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

Bioenergia Cogeradora S.A ("Bioenergia"), correspondig to the Santo Antonio Mill (USA – from the Portuguese "Usina Santo Antônio") and the São Francisco mill (USFR – from the Portuguese "Usina São Francisco")

A.2. Description of the project activity

The Santo Antonio Mill (USA – from the Portuguese "Usina Santo Antônio") and the São Francisco mill (USFR – from the Portuguese "Usina São Francisco") are sugarcane mills located in Sertãozinho, São Paulo, Brazil. The history of the owner of these two mills begins in 1946, with the foundation of the Balbo Group. The landmark of the group activities was the implementation of the Santo Antonio plant in the city of Sertãozinho in the State of São Paulo. In its first harvest in 1947, USA produced 1,383 tonnes of sugar (23,046 60-kilo sacks). In 1957, Balbo Group purchased another company in Sertaozinho: the São Francisco Sugar Mill. In the first harvest in 1957, 7,375 tonnes of sugar (122,913 60-kilo sacks) were produced in USFR. Continuing the growing process in 1962 and 1965, respectively, the Santana plants in Sertãozinho and Perdigão in Ribeirão Preto were purchased and incorporated into the Santo Antonio Plant. It should be mentioned that all the facilities of the Balbo Group are fully owed by the Balbo family.

Another interesting point is that Agropecuaria Tambori and around 300 other autonomous producers supply all the sugarcane utilized by the plants. The Santo Antonio and the Sao Francisco mills, in terms of energy, are self-sufficient for more than 14 years, in other words: they consume energy that is produced by sugarcane bagasse generated in their own units.

The plants of the Balbo Group have been maintaining a pioneer posture in several aspects. In 1999 the group implemented the Plan of Participation in Results (PPR). This plan consists of the establishment of goals to be achieved in terms of diligence and security. Those objectives were based upon historical coefficients, in order to guarantee their execution. Besides the pioneer posture adopted in the employee-employer relationship, the Balbo Group was also a pioneer in an industrial-scale production of organic-sugar in Brazil. The organic sugar of the Balbo Group – the 'Native' - was a result of a project that required investments of US$6 million.

As it was shown above, during its history the Balbo Group has invested in its growth and improvement. As a result, the Group managed to increase its production, processing 3.000.000 tonnes of sugarcane and producing 250,000 tonnes of sugar and 150,000 m³ of alcohol in the 2001/2002 season.

It should be mentioned that the "Bioenergia Cogeradora S.A" is a special purpose company (SPC) set up to use residues from sugarcane milling in the city of Sertãozinho to generate electricity in a power plant using a high pressure boiler (63 bar) coupled with a new 24 MW generator (Figure 1). For the expected electric energy output (around 78,000 from 2002 on, assuming 90% capacity factor) there is a Power Purchase Agreement (PPA) signed with the local power utility (CPFL, Companhia Paulista de Força e Luz).

A more efficient cogeneration of this renewable fuel allows Bioenergia 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.

This type of project typically does not incur large expenditures nor require significant employment demand. The project employed one hundred and twenty one workers during the construction of the bagasse thermo facility and it annually employs sixty-five workers to operate the plant. However, it contributes to the larger social welfare of the region; the entire project activity complex, including both sugar mills, currently and directly employees 2,500 workers, which represent more than 5% of Sertãozinho's population.

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.

A.3. Project participants

Credit Owner and Project Operator: Bioenergia Cogeradora S.A. authorized by Interministerial Commission on Global Climate Change (Brazilian Designated National Authority of the CDM). Brazil ratified the Kyoto Protocol on 23rd August 2002.

Please refer to Annex 1 for detailed contact information.

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

Sertãozinho

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

Sertãozinhio is a town of 103,000 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.

A.4.2. Category(ies) of project activity

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

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 São Francisco and Santo Antônio mills, 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.

São Francisco Mill operates with a configuration using two high-pressure boilers and a multiple stage backpressure turbine coupled with two 6MW generators. Santo Antônio Mill operates with a configuration using 3 high-pressure boilers and a multiple stage backpressure turbine coupled with a new 24MW generator. The two mills produce together a 19.3MW power surplus, operating at full capacity during the season (May to November). The local power utility (CPFL, "Companhia Paulista de Força e Luz") has signed a 10 year Power Purchase Agreement (PPA) with Bioenergia Cogeradora S.A.

The Bioenergia Project (Figure 5) uses the following equipments in each mill:

- USA: 3 high-pressure boilers (254 tonnes of steam per hour capacity) coupled with a 24 MW turbo-generator.
- USFR: 2 high-pressure boilers (154 tonnes of steam per hour capacity) coupled with two 6MW turbo-generators.
- Sub-station: 13.8 – 138kV
- Transmission Line: 138kV
- Chiller: 300 m³/h

Situation WITHOUT the Project	**Plant**	**USA**	**UFRA**	**Consolidated**
Boilers				
- Quantity	Un.	3	2	5
- Production Capacity	t/h	250	150	400
- Generators				
- Quantity	Un.	2	1	3
- Production Capacity	kWh/h	6,600	3,300	9,900
- (Own Consumption)	kWh/h	6,600	3,000	9,600
- Stand-by	kWh/h	0	300	0
- Surplus for Sale	kWh/h	0	300	300
Situation WITH the Project	**Plant**	**USA**	**UFRA**	**Consolidated**
- Boilers				
- Quantity	Un.	3	2	5
- Production Capacity	t/h	254	154	408
- Generators				
- Quantity	Un.	1	2	3
- Production Capacity	kWh/h	24,000	6,140	30,140
- (Own Consumption)	kWh/h	7,200	3,640	10,840
- Stand-by	kWh/h	0	0	0
- Surplus for Sale	kWh/h	16,800	2,500	19,300

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

Bioenergia 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.

With a baseline of 452 kgCO_2-eq./MWh, the implementation of the Bioenergia Cogeneration project connected to the Brazilian interconnected power grid will generate an estimated annual reduction of 35,590 tCO_2 equivalent (23,504 tCO_2 equivalent on the first year), and a total reduction of 336,408 tCO_2 equivalent over 10 years. See Table 1.

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".

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 Bioenergia project activity.

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

The Bioenergia project is installed inside the Santo Antônio and the São Francisco sugarcane mills. The sugar mills 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 the sugarcane mills.

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 Santo Antônio and the São Francisco sugar mills 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 Bioenergia Project could only be set up by the private sector.

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

The Santo Antônio and the São Francisco sugar mills produce 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 2 for verifying the volume of sugarcane and bagasse generated at the Santo Antônio and the São Francisco sugar mills in the recent years. As can be seen the fluctuation of sugarcane production and fibre is minimal.

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

The *Bioenergia Cogeneration Project* is a cogeneration project connected to the electricity grid. The project fulfils all the "additionality" requisites (see application of the "additionality tool[1]" 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 AM-0015, 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).

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 *Bioenergia Cogeneration* project activity.

Following are the steps necessary for the demonstrations and assessment of *Bioenergia Cogeneration* project additionality:

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

a) Project Start date: June 2002

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

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[2] (sugar industry) and SIFAESP[3] (ethanol industry).

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[1] 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/

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

[3] 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.

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.

São Francisco and Santo Antônio mills, 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 Bioenergia Cogeneration project.

Both mills are also members 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 about Global Warming and how ethanol might contribute to its mitigation. Balbo 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[4] is founder member of the IETA[5] – 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.

[4] UNICA – www.unica.com.br

[5] IETA – www.ieta.org

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 the Santo Antonio and the Sao Francisco mills are taking a hands-on approach in 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 for the investors is the continuation of the current (previous) situation, with the investment of surplus capital in the financial market. The main project sponsor had no previous experience with the power market.

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

2. 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.

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 7). Despite high expectations, investments in new generation did not follow the increase in consumption.

The decoupling of GDP (average of 2% increase in the period of 1980 to 2000) from electricity consumption increase (average of 5% increase in the same period) is well known in developing countries, mainly due to the expansion of the supply services to new areas and the growing infra-structure. The necessary measures to prevent bottlenecks in services were taken. These include an increase of generation capacity higher than the GDP growth rate and strong investments in energy efficiency. In the Brazilian case, the increase in the installed generation capacity (average of 4% in the same period) did not follow the growth of consumption as can be seen in Figure 8.

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 objectives of the program were commendable the results were limited, mainly due to insufficient investment and poorly managed strategies.

The remaining alternative, to increase the capacity factor of the old plants, was actually the most widely used, as can be seen in Figure 9. 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 10 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.

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). With discoveries of vast reserves of natural gas in the Santos Basin in 2003 (Figure 11) the policy of using natural gas to generate electricity remains a possibility and it still will continue to have interest from private-sector investments in the Brazilian energy sector.

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

- Electricity demand and supply will be coordinated through a "Pool" Demand will be estimated by the distribution companies, which will have to contract 100 per cent of their projected electricity demand over the following 3 to 5 years. These projections will be submitted to a new institution (*Empresa de Planejamento Energético*, EPE), which will estimate the required expansion in supply capacity to be sold to the distribution companies through the Pool. The price at which electricity will be traded through the Pool is an average of all long-term contracted prices and will be the same for all distribution companies.
- In parallel to the "regulated" long-term Pool contracts, there will be a "free" market. Although in the future, large consumers (above 10 MW) will be required to give distribution companies a 3-year notice if they wish to switch from the Pool to the free market and a 5-year notice for those moving in the opposite direction a transition period is envisaged during which these conditions will be made more flexible. These measures should 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 the new model reduces market risk, its ability to encourage private investment in the electricity sector will depend on how the new regulatory framework is implemented. Several challenges are noteworthy in this regard. *First,* the risk of regulatory failure that might arise due to the fact that the government will have a considerable role to play in long-term planning should be avoided by enhancing the Ministry of Mines and Energy's technical capabilities, while insulating the new institutions from political interference. *Second,* rules will need to be designed for the transition from the current to the new model to allow current investments to be rewarded adequately. *Third,* because of its small size, price volatility may increase in the short-term electricity market, in turn bringing about higher investment risk, albeit this risk will be attenuated by the role of large consumers. The high share of hydropower in Brazil's energy mix and uncertainty over rainfall also contribute to higher volatility of the short-term electricity market. *Fourth,* although the new model will require total separation between generation and distribution, regulations for the unbundling of vertically integrated companies still have to be defined. Distribution companies are currently allowed to buy up to 30 per cent of their electricity from their own subsidiaries (self-dealing). *Finally,* the government's policy for the natural gas sector needs to be defined within a specific sectoral framework.

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

Investment Barrier

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

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

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

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

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

The most liquid government bond is the LFT (floating rate bonds based on the daily Central Bank reference rate). As of January 2004, 51.1% of the domestic federal debt was in LFTs and had duration of one day. This bond rate is almost the same as the CDI - Interbank Deposit Certificate rate that is influenced by the SELIC rate, defined by COPOM[6].

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 12.

The Bioenergia project was developed on a project finance basis. To finance construction, project sponsor (Balbo Group) took advantage of the financing lines of BNDES. This financial support covered 57% 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.

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

As can be seen in the worksheet FCF_Bioenergia(CER)[7], 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 200 basis point from 18,4% to 20,5%. Such increase in return would compensate for the additional risk investor would take with this project.

In addition to the increase of 200 basis points, CER revenues would bring the project additional benefits due to the fact that they are generated in hard currencies (USD or EUR). The CDM incentive allows Grupo Balbo 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.

The conclusion is that CDM incentives play a very important role in overcoming financial barriers (Table 3).

Institutional Barrier

As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created to try to organize and to provide incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period electricity prices surpassed BR$ 600/MWh (around USD 200/MWh) and the forecasted marginal price of the new energy reached levels of BR$ 120 – 150/MWh (around USD 45). In the middle of 2004 the average price was bellow BR$ 50/MWh (less than USD 20/MWh). The high volatility of the electricity price in Brazil indicates an inconsistency in government policies and there is no guarantee that the project will operate in a secure regulatory energy market.

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.

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[7] The worksheet is available for consultant

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 project sponsor could invest their resources in different financial market investments. Therefore the barriers above have not affected the investment in other opportunities. To the contrary Brazilian interest rates, which represent a barrier for the project activity, is a viable investment alternative.

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.

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 excessive 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. 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[8] 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 Bioenergia and the majority of these project developers have taken into consideration CDM in their decision to expand their cogeneration plant.

The intention of Balbo Group 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 Bioenergia Cogeneration Project. 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

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

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 20 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.

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

In the Bioenergia Coneration Project, an existing power plant was retrofitted with new modified parts of certain equipment (boiler, steam turbine, transmission lines, etc.) in order to optimize the energy use inside a sugarcane mill, and allow the export of electricity to the grid.

Today the sugar and alcohol production plant is self-sufficient in energy use and generation. All the bagasse delivered from the milling of the sugarcane is burned for production of steam and subsequent production of electricity as can be seen in see in Figure 13.

Within the project boundary the only new sources of emission will be related to construction and installation of the new equipment and transmission lines. No expansion of the milling capacity is planned and therefore no new biomass will be burned and no new continuous source of greenhouse gases will be created.

Energy Grid Boundary

The South/Southeast and Midwest section of the interconnected subsystem of the Brazilian grid is where the project activity is located and is considered boundary. In this part of the country the majority of the electricity is generated and also accounts for 70% of GDP. This subsystem receives electricity exported from Bioenergia cogeneration plant which uses bagasse as fuel (Figure 14).

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

The date of completing the final draft of this baseline section was 19/04/2005.

Name of person/entity determining the baseline:

Company:	Ecoinvest Assessoria Ltda. (Project Advisor)
Name	Mr. Ricardo Esparta

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

May 2002

C.1.2. Expected operational lifetime of the project activity

20y-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

June 2002

C.2.1.2. Length of the first crediting period

07y-0m

C.2.2. Fixed crediting period

Not applicable

C.2.2.1. Starting date

C.2.2.2. Length

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 numbers to*	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? (Electronic/	Comment

ease cross-referencing to				estimated (e)		monitored	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)	Monthly	100%	Electronic and paper	Data is being archived and administered by Bioenergia

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:

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

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

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

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

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								
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

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

Indirect emissions can result from project construction, transportation of materials, fuel and other upstream activities. The project does not claim emission reductions from these activities. No significant net leakage from these activities was identified.

Thus, 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 projects are based on a renewable energy source, which do not give rise to direct GHG emissions. Therefore, no formulae for calculation of the direct emissions are provided here.

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	Data is being monitored by the Bioenergia and the utility company.
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.
10	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

Company:	Ecoinvest
Address:	Rua Padre João Manoel, 222
Zip code + city address:	01411-000 São Paulo, SP
Country:	Brazil
Contact person:	Ricardo Esparta
Job title:	Director
Telephone number:	+55 (11) 3063-9068
Fax number:	+55 (11) 3063-9069
E-mail:	esparta@ecoinv.com

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 (PE_y) are zero. Therefore, no calculation of estimate of GHG emissions is necessary.

E.2. Estimated leakage

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

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

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

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

According to the selected approved methodology (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.

Brazil's electric power system is geographically divided in 5 macro-regions: South (S), Southeast (SE), Midwest (CO, from the Portuguese *Centro-Oeste*), North (N) and Northeast (NE). Regarding the electricity system, three different electric systems supply the five macro-regions of the country. The largest interconnected power transmission system, which includes the Southeast, South, and Mid-West regions, accounts for more than 70% of the Brazilian total installed capacity. It includes the hydroelectric power plant of Itaipu, and the only two nuclear power plants currently in operation in Brazil: Angra I (657 MW), and Angra II (1309 MW). The second interconnected grid system connects the north and northeast regions, accounting for almost 25% of the Brazilian total installed capacity. Finally, the third system includes small, independent grids that are isolated in terms of electric power, largely in the northern region. These isolated systems accounted for less than 5% and are based mainly on thermal power plants (SIESE, 2002).

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

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.

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[9] constitute less than 50% of total grid generation in: 1) average of 5 most recent years, or 2) based on long-term normalcy for hydroelectricity production. Table 4 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 Bioenergia project.

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

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

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

Where:

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

[9] Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation (AM-0015).

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

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

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

Where:

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

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

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

Where:

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

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

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

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

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

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

Where variable and parameters used are:

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

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

The λ_y factors are calculated as indicated in methodology AM-0015, with date obtained from the ONS database. Figures 14, 15 and 16 present the load duration curves and λ_y calculations for years 2001, 2002 and 2003, respectively.

The results for years 2001, 2002 and 2003 are presented in Table 5.

With the numbers from ONS, the first step was to calculate the lambda factors and the emission factors for the simple operating margin. The obtained values can be seen in Table 5, Figure 15, Figure 16, Figure 17 and Figure 18.

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

- *$EF_{OM,simple\text{-}adjusted,2001\text{-}2003}$ = 0.452 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:

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

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (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 2:

- $EF_{BM,2003}$ = *0.096 tCO_{2e}/MWh.*

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

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

Where the weights 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.

The document which originated the proposition of the adjusted operating margin emission factor for the calculation of baselines in the power sector (Kartha et al., 2002) states: “The choice of baseline for electricity projects often revolves around the choice between *operating margin* versus *build margin*, and the question of which best represents the source(s) of avoided generation. Some baseline scenarios or methodologies reflect the belief that a given project will have no effect on other power sector investments, either because it is too small or because it brings additional investment to a sector that is short on capital for new power plant investments. These scenarios are *operating margin* scenarios, in that they assume the principal effect of a new project would be on the operation of current or future power plants”.

The Bioenergia project account for 23 MW, representing an increase of around 0.05 % in the S-SE-CO electric system installed power, and that is an initial indication that alternative weights must be considered. Renewable energy projects, such as Bioenergia, will have little or no effect on which plants are built or retired, and thus avoid generation mainly, if not only, from existing plants. Such an argument suggests that for smaller projects the *operating* margin provides a more relevant baseline than the *build* margin. Indeed, in Brazil, capital availability and other intangible factors (e.g. public policy instability) are the principal drivers.

Alternative weights proposed here are based not only on the argumentation above but also and mainly on the evidence that a sector crisis occurred in 2001 and 2002, an extreme event to be considered. During that time a restriction was imposed on consumers: a compulsory reduction of 20% in relation to the average electricity consumption in the period of May to July 2000. Considering that between January and May 2001, the period immediately preceding the shortage, the average demand was around 6%

higher than that of the same period of the previous year, the actual rationing was much greater than the 20% announced. In other words, during the second half of 2001 and the beginning of 2002 there was a cut of about 24.5% compared to a "business-as-usual" scenario. The rationing plan lasted for ten months, from June 1, 2001 through February 28, 2002, causing a GDP growth reduction of 1.0 to 1.5% (Pinto Júnior, 2003).

It is interesting to compare the numbers that arose from the ex-post monitoring based on the national dispatch center data (ONS, 2004) obtained above and the ones from an ex-ante study by the International Energy Agency (Bosi et al., 2002), prepared without taking fully into account the impact of the rationing period of 2001-2002. The assumptions announced in the study where made specifically for private initiative and government investment plans in the power sector and a rationally operated system. The study represented at that time a very likely business as usual scenario, and it helped interested investors seriously considering the incentive from the CDM to evaluate the impact of the mechanism in their decision to proceed with their project activities, including among them the Bioenergia investors (Table 6).

Also as an evidence of the impact it can be noted that in the analyzed period, 19 centrally dispatched plants started operation, totalizing 3,673.8 MW of installed power using natural gas and 2,436.5 MW of installed hydropower plants (Table 7).

In Table 7 it can be seen that the natural gas fired power plants operated at a capacity factor weighted average of around 21.3%, clearly a distortion when compared to business-as-usual investments in these kind of power plants, while the hydropower plants operated at 37.4% weighted average capacity factor. For specific plants the reasoning should be expanded, for example, the Araucária natural gas power plant almost did not operate in 2003 due to judicial dispute. Nevertheless the origin of the dispute can be traced to the extreme reduction in demand caused by the 2001-2002 crisis.

From the above mentioned evidence it is clear that the Bioenergia project has practically no influence in the build margin and, therefore, the proposed weights to be applied in Equation 3 are, w_{OM} = 1 and w_{BM} = 0. With these numbers:

- EF_{2003} = *0.452* tCO_{2e}/MWh.

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

BIOENERGIA

	Exported energy (MWh)	tCO_2 abated	Total tCO_2 abated (acummulated)	
Total 2002	51.999	23.504	23.504	1st
Total 2003	67.893	30.688	54.191	2nd
Total 2004	73.193	33.083	87.274	3rd
Total 2005	78.740	35.590	122.865	4th
Total 2006	78.740	35.590	158.455	5th
Total 2007	78.740	35.590	194.046	6th
Total 2008	**78.740**	**35.590**	**229.636**	**7th**
Total 2009	78.740	35.590	265.227	8th
Total 2010	78.740	35.590	300.817	9th
Total 2011	**78.740**	**35.590**	**336.408**	**10th**
Total 2012	78.740	35.590	371.998	11th
Total 2013	78.740	35.590	407.589	12th
Total 2014	78.740	35.590	443.179	13th
Total 2015	**78.740**	**35.590**	**478.770**	**14th**
Total 2016	78.740	35.590	514.360	15th
Total 2017	78.740	35.590	549.951	16th
Total 2018	78.740	35.590	585.541	17th
Total 2019	78.740	35.590	621.132	18th
Total 2020	78.740	35.590	656.722	19th
Total 2021	78.740	35.590	692.313	20th
Total 2022	**78.740**	**35.590**	**727.903**	**21st**

Table 1 – Bioenergia Cogeneration Estimated Emission Reductions

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.

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 is based on Resolution CONAMA n. 237/97, which is a federal legislation but also applies to the state level. The basic licences are:

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

As the Bioenergia Cogeneration project is a power plant expansion based on energy efficiency, the fast-track procedure to obtain the licenses can be used (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

The project also conforms with the subsidiary environmental legislation, such as Resolution CONAMA n.1, which applies to the noise levels, Resolution CONAMA n.3, which applies to the air quality and Resolution CONAMA n.20, which applies to the waste water and water quality. The Bioenergia Project has the authorization issued by ANEEL to operate as an independent power producer (ANEEL Resolution no. 403 of October 1st, 2001).

It also follows the municipal, state and federal environmental legislation.

Considering the municipality legislation (Sertãozinho), the project conforms with all the respective legislation. Also, it conforms to the land occupation legislation, subject to the Law no. 3,426 of November 10th, 1999.

As for the state legislation (São Paulo), the project is equally approved, including the ones corresponding to the soil, air and water treatment and emissions. The power plant has the Construction License – nº 00229 (Figure 19) emitted by CETESB (www.cetesb.sp.gov.br), the environmental agency of the state of Sao Paulo.

Contributing to emission reductions is an important goal for Grupo Balbo, as it is committed to the environment and to the social and environmental sustainability. This policy is confirmed by Grupo Balbo's fulfilment of several public requirements such as:

- Certification "Embalagem Papel Cartão – Aprovado Pela Natureza" (Cardboard Packaging Paper - Approved By Nature). Aims to identify and certify products packaged in cardboard paper, by companies with environmental responsibility.

BRACELPA - Associação Brasileira de Celulose e Papel.

Campanha Papel Cartão

- Companies that forbid the nocturne, dangerous or unhealthy work for younger than 18 years old people, and any work for younger than 16 years old, except for apprentices after 14 years old. The company develops programs to assist children and teenagers.

Fundação ABRINQ pelos direitos da criança

- The industrial pollution system is audited on a semi-annual basis, objecting certify the plant quality system to conform to the international quality standards proposed by ISO-9001.

BVQI (Bureau Veritas Quality International)

INMETRO (Instituto Nacional de Metrologia)

- The industrial process conforms to the Jewish norms (Kosher).

KOSHER PARVE

Rabbi M. A. Iliovits – Brazilian Kashrus Authority

- The agroindustrial system is audited on a yearly basis, objecting certify the process from planting to packaging that it is free from synthetic chemical products. It also assesses the environmental and social impacts of the activity over the local community (IFOAM).

IBD – Instituto BioDinâmico – Brasil

IFOAM - International Federation of Organic Agriculture Movements

- The agroindustrial system is audited on a yearly basis, objecting certify the process from planting to packaging that it is free from synthetic chemical products. It also assesses the environmental and social impacts of the activity over the local community (Government of Japan).

ICS Japan, Inc. (International Certification Services) – Japão

JAS (Japan Agriculture Standards)

- The agroindustrial system is audited on a yearly basis, objecting certify the process from planting to packaging that it is free from synthetic chemical products. It also assesses the environmental and social impacts of the activity over the local community (European Economic Community).

ECOCERT International França/Alemanha

EEC (European Economic Community)

- The agroindustrial system is audited on a yearly basis, objecting certify the process from planting to packaging that it is free from synthetic chemical products. It also assesses the environmental and social impacts of the activity over the local community (IFOAM - USA).

FVO (Farm Verified Organic) Dakota do Norte – EUA

IFOAM (International Federation of Organic Agriculture Movements)

As a cogeneration process, the project has advantages when compared to conventional thermal processes. Besides of being a renewable energy source, with existing units, plantation and procedures, another positive impact can be addressed to the water collection and utilization. The water consumption is lower, although still necessary for cooling the system. The waste water temperature would be increased on about 7^{o}C, which is lower than the legislation maximum limit, but Bioenergia decided to make an evaporative cooling system which will not only reduce the temperature, but also allow it to use this same water back on the process, dramatically reducing (99%) the volume of water collection needed on the whole system.

One of the biggest impacts of the thermal plants is the particulate emission. One mitigation action to be performed by the project is the control and regulate the boiler, in order to maximize the bagasse burning and to install pollution control equipment, minimizing the emission of such material. After the careful process to remove the particulates from the emission gases (based on the existing legislation and on the higher industrial quality of the group), the remaining emission will not affect the local population. Also, the new boilers are 10% more efficient than the existing units, which will be replaced, resulting on a more efficient burning process and reducing the emission, even not considering the particulate removal procedures.

The project will take actions to reduce the soil contamination risk due to a not proper disposal of solid residues.

As for the noise impact, although the project is located on the rural area, it will follow the existing legislation to limit and control the noise effect to 95 dBA at a 2 meters distance.

Grupo Balbo also supports a reforestation program with native species, not only on deforested areas but also in the form of seedlings to distribute to the local community (90,000 seedlings per year).

One of the most important applications of the process know-how of the group is the mechanical harvesting of the "raw sugarcane" (which means the harvesting process without burning the field before) initiated in 1987. This work resulted on the construction of a specific truck to harvest "raw sugarcane", in cooperation with the manufacturer, together with the specification of the whole crop process to support such innovation. The harvesting of "raw sugarcane" has a much better environmental impact, avoiding air pollution, degradation of the soil and a better final energetic yield.

This new production system, eliminating the burning, mechanical harvesting, the biological control of pests, otimization of the industrial process organic residues use as a source of nutrient and also the utilization of the organic fertilizer, made the company eligible to get the large scale sugarcane organic producer certification. It is the major organic agriculture project in the world.

As a result of this innovative work, São Francisco was the first mill in Brazil to get a international certification, provided by the Farm Verified Organic (FVO/IFOAM), USA, by EcoCert International, France and Germany, and by ICS Japan.

Besides the action on the environmental side, Grupo Balbo is also active on the actions to promote of the welfare. In 1980, Grupo Balbo formed a multdisciplinar team to assess the life conditions and health of its emplyees and families, on a program called "Médico-Social" (Social-Doctor). Both USA and UFRA have today 2,800 employees, and 9,800 people, including their family. Approximately 11,250 people live on houses freely lended by the company, with access to education, leisure and healthcare. In 1987, as a recognition of the program offered by the company, Grupo Balbo was awarded with the "Prêmio Eco" (Eco Prize) of Entrepreneurship Contribution to the Community, offered by the Brazilian branch of the American Chamber of Commerce.

The environmental and social sustainability of Bioenergia is consistent to other activities and programs sponsored by Grupo Balbo, which works on the environmental protection since 1981, such as:

- production of "green sugarcane";
- production of organic sugar;
- production of organic orange juice and coffee;
- production of biodegradable plastic;
- bio control of pests (reduction of synthetic chemical pesticides).

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

The Brazilian Designated National Authority, "Comissão Interministerial de Mudanças Globais de Clima", requests comments by local stakeholders and the validation report issued by an authorized DOE according to the 11th September 2003 resolution # 1 in order to provide the letter of approval.

The proponent of the project will send these letters to the stakeholders in order to invite their comments while the PDD of the project is open for comments in the validation stage in the United Nations Framework Convention on Climate Change "unfccc.int" website since anyone can have access to the mentioned document from a legitimate source.

Also, this project was supported by UNDP[10], UNCTAD[11] and UNIDO[12], on the Project GLO/99/H06, "Private Sector Engagement on the CDM Activities", and because of that there were a ample policy to disclose the information of the project: 1) seminars (city of Campinas, State of São Paulo, on March 19-21, 2003) to inform about the project and the activities to be done; 2) disclosure of information and the documentation of the project to request comments and suggestions from all possible interested parties. Besides that, the UNDP, UNCTAD and UNIDO sites, as well as the ones from Bioenergia and the Climate Change Network (CCN), hosted all the information and documents of the project, given access to such information to interested parties.

Following the law established by CETESB (the environmental agency), Bioenergia has published a public call in a local newspaper informing the issuing of the Construction License, LI (Figure 20).

G.2. Summary of the comments received

Brazilian DNA requests that projects be open for comments prior to validation. Thus, in addition to UNFCCC global stakeholders comments this project will be open for inputs from locals at the same time. Any comments will be disclosed after validation.

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[10] United Nations Development Programme

[11] United Nations Conference on Trade and Development

[12] United Nations Industrial Development Organization

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

Brazilian DNA requests that projects be open for comments prior to validation. Thus, in addition to UNFCCC global stakeholders comments this project will be open for inputs from locals at the same time. Any comments will be disclosed after validation.

SECTION H. Annexes

Annex 1. Contact information on participants in the project activity

Project Sponsor (CER Seller): Grupo Balbo

Organization:	Bioenergia Cogeradora S.A
Street/P.O.Box:	Fazenda Santo Antonio, s/n, 536
City:	Sertãozinho
State/Region:	São Paulo
Postfix/ZIP:	14.174-000
Country:	BRAZIL
Telephone:	+55 (16) 3946-4003
FAX:	+55 (16) 3946-4053
URL:	www.nativealimentos.com.br
Title:	Director
Salutation:	Mr.
Last Name:	Balbo
First Name:	Clésio
Department:	Financial
Personal E-Mail:	clesio@canaverde.com.br

Organization:	Grupo Balbo
Street/P.O.Box:	Fazenda Santo Antonio, s/n, 536
City:	Sertãozinho
State/Region:	São Paulo
Postfix/ZIP:	14.174-000
Country:	BRAZIL
Telephone:	+55 (16) 3946-4003
FAX:	+55 (16) 3946-4053
URL:	www.nativealimentos.com.br
Title:	Director
Salutation:	Mr.
Last Name:	Balbo
First Name:	Clésio
Department:	Financial
Personal E-Mail:	clesio@canaverde.com.br

Annex 2. Information regarding public funding

Not applicable

Annex 3. Baseline Information

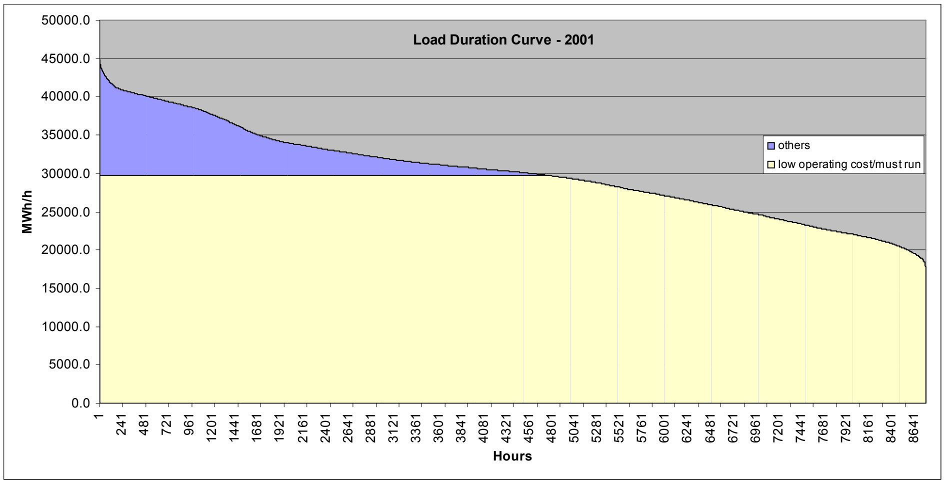

Figure 15 - Load duration curve for the S-SE-CO system, 2001

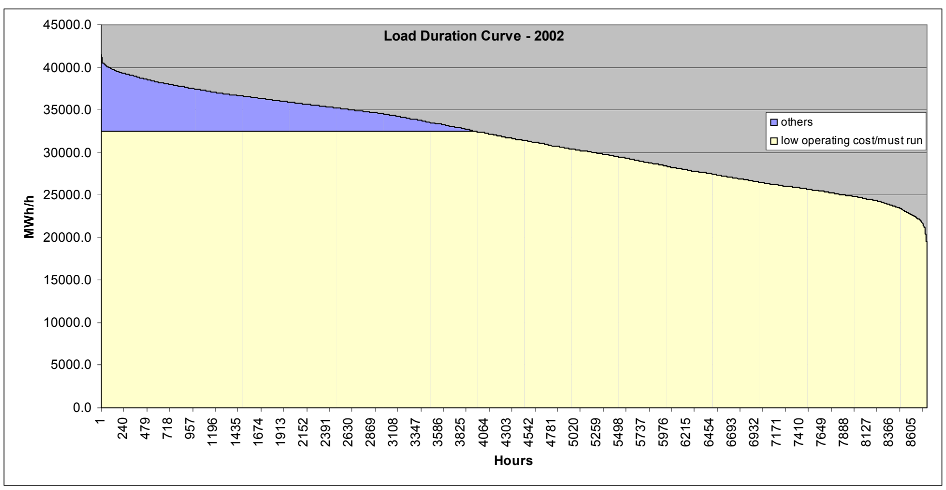

Figure 16 - Load duration curve for the S-SE-CO system, 2002

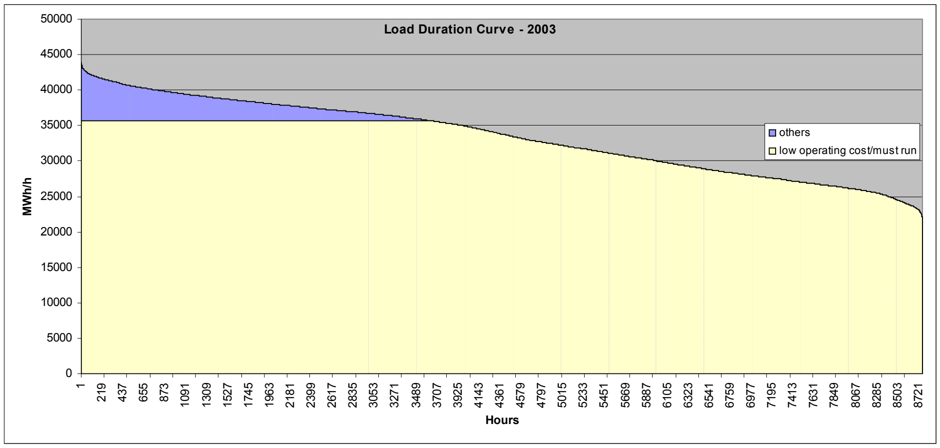

Figure 17 - Load duration curve for the S-SE-CO system, 2003

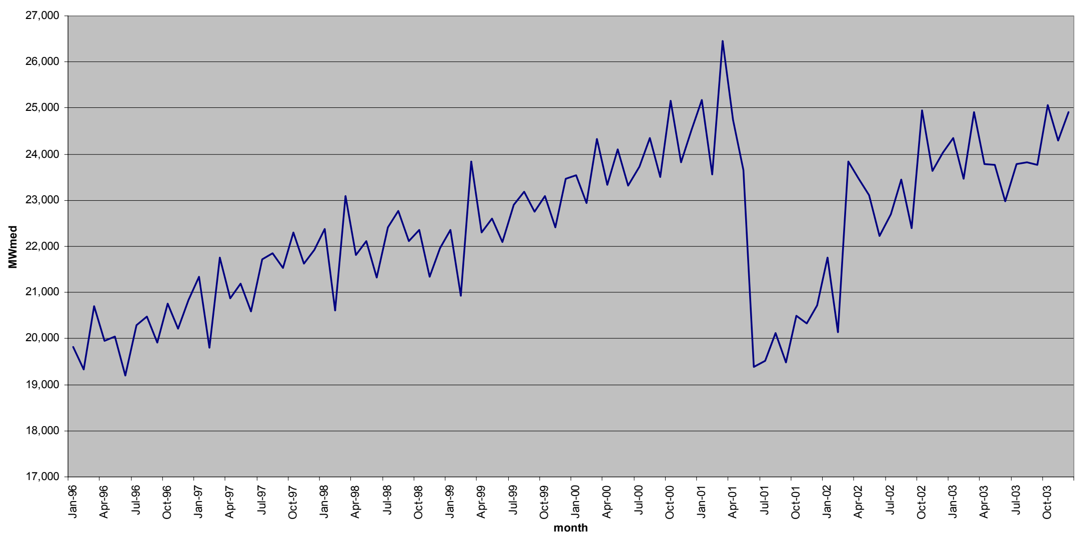

Figure 18 – Monthly load average in the Brazilian S-SE-CO interconnected electricity system from 1996 to 2003 (ONS, 2004)

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

Table 2 - Share of hydroelectricity production in the Brazilian S-SE-CO interconnected system from 1999 to 2003 (ONS, 2004).

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}}$ [tCO_2/MWh]	λ_y [%]
2001	0.948	0.457
2002	0.931	0.550
2003	0.969	0.582

Table 3 - Share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin in the S-SE-CO system for the period 2001-2003 (ONS-ADO, 2004).

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

	Plant	Energy Source	Installed Power (MW)	Capacity Factor (%, forecasted)	Capacity Factor (%, measured)
1	Três Lagoas	Natural gas	306.00	75.0	25.5
2	Ibirité	Natural gas	226.00	75.0	26.8
3	Jauru	Hydro	121.5	56.0	25.0
4	Guaporé	Hydro	120.00	56.0	27.7
5	Funil (MG)	Hydro	180.0	56.0	23.7
6	Itiquira I	Hydro	156.1	56.0	29.9
7	Araucária	Natural gas	484.5	75.0	0.01
8	Canoas	Natural gas	160.6	75.0	13.0
9	Piraju	Hydro	81.0	56.0	58.9
10	Nova Piratininga	Natural gas	384.9	75.0	1.42
11	Cana Brava	Hydro	465.9	56.0	53.9
12	Santa Clara	Hydro	60.0	56.0	32.2
13	Machadinho	Hydro	1,140.0	56.0	34.4
14	Juiz de Fora	Natural gas	87.0	75.0	0.77
15	Macaé Mechant	Natural gas	922.6	75.0	29.6
16	Eletrobolt	Natural gas	379.0	75.0	7.30
17	Porto Estrela	Hydro	112.0	56.0	41.8
18	W. Arjona	Natural gas	194.0	75.0	32.4
19	Cuiabá	Natural gas	529.2	75.0	48.0
Total			**6,110.3**	**-**	**-**

Table 5 – Capacity factor for centrally dispatched power plants in the Brazilian S-SE-CO interconnected grid with operation start in the period 2001-2003 (Sources: forecasted, Bosi *et al.*, 2002; realized, ONS, 2004).

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”

The project sponsor will proceed with the necessary measures for the power control and monitoring. Together with the information produced by both ANEEL and ONS, it will be possible to monitor the power generation of the project and the grid power mix.

Annex 5 - Figures

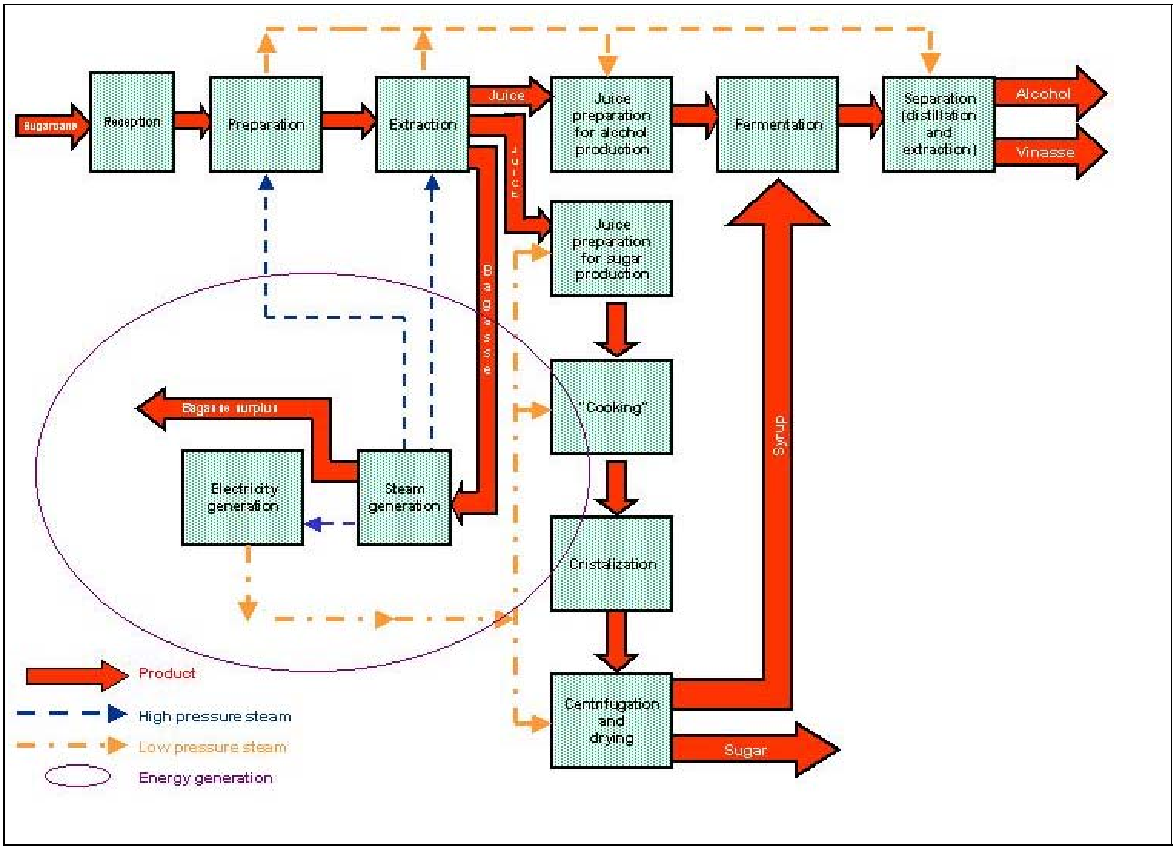

Figure 1 - Flowchart of the electricity generation inside a Sugar and Alcohol Production (Source: Codistil)

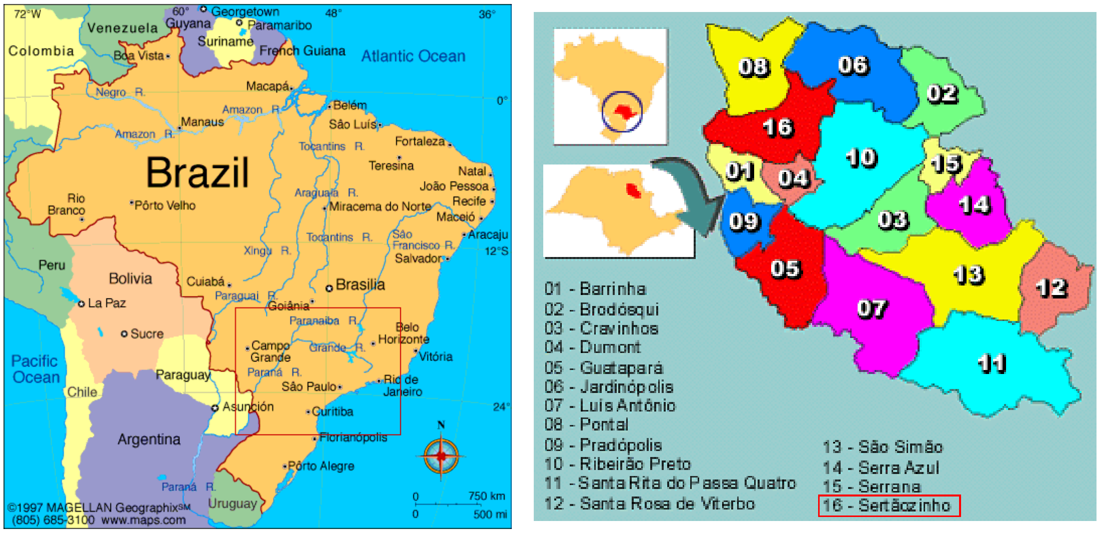

Figure 2 - Geographical Position of the City of Sertãozinho (Source www.aondefica.com)

Figure 3 - Santo Antônio Sugarcane Mill - Aerial Overview (Source: Company)

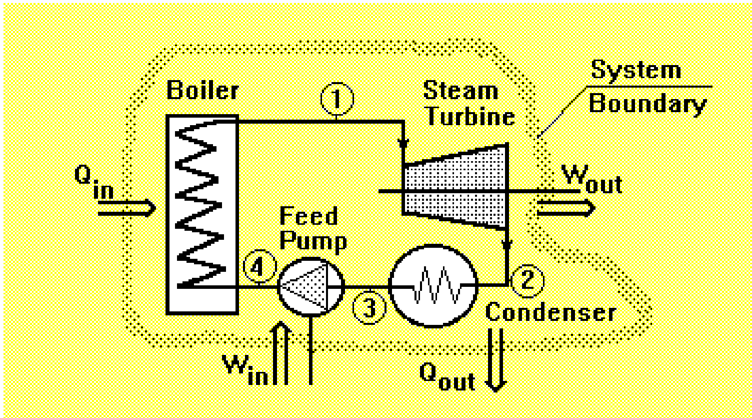

Figure 4 - Rankine Cycle (Source: Taftan Data, 1998)

Figure 5 -Bioenergia Power Plant

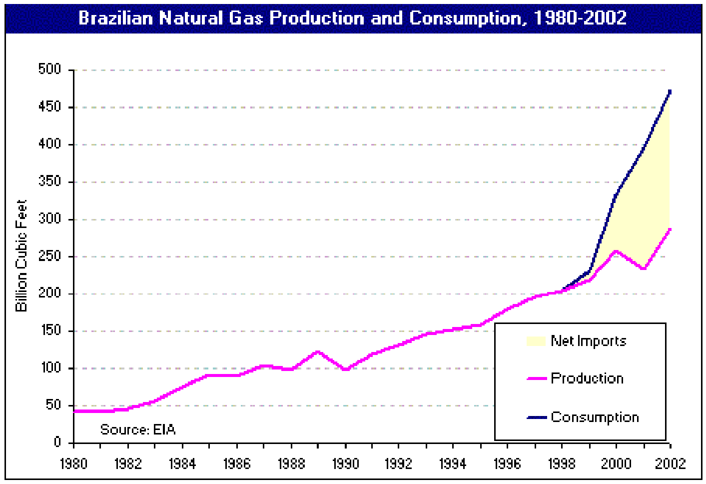

Figure 6 – Historical Brazilian Natural Gas Consumption and Production (Source: EIA[13])

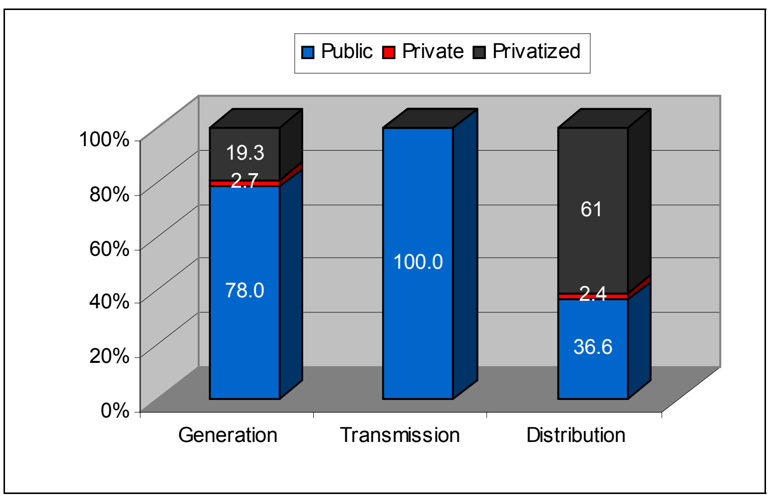

Figure 7 - Participation of private capital in the Brazilian electricity market in December 2000 (Source: BNDES, 2000).

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

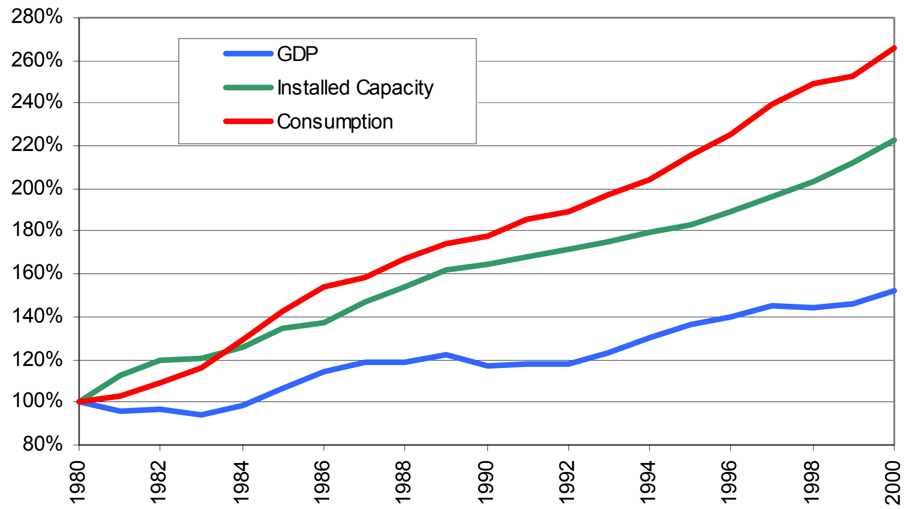

Figure 8 - Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption). Source: Eletrobrás, IBGE.

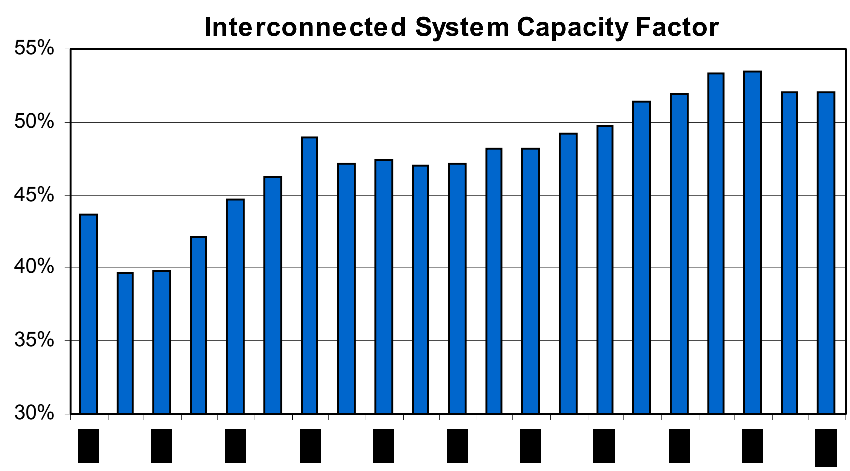

Figure 9 - Evolution of the rate of generated energy to installed capacity (Source: Eletrobrás).

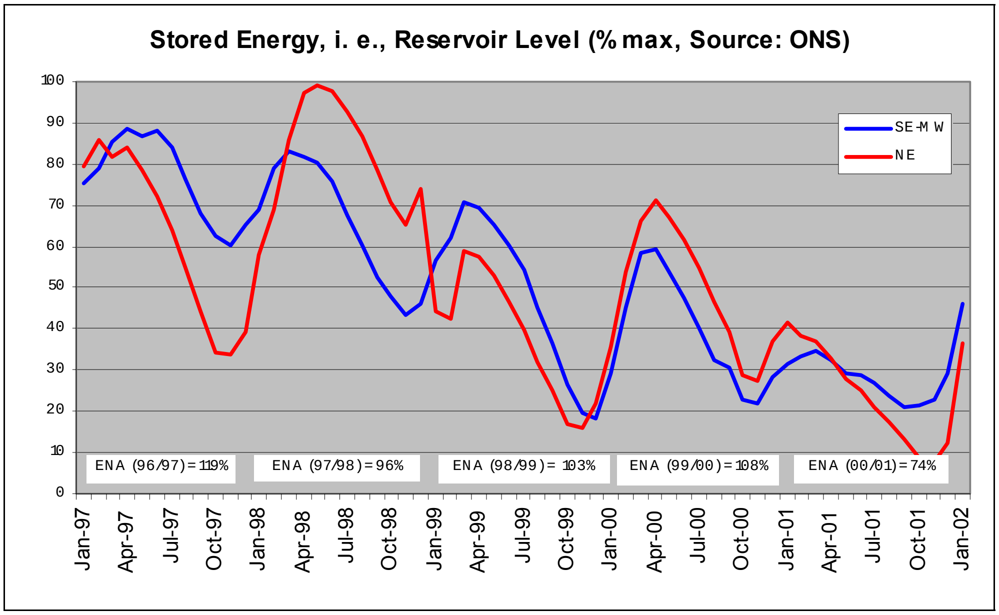

Figure 10 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS).

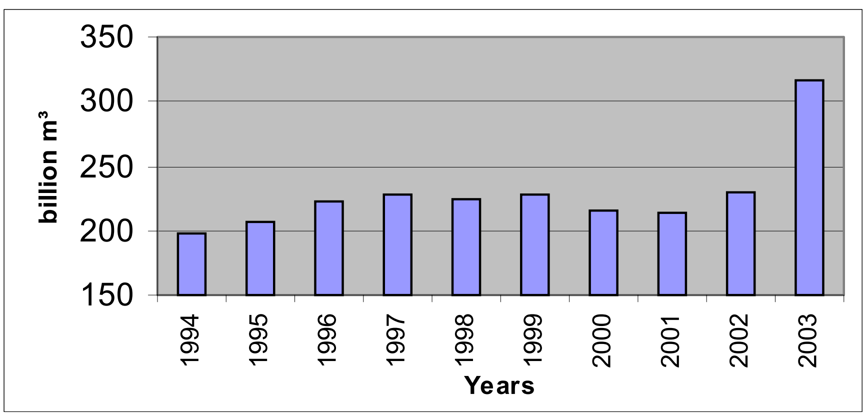

Figure 11 - National Historical Proved Reserves of Natural Gas (Source: Petrobras)

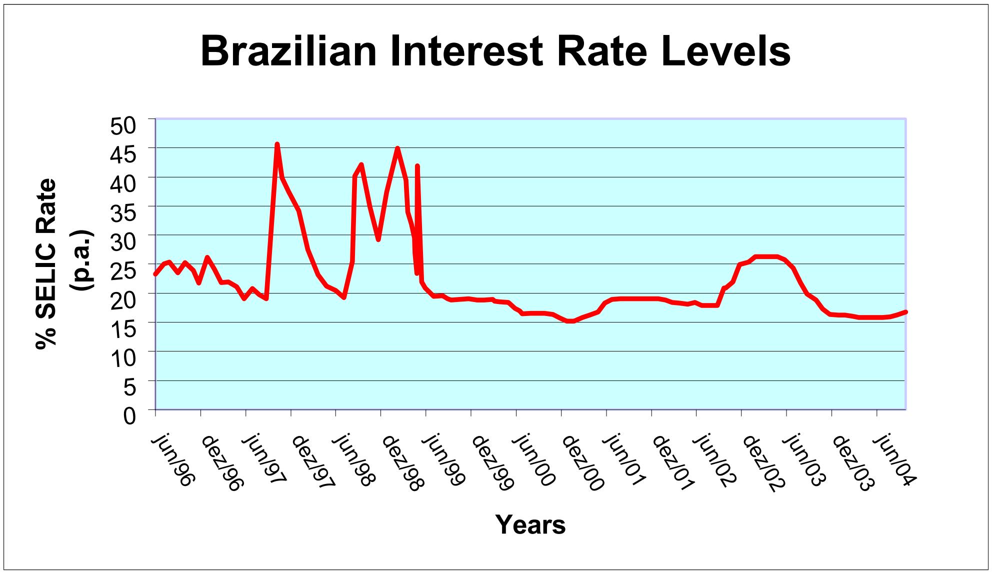

Figure 12 - SELIC rate (source: Banco Central do Brasil)

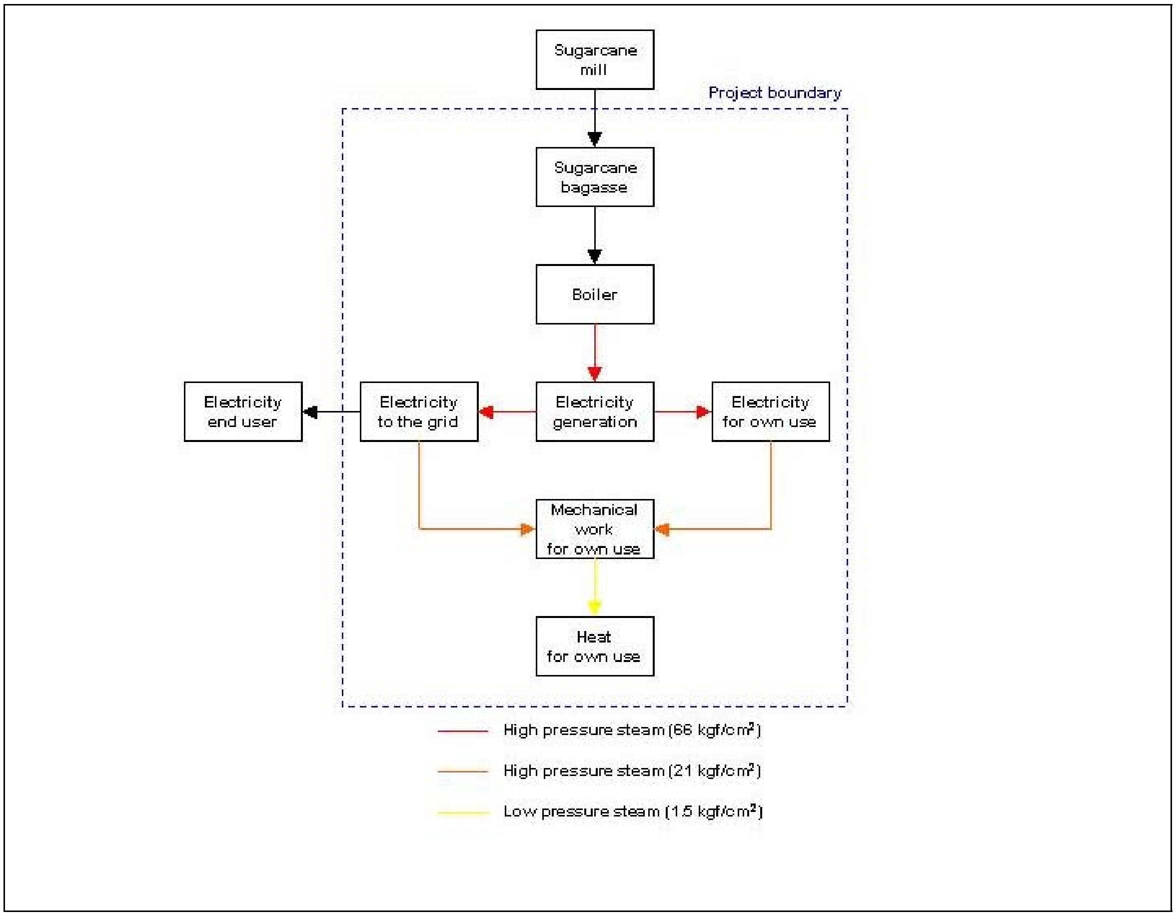

Figure 13 – Flowchart of the Project Boundaries

Horizonte 2006

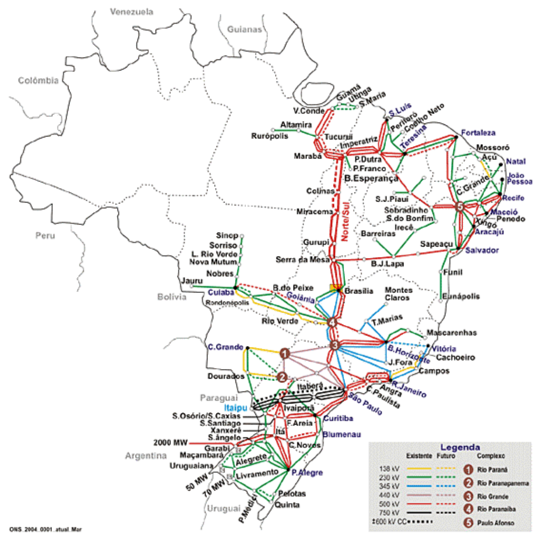

Figure 14 - Brazilian Interconnected System (Source: ONS, http://www.ons.org.br/)

GOVERNO DO ESTADO DE SÃO PAULO
SECRETARIA DE ESTADO DO MEIO AMBIENTE

LICENÇA AMBIENTAL DE INSTALAÇÃO

N° 00229

PROCESSO SMA
Nº 13569/2001

A Secretaria do Meio Ambiente do Estado de São Paulo - SMA, no uso das atribuições que lhe confere a Lei Federal 6938, de 31 de agosto de 1981, que dispõe sobre a Política Nacional do Meio Ambiente, regulamentada pelo Decreto Federal 99.274, de 06 de junho de 1990, e demais normas pertinentes, emite a presente **Licença Ambiental de Instalação,** com base no Parecer Técnico CPRN/DAIA/185/2002 e na Licença Ambiental Prévia n° 00453, para:

IDENTIFICAÇÃO DO EMPREENDEDOR

RAZÃO SOCIAL: BIOENERGIA COGERADORA LTDA.
CNPJ: 71.324.784/0001-51
LOGRADOURO: FAZENDA SANTO ANTONIO
BAIRRO: BAIRRO DO CAMPINHO
MUNICÍPIO: SERTÃOZINHO CEP: 14160-000

IDENTIFICAÇÃO DO EMPREENDIMENTO

NOME: USINA TERMOELÉTRICA DE COGERAÇÃO "UTE SANTO ANTONIO"
LOGRADOURO: FAZENDA SANTO ANTONIO
MUNICÍPIO(S): SERTÃOZINHO

CARACTERIZAÇÃO DO EMPREENDIMENTO

DESCRIÇÃO: USINA TERMOELÉTRICA DE COGERAÇÃO COM POTÊNCIA NOMINAL DE 25 MW

OBSERVAÇÕES

a) A presente Licença Ambiental de Instalação deverá permanecer no local do empreendimento.
b) Previamente à operação do empreendimento deverá ser obtida a Licença Ambiental de Operação, sob pena de aplicação das penalidades previstas na legislação em vigor.
c) A Licença Ambiental de Operação somente será concedida após o cumprimento das exigências relacionadas neste documento.
d) A presente Licença Ambiental de Instalação não dispensa nem substitui quaisquer alvarás, licenças, autorizações ou certidões de qualquer natureza, exigidos pela legislação federal, estadual ou municipal, bem como não significa reconhecimento de qualquer direito de propriedade.
e) Integra(m) a presente Licença 01 anexo(s).
f) O prazo de validade desta Licença Ambiental de Instalação é de 01 (hum) ano(s), a contar da data de sua emissão.

1ª via (branca) - interessado 2ª via (verde) - ambiente 3ª via (rosa) - arquivo

O presente documento foi emitido sem rasura e/ou colagem

USO DA COORDENADORIA DE LICENCIAMENTO AMBIENTAL E DE PROTEÇÃO DE RECURSOS NATURAIS

Data: 27 12 02

JOSE GOLDEMBERG - Secretário de Estado

Selo de Autenticidade
Secretaria de Estado do Meio Ambiente
Governo do Estado de São Paulo
AA000519

Figure 19 – Construction License

Annex 5 – Tables

Season	Sugarcane Produced	Bagasse Produced
1995/96	2,238,761.920	604,465.72
1996/97	2,783,352.050	751,505.05
1997/98	2,843,629.690	767,780.02
1998/99	3,020,974.000	815,662.98
1999/00	2,934,456.010	792,303.12
2000/01	2,424,076.690	654,500.71
2001/02	2,773,868.890	748,944.60
2002/03	2,822,778.950	762,150.32
2003/04	2,935,371.290	792,550.25
2004/05 (*)	3,186,000.000	860,220.00

(*) Forecast in tonnes

Table 6 - Historical Bagasse Generation of Balbo sugarcane mills

Financial Sensitivity Analysis - Bioenergia

SELIC rate* (1996 - 2004)	%	Project NPV	Project NPV with CER
Maximum Level	45,00%	(R$ 11.031.467)	(R$ 10.219.757)
Average	22,36%	(R$ 3.571.489)	(R$ 1.668.722)
Minimum Level	15,25%	R$ 4.067.619	R$ 6.906.498
Current Discount Rate	**17,00%**	**R$ 1.660.043**	**R$ 4.209.156**
Project IRR		**18,42%**	**20,54%**

* The SELIC rate was created in 1996.

Table 7 – Bioenergia Financial Sensitivity Analysis

Annex 6 – Bibliography

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