



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

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

Project title: Picada Run-of-river Hydropower Plant CDM Project Activity (hereafter referred to simply as “Picada Project”).

PDD version number: 1

Date (DD/MM/YYYY): 07/02/2006.

A.2. Description of the project activity:

The primary objective of the Picada Run-of-river Hydropower Plant CDM Project Activity is to help meet Brazil’s rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy’s share of the total Brazilian (and the Latin America and the Caribbean region’s) electricity consumption.

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

The privatization process initiated in 1995 arrived with an expectation of adequate tariffs 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 an under-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 hydropower projects.

This indigenous and cleaner source of electricity will also have an important contribution to environmental sustainability by reducing carbon dioxide emissions that would have occurred otherwise in the absence of the project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding

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."



electricity generation by fossil fuel sources (and CO₂ emissions), which would be generating (and emitting) in the absence of the project.

Picada Project improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. Small to medium scale hydropower run-of-river plants provide local distributed generation and 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;
- Mitigation of transmission and distribution congestion, and;
- Increased system capacity with reduced T&D investment.

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

The project activity is a run-of-river hydropower plant with a total installed capacity of 50 MW, located in the city Juiz de Fora, state of Minas Gerais, Southeast region of Brazil. The first Francis turbine (25 MW) started its operation in July 01st 2006. The second one (25MW), started its operations in July 07th, 2006.

The Project is owned by Consórcio Paraibuna composed by Companhia Paraibuna de Metais and Paraibuna de Energia Ltda. Consórcio Paraibuna is controlled by Votorantim Group.

A.3. Project participants:

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

Credit owner and project operator, Consórcio Paraibuna, a private company, is author and the responsible for all activities related to the project management, registration, monitoring, and measurement and reporting.



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)	Consórcio Paraibuna	No
	Ecoinvest Carbon Brasil Ltda. (private entity)	
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

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

A.4. Technical description of the project activity:**A.4.1. Location of the project activity:****A.4.1.1. Host Party(ies):**

Brazil.

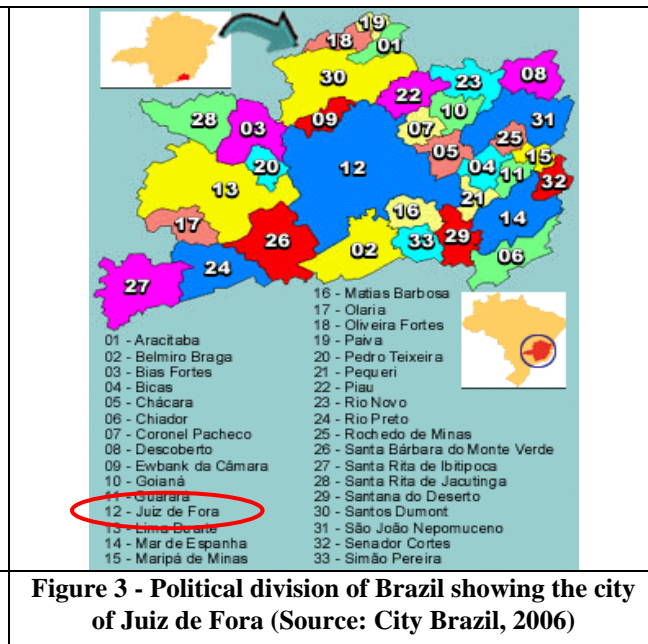
A.4.1.2. Region/State/Province etc.:

State of Minas Gerais.

A.4.1.3. City/Town/Community etc:

Juiz de Fora town.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):Juiz de fora is a city with 501,153 inhabitants and 1,437 km².



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

Renewable electricity generation for a grid.
Sectoral Scope: 1 – Energy industries (renewable - / non-renewable sources)

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



Figure 1 – Picada power plant location and physical configuration
Source: www.usinapicada.com.br



The facility description follows:

- 127.93 m waterfall for 50 MW total installed capacity (2 × 25 MW Francis turbines). The first Francis turbine (25 MW) started its operation in July 01st 2006. The second one (25MW), started its operations in July 07th, 2006.
- Reservoir size of 1.10 km² and power density of 45.45 W/m² (as a matter of comparison the average of the 43 biggest Brazilian hydropower plants, totalizing 63,417 MW installed capacity, is 2.23 W/m²).

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

Considering the baseline 0.2611 tonCO₂e/MWh, applicable to grid-connected renewable power generation project activities in Brazil, the full implementation of the small hydropower plant connected to the Brazilian interconnected power grid will generate the estimated annual reduction as in Table 5 below.

Years	Annual estimation of emission reductions in tonnes of CO2
2007 (Starting in October 1st)	15,566
2008	61,755
2009	61,755
2010	61,755
2011	61,755
2012	61,755
2013	61,755
2014 (Until September 30th)	46,190
Total Estimated Emissions Reductions	432,288
Total number of crediting years	7
Annual average over the crediting period of estimated reductions	61,755

Table 2 - Project Emission Reductions Estimation

A.4.5. Public funding of the project activity:

No public funding, including official development assistance, was or will be used in Picada Run-of-river Hydropower Plant CDM Project Activity.

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

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

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

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

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

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

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

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

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

The boundaries of the subsystems are defined by the capacity of transmission. The transmission lines between the subsystems have a limited capacity and the exchange of electricity between those subsystems is difficult. The lack of transmission lines forces the concentration of the electricity generated



in each own subsystem. Thus the South-Southeast-Midwest interconnected subsystem of the Brazilian grid where the project activity is located is considered as a boundary.

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

Considering that the power density of Picada is greater than $10\text{W}/\text{m}^2$, there is no emissions from the project activity neither a spatial boundary for project activity emissions. Indirect emissions can result from project construction, transportation of materials and fuel and other upstream activities. Nevertheless no significant net leakage from these activities was identified.

	Source	Gas	Included?	Justification / Explanation
Baseline	Electric Energy Use	CO ₂	Yes	To generate electricity as happen in thermo plants emits greenhouse gases such as: carbon dioxide "CO ₂ "
Project Activity	Emission from reservoir	CH ₄	No	No significant emission from reservoir is identified in the project activity, according to the power density calculation

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

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

In the absence of the project activity, large quantities of carbon dioxide (CO₂) would be emitted to the atmosphere. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation by fossil fuel sources (and CO₂ emissions), which would be generating (and emitting) in the absence of the project. So, the baseline scenario is identified as the continuation of the current (previous) situation of electricity supplied by large hydro and thermal power stations – or by Diesel oil, in the case of isolated systems.

As an alternative for the group company, there is the investment in other opportunities, like the financial market. Given that Consórcio Paraibuna is a company from Votorantim Group (holding company), it could as well have decided to focus on the other company areas of the group and not on the power market, as it is the case with the project activity.

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



The additionality of the project activity shall be demonstrated and assessed using the latest version of the “Tool for the demonstration and assessment of additionality” agreed by the CDM Executive Board, which is available on the UNFCCC CDM web site².

Following are the necessary steps for the demonstration and assessment of Picada Project additionality.

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

Not applicable.

SATISFIED/PASS – Proceed to Step 1

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

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

1. The identified realistic alternatives to the project activity are:

- Continuation of the present scenario, with the supply of electricity from the S-SE-CO Brazilian interconnected grid.
- The implementation of the project without incentives from the CDM.

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

2. Not applicable.

3. Not applicable.

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

SATISFIED/PASS – Proceed to Step 2

Step 2. Investment analysis

SATISFIED/PASS – Proceed to Step 3

Step 3. Barrier analysis

The considered barriers are the following:

- Lack of investment sources to finance the private sector in the country, and the high costs of the available alternatives,
- Energy sector regulation impact, once the sector was under complete reformulation in the period (2000 to 2004).

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

² UNFCCC - United Nations Framework Convention on Climate Change (www.unfccc.int)

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

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

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

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

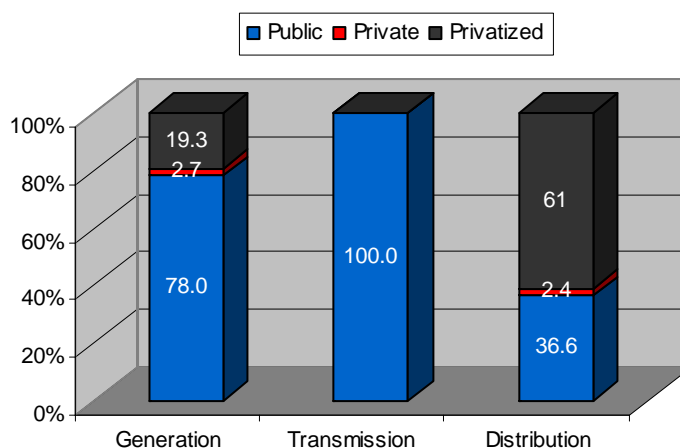


Figure 2 - Participation of private capital in the Brazilian electricity market in December 2000
(Source: BNDES, 2000).

At the end of 2000, five years after the beginning of the privatization process, the results were still modest (**Erro! Fonte de referência não encontrada.**). 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 (average of 5% increase in the same period) is well known in developing countries, mainly due to the expansion of supply services to new areas and the growing infrastructure. The necessary measures to prevent bottlenecks in services were taken. These include an increase of generation capacity higher than GDP growth rates and strong investments in energy efficiency. In the Brazilian case, the

increase in the installed generation capacity (average of 4% in the same period) did not follow the growth of consumption as can be seen in Figure 3.

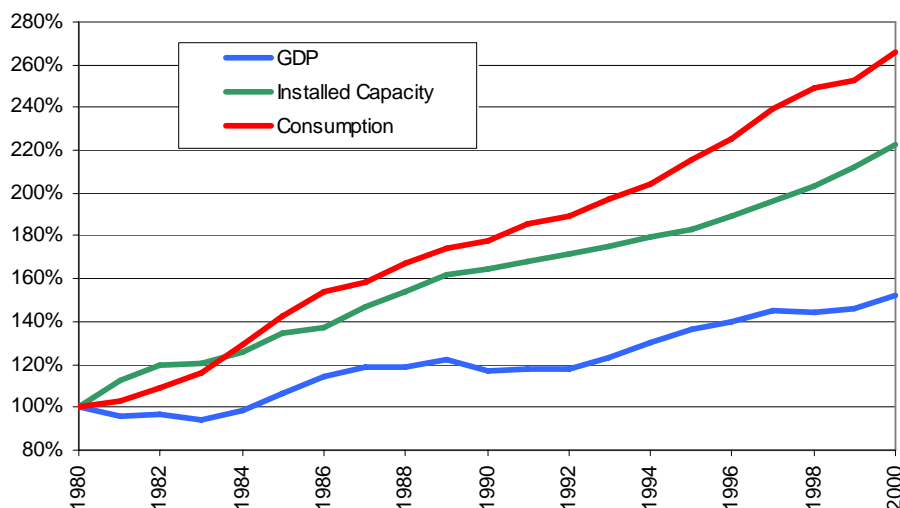


Figure 3 - Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption) (Source: Eletrobrás, <http://www.eletrobras.gov.br>; IBGE, <http://www.ibge.gov.br/>).

Without new installed capacity, the only alternatives were energy efficiency improvements or higher capacity utilization (capacity factor).

Regarding energy efficiency, the government established in 1985 PROCEL (the National Electricity Conservation Program). Although the program achieved considerable results, it was not able to alone balance the increase of demand.

The remaining alternative, to increase the capacity factor of the older plants, was the most widely used, as can be seen in Figure 5. 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.

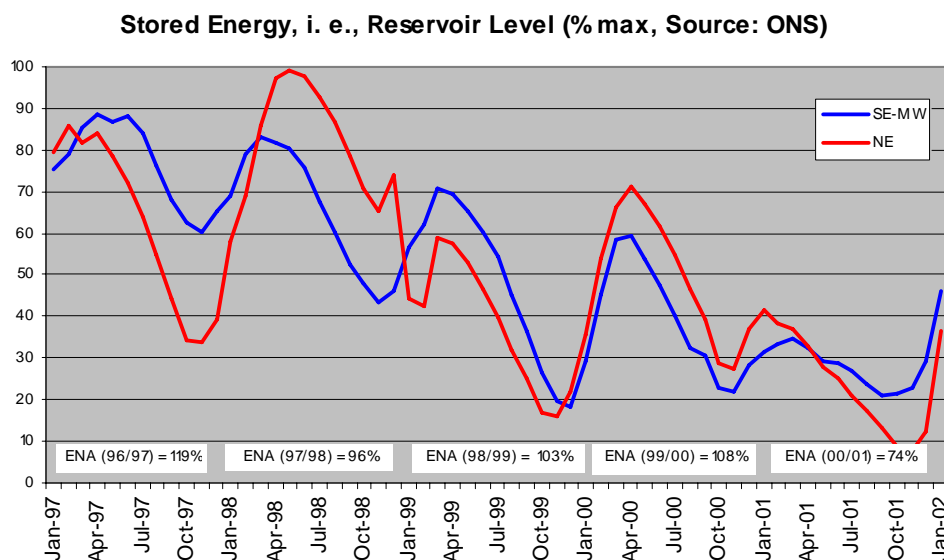


Figure 4 – Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS, <http://www.ons.org.br/>)

Figure 4 shows what happened to the levels of “stored energy” in reservoirs from January 1997 to January 2002. It can be seen that reservoirs which were planned to withstand 5 years of less-than-average rainy seasons, almost collapsed after a single season of low rainfall (2000/2001 experienced 74% of the historical average rain. This situation depicts a very intensive use of the country’s hydro resources to support the increase in demand without increase of installed capacity. Under the situation described there was still no long-term solution for the problems that finally caused shortage and rationing in 2001.

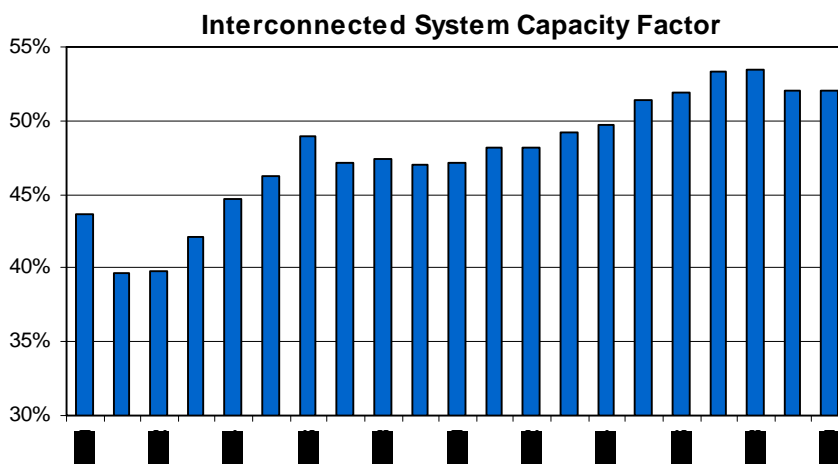


Figure 5 - Evolution of the rate of generated energy to installed capacity (Source: Eletrobrás, <http://www.eletronbras.gov.br/>).

Aware of the difficulties since the end of the 1990's, the Brazilian government signaled that it was strategically important for the country to increase thermoelectric generation and consequently be less dependent on hydropower. With that in mind the federal government launched at the beginning of the year of 2000 the Thermoelectric Priority Plan (PPT, “Plano Prioritário de Termelétricas”, Federal Decree 3,371 of February 24th, 2000, and Ministry of Mines and Energy Directive 43 of February 25th, 2000), originally planning the construction of 47 thermo plants using Bolivian natural gas, totaling 17,500 MW of new installed capacity to be completed by December 2003. During 2001 and the beginning of 2002 the plan was reduced to 40 plants and 13,637 MW to be installed by December 2004 (Federal Law 10,438 of April 26th, 2002, Article 29). As of December 2004, only 20 plants totaling around 9,700 MW were operational.

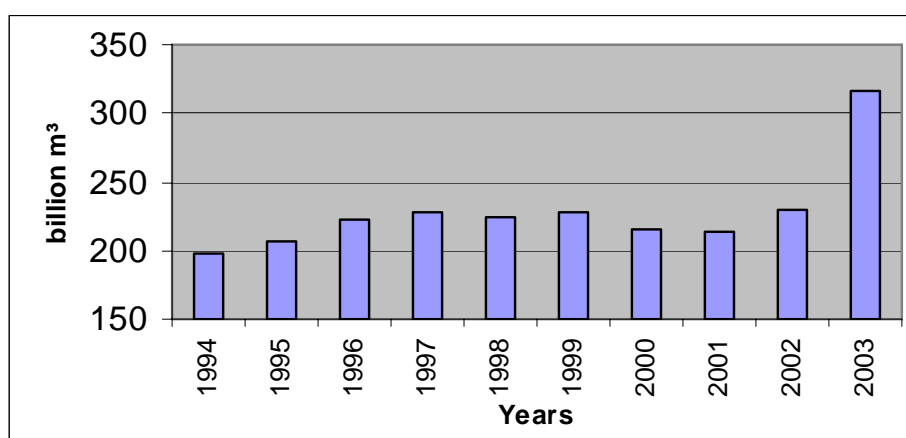


Figure 8 - Evolution of the Brazilian natural gas proved reserves (Source: Petrobras, <http://www.petrobras.com.br/>)

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

It is clear that hydroelectricity is and will continue to be the main source for the electricity base load in Brazil. However, most if not all-hydro resources in the South and Southeast of the country have been exploited, and most of the remaining reserves are located in the Amazon basin, far from the industrial and population centers (OECD, 2001). Clearly, new additions to Brazil's electric power sector are shifting from hydroelectricity to natural gas plants (Schaeffer et al., 2000). In the Figure 8, it can be realized that with discoveries of vast reserves of natural gas, specially with the discovery of Santos Basin in 2003, the policy of using natural gas to generate electricity remains a possibility and will continue to have interest from private-sector investments in the Brazilian energy sector.

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

- Electricity demand and supply will be coordinated through a “Pool.” Demand will be estimated by the distribution companies, which will have to contract 100% of their projected electricity



demand over the following 3 to 5 years. These projections will be submitted to a new institution called Energy Planning Company (*Empresa de Planejamento Energético*, EPE), which will estimate the required expansion in supply capacity to be sold to the distribution companies through the Pool. The price at which electricity will be traded through the Pool is an average of all long-term contracted prices and will be the same for all distribution companies.

- In parallel to the “regulated” long-term Pool contracts, there will be a “free” market. Although in the future, large consumers (above 10 MW) will be required to give distribution companies a 3-year notice if they wish to switch from the Pool to the free market and a 5-year notice for those moving in the opposite direction a transition period is envisaged during which these conditions will be made more flexible. If actual demand turns out to be higher than projected, distribution companies will have to buy electricity in the free market. In the opposite case, they will sell the excess supply in the free market. Distribution companies will be able to pass on to end consumers the difference between the costs of electricity purchased in the free market and through the Pool if the discrepancy between projected and actual demand is below 5%. If it is above this threshold, the distribution company will bear the excess costs.
- The government opted for a more centralized institutional set-up, reinforcing the role of the Ministry of Mines and Energy in long-term planning. EPE will submit to the Ministry its desired technological portfolio and a list of strategic and non-strategic projects. In turn, the Ministry will submit this list of projects to the National Energy Policy Council (*Conselho Nacional de Política Energética*, CNPE). Once approved by CNPE, the strategic projects will be auctioned on a priority basis through the Pool. Companies can replace the non-strategic projects proposed by EPE, if their proposal offers the same capacity for a lower tariff. Another new institution is a committee, Power Monitoring Committee (*Comitê de Monitoramento do Setor Elétrico*, CMSE), which will monitor trends in power supply and demand. If any problem is identified, CMSE will propose corrective measures to avoid energy shortages, such as special price conditions for new projects and reserve of generation capacity. The Ministry of Mines and Energy will host and chair this committee. No major further privatizations are expected in the sector.

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

Interest Rate Environment in Brazil

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

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

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

Financial domestic markets with a maturity of greater than 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 horizon of their placements. It has made savers look for the most liquid investment and place their money in short-term government bonds instead of investing in long-term opportunities that could finance infrastructure projects.

Financial and Currency Risk

Picada Project is being developed with corporate guarantees posted by Votorantim Group and financed by BNDES. The project was set up with an expected financial IRR (Internal Rate of Return) of approximately 13.9 % before taxes and un-leverage per year. This average project IRR is below to the SELIC rate, set on the 24% level as of July/August 2003 (when Picada started construction), although the project is a much riskier investment as compared to Brazilian government bonds. The inclusion of the revenues from CERs makes the project's IRR increase by approximately 1.1 points from 13.9% to 15 % (IRR calculation under request). Such increase in return would partially compensate for the additional risk the investor would take with this project.

In addition the CER revenues would bring the project additional benefits due to the fact that they are generated in hard currencies (US Dollar or EURO). That revenue allows the project sponsors to hedge its debt cash flow against currency devaluation. Moreover, the CER Free Cash Flow, in US dollars or

euro, could be discounted at an applicable discount interest rate, thus increasing the project leverage, that currently is un-leverage.

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

Plant	IRR with CER	IRR without CER
Picada	15%	13.9%

Table 4: Project Financial Analysis

In order to assess the feasibility of Project Picada one can compare its ROE with fixed income securities issued by the Brazilian Government. 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 follows the CDI - Interbank Deposit Certificate rate; which by its turn, is influenced by the SELIC rate, defined by COPOM³. The SELIC rate is the Brazilian equivalent of the US Fed Funds rate established by the Federal Open Market Committee.

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).

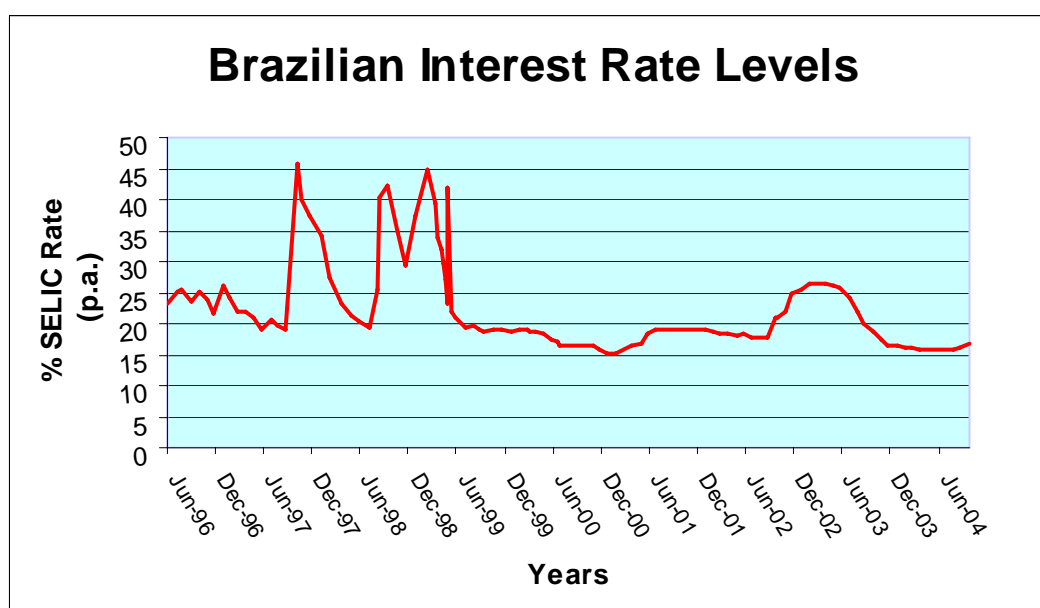


Figure 15 - SELIC rate (Source: Banco Central do Brasil, <http://www.bcb.gov.br/>)

The Table below can demonstrate the ROE increase by adding the CER revenues to the project's operational Cash Flow. Such increase in yield would compensate for the additional risk investor would take with this project, and would make investment attractive from a financial standpoint.

3 COPOM – Comitê de Política Monetária



Besides the increase of 1.1 points to project ROE, CER revenues would bring the project additional benefits due to the fact that these revenues are generated in hard currencies such as the US Dollar or the Euro. The potential revenues from CDM allow Consórcio Paraibuna to hedge its debt cash flow against currency devaluation and can be eventually discounted at an applicable interest rate, thus increasing the project leverage.

CASH FLOW - PICADA												
Revision RIC Capital Investment Requisition MAY/2003												
Data-base		dez-02	dez-03	dez-04	dez-05	dez-06	dez-07	dez-08	dez-09	dez-10	dez-11	dez-12
Total Flow for Constant Shareholders (R\$ 000)	dez-02	(7,900)	(819)	(21,129)	(7,902)	2,527	3,659	4,094	4,447	4,792	5,133	5,469
Total Flow for Constant Shareholders (R\$ 000)	dez-06	(10,108)	(1,047)	(27,035)	(10,111)	3,233	4,682	5,239	5,690	6,132	6,568	6,998
IRR (BRL)		13.9%										
IRR (BRL) - 31/DEC/2006		13.9%										
MWh						117,965	236,520	237,160	236,520	236,520	236,520	237,160
Annual estimation of emission reductions [tCO2] - cálculo VE		0.2611					61.92	61.76	61.76	61.76	61.76	61.92
Annual estimation of emission reductions [tCO2] - e-mail Ecoinvest							15.23	61.76	61.76	61.76	61.76	61.76
Annual estimation of emission reductions [tCO2]		31-dez-06					61.92	61.76	61.76	61.76	61.76	61.92
R\$/tCO2		34.08					2,110	2,105	2,105	2,105	2,105	2,110
(c) IRR/CS							1,393	1,389	1,389	1,389	1,389	1,393
Total Flow for Constant Shareholders (R\$ 000)		(10,108)	(1,047)	(27,035)	(10,111)	3,233	4,682	6,632	7,079	7,521	7,957	8,391
IRR (RRI)		15.0%										
IRR Increase in Percentage Points		1.1%										

Table 4 – Picada RoE with and without CER revenues

Completion and Credit Risk

Financing from BNDES is only available to companies willing to offer corporate or real guarantees in excess of total amount borrowed. In other words, Consórcio Paraibuna had to use its own balance sheet and capital to raise funds from BNDES. In case projects underperform or become unfeasible, BNDES will call Consórcio Paraibuna's guarantees and real assets up to their initial credit exposure. In addition to leveraging their balance sheet with sizeable borrowings, Consórcio Paraibuna, through its holding company Votorantim Group, faces completion risk of the projects and credit risk of the utility. Completion risk is mitigated by guarantees pledged by the construction company; which are however, of limited recourse. The credit risk of the utility though is difficult to hedge.

Conclusion

CDM offered Picada Project an additional source of revenue that could mitigate the projects' exposure to currency devaluation, interest rate increases, and credit risk. The pro-forma income statement analysis of the projects shows that investor's return on equity could increase by as much as 100 basis points when revenues from CERs are considered and thus render projects marginally attractive when compared to risk free bond rates. In sum, in the absence of CDM, Picada Project would be a riskier, less attractive and ultimately unfeasible project.

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



As described above, the main alternative to the project activity is to continue the status quo. Implementing the project activity without the CDM incentive is not a feasible alternative. Possible project sponsors would certainly prefer to invest their resources in different financial market investments. Therefore the barriers above have not affected the investment in other opportunities. To the contrary Brazilian interest rates, which represent a barrier for the project activity, is an interesting investment alternative.

SATISFIED/PASS – Proceed to Step 4

Step 4. Common practice analysis

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

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

Both processes of negotiating a PPA with utility companies and obtaining funding from BNDES have proved to be very cumbersome. The developers perceive BNDES requiring excessive guarantees in order to provide financing. Although this might be the Bank role as a financing institution to mitigate risk, it is understood as a market barrier. Other risks and barriers are related to the operational and technical issues associated with hydropower plants, 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 financial burden. Project feasibility requires a PPA contract with a utility company, but the utilities do not have the incentives or motivation to buy electricity directly from independent power producers.

Because of the reasons mentioned above almost no new installed capacity was added to the Brazilian generation park in the period.

SATISFIED/PASS – Proceed to Step 5

Step 5 – Impact of CDM registration

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 recently installed capacity. With the financial benefit derived from the CDM, it is anticipated that other project developers would benefit from this new source of revenue and then would decide to develop such projects. An increase of approximately 100 basis points, derived from CERs is an important factor in determination to implement the project.

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

SATISFIED/PASS – Project is ADDITIONAL

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:



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

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

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

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

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

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

Where:

- λ_y is the share of hours in year y (in %) for which low-cost/must-run sources are on the margin.
- $\sum_{i,j} F_{i,j,y}$ is the amount of fuel i (in mass or volume unit) consumed by relevant power sources j (analogous for sources k) in year(s) y ,
- $COEF_{i,j}$ is the 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 (tCO₂e/MWh) of a sample of power plants m , as follows:

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

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (ACM0002, 2006) for plants m , based on the most recent information available on plants already built. The sample group m consists of either:

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

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

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

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

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

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

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

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

where,

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



- b) If power density of the project is greater than $10\text{W}/\text{m}^2$, $\text{PE}_y = 0$.

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

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

This section shall include a compilation of information on the data and parameters that are not monitored throughout the crediting period but that are determined only once and thus remains fixed throughout the crediting period and that are available when validation is undertaken. All data of Picada project activity become available only after validation of the project activity and are monitored during the crediting period. Please see table in section B.7.1.

B.6.3 Ex-ante calculation of emission reductions:

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

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

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

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

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

- Dispatch data analysis operating margin
- Average operating margin.

Dispatch data analysis operating margin should be the first methodological choice. Since not enough data was supplied by the Brazilian national dispatch center, the choice is not currently available. The simple operating margin can only be used where low-cost/must-run resources⁴ constitute less than 50% of total grid generation in: 1) average of 5 most recent years, or 2) based on long-term normals for hydroelectricity production. Table 5 shows the share of hydroelectricity in the total electricity production for the Brazilian S-SE-CO interconnected system. However the results show the non-applicability of the simple operating margin to the Project.

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

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

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

The simple adjusted operating margin emission factor ($EF_{OM,adjusted,y}$ in tCO₂/MWh) is a variation on the simple operating margin, where the power sources (including imports) are separated in low-cost/must-run power sources (k) and other power sources (j):

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

Where:

- 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 ,

⁴ Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation (ACM0002, 2006).



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

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

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

Where:

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

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

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

Where:

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

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

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

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

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

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

Where variable and parameters used are:

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

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

The λ_y factors are calculated as indicated in methodology ACM0002, with data obtained from the ONS database. Figure 11, Figure 12 and Figure 13 present the load duration curves and λ_y calculations for years 2003, 2004 and 2005, respectively.

The results for years 2003, 2004 and 2005 are presented in Table 6.

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$ [tCO ₂ /MWh]	λ _y [%]
2003	0.9823	0.5312
2004	0.9163	0.5055



2005	0.8086	0.5130
------	--------	--------

Table 6 - Share of hours in year y (in %) for which low-cost/must-run sources are on the margin in the S-SE-CO system for the period 2003-2005 (ONS-ADO, 2006).

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

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

<ul style="list-style-type: none"> $EF_{OM, simple-adjusted, 2003-2005} = 0.4349 \text{ tCO}_2\text{e/MWh}.$
--

- STEP 2** – Calculate the build margin mission factor ($EF_{BM,y}$) as the generation weighted average emission factor ($\text{tCO}_2\text{e/MWh}$) of a sample of power plants m , as follows:

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

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (ACM0002, 2006) for plants m , based on the most recent information available on plants already built. The sample group m consists of either:

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

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

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

<ul style="list-style-type: none"> $EF_{BM,2005} = 0.0872 \text{ tCO}_2\text{e/MWh}.$

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

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

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



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

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

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

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

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

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

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

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

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

where,

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

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

Installed capacity: 50MW

Reservoir area: 1,10 km²

Power density: 50MW/1,10 km² = 45.45 MW/ km² or 45.45 W/m².

The power density of Picada Project is greater than 10W/m², then $PE_y = 0$.

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



Years	Estimation of Project Activity Emissions (tonnes of CO ₂ e)	Estimation of Baseline Emissions (tonnes of CO ₂ e)	Estimation of Leakage (tonnes of CO ₂ e)	Estimation of Overall Emission Reductions (tonnes of CO ₂ e)
2007 (Starting in October 1st)	0	15,565.74	0	15,565.74
2008	0	61,755.37	0	61,755.37
2009	0	61,755.37	0	61,755.37
2010	0	61,755.37	0	61,755.37
2011	0	61,755.37	0	61,755.37
2012	0	61,755.37	0	61,755.37
2013	0	61,755.37	0	61,755.37
2014 (Until September 30th)	0	46,189.63	0	46,189.63
Total (tonnes of CO ₂ e)	0	432,287.60	0	432,287.60

Table 9: tCO₂ total estimation reduction of the project**B.7 Application of the monitoring methodology and description of the monitoring plan:****B.7.1 Data and parameters monitored:**

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

(Copy this table for each data and parameter)

Data / Parameter:	EF _y
Data unit:	tCO ₂ /MWh
Description:	CO ₂ emission factor of the grid
Source of data to be used:	ONS (Operador Nacional do Sistema Eléctrico – Operator of the Brazilian Electric System)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.2611 tCO ₂ /MWh
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	The baseline emission factor (EF _y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. Calculations for this combined margin are based on data from official sources (National Dispatch Center for the power generation data; EB decision regarding thermodynamic efficiency of power by fuel types information) with very low level of uncertainty and made publicly available. Data ex-post calculated and monitored at every verification.



Any comment:	
Data / Parameter:	$EF_{OM,y}$
Data unit:	tCO ₂ /MWh
Description:	CO ₂ Operating Margin emission factor of the grid
Source of data to be used:	Data provided by ONS (National dispatch center). Calculated according the approved methodology – ACM0002
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.4349 tCO ₂ /MWh
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Data ex-post calculated and monitored at every verification.
Any comment:	
Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO ₂ /MWh
Description:	CO ₂ Build Margin emission factor of the grid
Source of data to be used:	Data provided by ONS. Calculated according the approved methodology – ACM0002
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0872 tCO ₂ /MWh
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Data ex-post calculated and monitored at every verification.
Any comment:	
Data / Parameter:	λ_v
Data unit:	
Description:	Fraction of time during which low-cost/must-run sources are on the margin
Source of data to be used:	Data provided by ONS. Calculated according the approved methodology – ACM0002
Value of data applied for the purpose of calculating expected emission reductions in	Please, see Annex 3



section B.5	
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Data ex-post calculated and monitored at every verification.
Any comment:	

Data / Parameter:	Electricity generation of the Project delivered to grid (EGy)
Data unit:	MWh
Description:	Energy metering connected to the grid and the annual energy generation report
Source of data to be used:	Energy meter and receipt of electricity purchase
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Energy metering QA/QC procedures are explained in Annex 4 (the equipments used have by legal requirements extremely low level of uncertainty). Measured and monitored at every verification.
Any comment:	

Data / Parameter:	
Data unit:	km ²
Description:	
Source of data to be used:	Surface area at full reservoir level
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,10 km ²
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Data is monitored only at start of the project. The value is estimated by the national electricity agency at the concession phase and is thoroughly calculated and determined during the environmental licensing phase (very low uncertainty level).
Any comment:	

**B.7.2 Description of the monitoring plan:****B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)**

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

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Ecoinvest is the Project Advisor and also a Project Participant.

SECTION C. Duration of the project activity / crediting period**C.1 Duration of the project activity:****C.1.1. Starting date of the project activity:**

(DD/MM/YYYY) 01/10/2007.

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

35y-0m

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

(DD/MM/YYYY) 01/10/2007.

C.2.1.2. Length of the first crediting period:



7y-0m

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

Not applicable.

C.2.2.2. Length:

Not applicable.

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

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

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

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

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

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

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

- Inundation of Indian lands and slaves historical areas – the authorization for that depends on National Congress decision;



- Inundation of environmental preservation areas, legally formed as National Parks and Conservation Units;
- Inundation of urban areas or country communities;
- Reservoirs where there will be urban expansion in the future;
- Elimination of natural patrimony;
- Expressive losses for other water uses;
- Inundation of protected historic areas; and
- Inundation of cemeteries and other sacred places.

The process starts with a previous analysis (preliminary studies) by the local environmental department. After that, if the project is considered environmentally feasible, the sponsors have to prepare the Environmental Assessment, which is basically composed by the following information:

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

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

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

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

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

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

a) Contribution to the local environmental sustainability

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

Although natural gas is the cleanest fossil fuel, the combustion in generating electricity in thermo plants emits greenhouse gases such as: carbon dioxide “CO₂”, methane “CH₄”, and nitrous oxide “N₂O”, which are, according to the Organization for Economic Cooperation and Development (OECD, 2004), the



three greenhouse gases “GHGs” which account for the majority of human induced global warming effects.

However, although Picada Run-of-river Hydropower Plant CDM Project Activity fit in a hydropower plant according its installed capacity of 50MW, Picada has characteristics of a small scale power plant (SHP). According ANEEL Resolutions n° 394 04/12/1998 and n° 652 from 09/12/2003, a SHP can have a reservoir until 3.0 km² and Picada has a reservoir of 1.1 km².

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

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

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

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

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

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

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

c) Contribution to the fair income distribution

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

d) Contribution to the technological development and capacity building



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

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

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

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

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

Elliot (2000) in his article "Renewable Energy and Sustainable Futures", proposes the change from a conventional paradigm to a new energy paradigm, which is closely related to the proposal of the 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. 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 Picada Project. The local economy not only indirectly benefits during the construction, but also attracts new businesses after the construction period due to a more steady and reliable supply of electricity.

Conclusion

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



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

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

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

The environmental impacts of the Project are considered small due to the fact that Picada has characteristics of a small scale power plant (SHP). According ANEEL Resolutions n° 394 04/12/1998 and n° 652 from 09/12/2003, a SHP can have a reservoir until 3.0 km² and Picada has a reservoir of 1.1 km². This demonstrates that Picada has a minimum environmental impact.

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

Besides, it was approved a specific environmental plan that involves different programs for the project:

- Environmental management
- Social communication program
- Security and alert program
- Local sustainable development program
 - Public health project
 - Social assistance project
 - Compensation plan and lands acquisition
 - Strategic plan for employing local and regional labour
 - Tourist development plan and compensatory alternatives
 - Environmental education project
 - Measures for the maintenance of the sand extraction activity
 - Social-economic indicators accompaniment plan
- Conservancy and environmental protection program
 - Creation of a Conservation Unit
 - Recuperation and Preservation of the Reservoir Margins program
 - Reduced outflow area and reservoir use plan
 - Monitoring, rescue and relocation of the land fauna project
 - Flora rescue project
 - Aquatic flora conservation program
 - Reservoir margin deforestation monitoring project
 - Archeological diagnoses



- Environmental monitoring program

SECTION E. Stakeholders' comments

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

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

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

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

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

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

- *Prefeitura Municipal de Juiz de Fora* (Juiz de Fora City Hall)
- *Câmara Municipal de Juiz de Fora* (Municipal Assembly of Juiz de Fora)
- *Secretaria do Meio Ambiente de Juiz de Fora* (Environmental Agency of Juiz de Fora)
- *Associação de Juiz de Fora* (Juiz de Fora Association)
- *FEMA – Fundação Estadual do Meio Ambiente de Minas Gerais* (Minas Gerais Environmental Agency)
- *Ministério Público do Minas Gerais* (State Attorney for the Public Interest of the State of Minas Gerais)
- *Fórum Brasileiro de ONGs e Movimentos Sociais para o Desenvolvimento e Meio Ambiente* (Brazilian Forum of NGOs and Social Movements for the Development and Environment)

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



E.2. Summary of the comments received:

So far, a letter from FBOMS was received, suggesting the use of Gold Standard or similar tools.

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

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

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

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the present project.

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



Annex 3

BASELINE INFORMATION

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

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

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

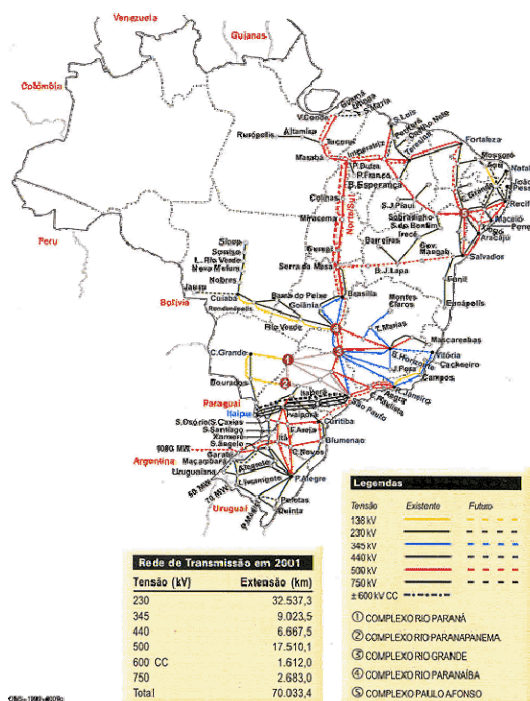
“... where the Brazilian Electricity System is divided into three separate subsystems:

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

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

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

Sistema de Transmissão 2001-2003



Brazilian Interconnected System (Source: ONS)

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

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



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

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

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

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to ANEEL, in fact, ONS centralized dispatched plants accounted for 75,547 MW of installed capacity by 31/12/2004, out of the total 98,848.5 MW installed in Brazil by the same date (http://www.aneel.gov.br/arquivos/PDF/Resumo_Gr%C3%A1ficos_mai_2005.pdf), which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23.6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International Energy Agency database built when carrying out the study from Bosi *et al.* (2002). Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only (Table 7).

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

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



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

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

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	EF_{OM} [tCO ₂ /MWh]	Load [MWh]	LCMR [MWh]	Imports [MWh]
2003	0,9823	288.933.290	274.670.644	459.586
2004	0,9163	302.906.198	284.748.295	1.468.275
2005	0,8086	314.533.592	296.690.687	3.535.252
	Total (2003-2005) =	906.373.081	856.109.626	5.463.113
	$EF_{OM, simple-adjusted}$ [tCO ₂ /MWh]	$EF_{BM,2005}$	Lambda	
	0,4349	0,0872	λ_{2003}	
	Alternative weights	Default weights	0,5312	
	$w_{OM} = 0,75$	$w_{OM} = 0,5$	λ_{2004}	
	$w_{BM} = 0,25$	$w_{BM} = 0,5$	0,5055	
	Alternative EF_y [tCO₂/MWh]	Default EF_y [tCO₂/MWh]	λ_{2005}	
	0,3480	0,2611	0,5130	

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

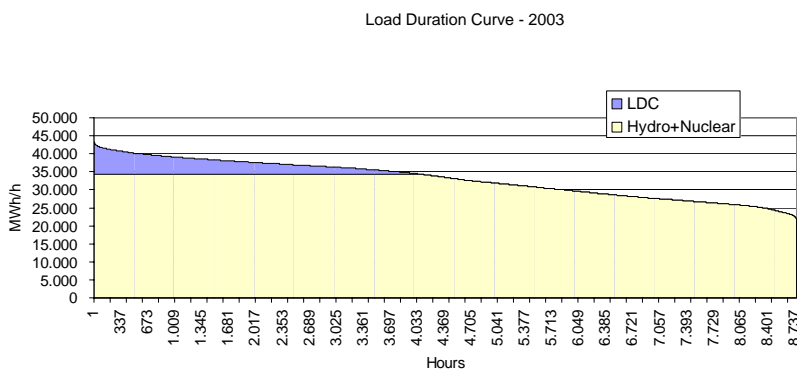


Figure 11 - Load duration curve for the S-SE-CO system, 2003

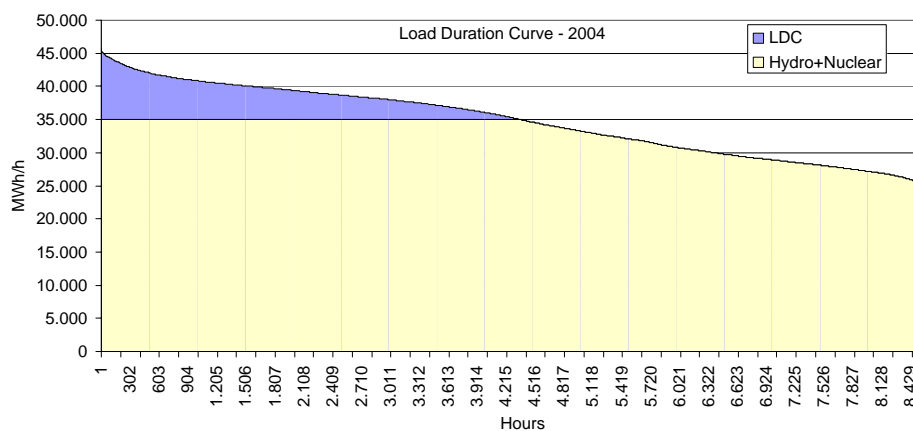


Figure 12 - Load duration curve for the S-SE-CO system, 2004

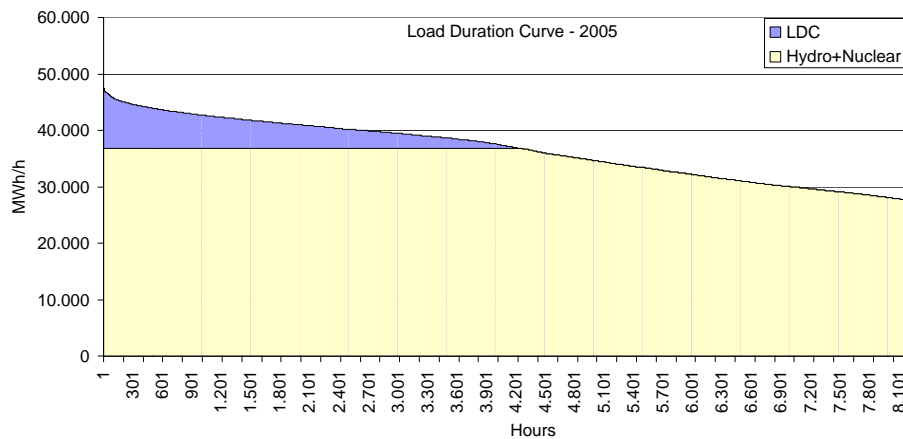


Figure 13 – Load duration curve for the S-SE-CO system, 2005



	Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fuel conversion efficiency (%) [2]	Carbon emission factor (tCO ₂ /TJ) [3]	Fraction carbon oxidized [3]	Emission factor (tCO ₂ /MWh)
1	S-SE-CO	H	Jauru	Sep-2003	121.5	1	0.0	0.0	0.000
2	S-SE-CO	H	Gasporé	Sep-2003	120.0	1	0.0	0.0	0.000
3	S-SE-CO	G	Três Lagoas	Aug-2003	308.0	0.3	15.3	99.5%	0.670
4	S-SE-CO	H	Furnil (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	Canóas	Sep-2002	160.6	0.3	15.3	99.5%	0.670
8	S-SE-CO	H	Pirajú	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	Caná 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	Júiz 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	Eletrobril	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	Cuiabá (Marlo Covas)	Aug-2001	529.2	0.3	15.3	99.5%	0.670
22	S-SE-CO	G	W. Arinos	Jan-2001	194.0	0.26	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	Canóas I	Jan-1999	82.5	1	0.0	0.0	0.000
26	S-SE-CO	H	Canóas 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	Cuiabá (Marlo Covas)	Oct-1998	529.2	0.27	20.2	99.0%	0.978
30	S-SE-CO	H	Sobral	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 COPTEL	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	Gullmam 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	Mirandópolis	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	Manoá	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. Imbués	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	1,132.0	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., J. 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] Intergovernmental Panel on Climate Change. Revised 1996 Guidelines for National Greenhouse Gas Inventories.
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Table 10 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 1



	Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fuel conversion efficiency (%) [2]	Carbon emission factor (tC/TJ) [3]	Fraction carbon oxidized [3]	Emission factor (tCO ₂ /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	Jan-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	Sã Cavalho	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	Jupia	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 Oliveira)	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	Funiil (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	Cariboba	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).
[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.
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Table 11 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 2



Annex 4

MONITORING INFORMATION

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

The project will proceed with the necessary measures for the power control and monitoring. Together with the information produced by both ANEEL and ONS, it will be possible to monitor the power generation of the project and the grid power mix. Beyond that, information about power generation and energy supplied to the grid are controlled by the Chamber of Electric Energy Commercialization CCEE (from the Portuguese *Câmara de Comercialização de Energia Elétrica*). CCEE makes feasible and regulates the electricity energy commercialization and is responsible for monitors monthly the energy delivered to the grid.

The energy meters (four in the total) are specified by the energy distribution company and approved by ONS. Picada utilizes an ION 8400, manufactured by Power Measurement. These meters are calibrated by Metrum. Measurements are controlled in real time by the SHP Digital System, so that any problems can be detected (like water shortage, materials inside the turbines, meter inaccuracy, etc). In case of any problem, plant personnel will be put in action.

The SHP is responsible for the project management, as well as for organising and training of the staff in the appropriate monitoring, measurement and reporting techniques. The SHP will work with about 09 people in the total: 5 power plant operators and 4 assistants.

Votorantim, through Consórcio Paraibuna - the company that controls Picada SHP - have hired expert companies to execute their environmental programs and the programs included in the PBA are being executed by the SHP’s technicians. After the beginning of the commercial operations, renovation of degraded areas and of permanent preservation areas will be done according to the regulations of the environmental agencies, through a team of environment experts, that will also monitor the compliance with the environmental agencies’ regulations. Studies done during the design phase of the project activities have shown the environmental impacts and the interference on the social development in the region of the plant, indicating the mitigation measures to be adopted during the construction phase. These measures are being taken rigorously. Data about environmental impact are being archived by the SHP and the environmental agencies.

The following environmental and social programs will be monitored:

- Environmental management
- Social communication program
- Security and alert program
- Local sustainable development program
 - Public health project
 - Social assistance project
 - Compensation plan and lands acquisition
 - Strategic plan for employing local and regional labour
 - Tourist development plan and compensatory alternatives
 - Environmental education project



- Measures for the maintenance of the sand extraction activity
- Social-economic indicators accompaniment plan
- Conservancy and environmental protection program
 - Creation of a Conservation Unit
 - Recuperation and Preservation of the Reservoir Margins program
 - Reduced outflow area and reservoir use plan
 - Monitoring, rescue and relocation of the land fauna project
 - Flora rescue project
 - Aquatic flora conservation program
 - Reservoir margin deforestation monitoring project
 - Archeological diagnoses
- Environmental monitoring program



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