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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Angelina Small Hydro Power Plant Project – A Brascan Energética S/A Project Activity.

PDD version number: 01

Date (DD/MM/YYYY): 19/10/2007.

A.2. Description of the project activity:

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

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

The privatization process initiated in 1995 arrived with an expectation of adequate tariffs (less subsidies) and better prices for generators. It drew the attention of investors to possible alternatives not available in the centrally planned electricity market. Unfortunately the Brazilian energy market lacked a consistent expansion plan, with the biggest problems being political and regulatory uncertainties. At the end of the 1990's a strong increase in demand in contrast with a less-than-average increase in installed capacity caused the supply crisis/rationing from 2001/2002. One of the solutions the government provided was flexible legislation favoring smaller independent energy producers. Furthermore the possible eligibility under the Clean Development Mechanism of the Kyoto Protocol drew the attention of investors to small hydropower projects.

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

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

The project consists of a small hydroelectric power plant ("PCH", from the Portuguese, *Pequena Central Hidrelétrica*), Angelina SHPP with 26.27 MW of installed capacity. The plant is located in the Garcia River, in Angelina and Major Gercino cities, state of Santa Catarina, South region of Brazil. The provision to become fully operational is in March 2009.

Lumbrás Energética S.A., owner of Angelina Project, is a company 89.7% from Brascan Group. 10.3% from Lumbrás Energética S.A. are divided in 3 different people and Garcia Energética S.A. company.

Brascan is a Canadian holding company with activities in different sectors: real state, agribusiness, mining, financial market and energy. Brascan Energética is the company set up in January 1998 by the Brookfield Assets Management to work in the electric sector in Brazil. Its main objective is to increase the power generating capacity in Brazil by developing, constructing and operating up to 576 MW, in small hydro facilities, with focus in renewable energy.

A.3. Project participants:

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 whishes to be considered as project participant (Yes/No)
Brazil (host)	Lumbrás Energética S.A.	No
	Ecoinvest Carbon Brasil Ltda. (private entity)	
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

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

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

A.4. Technical description of the project activity:

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

Angelina Small Hydro Power Plant Project uses water from the Garcia River to generate electricity, with a 26.27 MW installed capacity. Angelina SHPP is classified as a new hydro electric project, according ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (version 6), with a reservoir of 0.4 km^2, which results on a minimum environmental impact.

Small hydro electric power projects is considered to be one of the most cost effective power plants in Brazil, given it is possible to generate distributed power and to supply small urban areas, rural regions and remote areas of the country. Generally, it consists of a hydro electric power project with small reservoir.

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil.

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

Brazilian South macro geographical region, state of Santa Catarina.

A.4.1.3. City/Town/Community etc:

Angelina and Major Gercino towns.

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

The project is located in the South of Brazil, state of Santa Catarina, Angelina and Major Gercino municipalities (Figure 3), and uses the hydro potential of Garcia river.

Figure 2 - Political division of Brazil showing the state of Santa Catarina (Source: City Brazil, 2007)

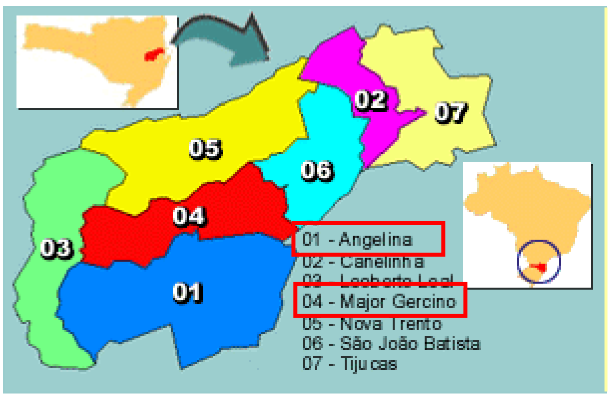


Figure 3 - Political division of Brazil showing the cities of Angelina and Major Gercino (Source: City Brazil, 2007)

Angelina Small Hydroelectric Power Plant is located in Angelina and Major Gercino, on Garcia River, east of Santa Catarina state, Brazil. Angelina and Major Gercino are located on the Tujucas micro region.

Angelina has 5,479 inhabitants and 500 km^2 (IBGE, 2007). It is located 70 km far from Florianópolis, capital of Santa Catarina and its economy is based in the agriculture and tourism.

Major Gercino has 2,697 inhabitants and 286 km^2 (IBGE, 2007). Major Gercino is 100 km far from Florianópolis and its economy is based on the wine and champagne production.

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

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

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

The Francis turbines, used in Angelina Small Hydroelectric Power Plant, are the most widely used among water turbines (Figure 6).

Francis turbine is a type of hydraulic reaction turbine in which the flow exits the turbine blades in the radial direction. Francis turbines are common in power generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through a spiral tank and is directed onto the blades. The low momentum water then exits the turbine through a ducting known as suction tube. In the model, water flow is supplied by a variable speed centrifugal pump. A load is applied to the turbine by means of a magnetic brake, and torque is measured by observing the deflection of calibrated springs. The performance is calculated by comparing the output energy to the energy supplied.

Figure 2 - Example of a Francis Turbine
(Source: HISA, http://www.hisa.com.br/produtos/turbinas/turbinas.htm)

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

Technical Description
Installed capacity (MW): 26.27 MW
Reservoir area: 0.4 km^2

Turbine
Type: Francis horizontal
Quantity: 3 units
Manufacturer: VOITH SIEMENS HYDRO POWER GENERATION LTDA

Gerador
Manufacturer: WEG INDÚSTRIA S.A.

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

Considering the baseline 0.2826 tonCO_2e/MWh, applicable to grid-connected renewable power generation project activities in Brazil, the full implementation of the small hydropower plant connected to the Brazilian interconnected power grid will generate the estimated annual reduction as in Table 5 below.

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
Year 1 - (2009)*	25,122
Year 2 - (2010)	37,580
Year 3 - (2011)	37,580
Year 4 - (2012)	37,580
Year 5 - (2013)	37,580
Year 6 - (2014)	37,580
Year 7 - (2015)	37,580
Year 8 - (2016)**	12,458
Total estimated reductions (tonnes of CO_2e)	263,061
Total number of crediting years	7
Annual average over the first crediting period of estimated reductions (tonnes of CO_2e)	37,580

*starting in 01st May
**until 30th April

Table 3 - Project Emission Reductions Estimation

A.4.5. Public funding of the project activity:

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

SECTION B. Application of a baseline and monitoring methodology

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

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

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

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

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

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

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

	Source	Gás	Included?	Justification / Explanation
Baseline	Electric Energy Use	CO2	Yes	To generate electricity as happen in thermo plants emits greenhouse gases such as: carbon dioxide "CO2"
Project Activity	Emission from reservoir	CH4	No	No significant emission from reservoir is identified in the project activity, according to the power density calculation

[2] Tool for the demonstration and assessment of additionality. UNFCCC, CDM Executive Board 29th Meeting Report, 15-16 February 2007, Annex 5. Web-site: http://cdm.unfccc.int/

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

In the absence of the project activity, 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 CO_2 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 Brascan Energética S.A. is the greater shareholder of Lumbrás Energética S.A., Brascan Energética S.A., as a company from Brookfield Asset Management[3], it could as well have decided to focus on the other company traditional areas of the group (e.g., baking, real state, etc.), and not on the power market, as it is the case with the project activity.

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

The proposed baseline methodology includes an Additionality Tool (version 3) approved by the Executive Board. This tool considers some important steps necessary to determine whether the project activity is additional and it is also important to demonstrate how the emission reductions would not occur in the absence of Angelina SHPP activity. The tool refers to the project activity described above.

Following are the steps necessary for the demonstration and assessment of Angelina SHPP additionality.

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

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

1. The alternative to the project activity is the continuation of the current (previous) situation of electricity supplied by large hydro and thermal power stations.
2. The proposed project activity undertaken without being registered as a CDM project activity.

Sub-step 1b. Consistency with mandatory laws and regulations:

Both the project activity and the alternative scenario are in compliance with all regulations according the following entities: National Electric System Operator (ONS from the Portuguese *Operador Nacional do Sistema Elétrico*), Electricity Regulatory Agency (ANEEL from the Portuguese *Agência Nacional de*

[3] http://www.brookfield.com/

Energia Elétrica), Santa Catarina Environmental Agency (from the Portuguese *Fundação do Meio Ambiente de Santa Catarina - FATMA)* and the CDM Executive Board.

SATISFIED/PASS – Proceed to Step 2

Step 2. Investment analysis

Not applicable.

SATISFIED/PASS – Proceed to Step 3

Step 3. Barrier analysis

The considered barriers are the following:

- Regulatory uncertainty, once a completely new power sector regulation is under development since January 2002;
- Lack of investment sources to finance the private sector in the country, and the high costs of the available alternatives, as indicated by the project debt structure, which is mostly dependent to the equity capital. The creation of PROINFA, in 2002, is a strong indication that without a financial support, investments in alternative sources of energy for power generation ambit would not be made otherwise;
- Lack of infrastructure, once in the region where the project is located is isolated and undeveloped.

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

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

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

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

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

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

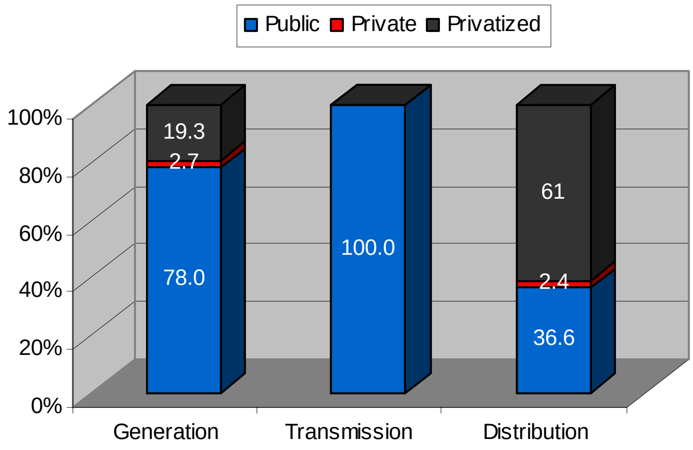


Figure 5 - Participation of private capital in the Brazilian electricity market in December 2000 (Source: BNDES, 2000)

The decoupling of GDP (average of 2% increase in the period of 1980 to 2000) from electricity consumption (average of 5% increase in the same period) is well known in developing countries, mainly due to the expansion of supply services to new areas and the growing infrastructure. The necessary measures to prevent bottlenecks in services were taken. These include an increase of generation capacity higher than GDP growth rates and strong investments in energy efficiency. In the Brazilian case, the increase in the installed generation capacity (average of 4% in the same period) did not follow the growth of consumption as can be seen in Figure 6.

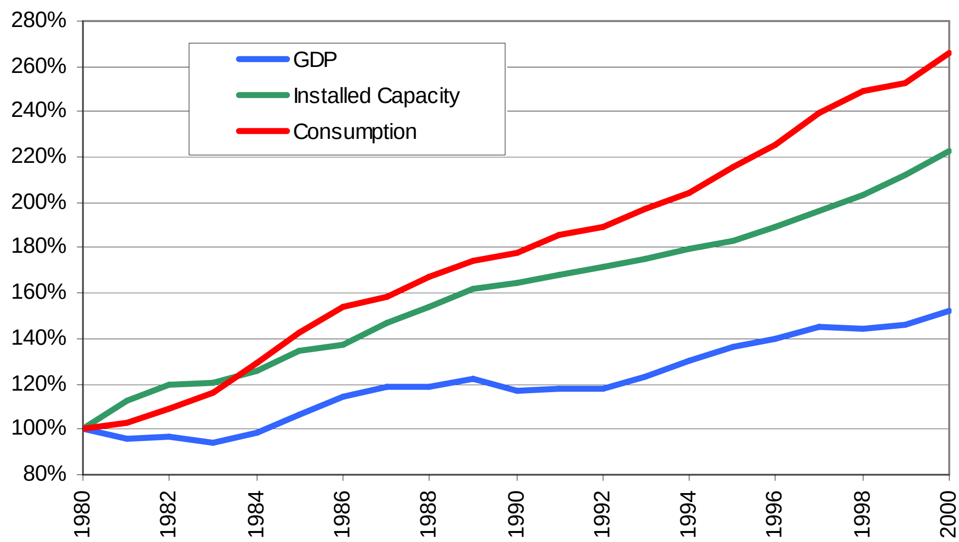


Figure 6 - Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption).

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

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

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

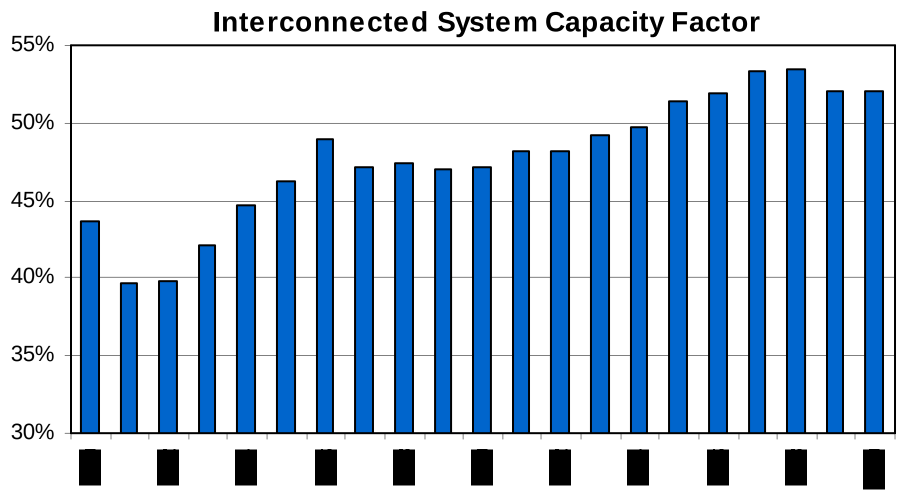


Figure 7 - Evolution of the rate of generated energy to installed capacity (Source: Eletrobrás, http://www.eletrobras.gov.br/)

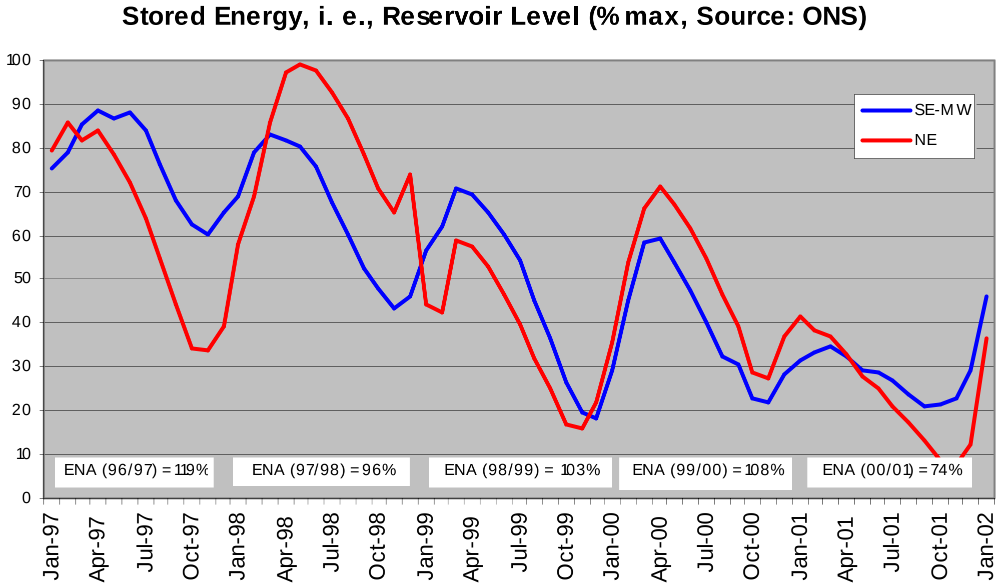


Figure 8 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS, http://www.ons.org.br/)

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

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

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

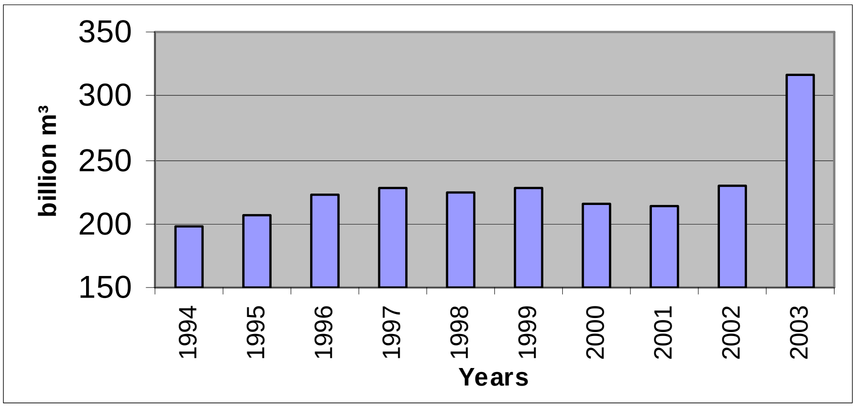


Figure 9 – Evolution of the Brazilian natural gas proved reserves
(Source: Petrobras, http://www.petrobras.com.br/)

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

- Electricity demand and supply will be coordinated through a "Pool" Demand to be estimated by the distribution companies, which will have to contract 100% of their projected electricity demand over the following 3 to 5 years. These projections will be submitted to a new institution called Energy Research Company (*Empresa de Pesquisa Energética*, EPE), which will estimate the required expansion in supply capacity to be sold to the distribution companies through the Pool. The price at which electricity will be traded through the Pool is an average of all long-term contracted prices and will be the same for all distribution companies.
- In parallel to the "regulated" long-term Pool contracts, there will be a "free" market. Although in the future, large consumers (above 10 MW) will be required to give distribution companies a 3-year notice if they wish to switch from the Pool to the free market and a 5-year notice for those moving in the opposite direction a transition period is envisaged during which these conditions will be made more flexible. If actual demand turns out to be higher than projected, distribution companies will have to buy electricity in the free market. In the opposite case, they will sell the excess supply in the free market. Distribution companies will be able to pass on to end consumers the difference between the costs of electricity purchased in the free market and through the Pool if the discrepancy between projected and actual demand is below 5%. If it is above this threshold, the distribution company will bear the excess costs.
- The government opted for a more centralized institutional set-up, reinforcing the role of the Ministry of Mines and Energy in long-term planning. EPE will submit to the Ministry its desired technological portfolio and a list of strategic and non-strategic projects. In turn, the Ministry will submit this list of projects to the National Energy Policy Council (*Conselho Nacional de Política Energética*, CNPE). Once approved by CNPE, the strategic projects will be auctioned on a priority basis through the Pool. Companies can replace the non-strategic projects proposed by EPE, if their proposal offers the same capacity for a lower tariff. Another new institution is a committee, Power Monitoring Committee (*Comitê de*

Monitoramento do Setor Elétrico, CMSE), which will monitor trends in power supply and demand. If any problem is identified, CMSE will propose corrective measures to avoid energy shortages, such as special price conditions for new projects and reserve of generation capacity. The Ministry of Mines and Energy will host and chair this committee. No major further privatizations are expected in the sector.

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

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

Investment Barrier

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

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

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

Financial domestic markets with a maturity of greater than a year are practically non-existent in Brazil. Experience has shown that in moments of financial stress the duration of savings instruments have contracted to levels close to one day with a massive concentration in overnight banking deposits. Savers do not hold long-term financial contracts due to the inability to price-in the uncertainty involved in the preservation of purchasing power value (Arida et al., 2004). Also, the capital market is not well developed in the country to provide stock market public funding.

The lack of a local long-term market results not from a disinterest of financial investment opportunities, but from the reluctance of creditors and savers to lengthen the horizon of their placements. It has made savers look for the most liquid investment and place their money in short-term government bonds instead of investing in long-term opportunities that could finance infrastructure projects.

The most liquid government bond is the LFT (floating rate bonds based on the daily Central Bank reference rate). As of January 2004, 51.1% of the domestic federal debt was in LFTs and had duration of one day. This bond rate is almost the same as the CDI - Interbank Deposit Certificate rate that is influenced by the SELIC rate, defined by COPOM[4].

The SELIC Rate has been oscillating since 1996 from a minimum of 15% p.a. in January 2001 to a maximum of 45% p.a. in March 1999 (Figure 10).

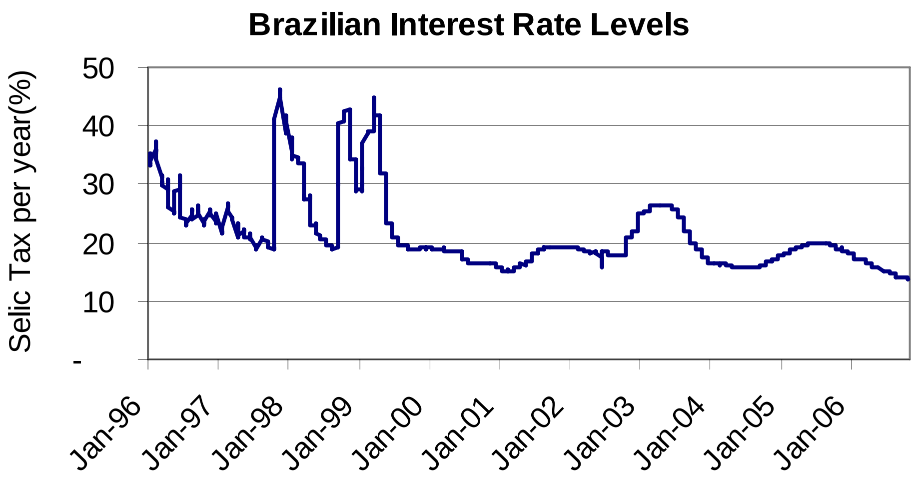


Figure 10 – SELIC rate (Source: *Banco Central do Brasil*)

Today, the proposed small hydro project activity is under development with its own capital. A financing line trading with BNDES is in course to finance construction.

This investment analysis takes a look at the factors relating to potential certified emission reductions (CERs) and the incentives derived from them in the project investment decision taking process. Thus, in taking the decision to undertake the project, the investment profitability studies considered the potential monetization of CO2 credits that the project would produce.

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.

It is important to notice that the direct comparison between the SELIC or CDI rate and the IRR is not accurate and the idea is not to introduce a benchmark analysis, but to set a parameter as a reference. Given a small hydro power project is a much riskier investment than a government bond, it is necessary to have a much higher financial return, compared to the SELIC reference rate. Given the circumstances,

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

rationale and distortions of the Brazilian economy, it is not straightforward to define the meaning of this difference of rates, and a developer might feel more comfortable than others, depending on the situation.

The PPA (Power Purchase Agreement) is required in order to obtain long-term financing from a bank and the lack of adequate commercial agreements from the energy buyers may influence directly the negotiation between the bank and the project developer. Most of the utilities in Brazil do not have a satisfactory credit risk, thus representing a barrier to obtain long-term funding. Besides, normally, a "mature" PPA is less than 5 years in the free market, making difficult a project finance.

It is evident that there are barriers for developing new projects regarding the high level of guarantees required to finance an energy project in Brazil and other financial barriers related to the power purchase agreement (PPA), but Angelina SHPP Project are trying to surpass these barriers and the CDM incentives are important in this course.

Given the various programs and incentives which were considered along the last years, but never successfully implemented, it is easy to notice the difficulty and barriers to implement small hydro projects in the country. The first one was called PCH-COM structured by the end 2000/beginning 2001. In February/2001 the tariff was the reference price of the so-called "competitive power source", or the average regular power generation addition cost, but the reference market price for the SHPP source at that time was higher than the tariff planned. Despite of the lower tariff, the incentive relied on the PPA guarantee and the special financing source. The program was not successful because of the guarantees needed and the clauses of the contract. E.g.., the project was not considered as a project finance basis and the lender demanded for direct guarantees from the developer (other than the project itself).

In April 2002, the Proinfa law was issued to incentive the sector. The existence of Proinfa is a proof that a sound incentive is necessary to promote the construction of renewable energy projects in Brazil and there is room for CDM projects. The analysis of Proinfa and of other power sector incentives illustrates the hurdles that the developers who are not participating in any program have to face. During the Proinfa first Public Hearing in beginning 2003, the SHPP tariff was planned to be of R$ 125.09/MWh (base June 2003, and to be escalated by the inflation index IGP-M). But on March 30th, 2004, the Ministry of Mines and Energy (MME) issued the Portaria n° 45, which set the tariff at R$ 117.02/MWh (base March 2004, and escalated by IGP-M), in January 2005 it was around R$ 129.51/MWh. In 2005, BNDES presented the last final version of its financing incentive line to Proinfa, which is different from the one first considered for the program, that was considered insufficient. It means that for the last 5 years, the government had to present a new proposition (or incentive) per year, in order to convince the developers to invest in the small hydro sector. Angelina SHPP Project is not assessing PROINFA opportunity, given that the established limit date to submit projects was May 05th 2004, then it is competing in the market with other projects (as thermo and other energy sources) and opportunities, selling power to other companies.

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

Due to all the difficulties exposed, and in spite of all government incentives, there are 195 approved SHPP projects in Brazil[5], between 1998 and 2005, which have not started construction yet. And only

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

1.70% of the power generated in the country comes from SHPPs. The conclusion is that CDM incentives play a very important role in overcoming the above mentioned financial barriers.

Lack of Infrastructure

The region where the project is located is isolated and undeveloped. There is a lack of infrastructure, such as roads, reliable electricity supply, communication and transports. The project sponsor had to develop these facilities before the implementation of the project.

Institutional Barrier

As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created to try to organize and to provide incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period electricity prices surpassed BR$ 600/MWh (around USD 200/MWh) and the forecasted marginal price of the new energy reached levels of BR$ 120 – 150/MWh (around USD 45). In the middle of 2004 the average price was bellow BR$ 50/MWh (less than USD 20/MWh). This relatively high volatility of the electricity price in Brazil, although in the short term, contributes to the difficult the analysis of the market by the developers (CCEE, 2007).

Also, an article written in 2004 by two professors of Energy Planning at the Universidade Federal do Rio de Janeiro analyzes Brazilian energy regulations and identifies four fragilities that can undermine their suitable implementation. Those fragilities refer to:

1) The guarantee of the purchase of electricity. Some points are still to be clarified, regarding:
    a) Minimum and maximum limits for the purchase of energy;
    b) the possibility of the ONS - Electrical System Operator to determine production increase or decrease, depending on the demand variation;
    c) Payment for the availability of production capacity, in periods when there is abundant energy offer.
2) The definition of the role of the three different regulatory agents: MME – Ministry of Mines and Energy, ANEEL - Brazilian power regulatory agency - *Agência Nacional de Energia Elétrica* and Eletrobrás – Brazilian Electricity Company – *Centrais Elétricas Brasileiras*. There are coordination problems among these institutions, due to an unclear division of their functions. This leads to investor's insecurity, because they have three different interlocutors, instead of one.
3) Juridical problems in the public calls legislation. Some rules are not totally compatible with the legislation, what might even lead to contract annulations.
4) The way the energy price is presently established, through the calculation of an average price for each type of energy source, penalizes projects with a lower cost-benefit rate. The authors suggest that the prices should be set according to the characteristics of each project.

Link to this article (with an abstract in English): http://www.seeds.usp.br/pir/arquivos/congressos/CBPE2004/Artigos/PROINFA%20E%20CDE%20-%20QUESTIONAMENTOS%20SOBRE%20A%20LEGISLA%C7%C3O%20E%20REGULA.pdf

There is a rising demand for energy in Brazil, but it is not being attended by small hydro power plants. In the most recent energy auctions in Brazil, the results were the following: in an auction which took place on July 26, 2007, there was in an increase of 1.781,8 MW into National Electric System, all of them from oil thermo plants[6]; in an auction which took place on October 16, 2007, there was in an increase of 4,353 MW into National Electric System, from which 69% originated from fossil fuel (oil, coal and natural gas) plants[7].

In the energy auction for alternative energy sources, that took place on June 18, 2007, 2,803 MW were qualified, but only 638.64 MW were negotiated[8], what shows the lack of interest by most of the participants, due to the price and conditions presented. From the estimated 1,165 MW available from sugarcane bagasse plants and small hydro power plants, only 97 MW from small hydro were sold. The result of the auction was considered “disappointing” by Nelson Hubner, the minister of Mines and Energy[9].

The barriers mentioned above can be evidenced by the fact that the generation of electrical energy from small hydro power plants represents only 1.7 % of the total generation of electricity in Brazil, as can be seeing in sub-step 4a and 4b.

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

As described in Sub-step 1a, the main alternative to the project activity is to continue the status quo or undertaken without being registered as a CDM project activity. Considering the barriers that the project would face without being registered as a CDM project activity - as described in Sub-step 3a -, consequently without its benefits, the project sponsor could invest their resources in different financial market investments. Therefore, the barriers above do not affect the investments in other opportunities. On the contrary: Brazilian interest rates, which represent a barrier for the project activity, are very attractive and a viable investment alternative.

SATISFIED/PASS – Proceed to Step 4

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

One of the points to be considered when analyzing a small hydro power project investment in the period (2001-2005) was the possibility to participate in the Proinfa Federal Government Program. Although some projects started construction independently from Proinfa -because Proinfa was limited only to 3,300 MW -, the program is considered one of the more viable financing alternatives for this project, which will

[6] Source: http://www.epe.gov.br/Lists/LeilaoA32007/DispForm.aspx?ID=44

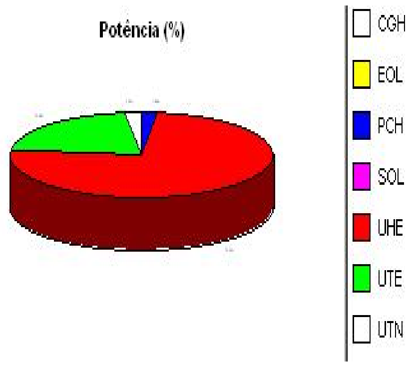
[7] Source: Newspaper Folha de S. Paulo, 17/10/2007, http://www1.folha.uol.com.br/fsp/dinheiro/fi1710200730.htm

[8] Source: http://www.epe.gov.br/PressReleases/20070618_1.pdf

[9] Source: Newspaper Folha de S. Paulo, 17/07/2007, http://www1.folha.uol.com.br/folha/dinheiro/ult91u305247.shtml

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

Regardless of the risks and barriers mentioned in Step.3, the main reason for the reduced number of similar project activities is the economic cost. Project feasibility requires a PPA contract with a utility company, but utilities usually do not have incentives or motivation to buy electricity generated by small hydro power projects.



Legend	
CGH	Hydroelectric Generator Center
CGU	Undi-Eletric Generator Center
EOL	Wind Generator Center
PCH	Small Hydroelectric Power Plant
SOL	Solar Generation Center Photovoltaic
UHE	Hydroelectric Power Plant
UTE	Thermoelectric Power Plant
UTN	Thermonuclear Power Plant

Figure – Operational types of project (Source: ANEEL, 2007)

Most of the developers which funded their projects outside of Proinfa have taken CDM as decisive factor for completing their projects. Therefore, to the best of our knowledge, the vast majority of similar projects being developed in the country are participating in the Proinfa Program, and those not are participating in the CDM. Additionally, the Brazilian government has endorsed that the projects under the Proinfa Program will also be eligible to participate in the CDM, in accordance with the decision of the UNFCCC about elegibility of projects derived from public policies. The legislation which created Proinfa took into account possible revenues from the CDM in order to proceed with the program.

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

The power sector suffered with more than one year (2003-2004) without regulation, and even today the legislation is not clear yet for all the investors and players. The prevailing business practice in Brazil, as far as obtaining financing and financial guarantees to the projects, is a barrier to investment in renewable energy projects. The access of long-term funding for renewable energy projects is difficult, mainly because of the guarantees needed and the lack of a real project finance structure. The high cost of capital in Brazil is a barrier for projects to be developed.

Because of the reasons mentioned above, only 1.*70*% of Brazil’s installed capacity comes from small hydro power sources (1.6 GW out of a total of 98.1 GW). Also, from the 3.6 GW under construction in the country, only 948 MW are small hydro. Many other projects are still under development, waiting for better investment opportunities. Common practice in Brazil has been the construction of large-scale hydroelectric plants and, more recently, of thermal fossil fuel plants, with natural gas, which also receive incentives from the government. Already 21.3% of the power generated in the country comes from thermal power plants, and this number tends to increase in the next years, since 42% of the projects approved between 1998 and 2005 are thermal power plants (compared to only 14% of SHPPs)[10].

These numbers show that incentives for the construction of thermal power plants have been more effective than those for SHPPs. The use of natural gas has been increasing in Brazil since the construction of GASBOL (the Brazil-Bolivia pipeline). Besides, the obtaining of the licenses required by the Brazilian environmental regulation take much longer for hydropower plants (years) than for thermal (two months)

In the most recent energy auction, which took place on December 16th, 2005, in Rio de Janeiro, 20 concessions for new power plants were granted, of which only two are for SHPPs (28 MW). From the total of 3,286 MW sold, 2,247 MW (68%) will come from thermal power plants, from which 1,391 come from natural gas fired thermal power plants, i.e., 42% of the total sold[11]. Brascan Energética, the group that controls Lumbrás Energética S/A, has 14 small hydro power plants and 11 are CDM Project Activities.

In summary, this project cannot be considered common practice and therefore is not a business as usual type scenario. And it is clear that, in the absence of the incentive created by the CDM, this project would not be the most attractive scenario.

SATISFIED/PASS – 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 (*EFy*) 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

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

[11] Rosa, Luis Pinguelli. Brazilian. Newspaper “Folha de São Paulo”, December 28, 2005.

- Average operating margin.

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

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

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

Where:

- λ_y is the share of hours in year y (in %) for which low-cost/must-run sources are on the margin.
- $\sum_{i,j} F_{i,j,y}$ is the amount of fuel i (in mass or volume unit) consumed by relevant power sources j (analogous for sources k) in year(s) y,
- $COEF_{i,j}$ is the CO_2e coefficient of fuel i (tCO_2e/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources j (analogous for sources k) and the percent oxidation of the fuel in year(s) y and,
- $\sum_j GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j (analogous for sources k),

- **STEP 2** – Calculate the build margin mission factor ($EF_{BM,y}$) as the generation weighted average emission factor (tCO_2e/MWh) of a sample of power plants m, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}}$$ **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 ($EF_{BM,y}$):

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

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

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

where,

PE_y	Emission from reservoir expressed as tCO_2e/year
ES_{Res}	is the default emission factor for emissions from reservoirs, and the default value as perEB23 is 90 Kg CO_2e /MWh.
EG_y	Electricity produced by the hydro electric power project in year y, in MWh

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

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

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

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

Data / Parameter:	Area
Data unit:	km^2
Description:	
Source of data used:	Surface area at full reservoir level
Value applied:	0.4 km^2
Justification of the choice of data or description of	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

measurement methods and procedures actually applied:	level).
Any comment:	

Data / Parameter:	**EF_y**
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of the grid
Source of data used:	ONS (Operador Nacional do Sistema Elétrico – National Electric System Operator)
Value applied:	0.2826 tCO2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	The baseline emission factor (EFy) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors. Calculations for this combined margin are based on data from an official sources (National Dispatch Center for the power generation data; EB decision regarding thermodynamic efficiency of power by fuel types information) with very low level of uncertainty and made publicly available. Data ex-ante calculated and monitored at the validation.
Any comment:	

Data / Parameter:	**$EF_{OM,y}$**
Data unit:	tCO_2/MWh
Description:	CO_2 Operating Margin emission factor of the grid
Source of data used:	Data provided by ONS (National dispatch center). Calculated according the approved methodology – ACM0002
Value applied:	0.4749 tCO2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	Data ex-ante calculated and monitored at the validation
Any comment:	

Data / Parameter:	**$EF_{BM,y}$**
Data unit:	tCO_2/MWh
Description:	CO_2 Build Margin emission factor of the grid
Source of data used:	Data provided by the National Electric System Operator (ONS). Calculated according the approved methodology – ACM0002
Value applied:	0.0903 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied:	Data ex-ante calculated and monitored at the validation
Any comment:	

Data / Parameter:	λ_y
Data unit:	
Description:	Fraction of time during which low-cost/must-run sources are on the margin
Source of data used:	Data provided by the National Electric System Operator (ONS). Calculated according the approved methodology – ACM0002
Value applied:	λ_{2004}=0.4937, λ_{2005}=0.5275, λ_{2006}=0.4185
Justification of the choice of data or description of measurement methods and procedures actually applied:	Data ex-ante calculated and monitored at the validation
Any comment:	

Data / Parameter:	$F_{i,y}$
Data unit:	Mass of volume
Description:	Amount of fossil fuel consumed by each power plant
Source of data used:	Latest local statistics
Value applied:	Large amount of data (individual data/parameter for each power plant). Data used in the calculations are presented in the spreadsheets appended to the PDD.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Publicly available official data. Data ex-ante calculated and monitored at the validation
Any comment:	

Data / Parameter:	$GEN_{j/k/n,y}$
Data unit:	MWh/a
Description:	Electricity generation of each power plant
Source of data used:	Latest local statistics
Value applied:	Large amount of data (individual data/parameter for each power plant). Data used in the calculations are presented in the spreadsheets appended to the PDD.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Publicly available official data. Data ex-ante calculated and monitored at the validation
Any comment:	

Data / Parameter:	$GEj_{i/k/ll,y\ IMPORTS}$
Data unit:	MWh
Description:	Electricity imports quantity to the project electricity system
Source of data used:	Latest local statistics

Value applied:	Large amount of data (individual data/parameter for each power plant). Data used in the calculations are presented in the spreadsheets appended to the PDD.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Publicly available official data. Data ex-ante calculated and monitored at the validation
Any comment:	

Data / Parameter:	***$COEF_{i,j\,y}$***
Data unit:	tCO_2/mass or volume unit
Description:	CO_2 emission coefficient of fuels used in connected electricity systems
Source of data used:	Obtained from Intergovernmental Panel on climate Change (IPCC), International Energy Agency (IEA) and Organisation for Economic Co-operation and Development (OECD).
Value applied:	Large amount of data. Data used in the calculations are presented in the spreadsheets appended to the PDD.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Publicly available official data. Data ex-ante calculated and monitored at the validation
Any comment:	

Data / Parameter:	***$COEF_i$***
Data unit:	tCO_2/mass or volume unit
Description:	CO_2 emission coefficient of each fuel type
Source of data used:	Obtained from Intergovernmental Panel on climate Change (IPCC), International Energy Agency (IEA) and Organisation for Economic Co-operation and Development (OECD).
Value applied:	Massive amount of data, individual values for each plant of the grid, raw data available for validation.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Publicly available official data. Default data and literature statistics are used to check the local data. Data ex-ante calculated and monitored at the validation
Any comment:	

Data / Parameter:	***Plant name***
Data unit:	Text
Description:	Identification of power source/ plant for the OM
Source of data used:	Obtained from the National Electric System Operator (ONS)
Value applied:	Massive amount of data. Data used in the calculations are presented in the

	spreadsheets appended to the PDD.
Justification of the choice of data or description of measurement methods and procedures actually applied:	Data ex-ante calculated and monitored at the validation
Any comment:	

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

B.6.3 Ex-ante calculation of emission reductions:

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

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

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

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

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

Dispatch data analysis operating margin should be the first methodological choice. Since not enough data was supplied by the Brazilian national dispatch center, the choice is not currently available. The simple operating margin can only be used where low-cost/must-run resources[12] 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 (%)
2002	88.9%
2003	90.7%
2004	86.9%
2005	88.2%
2006	86.1%

Table 5 – Share of hydroelectricity production in the Brazilian S-SE-CO interconnected system from 2002 to 2006 (ONS, 2007)

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

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

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

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

Where:

- λ_y is the share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin.
- $\sum_{i,j} F_{i,j,y}$ is the amount of fuel *i* (in mass or volume unit) consumed by relevant power sources *j* (analogous for sources *k*) in year(s) *y*,
- $COEF_{i,j}$ is the CO_2e coefficient of fuel *i* (tCO_2e/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources *j* (analogous for sources *k*) and the percent oxidation of the fuel in year(s) *y* and,
- $\sum_j GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j* (analogous for sources *k*).

The most recent numbers for the interconnected S-SE-CO system were obtained from the Brazilian national dispatch center, ONS - *Operador Nacional do Sistema Elétrico,* in the form of daily consolidated reports (ONS-ADO, 2007). Data from 143 power plants, comprising 68.2 GW installed capacity and around 932 TWh electricity generation over the 3-year period were considered. With the numbers from ONS, Equation 5 is calculated, as described below:

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

Where:

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

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

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

Where:

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

Non-low-cost/must-run resources in Brazilian S-SE-CO interconnected system are 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:

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

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

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

Where variable and parameters used are:

- $\sum_{i,j} F_{i,j,y}$ is given in [kg], $COEF_{i,j}$ in [tCO_2e/kg] and $F_{i,k,y} \cdot COEF_{i,k}$ in [tCO_2e]
- $GEN_{i,k,y}$ is the electricity generation for plant *k*, with fuel *i*, in year *y*, obtained from the ONS database, in MWh
- $EF_{CO2,i}$ is the emission factor for fuel *i*, obtained from the Revised 1996 Intergovernmental Panel on climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, in tC/TJ.
- $OXID_i$ is the oxidization factor for fuel *i*, obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, in %.
- 44/12 is the carbon conversion factor, from tC to tCO_2.
- 3.6×10^{-6} is the energy conversion factor, from MWh to TJ.
- $\eta_{i,k,y}$ is the thermal efficiency of plant *k*, operating with fuel *i*, in year *y*, obtained from Bosi et al. (2002).

- NCV_i is the net calorific value of fuel *i* [TJ/kg].

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

The λ_y factors are calculated as indicated in methodology ACM0002, with date obtained from the ONS database. Figure 11, Figure 12 and Figure 13 present the load duration curves and λ_y calculations for years 2004, 2005 and 2006, respectively.

The results for years 2004, 2005 and 2006 are presented in Table 6.

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}}$ **[tCO2/MWh]**	λ_y **[%]**
2004	0.9886	0.4937
2005	0.9653	0.5275
2006	0.8071	0.4185

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 2004-2006 (ONS-ADO, 2007).

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 $EF_{OM,simple\text{-}adjusted,2003\text{-}2005}$ as the weighted average *of* $EF_{OM,simple\text{-}adjusted\ 2004}$, $EF_{OM\ simple\text{-}\ adjusted,2005}$ *and* $EF_{OM,simple\text{-}adjusted,2006}$ and λ_y to Equation 1:

- $EF_{OM,simple\text{-}adjusted,2004\text{-}2006}$ *= 0.4749 tCO2e/MWh.*

- **STEP 2** – Calculate the build margin mission factor ($EF_{BM,y}$) as the generation weighted average emission factor (tCO_2e/MWh) of a sample of power plants *m*, as follows:

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

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

- $EF_{BM,2006} = 0.0903\ tCO_2e/MWh.$

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

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$

Equation 11

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

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

- $EF_y = 0.2826\ tCO_2e/MWh.$

Baseline emissions are calculated by using the annual generation (project annual electricity dispatched to the grid) times the CO_2 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 tCO_2e/MWh) times the electricity supplied by the project to the grid (EG_y, in MWh), as follows:

$$ER_y = EF_y \cdot EG_y$$

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:

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

where,

PE_y	Emission from reservoir expressed as tCO_2e/year
ES_{Res}	is the default emission factor for emissions from reservoirs, and the default value as perEB23 is 90 Kg CO_2e /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 W/ m^2, PE_y = 0.

Power density = installed power/reservoir area

Installed power = 26.27 MW
Reservoir area: 0.4 km^2
Power density = 65.67 W/m^2 or 65.67 MW/ km^2

The power density is greater than 10 W/ m^2, then PEy = 0

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

Years	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
Year 1 - (2009)*	0.0	25,122	0.0	25,122
Year 2 - (2010)	0.0	37,580	0.0	37,580
Year 3 - (2011)	0.0	37,580	0.0	37,580
Year 4 - (2012)	0.0	37,580	0.0	37,580
Year 5 - (2013)	0.0	37,580	0.0	37,580
Year 6 - (2014)	0.0	37,580	0.0	37,580
Year 7 - (2015)	0.0	37,580	0.0	37,580
Year 8 - (2016)**	0.0	12,458	0.0	12,458
Total (tonnes of CO_2e)	0.0	263,061	0.0	263,061

*starting in 01st May

**until 30th April

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:

Data monitored and required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later. The parameters chosen for the calculation of emission reductions were ex-ante (see Section B.6.2).

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	132,980 MWh/year
Description of measurement methods and procedures to be applied:	n/a
QA/QC procedures to be applied:	Energy metering QA/QC procedures are explained in Annex 4 (the equipments used have by legal requirements extremely low level of uncertainty). Measured and monitored yearly.
Any comment:	

B.7.2 Description of the monitoring plan:

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): 30/07/2007.

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Ecoinvest Carbon Brasil Ltda. 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) 01/09/2007.

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) 30/03/2009.

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:

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

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

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

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

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

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

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

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

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

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

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

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

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.

The plant possesses preliminary and construction licenses issued by Santa Catarina Environmental Agency (*FATMA - Fundação do Meio Ambiente de Santa Catarina*). Given that, the project does not imply in negative transboundary environmental impacts, on the contrary, the licenses would not be issued.

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

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

The environmental impacts of the Project are considered small by the host country definition of small-hydro plants. By legal definition of the Brazilian Power Regulatory Agency (ANEEL), Resolution no. 652, December 9th, 2003, small hydro in Brazil must have installed capacity greater than 1 MW but not more than 30 MW and with reservoir area less than 3 km², or, if the area is between 3 km² and 13 km², it should have a minimum environmental impact. Angelina SHPP is rated at 26.27 MW and its reservoir 0.4 km².

The plant possesses preliminary and construction licenses. The preliminary licenses were issued by the Santa Catarina Environmental Agency FATMA - *Fundação do Meio Ambiente de Santa Catarina*. All licenses for the project are available for consultation under request, as well as the environmental studies.

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

- Water quality monitoring program;
- Hydro-sediment and level water monitoring program;
- Erosion monitoring program;
- Local roads and roads monitoring program;
- Recuperation of degraded areas program;
- Deforestation and reservoir cleaning programs;
- Environmental education and social communication program;

- Environmental communication program;
- Endemies control program.

SECTION E. Stakeholders' comments

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

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

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

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

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

- *Prefeitura de Angelina e Major Gercino* (Angelina and Major Gercino City Hall)
- *Câmara Municipal de Angelina e Major Gercino*
  (Municipal Assembly of Angelina and Major Gercino)
- *Secretaria do Meio Ambiente de Angelina e Major Gercino*
  (Environmental Agency of Angelina and Major Gercino)
- *Associação Comunitária de Angelina e Major Gercino*
  (Angelina and Major Gercino Comunitarian Association)
- *FEMA – Fundação Estadual do Meio Ambiente de Santa Catarina*
  (Santa Catarina Environmental Agency)
- *Ministério Público de Santa Catarina*
  (State Attorney for the Public Interest of the State of Santa Catarina)
- *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:

No comments were received.

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

No comments were received.

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.

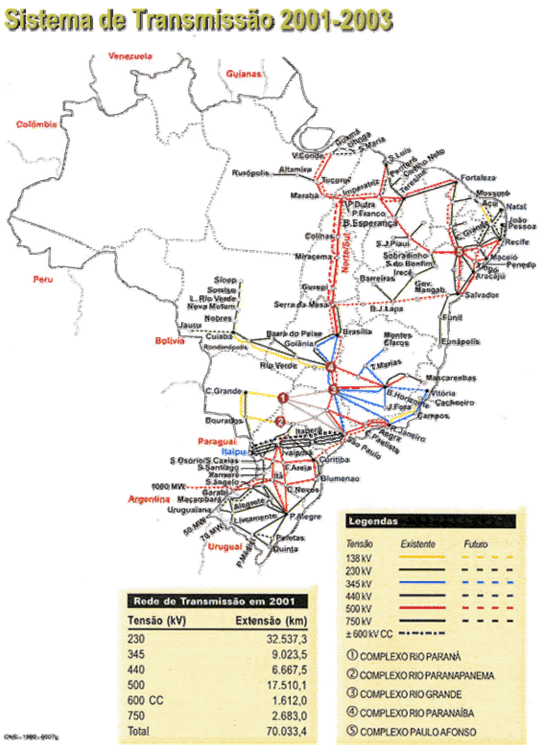
Nevertheless, even after the interconnection had been established, technical papers still divided the Brazilian system in two (Bosi, 2000):

"… 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."



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_Gráficos_mai_2005.pdf), which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23.6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

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

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

Table 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	EF_{OM} [tCO_2/MWh]	λ_y	Generation [MWh]
2006	0.8071	0.4185	315,192,117
2005	0.9653	0.5275	315,511,628
2004	0.9886	0.4937	301,422,617
	$EF_{OM,simple-adjusted}$ [tCO_2/MWh]	$EF_{BM,2006}$	Default EF_y [tCO_2/MWh]
	0.4749	0.0903	0.2826
	Alternative weights	Default weights	
	w_{OM} = 0.75	w_{OM} = 0.5	Alternative EF_y [tCO_2/MWh]
	w_{BM} = 0.25	w_{BM} = 0.5	0.379

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

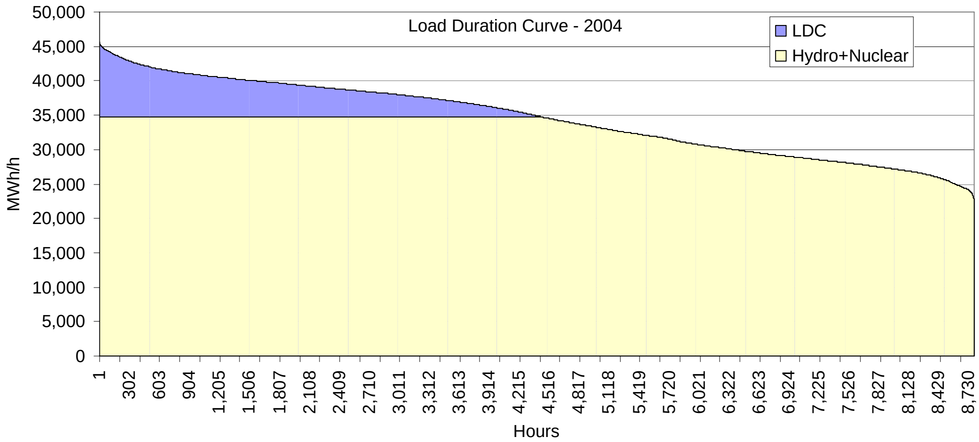


Figure 11 - Load duration curve for the S-SE-CO system, 2004

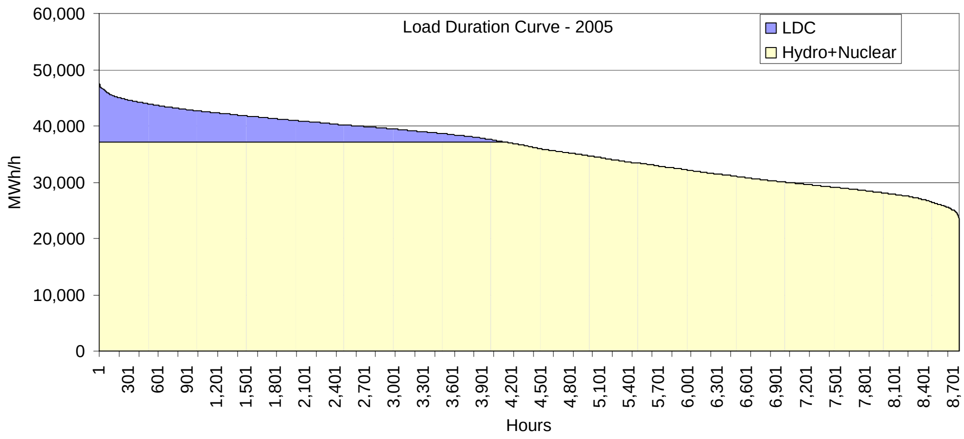


Figure 12 - Load duration curve for the S-SE-CO system, 2005

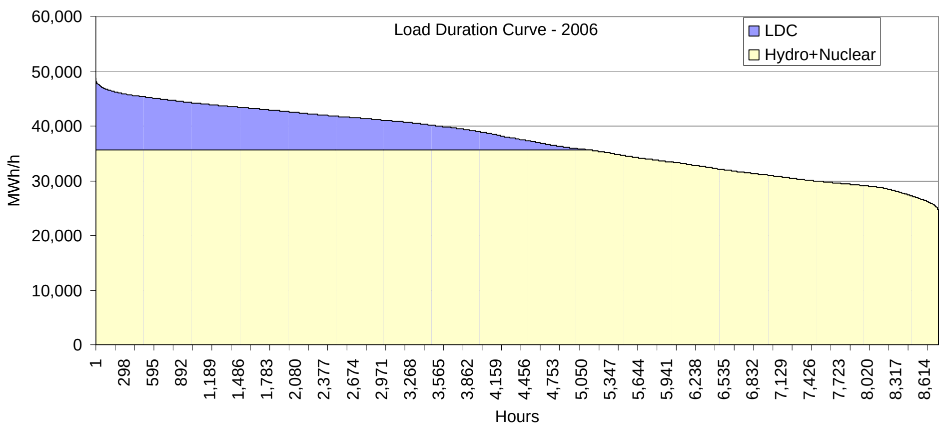


Figure 13 – Load duration curve for the S-SE-CO system, 2006

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.

There will be two energy meters (principal and back up) specified by CCEE and, before the operations start, CCEE demands that these meters are calibrated by an entity with Rede Brasileira de Calibração (RBC) credential. Measurements will be controlled in real time by the Operation and Management System Center (COGS) in Curitiba. Measurement data will be compared between the meters, so that any problems can be detected. In case of any problem, plant personnel will be put in action.

A measurement report will be signed monthly by the SHPP and sent to CCEE for approval. After approval, a bill of sale will be emitted by CCEE. When data will be submitted for verification, the SHPP will provide all the measurement maps.

Lumbrás Energética S/A will be responsible for the calibration (each 2 years) and maintenance of the monitoring equipment, for dealing with possible monitoring data adjustments and uncertainties, for review of reported results/data, for internal audits of GHG project compliance with operational requirements and for corrective actions.

Brascan Energética is responsible for the project management, as well as for organising and training of the staff in the appropriate monitoring, measurement and reporting techniques. Also, Brascan Energética is preparing an operation, maintenance and emergency manual. Technicians will be trained on mounting and start-up.

ANEEL can visit the plant to inspect the operation and maintenance of the facilities.

Lumbrás Energética S.A., the company that controls Angelina SHPP, has hired expert companies to execute their environmental programs. 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 SHPP and the environmental agencies.

Angelina Project predicts some environmental plan that involves different programs:

- Reservoir downstream monitoring program;
- Water quality control monitoring program;

- Aquatic management monitoring program;
- Flora management monitoring program;
- Terrestrial fauna management monitoring program;
- Program of environmental control actions from SHPP construction activities;
- Recuperation program for depredated areas caused by SHPP construction;
- Reservoir cleaning program;
- Geological impact monitoring program:
    - Slopes stability monitoring sub-program;
    - Water table monitoring sub-program;
- Population monitoring program;
- Program of conservation unit creation;
- Public health control program;
- Archeological patrimony rescue program;
- Social communication program;
- Environmental education program;
- Environmental supervision program from SHPP construction;
- Water occupation/use and reservoir margin plan;
- Dam security plan;
- Dam operation plan;
- Fauna and flora operational centre;
- Plant suppression program;
- Plant suppression program of reservoir formation area;
- Deforestation control program.

Annex 5

BIBLIOGRAPHY

ACM0002 (2006). Approved Consolidated Baseline Methodology 0002 – Consolidated Methodology for grid-connected electricity generation from renewable sources. Version 6; 19th May 2006. Web-site: http://cdm.unfccc.int/.

ANEEL (2007). Banco de Informações de Geração - BIG. Capacidade de Geração. Agência Nacional de Energia Elétrica. http://www.aneel.gov.br/.

Arida, P. E. L. Bacha, and A. L. Resende (2005). *Credit, Interest, and Jurisdictional Uncertainty: Conjectures on the Case of Brazil."* In F. Giavazzi, I. Goldfajn e S. Herrera (orgs.), Inflation Targeting, Debt, and the Brazilian Experience, 1999 to 2003. Cambridge, MA: MIT Press.

Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A. F. Simoes, H. Winkler and J.-M. Lukamba (2002). Road testing baselines for greenhouse gas mitigation projects in the electric power sector. OECD and IEA information paper.

BNDES (2000). O setor elétrico – Desempenho 1993/1999. Banco Nacional de Desenvolvimento Econômico e Social. Informe Infra-estrutura, nº 53. http://www.bndes.gov.br/.

CCEE (2007). Histórico de preços semanais. Câmara de Comercialização de Energia Elétrica. Web-site: http://www.ccee.org.br/

CGE/CBEE (2002). Programa de Energia Emergencial. Câmara de Gestão da Crise de Energia Elétrica – Comercializadora Brasileira de Energia Emergencial.

Eletrobrás (1999). Diretrizes para estudos e projetos de pequenas centrais hidrelétricas. Centrais Elétricas Brasileiras S/A Web-site: http://www.eletrobras.gov.br/.

Elliot, D. (2000). Renewable Energy and Sustainable Futures. Futures 32 CTS Special 'Sustainable Futures' Issue, pp261-274, April/May 2000.

IBGE (2007). Banco de dados Cidades@,. Instituto Brasileiro de Geografia e Estatística http://www.ibge.gov.br/.

Kartha, S., M. Lazarus and M. Bosi (2002). Practical baseline recommendations for greenhouse gas mitigation projects in the electric power sector. OECD and IEA information Paper.

OECD (2001). OECD Economic Surveys: Brazil. Organization for Economic Co-Operation and Development, Paris, France.

OECD (2004). Environmental Outlook. Organization for Economic Cooperation and Development. Web-site: http://www.oecd.org/env/

OECD (2005). OECD Economic Survey of Brazil 2005: Regulation of the electricity sector. Organization for Economic Co-Operation and Development, Paris, France

ONS (2007). Histórico de energia: Geração de energia 2002-2006. Operador Nacional do Sistema Elétrico Brasileiro. Web-site: http://www.ons.gov.br/.

ONS-ADO (2004). Acompanhamento Diário da Operação do Sistema Iterligado Nacional. ONS-CNOS, Centro Nacional de Operação do Sistema. Daily reports on the whole interconnected electricity system from Jan. 1, 2001 to Dec. 31, 2003. Web-site: http://www.ons.gov.br/.

Pinto Júnior, H. (2003). Les problèmes des réformes structurelles et institutionnelles inachevées: le cas de l'industrie éléctrique au Brésil. Révue de l'Energie **544**, 103-111.

Schaeffer, R., J. Logan, A. S. Szklo, W. Chandler and J. C. de Souza (2000). Electric Power Options in Brazil. Pew Center on Global Climate Change.

SIESE (2002). Sistema de Informações Empresariais do Setor de Energia Elétrica: Boletim Anual. Eletrobrás (Centrais Elétricas Brasileiras S/A) - MME (Ministério de Minas e Energia do Brasil). Web-site: http://www.eletrobras.gov.br/IN_Informe_SIESE/

Tolmasquim, M.T. (2003) [Ed.]. Fontes Renováveis de Energia no Brasil. Editora Interciência.

UNEP-LAC (2002). Final Report of the 7th Meeting of the Inter-Sessional Committee of the Forum of Ministers of Environment of Latin America and the Caribbean. United Nations Environment Programme, Regional Office for Latin America and the Caribbean. 15 to 17 May, 2002, São Paulo (Brazil).

WCED (1987). Our Common Future. The World Commission on Environment and Development. Oxford University Press.