CLEAN DEVELOPMENT MECHANISM

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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Rio Grande do Sul Cooperatives Small Hydro Power Plants.
PDD version number: 05
Date (DD/MM/YYYY): 28/05/2007.

A.2. Description of the project activity:

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

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

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

[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.*"

The Cascatas das Andorinhas, Caraguatá and Linha Três Leste Small Hydro Power Plants Project improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. Small scale hydro electric power projects 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. This kind of project provides site-specific reliability and 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, moreover better income distribution in the region where the Cascatas das Andorinhas, , Caraguatá and Linha Três Leste Small Hydro Power Plants Project 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 that 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.

Project activity consists of newly built 3 small hydroelectric power plants: Cascatas das Andorinhas, Caraguatá and Linha Três Leste located in the South Region of Brazil with a 16.283 MW of total installed capacity. The Cascata das Andorinhas SHP is a Run-of-river that does not require any damming of water, and the other 2 SHPs have a small reservoir with minor environmental impact.

Cooperativa Regional de Eletrificação Rural do Alto Uruguai Ltda. (CRERAL) is the owner of Cascatas das Andorinhas SHP. CRERAL was originated in July 23rd, 1969 by a farmer group that wishes electric energy in their properties and, at the time, the power utility did not construct grids in the rural area. CRERAL first grids were founded in 1970 in Nossa Senhora do Carmo community, Sananduva town. During the seventies and eighties, CRERAL expanded in the region. Nowadays, acts in 37 towns and has 6.100 active associated. Distributes energy in 03 towns' headquarters in the total (Floriano Peixoto, Gramado dos Loureiros and Santo Expedito do Sul) and part of the urban area of Sananduva and Estação. More than 90% of the associated are farmers. Beyond, small industries and commerce are also attended by CRERAL.

Cooperativa de Eletrificação e Desenvolvimento da Fronteira Noroeste Ltda. (COOPERLUZ) is the owner of Santo Antonio and Caraguatá SHPs. Caraguatá is known locally as Comandaí SHP due to the river Comandaí where water is taken. COOPERLUZ was originated in December 05th, 1970. The primary objective of COOPERLUZ is to acquire and produce electric energy, distributing in rural and urban to industry and home use, beyond to develop support programs of familiar agriculture and regional development.

Cooperativa Regional de Energia e Desenvolvimento Ijuí Ltda (CERILUZ) is the owner of Linha Três Leste SHP and was originated in August 20th, 1966. In 1971 started the construction of the first stretch of the distribution system and was concluded in February 1972 with 5 kilometers benefiting 12 residents. In

1995 are defined as priority targets quality and efficiency in the distribution and implementation of own generated electricity. In 1999 began the production of 680kW in the first SHP of his own.

A.3. Project participants:

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

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) Project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Cooperativa Regional de Eletrificação Rural do Alto Uruguai Ltda. (CRERAL)	No
	Cooperativa de Eletrificação e Desenvolvimento da Fronteira Noroeste Ltda. (COOPERLUZ)	
	Cooperativa Regional de Energia e Desenvolvimento Ijuí Ltda. (CERILUZ)	
	Ecoinvest Carbon Brasil Ltda. (private entity)	
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		

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

A.4. Technical description of the project activity:

By legal definition of the Brazilian Power Regulatory Agency (ANEEL- *Agência Nacional de Energia Elétrica*), 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 km^2, which is the case of all three SHPs on this project.

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 hydroelectric power project with reservoir, which results on a minimum environmental impact.

Caraguatá and Linha Três Leste SHPs are hydroelectric power project with reservoir with minimum diversion dams, which store water to generate electricity for short periods of time. On the other side Cascata das Andorinhas SHP is a run-of-river hydroelectric where there is no water storage reservoir, accordingly to the World Commission of Dams (WCD, 2000). A typical run-of-river scheme is shown in Figure 1. A low-level diversion dam raises the water level in 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.

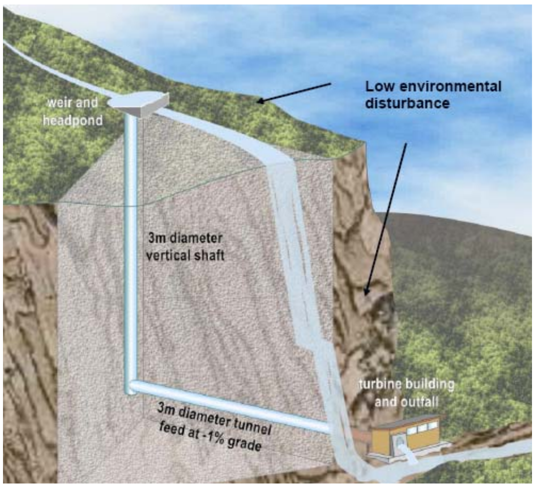


Figure 1 – Schematic view of arun-of-river power plan

Table 2 Main Project Characteristics

	Caraguatá	**Linha Três Leste**		**Cascata das Andorinhas**
Installed Power (MW)	0.953	13.5	0.83	1.0
Capacity Factor (%)	71.1	63.0	95.0	78
Waterfall (meters)	8.0	25.86	11.00	143
Reservoir (km^2)	0.011	1.306		0 (run-of-river)

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil.

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

State of Rio Grande do Sul (RS), South of Brazil

A.4.1.3. City/Town/Community etc:

Cascatas das Andorinhas SHP: Nonoai town.

Caraguatá SHP: Campina das Missões town and Salvador das Missões town.

Linha Três Leste SHP: Ijuí town.

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

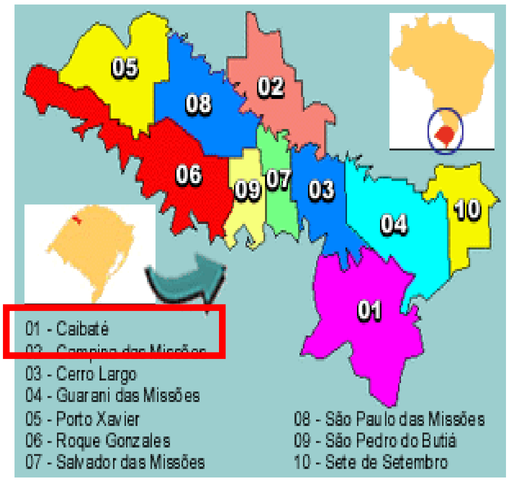
The project is located in the northwest part of state of Rio Grande do Sul (RS). Figure 2 shows state and towns localizations. **Caraguatá** (28º 01' 27" south latitude, 54º 50' 10" west longitude) is located in two towns, Campina das Missões and Salvador das Missões, taking water from Comandaí river sub-basin 74. Campina das Missões is a city with 226 km^2 and 6,535 inhabitants (IBGE, 2006). **Linha Três Leste** (28° 17' 35" south latitude, 53° 52' 27" west longitude) is located in Ijuí town, taking water from Ijuí river, sub-basin 75. Ijuí is a city with 689 km^2, 78,990 inhabitants and 400 km far from Porto Alegre, capital of the state. (IBGE, 2006). **Cascata das Andorinhas** (27º 21' 09" south latitude, 52° 46' 08" west longitude) is located in Nonoai town, taking water from Lajeado do Tigre, sub-basin 73. Nonoai is a city with 469 km^2 and 12,941 inhabitants (IBGE, 2006), and 412 km far from Porto Alegre, capital of the state. Nonoai was founded through the Law n° 3695 of January 30th 1959[2].

Political division of Brazil showing the state of Rio Grande do Sul

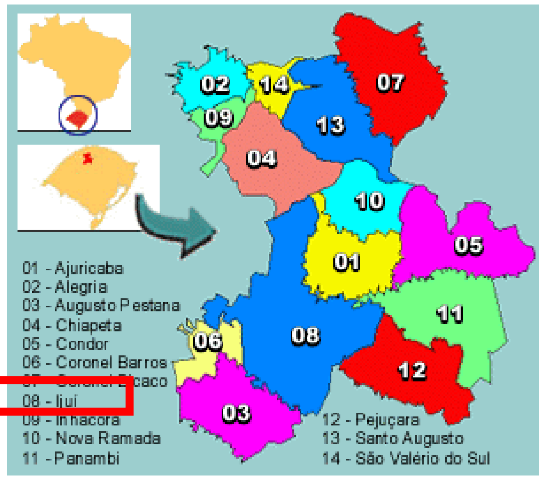
(Source: Portal Brasil, 2006)

Political division of Brazil showing the city of Nonoai (Source: City Brazil, 2006)

[2] www.nonoai.rs.gov.br



Political division of Brazil showing the city of Campina das Missões (Source: City Brazil, 2006)



Political division of Brazil showing the city of Ijuí (Source: City Brazil, 2006)

Figure 2 - Project location

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

Energy industries (renewable sources – hydro electric power).

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

The technology 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 3).

Table 3 - Turbine and Generator Description

	Description	Cascatas das Andorinhas SHP	Caraguatá SHP	Linha Três Leste SHP	
Turbines	Type	Francis	Kaplan		
	Quantity	2	1	3	1
	Power (MW)	0.6 / unit	0.95 / unit	4.5 / unit	0.835 / unit
	Manufacturer	Hacker Industrial Ltda			
Generators	Type	Synchronous	Synchronous	Synchronous	
	Quantity	2	1	3	1
	Nominal Power (MVA)	0.75	1.050	5.0	1.0
	Nominal Power (MW)	0.60		4.5	0.835
	Voltage (KV)	4.16	0.48	6.6	0.380
	Manufacturer	WEG		GE	WEG

The technology employed at Cascatas das Andorinhas, Caraguatá and Linha Três Leste Small Hydro Power Plants Project is established in the industry: Francis and Kaplan turbines (Figure 3 and 4) 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 Caraguatá and Linha Três Leste Small Hydro Power Plants 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 cinetic in mechanical energy.

Figure 3 - Example of a Francis Turbine

Figure 4 – Example of a Kaplan S Turbine

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

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

Considering the baseline of 0.2611 $tonCO_2e/MWh$, applicable to grid-connected renewable power generation project activities in Brazil, the full implementation of the small hydropower plant connected to the Brazilian interconnected power grid will generate the estimated annual reduction as in Table 4 below.

Table 4 - Project Emission Reductions Estimation

Years	Annual estimation of emission reductions in tonnes of CO_2e
2007 (from 15th July)	13,320
2008	24,590
2009	24,590
2010	24,590
2011	24,590

2012	24,590
2013	24,590
2014 (until 14th June)	11,271
Total estimated reductions (tones CO_2e)	172,132
Total number of crediting years	7
Annual average over the crediting period of estimated reduction (tones CO_2e)	24,590

A.4.5. Public funding of the project activity:

This project does not receive any public funding and it is not a diversion of official development assistance.

All 3 SHPs is being financed part from own resource but the large part by the Brazilian Development Bank – BNDES (from Portuguese “Banco Nacional de Desenvolvimento Econômico e Social”). BNDES is a federal owned company subordinated to the Ministry of Development, Industry and Foreign Trade. Despite of being a state-owned bank, BNDES is one of the unique sources of long-term financing in the country and is the preferable debt sources for the private sector in Brazil.

SECTION B. Application of a baseline and monitoring methodology

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

ACM0002 – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (version 6, May 19th,2006).

Version 2 of the tool for demonstration and assessment of additionality.

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

The methodology ACM0002 (version 6, 2006), for grid-connected electricity generation from renewable sources, uses derived margins, which have been applied in the context of the project activity through the determination of the emissions factor for the interconnected Brazilian grid (electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints).

Applicability conditions for Methodology ACM0002[3] are as follow:

- Cascata das Andorinhas SHP is a run-of-river hydro power and the other 2 are hydroelectric power with reservoirs having power densities greater than 4 W/m^2. Caraguatá has a power density of 86.6 W/m^2 and Linhas Três Leste 11.0 W/m^2. All of the 3 SHPs are interconnected to the grid.
- this project activities do not involve switching from fossil fuel to renewable energy at the site of project.
- geographic and system boundaries for the interconnected Brazilian grid is identified and explained in section B.4 and Annex .

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

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

	Source	Gas	Included?	Justification/Explanation
Baseline	Electric energy use	CO_2	Yes	To generate electricity as happen in thermo plants emits greenhouse gases such as carbon dioxide "CO_2"
Project Activity	Emission from reservoir	CH_4	Yes	Green-house gas emissions from reservoirs

[3] ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", 19 May 2006. UNFCCC, CDM Executive Board. Web-site: http://cdm.unfccc.int/

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

In the absence of the project activity, electricity delivered to the grid by the project would have otherwise been imported from the actual grid-connected power plants and/or generated by fossil fuel sources causing emission of larger quantities of carbon dioxide (CO_2). For conservativeness reasons, we consider that all the energy in the absence of the project activity will be imported from the interconnected grid.

On this way, the baseline scenario is identified as the continuation of the current (previous) situation of electricity supplied by large hydro and thermal power stations – or by Diesel oil, in the case of isolated systems.

According to the selected approved methodology (ACM0002, version 6, 2006), the baseline emission factor is defined as EF_y and is calculated as a combined margin (*CM*), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly a connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

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

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

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

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

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

An extensive discussion of the baseline for electricity generation for the Brazilian interconnected grid can be seen in *Esparta & Martins Jr. (2001)*[4]. Its baseline for large scale projects is 261.1 Kg CO_2/MWh. This project baseline methodology/approach has been validated for a similar CDM activity consisting of power capacity expansion of biomass to energy power plant in Brazil.

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

The 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 Cooperatives SHPs activities. The tool refers to the project activity described above.

Following are the steps necessary for the demonstration and assessment of Cooperatives SHPs additionality.

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

Although the step 0 is not applicable because this project is not requiring retroactive credits, as the three plants started operation in 2003 and 2004, i.e., before the project activity is requested to register to CDM project, it is necessary to provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity.

In Rio Grande do Sul State, there is the Federation of Energy, Telephone and Rural Development Cooperatives that organizes studies and meetings to help developing cooperatives activities has started study about CDM since its beginning.

As evidence, there is a Minute of the Meeting held by the Federation at July 23th 2004, and June 20th 2003 where was discussed among others, about the contract of a company to realize viability studies for CDM projects in the cooperatives activities. Although the meeting date is after operation start, one can realize that the studies started even before to culminate in the company contract.

Evidence available by request.

SATISFIED/PASS – Proceed to Step 1

[4] 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.

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

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

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, 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 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.

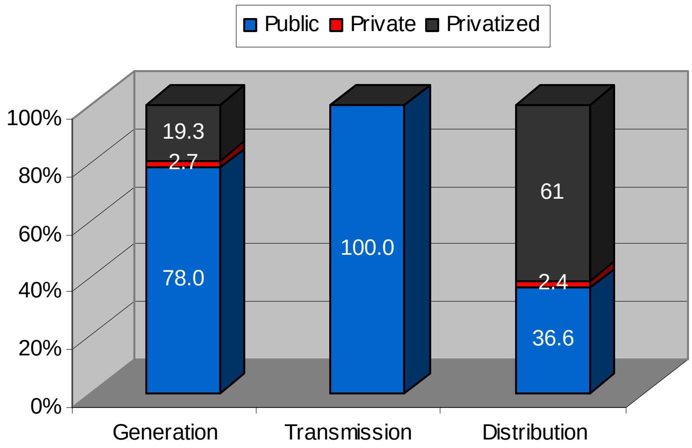


Figure 5 – Participation of private capital in the Brazilian electricity market in December 2000 (Source: BNDES, 2000)

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.

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.

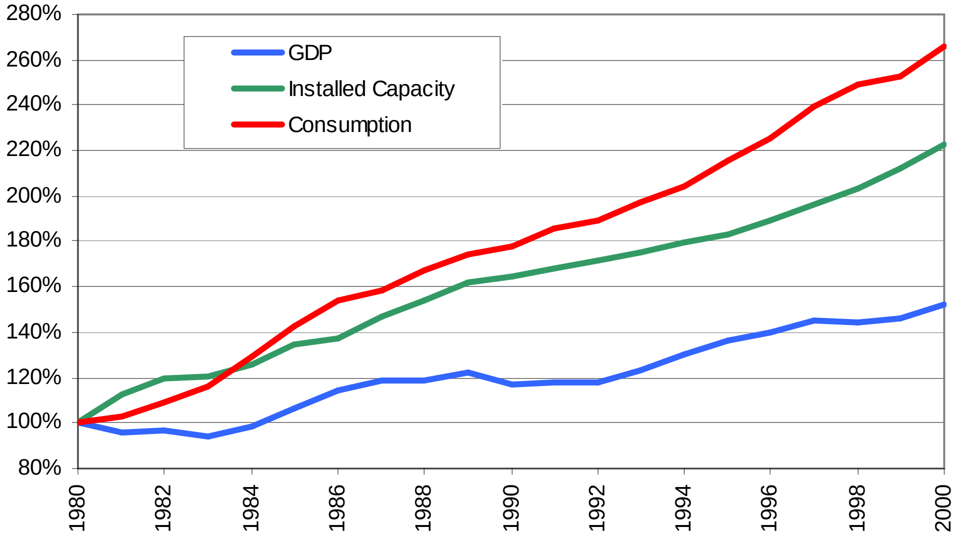


Figure 6 – Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption). (Source: Esparta (2005)

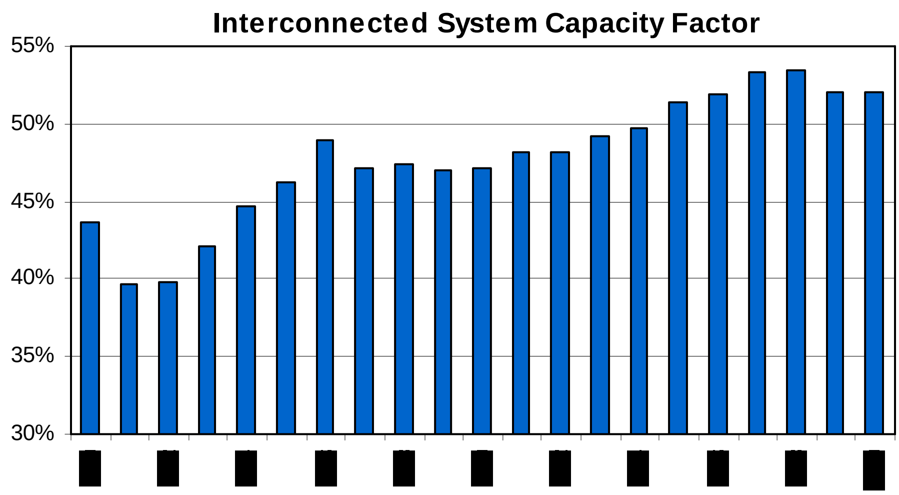


Figure 7 – Evolution of the rate of generated energy to installed capacity (Source: Esparta, 2005))

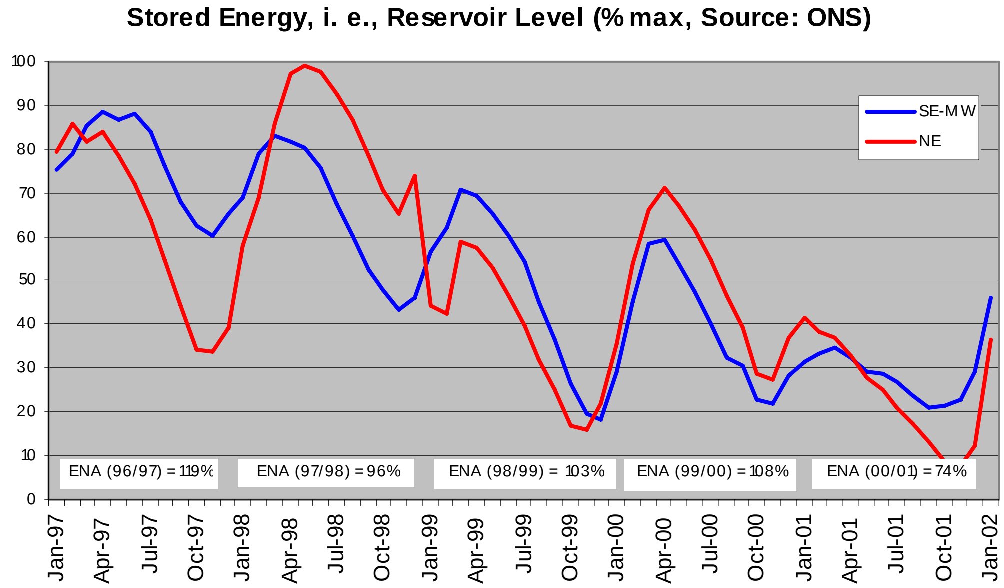


Figure 8 – Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: Esparta, 2005)

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).

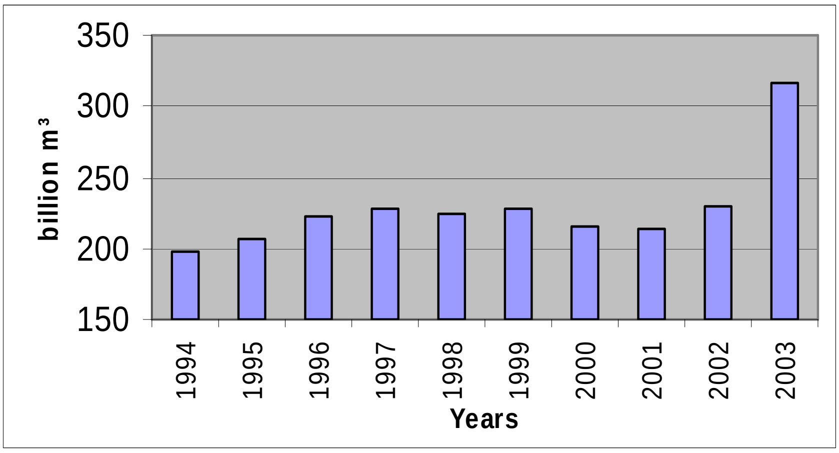


Figure 9 – Evolution of the Brazilian natural gas proved reserves

(Source: Esparta, 2005)

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 Research Company (*Empresa de Pesquisa Energética*, EPE), which will estimate the required expansion in supply capacity to be sold to the distribution companies through the Pool. The price at which electricity will be traded through the Pool is an average of all long-term contracted prices and will be the same for all distribution companies.
- In parallel to the "regulated" long-term Pool contracts, there will be a "free" market. Although in the future, large consumers (above 10 MW) will be required to give distribution companies a 3-year notice if they wish to switch from the Pool to the free market and a 5-year notice for those moving in the opposite direction a transition period is envisaged during which these conditions will be made more flexible. If actual demand turns out to be higher than projected, distribution companies will have to buy electricity in the free market. In the opposite case, they will sell the excess supply in the free market. Distribution companies will be able to pass on to end consumers the difference between the costs of electricity purchased in the free market and through the Pool if the discrepancy between projected and actual demand is below 5%. If it is above this threshold, the distribution company will bear the excess costs.
- The government opted for a more centralized institutional set-up, reinforcing the role of the Ministry of Mines and Energy in long-term planning. EPE will submit to the Ministry its desired technological portfolio and a list of strategic and non-strategic projects. In turn, the Ministry will submit this list of projects to the National Energy Policy Council (*Conselho Nacional de Política Energética*, CNPE). Once approved by CNPE, the strategic projects will be auctioned on a priority basis through the Pool. Companies can replace the non-

strategic projects proposed by EPE, if their proposal offers the same capacity for a lower tariff. Another new institution is a committee, 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[5].

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).

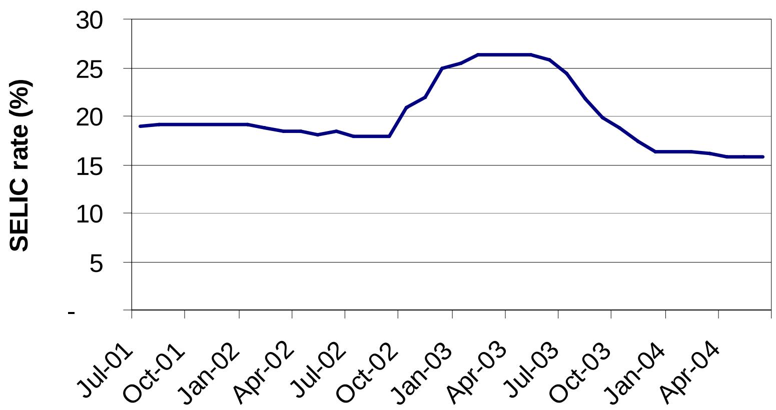


Figure 10 – SELIC rate (Source: *Banco Central do Brasil*)

The proposed small hydro project activity is under development on a project finance basis. To finance construction, project sponsors (Creral, Cooperluz and Ceriluz) took advantage of the financing lines of BNDES.

This financial support covers 68% of Creral investment, 57% of Cooperluz investment, 80% of Ceriluz investment of the project costs with a TJLP[6] (BNDES Long Term Interest Rate) rate of 9% plus a 4.0% spread risk for a term of 10, 8.5, 12 years and grace period of 2 years for Creral, Cooperluz and Ceriluz respectively.

The project has a financial IRR (Internal Rate of Return) of expected IRR of -7.49% for Cascata das Andorinhas, 6.23% for Caraguatá and 14.57% for Linha Três Leste. Linha Três Leste has the highest IRR due to its larger capacity, however still it is very low comparing to the SELIC rate, set on the level of 25% during end of 2002 to first half of 2003, when Cascata das Andorinhas, Caraguatá and Linha Três Leste started construction. Although the project is a much riskier investment as compared to Brazilian

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

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

government bonds, project sponsors chose to invest in the power plant construction, because as they are farmer cooperatives to ensure electricity supply in case of lack in the interconnected grid.

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 finance ability. Besides, this is small scale project, which generally have more difficult access (than large scale projects) to financing lines in Brazil, due to real or perceived risks.

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 and with new plants, which usually attract the attention of the financial market.

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 renewable energy projects in Brazil and there is room for CDM projects. 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 265 approved SHP projects in Brazil[7], between 1998 and 2006, which have not started construction yet. And only 1.43% 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 region where the project is located is isolated and undeveloped. The regional electrical company did not construct distribution grid in rural area. And due to that, there is a lack of infrastructure, such as roads, reliable electricity supply, communication and transports. The project sponsors developed the distribution grid as electrical poles before the implementation of this project. In addition, there were no qualified personnel available in the region 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 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.

Moreover, the Cooperatives have an agreement with the regional electrical company Rio Grande Energia S/A (RGE) to equilibrate the excess and lack of energy generated in the SHP compared to the cooperatives associates consumption. In the close of a month, when there is excess, it is used to compensate lack in next months. When there is lack, cooperative must pay to the electrical company R$108.89 / MWh.

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

As described in Sub-step 1a, the main alternative to the project activity is to continue the status quo or undertaken without being registered as a CDM project activity. Considering the barriers that the project would face without being registered as a CDM project activity - as described in Sub-step 3a -, consequently without its benefits, the project sponsor could invest their resources in different financial market investments. Given that Creral, Cooperluz and Ceriluz are cooperatives of farmers, it could as well have decided to focus on other common activities of similar groups (e.g., building cooperative market, selling fertilizers, etc.), and not on the power market, as it is the case with the project activity. 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

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

Step 4. Common practice analysis

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

In all Rio Grande do Sul State, there are 142 small hydro power plants in operation or in license process. Among them, 37 are owned by cooperatives. There are inclusive, some projects differed its implementation[8]. Below are exemplified similar projects in scale implemented by cooperatives:

SHP Linha Aparecida, 25MW installed capacity, 300ha reservoir, located in Várzea River, between the cities Liberato Salzano e Novo Tiradentes. 27° 32’02” south, 53° 07’48” west. This project is under Previous License.

Is under construction a run-of-river SHP Rastro de Auto in Forqueta river, 7,0 MW installed capacity, adduction tunnel of 1,000 meters, water fall pipeline of 250m. Constructed by Cooperativa de Eletrificação Regional Teutônia Ltda, located at São José do Herval e Putinga –RS.

Is operating since November 2003 a SHP of 3.6 MW installed capacity, with 5.49 ha reservoir in Ijuizinho river, Entre-Ijuís City. Owned by Cooperativa Regional de Eletrificação Rural das Missões Ltda.

For the best of our knowledge all of the cooperatives participate the Federation of Energy, Telephone and Rural Development Cooperatives who is studying about CDM for long period, and are expecting for the here exposed project been implemented.

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 this project, which will provide long-term PPAs and special financing conditions. The project activity is not participating in the Program.

Both processes of negotiating a PPA with utility companies and obtaining funding from BNDES are frequently very cumbersome. Many 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 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 endorsed that the projects under the Proinfa Program will also be eligible to participate in the CDM, in accordance with the decision of the

[8] FEPAM, Fundação Estadual de Proteção Ambiental, http://www.fepam.rs.gov.br/licenciamento/area3/default.asp

UNFCCC about elegibility of projects derived from public policies. 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[9]:

Installation of SHP (Reference: Aneel, 2006)

Year	MW
2001	69.1
2002	55.5
2003	267.7
2004	67.8
2005	126.4
2006 (until October)	76.6

Because of the reasons mentioned above, only 1.54% of Brazil’s installed capacity comes from small hydro sources (1.48 GW out of a total of 96,4 GW). Also, from the 3.16 GW under construction in the country, only 625 MW are small hydro. In 2004, only 9 small-hydro projects, a total of just 5.22 MW, were authorized by the regulatory agency[10]. 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 21.5% of the power generated in the country comes from thermal power plants, and this number tends to increase in the next years, since 40% of the projects approved between 1998 and 2005 are thermal power plants (compared to only 14% of SHPs)[11].

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 obtaini ng 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. From the total of 3,278 MW sold, only three are for

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

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

[11] ANEEL – *Agência Nacional de Energia Elétrica* (Brazilian power regulatory agency). **Capacidade de Geração do Brasil, December 8th 2006**

SHPs (38 MW). , 2,278 MW (69%) will come from thermal power plants, from which 1,467 come from natural gas fired thermal power plants, i.e., 45% of the total sold[12].

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.

SATISFIED/PASS – Proceed to Step 5

Step 5 – Impact of CDM registration

According to Brazilian legislation[13] 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 small hydro plant with reservoir, 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..

To proceed with the project activity, i.e. self-generation of electricity, there is a need for incentives, as they are having financial barriers to proceed.

The inclusion of the revenues from CERs makes the project's IRR increase 50 basis points (IRR calculation under request) to Caraguatá, 300 to Cascata das Andorinhas and 130 to Linha Três Leste. Although Cascata das Andorinhas has a relative high increase, still is negative, however such increase in return would partially compensate for the additional risk the investor is taking with this project.

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.

In addition, 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 the project sponsors 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.

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 Table 5 below shows the CER revenues attractiveness of the project, based on the project IRR.

Table 5: Project Financial Analysis

Plant	IRR with CER	IRR without CER

[12] ANEEL – *Agência Nacional de Energia Elétrica* (Brazilian power regulatory agency). **Leilão Nº 002/2205-ANEEL. Resultado do Leilão Resumo Vendedor**

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

Cascata das Andorinhas (Creral)	-4.36 %	-7.49 %
Caraguatá (Cooperluz)	6.78 %	6.23 %
Linha Três Leste (Ceriluz)	15.91 %	14.57 %

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.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to ACM0002, version 6, 19 May 2006, the emission reduction (*ERy*) by the project activity during a given year *y* is the difference between baseline emissions (*Bey*), project emissions (*PEy*) and emissions due to leakage (*Ly*), as follows:

$$ERy = Bey - PEy - Ly$$ **Equation 1**

Baseline emissions (*Bey*) are the product of the baseline CO_2 emission factor (*EFy* in tCO_2/MWh) calculated in Step 3 above, times the annual electricity supplied by the project activity to the grid (*Egy* in MWh), as follows:

$$Bey = Egy * EFy$$ **Equation 2**

Project emissions (*PEy*) is null for run-of-river hydropower, and for new hydro electric power projects with reservoirs, are estimated as follows:

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

$$PEy = \frac{EF_{Res} * EGy}{1000},$$ **Equation 3**

where, *PEy*: Emission from reservoir expressed as tCO_2e/year
EF_{Res}: is the default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 $KgCO_2e$/MWh
Egy: 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^2, PEy = 0.

Cascata das Andorinhas SHP is a run-of-river hydropower, thus does not have project emissions.

The other two SHPs Caraguatá and Linha Três Leste power densities are as follow:

Table 6 – SHPs Power Densities

	Caraguatá	Linha Três Leste
Capacity (MW)	0.953	14.33
Area of reservoir (km^2)	0.011	1.306
Power Density (W/m^2)	56.1	11.0

They have power density greater than 10 W/m^2, in this way, project emissions (*PEy*) is equal zero.

Potential leakage (*Ly*) emissions in the context of electric sector projects are emissions arising due to project construction, transportation, material handling, land inundation and other upstream activities. Applying ACM0002 methodology, do not need to consider emission sources as leakage. In this way, *Ly* is equal zero.

Considering above explanations in Equation 1, emission reductions by the project activity (ER_y) during a given year *y* are the baseline emissions (*Bey*) themselves. So, emission reductions are calculated as the product of the baseline emissions factor (EF_y, in tCO_2e/MWh) and the electricity supplied by the project to the grid (EG_y, in MWh), as follows:

$$ERy = Egy * EFy \qquad \textbf{Equation 4}$$

From ACM0002, version 6, 2006, a baseline emission factor (*EFy*) is calculated 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[14] 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 7 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 Cascata das Andorinhas, Caraguatá and Linha Três Leste SHPs project.

Table 7 – Share of hydroelectricity production in the Brazilian S-SE-CO interconnected system from 1999 to 2003 (ONS, 2004).

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

[14] Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation (ACM0002, 2006).

2003	92.9

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*):

$$EF_{OM,simple-adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$ **Equation 5**

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 (from the Portuguese *Operador Nacional do Sistema Elétrico)* in the form of daily consolidated reports (ONS-ADO, 2004). Data from 126 power plants, comprising 66 GW installed capacity and around 828 TWh electricity generation over the 3-year period were considered.

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., $COEF_{i,k}$ for these plants is zero. Hence, the low-cost/must-run part of the Equation 5 is null, so this equation turns to the following:

$$EF_{OM,simple-adjusted,y} = (1-\lambda_y).EF_{OM-non,y} = (1-\lambda_y).\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}}$$ **Equation 6**

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

Non-low-cost/must-run resources in Brazilian S-SE-CO interconnected system are thermopower 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 $\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}$ for each one of the plants was obtained from the following formulae:

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

$$COEF_{i,j} = NCV_i \cdot EF_{CO2,i} \cdot 44/12 \cdot OXID_i$$ **Equation 8**

$$Hence,\ F_{i,j,y} \cdot COEF_{i,j} = \frac{GEN_{i,j,y} \cdot EF_{CO2,i} \cdot OXID_i \cdot 44/12 \cdot 3{,}6 \times 10^{-6}}{\eta_{i,j,y}}$$ **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 $F_{i,j,y} \cdot COEF_{i,j}$ in [tCO_2e]
- $GEN_{i,j,y}$ is the electricity generation for plant *j*, 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 x 10^{-6} is the energy conversion factor, from MWh to TJ.
- $\eta_{i,j,y}$ is the thermal efficiency of plant *j*, 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].

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

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$ **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, version 6, 2006) 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 11**

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., w_{OM} = w_{OM} = 0.5).

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

Data / Parameter:	Area
Data unit:	m^2
Description:	Surface area at full reservoir level
Source of data used:	According to License of Operation.
Value applied:	1,323
Justification of the choice of data or description of measurement methods and procedures actually applied:	Data is monitored only at start of the project. The value is estimated by the national electricity agency at the concession phase and is thoroughly calculated and determined during the environmental licensing phase (very low uncertainty level).
Any comment:	

Data / Parameter:	EF_y
Data unit:	tCO_2/MWh
Description:	Emission factor for the Brazilian South-Southeast-Midwest interconnected grid
Source of data used:	Data provided by ONS (National dispatch center). Calculated according to the approved methodology – ACM0002, version 6, 2006.
Value applied:	0.2611
Justification of the choice of data or description of measurement methods and procedures actually applied:	The baseline emission factor (EFy) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. Calculations for this combined margin are based on data from an official sources (National Dispatch Center for the power generation data; EB decision regarding thermodynamic efficiency of power by fuel types information) with very low level of uncertainty and made publicly available.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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

Future electricity supplied by the project to the grid is estimated based from installed capacity of hydropower plants and capacity factor presented in Table 2.

For EF_{OM} calculation, first the λ_y factors are calculated as indicated in methodology ACM0002, version 6, 2006, with date obtained from the ONS database. Figure 9, Figure 10 and Figure 11 in Annex3 present the load duration curves and λ_y calculations for years 2003, 2004 and 2005, respectively.

The results for years 2003, 2004 and 2005 are presented in Table 8.

Table 8–- Share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin in the S-SE-CO system for the period 2003-2005 (ONS-ADO, 2006).

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}}$ [tCO_2/MWh]	λ_y [%]
2003	0.9823	0.5312
2004	0.9163	0.5041
2005	0.8086	0.5130

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

$EF_{OM,simple-adjusted,2003-2005}$ = 0.4349 tCO_2e/MWh.

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

- $EF_{BM,2005} = 0.0872\ tCO_2e/MWh$.

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

$$EF_y = 0.5 \times 0.4349 + 0.5 \times 0.0872$$

- $EF_y = 0.2611\ tCO_2e/MWh$.

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

Year	Estimation of project activity emissions	Estimation of baseline emissions	Estimation of leakage	Estimation of overall emission reductions

	(tones of CO_2e)	(tones of CO_2e)	(tones of CO_2e)	(tones of CO_2e)
2007 (From 15th July)	0	13,320	0	13,320
2008	0	24,590	0	24,590
2009	0	24,590	0	24,590
2010	0	24,590	0	24,590
2011	0	24,590	0	24,590
2012	0	24,590	0	24,590
2013	0	24,590	0	24,590
2014 (until 14th June)	0	11,271	0	11,271
Total (tonnes of CO_2e)	0	172,132	0	172,132

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

B.7.1 Data and parameters monitored:

Methodology applicable to this project is the approved consolidated monitoring methodology ACM0002, version 6, May 19, 2006 – “Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources”.

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

The parameters chosen for the calculation of emission reductions were ex-post. Data monitored and required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter:	EF_y
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of the grid
Source of data to be used:	ONS (Operador Nacional do Sistema Elétrico – National Electric System Operator)
Value of data applied	0.2611 tCO2/MWh

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	The baseline emission factor (EFy) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. Calculations for this combined margin are based on data from an official sources (National Dispatch Center for the power generation data; EB decision regarding thermodynamic efficiency of power by fuel types information) with very low level of uncertainty and made publicly available. Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	$EF_{OM,y}$
Data unit:	tCO_2/MWh
Description:	CO_2 Operating Margin emission factor of the grid
Source of data to be used:	Data provided by ONS (National dispatch center). Calculated according the approved methodology – ACM0002
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.4349 tCO2/MWh
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO_2/MWh
Description:	CO_2 Build Margin emission factor of the grid
Source of data to be used:	Data provided by the National Electric System Operator (ONS). Calculated according the approved methodology – ACM0002
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0872 tCO_2/MWh
Description of measurement methods	n/a

and procedures to be applied:	
QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	λ_y
Data unit:	No unit
Description:	Fraction of time during which low-cost/must-run sources are on the margin
Source of data to be used:	Data provided by the National Electric System Operator (ONS). Calculated according the approved methodology – ACM0002
Value of data applied for the purpose of calculating expected emission reductions in section B.5	λ_{2003}=0.5312, λ_{2004}=0.5055, λ_{2005}=0.5130
Description of measurement methods and procedures to be applied:	Calculated according to the approved methodology – ACM0002, version 6, 2006. See more details in Annex 3.
QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	Electricity generation of the Project delivered to grid (EGy)
Data unit:	MWh
Description:	Energy metering connected to the grid and the annual energy generation report
Source of data to be used:	Energy metering at generation plant using annual energy generation report
Value of data applied for the purpose of calculating expected emission reductions in section B.5	16,488 MWh
Description of measurement methods and procedures to be applied:	Continuously electronic measurement for each 1MW generated and Weakly recording.
QA/QC procedures to be applied:	Energy metering QA/QC procedures are explained in Annex 4 (the equipments used have by legal requirements extremely low level of uncertainty). Measured and monitored yearly.
Any comment:	The electricity delivered to the grid is monitored by the Project as well as by the energy buyer

Data / Parameter:	$F_{i,y}$
Data unit:	Mass of volume
Description:	Amount of fossil fuel consumed by each power plant

Source of data to be used:	Latest local statistics
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Large amount of data (individual data/parameter for each power plant). Data used in the calculations are presented in the spreadsheets appended to the PDD.
Description of measurement methods and procedures to be applied:	Publicly available official data.
QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	$GEN_{j/k/n,y}$
Data unit:	MWh/a
Description:	Electricity generation of each power plant
Source of data to be used:	Latest local statistics
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Large amount of data (individual data/parameter for each power plant). Data used in the calculations are presented in the spreadsheets appended to the PDD.
Description of measurement methods and procedures to be applied:	Publicly available official data.
QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	$GEj_{i/k/ll,y\ IMPORTS}$
Data unit:	MWh
Description:	Electricity imports quantity to the project electricity system
Source of data to be used:	Latest local statistics
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Large amount of data (individual data/parameter for each power plant). Data used in the calculations are presented in the spreadsheets appended to the PDD.
Description of measurement methods and procedures to be applied:	Publicly available official data.

QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	$COEF_{i,j\ y}$
Data unit:	tCO_2/mass or volume unit
Description:	CO_2 emission coefficient of fuels used in connected electricity systems
Source of data to be used:	Obtained from Intergovernmental Panel on climate Change (IPCC), International Energy Agency (IEA) and Organisation for Economic Co-operation and Development (OECD).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Publicly available official data.
QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	$COEF_i$
Data unit:	tCO_2/mass or volume unit
Description:	CO_2 emission coefficient of each fuel type
Source of data to be used:	Obtained from Intergovernmental Panel on climate Change (IPCC), International Energy Agency (IEA) and Organisation for Economic Co-operation and Development (OECD).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Massive amount of data, individual values for each plant of the grid, raw data available for validation.
Description of measurement methods and procedures to be applied:	Publicly available official data. Default data and literature statistics are used to check the local data.
QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	*Plant name*
Data unit:	Text
Description:	Identification of power source/ plant for the OM
Source of data to be used:	Obtained from the National Electric System Operator (ONS)

Value of data applied for the purpose of calculating expected emission reductions in section B.5	Massive amount of data. Data used in the calculations are presented in the spreadsheets appended to the PDD.
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

Data / Parameter:	*Plant name*
Data unit:	Text
Description:	Identification of power source/ plant for the BM
Source of data to be used:	Obtained from the National Electric System Operator (ONS)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Massive amount of data. Data used in the calculations are presented in the spreadsheets appended to the PDD.
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	Data ex-post calculated and monitored yearly.
Any comment:	

B.7.2 Description of the monitoring plan:

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.

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

- SHP Linha Três Leste: Elo 2180, manufacture ELO Sistemas, with GPS synchronism and remote access by mobile phone, Class 2 accuracy. 10 operators are allocated in SHP operation. For the minor generator with 0.83MW capacity, is installed a ELSTER meter, model A3RBR, with monitoring on-site. The substitution of this meter by Elo 2180, the same for the larger generator, is been discussed to equal the 2 (two) generation monitoring systems. Meter is calibrated each 5 years as defined by manufacture.
- SHP Cascata das Andorinhas: there is one meter installed for each generator, electronic meters, Nansen manufacture, model Spectrum-Sdat-R, which has digital cumulative data reading system,

0.5% accuracy. Also, a report will be done once a week. 3 operators and 1 maintenance technician to SHP operation. Meter was fabricated at september 2006, and has a 15 years life time. In 2021, at the end of its life time, the meter will be replaced by a new one.

- SHP Caraguatá: actually a COMAP Inteligen meter is installed inside WEG control panel, with GPS synchronism and remote access by mobile phone, Class 3 accuracy. 4 operators are allocated in SHP operation. Meter is calibrated each 10 years as defined by manufacture. Maintenance is made by WEG when need, and calibration by COMAP. Until the start of crediting period (July 2007) will be installed an independent electronic electricity meter as in Linha Três Leste and Cascata das Andorinhas SHPs.

All the energy meters meet the Brazilian Technical Standards (ABNT) concerned: ABNT 14519, 14520, 14521 and 14522.

Each energy distribution company – Cooperluz, Ceriluz and Creral - will be responsible for the project management as well as for organizing and training of the staff in the appropriate monitoring, measurement and reporting techniques. Manufacture is responsible for the calibration and maintenance. For the operation of the power plant, cooperative hired full time operators allocated at each SHP to operate the plant. Data collection and archiving is under responsibility of Cooperative as well as 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.

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

Date of completing the final draft of this baseline section (DD/MM/YYYY): 28/08/2006.

Name of person/entity determining the baseline:

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

Ecoinvest is the Project Advisor and also a Project Participant.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

SHP Caraguatá: 15 December 2004

SHP Linha Três Leste: 31 December 2003

SHP Cascata das Andorinhas: 15 July 2003

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

50years 0 months

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

C.2.1. Renewable crediting period

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

15 July 2007

C.2.1.2. Length of the first crediting period:

7 years, 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

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

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. Generally, it consists of a hydro electric power project with reservoir, which results in having 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.

<u>Contribution to Sustainable Development (host-party CDM letter or approval requirement)</u>

a) Contribution to the local environmental sustainability

The “Rio Grande do Sul Cooperatives Small Hydro Power Plants” project is part of the interconnected Brazilian 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

All three SHPs are already in operation. Many civil workers were allocated during construction, more than 100 people in each SHP. 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.

One of the most important contributions from the construction of these hydro electric power project 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 that 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 Cooperatives project 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. Better income distribution in the region where the Cooperatives 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 that 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 capacities, 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 teach 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 Cooperatives 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 that now has a better guarantee of electrical supply. This is the case of Cooperatives SHPs. 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 Cooperatives 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 a hydro electric power project with reservoir, which are renewable sources of energy, to generate electricity for local use and for delivery to the grid, the Cooperatives 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

Since beginning of construction, 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, 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.

- SHP Linha Três Leste: SHP develops a Environmental Education Program involving all population including 600 children at schools located around the hydropower plant. There are also reforestation and water quality monitoring programs, motivating the conservation of permanent conservation areas. Moreover there are constant incentive actions for planting. The cooperative CERILUZ develops other environmental programs in schools and communities extending to all 24 cities where cooperative acts, with seminars and lectures about water and environment by cooperative expertise and contracted biologist.
- SHP Cascata das Andorinhas: environmental education in schools of Nonoai City about "water" theme by SHP. Native seeds distribution and planting seedling activities. Sponsoring and participation in environmental educations promoted by the City Hall. Cooperative CRERAL also writes a column in the environmental journal called "A visão da notícia" (The vision of news") with local circulation.
- SHP Comandai: cooperative develops environmental education in schools at the cities participating in the cooperative, with lectures and field activities as identification of environmental problems, riverside recovery, seedling planting, etc. In 2005, 1660 students,

parents and teachers participate the program. Also publishes an informative bulletin to disseminate environmental concepts, mainly about sustainability.

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 project is located, as listed below:

- SHP Linha Três Leste: 20 km upstream in the same Ijuí river there is the Ruben Kesseker da Silva SHP, and also 20 km away is the Usina Velha SHP in Potiribu river.
- SHP Cascata das Andorinhas: 40 km away between the same Nonoai City and Faxinalzinho City is been projected a large scale hydropower Monjoinho 65.8MW.
- SHP Comandai: there is no other existing or projecting dams in the neighborhood

d) Sustaining rivers and livelihoods

Although some environmental impact is expected from the project, the project sponsor is committed to mitigating this with close cooperation from the local community. Mitigation and/or compensatory measures are been held and others in course 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.

- SHP Linha Três Leste: 200,000 native seedlings were planted there will be significantly improve
- SHP Cascata das Andorinhas:
- SHP Comandai:

e) Recognizing entitlements and sharing benefits

There was a small displacement of population only in the Caraguatá SHP site that was compensated. Reservoir inundation did not lead to productive area lost or fauna damage from a narrow native vegetation remove.

In this way, there is neither significant economic impacts nor negative effect to population interests and rights related to the project.

As for sharing the benefits, degraded areas are being renovated, reforestation work is underway and specific program in each SHPs is in action as described below:

- SHP Linha Três Leste: Cooperative CERILUZ organizes meetings with the surrounding communities with a psychologist to give new knowledge and increase self-confidence. These meeting have the objective to improve life quality by means of changing personal habits.
- SHP Cascata das Andorinhas: energy generated will supply 2500 agriculture families representing 90% of associates.
- SHP Comandai: Cooperative COOPERLUZ is supporting technically and financially the creation of CRECAF - Central Regional de Cooperativas da Agricultura Familiar (Familiar Agriculture Cooperatives Regional Centre)

f) Ensuring compliance

The project complies 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 project complies 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 minimal water flow is ensured not affecting downstream waters. Transposing way are constructed to fish path.

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

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

Each SHP of the project possesses preliminary, construction and operation licenses. All licenses were issued by the Rio Grande do Sul Environmental Agency, *Fundação Estadual de Proteção Ambiental*. Caraguatá SHP has LO 7714/2004, Cascata das Andorinhas SHP has LO 6117/2004 and Linhas Três Leste has LO 533/2005. All licenses for the project are available for consultation under request, as well as the environmental studies.

The projects has also been reviewed under 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.

For each SHP project operation license was approved with conditions and restrictions that must be executed and monitored as listed in table below. The execution of these programs is necessary to renewal the Operation License.

Table 9 - Environmental Control Plan Programs

	Linhas Três Leste	Cascata das Andorinhas	Caraguatá
Maintain a Permanent Preservation Area	X	X Including construction of a fence	X
Guarantee minimal flow in downstream of hydropower plant	> 8.89 m^3/sec	> 0.12 m^3/sec	> 3.0 m^3/sec
Build a transposition system to fishes at the dam.	X		X
Erosion process control	X	X	
Recovery of degraded area	X		X
Forestation compensating degraded area	X		
Environmental Education Program	X	X	
Monitoring of water and limnology quality of the river and affluent	X	X Each semester	X Each semester At 4 points
Monitoring and rescue of fauna and flora	X		X
Inspection against hunting and catching native animals	X	X	
Construct a solid residue retention utility		X	

SECTION E. Stakeholders' comments

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 and in the regional newspapers.

In all Caraguatá, Linha Três Leste and Cascata das Andorinhas there were no need for public hearing as they have small reservoirs and the last does not have reservoir.

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

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.

The Resolution determines that copies of the invitations for comments should be sent by the project proponents at least to the following agents involved in and affected by project activities:

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

Invitation letters were sent to the agents (copies of the letters and post office confirmation of receipt communication are available upon request) described in the following Table:

Table 10 – List of Stakeholders Invited for Comments

Cooperative	Creral	Cooperluz		Ceriluz
SHP	Cascata das Andorinhas	Comandaí		Linha Três Leste
City Hall	Prefeitura Municipal de Nonoai	Prefeitura Municipal de Campina das Missões	Prefeitura Municipal de Salvador das Missões	Prefeitura Municipal de Ijuí
Municipal Assembly	Câmara Municipal dos Vereadores de Nonoai	Câmara Municipal dos Vereadores de Campina das Missões	Câmara Municipal dos Vereadores de Salvador das Missões	Câmara Municipal dos Vereadores de Ijuí
Municipal Environmental Agency	Secretaria de Meio Ambiente de Nonoai	Assessoria a Planejamento inside City Hall	Departamento de Educação inside City Hall	Secretaria Municipal de Saúde e Meio Ambiente
Local Community	Centro Municipal de Atendimento a Criança e ao Adolescente Adílio Daronchi - CEMACAAD	Sociedade Familiar e Cultural São Cristóvão	Sociedade Santa Cecília	Associação de Pais de Excepsionais de Ijuí-APAE
State Environmental Agency	Fundação Estadual de Proteção Ambiental – FEPAM			
State Attorney for the Public Interest	Ministério Público do Rio Grande do Sul			
Brazilian Forum of NGOs and Social Movements for the Development and Environment)	Fórum Brasileiro de ONGs e Movimentos Sociais para o Desenvolvimento e Meio Ambiente (FBOMS)			

E.2. Summary of the comments received:

For Cascata das Andorinhas SHP, a letter from CEMACAAD and Prefeitura Municipal de Nonoai (City Hall) were received.

Both give high confidence on CRERAL (the responsible cooperative for the SHP) works as electricity supplier. Also demonstrate that Cascata das Andorinhas SHP have good public acceptance due to its open visitation program used by students and teachers, and possibilities to enlarge tourism and social programs.

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

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

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

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Organization:	Cooperativa Regional de Eletrificação Rural do Alto do Uruguai Ltda. (CRERAL)
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the present project.

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

Annex 3

BASELINE INFORMATION

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

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)"

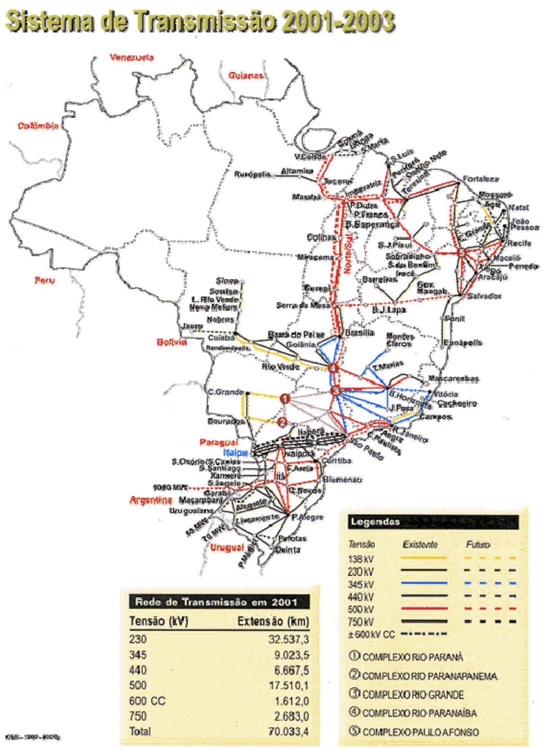

Figure 11 – Brazilian Interconnected System (ONS)

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

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

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

coherent with the generation database they have available as of the time of the PDD submission for validation, a situation where the electricity flow between the subsystems was even more restricted is to be considered.

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

Approved methodologies ACM0002, version 6, 2006, 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 11).

Table 11 – Ex ante and ex-post operating and build margin emission factors (ONS-ADO, 2004; Bosi *et al.*, 2002)

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

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

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

Table 12- Emission Factors for the Brazilian South-Southeast-Midwest interconnected grid (simple adjusted operating margin factor)

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [MWh]	Imports [MWh]
2003	0,9823	288.933.290	274.670.644	459.586
2004	0,9163	302.906.198	284.748.295	1.468.275
2005	0,8086	314.533.592	296.690.687	3.535.252
	Total (2003-2005) =	**906.373.081**	**856.109.626**	**5.463.113**
	$EF_{OM,\ simple\text{-}adjusted}$ [tCO2/MWh]	$EF_{BM,2005}$	Lambda	
	0,4349	0,0872	λ_{2003}	
	Alternative weights	Default weights	0,5312	
	w_{OM} = 0,75	w_{OM} = 0,5	λ_{2004}	
	w_{BM} = 0,25	w_{BM} = 0,5	0,5055	
	Alternative EF_y [tCO2/MWh]	Default EF_y [tCO2/MWh]	λ_{2005}	
	0,3480	**0,2611**	0,5130	

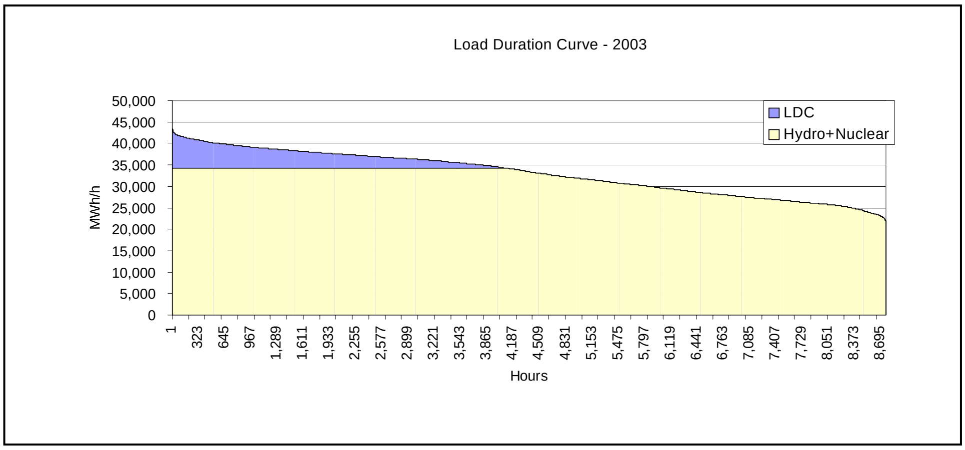

Figure 12- Load duration curve for the S-SE-CO system, 2003

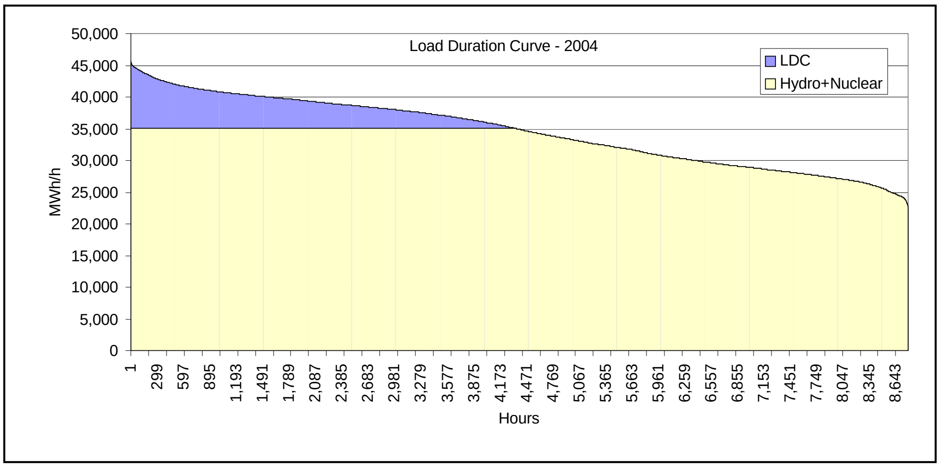

Figure 13 - Load duration curve for the S-SE-CO system, 2004

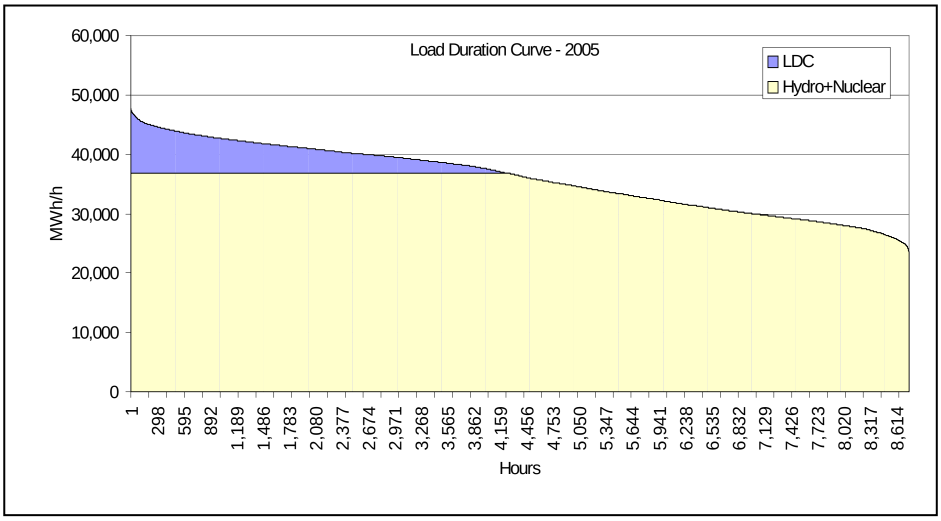

Figure 14 – Load duration curve for the S-SE-CO system, 2005

Table 13 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 1

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

[1] Agência Nacional de Energia Elétrica. *Banco de Informações da Geração* (http://www.aneel.gov.br/, data collected in november 2004).
[2] Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A. F. Simoes, H. Winkler and J.-M. Lukamba. *Road testing baselines for greenhouse gas*
[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
[5] Agência Nacional de Energia Elétrica. Superintendência de Fiscalização dos Serviços de Geração. *Resumo Geral dos Novos Empreendimentos de*
[6] Centrais Elétricas Brasileiras S/A. Plano anual de combustíveis - Sistema interligado S/SE/CO 2005 (released December 2004).

Table 14 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 2

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

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Annex 4

MONITORING INFORMATION

Energy Generation Monitoring

Energy generated at each SHP is sent directly to the cooperative electricity distribution network. At time there is more generation then consumed by cooperate members, the surplus amount is sent to the local distributor company Rio Grande Energia (RGE). At time there is less generation then consumed by cooperate members, RGE energy is imported to the cooperative distribution network.

All energy generated by the SHPs is replacing grid energy, not only the amount exported to the grid. Therefore, the monitoring will be held at SHP control panel electricity meter.

Operation and maintenance data are sent from the SHP to Control Room at cooperative headquarter by radio and/or satellite sign. For Cascata das Andorinhas SHP and Caraguatá SHP the energy generated is inputted and archived in real time at cooperative administrative headquarters. For Linha Três Leste SHP, energy generated is inputted and archieved at SHP computer, and sent monthly to the cooperative headquarter. Measurement data is compared between the meters at the output of the generators and the values at cooperative headquarter Control Room, so that any problems can be detected (like water shortage, materials inside the turbines, meter inaccuracy, etc). In case of any problem, plant personnel will be put in action.

Energy generation data are accumulated in the meters at each SHP, which is possible to be recovered at any time until its accumulation capacity. A measurement report is signed monthly by the Cooperative administrator. When data is submitted for verification, the SHP will provide all the measurement maps.

Detailed Monitoring Plan is available for consult by request.

Environmental Impact Monitoring

Cascata das Andorinhas has a contracted biologist to monitor environmental programs.

Caraguatá has consultant of a forestry engineer, geologist and biologist, working together with Cooperative employees.

Linha Três Leste contracts third part consultant to monitor environmental programs.

Cooperatives have hired expert companies to train and help execution of their environmental programs. The programs are being executed by the Cooperatives technicians. Since the beginning of construction, renovation of degraded areas and of permanent preservation areas are been done according to the regulations of the environmental agencies, through a team of environment experts that will also monitor the compliance with the environmental agencies' regulations. Studies done during the design phase of the project activities have shown the environmental impacts and the interference on the social development in the region of the plant, indicating the mitigation measures to be adopted during the construction phase. These measures are being taken rigorously. Data about environmental impact are being archived by the environmental agencies.

The following environmental and social programs that are been monitored nowadays:

- Renovation and reforestation of degraded areas

- Monitoring program of water and limnology quality
- Hydro-sediment monitoring program
- Erosion process controlling
- Fauna monitoring and rescue
- Ictyofauna monitoring and rescue
- Environmental education

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Annex 5

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