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:

Piedade Small Hydro Power Plant CDM Project Activity.

PDD version number: 06

Date (DD/MM/YYYY): 18/04/2008

A.2. Description of the project activity:

The primary objective of Piedade Small Hydro Power Plant is to help meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy's share of the total Brazilian (and the Latin America and the Caribbean region's) electricity consumption.

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

Piedade Small Hydro Power Plant consists of a new small-hydro power plant (16 MW), that has a small reservoir (1,5 km²) with minor environmental impact.

Piedade Usina Geradora de Energia S/A is the owner of Piedade SHPP. The company was originated in order to specifically administrate Piedade activities. The main shareholder of Piedade Usina Geradora de Energia S/A is PST Energias Renováveis e Participações S/A. PST invests preferably in renewable energy projects. The other shareholders of PST are members of Gomes Lourenço's family who also own Construtora Gomes Lourenço Ltda. – one of the most important builder companies of the country.

The project is located in the Southeast of Brazil. It is located in the Piedade River, in the city of Monte Alegre de Minas, state of Minas Gerais. Monte Alegre de Minas is a city with 18,061 inhabitants (IBGE, 2005).

The Piedade Small Hydro Power Plant Project improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. Small-scale hydropower plants provide local distributed generation, in contrast with the business as usual large

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

hydropower and natural gas fired plants built in the last 5 years, and these small-scale projects provide site-specific reliability and transmission and distribution benefits including:

- increased reliability and shorter and less extensive outages;
- lower reserve margin requirements;
- improved power quality;
- reduced lines losses;
- reactive power control;
- mitigation of transmission and distribution congestion; and
- increased system capacity with reduced T&D investment.

This indigenous and cleaner source of electricity will also have an important contribution to environmental sustainability by reducing carbon dioxide emissions that would have occurred otherwise in the absence of the project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation by fossil fuel sources (and CO_2 emissions), which would be generating (and emitting) in the absence of the project.

It can be said that fair income distribution is achieved from job creation and an increase in people's wages, however better income distribution in the region where the Piedade Project is located is obtained mainly from less expenditures and more income in the local municipalities. The surplus of capital that these municipalities will have could be translated into investments in education and health, which will directly benefit the local population and indirectly impact a more equitable income distribution. The lower expenditure is generated due to the fact that money will no longer be spent in the same amount to "import" electricity from other regions in the country through the grid. This money would stay in the region and be used for providing the population better services, which would improve the availability of basic needs, and avoid emigration. The local population will receive economic benefits from royalties paid to the municipalities for the water rights granted to Piedade Small Hydro Power Plant.

A.3. Project participants:

Table 1 - Party(ies) and private/public entities involved in the project activity

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

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 Minas Gerais (Southeast of Brazil).

A.4.1.3. City/Town/Community etc:

Monte Alegre de Minas.

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

The project uses the hydro potential of the Piedade River which is part of the Paraná basin (Figure 1).

Figure 1 - Major Brazilian river basins. The project is located in the "Leste-Sudeste" Basin (Source: http://www.portalbrasil.net/)

Piedade SHPP is located in the Southeast of Brazil, state of Minas Gerais, city of Monte Alegre de Minas (latitude 18°39’58’’S and longitude 49°03’48’’W) (Figure 2).

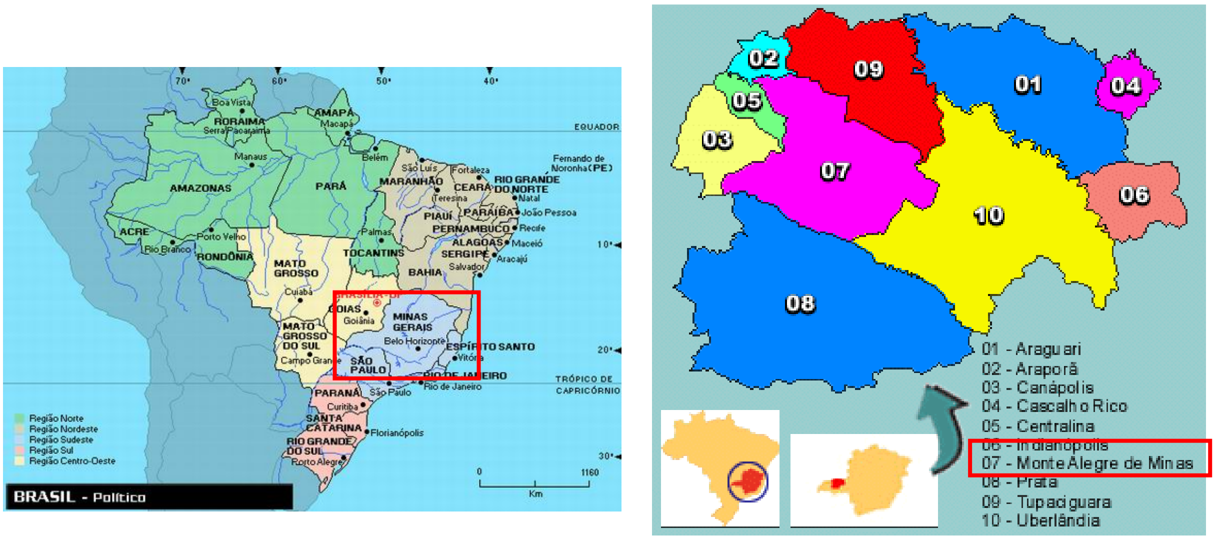

Figure 2 - Political division of Brazil showing the state of Minas Gerais (Source: Portal Brasil, 2006) and the city involved in the project activity (Source: City Brazil, 2006).

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

Energy industries (renewable sources – hydro electric power).

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

The technology employed at Piedade Small Hydro Power Plant project is established in the industry. The Francis turbine (Figure 3) is the most widely used among water turbines. In this project, the turbine is produced in Brazil with a Swedish technology that improves its efficiency. This turbine is a type of hydraulic reactor turbine in which the flow exits the turbine blades in the radial direction. Francis turbines are common in power generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through a volute casing and is directed onto the blades by wicket gates. The low momentum water then exits the turbine through a draft tube. In the model, water flow is supplied by a variable speed centrifugal pump. A load is applied to the turbine by means of a magnetic brake, and torque is measured by observing the deflection of calibrated springs. The performance is calculated by comparing the output energy to the energy supplied.

Figure 3 - Example of a Francis Turbine

(Source: HISA, http://www.hisa.com.br/produtos/turbinas/turbinas.htm)

The technology and equipment used in the project were developed and manufactured locally and has been successfully applied to similar projects in Brazil and around the world (Table 2).

Table 2 - Specifications of the equipment used at Piedade Small Hydro Power Plant

Turbines	
Type	Francis
Manufacturer	Mecamidi
Quantity	2
Power (MW)	8.247
Water head	123.70 m
Generators	
Type	Synchronous
Manufacturer	WEG
Quantity	2
Nominal Power (MVA)	8.90
Voltage (KV)	6.9

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

Considering the baseline of 0.2826 tonCO_2e/MWh applicable to grid-connected renewable power generation projects activities in Brazil, the full implementation of the small hydropower plant connected to the Brazilian interconnected power grid will generate the estimated annual reduction as in Table 3 below.

Table 3 - Project Emission Reductions Estimation

Years	**Annual estimation of emission reductions [tCO_2e]**
2009 (from January)	24,300
2010	24,300
2011	24,300
2012	24,300
2013	24,300
2014	24,300
2015 (until December)	24,300
Total estimated reduction (tCO_2e)	**170,101**
Total number of crediting years	7
Annual average over the crediting period of estimated reduction (tCO_2e)	24,300

A.4.5. Public funding of the project activity:

This project does not receive any public funding and it is not a diversion of ODA.

SECTION B. Application of a baseline and monitoring methodology

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

ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (version 7, 2007).

Version 4 of the tool for demonstration and assessment of additionality.

Version 1 of the tool to calculate the emission factor for an electricity system.

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

The methodology ACM0002 (version 7, 2007), for grid-connected electricity generation from renewable sources, uses derived margins, which have been applied in the context of the project activity through the determination of the emissions factor for the interconnected Brazilian grid (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).

Applicability conditions for Methodology ACM0002[2] are as follow:

- Piedade SHP is a new hydro power with a small reservoir. Its power density is greater than 4 W/m^2. Please refer to section B.6.1 for power density calculation.
- This project activity does not involve switching from fossil fuel to renewable energy at the site of project.
- Geographic and system boundaries for the interconnected Brazilian grid is identified and explained in section B.4 and Annex .

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

As described in ACM0002 methodology, baseline determination shall only account CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to the project activity.

	Source	Gas	Included?	Justification/Explanation
Baseline	Electric energy use	CO_2	Yes	To generate electricity as happen in thermo plants emits greenhouse gases such as carbon dioxide "CO_2"

[2] ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 7, 36th Executive Board Meeting, 2007. UNFCCC, CDM Executive Board. Web-site: http://cdm.unfccc.int/

Project Activity	Emission from reservoir	CH_4	No	This source of emission corresponds to GHG emissions from reservoirs. It was excluded because the power density of the reservoir is greater than $10W/m^2$.

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

The project activity does not modify or retrofit an existing electricity generation facility. Hence, accordingly to ACM0002 the baseline scenario is the following:

"Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations as described below."

For conservativeness reasons, we consider that all the energy in the absence of the project activity will be imported from the interconnected grid. Hence, the baseline scenario is identified as the continuation of the current (previous) situation of electricity supplied by large hydro and thermal power stations – or by Diesel oil, in the case of isolated systems.

According to the selected approved methodology (ACM0002, version 7, 2007), the baseline emission factor is defined as EF_y and 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.

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

As Brazil is a large country with layered dispatch systems, the regional grid definition will be used. Brazil is divided in five macro-geographical regions, North, Northeast, Southeast, South and Midwest. The majority of the population is concentrated in the regions South, Southeast and Northeast regions. Thus the energy generation and, consequently, the transmission are concentrated in two subsystems. The energy expansion has concentrated in two specific areas:

- North-Northeast: The electricity for this region is basically supplied by the São Francisco River. There are seven hydro power plants on the river with total installed capacity of approximately 10.5 GW. 80% of the Northern region is supplied by diesel. However, in the city of Belém, capital of the state of Pará where the mining and aluminum industries are located, electricity is supplied by Tucuruí, the second biggest hydro plant in Brazil;
- South/Southeast/Midwest: The majority of the electricity generated in the country is concentrated in this subsystem. These regions also concentrate 70% of the GDP generation in Brazil. There are more than 50 hydro power plants generating electricity for this subsystem.

The boundaries of the subsystems are defined by the capacity of transmission. The transmission lines between the subsystems have a limited capacity and the exchange of electricity between those subsystems is difficult. The lack of transmission lines forces the concentration of the electricity generated in each own subsystem. Thus the South-Southeast-Midwest interconnected subsystem of the Brazilian grid where the project activity is located is considered as a boundary.

Part of the electricity consumed in the country is imported from other countries. Argentina, Uruguay and Paraguay supply a very small amount of the electricity consumed in Brazil. In 2003 around 0.1% of the electricity was imported from these countries. In 2004 Brazil exported electricity to Argentina which was experiencing a shortage period. The energy imported from other countries does not affect the boundary of the project and the baseline calculation.

An extensive discussion of the baseline for electricity generation for the Brazilian interconnected grid can be seen in *Esparta & Martins Jr. (2001)*[3]. Its baseline for large scale projects is 261.1 Kg CO_2/MWh. This project baseline methodology/approach has been validated for a similar CDM activity consisting of power capacity expansion of biomass to energy power plant in Brazil.

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):

The project fulfils all the “additionality” prerequisites (see application of the “tool for the demonstration and assessment of additionality[4]”, hereafter referred to simply as “additionality tool,” below) demonstrating that it would not occur in the absence of the CDM.

The “additionality tool” shall be applied to describe how the anthropogenic emissions of GHG are reduced below those that would have occurred in the absence of the Piedade Project. The additionality tool provides a general step-wise framework for demonstrating and assessing additionality. These steps, numbered from 1 to 4, include:

1. Identification of alternatives to the project activity
2. Investment analysis and/or
3. Barrier analysis
4. Common practice analysis

The application of the additionality tool to the Piedade Project follows.

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

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

1. The proposed project activity undertaken without being registered as a CDM project activity.

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[3] Esparta, A. R. J. & C. M. Martins Jr. (2002). *Brazilian Greenhouse Gases Emission Baselines from Electricity Generation*, RIO 02 - World Climate & Energy Event, Rio de Janeiro-Brazil, January 6-11.

[4] *Tool for the demonstration and assessment of additionality*. UNFCCC - EB 36, 30th November 2007, Version 4.

2. The continuation of the current (previous) situation of electricity supplied by large hydro and thermal power stations.

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

Both the project activity and the alternative scenario are in compliance with all applicable regulations. There are no laws and/or regulations in the region that forbid the implementation of the alternatives listed above.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

Additionality is demonstrated through an investment benchmark analysis (option III)

Sub-step 2b and 2c– Option III - benchmark analysis

Financial indicator identified for Piedade project activity is the project IRR, and the benchmark is derived from the company internal benchmark (weighted average capital cost of the company - WACC). A second third-party benchmark identified is the minimum return considered by Brazilian Federal Government at the decision of Proinfa program launch.

Calculation of the Weighted Average Cost of Capital (WACC)

The rate used to discount the business cash flow is also known as the weighted-average cost of capital (WACC) and converts the future cash flow into a present value, considering that both creditors and shareholders expect compensation towards the opportunity cost of investing resources in an specific business instead of investing such resources in another business of equivalent risk.

The basic principle to be followed when calculating the WACC is consistency with the valuation method and with the definition of the discounted cash flow. The formula used to estimate the company's WACC after taxes is:

$$WACC = [(Kd \times (1-t) \times Pd)+(Ke \times (1-Pd))]$$

Where,

WACC= Weighted-average cost of capital
Kd= Cost of Debt (third-party capital)
t = Marginal corporate income tax
Pd= Debt as a percentage of total capitalization
Ke= Cost of Equity (own capital)

Considering that Piedade is being financed with their own capital and other debtors, we have adopted the case of a leveraged company to calculate the firm's WACC. Cost of debt is 17.8% per year.

The financing line that *Caixa Econômica* offered to Piedade covers 76.64% of the project. Therefore, Pd is 76.64%. Piedade provided the other 23.36%. The average of the marginal corporate income tax is 25% per year.

Estimating the Cost of Equity (Ke) was possible by using the parameters observed in global financial markets, allowing the application of the CAPM model. Given these assumptions, the cost of capital in Brazil should be close to a global cost of capital adjusted for local inflation and capital structure. It should be noted that as far as calculating the inflation differential we have used an estimate of the compounded difference between the local inflation rate and the US inflation rate over ten years. Also, for calculation purposes, we have used a Beta, which measures systemic equity risk within the company's industry, typical of the environmental services sector. Thus, in order to calculate Piedade's cost of equity we have used the following parameters[5]:

Cost of Equity – *Piedade*		
Yield of Sovereign 20-year BB Debt	**Plus**	13%p.a.
10-year BB Credit risk premium over US Treasuries[6]	**Minus**	2.4%p.a.
10-year US/Brazil inflation differential	**Plus**	4.65%p.a.
International Market Equity Risk Premium[7]	**Plus**	8.66%p.a.
Adjustment of Market Equity Risk with Beta of 0[8]	**Minus**	0%p.a.
Cost of Equity with Brazilian Country Risk		23.8%p.a.

Applying Ke=23.8% to the formula below:

WACC = [(17.8% x (1 - 25%) x 76.64%) + (23.8%p.a. x 23.36%)] = 15.8%p.a.

Thus, Piedade's Weighted Average Cost of Capital is equal to 15.8%p.a., and this figure will be used to discount the company's cash flow throughout this study.

Financial Indicator, Internal rate of return (IRR)

Piedade's cash flow (see annexed spreadsheet "PLANILHA FINANCEIRA - CRÉDITO DE CARBONOS") shows that the IRR of the project without CERs, 12.81%, is lower than the WACC 15.8%. This evidences that project activity is not financially attractive to investor.

In addition, there is another financial indicator that is worth mention. In order to implement the PROINFA program, the Mines and Energy Ministry (from Portuguese *Minitério de Minas e Energia*) has developed several actions, of which established the parameters to calculate the economic value of projects willing to participate on the program. The Decree n.º 5.025, from 2004, mention this parameters and the government has indicated that the minimum attractiveness tax to be considered in a energy project is 14,89%[9]. Thus considering this value, the project activity can not be considered an attractive option.

[5] Copeland et al.; Measuring and Managing the Value of Companies; Third Edition.

[6] Source: Bloomberg

[7] http://pages.stern.nyu.edu/~adamodar/pdfiles/country/ERP.pdf

[8] There is not a weighted average of the Beta for Small Hydro Power Plants listed in the Bovespa.

[9] *Valor Econômico da Tecnologia Específica da Fonte (VETEF)* from PROINFA program.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis was conducted by altering the following parameters:

- Increase in project revenue
- Reduction in running costs

Those parameters were selected as being the most likely to fluctuate over time. Financial analyses were performed altering each of these parameters by 5%, and assessing what the impact on the project IRR would be. The average Brazilian inflation in 2006 was equal to 3.14%[10]. The use of 5% of variation in the costs and revenues of the project activity was chosen as a conservative value. See results in the Table below.

For the calculation, see annexed spreadsheet "Análise de Sensibilidade.xls"). As it can be seen, the project IRR remains lower than the benchmark in the case where the parameters change in favor of the project.

Table: Sensitivity analysis

Scenario	% change	IRR (%)
Original	-	12.81
Increase in project revenue	5%	13.83
Reduction in project costs	5%	12.97

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

Step 3. Barrier analysis

3.a. Identify barriers that would prevent the implementation of the proposed CDM project activity:

Sector regulation

Energy sector regulation must be considered as an important barrier once a completely new power sector regulation is under development since January 2002. In addition, there is a lack of investment sources to finance the private sector in the country. The creation of Proinfa is a strong indication that without a financial support, investments in alternative sources of energy for power generation ambit would not be made otherwise.

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[10] The IPCA is used as a parameter for the inflation targeting system. In 2006 IPCA's accumulated growth was equal to 3.14%. This index is published by several institutions in the country. One of these institutions is the Central Bank of Brazil in its annual bulletins available at http://www.bcb.gov.br/?ECONOMIA.

To support the barrier analysis a brief overview of the Brazilian electricity market in the last years is first presented.

Until the beginning of the 1990's, the energy sector was composed almost exclusively of state-owned companies. From 1995 on due to the increase in international interest rates and the lack of investment capacity of the State, the government was forced to look for alternatives. The solution recommended was to initiate a privatization process and the deregulation of the market.

The four pillars of the privatization process initiated in 1995 were:

- Building a competition friendly environment, with the gradual elimination of the captive consumer. The option to choose an electricity services supplier which began in 1998 for the largest consumers, and should be available to the entire market by 2006;
- Dismantling of the state monopolies, separating and privatizing the activities of generation, transmission and distribution;
- Allowing free access to the transmission lines, and
- Placing the operation and planning responsibilities to the private sector.

At the same time three entities were created, the Electricity Regulatory Agency, ANEEL set up to develop the legislation and to regulate the market; the National Electric System Operator, ONS, to supervise and control the generation, transmission and operation; and the Wholesale Electricity Market, MAE, to define rules and commercial procedures of the short-term market.

At the end of 2000, after five years of the privatization process, results were modest (Figure 4). Despite high expectations, investments in new generation did not follow the increase in consumption.

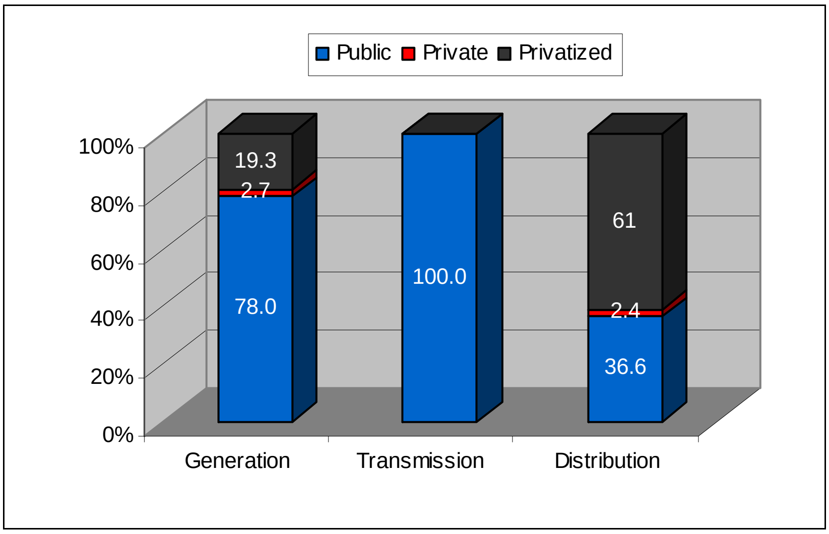


Figure 4 - Participation of private capital in the Brazilian electricity market in December 2000 (BNDES, 2000)

The decoupling of GDP (average of 2% increase in the period of 1980 to 2000) from electricity consumption increase (average of 5% increase in the same period) is well known in developing countries, mainly due to the broadening of supply services to new areas and the growing infra-structure. The necessary measures to prevent bottlenecks in services were taken. These include an increase of generation capacity higher than the GDP growth rate and strong investments in energy efficiency. In the Brazilian case, the increase in the installed generation capacity (average of 4% in the same period) did not follow the growth of consumption as can be seen in Figure 5.

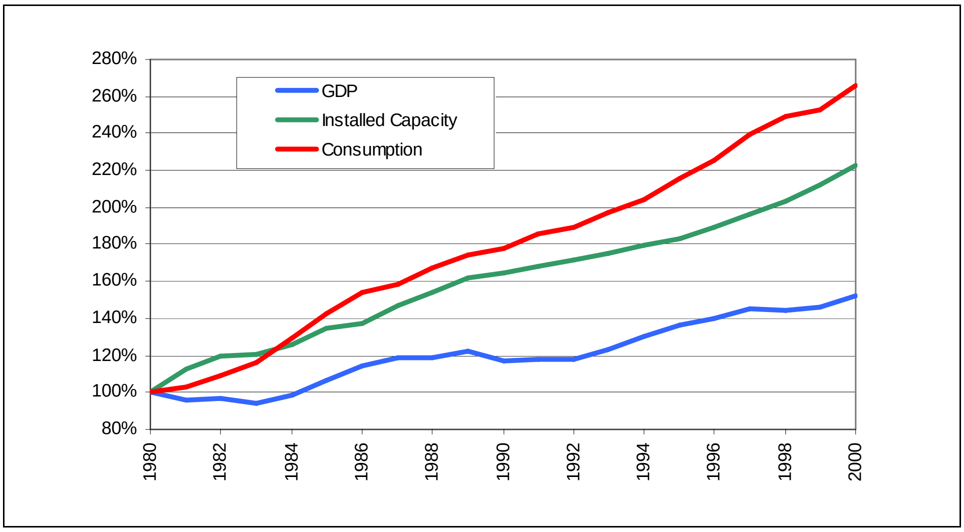


Figure 5 - Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption) (Source: Eletrobrás, http://www.eletrobras.gov.br; IBGE, http://www.ibge.gov.br/)

Without new installed capacity, the only alternatives were energy efficiency improvements or higher capacity utilization (capacity factor). Regarding energy efficiency, the government established in 1985 PROCEL (the National Electricity Conservation Program).

The remaining alternative, to increase the capacity factor of the old plants was the most widely used, as can be seen in Figure 6. To understand if such increase in capacity factor brought positive or negative consequences one needs to analyze the availability and price of fuel. In the Brazilian electricity model the primary energy source is water accumulated in the reservoirs. Figure 7 shows what has happened to the levels of “stored energy” in the reservoirs from January 1997 to January 2002. It can be seen that reservoirs which were planned to withstand 5 years of less-than-average rainy seasons, almost collapsed after a single season of low rainfall (2000/2001 experienced 74% of historical average rainfall. This situation depicts a very intensive use of the country’s hydro resources to support the increase in demand without increase of installed capacity. Under the situation described there was no long-term solution for the problems that finally caused shortage and rationing in 2001.

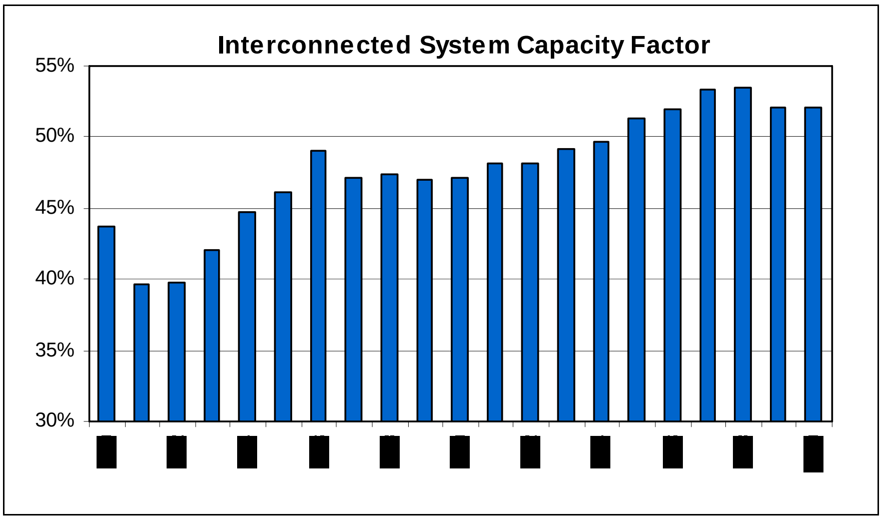


Figure 6 - Evolution of the rate of generated energy to installed capacity (Source: Eletrobrás, http://www.eletrobras.gov.br/).

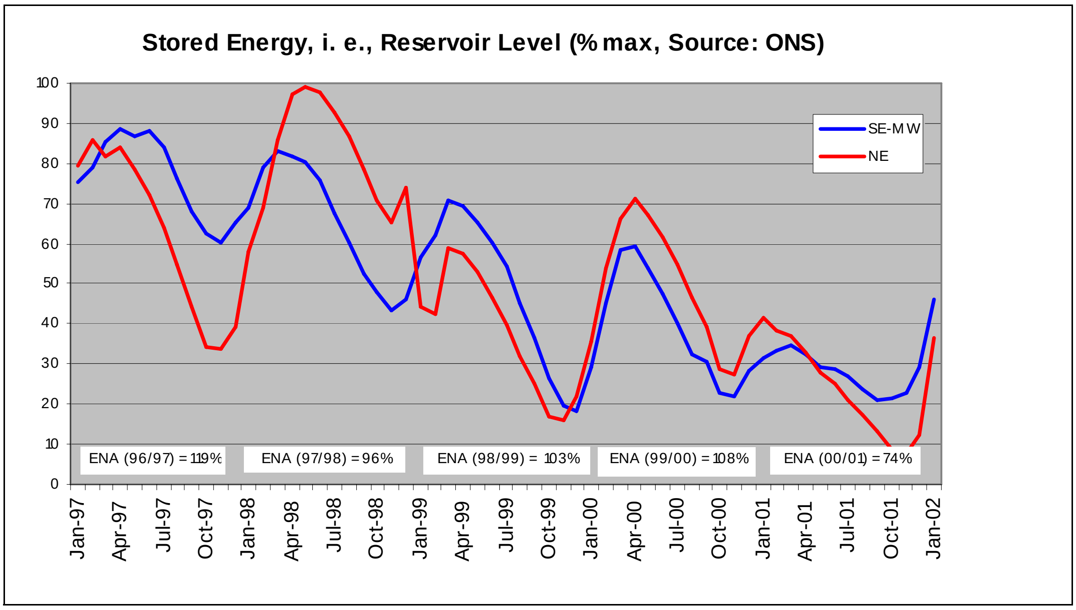


Figure 7 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS, http://www.ons.org.br/)

Aware of the difficulties since the end of the 1990's, the Brazilian government signalized that it was strategically important for the country to increase thermoelectric generation and consequently be less dependent of hydropower. With that in mind the federal government launched in the beginning of the year of 2000 the Thermoelectric Priority Plan (PPT, *Plano Prioritário de Termelétricas*, Federal Decree 3,371 of February 24th, 2000, and Ministry of Mines and Energy Directive 43 of February 25th, 2000), originally planning the construction of 47 thermo plants using Bolivian natural gas, totalizing 17,500 MW of new installed capacity by December of 2003. During 2001 and the beginning of 2002 the plan was reduced to 40 plants and 13,637 MW to be installed by December 2004 (Federal Law 10,438 of April 26th, 2002, Article 29). As of today, December 2004, 20 plants totalizing around 9,700 MW are operational.

During the rationing of 2001 the government also launched the Emergency Energy Program with the short-term goal of building 58 small to medium thermal power plants until by end of 2002 (using mainly diesel oil, 76,9%, and residual fuel oil, 21.1%), totalizing 2,150 MW power capacity (CGE-CBEE, 2002).

It is clear that hydroelectricity is and will continue as the main source for the electricity base load in Brazil. However, most if not all-hydro resources in the South and Southeast of the country have been exploited, and most of the remaining reserves are located in the Amazon basin, far from the industrial and population centers (OECD, 2001). Clearly, new additions to Brazil's electricity power sector are shifting from hydro to natural gas plants (Schaeffer *et al.*, 2000). With discoveries of vast reserves of natural gas in the Santos Basin in 2003 the policy of using natural gas to generate electricity remains a possibility and it will continue to generate interest from private-sector investors in the Brazilian energy sector.

In power since January 2003, the newly elected government decided to fully review the electricity market institutional framework. A new model for the electricity sector was approved by Congress in March 2004. The new regulatory framework for the electricity sector has the following key features (OECD, 2005):

- Electricity demand and supply will be coordinated through a "Pool" Demand to be estimated by the distribution companies, which will have to contract 100 per cent of their projected electricity demand over the following 3 to 5 years. These projections will be submitted to a new institution called Energy Planning Company (*Empresa de Pesquisa Energética*, EPE), which will estimate the required expansion in supply capacity to be sold to the distribution companies through the Pool. The price at which electricity will be traded through the Pool is an average of all long-term contracted prices and will be the same for all distribution companies.
- In parallel to the "regulated" long-term Pool contracts, there will be a "free" market. Although in the future, large consumers (above 10 MW) will be required to give distribution companies a 3-year notice if they wish to switch from the Pool to the free market and a 5-year notice for those moving in the opposite direction a transition period is envisaged during which these conditions will be made more flexible. If actual demand turns out to be higher than projected, distribution companies will have to buy electricity in the free market. In the opposite case, they will sell the excess supply in the free market. Distribution companies will be able to pass on to end consumers the difference between the costs of electricity purchased in the free market and through the Pool if the discrepancy between projected and actual demand is below 5%. If it is above this threshold, the distribution company will bear the excess costs.
- The government opted for a more centralized institutional set-up, reinforcing the role of the Ministry of Mines and Energy in long-term planning. EPE will submit to the Ministry its desired technological portfolio and a list of strategic and non-strategic projects. In turn, the Ministry will submit this list of projects to the National Energy Policy Council (*Conselho Nacional de Política Energética*, CNPE). Once approved by CNPE, the strategic projects will be auctioned on a priority basis through the Pool. Companies can replace the non-strategic projects proposed by EPE, if their proposal offers the same capacity for a lower tariff. Another new institution is a committee (*Comitê de Monitoramento do Setor Elétrico*, CMSE), which will monitor trends in power supply and demand. If any problem is identified, CMSE will propose corrective measures to avoid energy shortages, such as special price conditions for new projects and reserve of generation capacity. The Ministry of Mines and Energy will host and chair this committee. No major further privatizations are expected in the sector.

Although the new model reduces market risk, its ability to encourage private investment in the electricity sector will depend on how the new regulatory framework is implemented. Several challenges are noteworthy in this regard. *First*, the risk of regulatory failure that might arise due to the fact that the government will have a considerable role to play in long-term planning should be avoided by preventing from political interference. *Second*, rules will need to be designed for the transition from the current to the new model to allow current investments to be rewarded adequately. *Third*, because of its small size, price volatility may increase in the short-term electricity market, in turn bringing about higher investment risk, albeit this risk will be attenuated by the role of large consumers. The high share of hydropower in Brazil's energy mix and uncertainty over rainfall also contribute to higher volatility of the short-term electricity market. *Fourth*, although the new model will require total separation between generation and distribution, regulations for the unbundling of vertically integrated companies still have to be defined. Distribution companies are currently allowed to buy up to 30 per cent of their electricity from their own subsidiaries (self-dealing). *Finally*, the government's policy for the natural gas sector needs to be defined within a specific sectoral framework.

Lack of Infrastructure

The regions where the projects are located are isolated and undeveloped. There is a lack of infrastructure, such as roads, reliable electricity supply, communication and transports. In addition, there were no qualified personnel available in the regions due to the lack of schools and universities.

The risks resulting from complicated geological conditions, greater difficulty in transporting materials and equipment and delays caused by bad weather can be considered as construction challenges which can delay the operation of the plant. These bad construction conditions can also increase the costs of the project activity, reducing the interest in investments in this sector. Specifically to this project activity, project participants spent over a million Reais to improve the access to the jobsite before starting the construction of the plant.

Institutional Barrier

As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created to try to organize and to provide incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period electricity prices surpassed BRL 600/MWh (around USD 200/MWh) and the forecasted marginal price of the new energy reached levels of BR$ 120 – 150/MWh (around USD 45). In the middle of 2004 the average price was bellow BRL 50/MWh (less than USD 20/MWh). In the middle of 2004 the average price was bellow BRL 50/MWh (less than USD 20/MWh). This low price of energy was also observed during the year of 2005. In 2006 the energy price was, as of September, the BRL 123/MWh and again in 2007, the prices decreased significantly, reaching less than BRL 40/MWh[11]. This relatively high volatility of the electricity price in Brazil, although in the short term, contributes to the difficult the analysis of the market by the developers.

[11] Source: http://www.ccee.org.br/

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

As described in Sub-step 1a, the main alternatives to the project activity are either to continue the status quo or undertake the project without being registered as a CDM project activity. The outcome of step 2 was that the project activity is not feasible without the CDM related benefits. Thus, the alternative of developing the project without being registered as CDM project activity was eliminated. Considering the barriers as described in Sub-step 3a the main alternative to the project activity is to continue the status quo once they do not affect investments in other opportunities (thermal power plants and large hydros).

Step 4. Common practice analysis:

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

One of the points to be considered when analyzing a small hydro project investment is the possibility to participate in the Proinfa Federal Government Program. Although some projects started construction independently from Proinfa, the program is considered one of the more viable financing alternatives for these projects, which will provide long-term PPAs and special financing conditions. Piedade is not participating in the program and is addressing the market as it structures its projects.

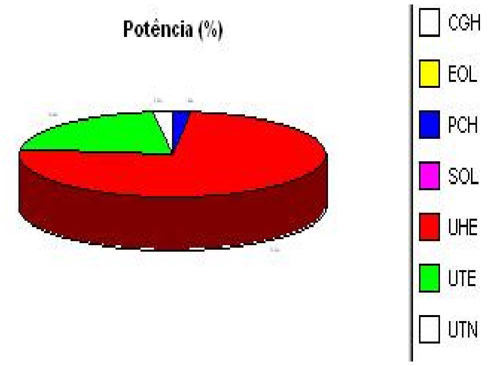
Both process of negotiating a PPA with utility companies and obtaining funding from BNDES have proved to be very cumbersome. BNDES also requires excessive guarantees in order to provide financing. Other risks and barriers are related to the operational and technical issues associated with small hydros, including their capability to comply with the PPA contract and the potential non-performance penalties.

Regardless of the risks and barriers mentioned above, the main reason for the reduced number of similar project activities is the economic cost. Project feasibility requires a PPA contract with a utility company, but the utilities do not have the incentives or motivation to buy electricity generated by small hydro projects.

Most of the developers that funded their projects outside of Proinfa have taken CDM as decisive factor for completing their projects. Therefore, to the best of our knowledge the vast majority of similar projects being developed in the country are participating in the Proinfa Program and not in the CDM. Nevertheless, there is no official restraint for projects derived from public policies to participate in the CDM.

Only 1.70% of Brazil's installed capacity comes from small hydro power sources (1.6 GW out of 98.1 GW). Also, from the 3.6 GW under construction in the country, only 948 MW are small hydro. Many other projects are still under development, waiting for better investment opportunities. Common practice in Brazil has been the construction of large-scale hydroelectric plants and, more recently, of thermal fossil fuel plants, with natural gas, which also receive incentives from the government. Already 21.3% of the power generated in the country comes from thermal power plants, and this number tends to increase in the next years, since 42% of the projects approved between 1998 and 2005 are thermal power plants (compared to only 14% of SHPPs)[12].

[12] ANEEL – *Agência Nacional de Energia Elétrica* (Brazilian power regulatory agency)



Legend	
CGH	Hydroelectric Generator Center
CGU	Undi-Eletric Generator Center
EOL	Wind Generator Center
PCH	Small Hydroelectric Power Plant
SOL	Solar Generation Center Photovoltaic
UHE	Hydroelectric Power Plant
UTE	Thermoelectric Power Plant
UTN	Thermonuclear Power Plant

Figure 8 - Operational types of project (Source: ANEEL, 2007)

Moreover, in the most recent energy auction, which took place on December 16th, 2005, in Rio de Janeiro, 20 concessions for new power plants were granted, of which only two are for SHPPs (28 MW). From the total of 3,286 MW sold, 2,247 MW (68%) will come from thermal power plants, from which 1,391 come from natural gas fired thermal power plants, i.e., 42% of the total sold[13].

Project participants (PPs) also held a research about the small hydro power plants (SHPPs) that started operation since 2005. It was identified the number of SHPPs that received any kind of financial incentive (Proinfa or CDM).

Table 4 - Operations start of SHPPs from 2005 to 2007.

Started operations in 2005															
	Name	State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	CDM	Proinfa
1	Camargo Corrêa	MT												2,00		
2	Comendador Venâncio	RJ			0,77											
3	Cristalino	PR								4,00					X	
4	Faxinal II	MT											10,00			
5	Furnas do Segredo	RS										9,80			X	
6	Ivan Botelho III	MG	12,20	12,20											X	
7	Ombreiras	MT							26,00						X	
8	Porto Góes	SP											14,30			
9	Salto Corgão	MT						13,50	13,50						X	
10	Santa Clara I	PR								3,60					X	
11	Santo Antônio	RS										4,50				
	PARTIAL TOTAL		12,20	12,20	0,77	-	-	13,50	39,50	7,60	-	14,30	24,30	2,00	6	0
			TOTAL = 126,37 MW													

[13] Rosa, Luis Pinguelli. Brazilian. Newspaper "Folha de São Paulo", December 28, 2005.

Started operations in 2006

	Name	State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	CDM	Proinfa
1	Aquarius	MS/MT									4,20				x	x
2	Camargo Corrêa	MT	2,00													
3	Canoa Quebrada	MT												28,00		x
4	Carlos Gonzatto	RS				9,00										x
5	Comendador Venâncio	RJ					0,84									
6	Esmeralda	RS												22,20		x
7	Fundão I	PR												2,48	x	
8	Garganta da Jararaca	MT											14,65	14,65	x	
9	Mosquitão	GO												30,00		x
10	Piranhas	GO												18,00		x
11	Rio Palmeiras I	SC							1,50							
12	Rio Palmeiras II	SC											1,38			
13	Sacre 2	MT									10,00	20,00			x	
14	Saldanha	RO			4,80										x	
15	Santa Edwiges I	GO											10,10		x	
16	Santa Edwiges II	GO	13,00												x	
17	São Bernardo	RS								15,00						x
18	Senador Jonas Pinheiro	MT									6,30					x
	PARTIAL TOTAL		15,00	-	4,80	9,00	0,84	-	1,50	15,00	20,50	20,00	26,13	115,33	7	8
			TOTAL = 228,1 MW													

Started operations in 2007

	Name	State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	CDM	Proinfa
1	Braço Norte IV	MT											14,00		x	
2	Buriti	MS		30,00											x	x
3	Caju	SC						3,20								
4	Contestado	SC											5,55			
5	Coronel Araújo	SC											5,55			
6	Faxinal dos Guedes	SC		4,00											x	
7	Flor do Sertão	SC							16,50							x
8	José Gelásio da Rocha	MT		23,70												x
9	Ludesa	SC								30,00						x
10	Mafrás	SC											2,16			
11	Primavera	RO		13,65	4,55										x	
12	Rondonópolis	MT												26,60		x
13	Santa Laura	SC										15,00				x
14	São João (Castelo)	ES				25,00									x	
	PARTIAL TOTAL		-	71,35	4,55	25,00	-	3,20	16,50	30,00	-	15,00	27,26	26,60	5	6
			TOTAL = 219,46 MW													

Sources: Agência Nacional de Energia Elétrica (ANEEL), 2007 and United Nations Framework Convention on Climate Change (UNFCCC), 2007.

In number of SHPPs, there were 43 that started operations from 2005 to 2007, where 18 received CDM incentives and 14 from Proinfa, totalizing 32 projects with some kind of incentives, which represents 74.4 % of the total SHPPs. In terms of installed capacity it is 90.6 % of the total 520.18 MW.

For the specific year of 2007, when the construction of Piedade begun, among the 14 SHPPs that started operations, 10 received incentives. In terms of installed capacity represents 92.4 % of the total 219.4 MW. Considering the state of Minas Gerais only one SHPP became operational in 2005. This plant corresponds to a CDM project.

Regarding the South-Southeast-Midwest sub-system where the plant is located, it can be seen in the above table that only one SSPH became operational in the North region. Hence, the information mentioned above is representative for the sub-system which the plant is connected to.

From this result, it is clearly demonstrated that common practice for SHPPs is the implementation of the activity through the CDM incentives. Through numbers presented above, it can be proved that it is required a strong incentive to promote the construction of renewable energy projects in Brazil, where it includes SHPPs.

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

The barriers mentioned in Step 3 could be seen as common practice, representing the majority situation of small hydros in Brazil. They required some source of financial incentives to be constructed in the last years. Also, it is demonstrated that the construction of small hydros WITHOUT financial incentives are specific cases and that a NEED to financial incentives is the common practice.

Regarding the grid, it was demonstrated that SHPPs construction is not a common practice in the country. Relating to the construction of similar activities in the state, it can be seen that financial incentives is the common practice once 100% of the installed capacity of the region was achieved through some sort of incentive.

In summary, this project cannot be considered common practice and therefore is not a business as usual type scenario. And it is clear that, in the absence of the incentive created by the CDM, this project would not be the most attractive scenario.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to the selected approved methodology (ACM0002, 2007) and the methodological tool to determine the CO_2 emission factor for the displacement of electricity generated by power plants in an electricity system, the baseline emission factor (EF_y) is achieved by calculating the “operating margin” (OM) and “build margin” (BM) as well as the “combined margin” (CM). The operating margin refers to a cohort of power plants that reflect the existing power plants whose electricity generation would be affected by the proposed CDM project activity. The build margin refers to a cohort of power units that reflect the type of power units whose construction would be affected by the proposed CDM project activity.

According to the selected approved methodology (ACM0002, 2007) and methodological tool (2007), Project Participants shall apply the following six steps to the baseline calculation:

STEP 1 - Identify the relevant electric power system.

STEP 2 - Select an operating margin (OM) method.

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

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

STEP 5 - Calculate the build margin emission factor.

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

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

For the purpose of determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

Similarly, a connected electricity system, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

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

- **STEP 2 -** Select an operating margin (OM) method

The calculation of the operating margin emission factor (EFgrid,OM,y) is based on one of the following methods:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

- **STEP 3 -** Calculate the operating margin emission factor according to the selected method

The simple adjusted operating margin emission factor ($EF_{OM,adjusted,y}$ in tCO_2/MWh) is a variation on the simple operating margin, where the power sources (including imports) are separated in low-cost/must-run power sources (*k*) and other power sources (*j*):

$$EF_{OM,simple-adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum F_{i,k,y} \cdot COI}{\sum_k GEN_{k,}}$$

Equation 1

Where:

- λ_y is the share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin.
- $\sum_{i,j} F_{i,j,y}$ is the amount of fuel *i* (in mass or volume unit) consumed by relevant power sources *j* (analogous for sources *k*) in year(s) *y*,
- $COEF_{i,j}$ is the CO_2e coefficient of fuel *i* (tCO_2e/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources *j* (analogous for sources *k*) and the percent oxidation of the fuel in year(s) *y* and,
- $\sum_j GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j* (analogous for sources *k*),

- **STEP 4 -** Identify the cohort of power units to be included in the build margin (BM)

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

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

Project participants should use the set of power units that comprises the larger annual generation.

- **STEP 5** – Calculate the build margin mission factor ($EF_{BM,y}$)

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

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COI}{\sum_m GEN_{m,}}$$

Equation 2

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

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot E$$ **Equation 3**

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

Baseline emissions are calculated by using the annual generation (project annual electricity dispatched to the grid) times the CO_2 average emission rate of the estimated baseline, as follows:

Monitored project power generation	(MWh)	(A)
Baseline emission rate factor	(tCO_2/MWh)	(B)
(A) x (B)	(tCO_2)	

The emission reductions by the project activity (ER_y) during a given year *y* are the product of the baseline emissions factor (EF_y, in tCO_2e/MWh) times the electricity supplied by the project to the grid (EG_y, in MWh), as follows:

$$ER_y = EF_y \cdot$$ **Equation 4**

According to ACM0002, version 7, EB 36, new hydro electric power projects with reservoirs, shall account for project emissions, estimated as follows:

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

$$PE_y = \frac{EF_{Res} \cdot TEG_y}{1000}$$

Where:

PEy = Emission from reservoir expressed as tCO_2e/year.

EF_{Res} = is the default emission factor for emissions from reservoirs, and the default value as perEB23 is 90 Kg CO_2e/MWh.

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

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

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

Where:

PD = Power density of the project activity, in W/m^2.

Cap_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W).

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

A_{PJ} = Area of the 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 reservoirs, this value is zero.

Indirect emissions can result from project construction, transportation of materials and fuel and other upstream activities. Nevertheless no significant net leakage from these activities was identified.

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

Data / Parameter:	***EF_y***
Data unit:	tCO_2/MWh
Description:	Emission factor for the Brazilian South-Southeast-Midwest interconnected grid
Source of data used:	Data provided by ONS (National dispatch center). Calculated according to the approved methodology – ACM0002, version 7, 2007.
Value applied:	0.2826
Justification of the choice of data or description of measurement methods and procedures actually applied :	The baseline emission factor (EFy) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. Calculations for this combined margin are based on data from an official sources (National Dispatch Center for the power generation data; EB decision regarding thermodynamic efficiency of power by fuel types information) with very low level of uncertainty and made publicly available.
Any comment:	

Data / Parameter:	***$EF_{OM,y}$***
Data unit:	tCO_2/MWh
Description:	CO_2 Operating Margin emission factor of the grid in a year *y*
Source of data used:	Data provided by ONS (National dispatch center). Calculated according to the approved methodology – ACM0002, version 7, 2007
Value applied:	0.4749
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0002, version 7, 2007, the option chosen for the calculation of the emission factor in this project is option (a): simple adjusted operating margin factor. This choice is due to the fact that, in Brazil, even though most of the energy produced in the country comes from hydroelectric power, most of these low costs investments in hydro electrics are exhausted. Therefore, the possibility of investments in non-renewable sources arises, such as thermoelectric power plants. As thermal plants use fossil, these companies end up having higher operational costs than hydro plants. As a

	result, they are likely to be displaced by any hydro added to the grid. See more details section B.6.1.
Any comment:	

Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO_2/MWh
Description:	CO_2 Build Margin emission factor of the grid in a year *y*
Source of data used:	Data provided by ONS (National dispatch center).
Value applied:	0.0903
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated according to the approved methodology – ACM0002, version 7, 2007. See more details in section B.6.1.
Any comment:	

Data / Parameter:	λ_y
Data unit:	No unit
Description:	Fraction of time during which low-cost/must-run sources are on the margin
Source of data used:	Data provided by ONS.
Value applied:	λ_{2004}=0.4185, λ_{2005}=0.5275, λ_{2006}=0.4937
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated according to the approved methodology – ACM0002, version 7, 2007. See more details in section B.6.1.
Any comment:	

Data / Parameter:	$F_{i,y}$
Data unit:	Mass of volume
Description:	Amount of fossil fuel consumed by each power plant
Source of data used:	Data provided by ONS
Value applied:	Please see table below for data $\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002
Any comment:	As the amount of values/data is extraordinary large, it will be omitted here. Data is available under request, together with the emission factor for grid calculations.

Data / Parameter:	$COEF_{i,j\,y}$
Data unit:	tCO_2/mass or volume unit

Description:	CO_2 emission coefficient of each fuel type i
Source of data used:	Data provided by ONS.
Value applied:	Please see table below for data $\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002
Any comment:	As the amount of values/data is extraordinary large, it will be omitted here. Data is available under request, together with the emission factor for grid calculations.

Data / Parameter:	***$GEN_{j/k/n,y}$***
Data unit:	MWh/year
Description:	Electricity generation of each power source/plant *j*, *k*, or n in year *y*
Source of data used:	Data provided by ONS.
Value applied:	Please see table below for data $\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002
Any comment:	As the amount of values/data is extraordinary large, it will be omitted here. Data is available under request, together with the emission factor for grid calculations.

Data / Parameter:	***$GEj_{i/k/ll,y\ IMPORTS}$***
Data unit:	MWh
Description:	Electricity imports to the project electricity system
Source of data used:	Data provided by ONS.
Value applied:	Please see table below for data $\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002
Any comment:	As the amount of values/data is extraordinary large, it will be omitted here. Data is available under request, together with the emission factor for grid calculations.

Data / Parameter:	**COEF i/j,y, imports**
Data unit:	tCO_2/mass or volume unit
Description:	CO_2 emission coefficient of fuels used in connected electricity systems (if imports occur)
Source of data used:	Data provided by ONS.
Value applied:	$\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$ Please see table below for data
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated according the approved methodology – ACM0002
Any comment:	As the amount of values/data is extraordinary large, it will be omitted here. Data is available under request, together with the emission factor for grid calculations.

Data / Parameter:	$\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$
Data unit:	tCO_2/MWh
Description:	Operating Margin for non low-cost/must run power sources *j*
Source of data used:	Data provided by ONS. Calculated according the approved methodology – ACM0002
Value applied:	2004: 0.9886 2005: 0.9653 2006: 0.8071
Justification of the choice of data or description of measurement methods and procedures actually applied :	Both electricity generated from power plants in the grid and electricity imported are included.
Any comment:	

Data / Parameter:	**Area**
Data unit:	km^2
Description:	Surface area at full reservoir level
Source of data used:	According to the Basic Project.
Value applied:	1.5
Justification of the choice	Data is validated at start of the project. The value is estimated by the national

of data or description of measurement methods and procedures actually applied:	electricity agency at the concession phase and is thoroughly calculated and determined during the environmental licensing phase (very low uncertainty level).
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

As described in section B.6.1, emission reductions (*ER*) in this project are calculated directly from electricity supplied by the project to the grid (*EG*) multiplied by the emission factor (*EF*). Detailed information of emission factor calculation is described in Annex 3.

Future electricity supplied by the project to the grid is estimated based on the installed capacity of the hydropower plant and its capacity factor. The estimative of energy generation is presented in the section of the monitored parameters.

For EF_{OM} calculation, first the λ_y factors are calculated as indicated in methodology ACM0002, version 7, 2007, with date obtained from the ONS database. Figure 10, Figure 11 and Figure 12 in Annex3 present the load duration curves and λ_y calculations for years 2003, 2004 and 2005, respectively.

The results for years 2003, 2004 and 2005 are presented in Table 5.

Table 5 - Share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin in the S-SE-CO system for the period 2003-2005 (ONS-ADO, 2006).

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$ [tCO_2/MWh]	λ_y [%]
2004	0.9886	0.4185
2005	0.9653	0.5275
2006	0.8071	0.4937

Finally, applying the obtained numbers to calculate $EF_{OM,simple-adjusted,2003-2005}$ as the weighted by generation capacity average *of* $EF_{OM,simple-adjusted\ 2003}$, $EF_{OM\ simple-\ adjusted,2004}$ *and* $EF_{OM,simple-adjusted,2005}$ and λ_y to Equation 6:

$$EF_{OM,simple-adjusted,2004-2004} = 0.4749\ tCO_2e/MWh.$$

Applying the data from the Brazilian national dispatch center to Equation 10, the 20% of the system generation from most recently build has larger annual generation, giving:

$$EF_{BM,2006} = 0.0903\ tCO_2e/MWh.$$

With these numbers, applying in Equation 11, we have:

$$EF_y = 0.5 \times 0.4749 + 0.5 \times 0.0903$$

$$EF_y = 0.2826\ tCO_2e/MWh.$$

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

Year	Estimation of project activity emissions (tones of CO_2e)	Estimation of baseline emissions (tones of CO_2e)	Estimation of leakage (tones of CO_2e)	Estimation of overall emission reductions (tones of CO_2e)
2009	0	24,300	0	24,300
2010	0	24,300	0	24,300
2011	0	24,300	0	24,300
2012	0	24,300	0	24,300
2013	0	24,300	0	24,300
2014	0	24,300	0	24,300
2015	0	24,300	0	24,300
Total (tonnes of CO_2e)	**0**	**170,101**	**0**	**170,101**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	EGy
Data unit:	MWh
Description:	Electricity supplied by the project activity to the grid.
Source of data to be used:	Energy metering at generation plant using annual energy generation report
Value of data applied for the purpose of calculating expected emission reductions in section B.5	85,988 MWh/year
Description of measurement methods and procedures to be applied:	Continuously electronic measurement for each 1MW generated and Weakly recording.
QA/QC procedures to be applied:	Energy metering QA/QC procedures are explained in Annex 4 (the equipments used have by legal requirements extremely low level of uncertainty). Measured and monitored yearly.
Any comment:	The electricity delivered to the grid is monitored by the Project as well as by the

	energy buyer

Data / Parameter:	TEGy
Data unit:	MWh
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 to be used:	Energy meter or Project Sponsor internal control and receipt of electricity purchase or evidences from .CCEE – Câmara de Comercialização de Energia Elétrica, a Brazilian government entity which monitors the electricity on the national interconnected grid.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Energy metering QA/QC procedures are explained in Annex 4 (the equipments used have by legal requirements extremely low level of uncertainty). Hourly measurement and monthly recording.
Any comment:	Data will be archived in electronic and paper format.

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 to be used:	Official data.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Determine the installed capacity based on recognized standards.
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Yearly
Any comment:	Data will be archived in paper format.

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 to be used:	Official data.

Value of data applied for the purpose of calculating expected emission reductions in section B.5	Measured from topographical surveys, maps, satellite pictures, etc.
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Yearly
Any comment:	Data will be archived in paper format.

B.7.2 Description of the monitoring plan:

Methodology applicable to this project is the approved consolidated monitoring methodology ACM0002, version 7, 2007 – "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources".

It consists in using meter equipment projected to registry and verifies bidirectionally the energy generated by the facility. This energy measurement is fundamental to verify and monitor the GHG emission reductions. The Monitoring Plan permits the calculation of GHG emissions generated by the project activity in a straightforward manner, applying the baseline emission factor.

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

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 (DD/MM/YYYY): 30/07/2007.

Name of person/entity determining the baseline:

Company:	Ecoinvest Carbon Brasil Ltda. (Project participant)
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Country:	Brazil
Contact person:	Ricardo Esparta
Job title:	Director
Telephone number:	+55 (11) 3063-9068
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E-mail:	ricardo.esparta@ecoinvestcarbon.com

Ecoinvest is the Project Advisor and also a Project Participant.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

29/06/2006

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

30y-0m

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

C.2.1. Renewable crediting period

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

01/01/2009

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

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

As for the environmental permits, the proponent of any project that involves the construction, installation, expansion, and operation of any polluting or potentially polluting activity or any activity capable of causing environmental degradation is required to secure a series of permits from the respective state environmental agency. In addition, any such activity requires the preparation of an environmental assessment report, prior to obtaining construction and operation permits. Three types of permits are required. The first is the preliminary permit (*Licença Prévia* or L.P.) issued during the planning phase of the project and which contains basic requirements to be complied with during the construction, and operating stages. The second is the construction permit (*Licença de Instalação* or L.I.) and, the final one is the operating permit (*Licença de Operação* or L.O.).

The preparation of an Environmental Impact Assessment is compulsory to obtain the construction and the operation licenses. In the process a report containing an investigation of the following aspects was prepared:

- Impacts to climate and air quality.
- Geological and soil impacts.
- Hydrological impacts (surface and groundwater).
- Impacts to the flora and animal life.
- Socio-economical (necessary infra-structure, legal and institutional, etc.).

From the environmental process perspective there are two types of small hydro projects: (a) those ones that only have to prepare a Preliminary Environmental Assessment ("*Relatório Ambiental Preliminar*", RAP) and (b) those ones that have to further set up assessments called Environmental Impact Study ("*Estudo de Impacto Ambiental*", EIA.) and Environmental Impact Assessment ("*Relatório de Impacto Ambiental"*, RIMA). Later on, the local environmental agency can request another assessment called Basic Environmental Project ("*Projeto Básico Ambiental*", P.B.A.) for both types of project.

In order to start the process of obtaining environmental licenses every hydro project has to confirm that the following will not occur:

- Inundation of Indian lands and slaves historical areas;
- Inundation of environmental preservation areas;
- Inundation of urban areas;
- Inundation of areas where there will be urban expansion in the foreseeable future;
- Elimination of natural patrimony;
- Expressive losses for other water uses;
- Inundation of protected historic areas; and
- Inundation of cemeteries and other sacred places.

The process starts with a previous analysis (preliminary studies) by the local environmental department. After that, if the project was considered environmentally feasible, the sponsors have to prepare the Preliminary Environmental Assessment ("*Relatório Ambiental Preliminar*" – R.A.P.), which is basically composed by the following information:

- Reasons for project implementation;
- Project description, including information regarding the reservoir and the utility;
- Preliminary Environmental Diagnosis, mentioning main biotic, and anthropic aspects;
- Preliminary estimative of project impacts; and
- Possible mitigation measures and environmental programs.

The result of a successful submission of those assessments is the preliminary license (LP), which reflects the environmental local agency positive understanding about the environmental project concepts. To get the construction license (LI) it will be necessary to present either: (a) additional information into previous assessment; or (b) a new more detailed simplified assessment; or (c) the "Environmental Basic Project", according environmental local agency decision at the LP issued. The operation license (LO) will be obtained as result of pre-operational tests during the construction phase, carried out to verify if all exigencies made by environmental local agency were satisfied.

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:

As for the regulatory permits, the ANEEL Resolution n° 399, issued on August 12th, 2003 authorized Construtora Gomes Lourenço Ltda. to transfer the previous authorization to Piedade Usina Geradora de Energia S/A. The Basic Project of the SHPP Piedade was approved accordingly to ANEEL Dispatch nº 2.077, issued on July 04th, 2007.

The project has the necessary environmental licenses. The licenses were issued by the state environmental agency, FEAM *(Fundação Estadual do Meio Ambiente),* LI number 124/2006 was issued on November 06th, 2006, valid until May 6th, 2007. The LI was renewed on April 24th, 2006 and will be valid until May 6th, 2010. All documents related to operational and environmental licensing are public and can be obtained at the state environmental agency (FEAM-MG).

SECTION E. Stakeholders' comments

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

The Brazilian resolution CONAMA 279 of June 2001 establishes that hydropower plants with less than 10 MW of installed power do not need to elaborate Environmental Impact Assessment (EIA). Piedade Small Hydro Power Plant is a 16 MW hydropower plant. When it is necessary to elaborate the EIA, a public audience is also required.

However, the legislation requests the announcement of the issuance of the licenses (LP, LI and LO) in the local state official journal (*Diário Oficial do Estado*) and in the regional newspaper to make the process public and allow stakeholders' comments.

Besides the stakeholders comments requested for the environmental licenses, the Brazilian Designated National Authority, "*Comissão Interministerial de Mudanças Globais do Clima*", requests comments from local stakeholders, and the validation report issued by an authorized DOE according to the Resolution no. 1, issued on 11th September 2003, in order to provide the letter of approval. The Resolution determines that copies of the invitations for comments sent by the project proponents at least to the following agents involved in and affected by project activities:

- Municipal governments and City Councils;
- State and Municipal Environmental Agencies;
- Brazilian Forum of NGOs and Social Movements for Environment and Development;
- Community associations;

- State Attorney for the Public Interest;

Invitation letters were sent on July 5th, 2007, to the following agents (copies of the letters and post office confirmation of receipt communication are available upon request):

- Monte Alegre de Minas City Hall
- Municipal Assembly of Monte Alegre de Minas
- State of Minas Gerais Environmental Agency
- Monte Alegre de Minas Environmental Agency
- State Attorney for the Public Interests of the State of Minas Gerais
- Brazilian Forum of NGOs and Social Movements for the Development and Environment
- APAE - Associação de Pais de Amigos dos Excepcionais de Monte Alegre

The PDD of the project is also open for comments at the validation stage in the United Nations Framework Convention on Climate Change website (http://www.unfccc.int/), since anyone can have access to the mentioned document from a legitimate source.

E.2. Summary of the comments received:

FBOMS sent a letter suggesting the use of Gold Standard or similar tools.

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

The project participants consider that requests made by the Brazilian Government are sufficient to be used as sustainable indicators which are attended by this CDM project activity.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the present project.

This project is not a diverted ODA from an Annex 1 country.

Annex 3

BASELINE INFORMATION

The Brazilian electricity system (figure below) has been historically divided into two subsystems: the North-Northeast (N-NE) and the South-Southeast-Midwest (S-SE-CO, From the Portuguese *Sul-SudEste-Centro-Oeste*). This is due mainly to the historical evolution of the physical system, which was naturally developed nearby the biggest consuming centers of the country.

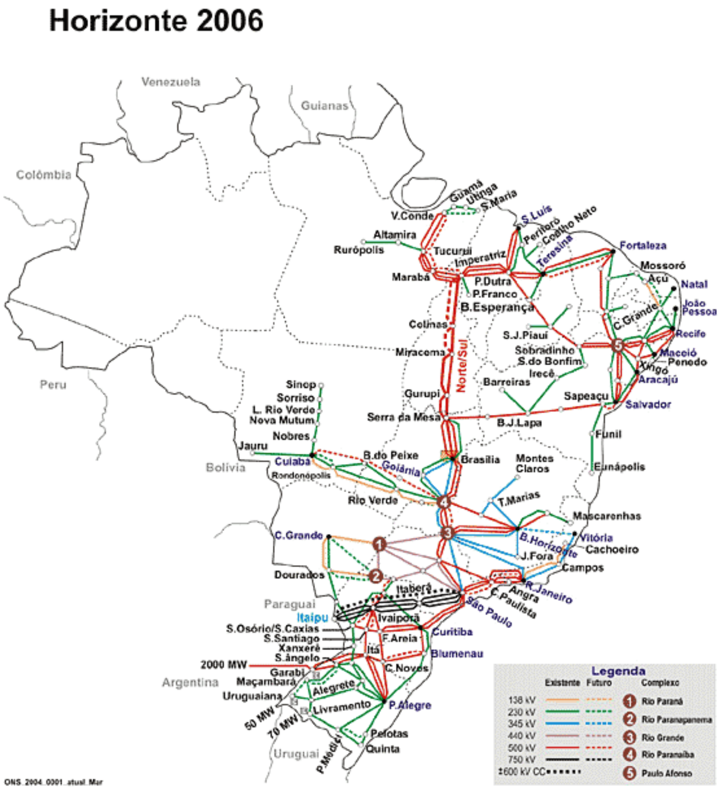

Figure 9 - Brazilian Interconnected System (Source: ONS, http://www.ons.org.br/)

The natural evolution of both systems is increasingly showing that integration is to happen in the future. In 1998, the Brazilian government was announcing the first leg of the interconnection line between S-SE-CO and N-NE. With investments of around US$ 700 million, the connection had the main purpose, in the government's view, at least, to help solve energy imbalances in the country: the S-SE-CO region could supply the N-NE in case it was necessary and vice-versa.

Nevertheless, even after the interconnection had been established, technical papers still divided the Brazilian system in two (Bosi, 2000):

"… where the Brazilian Electricity System is divided into three separate subsystems:

i) The South/Southeast/Midwest Interconnected System;

ii) The North/Northeast Interconnected System; and

iii) The Isolated Systems (which represent 300 locations that are electrically isolated from the interconnected systems)"

Moreover, Bosi (2000) gives a strong argumentation in favor of having so-called *multi-project baselines*:

"For large countries with different circumstances within their borders and different power grids based in these different regions, multi-project baselines in the electricity sector may need to be disaggregated below the country-level in order to provide a credible representation of 'what would have happened otherwise."

Finally, one has to take into account that even though the systems today are connected, the energy flow between N-NE and S-SE-CO is heavily limited by the transmission lines capacity. Therefore, only a fraction of the total energy generated in both subsystems is sent one way or another. It is natural that this fraction may change its direction and magnitude (up to the transmission line's capacity) depending on the hydrological patterns, climate and other uncontrolled factors. But it is not supposed to represent a significant amount of each subsystem's electricity demand. It has also to be considered that only in 2004 the interconnection between SE and NE was concluded, i.e., if project proponents are to be coherent with the generation database they have available as of the time of the PDD submission for validation, a situation where the electricity flow between the subsystems was even more restricted is to be considered.

The Brazilian electricity system nowadays comprises of around 91.3 GW of installed capacity, in a total of 1,420 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 5.3% are diesel and fuel oil plants, 3.1% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw and biogas), 2% are nuclear plants, 1.4% are coal plants, and there are also 8.1 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid. (http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp). This latter capacity is in fact comprised by mainly 6.3 GW of the Paraguayan part of *Itaipu Binacional*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

Approved methodologies ACM0002, version 7, 2007, asks project proponents to account for "all generating sources serving the system". In that way, when applying the methodology, project proponents in Brazil should search for, and research, all power plants serving the Brazilian system.

In fact, information on such generating sources is not publicly available in Brazil. The national dispatch center, ONS – *Operador Nacional do Sistema* – argues that dispatching information is strategic to the power agents and therefore cannot be made available. On the other hand, ANEEL, the electricity agency, provides information on power capacity and other legal matters on the electricity sector, but no dispatch information can be got through this entity.

In that regard, project proponents looked for a plausible solution in order to be able to calculate the emission factor in Brazil in the most accurate way. Since real dispatch data is necessary after all, the ONS was contacted, in order to let participants know until which degree of detail information could be provided. After several months of talks, plants' daily dispatch information was made available for years 2002, 2003 and 2004.

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to ANEEL, in fact, ONS centralized dispatched plants accounted for 75,547 MW of installed capacity by 31/12/2004, out of the total 98,848.5 MW installed in Brazil by the same date (http://www.aneel.gov.br/arquivos/PDF/Resumo_Gráficos_mai_2005.pdf), which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23.6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International Energy Agency database built when carrying out the study from Bosi *et al.* (2002). Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only (Table 6).

Table 6 - Ex ante and ex-post operating and build margin emission factors

(ONS-ADO, 2004; Bosi *et al.*, 2002)

Year	$EF_{OM\ non\text{-}low\text{-}cost/must\text{-}run}$ [tCO_2/MWh]		EF_{BM} [tCO_2/MWh]	
	Ex-ante	Ex-post	Ex-ante	Ex-post
2001-2003	0.719	0.950	0.569	0.096

Therefore, considering all the rationale explained, project developers decided for the database considering ONS information only, as it was capable of properly addressing the issue of determining the emission factor and doing it in the most conservative way.

The aggregated hourly dispatch data got from ONS was used to determine the lambda factor for each of the years with data available (2003, 2004 and 2005). The Low-cost/Must-run generation was determined as the total generation minus fossil-fuelled thermal plants generation, this one determined through daily dispatch data provided by ONS. All this information has been provided to the validators, and extensively discussed with them, in order to make all points crystal clear. The figures below show the load duration curves for the three considered years, as well as the lambda calculated.

Table 7 - Emission Factors for the Brazilian South-Southeast-Midwest interconnected grid (simple adjusted operating margin factor)

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid

Baseline	EF_{OM} [tCO_2/MWh]	λ_y	Generation [MWh]
2006	0.8071	0.4185	315,192,117
2005	0.9653	0.5275	315,511,628
2004	0.9886	0.4937	301,422,617
	$EF_{OM,simple\text{-}adjusted}$ [tCO_2/MWh]	$EF_{BM,2006}$	Default EF_y [tCO_2/MWh]
	0.4749	0.0903	0.2826
	Alternative weights	Default weights	
	w_{OM} = 0.75	w_{OM} = 0.5	Alternative EF_y [tCO_2/MWh]
	w_{BM} - 0.25	w_{BM} - 0.5	0.379

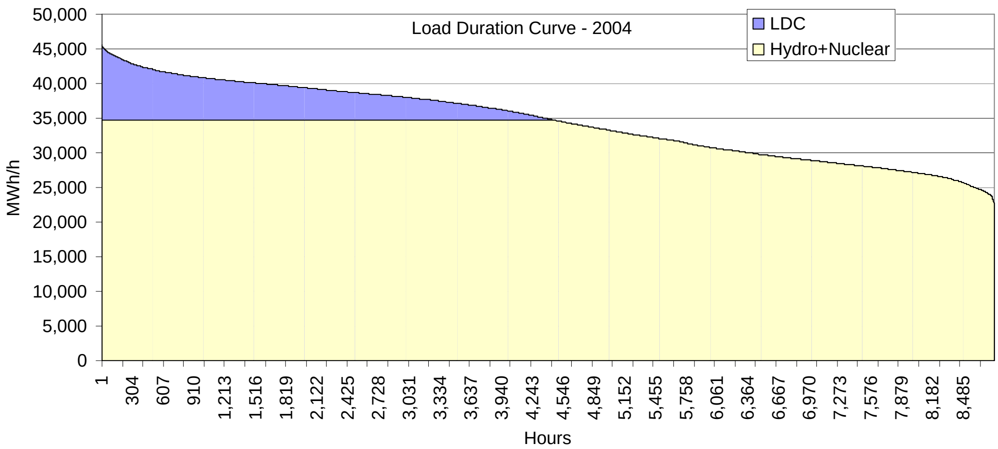

Figure 10 - Load duration curve for the S-SE-CO system, 2003

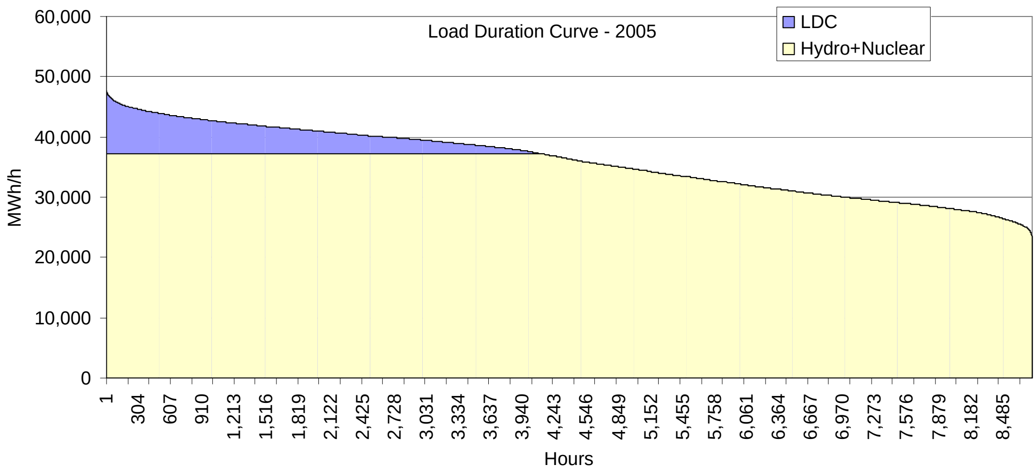

Figure 11 - Load duration curve for the S-SE-CO system, 2004

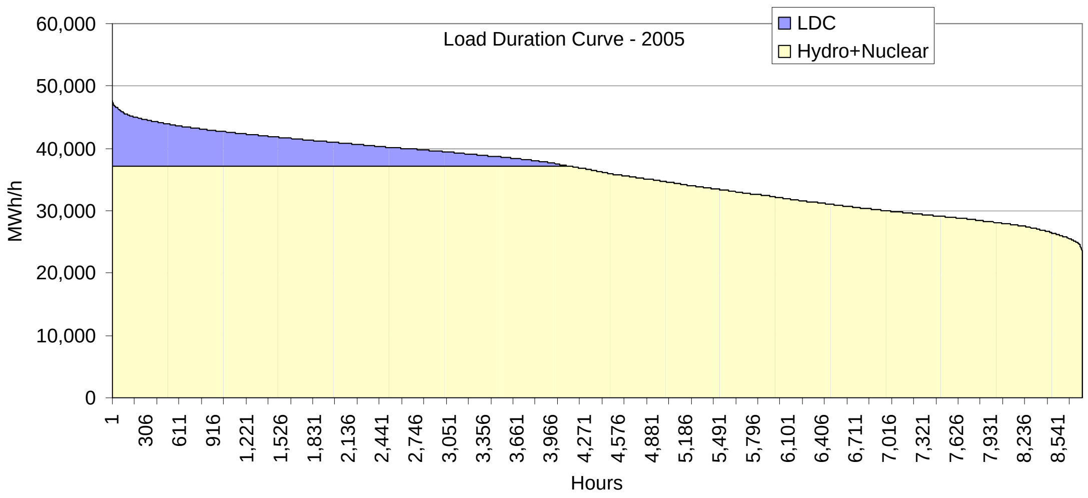

Figure 12 - Load duration curve for the S-SE-CO system, 2005

Table 1 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 1

	Power plant name	Subsystem	Fuel source	Operation start	Installed capacity	Fossil fuel conversion efficiency	Fraction carbon oxidized	Baseline
					[MW]	[%]	[%]	[tCO_2/MWh]
1	TermoRio	SE-CO	natural gas	Nov-2004	423.3	50%	99.5%	0.402
2	Candonga	SE-CO	hydro	Sep-2004	140.0	100%	-	-
3	Queimado	SE-CO	hydro	May-2004	105.0	100%	-	-
4	Norte Fluminense	SE-CO	natural gas	Feb-2004	860.2	50%	99.5%	0.402
5	Jauru	SE-CO	hydro	Sep-2003	121.5	100%	-	-
6	Guaporé	SE-CO	hydro	Sep-2003	120.0	100%	-	-
7	Três Lagoas	SE-CO	natural gas	Aug-2003	306.0	32%	99.5%	0.628
8	Funil (MG)	SE-CO	hydro	Jan-2003	180.0	100%	-	-
9	Itiquira I	SE-CO	hydro	Sep-2002	156.1	100%	-	-
10	Araucária	S	natural gas	Sep-2002	484.5	32%	99.5%	0.628
11	Canoas	S	natural gas	Sep-2002	160.6	32%	99.5%	0.628
12	Piraju	SE-CO	hydro	Sep-2002	81.0	100%	-	-
13	N. Piratininga	SE-CO	natural gas	Jun-2002	384.9	32%	99.5%	0.628
14	PCT CGTEE	S	fuel oil	Jun-2002	5.0	33%	99.0%	0.902
15	Rosal	SE-CO	hydro	Jun-2002	55.0	100%	-	-
16	Ibirité	SE-CO	natural gas	May-2002	226.0	32%	99.5%	0.628
17	Cana Brava	SE-CO	hydro	May-2002	465.9	100%	-	-
18	Sta Clara	SE-CO	hydro	Jan-2002	60.0	100%	-	-
19	Machadinho	S	hydro	Jan-2002	1,140.0	100%	-	-
20	Juiz de Fora	SE-CO	natural gas	Nov-2001	87.0	32%	99.5%	0.628
21	Macaé Merchant	SE-CO	natural gas	Nov-2001	922.6	32%	99.5%	0.628
22	Lajeado	SE-CO	hydro	Nov-2001	902.5	100%	-	-
23	Eletrobolt	SE-CO	natural gas	Oct-2001	379.0	32%	99.5%	0.628
24	Porto Estrela	SE-CO	hydro	Sep-2001	112.0	100%	-	-
25	Cuiaba (Mario Covas)	SE-CO	natural gas	Aug-2001	529.2	32%	99.5%	0.628
26	W. Arjona	SE-CO	natural gas	Jan-2001	194.0	32%	99.5%	0.628
27	Uruguaiana	S	natural gas	Jan-2000	639.9	50%	99.5%	0.402
28	S. Caxias	S	hydro	Jan-1999	1,240.0	100%	-	-
29	Canoas I	SE-CO	hydro	Jan-1999	82.5	100%	-	-
30	Canoas II	SE-CO	hydro	Jan-1999	72.0	100%	-	-
31	Igarapava	SE-CO	hydro	Jan-1999	210.0	100%	-	-
32	P. Primavera	SE-CO	hydro	Jan-1999	1,540.0	100%	-	-
33	Cuiaba (Mario Covas)	SE-CO	diesel oil	Oct-1998	529.2	33%	99.0%	0.800
34	Sobragi	SE-CO	hydro	Sep-1998	60.0	100%	-	-
35	PCH EMAE	SE-CO	hydro	Jan-1998	26.0	100%	-	-
36	PCH CEEE	S	hydro	Jan-1998	25.0	100%	-	-
37	PCH Enersul	S	hydro	Jan-1998	43.0	100%	-	-
38	PCH CEB	SE-CO	hydro	Jan-1998	15.0	100%	-	-
39	PCH Escelsa	SE-CO	hydro	Jan-1998	62.0	100%	-	-
40	PCH Celesc	S	hydro	Jan-1998	50.0	100%	-	-
41	PCH CEMAT	SE-CO	hydro	Jan-1998	145.0	100%	-	-
42	PCH CELG	SE-CO	hydro	Jan-1998	15.0	100%	-	-
43	PCH CERJ	SE-CO	hydro	Jan-1998	59.0	100%	-	-
44	PCH Copel	S	hydro	Jan-1998	70.0	100%	-	-
45	PCH CEMIG	SE-CO	hydro	Jan-1998	84.0	100%	-	-
46	PCH CPFL	SE-CO	hydro	Jan-1998	55.0	100%	-	-
47	S. Mesa	SE-CO	hydro	Jan-1998	1,275.0	100%	-	-
48	PCH Eletropaulo	SE-CO	hydro	Jan-1998	26.0	100%	-	-
49	Guilmam Amorim	SE-CO	hydro	Jan-1997	140.0	100%	-	-
50	Corumbá	SE-CO	hydro	Jan-1997	375.0	100%	-	-
51	Miranda	SE-CO	hydro	Jan-1997	408.0	100%	-	-
52	Nova Ponte	SE-CO	hydro	Jan-1994	510.0	100%	-	-
53	Segredo	S	hydro	Jan-1992	1,260.0	100%	-	-
54	Taquaruçu	SE-CO	hydro	Jan-1989	554.0	100%	-	-
55	Manso	SE-CO	hydro	Jan-1988	210.0	100%	-	-
56	D. Francisca	S	hydro	Jan-1987	125.0	100%	-	-
57	Itá	S	hydro	Jan-1987	1,450.0	100%	-	-
58	Rosana	SE-CO	hydro	Jan-1987	369.2	100%	-	-
59	Angra	SE-CO	nuclear	Jan-1985	1,874.0	100%	-	-
60	T. Irmãos	SE-CO	hydro	Jan-1985	807.5	100%	-	-
61	Itaipú 60 Hz	SE-CO	hydro	Jan-1983	6,300.0	100%	-	-
62	Itaipú 50 Hz	SE-CO	hydro	Jan-1983	5,375.0	100%	-	-
63	Emborcação	SE-CO	hydro	Jan-1982	1,192.0	100%	-	-
64	Nova Avanhandava	SE-CO	hydro	Jan-1982	347.4	100%	-	-

[1] Agência Nacional de Energia Elétrica. *Banco de Informações da Geração* (http://www.aneel.gov.br/, data collected in november 2004).
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[6] Centrais Elétricas Brasileiras S/A. Plano anual de combustíveis - Sistema interligado S/SE/CO 2005 (released December 2004).

Table 2 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 2

65	Gov. Bento Munhoz	S	hydro	Jan-1980	1,676.0	100%	-	-
66	S. Santiago	S	hydro	Jan-1980	1,420.0	100%	-	-
67	Itumbiara	SE-CO	hydro	Jan-1980	2,280.0	100%	-	-
68	Igarapé	SE-CO	fuel oil	Jan-1978	131.0	33%	99.0%	0.820
69	Itauba	S	hydro	Jan-1978	512.4	100%	-	-
70	A. Vermelha	SE-CO	hydro	Jan-1978	1,396.2	100%	-	-
71	S. Simão	SE-CO	hydro	Jan-1978	1,710.0	100%	-	-
72	Capivara	SE-CO	hydro	Jan-1977	640.0	100%	-	-
73	S. Osório	S	hydro	Jan-1975	1,078.0	100%	-	-
74	Marimbondo	SE-CO	hydro	Jan-1975	1,440.0	100%	-	-
75	Promissão	SE-CO	hydro	Jan-1975	264.0	100%	-	-
76	Pres. Medici	S	coal	Jan-1974	446.0	33%	98.0%	1.019
77	Volta Grande	SE-CO	hydro	Jan-1974	380.0	100%	-	-
78	Porto Colombia	SE-CO	hydro	Jun-1973	320.0	100%	-	-
79	Passo Fundo	S	hydro	Jan-1973	220.0	100%	-	-
80	Passo Real	S	hydro	Jan-1973	158.0	100%	-	-
81	Ilha Solteira	SE-CO	hydro	Jan-1973	3,444.0	100%	-	-
82	Mascarenhas	SE-CO	hydro	Jan-1973	131.0	100%	-	-
83	Gov. Parigot de Souza	S	hydro	Jan-1971	252.0	100%	-	-
84	Chavantes	SE-CO	hydro	Jan-1971	414.0	100%	-	-
85	Jaguara	SE-CO	hydro	Jan-1971	424.0	100%	-	-
86	Sá Carvalho	SE-CO	hydro	Apr-1970	78.0	100%	-	-
87	Estreito	SE-CO	hydro	Jan-1969	1,050.0	100%	-	-
88	Ibitinga	SE-CO	hydro	Jan-1969	131.5	100%	-	-
89	Jupiá	SE-CO	hydro	Jan-1969	1,551.2	100%	-	-
90	Alegrete	S	fuel oil	Jan-1968	66.0	33%	99.0%	0.820
91	Campos	SE-CO	natural gas	Jan-1968	30.0	32%	99.5%	0.628
92	Santa Cruz (RJ)	SE-CO	natural gas	Jan-68	766.0	32%	99.5%	0.628
93	Paraibuna	SE-CO	hydro	Jan-1968	85.0	100%	-	-
94	Limoeiro	SE-CO	hydro	Jan-1967	32.0	100%	-	-
95	Cacaonde	SE-CO	hydro	Jan-1966	80.4	100%	-	-
96	J. Lacerda C	S	coal	Jan-1965	363.0	33%	98.0%	1.019
97	J. Lacerda B	S	coal	Jan-1965	262.0	33%	98.0%	1.019
98	J. Lacerda A	S	coal	Jan-1965	232.0	33%	98.0%	1.019
99	Bariri	SE-CO	hydro	Jan-1965	143.1	100%	-	-
100	Funil (RJ)	SE-CO	hydro	Jan-1965	216.0	100%	-	-
101	Figueira	S	coal	Jan-1963	20.0	33%	98.0%	1.019
102	Furnas	SE-CO	hydro	Jan-1963	1,216.0	100%	-	-
103	Barra Bonita	SE-CO	hydro	Jan-1963	140.8	100%	-	-
104	Charqueadas	S	coal	Jan-1962	72.0	33%	98.0%	1.019
105	Jurumirim	SE-CO	hydro	Jan-1962	97.7	100%	-	-
106	Jacui	S	hydro	Jan-1962	180.0	100%	-	-
107	Pereira Passos	SE-CO	hydro	Jan-1962	99.1	100%	-	-
108	Tres Marias	SE-CO	hydro	Jan-1962	396.0	100%	-	-
109	Euclides da Cunha	SE-CO	hydro	Jan-1960	108.8	100%	-	-
110	Camargos	SE-CO	hydro	Jan-1960	46.0	100%	-	-
111	Santa Branca	SE-CO	hydro	Jan-1960	56.1	100%	-	-
112	Cachoeira Dourada	SE-CO	hydro	Jan-1959	658.0	100%	-	-
113	Salto Grande, SP	SE-CO	hydro	Jan-1958	70.0	100%	-	-
114	Salto Grande (MG)	SE-CO	hydro	Jan-1956	102.0	100%	-	-
115	Mascarenhas de Moraes	SE-CO	hydro	Jan-1956	478.0	100%	-	-
116	Itutinga	SE-CO	hydro	Jan-1955	52.0	100%	-	-
117	S. Jerônimo	S	coal	Jan-1954	20.0	33%	98.0%	1.019
118	Carioba	SE-CO	fuel oil	Jan-1954	36.2	33%	99.0%	0.820
119	Piratininga	SE-CO	fuel oil	Jan-1954	472.0	33%	99.0%	0.820
120	Canastra	S	hydro	Jan-1953	42.5	100%	-	-
121	Nilo Peçanha	SE-CO	hydro	Jan-1953	378.4	100%	-	-
122	Fontes Nova	SE-CO	hydro	Jan-1940	130.3	100%	-	-
123	H. Borden Sub.	SE-CO	hydro	Jan-1926	420.0	100%	-	-
124	H. Borden Ext	SE-CO	hydro	Jan-1926	469.0	100%	-	-
125	I. Pombos	SE-CO	hydro	Jan-1924	189.7	100%	-	-
126	Jaguari	SE-CO	hydro	Jan-1917	11.8	100%	-	-

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Annex 4

MONITORING INFORMATION

In accordance with the procedures set by the Approved Consolidated Methodology 0002 – "Consolidated Methodology for grid-connected electricity generation from renewable sources", monitoring shall consist of metering the electricity generated by the renewable technology.

The project will proceed with the necessary measures for the power control and monitoring. Information about power generation and energy supplied to the grid are controlled by the Chamber of Electric Energy Commercialization CCEE (from the Portuguese *Câmara de Comercialização de Energia Elétrica*). CCEE regulates the electricity energy commercialization and is responsible for monitoring, on a monthly basis, the energy delivered to the grid. Additionally the National Electric System Operator (*from the Portuguese Operador Nacional do Sistema Elétrico* - ONS) established the procedures to measure and report the electricity generation by all the plants interconnected to the national grid[14].

Two energy meters are going to be installed at SHPP Piedade, one will work as the principal meter and the other will function as a back-up, in accordance to what ONS establishes. These kind of meters have been successfully applied to similar projects in Brazil and around the world and have by legal requirements extremely low level of uncertainty (0.2 ANSI's accuracy class).

The SHP is responsible for the project management, as well as for organising and training of the staff in the appropriate monitoring, measurement and reporting techniques according to the determinations of the equipments suppliers. The energy distribution company will be defined before the SHP becomes operational.

Annex 5

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[14] For more details please refer to the document *Procedimento de Rede ONS – Módulo 12* available at http://www.ons.org.br/procedimentos/modulo_12.aspx

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