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

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Annexes

SECTION A. General description of project activity

A.1. Title of the project activity

Central Energética do Rio Pardo cogeneration project ("CERPA").

PDD version number: 4

Date: October 31, 2005

A.2. Description of the project activity

Usina da Pedra is a sugar mill located in Serrana, state of São Paulo. The company is owned by the Biagi family, which is one of the most traditional producers in the sugar industry in Brazil. Irmãos Biagi S/A, the family company, owns two other sugarcane mills (Ibirá Mill and Buriti Mill). Usina da Pedra produces sugar and anhydrous and hydrated alcohol, as well as generates its own electricity. During the 2003 - 2004 crop season, Usina da Pedra processed 3,341,870 tones of sugarcane, produced 3,871,428 sugar sacks (50Kg each), 90,516,000 liters of anhydrous alcohol, and 92,271,000 liters of hydrated alcohol.

In May 2003, CERPA, which is the thermoelectric plant of Usina da Pedra, sold its first MWh to the local power utility CPFL (Companhia Paulista de Força e Luz). Currently there is a PPA signed with CPFL to commercialize 18 MW during the season.

CERPA in 2003 upgraded its equipment with the objective of using bagasse more efficiently to cogenerate electricity (see to Figure 1). A more efficient cogeneration of this renewable fuel allows Da Pedra mill to sell a surplus of electricity to the grid and creates a competitive advantage. The electricity sold to the grid diversifies income to the mill and it helps 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.

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.

Projects of this type typically do not incur large expenditures nor require significant employment demand. CERPA directly employed two hundred workers and it indirectly employed six hundred workers during the year of construction of the bagasse thermo facility and it annually employs nine workers to operate the plant. However, it contributes to the larger social welfare of the region; the entire Da Pedra complex directly employees about 3,000 workers.

Income distribution will be derived from this project due to job creation, employees' salaries and package of benefits such as social security and life insurance, and credits of emission reductions.

Additionally, lower expenditure is achieved due to the fact that money will no longer be spent in the same amount to "import" electricity from other regions in the country through the grid. This money would stay in the region and be used for providing the population better services which would improve the availability of basic needs. This surplus of capital could be translated in investments in education and health that would directly benefit the local population and indirectly in a more equitable income distribution.

In addition, the project sponsor is working with local communities on environmental education projects, reforestation of degraded areas, regular water quality assessment, support for environmental parks, hiring of local manpower, erosion control, and support for community agriculture.

The Proinfa Program, Law no. 10,438 enacted in April 2002, created the "Program of Incentives to Alternative Energy Sources" (Proinfa from the Portuguese *Programa de Incentivo as Fontes Alternativas de Energia Elétrica*). Among others, one of this initiative's goals is to increase the renewable energy sources share in the Brazilian electricity market, thus contributing to a greater environmental sustainability. In order to achieve such goals, the Brazilian government has designated the federal state-owned power utility (Centrais Elétricas Brasileiras S.A. – "Eletrobras") to act as the primary offtaker of electric energy generated by Alternative Energy facilities in Brazil, by entering into long-term power purchase agreements ("PPAs") with Alternative Energy producers, at a guaranteed price of at least 80% of the average energy supply tariff charged to ultimate consumers in Brazil.

CERPA began construction prior to Proinfa's legislation being in full effect. Although the projects would be eligible for Proinfa, they have not applied for the Program in 2002, because had started operations before the project starts invoicing the power generation, which is after January 2006 and due to certain uncertainties of the program. As such it does not have access to the financial advantages of the program. For that reason the project can be seen as an example of a solution by the private sector to the Brazilian electricity crisis of 2001 which contributes to the sustainable development of Brazil. But Proinfa was structured by the Law 10,438 and issued in April 2002. It means the government noticed the weak development of the biomass projects and the market barriers, and decided to structure the incentive. The creation of Proinfa indicates that without a specific support, the renewable sources and the small projects would not be implemented otherwise. Once the project is not accessing the Proinfa opportunity, its benefits and incentives, it is competing in the market with other projects and opportunities, and selling its power to other companies other than Eletrobrás, as bilateral contracts. Also, only in 2004 with Portaria 45 (and considering Proinfa was set in 2002), it was clear that the Proinfa projects would be billed just in 2006. Some of the project which were considered to particpate in Proinfa in 2003 or 2004 had to be initiated without the incentives.

The existance of Proinfa is a proof that a sound incentive is necessary to promote the construction of biomass projects. And another proof that the barriers are huge, most of the selected and contracted projects are not already under construction, and some are supposed to not be even constructed. The analysis of Proinfa, and of the other incentives of the power sector for the other sources, illustrates the hurdles that the developers who are not participanting in any program have to face.

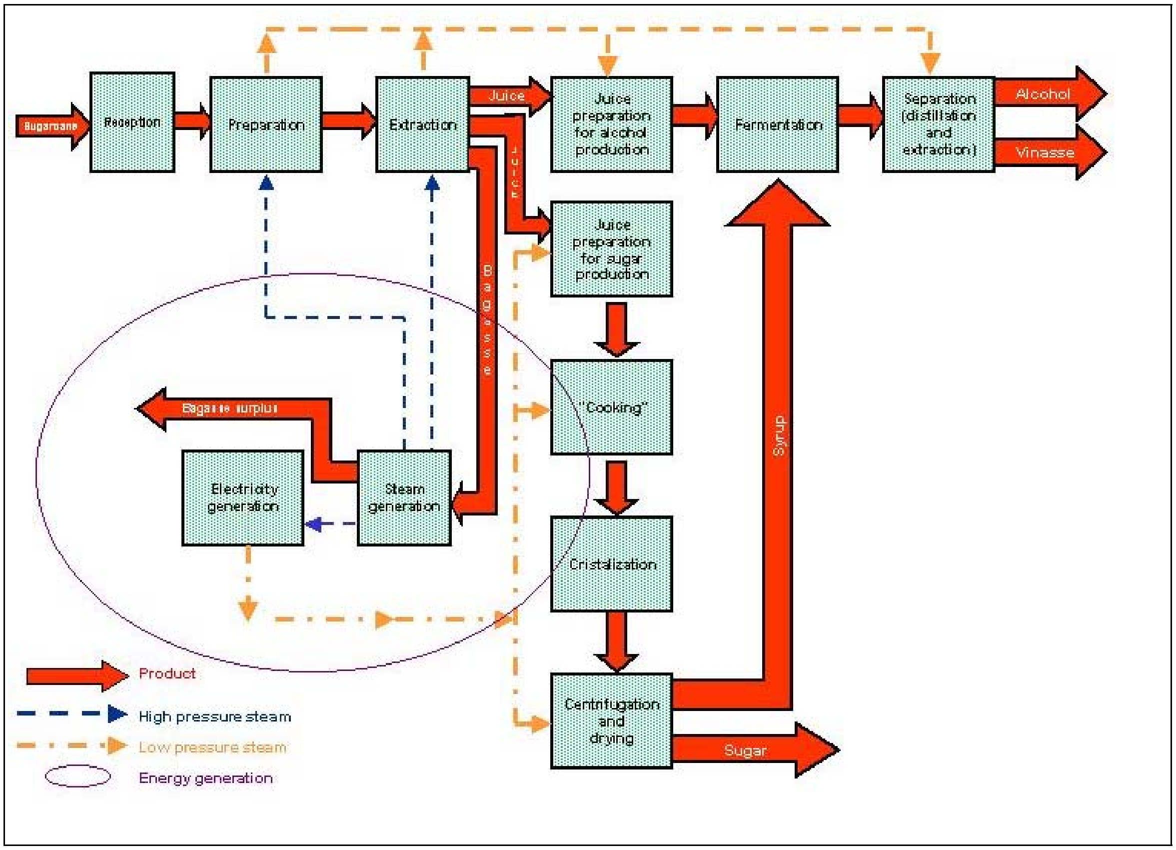

Figure 1 - Flowchart of the electricity generation inside a Sugar and Alcohol Production (Source: Codistil)

A.3. Project participants

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

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	CERPA – Central Energética do Rio Pardo Ltda.	No
(*) 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 CERPA project activity

A.4. Technical description of the project activity

A.4.1. Location of the project activity

A.4.1.1. Host Party(ies)

Brazil

A.4.1.2. Region/State/Province etc.

Southeast Region/ State of São Paulo

A.4.1.3. City/Town/Community etc

Serrana

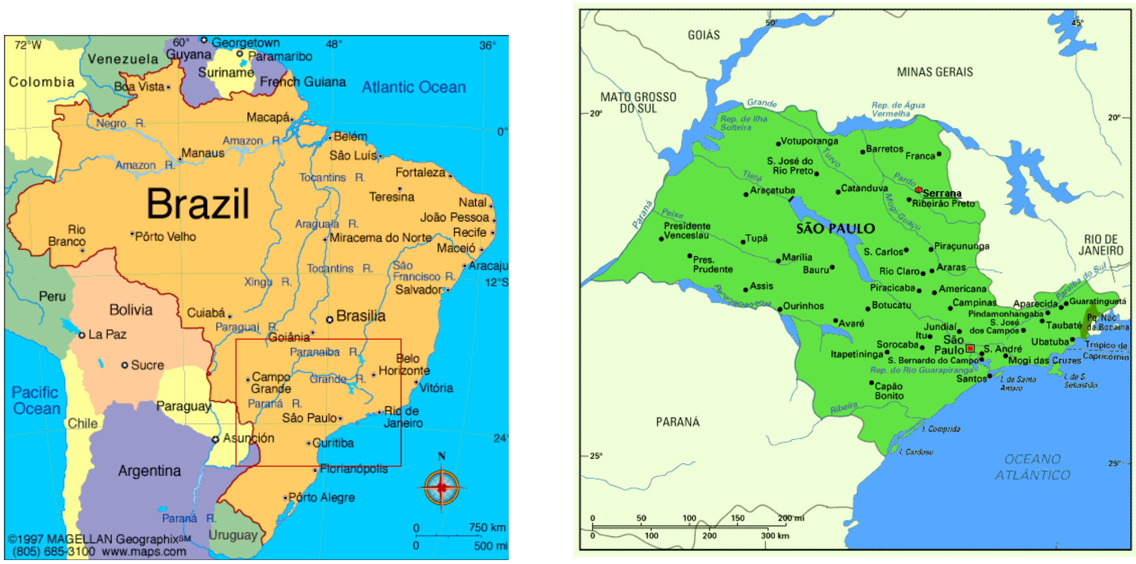

Figure 2 - Geographical Position of the City of Serrana (Source www.aondefica.com)

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

Serrana is a town of 37,500 inhabitants in the State of São Paulo. It is located in one of the main agricultural heartlands of the country (Figure 2). The sugarcane mill (Figure 3) is located near Ribeirão Preto, which is the major city of the north-eastern part of the state. Ribeirão Preto is an important road and rail hub which makes it an important distribution center for a large coffee growing and livestock-breeding area. Cotton, sugarcane, and grains are cultivated near the city, which is at the center of a region that produces 70 percent of the nation's orange juice and is considered Brazil's largest sugarcane planter and sugar and alcohol producer. In this region there are more than 40 mills, responsible for about 25% of the national production of sugarcane, sugar and alcohol. Additionally, there are a number of related industries and supply companies.

Figure 3 - Da Pedra Sugarcane Mill - Aerial Overview (Source: Usina da Pedra)

A.4.2. Category(ies) of project activity

Type: Energy and Power.Sectoral Scope: 1 – Energy industries (renewable - / non-renewable sources).

Category: Renewable electricity generation for a grid (energy generation, supply, transmission and distribution).

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

Biomass power conversion technologies for electricity production can be broadly categorized as one of three technologies: direct combustion technology, gasification technology, and pyrolysis. Direct combustion technology, like the one used in CERPA, is the most widely used for simultaneous power generation and heat production from biomass. It involves the oxidation of biomass with excess air in a process that yields hot flue gases that are used to produce steam in boilers. The steam is used to produce electricity in a Rankine cycle engine. The Rankine cycle is a heat engine with a vapor power cycle, as can be seen in Figure 4. The working fluid is water. Typically, electricity is produced in a "condensing" steam cycle, while electricity and steam are co-generated in an "extracting" steam cycle.

CERPA operates with a configuration using a high-pressure boiler and a multiple stage backpressure turbine coupled with two new 15 MW generators. There are 18 MW power surplus, operating at full capacity during the season (May to November) and the plant exports approximately from 45,000 MWh to 60,000 MWh every year since 2003, assuming 90% capacity factor. The local power utility (CPFL, “Companhia Paulista de Força e Luz”) has signed a Power Purchase Agreement (PPA) with CERPA.

CERPA power plant uses the following equipment, which was fully upgraded in 2003:

- 65-kgf/cm^2-operation pressure, 150 tones of steam per hour capacity.
- Turbo-generator: 2 X 15 MW power capacity, 65 bar operation pressure.
- Sub-station: 13.8 – 69KV
- Transmission Line: 69KV (~3.2 Km)
- Chiller: 3,300 m^3/h

The sugar mill train the local staff yearly focusing on the following issues:

- NR 10[1]: Technical instruction for electric installation and services;
- NR 13: Technical instruction for boilers and pressure vessels;
- Boiler combustion (in accordance with the equipment supplier).

The operation and maintenance of the facility are administered by the sugar mill. The activities are divided in:

- Special predictive maintenance: vibration analysis (monthly), thermo inspections (twice during the season), analysis of the transformer’s insolating oil (once during the season);
- Standard predictive maintenance: according ISO 9001.

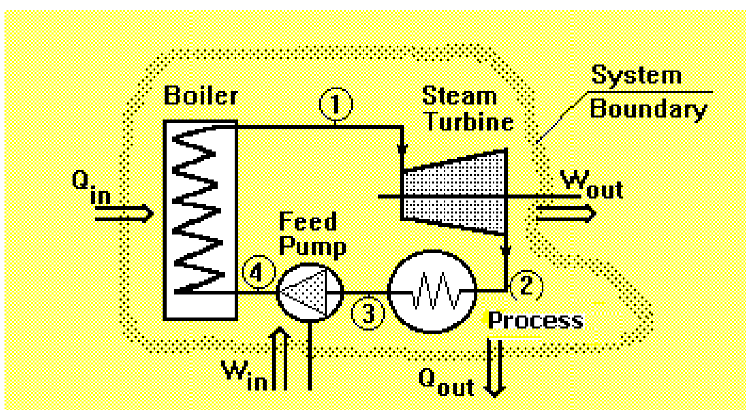

Figure 4 - Rankine Cycle (Source: Taftan Data, 1998)

[1] Ministério do Trabalho e Emprego (Ministry of Labour and Employment, http://www.mte.gov.br/).

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

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

As Kartha et al. (2002) stated, "The crux of the baseline challenge for electricity projects clearly resides in determining the 'avoided generation', or what would have happened without the CDM or other GHG-mitigation project. The fundamental question is whether the avoided generation is on the 'build margin' (i.e. replacing a facility that would have otherwise been built) and/or 'operating margin' (i.e. affecting the operation of current and/or future power plants)."

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

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

The approved consolidated baseline methodology AM0015 – "Bagasse-based cogeneration connected to an electricity grid", applies to electricity capacity additions from Bagasse-based cogeneration Facility, which is the proposed project activity. The baseline scenario considers the electricity, which would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

The full implementation of the CERPA Project connected to the Brazilian South-Southeast-Midwest electricity interconnected grid will avoid an average estimated yearly emission of around 16,935 tCO_2e (emission factor baseline of 278.3$kgCO_2e$/MWh, detailed calculation in section E), and a total reduction of about 118,546 tCO_2e over the first crediting period

Years	Annual estimation of emission reductions in tonnes of CO_2e
Year 1 - (2003)	12.722
Year 2 - (2004)	15.376
Year 3 - (2005)	18.090
Year 4 - (2006)	18.090
Year 5 - (2007)	18.090
Year 6 - (2008)	18.090
Year 7 - (2009)	18.090
Total estimated reductions (tonnes of CO_2e)	118.546
Total number of crediting years	7
Annual average over the first crediting period of estimated reductions (tonnes of CO_2e)	16.935

Table 2 – Estimated emission reductions over the chosen crediting period

A.4.5. Public funding of the project activity

There is no public funding involved for this Project.

SECTION B. Application of a baseline methodology

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

AM0015 – "Bagasse-based cogeneration connected to an electricity grid" (AM0015, 2004).

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

The chosen methodology provides a procedures / conditions to determine if the referred methodology is applicable to the CERPA project activity.

The bagasse to be used as the feedstock for cogeneration shall be supplied from the same facility where the project is implemented;

CERPA is installed inside the Da Pedra sugarcane mill. The sugar mill retrofitted the power plant in order to generate excess electricity to export to the grid using the same quantity of bagasse as before the retrofitting entirely supplied by Da Pedra sugarcane mill.

Documentation is available supporting the project activity would not be implemented by the public sector, project participants or other relevant potential developers, notwithstanding of the government policies/ programs to promote renewables if any, in the absence of the CDM;

The project is located within the Da Pedra sugar mill premises using the bagasse produced from the sugarcane milling process; therefore, no other entity could develop this project. The government does not control sugar mills in Brazil; therefore projects such as the CERPA could only be set up by the private sector.

The implementation of the project shall not increase the bagasse production in the facility;

The Da Pedra sugar mill produces the same amount of sugarcane and bagasse as before the project activity was implemented. The fluctuation of the amount of sugarcane produced and, consequently the bagasse is due to climate, crop and market conditions that could vary from year to year. Additionally, the percentage of fibre present in the sugarcane could influence in the amount of bagasse (see Table 3).

Year	(kg)
1998	1044930
1999	1016087
2000	723789
2001	839238
2002	940031
2003	1032149
2004*	1004400

* estimative

Table 3 - Historical Bagasse Generation at Da Pedra Sugar Mill

The bagasse at the project facility should not be stored for more than one year.

The sugar mills, generally, store a small amount of bagasse for the next season in order to start plant operations when the new crop season/ harvest begins. The bagasse is stored from the end of the harvest season in November in the South/Southeast region, until the beginning of the following harvest season in May. The volume of bagasse stored between seasons is insignificant, less than 5% of the total amount of bagasse generated during the year or during the harvest period.

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

CERPA is a cogeneration project connected to the electricity grid. The project fulfils all the "additionality" requisites (see application of the "additionality tool[2]" below) and demonstrates why the project would not occur in the absence of the CDM.

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

The methodology AM0015, for cogeneration projects, uses derived margins, which have been applied in the context of the project activity through the determination of the emissions factor for the South-Southeast-Midwest subsystem of the interconnected Brazilian grid (electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints).

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

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

The proposed baseline methodology includes an Additionality Tool approved by the Executive Board. This tool considers some important steps that are necessary in order to determine if the project activity is additional and also demonstrates the importance that emissions reductions would not occur in the absence of the CERPA activity.

Following are the steps necessary for the demonstrations and assessment of CERPA additionality:

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

a) **Project Start date:** 01/05/2003

b) Evidence demonstrates that CDM incentives were seriously considered in the development of the CERPA.

The sugar and ethanol mills located in the state of São Paulo are allied in a strong association that allows them to be represented as a single entity, strengthening their dialogue with the government and the market. UNICA - the São Paulo Sugarcane Agroindustry Union was created in 1997 combining into a single entity two existing unions in this sector: SIAESP[3] (sugar industry) and SIFAESP[4] (ethanol industry).

UNICA has been proactive in providing its associates with a great amount of information about different issues, including CDM and its opportunities. Since 1997 this entity has provided seminars, books and research papers in order to inform and advise the sugar mills on procedures, incentives and opportunities regarding CDM.

Da Pedra mill, being an associate of UNICA, has been exposed to CDM in several forums and activities promoted by the entity. All of the information obtained was extremely important in the decision to proceed with the project activity and eventually to initiate the CERPA project.

Irmãos Biagi Group, which is the owner group of Da Pedra mill, is also member of Copersucar - a Cooperative of 32 sugar and ethanol producers. In addition to being the biggest sugar and ethanol producer in the world, Copersucar is the owner of CTC - Copersucar Technology Center, its technology arm. The Center is one of the most advanced research and development centres for sugar cane production and processing and has developed numerous research papers to instruct its partners regarding the CDM.

Below are some activities developed by UNICA, Copersucar/CTC and other sector participants that provide evidence of the intention to maintain their associates informed about CDM:

- "Alcool e Aquecimento Global", 1997. (CNI, Copersucar and COPPE-UFRJ). Alcohol and Global Warming. This book was financed by Copersucar to make partners aware

[3] SIAESP – Sindicato da Industria do Açúcar do Estado de São Paulo. The Syndicate of Sugar Industry on the State of São Paulo.

[4] SIFAESP – Sindicato da Industria da Fabricação do Álcool no Estado de São Paulo. The Syndicate of the Alcohol Production Industry of the State of São Paulo.

about Global Warming and how ethanol might contribute to its mitigation. Da Pedra is also part of Copersucar.

- "O álcool combustível e o desenvolvimento sustentado", 1998. (João Guilherme Sabino Ometto, sugar producer and former president of SIAESP, SIFAESP and Copersucar). Fuel Alcohol and Sustainable Development. This book was developed to inform the sector about the opportunities of using alcohol in the CDM scenario. This book is based on the Kyoto Protocol prerogatives.
- UNICA[5] is founder member of the IETA[6] – International Emissions Trading Association (1998). The objective of the association is to develop an active, global greenhouse gas market, consistent across national boundaries and involving all flexibility mechanisms: the Clean Development Mechanism, Joint Implementation and emissions trading.
- BRAZIL/U.S. ASPEN GLOBAL FORUM. *University of Colorado at Denver*. Copersucar participated in the following documents regarding Climate Change:
- Early Start Carbon Emission Reduction Projects. Challenge & Opportunity, 1999
- Task Forces on Early Start Projects for Carbon Emissions Reductions, 2000
- "O Ciclo da Cana-de-Açucar e Reduções Adicionais nas Emissões de CO_2", 2000. (Isaías de Carvalho Macedo, CTC – Copersucar). The Sugarcane Cycle and the Additional CO_2 Emission Reductions. Research paper prepared to inform the partners of Copersucar.
- "Sugar cane residues for power generation in the sugar/ ethanol mills in Brazil". *Energy for Sustainable Development – Volume V Nº 1 – 2001*. Prepared by the technical staff of the CTC – Copersucar.

As demonstrated above, the sugarcane industry sector has been informed about the Clean Development Mechanism and has been proactive in participating in the CDM. Therefore, the sugarcane sector and consequently Irmãos Biagi Group is assuming a protagonist role under the CDM.

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

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

1. The alternative to the project activity is the continuation of the current (previous) situation, with the investment in the sugar and ethanol industry that are the core business of the companies.

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

2. The alternative is in compliance with all applicable legal and regulatory requirements.

3. Non-applicable.

4. The project activity and the alternative scenario are in compliance with the legal and regulatory requirements.

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[5] UNICA – www.unica.com.br

[6] IETA – www.ieta.org

Step 2. Investment Analysis:

Non applicable.

Step 3. Barrier Analysis:

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

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

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

Building a competition friendly environment, with the gradual elimination of the captive consumer. The option to choose an electricity services supplier, which began in 1998 for the largest consumers, and should be available to the entire market in 2006;

Dismantling of the state monopolies, separating and privatizing the activities of generation, transmission and distribution;

Allowing free access to the transmission lines, and

Placing the operation and planning responsibilities to the private sector.

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

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

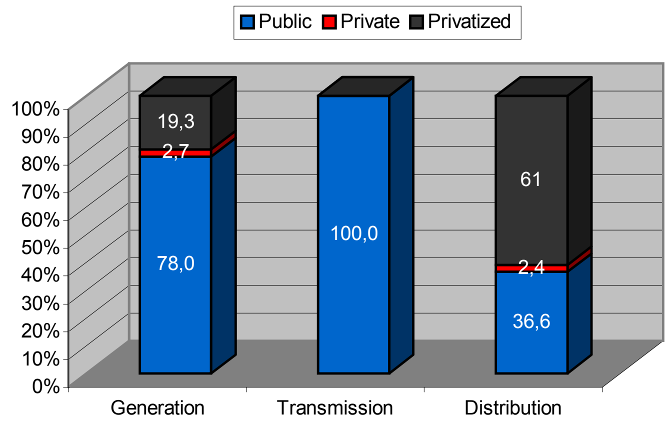

Figure 5 - Participation of private capital in the Brazilian electricity market in December 2000 (Source: BNDES, 2000).

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

Without new installed capacity, the only alternatives were energy efficiency improvements or higher capacity utilization (capacity factor). Regarding energy efficiency, the government established in 1985 PROCEL (the National Electricity Conservation Program). Although the results of the program were remarkable, the efficiency achievement was not big enough to cover the mentioned gap between the need of new generation capacity and consumption growth.

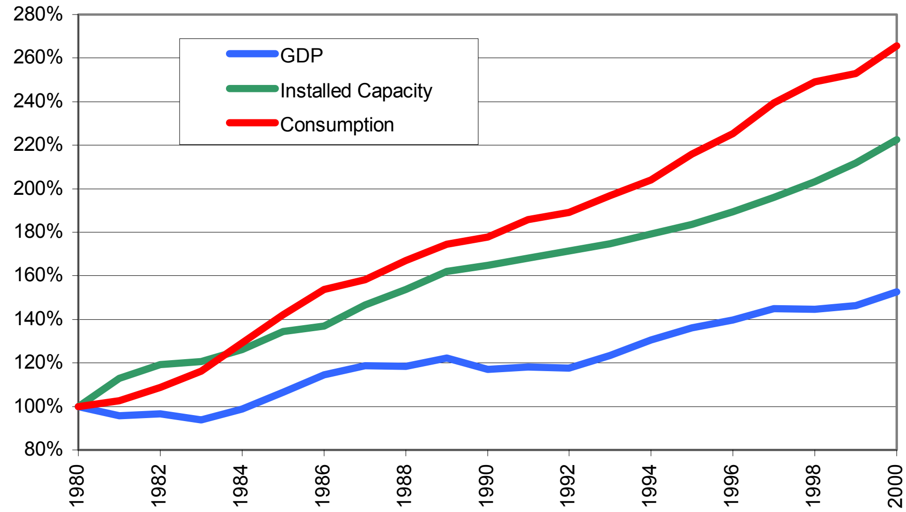

Figure 6 - Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption). Source: Eletrobrás, IBGE.

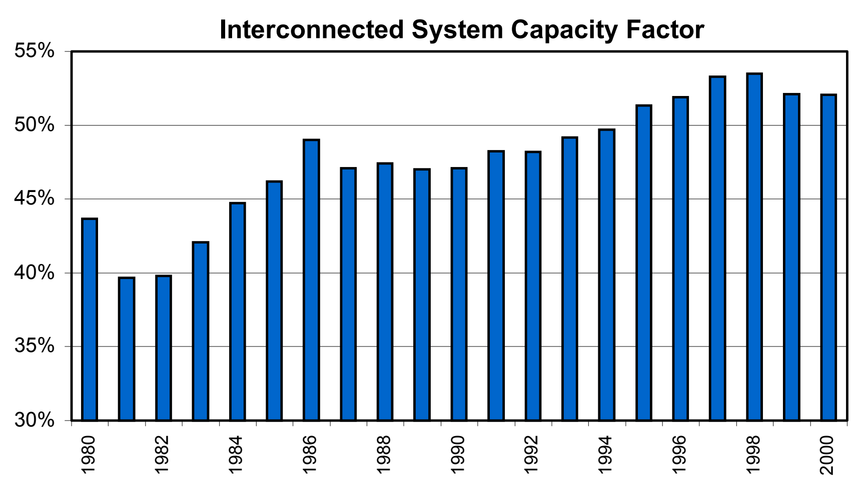

Figure 7 - Evolution of the rate of generated energy to installed capacity (Source: Eletrobrás).

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

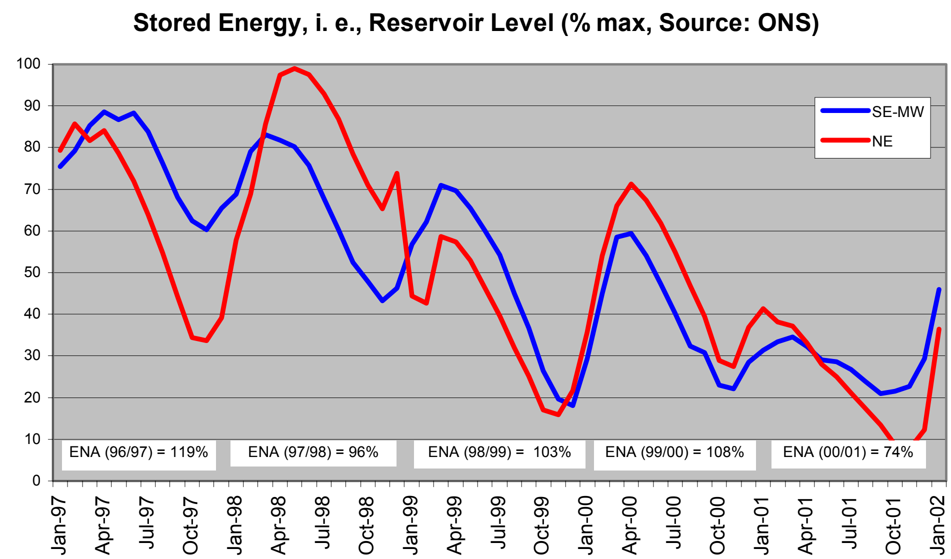

Figure 8 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS).

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

During the rationing of 2001 the government also launched the *Emergency Energy Program* with the short-term goal of building 58 small to medium thermal power plants until the end of 2002 (using mainly diesel oil, 76,9 %, and residual fuel oil, 21.1 %), totalizing 2,150 MW power capacity (CGE-CBEE, 2002).

It is clear though that hydroelectricity is and will continue as the main source responsible for the electricity base load in Brazil. However, most if not all-hydro resources in the South and Southeast of the country have been exploited, and most of the remaining reserves are located in the Amazon basin, far from the industrial and population centers (OECD, 2001). Clearly, new additions to Brazil's electric power sector are shifting from hydroelectricity to natural gas plants (Schaeffer *et al.,* 2000).

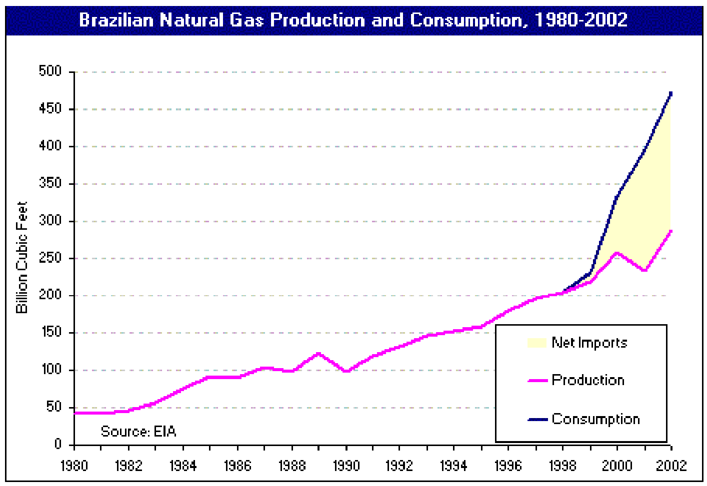

Figure 9 – Historical Brazilian Natural Gas Consumption and Production (Source: EIA[7])

With discoveries of vast reserves of natural gas in the Santos Basin in 2003 (Figure 10) the policy of using natural gas to generate electricity remains a possibility and it still will continue to have interest from private-sector investments in the Brazilian energy sector.

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

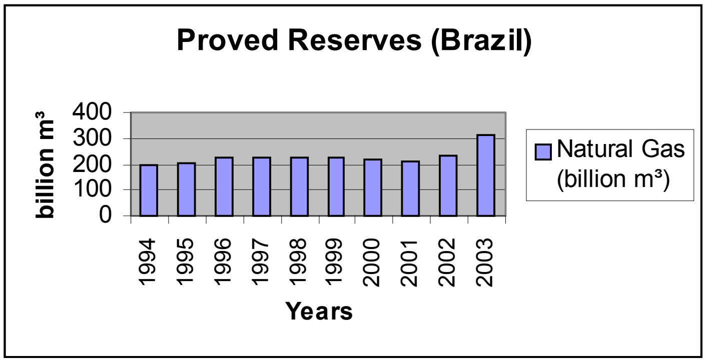

Figure 10 - National Historical Proved Reserves of Natural Gas (Source: Petrobras)

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

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

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

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

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

Investment Barrier

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

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

Interest rates for local currency financing are significantly higher than for US Dollar financing. The National Development Bank – BNDES is the only supplier of long-term loans. Debt financing from BNDES are made primarily through commercial banks. The credit market is dominated by shorter maturities (90-days to 1-year) and long-term credit lines are available only to the strongest corporate borrowers and for special government initiatives. Credit is restricted to the short-term in Brazil or the long-term in dollars offshore.

Financial domestic markets with a maturity of greater than 1 year are practically non-existent in Brazil. Experience has shown that in moments of financial stress the duration of savings instruments have contracted to levels close to one day with a massive concentration in overnight banking deposits. Savers do not hold long-term financial contracts due to the inability to price-in the uncertainty involved in the preservation of purchasing power value. (Arida et al., 2005).

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

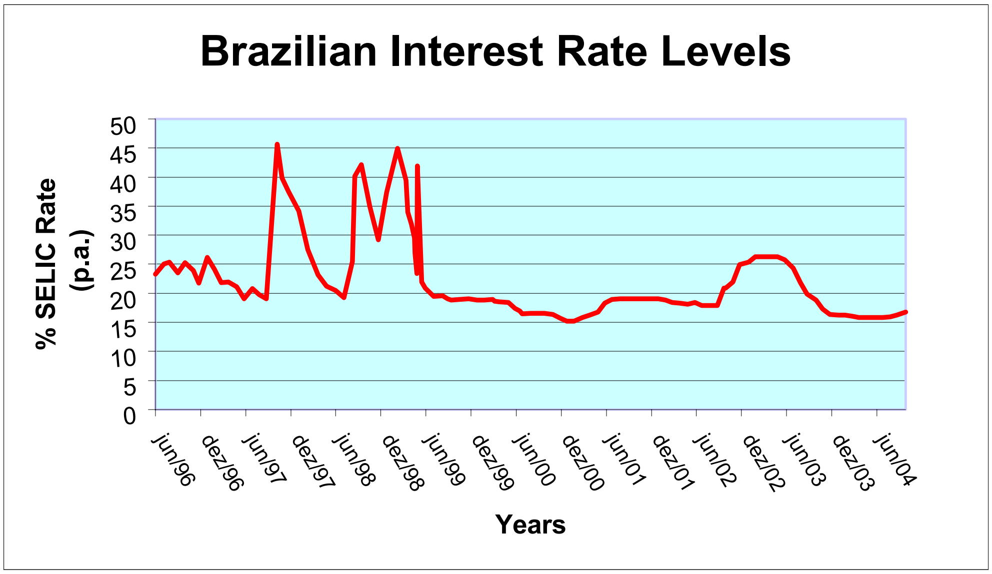

Figure 11 - SELIC rate (source: Banco Central do Brasil)

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[8].

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, as it is possible to see in Figure 11.

The CERPA project was developed on a project finance basis. To finance construction, project sponsor (Da Pedra Mill) took advantage of the financing lines of BNDES. This financial support covered 80% of the project costs with a rate of TJLP (BNDES Long Term Interest Rate – 10%) plus a 5% spread risk for a term of 8-year and 1-year grace period.

The Project was set up with an expected financial IRR – Internal Rate of Return of the approximately 18% per year. The project's IRR is very similar to the SELIC rate in effect at the time of financing although the project is a riskier investment as compared to Brazilian government bonds. The inclusion of the revenues from CERs makes the project's IRR increase in about 400 basis point from 15% to 19%. Such increase in return would compensate for the additional risk investor would take with this project.

8 COPOM – Comitê de Politica Monetária (Monetary Policy Committee).

Financial Sensitivity Analysis - CERPA			
SELIC rate* (1996 - 2004)	**%**	**Project NPV**	**Project NPV with CER**
Maximum Level	45,00%	(R$ 7.282.872)	(R$ 6.432.150)
Average	22,36%	(R$ 3.502.720)	(R$ 1.699.640)
Minimum Level	15,25%	(R$ 277.379)	R$ 2.176.763
Current Discount Rate	**18,00%**	**(R$ 1.735.024)**	**R$ 431.826**
Project IRR		**15%**	**19%**

* The SELIC rate was created in 1996.

Table 4 - Financial Sensitivity Analysis

In addition to the increase of 400 basis points, CER revenues would bring the project additional benefits due to the fact that they are generated in hard currencies (USD or EUR). The CDM incentive allows CERPA to hedge its debt cash flow against currency devaluation. Moreover, the CER Free Cash Flow, in US dollars or EURO, could be discounted at an applicable discount interest rate, thus increasing the project leverage.

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

Other financial barriers are related to the power purchase agreement (PPA). The PPA is required in order to obtain long-term financing from a bank and the lack of adequate commercial agreements from the energy buyers may influence directly the negotiation between the bank and the project developer. Most of the utilities in Brazil do not have a satisfactory credit risk thus representing a barrier to obtain long-term funding.

In addition to all those barriers mentioned above, the sugar mills do not have a strong incentive to invest in their own power plants. In general, the revenues of selling electricity in a cogeneration project does not represent more than 5% of the total revenues of a sugar mill. Thus, the sugar mills tend to invest in their core business, sugar and ethanol, instead of investing in electricity generation for the grid.

The conclusion is that CDM incentives play a very important role in overcoming financial barriers. (Table 4)

Institutional Barrier

As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created to try to organize and to provide incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period electricity prices surpassed BRL 600/MWh (around USD 200/MWh) and the forecasted marginal price of the new energy reached levels of BRL 120 – 150/MWh (around USD 45). In the middle of 2004 the average price was bellow BRL 50/MWh (less than USD 20/MWh). The volatility of the electricity price in Brazil has a correlation with the instability in government policies in the period, with 3 different regulatory environments in a 10 year period (from 1995 to 2004). In theory the new regulatory framework has the potential to reduce market risk considerably. Nevertheless only time will prove the efficiency of the new model in relation to market risks reduction and private investment attraction[9]. In that sense, it will interesting to evaluate the results of the first auction of licenses for the construction of new power plants in order to correctly assess the success of the implementation of the new regulatory framework

Cultural Barrier

The history of the sugarcane industry has demonstrated that the industry is a traditional stable business and has consistently helped to support the country's economy. It has historically enjoyed governmental support such as fixed prices and subsidies. Another characteristic of this sector is the specialization in commodity (sugar and ethanol) transactions. Therefore, the cultural barrier is a considerable obstacle since the generation of electricity to sell to the grid and the electricity negotiation in the market is something relatively new to this industry, which can be in part overcome with the Clean Development Mechanism.

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

As described above, the main alternative to the project activity is to continue the status quo, the sugarcane mills only focusing their investments on sugar and ethanol. Therefore the barriers above have not affected the investment in other opportunities

Step 4. Common practice analysis

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

Some sugar mills have optimized their power plants in order to export electricity; numerous risks and barriers have prevented the implementation of the proposed project activity among the majority of the sugar mills. In the Centre-South Region, there are more than 250 sugar mills producing sugar, ethanol and electricity for their self-consumption but less than 30 mills have developed expansion programs for their power plants.

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

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

Both processes of negotiating a PPA with utility companies and obtaining funding from BNDES have proved to be very cumbersome. BNDES also requires several guarantees in order to provide financing. Other risks and barriers are related to the operational and technical issues associated with small cogeneration projects, including their capability to comply with the PPA contract and the potential non-performance penalties. At that time the mechanisms, set up by the new energy model, to sell electricity from biomass cogeneration to the grid were not yet established and, therefore, Da Pedra sugar mill could not take that competitive advantage Moreover, traditional sugar producers would prefer concentrating investments on their traditional business (sugar and ethanol) than venturing in new projects with new risks and low returns (see Investment Barrier) where they have little or no know-how.

Regardless of the risks and barriers mentioned above, the main reason for the reduced number of similar project activities is the economic cost. Project feasibility requires a PPA contract with a utility company, but the utilities do not have the incentives or motivation to buy electricity generated by small cogeneration projects. The marginal cost for electricity expansion is US$ 33/MWh[10] and the cost of cogeneration electricity ranges from US$ 35 to US$ 50.

Because of reasons mentioned above, no more than 10% of the sugar mills in the Centre-South region have developed similar activities to that of CERPA and the majority of these project developers have taken into consideration CDM in their decision to expand their cogeneration plant.

The intention of Irmãos Biagi to diversify its revenues and hedge against the volatility of sugar and ethanol prices was fundamental for the company to set up this pioneer project and create the CERPA. The company has also been a pioneer in looking for CER revenues to increase the project IRR and consequently making it economically feasible.

Step 5 – Impact of CDM Registration

The sugarcane plantation is part of the country's colonization period. The commercialization of sugarcane has become part of the Brazilian culture was introduced during the XVI century when the Portuguese colonized the country. Brazil became the first producer and exporter of sugar in the world. Since then, sugarcane has been an important part of the Brazilian agricultural industry.

Currently in Brazil, there are more than 5 million hectares of land producing sugarcane and there are more than 320 sugar mills producing sugar, ethanol and electricity to supply their own energy consumption. Consequently the potential to generate electricity for commercialization (exporting to the grid), is estimated at around 12 GW. This potential has always existed and has grown as the sugarcane industry has grown. However the investments to expand the sugar mills' power plants have only occurred since 2000. Although a flexible legislation allowing independent energy producers has existed since 1995, it was only after 2000 that sugar producers started to study this proposed project activity as an investment alternative for their power plants in conjunction with the introduction of the CDM.

The CDM has made it possible for the mills set up their cogeneration plants and export excess electricity to the grid by helping to overcome financial barriers through the financial benefits obtained from CDM revenues; this is summarized in Table 3. Additionally, CDM has helped to overcome institutional and cultural barriers since the CDM has made the project sponsors take more seriously into consideration the generation of renewable electricity.

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[10] MME – Ministério de Minas e Energia (Ministry of Mines and Energy)

Therefore, the registration of the proposed project activity will have a strong impact in paving the way for similar projects to be implemented in Brazil, which may bring about among other things development in technologies.

This kind of activity will be encouraged once this project activity gets registered.

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

Project Boundary

CERPA: The project boundaries are defined by the emissions targeted or directly affected by the project activity, construction and operation. It encompasses the physical, geographical site of the bagasse power generation source, which is represented by the sugarcane mill (Da Pedra), the sugarcane plantation that supply biomass to the mill and the region located close to the power plant facility and the interconnected grid.

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

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

The boundaries of the subsystems are defined by the capacity of transmission. The transmission lines between the subsystems have a limited capacity and the exchange of electricity between those subsystems is difficult. The lack of transmission lines forces the concentration of the electricity generated in each own subsystem. Thus the South-Southeast-Midwest interconnected subsystem of the Brazilian grid where the project activity is located is considered as a boundary. (please see it at Annex 3)

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

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

Date of completing the final draft of this baseline section (DD/MM/YYYY): 30/08/2005.

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Brazil.

SECTION C. Duration of the project activity / Crediting period

C.1. Duration of the project activity

C.1.1. Starting date of the project activity

01/05/2003

C.1.2. Expected operational lifetime of the project activity

25y-0m

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

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period

01/05/2003

C.2.1.2. Length of the first crediting period

07y-0m

C.2.2. Fixed crediting period

C.2.2.1. Starting date

Not applicable

C.2.2.2. Length

Not applicable.

SECTION D. Application of a monitoring methodology and plan

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

Approved monitoring methodology AM0015: "Bagasse-based cogeneration connected to an electricity grid"

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

The chosen methodology is applicable to all bagasse-based cogeneration projects connected to the grid. The monitoring methodology and plan considers monitoring emission reductions generated from cogeneration projects using sugarcane bagasse as fuel.

The main data to be considered in determining the emissions reductions is the electricity exported to the grid. The emissions reduction is reached by applying an emissions factor through the electricity dispatched to the grid, that is verified and monitor by a two party verification: by the power plant that sells the electricity and by the utility company that buys the electricity.

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

The project emissions (PE_y) are zero; therefore table D.2.1.1 below is empty.

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived

ID number *(Please use*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or	Recording frequency	Proportion of data to be	How will the data be archived?	Comment

numbers to ease cross-referencing to				estimated (e)		monitored	(Electronic/ paper)	

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

The project emissions (PE_y) are zero, therefore no formula for calculation of direct emissions are necessary.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	Comment
1. EG_y	Electricity supplied to the grid by the project	Readings of the energy metering connected to the grid and Receipt of sales	MWh	(m)	15-minutes-measurement and Monthly recording	100%	Electronic and paper	The electricity delivered to the grid is monitored by the Project as well as by the energy buyer through a double check by receipt of sales.

2. EF_y	Emission Factor	Calculated	tCO_2/MWh	(c)	At the validation	0%	Electronic	Data is available under request. Factors were calculated according to the Approved monitoring methodology AM0015
3. $EF_{om,y}$	Emission factor	Calculated	tCO_2/MWh	(c)	At the validation	0%	Electronic	Data is available under request. Factors were calculated according to the Approved monitoring methodology AM0015
4. $EF_{BM,y}$	Emission factor	Calculated	tCO_2/MWh	(c)	At the validation	0%	Electronic	Data is available under request. Factors were calculated according to the Approved monitoring methodology AM0015
5. λ_y	Fraction of time during which low-cost/must-run sources are on the margin	Calculated	Non dimensional	(c)	At the validation	0%	Electronic	Data is available under request. Factors were calculated according to the Approved monitoring methodology AM0015

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

According to the selected approved methodology (AM-0015), the baseline emission factor is calculated as (EF_y) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly a connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

From AM-0015, a baseline emission factor (*EF*$_y$) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to the following three steps:

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

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

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

$$EF_{OM,simple-adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$ **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 (ACM0015, 2004) for plants *m*, based on the most recent information available on plants already built . The sample group m consists of either

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

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

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

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

Where the weights are by 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.

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

Not applicable.

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

Not applicable.

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/paper)	Comment

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

Not applicable.

D.2.3. Treatment of leakage in the monitoring plan

The main emissions giving rise due to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction, transportation of materials, fuel handling (extraction, processing and transport) and other upstream activities. Project participants do no need to consider these emissions these emission sources as leakage in applying this methodology. Nevertheless project's lifetime upstream emissions from the wells drilling and maintenance will be estimated to assure that they are effectively their negligible.

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

ID number *(Please use numbers to ease crossreferencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	Comment

No sources of emissions were identified, and therefore no data will be collected and archived. There are no entries in the table D.2.3.1 above.

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

Leakage is not applicable to the projects activity approved methodology

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

The project activity mainly reduces carbon dioxide through substitution of grid electricity generation with fossil fuel fired power plants by renewable electricity. The emission reduction by the project activity (ER_y) during a given year (y) is the difference between the baseline emissions (BE_y, in tCO_2), project emissions (PE_y, in tCO_2e) and due to leakage (L_y, in tCO_2e), as follows:

$$ER_y = BE_y - PE_y - L_y$$ **Equation 4**

Where the baseline emissions are the product of the the electricity supplied by the project to the grid (EG_y in *MWh*) times the baseline emission factor (EF_y in tCO_2e/MWh), as follows:

$$BE_y = EG_y \cdot EF_y$$ **Equation 5**

Project emissions are the sum of the fugitive carbon dioxide and methane emissions due to the release of non-condensable gases from the produced steam (PES_y, *in* tCO_2) and carbon dioxide emissions from fossil fuel combustion ($PEFF_y$, *in* tCO_2), as follows:

$$PE_y = PES_y + PEFF_y$$ **Equation 6**

The main emissions giving rise due to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction, fuel handling (extraction, processing and transport). Project participants do no need to consider these emissions these emission sources as leakage in applying this methodology. Therefore:

$$L_y = 0$$ **Equation 7**

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

Data *(Indicate table and ID number e.g. 3.1; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	Low	These data will be used for calculate the emission reductions. Two meters are used to measure the electricity delivered to the grid (main meter and backup meter). Equipments used to measure the electricity delivered to the grid are yearly audited by private companies accredited by the national dispatch center.
2	Low	Data acquired from ONS and ANEEL and does not need to be monitored.
3	Low	Data acquired from ONS and ANEEL and does not need to be monitored.
4	Low	Data acquired from ONS and ANEEL and does not need to be monitored.
5	Low	Data acquired from ONS and ANEEL and does not need to be monitored.

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

As the project is neither associated with leakage effects nor with new emissions of pollutants and all other pertinent data is necessary to be analyzed and presented only at the validation phase of the project, the only data that has to be monitored going forward during the life of the contract is the electricity supplied to the grid by the project (EG_y).

This data is monitored through a spreadsheet that has to collect by meters installed in the exit of the mill and entrance of the transmission lines and by the sales receipts issued by the electricity utility to the mill.

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

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SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources

Based on the renewable source of technology, the project emissions are nil. Therefore, no calculation of estimate of GHG emissions is necessary.

$$PE_y = 0$$ **Equation 8**

E.2. Estimated leakage

No leakage was identified. Therefore, no calculation of estimate of GHG emissions is necessary.

$$L_y = 0$$ **Equation 9**

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

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

$$PE_y + L_y = 0 \; tCO_2e$$ **Equation 10**

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

According to the selected approved methodology (AM-0015), the baseline emission factor is defined as (EF_y) and is calculated as a combined margin (*CM*), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly a connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

The CERPA project is located in the State of São Paulo and is integrated to the South-Southeast-Midwest (S-SE-CO) connected electricity system.

From AM0015, a baseline emission factor (EF_y) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to the following three steps:

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

Dispatch data analysis operating margin should be the first methodological choice. Since not enough data was supplied by the Brazilian national dispatch center, the choice is not currently available. The simple operating margin can only be used where low-cost/must-run resources[11] 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 CERPA project.

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

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

The fourth alternative, an average operating margin, is an oversimplification and does not reflect at all the impact of the project activity in the operating margin. Therefore, the simple adjusted operating margin will be used in the project.

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 11**

Where:

[11] Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation (AM0015, 2004).

- λ_y is the share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin.
- $F_{i,j,y}$ 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*,
- *j* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid. For imports from connected electricity system located in another country, the emission factor is 0 (zero).
- *k* refers to the low-operating cost and must-run power sources.
- $COEF_{i,j}$ 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,
- $GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j* (analogous for sources *k*),

The most recent numbers for the interconnected S-SE-CO system were obtained from the Brazilian national dispatch center, ONS (from the Portuguese *Operador Nacional do Sistema Elétrico)* in the form of daily consolidated reports (ONS-ADO, 2004). Data from 120 power plants, comprising 63.6 GW installed capacity and around 828 TWh electricity generation over the 3-year period were considered. With the numbers from ONS, Equation 12 is calculated, as described below:

$$EF_{OM-LCMR,y} = \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{j,k}} \qquad \textbf{Equation 12}$$

Where:

- $EF_{OM-LCMR,y}$ is emission factor for low-cost/must-run resources(in tCO_2/MWh) by relevant power sources *k* 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, $EF_{OM,y} = 0$.

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \qquad \textbf{Equation 13}$$

Where:

- $EF_{OM,y}$ is the simple operating margin emission factor (in tCO_2/MWh), or the emission factor for **non**-low-cost/must-run resources by relevant power sources *j* 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. The product $\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}$ for each one of the plants was obtained from:

$$F_{i,k,y} = \frac{GEN_{i,k,y} \cdot 3.6 \times 10^{-6}}{\eta_{i,k,y} \cdot NCV_i}$$ **Equation 14**

$$COEF_{i,k} = NCV_i \cdot EF_{CO2,i} \cdot 44/12 \cdot OXID_i$$ **Equation 15**

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 16**

Where variable and parameters used are:

- $\sum_{i,j} F_{i,j,y}$ is given in [kg], $COEF_{i,j}$ in [tCO_2e/kg] and $F_{i,k,y} \cdot COEF_{i,k}$ in [tCO_2e]
- $GEN_{i,k,y}$ is the electricity generation for plant *k*, with fuel *i*, in year *y*, obtained from the ONS database, in MWh
- $EF_{CO2,i}$ is the emission factor for fuel *i*, obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, in tC/TJ.
- $OXID_i$ is the oxidization factor for fuel *i*, obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, in %.
- 44/12 is the carbon conversion factor, from tC to tCO_2.
- 3.6×10^{-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 PCF (2003).
- NCV_i is the net calorific value of fuel *i* [TJ/kg].

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

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}}$ [tCO_2/MWh]	λ_y
2002	*0.8504*	*0.5053*
2003	*0.9378*	*0.5312*
2004	*0.8726*	*0.5041*

Table 6 – Simple operating margin emission factors and share of hours in year *y* for which low-cost/must-run sources are on the margin in the Brazilian S-SE-CO system for the period 2002-2004 (ONS-ADO, 2005).

With the numbers from ONS, the first step was to calculate the lambda and the emission factors for the simple operating margin. The λ_y factors are calculated as indicated in methodology AM0015, with data obtained from the ONS database. Figure 12, Figure 13 and Figure 14 present the load duration curves and λ_y determination for years 2002, 2003 and 2004, respectively. The results for years 2002, 2003 and 2004 are presented in Table 6.

Finally, applying the obtained numbers to calculate $EF_{OM,simple\text{-}adjusted,2002\text{-}2004}$ as the weighted average *of* $EF_{OM,simple\text{-}adjusted\ 2002}$, $EF_{OM\ simple\text{-}\ adjusted,2003}$ *and* $EF_{OM,simple\text{-}adjusted,2004}$ and λ_y to Equation 11:

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

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

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}} \qquad \textbf{Equation 17}$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (AM-0015) 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 17:

- $EF_{BM,2004}$ = 0.1256 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 18**

Finally, the electricity baseline emission factor is calculated through a weighted-average formula, considering both the OM and the BM, being the weights 50% and 50% by default:

$$EF_y = 0.5 \times 0.4310 + 0.5 \times 0.1256$$ **Equation 19**

- $EF_y = 0.2783\ tCO_2/MWh$

The baseline emissions would be then proportional to the electricity delivered to the grid throughout the project's lifetime. Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor ($EF_{CM,2001\text{-}2003}$) with the electricity generation of the project activity.

$$BE_{,y} = EF_y \times EG_y$$ **Equation 20**

Therefore, for the first crediting period, the baseline emissions (BE_y in tCO_2e) will be calculated as follows:

$$BE_y = 0.2783 \times EG_y$$ **Equation 21**

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

The emission reduction by the project activity (ER_y in tCO_2e) during a given year (y) is the difference between the baseline emissions (BE_y), project emissions (PE_y) and due to leakage (L_y), as follows:

$$ER_y = BE_y - PE_y - L_y = 0.2783 \ x\ EG_y - 0 - 0$$ **Equation 22**

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

The full implementation of the CERPA Project connected to the Brazilian South-Southeast-Midwest electricity interconnected grid will avoid an estimated yearly emission of around 18,090 tCO_2e, and a total reduction of about 118,546 tCO_2e over the first 7-year crediting period (up to and including 2009, see Table 7)

Years	Estimation of project activity emissions reductions (tonnes of CO_2e)	Estimation of baseline emissions reductions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
Year 1 - (2003)	0,0	12.722	0,0	12.722
Year 2 - (2004)	0,0	15.376	0,0	15.376
Year 3 - (2005)	0,0	18.090	0,0	18.090
Year 4 - (2006)	0,0	18.090	0,0	18.090
Year 5 - (2007)	0,0	18.090	0,0	18.090
Year 6 - (2008)	0,0	18.090	0,0	18.090
Year 7 - (2009)	0,0	18.090	0,0	18.090
Total (tonnes of CO_2e)	0,0	118.546	0,0	118.546

Table 7 – Yearly estimated emission reductions of the CERPA project

SECTION F. Environmental impacts

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

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

As the CERPA project is a power plant expansion based on energy efficiency, the fast-track procedure can be used (Preparation of a Preliminary Environmental Report - "Relatório Ambiental Preliminar," RAP). The process had been completed and a report containing an investigation of the following aspects has been produced:

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

In Brazil, the sponsor of a project which involves construction, installation, expansion or operation, even with no new significant environmental impact, must obtain new licenses (see State of São Paulo Environmental Secretary CONSEMA Resolution 42 of December 29th, 1994). The licenses required by the Brazilian environmental regulation are (Resolution CONAMA n. 237/97):

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

The construction license ("Licença de Instalação" or L.I.); and

The operating license ("Licenca de Operacao" or L.O.).

The *CERPA* has the authorization issued by ANEEL to operate as an independent power producer (*ANEEL Resolution 394 of September 23rd, 2002*). Moreover, the power plant has the following licenses emitted by CETESB (www.cetesb.sp.gov.br), the environmental agency of the state of Sao Paulo.

The power plant has fulfilled all the requests made by CETESB and already requested the "Operating License" in the beginning of 2004. CETESB has already provided a Precarious License, (from the Portuguese *"Licença Precária de Operação"*). This license is a provisory license, and the requisition of the "final" Operating Lincese is being analysed at CETESB.

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

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

After the assessment of the preliminary environmental report by the state environmental authority some minor requirements were made in order to issue the licenses. The project sponsors are fulfilling all the requirements. In conclusion the environmental impact of the project activity is not considered significant and no full environmental impact assessment was required.

SECTION G. Stakeholders' comments

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

Following the law established by CETESB, the environmental agency, CERPA Cogeneration Project has published a public call in a local newspaper informing the request of Construction License, LI.

The public call was published on December 27th of 2001 on D.O.E; Empresarial, São Paulo.

Public discussion with local stakeholders is compulsory for obtaining the environmental construction and operating licenses, and once the project already received the licenses, the project has consequently gone through a stakeholder comments process. The legislation also requests the announcement of the issuance of the licenses (LP, LI and LO) in the local state official journal (*Diário Oficial do Estado de São Paulo*) and in the regional newspaper to make the process public and allow public information and opinion.

Representatives of the municipality of Serrana, where the facility is located, participated on the public hearing process.

Besides the public discussion for the environmental licensing, the project invited local stakeholders for comments on the CDM Central Energética Rio Pardo Cogeneration Project. Several organizations and entities were invited for comments on the project:

- Serrana, City Hall
- Serrana City Council.
- CETESB – State of São Paulo Environmental Agency.
- Environmental and Agricultural Department of Lençóis Pta.
- ABEPOLAR – Association of ecology and water quality prevention.
- São Paulo State Public Attorney

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

G.2. Summary of the comments received

No comments were received.

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

No comments were received. The project was developed as planned and following the requests made by CETESB, the environmental agency.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Cerpa – Central Energética Rio Pardo Ltda.
Street/P.O.Box:	Usina da Pedra, Zona Rural
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State/Region:	São Paulo
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Telephone:	+ 55 (16) 39879048
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Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Ortega
First Name:	Sylvio
Department:	Financial
Direct FAX:	+ 55 (16) 39879048
Direct tel:	+ 55 (16) 39879018
Personal E-Mail:	ortega@uspedra.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the present project.

Annex 3

BASELINE INFORMATION

CERPA - Central Energética Rio Pardo Ltda.

Years	Total Installed Capacity (MW)	Self-Consumption (MW)	For Export (MW)	Electricity for the grid (MWh)
Year 0_2001	15,00	10,00	-	-
Year 0_2002	15,00	10,00	-	-
Year 1_2003	40,00	12,00	18,00	45.713,00
Year 2_2004	40,00	12,00	18,00	55.251,00
Year 3_2005	40,00	12,00	18,00	65.000,00
Year 4_2006	40,00	12,00	18,00	65.000,00
Year 5_2007	40,00	12,00	18,00	65.000,00
Year 6_2008	40,00	12,00	18,00	65.000,00
Year 7_2009	40,00	12,00	18,00	65.000,00

*** 5MW generator - Stand-by**

Table 8 – CERPA – Electricity generation evolution

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

Nevertheless, even after the interconnection had been established, technical papers still divided the Brazilian system in two (Bosi, 2000)[12]:

"… 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

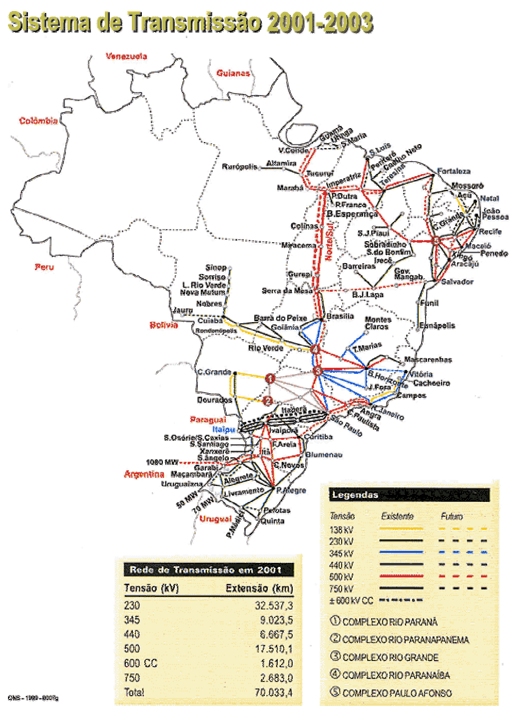
(iii) The Isolated Systems (which represent 300 locations that are electrically isolated from the interconnected systems)"

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

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

disaggregated below the country-level in order to provide a credible representation of 'what would have happened otherwise'".



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

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

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

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

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

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to ANEEL, in fact, ONS centralized dispatched plants accounted for 75,547 MW of installed capacity by 31/12/2004, out of the total 98,848.5 MW installed in Brazil by the same date (http://www.aneel.gov.br/arquivos/PDF/Resumo_Gráficos_mai_2005.pdf), which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23.6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International Energy Agency database built when carrying out the study from Bosi *et al.* (2002). Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only (Table 9).

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

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

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

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

Baseline (including imports)	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [GWh]	Imports [MWh]
2002	0,8504	275.402.896	258.720	1.607.395
2003	0,9378	288.493.929	274.649	459.586
2004	0,8726	297.879.874	284.748	1.468.275
	Total (2001-2003) =	861.776.699	818.118	3.535.256
	$EF_{OM, simple-adjusted}$ [tCO2/MWh]	$EF_{BM,2004}$	Lambda	
	0,4310	0,1256	λ_{2002}	
	Alternative weights	Default weights	0,5053	
	w_{OM} = 0,75	w_{OM} = 0,5	λ_{2003}	
	w_{BM} = 0,25	w_{BM} = 0,5	0,5312	
	EF_{CM} [tCO2/MWh]	Default EF_{OM} [tCO2/MWh]	λ_{2004}	
	0,3547	0,2783	0,5041	

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

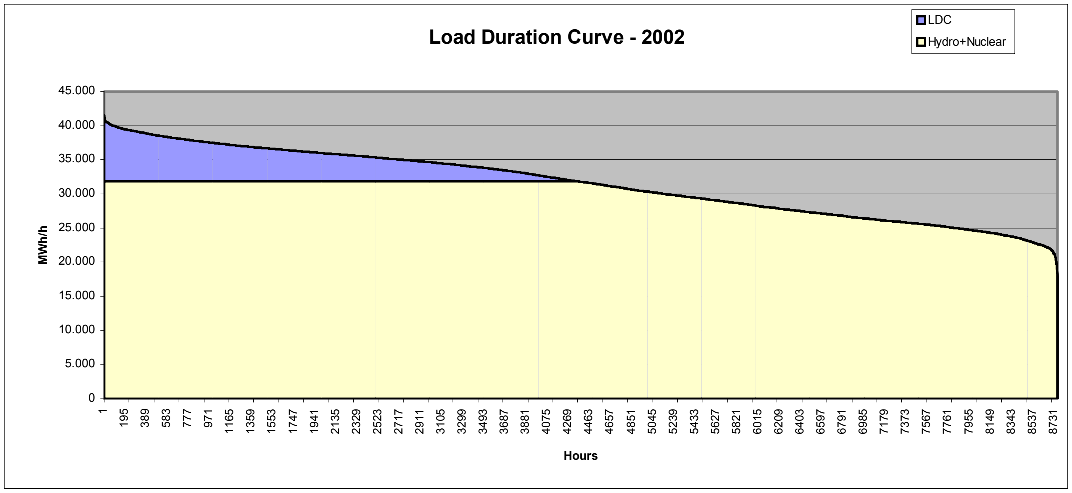


Figure 12: 2002 Load Duration Curve S/SE/MW (source: ONS – Operador Nacional do Sistema)

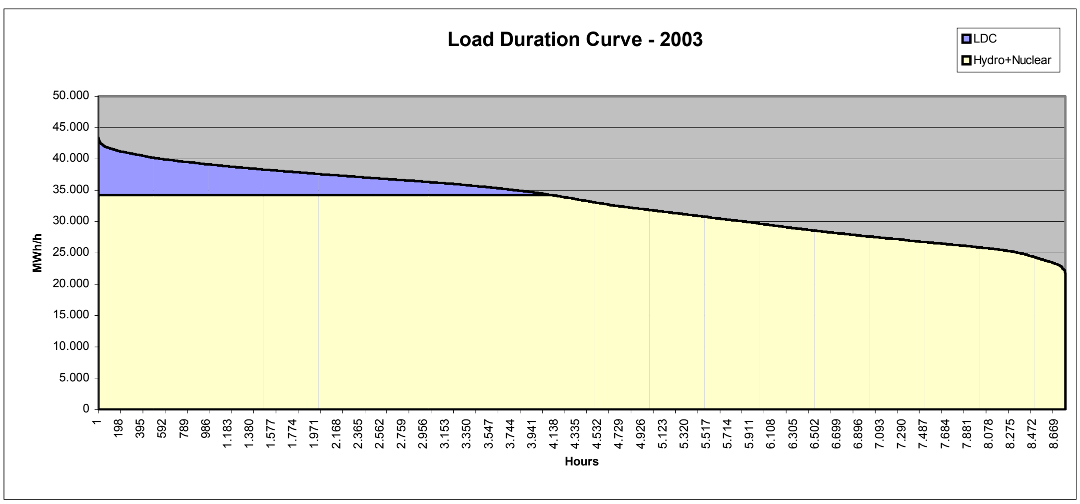


Figure 13: 2003 Load Duration Curve S/SE/MW (source: ONS – Operador Nacional do Sistema)

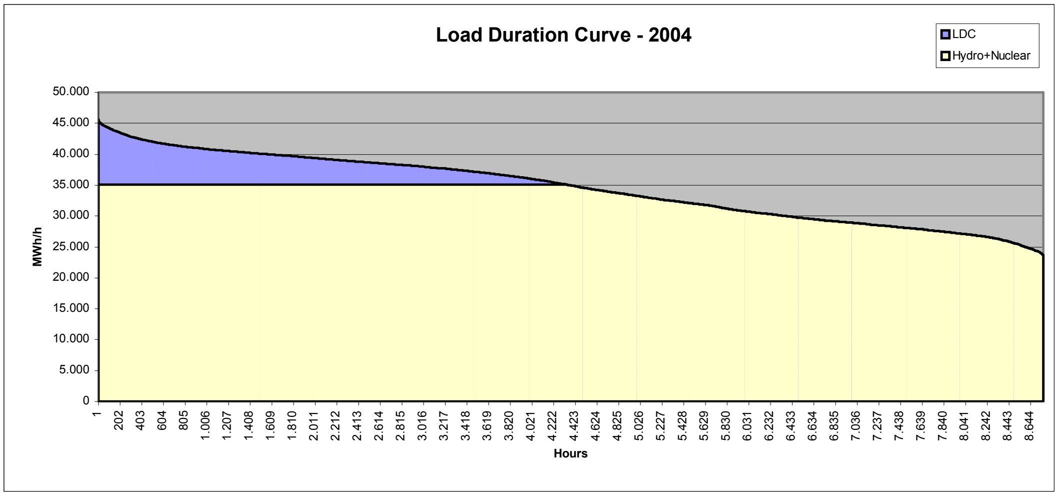


Figure 14: 2004 Load Duration Curve S/SE/MW (source: ONS – Operador Nacional do Sistema)

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

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

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

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

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

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Table 11 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 1

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

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

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

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

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

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Table 12– Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 2

Annex 4

MONITORING PLAN

As per the procedures set by the Approved monitoring methodology AM0015: "Monitoring methodology for emissions reductions from grid connected bagasse cogeneration projects"

CERPA 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.

Annex 5

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