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

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

Santo Antonio Hydropower Project

PDD version: 01.1 (27/10/2011)

A.2. Description of the project activity:

The Santo Antonio Hydropower Project (hereafter referred to as the "Project") developed by Santo Antônio Energia S.A (hereafter referred to as the "Project Developer"), is a grid-connected hydropower plant with a run-of-river reservoir in Rondônia, Brazil (hereafter referred to as the "Host Country"). Total installed capacity of the Project will be 3,150.4 MW, consisting of 44 horizontal bulb turbine units, with a predicted total electricity generation of 2,218 MW_{avg} or 19,429,680 MWh per annum[1].

The purpose of the Project is to utilise the hydrological resources of the Madeira River close to the city of Porto Velho, capital of the state of Rondonia, in order to generate low emissions electricity for the Brazilian National Interconnected System (SIN, from the Portuguese, "Sistema Interligado Nacional"), thereby displacing more carbon-intensive electricity generation, reducing greenhouse gas (GHG) emissions. The baseline scenario is the continuation of the current situation, i.e. to use all power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance. The additional power generated under the project would be generated in existing and new grid-connected power plants in the electricity system.

The Project unequivocally contributes to sustainable development of the Host Country. Specifically, the Project:

- Increases employment opportunities in the area where it is located during the construction and operation;
- Enhances the local investment environment, and therefore improves the local economy;
- Diversifies the sources of electricity generation through regional integration. This is important for meeting growing energy demands, and transitioning away from fossil-fuel-fired electricity generation. Additionally, the Project was designed to have the lowest possible impact on the environment, for example, the horizontal bulb turbines use to reduce the increased flooded area of the reservoir and,
- Makes use of renewable hydroelectric resources.

It is also worth mentioning that, as a "prerogative of the host country on the design and implementation of policies to promote or give competitive advantage to low greenhouse gas emitting

[1] *Brazilian Ministry of Mines & Energy* (MME, from the Portuguese "Ministério das Minas e Energia"), Ordinance 293 issued on 22/10/2007. Estimated total yearly generation: 365 days/year × 24 h/day × 2,218.0 MW_{avg} = 19,429,680 MWh/year

fuels and technologies[2]," the Brazilian Government already in the first version of its *National Plan on Climate Change*[3] included the goal to keep a high share of renewables in the primary energy sources and to increase hydropower generation. In the plan the Project and other hydropower plants are referenced as cumulatively reducing 184 million tCO_2e. The goal was later communicated by the Brazilian Government to the UNFCCC in January 2010[4], as a follow up of the Copenhagen Accord, as follows:

> *Increase in energy supply by hydroelectric power plants (range of estimated reduction: 79 to 99 million tons of CO2 eq in 2020).*

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Santo Antonio Energia S.A	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Further contact information of project participants is provided in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil

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

State of Rondônia

A.4.1.3. City/Town/Community etc:

[2] UNFCCC (2009). Decision 5/CMP.5, paragraph 11.
[3] Comitê Interministerial sobre Mudança do Clima (2008). Plano Nacional sobre Mudança do Clima.
[4] Communication from the Government of Brazil to the UNFCCC indicating the intended nationally appropriate mitigation actions, the use of the CDM not excluded (29 January 2010). Retrieved on 04/10/2011from http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5262.php.

City of Porto Velho

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

The exact location of the Project is defined using geographic coordinates of the dam's axis 8°47'31"S 63°57'7"W[5]

Figure 1 - Physical location of the project activity

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

Renewable electricity generation for a grid.

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

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

The purpose of the Project is to use well-established hydro power generation technology for electricity generation and transmission. This low emissions electricity will be delivered to the grid, thereby displacing CO_2 emissions from grid-generated electricity. The baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity: electricity delivered to the grid by the Project would have otherwise been generated by the operation of grid-connected power plants, and by the addition of new generation sources. Equipment and systems in operation in the scenario existing prior to the start of the implementation are all power plants physically connected to the grid to which the Project is connected[6].

[5] Despacho ANEEL 3.115, de 21 de agosto de 2008.

[6] The Brazilian Designated National Authority for the CDM released on 26/05/2008 resolution # 8 defining the Brazilian National Interconnected Grid as a single system (http://www.mct.gov.br/upd_blob/0024/24719.pdf, retrieved on 17/10/2011).

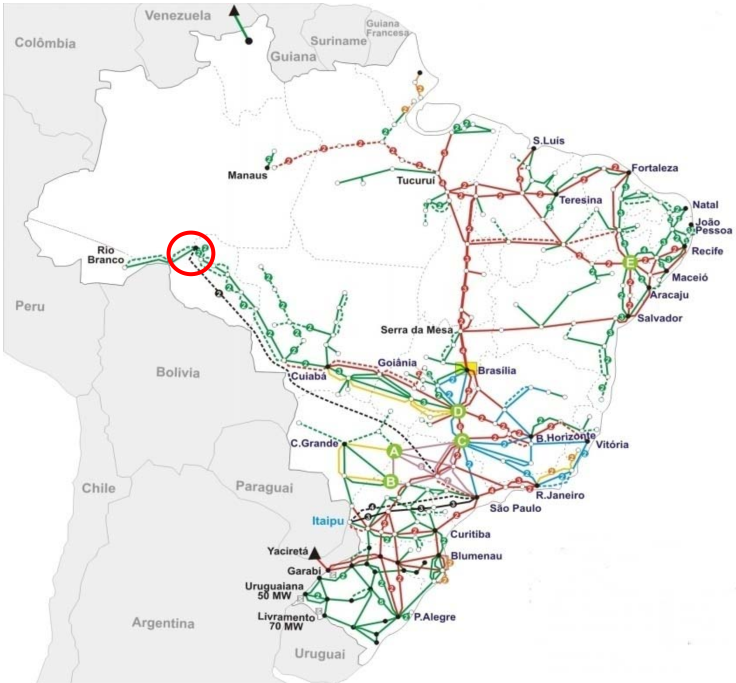

Figure 2 - Brazilian National Interconnected Grid[7]

The Project is a run-of-river hydropower plant with total installed capacity of 3,150.4 MW. Run-of-river plants produce electricity according to the flow of water in the river it has been built in. Water is shored at lowhead hydroelectric plants and channeled through turbines using the natural force of the river flow. Seasonal variations determine the water level in the river and thus the strength of the water flow and its implicit available energy[8]. Using the long-term average river flow of 18,847 m^3/s and the reservoir normal total volume of $2,888.36\times10^6$ m^3, less than 2 days of total storage capacity[9].

The following technical information is retrieved from the revised Basic Project Design, approved by the *Brazilian Electricity Regulatory Agency*[5] (ANEEL from the Portuguese, “Agência Nacional de Energia Elétrica”) in 2008 and, further revised in 2009. Still, it shall be clear that during the construction some technical specifications, may suffer small changes.

The water barrier consists of an earth-filled embankment and compacted concrete gravity dam. The earth filled one has approximate length of 390m and height of 40m[10]. The total length of the dam is approximately 662m with a maximum height of 55m[11]. Two controlled spillways with a total of 18 radial gates have a water flow capacity of 84,000 m³/s and length of about 460m will regulate the water level of the reservoir[12].

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[7] Source: *National Electric System Operator* (ONS, from the Portuguese “Operador Nacional do Sistema Elétrico”). Retrieved on 15 April 2011 from http://www.ons.org.br/conheca_sistema/mapas_sin.aspx#.
[8] International Energy Agency (2004). Variability of Wind Power and Other Renewables, Management options and strategies.
[9] UHE Santo Antônio response letter from 16/06/2011 in response to the ANEEL request from 14/04/2011.
[10] UHE Santo Antônio (2009). Basic Project Design, Volume I, chapter 5, page 21
[11] UHE Santo Antônio (2009). Basic Project Design, Volume I, chapter 5, page 16.
[12] UHE Santo Antônio (2009). Basic Project Design, Volume I, chapter 5, page 17

The reservoir area was initially determined based on an elevation of 70.0 m. However, the calculation was updated in 2011 by considering an elevation of 70.5 m[13]. The maximum reservoir area, calculated for the maximum river flow of 38,550 m3/s (maximum-maximorum with annual recurrence), is 546.0 km^2, including the remanso/backwater effect[14]. Nevertheless the figure cannot be considered flooded area due to the backwater short duration. The project's reservoir area under the normal maximum water level of 70.5 m is 354.40 km^2, of which 164.00 km^2 are the river course and, therefore, the increased flooded area is190.40 km^2.

According to a clarification approved by the CDM EB[15], "in order to calculate power density, the correct equation will be the increased power capacity divided by the increased flooded area measured in the water surface". Therefore, the power density of the project activity is 16.55 W/m^2, in compliance with the applicability condition of the methodology.

The annual high and steady water flow of the Madeira River (long term average flow of 18,850 m^3/s)[16] and construction of a low dam enables the use of the bulb type turbine (Figure 3), consequently resulting in a small reservoir. The 44 turbine/generator sets will be distributed in 4 units. The first set (1 to 8) is located on the right margin of the complementary spillway. The second (9 to 20) and third set (21 to 32) are located on the left margin and the fourth one (33 to 44) on the river bed.[17]

The plant will be connected to the Porto Velho substation by four 525 kV three-phase 60 Hz transmission lines, located close to the city of Porto Velho and, used for connecting the power plant to the national grid.

Additionally, a navigation channel equipped with a sluice gate on the left margin of the river will be constructed to enable the navigation along this river portion, thus making the Madeira River integrally navigable[18], constituting an important step for the formation of a waterway system connecting Brazil, Bolivia and Peru.

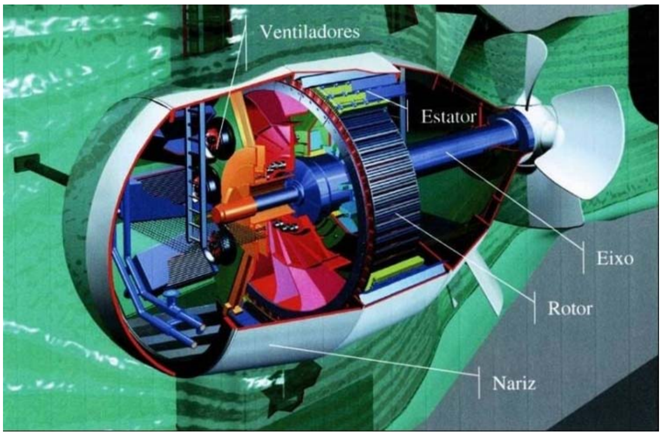

Figure 3 - Bulb Turbine

[13] Third concession contract amendment dated on June 2nd, 2011.
[14] IBAMA, Licença de operação Nº 1044/2011.
[15] AM_CLA_0049 available at http://cdm.unfccc.int/methodologies/DB/AS1DOF3L010BY57ZT2UZNQ8Y9K83CN/view.html
[16] UHE Santo Antônio (2010). Estudos de Remanso do Reservatório da UHE Santo Antonio.
[17] UHE Santo Antônio (2009). Basic Project Design, Volume I, chapter 5, page 4.
[18] Leme Engenharia (2005). RIMA Usinas Hidrelétricas de Santo Antonio e Jirau.

The main technical parameters of the proposed Project are shown in Table 1.

Table 1 - Main technical parameters of the proposed Project

Technical Parameter	Value	Source
Forecasted installed capacity (MW)	3,150.4	MME Ordinance 293/2007
Forecasted guaranteed energy generation (MW)	2218.0	MME Ordinance 293/2007
Forecasted annual power generation, at full operation (MWh/yr)	19,429,680	Calculated
Additional surface area at full reservoir level (km^2)	190,40	UHE Santo Antônio letter from 16/06/2011 in response to the ANEEL request from 14/04/2011.
Power Density (W/m^2)	16.55	Calculated according to methodology

Table 2 - Technical characteristics of the generating equipment[19]

Turbine		
Turbine Type	Bulb (Kaplan rotor)	
Number of blades	4	5
Nominal Capacity (kW)	73,280	69,590
Generator		
Generator Type	Three-phase synchronous	
Designed Capacity (MW)	74,025	
Nominal Capacity (kVA)	82,250	

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

Table 3 – Project emissions reductions over the crediting period

[19] UHE Santo Antônio – Basic Project Design (Projeto Básico Consolidado), chapter 5, page 4

Years	Annual estimation of emission reductions in tonnes of CO_2e
2012*	518,205
2013	2,720,189
2014	4,953,586
2015	5,830,126
2016	5,846,099
2017	5,830,126
2018	5,830,126
2019	5,830,126
2020	5,846,099
2021	5,830,126
2022**	2,429,219
Total estimated reductions (tonnes of CO_2e)	51,464,028
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	5,146,403

* June to Dec.

** Jan. to May

Refer to Section B.6.3 for further details on the quantification of GHG emission reductions associated with the Project.

A.4.5. Public funding of the project activity:

No official development assistance or related public funding was or will be used in Santo Antonio Hydropower Project.

SECTION B. Application of a baseline and monitoring methodology

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

1. ACM0002 - Consolidated methodology for grid-connected electricity generation from renewable sources, version 12.2.0;
2. Tool for demonstration and assessment of additionality, version 06.0.0;
3. Tool to calculate the emission factor for an electricity system, Version 02.2.1.

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

ACM0002 is chosen and applicable to the proposed project for the following reasons:

- The project activity is a grid-connected renewable power generation project activity that installs a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity;
- The project activity is the installation of a run-of-river hydroelectric power plant;
- The project activity results in a new reservoir, and the power density of the power plant is greater than 4 W/m^2;
- The project activity does not involve switching from fossil fuels to renewable energy at the site of the project activity;
- The project activity is not a biomass fired plant.

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

The project boundary is defined by the emissions targeted or directly affected by the project activities, construction and operation. It encompasses the physical, geographical site of the hydropower generation source, which is represented by the respective river basin of the project close to the power plant facility, as well as the interconnected grid (Figure 4).

On May 26th, 2008, the Brazilian Designated Authority for the CDM released resolution number 8 defining the SIN as a single system[6].

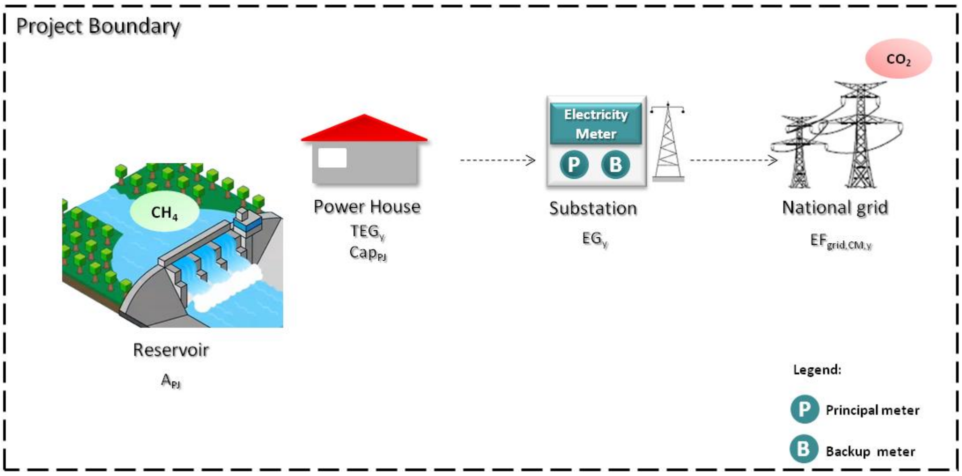

Figure 4 – Project boundary

The GHG sources and gases included in the project boundary are listed in Table 4.

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

	Source	Gas	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants connected to the Brazilian Interconnected System	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source.
		N_2O	No	Minor emission source.
Project Activity	Emissions of CH_4 from the reservoir	CO_2	No	Minor emission source
		CH_4	No	Since the power density of the project is greater than 10 W/m^{2,} no GHG emissions from the project have to be considered according to ACM0002.
		N_2O	No	Minor emission source.

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

As the project activity is the installation of a new grid-connected renewable power plant, the baseline scenario in accordance with ACM0002 is the following:

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

Table 5 - Key information and data used for the baseline scenario calculation

Variable	Unit	Data Source
Operating margin emission factor ($EF_{grid,OM,y}$)	tCO_2/MWh	Brazilian DNA.
Build margin emission factor ($EF_{grid,BM,y}$)	tCO_2/MWh	Brazilian DNA.
Baseline (combined margin) emission factor ($EF_{grid,CM,y}$)	tCO_2/MWh	Calculated
Forecasted annual power supply to the grid	MWh	Calculated (electricity generated by the Project based on the officially defined assured energy)

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

According to ACM0002, the additionality of the project activity shall be demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality." Therefore, the following stepwise approach is applied.

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

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

Santo Antonio Energia S.A. is a special purpose company (SPC) set up specifically to construct and operate the UHE Santo Antonio. Hence, based on the nature of these companies, namely the project participants, the only realistic alternatives to the project activity identified are:

(a) Alternative 1: The proposed Project activity undertaken without being registered as a CDM project activity;

(b) Alternative 2: Continuation of the current situation, i.e. electricity will continue to be generated by the existing generation mix operating in the grid.

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

The alternative(s) shall be in compliance with all mandatory applicable legal and regulatory requirements.

(a) Alternative 1: Is consistent with current laws and regulations. There is no regulation in Brazil preventing the implementation of hydroelectric power plants.

(b) Alternative 2: Is consistent with current laws and regulations.

Outcome of step 1b: Both identified realistic and credible alternative scenario(s) to the project activity that are in compliance with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

Proceed to Step 2 (Investment analysis) or Step 3 (Barrier analysis).

PPs selected to complete step 2, investment analysis.

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

According to the "Tool for the demonstration and assessment of additionality", three options can be applied to conduct the investment analysis. These are "Simple Cost Analysis" (Option I), "Investment Comparison Analysis" (Option II), and "Benchmark Analysis" (Option III).

Options I and II are not applicable to the proposed project activity since:

- Alternatives identified in Step 1 generate financial and economic benefits other than CDM related income (option I not applicable).
- The implementation of other project types of renewable energy generation are not potential alternatives in the site where the project is planned (option II not applicable).

Sub-step 2b. Option III – Application of benchmark analysis

The likelihood of development of the Project, as opposed to the continuation of the generation of grid electricity from the existing generation mix (i.e., *Alternative 2*), will be determined by comparing the Project IRR without CDM financing (*Alternative 1*) with benchmark rates applicable to a local investor.

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

The most suitable financial indicator for the benchmark analysis is the Internal Rate of Return (IRR). The IRR is the annualized effective compounded return rate which can be earned on the invested capital, i.e., the yield on the investment. In other words, it is the precise discount rate that makes the present value of the future cash returns from a capital investment exactly equal to the initial amount of capital invested. If IRR is higher than the benchmark, the investment is an attractive opportunity; if less, the investment is substandard from the cost-of capital point of view.

Naturally, investors are typically looking for a constant and secure return on their investment, consequently when investing in a different activity (sector) such as renewable energy generation; a higher return rate is expected because of all involved risks.

The World Bank published a report in 2008[20] stating that *"The combination of regulatory uncertainties arising from the environmental legal framework and (to a lesser extent) from the legal framework governing the energy sector, represents substantial risks for potential investors. Investors are*

[20] Environmental Licensing for Hydroelectric Projects in Brazil: A Contribution to the Debate, Volume I, Summary Report, 2008. Available at: http://siteresources.worldbank.org/EXTWAT/Resources/4602122-1214578930250/Summary_Report.pdf

obliged to put a price on this risk and pass on the costs to consumers. The Brazilian Electricity Regulator (ANEEL) estimates that investors are prepared to invest in electricity generation only when rates of return are approximately 15%".

Furthermore, ANEEL also calculated an adequate return on capital investments in the Brazilian electricity distribution sector as described in their technical report in 2008[21] through which they evaluated that the cost of equity for investing in the energy distribution sector should be 13.75% in real terms. According to IPEA[22], the current methodology adopted by ANEEL to estimate the rate of return (cost of capital) should be modified by adding the country risk, exchange rate risk and regulatory risk in order to estimate a more proper return. Based on that, the expected return on equity in real terms should range between 13.4 and 15.4%[23] in the Host Countries energy sector.

Another suitable Benchmark is calculated applying the *Weighted Average Cost of Capital* (WACC) for the power generation sector in Brazil.

The WACC of the sector considered is the one calculated for 2007 (see decision-making context discussion below) and is equal to 10.35%. The calculation is developed below.

WACC = Wd x Kd + We x Ke

We and **Wd** are, respectively, the weights of equity and debt typically observed at the sector. **We** is of 50.00%, and **Wd** of 50.00%. These numbers derive from derive from the Guidelines on the assessment of investment analysis[24], which considers a default value for CDM projects.

Kd is the cost of debt, which is observed in the market related to the project activity, and which already accounts for the tax benefits of contracting debts. This parameter is calculated through the following equation: [1 + (a+b+c) x (1-t)]/ [(1+d) -1] (Table 6).

Table 6: Cost of debt (Kd) calculation

Cost of Debt (Kd)	
(a) Financial cost[25]	9.28%
(b) BNDES fee[26]	0.90%
(c) Spread[27]	2.00%
(a+b+c) Pre-Cost of Debt	12.18%
(t) Marginal tax rate[28]	34.00%

[21] According to the technical note N°68/2007 published by ANEEL para.108 Available at: http://www.aneel.gov.br/aplicacoes/audiencia/arquivo/2006/008/resultado/nota_tecnica_n%C2%BA_68-2007_wacc.pdf

[22] IPEA (Instituto de Pesquisa Econômica Aplicada - Governmental Institute for Economic Research) is a public foundation associated to the Secretariat for Strategic Affairs of the Presidency and is responsible for providing technical and institutional support to the government.

[23] Custo de capital das concessionárias de distribuição de energia elétrica no processo de revisão tarifária, April 2006 Available at: http://desafios.ipea.gov.br/pub/td/2006/td_1174.pdf

[24] CDM EB 62th Meeting Report, Annex 5, paragraph 18.

[25] http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Custos_Financeiros/Taxa_de_Juros_de_Longo_Prazo_TJLP/index.html.

[26] http://www.bndes.gov.br/SiteBNDES/export/sites/default/bndes_pt/Galerias/Arquivos/conhecimento/bnset/Set2901.pdf

[27] http://www.bndes.gov.br/SiteBNDES/export/sites/default/bndes_pt/Galerias/Arquivos/conhecimento/bnset/Set2901.pdf

[28] http://www.receita.fazenda.gov.br/Aliquotas/ContribCsll/Aliquotas.htm http://www.receita.fazenda.gov.br/Aliquotas/ContribPj.htm

(d) Inflation forecast[29]	4.50%
After tax Cost of Debt (p.a.)	3.39%

According to the table above, **Kd** is of 3.39%.

Ke is the cost of equity and represents the rate of return for equity investments and is estimated through the equation: [1 + (Rf + (β x Rm) + Rc)] x (1 + π) / (1+ π')] (Table 7).

Table 7: Cost of equity (Ke) calculation

Cost of Equity (Ke)	
(Rf) Risk-free rate[30]	4.88%
(Rm) Equity risk premium[31]	6.57%
(Rc) Estimated country risk premium[32]	6.06%
(β) Sectoral Risk[33]	1.34
(I) US expected inflation[34]	2.39%
Cost of Equity with Brazilian Country Risk (p.a.)	17.31%

In line with the table above, Ke is of 17.31%. As can be seen, Ke derives from a risk free rate plus the market risk premium adjusted to the sector through Beta (β).

Plugging these numbers into WACC formulae:

WACC = 50.00% x 3.39% + 50.00% x 17.31% = 10.35%

All information used in the calculation of the benchmark is fully reference in the WACC calculation spreadsheet (Appendix 1 to the PDD). The spreadsheet with the WACC calculation is part of the PDD.

All above mentioned benchmarks, substantiated by a third party / independent sources, are suitable to investments in the Brazilian electricity sector and, are in accordance with the date on which the decision to invest in the project was taken. Most importantly, all data comply with the requirements set out in the "Tool for the Demonstration and Assessment of Additionality" and "Guidance on the Assessment of Investment Analysis". Thus, the project participants select the most conservative benchmark applicable to the project activity which corresponds to WACC of 10.35%.

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

[29] http://www.bcb.gov.br/pec/metas/InflationTargetingTable.pdf
[30] http://pages.stern.nyu.edu/~adamodar/
[31] http://pages.stern.nyu.edu/~adamodar/
[32] http://www.cbonds.info/all/eng/index/index_detail/group_id/1/
[33] http://pages.stern.nyu.edu/~adamodar/
[34] http://www.federalreserve.gov/econresdata/researchdata.htm

As mentioned above, the financial indicator identified shall be the Internal Rate of Return (IRR), which can be the Project IRR or the Equity IRR. The Project IRR can be compared with the WACC as the Equity IRR with the Return on Equity (Ke)[35].

Table 8 below provides a list with key input values in the IRR calculation as well as a brief justification for their use. All information used in the calculation of the rate is fully reference in the IRR calculation spreadsheet (Appendix 2 to the PDD). The spreadsheet with the IRR calculation is part of the PDD.

Table 8 – IRR calculation key input values[36]

Parameter	Value	Source
Generation Characteristics		
Installed capacity (MW)	3,150.4	Mines & Energy Ministry (Ordinance MME n° 293/2007)
Forecasted Guaranteed Energy Generation (MW_{avg})	2218.0	Mines & Energy Ministry (Ordinance MME n° 293/2007).
Forecasted gross annual power supplied to the grid (MWh)	18,807,930	Calculated[37]
Investments, Operational Expenses and Sectoral Tariffs		
Total investment – CAPEX (R$)	12,198,630,798	Santander financial coordination contract
O&M (R$)	227,845,256	O&M contract
TUST (R$/KW month)	IRR calculation spreadsheet	ANEEL through the Ratifying Resolution N°561, 2007
UBP (%)	0.50	Auction Notice N°05/2007, page 18 and appendix V, page 10
TFSEE (%)	0.50	ANEEL[38]
Royalties (%)	6.75	
TAR (R$/MWh)	57.63	
ONS (%)	0.04	ANEEL Resolution N°328/04[39]

[35] Guidance 12, Annex 5, EB 62.

[36] All adopted assumptions in the demonstration of additionality and CERs calculation are valid and applicable at the project starting date (June 2008), in line with the "Guidelines on the Assessment of Investment Analysis" (EB 62, annex 5, paragraph 6). At the time of the PDD publication for the local and global stakeholders consultation processes the project was already slightly modified. The modifications will be disclosed and discussed with the DOE during the validation process.

[37] The expected gross annual power supplied to the gird was calculated based on the forecasted guaranteed energy generation multiplied by the number of hours (8760) in a given calendar year. In order to obtain the amount of net forecasted power supplied to the grid, the plants own consumption and transmission losses are subtracted from the gross generated energy.

[38] Please refer to section B.5, sub-step 2d-Sensitivity Analysis for a detailed description of each tariff and its respective source.

P&D (% of net operational revenues)		1.00	Art. n°2 of Law n° 9.991/00[40]
Applicable Taxes			
Income tax (%)		25	Art. n°2 of Law n° 9.430/96[41]
PIS (%)		1.65	Art. n°2 of Law n° 10.637/02[42]
COFINS (%)		7.6	Law n° 9.718/98[43]
CS (%)		9	Art n°3 of Law n° 7.689/88[44]
Power Purchase Agreements (PPA's)			
Electricity tariff, (R$/MWh)	ACR (70%)	78.87	PPA - clause 8
	ACL	135	PP's estimation
Others			
Weighted average depreciation rates (%)		2.71	Determined by ANEEL[45]

The IRR of the project calculated using the assumption presented above shows that the IRR of the project without considering CERs revenues is 5.63%, significantly lower than the chosen benchmark, WACC of the sector of 10.35%. The result clearly demonstrates that the project activity has a less favorable indicator than the benchmark and cannot be considered as financially attractive.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis was conducted using assumptions that are conservative from the point of view of analysing additionality, i.e. the 'best-case' conditions for the Project IRR were assumed by altering the following parameters:

- Investment costs
- Electricity tariff
- Annual power supplied to the grid
- Total operating costs

Table 9 summarizes the results of the sensitivity analysis, showing the variation of each parameter required to reach the benchmark.

Table 9 - Results of the sensitivity analysis

	IRR with 10% variation	Variation to reach the benchmark

[39] Available at: http://www.aneel.gov.br/cedoc/rea2004328.pdf
[40] Available at: http://www.planalto.gov.br/ccivil_03/Leis/L9991.htm
[41] Available at: http://www.normaslegais.com.br/legislacao/tributario/lei9430.htm
[42] Available at: http://www.receita.fazenda.gov.br/Legislacao/Leis/2002/lei10637.htm
[43] Available at: http://www.normaslegais.com.br/legislacao/tributario/lei9718.htm
[44] Available at: http://www.planalto.gov.br/ccivil_03/Leis/L7689.htm
[45] For each specific depreciation rate please refer to the Projects Financial Analysis' Fixed Assets ANEEL tab.

Original value	5.63%	n.a.
Investment costs	6.53%	-39%
Electricity tariff	6.85%	+47%
Power generation	6.47%	+68%
Total operating costs	6.14%	-114%

In the next paragraphs it is discussed why these variations do not reflect a realistic range of assumptions for the input parameters of the financial analysis.

Investment costs: A decrease of 39% in investment costs is very unlikely to happen, as it is much more likely that hydropower projects will experience cost *increases* rather than cost decreases during construction. For the proposed Project, investment costs have been increased by approximately 25%[46] compared to what was estimated in the basic project design. This increase demonstrates that a decrease in investment costs is extremely unrealistic.

Electricity tariff: The electricity tariff of the Project was established by the energy auction carried out by the Chamber of Electric Energy Commercialization (CCEE from the Portuguese "Câmera de Comercialização de Energia Elétrica") on December 10th, 2007.[47] The value of the electricity tariff was fixed at R$78.87[48] for a term of 30 years (until 2041) which will be commercialized in the Regulated Contracting Environment (ACR). According to the auction notice, 70% of the forecasted annual power supply to the grid[49], has to be commercialized in the ACR and the remaining energy will thus be commercialized at an estimated fixed price of R$135 in the Free Contracting Environment (ACL)[50]. Since the tariff for the ACR is fixed, a variation of 47% in total revenues from the electricity sales in the ACL, which corresponds to only 30% of the forecasted power generation, is required to reach the benchmark, clearly not a plausible scenario.

Annual power supplied to the grid: The expected annual power supplied to the grid by the Project as established by the Mines and Energy Ministry (Ordinance MME n°293/2007) is calculated based on 76 years' (1931 – 2007) worth of historical hydrological data and therefore the long term average annual power supplied is unlikely to be significantly different to the value used in the financial analysis.

The Brazilian electricity model defines that electric energy commercialization is performed in two market environments, the Regulated Contracting Environment (ACR)[51] and the Free Contracting Environment (ACL)[52].

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[46] Detailed additional investment references will be made available to the DOE.
[47] Ministry of Mines and Energy, Ordinance N° 293 dated on October 22nd, 2007. Available at: http://www.epe.gov.br/leiloes/Documents/LeilaoMadeira07_7/Portaria%20MME%20n%C2%B0%20293-07.pdf
[48] Result of the energy auction published by EPE (Empresa de Pesquisa Energética – Company for Energetic Research). Available at: http://www.epe.gov.br/leiloes/Paginas/Leil%C3%A3o%20UHE%20Santo%20Ant%C3%B4nio%20-%20Rio%20Madeira/LeilaoMadeira07_10.aspx?CategoriaID=40
[49] ANEEL - Edital Leilão (Auction Notice) N°05/2007, page 31
[50] At the moment of the PDD publication for public consultation (Dec. 2011) there is a reducing trend in the ACL prices: 125 to 130 R$/MWh in 2010 and, 110 to 120 R$/MWh in 2011 (Workshop A&C 2011 – Conjuntura Atual do Mercado Brasileiro, available at http://bit.ly/sLmL1o).
[51] Regulated Contracting Environment (ACR from the Portuguese "Ambiente de Contratação Regulada"), official definition available at: http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=fbcca5c1de88a010VgnVCM100000aa01a8c0RCRD

In the Regulated Environment, electric energy sellers and distributors can participate through public auctions regulated by ANEEL and made operational by CCEE. In order to ensure the compliance with the market demand, the distribution agents can acquire energy according to article 13 of Decree N°5.163/2004 in the following ways:

- Electric energy purchase auctions from existing and new generation plants;
- Distributed generation, as long as the contracting (hiring) is preceded by a public call made by the distribution agent and limited by an amount of 10% of the distributors market;
- Plants that generate electric energy from wind, small hydropower and biomass plants that were contracted in the first trench (step – stage) of the Program for Renewable Energy Sources (PROINFA) and;
- Itaipu Hydropower plant (bi-national).

In the Free Contracting Environment, generation and commercialization agents as well as electric energy importers, exporters and free consumers can participate. In this environment electric energy purchase and selling volumes as well as their price can be freely negotiated through bilateral contracts. Additionally to the existence of two commercialization environments as explained above, a short-term market (administrated by CCEE) where the difference between the generated/consumed physical energy and contracted energy are accounted for and liquidated. Participation is compulsory for generators, distributors, importers, exporters, traders and free consumers connected to the National Grid. The market price used in the short term market is denominated *Settlement Price Difference* (PLD, from the Portuguese "Preço de Liquidação das Diferenças"). The PLD is calculated based on the predominance of hydroelectric generation, which aims to find the optimal balance between the present benefit of using hydroelectric resources (water) and storing it, measured in terms of the expected fuel oil savings consumed by thermoelectric plants. Therefore, based on hydrological conditions, energy demand, fuel prices, deficit cost, operation start of new projects and availability of generation and transmission equipments, the pricing model obtains the optimal dispatch for a given period, defining the hydraulic and thermal generation for each sub-market.

In order to share and mitigate the hydrological risks associated with the centralized dispatch and optimization of the hydrothermal system by ONS, the *Reallocation Energy Mechanism* (MRE from the Portuguese "Mecanismo de Realocação de Energia") is used. The objective is to ensure that all plants that are part of the MRE receive their levels of physical guarantee regardless of their level of energy generation, provided that the total generation of the MRE is not below the total physical guarantee of the system. This means that the MRE reallocates energy by transferring the surplus from those that produced beyond their physical guarantee to those that generated less. In other words, the intention of the MRE is to assure that all generators commercialize the guaranteed energy assigned to them independently from their real energy generation.

The reallocation/transfer of energy between hydro's incurs in the cost called "minimum water cost" which is based on an optimization tariff determined by ANEEL to cover the incremental cost incurred in the operation and maintenance of the plant, payment of a financial tariff compensation fee of hydrological

[52] Free Contracting Environment (ACL from the Portuguese "Ambiente de Contratação Livre "), official definition available at: http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=84dca5c1de88a010VgnVCM100000aa01a8c0RCRD

resources used which is calculated based on the amount of energy generated. Whenever attributed energy of a generator after being reallocated in the MRE is higher than the contracted one, the generator is entitled to sell this surplus in the short term market at the momentary PLD value. The same applies in the opposite situation, in which the generator will have to purchase energy from the short term market if they don't comply with their contractual obligations (energy generation deficit).

Consequently, this means that if a plant generates more energy and it is reallocated in the MRE, the compensation fee the plant receives will not generate any additional revenues, but only cover the cost (O&M) of its additional generation.

The proposed project activity is contractually bound to sell 70% of the generated electric energy in the ACR market at a fixed price as determined by the energy auction and the rest to the ACL market. Based on the aforementioned, assuming an increase of 68% in the long term average annual power supplied to the grid is absolutely not reasonable.

Total operating costs: The results of the sensitivity analysis shows that if the Project incurred a reduction of 114% of the operating costs the IRR of the Project would reach the 10.35% benchmark. This is obviously not a plausible scenario because. Besides the fact that the reduction of 114% has only a mathematical meaning, because it would mean negative operation cost, in the following paragraphs reasons are disclosed to confirm the appropriateness of the assumed operation costs.

The project developer signed a contract with a specialized firm that will be responsible for the operation and maintenance service of the plant which is fixed for a 10 year period.[53]

Additionally, the following tariffs are part of the operating costs as described below:

I. "TUST" is the tariff for the use of electric energy transmission lines which was fixed by ANEEL until 2021[54];

Table 10 - Annual ANEEL TUST tariff evolution

Period	TUST Tarrif R$ kW/month
Jan/12 - Jun/12	13.019
Jul/12 - Jun/13	12.930
Jul/13 - Jun/14	12.840
Jul/14 - Jun/15	12.751
Jul/15 - Jun/16	12.662
Jul/16 - Jun/17	12.662
Jul/17 - Jun/18	12.662
Jul/18 - Jun/19	12.662

[53] Operation and Maintenance service contract, page 26 of Annex II (Commercial Proposal)
[54] The transmission lines usage tariff was established by ANEEL through the Ratifying Resolution n°561, dated on October, 30th, 2007. Available at: http://www.aneel.gov.br/cedoc/reh2007561.pdf

Jul/19 - Jun/20	12.662
Jul/20 - Jun/21	12.662

II. "UBP" is the tariff for the use of a public good which was determined by the Auction Notice[55] and consists of an annual value of R$ 11,852,104.80;

III. "TFSEE" is a inspections tariff charged by ANEEL which as demonstrated in the Table 11 below has been constantly increasing;

Table 11 - Annual ANEEL inspection tariff evolution[56]

Year	TFSEE Tarrif R$/ kW
2011	385.73
2010	363.60
2009	335.42
2008	303.78
2007	289.22

IV. "Royalties" are considered the financial compensation for the hydrological exploitation of water resources and are established as 6.75% of effective measured generated electric energy.57 This value is fixed by ANEEL according to the Federal constitution, article 20 which defines potential hydrological resources as a property of the Union and therefore establishes that a financial compensation for its exploitation is required.

V. "TAR" represents the updated Reference Tariff[58] and is one parameter that is used to calculate the financial compensation mentioned in item IV. This tariff is fixed by ANEEL and revised every four years, but updated annually as demonstrated in Table 12 below.

Table 12 - Reference tariff price evolution

Year	Determined by Resolution	TAR tariff value (R$)
2010	ANEEL N° 917, 08.12.2009	64.69
2009	ANEEL N° 753, 16.12.2008	62.33
2008	ANEEL N°586, 11.12.2007	60.04
2007	ANEEL N°404, 12.12.2006	57.63
2006	ANEEL N°192, 19.12.2005	55.94
2005	ANEEL N°285, 23.12.2004	52.67

[55] ANEEL - Edital Leilão (Auction Notice) n°05/2007, page 28
[56] ANEEL Dispatch N°360 dated on February 4th, 2011 Available at: http://www.aneel.gov.br/cedoc/dsp2011360.pdf
[57] Available at: http://www.aneel.gov.br/aplicacoes/atlas/energia_hidraulica/4_11.htm
[58] Available at: http://www.aneel.gov.br/area.cfm?idArea=536

2004	ANEEL N°647, 08.12.2003	44.20
2003	ANEEL N°797, 26.12.2002	39.43

VI. "ONS" tariff refers to the reimbursement of part of the administration and operation costs of ONS applied to all generation, transmission and distribution agents as well as free consumers that are connected to the national grid59.

VII. P&D (Research & Development) tariff corresponds to at least 1% of each independent energy generator net income as determined by Article N°2 of Law N°9.991 dated on July 24th, 2000[60].

Operation and maintenance costs are contractually established between the project developer and the service provider at a fixed rate and will be increased according to the IPCA (National Index of Consumer Prices). Furthermore, all applicable tariffs as described and demonstrated above are determined by specific national entities and a decrease in operating costs/tariffs is very unlikely to happen; more importantly, it's more realistic to expect an increase as demonstrated above. Additionally, all prices are corrected based on the annual inflation rate. Therefore, no significant decrease of the O&M costs can be reasonably expected.

These results clearly show that only under very unrealistic and highly favourable circumstances it would be possible to reach the Project IRR benchmark. We can conclude that the IRR is lower than the benchmark for a realistic range of assumptions for the key input parameters and therefore, that the Project is not financially attractive.

Outcome of step 2: As a result we can conclude that the project activity is unlikely to be the most financially/economically. Proceed to Step 4.

Step 4. Common practice analysis

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

The project activity will supply energy to the SIN. All projects connected to the SIN that are considered similar, 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 and access to financing are included in this analysis. 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 included in the analysis.

On 20 September 2011 a total of 947 hydroelectric plants with a total installed capacity of roughly 81,929 MW were in operation[61].

In order to assess if any of the aforementioned plants connected to the SIN are similar to the proposed project activity, the criteria from Table 13 have been defined

Table 13 - Established criteria for identifying similar project activities

[59] According to resolution ANEEL N°328 dated on August 12th, 2004. Available at: http://www.aneel.gov.br/cedoc/rea2004328.pdf
[60] ANEEL- Article N°2 of Law N°9.991 dated on July 24th, 2000. Available at: http://www.aneel.gov.br/cedoc/lei20009991.pdf
[61] ANEEL, Generation Database. Available at: http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp, data retrieved on 20 September 2011.

Criteria	Description
Installed capacity (MW)	Range of Analysis equals to 50% ± of the proposed project activity, resulting in a range from 1,575 to 4,726[62]
Regulatory Framework	Refers to plants constructed under the regulatory framework of the Brazilian Electricity Market New Model from 2003

Applying the installed capacity criteria to the 864 hydroelectric plants connected to the SIN, 691 plants are small scale[63] (installed capacity under 30MW) according to the criteria determined by the Federal Electricity Agency (ANEEL from the Portuguese "*Agencia Nacional de Energia Elétrica*") and, therefore, can't be compared to the Project activity. This brings the number of hydroelectric plants down to 173, of which only 6 plants fit the first criteria description as indicated in Table 13. These 6 plants are listed in Table 14.

Based on the regulatory framework criteria, only projects which were developed under the regulatory framework of the Brazilian Electricity Market new model, released in 2003 and approved by the Congress in March 2004, will be further considered in the common practice analysis.

Table 14 - Identified similar plants

Plant	Installed Capacity (kW)	Operation Start	Power Density (W/m^2)	Owner / Type
Governador Bento Munhoz da Rocha Neto (Foz do Areia)	1,676,000	1980	12.09	COPEL / State-owned
Ilha Solteira	3,444,000	1978	2.88	CESP / State-owned
Itumbiara	2,082,000	1981	2.68	FURNAS / State-owned
São Simão	1,710,000	1978	2.38	CEMIG / State-owned
Paulo Afonso IV	2,462,400	1979	190.88	CHESF / State-owned
Xingó	3,162,000	1994	52.70	CHESF / State-owned

In the following paragraphs it is given a brief description of the Brazilian electricity market developments since the start of the privatization process in the 1990s.

The year 1995 was a key year for the power industry in Brazil. The power industry underwent a significant reform, switching from a so called *Old Model* ("Modelo Antigo") in which the Government controlled Brazil's electricity market, in which investments were done by the government in a monopolist market to a *Free Market Model* ("Modelo de Livre Mercado") in which the Brazilian government

[62] This range was deemed acceptable by the Board as per the Request raised by the CDM Executive Board in the context of the request for review of the CDM Project Activity Ref. # 2010. Document is available at < http://cdm.unfccc.int/Projects/DB/TUEV-SUED1218108477.61/Review/0TR4ZO639HTMUB7EMY2AYRD5BSWR0I/display>. Retrieved on 03 October 2011.

[63] Definition of small scale hydro projects in Brazil according to the legal definition of the National Electricity Agency (ANEEL), Art. n°3 of Resolution n° 652 dated on December 9th, 2003. Available at: http://www.aneel.gov.br/cedoc/res2003652.pdf

initiated a radical restructuring with the main objectives to create a free market through efficiency incentives and by limiting governmental interventions.[64,65]

The Brazilian energy sector has undergone profound transformation in its organizational and financing structure since the nineties. These changes are consequence of a chronic crisis in public financing in a sector dominated by state-owned companies since the early fifties[66]. The energy sector reform started in 1993 with the publication of Law n° 8.631, abolishing the tariff equalization, creating supply contracts between generators and distributers and additionally through Law n° 9.074 the independent energy producer and the concept of the free consumer[67] were created.

Due to the rising risk of an energy shortage associated with the collapse of the sectors investments, the restructuring process was accelerated in early 1995 with Law n° 8.987 which regulated the concession process of the electric sector for investors and by privatizing the existing entrepreneurships[68].

In 1996, the Ministry of Mines and Energy implemented the Brazilian Energy Sector Restructuring Project which objective was the decentralization of electric energy companies by splitting them by segment (generation, transmission and distribution), encouraging the competition between the generation and commercialization segments and maintaining the distribution and transmission sector under state regulation.

Furthermore, a National Electricity Agency (ANEEL) and National Electric System Operator (ONS from the Portuguese “Operador Nacional do Sistema Elétrico”) were created together with an energy transaction environment called the Wholesale Electricity Market (MAE from the Portuguese “Mercado Atacadista de Energia Elétrica)[69].

In 2001, the electricity sector suffered a severe supply crisis which was triggered by the lack of additional financial resources that led to the suspension or delay of the planned generation and transmission expansion. On one hand, the consumption increased while the economy was growing, and on the other, while the economy began to stagnate, the electricity consumption continued to rise as more people were having access to electricity[70].

Consequently, the new elected Brazilian Government started another restructuring cycle of the national electricity sector. During 2003 and 2004, the Federal Government announced the new model for the Brazilian Electricity Market sustained by Laws n°10.847 and 10.848 of March 15th, 2004 and Decree n°5.163 of July 30th, 2004. This new model defined the creation of:

- A new institution responsible for the long term planning of the energy sector (Energy Research Company – EPE);
- An institution to evaluate continuously the electric energy supply (Electric Sector Monitoring Committee - CMSE) and;

[64] Reforma e crise do setor elétrico no período FHC, Tempo social, 2003.
[65] Environmental Licensing for Hydroelectric Projects in Brazil: A Contribution to the Debate. Summary Report, World Bank, 2008.
[66] Why do Brazilian State-owned Companies Refrain from Investing? , GESEL-UFRJ, 2007.
[67] CCEE Available at: http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=e1f9a5c1de88a010VgnVCM100000aa01a8c0RCRD
[68] Trajetória das Reformas Institucionais da Indústria Elétrica Brasileira e Novas Perspectivas de Mercado, Revista Econômica, 2006.
[69] Um Novo Modelo para o Setor Elétrico Brasileiro, USP, 2002.
[70] As perspectivas do setor elétrico após o racionamento, Revista do BNDES, 2002.

- An institution to continue performing the activities that were taking care by the Wholesale Electric Energy Market (MAE) related to the commercialization of the interconnected electric energy system.

According to OECD[71], “Central to the new model is the creation of the ‘Pool’ (Ambiente de Contratação Regulado, ACR), matching electricity demand and supply capacity through long-term contracts, which will replace on a competitive bases the “initial contracts” inherited from the 1990s. These contracts were designed as a bridge between the 1980s and the new environment after the privatization of most distribution companies and schedule to gradually expire after 2002. The new framework is inspired by the “single-buyer” model, where an entity — typically the government — buys all electricity from producers and sells it to distributors. However, although establishing a common mechanism for the purchase of energy, the model allows market risk to be shared among participants instead of being borne exclusively by the government, which acts rather like an auctioneer than a buyer. With long-term contracts set through the Pool, price uncertainty will be broadly restricted to electricity traded in the free, short-term market and bilateral contracts between generators and large consumers.”

A comparison between the old Electricity Markets and its transition to the New Model can be seen in detail in the Table 15[72] below:

Table 15 - Brazilian electricity market development

Old Model (until 1995)	Free Market Model (1995 - 2003)	New Model (2004)
Financing through public resources	Financing through public and private resources	Financing through public and private resources
Vertically Integrated Companies	Companies divided by activity: generation, transmission, distribution and commercialization	Companies divided by activity: generation, transmission, distribution, commercialization, import and export
Predominantly State Owned Companies	Emphasis on privatization and starting new companies	Coexistence between state owned and private companies
Monopolies - Nonexistent competition	Generation and commercialization competition	Generation and commercialization competition
Captive consumers	Free and captive consumers	Free and captive consumers
Regulated tariffs in all segments	Generation and commercialization prices freely negotiated	*Free Environment (ACL):* Generation and commercialization prices freely negotiated *Regulated Environment(ACR):* Auction and bidding for the lowest tariff

[71] *Regulation of the Eletricity Sector IN OECD Economic Surveys of Brazil 2005*.
[72] Electricity Markets Comparison retrieved on 03 October 2011 from http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=96a0a5c1de88a010VgnVCM100000aa01a8c0RCRD.

Regulated Market	Free Market	Regulated and Free market
Determinative planning: Energy System planning coordinating group	Indicative planning by the National Energy Policy Council	Planned by the Energetic Research Company (EPE)
Contracting: 100% of the Market	Contracting: 85% of the Market (until august/2003) and 95% (until December/2004)	Contracting: 100% of the Market + reserve
Energy balance surplus / deficit is divided between consumers	Energy balance surplus / deficit is settled by the Wholesale Electric Energy Market (MAE)	Energy balance surplus / deficit is settled by the Electric Energy Commercialization Chamber (CCAA) and through a compensation mechanism (MCSD) for distributors.

Concluding, the Brazilian energy supply crisis originated from the fatigued old state-owned energy model, evolving through a Free Market until reaching the new, more competitive and more robust actual model. Since the exhaustion of the state-owned models investment capacity was perceived, a fast transition to a private model was attempted. However, this new model was not capable of achieving the required effects and an alternative sectoral model had to be constituted in order to enable a balanced co-existence of public and private capital in a competitive environment.

As a result, the investment environment of power production projects in Brazil started changing significantly in 1995, and projects developed prior to 2003/2004 cannot be considered similar to the proposed Project Activity. This is clearly demonstrated by the fact that all hydro plants included in the common practice analysis are all state owned companies under the status of "public service" and constructed/commissioned prior to 2003 (actually prior to 1994).

Therefore, based on the aforementioned, the proposed project activity is not common practice in the Host Country.

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

Considering the analysis provided in Sub-step 4a, there are no similar options occurring, therefore the proposed project activity cannot be considered common practice.

In conclusion, as Sub-steps 4a and 4b are satisfied, i.e.(i) similar activities cannot be observed or (ii) similar activities are observed, but essential distinctions between the project activity and similar activities can reasonably be explained, then the proposed project activity is additional.

CDM Consideration

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

In 2001, the Furnas (generation, transmission and energy commercialization company) and Odebrecht (Engineering company) consortium was authorized by ANEEL to start the hydroelectric inventory study of the Madeira River which was concluded in 2002. The outcome of this study indicated the feasibility to construct two hydropower plants along the river, one of them being the proposed project activity[73]. Consequently between 2003 and 2005, the technical and economical feasibility study was conducted. Concomitantly, Odebrecht started in 2003 to discuss the emission reduction potential of the project activity with several carbon advisors. As a result of their meetings, two CER generation proposals (service for developing all necessary steps until the projects registration) were received in November, 2004.

In the meantime, the Environmental Impact Study (EIA from the Portuguese "*Estudo de Impacto Ambiental*") was being developed and, ultimately released in May 2005, with a clear indication of the CDM revenues are decisive in the feasibility of the project activity[74]:

> *Through renewable energy generation, the Santo Antonio hydroelectric plant will help maintain Brazil's low carbon emission energy matrix, thus, contributing to the overall greenhouse gas emission reduction and sustainable development of the country. Furthermore, Certified Emission Reductions (CER's) in accordance with the Clean Development Mechanism as part of the Kyoto and Marrakesh Protocol, should assist in the feasibility of the proposed project activity.*

Meanwhile, the financial model of the project activity was being developed for the energy auction and since CDM revenues were considered essential for the projects feasibility as stated in the EIA, during March 2007 the Project Developer consulted a law firm on how these revenues should be taxed and which applicable national laws were inherent to it and thus enabling its inclusion in the financial model.

Based on the aforementioned, the Project Developer's awareness of the CDM is clearly demonstrated and most importantly that CDM revenues were seriously considered prior to any real action of the project activity.

The Project starting date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the Project Activity. In the case of the Santo Antonio Hydropower, a conditional EPC contract was signed on 17 December 2007. The contract would on be valid after the signature concession contract and could be terminated anytime before with a 5% penalty. Based on the aforementioned, the starting date is considered the entry into force of the EPC contract on the date of the concession contract signature, 13 June 2008.

Once financing of the project activity was fully secured in March, 2009, the project developer restarted conversation with CDM project developers and in May 2009. Meanwhile, even though the project starting date is before August 2nd, 2008, the Project Developer just to be sure decided to notify the UNFCCC and DNA of the project activity's prior consideration of the CDM in September 2009. The first contract to develop the PDD was signed on May 25th, 2010. For a more detailed timeline with each specific milestone please refer to the Figure 5.

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[73] ANEEL – Dispatch n°817, published on 17/12/2002
[74] Estudo de Impacto Ambiental (EIA) - Aproveitamentos Hidrelétricos Santo Antônio e Jirau, Rio Madeira – RO. Maio de 2005 (Tomo A Volume 1 – p. VII-3).

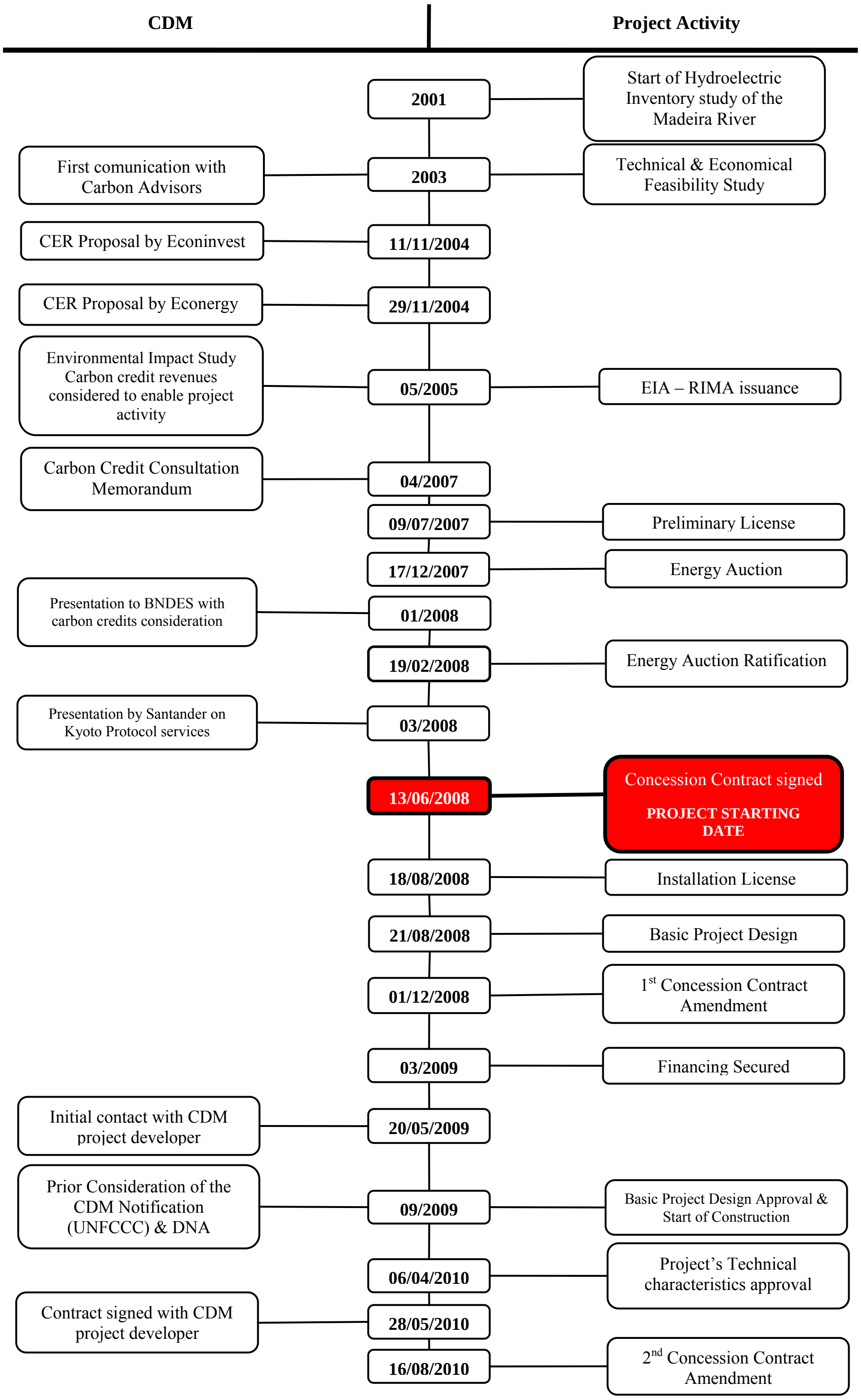

Figure 5 - CDM consideration and project activity milestones

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Project Emissions (PE):

The project emissions are accounted for by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$ **Equation 1**

Where:

PE_y Project emissions in year y (tCO_2e/yr)

$PE_{FF,y}$ Project emissions from fossil fuel consumption in year *y* (tCO_2e/yr)

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

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

According to the methodology, project emissions due to fossil fuel combustion and emissions of non-condensable gases from the operation of geothermal power plants are set to zero for hydropower projects ($PE_{GP,y} = PE_{FF,y} = 0$).

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

For hydro power project activities that result in a new reservoir:

- the methodology is not applicable id the power density (*PD*) of the project activity is less or equal to 4 W/m^2;
- CH_4 and CO_2 emissions from the reservoir shall be accounted if the power density of the project activity is greater than 4 W/m^2 and less than or equal to 10 W/m^2 and;
- Emissions from water reservoir are set to zero if the power density of the project activity is greater than 10 W/m^2.

The Project power density is 16.55 W/m^2, thus emissions from water reservoir are estimated to be zero ($PE_{HP,y}$=0).

Baseline Emissions (BE_y):

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

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

Where:

BE_y Baseline emissions in year *y* (tCO_2/yr)

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

$EF_{grid,CM,y}$ Combined margin CO_2 emission factor for grid connected 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)

Calculation of $EG_{PJ,y}$

The project activity is the installation of a new grid connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, thus $EG_{PJ,y}$ is calculated according to option (a) Greenfield renewable energy power plants as follows:

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

Where:

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

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

Determination of $EF_{grid,CM,y}$

The Project Activity is connected to the Brazilian National Interconnected System (SIN). The grid emission factor is calculated by the Brazilian DNA, according to the "Tool to calculate the emission factor for an electricity system".

Step 1: Identify the relevant electricity system

By means of the Resolution number 8, issued on May 26th, 2008, the "Interministerial Commission on Global Climate Change" (Comissão Interministerial de Mudança Global do Clima – CIMGC), the Brazilian DNA, delineated the electricity system as the National Interconnected Grid (Sistema Interligado Nacional – SIN), for CDM purposes.

Step 2: Choose whether to include off-grid power plants in the project electricity system

The option chosen to calculate the operating margin and build margin emission factor is Option I: Only grid power plants are included in the calculation.

Step 3: Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is calculated by the Brazilian DNA[75] based on the following method: Option (c): Dispatch data analysis OM

Step 4: Calculate the operating margin emission factor according to the selected method

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour h where the project is displacing grid electricity. The emission factor is calculated as follows:

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

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

Where:

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

Calculation of CO_2 emission factor $EF_{EL,DD,h}$

Project participants neither have access to the decisions that the Brazilian DNA took in order to calculate the hourly emission factor nor to the spreadsheet used. Only final values are available for public consultation.

Calculation to determine the set of grid power units *n* on top of the dispatch

Project participants neither have access to the decisions that the Brazilian DNA took in order to determine the set of power units *n* nor to the spreadsheet used. Only final values for the hourly emission factor ($EF_{EL,DD,h}$) are available for public consultation.

Step 5: Indentify the group of power units to be included in the build margin

The sample group of power units *m* used to calculate the build margin consists of either:

a) The set of five power units that have been built most recently; or

b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

The option that uses the set of power units that comprises the larger annual generation should be selected. The emission factor is calculated by the Brazilian DNA according to the “Tool to calculate the emission factor for an electricity system” approved by the Executive Board. However, the individual steps used are not publically available. Hence, the project participants are not able to describe which method has been used to determine the cohort of power units included in the build margin.

In terms of vintage of data, project participants chose: option 2 (*ex-post*).

Step 6: *Calculat*e the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$ **Equation 5**

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

Step 7: Calculate the combined margin emission factor

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

Where:

$EF_{grid,CM,y}$	Combined margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh
w_{OM}	Weighting of operating margin emission factor (%)
w_{BM}	Weighting of build margin emission factor (%)

For w_{OM} and w_{BM} the default value of 0.5 is used according to the “Tool to calculate the emission factor for an electricity system”.

Leakage Emissions (L_y)

No leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transport). These emissions sources are neglected.

Emission Reduction (ER_y)

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$ **Equation 7**

Where:

ER_y	Emission reductions in year *y* ($t\ CO_2/yr$)
ER_y	Baseline emissions in year *y* ($t\ CO_2/yr$)
ER_y	Project emissions in year *y* ($t\ CO_2/yr$)

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

Data / Parameter:	w_{OM}
Data unit:	Fraction

Description:	Weighting
Source of data used:	"Tool to calculate the emission factor for an electricity system"
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default weight value for Operating Margin according to the "Tool to calculate the emission factor for an electricity system"
Any comment:	

Data / Parameter:	w_{BM}
Data unit:	Fraction
Description:	Weight
Source of data used:	"Tool to calculate the emission factor for an electricity system"
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default weighting value for Build Margin according to the "Tool to calculate the emission factor for an electricity system"
Any comment:	

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	Grid build margin
Value applied:	Brazilian Designated National Authority for the CDM
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1404
Justification of the choice of data or description of measurement methods and procedures actually applied :	BM is calculated according to methodology ACM0002 and the "Tool to calculate the emission factor for an electricity system" by the Brazilian DNA. Project proponents chose Option 2: calculate the build margin emission factor ex-post based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. The Brazilian DNA's most recent calculation published is based on 2010 data, thus it is used in the PDD.
Any comment:	

Data / Parameter:	Cap_{BL}
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity (W)

Source of data used:	ACM0002
Value applied:	0.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project consists of a new power plant. As defined in the methodology, for new hydro power plants, this value is zero.
Any comment:	

Data / Parameter:	A_{BL}
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full.
Source of data used:	ACM0002
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project consists of a new run of river power plant.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

All equations used to estimate the emission reductions were provided in section B.6.1. Detailed information of how the equations were used, and values applied are provided in the CER calculation spreadsheet (Appendix 3 to the PDD). The spreadsheet with the WACC calculation is part of the PDD.

Baseline emissions

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

The estimation of the net electricity generated by the plant, equivalent to the total amount of energy effectively dispatched to the national grid, is based on the assured energy determined for the plant. Additionally, as per article 28 of the Federal Decree[76] nr 5.163/2004, the amount of electricity established in the *Electric Power Commercialization Agreements within the Regulated Ambience* (CCEAR from the Portuguese "Contratos de Comercialização de Energia Elétrica no Ambiente Regulado") must be the estimated amount of electricity to be dispatched to the grid at the Gravity Point[77] of the system.

[76] Available in Portuguese at http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/Decreto/D5163.htm.

[77] The Gravity Point is the virtual point where the losses of the generation and consumption points become even. At this point all the purchases and sales of electric power at the CCEE are computed. The losses of electric power are shared equally between the points of generation and consumption, where half the losses are deducted from the total amount generated and the other half is added to the total amount consumed (Electric Power Commercialization Chamber (from the Portuguese *Câmara de Comercialização de Energia Elétrica* – CCEE) <www.ccee.org.br>).

Therefore, the transmission losses have to be discounted from the estimated total electricity to be generated by the plant.

The project activity's assured energy is 2,218$MW_{average}$. Transmission losses at the Gravity Point are calculated to be 3.2% and the internal consumption is estimate to be 0.2%[78]. Conservatively assuming the plant operational 8,760 hours/year, the total generated by the plant, when fully operational, i.e., from 2015 onwards, is 19,429,680 MWh/year and the net electricity dispatched to the grid at the gravity point of the system is 18,807,930 MWh/year.

Additionally, the calculation of the combined margin CO_2 emission factor for grid connected power generation ($EF_{grid,CM,y}$) follows the steps established in the "*Tool to calculate the emission factor for an electricity system*". The results are presented below.

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

According to Resolution number 8 issued by the Brazilian DNA on 26th May 2008, the SIN corresponds to the system to be considered.

- **STEP** 2 – Choose whether to include off-grid power plants in the project electricity system

Option I was chosen and only grid connected power plants are considered.

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

The dispatch data analysis is the chosen method.

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

The dispatch data analysis operating margin emission factor is calculated by the Brazilian DNA and made publicly available at http://www.mct.gov.br/index.php/content/view/74689.html. An estimated average operating margin emissions factor for 2010, assuming constant generation throughout the year, is used here for the ex-ante estimation of the emission reductions. The calculation is also available in appendix 3 to the PDD.

$$EF_{grid,OM-DD,y} = 0.4796 \text{ tCO}_2\text{e/MWh}$$

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

The build margin emission factor is calculated by the Brazilian DNA and made publicly available at http://www.mct.gov.br/index.php/content/view/74689.html.

$$EF_{grid,BM,y} = 0.1404 \text{ tCO}_2\text{e/MWh}$$

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

Applying the results presented above in STEPS 4 and 6 above to the Equation 6 presented in section B.6.1. and considering the weights w_{OM} = 0.5 and w_{OM} = 0.5:

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

$$EF_{grid,CM,y} = 0.5 \times 0.4796 + 0.5 \times 0.1404 = 0.3100 \text{ tCO}_2\text{e/MWh}$$

Finally, baseline emissions can be determined applying the results of $EG_{facility,y}$ and $EF_{grid,CM.y}$ to Equation 2:

[78] Res. N° 395/2002; Regras de Comercialização – Contabilização - Módulo 2

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

$$EG_{PJ,y} = EG_{facility,y} = 18{,}807{,}930 \text{ MWh/year (when fully operational)}$$

$$BE_y = 18{,}807{,}930 \text{ MWh/year } x \text{ } 0.3100 \text{ tCO}_2\text{/MWh}$$

$$BE_y = 5{,}830{,}126 \text{ tCO}_2\text{/year}$$

Project emissions

The project's reservoir area under the normal maximum water level of 70.5 m is 354.40 km^2, of which 164.00 km² are the river course and, therefore, the increased flooded area is 190.40 km².

With an installed capacity of 3,150.4 MW, the power density of the project activity is 16.55 W/m² (refer to A.4.3 for the calculation). Therefore, once the project's power density is above 10W/m^2, no calculation of project emissions is required.

Leakage emissions (LE_y)

The calculation of leakage emissions is not required by the methodology.

$$LE_y = 0 \text{ tCO}_2\text{/MWh.}$$

Emission reductions (ER_y)

Applying the results discussed above to Equation 1 we obtain,

$$ER_y = BE_y – PE_y - LE_y$$

$$ER_y = 5{,}830{,}126 – 0 – 0 = 5{,}830{,}126 \text{ tCO}_2\text{/year}$$

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

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
2012*	0	518,205	0	518,205
2013	0	2,720,189	0	2,720,189
2014	0	4,953,586	0	4,953,586
2015	0	5,830,126	0	5,830,126
2016	0	5,846,099	0	5,846,099
2017	0	5,830,126	0	5,830,126
2018	0	5,830,126	0	5,830,126
2019	0	5,830,126	0	5,830,126
2020	0	5,846,099	0	5,846,099
2021	0	5,830,126	0	5,830,126
2022**	0	2,429,219	0	2,429,219
Total (tonnes of CO2e)	0	51,464,028	0	51,464,028

* June to Dec.

** Jan. to May

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{facility,y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the project plant to the grid in year *y*
Source of data to be used:	Project activity site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	18,807,930 MWh
Description of measurement methods and procedures to be applied:	The measurement of this parameter will be carried out by energy meters installed at the substation in accordance with Module 12 of the Procedures established by the National System Operator – ONS (from the Portuguese *Operador Nacional do Sistema)*.
QA/QC procedures to be applied:	The equipment used to meter electricity production by the plant has by legal requirements extremely low level of uncertainty. Energy will be measured continuously, aggregated each 15 minutes and will be monthly consolidated. Electricity generation by the plant as published by CCEE will be used to cross check project participant's information.
Any comment:	Consolidation reports issued by CCEE already discount losses.

Data / Parameter:	Cap_{PJ}
Data unit:	MW
Description:	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data to be used:	Project site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3,150.4 MW
Description of measurement methods and procedures to be applied:	The installed capacity will be determined based on recognised standards.
QA/QC procedures to be applied:	In Brazil the installed capacity of hydropower plant is determined and authorized by the competent regulatory agency. In addition, any modification also has to be authorized and be publicly available. Hence, on a yearly basis, any new authorization to increase the installed capacity of the plant will be monitored.
Any comment:	

Data / Parameter:	$\boldsymbol{EF_{grid,OM,y}}$
Data unit:	tCO_2/MWh
Description:	Grid operating margin
Source of data used:	Brazilian Designated National Authority for the CDM
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.4796
Description of measurement methods and procedures to be applied	OM is calculated according to methodology ACM0002 and the "Tool to calculate the emission factor for an electricity system" by the Brazilian DNA. Project proponents chose Option (c): Dispatch data analysis OM The dispatch data analysis operating margin emission factor is calculated by the Brazilian DNA. An estimated average operating margin emissions factor for 2010, assuming constant generation throughout the year, is used here for the ex-ante estimation of the emission reductions. The calculation is also available in appendix 3 to the PDD.
QA/QC procedures to be applied:	
Any comment	

Data / Parameter:	A_{PJ}
Data unit:	km^2
Description:	Area of the reservoir measured on the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data to be used:	Project Developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	190.40 km^2
Description of measurement methods and procedures to be applied:	The project's reservoir area under the normal maximum water level of 70.5 m is 354.40 km^2, of which 164.00 km^2 are the river course and, therefore, the increased flooded area is 190.40 km^2.
QA/QC procedures to be applied:	In Brazil, every modification carried out in hydropower plants has to and be made publicly available and authorized by the competent regulatory agency.
Any comment:	

Please refer to Annex 4 for further background documentation.

B.7.2 Description of the monitoring plan:

The monitoring plan of the emission reductions by the project activity is in accordance with the procedures set by the methodology ACM0002.

The Project owner will proceed with the necessary monitoring measures as established in the official procedures from ONS, ANEEL and, CCEE.

ONS is the entity responsible for coordinating and controlling the operation of generation and transmission facilities in the SIN under supervision and regulation of ANEEL[79] which is the regulatory agency determining conditions for the electric power market to develop a balance between the agents and the benefit of society[80]. CCEE is a not-for-profit, private, civil organization company that is in charge of carrying out the wholesale transactions and commercialization of electric power within the SIN, for both ACR and ACL[81].

According to the procedures established by ONS, it will be possible to monitor total electricity exported to the grid. Beyond that, energy information will be controlled in real time by CCEE. Once the measurement points are physically defined and the invoice measurement system and the communication infrastructure are installed, the measurement points will be registered in the SCDE (System of Energy Data collection) managed by CCEE.

There will be at least two energy meters (principal and backup) for which the model and type are specified by ONS. In addition, before the operations start, ONS demands that these meters are calibrated by an entity with Brazilian Calibration Network (RBC form the Portuguese "Rede Brasileira de Calibração") accreditation. According ONS, these meters have to be calibrated every two years after operation start. The Special Purpose Company (SPC) responsible for the implementation and operation of the Santo Antonio Hydropower Projectwill be responsible for these calibrations. In order to confirm and to give certainty about the energy measurement, it will be controlled in real time by the plant and by CCEE.

Santo Antonio Hydropower Projectwill also be responsible for the maintenance of the equipments' monitoring, for dealing with possible monitoring data adjustments and uncertainties, for review of reported results/data, for internal audits of GHG project compliance with operational requirements and for corrective actions. Yet, it is also responsible for the project management, as well as for organising and training of the staff in the appropriate monitoring, measurement and reporting techniques.

It is important to mention that ANEEL can visit the plant and inspect operation and maintenance of the facilities at any time. Yet, during the periodic verifications, the plant will provide all the necessary documents evidencing the amount of net energy exported to the grid. This data is going to be kept for at least two years after the crediting period ends.

All data collected on-site will be checked internally before being compiled in an electronic format, to ensure that it is complete and of appropriate quality. A final check of the data and project analysis prior to any verification will be carried out.

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

[79] Information available at <http://www.ons.org.br/institucional/modelo_setorial.aspx?lang=en>.
[80] Information available at <http://www.aneel.gov.br/>.
[81] Information available at <http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=25afa5c1de88a010VgnVCM100000aa01a8c0RCRD>.

28/10/2011

The application of the baseline study and monitoring methodology was completed on October 2011. The entity determining the baseline study and the monitoring methodology, and participating in the Project as Carbon Advisor is EQAO with the following contact information:

Address: Rua Padre Joao Manoel 222

City: São Paulo

ZIP-code: 01411-000

Country: Brazil

Tel.: +55 (11) 3063-9068

e-mail: eqao@focalpoint.com.br

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

13/06/2008

The Project starting date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the Project Activity. In the case of the Santo Antonio Hydropower, a conditional EPC contract was signed on 17 December 2007. The contract would be valid after the concession contract signature and could be terminated anytime before with a 5% penalty. Based on the aforementioned, the starting date is considered the entry into force of the EPC contract on the date of the concession contract signature, 13 June 2008.

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

35 years 0 months

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

C.2.1. Renewable crediting period

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

Not applicable.

C.2.1.2. Length of the first crediting period:

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

The crediting period is estimated to begin on 30/09/2012, or on the date of registration of the CDM project activity, whichever is later.

C.2.2.2. Length:

10 years.

SECTION D. Environmental impacts

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

The decision related to the implementation of a hydroelectric plant is complex and involves a number of governmental and non-governmental agents. The governmental ones are mainly responsible for regulating the electric energy sector, water resource management, control natural resources and soil use. Among non-governmental agents are the ones interested in exploiting the electricity market, investors, product and equipment suppliers, NGO's and the directly and indirectly affected population. Hence, for the implementation of a successful hydropower plant, a consensus between all parties has to be reached, meaning that the following points, just to mention a few, are met:

- Existent energy demand that justifies the project activity;
- Technical viability for its execution;
- Implementation and operation of the plant lead to reversible impacts and / or are possible to be compensated (counterbalanced);
- Absence of conflicts between the plant's operation and comprehensives area water use;
- Local affected population can be duly compensated, and;
- Interested agents in constructing and financing the plant.

Additionally, the implementation of a hydroelectric plant has to be in accordance with National Regulations in order to receive all necessary permits to starts is construction and operation. According to Clause 25 by means of item IV of the Brazilian Constitution, the Project entity must elaborate an *environmental impact study* (EIA from the Portuguese "Estudo de Impacto Ambiental") and a corresponding *environmental impact report* (RIMA from the Portuguese "Relatório de Impacto Ambiental") and make them publically available[82] before utilising natural resources and beginning the construction of the project. Furthermore, normative instruction n°65/2005, through which the *Brazilian Institute of Environmental and Renewable Natural Resources* (the federal environmental agency, IBAMA from the Portuguese "Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis") establishes the procedures required for licensing hydropower plants and Federal Decree n°99274/90, complemented by CONAMA's Resolutions[83] 01/86, 06/86, 06/87, 09/87 and n° 237/97, set forth a three-stage process for the issuing of licenses as follows:

a) A *Preliminary License* (LP from the Portuguese "Licença Prévia") is granted during the preliminary planning stage of a project for a maximum term of five-years. The license approves the location and design of the project, certifies its environmental feasibility and

[82] IBAMA – Sistema Informatizado de Licenciamento Ambiental Federal (http://www.ibama.gov.br/licenciamento/).

[83] Brazil's federal environmental entities are the policy-setting *National Environmental Council* (CONAMA from the Portuguese "Conselho Nacional do Meio Ambiente") and the policy-enforcing IBAMA.

establishes the basic requirements and conditions to be complied with during subsequent implementation stages.

b) The *Installation License* (LI from the Portuguese "Licença de Instalação") authorizes the installation of the project activity in accordance with the specifications contained in the approved plans, programs and projects, including environmental mitigation provisions and other conditions.

c) The *Operation License* (LO from the *Portuguese* "Licença de Operação") authorizes operation of the project activity in accordance with environmental mitigation measures and operating requirements. The Operating License can vary from 4-10 years and is renewable within the legal timeframe established by the competent environment agency.

The Project Developer therefore commissioned a third party, Leme Engenharia, to develop the required EIA - RIMA which was released in 2005 and enabled the Project Developer to obtain the "*Preliminary License*". The EIA - RIMA developed for the Project Activity highlights the environmental impacts of the hydroelectric plant and the proposed actions to minimize the adverse impacts. The environmental impacts described in the EIA - RIMA will be object of specific actions, under the responsibility of the project owner, aiming to neutralize or minimize potential negative impacts, as summarized in the table below.

Table 16 - Environmental Impacts of the project activity according to approved EIA -RIMA

Impact	Environment	Mitigation (Monitoring) Program
Interference in egg, larvae and migratory fish dispersion	Biotic	*Ichthyofauna Conservation and Rescue*
Introduction of allochthonous species		
Species composition modification		
Loss of spawning and grow out areas		
Local loss of biodiversity		
Downstream fish school concentration		
Loss of specific avifauna habitats	Biotic	*Fauna Conservation*
Loss and/or escape of existing fauna		
Loss of reproduction areas		
Modification of ecological and biological characteristics of aquatic and semi-aquatic mammals.		
Migratory interference of marine organisms		
Loss of Flora in area of new reservoir	Biotic	*Flora Conservation*

Suppression of lowland forest formation in area of new reservoir.		
Increase in anthropogenic pressure on forest resources		
Change in abiotic factors downstream and new reservoir area	Physical	*Limnology*
Creation of propitious conditions for proliferation of aquatic vectors	Biotic	
Increase in oil and metal levels	Physical	*Hydro biogeochemistry*
Sediment (ary) elements re-suspension		
Retention of solids in suspension	Physical	*Hydro sedimentology*
Increase in erosion potential		
Change in fluid geomorphology		
Change in hydrological regime	Physical	*Climatology*
Increase in Cyanobacteria and Aquatic Macrophyte biomass	Biotic	*Macrophyte*
Occurrence of induced earthquakes	Physical	*Seismology*
Interference and loss of Archaeological heritage	Physical	*Preservation of Paleontological Heritage*
Interruption of migratory routes of local fish populations as a result of the dam construction	Biotic	*Transposition System*
Landscape modifications	Physical	*Environmental Construction Plan*
Loss of farmland	Physical	*Downstream Action Plan*
Possibility of impairment of downstream river dwellers activities	Socioeconomic	
Change in social and political organization of the population	Socioeconomic	*Social Communication & Compensation and Environmental Education*
Change in quality of life of the population affected by new reservoir		
Rise in unemployment and retraction of economic activities		
Increased demand for public services		

Loss of Ichthyofauna because of increased fishing	Biotic	
Compromised infrastructure	Physical	*Affected Infrastructure Recovery Plan*
Increased incidence of malaria and other diseases	Socioeconomic	*Public Health*
Change in population dynamics of vectors		
Impairment of local communities	Socioeconomic	*Resettlement of Affected Population*
Pressure on land of indigenous communities	Socioeconomic	*Support to Indigenous Communities*

An extensive list and description of all mitigation actions to be implemented is publicly available in the Project's EIA.

Resettlement (relocation) of affected population program

The capacity of the local communities to handle a series of modifications caused by the construction of such a project is in general terms small, especially when these people have low incomes. Therefore, the requirements of the entrepreneur in providing the necessary financial, material and/or organizational resources to overcome these problems is one of the most important aspects of the environmental licensing process. This Program is part of the Basic Environmental Project (PBA from the Portuguese "Projeto Básico Ambiental") which subsidizes the solicitation of the LI. Furthermore, this program was proposed in the EIA, having been endorsed by the LP 251/2007 issued by IBAMA.

The resettlement program incorporates a number of actions to support the population that live in areas directly affected by the construction site and new reservoir area, thus minimizing the derangement caused by the implementation of the hydropower plant and enabling the re-composition of the families economic, social and cultural activities in another locality. This new locality should maintain or even improve the quality of life by providing employment, water and sanitation services, healthcare, education, security and leisure. The proposed measures are the commitments of the consortium entrepreneur to meet current legislation and best international practices regarding resettlement and social compensations.

The types of measures to achieve the aforementioned are:

Table 17 - Types of reallocation measures

Measure	Description
Relocation in property	This alternative means the transfer of improvements and housing for the remaining area of the property, plus resources and technical assistance for the reorganization of productive activities. It is possible to be adopted in cases in which the remaining area is considered viable in their productive potential.
Indemnity	This form means the cash value for the assets and activities committed by the deployment of the enterprise for those who prefer to rebuild, autonomously, their productive activities and housing.

Resettlement	Considers the population shift to a new location, contemplating new land for production, housing and infrastructure.
Relocation of urban areas	Consist in rebuilding urban and community facilities, shops and public institutions, religious and cultural factors that will be affected in the villages of Teotônio, Amazon and Jaci - Paraná.
Technical assistance	Includes support for those affected directly or indirectly, through social assistance, technical advice and / or legal and others that are necessary to minimize inconvenience caused by the need for change or other changes imposed by new development.

The resettlement program started in the beginning of 2008 and by the end of 2011, 1,735 cases were registered. Of this total, 1,721 cases are already concluded. A total of 574 houses in six different locations (settlements) are constructed and already finished. Example of houses in different villages can be seen in the pictures below.

Figure 6 - Newly build house in Nova Teotônio

Figure 7 - Newly build house in Jacy Paraná

A participatory process of the local population discussing issues related to the construction and operation of the hydroelectric power plant was held. This process consisted of 64 public meetings with the participation of 2000 people from the local communities that inhabit the area of direct influence of the hydroelectric plant. The main result of these meetings is composed of a number of proposals that were later consolidated and presented to public authorities and members of the local communities and later incorporated into the entrepreneur's responsibility if deemed applicable by the local authorities.

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

The project has all required environmental licenses issued by IBAMA. LP 251/2007 issued on 9 July 2007, LI 540/2008 issued on 18 August 2008 and, LO 1044/2011 issued on 14 September 2011.

Furthermore, with mitigation controls planned as part of the Project construction and EIA process as summarized in section D.1, and the contribution made by the project to sustainable development for the local, regional and, national area, the Project will have an overall positive impact on the local and global environments. Nevertheless, mitigation measures will ensure that there are no significant residual impacts associated with the Project.

SECTION E. Stakeholders' comments

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

According to the federal and local states legislation, the environmental licensing process requests public hearings with the local community. Also, the same legislation requests the announcement of the issuance of the licenses (LP, LI and LO) in the local state official journal and in the regional newspapers.

Besides, according to CIMGC resolution 7, issued on 5 March 2008[84], the Brazilian Designated National Authority for the CDM (CIMGC from the Portuguese "Comissão Interministerial de Mudanças Globais do Clima") requests, among other documents, comments from local stakeholders in order to provide the Letter of Approval for a project. The Resolution determines that the project proponent has to directly invite by hard letters selected local stakeholders, which include at least, the following agents involved in and affected by project activity:

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

The same resolution also requires that at the time these letters are sent, a version of the PDD in Portuguese and a declaration stating how the project contributes to the sustainable development of the country must be made available to these stakeholders at least 15 days before to the starting of the Global Stakeholder Process (GSP). The Portuguese version of the PDD was made publicly available[85] on December 2011, which is also when the invitation letters were sent to the following agents:

- Federal Attorney for the Public Interest;
- State Attorney for the Public Interest of Rondonia;
- Environmental Agencies of Rondonia;
- Brazilian Forum of NGOs and Social Movements for Environment and Development;
- City Halls of Porto Velho;
- City Councils of Porto Velho;
- Environmental Agencies of Porto Velho;
- Community Associations of Porto Velho;

Copies of the letters and post office confirmation of receipt will be made available to the DOE during the validation of the Project Activity.

[84] Available at http://www.mct.gov.br/index.php/content/view/14797.html (retrieved on 27 October 2011).
[85] Available at http://sites.google.com/site/consultadcp/.

E.2. Summary of the comments received:

PDD version prepared for the local and global stakeholders consultation, therefore, no comments have been received yet.

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

PDD version prepared for the local and global stakeholders consultation, therefore, no comments have been received yet.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No official development assistance or related public funding was or will be used in Santo Antonio Hydropower Project.

Annex 3

BASELINE INFORMATION

This section is intentionally left blank.

For details please refer to section B.6.1. and B.6.3. above.

Annex 4

MONITORING INFORMATION

This section is intentionally left blank.

For details please refer to section B.7.2. above.