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

Contents

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity

ARAPUtanga **C**entrais **EL**étricas S. A. - **ARAPUCEL** - Small Hydroelectric Power Plants Project (hereafter referred to as "Arapucel Project").

PDD version number: 06

Date: 17/12/2010

A.2. Description of the project activity

The primary objective of the Arapucel 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 1992. In the WSSD final Plan of Implementation no specific targets or timeframes were stated, however, their importance was recognized for achieving sustainability in accordance with the Millennium Development Goals[1].

The privatization process initiated in 1995 arrived with an expectation of adequate tariffs (less subsidies) and better prices for generators. It drew the attention of investors to possible alternatives not available in the centrally planned electricity market.. 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 in small hydropower projects.

In this scenario, *Brennand Energia, the holding company,* began to consider investing in small renewable energy power projects (thermo and hydro) in Brazil. One of the main ventures of the company,

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

the Arapucel Project, under development since 2001, explores the hydropower potential in three locations of the Jaurú River near the cities of Araputanga and Jaurú, in the State of Mato Grosso, Midwest of Brazil.

The project consists of three small hydroelectric power plants ("PCH", from the Portuguese, *Pequena Central Hidrelétrica*), PCH Alto Jauru[2] (21.96 MW), PCH Indiavaí (28.0 MW) and PCH Ombreiras (26.0 MW), totalizing 75.96 MW installed capacity. The plants are located in the Jauru River in the state of Mato Grosso, Midwest region of Brazil. The project is being developed in three phases. The first phase was initiated in the first semester of 2001 and concluded in September 2002, when PCH Alto Jauru started operation. The second phase finished in July 2004 when PCH Indiavaí started to operate adding 28 MW to the Arapucel Project. The third phase of the project is the implementation of the PCH Ombreiras, which added more 26 MW to project installed capacity. Ombreiras is operational since July 2005. This PDD applies to the three phases.

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

The Arapucel Project improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. Small-scale hydropower run-of-river plants provide local distributed generation, in contrast with the business as usual large hydropower and natural gas fired plants built in the last 5 years, these small-scale projects provide 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 investments

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 Arapucel 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

[2] The name of Alto Jauru small hydropower plant was changed to Antonio Brennand. This modification was approved by the Brazilian power regulatory agency (from the Portuguese *Agência Nacional de Energia Elétrica – ANEEL*) through its Resolution nr. 618 issued on November 25th, 2003.
In addition, after operation start in October 2002 it became clear that the assumed hydropower potential at PCH Alto Jauru was too conservative. In 17 April 2003 ANEEL authorized the increase of the installed capacity (see ANEEL Dispatch nr. 223 dated April 17th, 2003). Since May 2003 PCH Alto Jauru operates with 21,960 kW installed capacity.

directly benefit the local population and indirectly impact a more equitable income distribution. The lower expenditure is generated due to the fact that money will no longer be spent in the same amount to "import" electricity from other regions in the country through the grid. This money would stay in the region and be used for providing the population better services, which would improve the availability of basic needs. The local population will receive economic benefits from royalties paid to the municipalities for the water rights granted to Arapucel.

The Proinfa Program, Law # 10,438 enacted in April 2002, created the "Program of Incentives to Alternative Energy Sources" (**Proinfa** from the Portuguese *Programa de Incentivo as Fontes Alternativas de Energia Elétrica*). Among others, one of this initiative's goals is to increase the renewable energy sources share in the Brazilian electricity market, thus contributing to a greater environmental sustainability. In order to achieve such goals, the Brazilian government has designated the federal state-owned power utility (Centrais Elétricas Brasileiras S.A. – "Eletrobras") to act as the primary off taker of electric energy generated by Alternative Energy facilities in Brazil, by entering into long-term power purchase agreements ("PPAs") with alternative energy producers, at a guaranteed price of at least 80% of the average energy supply tariff charged to ultimate consumers in Brazil.

The Arapucel Project began construction in 2001 prior to Proinfa's legislation being in effect. Furthermore it was eligible in 2002 and it did not apply then due to certain uncertainties of the program. As such it does not have access to the financial advantages of the program. For that reason the project can be seen as an example of a solution by the private sector to the Brazilian electricity crisis of 2001, which contributes to the sustainable development of Brazil.

A.3. Project participants

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

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)	Araputanga Centrais Elétricas S.A (Private Entity)	No
	Arapucel Indiavaí S.A (Private Entity)	
	Arapucel Ombreiras S.A (Private Entity)	
Japan	The Chugoku Electric Power Co., Inc.	No
	Sumitomo Mitsui Banking Corporation	
(*) 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 Arapucel Project activity

A.4. Technical description of the project activity

The three facilities of the Arapucel Project utilize water from the Jauru River to generate electricity (total installed capacity of 75.96 MW). All the Arapucel Project facilities are run-of-river plants and have minimum diversion dams, which store water to generate electricity for short periods of time. Run-of-River schemes do not include significant water storage, and must therefore make complete use of the water flow. A typical run-of-river scheme involves a low-level diversion dam and is usually located on swift flowing streams (Figure 1). A low level diversion dam raises the water level of the river sufficiently to enable an intake structure to be located on the side of the river. The intake consists of a trash screen and a submerged opening with an intake gate. Water from the intake is normally taken through a pipe (called a penstock) downhill to a power station constructed downstream of the intake and at as low a level as possible to gain the maximum head on the turbine (Figure 2). According to Brazilian legislation (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” and small hydropower

projects the ones with installed capacity equal or smaller than 30 MW and reservoir area equal or smaller than 3 km^2.

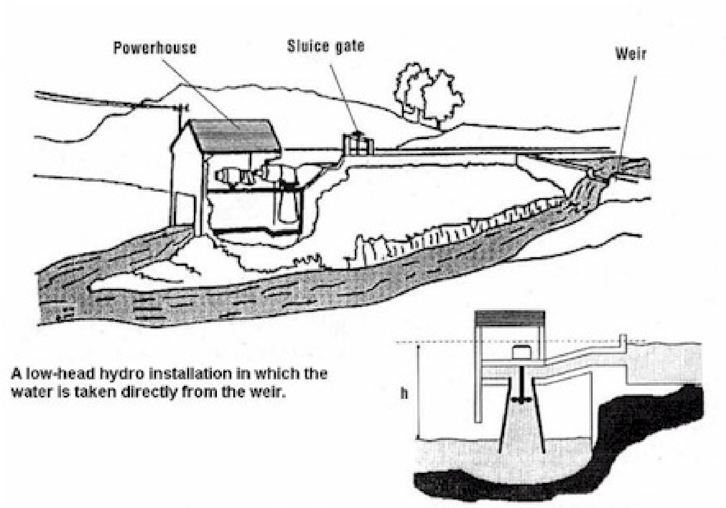


Figure 1 – Schematic view of a run-of-river power plan

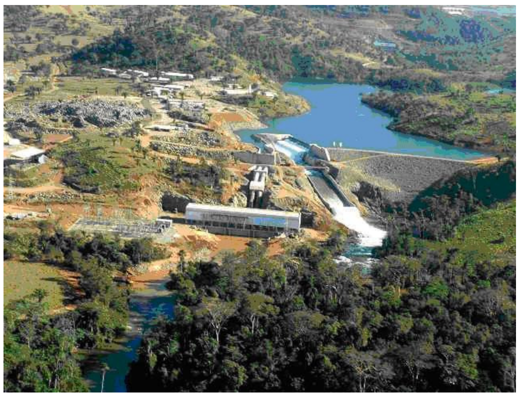


Figure 2 – Power plants aerial view (Alto Jauru, left, and Indiavaí)

According to the project developers the minimum required for each turbine is:

Alto Jauru: 9.1 m^3/s

Ombreiras: 16.8 m^3/s

Indiavaí: 8,5 m^3/s

As the power plant can be operated with a single turbine, the minimum required flow is the same value.

To determine the river's dry season flow rate, data provided by Aneel indicating monthly average river flow at the project activity location from 1931 to 1997 was used.

Rigorously, winter (June to September) is the dry season in the region. For the purposes of the project the smallest values (August to October) will be used. With the numbers in the table the average dry season flow rate is even higher than the minimum flow required for the operation of the turbines for the three power plants.

Average Flow Rate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Alto Jauru (1931 to 1992)	84,0	87,4	94,1	80,8	71,7	66,9	64,3	61,3	60,2	63,6	67,5	74,8
Ombreiras (1931 to 1997)	*88,8*	*102,9*	*117,8*	*95,2*	*76,1*	*67,3*	*62,3*	*58,0*	*55,8*	*56,2*	*60,6*	*70,7*
Indiavaí (1931 to 1995)	82,0	95,0	108,7	87,9	70,3	62,1	57,5	53,5	51,5	51,9	55,9	65,3

Table 2– Jauru's river monthly average flow at the power plant's location.

Also, one of the demands to the project was a guarantee of a minimum downstream flow of 80% of the river's dry season minimum average flow.

Then, to the understanding or the project participants, the facilities of the Arapucel project can be considered a run-of-river power plant according to 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.

Brazilian Midwest macro geographical region, state of Mato Grosso. (Figure 3)

A.4.1.3. City/Town/Community etc

Araputanga, Indiavaí and Jauru. (Figure 3).

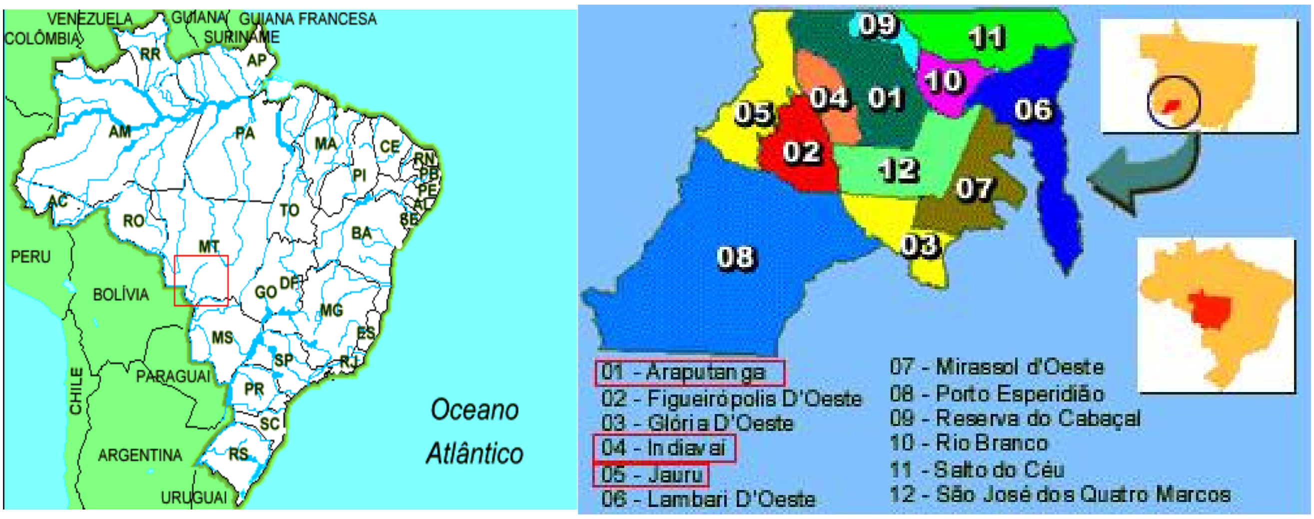


Figure 3 - Geographical position of the cities of Araputanga, Indiavaí and Jauru (Source: http://www.citybrazil.com.br/).

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

The units of the project are located along the Jauru River in the state of Mato Grosso. The Jauru River forms part of the Paraguay River basin (Figures 4 and 5).

The region of the Arapucel Project, around the Jauru River, is comprised of several small cities in the State of Mato Grosso. The facilities are located in the southwest region of the State of Mato Grosso. The major city of the southwestern part of the state is Cáceres. The main economic activity is cattle breeding which has made the region one of the most important suppliers of meat to the Southeast and abroad. Although the region near the Jauru River, as well as the State of Mato Grosso, has high economic growing rates, there has been a lack of infrastructure development which has been a barrier to new investments in the region.

As soon as the Arapucel Project is fully operational, it will benefit approximately two-hundred-forty thousand inhabitants of the southwest of the State of Mato Grosso covering an area over 75 thousand km², and generating 350 direct jobs. This new, more reliable supply of electricity is the main social and economic catalyst in a region that shows substantial growth in farming and cattle breeding.

The exact geographical coordinate of the Arapucel Project plants are (Figure 5):

- Alto Jauru - 15º 02’ 47’’ south latitude, 58º 45’ 09’’ west longitude.
- Indiavaí - 15º 15’ 49’’ south latitude, 58º 43’ 12’’ west longitude.
- Ombreiras - 15º 02’ 23’’ south latitude, 58º 44’ 03’’ west longitude.

Figure 4 – Major Brazilian river basins (Source: http://www.portalbrasil.net/).

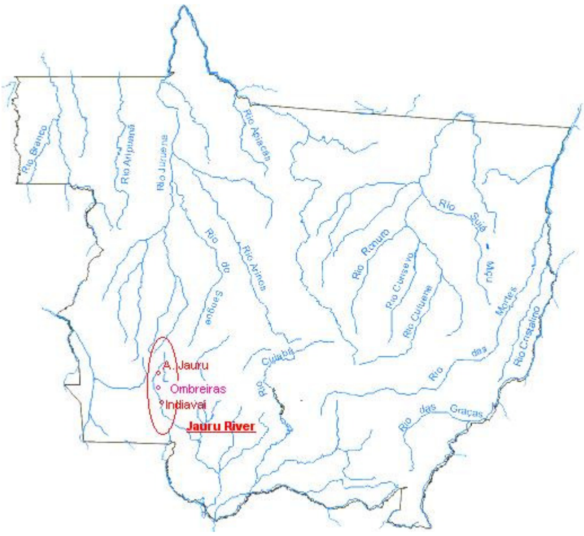


Figure 5 – Geographical location of the projects in the Jauru River (Source: http://www.citybrazil.com.br/).

A.4.2. Category(ies) of project activity

Renewable electricity generation for a grid

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

The Francis turbine, used in the PCH Alto Jauru and PCH Indiavaí, is the most widely used among water turbines (Figure 6). This turbine is a type of hydraulic reactor turbine in which the flow exits the turbine blades in the radial direction. Francis turbines are common in power generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through a volute casing and is directed onto the blades by wicket gates. The low momentum water then exits the turbine through a draft tube. In the model, water flow is supplied by a variable speed centrifugal pump. A load is applied to the turbine by means of a magnetic brake, and torque is measured by observing the deflection of calibrated springs. The performance is calculated by comparing the output energy to the energy supplied.

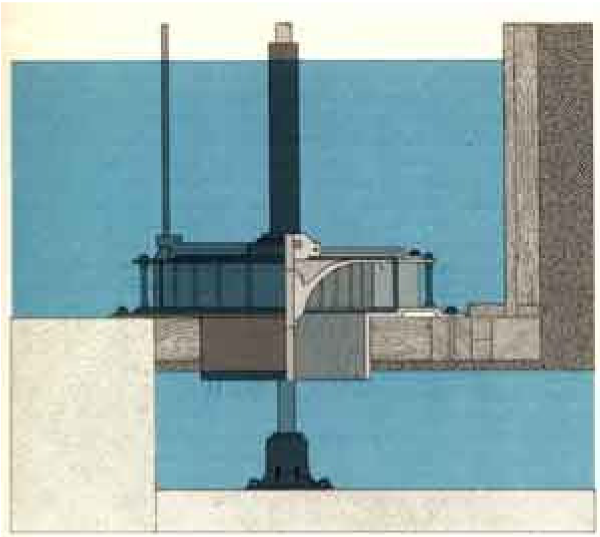
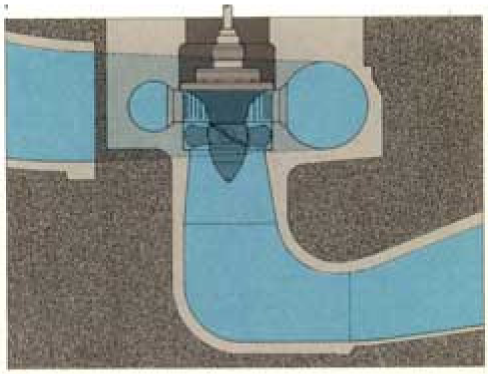


Figure 6 – Francis turbine (Sources: Alstom, http://www.alstom.com.br/ and Water Wheel Factory http://www.waterwheelfactory.com/).



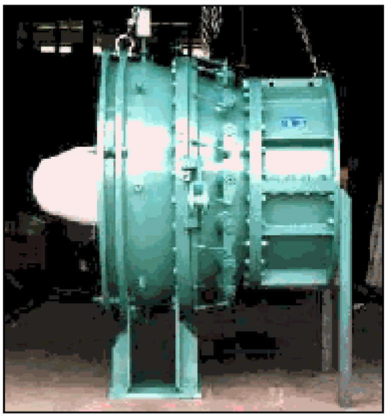


Figure 7 – Kaplan Turbine (Source: Water Wheel Factory, http://www.waterwheelfactory.com/**).**

PCH Ombreiras uses a different turbine technology. Ombreiras set up two Kaplan turbines to generate electricity (Figure 7). Kaplan turbines are well suited to situations in which there is a low head and a large amount of discharge. The adjustable runner blades enable high efficiency during partial load periods, and there is a very small decrease in efficiency due to head variation or load. As a result of recent developments, the range of Kaplan turbine applications has been greatly increased. They are being

applied, for example, in exploiting many hydro sources previously discarded for economic or environmental reasons. The adjustable runner blades add to the complexity of the construction of a Kaplan turbine. The runner blade operating mechanism consists of a pressure oil head, a runner servomotor, and the blade operating rod inside the shaft.

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

<u>PCH Alto Jauru:</u>

- Average flow rate (critical period): 30.00 m^3/s
- Average flow rate (long time period): 39.00 m^3/s
- Reservoir area: 0.14 km^2
- Useful reservoir volume (10^6 m^3): 0.38
- Maximum reservoir volume (10^6 m^3): 0.38
- Head: 44.70 m
- Installed capacity: 21.96 MW
- Turbine: 2 Vatech Francis Turbine, horizontal axis, 10.307 MW, 327.3 rpm
- Generator: 2 Toshiba synchronous, 12.2 MVA, 13.8 kV, 60 Hz
- Nominal Turbine flow rate: 25.8 m^3/s

<u>PCH Indiavaí:</u>

- Average flow rate (critical period): 31.00 m^3/s
- Average flow rate (long time period): 70.00 m^3/s
- Reservoir area: 0.38 km^2
- Useful reservoir volume (10^6 m^3): 3.45
- Maximum reservoir volume (10^6 m^3): 3.45
- Head: 34.40 m
- Installed capacity: 28 MW
- Turbine: 4 Vatech Francis Turbine, horizontal axis, 7.5 MW, 327.3 rpm
- Generator: 4 Toshiba synchronous generators 7.78 MVA, 13.8 kV, 60 Hz.
- Nominal Turbine flow rate: 24.3 m^3/s

<u>PCH Ombreiras:</u>

- Average flow rate (critical period): 50.20 m^3/s
- Average flow rate (long time period): 76.00 m^3/s
- Reservoir area: 2.9 km^2

- Useful reservoir volume (10^6 m³): 14.83
- Maximum reservoir volume (10^6 m³): 29.08
- Head: 30.22 m
- Installed capacity 26 MW
- Turbine: 2 Alstom Kaplan – Type S, 13.5 MW, 300 rpm
- Generator: 2 Toshiba synchronous generators 14.5 MVA, 13.8 kV, 60 Hz.
- Nominal Turbine flow rate: 49.00 m³/s

It is important to mention that hydropower plants of the project operate according to the installed capacities authorized by the environmental agency of Mato Grosso State (which can be confirmed by the operation licenses) and authorizations issued by the Brazilian Electricity Regulatory Agency (from the Portuguese *Agência Nacional de Energia Elétrica - ANEEL*).

The operation and maintenance of the facilities are administered by Alstom, a leading worldwide energy company. The activities managed by Alstom are divided in two sub-activities:

- Maintenance Support: Breakdown support and technical assistance
- Operations and Maintenance (O&M): Maintenance Engineering and Remote control implementation.

The company is training the local staff through a combination of theory instruction and practical training. By maintaining in-house O&M competence levels, Arapucel has developed preventive and condition-based maintenance.

Technical and operational personnel already employed:

- PCH Indiavaí: 5 operational technicians and 12 maintenance technicians
- PCH Alto Jauru: 5 operational technicians and 10 maintenance technicians

There are also staff employees working in both facilities: two engineers in the management of the power plants and five engineers at the technical support.

Of the total personnel working at the operational Arapucel Project power plants, 24 are from the region and 15 are from other parts of the country.

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

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

As Kartha et al. (2002) stated, "the crux of the baseline challenge for electricity projects clearly resides in determining the 'avoided generation', or what would have happened without the CDM or other

GHG-mitigation project. The fundamental question is whether the avoided generation is on the 'build margin' (i.e. replacing a facility that would have otherwise been built) and/or 'operating margin' (i.e. affecting the operation of current and/or future power plants)."

The baseline emission factor is calculated as a combined margin consisting of the combination of operating margin and build margin factors. For the purpose of determining the build margin and the operating margin emission factors, a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly a connected electricity system is defined as one which is connected by transmission lines to the project electricity system and in which power plants can dispatch without significant transmission constraints.

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

The full implementation of the Arapucel Project connected to the Brazilian South-Southeast-Midwest electricity interconnected grid will avoid a yearly estimated emission of around 108,093 tCO_2e (emission factor baseline of 263.6 $kgCO_2e$/MWh, detailed calculation in section E), and a total reduction of about 756,650 tCO_2e over the first crediting period, from September 01, 2002 to August 31, 2009 (Table 3).

Table 3 – Estimated emission reductions over the chosen crediting period

Years	Annual estimation of emission reductions in tonnes of CO_2e
Year* 1 - (2002)	11,886
Year 2 - (2003)	61,576
Year 3 - (2004)	91,139
Year 4 - (2005)	111,792
Year 5 - (2006)	130,914
Year 6 - (2007)	130,914
Year 7 - (2008)	131,273
Year** 8 - (2009)	87,156
Total estimated reductions (tonnes of CO_2e)	756,650
Total number of crediting years	7
Annual average over the first crediting period of estimated reductions (tonnes of CO_2e)	108,093

* Since September 2002

** Until August 2009

A.4.5. Public funding of the project activity

No public funding was and will be used in the present project.

SECTION B. Application of a baseline methodology

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

ACM0002, version 5 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".

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

The chosen methodology is applicable to grid-connected renewable power generation projects, under the condition of electricity capacity additions from run-of-river hydro power plants, as is the case with the Arapucel Project.

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

The Arapucel project is a renewable energy project connected to the electricity grid. The project fulfils all the "additionality" requisites (see application of the "additionality tool[3]" below) and demonstrates why the project would not occur in the absence of the CDM.

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

The methodology ACM0002 (2004)[4], for grid-connected electricity generation from renewable sources, uses derived margins, which have been applied in the context of the project activity through the determination of the emissions factor for the South-Southeast-Midwest subsystem of the interconnected Brazilian grid (electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints).

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

[4] The present PDD uses ACM0002, version 5.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity

To demonstrate additionality, the "tool to demonstrate and assess additionality" will be used.

Step 0. Preliminary screening based on the project start date:

a) **Project Start date:** September 2002, Alto Jauru started its commission phase. Start-up occurred on October 2002 when the power plant delivered its first MWh to the interconnected grid.

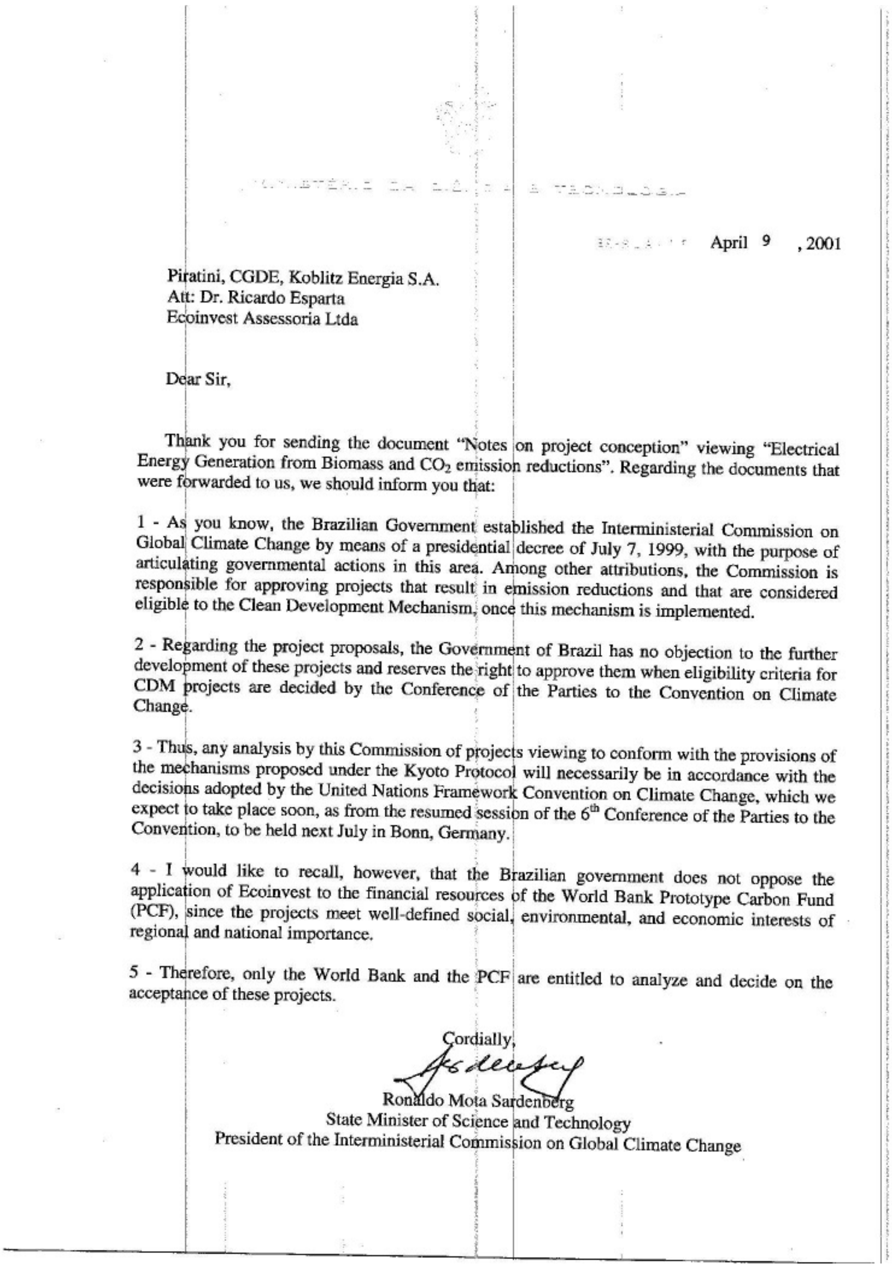
b) **Evidence demonstrates that CDM incentives were seriously considered in the development of The Arapucel project.** BK Energia Participações Ltda, a partnership between Koblitz Ltda. (Koblitz) and Brennand Group developed The Arapucel Project. Currently, the Brennand Energia, a Brennand Group holding company owns the Arapucel Project.

Koblitz is a 100% Brazilian EPC[5] contractor operating since 1975 in the area of energy systems, with solid know-how in industrial generation and cogeneration. Koblitz features a portfolio of over 200 projects in the areas of residual fuel oil, natural gas, coke oven gas, renewable energy sources (mainly agricultural residues as sugarcane bagasse, wood chips, rice straw and cashew nuts husks), and others.

Since 2000, Koblitz has formed several partnerships in order to invest in renewable energy projects throughout Brazil. In partnership with the Brennand Group, Koblitz developed the following renewable energy projects: Arapucel (small-hydro), Uruguaiana (rice husk fueled thermal power plant) and Itacoatiara (wood chips fueled thermal power plant). In another partnership with C.G.D.e, the Brazilian energy branch of the Portuguese bank Caixa Geral de Depósitos, the project developed was Piratini, C.G.D.e, Koblitz Energia S.A. (Piratini Project). In the second half of 2000, the Piratini project requested from the Brazilian government, through Ecoinvest, a position regarding its participation in the Clean Development Mechanism. In April 2001, the project received a non-objection letter from the Brazilian government (Figure 8) and in the beginning of 2002, Piratini, through Ecoinvest, negotiated 1,600 tCO_2e verified emission reductions with the Canadian government. The Piratini project, which is currently fully controlled by Koblitz, is the first project registered (V-AAA-001) in the Canadian GHG Reductions Registry (http://reductions.vcr-mvr.ca/rer_masterprojects_e.cfm).

Through their experience with the Piratini project, Koblitz Ltda. developed the human capital and internal capabilities to apply CDM principles to future projects. By the end of 2000, all possible ventures by Koblitz Ltda. and the Brennand Group using renewable energy sources were analysed in order to evaluate their eligibility under the CDM. The impact of the CDM financial incentives was also considered in the development of the projects.

[5] EPC – Engineering, Procurement and Construction



MINISTÉRIO DA CIÊNCIA E TECNOLOGIA

Brasília, April 9 , 2001

Piratini, CGDE, Koblitz Energia S.A.
Att: Dr. Ricardo Esparta
Ecoinvest Assessoria Ltda

Dear Sir,

Thank you for sending the document "Notes on project conception" viewing "Electrical Energy Generation from Biomass and CO_2 emission reductions". Regarding the documents that were forwarded to us, we should inform you that:

1 - As you know, the Brazilian Government established the Interministerial Commission on Global Climate Change by means of a presidential decree of July 7, 1999, with the purpose of articulating governmental actions in this area. Among other attributions, the Commission is responsible for approving projects that result in emission reductions and that are considered eligible to the Clean Development Mechanism, once this mechanism is implemented.

2 - Regarding the project proposals, the Government of Brazil has no objection to the further development of these projects and reserves the right to approve them when eligibility criteria for CDM projects are decided by the Conference of the Parties to the Convention on Climate Change.

3 - Thus, any analysis by this Commission of projects viewing to conform with the provisions of the mechanisms proposed under the Kyoto Protocol will necessarily be in accordance with the decisions adopted by the United Nations Framework Convention on Climate Change, which we expect to take place soon, as from the resumed session of the 6th Conference of the Parties to the Convention, to be held next July in Bonn, Germany.

4 - I would like to recall, however, that the Brazilian government does not oppose the application of Ecoinvest to the financial resources of the World Bank Prototype Carbon Fund (PCF), since the projects meet well-defined social, environmental, and economic interests of regional and national importance.

5 - Therefore, only the World Bank and the PCF are entitled to analyze and decide on the acceptance of these projects.

Cordially,

Ronaldo Mota Sardenberg
State Minister of Science and Technology
President of the Interministerial Commission on Global Climate Change

Figure 8 – Non-objection letter received by the Piratini, CGDe, Koblitz Energia S. A. from the Brazilian Interministerial Commission on Global Climate Change.

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 situation with the national electricity grid being supplied by large hydro projects and by fossil fuel power plants. In terms of alternatives to investor the most feasible scenario is the investment of surplus capital in the financial market. The main project sponsor had no previous experience with the power market.

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

2. Not applicable.

3. Not applicable.

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

Step 3. Barrier Analysis:

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 State, the government was forced to look for alternatives. The solution recommended was to initiate a privatization process and the deregulation of the market.

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

- Building a competition friendly environment, with the gradual elimination of the captive consumer. The option to choose an electricity services supplier, which began in 1998 for the largest consumers, and should be available to the entire market in 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 set up to develop the legislation and to regulate the market; the National Electric System Operator, ONS, to supervise and control the generation, transmission and operation; and the Wholesale Electricity Market, MAE, to define rules and commercial procedures of the short-term market.

At the end of 2000, after five years of privatization, the results were modest (Figure 9). Despite high expectations, investments in new generation did not follow the increase in consumption.

The decoupling of GDP (average of 2% increase in the period of 1980 to 2000) from electricity consumption increase (average of 5% increase in the same period) is well known in developing countries, mainly due to the expansion of the supply services to new areas and the growing infra-structure. The necessary measures to prevent bottlenecks in services were taken. These include an increase of generation capacity higher than the GDP growth rate and strong investments in energy efficiency. In the Brazilian case, the increase in the installed generation capacity (average of 4% in the same period) did not follow the growth of consumption as can be seen in Figure 10.

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). Although the results of the program were remarkable, the efficiency achievement was not big enough to cover the mentioned gap between the need of new generation capacity and consumption growth.

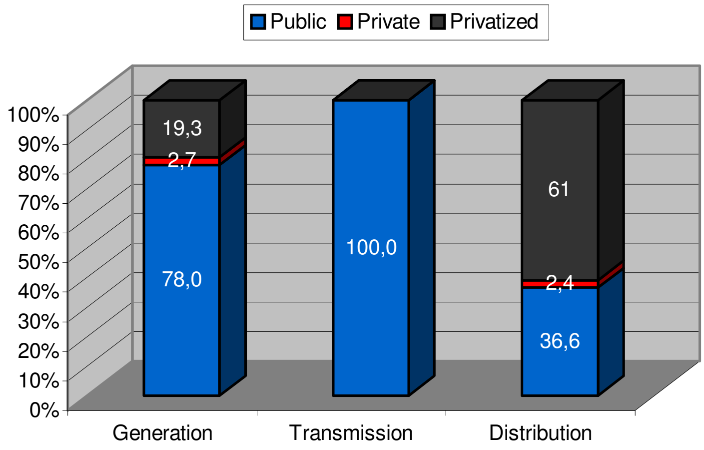


Figure 9 - Participation of private capital in the Brazilian electricity market in December 2000 (Source: BNDES, 2000).

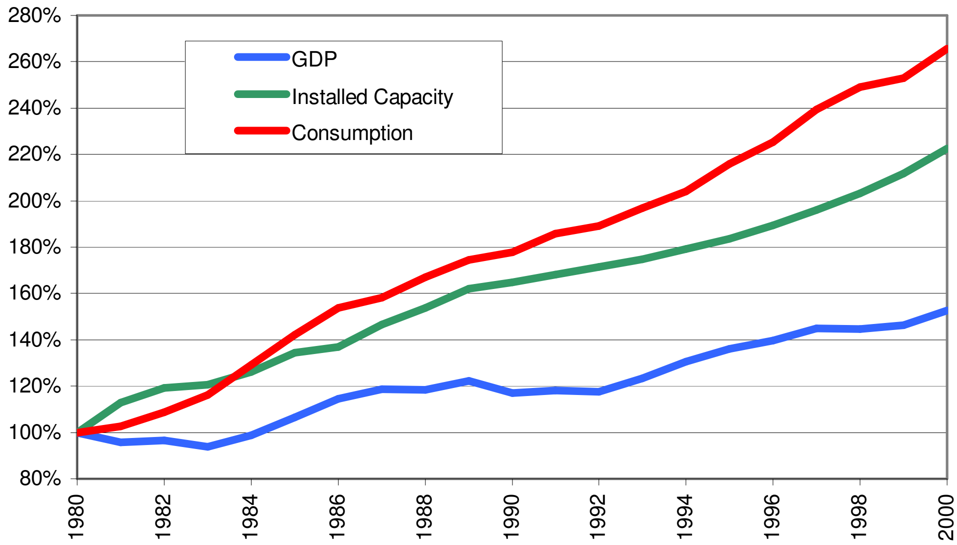


Figure 10 - Cumulated variation of GDP, power installed capacity and electricity consumption (Source: Eletrobrás and IBGE).

The remaining alternative, to increase the capacity factor of the old plants, was actually the most widely used, as can be seen in Figure 11.

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 12 shows what happened to the levels of "stored energy" in the reservoirs from January 1997 to January 2002. It can be seen that reservoirs which were planned to withstand 5 years of less-than-average rainy seasons, almost collapsed after a single season of low rainfall (2000/2001 experienced 74% of 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.

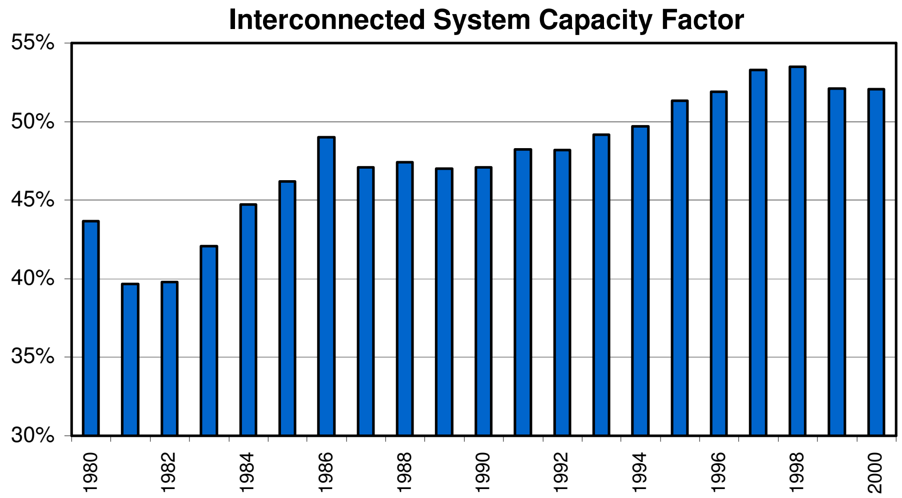


Figure 11 - Evolution of the rate of generated energy to installed capacity (Source: Eletrobrás).

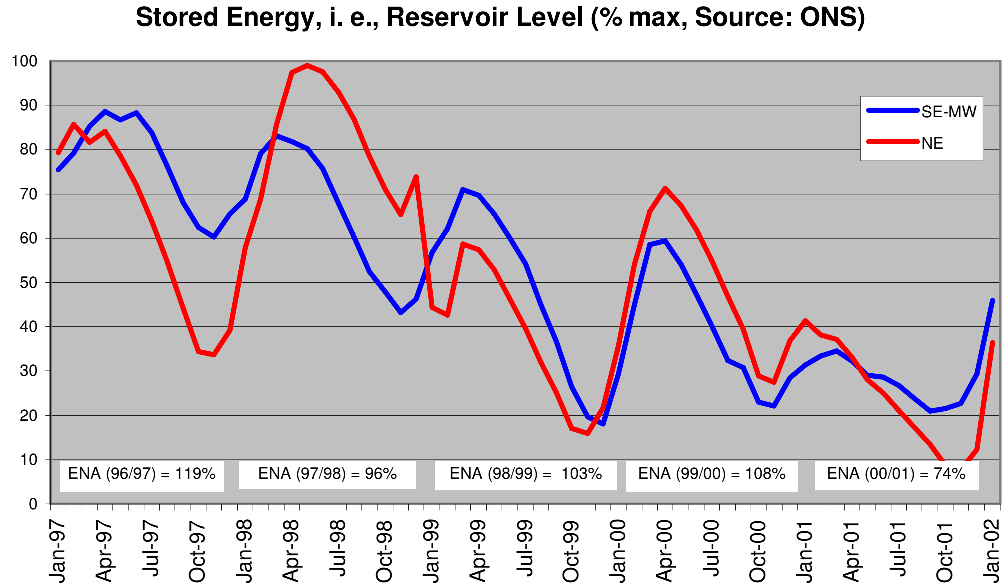


Figure 12 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS).

Aware of the difficulties since the end of the 1990's, the Brazilian government signalized that it was strategically important for the country to increase thermoelectric generation and consequently be less dependent of hydropower. With that in mind the federal government launched in the beginning of the year of 2000 the *Thermoelectric Priority Plan* (*PPT*, "*Plano Prioritário de Termelétricas*", Federal Decree 3,371 of February 24th, 2000, and Ministry of Mines and Energy Directive 43 of February 25th, 2000), originally planning the construction of 47 thermo plants using Bolivian natural gas, totalizing

17,500 MW new installed capacity until December of 2003. During 2001 and the beginning of 2002 the plan was rearranged to 40 plants and 13,637 MW to be installed until December 2004 (Federal Law 10,438 of April 26th, 2002, Article 29). As of today, December 2004, 20 plants totalizing around 9,700 MW are operational.

During the rationing of 2001 the government also launched the *Emergency Energy Program* with the short-term goal of building 58 small to medium thermal power plants until 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 though that hydroelectricity is and will continue as the main source responsible 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 (Figure 13, Schaeffer *et al.*, 2000).

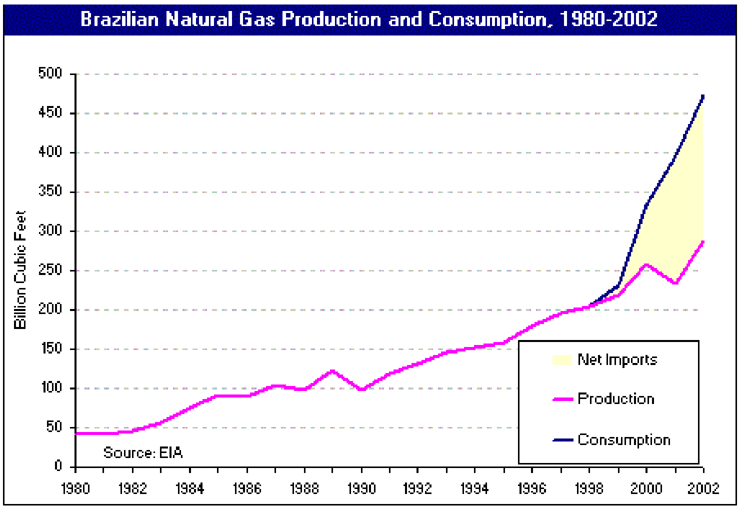


Figure 13 – Historical Brazilian Natural Gas Consumption and Production (Source: EIA[6])

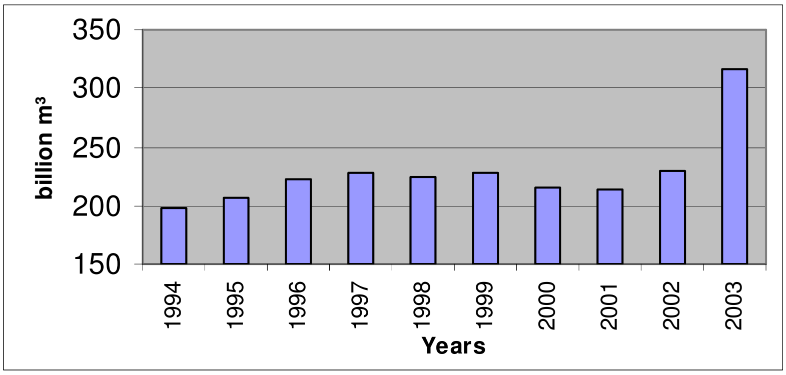


Figure 14 - National Historical Proved Reserves of Natural Gas (Source: Petrobras)

[6] EIA – Energy Information Administration (www.eia.doe.gov)

With discoveries of vast reserves of natural gas in the Santos Basin in 2003 (Figure 14) the policy of using natural gas to generate electricity remains a possibility and it still will continue to have interest from private-sector investments in the Brazilian energy sector.

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

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

Although one of the new model biggest aims is to reduce market risk, its ability to encourage private investment will depend on how the new regulatory framework is implemented. Several challenges are noteworthy in this regard. *First,* the risk of regulatory failure that might arise due to the fact that the government will have a considerable bigger role to play in long-term planning should be avoided by close monitoring of new rules applicability. *Second,* rules will need to be designed for the transition from the current to the new model to allow current investments to be rewarded adequately. *Third,* because of its small size, price volatility may increase in the short-term electricity market, in turn bringing about higher

investment risk, albeit this risk will be attenuated by the role of large consumers. The high share of hydropower in Brazil's energy mix and uncertainty over rainfall also contribute to higher volatility of the short-term electricity market. *Fourth,* although the new model will require total separation between generation and distribution, regulations for the unbundling of vertically integrated companies still have to be defined. Distribution companies are currently allowed to buy up to 30 per cent of their electricity from their own subsidiaries (self-dealing). *Finally,* the government's policy for the natural gas sector needs to be defined within a specific sectoral framework.

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

Investment Barrier

In order to analyse 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 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 financing. 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 financing from BNDES are made primarily through commercial banks. The credit market is dominated by shorter maturities (90-days to 1-year) and long-term credit lines are available only to 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 1 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., 2005).

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 term of their placements. It has made savers opt for the most liquid investments and to place their money in short-term government bonds instead of investing in long-term opportunities that could finance infrastructure projects.

The most liquid government bond is the LFT (floating rate bonds based on the daily Central Bank reference rate). As of January 2004, 51.1% of the domestic federal debt was in LFTs and had duration of one day. This bond rate is almost the same as the CDI - Interbank Deposit Certificate rate that is influenced by the SELIC rate, defined by COPOM[7].

The SELIC Rate has been very volatile ranging from a minimum of 15% p.a. in January 2001 to a maximum of 45% p.a. in March 1999 (Figure 15).

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

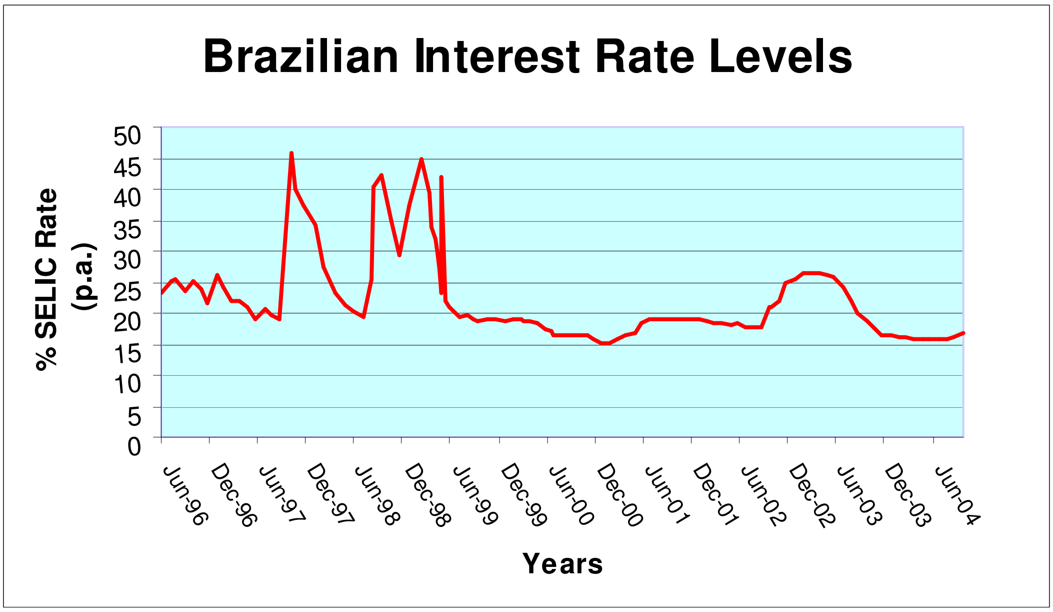


Figure 15 - SELIC rate (Source: Banco Central do Brasil, http:/www.bcb.gov.br/)

The ARAPUCEL project is being developed on a project finance basis. To finance construction, project sponsor (Brennand Energia) took advantage of the financing lines of BNDES. This financial support coveres 80% of the project costs with a rate of TJLP (BNDES Long Term Interest Rate – 10%) plus a 5% spread risk for a term of 8-years and grace period of 1-year.

As can be seen in the worksheet FCF_AltoJauru(CER).xls[8] and FCF_Indiavai(CER), the facilities were set up with an expected financial ROE – Return on Equity of approximately 19% per year[9]. The ROE is very similar to the SELIC rate in effect at the time of financing although the project is a riskier investment as compared to Brazilian government bonds. The inclusion of the revenues from CERs makes the investor's ROE increase by approximately 200 basis points, from 20.3% to 22.0% (Table 4, Table 5 and Table 6). Such increase in return would compensate for the additional risk investor would take with this project.

In addition to the increase of approximately 200 basis points, CER revenues would bring the project additional benefits due to the fact that they are generated in hard currencies (USD or EUR). The CDM incentive allows Brennand Energia to hedge its debt cash flow against currency devaluation. Moreover, the CER Free Cash Flow, in US dollars or EURO, could be discounted at an applicable discount interest rate, thus increasing the project leverage.

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

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.

8 Available upon request.

9 18.72% is the average considering the three power plants of the project activity.

Most of the utilities in Brazil do not have a satisfactory credit risk thus representing a barrier to obtain long-term funding.

Cash Flow (R$): ALTO JAURU

	2000	2001	2002	2003	2010	2011	2012
Net Income	(197,260)	(2,158,934)	(568,575)	5,693,699	5,597,493	5,704,886	7,786,497
(+) Depreciation	197,260	2,158,934	2,603,918	2,603,918	2,603,918	2,603,918	2,603,918
(-) Equity	(8,000,000)	(35,178,681)	(8,899,670)	0	0	0	0
(+) Funding	0	0	22,066,000	0	0	0	0
(-) Amortization	0	0	0	(596,378)	(2,385,514)	(2,385,514)	(2,385,514)
(+) Perpetuity							87,314,412
Investor Cash Flow	**(8,000,000)**	**(35,178,681)**	**15,201,672**	**7,701,239**	**5,815,897**	**5,923,290**	**95,319,313**

Return on Equity	**20.3%**

Table 4 – ARAPUCEL (Alto Jauru) RoE without CER revenues

Cash Flow + CER(R$): ALTO JAURU

	2000	2001	2002	2003	2004	2010	2011	2012
Net Income	(197,260)	(2,158,934)	(568,575)	5,693,699	4,953,136	5,597,493	5,704,886	7,786,497
(+) Depreciation	197,260	2,158,934	2,603,918	2,603,918	2,603,918	2,603,918	2,603,918	2,603,918
(-) Equity	(8,000,000)	(35,178,681)	(8,899,670)	0	0	0	0	0
(+) Funding	0	0	22,066,000	0	0	0	0	0
(-) Amortization	0	0	0	(596,378)	(2,385,514)	(2,385,514)	(2,385,514)	(2,385,514)
(+) CER Revenues			249,078	1,010,148	1,010,148	1,010,148	1,010,148	1,010,148
(+) Perpetuity								87,314,412
Investor Cash Flow	**(8,000,000)**	**(35,427,759)**	**14,440,602**	**7,701,239**	**5,171,540**	**5,815,897**	**5,923,290**	**96,329,461**
Investor Cash Flow + CER	**(8,000,000)**	**(35,178,681)**	**15,450,750**	**8,711,386**	**6,181,688**	**6,826,045**	**6,933,438**	**96,329,461**

Return on equity + CER	**22.0%**

Table 5 – ARAPUCEL (Alto Jauru) RoE with CER Revenues

Financial Sensitivity Analysis - PCH Alto Jauru

SELIC rate* (1996 - 2004)	%	Project NPV	Project NPV with CER
Maximum Level	45.00%	(R$ 12,561,076)	(R$ 11,400,927)
Average	22.36%	(R$ 3,202,280)	(R$ 419,596)
Minimum Level	15.25%	R$ 9,201,779	R$ 13,170,018
Current Discount Rate	**18.00%**	**R$ 3,216,264**	**R$ 6,655,483**
Project IRR		**20.3%**	**22.0%**

* The SELIC rate was created in 1996.

Table 6 – Sensitivity analysis of the PCH Alto Jauru investment to the SELIC rate variations in the last 10 years.

The conclusion is that CDM incentives play a very important role in overcoming 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, communication and transportation. The project sponsors had to develop these facilities before the implementation of the project. In addition there were no qualified personnel available in the region due of the lack of schools and universities.

Institutional Barrier

As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created to try to organize and to provide incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period electricity prices surpassed BRL 600/MWh (around USD 200/MWh) and the forecasted marginal price of the new energy reached levels of BRL 120 – 150/MWh (around USD 45). In the middle of 2004 the average price was bellow BRL 50/MWh (less than USD 20/MWh). The volatility of the electricity price in Brazil has a correlation with the instability in government policies in the period, with 3 different regulatory environments in a 10 year period (from 1995 to 2004). In theory the new regulatory framework has the potential to reduce market risk considerably. Nevertheless only time will prove the efficiency of the new model in relation to market risks reduction and private investment attraction[10]. In that sense, it will interesting to evaluate the results of the first auction of licenses for the construction of new power plants in order to correctly assess the success of the implementation of the new regulatory framework.

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

As described above, the main alternative to the project activity is to continue the current electricity generation in the brazilian grid. The project sponsor could invest their resources in different financial market investments. Therefore the barriers above have not affected the investment in other opportunities. There’s no lack of long term funding for large hydro and thermo power plants therefore, the identified barriers do not prevent the implementation of the alternatives.

Step 4. Common practice analysis:

One of the points to be considered when analyzing a small hydro project investment in the period (2001-2005) was the possibility to participate in the Proinfa Federal Government Program. Although some projects started construction independently from Proinfa, the program is considered one of the more viable financing alternatives for these projects, which will provide long-term PPAs and special financing conditions. Arapucel is not participating in the program and is addressing the market risk as it structures its projects.

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

Regardless of the risks and barriers mentioned above, the main reason for the reduced number of similar project activities is the economic cost. Project feasibility requires a PPA contract with a utility

[10] The reform of the legal framework of the Brazilian electricity sector started with Provisional Measure No. 144, later converted into Law No. 10,848, of 15 March 2004 - was unveiled with the publication of Decree No. 5,163, of 30 July 2004.

company, but the utilities do not have the incentives or motivation to buy electricity generated by small hydro projects.

Because of the reasons mentioned above, only 1.3% of installed capacity comes from small hydro sources (1.2 GW out of a total of 88.7 GW). Also, from the 6,934 MW under construction in the country, only 403 MW are small hydro. In 2004, only 9 small-hydro projects, a total of just 5.22 MW, were authorized by the regulatory agency[11]. Many other projects are still under development, waiting for better investment opportunities. Most of the developers which funded their projects outside of Proinfa have taken CDM as decisive factor for completing their projects. Therefore, to the best of our knowledge the vast majority of similar projects being developed in the country are participating in the Proinfa Program and those not are participating in the CDM. Additionally, the Brazilian government has stated that the projects under the Proinfa Program will also be eligible to participate in the CDM.

Step 5 – Impact of CDM Registration

According to Brazilian legislation[12] small hydro power plants must have installed capacity greater than 1 MW but not more than 30 MW and with reservoir area less or equal to 3 km². Generally, it consists of a run-of-the-river hydro plant, with minimum environmental impact.

This project activity is not the business-as-usual scenario in the country where large hydro and natural gas fired thermal power projects represent the majority of new installed capacity. With the financial benefit derived from the CERs, it is anticipated that other project developers would benefit from this new source of revenue and then would decide to develop such projects. An increase of approximately 100 to 200 basis points, derived form CERs is an important factor in determination to implement the project.

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

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

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

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

[11] ANEEL – Agência Nacional de Energia Elétrica (National Power Regulatory Agency)

[12] As defined by ANEEL Resolution n. 394, December 4th, 1998.

- 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.
- South/Southeast/Midwest: The majority of the electricity generated in the country is concentrated in this subsystem. These regions also concentrate 70% of the GDP generation in Brazil. There are more than 50 hydro power plants generating electricity for this subsystem.
- North : 80% of the Northern region is supplied by diesel. However, in the city of Belém, capital of the state of Pará where the mining and aluminum industries are located, electricity is supplied by Tucuruí, the second biggest hydro plant in Brazil.

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

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

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

Mr. A. Ricardo J. Esparta

Ecoinvest Carbon Assessoria Ltda.

Rua Padre João Manoel, 222

Postal code: 01411-000

São Paulo, Brazil

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

01/09/2002

C.1.2. Expected operational lifetime of the project activity

25y-0m

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

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period

01/09/2002

C.2.1.2. Length of the first crediting period

07y-0m

C.2.2. Fixed crediting period

C.2.2.1. Starting date

Not applicable.

C.2.2.2. Length

Not applicable.

SECTION D. Application of a monitoring methodology and plan

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

Approved consolidated monitoring methodology ACM0002, version 5 – "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources".

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

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

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

D.2.1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

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

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	Comment

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_{2e})

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

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	Comment
1. EG_y	*Electricity generation of the Project delivered to grid*	*Energy metering connected to the grid or Receipt of Sales*	*MWh*	*M*	*15-minutes-measurement and Monthly recording*	*100%*	*Electronic and Paper*	*The electricity delivered to the grid is monitored by the Project as well as by the energy buyer.*
2. EF_y	CO_2 *emission factor of the grid*	*Calculated*	tCO_2/MWh	*C*	*Every year*	*n.a.*	*Electronic and Paper*	*Data will be collected every year during the crediting period according the approved methodology –*

								ACM0002.
3. *$EF_{OM,y}$*	*CO_2 Operating Margin emission factor of the grid*	*Data provided by ONS (National dispatch center). Calculated according the approved methodology – ACM0002*	*tCO_2/MWh*	*C*	*Every year*	*n.a.*	*Electronic and Paper*	*Data will be collected every year during the crediting period according the approved methodology – ACM0002*
4. *$Ef_{BM,y}$*	*CO_2 Build Margin emission factor of the grid*	*Data provided by ONS. Calculated according the approved methodology – ACM0002*	*tCO_2/MWh*	*C*	*Every year*	*n.a.*	*Electronic and Paper*	*Data will be collected every year during the crediting period according the approved methodology – ACM0002*
5. *λ_y*	*Fraction of time during which low-cost/must-run sources are on the margin*	*Data provided by ONS. Calculated according the approved methodology – ACM0002*		*C*	*Every year*	*n.a.*	*Electronic and Paper*	*Data will be collected every year during the crediting period according the approved methodology – ACM0002*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_{2e})

According to the selected approved methodology (ACM0002, 2004), the baseline emission factor is calculated as (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 (2004)[13], 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*):

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

[13] The present PDD uses ACM0002, version 5.

- $COEF_{i,j}$ is the CO_{2e} coefficient of fuel *i* (tCO_{2e}/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources *j* (analogous for sources *k*) and the percent oxidation of the fuel in year(s) *y* and,
- $\sum_j GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j* (analogous for sources *k*),

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

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

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

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

Project participants should use from these two options that sample group that comprises the larger annual generation.

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

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

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

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

Not applicable.

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

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_{2e})

Not applicable.

D.2.3. Treatment of leakage in the monitoring plan

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

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

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

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_{2e})

Not applicable.

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

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

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.1; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	*Low*	*These data will be used for calculate the emission reductions.*
2	*Medium*	*Data will be collected from ONS and calculated every year according the methodology ACM0002*
3	*Medium*	*Data will be collected from ONS and calculated every year according the methodology ACM0002*
4	*Medium*	*Data will be collected from ONS and calculated every year according the methodology ACM0002*
5	*Medium*	*Data will be calculated every year according the methodology ACM0002*

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

Not applicable.

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

Mr. A. Ricardo J. Esparta

Ecoinvest Assessoria Ltda.

Rua Padre João Manoel, 222

Postal code: 01411-000

São Paulo, Brazil

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources

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

E.2. Estimated leakage

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

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

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

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

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

According to the selected approved methodology (ACM0002, 2004), 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 in 5 macro-regions: South (S), Southeast (SE), Midwest (CO, from the Portuguese *Centro-Oeste*), North (N) and Northeast (NE). Regarding the electricity system, three 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 (1309 MW). The second interconnected grid system connects the north and northeast regions, accounting for almost 25% of the Brazilian total installed capacity. Finally, the third 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 Arapucel project is located in the State of Mato Grosso and is integrated to the South-Southeast-Midwest (S-SE-CO) connected electricity system.

From ACM0002 (2002), 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 resources[14] constitute less than 50% of total grid generation in: 1) average of 5 most recent years, or 2) based on long-term normals for hydroelectricity production. Table 7 shows the share of hydroelectricity in the total electricity production for the Brazilian S-SE-CO interconnected system. However, the results show the non-applicability of the simple operating margin to the Arapucel project.

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

Table 7 – 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.

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

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

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

Where:

- λ_y is the share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin.
- $\sum_{i,j} F_{i,j,y}$ is the amount of fuel *i* (in mass or volume unit) consumed by relevant power sources *j* (analogous for sources *k*) in year(s) *y*,
- $COEF_{i,j}$ is the CO_{2e} coefficient of fuel *i* (tCO_{2e}/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources *j* (analogous for sources *k*) and the percent oxidation of the fuel in year(s) *y* and,
- $\sum_j GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j* (analogous for sources *k*),

The most recent numbers for the interconnected S-SE-CO system were obtained from the Brazilian national dispatch center, ONS (from the Portuguese *Operador Nacional do Sistema Elétrico)* in the form of daily consolidated reports (ONS-ADO, 2004). Data from 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:

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

Where:

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

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

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

Where:

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

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

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

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

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

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

Where variable and parameters used are:

- $\sum_{i,j} F_{i,j,y}$ is given in [kg], $COEF_{i,j}$ in [tCO_2e/kg] and $F_{i,k,y} \cdot COEF_{i,k}$ in [tCO_2e]
- $GEN_{i,k,y}$ is the electricity generation for plant k, with fuel i, in year y, obtained from the ONS database, in MWh
- $EF_{CO2,i}$ is the emission factor for fuel i, obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, in tC/TJ.
- $OXID_i$ is the oxidization factor for fuel i, obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, in %.
- 44/12 is the carbon conversion factor, from tC to tCO_2.
- 3,6 x 10^{-6} is the energy conversion factor, from MWh to TJ.
- $\eta_{i,k,y}$ is the thermal efficiency of plant k, operating with fuel i, in year y, obtained from Bosi et al. (2002).
- NCV_i is the net calorific value of fuel i [TJ/kg].

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

The λ_y factors are calculated as indicated in methodology ACM0002, with date obtained from the ONS database. Figures 16, 17 and 18 present the load duration curves and λ_y calculations for years 2002, 2003 and 2004, respectively.

The results for years 2002, 2003 and 2004 are presented in Table 8.

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}}$ [tCO_2/MWh]	λ_y
2002	*0.8504*	*0.5053*
2003	*0.9378*	*0.5312*
2004	*0.8720*	*0.5041*

Table 8 - Share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin in the S-SE-CO system for the period 2002-2004 (ONS-ADO, 2005).

With the numbers from ONS, the first step was to calculate the lambda factors and the emission factors for the simple operating margin. The obtained values can be seen in Table 8, Figure 16, Figure 17 and Figure 18.

Finally, applying the obtained numbers to calculate $EF_{OM,simple\text{-}adjusted,2001\text{-}2003}$ as the weighted average *of* $EF_{OM,simple\text{-}adjusted\ 2001}$, $EF_{OM\ simple\text{-}\ adjusted,2002}$ *and* $EF_{OM,simple\text{-}adjusted,2003}$ and λ_y to Equation 1:

- *$EF_{OM,simple\text{-}adjusted,2002\text{-}2004}$ = 0.4310 tCO_{2e}/MWh.*

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

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

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

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

Project participants should use from these two options that sample group that comprises the larger annual generation.

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

- *$EF_{BM,2004}$ = 0.0962 tCO_{2e}/MWh.*

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

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

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

- $EF_{2003} = 0.5 \times 0.4310 + 0.5 \times 0.0962 = 0.2636\ tCO_{2e}/MWh$.

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

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

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

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

Years	Estimation of project activity emissions reductions (tonnes of CO_2e)	Estimation of baseline emissions reductions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
2002*	0.0	11,886	0.0	11,886
2003	0.0	61,576	0.0	61,576
2004	0.0	91,139	0.0	91,139
2005	0.0	111,792	0.0	111,792
2006	0.0	130,914	0.0	130,914
2007	0.0	130,914	0.0	130,914
2008	0.0	131,273	0.0	131,273
2009**	0.0	87,156	0.0	87,156
Total	**0.0**	**756,650**	**0.0**	**756,650**

Table 9 – Arapucel project – CER generation

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including trans-boundary 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.

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. 394, December 4th, 1998, small hydro in Brazil is a hydro plant with installed capacity greater than 1 MW and up to 30 MW, with a reservoir area less or equal to 3 km². Generally, it consists of a run-of-the-river hydro plant, which results in having a minimum environmental impact.

The facilities of the ARAPUCEL project possess all necessary environmental and construction licenses. All three environmental licenses (LP, LI and LO) were issued by the State of Mato Grosso Environmental Protection Foundation (*Fundação Estadual do Meio Ambiente*– FEMA).

As the ARAPUCEL project is comprised of three small-hydro power plants, the fast-track procedure must be completed (Preparation of a Preliminary Environmental Report - "Relatório Ambiental Preliminar," RAP). The process has been completed and a report containing an investigation of the following aspects has been produced:

- Resources usage
- Legislation to be observed
- Impacts to climate and air quality
- Geological and soil impacts
- Hydrological impacts (surface and groundwater)
- Impacts to the flora and animal life
- Socio-economical (necessary infra-structure, legal and institutional, etc.)
- Local stakeholders comments
- Mitigation measures
- Monitoring plan

In Brazil, the sponsor of any project that involves construction, installation, expansion or operation, even with no new significant environmental impact, new licenses are necessary.

The licenses required by the Brazilian environmental regulation are (Resolution CONAMA # 237 from 1997):

- The preliminary license ("*Licença Prévia*" or L.P.),

- The construction license ("*Licença de Instalação*" or L.I.); and
- The operating license ("*Licenca de Operacao*" or L.O.).

Alto Jauru and Indiavaí have all the three licenses necessary to operate as an electricity producer. Ombreiras has the preliminary license and the construction license (FEMA-MT 497/2004) and has already requested the "Operation License".

The ARAPUCEL project has an authorization issued by ANEEL to operate as an independent power producer (*ANEEL Resolution 334 of August 14th, 2001*).

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

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

a) Contribution to the local environmental sustainability

An April 2002 law # 10,438 created Proinfa (Programa de Incentivo as Fontes Alternativas de Energia Elétrica). 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.

Although Arapucel is eligible for Proinfa, it has not applied for financing under Proinfa and therefore, does not have access to the advantages of the program. However, this project plays an important role in local environmental sustainability, specifically in superior air quality compared to an increase in natural gas which is part of the installed capacity of the country's electricity matrix.

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

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

Alto Jauru and Indiavaí, the municipalities where the project is located, currently use the electricity delivered by the grid. However, this supply of electricity has not been steadily delivered. These municipalities have been facing numerous electricity failures, which make regional industries, such as local slaughterhouses use diesel generators as backups for the

electricity system. The local air contamination from the combustion of this fuel is greater than those presented by natural gas.

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 Arapucel Project is associated with large expenditures and significant employment demands. Indiavaí, one of the project locations has a population of 2,000 inhabitants according to IBGE (2004) and a significant portion is employed by the project.

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

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

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

Another important point to highlight is the Arapucel 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 Arapucel 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. The lower expenditure is generated due to the fact that money will no longer be spent in the same amount to "import" electricity from other regions in the country through the grid. This money would stay in the region and be used for providing the population better services which would improve the availability of basic needs. The local population will receive economic benefits from royalties paid to the municipalities for the water rights granted to Arapucel.

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 (PCH Indiavaí, 2003) by technical professionals that teach local educators the importance of the environment to their society. An example of topics covered are the 3Rs (Reduce, Reuse, and Recycle).

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 Arapucel 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 ARAPUCEL. 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.

f) Conclusion

In conclusion, although the Arapucel 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 Brundtland report (WCED, 1987) defines: the

sustainable development which is the satisfaction of the present needs without compromising the ability of future generations to meet their own needs. In other words, by using run-of-river hydropower facilities, which are renewable sources of energy, to generate electricity for local use and for delivery to the grid, the Arapucel Project displaces part of the electricity derived from natural gas, a finite fossil fuel, and gives less incentives for the construction of large hydro plants, which, although are considered renewable, can have major environmental, and social impacts.

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

World Commission on Dams recommendations checklist

a) Gaining public acceptance

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

b) Comprehensive options assessment

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

c) Addressing existing dams

There are no existing dams in the region where the projects are located.

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

The reservoirs are considered to be of low impact.

d) Sustaining rivers and livelihoods

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

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

e) Recognizing entitlements and sharing benefits

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

As for sharing the benefits, funds are being structured to support local environmental parks. Also, degraded areas are being renovated, and reforestation work is underway for the 3 plants.

f) Ensuring compliance

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

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

g) Sharing rivers for peace, development and security

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

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

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

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

After the assessment of the preliminary environmental report by the state environmental authority some minor requirements were made in order to issue the licenses. All the requirements were and are being fulfilled by the project sponsors. As conclusion the environmental impact of the project activity is not considered significant and no full environmental impact assessment was demanded.

SECTION G. Stakeholders' comments

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

Following the law established by FEMA - MT, the environmental agency, ARAPUCEL has published a public call for stakeholder's comments in a local newspaper while requesting the Operation License, LO.

The public call for the environmental licenses was published on July 27th of 2002.

Beside of the stakeholders comments requested for the environmental licenses, the Brazilian Designated National Authority, "Comissão Interministerial de Mudança Global do Clima", requests comments by local stakeholders and the validation report issued by an authorized DOE according to the 11th September 2003 resolution # 1 in order to provide the letter of approval.

The proponent of the project has sent these letters to the local stakeholders in order to invite their comments while the PDD of the project was open for comments in the validation stage in the United Nations Framework Convention on Climate Change website (http://cdm.unfccc.int/) since anyone can have access to the mentioned document from a legitimate source.

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

- Araputanga, Indiavaí and Jauru, City Hall
- Araputanga, Indiavaí and Jauru City Council.
- FEMA - MT – State of Mato Grosso Environmental Agency.
- Water and Sewage Department of Araputanga.
- ICV - Instituto Centro de Vida
- State Public Attorney

G.2. Summary of the comments received

No comments were received on the licensing process.

Regarding Ombreiras, that has initiated the licensing process after the other two facilities; no comments were received by the project participants.

Brazilian DNA requests that projects be open for comments prior to validation. Thus, in addition to UNFCCC global stakeholders' comments this project was open for inputs from locals at the same time. Only the City Hall of Indiavaí has called for clarifications but has not done any comments.

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

No comments were received. The project was developed as planned and following the requests made by the local environmental authority (FEMA – MT).

The research paper prepared by the Arapucel Project analyzing on the impact of the facilities in the region is available upon request.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Araputanga Centrais Elétricas S.A.
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Middle name:	
First name:	Takashi

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City:	Tokyo
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Country:	
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E-Mail:	
URL:	
Represented by:	Mrs. Masayuki Oku
Title:	President
Salutation:	Mrs.
Last name:	Oku
Middle name:	
First name:	Masayuki
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal e-mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding was and will be used in the present project.

Annex 3

BASELINE INFORMATION

The Brazilian electricity system has been historically divided into two subsystems: the North-Northeast (N-NE) and the South-Southeast-Midwest (S-SE-CO). This is due mainly to the historical evolution of the physical system, which was naturally developed nearby the biggest consuming centers of the country.The natural evolution of both systems is increasingly showing that integration is to happen in the future. In 1998, the Brazilian government was announcing the first leg of the interconnection line between S-SE-CO and N-NE. With investments of around US$700 million, the connection had the main purpose, in the government's view, at least, to help solve energy imbalances in the country: the S-SE-CO region could supply the N-NE in case it was necessary and vice-versa.

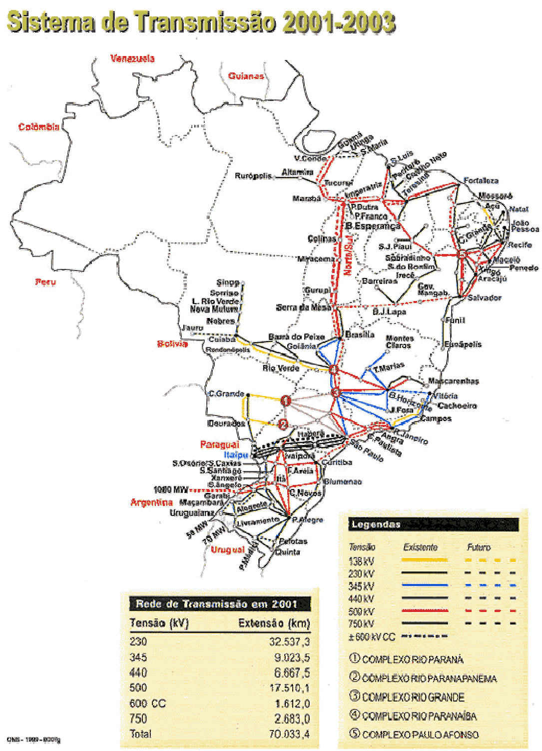

Figure 9 – Brazilian electricity grid

Nevertheless, even after the interconnection had been established, technical papers still divided the Brazilian system in two (Bosi, 2000)[15]:

"… 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

[15] Bosi, M. *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study.* International Energy Agency. Paris, 2000.

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

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

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

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

The Brazilian electricity system nowadays comprises of around 91,3 GW of installed capacity, in a total of 1,420 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 5.3% are diesel and fuel oil plants, 3.1% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw and biogas), 2% are nuclear plants, 1.4% are coal plants, and there are also 8,1 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid. (http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp). This latter capacity is in fact comprised by mainly 6,3 GW of the Paraguayan part of *Itaipu Binacional*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

Approved methodologies AM0015 and ACM0002 ask project proponents to account for "all generating sources serving the system". In that way, when applying one of these methodologies, project proponents in Brazil should search for, and research, all power plants serving the Brazilian system.

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

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

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to ANEEL, in fact, ONS centralized dispatched plants accounted for 75,547 MW of installed capacity by

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

In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International Energy Agency database built when carrying out the study from Bosi *et al.* (2002). Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only (Table 10).

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

Table 10 – Ex ante and ex-post operating and build margin emission factors (ONS-ADO, 2004; Bosi et al., 2002)

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

The aggregated hourly dispatch data got from ONS was used to determine the lambda factor for each of the years with data available (2002, 2003 and 2004). The Low-cost/Must-run generation was determined as the total generation minus fossil-fuelled thermal plants generation, this one determined through daily dispatch data provided by ONS. All this information has been provided to the validators, and extensively discussed with them, in order to make all points crystal clear. The figures below show the load duration curves for the three considered years, as well as the lambda calculated.

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

Baseline (including imports)	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [GWh]	Imports [MWh]
2002	0.8504	275,402,896	258,720	1,607,395
2003	0.9378	288,493,929	274,649	459,586
2004	0.8726	297,879,874	284,748	1,468,275
	Total (2002-2004) =	**861,776,699**	**818,118**	**3,535,256**
	$EF_{OM,\ simple\text{-}adjusted}$ [tCO2/MWh]	$EF_{BM,2004}$	Lambda	
	0.4310	0.0962	λ_{2002}	
	Alternative weights	Default weights	0.5053	
	w_{OM} = 0.75	w_{OM} = 0.5	λ_{2003}	
	w_{BM} = 0.25	w_{BM} = 0.5	0.5312	
	Alternative EF_{CM} [tCO2/MWh]	Default EF_{OM} [tCO2/MWh]	λ_{2004}	
	0.3473	**0.2636**	0.5041	

Table 11 – Emission factors for the Brazilian South-Southeast-Midwest interconnected grid (simple adjusted operating margin factor)

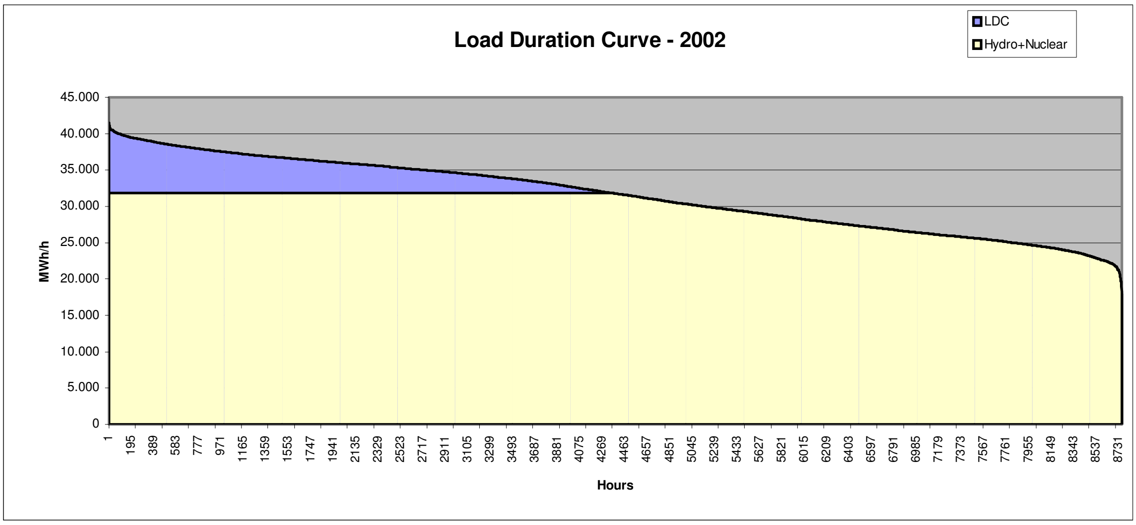

Figure 16: 2002 Load Duration Curve S/SE/MW (source: ONS – Operador Nacional do Sistema)

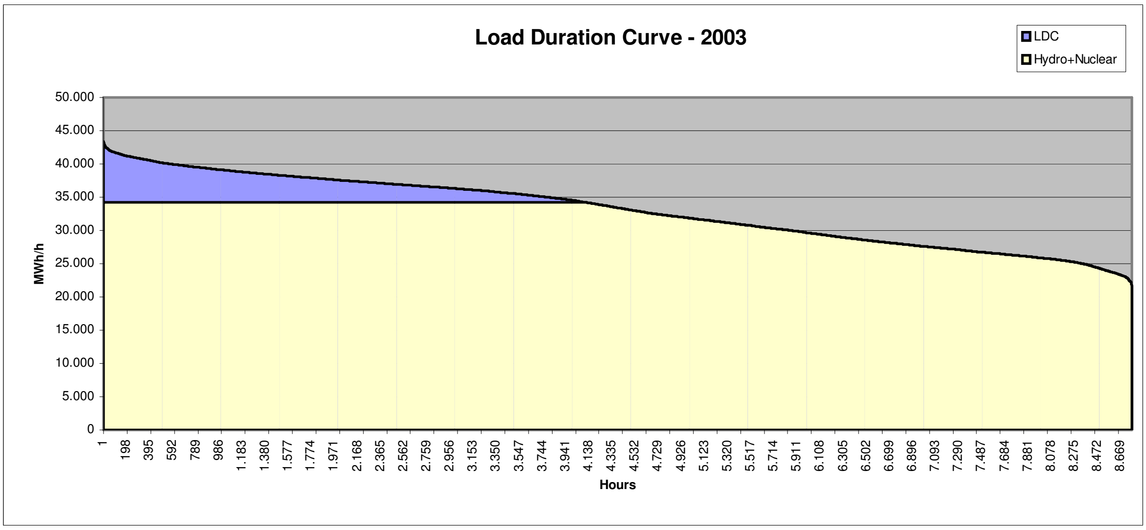

Figure 17: 2003 Load Duration Curve S/SE/MW (source: ONS – Operador Nacional do Sistema)

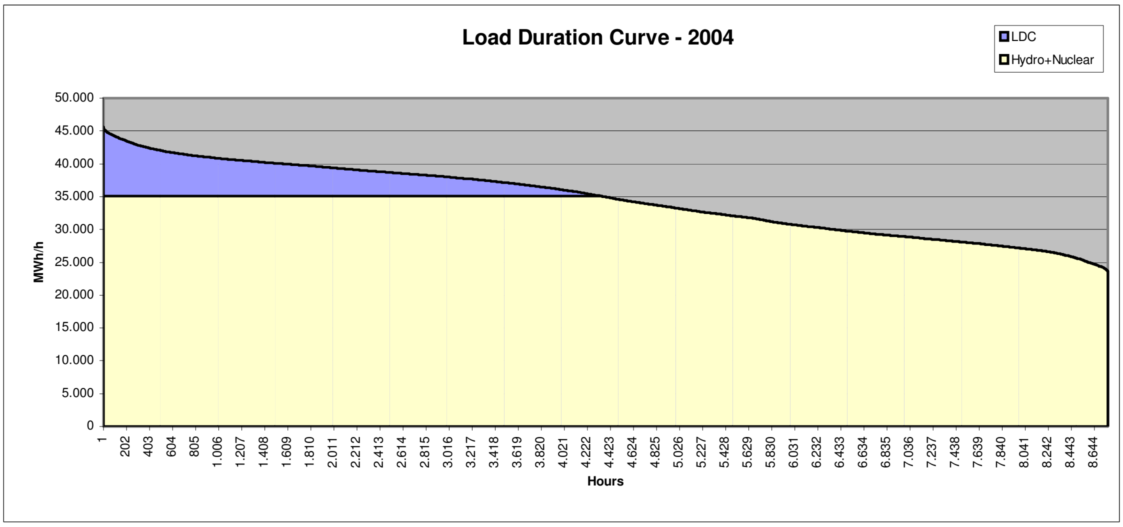

Figure 18: 2004 Load Duration Curve S/SE/MW (source: ONS – Operador Nacional do Sistema)

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

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

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

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

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

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

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

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

Table 12 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 1

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

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

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

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Table 13 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 2

Annex 4

MONITORING PLAN

As per the procedures set by the Approved monitoring methodology ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources")

The project sponsor 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.

Although the dispatching information is considered strategic to power agents, the national dispatch center, ONS – *Operador Nacional do Sistema* – will make it available for grid emission factor calculation. The data from ONS will be collected every year and the project participants through CDM consultants will calculate of the emission factor.

Annex 5

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