in general these entities do not have competitive rates when compared to BNDES. Loan conditions are similar for all SHPPs with a small variation in the spread.

In 2002, the Brazilian government launched a program called Incentive Program for Alternative Electricity Sources (*Programa de Incentivo às Fontes Alternativas de Energia Elétrica* – Proinfa). As defined in the Decree #5,025/2004, the Program was established to raise the share of the electricity generated in the country by enterprises based on renewable sources such as eolic, biomass and SHPPs connected to the national grid (SIN[12]). The Program guarantees a safe market established with long term contracts guaranteed by Eletrobrás at attractive prices and a special credit line granted by BNDES. In its first phase, 63 SHPPs adhered with an installed capacity of 1,191 MW. This first phase ended in 2004 and there is no indication that if or when a second phase will open. Proinfa rulings had still another article stating that all revenues coming from any emission reduction scheme, including the

[11] In Brazil, Small Hydro Power Plants are those with na installed capacity between 1 MW and 30 MW.

http://www3.aneel.gov.br/empreendedor/documentos/002_Capitulo_02.pdf

[12] http://www.mme.gov.br/programas/proinfa

CDM/UNFCCC, would revert to the government. There is still pending litigation as some projects counted on both incentives.

iii. Promotional policies;

No promotional policies were considered as criteria to establish differences between the similar power plants to SHPP Maracanã.

iv. Legal regulations;

This analysis only considered those power plants operating as Independent Energy Producers (PIE – *Produtor Independente de Energia*) such as SHPP Maracanã. In Brazil, there are three other ways to provide electricity:

- Public service (SP – *Serviço Público*);
- Auto electricity production (APE – *Auto Produção de Energia*); and
- Register (REG – *Registro*).

Also, the actual Brazilian regulatory framework for the energy sector was developed between 1994 and 2004, basically in two steps. The first one focused on privatizing and reorganizing the existing structure and in creating regulatory agencies (operational, institutional and market), while the second focused on centralizing planning in order to secure the country's electricity supply, since Brazil suffered a crisis in 2002 when a rationing was enforced due to a severe draught that depleted the main reservoirs in the country, and to speed up the integration of the country's population into the national electric grid[13].

As described in the Electric Power Commercialization Chamber's website[14] (CCEE - *Câmara de Comercialização de Energia Elétrica*), the reform of the Brazilian Electric Sector began in 1993 with the enactment of Law #8,631 which extinguished the equalization of the tariffs that were in effect and created supply contracts between generators and distributors, and which was enhanced by the enactment of Law #9,074 dated of 1995, that created the Independent Producer of Electric Power and the concept of Free Consumers.

In 1996 the Restructuring Project for the Brazilian Electric Sector was implemented (Project RE-SEB), coordinated by the Ministry of Mines and Energy. The paramount conclusions for the project were the need to implement the deverticalization of the electric power companies, that is, to split them up into the generation, transmission and distribution segments, to incentive competition in the segments of generation and commercialization, and to keep the segments of distribution and transmission of electricity under regulation, considered to be natural monopolies under State control. Having been concluded in August of 1998, the RE-SEB Project defined the conceptual and institutional frame of the model to be implemented for the Brazilian Electric Sector.

In 2001, the electric system underwent a serious supply crisis which culminated in an electricity rationing plan. This event generated a series of questionings about the course the electric sector was taking. Purporting to adapt the model being implemented, the Committee for the Revitalization of the Electric Sector Model was instituted in 2002, whose work resulted in an agglomerate of change proposals for the Brazilian electric sector.

Between 2003 and 2004, the Federal Government set the bases for a new model for the Brazilian Electric Sector, supported by Laws #10,847 and #10,848 dated of 15/03/2004, and by the Decree #5,163 dated of 30/07/2004. In institutional terms, the new model defined the creation of an institution that would become responsible for the long term planning of the

[13] http://www.aneel.gov.br/aplicacoes/atlas/pdf/02-Aspectos_Institucionais.pdf

[14] http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=3df6a5c1de88a010VgnVCM100000aa01a8c0RCRD

electrical sector (Energetic Research Company - EPE), an institution the function whereof was to evaluate on a perennial basis the safety of the supply of electricity (Committee for the Monitoring of the Electric Sector - CMSE).

As regards to the electricity commercialization, two ambiences were instituted to execute power purchase and sale agreements - the Regulated Contracting Ambience (ACR), in which participated the Agents for the Generation and Distribution of Electric Power, and the Ambience for Free Contracting (ACL), in which participated the Agents for the Generation, Commercialization, the Importers and Exporters of Electric Power as well as the Free Consumers.

Over this last decade, the Brazilian Electric Sector underwent several changes until the model currently in effect was derived. The table below presents a summary of the major differences between the previous models and the current model, which wound up resulting in changes to the activities to some of the agents for the sector.

Table 6 – Differences between the Brazilian Electric Sector phases
Source: Electric Power Commercialization Chamber's[15]

FORMER MODEL (until 1995)	FREE MARKET MODEL (1995 to 2003)	NEW MODEL (2004 onwards)
Financing using public funds	Financing using public and private funds	
Verticalized companies	Companies classified by activity: generation; transmission; distribution; and commercialization.	Companies classified by activity: generation; transmission; distribution; commercialization; imports; and exports.
Predominantly State- controlled	Competition in generation and commercialization.	
Monopolies – No competition	Competition in generation and commercialization	
Captive consumers	Both free and captive consumers	
Tariffs regulated throughout all sectors	Prices are freely negotiated for the generation and commercialization.	In a free environment: prices are freely negotiated for the generation and commercialization. In a regulated environment: auctions and bids for the least
Regulated market	Free market	Coexistence between free and regulated market.
Determinative planning:	Indicative	Planning accomplished by the

15 http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=3df6a5c1de88a010VgnVCM100000aa01a8c0RCRD

Coordinator Group for the Planning of Eclectic Systems (GCPS).	accomplished by the National Council for Energy Policy (CNPE).	Research Company (EPE).

Taking into account this new regulatory framework, it is only reasonable to consider projects for which the decision making process happened after March of 2004. As PP were unable to find this information for all power plants analyzed in this step, the power plants were only considered similar if they operation started after March, 2004 in a way that they are all set to the same regulatory framework.

Therefore, considering the power plants identified in table 5, only the SHPPs presented below follow the criteria applied and discussed above:

Table 7 – Similar power plants within the criteria established in Step 3

Power	Installed Capacity (MW)	Electricity Generation	Type	CDM	Operation/Commissioning Start	Proinfa
Dianópolis	5.5	PIE	PCH	N	2006	N
Contestado	5.6	PIE	PCH	N	nov/07	N
Caju	10	PIE	PCH	N	jun/07	N

Therefore, N_{diff} = 95.

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

a) $F = 1 – N_{diff} / N_{all}$

$F = 1 – 95 / 98$

$F = 1 – 0.969387$

$F = 0.030613$

As per the “Tool”, the project activity is only a common practice within a sector in the applicable geographical area if both the following conditions are fulfilled:

(a) The factor F is greater than 0.2, and
(b) $N_{all} – N_{diff}$ is greater than 3.

As presented above, the factor F is not greater than 0.2 and, thus, the SHPP Maracanã is not a common practice in the country.

OUTCOME OF STEP 4: As demonstrated in the common practice analysis, similar projects to SHPP Maracanã are not broadly observed and commonly made in Brazil and, thus, the project activity is not considered as a common practice in the country

OUTCOME OF ADDITIONALITY: From all the steps included here in B.5., the conclusion is that the Project is additional, and not (part of) the baseline scenario. Without CDM support, the Project would not be implemented.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

>>For emission factor calculation the method used to make this calculation is the method of dispatch analysis, which is the most appropriate in determining the emission factor of the electrical grid.
This information is needed for renewable energy projects connected to the electric grid and implanted in Brazil under the **Clean Development Mechanism (CDM)** of the Kyoto Protocol.
The data result from the work of the Electrical System Operator (ONS) of the Ministry of Mines and Energy (MME) and the Ministry of Science and Technology, which are available to proponents of CDM projects.
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.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html

The emission reductions of project activity (ER_y) are quantified through the subtraction of project emissions ($PE_{HP,y}$) from baseline emissions (BE_y).

$$ER_y = BE_y - PE_y$$

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

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

According to the methodology ACM0002, 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 higher than 4W/m^2 and lower than or equal to 10W/m^2:

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

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 power density of project is greater than 10 W/m^2:

$PE_{HP,y} = 0$

The power densities of the project activity are calculated as follows:

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

Where:

PD Power density of the project activity, in W/m^2.
Cap_{PJ} Installed capacity of the hydro power plant after the implementation of the project activity (W).
Cap_{BL} Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero.
A_{PJ} Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).
A_{BL} Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

SHPP Maracanã has power density greater than $10 W/m^2$:

PD=10,656,000–0 / 318,000–0 = 33.51 W/m^2

The reservoir emissions are zero.

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:

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

Where:
BE_y Baseline emissions in year y (tCO_2e/yr);
$EG_{PJ,y}$ Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr);
$EF_{grid,CM,y}$ Combined margin CO_2 emission factor for grid connected 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 three new grid-connected renewable power plants/units at sites where no renewable power plants were operated prior to the project activity implementation , thus classified as a Greenfield renewable energy power plants.

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

$$EG_{PJ,y} = EG_{PJ,\ facility,y}$$

Where:
$EG_{PJ,y}$ Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr);
$EG_{facility,y}$ Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr).

$$EG_{PJ,facility,y} = EG_{Maracanã}$$

$$EG_{PJ,facility,\ y} = 60{,}969 \text{ MWh/yr}$$

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$Cap_{BL,y}$
Data unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Project site.
Value(s) applied	0
Choice of data or measurement methods and procedures	The methodology for which this value is applied in new hydroelectric plants.
Purpose of data	Calculation of project emissions.
Additional comment	

Data/Parameter	$A_{BL,y}$
Data unit	m^2
Description	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). 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	$EF_{grid,BM,y}$
Data 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	0.1370
Choice of data or measurement methods and procedures	According procedures established by the most recent version of "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions.
Additional comment	To the *ex-ante* estimative of the emission reductions, were used the datas related to the year 2018 (ultimate available data).

B.6.3. Ex ante calculation of emission reductions

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

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”, and the fact that the 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), the Brazilian electricity system boundaries are clearly defined.

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

Since the Brazilian DNA has made available the 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 12 months emission factors of the operating margin, published by the DNA (data available to year 2019)[16].

Table 8: Emission Factor of Operating Margin for year 2019

OPERATING MARGIN												
Average Emission Factor (tCO_2 / MWh)												
2019	MONTH											
	January	February	March	April	May	June	July	August	September	October	November	December
	0.3540	0.5573	0.5075	0.5095	0.4794	0.4175	0.5914	0.5312	0.5606	0.5370	0.5720	0.5997

Thus, the Emission Factor of Operating Margin is:

$$EF_{grid,OM-DD,y} = 0.5181$$

[16] http://www.mct.gov.br/index.php/content/view/74689.html

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 of these are made publicly available in its web site to consultation.

According to the used 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 $EF_{grid,BM,y}$ also will be adopted the 2018 year value published by the DNA [17].

Table 9: Latest data from Brazilian DNA to Emission Factor Build Margin (2018)

BUILD MARGIN	
Average Emission Factor (tCO_2/MWh) - **ANNUAL**	
2018	
	0.1370

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

$$EF_{grid,BM,y} = 0.1370$$

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

To calculation of combined margin emission factor (combination of operation and build margins) is used a weighted-average formula, considering w_{OM} = 0.25 and w_{BM} = 0.75 (second credit period). As a conservative approach, below is presented the emission factor calculated using four decimal places, rounded down. Thus, the result is:

$$EF_{grid,CM,y}=0.5181x0.25+0.1370x0.75=0.23227\ (tCO_2/MWh)$$

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.

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

$$BE_y = 60{,}969 \times 0.23227 = 14{,}161\ tCO_2/yr$$

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

$$ER_y = BE_y - PE_{HP,y}$$

Where:
ER = Emission reductions in year y (tCO_{2e}/yr)
BE = Baseline emissions in year y (tCO_2/yr)
PE = Project emissions in year y (tCO_{2e}/yr)

Considerening the emissions related to the SHP reservoirs are zero, the Project activity emissions reductions are calculated as below:

[17] http://www.mct.gov.br/index.php/content/view/338049.html#ancora

$$ER_y = 14,161 - 0 = 14,161\ (tCO_2/yr)$$

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

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
2019 December	889	0	0	889
2020	14,161	0	0	14,161
2021	14,161	0	0	14,161
2022	14,161	0	0	14,161
2023	14,161	0	0	14,161
2024	14,161	0	0	14,161
2025	14,161	0	0	14,161
2026 December	13,272	0	0	13,272
Total	99,127	0	0	99,127
Total number of crediting years	7			
Annual average over the crediting period	14,161	0	0	14,161

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$EG_{PJ,facility,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Electricity meter at output of substation
Value(s) applied	60,969
Measurement methods and procedures	The measurement of the energy generated and delivered to the grid will be done by two bi-directional energy meters which will send data to the grid through a gateway. When the main meter fails to work normally, the spare meter starts reading and the information is not lost. The precision of the meters are Class – 0.2% as per Brazilian regulations ("*Norma Brasileira Medidores Eletrônicos de Energia Elétrica (estáticos)* NBR 14,519"). The calibration of the meters will be done complying with the National System Operator (*Operador Nacional do Sistema* – ONS) regulations.
Monitoring frequency	Continuous monitoring, hourly measurement and at least monthly recording
QA/QC procedures	Uncertainty level of data is Low. The electricity generated will be monitored by project participants and it will be checked by the available datasheets in the CCEE website (information comparison between operation data and CCEE reports, mainly the report ME001).
Purpose of data	Calculation of baseline emissions.

Additional comment	-

Data/Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2e/MWh
Description	Combined Margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”.
Source of data	Based on data provided by DNA (Designated National Authority).
Value(s) applied	0.23227
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} = 0.25 and w_{BM} = 0.75. 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 *ex-ante* estimative of the emission reductions, were used the datas related to the year 2019 for $EF_{grid,OM-DD,y}$ and 2018 for $EF_{grid,BM,y}$ (ultimate available datas).

Data/Parameter	$EF_{grid,OM-DD,y}$
Data 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	0.5181
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 *ex-ante* estimative of the emission reductions, were used the datas related to the year 2019 (ultimate available datas).

Data/Parameter	A_{PJ}
Data unit	m^2
Description	Area of the reservoir measured in the water surface, after the implementation of the project activity, when the reservoir is full.
Source of data	Reservoir in the Project site.
Value(s) applied	318,000
Measurement methods and procedures	Measured from topographical surveys, maps, satellite pictures, etc.
Monitoring frequency	Once at the beginning of each crediting period
QA/QC procedures	
Purpose of data	Calculation of the project emissions
Additional comment	This data is applied for the Power Density calculation.

Data/Parameter	Cap_{PJ}
Data unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data	Equipments Plaques
Value(s) applied	10,656,000
Measurement methods and procedures	Technical specifications on the installed equipments.
Monitoring frequency	Once at the beginning of each crediting period
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	

B.7.2. Sampling plan

>> Not applicable.

B.7.3. Other elements of monitoring plan

>> Data that has to be monitored during the life of the contract of the project is the quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity ($EG_{BL,y}$), which the project owner will continuously measure, as per the procedures set by the approved monitoring methodology "AMS-I.D. Grid connected renewable electricity generation" (version 18.0) for emissions reductions from small scale projects.

The monitoring procedures for data measurement, quality assurance and quality control are described below. The grid Emission Factor, which will be applied *ex-post*, is published annually on an hourly basis by the Brazilian DNA.

Monitoring Procedures

The measurement of the electricity generated and delivered to the grid will be done by two bi-directional energy redundant meters which will send data to the grid through a gateway. Energy generation measurements will be made at two points:

a) At the output of the powerhouse (total energy);
b) At the output of the substation, point of dispatch to the national grid, integrated with the substation's control system, this meter transmits energy measurements to:

- ONS (National System Operator) – via VPN; and
- CCEE (*Câmara de Comercialização de Energia Elétrica*), official regulator of the electricity market, acting as the registry for contracts and transactions. CCEE uses electricity generation information in order to bill the transmission services between generator and end-consumer, among other uses.

The figure below shows the simplified unifilar diagram indicating the instruments location:

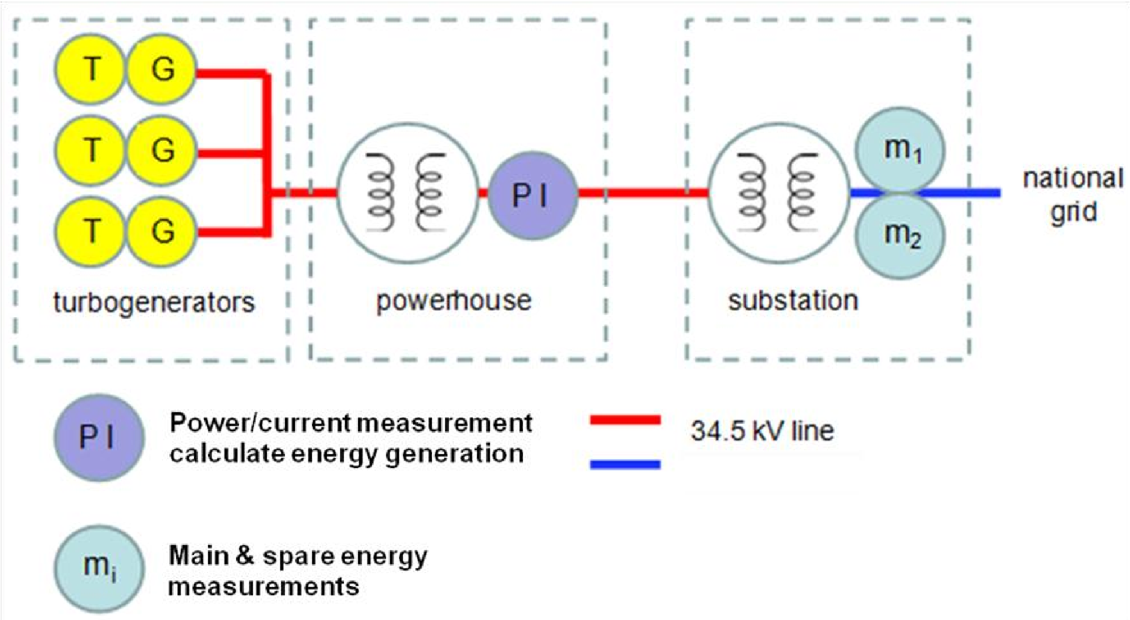

Figure 7 – Simplified unifilar diagram

All the procedures for measuring the electricity are defined by ONS according to "Module 12" of the Grid Procedures document, which provides for measurements with invoice purposes aiming to establish the responsibilities, systematic and deadlines for the development of projects under the Measurements with Invoice Purposes System ("*Sistema de Medição para Faturamento"* – SMF), for the maintenance and inspection of the system and for SMF standard meter readings and certification. The established procedures reflect good monitoring and reporting practices.

Management and organization structure

The project sponsor will proceed with the necessary measures for electricity control and monitoring. Additionally, using the data collected by ANEEL and ONS, it will be possible to monitor the electricity generation of the project and the grid power mix.

Quality Control and Quality Assurance

Calibration

The meters calibration will be done according to ONS's Sub-Module 12.3 "Maintenance of the Measurement System for Billing"[18], which attributes responsibilities regarding standards certification and establishes all necessary activities to guide responsible agents in the SMF (the Invoice Measurement System, or *Sistema de Medição para Faturamento*) maintenance, considering traceability guarantee and work standards calibration with reference to INMETRO's standards or RBC (the Brazilian Calibration Grid or *Rede Brasileira de Calibração*) laboratories.

When doubts are detected in either the main or spare meter, an order is issued to calibrate, test and repair the meter.

[18] Link: http://www.ons.org.br/%2FProcedimentosDeRede%2FM%C3%B3dulo%2012%2FSubm%C3%B3dulo%2012.3%2FSubm%C3%B3dulo%2012.3%202016.12.pdf

Maintenance and training procedures

Maracanã Energética will be responsible for the maintenance of the monitoring equipments for dealing with possible monitoring data adjustments and uncertainties.

Maracanã Energética is the responsible for the project management as well as for organizing and training of the staff in the appropriate monitoring, measurement and reporting techniques.

Data Archiving

All metering data is stored according to ONS's Sub-Module 12.4 "Invoice Measurement Data Collection", which establishes all responsibilities and activities regarding the direct and/or indirect collection of energy generation data, the quality of this energy and the meters in the SMF. The direct collection of electricity related data from the SMF is done through direct access of the meters by the SCDE (the Energy Collection Data System or *Sistema de Coleta de Dados de Energia*).

The SCDE is responsible for the daily collection and treatment of all measurement data, obtained directly from the meters. This system allows the performance of logical inspections with direct access to meters, providing a much more reliable and accurate data.

The frequency of archiving and submitting data related to the SHPP Maracanã will be done annually. According to an internal procedure of SHPP Maracanã, all data collected as part of the monitoring plan will be archived electronically and will be kept for 2 years after the last credit issuance. The procedures for data collection and storage are described on the Document: "Procedure for Control and Archiving of Documents Related to CERs Changes in SHPP Maracanã".

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>05/12/2011, date in which the project's Construction Consortium contract was signed.

C.2. Expected operational lifetime of project activity

>>30 years and 0 months.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>> Renewable being:

07/12/2019 until 06/12/2026 the second crediting period

C.3.2. Start date of crediting period

>> The starting date of the second crediting period of the project activity is 07/12/2019

C.3.3. Duration of crediting period

>>7 years and 0 months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>> As for the regulatory permits, the proposed project activity has received the following authorization resolutions issued by ANEEL:

- ANEEL Dispatch n° 1,994 issued on 23/05/2008: Approves the Basic Project of SHPP Maracanã;
- ANEEL Authorization Resolution n° 2,144 issued on 27/10/2009: Authorizes Maracanã Energética S.A. to operate as an independent electricity producer and gives the right to operate the SHPP Maracanã.

The resolution CONAMA n° 001 of 23/01/1986 establishes that hydropower plants with more than 10 MW need an Environmental Impact Assessment (EIA) and the respective Environmental Impact Report (RIMA).

The national legislation requires the issuance of the following environmental permits:

- Preliminary Permit (Licença Prévia or L.P.) – issued during the preliminary phase of the project planning, attesting the environmental viability, and containing basic requirements to be presented during the construction and operation.
- Construction Permit (Licença de Instalação or L.I.)
- Operating Permit (Licença de Operação or L.O.) – issued before the dam closin

The project has the following environmental licenses:

- Preliminary Permit #299826, issued on 10/12/2010 by the Mato Grosso Environmental Secretary Secretaria de Estado do Meio Ambiente – SEMA).
- Construction Permit #58793, issued on 10/12/2010 by the Mato Grosso Enviromental Secretary Secretaria de Estado do Meio Ambiente – SEMA).

D.2. Environmental impact assessment

>> The environmental impacts caused by the project's activities are considered not significant. Small run of river hydropower plants have as main characteristic the construction of small reservoirs, which is one of the SHPP Maracanã main features.

The SHPP Maracanã meets the environmental requirements for its implantation, as can be demonstrated by the fact that the project has a Construction Permit and meets ANEEL's (Brazilian Electric Energy Agency) norms. Even so, project participants, when developing the Project Basic Design Document, identified the main negative environmental impacts which can occur as a result of the implementation of the project activity. These impacts are considered in the Project Basic Design Document and are listed below:

- Development or acceleration of erosion and siltation points;
- Interference in water quality;
- Interference in groundwater levels;
- Slope instabilities;
- Flora interference;
- Interference in biodiversity;
- Macrophytes proliferation in the project reservoir; and
- Ichthyofauna interference upstream the project's dam.

<u>Development or acceleration of erosion and siltation points</u>

This impact is considered during the construction of the SHPP Maracanã, as a result of earth moving and excavations in areas which may be susceptible to erosion, and due to the exploration of construction materials necessary to the project construction.

This aspect is considered as a negative, local and temporary impact, which will not provoke significant environmental modifications that can compromise the construction or the environment, as long as preventive and/or corrective actions are adopted to mitigate these impacts. The preventive measures suggested are:

- Slopes coating with plants, immediately after the conclusion of earth moving and excavations, preferably with grasses and legume plants;
- Execution of an efficient drainage system for rainwater on the access roads, and provisional drainage during the project construction.

Interference in water quality

The interference in the reservoir water quality ought to be considered in the early stages of project implantation by earth moving, with an increase in suspended solids. When the area next to the reservoir is not cleared, the decomposition of organic matter reduces the dissolved oxygen content and increases the concentration of nutrients, acidity and turbidity, causing problems downstream and compromising the quality of the water. The following measures can be taken to prevent these problems:

- Deforestation of the reservoir area;
- Deploy a limnological and a water quality monitoring program.

Interference in groundwater levels

The creation or formation of artificial reservoirs in regions with sandy soil induces modifications in surface and ground water regimes in the area surrounding the reservoir, exerting an influence on the aquifer, with the immediate consequence of raising the groundwater level. This phenomenon can cause physical changes such as wetlands, increasing relative humidity of the soil by decreasing the unsaturated zone, and erosion. In order to minimize these impacts, the most susceptible areas will be identified, considering geological, hydrological, geomorphological, soil and geotechnical characteristics in the area next to the reservoir, and water level meters will be implanted (piezometer) in selected areas to monitor eventually interferences in the groundwater levels.

Slope instabilities

The SHPP Maracanã will be constructed in an area susceptible to instability which can suffer slope's blocks sliding, especially in the penstock, power house and adduction canal areas. Therefore, the following measures are suggested to prevent slope instabilities:

- Identification of susceptible areas through geological-geotechnical mapping;
- Identification of upwelling areas along the slope and other areas susceptible to movement
  (cracks, rebates or any other slip areas); and
- Proposition of preventive and/or corrective control measures.

Flora interference

This is an impact resulting from the clearing of riparian vegetation part of the permanent preservation area along the Maracanã stream and of native vegetation on the reservoir area and construction site, leading to disruption of wildlife corridors and reducing the production of food for animals. The areas affected by this impact are covered by different vegetation types, involving Alluvial Forest and Wooded Savannah (Cerrado), with predominance of the Cerrado.

One way to minimize such impacts will be the implementation of a system of reforestation using native species that originally occupied these spaces on the entire edge of the reservoir, in the range of 100 meters wide. Other recommended measures are:

- Rescue of wildlife during the deforestation process; and

- Execution of a rational deforestation seeking individuals to work in construction, firewood or other activities in the rural properties surrounding the project.

<u>Interference in biodiversity</u>
This impact is caused by the removal of vegetation, increased movement around the area, noise, resulting in decreased rates of fauna and floral diversity, and changing the composition of communities, directly affecting the local populations, which may cause the extinction of some species. Added to these events is the increased mortality as a result of hunting in the region, potentially related to the arrival of workplace and with the filling of the reservoir. The mitigation measures proposed are:

- Rescue of individuals before filling the reservoir;
- Deforestation outside the reproductive period, in order to mitigate the loss of active nests; and
- Deployment of an environmental education program among the workers and the surrounding population, in order to reduce poaching.

<u>Macrophytes proliferation in the project reservoir; and</u>
This is an impact that may occur with the formation of the reservoir, since it creates a favorable condition for the reduction in the system's hydrodynamic and nutrients release through degradation of flooded organic matter to the proliferation of macrophytes. This event, on one hand, increases in the niche space supply and on spawning areas for some species, significantly altering the aquatic ecosystem metabolism and resulting in the formation of propitious environments to vector diseases.

The mitigation measures recommended are:

- Monitoring the evolution of macrophytes; and
- Mechanical removal of macrophytes in critical locations in the reservoir.

<u>Ichthyofauna interference upstream the project's dam</u>

The reservoir that will be formed with the implementation of the project activity, a new environment will be formed with crystalline water and with the formation of rapids and a waterfall. This fluvial landscape modification will reflect, in the influence area, on the composition of aquatic groups with the eventual loss of aquatic biodiversity. On the other hand, a significant increase on biomass can be expected with the development of new species in the area.

Regarding the quality of fishes, the levels of metals present in the area are low, making a contamination unlikely to happen. Still, it recommended the adoption of follow-up actions and mitigation measurement such as the monitoring of the Ichthyofauna and fishes quality.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>> As per Resolution n° 1 of 01/09/2003 and Resolution n° 7 of 07/03/2008, issued by the Brazilian DNA – Inter-Ministry Commission on Global Climate Change (CIMGC), any CDM projects shall send a letter describing it activities and requesting commentaries by local interested parties. Invitation letters were sent in 20/01/2011 to the agents listed below (copies of the letters and post office confirmation of receipt communication are available upon request). The return receipts of the letters were received between.26 and 27/01/2011.

- *Ministério Público Federal* (Federal Public Attorney);

- *Fórum Brasileiro de ONGs e Movimentos Sociais para o Meio Ambiente e Desenvolvimento – FBOMS* (Brazilian Forum of ONGs and Social Movements for the Development and Environment);
- *Ministério Público Estadual do Mato Grosso* (Mato Grosso's State Public Attorney);
- *Secretaria de Estado do Meio Ambiente do Mato Grosso* (Mato Grosso's State Environmental Agency);
- *Prefeitura Municipal de Nova Marilândia – MT* (Nova Marilândia's City Hall);
- *Câmara dos Vereadores de Nova Marilândia – MT* (Nova Marilândia's City Council);
- *Secretaria de Meio Ambiente de Nova Marilândia - MT (Nova Marilândia's Environmental Agency);*
- *Associação dos Avicultores de Nova Marilândia – MT* (Nova Marilândia's Poultry Association).

E.2. Summary of comments received

>> No comment has been received.

E.3. Consideration of comments received

>> No comment has been received.

SECTION F. Approval and authorization

>> The Letter of Approval was obtained after the DOE´s Final Validation Report issuance and before the CDM Executive Board project request for registration in 23/11/2012.

Appendix 1. Contact information of project participants

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Fax	
E-mail	sergio.ennes@luminaenergia.com.br
Website	
Contact person	Sérgio Augusto Weigert Ennes

Appendix 2. Affirmation regarding public funding

There is no kyoto protocol annex 1 country public fund financing this project activity

Appendix 3. Applicability of methodologies and standardized baselines

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 CO_2 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.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html .

Appendix 5. Further background information on monitoring plan

The monitoring plan will be executed based on the simplified baseline and monitoring procedures established in the AMS-I.D, "Grid-connected renewable electricity generation" - version 18.0.

Maracanã Energética will be responsible for proceeding with the established procedures and will record the data related to the electricity generated by the renewable technology.

All the procedures that will be used in the monitoring are described on the item B.7.

Appendix 6. Summary report of comments received from local stakeholders

Not applicable

Appendix 7. Summary of post-registration changes

Post-registration changes, PRC-8474-001, approved on 14/01/2016 (1st Crediting Period).
Reason: Adjustments over installed power capacity, installed equipments, reservoir area.

In resume, the changes in the parameters of the registered CDM project activity were:

Table 10: Changes in the parameters

Parameters:	PDD version 02 1st CP	PDD version 03 1st CP
Generators (MW) - 2 units	5.24	5.328
Turbines (MW) – 2 units	5.41	5.528
Installed Capacity (MW)	10.5	10.656
Energy Assured (MWavg)	7.03	6.96
Reservoir (km^2)	0.05	0.318
Power Density (W/m^2)	210	33.51

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).

Version	*Date*	*Description*
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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