CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Atiaia Energia S/A – Buriti and Canoa Quebrada Small Hydropower Plants. Hereafter referred as "Project".

Version: 01.

Date (DD/MM/YYYY): 06/01/2006.

A.2. Description of the project activity:

The project activity consists of 58 MW installed capacity divided into two small hydropower plants (SHP): SHP Buriti 30 MW and SHP Canoa Quebrada 28 MW. Both are in the Midwest region of Brazil and are connected to the interconnected grid South-Southeast-Midwest.

Atiaia Energia S/A is a holding company that controls two project companies, corresponding to the two facilities, with the following structure:

1) SHP Buriti: is controlled by Pouso Alto Energia S/A, owned 100% by Atiaia Energia S/A.
2) SHP Canoa Quebrada: is controlled by Amper Energia Ltda, owned 100% by Atiaia Energia S.A.

Atiaia Energia S/A have the following structure:
- 75% is owned by ICAL Energia, where 100% is owned by Grupo Cornélio Brennand;
- 10% is owned by Koblitz S/A;
- 15% is owned by 03 members of Cornélio Brennand family.

Koblitz S/A is a 100% Brazilian EPC contractor operating since 1975 in the area of energy systems, with solid know-how in industrial generation and cogeneration. With a portfolio of over 200 projects using from residual fuel oil, natural gas, coke oven gas to renewable energy sources (mainly agricultural residues as sugarcane bagasse, wood chips, rice straw, cashew nuts husks and others), the company experience totalizes over 450 machines and around 1,200 MW installed power.

Cornélio Brennand Group was founded with the division of Brennand Group, existing since 1917. Cornélio Brennand Group has activities in different sectors: properties, small hydro facilities, packaging and glass utilities areas. The main operating company is CIV – *Companhia Industrial de Vidros* created since 1958 with installed capacity of 800 ton of glasses per day.

<u>Project's contribution to sustainable development</u>

The primary objective of the project activity 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 1992. 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].

The privatization process initiated in 1995 arrived with an expectation of adequate tariffs (less subsidies) and better prices for generators. It drew the attention of investors to possible alternatives not available in the centrally planned electricity market. Unfortunately the Brazilian energy market lacked a consistent expansion plan, with the biggest problems being political and regulatory uncertainties. At the end of the 1990's a strong increase in demand in contrast with a less-than-average increase in installed capacity caused the supply crisis/rationing from 2001/2002. One of the solutions the government provided was flexible legislation favouring smaller independent energy producers. Furthermore the possible eligibility under the Clean Development Mechanism of the Kyoto Protocol drew the attention of investors to small hydropower projects.

This indigenous and cleaner source of electricity has also 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 generated (and emitted) in its absence.

At the same time, the Project contributes to the regional economic development. Small hydropower run-of-river plants provide local distributed generation, in contrast with the business as usual large hydropower and natural gas fired plants built in the last 5 years, these small hydropower projects provide site specific reliability, transmission and distribution benefits including:

- increased reliability, 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.

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 Project is located is obtained from less

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."

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. This money would stay in the region and be used for providing the population better services which would improve the availability of basic needs. A greater income comes from the local investment on the local economy, and a greater tax payment, which will benefit the local population.

The law nº 10,438, enacted in April 2002, created the Proinfa - *Programa de Incentivo às Fontes Alternativas de Energia Elétrica* (Program of Incentives to Alternative Energy Sources). Among others, one of this initiative's goals is to increase the renewable energy sources share in the Brazilian electricity market, thus contributing to a greater environmental sustainability. In order to achieve such goals, the Brazilian government has designated the federal state-owned power utility Eletrobras - *Centrais Elétricas Brasileiras S/A* to act as the primary offtaker of electric energy generated by alternative energy facilities in Brazil, by entering into long-term PPAs (Power Purchase Agreements) with alternative energy producers, at a guaranteed price of at least 80% of the average energy supply tariff charged to ultimate consumers. Buriti and Canoa Quebrada applied for Proinfa and were elected.

The creation of Proinfa indicates that, without specific support, the renewable sources and the small projects would hardly be implemented otherwise. The Project can be seen as an example of a solution by the private sector to the Brazilian electricity crisis of 2001, contributing to the sustainable development of the country.

A.3. Project participants:

<table>
<tr><th>Name of Party involved (*) ((host) indicates a host Party)</th><th>Private and/or public entity(ies) Project participants (*) (as applicable)</th><th>Kindly indicate if the Party involved whishes to be considered as project participant (Yes/No)</th></tr>
<tr><td rowspan="2">Brazil (host)</td><td>Atiaia Energia S/A (private entity)</td><td rowspan="2">No</td></tr>
<tr><td>Ecoinvest Carbon (private entity)</td></tr>
<tr><td>The Netherlands</td><td>The Netherlands represented by its Ministry of Housing, Spatial Planning and the Environment acting through the International Finance Corporation, in its individual capacity and as a Trustee of the IFC-Netherlands Carbon Facility (INCaF) (Public)</td><td>No</td></tr>
<tr><td colspan="3">(*) 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.</td></tr>
</table>

Note:
- SHP Buriti is controlled by Pouso Alto Energia S/A, owned 100% by Atiaia Energia S/A.
- SHP Canoa Quebrada is controlled by Amper Energia Ltda, owned 100% by Atiaia Energia S/A.

A.4. Technical description of the project activity:

By legal definition of the Brazilian power regulatory agency (ANEEL – *Agência Nacional de Energia Elétrica*), Resolution n° 652, issued on December 9th, 2003, to be considered small hydro, the utility must have installed capacity greater than 1 MW, but not more than 30 MW, and have a reservoir area less than 3 km², which is the case of Buriti, or, if the area is between 3 km² and 13 km², which is the case of Canoa Quebrada, it should have a minimum environmental impact. According to ANEEL resolutions, both plants are considered small hydropower plants.

Run-of-river projects are defined as “the projects where the river’s dry season flow rate is the same or higher than the minimum required for the turbines” (Eletrobrás, 1999). Run-of-river schemes do not include significant water storage, and must therefore make complete use of the water flow. A typical run-of-river scheme involves a low-level diversion dam and is usually located on swift flowing streams (Figure 1). A low level diversion dam raises the water level of the river sufficiently to enable an intake structure to be located on the side of the river. The intake consists of a trash screen and a submerged opening with an intake gate. Water from the intake is normally taken through a pipe (called a penstock) downhill to a power station constructed downstream of the intake and at as low a level as possible to gain the maximum head on the turbine.

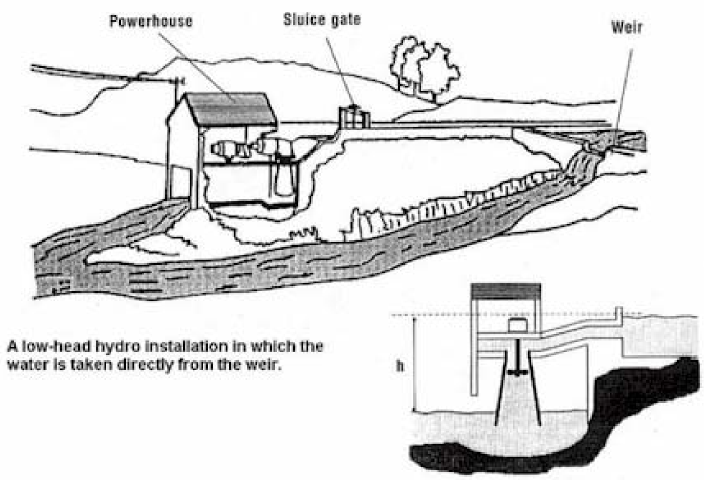

Figure 1 – Schematic view of a run-of-river power plan

Small hydro is considered to be one of the most cost effective power plants in Brazil, given it is possible to generate distributed power and to supply small urban areas, rural regions and remote areas of the country. Generally, it consists of a run-of-the-river hydro plant, which results on a minimum environmental impact.

Buriti and Canoa Quebrada facilities are run-of-river plants and have minimum diversion dams, which store water to generate electricity for short periods of time.

SHP Buriti

The turbine system possesses 2 units of 15.46 MW each, and the generator 15 MVA at 13.8 kV.

The main design characteristics of the Buriti project are shown in Table 1 below:

Buriti	
Power	30 MW
Capacity Factor	92%
Efficiency	89.7%
Waterfall	31.9 meters
Reservoir	0.38 km²

Table 1: Buriti main technical characteristics

SHP Canoa Quebrada

The turbine system possesses 2 units of 14.43 MW each, and the generator 14 MVA at 13.8 kV.

The main design characteristics of the Canoa Quebrada project are shown in Table 2 below:

Canoa Quebrada	
Power	28 MW
Capacity Factor	86%
Efficiency	90%
Waterfall	25.2 meters
Reservoir	10.5 km²

Table 2: Canoa Quebrada main technical characteristics

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil.

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

SHP Buriti - State of Mato Grosso do Sul (MS), Midwest of Brazil.
SHP Canoa Quebrada - State of Mato Grosso (MT), Midwest of Brazil.

A.4.1.3. City/Town/Community etc:

SHP Buriti - Towns of Chapadão do Sul and Água Clara.
SHP Canoa Quebrada – Towns of Lucas de Rio Verde and Sorriso.

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

SHP Buriti is located between Chapadão do Sul and Água Clara, state of Mato Grosso do Sul (MS), Midwest of Brazil (Figure 2). River Sucuriú.

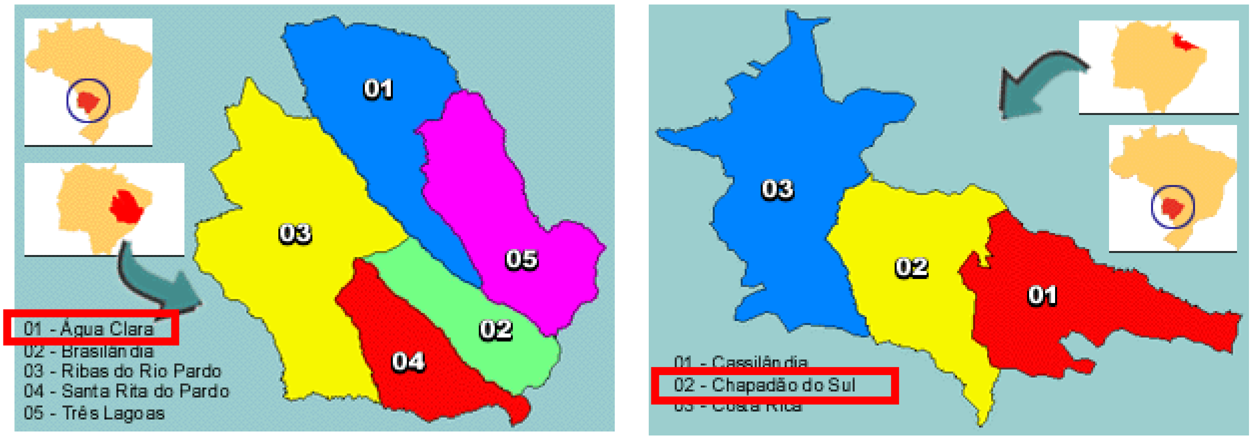

Figure 2: Location of Buriti SHP
Source: www.citybrazil.com.br

SHP Canoa Quebrada is located in Lucas de Rio Verde and Sorriso, state of Mato Grosso (MT), Midwest of Brazil (Figure 3). River Verde.

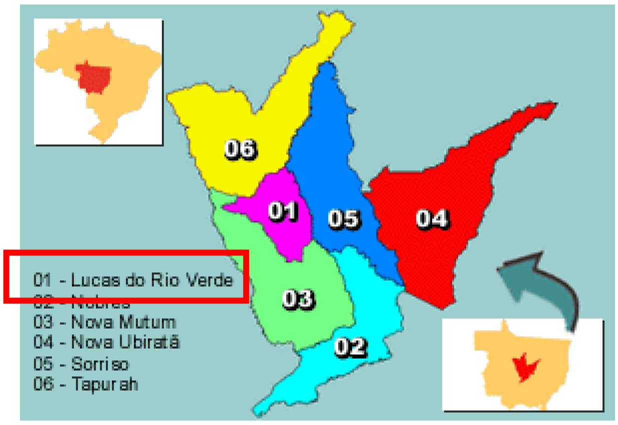

Figure 3: Location of SHP Canoa Quebrada
Source: www.citybrazil.com.br

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

Renewable electricity generation for a grid (run-of-river hydro power plants).

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

The technology employed is an established one. For very low heads and high flow rates a different type of turbine, the Kaplan or Propeller turbine is usually employed. In the Kaplan turbine the water flows through the propeller and sets the latter in rotation. In this turbine the area through the water flows is as big as it can be – the entire area swept by the blades. For this reason Kaplan turbines are suitable for very large volume flows and they have become usual where the head is only a few meters. The water enters the turbine laterally, is deflected by the guide vanes, and flows axially through the propeller. For this reason, these machines are referred to as axial-flow turbines. They have the advantage over radial-flow turbines that it is technically simpler to vary the angle of the blades when the power demand changes what improves the efficiency of power production.

The flow rate of the water through the turbine can be controlled by varying the distance between the guide vanes; the pitch of the propeller blades must then also be appropriately adjusted. Each setting of the guide vanes corresponds to one particular setting of the propeller blades in order to obtain high efficiency. Important feature is that the blade speed is greater than the water speed – as much as twice as fast. This allows a rapid rate of rotation even with relatively low water speeds.

Kaplan turbines come in a variety of designs. Their application is limited to heads from 1 m to about 30 m. Under such conditions, a relatively larger flow as compared to high head turbines is required for a given output. These turbines therefore are comparatively larger.

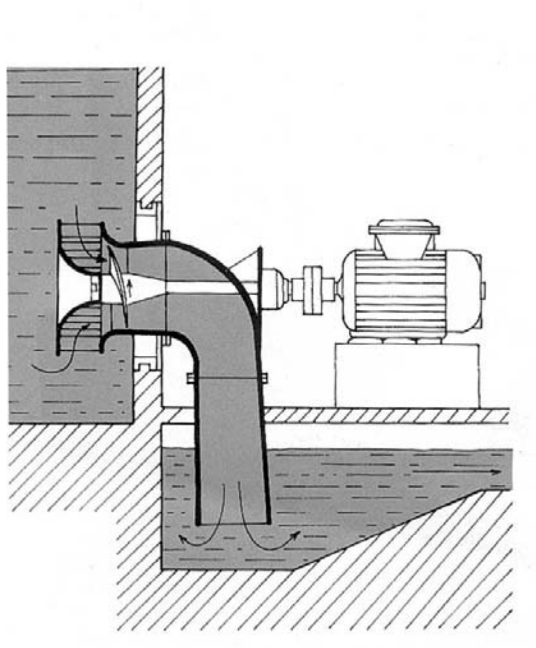

Figure 4 – Kaplan turbine
(Sources: Alstom, http://www.alstom.com.br/)

Hydraulic turbines:

- Buriti - ALSTOM Kaplan “S” type turbine, horizontal axis, 15.46 MW (2 units).
- Canoa Quebrada - ALSTOM Kaplan “S” type turbine, horizontal axis 9.62 MW (3 units).

Generators:

- Buriti - Synchronous Generators 15 MVA, 13.8 kV, 60 Hz (2 units). Supplier: Gevisa.
- Canoa Quebrada - Synchronous 9.3333 MVA, 13.8 kV, 60 Hz (3 units). Supplier: Gevisa.

The equipment and service suppliers have a long experience on the small-hydro market, performed by Alstom Power Brasil and Gevisa. The civil work construction companies are also experienced on the hydroelectric market and supervised by MEK Engenharia e Consultoria Ltda., which has a long experience in the construction of hydropower plants.

Atiaia Energia uses the support and technological expertise of Koblitz, a Brazilian EPC contractor operating since 1975 in the area of energy systems, with solid know-how in industrial generation and cogeneration.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

The Project, a greenhouse gas (GHG) free power generation project, will result in GHG emissions reductions as the result of the displacement of generation from fossil-fuel thermal plants that would have otherwise been delivered to the interconnected grid.

As Kartha et al. (2002) stated, "the crux of the baseline challenge for electricity projects clearly resides in determining the 'avoided generation', or what would have happened without the CDM or other GHG-mitigation project. The fundamental question is whether the avoided generation is on the 'build margin' (i.e. replacing a facility that would have otherwise been built) and/or 'operating margin' (i.e. affecting the operation of current and/or future power plants)".

The baseline emission factor is calculated as a combined margin, consisting of the combination of operating margin and build margin 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 one which is connected by transmission lines to the project electricity system and in which power plants can dispatch without significant transmission constraints.

The approved consolidated baseline methodology ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", applies to electricity capacity additions from run-of-river hydro power plants, which is the proposed project activity. The baseline scenario considers the electricity which would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

Reduction in CO_2 emissions by the projects activity two small hydro power plants is the result of the displacement of generation from fossil-fuel thermal plants that would have otherwise delivered to the interconnected grid.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Considering the baseline of 0.2677 tonCO_2e/MWh, applicable to grid-connected renewable power generation project activities in Brazil, the full implementation of the small hydropower plants connected to the Brazilian interconnected power grid will generate the estimated annual reduction as in Table 3 below.

Years	Annual estimation of emission reductions in tCO_2e
2007	121,192
2008	121,192
2009	121,192
2010	121,192
2011	121,192
2012	121,192
Total estimated reduction (tCO_2e)	727,152
Total number of crediting years	7
Annual average over the crediting period of estimated reduction (tCO_2e)	121,192

Table 3: Project Emission Reduction Estimation

For more details, please refer to section E.6 below.

A.4.5. Public funding of the project activity:

There is no public funding involved in the project activity.

Buriti and Canoa Quebrada are being financed by the Brazilian Development Bank, BNDES - *Banco Nacional de Desenvolvimento Econômico e Social*, which is a federal owned company subordinated to the Ministry of Development, Industry and Foreign Trade, MDIC- *Ministério do Desenvolvimento, Indústria e Comércio Exterior*.

SECTION B. Application of a baseline methodology

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

ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

The Atiaia small hydropower plants will displace fossil fuel from the Brazilian interconnected grid.

The methodology is applicable to grid-connected renewable power generation project activities, under the condition of electricity capacity additions from run-of-river hydro power plants, as it is the case of Buriti and Canoa Quebrada SHPs.

An extensive discussion of the baseline for electricity generation for the Brazilian interconnected grid can be seen in *Esparta & Martins Jr. (2001)*[2]. Its baseline for large scale projects is 0.2677 tonCO_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.

Brazil's large territorial extension and its vast hydro potential have been so far decisive in the definition of the country's current electricity generation industry, which is predominantly hydro-based. But the future scenario shows an increase in the consumption of fossil fuels, mainly natural gas, in accordance with the intention of the government to diversify the Brazilian's energy supply.

B.2. Description of how the methodology is applied in the context of the project activity:

The project activity is a group of small hydro projects interconnected to the electricity grid. The project fulfils all the "additionality" requisites (see application of the "additionality tool"[3] below), which demonstrate that the project would not occur in the absence of the CDM.

In a period of restructuring the entire electricity market (generation, transmission and distribution), as it is the Brazilian situation, investment uncertainty is the main barrier for small/medium renewable energy power projects. In this scenario, new projects compete with existing plants (operating margin) and with new plants (build margin), which usually attract the attention of the financial market. Operating and build margins have been used to calculate the emission factor for the connected grid.

The methodology ACM0002, 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 South-Southeast-Midwest subsystem of 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).

B.3. 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:

The proposed baseline methodology includes an Additionality Tool approved by the Executive Board. This tool considers some important steps necessary to determine whether the project activity is additional and it is also important to demonstrate how the emission reductions would not occur in the absence of Atiaia small hydro project activity. The tool refers to the project activity described above.

Following are the steps necessary for the demonstration and assessment of Atiaia small hydro project additionality.

[2] 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.

[3] Tool for the demonstration and assessment of additionality. UNFCCC, CDM Executive Board 16th Meeting Report, 22 October 2004, Annex 1. Web-site: http://cdm.unfccc.int/

Step 0. Preliminary screening based on the starting date of the project activity

Not applicable.

SATISFIED/PASS – Proceed to Step 1

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 alternative to the project activity is the continuation of the current (previous) situation of electricity supplied by large hydro and thermal power stations. As an alternative for the group company, there is the investment in other opportunities, like the financial market. Given Cornélio Brennand is a holding company, it could as well have decided to focus on the other company traditional areas of the group (e.g., glass industry, real estate, etc.), and not on the power market, as it is the case with the project activity.

Sub-step 1b. Enforcement of applicable laws and regulations:

2. Not applicable.
3. Not applicable.
4. Not applicable. Both the project activity and the alternative scenario are in compliance with all regulations.

SATISFIED/PASS – Proceed to Step 2

Step 2. Investment analysis

Not applicable.

SATISFIED/PASS – Proceed to Step 3

Step 3. Barrier analysis

The considered barriers are the following:

- Lack of investment sources to finance the private sector in the country, and the high costs of the available alternatives;
- Energy sector regulation impact, the creation of Proinfa indicates that, without specific supports, the renewable sources and the small projects would not be implemented otherwise.

To substantiate 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 of international interest rates and the lack of investment capacity of the government, it 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.

Three governmental entities were created: the Electricity Regulatory Agency (ANEEL), to 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, five years after privatization began, the results were modest (Figure 5). Despite high expectations, investments in new generation did not follow the increase in consumption.

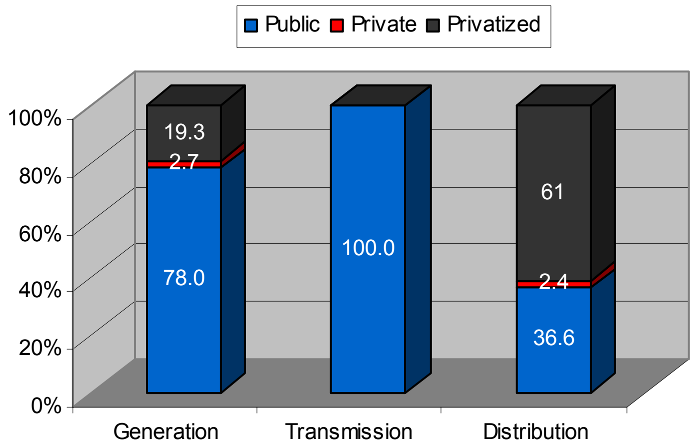

Figure 5 - Participation of private capital in the Brazilian electricity market in December 2000 (Source: BNDES, 2000)

The decoupling of GDP (average of 2% increase in the period of 1980 to 2000) from electricity consumption (average of 5% increase in the same period) is well known in developing countries, mainly due to the expansion of supply services to new areas and the growing infrastructure. The necessary measures to prevent bottlenecks in services were taken. These include an increase of generation capacity higher than GDP growth rates 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 6.

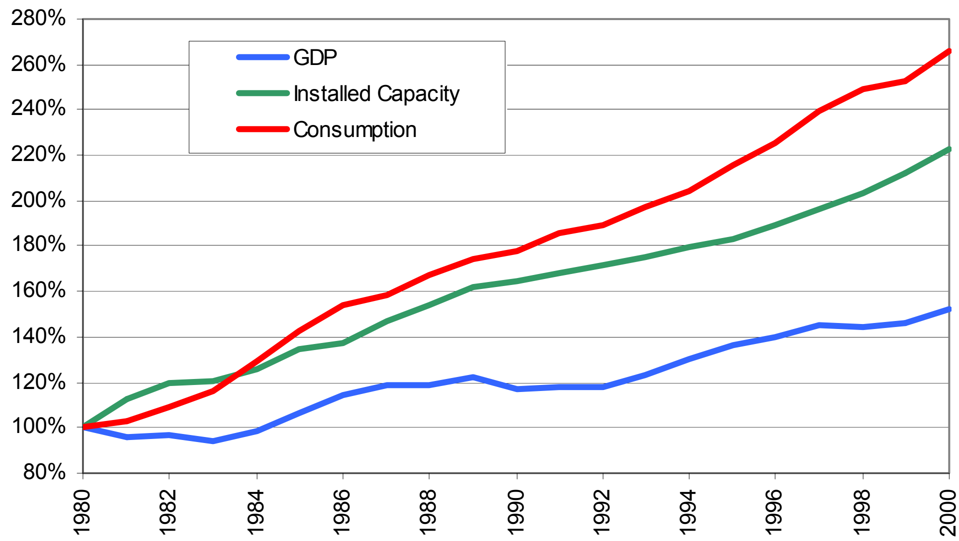

Figure 6 - Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption). (Source: Eletrobrás, http://www.eletrobras.gov.br; IBGE, http://www.ibge.gov.br/)

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 older plants, was the most widely used, as can be seen in Figure 7. 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 the water accumulated in the reservoirs. Figure 8 shows what happened to the levels of "stored energy" in 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 the historical average rain. 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 still no long-term solution for the problems that finally caused shortage and rationing in 2001.

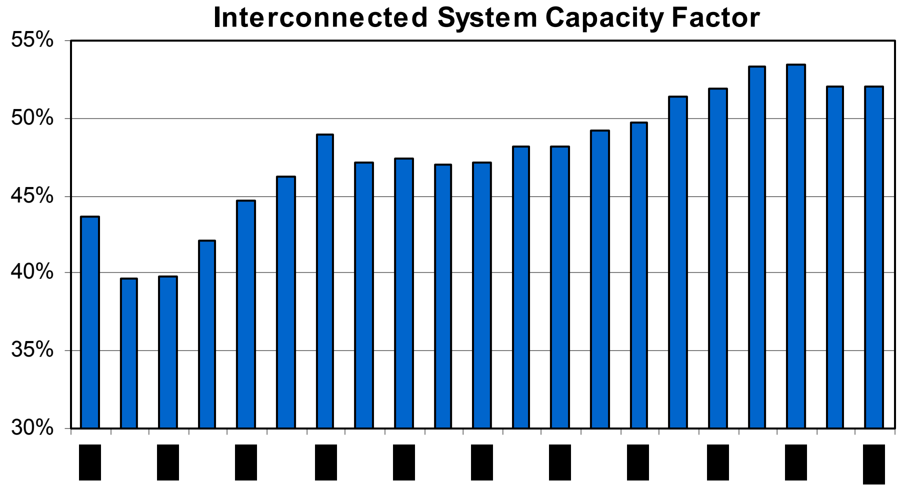

Figure 7 - Evolution of the rate of generated energy to installed capacity (Source: Eletrobrás, http://www.eletrobras.gov.br/)

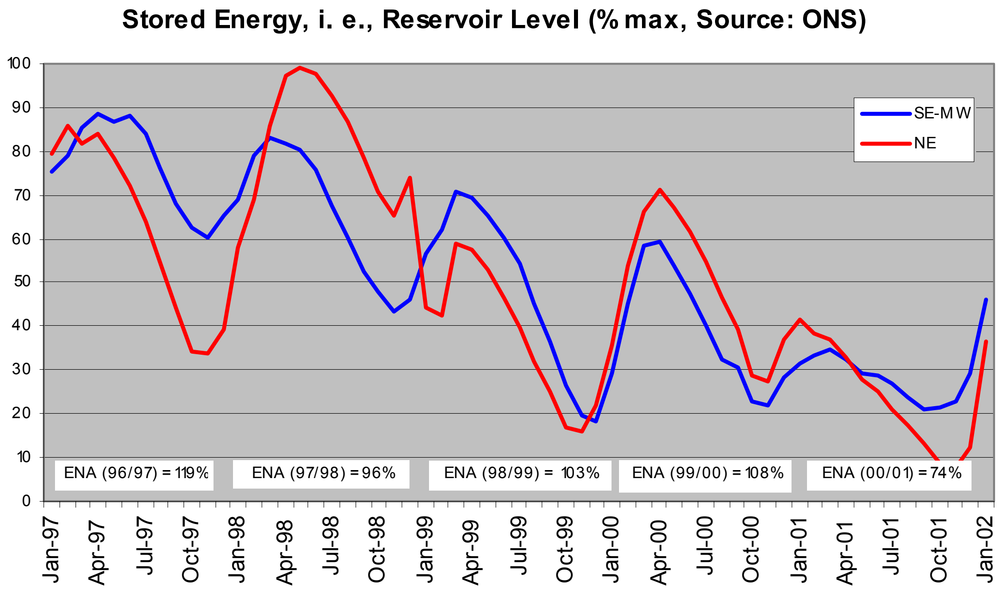

Figure 8 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS, http://www.ons.org.br/)

Aware of the difficulties since the end of the 1990's, the Brazilian government signaled that it was strategically important for the country to increase thermoelectric generation and consequently be less dependent on hydropower. With that in mind, the federal government launched at 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, to be completed by December 2003. During 2001 and the beginning of 2002 the plan was reduced to 40 plants and 13,637 MW were to be installed by December 2004 (Federal Law 10,438 of April 26th, 2002, Article 29). As of December 2004, only 20 plants totalizing around 9,700 MW were 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 the 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 to be 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 electric power sector are shifting from hydroelectricity to natural gas plants (Schaeffer et al., 2000). With discoveries of vast reserves of natural gas in the Santos Basin in 2003 (Figure 9) the policy of using natural gas to generate electricity remains a possibility and will continue to have interest from private-sector investments in the Brazilian energy sector (see also step 4).

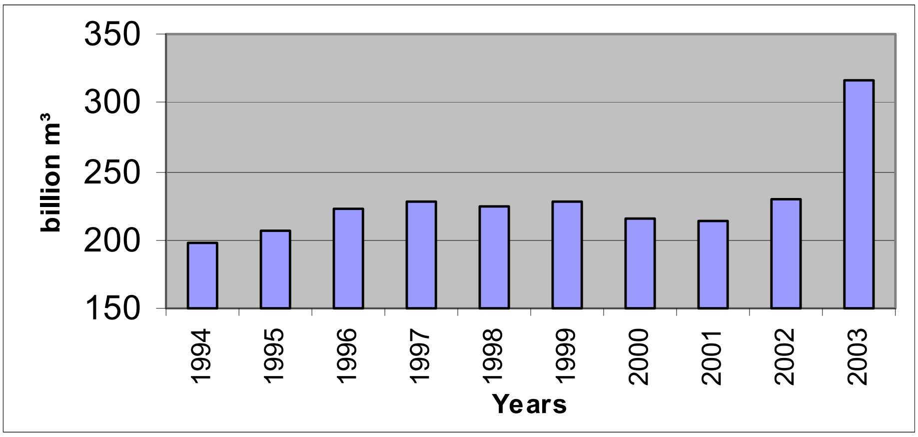

Figure 9 – Evolution of the Brazilian natural gas proved reserves (Source: Petrobras, http://www.petrobras.com.br/)

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% 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 Planejamento Energético*, 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, Power Monitoring 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 matter. 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 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% 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.

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity

Investment Barrier

In order to analyze accurately the investment environment in Brazil, the Brazilian Prime Rate, known, as SELIC rate, as well as the CDI – Interbank Deposit Certificate, which is the measure of value in the short-term credit market, need to be taken into account. Real interest rates have been extraordinarily high since the Real plan stabilized inflation in 1994.

As a consequence of the long period of inflation, the Brazilian currency experienced a strong devaluation, effectively precluding commercial banks from providing any long-term debt operation. The lack of a long-term debt market has caused a severe negative impact on the financing of energy projects in Brazil.

Interest rates for local currency financing are significantly higher than for US Dollar financing. The National Development Bank, BNDES, is the only supplier of long-term loans. Debt funding operations from BNDES are made primarily through commercial banks. As the credit market is dominated by shorter maturities (90-days to 01-year) there are rare long-term credit lines being made available except for the strongest corporate borrowers and for special government initiatives. Credit is restricted to the short-term in Brazil or the long-term in dollars offshore.

Financial domestic markets with a maturity of greater than a year are practically non-existent in Brazil. Experience has shown that in moments of financial stress the duration of savings instruments have contracted to levels close to one day with a massive concentration in overnight banking deposits. Savers do not hold long-term financial contracts due to the inability to price-in the uncertainty involved in the preservation of purchasing power value (Arida et al., 2004). Also, the capital market is not well develop in the country to provide stock market public funding.

The lack of a local long-term market results not from a disinterest of financial investment opportunities, but from the reluctance of creditors and savers to lengthen the horizon of their placements. It has made savers look for the most liquid investment and place their money in short-term government bonds instead of investing in long-term opportunities that could finance infrastructure projects.

The most liquid government bond is the LFT (floating rate bonds based on the daily Central Bank reference rate). As of January 2004, 51.1% of the domestic federal debt was in LFTs and had duration of one day. This bond rate is almost the same as the CDI - Interbank Deposit Certificate rate that is influenced by the SELIC rate, defined by COPOM[4].

The SELIC Rate has been oscillating since 1996 from a minimum of 15% p.a. in January 2001 to a maximum of 45% p.a. in March 1999 (Figure 10).

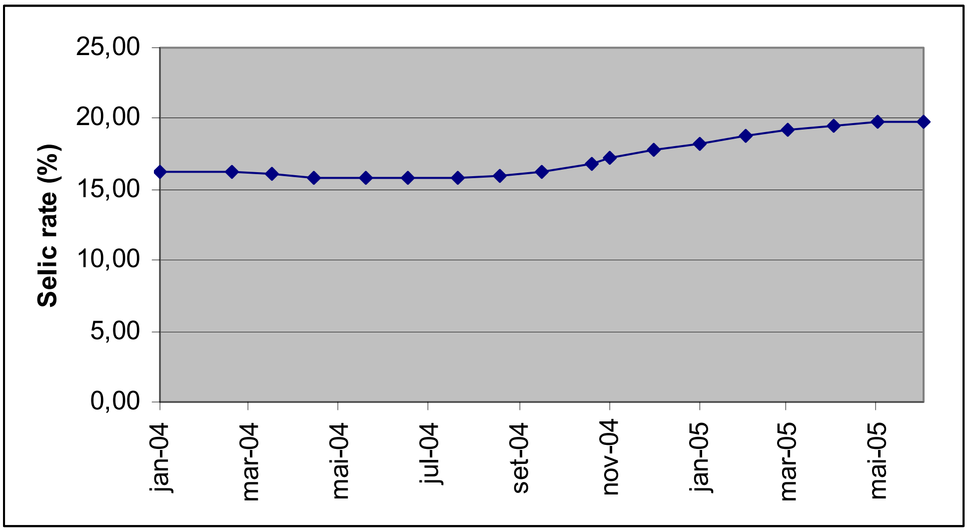

Figure 10 – SELIC rate (Source: *Banco Central do Brasil*)

[4] COPOM – *Comitê de Politica Monetária* (Monetary Policy Committee).

The proposed small hydro project activity (consisting of the two plants) is under development on a project finance basis. To finance construction, project sponsor (Atiaia) took advantage of the financing lines of BNDES. This financial support covers, on average, 67% of the project costs with a TJLP[5] (BNDES Long Term Interest Rate) rate of 9.75% plus a 3.5% spread risk for a term of 8 years and 2 years grace period, on average for the two projects.

This investment analysis takes a look at the factors relating to potential certified emission reductions (CERs) and the incentives derived from them in the project investment decision taking process. Thus, in taking the decision to undertake the project, the investment profitability studies considered the potential monetization of CO2 credits that the project would produce.

The projects were set up with an expected financial IRR (Internal Rate of Return) on average (for the two projects) of approximately 19.55 % per year, without the benefit of the CER revenues. This average project IRR is very close to the SELIC rate, set on the 19.50% level as of April 2005 (when Canoa Quebrada started construction), although the project is a much riskier investment as compared to Brazilian government bonds. The inclusion of the revenues from CERs makes the project's IRR increase by approximately 88 basis points from 19.55% to 20.43%. Such increase in return would partially compensate for the additional risk the investor would take with this project.

In addition, the increase of 88 basis points, the CER revenues would bring the project additional benefits due to the fact that they are generated in hard currencies (US Dollar or EURO). That revenue allows Atiaia to hedge its debt cash flow against currency devaluation. Moreover, the CER Free Cash Flow, in US dollars or euro, could be discounted at an applicable discount interest rate, thus increasing the project leverage.

The Table 4 below shows the CER revenues attractiveness of the projects, based on the project IRR.

Plant	IRR with CER	IRR without CER
Buriti	20.59%	19.77%
Canoa Quebrada	20.27%	19.33%
Average	20.43%	19.55%

Table 4: Project Financial Analysis

It is important to notice that the direct comparison between the SELIC rate and the IRR is not accurate and the idea is not to introduce a benchmark analysis, but to set a parameter as a reference. Given a small hydro power project is a much riskier investment than a government bond, it is necessary to have a much higher financial return, compared to the SELIC reference rate. Given the circumstances, rationale and distortions of the Brazilian economy, it is not straightforward to define the meaning of this difference of rates, and a developer might feel more comfortable than others, depending on the situation.

The high level of guarantees required to finance an energy project in Brazil is a barrier for developing new projects. Insurance, financial guarantees, financial advisories are requirements which increase the cost of the project and are barriers to the project's financeability.

[5] TJLP is the BNDES long term and reference interest rate for the Bank financing.

Other financial barriers are related to the power purchase agreement (PPA). The PPA is required in order to obtain long-term financing from a bank and the lack of adequate commercial agreements from the energy buyers may influence directly the negotiation between the bank and the project developer. Most of the utilities in Brazil do not have a satisfactory credit risk, thus representing a barrier to obtain long-term funding.

Given the various programs and incentives which were considered along the last years, but never successfully implemented, it is easy to notice the difficulty and barriers to implement small hydro projects in the country. The first one was called PCH-COM structured by the end 2000/beginning 2001. In February/2001 the tariff was planned to be R$ 67.00/MWh, which was the reference price of the so-called "competitive power source", or the average regular power generation addition cost, but the reference market price for the SHP source at that time was around R$ 80.00/MWh. Despite of the lower tariff, the incentive relied on the PPA guarantee and the special financing source. The program was not successful because of the guarantees needed and the clauses of the contract. E.g.., the project was not considered as a project finance basis and the lender demanded for direct guarantees from the developer (other than the project itself).

In April 2002, the Proinfa law was issued to incentive the sector. The existence of Proinfa is a proof that a sound incentive is necessary to promote the construction of small hydro projects in Brazil. Another proof that barriers are huge: most of the selected and contracted projects by Proinfa are not under construction yet, and some are supposed never to be constructed. The analysis of Proinfa and of other power sector incentives illustrates the hurdles that the developers who are not participating in any program have to face. During the Proinfa first Public Hearing in beginning 2003, the SHP tariff was planned to be of R$ 125.09/MWh (base June 2003, and to be escalated by the inflation index IGP-M). But on March 30th, 2004, the Ministry of Mines and Energy (MME) issued the Portaria n° 45, which set the tariff at R$ 117.02/MWh (base March 2004, and escalated by IGP-M), in January 2005 it was around R$ 129.51/MWh. In 2005, BNDES presented the last final version of its financing incentive line to Proinfa, which is different from the one first considered for the program, that was considered insufficient. It means that for the last 5 years, the government had to present a new proposition (or incentive) per year, in order to convince the developers to invest in the small hydro sector.

Due to all the difficulties exposed, and in spite of all government incentives, there are 213 approved SHP projects in Brazil[6], between 1998 and 2005, which have not started construction yet. And only 1.3% of the power generated in the country comes from SHPs. The conclusion is that CDM incentives play a very important role in overcoming the above mentioned financial barriers.

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. The project sponsor had to develop these facilities before the implementation of the projects. In addition, there were no qualified personnel available in the regions due to the lack of schools and universities.

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

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6 Source: ANEEL - *Agência Nacional de Energia Elétrica* (Brazilian power regulatory agency).

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 BR$ 600/MWh (around USD 200/MWh) and the forecasted marginal price of the new energy reached levels of BR$ 120 – 150/MWh (around USD 40). In the middle of 2004, the average price was bellow BR$ 50/MWh (less than USD 20/MWh). This relatively high volatility of the electricity price in Brazil, although in the short term, contributes to difficult the analysis of the market by the developers.

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives:

As described above, the main alternative to the project activity is to continue the status quo. The project sponsor could invest their resources in different financial market investments. Therefore, the barriers above do not affect the investments in other opportunities. On the contrary: Brazilian interest rates, which represent a barrier for the project activity, are very attractive and a viable investment alternative.

SATISFIED/PASS – Proceed to Step 4

Step 4. Common practice analysis
Sub-step 4a. Analyze other activities similar to the proposed project activity:
Sub-step 4b. Discuss any similar options that are occurring:

One of the points to be considered when analyzing a small hydro project investment in the period (2001-2005) was 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. The project activity is participating in the Program.

Both processes of negotiating a PPA with utility companies and obtaining funding from BNDES are always 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 utilities usually do not have incentives or motivation to buy electricity generated by small hydro projects.

Most of the developers which 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 those not are participating in the CDM. Additionally, the Brazilian government has stated that the projects under the Proinfa Program will also be eligible to participate in the CDM. The legislation which created Proinfa took into account possible revenues from the CDM in order to proceed with the program.

The power sector suffered with more than one year (2003-2004) without regulation, and even today the legislation is not clear yet for all the investors and players. The prevailing business practice in Brazil, as far as obtaining financing and financial guarantees to the projects, is a barrier to investment in renewable energy projects. The access of long-term funding for renewable energy projects is difficult, mainly because of the guarantees needed and the lack of a real project finance structure. The high cost of capital in Brazil is a barrier for projects to be developed.

As an example, a quick analysis over the installation of small hydro power plants in Brazil since 2001, shows that the incentives for this source were inexistent, or rather, not effective, indicating a market/financial barrier[7]:

Installation of SHP

Year	MW
2001	69.07
2002	51.46
2003	267.68
2004	67.79
2005 (until March)	25.20

Because of the reasons mentioned above, only 1.3% of Brazil's installed capacity comes from small hydro sources (1.2 GW out of a total of 88.7 GW). Also, from the 6,934 MW under construction in the country, only 403 MW are small hydro. In 2004, only 9 small-hydro projects, a total of just 5.22 MW, were authorized by the regulatory agency[8]. 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 SHPs)[9].

These numbers show that incentives for the construction of thermal power plants have been more effective than those for SHPs. The use of natural gas has been increasing in Brazil since the construction of GASBOL (the Brazil-Bolivia pipeline). Besides, the obtaintion of the licenses required by the Brazilian environmental regulation take much longer for hydropower plants (years) than for thermal (two months)

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 SHPs (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[10].

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.

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

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

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

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

SATISFIED/PASS – Proceed to Step 5

Step 5 – Impact of CDM registration

According to Brazilian legislation[11] small hydro power plants must have installed capacity greater than 1 MW but not more than 30 MW and with reservoir area less than 3 km². Generally, it consists of a run-of-the-river hydro plant, with minimum environmental impact.

This project activity is not the business-as-usual scenario in the country where large hydro and natural gas fired thermal power projects represent the majority of new installed capacity. With the financial benefit derived from the CERs, it is anticipated that other project developers would benefit from this new source of revenue and then would decide to develop such projects. An increase of approximately 100 basis points, derived from CERs, is an important factor for the implementation of the project.

CDM has made it possible for some investors to set up their small hydro plants and sell their electricity to the grid. The registration of the proposed project activity will have a strong impact in paving the way for similar projects to be implemented in Brazil.

SATISFIED/PASS – Project is ADDITIONAL

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

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

Brazil is a large country and 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 three 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.

[11] As defined by ANEEL Resolution no. 652, December 9th, 2003.

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.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity(ies) determining the baseline:

Date of completing the final draft of this baseline section (DD/MM/YYYY): 21/12/2005.

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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:

May 2005.

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

35y-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:

January 2007.

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. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

ACM0002 "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources".

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

This monitoring methodology shall be used in conjunction with the approved baseline methodology ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources, and applies to electricity capacity additions from run-of-river hydro power plants.

The methodology is applicable to the project activity. It consists in using meter equipment projected to registry and verify 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.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

Based on the hydropower technology, the project emissions (PE_y) are zero, therefore table D.2.1.1 below is empty.

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Based on the hydropower technology, the project emissions (PE_y) are zero, therefore no formula for calculation of direct emissions are necessary.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

1. *EF_y*	*CO_2 emission factor of the grid*	*Calculated*	*tCO_2/MWh*	*C*	*At the validation*	*n.a.*	*Electronic and Paper*	*Data will be archived during the credit period according to internal procedures.*
2. *$EF_{OM,y}$*	*CO_2 Operating Margin emission factor of the grid*	*Data provided by ONS (National dispatch center). Calculated according the approved methodology – ACM0002*	*tCO_2/MWh*	*C*	*At the validation*	*n.a.*	*Electronic and Paper*	*Data will be archived during the credit period according to internal procedures.*
3. *$Ef_{BM,y}$*	*CO_2 Build Margin emission factor of the grid*	*Data provided by ONS. Calculated according the approved methodology – ACM0002*	*tCO_2/MWh*	*C*	*At the validation*	*n.a.*	*Electronic and Paper*	*Data will be archived during the credit period according to internal procedures.*
4. *λ_y*	*Fraction of time during which low-cost/must-run sources are on the margin*	*Data provided by ONS. Calculated according the approved methodology – ACM0002*		*C*	*At the validation*	*n.a.*	*Electronic and Paper*	*Data will be archived during the credit period according to internal procedures.*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

According to the selected approved methodology (ACM0002, 2004), the baseline emission factor (*EF_y*) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly a connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

From ACM0002 (2002), a baseline emission factor (*EFy*) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to the following three steps:

- **STEP 1 -** Calculate the operating margin emission factor(s), based on one of the following methods
    - Simple operating margin
    - Simple adjusted operating margin
    - Dispatch data analysis operating margin
    - Average operating margin.

The second alternative, simple adjusted operating margin, will be used here.

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*):

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

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 2** – Calculate the build margin mission factor ($EF_{BM,y}$) as the generation weighted average emission factor (tCO_2e/MWh) of a sample of power plants m, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}} \qquad \textbf{Equation 2}$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (ACM0002, 2004) for plants m, based on the most recent information available on plants already built . The sample group m consists of either:

- The five power plants that have been built most recently, or
- The power plants 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 from these two options that sample group that comprises the larger annual generation.

- **STEP 3** – Calculate the baseline emission factor EF_y, as the weighted average of the operating margin factor ($EF_{OM,y}$) and the build margin factor ($EF_{BM,y}$):

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$ **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.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Option 2 is not applicable.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Option 2 is not applicable.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Indirect emissions can result from project construction, transportation of materials and fuel and other upstream activities. The project does not claim emission reductions from these activities. No significant net leakage from these activities was identified.

Project emissions in the form of methane can also result from the construction and operation of a water reservoir if biomass is permanently submerged in the process. The projects under the project activity are run-of-river hydropower plants, therefore only have minor reservoirs and no significant methane emissions from biomass decay.

Thus, no sources of emissions were identified, and therefore no data will be collected and archived. There are no entries in the table D.2.3.1.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Not applicable.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Based on the hydropower technology, the project emissions (PE_y) are zero, therefore no formula for calculation of direct emissions are necessary.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.2.1.3-1.	*Low*	*These data will be used for calculate the emission reductions.*
D.2.1.3-2.	*Low*	*Data does not need to be monitored*
D.2.1.3-3.	*Low*	*Data does not need to be monitored*
D.2.1.3-4.	*Low*	*Data does not need to be monitored*
D.2.1.3-5.	*Low*	*Data does not need to be monitored*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Electricity generation of the Project delivered to grid	*Energy metering connected to the grid and Receipt of Sales*	*MWh*	*M*	*15-minutes-measurement and Monthly recording*	*100%*	*Electronic and Paper*	*The electricity delivered to the grid is monitored by the Project as well as by the energy buyer.*

D.5 Name of person/entity determining the monitoring methodology:

Ecoinvest Carbon
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SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

Based on the hydropower technology, the project emissions (PE_y) are zero. Therefore, no calculation of estimate of GHG emissions is necessary.

E.2. Estimated leakage:

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.

Project emissions in the form of methane can also result from the construction and operation of a water reservoir if biomass is permanently submerged in the process. The projects under the project activity are run-of-river hydropower plants, therefore only have minor reservoirs and no significant methane emissions from biomass decay.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Given there are no entries for both E.1 and E.2, the sum in E.3 is zero.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

According to the selected approved methodology (ACM0002), 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.

Brazil's electric power system is geographically divided into 5 macro-regions: South (S), Southeast (SE), Midwest (CO, from the Portuguese *Centro-Oeste*), North (N) and Northeast (NE). Regarding the electricity system, two different electric systems supply the five macro-regions of the country. The largest interconnected power transmission system, which includes the Southeast, South, and Mid-West regions, accounts for more than 70% of the Brazilian total installed capacity. It includes the hydroelectric power plant of Itaipu, and the only two nuclear power plants currently in operation in Brazil: Angra I (657 MW), and Angra II (1,309 MW). The second interconnected grid system connects the north and northeast regions, accounting for almost 25% of the Brazilian total installed capacity. A smaller system includes small independent grids that are isolated in terms of electric power, largely in the northern region. These isolated systems accounted for less than 5% and are based mainly on thermal power plants (SIESE, 2002).

The plants will be integrated to the South-Southeast-Midwest interconnected electricity system.

From ACM0002, a baseline emission factor (*EFy*) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to the following three steps:

- **STEP 1** - Calculate the operating margin emission factor(s), based on one of the following methods:
  - Simple operating margin
  - Simple adjusted operating margin
  - Dispatch data analysis operating margin
  - Average operating margin.

Dispatch data analysis operating margin should be the first methodological choice. Since not enough data was supplied by the Brazilian national dispatch center, the choice is not currently available. The simple operating margin can only be used where low-cost/must-run resources[12] constitute less than 50% of total grid generation in: 1) average of 5 most recent years, or 2) based on long-term normals for hydroelectricity production. Table 5 shows the share of hydroelectricity in the total electricity production for the Brazilian S-SE-CO interconnected system. However the results show the non-applicability of the simple operating margin to the Project.

Year	Share of hydroelectricity (%)
1999	94.0
2000	90.1
2001	86.2
2002	90.0
2003	92.9

Table 5 – Share of hydroelectricity production in the Brazilian S-SE-CO interconnected system from 1999 to 2003 (ONS, 2004)

The fourth alternative, an average operating margin, is an oversimplification and, due to the high share of a low operating cost/must run resource (hydro), does not reflect at all the impact of the project activity in the operating margin. Therefore, the simple adjusted operating margin will be used here.

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*):

$$EF_{OM,simple-adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y}\cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum F_{i,k,y}\cdot COEF_{i,k}}{\sum_k GEN_{k,y}} \qquad \textbf{Equation 4}$$

[12] Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation (ACM0002, 2004).

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*).

The most recent numbers for the interconnected S-SE-CO system were obtained from the Brazilian national dispatch center, ONS - *Operador Nacional do Sistema Elétrico,* in the form of daily consolidated reports (ONS-ADO, 2004). Data from 120 power plants, comprising 63.6 GW installed capacity and around 828 TWh electricity generation over the 3-year period were considered. With the numbers from ONS, Equation 4 is calculated, as described below:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$ **Equation 5**

Where:

- $EF_{OM,y}$ is the simple operating margin emission factor (in tCO_2/MWh), or the emission factor for low-cost/must-run resources by relevant power sources *j* in year(s) *y.*

Low-cost/must-run resources in Brazilian S-SE-CO interconnected system are hydro and thermonuclear power plants, considered free of greenhouse gases emissions, i.e., $COEF_{i,j}$ for these plants is zero. Hence, the emission factor for low-cost/must-run resources results, $EF_{OM,y} = 0$.

$$EF_{OM-non,y} = \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{j,k}}$$ **Equation 6**

Where:

- $EF_{OM\text{-}non,y}$ is emission factor for **non**-low-cost/must-run resources(in tCO_2/MWh) by relevant power sources *k* in year(s) *y*.

Non-low-cost/must-run resources in Brazilian S-SE-CO interconnected system are thermo power plants burning coal, fuel oil, natural gas and diesel oil. These plants result in non-balanced emissions of greenhouse gases, calculated as follows:

The product $\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}$ for each one of the plants was obtained from the following formulae:

$$F_{i,k,y} = \frac{GEN_{i,k,y} \cdot 3{,}6 \times 10^{-6}}{\eta_{i,k,y} \cdot NCV_i} \qquad \textbf{Equation 7}$$

$$COEF_{i,k} = NCV_i \cdot EF_{CO2,i} \cdot 44/12 \cdot OXID_i \qquad \textbf{Equation 8}$$

$$Hence,\ F_{i,k,y} \cdot COEF_{i,k} = \frac{GEN_{i,k,y} \cdot EF_{CO2,i} \cdot OXID_i \cdot 44/12 \cdot 3{,}6 \times 10^{-6}}{\eta_{i,k,y}} \qquad \textbf{Equation 9}$$

Where variable and parameters used are:

- $\sum_{i,j} F_{i,j,y}$ is given in [kg], $COEF_{i,j}$ in [tCO_2e/kg] and $F_{i,k,y} \cdot COEF_{i,k}$ in [tCO_2e]
- $GEN_{i,k,y}$ is the electricity generation for plant *k*, with fuel *i*, in year *y*, obtained from the ONS database, in MWh
- $EF_{CO2,i}$ is the emission factor for fuel *i*, obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, in tC/TJ.
- $OXID_i$ is the oxidization factor for fuel *i*, obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, in %.
- 44/12 is the carbon conversion factor, from tC to tCO_2.
- 3.6×10^{-6} is the energy conversion factor, from MWh to TJ.
- $\eta_{i,k,y}$ is the thermal efficiency of plant *k*, operating with fuel *i*, in year *y*, obtained from Bosi et al. (2002).
- NCV_i is the net calorific value of fuel *i* [TJ/kg].

$\sum_{k,y} GEN_{k,y}$ is obtained from the ONS database, as the summation of non-low-cost/must-run resources electricity generation, in MWh.

The λ_y factors are calculated as indicated in methodology ACM0002, with date obtained from the ONS database. Figure 11, Figure 12 and Figure 13 present the load duration curves and λ_y calculations for years 2002, 2003 and 2004, respectively.

The results for years 2002, 2003 and 2004 are presented in Table 6.

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$ **[tCO₂/MWh]**	λ_y **[%]**
2002	0.8504	0.5053
2003	0.9378	0.5312
2004	0.8726	0.5041

Table 6 - 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 2002-2004 (ONS-ADO, 2005).

With the numbers from ONS, the first step was to calculate the lambda factors and the emission factors for the simple operating margin. The obtained values can be seen in Table 6, Figure 11, Figure 12 and Figure 13.

Finally, applying the obtained numbers to calculate $EF_{OM,simple\text{-}adjusted,2002\text{-}2004}$ as the weighted average *of* $EF_{OM,simple\text{-}adjusted\ 2002}$, $EF_{OM\ simple\text{-}\ adjusted,2003}$ *and* $EF_{OM,simple\text{-}adjusted,2004}$ and λ_y to Equation 1:

- $EF_{OM,simple\text{-}adjusted,2002\text{-}2004} = 0.4310\ tCO_2e/MWh$.

- **STEP 2** – Calculate the build margin mission factor ($EF_{BM,y}$) as the generation weighted average emission factor (tCO_2e/MWh) of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}} \qquad \textbf{Equation 10}$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (ACM0002, 2004) for plants *m*, based on the most recent information available on plants already built. The sample group m consists of either:

- The five power plants that have been built most recently, or
- The power plants 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 from these two options that sample group that comprises the larger annual generation.

Applying the data from the Brazilian national dispatch center to Equation 2:

• $EF_{BM,2004} = 0.1045\ tCO_2e/MWh.$

- **STEP 3** – Calculate the baseline emission factor EF_y, as the weighted average of the operating margin factor ($EF_{OM,y}$) and the build margin factor ($EF_{BM,y}$):

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$ **Equation 11**

Where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{OM} = 0.5$). With these numbers:

$$EF_y = 0.5 \times 0.4310 + 0.5 \times 0.1045$$

• $EF_y = 0.2677\ tCO_2e/MWh.$

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)	

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

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:

$$ER_y = EF_y \cdot EG_y$$ **Equation 12**

E.6. Table providing values obtained when applying formulae above:

Below follows Table 9 of the emission reductions profile of the two projects under the project activity.

SHP	Buriti	Canoa Quebrada
Installed power (MW)	30	28
Capacity factor for commercialization	0,92	0,86
baseline (tCO2/MWh)	0,2677	

	Buriti		Canoa Quebrada			
	Energy (MWh)	tCO2 abated	Energy (MWh)	tCO2 abated	Total tCO2 abated	
Total 2007	241.776	64.723	210.941	56.469	121.192	1st
Total 2008	241.776	64.723	210.941	56.469	121.192	2nd
Total 2009	241.776	64.723	210.941	56.469	121.192	3rd
Total 2010	241.776	64.723	210.941	56.469	121.192	4th
Total 2011	241.776	64.723	210.941	56.469	121.192	5th
Total 2012	241.776	64.723	210.941	56.469	121.192	6th
Total of the period	1.450.656	388.341	1.265.645	338.813	727.152	

Table 9: tCO2 total estimation reduction of the project (Buriti plus Canoa Quebrada)

SECTION F. Environmental impacts

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

The growing global concern on sustainable use of resources is driving a requirement for more sensitive environmental management practices. Increasingly this is being reflected in countries' policies and legislation. In Brazil the situation is not different. Environmental rules and licensing policies are very demanding in line with the best international practices.

In Brazil, the sponsor of any project that involves construction, installation, expansion or operation of any polluting or potentially polluting activity or any other capable to cause environmental degradation is obliged to secure a series of permits from the relevant environmental agency (federal and/or local, depending on the project).

The environmental impact of the Project is considered small by the host country definition of small-hydro plants. By legal definition of the Brazilian Power Regulatory Agency (ANEEL), Resolution no. 652, December 9th, 2003, small hydro in Brazil must have installed capacity greater than 1 MW but not more than 30 MW and with reservoir area less than 3 km², or, if the area is between 3 km² and 13 km², it should have a minimum environmental impact.

Although small hydro projects has reduced environmental impacts given the smaller dams and reservoir size, project sponsors have to obtain all licenses required by the Brazilian environmental regulation (Resolution CONAMA - *Conselho Nacional do Meio Ambiente* (National Environmental Council) n° 237/97):

- The preliminary license (*Licença Prévia* or LP),
- The construction license (*Licença de Instalação* or LI); and
- The operating license (*Licenca de Operação* or LO).

The environmental permit process has an administrative nature and was implemented by the National Environmental Policy, established by the Law n. 6938 dated on October 31st, 1981. Additionally, other norms and laws were issued by CONAMA and local state agencies.

In order to obtain all environmental licenses every small hydro projects shall mitigate the following impacts:

- Inundation of Indian lands and slaves historical areas – the authorization for that depends on National Congress decision;
- Inundation of environmental preservation areas, legally formed as National Parks and Conservation Units;
- Inundation of urban areas or country communities;
- Reservoirs where there will be urban expansion in the 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 is considered environmentally feasible, the sponsors have to prepare the Environmental Assessment, which is basically composed by the following information:

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

The result of those assessments is the Preliminary License (LP), which reflects the environmental local agency positive understanding about the environmental project concepts.

In order to obtain the Construction License (LI) it is necessary to present (a) additional information about previous assessment; (b) a new simplified assessment; or (c) the Environmental Basic Project, according to the environmental agency decision informed at the LP.

The Operation License (LO) is a result of pre-operational tests during the construction phase to verify if all exigencies made by environmental local agency were completed.

Two other guidelines were used in order to evaluate the project with respect to environmental sustainability, the requirements of the Brazilian government to obtain the letter of approval and the recommendations checklist of the World Commission on Dams. The results of the evaluations follow.

Project's contribution to Sustainable Development (CDM letter or approval requirement)

a) **Contribution to the local environmental sustainability**

In April 2002 Law no. 10,438 created Proinfa (*Programa de Incentivo as Fontes Alternativas de Energia*). Proinfa is a Brazilian federal program that gives incentive to alternative sources of electricity (wind energy, biomass cogeneration, and a small scale hydropower plant). Among other factors, this initiative's goal is to increase the renewable energy source share in the Brazilian electricity matrix in order to contribute to a greater environmental sustainability through giving these renewable energy sources better economic advantages. The Brazilian government has committed a large monetary fund in order to develop this plan.

Atiaia applied for financing under Proinfa, which plays an important role in local environmental sustainability, specifically in superior air quality compared to an increase in natural gas which is part of the installed capacity of the country's electricity matrix.

The Project is part of the interconnected sub-sector of the South-Southeast-Midwest electricity grid, which transports electricity from the installed capacity. This is further explained in the baseline scenario section in the Project Document Description that shows that the Brazilian electric matrix is roughly constituted mainly by electricity derived from large hydro plants and in part by thermal electricity derived from biomass, coal, and mainly natural gas, which has been increasing in use since the construction of GASBOL (the Brazil-Bolivia pipeline).

Although natural gas is the cleanest fossil fuel, the combustion in generating electricity in thermo plants emits greenhouse gases such as: carbon dioxide "CO_2", methane "CH_4", and nitrous oxide "N_2O", which are, according to the Organization for Economic Cooperation and Development (OECD, 2004), the three greenhouse gases "GHGs" which account for the majority of human induced global warming effects.

A local, small scale hydropower plant would supply a more constant energy flow that would discourage thermal generators. This indigenous and cleaner source of electricity would also have another contribution to environmental sustainability. It reduces technical losses occurred in the grids that deliver electricity to these distant communities.

b) **Contribution to the development of the quantity and quality of jobs**

The Project is associated with large expenditures and significant employment demands. Although not all employment is filled by the local population, a part of the demand for workers is absorbed by regional manpower.

The general employee profile for the project's type of construction is on average a person with few years of formal education. This profile would have difficulty finding a formal job in an informal economy, which is a common characteristic of this region's labor market.

The Project provides its employees, and in some cases the entire community, many facilities which contribute to the quality of life of its workers such as housing, social security, health assistance, and life insurance.

One of the most important contributions from the construction of these two run-off-river hydro plants is that it can create the potential for the promotion of regional development which will generate a greater number of jobs and better living standards.

One of the factors which facilitate job creation is a more reliable energy supply. This is essential for making a decision between carrying-out or not an investment which creates jobs in the region.

Another important point to highlight is Project's contribution to the development of good quality jobs and the fact that the project has professionals responsible for educating the workers and population about environmental preservation and prevention of illness.

c) **Contribution to the fair income distribution**

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 Project is located is obtained 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. This money would stay in the region and be used for providing the population better services which would improve the availability of basic needs. A greater income comes from the local investment on the local economy, and a greater tax payment, which will benefit the local population.

d) **Contribution to the technological development and capacity building**

In the past, Brazil protected its markets against external competition and as a consequence local technology did not develop at the same pace as compared to other countries. Brazil, having one of the world's largest hydro capacity, has invested heavily in large hydropower projects, which make the country an authority in this field.

As Tolmasquim (2003) says, "the national industry is qualified to supply part of the electrical equipment and hydro-mechanisms for the small scale hydropower plants".

The project does not create new technology, however, it builds up the local capacity necessary for properly managing the project.

Another important contribution to the local capacity building is educational programs that are carried out by technical professionals that teaches local educators the importance of the environment to their society.

The educators are the bridge of this knowledge to the local children which are expected to have a better environmental consciousness as compared to the current knowledge about the environment.

e) **Contribution to the regional integration and relationships among other sectors**

Elliot (2000) in his article "Renewable Energy and Sustainable Futures", proposes the change from a conventional paradigm to a new energy paradigm, which is closely related to the proposal of the Project, "to a world that is moving towards a sustainable approach to energy generation" that has enormous influence on, among other things, a better environment.

This new energy paradigm is the one that uses renewable fuels versus finite stock, smaller scale technology versus large scale, small and local environmental impacts versus large and global, and a liberalized market versus a monopoly.

Despite this, Elliot states that a decentralized generation of energy is a better contribution to sustainable development than a centralized one.

Currently this is the Brazilian tendency, because among other advantages, the electricity system has fewer losses, and local economies receive a greater income. Also, regional integration is developed since decentralized systems connected to the grid diminish the country's electricity system vulnerability and dependency on specific and limited electricity sources.

Therefore, decentralization of the electricity generation activity promotes integration and a higher degree of security for the other sectors of the economy to invest in an area which now has a better guarantee of electrical supply. This is the case of Atiaia. The local economy not only indirectly benefits during the construction, but also attracts new businesses after the construction period due to a more steady and reliable supply of electricity.

Conclusion

In conclusion, although the Project does not have a large stake in the sustainability of the country, it is part of a greater idea (which the federal government supports through Proinfa) and it contributes to as the Brundland report (WCED, 1987) defines: the sustainable development which is the satisfaction of the present needs without compromising the ability of future generations to meet their own needs. In other words, by using run-of-river hydropower facilities, which are renewable sources of energy, to generate electricity for local use and for delivery to the grid, the Project displaces part of the electricity derived from diesel, a finite fossil fuel, and gives less incentives for the construction of large hydro plants, which, though renewable, can have major environmental and social impacts.

Finally, the project has fewer impacts on the environment and it can boost the regional economy, therefore resulting in a better quality of life and social standards for the local people, in other words, the project contributes to the local sustainable development.

World Commission on Dams recommendations checklist

a) **Gaining public acceptance**

The projects are in different phases of development. Although civil works are underway, the project sponsor is working to gain public acceptance by developing environmental education projects, as well as other local activities, such as reforestation of degraded areas, regular water quality assessment, support to environmental parks, hiring of local manpower, erosion control, support to agriculture for the local community, among other initiatives. Therefore, significant modifications in the present environmental conditions are not expected.

b) **Comprehensive options assessment**

Various assessments were conducted in order to optimize the use of the water supply to increase the generating capacity, and to reduce the environmental impact.

c) **Addressing existing dams**

There are existing dams in the region where the projects are located.

1) SHP Buriti: SHP Paraíso, 55 km away, operating; SHP Rio Sucuriú, 30 Km away (under construction); SHP Porto das Pedras, 30 km away (construction will begin in 2007).

2) SHP Canoa Quebrada: no dams in the region.

Regarding the construction requirements for the new generating units, the optimization of the river use is sufficient to increase the energy generation.

The reservoirs are considered to be of low impact.

d) **Sustaining rivers and livelihoods**

Although some environmental impact is expected from the projects, the project sponsor is committed to mitigating this with close cooperation from the local community. Mitigation and/or compensatory measures are to be considered to reduce any negative impacts to neighboring communities or to the population in general.

It is not anticipated to cause any relevant impact to the aquatic ecosystems due to the mitigation measures as well as the optimization work.

e) **Recognizing entitlements and sharing benefits**

There is neither displacement of population nor a negative effect to its interests and rights related to the project.

As for sharing the benefits, funds are being structured to support local environmental parks. Also, degraded areas are being renovated.

f) **Ensuring compliance**

The projects comply with the national and local environmental legislation, such as the CONAMA Resolution nº 237/97, Resolution 009/87, Resolution 006/86, Resolution 001/86, Law 6938/81, and the correspondent legislation. This legislation regulates the environmental licenses and the public hearing procedures. Currently, the national environmental regulations include the mandate to promote sustainable development.

The projects comply with the electricity legislation, as well, such as the National Electricity Agency (ANEEL) Resolution nº 112/99 and related regulations. The electricity sector regulations include the mandate to comply with all the national environmental regulations, which for this case means environmental protection, mitigation and compensatory measures and social-economic concern.

g) **Sharing rivers for peace, development and security**

Protective installations on the shore of the river have been anticipated, and will not affect downstream waters.

An environmental impact evaluation was carried out for the project which explains in additional detail the relevant information about environmental and social impacts and mitigation measures.

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

The growing global concern on sustainable use of resources is driving the requirement for more sensitive environmental management practices. Increasingly this is being reflected in countries' policies and legislation. In Brazil the situation is not different; environmental rules and licensing process policy are very demanding in line with the best international practices.

The environmental impacts of the Projects are considered small by the host country definition of small-hydro plants. By legal definition of the Brazilian Power Regulatory Agency (ANEEL), Resolution no. 652, December 9th, 2003, small hydro in Brazil must have installed capacity greater than 1 MW but not more than 30 MW and with reservoir area less than 3 km², or, if the area is between 3 km² and 13 km², it should have a minimum environmental impact. Generally, it consists of a run-of-the-river hydro plant. Buriti is rated at 30 MW (0.38 km² reservoir) and Canoa Quebrada at 28 MW (10.49 km^2 reservoir).

The plants possess preliminary and construction licenses. The preliminary licenses were issued by the Mato Grosso and Mato Grosso do Sul Environmental Agency, SEMA - *Secretaria Estadual do Meio Ambiente*. All licenses for the projects are available for consultation under request, as well as the environmental studies.

In the processes, reports containing investigation of the following aspects were prepared:

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

The projects has also been reviewed under "*IFC's Environmental & Social Guidelines and Safeguards Policies*" (WB, 1998) and the "*World Commission on Dams Guidelines for Good Practice*" (WCD, 2000) in order to determine its potential entry and acceptance and in our best understanding exigencies were attended because the three required licenses were secured, all mitigating measures and programs were implemented.

Environmental Control Plans and Basic Environmental Project were approved by the Mato Grosso and Mato Grosso do Sul Environmental Agencies SEMA - *Secretaria Estadual do Meio Ambiente*, depending on the project location. For each project was approved a specific environmental plan that involves different programs:

Buriti

- Environmental education with local communities
- Flora rescue
- Renovation and reforestation of degraded areas
- Water quality monitoring program
- Fauna monitoring
- Fire prevention program
- Health program with local communities

Canoa Quebrada

- Underground water quality monitoring
- Fauna monitoring
- Renovation of degraded areas
- Water quality monitoring
- Diseases control in the SHP's area
- Environmental education with local communities

SECTION G. Stakeholders' comments

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

According to the federal and local state legislation, the environmental licensing process requests public hearings with the local community. Also, the same legislation requests the announcement of the issuance of the licenses (LP, LI and LO) in the local state official journal (*Diário Oficial do Estado*) and in the regional newspapers. The announcements for the projects are available for consultation under request.

Beside of the stakeholders comments requested for the environmental licenses, the Brazilian Designated National Authority, *Comissão Interministerial de Mudanças Globais de Clima*, requests comments by local stakeholders based on a translated version of the PDD, 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 proponent of the project sent these letters to the stakeholders in order to invite their comments while the PDD of the project was open for comments in the validation stage in the United Nations Framework Convention on Climate Change website (www.unfccc.int), since anyone can have access to the mentioned document from a legitimate source.

G.2. Summary of the comments received:

All comments received in the context of the environmental licensing and operation permits process were incorporated into executive projects.

Brazilian DNA requests that projects be open for comments prior to validation. Thus, in addition to UNFCCC global stakeholders comments this project was open for inputs from locals at the same time. Any comments will be disclosed after validation.

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

All comments received in the context of the environmental licensing and operation permits process were incorporated into executive projects.

The research paper prepared by the Project analyzing on the impact of the facilities in the region is available upon request. Brazilian DNA requests that projects be open for comments prior to validation. Thus, in addition to UNFCCC global stakeholders comments this project was open for inputs from locals at the same time. Any comments will be disclosed after validation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Represented by:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Not applicable.

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.

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.

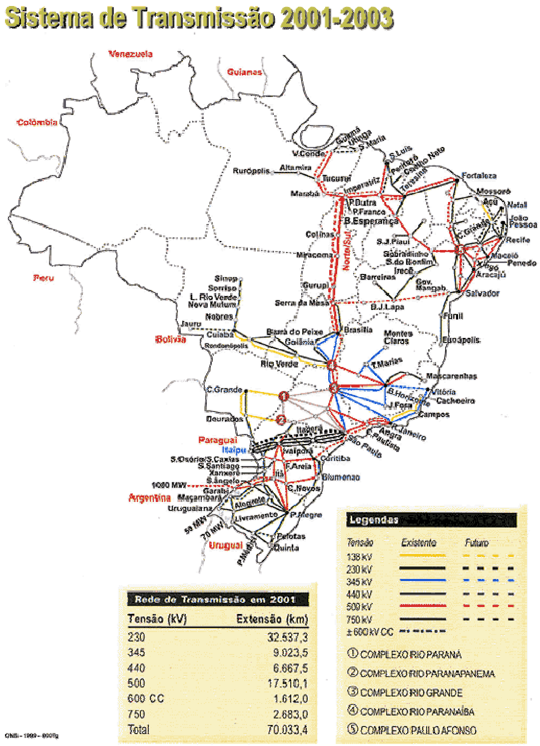
Nevertheless, even after the interconnection had been established, technical papers still divided the Brazilian system in two (Bosi, 2000):

"… 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."



Brazilian Interconnected System (Source: ONS)

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 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 7).

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

Table 7 – Ex ante and ex-post operating and build margin emission factors (ONS-ADO, 2004; Bosi *et al.*, 2002)

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 (2002, 2003 and 2004). 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.

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid					
Baseline (including imports)	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [GWh]	Imports [MWh]
2002	0,8504	275.402.896	258.720	1.607.395
2003	0,9378	288.493.929	274.649	459.586
2004	0,8726	297.879.874	284.748	1.468.275
	Total (2001-2003) =	861.776.699	818.118	3.535.256
	$EF_{OM, simple-adjusted}$ [tCO2/MWh]	$EF_{BM,2004}$	Lambda	
	0,4310	0,1045	λ_{2002}	
	Alternative weights	Default weights	0,5053	
	w_{OM} = 0,75	w_{OM} = 0,5	λ_{2003}	
	w_{BM} = 0,25	w_{BM} = 0,5	0,5312	
	EF_{CM} [tCO2/MWh]	Default EF_{OM} [tCO2/MWh]	λ_{2004}	
	0,3494	0,2677	0,5041	

Table 8 – Emission factors for the Brazilian South-Southeast-Midwest interconnected grid (simple adjusted operating margin factor)

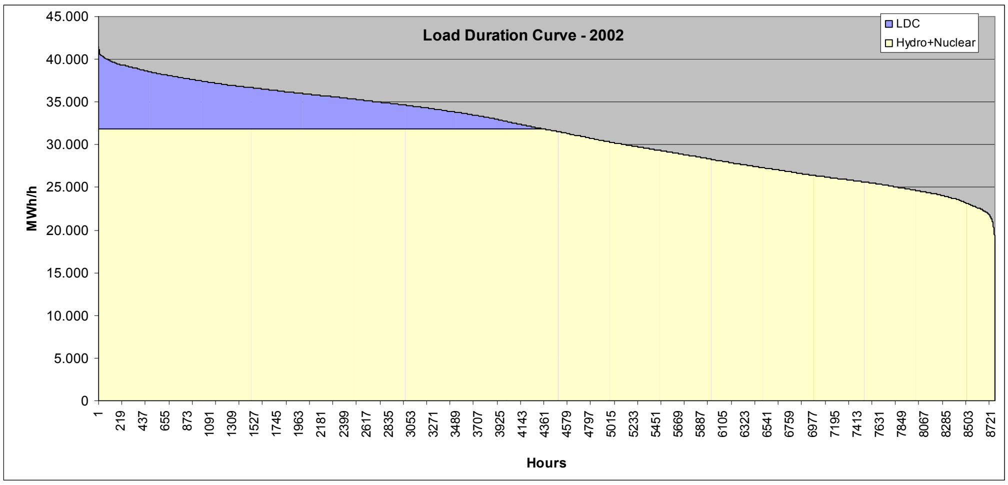


Figure 11 - Load duration curve for the S-SE-CO system, 2002

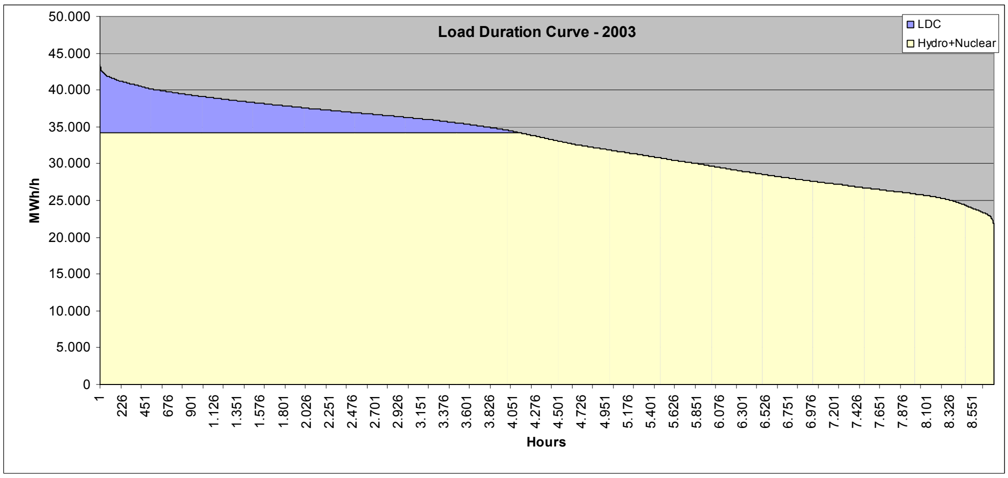


Figure 12 - Load duration curve for the S-SE-CO system, 2003

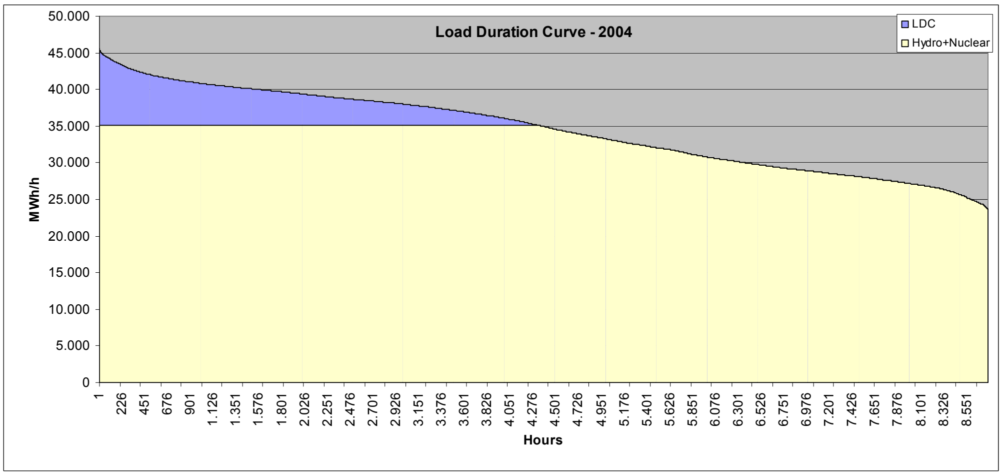


Figure 13 – Load duration curve for the S-SE-CO system, 2004

	Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fuel conversion efficiency (%) [2]	Carbon emission factor (tC/TJ) [3]	Fraction carbon oxidized [3]	Emission factor (tCO2/MWh)
1	S-SE-CO	H	Jauru	Sep-2003	121.5	1	0.0	0.0%	0.000
2	S-SE-CO	H	Gauporé	Sep-2003	120.0	1	0.0	0.0%	0.000
3	S-SE-CO	G	Três Lagoas	Aug-2003	306.0	0.3	15.3	99.5%	0.670
4	S-SE-CO	H	Funil (MG)	Jan-2003	180.0	1	0.0	0.0%	0.000
5	S-SE-CO	H	Itiquira I	Sep-2002	156.1	1	0.0	0.0%	0.000
6	S-SE-CO	G	Araucária	Sep-2002	484.5	0.3	15.3	99.5%	0.670
7	S-SE-CO	G	Canoas	Sep-2002	160.6	0.3	15.3	99.5%	0.670
8	S-SE-CO	H	Piraju	Sep-2002	81.0	1	0.0	0.0%	0.000
9	S-SE-CO	G	Nova Piratininga	Jun-2002	384.9	0.3	15.3	99.5%	0.670
10	S-SE-CO	O	PCT CGTEE	Jun-2002	5.0	0.3	20.7	99.0%	0.902
11	S-SE-CO	H	Rosal	Jun-2002	55.0	1	0.0	0.0%	0.000
12	S-SE-CO	G	Ibirité	May-2002	226.0	0.3	15.3	99.5%	0.670
13	S-SE-CO	H	Cana Brava	May-2002	465.9	1	0.0	0.0%	0.000
14	S-SE-CO	H	Sta. Clara	Jan-2002	60.0	1	0.0	0.0%	0.000
15	S-SE-CO	H	Machadinho	Jan-2002	1,140.0	1	0.0	0.0%	0.000
16	S-SE-CO	G	Juiz de Fora	Nov-2001	87.0	0.28	15.3	99.5%	0.718
17	S-SE-CO	G	Macaé Merchant	Nov-2001	922.6	0.24	15.3	99.5%	0.837
18	S-SE-CO	H	Lajeado (ANEEL res. 402/2001)	Nov-2001	902.5	1	0.0	0.0%	0.000
19	S-SE-CO	G	Eletrobolt	Oct-2001	379.0	0.24	15.3	99.5%	0.837
20	S-SE-CO	H	Porto Estrela	Sep-2001	112.0	1	0.0	0.0%	0.000
21	S-SE-CO	G	Cuiaba (Mario Covas)	Aug-2001	529.2	0.3	15.3	99.5%	0.670
22	S-SE-CO	G	W. Arjona	Jan-2001	194.0	0.25	15.3	99.5%	0.804
23	S-SE-CO	G	Uruguaiana	Jan-2000	639.9	0.45	15.3	99.5%	0.447
24	S-SE-CO	H	S. Caxias	Jan-1999	1,240.0	1	0.0	0.0%	0.000
25	S-SE-CO	H	Canoas I	Jan-1999	82.5	1	0.0	0.0%	0.000
26	S-SE-CO	H	Canoas II	Jan-1999	72.0	1	0.0	0.0%	0.000
27	S-SE-CO	H	Igarapava	Jan-1999	210.0	1	0.0	0.0%	0.000
28	S-SE-CO	H	Porto Primavera	Jan-1999	1,540.0	1	0.0	0.0%	0.000
29	S-SE-CO	D	Cuiaba (Mario Covas)	Oct-1998	529.2	0.27	20.2	99.0%	0.978
30	S-SE-CO	H	Sobragi	Sep-1998	60.0	1	0.0	0.0%	0.000
31	S-SE-CO	H	PCH EMAE	Jan-1998	26.0	1	0.0	0.0%	0.000
32	S-SE-CO	H	PCH CEEE	Jan-1998	25.0	1	0.0	0.0%	0.000
33	S-SE-CO	H	PCH ENERSUL	Jan-1998	43.0	1	0.0	0.0%	0.000
34	S-SE-CO	H	PCH CEB	Jan-1998	15.0	1	0.0	0.0%	0.000
35	S-SE-CO	H	PCH ESCELSA	Jan-1998	62.0	1	0.0	0.0%	0.000
36	S-SE-CO	H	PCH CELESC	Jan-1998	50.0	1	0.0	0.0%	0.000
37	S-SE-CO	H	PCH CEMAT	Jan-1998	145.0	1	0.0	0.0%	0.000
38	S-SE-CO	H	PCH CELG	Jan-1998	15.0	1	0.0	0.0%	0.000
39	S-SE-CO	H	PCH CERJ	Jan-1998	59.0	1	0.0	0.0%	0.000
40	S-SE-CO	H	PCH COPEL	Jan-1998	70.0	1	0.0	0.0%	0.000
41	S-SE-CO	H	PCH CEMIG	Jan-1998	84.0	1	0.0	0.0%	0.000
42	S-SE-CO	H	PCH CPFL	Jan-1998	55.0	1	0.0	0.0%	0.000
43	S-SE-CO	H	S. Mesa	Jan-1998	1,275.0	1	0.0	0.0%	0.000
44	S-SE-CO	H	PCH EPAULO	Jan-1998	26.0	1	0.0	0.0%	0.000
45	S-SE-CO	H	Guilmam Amorim	Jan-1997	140.0	1	0.0	0.0%	0.000
46	S-SE-CO	H	Corumbá	Jan-1997	375.0	1	0.0	0.0%	0.000
47	S-SE-CO	H	Miranda	Jan-1997	408.0	1	0.0	0.0%	0.000
48	S-SE-CO	H	Noav Ponte	Jan-1994	510.0	1	0.0	0.0%	0.000
49	S-SE-CO	H	Segredo (Gov. Ney Braga)	Jan-1992	1,260.0	1	0.0	0.0%	0.000
50	S-SE-CO	H	Taquaruçu	Jan-1989	554.0	1	0.0	0.0%	0.000
51	S-SE-CO	H	Manso	Jan-1988	210.0	1	0.0	0.0%	0.000
52	S-SE-CO	H	D. Francisca	Jan-1987	125.0	1	0.0	0.0%	0.000
53	S-SE-CO	H	Itá	Jan-1987	1,450.0	1	0.0	0.0%	0.000
54	S-SE-CO	H	Rosana	Jan-1987	369.2	1	0.0	0.0%	0.000
55	S-SE-CO	N	Angra	Jan-1985	1,874.0	1	0.0	0.0%	0.000
56	S-SE-CO	H	T. Irmãos	Jan-1985	807.5	1	0.0	0.0%	0.000
57	S-SE-CO	H	Itaipu 60 Hz	Jan-1983	6,300.0	1	0.0	0.0%	0.000
58	S-SE-CO	H	Itaipu 50 Hz	Jan-1983	5,375.0	1	0.0	0.0%	0.000
59	S-SE-CO	H	Emborcação	Jan-1982	1,192.0	1	0.0	0.0%	0.000
60	S-SE-CO	H	Nova Avanhandava	Jan-1982	347.4	1	0.0	0.0%	0.000
61	S-SE-CO	H	Gov. Bento Munhoz - GBM	Jan-1980	1,676.0	1	0.0	0.0%	0.000

* Subsystem: S - south, SE-CO - Southeast-Midwest

** Fuel source (C, bituminous coal; D, diesel oil; G, natural gas; H, hydro; N, nuclear; O, residual fuel oil).

[1] Agência Nacional de Energia Elétrica. *Banco de Informações da Geração* (http://www.aneel.gov.br/, data collected in november 2004).

[2] Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A.F. Simoes, H. Winkler and J.M. Lukamba. *Road testing baselines for GHG mitigation projects in the electric power sector.* OECD/IEA information paper, October 2002.

[3] Intergovernamental Panel on Climate Change. *Revised 1996 Guidelines for National Greenhouse Gas Inventories.*

[4] Operador Nacional do Sistema Elétrico. Centro Nacional de Operação do Sistema. *Acompanhamento Diário da Operação do SIN* (daily reports from Jan. 1, 2001 to Dec. 31, 2003).

[5] Agência Nacional de Energia Elétrica. Superintendência de Fiscalização dos Serviços de Geração. *Resumo Geral dos Novos Empreendimentos de Geração* (http://www.aneel.gov.br/, data collected in november 2004).

Table 10 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 1

	Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fuel conversion efficiency (%) [2]	Carbon emission factor (tC/TJ) [3]	Fraction carbon oxidized [3]	Emission factor (tCO2/MWh)
62	S-SE-CO	H	S.Santiago	Jan-1980	1,420.0	1	0.0	0.0%	0.000
63	S-SE-CO	H	Itumbiara	Jan-1980	2,280.0	1	0.0	0.0%	0.000
64	S-SE-CO	O	Igarapé	Jan-1978	131.0	0.3	20.7	99.0%	0.902
65	S-SE-CO	H	Itauba	Jan-1978	512.4	1	0.0	0.0%	0.000
66	S-SE-CO	H	A. Vermelha (Jose E. Moraes)	Jan-1978	1,396.2	1	0.0	0.0%	0.000
67	S-SE-CO	H	S.Simão	Jan-1978	1,710.0	1	0.0	0.0%	0.000
68	S-SE-CO	H	Capivara	Jan-1977	640.0	1	0.0	0.0%	0.000
69	S-SE-CO	H	S.Osório	Jan-1975	1,078.0	1	0.0	0.0%	0.000
70	S-SE-CO	H	Marimbondo	Jan-1975	1,440.0	1	0.0	0.0%	0.000
71	S-SE-CO	H	Promissão	Jan-1975	264.0	1	0.0	0.0%	0.000
72	S-SE-CO	C	Pres. Medici	Jan-1974	446.0	0.26	26.0	98.0%	1.294
73	S-SE-CO	H	Volta Grande	Jan-1974	380.0	1	0.0	0.0%	0.000
74	S-SE-CO	H	Porto Colombia	Jun-1973	320.0	1	0.0	0.0%	0.000
75	S-SE-CO	H	Passo Fundo	Jan-1973	220.0	1	0.0	0.0%	0.000
76	S-SE-CO	H	Passo Real	Jan-1973	158.0	1	0.0	0.0%	0.000
77	S-SE-CO	H	Ilha Solteira	Jan-1973	3,444.0	1	0.0	0.0%	0.000
78	S-SE-CO	H	Mascarenhas	Jan-1973	131.0	1	0.0	0.0%	0.000
79	S-SE-CO	H	Gov. Parigot de Souza - GPS	Jan-1971	252.0	1	0.0	0.0%	0.000
80	S-SE-CO	H	Chavantes	Jan-1971	414.0	1	0.0	0.0%	0.000
81	S-SE-CO	H	Jaguara	Jan-1971	424.0	1	0.0	0.0%	0.000
82	S-SE-CO	H	Sá Carvalho	Apr-1970	78.0	1	0.0	0.0%	0.000
83	S-SE-CO	H	Estreito (Luiz Carlos Barreto)	Jan-1969	1,050.0	1	0.0	0.0%	0.000
84	S-SE-CO	H	Ibitinga	Jan-1969	131.5	1	0.0	0.0%	0.000
85	S-SE-CO	H	Jupiá	Jan-1969	1,551.2	1	0.0	0.0%	0.000
86	S-SE-CO	O	Alegrete	Jan-1968	66.0	0.26	20.7	99.0%	1.040
87	S-SE-CO	G	Campos (Roberto Silveira)	Jan-1968	30.0	0.24	15.3	99.5%	0.837
88	S-SE-CO	G	Santa Cruz (RJ)	Jan-1968	766.0	0.31	15.3	99.5%	0.648
89	S-SE-CO	H	Paraibuna	Jan-1968	85.0	1	0.0	0.0%	0.000
90	S-SE-CO	H	Limoeiro (Armando Salles de Oliviera)	Jan-1967	32.0	1	0.0	0.0%	0.000
91	S-SE-CO	H	Caconde	Jan-1966	80.4	1	0.0	0.0%	0.000
92	S-SE-CO	C	J.Lacerda C	Jan-1965	363.0	0.25	26.0	98.0%	1.345
93	S-SE-CO	C	J.Lacerda B	Jan-1965	262.0	0.21	26.0	98.0%	1.602
94	S-SE-CO	C	J.Lacerda A	Jan-1965	232.0	0.18	26.0	98.0%	1.869
95	S-SE-CO	H	Bariri (Alvaro de Souza Lima)	Jan-1965	143.1	1	0.0	0.0%	0.000
96	S-SE-CO	H	Funil (RJ)	Jan-1965	216.0	1	0.0	0.0%	0.000
97	S-SE-CO	C	Figueira	Jan-1963	20.0	0.3	26.0	98.0%	1.121
98	S-SE-CO	H	Furnas	Jan-1963	1,216.0	1	0.0	0.0%	0.000
99	S-SE-CO	H	Barra Bonita	Jan-1963	140.8	1	0.0	0.0%	0.000
100	S-SE-CO	C	Charqueadas	Jan-1962	72.0	0.23	26.0	98.0%	1.462
101	S-SE-CO	H	Jurumirim (Armando A. Laydner)	Jan-1962	97.7	1	0.0	0.0%	0.000
102	S-SE-CO	H	Jacui	Jan-1962	180.0	1	0.0	0.0%	0.000
103	S-SE-CO	H	Pereira Passos	Jan-1962	99.1	1	0.0	0.0%	0.000
104	S-SE-CO	H	Tres Marias	Jan-1962	396.0	1	0.0	0.0%	0.000
105	S-SE-CO	H	Euclides da Cunha	Jan-1960	108.8	1	0.0	0.0%	0.000
106	S-SE-CO	H	Camargos	Jan-1960	46.0	1	0.0	0.0%	0.000
107	S-SE-CO	H	Santa Branca	Jan-1960	56.1	1	0.0	0.0%	0.000
108	S-SE-CO	H	Cachoeira Dourada	Jan-1959	658.0	1	0.0	0.0%	0.000
109	S-SE-CO	H	Salto Grande (Lucas N. Garcez)	Jan-1958	70.0	1	0.0	0.0%	0.000
110	S-SE-CO	H	Salto Grande (MG)	Jan-1956	102.0	1	0.0	0.0%	0.000
111	S-SE-CO	H	Mascarenhas de Moraes (Peixoto)	Jan-1956	478.0	1	0.0	0.0%	0.000
112	S-SE-CO	H	Itutinga	Jan-1955	52.0	1	0.0	0.0%	0.000
113	S-SE-CO	C	S. Jerônimo	Jan-1954	20.0	0.26	26.0	98.0%	1.294
114	S-SE-CO	O	Carioba	Jan-1954	36.2	0.3	20.7	99.0%	0.902
115	S-SE-CO	O	Piratininga	Jan-1954	472.0	0.3	20.7	99.0%	0.902
116	S-SE-CO	H	Canastra	Jan-1953	42.5	1	0.0	0.0%	0.000
117	S-SE-CO	H	Nilo Peçanha	Jan-1953	378.4	1	0.0	0.0%	0.000
118	S-SE-CO	H	Fontes Nova	Jan-1940	130.3	1	0.0	0.0%	0.000
119	S-SE-CO	H	Henry Borden Sub.	Jan-1926	420.0	1	0.0	0.0%	0.000
120	S-SE-CO	H	Henry Borden Ext.	Jan-1926	469.0	1	0.0	0.0%	0.000
121	S-SE-CO	H	I. Pombos	Jan-1924	189.7	1	0.0	0.0%	0.000
122	S-SE-CO	H	Jaguari	Jan-1917	11.8	1	0.0	0.0%	0.000
				Total (MW) =	64,478.6				

* Subsystem: S - south, SE-CO - Southeast-Midwest

** Fuel source (C, bituminous coal; D, diesel oil; G, natural gas; H, hydro; N, nuclear; O, residual fuel oil).

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Table 11 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 2

Annex 4

MONITORING PLAN

As of the procedures set by the "Approved consolidated monitoring methodology ACM0002" – "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources".

The project will proceed with the necessary measures for the power control and monitoring. Together with the information produced by both ANEEL and ONS, it will be possible to monitor the power generation of the project and the grid power mix.

Annex 5

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