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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Anhanguera Hydro Power Project.
Version 01.5
Date: 15/03/2011

A.2. Description of the project activity:

The Anhanguera small hydroelectric project (hereafter referred as the **Project**) is being developed by a private company called Central Elétrica Anhanguera. The purpose of the project is to use the hydrologic resources of the Sapucaí River to generate zero GHG emissions electricity for the Brazilian national grid.

The proposed project activity involves the development of a new small run-of-river[1] type power plant with 22.5 MW installed capacity consisting of 3 turbo-generators with Kaplan turbines[2]. Each turbo-generator unit has 8.823 MVA, which corresponds to 7.5[3] MWe with a power factor of 0.85. The annual electricity exported to the grid is projected to be 105,032 MWh/year. The power plant is connected to the grid at 138 kV to the distribution line. The reservoir area is estimated to be 2.05 km^2. The project is expected to reduce CO_2 emissions by 162,848 tCO_2 compared with the baseline scenario during the whole crediting period. Baseline scenario and the scenario prior to the start of implementation of the project activity is the same.

The Project will generate certified emission reductions (CERs) by displacing electricity generation from fossil fuel-fired power plants connected to the national grid. The proposed project will supply sustainable and clean energy for Brazil's increasing energy demands resulting from rapid economic growth.

Electricity generation from renewable resources has an important contribution to overall reduction of CO_2 emissions. Brazil's electricity has been supplied mostly by large hydro power plants. The table below shows the distribution of power plants by type as reported by ANEEL, Brazil's electricity regulatory agency.

[1] See the PCH Anhanguera's Data Sheet (Annex 5) and the WCD definitions of run-of-river, pg348 , Annex 2, 2000 World Commission of Dams Report
[2] The **Kaplan turbine** is a propeller-type water turbine that has adjustable blades
[3] The individual capacity is 7.56 when operating stand alone but when combined the capacity becomes 7.5.

Brazilian Energy Matrix - Operating plants							
Type		Installed capacity		%	Total		%
		number of plants	(kW)		number of plants	(kW)	
Hydro		870	80.024.790	67,19%	870	80.024.790	67,19%
Gas	Natural	93	11.050.530	9,28%	128	12.341.813	10,36%
	Process	35	1.291.283	1,08%			
Petroleum	Diesel oil	824	3.992.543	3,35%	853	6.516.346	5,47%
	Residual oil	29	2.523.803	2,12%			
Biomass	bagasse	312	5.957.146	5,00%	382	7.605.701	6,39%
	black liquor	14	1.240.798	1,04%			
	wood	40	327.827	0,28%			
	biogas	9	48.522	0,04%			
	rice husk	7	31.408	0,03%			
Nuclear		2	2.007.000	1,69%	2	2.007.000	1,69%
Mineral Coal	Mineral coal	9	1.594.054	1,34%	9	1.594.054	1,34%
Wind		46	835.336	0,70%	46	835.336	0,70%
Imports	Paraguay		5.650.000	4,74%		8.170.000	6,86%
	Argentina		2.250.000	1,89%			
	Venezuela		200.000	0,17%			
	Uruguay		70.000	0,06%			
TOTAL		2.290	119.095.040	100%	1.707	119.095.040	100%

Table 1 – Brazilian Energy Matrix – operating plants
Source: ANEEL, Oct, 2010 - http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp

Even though there is still untapped potential for large hydro projects in Brazil, the remaining projects are located in the Amazon region where environmental impacts are relatively large and the locations are extremely far from the grid. In the country's Southeast region, where most consumption takes place, there are no remaining, large (>100 MW) potential sites[4]. Although most of the electricity generated from hydropower plants, the country's electricity matrix expansion includes a larger participation of fossil fuel thermal power generation. During the next three years, another 72 large plants with 22.4 GW installed capacity will start operating. Of these, 51 plants will be fossil fuel thermal plants (coal and gas) with more than half of the new capacity. Brazil's national energy plan foresees that by 2030 hydro power will account for 78% of installed capacity compared with 90% today[5].

The Project will have some positive impact on the environment, introduce economic benefits to the region and contribute significantly to the region's sustainable development by providing:

- Supply of sustainable energy to meet growing energy demand
- Employment of 300 workers directly and 1,200 indirectly during the construction phase of the project and 20 local workers directly during the operational phase
- Reduction of pollutants such as sulphur dioxide, nitrogen oxides and particles resulting from electricity generation via fossil fuels

The main GHG emission source of the National Interconnected Power System is fossil fuel thermal power plants. In the absence of this project fossil fuel-intensive energy generation sources would be used instead of hydro power. The proposed project has no emissions and, therefore, contributes to the reduction of

[4] Plano Nacional de Energia, 2030, EPE - http://www.epe.gov.br/PNE/20080512_3.pdf, pg 15-54
[5] Plano Nacional de Energia, 2030, EPE - http://www.epe.gov.br/PNE/20080512_2.pdf, pg 345

GHG emissions and helps meet country's electricity demands for economic growth using sustainable renewable sources.

Central Elétrica Anhanguera is the project proponent in this CDM PDD. It is a company created by SEBAND (Sociedade de Energia Bandeirantes) and its partners: Volkswagen do Brasil and Pleuston Serviços Ltda with the share structure: SEBAND 33%, Volkswagen 40% and Pleuston 27%. SEBAND is a small private group of investors with strong history in engineering capabilities.

A.3. Project participants:

Name of Party Involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants	Kindly indicate if the Party involved wishes to be considered as project participant (yes/no)
Brazil (host)	Central Elétrica Anhanguera S.A.	No

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

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil

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

State of São Paulo, Southeast region

A.4.1.3. City/Town/Community etc:

São Joaquim da Barra and Guará.

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

The Small Hydro Anhanguera is located on the Sapucaí River. The GPS coordinates of the Intersection point of pivot (dam) and pivot (turbine No 2) are respectively 20^{o} 29.55'S and 47^{o} 51.53'W.

Figure 1 - Brazil and the State of São Paulo

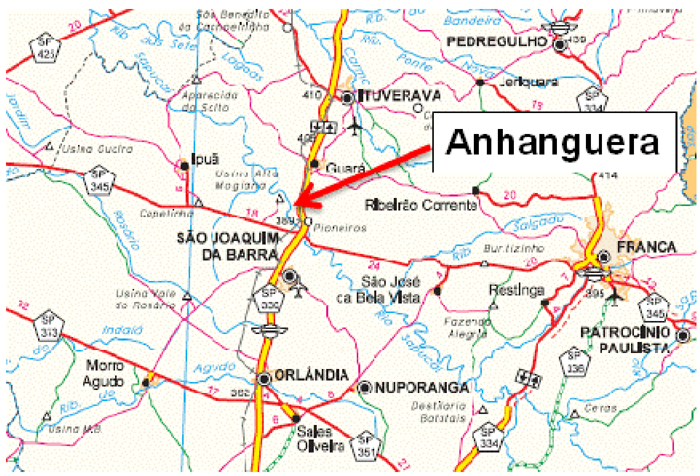


Figure 2 - PCH Anhanguera and neighbouring towns

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

The project activity is grid-connected electricity generation from renewable source.
Sectoral scope 1: energy industries (renewable/non renewable sources).

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

The baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity. According to ACM0002, *if the project activity is the installation of a new grid-connected renewable power plant/unit* (which is the case of this project)*, the baseline scenario is the following*:

> *"Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as*

reflected in the combined margin (CM) calculations as described in the "Tool to calculate the emission factor for an electricity system".

General Information			
1.	**Location**		
1.1.	Catchment	Sapucaí	
1.2.	Sub-basin	Rio Grande	
1.3.	River	Sapucaí	
1.4.	Nearest Cities	São Joaquim da Barra and Guará	
1.5.	GPS coordinates (dam axis)[6]	20° 29.55'S and 47° 51.53'W	
1.6.	Distance of the main cities of the region	415 Km from the city of São Paulo	
1.7.	Access	State Highway SP 330	
2.	**Main activity**	Power generation	
3.	**Energy and Power**		
3.1.	Power (installed capacity)	22.5	MW
3.2	Average annual generation (53.3% power factor)[7]	105,032	MWh

Table 2 – General project data from Anhanguera

The technology to be employed in the project is environmentally safe and the technology is well known in Brazil since many small hydro plants have been using it for a long time and the equipments are – domestically-made, the only technology being transferred to the host party are the generators imported from the United States of America.

The three turbines are tubular Kaplan type, manufactured by Voith, with the horizontal axis attached to an alternate current three-phase 60 Hz generator, manufactured by Hyundai, with a power factor 0.85.

The speed regulation digital system is based on a microprocessor with PID action and electro-hydraulic performance. Technical characteristics are as defined in the technical specification of the turbine.

The main parameters of the technical description of the equipment and technology, based on the "Anhanguera Basic Engineering Project – technical study" (available to the DOE) is shown below:

Parameter	Project Value
Average flow rate (m^3/s)	83.5
Reservoir area (km^2)	2.05
Head (m)	17.07
Installed Capacity (MW)	22.5
Nominal Turbine Flow rate (m^3/s)	50.07
Turbine (manufacturing date 2009)	3 Voith Kaplan S, horizontal axis, 225 rpm
Generator (manufacturing date 2009)	3 Hyundai[8] SAB x 7.5 MW (8,823 kVA, 138 kV)

[6] Intersection point of pivot (dam) and pivot (turbine No 2).
[7] Basic engineering project.
[8] "*Each generator is custom designed so that performance is optimized and customer requirements can be incorporated*"- http://www.idealelectricco.com/products/pdf/hydroelectric_generators.pdf.

Main Transformers	2 WEG 10 - TF A 3 60
Lifetime (years)	35

Table 3 - Technical description

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

Year	Annual estimation of emission reductions in tonnes of CO_2e
2012	16.284
2013	16.284
2014	16.284
2015	16.284
2016	16,284
2017	16,284
2018	16,284
2019	16,284
2020	16,284
2021	16,284
Total estimated reductions (tonnes of CO_2e)	162,848
Total number of crediting years	10 years
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	16,284

Table 4 – Emission reduction estimative for the Anhanguera Hydro Power[9]

A.4.5. Public funding of the project activity:

There is no public funding from Annex I Parties in this Project.

[9] There are two official values for annual energy generation: the highest one taken from the official engineering project presented to the national regulator is shown in table 2. This value was used in the financial spreadsheets supporting the demonstration of additionality. A second value is a low limit value assigned by the national authority (http://www.aneel.gov.br/cedoc/bren2004065.pdf) that in the case of this project activity is 99,601 MWh/y. This value was used to estimate the volume of CERs. This is conservative.

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. The baseline and monitoring methodology ACM0002: "Consolidated baseline methodology for grid connected electricity generation from renewable sources" version 12.1.0, EB 58;

2. Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (version 2 EB 41);

3. The "Tool for demonstration and assessment of additionality", Version 05.2, in effect as of EB 39.

4. The "Combined tool to identify the baseline scenario and demonstrate additionality", Version 02.2, in effect as of EB 28.

5. The "Tool to calculate the emission factor for an electricity system", Version 02, in effect as of EB 50.

6. The grid emission factor was published by the Brazilian DNA (see Resolution #8, June 18, 2008) which declared to have used the "Tool to calculate the emission factor for an electricity system", Version 02.

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

The methodology used for the proposed Project is the approved consolidated baseline and monitoring methodology ACM0002 "Consolidated baseline and monitoring methodology for grid-connected electricity generation from renewable sources", applicable to grid-connected renewable power generation project activities that install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant);.

The methodology is applicable to the proposed Project because:

- ✓ The project activity is the installation of a new run-of-river hydro power plant;
- ✓ The project activity is not the case of capacity addition, retrofit or replacement to an existing plant as well as there was no existing reservoir at project site before its implementation;
- ✓ The project activity results in a new reservoir and its power density is greater than 4 W/m^2. The installed capacity of the project is 22.5 MW and the maximum reservoir area is 2.05 km^2. Therefore the power density of the proposed Project is 10.98 W/m^2.
- ✓ The proposed Project involves the electricity capacity additions from a hydro power plant, connected to the Brazilian National Interconnected Power System.
- ✓ The geographic and system boundary of the National Interconnected Power System can be clearly identified and information on the characteristics of the grid is publicly available.
- ✓ The proposed Project does not involve switching from fossil fuels to renewable energy neither does energy generation by biomass fired power plants at the site of the project activity.
- ✓ The monitoring methodology is used in conjunction with the approved baseline methodology ACM0002.

Therefore, the approved consolidated baseline methodology ACM0002 "Consolidated baseline and monitoring methodology for grid-connected electricity generation from renewable sources." is applicable to the proposed Project.

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

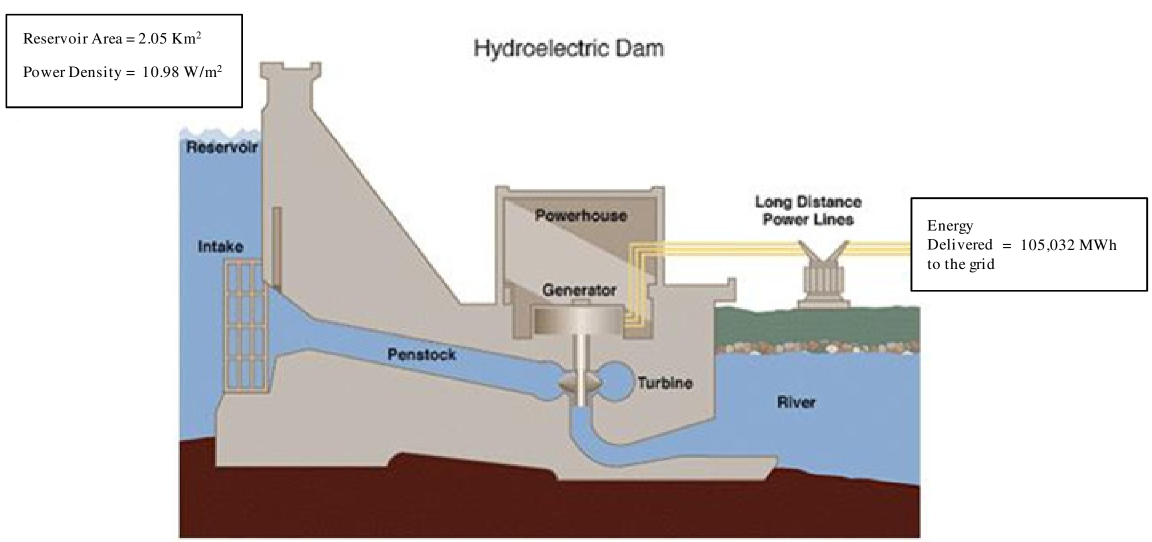
For hydro power project activities that result in new reservoirs, project proponents shall account for project emissions, estimated as follows:

	Source	Gas	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Yes	Main GHG emission source. The National Interconnected Power System includes thermal power plants that emit CO2.
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	For hydro power plants, emissions of CH_4 from the reservoir.	CO_2	No	Minor emission source
		CH_4	Yes	Main emission source. The power density of the Anhanguera's reservoir is larger than 10W/m2, therefore the project emissions are zero.
		N_2O	No	Minor emission source

Table 5 – Emissions sources included in or excluded from the project boundary

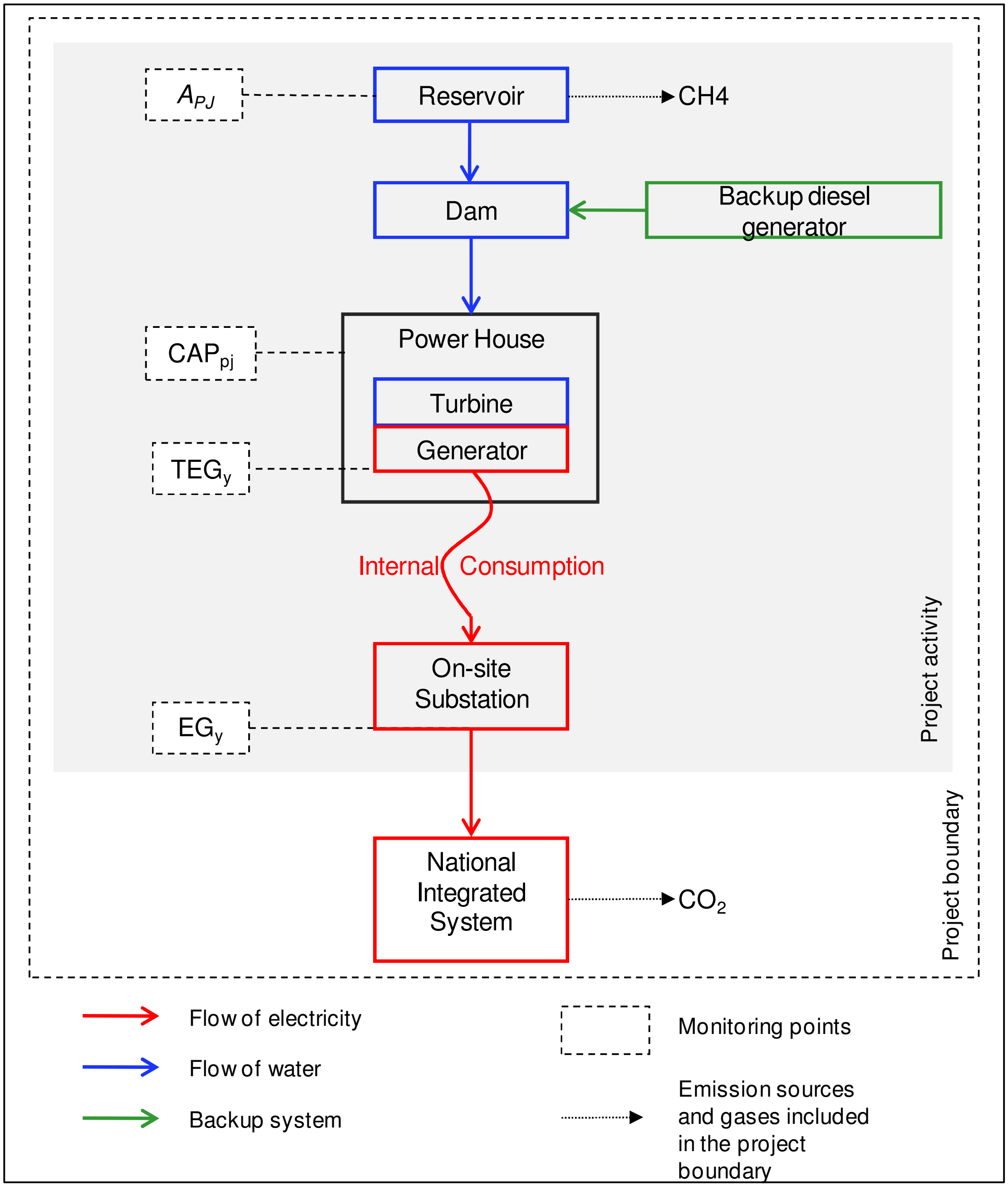
The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the National Interconnected Power System.

The two following figures illustrate a hydro power plant and the project activity flow and boundaries.



Source: Nation Master, 2005

Figure 3 - Diagram of a typical hydro power plant



Apj = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2);
CAPpj = Installed capacity of the hydro power plant after the implementation of the project activity (W);
TEGy = Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y*
EGy = Quantity of net electricity generation supplied by the project plant to the grid in year *y*

Figure 4 - Flow diagram of the project

The figure below shows the National Interconnected Power System to which the project activity plant will be connected to.

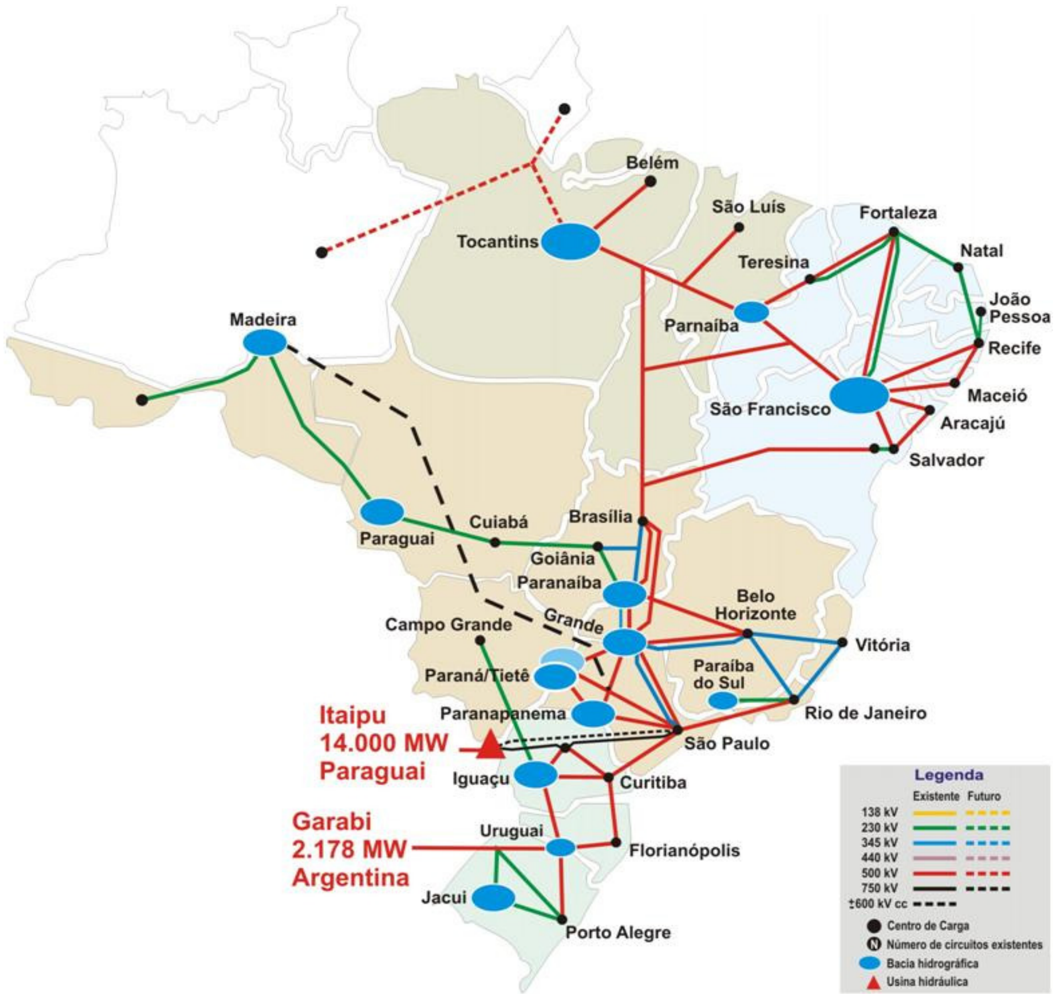


Figure 5 - Physical delineation of the project activity – National Interconnected Power System
Source: ONS transmission system 2007-2009
http://www.ons.org.br/conheca_sistema/pop/pop_integracao_eletroenergetica.aspx

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

According to ACM0002, *if the project activity is the installation of a new grid-connected renewable power plant/unit* (which is case of this project), *the baseline scenario is the following*:

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

The baseline scenario is the continuation of the pre-project situation regarding power generation. The project activity reduces emissions of greenhouse gas associated with the fossil fuel fraction of power generation, which would be emitted in the absence of the project.

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):

Before 2006, SEBAND had the concession to develop three small hydro plants in sequence along the Sapucaí River: Anhanguera (described in this PDD), Palmeiras and Retiro. Each plant would be run by a special purpose company. Central Elétrica Anhanguera (CELAN) was set up in late 2003 to run SHP Anhanguera and controlled by SEBAND. As most developers in the energy sector in Brazil, SEBAND sought a loan from the Brazilian Development Bank (BNDES). This loan, a special line for renewable energy projects, finances 80% of capital expenditures at better-than-market rates.

Being a small company, SEBAND faced difficulties in obtaining these favourable financial terms. By the end of 2006, in order to be able to develop at least one plant they decided to sell the two other hydro projects to a major utility company. By the sales contract, SEBAND would be paid as soon as the Installation Licenses for the two plants were issued, which happened in the end of 2007. In parallel SEBAND sought a strong partner who would bring equity for the project. Talks started in mid-2007 and were very well advanced at this point – for instance the future reference price was agreed upon as being 140.00 R$/MWh. In 15/December/2007, CELAN' board of directors took the decision to start the construction of the plant – this date is taken as the management decision date. They were confident that the agreement with the new partner would be signed soon and, principally, they wanted to use the dry season (between April and September of 2008) as much as possible to build the dam and the powerhouse. Otherwise the delay would have been of over a year. In 10/February/2008 CELAN signed a starting contract with a construction company and, later that month, the construction site was set up and earth movement started. This date of 10/February/2008 was taken as the starting date of project activities.

By mid-2008, Volkswagen signed a PPA with CELAN and joined the company as a partner, although the final authorization for this only came out in the end of that year. The PPA signed in July 2008 states a price of 140.00 R$/MWh – this is the price used in the IRR calculations.

SEBAND started considering CERs almost from their first financial analysis. For example, when they sold two projects (Palmeiras and Retiro) to the utility company, the contract stated that, regardless of the ownership of the plants, SEBAND would retain the rights over the CERs generated from these two plants. (As such SEBAND would be responsible for all development and registration costs.) This contract was signed on 22/02/2007. The loan SEBAND was seeking from BNDES required that they should demonstrate their capacity of providing the 20% of equity. Selling the two plants provided the equivalent of 69% of this amount. They expected that an upfront sale of 10-year CERs from the three plants would practically complete the 20% requirement. At that time it was also known that BNDES was seeking means of accepting future CERs from CDM project as part of a company's own participation in the operation.

The table below shows the main milestones of the project since its beginning and including those related to the CDM process. Highlighted in green are two events demonstrating the previous knowledge of CDM and CERs and highlighted in yellow is the management decision taken to start the construction of the plant taking into account, among other points, the necessity of CERs.

Data	Milestone*	Evidence
26/10/2001	Simplified Environmental Impact Assessment finished	Simplified Environmental Assessment
29/10/2001	Basic engineering project concluded	Basic Engineering Project
03/10/2002	Brazilian Electricity Regulatory Agency (ANEEL) authorizes SEBAND as an independent producer of electric energy to build the small hydro Anhanguera	http://www.aneel.gov.br/cedoc/res2002541.pdf
12/12/2003	Project owner officially established as Central Elétrica Anhnaguera LTDA	CELAN Constitution Contractual Instrument - Jucesp protocolo n. 915105/03-2
12/06/2007	Brazilian Electricity Regulatory Agency (ANEEL) authorizes the transfer of the right to explore SHP Anhanguera from SEBAND to Central Elétrica Anhanguera Ltda	http://www.aneel.gov.br/cedoc/rea2007957.pdf
22/02/2007	SHPs Palmeiras and Retiro are sold to Duke Energy. The contract states that SEBAND is entitled to all CERs issued from them	Contract with Duke Energy
16/10/2007	Contract with first CDM consultant - EcoAdvance	Contract with EcoAdvance
31/10/2007	Environmental license and Installation License granted by the Environmental Secretary of the State of São Paulo	Instalation 'Environmental License
15/12/2007	Management investiment decision to start the construction of plant based on, among other reasons, the expected revenues from the sales of the 2 plants and the CERs from the 3 plants.	Meeting Notes Seband
20/02/2008	Construction starts. Contract signed by the project owner with an engineer company to start construction on 10/02/2008	Contract with Leao Engenharia S.A
18/07/2008	Purchase of generators	Hyundai Invoice for generators
11/12/2008	Starting date of Global Stakeholder Publication of the CDM PDD on UNFCCC	http://cdm.unfccc.int/Projects/Validation/DB/283TFPYH2AJJ4IB7FHR37RUWPD0FQB/view.html
31/12/2008	New partners officially join the company now called Central Elétrica Anhanguera S.A.	Minutes of Meeting - Jucesp 41230/09-7
30/09/2008	Start of construction activities: powerhouse and dam construction	Daily Construction Report of 30/09/2008
20/02/2009	Substation and transmission lines began to be installed by CPFL	CPFL Daily Construction Report of 20/02/2009
21/02/2010	CPFL delivers the substation and transmission lines	Daily Construction Report of 21/02/2010

22/03/2010	First PDD withdrawn	withdrawal letter signed by Project Owner
31/03/2010	Turbine, generator and other equipments installed	E-mail confirmation sent by Voith to CELAN
25/05/2010	Date of the last land purchase	Final agreement contract[10]
30/07/2010	First CDM consultant informs that no longer wants to proceed with the contract	E-mail sent by consultant to Project Owner
01/10/2010	contract with new CDM consultant - PLANT	Contract
05/10/2010	DOE validation contract with TUV NORD	Contract
* during the development of the CDM project the first CDM consultant (Ecoadvance) was acquired by OneCarbon (a Econcern company), later Econcern was declared bankrupt and sold OneCarbon to Orbeo and then Orbeo decided not to continue with the project and the Project Participant and Orbeo asked TUEV-SUED to withdrawn the first PDD.		

Table 6 –Project Milestones

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

Step 1a. Define alternative scenarios to the proposed CDM project activity

This project activity reduces GHG emissions by displacing fossil fuel-fired energy generation with renewable hydro generation. From the project owner's perspective, there are no real alternatives.

From the National Interconnected Power System perspective, the absence of this specific plant would lead to an increase in fossil fuel generation as the main hydro potentials in the region are already developed and the remaining potential is located in sites thousands of miles north, in the Amazon region. In this sense, only two scenarios will be analyzed:

Scenario 1: The alternative to the project activity is the continuation of the current (previous) situation of electricity supplied by a mix of large hydro with large reservoirs and thermal power stations.
Scenario 2: The proposed project activity undertaken without being registered as a CDM project activity.

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

All alternatives are consistent with national and local laws and regulations.
Sub-step 1b is satisfied.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

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[10] Land purchase was carried out with more than 40 counterparties; this contract ends the process of land acquisition.

The project's main revenues come from electricity sales therefore the simple cost analysis is not applicable. Option II (Investment Analysis) is not adequate because there are no other options of investment from the project owner perspective with which the project can be compared with. Therefore additionality is demonstrated using an investment benchmark analysis (option III).

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

This analysis compares the Anhanguera' project IRR with a benchmark. The "Tool for Demonstration and Assessment of Additionality" offers as guidance on using valid benchmarks:

> *In cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR*

And further:

> *Internal company benchmarks/expected returns (including those used as the expected return on equity in the calculation of a weighted average cost of capital - WACC), should only be applied in cases where there is only one possible project developer and should be demonstrated to have been used for similar projects with similar risks, developed by the same company or, if the company is brand new, would have been used for similar projects in the same sector in the country/region.*

This project activity is the first small hydro developed by SEBAND. There is no history of similar projects within CELAN, SEBAND nor VOLKSWAGEN DO BRASIL from where to draw a WACC.

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

The WACC can be defined as per:

$$WACC = \frac{D}{A} \cdot R_d \cdot (1 - T_c) + \frac{E}{A} \cdot R_e$$

Where:

WACC	Weighted Average Capital Cost
R_d	Cost of debt (Interest rate charged by lenders)
T_c	Taxes over project (usually income related taxes)
R_e	Cost of Equity (defined below)
D/A	Weight of debt in capex
E/A	Weight of equity in capex

As of December 2007 (management decision date), total capital expenditures were estimated to be around 87 million reais (MR$) with land costing 8.9 MR$. This corresponds to around 2,000 USD/kW in 2007 exchange rates for a plant installed near the main developed centres of the country. This capex value is a conservative estimate. There is one set of proposals from suppliers associated with the 2002 basic engineering project and another set of invoices actual installation of the plant. By applying the main inflation indicators (IGP-M and IPCA) from 2001 to 2008, the basic engineering capex estimate would be almost 92MR$. Another set of proposals from suppliers were sought to set up the loan application documentation for BNDES. By deflating using the same indexes, the capex would be at the time around 99MR$. The value used in this analysis is conservative but at the same order of magnitude

BNDES finances 80% of the 78MR$ corresponding to capex except land. The debt/equity ratio is 72/28. Also at that time, BNDES loans carried a basic interest of 6.25% (known in Brazil as TJLP – taxa de juros de longo prazo – long term interest rate) plus a 3% spread for a 14 year loan with a 2 year grace period. The cost of debt was taken as 9.25%.
The marginal corporate tax (T_c) is 34% corresponding to income tax and an aggregate of social contributions.

According to the CAPM (Capital Asset Pricing Model), the cost of equity (R_E) is defined as:

$$R_e = R_f + \beta \cdot (R_m - R_f)$$

Where:

R_e	Cost of Equity
R_f	Risk free rate: the theoretical rate of return attributed to an investment with zero risk. The risk-free rate represents the interest on an investor's money that he or she would expect from an absolutely risk-free investment over a specified period of time. (e.g. government bonds);
R_m	Market return rate: reflects the effect of macro economic factors that essentially affect all companies which on its turn usually measured by a portfolio of stocks or a stock exchange index;
β	Beta: The measure of an asset's risk in relation to the market's risk (for example, the S&P500 in the USA). Calculated as the covariance between the asset return and the market return divided by the market variance.

As a risk free rate, this calculation used CDI the Interbank Certificate of Deposit. Besides an indicator, it is also a modality of investment paying an interest rate. It is only negotiated between banks for a holding period of one day. The daily average CDI rate is used as a reference for the cost of money (in other words, interest) and a tool to evaluate the profitability of fund investments.
A second indicator for R_f is the official individual Savings Account (Caderneta de Poupança), a tax exempt instrument whose remuneration is based on the TR (reference rate) + 0.5% a month, applied every 30 days. Silveira et allis[11] showed that both are valid indicators and, in the time range used here, are equivalent. The spreadsheet calculations will use only CDI as a risk free rate.

BM&F-BOVESPA's Ibovespa index was used as the market return rate because, besides being widely used in CAPM calculations in the country, it represents almost all of the Brazilian business market and is methodologically sound[12].

[11] "Conceito de Taxa Livre de Risco e sua Aplicação no Capital Asset Pricing Model - Um Estudo Exploratório Para o Mercado Brasileiro"; H.P.Silveira, R.Famá, L.A.B.Campos Barros
http://virtualbib.fgv.br/ocs/index.php/ebf/2EBF/paper/viewFile/1667/778

[12] e.g. see:
"O Retorno Justo Segundo o CAPM"; A.M.T.Limão, S.L.Cardoso, D.L.Souza; Adcontar, Belém, v. 2, nº 1, p. 7-10, maio 2001 http://www.nead.unama.br/site/bibdigital/pdf/artigos_revistas/237.pdf.;
"Teste do CAPM Zero-Beta no Mercado de Capitais Brasileiro", Jacques da Motta, L.F. and Silva, F.F. in http://www.iag.puc-rio.br/sobre/tds/TD09_TESTE%20DO%20CAPM%20ZERO.pdf, 2002;

Finally, this analysis will use the Electric Power Index (IEE) the first sectorial index created by BM&F-BOVESPA – the most important Brazilian institution to intermediate equity market transactions and the only securities, commodities and futures exchange in Brazil. BM&F-BOVESPA further acts as a driver for the Brazilian capital markets. IEE was launched in August 1996 to measure the performance of the electric power sector. In this sense, the index is a performance analysis instrument of portfolios specialized in the electric power sector. IEE's portfolio comprises 17 of the most important utilities in Brazil including state owned companies, local branches of global companies and fully national ones. Beta will be calculated using the ratio between IEE and Ibovespa, the main indicator of the Brazilian stock market performance. Ibovespa's relevance comes from two facts: it reflects the variation of BM&F-BOVESPA's most traded stocks and it has tradition, having maintained the integrity of its historical series without any methodological change since its inception in 1968. The major assumption here is in line with the guidance above, adopting a benchmark "*used for similar projects in the same sector in the country/region*".

The table below summarizes these values calculated for a five year period prior to the start of construction:

Ratio: Debt/Assets	D/A	71,8%
Ratio: Equity/Assets	E/A	28,2%
Taxes over project	Tc	34,0%
Interest rate on loan	Rd	9,3%
Risk free rate	Rf	14,1%
Market return rate	Rm	42,1%
β	β	92,9%
Expected return on equity	Re	40,1%
Wacc	Wacc	15,7%

Table 7 – WACC calculations

The basic assumptions in the IRR calculations are shown in table below:

"Risk of public and private financial institutions shares of the Brazilian bank system" Taffarel, M; Pacheco, V.; Clemente, A.; Gerigk, W., 2008, http://www.admpg.com.br/revista2008/artigos/ARTIGO%2014%20AREA%207%20-%20RESUMO.pdf

Project Assumptions	unit	value	source
additionality decision date		15/12/2007	Management Decision
installed capacity	MW	22,5	3 x Hyundai 7.5MW generators
power factor	%	53,3%	Energy Generation - Technical Study
electricity generated projected	GWh	105,032	Energy Generation - Technical Study
internal electricity consumption	%	0%	conservative
unit investment	R$/kW	3.478	calculated
static investment (without land)	R$	78.258.292	pre-study for BNDES loan
grid electricity sales price	R$/MWh	140,00	expected PPA price as of management decision date
O&M costs	R$/MWh	14,00	Project ow ners experience - pls see examples on line 76, below
local overhead and management	%	0,0%	% of revenues - conservative
Investment horizon	years	30	Eletrobras - Diretrizes para Estudos e Projetos de Pequenas Centrais Hidrelétricas, 2000, chap 9, pg 9-4 + 30 year authorization from Aneel

Table 8 – Parameters used in the calculation of the project IRR

Sources & references:

1. Minutes of CELAN board meeting on 15/December/2007 authorizing contracting engineering firm to start terrain levelling and setting up the construction site.
2. As per specification on the identification plates of the equipments.
3. Anhanguera' basic engineering project 2002, vol.1, pg 66, based on hydrological studies.
4. Energy = (installed capacity) x (power factor) x 8760.
5. Power house is 200 meters from the substation. Internal losses were considered negligible (conservative).
6. Unit investment = (static investment) / (installed capacity).
7. Static investment stated in an internal paper developed in the end of 2007.
8. By the end of 2007, CELAN had started negotiations of a PPA with VW in which one of the main points was this price. Later, in July 2008, the official PPA was signed using this value.
9. Eletrobras, the main Brazilian state company recommends a value of 5% of static investment (R$ 37.25/MWh) (http://www.eletrobras.com/ELB/data/Pages/LUMIS4AB3DA57PTBRIE.htm) – chap.9 pg.4. Registered CDM PDDs (reg.id. 1999, 2500, and 2793) use values varying from 3 – 40 R$/MWh. CELAN' team experience used 14 R$/MWh in their internal studies.
10. Administrative costs were included in the O&M costs as the company is a SPC running only the Anhanguera.
11. Eletrobras, the main Brazilian state company recommends using the authorization period issued by the Brazilian regulatory agency (http://www.eletrobras.com/ELB/data/Pages/LUMIS4AB3DA57PTBRIE.htm) – chap.9 pg 5; Brazilian laws dealing with authorization and concession periods for the electric sector are Law 9074/1995, Law 9327/1996 and Decree 2003/1996. The former, in its actual wording, deleted Article 10 that used to deal with extending the authorization period. The consensus is that after the 30 year period, all equipments and other assets are automatically transferred to the State.
    The 30 year investment horizon is therefore a value consistent with Brazilian laws.
    The "Guidelines on the Assessment of Investment Analysis version 03 - EB 51, annex 58" states that "In general a minimum period of 10 years and a maximum of 20 years will be appropriate", therefore the adopted value of 30 years is conservative (10 additional years of revenues) regarding the Guidelines.

This additionality demonstration assumes 2007 values. The grid emission factor at that point was being calculated and used in other Brazilian PDDs[13], adopting ACM0002 v.6 with data furnished by the

[13] See e.g.: Brasil Central Energia S.A. – Sacre II Small Hydro Power Plant Project., Rio Grande do Sul Cooperatives Small Hydro Power Plants, Fundão-Santa Clara Energetic Complex Project (FSCECP),

Operador Nacional do Sistema ("National Electric System Operator" – federal agency[14] in charge of dispatch management for the whole integrated grid, among others). The grid emission factor at this time was 0.2611 tCO_2/MWh.

To demonstrate the additionality of the project in a clear and conservative manner, the cash flow analysis was performed for Anhanguera Small Hydro.

The original spreadsheets contain sensitive information and will be sent to DOE, DNA and EB/CDM.

The IRR is 11.8%, a value smaller than the 15.7% of the WACC therefore it is not a financially attractive investment.
Sub-step 2c is satisfied.

Sub-step 2d Sensitivity analysis

The sensitivity analysis was conducted in two lines: varying critical parameters in ±10% and ±20% and stressing the parameter until project IRR equals the benchmark.

The table below shows the IRR where the critical parameters are varied by ±10% and ±20%.

Sensitivity	variation	value	irr	variation	value	irr
Investment R$ (-)	-10%	78.468.708	13,1%	-20%	69.749.963	14,7%
Generation MWh / y (+)	+10%	115.536	13,0%	+20%	126.039	14,2%
PPA price R$ / MWh (+)	+10%	154,00	13,2%	+20%	168,00	14,6%

Table 9 – Sensitivity analysis

Investment was decreased by 10% and 20% and energy generation and electricity price were increased by 10% and 20%.

Investment reduction: When using total investment, including land, 20% lower than planned, IRR is still below the WACC. This would be equivalent of lowering the unit investment from 3,875 to 3,100 R$/kW when, as of 2010, the average value is above 4,000 R$/kW[15].

Energy Generated: IRR calculations used the estimate for energy generation calculated in the basic engineering project using a standard algorithm and series of hydrology data. This value is higher than the Brazilian regulatory value called "assured energy". It is a value issued by Aneel, the regulatory agency and is obtained from deca-millenary hydrology. For Anhanguera, this corresponds to a utilization factor of 53.3%. So increasing output is not an unlikely scenario. With a 20% increase in energy generation, the IRR is still far from the benchmark (14.2% x 15.7%).

Sales price: The PPA price of 140.00 R$/MWh is higher than the price of 135 R$/MWh, reached in an auction held by the federal government in 2007, specifically for alternative energy sources. Adding another 20% to this price raises the price to 168R$/MWh and the IRR to 14.6%, still below the benchmark.

O&M costs: O&M costs were not analysed because their impact on IRR are very small.

[14] http://www.ons.org.br/institucional_linguas/o_que_e_o_ons.aspx?lang=en

[15] See UNEP Risoe's CDM Pipeline showing 2,400 USD/kW as the average of hydro projects during the last two years – using an exchange rate of 1.7 R$/USD gives 4,040 R$/kW.

A second way of examining the sensitivity of the financials is to stress these parameter values until the project IRR equals the benchmark and then examine the likelihood of this happening.

To achieve an IRR of 15.7%:

Sensitivity	variation	value
Investment R$ (-)	-25,38%	65.059.278
Generation MWh / y (+)	33,45%	140.166
PPA price R$ / MWh (+)	28,00%	179,20

Table 10 – Sensitivity analysis – variation necessary for the IRR to reach benchmark

- Capex would have needed to be 65 MR$ or 1,700 USD/kW at 2007 rates. UNEP Risoe's CDM pipeline shows that the average of this parameter was 2,400 USD/kW for small hydros. It is unlikely that a sharp fall of 30% in prices would occur.

- Anhanguera would have to generate 140 GWh/year, increasing in more than a third the original value. This is equivalent to a power factor of 71%. For the sake of comparison, there is a registered CDM project (489) comprising two other SHPs in the same river: São Joaquim is 15 km upstream from Anhanguera and Dourados is 28 km and there are no major afluents between them. There are now 6 years of data from monitoring these plants and the average power factor of the plants is 66% so it seems unlikely that Anhanguera would reach a performance much higher than the other plants.

- Energy price would have to be 179 R$/MWh.
  There are two public sources of electricity sales prices in Brazil that support the argument that this price is unlikely:

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

auction	New Energy		Adjustment auction		Renewable Energy	
	auction date	R$/MWh	auction date	R$/MWh	auction date	R$/MWh
1	16/12/2005	139,00	-			
2	29/06/2006	134,42	01/06/2006	postponed		
3	10/10/2006	138,00	29/09/2006	no deals		
4	26/07/2007	136,00	29/03/2007	no deals		
5	16/10/2007	131,49	28/06/2007	no prices	01/06/2007	137,32
6	17/09/2008	131,44	27/09/2007	138,25		
7	30/09/2008	146,00	19/06/2008	141,78		
8	27/08/2009		23/09/2008	145,67		

Table 11 – Energy auction prices
Source: http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=d3caa5c1de88a010VgnVCM100000aa01a8c0RCRD

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

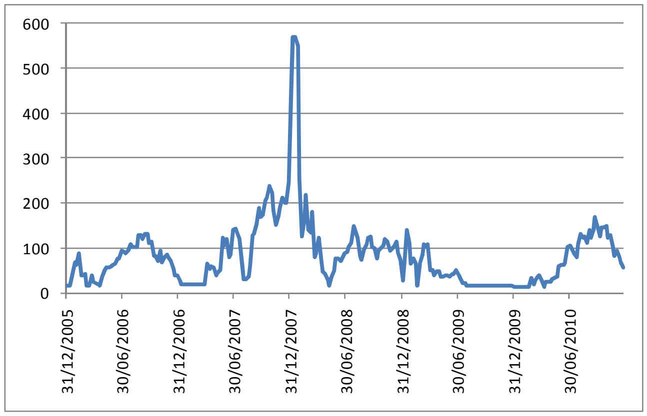


Figure 6 – Electricity spot prices

It is therefore safe to conclude that the project is stable against the critical parameters.
Sub-step 2d is satisfied.

Step 3. Barrier analysis

Not used.

Step 4. Common practice analysis

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

According to the "Tool for the demonstration and assessment of additionality" version 05.02 EB39, the analysis of "analysis of the extent to which the proposed project type has already diffused in the relevant sector and region" by checking other project activities similar to SHP Anhanguera. Also according to the "Tool", "projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc".

Relevant Region:

Brazil has an area of over 8.5 million square kilometres in which the climate comprises a wide range of weather conditions basically grouped in five major climatic subtypes: equatorial, tropical, semiarid, highland tropical, temperate, and subtropical. The different climatic conditions produce environments ranging from equatorial rainforests in the north and semiarid deserts in the northeast, to temperate coniferous forests in the south and tropical savannas in central Brazil. Both temperature range and rainfall pattern are also very different according to the region. Brazilian topography is also diverse and includes hills, mountains, plains, highlands, and scrublands. In the northern Amazon basin, for instance, much of the terrain lies between 200 and 800 metres in elevation while in the Southeast section, where SHP Anhanguera is located, is more rugged, with a complex mass of ridges and mountain ranges reaching elevations of up to 1,200 metres. Brazil has a dense and complex system of rivers, one of the world's most extensive, with twelve major drainage basins. SHP Anhanguera is located in the Paraná basin. Rio Sapucaí flows into Rio Grande which flows into Rio Paraná – (rio is river in Portuguese).

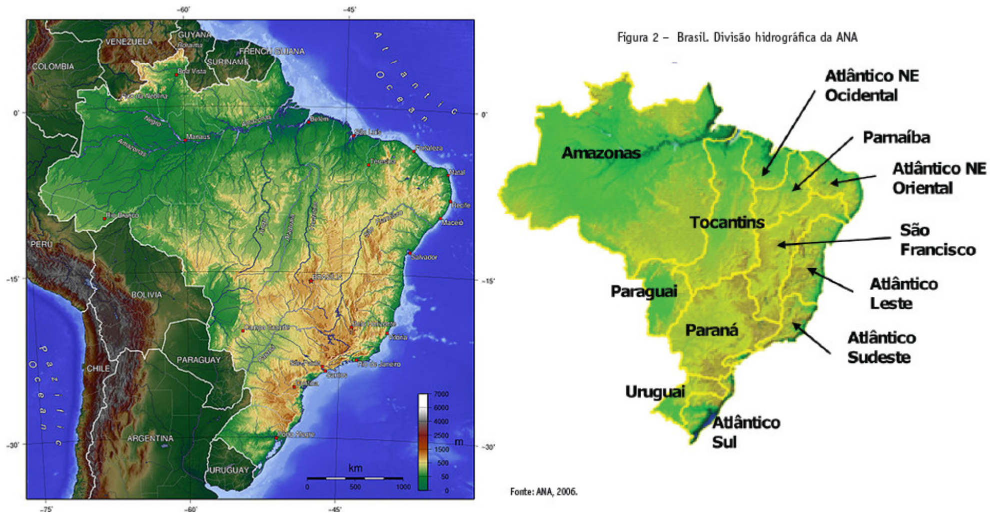


Figure 7 – Brazilian topography and drainage basins

According to the first edition of the Atlas of Electric Power in Brazil[16], in January 2002 there were 194 hydro plants with installed capacity between 1 - 30 MW summing almost 780 MW. Most of them were concentrated in the South and Southeast regions in the Paraná and Southeast Atlantic basins, as shown in the map below. This concentration corresponds to the main consumer markets of São Paulo, Rio de Janeiro and Belo Horizonte. By the end of 2010, the number of plants between 1 – 30 MW in operation was almost 380 with a total installed capacity of more than 3.2 GW[17].

[16]Atlas de energia elétrica do Brasil / Agência Nacional de Energia Elétrica ANEEL, 2002, pg.42 http://www.aneel.gov.br/aplicacoes/Atlas/index.html (the 1st is no longer available for download). All data came from: http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp

[17] http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp and http://www.aneel.gov.br/aplicacoes/ResumoEstadual/ResumoEstadual.asp

Figure 8 – Distribution of small hydro power plants in Brazil - 2002
Source: Atlas de energia elétrica do Brasil / ANEEL, 2002, pg.43
http://www.aneel.gov.br/aplicacoes/Atlas/index.html (the 1st is no longer available for download)

The new plants are more now dispersed because the remaining potential in the Southeast is being tapped. As of 2005, the Paraná Basin had already 72% of its potential being used and specifically the Rio Grande had more than 80% of its potential already generating power. As can be seen in the tables below:

Potential Power Generation per Basin	Generating	Future
Amazonas	1%	99%
Tocantins	44%	56%
Northeast Ocidental Atlantic	0%	100%
Parnaíba	22%	78%
Northeast Oriental Atlantic	5%	95%
São Francisco	58%	42%
East Atlantic	27%	73%
Southeast Atlantic	28%	72%
Paraguay	16%	84%
Paraná	72%	28%
Uruguay	40%	60%
South Atlantic	30%	70%

Potential Power Generation of the Paraná Basin	Generating	Future
Paranapanema	62%	38%
Paranaíba	69%	31%
Iguaçu	75%	25%
Grande	80%	20%
Tietê	95%	5%
Pardo	64%	36%
total	72%	28%

Table 12 – Power Potential by Basin and for the Paraná Basin
source: Atlas de energia elétrica do Brasil / Agência Nacional de Energia Elétrica, 2008, pg.58-60
http://www.aneel.gov.br/aplicacoes/Atlas/index.html

This diversity of conditions among regions and basins suggest that the common practice analysis should compare the project activity within its region or basin and not with the country as a whole.

This project activity will be compared with similar projects occurring with the region of the basin of Rio Paraná that were built or started construction after 2002, around the same time as the basic engineering project of SHP Anhanguera was conceived so to compare the same environment in terms of technique, financials and external incentives.

Size:

Only plants with capacity between 8 – 30 MW were considered. The upper limit corresponds to the legal definition of small hydro plants in Brazil[18] and was adopted because the legal framework and financial incentives that exist for this group do not apply or exist for larger plants. The lower limit was adopted to enclose more than a +/- 50% range of Anhanguera's capacity.

Technology:

All projects considered in this analysis are small hydro plants. Differences in type of turbine (Kaplan, Francis, etc) or if they are run-of-river or not were ignored in order to have a broader, and therefore more conservative, base of comparison.
Brazil has now been building its more than 440 small hydro plants since late 1800. Technology is easily accessible and both industry and engineering services are widely offered.

Regulatory Framework:

The actual Brazilian regulatory framework for the power sector was developed from 1994 – 2004 in basically two steps. The earlier one focused on privatizing and reorganizing the existing structure and creating regulatory agencies (operational, institutional and market). A second step was taken in 2004, focused on centralizing planning in order to secure the supply (Brazil suffered a crisis in 2002 when a rationing was enforced due to a severe draught than depleted the most important reservoirs in the country) and also to speed up the integration of the whole population of the country in to the electric grid[19].

Hydro power plants are roughly grouped according to size, as with the small hydro category, and location since there are regions in the northern part of the country that are still not connected to the national grid. All plants studied here belong to the same size group and are connected to the national grid so, therefore, comply with same set of regulations.

[18] The definition of small hydro power plants in Brazil is stated in Aneel's Resolution 652/2003. http://www.aneel.gov.br/cedoc/res2003652.pdf
[19] Atlas of Electric Power in Brazil / Atlas de Energia Elétrica do Brasil - ANEEL, 2009, pg.18 http://www.aneel.gov.br/aplicacoes/Atlas/index.html

Investment Climate and Access to Financing

BNDES (Banco Nacional de Desenvolvimento Econômico e Social / Brazilian Development Bank) is the major provider of long-term loans in the country; it supplies the financing for projects of all sizes. Contrary to other countries, long-term loans are scarcely provided by commercial banks, and in general, these entities do not have competitive rates compared to the BNDES. Loan conditions are similar for all small hydro projects with a small variation in the spread[20].

In 2002, the Brazilian government launched a programme called Proinfa, roughly translated as Incentive Programme for Alternative Electric Energy Sources, namely, small hydros, biomass co-generation and wind. The Programme guarantees a safe market established with long term contracts guaranteed by Eletrobras at attractive prices and a special credit line granted by BNDES (National Development Bank). In its first phase, 63 small hydros adhered with an installed capacity of 1,191 MW. This first phase closed in 2004 and there is no indication that if or when a second phase will open. Proinfa rulings had still another article stating that all revenues coming from any emission reduction scheme, including the CDM/UNFCCC, would revert to the government[21]. There is still pending litigation as some projects counted on both incentives but most opted for only one of them.

The analysis undertaken here considers the plants that started operations or construction from January 2002 to October 2010 (the most recent data available until the elaboration of this PDD). This table was made using data from:

- Plants operating in 2002: Atlas of Electric Power in Brazil / Atlas de Energia Elétrica do Brasil - ANEEL, 2002, pg.135 ff;
- Plants operating in 2010: Aneel's Power Generation Database (BIG – Banco de Informações de Geração) - http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp
- Proinfa: an excellent summary of the programme is given in a presentation delivered by one of its chief managers and can be downloaded from: http://www.mme.gov.br/programas/proinfa/galerias/arquivos/apresentacao/Situaxo_usinas_PROINFA_AGO-2009.pdf
- CDM: UNEP Risoe CDM/JI Pipeline Analysis and Database, October 1st 2010 - http://www.cdmpipeline.org/ and the CDM website for project details.
- ANEEL's authorization resolution for all plants contains the information regarding the basin in which it is located (http://www.aneel.gov.br/biblioteca/pesquisadigit.cfm).

All supporting tables are available for the DOE.

The table below summarizes the number of plants remaining after applying each of the criteria:

[20] e.g. see the Bank's website in Portuguese: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Produtos/FINEM/energia_eletrica_geracao.html

[21] https://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2006/Decreto/D5882.htm

Common Practice Analysis - filters	
SHP operating in 2002 in Brazil	194
Registered(*) Small Hydro Plants in Brazil in 2010	588
SHP in 2010 operating or under construction	442
SHP in 2010 between 8 - 30 MW	180
SHP in 2010 in the Parana Basin	33
- discarding plants operating before 2002	8
SHPs for Common Practice Analysis	25
(*) operating, under construction and simply authorized	

Table 13 – Quantity of SHPs remaining after applying filters

The remaining 25 plants are:

	plant	capacity (MW)	state	status	incentive
1	Irara	30,0	GO	operation	proinfa
2	Jataí	30,0	GO	operation	proinfa
3	Nova Aurora	21,0	GO	construction	proinfa
4	Retiro Velho	18,0	GO	operation	proinfa
5	Alto Sucuriú	29,0	MS	operation	proinfa
6	Ponte Alta	13,0	MS	operation	proinfa
7	Porto das Pedras	28,0	MS	operation	proinfa
8	Buriti	30,0	MS	operation	cdm / proinfa
9	Goiandira	27,0	GO	construction	cdm
10	Planalto	17,0	GO	operation	cdm
11	Riachão	13,4	GO	operation	cdm
12	Malagone	19,0	MG	operation	cdm
13	Piedade	21,7	MG	operation	cdm
14	Paraíso I	21,0	MS	operation	cdm
15	Pedrinho I	16,2	PR	operation	cdm
16	Pesqueiro	11,0	PR	operation	cdm
17	Salto Natal	16,0	PR	operation	cdm
18	São Francisco	14,0	PR	construction	cdm
19	Anhanguera	22,7	SP	construction	cdm
20	Dourados	10,8	SP	operation	cdm
21	Palmeiras	16,0	SP	construction	cdm
22	Retiro	16,0	SP	construction	cdm
23	São Joaquim	8,1	SP	operation	cdm
24	Pai Joaquim	23,0	MG	operation	
25	Boa Vista II	8,0	PR	operation	

Table 14 – List of SHPs for common practice analysis

All these projects, except for the last two, sought an additional incentive either from Proinfa or through the perspective of selling CERs issued by the CDM/UNFCCC. In other words, the common practice for developing small hydro plants in the region requires incentives.

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

The two plants that are operating that did not apply for extra incentives are SHP Pai Joaquim and SHP Boa Vista II.

SHP Pai Joaquim started to operate in April 2004[22] after a complicated development that started before 1993 and then had its project changed[23] because of a large hydro power plant that was built downstream. From 1997 to 2002, Cemig, a state owned utility company, sought partners to develop the project but ended deciding to carry it on itself[24]. Even after operations started, it faced a series of institutional problems that were only cleared out in 2007. This is clearly an exceptional situation that should not be used for comparison.

SHP Boa Vista II should also be excluded because it is run by an autoproducer[25], a pulp and paper company. In this case, financial analysis would not have included sales of electricity.

It is clear that during the period analysed, external incentives were required to develop small hydro plants in the region of the Paraná basin.

Proinfa was no longer open in 2007 when the management decision was taken.
According to the "Tool for demonstration and assessment of additionality": "*other CDM project activities are not to be included*". Therefore SHP Anhanguera's development is not common practice.

Early consideration of CDM and continuing CDM activity

Central Elétrica Anhanguera appears as project proponent in this CDM PDD. It is a company created by SEBAND (Sociedade de Energia Bandeirantes) and its partners: Volkswagen do Brasil and Pleuston.

SEBAND had started talking about the possibility of carbon revenues before 2007 and engaged with a project developer to develop a PDD and start the CDM registration process in October/2007.

When to the management decision to start building the plant was taken on 15/12/2007, the carbon credits already were an essential part of the project.

This demonstrates that the CDM incentives are essential to the successful development of the Project and that the project owner expects the Project to be registered as CDM project activity to alleviate the potential risks.

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

[22] http://www.aneel.gov.br/cedoc/dsp2004256.pdf
[23] http://www.aneel.gov.br/cedoc/prt1993175.pdf
[24] http://www.aneel.gov.br/cedoc/dsp1997sn78_2.pdf and http://www.aneel.gov.br/cedoc/res2002161.pdf
[25] http://www.aneel.gov.br/cedoc/prt1996435.pdf

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to the selected approved methodology (ACM0002), the baseline emission factor (*EF_y*) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly a connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

1. Project Emissions

From the methodology ACM0002 version 12.1.0, for hydro power project activities that result in new reservoirs, project proponents shall account for project emissions, estimated according to the following items:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \qquad (1)$$

Where:

PE_y	Project emissions in year *y* (tCO_2/yr);
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year *y* (tCO_2/yr);
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2/yr);
$PE_{HP,y}$	Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2/yr);

As per ACM0002, version 12.1.0, fossil fuel consumption is only to be accounted for in geothermal and solar thermal projects. Therefore, as the project activity involves only a hydro plant, $PE_{FF,y}$ and $PE_{GP,y}$ are zero.

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

For hydro power project activities that result in new reservoirs and hydro power project activities that result in the increase of existing reservoirs, project proponents shall account for CH4 and CO2 emissions from the reservoir, estimated as follows:

(a) If the power density of the project activity (*PD*) is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \cdot TEG_y}{1000} \qquad (3)$$

Where:

$PE_{HP,y}$	Project emissions from water reservoirs (tCO_2e/yr);
EF_{Res}	Default emission factor for emissions from reservoirs of hydro power plants in year *y* ($kgCO_2e/MWh$)
TEG_y	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y* (MWh)

(b) If the power density of the project activity (*PD*) is greater than 10 W/m^2:

$$PE_{HP,y} = 0 \quad (4)$$

The power density of the project activity (*PD*) is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad (5)$$

Where:

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

2. Baseline emissions

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:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \quad (6)$$

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 $EG_{PJ,y}$

Project activity is a greenfield plant, therefore net electricity is given by:

(a) Greenfield renewable energy power plants

$$EG_{PJ,y} = EG_{facility,y} \quad (7)$$

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)

The methodology assumes that all project electricity generation above baseline levels ($EG_{baseline}$) would have otherwise been generated by the operation of grid-connected power plants and by the addition of the new generation sources.

Calculation of $EF_{grid,CM}$

The Brazilian DNA published the Operating Margin Emission Factor and the Build Margin Emission Factor of the National Interconnected Power System[26] to which the Project is connected to. As the Brazilian DNA has published the Emission Factors of the Brazilian Interconnected grid since 2006; in this project the average EF for the last published year (2009) will be used to estimate the emission reductions of this project. The Emission Factor will be monitored to calculate the yearly emission reductions as the project will have ex-post calculation.

The calculation of CO_2 emission factors, published by the Brazilian DNA, followed the methodological tool "Tool to calculate the emission factor for an electricity system" Versions 1, 1.1 and 2 approved by the CDM Executive Board and published in Annex 12 of the EB 35 Report And EB 50 Report.

The emission factor $EF_{grid,CM}$ is calculated according to the "Tool to calculate the emission factor for an electricity system" through a series of six steps.

Step 1. Identify the relevant electric power system.

The electric system in Brazil has its main subsystem, the National Interconnected Power System, and several isolated systems, mostly in the Amazon region. The project activity generates electricity for the National Interconnected Power System and, therefore, it is the relevant electric power system. All data required by the Tool comes from the National Operator of the System (ONS) responsible for coordinating and controlling the operation of all generation and transmission installations in the National System. Brazil's DNA defined this system in its Resolution no.8[27]

Step 2. Select an operating margin (OM) method.

The method chosen by the Brazilian DNA is the Dispatch Data Analysis based on dispatch data supplied by ONS. The emission factors of the fossil-fuelled thermal plants were taken from IPCC defaults and the National Energy Balance[28].

The emission factor is given by:

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \qquad \text{(EF-10)}$$

[26] Available at http://www.mct.gov.br/index.php/content/view/303076.html#ancora

[27] Available at http://www.mct.gov.br/upd_blob/0024/24719.pdf

[28] http://www.mme.gov.br/mme/menu/todas_publicacoes.html

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 displace by the project activity in hour h of year y (MWh);
$EF_{EL,DD,h}$	CO_2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO_2/MWh);
$EG_{PJ,y}$	Total electricity displaced by the project activity in year y (MWh);
h	Hours in year y in which the project activity is displacing grid electricity;
y	Year in which the project activity is displacing grid electricity;

The hourly emissions factor is calculated based on the energy efficiency of the power unit and the fuel type used, as follows:

If hourly fuel consumption data is available, then the hourly emissions factor is determined as:

$$EF_{EL,DD,h} = \frac{\sum_{i,n} FC_{i,n,h} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_{n} EG_{n,h}} \quad \text{(EF-11)}$$

Where:

$EF_{EL,DD,h}$	CO_2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO_2/MWh)
$FC_{i,n,h}$	Amount of fossil fuel type i consumed by power unit n in hour h (Mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EFCO_{2,i,y}$	CO2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
$EG_{n,h}$	Electricity generated and delivered to the grid by power unit n in hour h (MWh)
n	Power units in the top of the dispatch (as defined below)
i	Fossil fuel types combusted in power unit n in year y
h	Hours in year y in which the project activity is displacing grid electricity
y	Year in which the project activity is displacing grid electricity

Otherwise, the hourly emissions factor is calculated based on the energy efficiency of the grid power unit and the fuel type used, as follows:

$$EF_{EL,DD>k} = \frac{\sum_{n} EG_{n,h} \cdot EF_{EL,n,y}}{\sum_{n} EG_{n,h}} \quad \text{(EF-12)}$$

Where:

$EF_{EL,DD,h}$	CO2 emission factor for power units in the top of the dispatch order in hour h in year y (tCO_2/MWh)

$EG_{n,h}$	Net quantity of electricity generated and delivered to the grid by power unit *n* in hour *h* (MWh)
$EF_{EL,n,y}$	CO_2 emission factor of power unit *n* in year *y* (tCO_2/MWh)
n	Power units in the top of the dispatch (as defined below)
h	Hours in year *y* in which the project activity is displacing grid electricity

Step 3. Calculate the operating margin emission factor according to the selected method.

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

As mentioned above, the host country's DNA will provide $EF_{EL,DD,h}$ in order for Project Participants to calculate the operating margin emission factor. Hence, this data will be updated annually applying the number published by the Brazilian DNA. For estimation purposes, the data of the most recent year available in the DNA website will be used.

Step 4. Identify the cohort of power units to be included in the build margin (BM).

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

Step 5. Calculate the build margin emission factor.

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

Step 6. Calculate the combined margin (CM) emissions factor.

The combined margin is calculated as follows:

$$EF_y = W_{OM} \cdot EF_{OM,y} + W_{BM} \cdot EF_{BM,y} \qquad \text{(EF-14)}$$

Where the weights W_{OM} and W_{BM}, by default, are 50% (i.e., $W_{OM} = W_{BM} = 0.5$). Alternative weights can be used, as long as $W_{OM} + W_{BM} = 1$, and appropriate evidence justifying the alternative weights is presented.

3. Leakage

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, transport). These emissions sources are neglected.

4. Emission Reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad (11)$$

Where:

ER_y	= Emission reductions in year y (t CO_2e/yr)
BE_y	= Baseline emissions in year y (t CO_2e/yr)
PE_y	= Project emissions in year y (t CO_2e/yr)

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

Data / Parameter:	EF_{Res}
Data unit:	kgCO_2e/MWh
Description:	Default emission factor for emissions from reservoirs
Source of data used:	Decision by EB23
Value applied:	90 kgCO_2e/MWh
Any comment:	-

Data / Parameter:	Cap_{BL}
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data used:	-
Value applied:	0 W
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 (m^2). For new reservoirs, this value is zero.
Source of data used:	-
Value applied:	0 m^2
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

1. **Project Emissions**

Power density

The power density of the project activity (*PD*) is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad (5)$$

Where:

PD Power density of the project activity (W/m^2);

Cap_{PJ} Installed capacity of the hydro power plant after the implementation of the project activity (W) = **22,500,000 W as per the manufacturer of the generators**;

Cap_{BL} Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero;

A_{PJ} Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2) = **2,050,000 m^2 as per project design**;

A_{BL} Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new hydro power plants, this value is zero;

$$PD = \frac{22{,}500{,}000 - 0}{2{,}050{,}000 - 0} = 10.98 W / m^2$$

As the power density of the power plant is greater than 10 W/m^2:

$$PE_{HP,y} = 0$$

And therefore:

$$PE_y = 0$$

2. **Baseline emissions**

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CMy} \qquad (6)$$

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).

In Brazil the regulatory agency (ANEEL) issues a “guaranteed energy” value to a plant, indicative of the minimum amount of energy to be produced during a less-than-average hydrological year. This value is used in PPAs as a base reference value. In the case of Anhanguera, this value is 99,601 MWh/y[29], which corresponds to a capacity factor of 50.5%.

[29] ANEEL - Resolução Normativa No 65, May 25, 2004

As the Brazilian DNA published the Emission Factors of the National Interconnected Power System for the years of 2007 through 2009, this section's calculations used the average Grid EF for 2009 was used to estimate the projected emission reductions of this project.

OPERATING MARGIN												
	Average Emission Factor (tCO_2/MWh) - monthly											
2009	MONTH											
	January	February	March	April	May	June	July	August	September	October	November	December
	0,2813	0,2531	0,2639	0,2451	0,4051	0,3664	0,2407	0,1988	0,1622	0,1792	0,1810	0,1940

BUILD MARGIN	
	Average Emission Factor (tCO_2/MWh) - **ANNUAL**
2009	
	0,0794

The Emission Factor for the year of 2009 is:

EF_{2009} = (Average of Operating Margin for 2009 + Building Margin of 2009) / 2
EF_{2009} = (0.2476 + 0.0794) / 2
$\mathbf{EF_{2009} = 0.1635\ tCO_2/MWh}$

This *ex-ante* calculation used the average grid emission factor during 2009, as discussed above.

$$BE_y = 99{,}601 \cdot 0.1634 = 16{,}284 tCO_2e / yr$$

3. Leakage

Transmission losses were neglected, as the distance between the power house and the substation is less than 200 meters. The substation project, construction and operation is outsourced to CPFL and is considered the point of dispatch to the national grid.

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, fuel handling (extraction, processing, and transport), and land inundation (for hydroelectric projects – applicability conditions above). Project participants do not need to consider these emission sources as leakage in applying this methodology.

Thus, $L_{PJ,y} = 0$

3. **Emission reductions**

Finally:

$$ER_y = BE_y - PE_y = 16{,}284 tCO_2e / yr \quad (11)$$

The financial analysis uses a higher estimate of the annual energy production based on the engineering studies. Using the guaranteed energy generates less CERs and, therefore, is conservative..

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 overall emission reductions (tonnes of CO_2e)
2012	0	16,284	0	16,284
2013	0	16,284	0	16,284
2014	0	16,284	0	16,284
2015	0	16,284	0	16,284
2016	0	16,284	0	16,284
2017	0	16,284	0	16,284
2018	0	16,284	0	16,284
2019	0	16,284	0	16,284
2020	0	16,284	0	16,284
2021	0	16,284	0	16,284
Total (tonnes of CO_2e)	0	162,848	0	162,848

Table 15 – Summary of the ex-ante estimation of emission reductions.

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:	Electricity meter at output of substation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	99,601 MWh/yr
Measurement procedures:	There are two meters at the output of substation – one is the main meter and the other is the spare meter. Both are bi-directional type. When the main meter fails to work normally, the spare meter starts reading and the information is not lost. The precision of the meters are Class – 0.2% (Norma Brasileira Medidores Eletrônicos de Energia Elétrica (estáticos) NBR 14519) The calibration frequency is every two years, complying with the National System Operator regulations (ONS).

	High voltage electricity meter sends generation data to four points: 1. Hydro Plant Operational Control Panel; 2. ONS (National System Operator) – via VPN 3. CPFL control room in Campinas; 4. CCEE (Câmara de Comercialização de Energia Elétrica) where monthly totals are used for commercialization billing $EG_{facility,y}$ is the same as $EG_{P,J,y}$ - Greenfield renewable energy power plants
Monitoring frequency:	Continuously measurement and monthly recording.
QA/QC procedures:	Total energy generation recorded in the Hydro Plant Operating Control Panel is cross checked with values recorded at the Câmara de Comercialização de Energia Elétrica – CCEE and at CPFL's control room. Energy metering QA/QC procedures are explained in section B.7.2 (the equipments used have by legal requirements extremely low level of uncertainty).
Any comment:	The substation is located no more than two hundred meters from the power house. The substation is the delivery point to the grid, as it is operated by the local utility, CPFL. Transmission losses can be neglected for such small distance.

Data / Parameter:	$TEG_{,y}$
Data unit:	MWh/yr
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y*
Source of data:	Electricity meter at input of substation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable
Measurement procedures:	Low voltage electricity meter sends generation data to the Hydro Plant Operational Control Panel where it is totalized monthly, reported and archived;
Monitoring frequency:	Constinuously measurement and monthly recording.
QA/QC procedures:	This value is used by Operations to monitor the efficiency of the substation against a lower threshold defined with CPFL – third party contractor to operate the substation.
Any comment:	-

Data / Parameter:	$EF_{,grid,CM,\ y}$
Data unit:	tCO_2/MWh
Description:	Combined Margin emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system".
Source of data:	As per the "Tool to calculate the emission factor for an electricity system"
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1635 tCO_2/MWh

Measurement procedures:	As per the "Tool to calculate the emission factor for an electricity system"
Monitoring frequency:	Yearly
QA/QC procedures:	As per the "Tool to calculate the emission factor for an electricity system"
Any comment:	As per instructions from the DNA, weights for OM and BM are both 50%

Data / Parameter:	$EF_{,grid,OM\text{-}DD,y}$
Data unit:	tCO_2/MWh
Description:	Operating Margin emission factor for grid connected power generation in year *y*.
Source of data:	Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.2476 tCO_2/MWh
Measurement procedures:	The selected option to calculate the operating margin was the dispatch analysis which does not permit the vintage of ex-ante calculation of the emission factor. Hence, this value will be calculated annually applying the numbers published by the Brazilian DNA and following the steps provided in the "Tool to calculate the emission factor for an electricity system"
Monitoring frequency:	Yearly
QA/QC procedures:	As per 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:	Build Margin emission factor for grid connected power generation in year *y* calculated using the values published by Brazilian DNA.
Source of data:	Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0794 tCO_2/MWh
Measurement procedures:	The selected option to calculate the operating margin was the dispatch analysis which does not permit the vintage of ex-ante calculation of the emission factor. Hence, this value will be calculated annually applying the numbers published by the Brazilian DNA and following the steps provided in the "Tool to calculate the emission factor for an electricity system"
Monitoring frequency:	Yearly
QA/QC procedures:	As per the "Tool to calculate the emission factor for an electricity system"
Any comment:	

Data / Parameter:	Cap_{PJ}
Data unit::	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity.

Source of data:	Project site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**22,500 W as per the manufacturer of the generators**;
Measurement procedures:	The nameplate installed capacity of the project activity is measured in accordance with international standards. Evidence will consist of photographic evidence and documents by the manufacturer of the technology.
Monitoring frequency:	yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	A_{PJ}
Data unit::	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data:	Project site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**2,050,000 m^2 as per project design**;
Measurement procedures:	Measured from topographical surveys using markers placed during construction of the plant indicating its 3-dimensional UTM coordinates
Monitoring frequency:	yearly
QA/QC procedures:	
Any comment:	

B.7.2. Description of the monitoring plan:

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

Monitoring Procedures

The power house is connected to the substation located less than 200 meters away. The substation construction was carried out by CPFL as well as its initial operation, one of the largest utility companies in Brazil and in whose concession area includes SHP Anhanguera's site. The plant's substation is the point of dispatch to the national grid. Transmission losses are negligible because of the small distance between the power house and the substation.

Energy generation measurements will be made at two points:

a. At the output of the powerhouse (total energy) at 13.8kV, a set of TP and TCs are used by the operation's supervisory system to calculate and totalize the energy sent to the substation. This system is part of Voith/Siemens control system installed in the plant's operating room;

b. At the output of the substation, point of dispatch to national grid, at 138kV, integrated with the substation's control system, this meter transmits energy measurements to:

a. Hydro plant control (energy generated is totalized, reported and archived)
b. ONS (National System Operator) – via VPN
c. CPFL's main operation centre in Campinas;
d. CCEE (Câmara de Comercialização de Energia Elétrica), official regulator of the electricity market, acting as the registry for contracts and transactions. CCEE uses the energy generation information in order to bill the transmission services between generator and end-consumer, among other uses. This value is used by Central Elétrica Anhanguera to issue electricity sale invoices.

CPFL is in charge of operating the high tension portion of the substation. They have an operational office 40 km from the Anhanguera plant and they own and operate 3 small hydro plants nearby (SHP Esmeril, Dourados and São Joaquim). These plants are part of a registered CDM project[30]. CPFL will also be responsible for all maintenance and calibration of the main high voltage meter, according to ONS regulations.

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

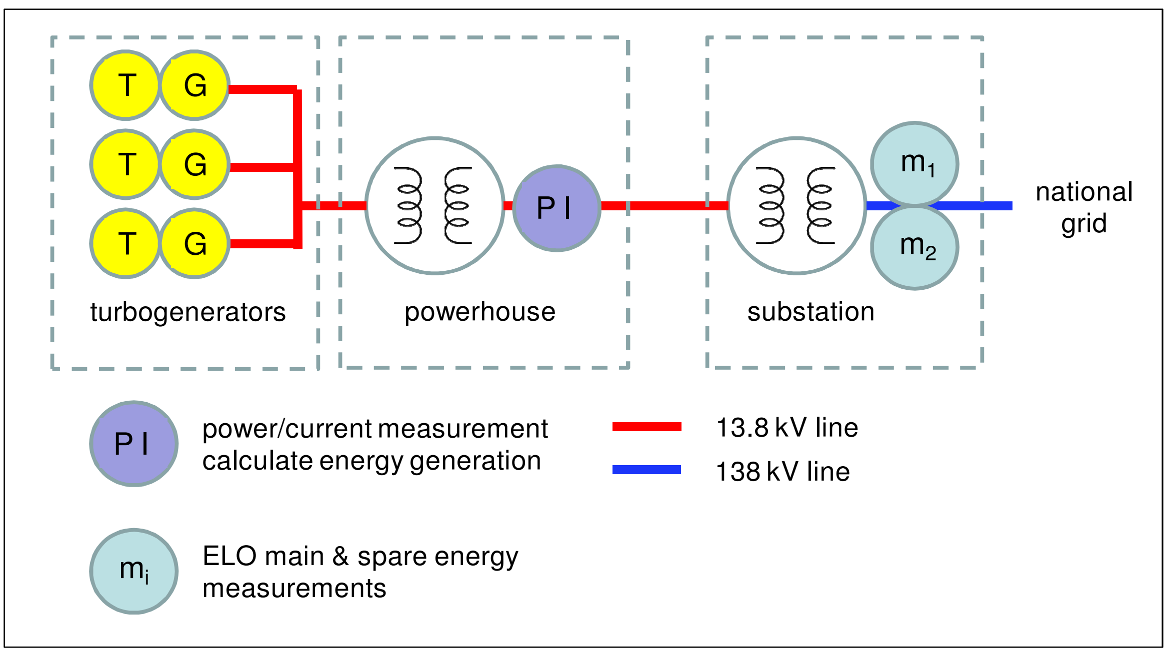


Figure 9 – Simplified unifilar diagram

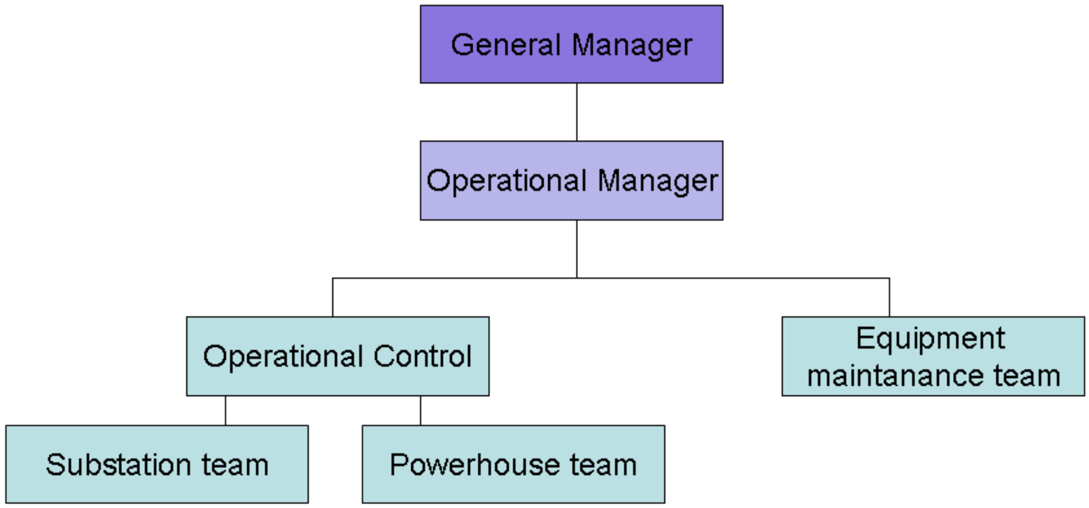
Management and organization structure

All invoices and other fiscal documents are kept in Central Elétrica Anhanguera's accounting system.

The person responsible for data collection and archiving is Mr. Luis Antonio Campos Ribeiro who is the operation manager at the Anhanguera small hydro power plant.

To ensure the operation of the monitoring activities, the operational and managerial structure will be established for the power plant as shown in Chart below, to determine the organization and related persons in charge of data collection and archiving.

[30] Repowering Small Hydro Plants in the State of São Paulo CDM ref.489



Quality Control and Quality Assurance

Calibration

The calibration of meters is carried out by CPFL who is qualified by the government and INMETRO and complies with national standards. The meters will be calibrated, in line with the requirements in the agreement with CPFL and by contract complying with ABNT NBR 6808/IEC 439. The meters are sealed and CPFL is the only institution that can open it. Copy of the calibration records will be archived with all other monitoring records and are available to the DOE.

When doubts are detected in either the main or spare meter, the project owner requires CPFL to calibrate, test and repair the meter. And if the doubts come from CPFL it is obligated to repair it.

Maintenance and training procedures

CPFL and CELAN will be responsible for the maintenance of the monitoring equipments for dealing with possible monitoring data adjustments and uncertainties. CPFL is responsible for the high tension portion of the substation and CELAN is responsible for the low tension portion at the power house and substation.

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

Anhanguera had assisted operation by Voith/Siemens from March to September 2010. During this time, the definitive operational structure was established and the team hired and trained by Voith/Siemens. In what regards this PDD, they will be responsible for monitoring energy generation at the output of the plant's powerhouse.

Data Archiving

Operational data has supervisory backup, data from energy production are all transmitted to the computer of the operating manager and this computer has a daily backup (including the signal that captures from the electronic meter (ELO.2180).

All data is automatically measured in digital systems and stored in the central system. Standard backup procedures in place guarantee the safeguard of the data. Data will be kept during the crediting period and two years after for DOE's verification.

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

Date of completing the final draft of this baseline section and the monitoring methodology (15/10/2010)) by Plant Inteligência Ambiental. Plant Inteligência Ambiental acts as a CDM consultant and is not a project participant.

Main people involved in the PDD development and baseline definition:

Company: Plant Environmental Intelligence
Street: Rua Moraes Barros, 1413
City: Piracicaba – São Paulo
ZIP code: 13419-240
Country: Brazil
People involved: Janaina Dallan, Shigueo Watanabe and Warwick Manfrinato
Telephone: +55 (11) 9859 8928
Fax: +55 (19) 3433-0189
E-mails:
janainadallan@plantbr.com.br;swatanabe@co2consulting.com.br;warwick@plantbr.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:

February 10th 2008 –evidence is the contract between Central Elétrica Anhanguera and Leão Engenharia S.A. dated of February 10th 2008. Available to validator.

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

30 years (end of CELANs authorization to operate SHP Anhanguera)

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:

01/01/2012 or date of registration whichever is later.

C.2.2.2. Length:

10 years – 0 months

SECTION D. Environmental impacts

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

According to the relevant environmental law and regulations, an Environmental Impact Assessment (EIA)[31] was carried out by "Bauart Engenharia" and approved by the São Paulo State Secretary of Environment back in 1989. In 2001 a Simplified Environmental Impact Assessment (RAP) was conducted and approved by the São Paulo State Secretary of Environment in October 31, 2007. The main conclusions of the report are provided below:

1. Impact on Land Utilization and Migration
The project installation represents no immigration. The project owner will compensate for land occupation. The total occupied land will be 233,54 ha, where there is no nature reserves or cultural view.

2. Impact on Climate Conditions
The project does not require the formation of large lakes or reservoirs, typical of large power plants, thus the climate change impact is not considered significant.

3. Particulate Matter
During the construction period the excavation, explosion, crashing and machinery operations incurred in emissions of particulate matter to the atmosphere. The impact was restricted to the surroundings of the power plant and for a short period of time. Finally the construction site is far from residential areas counting with the protection of the natural topography of the site which forms a barrier to the dispersion of particles.

4. Geology and Geomorphology
Natural Slope – No instability of slopes will occur due to natural topography that presents marginal slopes.
Soil – maps and studies of the site confirm no mineral deposits in the area to be flooded. The erosion in the influence area will not be significant because of the nature of the soil that has no erosion potential and also the restoration of riparian vegetation will mitigate the erosion.

5. Impact on Ecosystem
The construction could affect the migration of some fish species caused by changes in the aquatic environment, which will be minimized by construction of fish ladders. Considering that the region has no professional fishery the impact will not be significant. The conditions of the water downstream of dams will have little change avoiding the death of fish.
The vegetation was removed before filling the reservoir preventing the decomposition of submerged biomass and deterioration of water quality in the reservoir.
The reduction of food for the fish fauna, benthos, plankton, caused by partial loss of riparian vegetation upstream of the axis Anhanguera will be minimal because the area of forest to be removed is very small.

[31] EIA was developed by CPFL which had the legal rights to exploit the hydroelectric potential of Anhanguera, with the change in the legislation CPFL lost the legal rights which were transferred to ANEEL. Seband requested the rights and presented under the new legislation a Simplified Environmental Assessment - RAP (rule of the new legislation) and formally received the rights by ANEEL through the resolution number 541. The State Department of Environment which had already issued a Environmental Previus License to CPFL transferred this License to Seband.

The terrestrial fauna was at first submitted to an environmental survey and monitoring; the large mammal (Allouata caraya) was the only mammal that needed to be transferred to other areas, following all the legislation and recommendations from the State Environmental Agency, reallocated and monitored in the new habitat to confirm adaptation. The fauna that stayed in the riparian areas and also that migrate to new reforested areas are all monitored by the environmental team at CELAN according to the specific program.

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 Installation License raised some concerns that were addressed by the following programs:

- Program of Riparian Forest Reforestation
- Program of Vegetation Suppression
- Program of Installation of Nursery
- Program of rescue, reallocation and monitoring of terrestrial fauna
- Program for Consolidation of the designated Conservation Unit
- Monitoring Program of Underground Water Level
- Construction of the “fish ladder”
- Installation of a Hydro-meteorological Station
- Program of Limnology and water quality
- Program of Disinfection of Barns and Sewage Pits
- Program to Control Geomorphic and Erosive Impacts
- Program of Social Communication
- Tourism Centre, Recreation and Environmental Education
- Program of Population Protection
- Recovery Program of degraded areas
- Monitoring Program of Ichthyofauna and fish ladders
- Rescue Program for Archaeological in Affected Areas
- Program for Environmental Management of the civil work and Health of Workers during construction
- Program of Dispossess and Reallocation of non Residents

Hired Entities

- School of Agriculture Luiz de Queiroz - ESALQ/USP (Flora Programs)
- Technological Center Foundation of Hydraulic - CTH-USP (Limnology and Water Quality)
- Technological Research Institute of the State of. São Paulo (Water Table, Geomorphic and Erosive Impacts)
- State University of Campinas - UNICAMP - Zoology Department (Terrestrial Fauna)
- Federal University of São Carlos – Ichthyology Department (Ichthyology and fish ladders)
- Paranapanema River Project (Archaeology)

Established Pacts:

- Agenda 21 of Guará (Technical Cooperation and Institutional Term: Implementation of Agenda 21, the creation of tourism and leisure centers)
- Zoobotanic Institute of Franca (Technical Cooperation Pact)

Environmental Compensation:
- Reforestation in proportion to the ratio of 1:3, meaning: deforested area/forested area

SECTION E. Stakeholders' comments

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

According to the Resolution number 7 of the Brazilian Inter-Ministerial commission on Climate Change[32], invitations for comments by local stakeholders are required by the Brazilian Designated National Authority (DNA) as part of the procedures for analyzing CDM projects and issuing letters of approval.
The DNA requires project participants to communicate with the public through letters, to be sent inviting for comments to:
- Brazilian Forum of NGOs and Social Movements for the Environment and the Development - FBOMS (Fórum Brasileiro de ONGs e Movimentos Sociais para o Meio Ambiente e Desenvolvimento)
- State and Federal governments.
- Local communities' associations.
- Government and State assembly of the project
- State Attorney Office for the Public Interest.

As defined by the Designated National Authority (DNA), invitation letters were sent by the project developers to the key institutions (see table below) in 17/06/2008.

On December 21st 2010 another invitation letter was sent to stakeholders after the new version of the PDD. The website made available to download the PDD as well as the contribution to sustainable development is www.celan.com.br .

Table contains the agents that received the invitation letters.

Name of institution	address	Contact Person
Guará City Hall	Rua Washington Luís, 146/188 Centro - Guará/SP Caixa Postal: 01 CEP: 14580-000 Guará – SP	Mayor Marco Aurélio Migliori
São Joaquim da Barra City Hall	Praça Prof. Ivo Vannuchi, S/N CEP: 14600-000 São Joaquim da Barra - SP	Mayor Maria Helena Borges Vannuchi
Guará City Council	Av. Francisco de Paula Leão, Nº 400 CEP: 14580-000 Guará - SP	Marcio Sandoval dos Santos
São Joaquim da Barra City Council	Rua Pará, 1841 Vila Bela Vista CEP: 14600-000 São Joaquim da Barra - SP	Eduardo Malheiro Dudu Fortes
Guará Environment Secretariat Agenda 21	Rua Washington Luiz, 146/188 CEP: 14580-000 Guará - SP	Luiz Fernando Coelho
São Joaquim da Barra Attorney for the Public Interest	Praça Magino Diniz Junqueira, 30 Centro	Public Attorney Dr. Marco Antonio de Souza

[32] Issued on March 5th 2008, which modifies resolution number 1 issued on December 2nd of the 2003 decree from July 7th 1999.

	CEP: 14600-000 São Joaquim da Barra - SP	
Guará Attorney for the Public Interest	Rua Carlos de Campos, 260 Centro CEP: 14580-000 Guará - SP	Public Attorney Dr. Renato Dias de Castro Freitas
Environment State Secretariat	Av. Prof. Frederico Herman Jr., 345 CEP: 05489-900 São Paulo – SP	Pedro Ubiratan Escorel de Azevedo
São Paulo State Attorney for the Public Interest	Rua Riachuelo, 115 Centro, CEP: 01007-904 São Paulo – SP	State Public Attorney Fernando Grella Vieira
State Agency for Water Resources (Conselho Estadual de Recursos Hídricos)	Av. Prof. Frederico Herman Jr., 345 Alto de Pinheiros CEP: 05489-900 São Paulo - SP	Executive Secretary - Rosa Maria de Oliveira Machado Mancini
ANA - National Water Agency	Setor Policial - Área 5 - Quadra 3 Blocos B, L e M CEP: 70610-200 Brasília - DF	Vicente Andreo Guillo
Brazilian Institute of Environment and Renewable Natural Resources IBAMA/SP	Alameda Tietê, 637 Jardim Cerqueira Cesar CEP: 014170-020 São Paulo/SP	Analice de Novaes Pereira
WWF Brazil	SHIS EQ QL 6/8 Conjunto E CEP: 71620-430 Brasilia, DF	Álvaro Antonio Cardoso de Souza
EMBRAPA - Brazilian Agricultural Research Corporation – Environmental division (Empresa Brasileira de Pesquisa Agropecuária)	Rodovia SP-340 (Campinas-Mogi Mirim), km 127,5 Tanquinho Velho Caixa Postal 69 CEP: 13820-000 Jaguariúna, SP	Celso Vainer Manzatto
Brazilian Forum of NGOs and Social Movements for the Environment and the Development - FBOMS	SCS – Quadra 08 – Bloco B-01 – Edifício Central, 13º andar – Sala 1302 CEP: 70333-900 Brasília – DF	Esther Neuhaus
Brazilian Attorney for the Public interest	SAF Sul Quadra 4 Conjunto C CEP: 70050-900 Brasília – DF	Federal Public Attorney – Roberto Monteiro Gurgel dos Santos
São Joaquim da Barra – Environment Secretary – City Hall	Praça Professor Ivo Vannuchi, SN CEP: 14600-000 São Joaquim da Barra - SP	Antonio Carlos Luiz
Basin Consortium of the Sapucaí Mirim and Grande River - Comitê da Bacia Hidrográfica do Sapucaí-Mirim e Grande	Av. Dr. Flávio Rocha, 4551 Vila Exposição CEP: 14405-600 Franca - SP	Reginaldo Antonio Branquinho Coelho

Table 16 – Institutions receiving invitation for comments

E.2. Summary of the comments received:

As of 22/01/2011, two comments were received:

Comment 1: The State Agency for Water Resources (Conselho Estadual de Recursos Hídricos) made a recommendation for the project to be appreciated by Technical Planning Chamber of the State Agency for Water Resources.

Comment 2: São Paulo State Attorney for the Public Interest clarified that it cannot issue opinions and comments to the project because it out of the scope of their attributions.

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

The first comment was addressed inviting comments from the Technical Planning Chamber of the State Agency for Water Resources.

Regarding comment 2, no actions were taken. The state attorney is part of the list of invitees of Resolution 7 of the Brazilian DNA.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	CENTRAL ELÉTRICA ANHANGUERA S.A.
Street/P.O.Box:	Rua Caminha do Amorim 199
Building:	-
City:	São Paulo
State/Region:	São Paulo
Postfix/ZIP:	05451-020
Country:	Brazil
Telephone:	55 11 3021 1922
FAX:	55 11 3021 1922
E-Mail:	nelias@seband.com.br
URL:	-
Represented by:	Nelson Elias
Title:	Director
Salutation:	Mister
Last Name:	Elias
Middle Name:	-
First Name:	Nelson
Department:	
Mobile:	-
Direct FAX:	55 11 3021 1922
Direct tel:	55 11 3021 1922
Personal E-Mail:	nelias@seband.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from Annex 1 Countries.

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING PLAN

Annex 5

TECHNICAL SPECIFICATIONS (as sent to Regulatory Agency)

1. LOCALIZAÇÃO					
RIO:	Sapucaí	SUB-BACIA:	*61*	BACIA:	*6 do Rio Paraná*
LATITUDE:	*20° 28'*	MUNICÍPIO:	*São Joaquim da Barra*		UF:
LONGITUDE:	*47° 52'*		*Guará*		*SP*

2. RESERVATÓRIO				
N.A. DE MONTANTE			ÁREAS INUNDADADAS	
NA (TR=100 ANO	*543.54*	m	NO NA MAX (TR=100 ANOS)	*2,05 km2*
MÁX. NORMAL:	*543.54*	m	NO NA MAX NORMAL	*2,05 km2*
MÁX MAXIMOR.:	*543.54*	m	VOLUMES	
N.A. DE JUSANTE			NO NA MAX NORMAL	*13,22 x 10^6 m3*
NORMAL	*526.69*	m	UTIL	*fio d' água*

3. TURBINAS			
TIPO:	*Kaplan*		
NÚMERO DE UNIDADES:	*3*	ROTAÇÃO SÍNCRONA:	*240rpm*
POTÊNCIA UNITÁRIA NOMINAL	*7,5 MW*	QUEDA DE PROJETO:	*17,43 m*

4. GERADORES			
NÚMERO DE UNIDADES:	*3*		
POTÊNCIA UNITÁRIA NOMINAL:	*8,4 kVA*	RENDIMENTO MÁXIMO:	*97.50%*
ROTAÇÃO SÍNCRONA:	*240rpm*	FATOR DE POTÊNCIA:	*0.9*
TENSÃO NOMINAL:	*13,8 KV*		

5. CUSTOS (x 10^3 R$)			
MEIO AMBIENTE:	*3,500.00*	LINHA DE TRANSMISSÃO:	*843.00*
OBRAS CIVIS:	*36,000.00*	SUBESTAÇÃO:	*5,057.00*
EQUIPAMENTOS ELETROMECÂNI	*49,000.00*	CONEXÃO:	*890.00*
JUROS DURANTE A CONSTRUÇÃ	*10,800.00*	DATA REFERÊNCIA (MÊS/ANO)	*mei-09*

6. ESTUDOS ENERGÉTICOS				
POTÊNCIA DA USINA:		*22,68 MW*	CUSTO INDICE:	*1003,28 US$/kW*
ENERGIA FIRME	(assegurada)	*11,37MWh*	CUSTO DA ENERGIA GERADA:	*29,90 US$/MWh*
	(média)	*13.041*		

7. INSTALAÇÕES DE TRANSMISSÃO DE INTERESSE RESTRITO A CENTRAL GERADORA			
LINHA DE TRANSMISSÃO		SUBESTAÇÃO (TRANSFORMADOR)	
EXTENSÃO:	*1,8 km*	NÚMETO DE UNIDADES:	*2*
TENSÃO:	*138 kV*	POTÊNCIA UNITÁRIA NOMINAL:	*15/18,75 MVA*
CIRCUITO (SIMPLES/DUPLO):	*duplo*	TENSÃO ENR. PRIMÁRIO:	*13,8 kV*
		TENSÃO ENR. SECUNDÁRIO:	*138 kV*

8. INFORMAÇÕES ADICIONAIS		
EMPREGOS		
DIRETOS	300	
INDIRETOS	1000	

PLANT	***PCH ANHANGUERA***				
COMPANY	*Central Elétrica Anhanguera Ltda.*				
CONTACT	*Nelson Elias*			telephone:	*(11) 3021 1922*
1. LOCATED					
RIVER:	Sapucaí	SUB-BASIN:	*61*	BASIN:	*6 do Rio Paraná*
LATITUDE:	*20° 28'*	COUNTY:	*São Joaquim da Barra*		STATE:
LONGITUDE:	*47° 52'*		*Guará*		*SP*
2. RESERVOIR					
UPSTREAM HEAD			FLOODED AREAS		
WATER LEVEL (TR=	*543,54*	m	AT MAX WL (TR=100 YEARS)		*2,05 km2*
NORMAL MAX:	*543,54*	m	AT NORMAL MAX		*2,05 km2*
TOP MAX.:	*543,54*	m	VOLUMES		
DOWNSTREAM N.A.			AT NORMAL MAX		*13,22 x 10^6 m3*
NORMAL	*526,69*	m	USAGE		*run of river*
3. TURBINES					
TYPE:		*Kaplan*			
QTY UNITS:		*3*	SYNC RPM:		*240rpm*
UNIT NOMINAL CAPACITY		*7,5 MW*	WATER DROP		*17,43 m*
4. GENERATORS					
QTY UNITS:		*3*			
UNIT NOMINAL CAPACITY		*8,4 kVA*	MAX EFFICIENCY		*97,50%*
SYNC RPM		*240rpm*	POWER FACTOR		*0,9*
NOMINAL VOLTAGE		*13,8 KV*			
5. COSTS (x 10^3 R$)					
ENVIRONMENT:		*3.500,00*	TRANSMISSION LINE:		*843,00*
CONSTRUCTION:		*36.000,00*	SUBSTATION:		*5.057,00*
EQUIPMENT:		*49.000,00*	CONEXION:		*890,00*
INTEREST DURING CONSTRUCTION:		*10.800,00*	REFERENCE DATE (MONTH/YEAR)		*MAY / 09*
6. ENERGY STUDIES					
PLANT CAPACITY:		*22,68 MW*	COST INDEX:		*1003,28 US$/kW*
ENERGY:	(officially guaranteed)	*11,37MW_{avg}*	ENERGY GENERATION COST		*29,90 US$/MWh*
	(average)	*13,041*			
7. TRANSMISSION INSTALATIONS CONCERNING ONLY GENERATOR					
TRANSMISSION LINE			SUBSTATION (TRANSFORMER)		
EXTENSION:		*1,8 km*	QTY UNITS:		*2*
VOLTAGE:		*138 kV*	UNIT NOMINAL CAPACITY		*15/18,75 MVA*
CIRCUIT (SIMPLE/DOUBLE):		*double*	PRIMARY COIL VOLTAGE:		*13,8 kV*
			SECONDARY COIL VOLTAGE:		*138 kV*
8. ADITIONAL INFORMATION					
JOBS					
DIRECT	300				
INDIRECT	1000				

The values in this table were taken from the 2002 basic engineering project and suffered minor changes when the plant was built. Most of them are due to changes in equipment specs from the selected suppliers. There is also the difference between the official guaranteed power generation from ANEEL, calculated based on worst-case hydrological scenario and the projected operational that used average annual hydrology.

Annex 6

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