



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

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

Brasil Central Energia S.A. – Sacre 2 Small Hydro Power Plant Project.

PDD version number: 09b.

Date (DD/MM/YYYY): 28/05/2007.

"The changes made to this version of the PDD compared to the PDD version 9 dated of 28/05/2007 referred to in the letter of approval of the Brazilian DNA are related to the use of the Tool for the demonstration and assessment of additionality (version 4), the presentation of 'Brazil Interconnected System' map in English on Annex 3, the starting date of the crediting period and the corrections requested by the CDM Executive Board in its 41st Meeting".

A.2. Description of the project activity:

The primary objective of Sacre 2 Small Hydro Power Plant Project is to help meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy's share of the total Brazilian (and the Latin America and the Caribbean region's) electricity consumption.

The Latin America and the Caribbean region countries have expressed their commitment towards achieving a target of 10% renewable energy of the total energy use in the region. Through an initiative of the Ministers of the Environment in 2002 (UNEP-LAC, 2002), a preliminary meeting of the World Summit for Sustainable Development (WSSD) was held in Johannesburg in 2002. In the WSSD final Plan of Implementation no specific targets or timeframes were stated, however, their importance was recognized for achieving sustainability in accordance with the Millennium Development Goals¹.

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.

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."*



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 CO₂ emissions), which would be generating (and emitting) in the absence of the project.

The Sacre 2 Small Hydro Power Plant Project improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. Small hydro electric power plants projects with small 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, however better income distribution in the region where the Sacre 2 Small Hydro Power Plant 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 which will directly benefit the local population and indirectly impact a more equitable income distribution. This money would stay in the region and be used for providing the population better services which would improve the availability of basic needs. A greater income comes from the local investment on the local economy, and a greater tax payment, which will benefit the local population.

The project consists of a small hydroelectric power plant ("PCH", from the Portuguese, *Pequena Central Hidrelétrica*), SHP Sacre 2 with 30 MW of installed capacity. The plant is located in the Sacre River, in the state of Mato Grosso, Midwest region of Brazil. The power plant became operational in September, 2006.

Brasil Central Energia S.A., owner of Sacre 2 Project, is a company from Bertin Group. Bertin Group is a holding 100% national and has 28 productive units with divisions in: farming, food, biodiesel, cosmetic, leather, dog toy, individual protection equipments, industrial hygiene and cleaning, energy, transport, sanitation and construction.

The project is located in Brasnorte, Mato Grosso State, Midwest of Brazil.

A.3. <u>Project participants:</u>
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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)	Brasil Central Energia S.A.	No
	Ecoinvest Carbon Brasil Ltda. (private entity)	
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

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

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

A.4. Technical description of the project activity:

By legal definition of the Brazilian power regulatory agency (ANEEL – *Agência Nacional de Energia Elétrica*), Resolution nr. 652, issued on December 9th, 2003, to be considered small hydro, the utility must have installed capacity greater than 1 MW, but not more than 30 MW, and have a reservoir area less than 3 km², which is the case of Sacre 2. According to ANEEL resolutions, the plant is considered a small hydropower plant.

Small hydro electric power projects is considered to be one of the most cost effective power plants in Brazil, given it is possible to generate distributed power and to supply small urban areas, rural regions and remote areas of the country. Generally, it consists of a hydro electric power project with small reservoir. Sacre 2 has no reservoir, which results on a minimum environmental impact.

Sacre 2 Small Hydro Power Plant Project uses water from the Sacre River to generate electricity, with a 30 MW installed capacity. Sacre 2 SHP facility contains a small dam, which stores water in order to generate electricity for short periods of time. Run-of-river projects do not include significant water storage, and must therefore make complete use of the water flow. A typical run-of-river scheme involves a low-level diversion dam and is usually located on swift flowing streams (Figure 1).

According to Eletrobrás (1999), run-of-river projects are defined as “the projects where the river’s dry season flow rate is the same or higher than the minimum required for the turbines,” as it is the case of Sacre 2 Small Hydro Power Plant Project. 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.

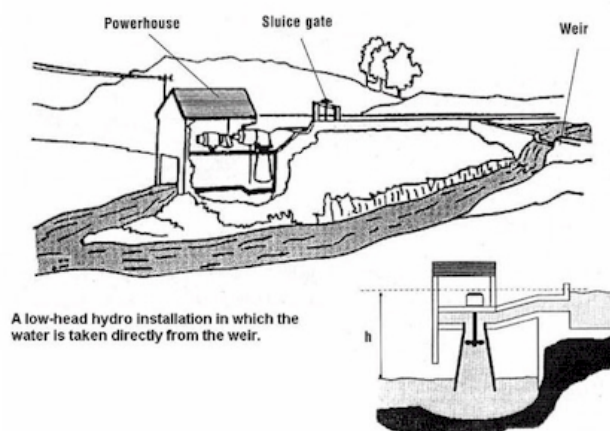


Figure 1 – Schematic view of a run-of-river power plan

Another way to characterize run-of-river power plants comes from the definition of the World Commission of Dams (WCD, 2000):

“Run-of-river dams. Dams that create a hydraulic head in the river to divert some portion of the river flows. They have no storage reservoir or limited daily pondage. Within these general classifications there is considerable diversity in scale, design, operation and potential for adverse impacts.”

Then, to the understanding of the project participants, the Sacre 2 Small Hydro Power Plant can be considered a run-of-river power plant according to all the presented criteria.

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 Mato Grosso.

A.4.1.3. City/Town/Community etc:

Brasnorte.

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 Midwest of Brazil, state of Mato Grosso, Brasnorte city (Figures 2 and 3), and uses the hydro potential of Sacre River.



Figure 2 - Political division of Brazil showing the state of Mato Grosso (Source: City Brazil, 2006)

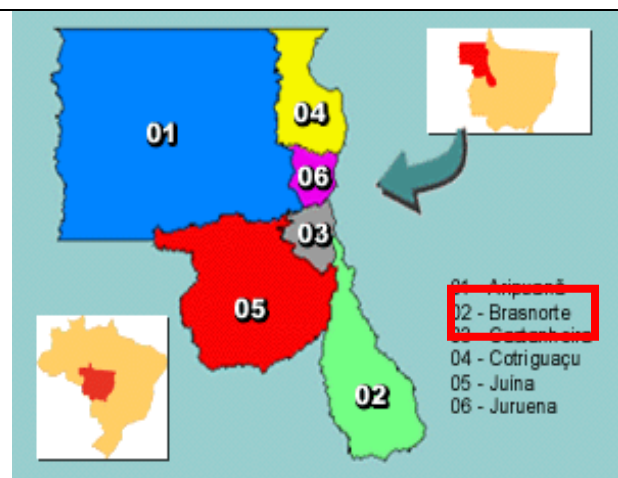


Figure 3 - Political division of Brazil showing the city of Brasnorte (Source: City Brazil, 2006)

The Small Hydroelectric Power Plant Sacre 2 is located in Brasnorte, 13°01'03" S and 58°11'23.1" W, on Sacre River, northwest of Mato Grosso state, Brazil. Brasnorte is located on the Aripuanã micro region, has 12,060 inhabitants and 15,959 km² (IBGE, 2006).

Mato Grosso economy is based on wood and rubber extracting, agriculture (sugarcane, rice, corn, soy), livestock farming, mining (limestone and gold) and industry (metallurgy and food). Its river grid is composed by 2 great basins: Amazonas river basins and Paraguai river basins. The project is been developed on Sacre River, Papagaio River tributary, which form Amazônica Basins.

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

Renewable electricity generation for a grid.

Sectoral Scope: 1 – Energy industries (renewable - / non-renewable sources)

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

The Francis turbine, used in the Sacre 2 Small Hydroelectric Power Plant, is the most widely used among water turbines (Figure 4). This turbine is a type of hydraulic reactor turbine in which the flow exits the turbine blades in the radial direction. Francis turbines are common in power generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through a volute casing and is directed onto the blades by wicket gates. The low momentum water then exits the turbine through a draft tube. In the model, a variable speed centrifugal pump supplies water flow. A load is applied to the turbine by means of a magnetic brake, and torque is measured by observing

the deflection of calibrated springs. The performance is calculated by comparing the output energy to the energy supplied.



Figure 4 - Example of a Francis Turbine

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

The equipment and technology used in the Sacre 2 Project has been successfully applied to similar projects in Brazil and around the world. Technical description of the facility follows.

Technical Description

Total installed power: 30 MW

Reservoir area: 0 km²

Annual average flow rate of the river: 161 m³/s

Turbine

Type: Francis Pair Horiz Turbine, horizontal axis

Quantity: 3

Nominal power: 10,480 kW

Waterfall height: 44,25 mca

Nominal outflow: 26,56 m³/s

Generator

Quantity: 3

Nominal power: 11,700 KVA

Nominal tension: 6,900 Vca

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

Considering the baseline 0.2611 tonCO₂e/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 2 below.



Years					Annual estimation of emission reductions in tonnes of CO ₂ e
Year	1	- (	2008	)*	31,767
Year	2	- (	2009	)	63,709
Year	3	- (	2010	)	63,709
Year	4	- (	2011	)	63,709
Year	5	- (	2012	)	63,709
Year	6	- (	2013	)	63,709
Year	7	- (	2014	)	63,709
Year	8	- (	2015	)**	31,942
Total estimated reductions (tonnes of CO ₂ e)					445,961
Total number of crediting years					7
Annual average over the <u>first</u> crediting period of estimated reductions (tonnes of CO ₂ e)					63,709

*Since 01st July

**Until 30th June

Table 2 - Project Emission Reductions Estimation

A.4.5. Public funding of the project activity:

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

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

ACM0002 - “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (Version 6, May 19th, 2006).

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

The project activity is a small hydro project interconnected to the electricity grid. The project fulfils all the “additionality” requisites (see application of the “additionality tool”² below), which demonstrate that the project would not occur in the absence of the CDM.

² Tool for the demonstration and assessment of additionality (version 4). UNFCCC, CDM Executive Board 36th Meeting Report, 30 November 2007, Annex 13. Web-site: <http://cdm.unfccc.int/>



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

The methodology (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).

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

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

Brazil is a large country and is divided in five macro-geographical regions, North, Northeast, Southeast, South and Midwest. The majority of the population is concentrated in the regions South, Southeast and Northeast regions. Thus the energy generation and, consequently, the transmission are concentrated in 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.

Considering that Sacre 2 has no reservoir, there is no emissions from the project activity neither a spatial boundary for project activity emissions. Indirect emissions can result from project construction, transportation of materials and fuel and other upstream activities. Nevertheless no significant net leakage from these activities was identified.



	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	No	There is no reservoir in the project activity

Table 3- Emission sources and gases related to the project activity

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

In the absence of the project activity, large quantities of carbon dioxide (CO₂) would be emitted to the atmosphere. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation by fossil fuel sources (and CO₂ emissions), which would be generating (and emitting) in the absence of the project. So, 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.

As an alternative for the group company, there is the investment in other opportunities, like the financial market. Given that Brasil Central Energia S.A. is a company from Bertin Group (holding company), it could as well have decided to focus on the other company areas of the group (e.g., farming, food, transport, etc.), and not on the power market, as it is the case with the project activity.

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):

According to the guidelines for completing the Project Design Document, *“If the starting date of the project activity is before the date of validation, provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and/or other corporate) documentation that was available at, or prior to, the start of the project activity”*. Considering statement above, Project Participants give introductory chronological information regarding the development of the Sacre 2 Project idea up to the point of the project’s purchase by Grupo Bertin. Also, it is explained why Grupo Bertin did not start the process to get Sacre 2 Project registered under CDM at the time of its implementation.

Sacre 2 hydropower potential concession was owned from December 2002 onwards by “Brasil Central Engenharia Ltda.,” a company of “Grupo Dias”³. Nevertheless receiving an authorization does not mean that all requirements determining the feasibility of the potential are met. Usually only after the concession

³ Evidenced through ANEEL Resolution/Authorization 711 from 17 December 2002.



is granted detailed feasibility studies (including assessing PPA and loans offers) are developed and the process to obtain final environmental licenses is started.

The process to obtain environmental licenses for hydropower projects in Brazil is very rigorous and, therefore, usually time-consuming. Actually it is widely known in the sector that many project developers are dedicated to obtaining concession, developing all the steps to fulfill accomplish legal requirements to sell the concession rights (not a fully developed project) with a premium at a later stage.

In the process of looking for feasible conditions for the Project Activity, Grupo Dias Board held on March 17th, 2003 a meeting with the objective of studying financial strategies, analyzing electricity commercialization approaches and, last but not least, to confirm the possibility of obtaining emission reduction credits under the UNFCCC's Kyoto Protocol framework (a proof of CDM incentives consideration at a very early stage of the project, well before the final decision to proceed with the project activity – copies of the meeting's minute and corresponding translation into English were supplied to the DOE in the validation process and forwarded to the CDM EB in the validation review process). Around 2 months after the mentioned meeting, Grupo Dias decided to create a controller company to further develop Sacre 2 Project, "Brasil Central Energia S/A".

Brasil Central Energia S/A was officially created on May 20th, 2003, through its subscription in the Federal Revenue Service - Registration of Corporate Taxpayers (in Portuguese "Cadastro Nacional de Pessoas Jurídicas" – CNPJ, evidence was supplied to the DOE in the validation process and forwarded to the CDM EB in the validation review process). The action is used to set the project start date (20 May 2003).

On April 1st, 2004, after around one year of additional project development, Sacre 2 Project was transferred to Bertin Group⁴, being represented by its holding company Heber Participações Ltda.

Considering information above, serious prior consideration of the CDM incentives is evidenced through Grupo Dias minutes of the meeting held on March 17th, 2003.

Although CDM incentives were considered in 2003, the project construction started only in December 2004. Officially the project should have started construction in May 2004 but it only really started in December 2004⁵. The first unit started operation in September 2006. Project Participants stress that at the time of the decision to implement the project (2003/2004), the applicable CDM regulation for the Project were not fully defined and even the Kyoto Protocol had not come into force. Also because of legal uncertainties, it was not clear how to obtain a letter of approval from the Brazilian DNA before the entry into force of the Kyoto Protocol, Grupo Bertin decided to initiate formal development of its potential CDM projects⁶ at the beginning of 2005. Because other projects had the potential of early credits, the company decided to concentrate the CDM development efforts in them.

⁴ Evidenced through Sacre 2 purchase contract.

⁵ See official schedule in June 2006 from the Brazilian Electricity Agency monthly newsletter: "ANEEL - Acompanhamento das Pequenas Centrais Hidrelétricas com Licença de Instalação, Junho de 2006", publicly available at <http://www.aneel.gov.br/area.cfm?idArea=37> (excerpt of the relevant pages and corresponding English translation were supplied to the DOE in the validation process and forwarded to the CDM EB in the validation review process).

⁶ Bertin's Slaughterhouses Fuel Switch Project (submitted for validation in 2005, <http://cdm.unfccc.int/Projects/Validation/DB/MEIIWD5444C4YA7FI9GD72HKOXE0QH/view.html>), Bracol Tanneries Fuel Switch (submitted for validation in 2005, <http://cdm.unfccc.int/Projects/Validation/DB/Z47VEZJJES4ZBS4BLGNISPL86QP7HX/view.html>), biodigestors, biodiesel, reforestation for energy, small hydropower plants (PCH Sacre 2).



The formal development of the Sacre 2 CDM Project was initiated in December 2005, around one year before the forecasted operation start of the project in the end of 2006. Project Participants estimated then around twelve months as a reasonable timeframe to validate the project and send it to registration. The strategy was to optimize resources starting the validation in a timely manner to send the project to registration by its operation start, not long before.

Unfortunately unforeseeable events, mainly with other projects of Bertin's CDM portfolio, caused many delays in the whole process. Also due to transition phases of new persons in charge of the company's portfolio (changed twice in the period), urgent tasks in the construction phase and lack of understanding of the CDM process from the PPs side, the first version of PDD of the Sacre 2 Project was only finalized in the second semester of 2006. Since then the validation has been carried out in a smoother and uninterrupted way and was finally submitted for registration in the beginning of September 2007.

For the purpose of additionality assessment, the ACM0002 includes an Additionality Tool (version 4, EB 36) approved by the Executive Board. The 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 Sacre 2 SHP activity. Following are the steps necessary for the demonstration and assessment of Sacre 2 SHP additionality.

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

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

1. The alternative to the project activity is the continuation of the current (previous) situation of electricity supplied by large hydro and thermal power stations. As an alternative for the group company, there is the investment in other opportunities, like the financial market. Given that Brasil Central Energia S.A. is a company from Bertin Group (holding company), it could as well have decided to focus on the other company areas of the group (e.g., farming, food, transport, etc.), and not on the power market, as it is the case with the project activity;
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

Sub-step 2a. Determine appropriate analysis method

Additionality is demonstrated through an investment benchmark analysis (option III); option III of the Additionality Tool. Options I and II are not applicable to the proposed project activity.

Sub-step 2b. Option III - benchmark analysis

The one-year average official SELIC (Brazilian Prime Rate) rate preceding the project start date (21.8%) is used as the applicable benchmark. Regarding the chosen benchmark, the PPs would like to describe in detail a justification for its use given to the DOE during the validation process.

The investment environment in Brazil is driven by the country's historical high interest levels. The Brazilian Prime Rate, known as the SELIC rate, as well as the CDI – Interbank Deposit Certificate, which is the measure of value in the short-term credit market, have been constantly 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, was the only supplier of long-term loans. Debt funding operations from BNDES are made primarily through commercial banks. As the credit market was dominated by shorter maturities (90-days to 01-year) there were rare long-term credit lines being made available except for the strongest corporate borrowers and for special government initiatives. Credit was restricted to the short-term in Brazil or the long-term in dollars offshore.



Figure 4 – SELIC rate (Source: *Banco Central do Brasil*)

Financial domestic markets with a maturity of greater than a year were 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 did 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). The scarcity of long-term financing is not a result of disinterest of financial investment opportunities, but rather from the reluctance of creditors and savers to lengthen the horizon of their placements. As depicted in the graph below, this high volatility environment for interest rates has caused Brazilian savers to look for the most liquid investment and place their money in short-term government bonds instead of investing in long-term opportunities that could be used to finance infrastructure projects. Between 1996 and 2004, the SELIC Rate traded from a minimum of 15% p.a. in January 2001 to a maximum of 45% p.a. in March 1999 (Figure 4). Within this context, the SELIC rate was used as the benchmark risk-free interest rate for investments in Brazil.



Just prior to financial closing and at the time when the investment decision was made, the SELIC rate varied between 18%p.a. to 25%p.a. (21.8% p.a. on average in the 12 months before project starting date). The estimated Internal Rate of Return (IRR) of the Project of 20.8%p.a. is thus marginally higher than the lowest SELIC rate of that period. In retrospect, the project's IRR does not address the risk of investing in an illiquid asset – the hydro plant – when compared with investing in a government bond with short maturity as reflected in the SELIC rate. At the time of investment, CDM offered Sacre 2 Project an additional source of revenue that could mitigate the projects' exposure to currency devaluation, interest rate hikes, and credit risk. The pro-forma income statement analysis of the projects shows that investor's return on equity would increase slightly when revenues from CERs are considered and thus render projects marginally attractive when compared to risk free bond rates. In sum, in the absence of CDM, Sacre 2 would be a riskier, less attractive and ultimately unfeasible project.

To confirm the applicability of the SELIC rate as a benchmark for investments, example calculations for the cost of equity with Brazilian country risk in the years of 2003 and 2004 are presented in table below.

Cost of equity with Brazilian country risk 2003				
Yield of Sovereign 10-year BB Debt ¹	Plus	10.6%	p.a.	
10-year BB Credit risk premium over US Treasuries ²	Minus	7.38%	p.a.	
10-year (1994-2004) US/Brazil inflation differential ³	Plus	7.5%	p.a.	
International Market Equity Risk Premium ⁴	Plus	13.1%	p.a.	
Adjustment of Market Equity Risk with Beta of 0 ⁵	Minus	0%	p.a.	
			23.7%	p.a.
Sources				
¹ Relatório anual Banco Central do Brasil - 2003 (page 184 - table 5.43 - see Global13).				
² Relatório anual Banco Central do Brasil - 2003 (page 184 - table 5.43 - see Global13).				
³ IBGE and U.S. Department of Labor - Bureau of Labor Statistics.				
⁴ Risk Premiums (Aswath Damodaran), available at http://pages.stern.nyu.edu/~adamodar/ .				
⁵ SHPP=0, there is no weighted average of the Beta for Small Hydro Power Plants listed in the Bovespa.				

Cost of equity with Brazilian country risk 2004				
Yield of Sovereign 10-year BB Debt ¹	Plus	10.8%	p.a.	
10-year BB Credit risk premium over US Treasuries ²	Minus	5.38%	p.a.	
10-year (1994-2004) US/Brazil inflation differential ³	Plus	7.5%	p.a.	
International Market Equity Risk Premium ⁴	Plus	10.8%	p.a.	
Adjustment of Market Equity Risk with Beta of 0 ⁵	Minus	0%	p.a.	
			23.7%	p.a.
Sources				
¹ Relatório anual Banco Central do Brasil - 2004 (page 171 - table 5.43 - see Global14).				
² Relatório anual Banco Central do Brasil - 2003 (page 184 - table 5.43 - see Global14).				
³ IBGE and U.S. Department of Labor - Bureau of Labor Statistics.				
⁴ Risk Premiums (Aswath Damodaran), available at http://pages.stern.nyu.edu/~adamodar/ .				
⁵ SHPP=0, there is no weighted average of the Beta for Small Hydro Power Plants listed in the Bovespa.				

Table 4 – Cost of equity with Brazilian country risk in 2003 and 2004



One final evidence of the SELIC rate as an applicable and reasonable benchmark for the investment is a simple comparison with the real interest loan rate applicable by the Brazilian Development Bank at the time of the decision to proceed with the project activity. The modalities applicable to Grupo Bertin were all based on the official long term interest rate (TJLP, from the Portuguese “Taxa de Juros de Longo Prazo”). In May 2003 TJLP was 12% p.a. (<http://www.bndes.gov.br/english/tjlp.asp>), and the applicable rates and modalities available to The Bertin Group⁷ were:

- BNDES EXIM = TJLP + 3.50% bank spread = 15.5% p.a.
- BNDES FINEM = TJLP + 3.85% bank spread = 15.85 p.a.
- BNDES FINAME = TJLP + 4.00% bank spread = 16% p.a.

An investment outside of the core business of the group would require a reasonable premium over the real interest loan rate (conservatively 4 to 6% p.a., i.e., an applicable benchmark of 19.5% p.a. to 22% p.a.), the use of the SELIC rate as a benchmark (average of 21.76% p.a. in the 12 months before the decision to proceed with the project activity) is not only reasonable as it is indeed still used in the Brazilian investment environment.

With an equity-debt ratio of 50%-50%, and using the above explained equity cost of 23.7% and debt cost of at least 19%, the average value of 21.35% p.a. undeniably confirms the appropriateness of the official SELIC rate as benchmark.

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

The financial indicator identified for the project is the Internal Rate of Return (IRR) calculated in the project cash-flow. As can be seen in this cash flow worksheet, the facility was set up with an expected IRR of approximately 20.8 % per year. The IRR of the project without CERs, 20.8 % is lower than the Selic rate average (21.8%), cost of equity average (23.7%) and the real interest loan average (21.35%). This evidences that project activity is not financially attractive to investor.

Additionally, it is important to mention that during the preparation of the documentation in the request for review phase it was found that the costs related to the construction of the transmission lines (around 20% of the total investment⁸) were not included as cost in the Sacre 2 Project's financial analysis in the PDD. New investment analysis including the costs related to the transmission lines were presented as anecdotal evidence at the time of the project review.

Including the system interconnection costs, internal rate of return of Sacre 2 Project is 16.9%, in contrast of what is stated in the PDD, 20.8%

Sub-step 2d: Sensitivity analysis

⁷ Loan contracts from 2003 were supplied to the DOE as evidence of the applicable bank spreads for Grupo Bertin.

⁸ Complete copy of the contracts for the construction of two separated transmission lines (18.8 km 138 kV primary line to the existing transmission line, and upgrading 93 km of the existing transmission line to increase its transmission capacity). Both contracts have a total value of BRL 23.9 million complete copies in Portuguese (readily available) and translation into English of the relevant parts can be prepared and supplied if necessary.



Possible positive variations in the IRR of the project would occur in the case of tariff increase (revenues increase) or costs decrease. Nevertheless such scenario is very unlikely as the project is planned to sell electricity under PPA contracts (tariff variation according to price indexes, i.e., following costs, therefore revenues increase is unlikely) and costs are usually higher than forecasted (costs decrease is unlikely). For example, in the case of the project activity an evidence of the grid connection cost forecasted (R\$ 24.7 million) and realized (R\$ 27.3 million, 10.5% higher) was provided to the DOE.

Considering information above, only very small positive variations in the IRR are likely while significant negative variations cannot be discarded (cost increase, accidents, etc.) .

Outcome

The IRR of the project activity without being registered as a CDM project is below Selic rate, evidencing that project activity is not the most financially attractive to investor. Then, the continuation of the current situation would be the most plausible scenario.

The IRR including CERs revenues (USD 10.0/CER assumed) is around 22%, slightly above the used benchmark. In that way, Grupo Bertin decided to carry out the project considering the possible CER's revenues and other correlated benefits that it could revert to the company (e.g. improving public perception of the company by its costumers).

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.

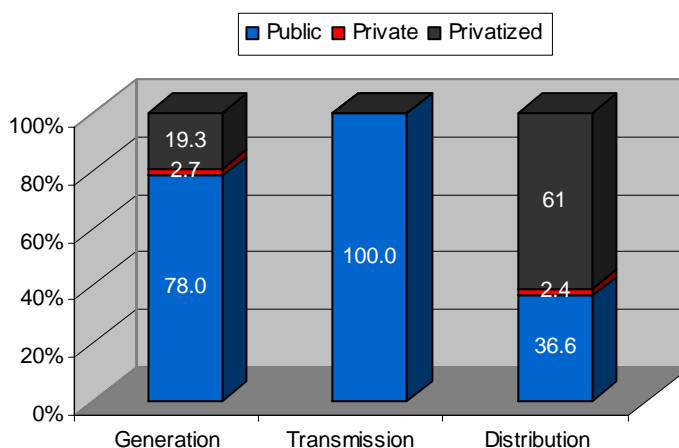


Figure 5 - Participation of private capital in the Brazilian electricity market in December 2000 (Source: BNDES, 2000)

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.

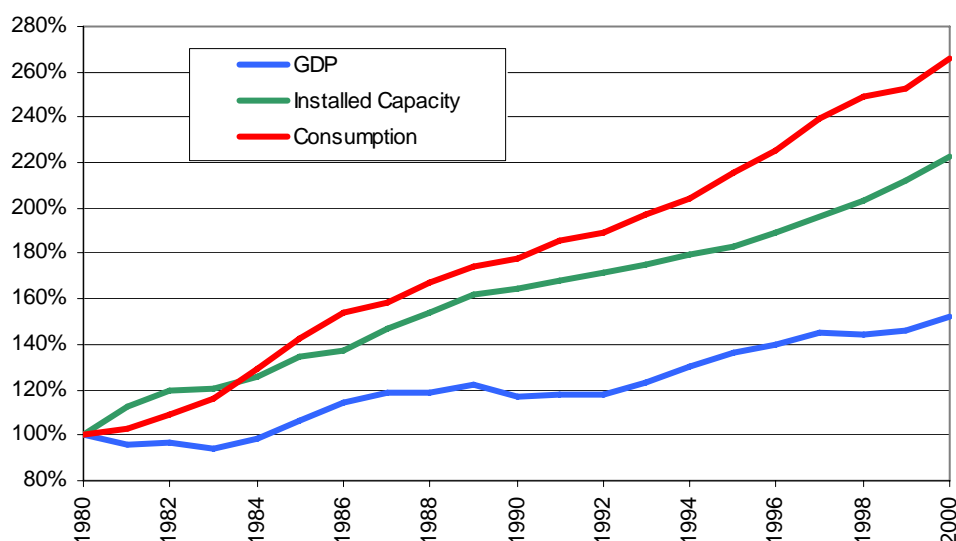


Figure 6 - Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption).

(Source: Eletrobrás, <http://www.eletrobras.gov.br>; IBGE, <http://www.ibge.gov.br/>)

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

The remaining alternative, to increase the capacity factor of the older plants, was the most widely used, as can be seen in Figure 7. To understand if such increase in capacity factor brought positive or negative consequences one needs to analyze the availability and price of fuel. In the Brazilian electricity model the primary energy source is the water accumulated in the reservoirs. Figure 8 shows what happened to the levels of “stored energy” in reservoirs from January 1997 to January 2002. It can be seen that reservoirs which were planned to withstand 5 years of less-than-average rainy seasons, almost collapsed after a single season of low rainfall (2000/2001 experienced 74% of the historical average rain. This situation depicts a very intensive use of the country’s hydro resources to support the increase in demand without increase of installed capacity. Under the situation described there was still no long-term solution for the problems that finally caused shortage and rationing in 2001.

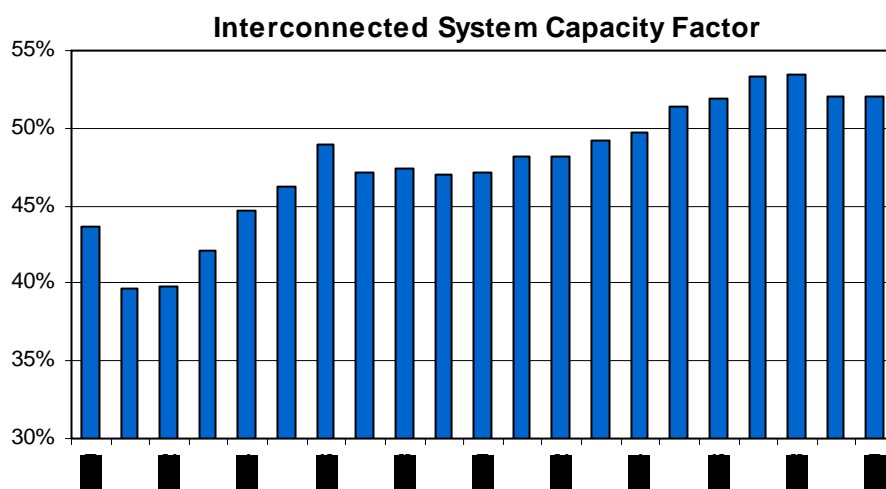


Figure 7 - Evolution of the rate of generated energy to installed capacity
(Source: Eletrobrás, <http://www.eletrobras.gov.br/>)

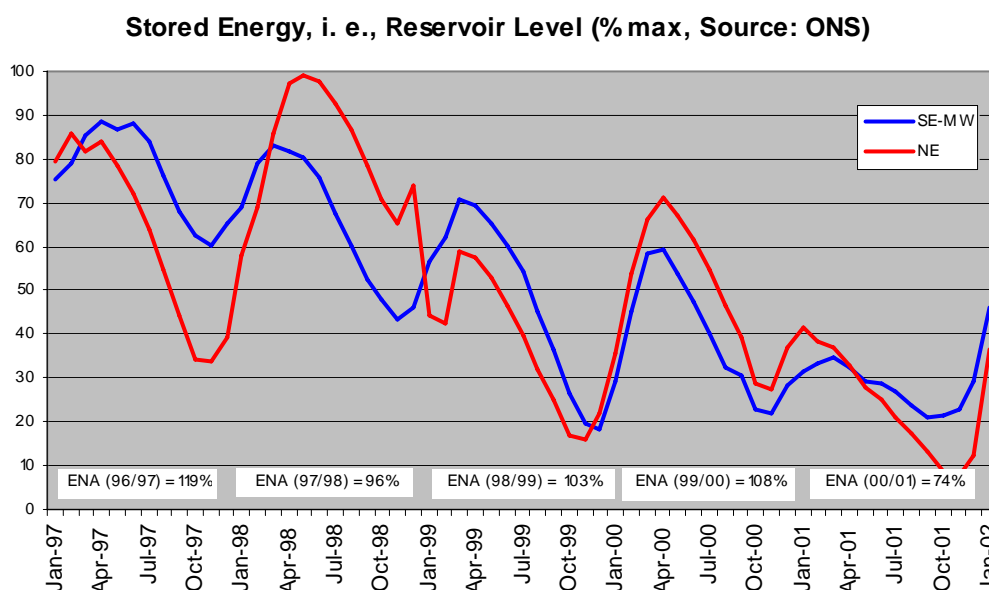


Figure 8 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS, <http://www.ons.org.br/>)

Aware of the difficulties since the end of the 1990's, the Brazilian government signaled that it was strategically important for the country to increase thermoelectric generation and consequently be less dependent on hydropower. With that in mind, the federal government launched at the beginning of the year of 2000 the Thermoelectric Priority Plan (PPT, "*Plano Prioritário de Termelétricas*", Federal Decree 3,371 of February 24th, 2000, and Ministry of Mines and Energy Directive 43 of February 25th, 2000),

originally planning the construction of 47 thermo plants using Bolivian natural gas, totalizing 17,500 MW of new installed capacity, to be completed by December 2003. During 2001 and the beginning of 2002 the plan was reduced to 40 plants and 13,637 MW were to be installed by December 2004 (Federal Law 10,438 of April 26th, 2002, Article 29). As of December 2004, only 20 plants totalizing around 9,700 MW were operational.

During the rationing of 2001 the government also launched the Emergency Energy Program with the short-term goal of building 58 small to medium thermal power plants until the end of 2002 (using mainly diesel oil, 76.9%, and residual fuel oil, 21.1%), totalizing 2,150 MW power capacity (CGE-CBEE, 2002).

It is clear that hydroelectricity is and will continue to be the main source for the electricity base load in Brazil. However, most if not all-hydro resources in the South and Southeast of the country have been exploited, and most of the remaining reserves are located in the Amazon basin, far from the industrial and population centers (OECD, 2001). Clearly, new additions to Brazil's electric power sector are shifting from hydroelectricity to natural gas plants (Schaeffer et al., 2000). With discoveries of vast reserves of natural gas in the Santos Basin in 2003 (Figure 9) the policy of using natural gas to generate electricity remains a possibility and will continue to have interest from private-sector investments in the Brazilian energy sector (see also step 4).

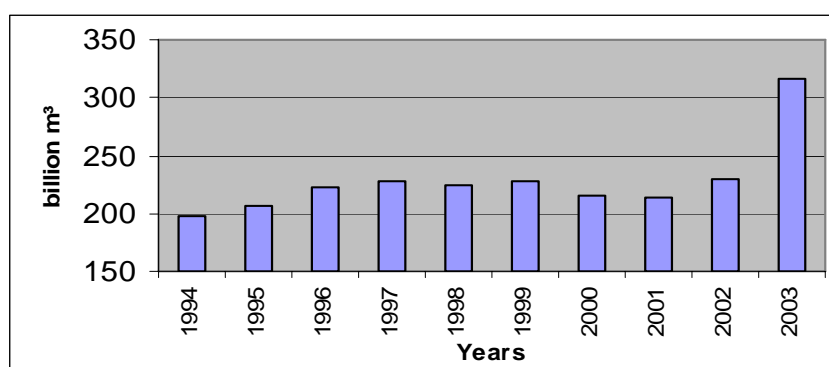


Figure 9 – Evolution of the Brazilian natural gas proved reserves
(Source: Petrobras, <http://www.petrobras.com.br/>)

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

- Electricity demand and supply will be coordinated through a “Pool” Demand to be estimated by the distribution companies, which will have to contract 100% of their projected electricity demand over the following 3 to 5 years. These projections will be submitted to a new institution called Energy 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 CDM 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 developed 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 COPOM⁹.

Considering explanations given in step 2, the parameters utilized to analyze the attractiveness of the project is the SELIC rate and IRR of the project. 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. However, the IRR of the project is lower than the SELIC average rate set of 21.8% in the year before project start date (May 2002 to May 2003). This demonstrates that the project is not financially attractive to investors. 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.

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

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

⁹ COPOM – *Comitê de Política Monetária* (Monetary Policy Committee).



“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.

Sacre 2 SHP Project is not assessing PROINFA but it has a PPA with CEMAT - Centrais Elétricas Matogrosses S.A., with a tariff of R\$ 74.60/ MWh. Proinfa has incentives like 20 years PPA with Eletrobrás and specific financing line with BNDES. These incentives are usually not as good for PPAs outside Proinfa as we can see in the table below.

Comparison: PPA project tariff x Proinfa tariff

Plant	PPA tariff	Proinfa tariff (approx.)
		(escalated as of January/06)
Sacre 2	R\$ 74.60/ MWh	R\$ 129.51/MWh

Due to all the difficulties exposed, and in spite of all government incentives, there are 265 approved SHP projects in Brazil¹⁰, 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. There is a lack of infrastructure, such as roads, reliable electricity supply, communication and transports. The project sponsor had to develop these facilities before the implementation of the project. In addition, there were no qualified personnel available in the region due to the lack of schools and universities.

Institutional Barrier

¹⁰ Source: ANEEL - Agência Nacional de Energia Elétrica (Brazilian power regulatory agency).

As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created to try to organize and to provide incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period, electricity prices surpassed BR\$ 600/MWh (around USD 280/MWh)¹¹ and the forecasted marginal price of the new energy reached levels of BR\$ 120 – 150/MWh. In the middle of 2004, the average price was below BR\$ 50/MWh (around USD 20/MWh)⁵. This relatively high volatility of the electricity price in Brazil, although in the short term, contributes to difficult the analysis of the market by the developers.

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

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

SATISFIED/PASS – Proceed to Step 4

Step 4. Common practice analysis

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

Regardless of the risks and barriers mentioned in Step. 3, the main reason for the reduced number of similar project activities is the economic cost. According figure below, more than 75 % of the Brazil's generation is composed by large hydro and 21 % by thermal power stations

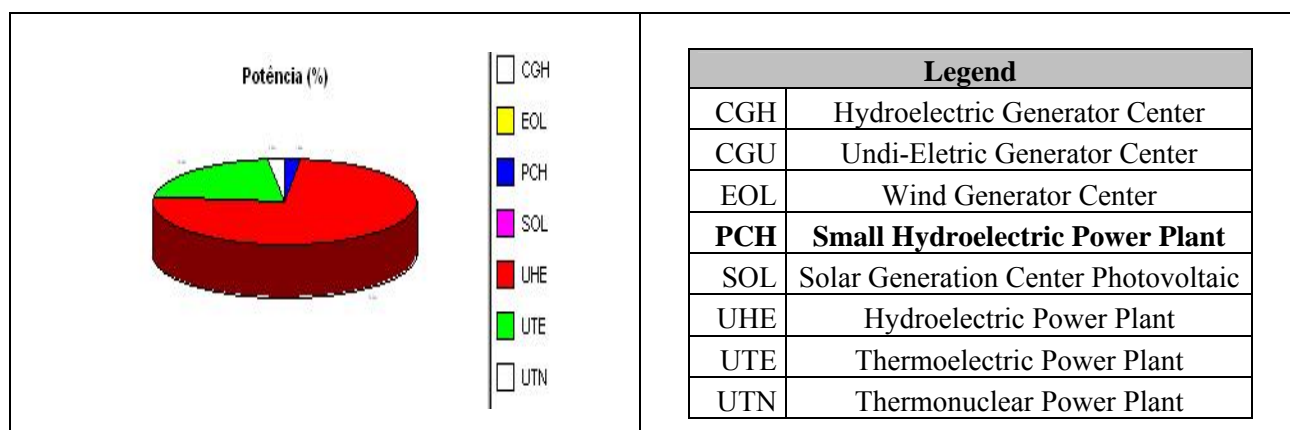


Figure 10 – Operational types of project

¹¹ Source: Universal Currency Converter (1USD = 2.14588BRL) December 7th, 2006.

(Source: ANEEL, 2008¹²)

It is important to stress that hydroelectric projects can differ significantly from each other considering the region to be implemented, climate, topography, availability of transmissions lines, river flow regularity, etc. For that reasons alone it is extremely difficult and not reasonable to compare different hydropower potential and plants. Moreover, hydro-power plants cannot be optimally placed (close to load centers and transmission lines) and easily transferred (moved to a new region where a better tariff is offered) as, for example, modular fossil-fuel-fired (diesel, natural gas) power plants. Differences may be even larger if no big water storage is possible, as in the case of small hydropower plants.

Brazil has an extension of 8,514,876.599 square kilometers¹³ (with over 4,000 km distance in the north-south as well as in the east-west axis) and 6 distinct climate regions: sub-tropical, semi-arid, equatorial, tropical, highland-tropical and Atlantic-tropical (humid tropical). These varieties of climates have obviously strong influence in the technical aspects related to a SHP implementation. In that way, it is not reasonable to assume that all small hydropower projects are comparable.

However, PPs decide to statically analyze different SHPs in the state of Mato Grosso (with equatorial and tropical climates, and an area of 903,358 km², larger than any European country) from the period of 2004 to 2007, considering that Sacre 2 SHP is located in this state.

Table 5 – Operations start of SHPs from 2004 to 2007.

Operations starting in 2004																
	Name	State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	CDM	Preinfa
1	Cachoeira da Lavrinha	GO					1,44									
2	Cach. Encoberta (Ormeo J. Bot	MG				11,35									X	
3	Paina II	PR							1,30							
4	Pai Joaquim	MG			23,00											
5	Paraíso I	MS		21,60											X	
6	Rio Branco	RO												6,90	X	
7	Rio São Marcos	RS												2,20		
PARTIAL TOTAL			-	21,60	23,00	11,35	1,44	-	1,30	-	-	-	-	9,10	3	0
TOTAL = 67,79 MW																

¹² Source: Agência Nacional de Energia Elétrica (ANEEL). Banco de Informações de Geração - BIG. Capacidade de Geração. Available at: <<http://www.aneel.gov.br/>>.

¹³ Available at: http://www.ibge.gov.br/english/geociencias/cartografia/default_territ_area.shtm.



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Operations starting in 2005

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

TOTAL = 126,37 MW

Operations starting in 2006

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

TOTAL = 228,1 MW



Operations starting in 2007

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

Source: Agência Nacional de Energia Elétrica (ANEEL), 2008. Resumo Geral do Acompanhamento das Usinas de Geração Elétrica - Versão abril de 2008. Available at: <http://www.aneel.gov.br/>.
United Nations Framework Convention on Climate Change (UNFCCC), 2008.

Among 12 SHPs, which started operations in the period of 2004 to 2007, 11 received some kind of incentives (CDM or Proinfa, a program that also considers CDM incentives). In terms of installed capacity, it represents 98.3 % from the total of 229.10 MW.

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

Considering research above, the single project not publicly receiving incentives either from CDM or Proinfa, Camargo Córrea SHP is a Project from ARROSSENSAL – Agropecuária e Indústria S.A.¹⁴, a company from Grupo Camargo Córrea S.A.¹⁵. Camargo Córrea is a company with presence in 20 countries and is one of biggest companies in Brazil. In 2007, it had gross revenues of BRL 12.4 billions¹⁶. According to KPMG do Brasil Report¹⁷, Grupo Camargo Córrea is the 7th company among 20 with the greatest assets abroad (including hydropower projects). Considering that Grupo Camargo Córrea has a solid structure, which enables the surpassing of the barriers as described in the PDD, the PPs considered reasonable not to compare their investment capacity with the one from Grupo Bertin.

¹⁴ Evidence by ANEEL Resolution nr. 311, dated July 27th, 2004. Available at: <http://www.aneel.gov.br/cedoc/rea2004311.pdf>.

¹⁵ Available at: http://www.bndes.gov.br/noticias/2005/not112_05.asp.

¹⁶ Available at: <http://www.camargocorrea.com.br/>.

¹⁷ Available at: http://www.kpmg.com.br/publicacoes/tax/Multinacionais_Brasileiras_08_portugues.pdf.



In the analysis conducted by Project Participants at the time of the request for review, there were 50 Small-Hydro-Power-Plants (SHPs) in whole Brazil that started operations from the period of 2004 to 2007, where 21 received CDM incentives and 14 from Proinfa, totalizing 35 projects which received incentives, representing 70% of the total SHPs that started operations in that period. Regarding the other 13 SHPs in the country not publicly receiving the mentioned additional economic incentives, the closest one is located around 1000 km away from the region of the project activity. Brief description of the other 13 activities location is presented in Annex 5 showing fundamental differences and making a simple comparison is not possible.

It is also important to state that the SHP is not close to any load center and, in contrast to most projects in the Southeast and South Brazilian regions, demanded a significant investment in grid connection.

In summary, this project activity is not the business-as-usual scenario in the country where large hydro and natural gas fired thermal power projects represent the majority of new installed capacity. With the financial benefit derived from the CERs, it is anticipated that other project developers would benefit from this new source of revenue and then would decide to develop such projects. 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 the selected approved methodology (ACM0002, 2006), the baseline emission factor (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly a connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

From ACM0002 (2006), a baseline emission factor (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following three steps:

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

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

The simple adjusted operating margin emission factor ($EF_{OM,adjusted,y}$ in tCO_2/MWh) is a variation on the

simple operating margin, where the power sources (including imports) are separated in low-cost/must-run power sources (k) and other power sources (j):

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

Where:

- λ_y is the share of hours in year y (in %) for which low-cost/must-run sources are on the margin.
 - $\sum_{i,j} F_{i,j,y}$ is the amount of fuel i (in mass or volume unit) consumed by relevant power sources j (analogous for sources k) in year(s) y ,
 - $COEF_{i,j}$ is the CO₂e coefficient of fuel i (tCO₂e/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources j (analogous for sources k) and the percent oxidation of the fuel in year(s) y and,
 - $\sum_j GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j (analogous for sources k),
- **STEP 2** – Calculate the build margin mission factor ($EF_{BM,y}$) as the generation weighted average emission factor (tCO₂e/MWh) of a sample of power plants m , as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}} \quad \text{Equation 2}$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (ACM0002, 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 ($EF_{BM,y}$):

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

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

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

a) if the power density of project is greater than 4W/m² and less than or equal to 10W/m²:

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

where,

PE_y	Emission from reservoir expressed as tCO ₂ e/year
EF_{Res}	is the default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 Kg CO ₂ e /MWh.
EG_y	Electricity produced by the hydro electric power project in year y, in MWh

b) If power density of the project is greater than 10W/m², $PE_y = 0$.

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

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

This section shall include a compilation of information on the data and parameters that are not monitored throughout the crediting period but that are determined only once and thus remains fixed throughout the crediting period and that are available when validation is undertaken. The parameters chosen for the calculation of the emissions factor were ex-ante.

Data / Parameter:	Area
Data unit:	m ²
Description:	
Source of data used:	Surface area at full reservoir level
Value applied:	0 m ²
Justification of the choice of data or description of measurement methods and procedures actually applied:	Data is validated 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:	CO ₂ emission factor of the grid
Source of data used:	ONS (Operador Nacional do Sistema Elétrico – National Electric System Operator)
Value applied:	0.2611 tCO ₂ /MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002. The baseline emission factor (EF _y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. 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-ante calculated at the validation.
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 used:	Data provided by ONS (National dispatch center). Calculated according the approved methodology – ACM0002
Value applied:	0.4349 tCO ₂ /MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002, using option (b) Simple Adjusted OM. Ex-ante data vintage was chosen.
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 used:	Data provided by the National Electric System Operator (ONS). Calculated according the approved methodology – ACM0002
Value applied:	0.0872 tCO ₂ /MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002. Ex-ante data vintage was chosen.
Any comment:	

Data / Parameter:	λ_y
Data unit:	
Description:	Fraction of time during which low-cost/must-run sources are on the margin



Source of data used:	Data provided by the National Electric System Operator (ONS). Calculated according the approved methodology – ACM0002
Value applied:	$\lambda_{2003}=0.5312$, $\lambda_{2004}=0.5055$, $\lambda_{2005}=0.5130$
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002.
Any comment:	

Data / Parameter:	$F_{i,y}$
Data unit:	Mass of volume
Description:	Amount of fossil fuel consumed by each power plant
Source of data used:	Latest local statistics. Publicly available official data.
Value applied:	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.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002.
Any comment:	

Data / Parameter:	$GEN_{i/k/n,y}$
Data unit:	MWh/a
Description:	Electricity generation of each power plant
Source of data used:	Latest local statistics. Publicly available official data.
Value applied:	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.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002.
Any comment:	

Data / Parameter:	$GE_{j/k/n,y} IMPORTS$
Data unit:	MWh
Description:	Electricity imports quantity to the project electricity system
Source of data used:	Latest local statistics. Publicly available official data.
Value applied:	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.
Justification of the choice of data or	



description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002.
Any comment:	

Data / Parameter:	$COEF_{ijv}$
Data unit:	tCO ₂ /mass or volume unit
Description:	CO ₂ emission coefficient of fuels used in connected electricity systems
Source of data used:	Obtained from Intergovernmental Panel on climate Change (IPCC), International Energy Agency (IEA) and Organisation for Economic Co-operation and Development (OECD). Publicly available official data.
Value applied:	Large amount of data. Data used in the calculations are presented in the spreadsheets appended to the PDD.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002.
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 used:	Obtained from Intergovernmental Panel on climate Change (IPCC), International Energy Agency (IEA) and Organisation for Economic Co-operation and Development (OECD). Publicly available official data. Default data and literature statistics are used to check the local data.
Value applied:	Massive amount of data, individual values for each plant of the grid, raw data available for validation.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according the approved methodology – ACM0002.
Any comment:	

Data / Parameter:	<i>Plant name</i>
Data unit:	Text
Description:	Identification of power source/ plant for the OM
Source of data used:	Obtained from the National Electric System Operator (ONS)
Value applied:	Massive amount of data. Data used in the calculations are presented in the spreadsheets appended to the PDD.
Justification of the choice of data or	



description of measurement methods and procedures actually applied:	According National Electric System Operator (ONS).
Any comment:	

Data / Parameter:	<i>Plant name</i>
Data unit:	Text
Description:	Identification of power source/ plant for the BM
Source of data used:	Obtained from the National Electric System Operator (ONS)
Value applied:	Massive amount of data. Data used in the calculations are presented in the spreadsheets appended to the PDD.
Justification of the choice of data or description of measurement methods and procedures actually applied:	According National Electric System Operator (ONS).
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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

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

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

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

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

Dispatch data analysis operating margin should be the first methodological choice. Since not enough data was supplied by the Brazilian national dispatch center, the choice is not currently available. The simple operating margin can only be used where low-cost/must-run resources¹⁸ 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 6 shows the share of hydroelectricity in the total electricity production for the Brazilian S-SE-CO interconnected system. However the results show the non-applicability of the simple operating margin to the Project.

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

Table 6 – Share of hydroelectricity production in the Brazilian S-SE-CO interconnected system from 1999 to 2003 (ONS, 2004)

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

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

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

Where:

¹⁸ Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation (ACM0002, 2006).

- 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 CO₂e coefficient of fuel i (tCO₂e/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources j (analogous for sources k) and the percent oxidation of the fuel in year(s) y and,
- $\sum_j GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j (analogous for sources k).

The most recent numbers for the interconnected S-SE-CO system were obtained from the Brazilian national dispatch center, ONS - *Operador Nacional do Sistema Elétrico*, in the form of daily consolidated reports (ONS-ADO, 2004). Data from 120 power plants, comprising 63.6 GW installed capacity and around 828 TWh electricity generation over the 3-year period were considered. With the numbers from ONS, Equation 5 is calculated, as described below:

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

Where:

- $EF_{OM,y}$ is the simple operating margin emission factor (in tCO₂/MWh), or the emission factor for low-cost/must-run resources by relevant power sources j in year(s) y .

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

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

Where:



- $EF_{OM-non,y}$ is emission factor for **non**-low-cost/must-run resources(in tCO₂/MWh) by relevant power sources k in year(s) y .

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

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

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

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

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

Where variable and parameters used are:

- $\sum_{i,j} F_{i,j,y}$ is given in [kg], $COEF_{i,j}$ in [tCO₂e/kg] and $F_{i,k,y} \cdot COEF_{i,k}$ in [tCO₂e]
- $GEN_{i,k,y}$ is the electricity generation for plant k , with fuel i , in year y , obtained from the ONS database, in MWh
- $EF_{CO2,i}$ is the emission factor for fuel i , obtained from the IPCC Guidelines for National Greenhouse Gas Inventories (2006, Volume 2), in kgC/GJ or tC/TJ.
- $OXID_i$ is the oxidization factor for fuel i , obtained from the IPCC Guidelines for National Greenhouse Gas Inventories (2006, Volume 2), in %.
- 44/12 is the carbon conversion factor, from tC to tCO₂.
- 3.6×10^{-6} is the energy conversion factor, from MWh to TJ.
- $\eta_{i,k,y}$ is the thermal efficiency of plant k , operating with fuel i , in year y , obtained from Bosi et al. (2002).
- NCV_i is the net calorific value of fuel i [TJ/kg].

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

The λ_y factors are calculated as indicated in methodology ACM0002, with data obtained from the ONS database. Figure 12, Figure 13 and Figure 14 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 7.

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}} \text{ [tCO}_2\text{/MWh]}$	λ_y [%]
2003	0.9823	0.5312
2004	0.9163	0.5055
2005	0.8086	0.5130

Table 7 - 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).

With the numbers from ONS, the first step was to calculate the lambda factors and the emission factors for the simple operating margin. The obtained values can be seen in Table 7, Figure 12, Figure 13 and Figure 14.

Finally, applying the obtained numbers to calculate $EF_{OM, \text{simple-adjusted}, 2003-2005}$ as the weighted average of $EF_{OM, \text{simple-adjusted}, 2003}$, $EF_{OM, \text{simple-adjusted}, 2004}$ and $EF_{OM, \text{simple-adjusted}, 2005}$ and λ_y to equation below:

$$\bullet \quad EF_{OM, \text{simple-adjusted}, 2003-2005} = 0.4349 \text{ tCO}_2\text{e/MWh}.$$

- STEP 2** – Calculate the build margin mission factor ($EF_{BM,y}$) as the generation weighted average emission factor (tCO₂e/MWh) of a sample of power plants m , as follows:

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

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (ACM0002, 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.



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

$$\bullet \quad EF_{BM,2005} = 0.0872 \text{ tCO}_2\text{e/MWh.}$$

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

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

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

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

$$\bullet \quad EF_y = 0.2611 \text{ tCO}_2\text{e/MWh.}$$

Baseline emissions are calculated by using the annual generation (project annual electricity dispatched to the grid) times the CO₂ average emission rate of the estimated baseline, as follows:

Monitored project power generation	(MWh)	(A)
Baseline emission rate factor	(tCO ₂ /MWh)	(B)
(A) x (B)	(tCO ₂)	

The emission reductions by the project activity (ER_y) during a given year y are the product of the baseline emissions factor (EF_y , in tCO₂e/MWh) times the electricity supplied by the project to the grid (EG_y , in MWh), as follows:

$$ER_y = EF_y \cdot EG_y \quad \text{Equation 12}$$

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

- a) if the power density of project is greater than 4W/m² and less than or equal to 10W/m²:

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

where,

PE_y	Emission from reservoir expressed as tCO ₂ e/year
EF_{Res}	is the default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 Kg CO ₂ e /MWh.
EG_y	Electricity produced by the hydro electric power project in year y , in MWh

- b) If power density of the project is greater than 10W/m², $PE_y = 0$.



Considering that Sacre 2 SHP is a run-of-river dams and has no storage reservoir or limited daily poundage, the power density calculation is not needed.

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

Years			Estimation of project activity emissions (tonnes of CO ₂ e)	Estimation of baseline emissions (tonnes of CO ₂ e)	Estimation of leakage (tonnes of CO ₂ e)	Estimation of overall emission reductions (tonnes of CO ₂ e)
Year	1	-(2008)*	0,0	31.767	0,0	31.767
Year	2	-(2009)	0,0	63.709	0,0	63.709
Year	3	-(2010)	0,0	63.709	0,0	63.709
Year	4	-(2011)	0,0	63.709	0,0	63.709
Year	5	-(2012)	0,0	63.709	0,0	63.709
Year	6	-(2013)	0,0	63.709	0,0	63.709
Year	7	-(2014)	0,0	63.709	0,0	63.709
Year	8	-(2015)**	0,0	31.942	0,0	31.942
Total (tonnes of CO₂e)			0,0	445.961	0,0	445.961
*Since 01st July						
**Until 30th June						

Table 8 - tCO₂ total estimation reduction of the project

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

B.7.1 Data and parameters monitored:

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. The parameters chosen for the calculation of the emissions factor were ex-ante (see Section B.6.2).

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 meter and receipt of electricity purchase
Value of data applied for the purpose of calculating expected emission reductions in section B.5	244,001 MWh/ year
Description of measurement methods and procedures to be applied:	n/a



QA/QC procedures to be applied:	Energy metering QA/QC procedures are explained in Annex 4 (the equipments used have by legal requirements extremely low level of uncertainty). Measured and monitored yearly.
Any comment:	

B.7.2 Description of the monitoring plan:

Monitoring plan is described in Annex 4.

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

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

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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:**

(DD/MM/YYYY) 20/05/2003.

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

35y-0m

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

The crediting period will start on 01/07/2008 (DD/MM/YYYY), or on the date of registration of the CDM project activity, whichever is later.

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:**C.2.2.1. Starting date:**

Not applicable.

C.2.2.2. Length:

Not applicable.

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

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

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

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



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

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



Other guideline was used in order to evaluate the project with respect to environmental sustainability, the requirements of the Brazilian government to obtain the letter of approval. The results of the evaluations follow.

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

a) Contribution to the local environmental sustainability

In April 2002 Law no. 10,438 created Proinfa (*Programa de Incentivo as Fontes Alternativas de Energia*). Proinfa is a Brazilian federal program that gives incentive to alternative sources of electricity (wind energy, biomass cogeneration, and a small scale hydropower plant). Among other factors, this initiative's goal is to increase the renewable energy source share in the Brazilian electricity matrix in order to contribute to a greater environmental sustainability through giving these renewable energy sources better economic advantages. The Brazilian government has committed a large monetary fund in order to develop this plan. Sacre 2 SHP Project is not assessing Proinfa.

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

Although natural gas is the cleanest fossil fuel, the combustion in generating electricity in thermo plants emits greenhouse gases such as: carbon dioxide "CO₂", methane "CH₄", and nitrous oxide "N₂O", which are, according to the Organization for Economic Cooperation and Development (OECD, 2004), the three greenhouse gases "GHGs" which account for the majority of human induced global warming effects.

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

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

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

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

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



One of the most important contributions from the construction of this small hydro plant is that it can create the potential for the promotion of regional development which will generate a greater number of jobs and better living standards.

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

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

c) Contribution to the fair income distribution

It can be said that fair income distribution is achieved from job creation and an increase in people's wages, however better income distribution in the region where the Project is located is obtained from less expenditures and more income in the local municipalities. The surplus of capital that these municipalities will have could be translated into investments in education and health which will directly benefit the local population and indirectly impact a more equitable income distribution. This money would stay in the region and be used for providing the population better services which would improve the availability of basic needs. A greater income comes from the local investment on the local economy, and a greater tax payment, which will benefit the local population.

d) Contribution to the technological development and capacity building

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

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

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

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

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

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

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



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

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

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

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

Conclusion

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

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

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

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

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



The plant possesses preliminary and construction licenses. The preliminary licenses were issued by the Mato Grosso Environmental Agency FEMA - *Fundação Estadual do Meio Ambiente do Estado do Mato Grosso*. All licenses for the project are available for consultation under request, as well as the environmental studies.

As the project was considered as a environment low-impact. It was approved a specific environmental plan that involves different programs:

- Erosion control program
- Slope stability program
- Hydrosedimentometric monitoring program
- Recuperation of degraded areas program
- Anthropology program
- Archaeology program

SECTION E. Stakeholders' comments

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

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

Besides the stakeholders comments requested for the environmental licenses, the Brazilian Designated National Authority, “*Comissão Interministerial de Mudanças Globais do Clima*”, requests comments from local stakeholders, and the validation report issued by an authorized DOE according to the Resolution no. 1, issued on 11th September 2003, in order to provide the letter of approval.

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

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

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

- *Prefeitura de Brasnorte* (Brasnorte City Hall)
- *Câmara Municipal de Brasnorte* (Municipal Assembly of Brasnorte)
- *Secretaria do Meio Ambiente de Brasnorte* (Environmental Agency of Brasnorte)
- *Associação de Brasnorte* (Brasnorte Association)



- *FEMA – Fundação Estadual do Meio Ambiente do Mato Grosso* (Mato Grosso Environmental Agency)
- *Ministério Público do Mato Grosso* (State Attorney for the Public Interest of the State of Mato Grosso)
- *Fórum Brasileiro de ONGs e Movimentos Sociais para o Desenvolvimento e Meio Ambiente* (Brazilian Forum of NGOs and Social Movements for the Development and Environment)

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

E.2. Summary of the comments received:

So far, a letter from FBOMS was received, 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.

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

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

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

“... where the Brazilian Electricity System is divided into three separate subsystems:

- i) The South/Southeast/Midwest Interconnected System;
- ii) The North/Northeast Interconnected System; and
- iii) The Isolated Systems (which represent 300 locations that are electrically isolated from the interconnected systems)”

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

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

Transmission System 2001 - 2003

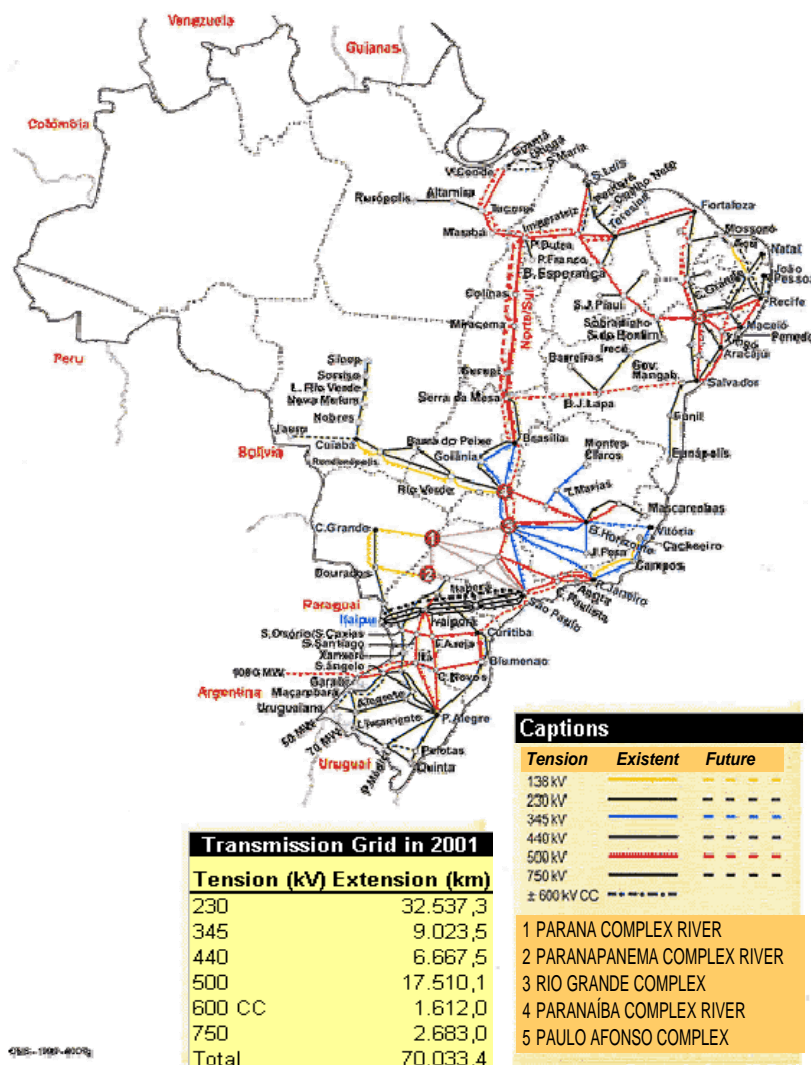


Figure 11 - Brazilian Interconnected System (Source: ONS)

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

The Brazilian electricity system nowadays comprises of around 91.3 GW of installed capacity, in a total of 1,420 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10%

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

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

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

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

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to ANEEL, in fact, ONS centralized dispatched plants accounted for 75,547 MW of installed capacity by 31/12/2004, out of the total 98,848.5 MW installed in Brazil by the same date (http://www.aneel.gov.br/arquivos/PDF/Resumo_Gr%C3%A1ficos_mai_2005.pdf), which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% 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 9).

Year	$EF_{OM\ non-low-cost/must-run}$ [tCO ₂ /MWh]	EF_{BM} [tCO ₂ /MWh]
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	Ex-ante	Ex-post	Ex-ante	Ex-post
2001-2003	0.719	0.950	0.569	0.096

Table 9 – Ex ante and ex-post operating and build margin emission factors (ONS-ADO, 2004; Bosi *et al.*, 2002)

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

The aggregated hourly dispatch data got from ONS was used to determine the lambda factor for each of the years with data available (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.

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	EF_{OM} [tCO ₂ /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
	$EF_{OM, simple-adjusted}$ [tCO ₂ /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 [tCO ₂ /MWh]	Default EF_y [tCO ₂ /MWh]	λ_{2005}	
	0,3480	0,2611	0,5130	

Table 10 – Emission factors for the Brazilian South-Southeast-Midwest interconnected grid (simple adjusted operating margin factor)

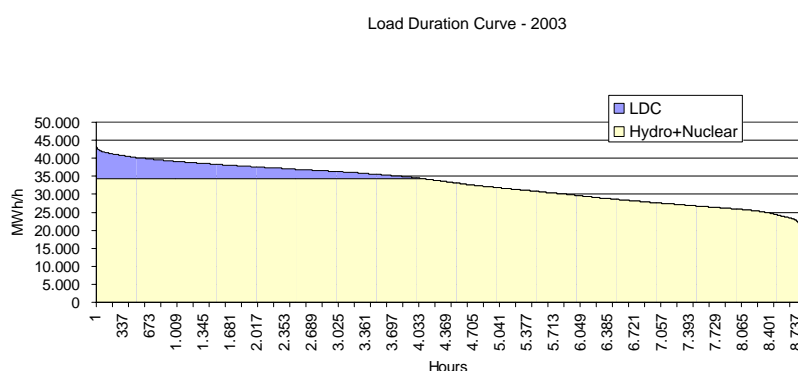


Figure 12 - Load duration curve for the S-SE-CO system, 2003

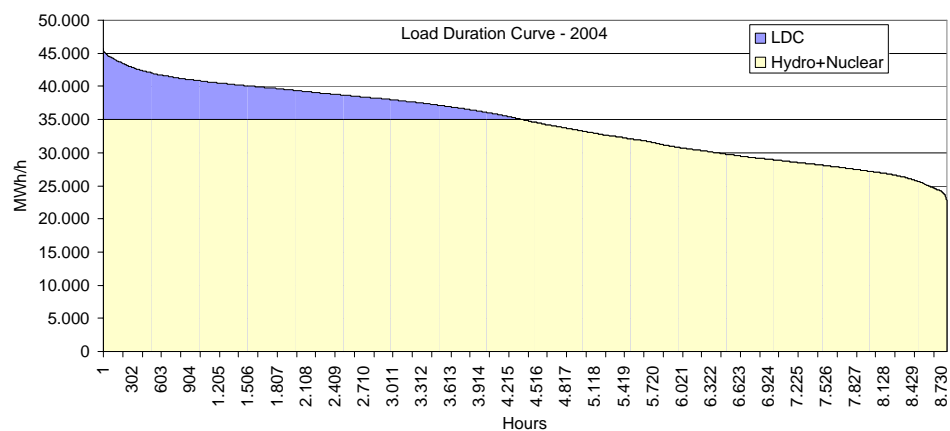


Figure 13 - Load duration curve for the S-SE-CO system, 2004

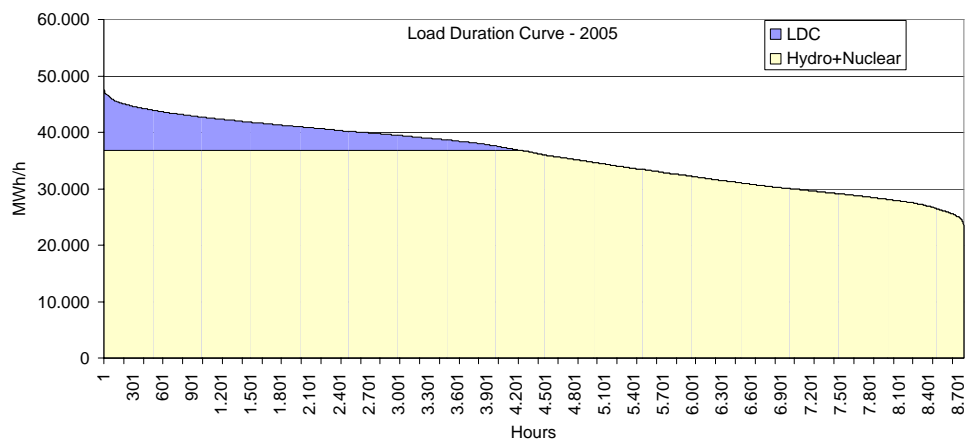


Figure 14 – Load duration curve for the S-SE-CO system, 2005



Annex 4

MONITORING INFORMATION

As of the procedures set by the “Approved consolidated monitoring methodology ACM0002” – “Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources”, Version 6 (2006).

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. Beyond that, information about power generation and energy supplied to the grid are controlled by the Chamber of Electric Energy Commercialization CCEE (from the Portuguese *Câmara de Comercialização de Energia Elétrica*). CCEE makes feasible and regulates the electricity energy commercialization and is responsible for monitors monthly the energy delivered to the grid.

The energy meters (two) are specified by the energy distribution company and approved by ONS. Sacre 2 utilizes an ION 8600, SM 3050/3 type, manufactured by Schlumberger. These meters are calibrated by CEMAT - Centrais Elétricas Matogrosses S.A. at every 2 years, according NBR 14521 (Brazilian Norms – Proceedings for accepting a portion of electric energy electronic meters, from the Portuguese *Procedimentos de Aceitação de lotes de medidores eletrônicos de energia elétrica*). The equipments and meters used in Sacre 2 SHP have been successfully applied to similar projects in Brazil and around the world and have by legal requirements extremely low level of uncertainty. Measurements are controlled in real time by the SHP Digital System and compared between the two meters at the substation, 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.

The SHP is responsible for the project management, as well as for organising and training of the staff in the appropriate monitoring, measurement and reporting techniques and the Energy Distribution company Rede Comercializadora de Energia S/A will be responsible for the operation and maintenance of Sacre 2 SHP as agreed under the contract signed in March 03rd, 2006.

The SHP will work with about 15 people in the total: 6 power plant operators with shift work of 8 hours a day (with 2 operators at the same time), responsible to supervise all the work at the SHP, 2 maintenance technicians and the rest divided in cleaning and vigilance people. All the operations will be centralized in Lins – SP, in the *Centro de Operação do Sistema – COS* (Systems Operation Center), which will operate and plan the maintenance of Sacre 2 SHP of Brasil Central Energia S/A.

Brasil Central Energia S/A, the company that controls Sacre 2 SHP, have hired expert companies to execute their environmental programs. The hired companies keep an environment engineer full time in the plant, and the programs included in the PBA are being executed by the SHP's technicians. After the beginning of the commercial operations, renovation of degraded areas and of permanent preservation areas will be 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 SHP and the environmental agencies.

The following environmental and social programs will be monitored:



- Erosion and slope stability control and prevention program;
- Hydrologic monitoring program;
- Recuperation of degraded areas program;
- Anthropology program:
 - Information and orientation to workers;
 - Information and orientation to Paresi indigenous community;
 - Protection and inspection of the indigenous land;
 - Estate education;
 - Scientific divulgation;
- Archaeology program;
- Hydrosedimentometric monitoring program;
- Environmental management program.



Brief description of the 13 SHPs not publicly received special incentives location, as mentioned in Sub-step 4:

- Pai Joaquim SHP is located in Sacramento and Santa Juliana municipalities, state of Minas Gerais (Southeast Region, the biggest load region in the country). Minas Gerais has 586,528 km², presents tropical and highland-tropical climates and the capital of the state is Belo Horizonte. The distance between Cuiabá – capital of the state of Mato Grosso – and Belo Horizonte is 1,594 km;
- Porto Góes SHP is located in Salto municipality, state of São Paulo. São Paulo has 248,209 km², presents climates sub-tropical, Atlantic-tropical and highland-tropical and the capital of the state is São Paulo. The distance between Cuiabá and São Paulo is 1,614 km;
- Comendador Venâncio SHP is located in Itaperuna municipality, state of Rio de Janeiro (Southeast Region, the biggest load region in the country). Rio de Janeiro has 43,696 km², presents Atlantic-tropical and highland-tropical climates and the capital of the state is Rio de Janeiro. The distance between Cuiabá and Rio de Janeiro is 2,017 km;
- Rio São Marcos and Santo Antônio SHPs are located in the state of Rio Grande do Sul (South Region, the second load region in the country). São Marcos SHP is located in São Marcos and Flores da Cunha municipalities; Santo Antônio SHP is located in Santa Rosa municipality. Rio Grande do Sul has 281,748 km², presents Atlantic-tropical and subtropical climate and the capital of the state is Porto Alegre. The distance between Cuiabá and Porto Alegre is 2,206 km;
- Paina II SHP is located in Castro municipality, state of Paraná (South Region, the second load region in the country). Paraná has 199,314 km², presents Atlantic-tropical climate and the capital of the state is Curitiba. The distance between Cuiabá and Curitiba is 1,679 km;
- Rio Palmeira I, Rio Palmeiras II, Caju, Contestado, Coronel Araújo and Mafrás SHPs are located in the state of Santa Catarina (South Region, the second load region in the country). Rio Palmeiras I SHP is located in Orleans and Urussanga municipalities; Rio Palmeiras II SHP in Urussanga; Caju SHP in Xanxerê; Constestado and Coronel Araújo SHPs in Água Doce and Mafrás SHP in Ibirama. Santa Catarina has 95,346 km², presents Atlantic-tropical climate and the distance between Cuiabá and Florianópolis is 1,986 km;
- Cachoeira da Lavrinha SHP is located in Rianápolis municipality, state of Goiás (Midwest Region). Goiás has 340,086 km², presents tropical and Atlantic-tropical climates and the capital of the state is Goiania. The distance between Cuiabá and Goiania is 934 km.

Annex 6

1.



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