



**CLEAN DEVELOPMENT MECHANISM  
SIMPLIFIED PROJECT DESIGN DOCUMENT  
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)  
Version 02**

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**Revision history of this document**

<b>Version Number</b>	<b>Date</b>	<b>Description and reason of revision</b>
01	21 January 2003	Initial adoption
02	8 July 2005	<ul style="list-style-type: none"><li>• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.</li><li>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <a href="http://cdm.unfccc.int/Reference/Documents">http://cdm.unfccc.int/Reference/Documents</a>.</li></ul>

**SECTION A. General description of the small-scale project activity****A.1. Title of the small-scale project activity:**

Agropecuária Salto do Leão Ltda. – Spessatto, Santo Expedito and Barra do Leão Small Hydroelectric Power Plant Project (hereafter referred to as “Spessatto, Santo Expedito and Barra do Leão Project”).

PDD version number: 03.

Date (DD/MM/YYYY): 06/09/2006.

**A.2. Description of the small-scale project activity:**

The primary objective of Spessatto, Santo Expedito and Barra do Leão Small Hydroelectric Power Plant Project is to help meet Brazil’s rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy’s share of the total Brazilian (and the Latin America and the Caribbean region’s) electricity consumption.

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

Spessatto, Santo Expedito and Barra do Leão Small Hydroelectric Power Plant Project consists of three small-hydro power plants with reservoirs:

- SHP Spessatto with 2.35 MW of installed capacity and a small reservoir of 0.0017 km<sup>2</sup>
- SHP Santo Expedito with 2.25 MW of installed capacity and a small reservoir of 0.005 km<sup>2</sup>
- SHP Barra do Leão with 3.55 MW of installed capacity and a small reservoir of 0.24604 km<sup>2</sup>

These small reservoir areas guarantee minor environmental impacts.

Spessatto, Santo Expedito and Barra do Leão Small Hydroelectric Power Plant Project is owned by Agropecuária Salto do Leão Ltda., a farmer that is investing in the construction of SHPs, beyond the production of eggs and organic manure.

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<sup>1</sup> 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.”



The project is located in the south of Brazil, where the largest coal reserves are located, as well as the majority of the power plants using this fuel in Brazil. They are located on the Leão River, in Campos Novos and Erval Velho cities, state of Santa Catarina.

Spessatto, Santo Expedito and Barra do Leão Project improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. Small-scale hydropower plants with reservoirs provide local distributed generation, in contrast with the business as usual large hydropower and natural gas fired plants built in the last 5 years, and these small-scale projects provide site-specific reliability and transmission and distribution benefits including:

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

This indigenous and cleaner source of electricity will also have an important contribution to environmental sustainability by reducing carbon dioxide emissions that would have occurred otherwise in the absence of the project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation by fossil fuel sources (and CO<sub>2</sub> emissions), which would be generating (and emitting) in the absence of the project.

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

For all the above mentioned reasons, the project was accepted as a special category project by the FATMA, *Fundação do Meio Ambiente*, the environmental agency of the state of Santa Catarina: a project of "social interest", according to State Law 9,428, article 14, January 7, 1994. Only social interest projects are allowed to deforest riparian forests in Santa Catarina for their implementation.

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. Spessatto, Santo Expedito and Barra do Leão Project thus comes to prove that with the commercialization of CERs, it is viable to develop a generation project in Brazil. This will have a positive effect for the country beyond the evident reductions in GHG emissions.

**A.3. Project participants:**

<b>Name of Party involved (*) (host) indicates a host Party)</b>	<b>Private and/or public entity(ies) Project participants (*) (as applicable)</b>	<b>Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)</b>
Brazil (host)	Agropecuária Salto do Leão Ltda. (Private)	No
	Ecoinvest Carbon Brasil Ltda.(private entity)	

(\*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.

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

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

**A.4. Technical description of the small-scale project activity:**

Spessatto, Santo Expedito and Barra do Leão Project use water from the Leão River to generate electricity with 8.15 MW of total installed capacity. The three facilities contain a small dam with a very small reservoir area, which store water in order to generate electricity for short periods of time.

By legal definition of the Brazilian Power Regulatory Agency (ANEEL), Resolution no. 652, December 9<sup>th</sup>, 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 km<sup>2</sup>, or, if the area is between 3 km<sup>2</sup> and 13 km<sup>2</sup>, it should have a minimum environmental impact.

Small hydro electric power projects with reservoirs 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 hydro electric power project with reservoir, which results on a minimum environmental impact.

The technology employed at Spessatto, Santo Expedito and Barra do Leão Project is established in the industry: Francis and Kaplan turbines (Figure 1 and 2) are the most widely used among water turbines.

Francis turbine is a type of hydraulic reactor turbine in which the flow exits the turbine blades in the radial direction. Francis turbines are common in power generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through a volute casing and is directed onto the blades by wicket gates. The low momentum water then exits the turbine through a draft tube. In the model, water flow is supplied by a variable speed centrifugal pump. A load is applied to

the turbine by means of a magnetic brake, and torque is measured by observing the deflection of calibrated springs. The performance is calculated by comparing the output energy to the energy supplied.

Kaplan S horizontal, with double regulation is common in power generation where high flow rates are available at small hydraulic head. The double regulation, used at Spessatto, Santo Expedito and Barra do Leão Project, has mobile blades that optimize its yield. Water enters the turbine through a volute casing and is directed onto the blades by wicket gates, converting kinetic in mechanical energy.



Figure 1 - Example of a Francis Turbine



Figure 2 – Example of a Kaplan S Turbine

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

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

	SHP SPESSATTO	SHP SANTO EXPEDITO	SHP BARRA DO LEÃO
<b><u>Turbines</u></b>			
Quantity	2	2	2
Power per unit	1,224 kW	1,171 kW	1,847 kW
Nominal liquid flow	4,175 m <sup>3</sup> /s	5,455 m <sup>3</sup> /s	6,40 m <sup>3</sup> /s
Water head	32.49 m	23.88 m	31.97 m
Rotation	900 rpm	600 rpm	720 rpm
Type	Francis - horizontal	Kaplan – horizontal	Francis - horizontal
<b><u>Generators</u></b>			
Quantity	2	2	2
Type	Synchronous - horizontal	Synchronous - horizontal	Synchronous - horizontal
Power per unit	1,190 kW	1,148 kW	1,785 kW
Nominal tension	4.16 kV	4.16 kV	6.9 kV
Frequency	60 Hz	60 Hz	60 Hz
Power factor	0.85	0.85	0.85



**Table 2 – Specifications of the equipment used at Spessatto, Santo Expedito and Barra do Leão Project**

**A.4.1. Location of the small-scale project activity:**

**A.4.1.1. Host Party(ies):**

Brazil.

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

State of Santa Catarina (South of Brazil).

**A.4.1.3. City/Town/Community etc.:**

SHP Spessatto: Erval Velho.

SHP Santo Expedito: Campos Novos and Erval Velho.

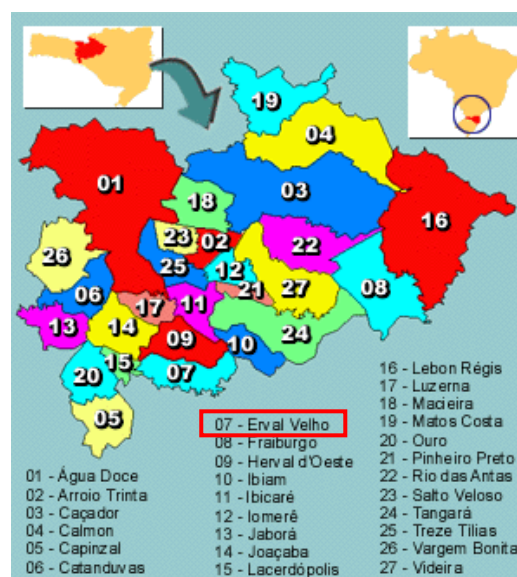
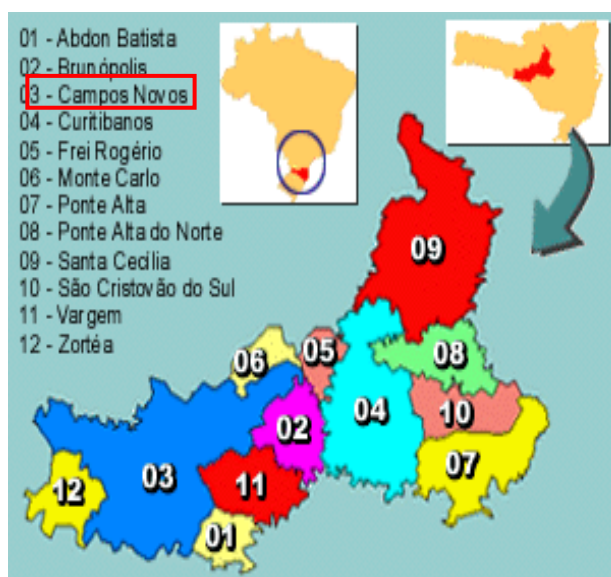
SHP Barra do Leão: Campos Novos and Erval Velho.

**A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):**

The project is located in the south of Brazil, state of Santa Catarina, in the cities of Erval Velho and Campos Novos. Erval Velho has 4,045 inhabitants and 208 km<sup>2</sup>. Campos Novos has 30,291 inhabitants and 1,660 km<sup>2</sup> (Figure 3). Following the geographic coordinates according to ANEEL:

	Latitude	Longitude
<i>SHP Spessatto</i>	27°19'05" S	51°28'36" W
<i>SHP Santo Expedito</i>	27°18'11" S	51°30'36" W
<i>SHP Barra do Leão</i>	27°17'58" S	51°33'05" W

The Project uses the hydro potential of the Leão River, tributary of Peixe River, being part of the Uruguay Basin (Figure 4).



**Figure 3 - Political division of Brazil showing the cities of Erval Velho**  
(Source: City Brazil, 2006).



**Figure 4 – Major Brazilian river basins. The project is located in the Uruguay Basin, showed in yellow** (Source: <http://www.portalbrasil.net/>)

#### **A.4.2. Type and category(ies) and technology of the small-scale project activity:**

Small-scale project activity.

Type 1: Renewable energy projects.

Category I.D.: Renewable energy generation for a grid.

Spessatto, Santo Expedito and Barra do Leão Project uses the renewable hydro potential of the Leão River to supply electricity to a distribution system (Brazilian South-Southeast-Midwest interconnected grid) and has 8.15 MW of installed capacity (below the eligibility limit of 15 MW for small scale projects). The equipment used in the project was developed and manufactured in Brazil.

#### **A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:**

Spessatto, Santo Expedito and Barra do Leão, 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 delivered to the interconnected grid.





Kartha et al. (2002) stated that, “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 the ‘operating margin’ (i.e. affecting the operation of current and/or future power plants).”

For Spessatto, Santo Expedito and Barra do Leão Project, the baseline emission factor is calculated as a combined margin, consisting of the operating margin and the build margin of the relevant electricity system. 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 that is connected by transmission lines to the project and in which power plants can be dispatched without significant transmission constraints.

**A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:**

Years	Annual estimation of emission reductions in tonnes of CO2
2007 (starting in August)	9,822
2008	23,573
2009	23,573
2010	23,573
2011	23,573
2012	23,573
2013	23,573
2014 (until July)	13,751
Total Estimated Emissions Reductions	165,012
Total number of crediting years	7
Annual average over the crediting period of estimated reductions	23,573

**A.4.4. Public funding of the small-scale project activity:**

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

**A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:**

According to Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM projects activities Debundling is defined as the fragmentation of a large project activity into smaller parts.

A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:



- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

Since the project activity do not corresponds to any of the above-mentioned points, it not shall be considered as part of a larger project activity.

## **SECTION B. Application of a baseline methodology:**

### **B.1. Title and reference of the approved baseline methodology applied to the small-scale project activity:**

AMS-1.D Grid connected renewable electricity generation (version 8, March 3, 2006)

### **B.2 Project category applicable to the small-scale project activity:**

Category I.D –Renewable electricity generation for a grid.

This is a type I small-scale CDM project activity: a renewable energy project activity with a maximum output capacity equivalent to up to 15 megawatts.

The capacity of the proposed project activity is 8.15 MW, and will not increase beyond 15 MW.

The baseline scenario is the continuation of the current situation of electricity supplied by large hydro and thermal power stations.

### **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 small-scale CDM project activity:**

The project fulfils all the “additionality” prerequisites (see application of the “tool for the demonstration and assessment of additionality<sup>2</sup>”, hereafter referred to simply as “additionality tool,” below) demonstrating that it would not occur in the absence of the CDM.

The “additionality tool” shall be applied to describe how the anthropogenic emissions of GHG are reduced below those that would have occurred in the absence of the Spessatto, Santo Expedito and Barra do Leão Project. The additionality tool provides a general step-wise framework for demonstrating and assessing additionality. These steps, numbered from 0 to 5, include:

0. Preliminary screening
1. Identification of alternatives to the project activity
2. Investment analysis and/or

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<sup>2</sup> *Tool for the demonstration and assessment of additionality*. UNFCCC, , 28 November 2005, version 2..



3. Barrier analysis
4. Common practice analysis
5. Impact of CDM registration

The application of the additionality tool to the Spessatto, Santo Expedito and Barra do Leão Project follows.

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

Not applicable.

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

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

To define the alternatives to the project activity, there are two-sided analysis, taking into consideration the perspective of the project owner and the perspective of the country.

From the country's perspective, the alternative to the project activity is the continuation of the current (previous) situation of electricity supplied by large hydro and thermal power stations. Brazil is increasingly depending on thermal plants (mainly natural gas fired).

As an alternative for the farmer, there is the investment in other opportunities, like the financial market. Given the main project sponsor had no previous experience with the power market, in terms of alternatives to investor the most feasible scenario is the investment of surplus capital in the financial market or in his traditional business, eggs production.

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

Both the project activity and the alternative scenario are in compliance with all applicable regulations.

#### **Step 2. Investment analysis**

Not applicable

#### **Step 3. Barrier analysis**

##### **3.a. Identify barriers that would prevent the implementation of type of the proposed project activity**

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, as indicated by the project debt structure, which is mostly dependent to the equity capital. The creation of PROINFA is a strong indication that without a financial support, investments in alternative sources of energy for power generation ambit would not be made otherwise;
- Regulatory uncertainty, once a completely new power sector regulation is under development since January 2002.

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

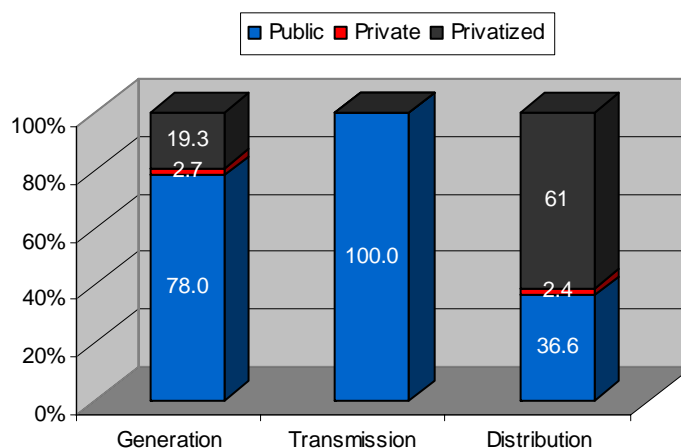
Until the beginning of the 1990's, the energy sector was composed almost exclusively of state-owned companies. From 1995 on due to the increase in international interest rates and the lack of investment capacity of the State, the government was forced to look for alternatives. The solution recommended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

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

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

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

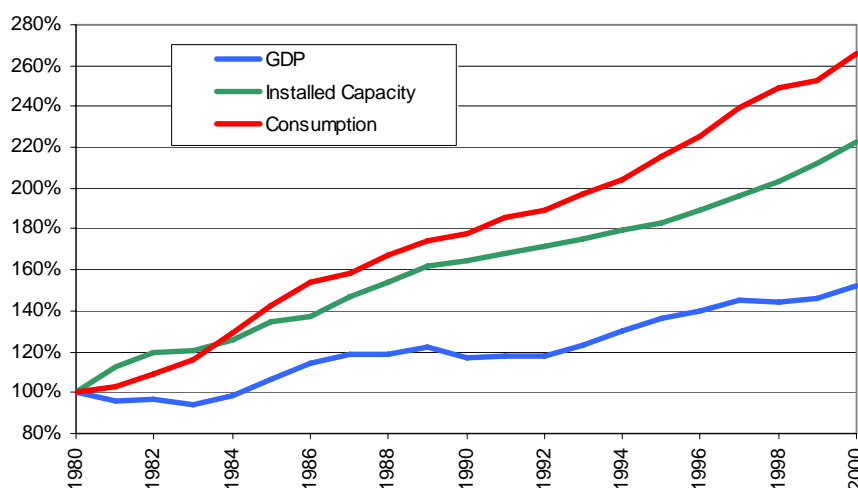
At the end of 2000, after five years of the privatization process, results were modest (Figure 5). Despite high expectations, investments in new generation did not follow the increase in consumption.



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

The decoupling (separação) of **GDP (PIB – Produto Interno Bruto)** (average of 2% increase in the period of 1980 to 2000) from electricity consumption increase (average of 5% increase in the same period) is well known in developing countries, mainly due to the broadening of supply services to new areas and the growing infra-structure. The necessary measures to prevent bottlenecks (acumulo) in services were taken. These include an increase of generation capacity higher than the GDP growth rate

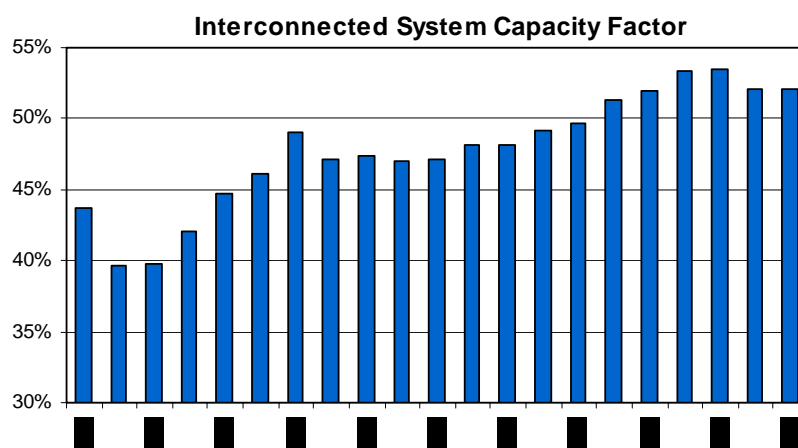
and strong investments in energy efficiency. In the Brazilian case, the increase in the installed generation capacity (average of 4% in the same period) did not follow the growth of consumption as can be seen in Figure 6.



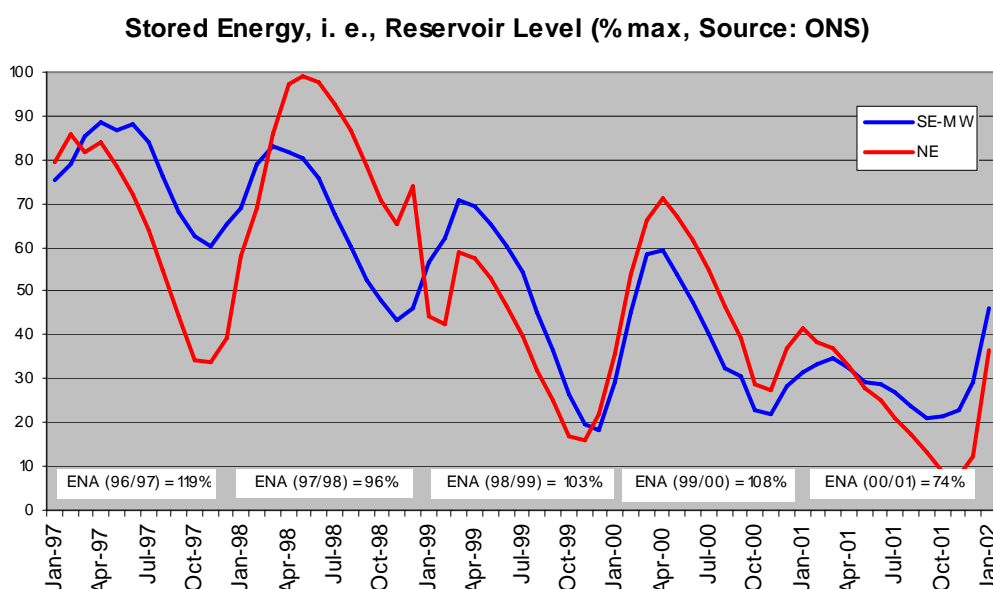
**Figure 6 - Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption)** (Source: Eletrobrás, <http://www.eletrobras.gov.br>; IBGE, <http://www.ibge.gov.br/>)

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 old 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 water accumulated in the reservoirs. Figure 10 shows what has happened to the levels of “stored energy” in the reservoirs from January 1997 to January 2002. It can be seen that reservoirs which were planned to withstand 5 years of less-than-average rainy seasons, almost collapsed after a single season of low rainfall (2000/2001 experienced 74% of historical average rainfall). This situation depicts a very intensive use of the country’s hydro resources to support the increase in demand without increase of installed capacity. Under the situation described there was no long-term solution for the problems that finally caused shortage and rationing in 2001.



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



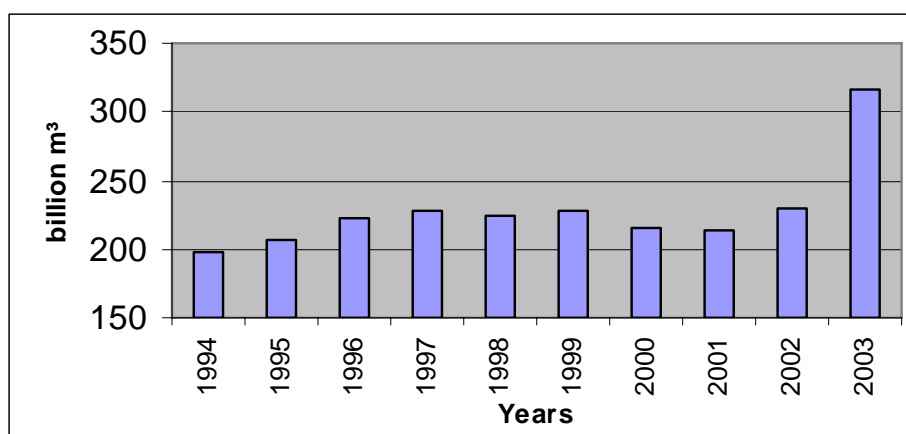
**Figure 8 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average**  
(Source: ONS, <http://www.ons.org.br/>)

Aware of the difficulties since the end of the 1990's, the Brazilian government signaledized that it was strategically important for the country to increase thermoelectric generation and consequently be less dependent of hydropower. With that in mind the federal government launched in the beginning of the year of 2000 the Thermoelectric Priority Plan (PPT, *Plano Prioritário de Termelétricas*, Federal Decree 3,371 of February 24<sup>th</sup>, 2000, and Ministry of Mines and Energy Directive 43 of February 25<sup>th</sup>, 2000), originally planning the construction of 47 thermo plants using Bolivian natural gas, totaling 17,500 MW of new installed capacity by December of 2003. During 2001 and the beginning of 2002 the plan was

reduced to 40 plants and 13,637 MW to be installed by December 2004 (Federal Law 10,438 of April 26<sup>th</sup>, 2002, Article 29). As of December 2004, 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 by end of 2002 (using mainly diesel oil, 76,9%, and residual fuel oil, 21.1%), totalizing 2,150 MW power capacity (CBEE, 2002).

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



**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. Congress approved a new model for the electricity sector in March 2004. The new regulatory framework for the electricity sector has the following key features (OECD, 2005):

- Electricity demand and supply will be coordinated through a “Pool” Demand to be estimated by the distribution companies, which will have to contract 100 per cent of their projected electricity demand over the following 3 to 5 years. These projections will be submitted to a new institution called Energy Planning Company (*Empresa de 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 (*Comitê de Monitoramento do Setor Elétrico*, CMSE), which will monitor trends in power supply and demand. If any problem is identified, CMSE will propose corrective measures to avoid energy shortages, such as special price conditions for new projects and reserve of generation capacity. The Ministry of Mines and Energy will host and chair this committee. No major further privatizations are expected in the sector.

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

### **Investment Barrier (Long-term funding)**

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 that increase the cost of the project and are barriers to the project financeability. Also, the project is generally not financed on a project finance basis, and then the developer is exposed to an extra financing risk.

Other financial barriers may be 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 PCH 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. I.e., 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. During the Proinfa first Public Hearing in beginning 2003, the PCH 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 30<sup>th</sup>, 2004, the Ministry of Mines and Energy (MME) issued the Portaria no. 45, which set the tariff in 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 not considered sufficient. 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. Spessatto, Santo Expedito and Barra do Leão Project is not assessing PROINFA.

**Comparison: Preliminary PPA project tariff x Proinfa tariff**

Plant	Preliminary PPA tariff	Proinfa tariff (approx.) (escalated as of January/06)
Spessatto, Santo Expedito and Barra do Leão	R\$ 120/ MWh for Barra do Leão SHP and the others to be defined	R\$ 129.51/MWh

The Project is negotiating a PPA with Electra Comercializadora de Energia Ltda., not under the Proinfa Law. Its tariff and time of validity are yet to be defined. Proinfa has incentives like 20 years PPA with Eletrobrás and specific financing line with BNDES. These incentives are usually not as good for PPAs outside Proinfa.

Due to all the difficulties exposed, and in spite of all government incentives, there are 265 approved SHP projects in Brazil<sup>3</sup>, between 1998 and 2005, which have not started construction yet. And only 1.43% of the power generated in the country comes from SHPs. So, though Spessatto, Santo Expedito and Barra do Leão Small Hydroelectric Power Plant Project is on the way to obtain a PPA, the difficulties described here regarding investment barriers are common practice in Brazil.

The conclusion is that CDM incentives play an important role in overcoming financial barriers.

### **Institutional Barrier**

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<sup>3</sup> Source: ANEEL - *Agência Nacional de Energia Elétrica* (Brazilian power regulatory agency).



As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created to try to organize and to provide incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period electricity prices surpassed BRL 600/MWh (around USD 200/MWh) and the forecasted marginal price of the new energy reached levels of BR\$ 120 – 150/MWh (around USD 45). In the middle of 2004 the average price was below BRL 50/MWh (less than USD 20/MWh). This relatively high volatility of the electricity price in Brazil, although in the short term, contributes to the difficult the analysis of the market by the developers. Beyond that, Agropecuária Salto do Leão is a farmer that produces eggs and organic manure. Power generation is not its business. For that reason, Agropecuária faced cultural and institutional barriers inside the own farm for dedicating in the construction and management of SHPs. Carbon credits and CDM were taken into account. They are as a guarantee for these SHPs, take into account that they need to be validated and approved.

**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 with the status quo. The project sponsor could invest their resources in different financial market investments. Therefore the barriers above have not affected the investment in other opportunities. On the contrary: Brazilian interest rates, which represent a barrier for the project activity, are a viable investment alternative.

**Step 4. Common practice analysis:**

One of the points to be considered when analyzing a small hydro project investment is the possibility to participate 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. Spessatto, Santo Expedito and Barra do Leão Project is not participating in the program and is addressing the market risk as it structures its projects.

Both process of negotiating a PPA with utility companies and obtaining funding from BNDES are frequently very cumbersome. The developers perceive BNDES requiring excessive guarantees in order to provide financing. Although this might be the Bank role as a financing institution to mitigate risk, it is understood as a market barrier. Other risks and barriers are related to the operational and technical issues associated with small hydros, including their capability to comply with the PPA contract and the potential non-performance penalties.

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

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

The power sector suffered with more than one year (2003-2004) without regulation, and even today the legislation is not already clear for all the investors and players. The prevailing business practice in Brazil as far as obtaining financing and financial guarantees to project is a barrier to investment in

renewable energy projects in the country. 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<sup>4</sup>:

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 1.43% of Brazil's installed capacity comes from small hydro sources (1.3 GW out of a total of 95.8 GW). Also, from the 3.4 GW under construction in the country, only 738 MW are small hydro. In 2004, only 9 small-hydro projects, a total of just 5.22 MW, were authorized by the regulatory agency<sup>5</sup>. 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 short term, since 41% of the projects approved between 1998 and 2005 are thermal power plants (compared to only 14% of SHPs)<sup>6</sup>.

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, obtaining the licenses required by the Brazilian environmental regulation takes much longer for hydropower plants (years) than for thermal (two months). The recent nationalization of the natural gas industry by the Bolivian government might change this situation, but perspectives are not clear so far.

In the most recent energy auction, which took place on December 16<sup>th</sup>, 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<sup>7</sup>.

Finally, as mentioned in section A.2, the project was accepted as a special category project by the FATMA, *Fundação do Meio Ambiente*, the environmental agency of the state of Santa Catarina: a project

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<sup>4</sup> Source: Agência Nacional de Energia Elétrica – ANEEL (Brazilian Power Regulatory Agency).

<sup>5</sup> ANEEL – *Agência Nacional de Energia Elétrica* (Brazilian power regulatory agency)

<sup>6</sup> ANEEL – *Agência Nacional de Energia Elétrica* (Brazilian power regulatory agency)

<sup>7</sup> Rosa, Luis Pinguelli. Brazilian. Newspaper "Folha de São Paulo", December 28, 2005.



of “social interest”. Only social interest projects are allowed to deforest riparian forests in Santa Catarina for their implementation, according to State Law 9,428, article 14, January 7, 1994.

In summary, this project cannot be considered common practice and therefore is not a business as usual type scenario.

### Step 5. Impact of CDM Registration

According to the Brazilian legislation<sup>8</sup> small hydro power plants are hydro power plants with installed capacity greater than 1 MW and up to 30 MW, and with reservoir area of less than 3 km<sup>2</sup>. Generally, it consists of a small hydro plant with reservoir, with has a minimum environmental impact.

This is not the business-as-usual scenario in a country where large hydro and thermal fossil fuel projects are preferable. With the financial benefit derived from the CERs, it is anticipated that other project developers would benefit from this new source of revenues and would then decide to develop such projects. An increase of approximately 100 to 200 basis points, derived from CERs would be an important factor in determination to start such project.

CDM has made it possible for some investors to set up small hydro plants and sell 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.

#### **B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the small-scale project activity:**

The Spessatto, Santo Expedito and Barra do Leão 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. Thus the energy generation and, consequently, the transmission are concentrated in three subsystems. The energy expansion has concentrated in three specific areas:

- Northeast: The São Francisco River basically supplies the electricity for this region. There are seven hydro power plants at the river with total installed capacity around 10.5 GW.
- 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.
- North: 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.

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<sup>8</sup> As defined by ANEEL Resolution no. 652, December 9<sup>th</sup>, 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 (Figure 10) where the project activity is located is considered as a boundary.

### Sistema de Transmissão 2001-2003

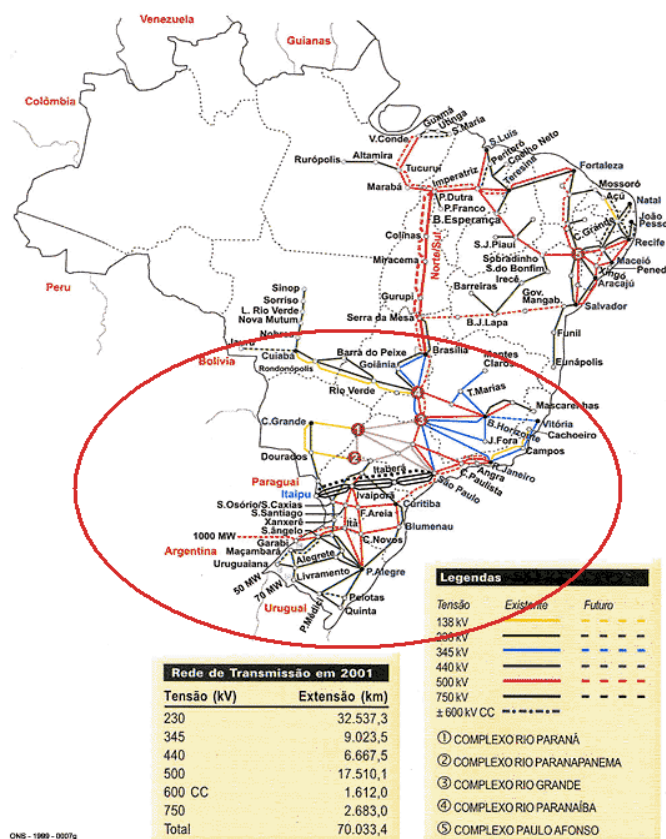


Figure 10 - Brazilian Interconnected System (Source: ONS, <http://www.ons.org.br/>)

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. Actually, in 2004 Brazil exported electricity to Argentina that was in a shortage period. So the energy imported from other countries does not affect the boundary of the project and the baseline calculation.

#### B.5. Details of the baseline and its development:

The project will have an installed capacity of 8.15 MW, hence this is a small-scale CDM project. and the Simplified M&P for Small-Scale CDM Project Activity, Category I. D. is applicable.



According to approved methodology AMS-1.D (version 8, March 3, 2006), there are the following options that can be applied in the selected project category.

“The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kgCO<sub>2</sub>e/kWh) calculated in a transparent and conservative manner:

- (a) The average of the “approximate operating margin” and the “build margin”, where:
  - (i) The “approximate operating margin” is the weighted average emissions (in kgCO<sub>2</sub>e/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;
  - (ii) The “build margin” is the weighted average emissions (in kgCO<sub>2</sub>e/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants. Project participants should use from these two options that sample group that comprises the larger annual generation. Power plant capacity additions registered as CDM project activities should be excluded from the sample group *m*. If 20% falls on part capacity of a plant, that plant is included in the calculation.

or

- (b) The weighted average emissions (in kgCO<sub>2</sub>e/kWh) of the current generation mix.
- (c) Approximate Operating Margin emission factor and the weighted average emission factor can be calculated using either of the two following data vintages for years(s) *y*:
  - Option 1:  
A 3-year average, based on the most recent statistics available at the time of PDD submission.
  - Option 2:  
The year in which project generation occurs, if emission factor is updated based on ex post monitoring.
- (d) Build margin emission factor can be calculated using either of the following data vintages for years(s) *y*:
  - Option 1  
Most recent information available on plants already built at the time of PDD submission.
  - Option 2  
For the first crediting period, emission factor is updated based on ex-post monitoring. For subsequent crediting periods, Emission factor should be calculated ex-ante, as described in option 1 above.

The option chosen in this project is option (a). This choice is due to the fact that, in Brazil, even though most of the energy produced in the country comes from hydroelectric power, most of these low costs investments in hydro electrics are exhausted. Therefore, the possibility of investments in non-renewable sources arises, such as thermoelectric power plants.

As thermal plants use fossil, these companies end up having higher operational costs than hydro plants. As a result, they are likely to be displaced by any hydro added to the grid.

The baseline emission factor is calculated in section E.1.2.4.

Date of completing the final draft of this baseline section (*DD/MM/YYYY*): 18/04/2006.

Name of person/entity determining the baseline:

Company:	Ecoinvest Carbon Brasil Ltda.
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Address:	Rua Padre João Manoel, 222
Zip code + city address:	01411-000 São Paulo - SP
Country:	Brazil
Contact person:	(Mr.) Ricardo Esparta
Job title:	Director
Telephone number:	+55 (11) 3063-9068
Fax number	+55 (11) 3063-9069
Personal e-mail:	esparta@ecoinvestcarbon.com

**SECTION C. Duration of the project activity / Crediting period:****C.1. Duration of the small-scale project activity:****C.1.1. Starting date of the small-scale project activity:**

01/08/2007

**C.1.2. Expected operational lifetime of the small-scale project activity:**

30y-0m.

**C.2. Choice of crediting period and related information:****C.2.1. Renewable crediting period:****C.2.1.1. Starting date of the first crediting period:**

01/08/2007

**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 small-scale project activity:**

According to option (a) of Type I, Category D of CDM small-scale project activity categories contained in Appendix B of the simplified M&P for CDM small-scale project activity, monitoring shall consist of metering the electricity generated by the renewable technology.

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

This Monitoring Plan has been chosen as it is suggested in the option (a) of Type I, Category D of CDM small-scale project activity categories contained in Appendix B of the simplified M&P for CDM small-scale project activity and applies to electricity capacity additions from small-scale hydro power plants with reservoir.

**D.3 Data to be monitored:**

ID number	Data type	Data variable	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)	For how long is archived data to be kept?	Comment
1	Electricity Generation	Electricity generation of the Project delivered to grid	MWh	M	15 minutes measurement and Monthly Recording	100%	Electronic and paper	During the credit period and two years after	The electricity delivered to the grid is monitored by the project (CER seller) and the energy buyer.
2	CO <sub>2</sub> emission factor	CO <sub>2</sub> emission factor of the grid	tCO <sub>2</sub> /MWh	C	At the validation	0%	Electronic	During the credit period and two years after	Data will be archived according to internal procedures.
3	CO <sub>2</sub> emission factor	CO <sub>2</sub> operating margin emission factor of the grid	tCO <sub>2</sub> /MWh	C	At the validation	0%	Electronic	During the credit period and two years after	
4	CO <sub>2</sub> emission factor	CO <sub>2</sub> build margin emission factor of the grid	tCO <sub>2</sub> /MWh	C	At the validation	0%	Electronic	During the credit period and two years after	

Credit owner and project operator, the special purpose company Agropecuária Salto do Leão Ltda. (listed under A.3. Project participants), is author and the responsible for all activities related to the project management, registration, monitoring, measurement and reporting.

**D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:**

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.
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D.3-1.	Low	<i>These data will be used for calculate the emission reductions.</i>
D.3-2.	Low	<i>Data does not need to be monitored</i>
D.3-3.	Low	<i>Data does not need to be monitored</i>
D.3-4.	Low	<i>Data does not need to be monitored</i>

**D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:**

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

The energy meters are specified by the energy distribution company and approved by ONS.

The energy distribution company will be responsible for the calibration and maintenance of the monitoring equipment , for dealing with possible monitoring data adjustments and uncertainties, for review of reported results/data, for internal audits of GHG project compliance with operational requirements and for corrective actions.

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

The SHP hired an expert company to execute their Basic Environmental Project.

**D.6. Name of person/entity determining the monitoring methodology:**

Company:	Ecoinvest Carbon Brasil Ltda.
Address:	Rua Padre João Manoel, 222
Zip code + city address:	01411-000 São Paulo, SP
Country:	Brazil
Contact person:	(Mr.) Ricardo Esparta
Job title:	Director
Telephone number:	+55 (11) 3063-9068
Fax number	+55 (11) 3063-9069
Personal e-mail:	esparta@ecoinvestcarbon.com

**SECTION E.: Estimation of GHG emissions by sources:****E.1. Formulae used:****E.1.1 Selected formulae as provided in appendix B:**

According to the baseline methodology activities contained in Appendix B of the simplified M&P for small-scale CDM project activities, as is the case of Spessatto, Santo Expedito and Barra do Leão Project, emission reductions are those that result from the application of the formula mentioned in item B.5.

**E.1.2 Description of formulae when not provided in appendix B:****E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:**

Not applicable (GHG emissions by the project activity are zero).

**E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities**

According to ACM0002, version 6, May 19, 2006, new Hydro electric power projects with reservoirs, shall account for project emissions, estimated as follows:

a) if the power density of project is greater than 4W/m<sup>2</sup> and less than or equal to 10W/m<sup>2</sup>:

$$PE_y = \frac{EF_{Res} * EG_y}{1000}$$

where,

$PE_y$	Emission from reservoir expressed as tCO <sub>2</sub> e/year
$EF_{Res}$	is the default emission factor for emissions from reservoirs, and the default value as per EB13 is 90 Kg CO <sub>2</sub> e /MWh.
$EG_y$	Electricity produced by the hydro electric power project in year y, in MWh

b) If power density of the project is greater than 10W/m<sup>2</sup>,  $PE_y = 0$ .

1) For SHP Spessatto,

Capacity of the project: 2.35 MW

Area of reservoir: 0.0017 Km<sup>2</sup>

Power density = 2.35/0.0017.

Power density = 1,382 W/m<sup>2</sup>

2) For SHP Santo Expedito,



Capacity of the project: 2.25 MW

Area of reservoir: 0.0005 Km<sup>2</sup>

Power density = 2.25/0.0005

Power density = 4,500 W/m<sup>2</sup>

3) For SHP Barra do Leão,

Capacity of the project: 3.55 MW

Area of reservoir: 0.246 Km<sup>2</sup>

Power density = 3.55/0.246

Power density = 14.42 W/m<sup>2</sup>

For the three SHPs, power density is over 10 W/m<sup>2</sup>. Therefore, PE<sub>y</sub> = 0

**E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:**

Not applicable (GHG emissions by the project activity are zero).

**E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:**

As explained in item B.5, the baseline emission factor will be calculated as the average of the “approximate operating” margin and the “build margin”, where:

(b) The average of the “approximate operating margin” and the “build margin”, where:

- (i) The “approximate operating margin” emission factor ( $EF_{OM,y}$ ) is the weighted average emissions (in kgCO<sub>2</sub>e/MWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. Using the notation from approved methodology (ACM0002):

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} \quad \text{Equation 1}$$

Where:

- $\sum_{i,j} F_{i,j,y}$  is the amount of fuel  $i$  (in mass or volume unit) consumed by relevant power sources  $j$  in year(s)  $y$ ,
- $COEF_{i,j}$  is the CO<sub>2</sub>e coefficient of fuel  $i$  (tCO<sub>2</sub>e/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources  $j$  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  $j$ ,

The CO<sub>2</sub>e coefficient  $COEF_i$  is obtained as,

$$COEF_{i,j} = NCV_i \cdot EF_{CO_2,i} \cdot OXID_i \quad \text{Equation 2}$$

Where:

- $NCV_i$  is the net calorific value (energy content) per mass or volume unit of fuel  $i$ ,
  - $OXID_i$  is the oxidation factor of the fuel  $i$ ,
  - $EF_{CO_2,i}$  is CO<sub>2</sub>e emission factor per unit of energy of the fuel  $i$ ,
- (ii) The “build margin” emission factor ( $EF_{BM,y}$ ) is the weighted average emissions (in kgCO<sub>2</sub>e/MWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants,

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}} \quad \text{Equation 3}$$

Where  $F_{i,m,y}$ ,  $COEF_{i,m}$  and  $GEN_{m,y}$  are analogous to the variables described above for the operating margin for plants  $m$  (sample group  $m$  defined in (ii)), based on the most recent information available on plants already built.

The baseline emission factor  $EF_y$  is the average of the operating margin factor ( $EF_{OM,y}$ ) and the build margin factor ( $EF_{BM,y}$ ),

$$EF_y = 0.5 \cdot EF_{OM,y} + 0.5 \cdot EF_{BM,y} \quad \text{Equation 4}$$



The National Dispatch Center (*Operador Nacional do Sistema Elétrico, Centro Nacional de Operação do Sistema, Acompanhamento Diário da Operação do Sistema Interligado Nacional*, daily reports from Jan. 1, 2002 to Dec. 31, 2004) supplied the raw dispatch data for the whole Brazilian interconnected grid. The following data sources were relevant for the calculation of the baseline:

- The Brazilian electricity system has been historically divided into two subsystems: the North-Northeast (N-NE) and the South-Southeast-Midwest (S-SE-CO). 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’.”

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. (Aneel, 2005.



<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.

The Small Scale Approved Methodology I.D asks project proponents to account for “all generating sources serving the system”. In that way, when applying this 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 (Aneel, 2005. [http://www.aneel.gov.br/arquivos/PDF/Resumo\\_Gr%C3%A1ficos\\_mai\\_2005.pdf](http://www.aneel.gov.br/arquivos/PDF/Resumo_Gr%C3%A1ficos_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% (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% (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.

The amount of fuel consumed by relevant fossil-fuel-fired plants, are the ones collected in a research made by the International Energy Agency (Bosi et. al., 2002).

The emission coefficients of each fuel are the ones indicated by the IPCC (1996).

Using the above mentioned data, the numbers in Table 2 (in section E.2) and Table 4 (below) arise from the calculation of the baseline and the amount of emission reduction over the chosen crediting period.  $EF_y = 0.5 \times 0.9520 + 0.5 \times 0.0962 = 0.5241$ .



**Table 4 - Brazilian South-Southeast-Midwest interconnected system  
baseline calculation**

SSC Emission factors for the Brazilian South-Southeast-Midwest interconnected grid		
Small-scale baseline (without imports)	OM (tCO <sub>2</sub> e/MWh)	Total generation (MWh)
2002	0,9352	276.731.024
2003	0,9725	295.666.969
2004	0,9472	301.422.617
	Average OM (2002-2004, tCO <sub>2</sub> e/MWh)	Total = 873.820.610
	0,9520	BM 2004 (tCO <sub>2</sub> e/MWh)
	OM*0.5+BM*0.5 (tCO <sub>2</sub> e/MWh)	0,0962
	0,5241	

**E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:**

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<sub>2</sub>e/MWh) times the electricity supplied by the project to the grid ( $EG_y$ , in MWh), as follows:

$$ER_y = EF_y \cdot EG_y \quad \text{Equation 5}$$

Since the project activity is not adding renewable energy capacity, nor a retrofit of an existing facility,  $EG_y$  (electricity production) =  $TE_y$  (actual electricity produced in the plant).

**E.2 Table providing values obtained when applying formulae above:**

Considering a baseline of 0.5241 tCO<sub>2</sub>e/MWh, the implementation of Spessatto, Santo Expedito and Barra do Leão Project connected to the Brazilian interconnected power grid will generate an estimated annual reduction as shown in Table 2 below.

Years	Estimation of project activity emissions reductions (tonnes of CO <sub>2</sub> e)	Estimation of baseline emissions reductions (tonnes of CO <sub>2</sub> e)	Estimation of leakage (tonnes of CO <sub>2</sub> e)	Estimation of emissions reductions (tonnes of CO <sub>2</sub> e)
Year 1 (2007, starting in August)	0	9.822	0	9.822
Year 2 (2008)	0	23.573	0	23.573
Year 3 (2009)	0	23.573	0	23.573
Year 4 (2010)	0	23.573	0	23.573
Year 5 (2011)	0	23.573	0	23.573
Year 6 (2012)	0	23.573	0	23.573
Year 7 (2013)	0	23.573	0	23.573
Year 8 (2014, until July)	0	13.751	0	13.751
Total (tonnes of CO <sub>2</sub> e)		165.012		165.012



**Table 2 – Estimated Spessatto, Santo Expedito and Barra do Leão Small Hydroelectric Power Plant Project emissions reductions**

SHP	Barra do Leão	Santo Expedito	Spessatto					
Installed power (MW)	3,55	2,25	2,35					
Capacity factor for commercialization	0,63	0,63	0,63					
baseline (tCO2/MWh)	0,5241							
	Barra do Leão		Santo Expedito		Spessatto		Total tCO2 abated	
	Energy (MWh)	tCO2 abated	Energy (MWh)	tCO2 abated	Energy (MWh)	tCO2 abated		
Total 2007 (starting in August)	8.163	4.278	5.174	2.712	5.404	2.832	9.822	1st
Total 2008	19.592	10.268	12.417	6.508	12.969	6.797	23.573	2nd
Total 2009	19.592	10.268	12.417	6.508	12.969	6.797	23.573	3rd
Total 2010	19.592	10.268	12.417	6.508	12.969	6.797	23.573	4th
Total 2011	19.592	10.268	12.417	6.508	12.969	6.797	23.573	5th
Total 2012	19.592	10.268	12.417	6.508	12.969	6.797	23.573	6th
Total 2013	19.592	10.268	12.417	6.508	12.969	6.797	23.573	7th
Total 2014 (until July)	11.429	5.990	7.243	3.796	7.565	3.965	13.751	8th
Total of the period	137.142	71.876	86.921	45.555	90.784	47.580	165.012	

## SECTION F.: Environmental impacts:

### F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

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

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

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

From the environmental process perspective there are two types of small hydro projects: (a) those ones that only have to prepare a Preliminary Environmental Assessment (“*Relatório Ambiental Preliminar*”, RAP) and (b) those ones that have to further set up assessments called Environmental



Impact Study (“*Estudo de Impacto Ambiental*”, EIA.) and Environmental Impact Assessment (“*Relatório de Impacto Ambiental*”, RIMA). Later on, the local environmental agency can request another assessment called Basic Environmental Project (“*Projeto Básico Ambiental*”, P.B.A.) for both types of project.

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

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

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

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

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

The power plant has the licenses emitted by *FATMA – Fundação do Meio Ambiente*, the environmental agency of the state of Santa Catarina (*Preliminary Permit - nº 313/2005*). All documents related to operational and environmental licensing are public and can be obtained at the state environmental agency (FATMA-SC).

As already mentioned in section A.2, the project is considered of “social interest” by the state of Santa Catarina, according to State Law 9,428, article 14, January 7, 1994.

Given the project is below the environmental legislation criteria of a small-scale size up to 15 MW, it has a fast-track environmental assessment process due to its reduced impact.

**SECTION G. Stakeholders' comments:****G.1. Brief description of how comments by local stakeholders have been invited and compiled:**

The resolution CONAMA 279 of June 2001 establishes that hydropower plants with less than 10 MW of installed power do not need to elaborate Environmental Impact Assessment (EIA – Estudo de Impacto Ambiental). Spessatto, Santo Expedito and Barra do Leão Project is an 8.15 MW hydropower plant. So, it is not necessary to elaborate the EIA.

Public discussion with local stakeholders is compulsory for obtaining the environmental construction and operating licenses, and once the project already received the licenses, the project has consequently gone through a stakeholder comments process.

The legislation also requests the announcement of the issuance of the licenses (LP, LI and LO) in the local state official journal and in the regional newspaper to make the process public and allow public information and opinion.

Additionally, the Brazilian Designated National Authority for the CDM, *Comissão Interministerial de Mudanças Globais do Clima*, requires the compulsory invitation of selected stakeholders to comment the PDD sent to validation in order to provide the letter of approval.

The organizations and entities invited for comments on the project were:

- Erval Velho and Campos Novos City Hall
- Erval Velho and Campos Novos City Council
- State of Santa Catarina Environmental Agency
- Environmental Department of Erval Velho and Campos Novos
- Erval Velho and Campos Novos NGO – Non-Governmental Organization:  
Centro Comunitário de Erval Velho Almérico Ganzer  
Associação Lar dos Meninos João Didomênico
- Santa Catarina State Public Attorney
- FBOMS – Fórum Brasileiro de ONGS e Movimentos Sociais para o Meio Ambiente e Desenvolvimento

Copies of the letters and post office confirmation of receipt communication are available upon request). The PDD of the project is open for comments at the validation stage in the United Nations Framework Convention on Climate Change website (<http://www.unfccc.int/>), since anyone can have access to the mentioned document from a legitimate source.

No concerns were raised so far in the public calls regarding the project.

It was also requested by the local environmental agency a Basic Environmental Project, which is being executed by AGRIMENSURA Serviços Topográficos Ltda

**G.2. Summary of the comments received:**



No comments were received.

<b>G.3. Report on how due account was taken of any comments received:</b>
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No comments were received.

Annex 1**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	Agropecuária Salto do Leão Ltda.
Street/P.O. Box:	Av. XV de Novembro 232 - 1º Andar
City:	Joaçaba
State/Region:	SC
Postfix/ZIP:	89600-000
Country:	Brazil
Telephone:	+55 (49) 3521-1812
FAX:	+55 (49) 3521-3686
URL:	<a href="http://www.fazendasinuolo.com.br/">http://www.fazendasinuolo.com.br/</a>
Represented by:	
Title:	
Salutation:	Mr.
Last name:	Spessatto
Middle name:	Eugenio
First name:	Norberto
Department:	
Mobile:	+55 (49) 9980-0330
Direct fax:	
Direct tel.:	
Personal e-mail:	<a href="mailto:norberto@fazendasinuolo.com.br">norberto@fazendasinuolo.com.br</a>



Organization:	Ecoinvest Carbon Brasil Ltda.
Street/P.O. Box:	Rua Padre João Manoel 222
City:	São Paulo
State/Region:	São Paulo
Postfix/ZIP:	01411-000
Country:	Brazil
Telephone:	+ 55 (11) 3063-9068
FAX:	+ 55 (11) 3063-9069
URL:	<a href="http://www.ecoinvestcarbon.com/">http://www.ecoinvestcarbon.com/</a>
Represented by:	
Title:	Manager
Salutation:	Mr.
Last name:	Martins
Middle name:	de Mathias
First name:	Carlos
Department:	
Mobile:	
Direct fax:	
Direct tel.:	
Personal e-mail:	cmm@ecoinvestcarbon.com

Annex 2**INFORMATION REGARDING PUBLIC FUNDING**

No public funding is involved in the present project.

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

Annex 3**BIBLIOGRAFY**

- ACM0002 (2005).** *Approved Consolidated Baseline Methodology 0002. Consolidated Methodology for grid-connected electricity generation from renewable sources.*
- Aneel (2005).** *Matriz de energia elétrica – Empreendimentos em operação* (Retrieved July 22, 2005 from <http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp>).
- Arida, P. E. L. Bacha, and A. L. Resende (2005).** *Credit, Interest, and Jurisdictional Uncertainty: Conjectures on the Case of Brazil.* In F. Giavazzi, I. Goldfajn e S. Herrera (orgs.), *Inflation Targeting, Debt, and the Brazilian Experience, 1999 to 2003.* Cambridge, MA: MIT Press.
- BNDES (2000).** *O setor elétrico – Desempenho 1993/1999.* Banco Nacional de Desenvolvimento Econômico e Social. Informe Infra-estrutura, nº 53.
- Bosi, M. (2000).** *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study.* International Energy Agency. Paris, 2000.
- Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A. F. Simoes, H. Winkler and J.-M. Lukamba (2002).** *Road testing baselines for greenhouse gas mitigation projects in the electric power sector.* OECD and IEA information paper, October 2002.
- CBEE, (2002).** *Comercilizadora Brasileira de Energia Emergencial.*
- City Brazil (2005).** *City Brazil – Percorrendo o Brasil de A a Z.* (Retrieved June 6, 2005 from <http://www.citybrazil.com.br/>).
- Eletrobrás (1999).** *Diretrizes para estudos e projetos de pequenas centrais hidrelétricas.* Centrais Elétricas Brasileiras S.A.
- IBGE (2004).** *Banco de dados Cidades,* Instituto Brasileiro de Geografia e Estatística (<http://www.ibge.gov.br/>).
- IPCC (1996).** *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.* Intergovernmental Panel on Climate Change.
- Kartha, S., M. Lazarus and M. Bosi (2002).** *Practical baseline recommendations for greenhouse gas mitigation projects in the electric power sector.* OECD and IEA information Paper.
- OECD (2001).** *OECD Economic Surveys: Brazil.* Organization for Economic Co-Operation and Development, Paris, France.
- OECD (2005).** *Organization for Economic Co-Operation and Development,* Paris, France.
- Oliveira, A. S. and L. S. Ribeiro (2001) [orgs.].** *Proposta de critérios e indicadores de elegibilidade para avaliação de projetos candidatos ao Mecanismo de Desenvolvimento Limpo.* Secretária de Qualidade Ambiental nos Assentamentos Humanos, Ministério do Meio Ambiente.
- Schaeffer, R., J. Logan, A. S. Szklo, W. Chandler and J. C. de Souza (2000).** *Electric Power Options in Brazil.* Pew Center on Global Climate Change.
- UNEP-LAC (2002).** *Final Report of the 7th Meeting of the Inter-Sectional Committee of the Forum of Ministers of Environment of Latin America and the Caribbean.* United Nations Environment Program, Regional Office for Latin America and the Caribbean. 15 to 17 May, 2002, São Paulo (Brazil).
- WCD (2000).** *Dams and development—A new framework for decision-making.* World Commission on Dams. November 2000.
- Wikipedia (2005).** *Wikipedia – The free Encyclopedia.* (Retrieved July 21, 2005 from <http://en.wikipedia.org/>).
- WSSD (2006),** *Changing unsustainable patterns of consumption and production.* World Summit on Sustainable Development, Plan of Implementation.