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

Zillo Lorenzetti Bagasse Cogeneration Project (for simplicity hereafter referred to simply as ZLBC Project).

PDD version number: 3

Date: October, 31, 2005

A.2. Description of the project activity

A.2.1 Purpose of the project activity

The project activity consists of the expansion of the bagasse cogeneration facilities at ***Usina Barra Grande de Lençóis*** (**BGL**) and ***Açucareira Zillo Lorenzetti*** (**AZL**), two Zillo Lorenzetti Group's sugar mills. With the expansion of the cogeneration plants, the mills have been able to export electricity from a renewable and sustainable source of energy, sugarcane bagasse, to the interconnected national grid.

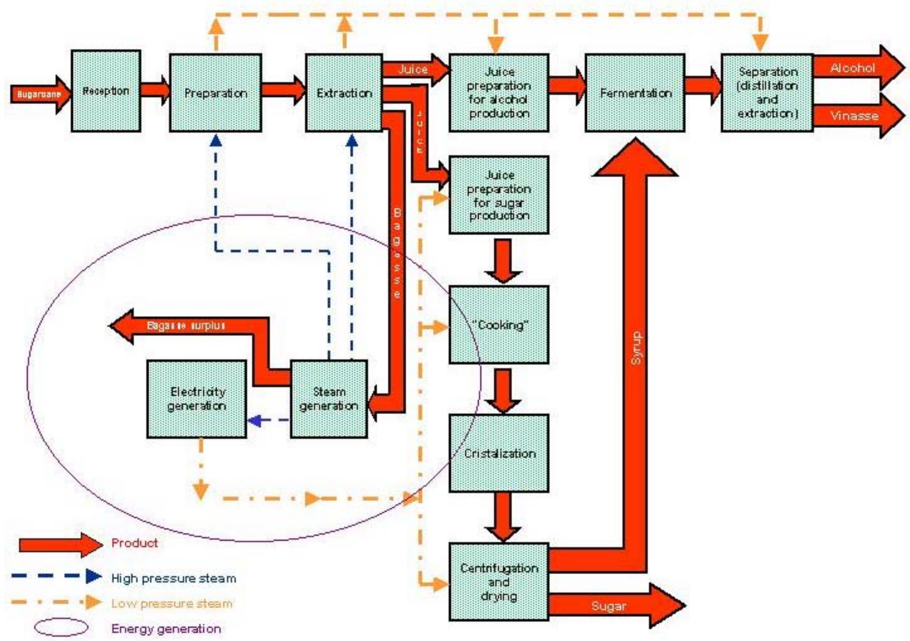

Figure 1 - Flowchart of the electricity generation inside a sugar and alcohol production (Source: Codistil)

The ***Empresas Zillo Lorenzetti*** (**ZL**) is the parent company founded in 1939 and is fully owned by Zillo and Lorenzetti families. The group owns three sugarcane mills (Usina Barra Grande de Lençóis S/A – Usina Barra Grande, Açucareira Zillo Lorenzetti S/A – Usina São José and, Açucareira Quatá S/A – Usina Quatá) that produce sugar and ethylic alcohol (anhydrous and hydrated), as well as generate its own electricity. During the 2003 - 2004 crop season, ZL group processed 8,530,000 tonnes of sugarcane, produced 575,000 tonnes of sugar and 420,000 m³ of alcohol. The ZL Group is one of the biggest conglomerates in the sector, and currently is the second largest sugarcane processor in Brazil.

ZL group began its plan to commercialize surplus electricity in 2000 and in 2003 the entire power plant expansion was completed. In 2001, BGL and AZL sold its first MWh to the local power utility CPFL (*Companhia Paulista de Força e Luz*). The first signed PPA, including both plants, corresponds to 25,5 MW and around 110,000 MWh. Currently there are two PPAs signed with CPFL to commercialize more than 50 MW during the season. The second PPA, signed only to BGL power plant expansion, has aggregated more 25 MW and 120,000 MWh.

In the end of the 2002-crop season BGL and AZL retrofitted their equipment with the objective of using bagasse more efficiently to cogenerate and export a higher amount of electricity (Figure 1). A more efficient cogeneration of this renewable fuel allows both mill to sell a surplus of electricity to the grid and creates a competitive advantage.

A.2.2 Contribution of the project activity to sustainable development

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

The 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.

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

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

Contributing to emission reductions is an important goal for ZL mills, as it is committed to the environment and sustainability. This policy is confirmed by ZL's fulfilment of several public requirements such as ISO 9001, NBR-ISO 14001, SA 8000, and OHSAS 18001.

Projects of this type typically do not incur large expenditures nor require significant employment demand. The project employed one thousand and two hundred and ten workers during the six-months of construction of the bagasse thermo facilities and it annually employs more than one hundred workers to operate both plants. However, it contributes to the larger social welfare of the region; both mills employee more than 6,000 workers, including directly employees and contracted workers.

Income distribution will be derived from this project due to job creation, employees' salaries and package of benefits such as social security and life insurance, and credits of emission reductions. Additionally, lower expenditure is achieved due to the fact that money will no longer be spent in the same amount to "import" electricity from other regions in the country through the grid. This money would stay in the region and be used for providing the population better services which would improve the availability of basic needs. This surplus of capital could be translated in investments in education and health that would directly benefit the local population and indirectly in a more equitable income distribution.

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

A.3. Project participants

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

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Usina Barra Grande de Lençóis S/A (Private Entity)	No
	Açucareira Zillo Lorenzetti S/A (Private Entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

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

A.4. Technical description of the project activity

A.4.1. Location of the project activity

A.4.1.1. Host Party(ies)

Brazil.

A.4.1.2. Region/State/Province etc.

Southeastern Brazil, state of São Paulo.

A.4.1.3. City/Town/Community etc

BGL is located in the city of Lençóis Paulista, state of São Paulo (22°37’ S, 48°45’ W).

AZL is located in the city of Macatuba, state of São Paulo (22°29’ S, 48°46’ W).

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

The sugarcane mills (Figure 2) are located near the city of Bauru, which is the major city of the center of the state.


Figure 2 – BGL (left) and AZL (right) sugar mills aerial view

Bauru is an important road, rail and waterway hub which makes it an important distribution center, and has a diversified industrial base that consists of informatics, industrial machines, automotive batteries, plastics, footwear, and food products.

The facilities are located in one of the main agricultural heartlands of the country (Figure 3).

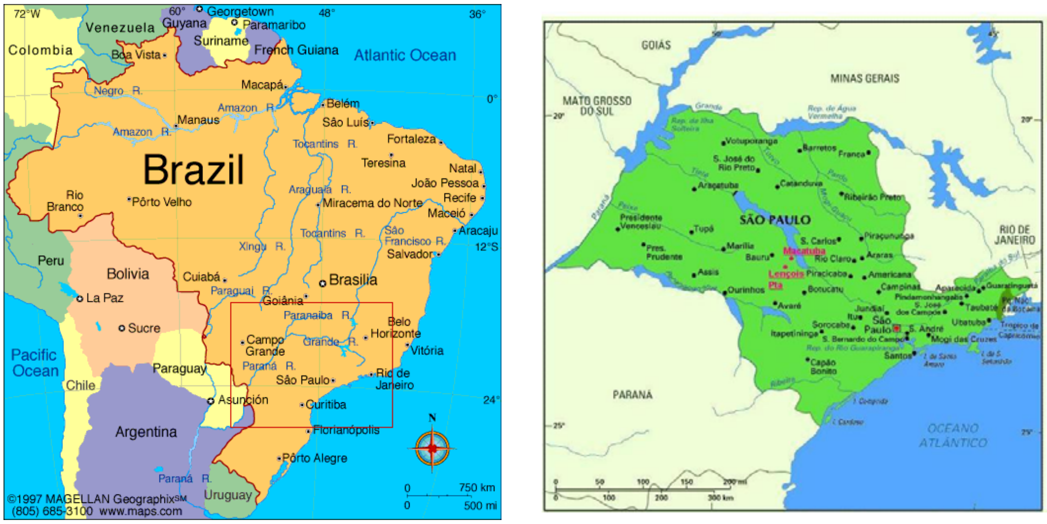

Figure 3 - Geographical Position of the City of Lençois Pta and Macatuba (Source www.aondefica.com)

A.4.2. Category(ies) of project activity

Type: Energy and Power.

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

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

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

Biomass power conversion technologies for electricity production can be broadly categorized as one of three technologies: direct combustion technology, gasification technology, and pyrolysis. Direct combustion technology, like the one used in ZLBC Project, 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 (Figure 4). 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.

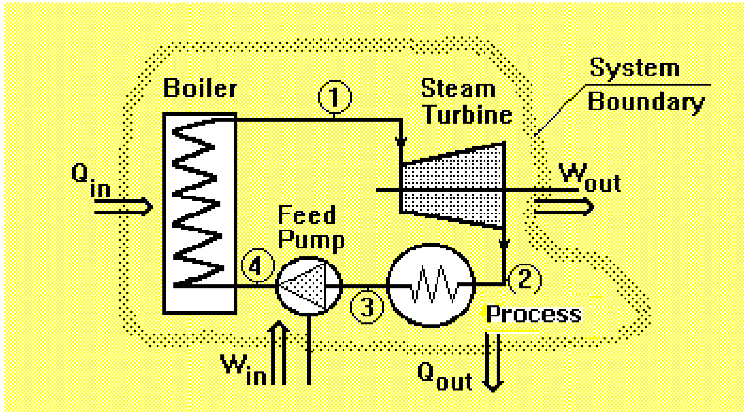

Figure 4- Rankine Cycle (Source: Taftan Data, 1998)

The ZLBC Project is divided in two different phases. The Phase 1 started in 2001 when both sugar mills substituted their generators, increasing the power potential at their power plants. The Phase 2 started in 2002 only at BGL, when that mill retrofitted its power plant. Before the Phase 1**,** AZL mill power plant use to operate burning all the bagasse produced in the milling process in four boilers operating at 21 kgf/cm^2 and one boiler operating at 42 kgf/cm^2 and three steam turbo-generators (1,750 kVA, 6,625 kVA and 3,750 kVA) . Under this configuration the plant was energy self-sufficient. A small amount of bagasse was stored for start-up/shut-down situations (Figure 5).

The BGL power plant use to operate burning all the bagasse produced in the milling process in three boilers operating at 21 kgf/cm2 and two boilers operating at 42 kgf/cm2 and four steam turbo generators (6,625 kVA, 2,000 kVA, 1,500 kVA and 4,000 kVA). Under this configuration the plant was energy self-sufficient. A small amount of bagasse was stored for start-up/shut-down situations (Figure 6).

In the end of the 2000 crop-season, ZL Group looking for the opportunities regarding the Kyoto Protocol, decided for expanding its electricity generation. Until the Phase 1 was set up, the aggregated power potential of both ZL's power plants was 24.40 MW.

Phase 1 - (2001): During **t**he Phase 1of the ZLBCP project two different modifications have occurred at the different power plants.

AZL – Installation of one 18,750 kVA turbo generator for exporting electricity. With this new configuration, AZL mill started operating with the same boilers and producing the same amount of steam. However the mill was able to sell around 10MW (Figure 7).

BGL – As occurred at AZL, during the Phase 1 was installed a new 18,750 kVA turbo generator for exporting electricity. With this new configuration, BGL mill started operating with the same boilers and producing the same amount of steam. However the mill was able to sell around 14.69 MW (Figure 8).

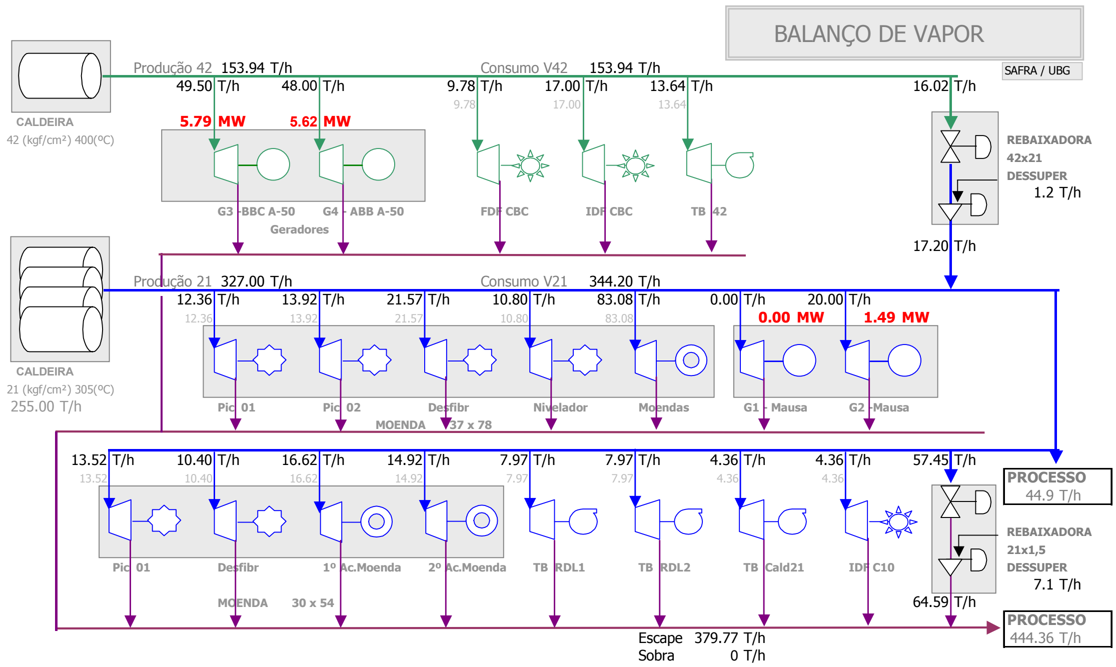

Figure 5- AZL configuration before the Phase 1

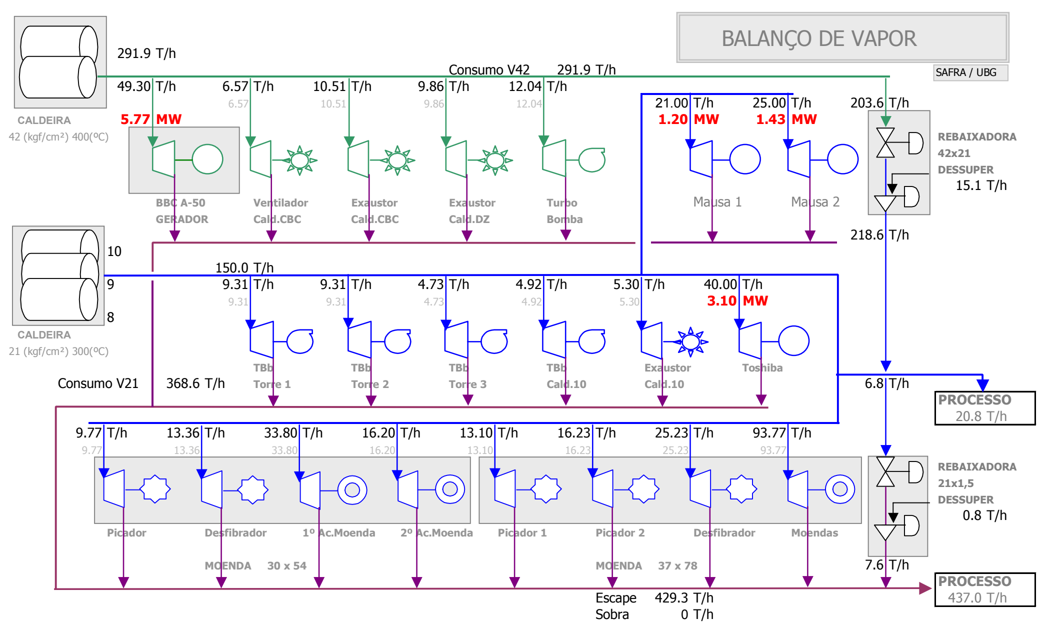

Figure 6- BGL configuration before the Phase 1

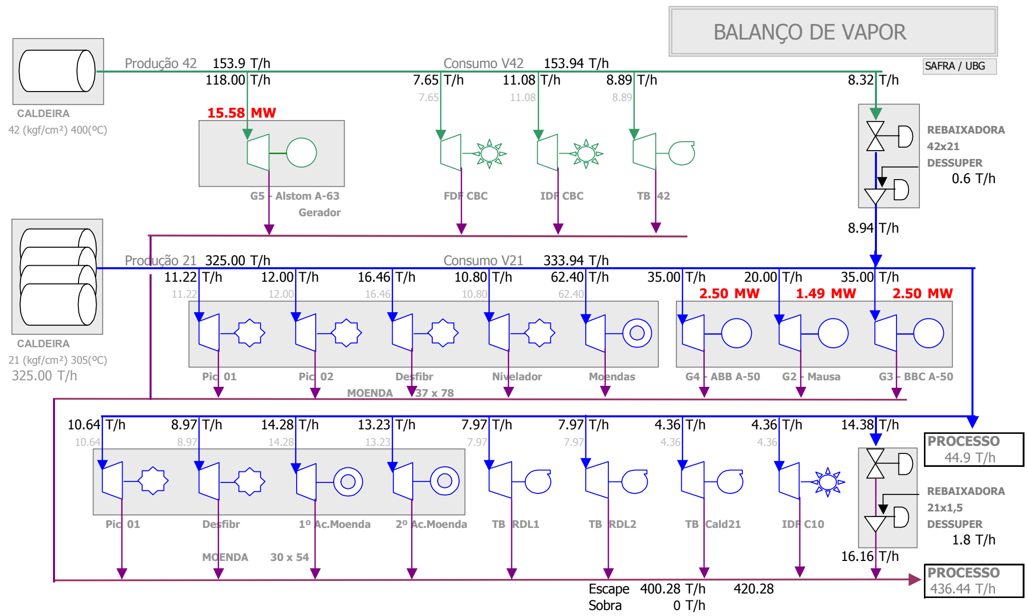

Figure 7- AZL configuration after the Phase 1

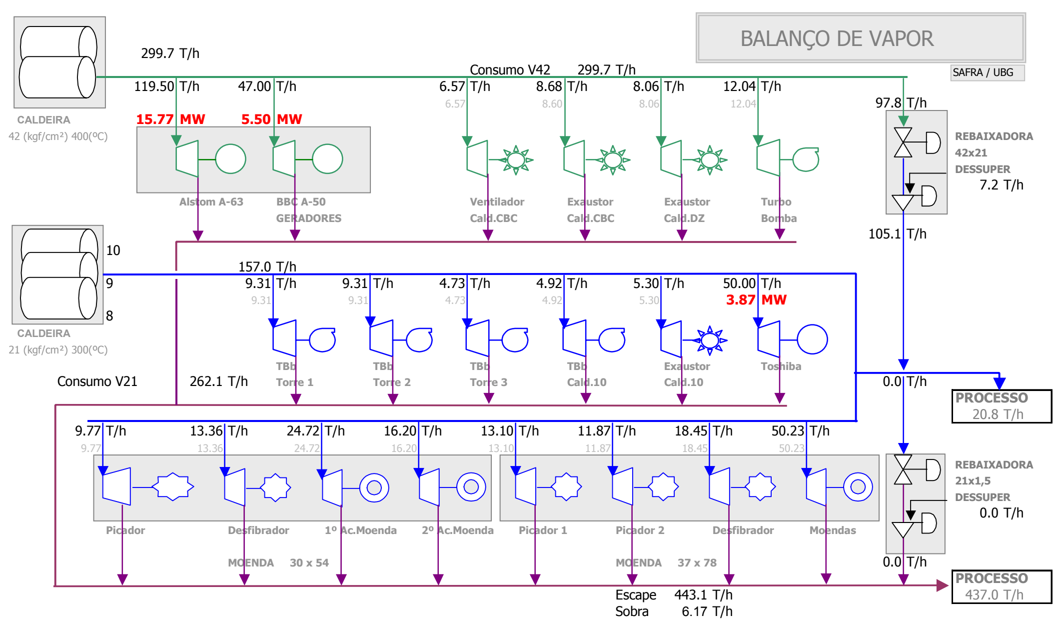

Figure 8- BGL configuration after the Phase 1

Phase 2 (2003): After the first expansion phase, the BGL mill decided to retrofit its power plant. For the Phase 2 BGL added a new high pressure boiler (65 bar) and a multiple stage back pressure steam and condensing turbine coupled with a new 45.750 KVA generator. A new Power Purchase Agreement (PPA), on around 128,000 MWh, with the local power utility (CPFL, *Companhia Paulista de Força e Luz*) was signed (Figure 9).

The BGL power plant at the Phase 2, has added the following equipments at the plant:

- 01 Boiler: 65 kgf/cm^2 operation pressure, 175 tonnes of steam per hour capacity.
- Turbo-generator: 45,750 kVA power capacity,
- Sub-station: 13.8 – 138KV
- Transmission Line: 138KV

Both sugar mills train the local staff yearly focusing on the following issues:

- NR 10[2]: Technical instruction for electric installation and services;
- NR 13: Technical instruction for boilers and pressure vessels;
- Boiler combustion (in accordance with the equipment supplier)

The operation and maintenance of the facilities are administered by both sugar mills. The activities are divided in:

- Special Predictive Maintenance: Vibration analysis (monthly), thermo inspections (twice during the season), analysis of the transformer's insolating oil (once during the season);
- Standard Predictive Maintenance: According ISO 9001;

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

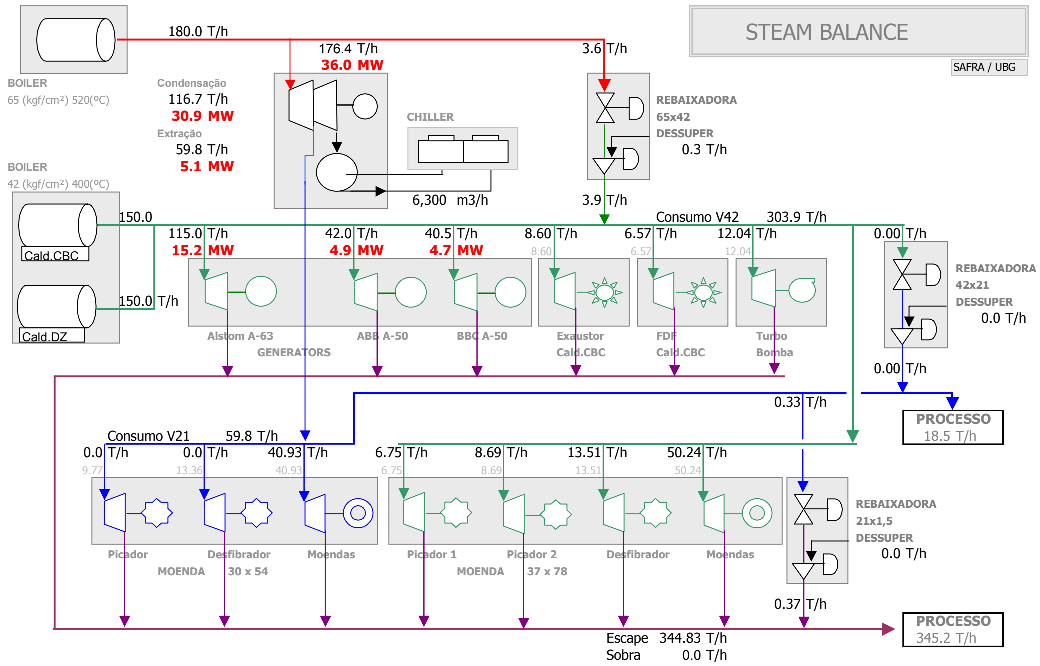

Figure 9- BGL current configuration after the Phase 2

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

The ZLBC 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

Years	Annual estimation of emission reductions in tonnes of CO_2e
Year* 1 - (2001)	28.340
Year 2 - (2002)	25.487
Year 3 - (2003)	46.142
Year 4 - (2004)	61.085
Year 5 - (2005)	67.073
Year 6 - (2006)	67.073
Year 7 - (2007)	67.073
Year** 8 - (2008)	27.947
Total estimated reductions (tonnes of CO_2e)	390.218
Total number of crediting years	7
Annual average over the first crediting period of estimated reductions (tonnes of CO_2e)	55.745

* From June 2001
** Until June 2008

Table 2 – Estimated emission reductions over the chosen crediting period

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

The full implementation of the ZLBC Project connected to the Brazilian South-Southeast-Midwest electricity interconnected grid will avoid an average estimated yearly emission of around 55,745 tCO_2e (emission factor baseline of 278.3kgCO_2e/MWh, detailed calculation in section E), and a total reduction of about 390,218 tCO_2e over the first crediting period

A.4.5. Public funding of the project activity

No public funding was and will be used in the ZLBC Project.

SECTION B. Application of a baseline methodology

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

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

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

The chosen methodology provides procedures/conditions to determine if the referred methodology is applicable to the ZLBC 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 ZLBC Project is installed inside the BGL and AZL 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 both 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 BGL and AZL 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 ZLBC Project could only be set up by the private sector.

	BGL		AZL	
Year	Sugarcane Produced	Bagasse Produced	Sugarcane Produced	Bagasse Produced
1996	3.880.959	1.154.826	3.824.419	1.065.987
1997	3.722.540	1.093.446	3.764.996	1.076.550
1998	4.103.964	1.233.309	4.140.396	1.198.876
1999	4.055.875	1.185.844	4.049.212	1.136.181
2000	3.086.609	842.979	3.167.860	897.154
2001	3.933.064	1.050.659	3.812.257	1.004.980
2002	3.578.666	903.347	3.560.465	862.261
2003	3.437.881	873.113	4.016.057	929.302
2004	3.901.453	977.691	3.853.613	930.542

Table 3 - Historical Bagasse Generation at BGL and AZL sugar mills

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

Both 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 3 for the volume of sugarcane and bagasse generated at the 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 ZLBC Project is a cogeneration project connected to the electricity grid. The project fulfils all the "additionality" requisites (see application of the "additionality tool[3]" below) and demonstrates why the project would not occur in the absence of the CDM.

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

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 ZLBCP project activity.

Following are the steps necessary for the demonstrations and assessment of ZLBC Projectadditionality:

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

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

a) Project Start date: 15/06/2001

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

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[4] (sugar industry) and SIFAESP[5] (ethanol industry).

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

ZL sugar mills, being an associate of UNICA, have 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 ZLBCP project.

ZL sugar mills are also member of Copersucar - a Cooperative of 32 sugar and ethanol producers. In addition to being the biggest sugar and ethanol producers cooperation 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 listed 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). The book was financed by Copersucar to make partners aware about Global Warming and how ethanol might contribute to its mitigation. ZL 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). The 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[6] is founder member of the IETA[7] – 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 preparation of the following documents regarding Climate Change:

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[4] SIAESP – *Sindicato da Indústria do Açúcar do Estado de São Paulo* (State of São Paulo's Sugar Industry Confederation).

[5] SIFAESP – *Sindicato da Indústria da Fabricação do Álcool no Estado de São Paulo* (State of São Paulo's Sugar Alcohol Production Confederation).

[6] UNICA – www.unica.com.br

[7] IETA – www.ieta.org

  - 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*" (Macedo, 2000). Research paper prepared to inform the members of Copersucar about greenhouse gases emission reductions associated to the "sugarcane cycle" (cultivation and production of sugar and alcohol).
- "Sugar cane residues for power generation in the sugar/ ethanol mills in Brazil". *Energy for Sustainable Development – Volume V Nº 1 – 2001.* Prepared by the technical staff of the CTC – Copersucar.

As demonstrated above, the sugarcane industry sector has been informed about the Clean Development Mechanism and has been proactive in participating in the CDM. Therefore, the sugarcane sector and consequently the ZL sugar 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 is the continuation of the current (previous) situation, with the investment in the sugar and ethanol industry that are the core business of the companies.

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

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

3. Non-applicable.

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

Step 2. Investment Analysis:

Non applicable.

Step 3. Barrier Analysis:

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

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

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

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

- Allowing free access to the transmission lines, and
- Placing the operation and planning responsibilities to the private sector.

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

At the end of 2000, after five years of privatization, the results were modest (Figure 10). Despite high expectations, investments in new generation did not follow the increase in consumption.

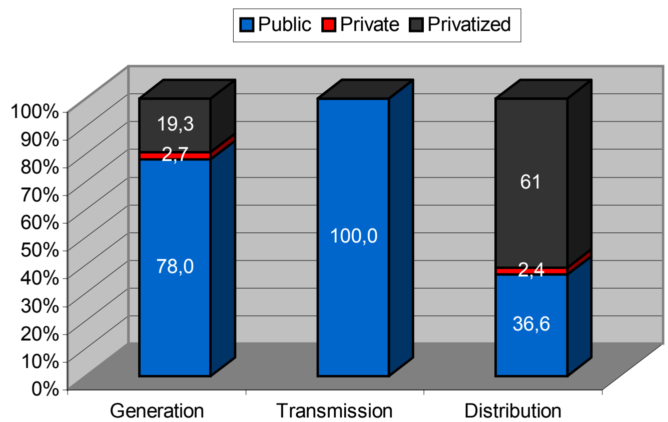

Figure 10 - Participation of private capital in the Brazilian electricity market in December 2000 (Source: BNDES, 2000).

The decoupling of GDP (average of 2% increase in the period of 1980 to 2000) from electricity consumption increase (average of 5% increase in the same period) is well known in developing countries, mainly due to the expansion of the supply services to new areas and the growing infra-structure. The necessary measures to prevent bottlenecks in services were taken. These include an increase of generation capacity higher than the GDP growth rate and strong investments in energy efficiency. In the Brazilian case, the increase in the installed generation capacity (average of 4% in the same period) did not follow the growth of consumption as can be seen in Figure 11.

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

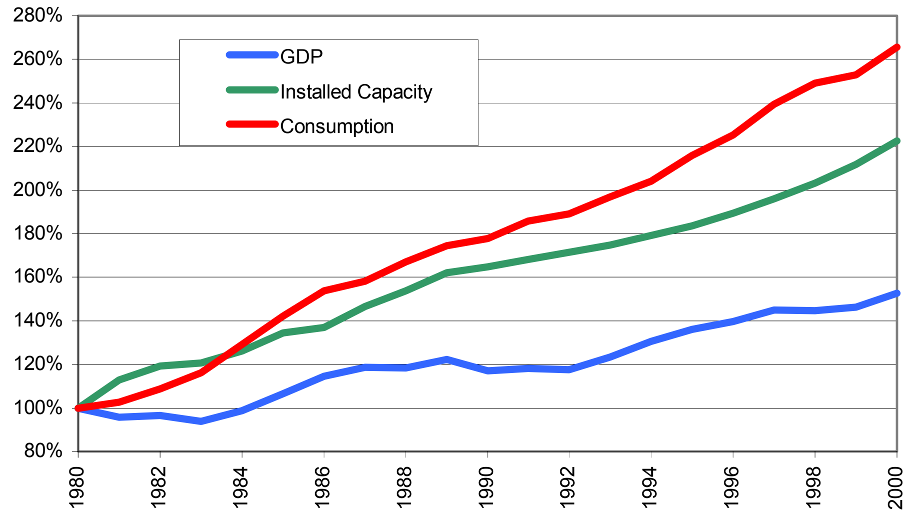

Figure 11 - Cumulated variation of GDP, power installed capacity and electricity consumption (Source: Eletrobrás and IBGE).

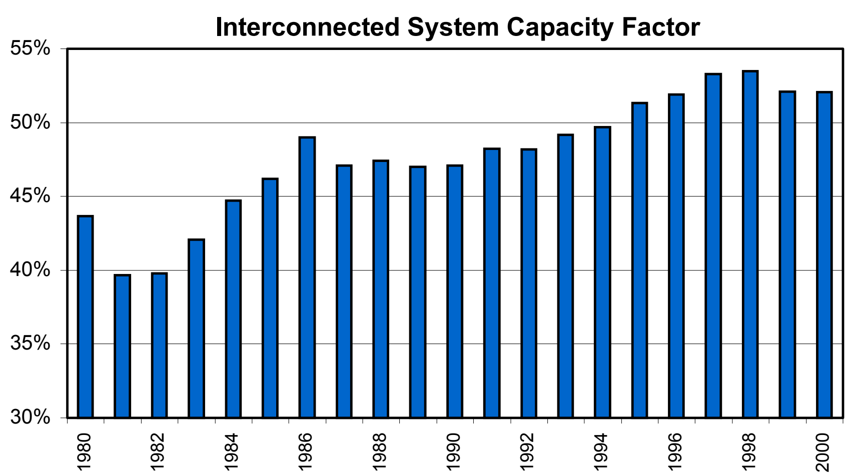

Figure 12 - Evolution of the rate of generated energy to installed capacity (Source: Eletrobrás).

The remaining alternative, to increase the capacity factor of the old plants, was actually the most widely used, as can be seen in Figure 12.

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

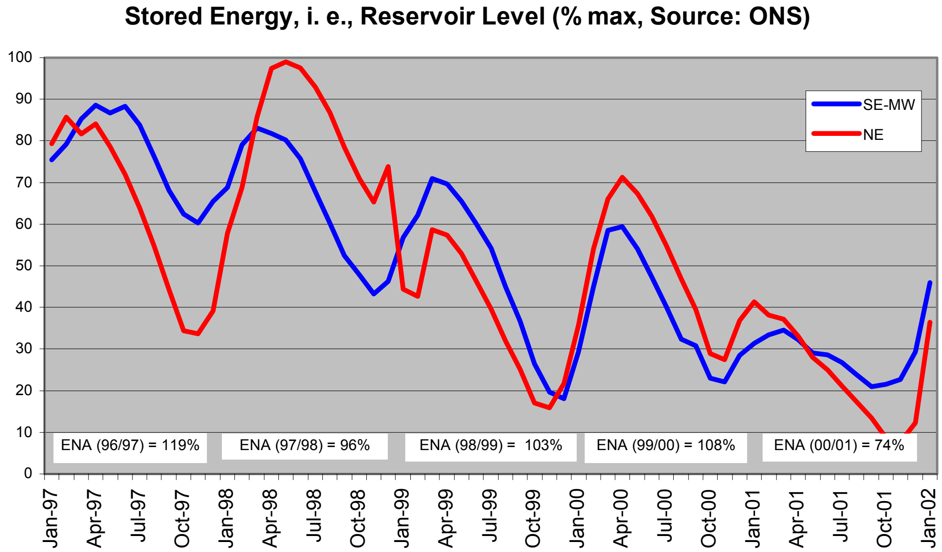

Figure 13 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS).

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

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

It is clear though that hydroelectricity is and will continue as the main source responsible for the electricity base load in Brazil. However, most if not all-hydro resources in the South and Southeast of the country have been exploited, and most of the remaining reserves are located in the Amazon basin, far from the industrial and population centers (OECD, 2001). Clearly, new additions to Brazil's electric power sector are shifting from hydroelectricity to natural gas plants (Figure 14, Schaeffer *et al.,* 2000).

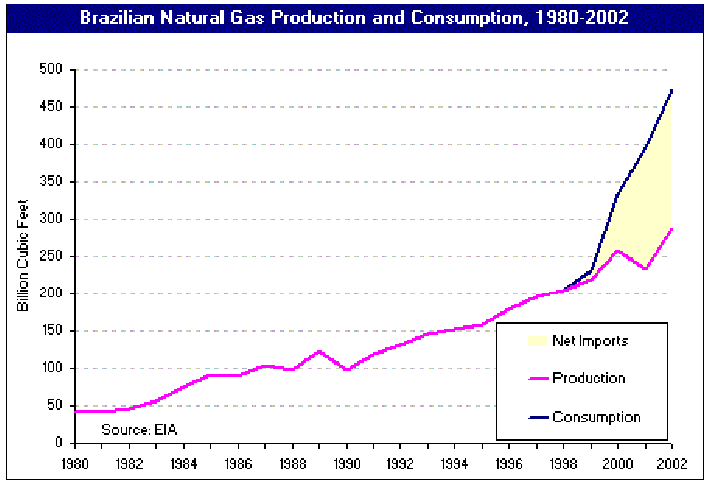

Figure 14 – Historical Brazilian Natural Gas Consumption and Production (Source: EIA[8])

With discoveries of vast reserves of natural gas in the Santos Basin in 2003 (Figure 15) 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.

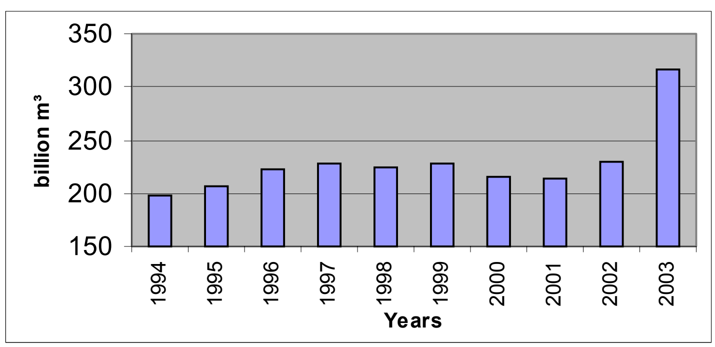

Figure 15 - National Historical Proved Reserves of Natural Gas (Source: Petrobras)

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

- Electricity demand and supply will be coordinated through a "Pool" Demand will be estimated by the distribution companies, which will have to contract 100 per cent of their projected electricity demand over the following 3 to 5 years. These projections will be submitted to a new institution (*Empresa de Planejamento Energético*, EPE), which will estimate the required

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

expansion in supply capacity to be sold to the distribution companies through the Pool. The price at which electricity will be traded through the Pool is an average of all long-term contracted prices and will be the same for all distribution companies.

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

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

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

Investment Barrier

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

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

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

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

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

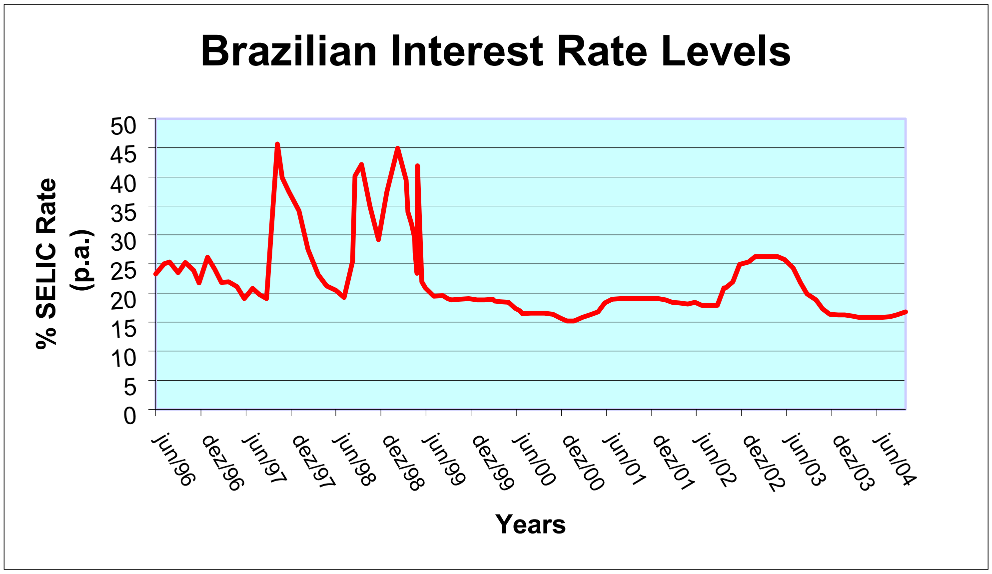

Figure 16 - SELIC rate (source: Banco Central do Brasil)

The most liquid government bond is the LFT (floating rate bonds based on the daily Central Bank reference rate). As of January 2004, 51.1% of the domestic federal debt was in LFTs and had duration of one day. This bond rate is almost the same as the CDI - Interbank Deposit Certificate rate that is influenced by the SELIC rate, defined by COPOM[9].

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 16.

The Phase 1 of the project was developed on an equity basis. The Phase 2 of the project was developed on a project finance basis. To finance construction, project sponsor (ZL) took advantage of the financing lines of BNDES. This financial support covered 80% of the project costs with a rate of TJLP (BNDES Long Term Interest Rate – 10%) plus a 5% spread risk for a term of 8-year and 1-year grace period.

As can be seen in the worksheet FCF_ZLBCP (CER)[10], the Project was set up with an expected financial IRR – Internal Rate of Return of the approximately 17% 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 700 basis point from 16.73% to 23.94%. Such increase in return would compensate for the additional risk investor would take with this project.

In addition to the increase of 700 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 ZL 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.

9 COPOM – Comitê de Politica Monetária (Brazilian Central Bank Monetary Policy Committee).

[10] The worksheet is available upon request

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.

Financial Sensitivity Analysis - ZLBCP

SELIC rate* (1996 - 2004)	%	Project NPV	Project NPV with CER
Maximum Level	45,00%	(R$ 7.635)	(R$ 5.870)
Average	22,36%	(R$ 3.010)	R$ 909
Minimum Level	15,25%	R$ 1.049	R$ 6.506
Current Discount Rate	**17,00%**	(R$ 176)	R$ 4.831
Project IRR		**16,73%**	**23,98%**

Table 4 - Financial Sensitivity Analysis

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

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

Institutional Barrier

As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created to try to organize and to provide incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period electricity prices surpassed BRL 600/MWh (around USD 200/MWh) and the forecasted marginal price of the new energy reached levels of BRL 120 – 150/MWh (around USD 45). In the middle of 2004 the average price was bellow BRL 50/MWh (less than USD 20/MWh). The volatility of the electricity price in Brazil has a correlation with the instability in government policies in the period, with 3 different regulatory environments in a 10 year period (from 1995 to 2004). In theory the new regulatory framework has the potential to reduce market risk considerably. Nevertheless only time will prove the efficiency of the new model in relation to market risks reduction and private investment attraction[11]. In that sense, it will interesting to evaluate the results of the first auction of licenses for the construction of new power plants in order to correctly assess the success of the implementation of the new regulatory framework.

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

Cultural Barrier

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

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

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

Step 4. Common practice analysis

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

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

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

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

Regardless of the risks and barriers mentioned above, the main reason for the reduced number of similar project activities is the economic cost. Project feasibility requires a PPA contract with a utility company, but the utilities do not have the incentives or motivation to buy electricity generated by small cogeneration projects. The marginal cost for electricity expansion is US$ 33/MWh[12] 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 ZL sugar mills and the majority of these project developers have taken into consideration CDM in their decision to expand their cogeneration plant.

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

The intention of ZL 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 ZLBCP 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

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

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

The CDM has made it possible for the mills set up their cogeneration plants and export excess electricity to the grid by helping to overcome financial barriers through the financial benefits obtained from CDM revenues; this is summarized in Table 4. 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

ZLBCP: The project boundaries are defined by the emissions targeted or directly affected by the project activities, construction and operation. It encompasses the physical, geographical site of the bagasse power generation source, which is represented by the sugarcane mills (BGL and AZL), the sugarcane plantation that supply biomass to the mill and the region located close to the power plants facilities and the interconnected grid.

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

- Northeast: The electricity for this region is basically supplied by the São Francisco River. There are seven hydro power plants at the river with total installed capacity around 10.5 GW.

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

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

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

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

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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

15/06/2001

C.1.2. Expected operational lifetime of the project activity

25y-0m

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

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period

15/06/2001

C.2.1.2. Length of the first crediting period

7y-0m

C.2.2. Fixed crediting period

C.2.2.1. Starting date

Not applicable.

C.2.2.2. Length

Not applicable.

SECTION D. 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

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

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

ID	Data	Source of	Data	Measured (m), calculated (c) or	Recording	Proportion of data to be	How will the data be	Comment

number	variable	data	unit	estimated (e)	frequency	monitored	archived?	

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

Project emissions (PE_y) are nil, therefore no formula for calculation of direct emissions are necessary.

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

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	Comment
1	EG_y , Electricity generation delivered to grid	Energy metering connected to the grid and receipt of sales	MWh	m	Fifteen-minutes-measurement and Monthly recording	100%	Electronic and paper	The electricity delivered to the grid is monitored by the Project as well as by the energy buyer.
2	EF_y, emission factor of the grid	Calculated	tCO_2/MWh	c	At the validation and baseline renewal	n.a.	Electronic and Paper	Data is available upon request. Factors are calculated according to AM0015 (2004). Data will be archived during the credit period according to internal procedures.

3	$EF_{OM,y}$, operating margin emission factor of the grid	Data provided by UT (National dispatch center).	tCO_2/MWh	c	At the validation and baseline renewal	n.a.	Electronic and Paper	Data is available upon request. Factors are calculated according to AM0015 (2004). Data will be archived during the credit period according to internal procedures.
4	$Ef_{BM,y}$, build margin emission factor of the grid	Data provided by UT.	tCO_2/MWh	c	At the validation and baseline renewal	n.a.	Electronic and Paper	Data is available upon request. Factors are calculated according to AM0015 (2004). Data will be archived during the credit period according to internal procedures.
5	λ_y , Fraction of time during which low-cost/must-run sources are on the margin	Data provided by UT.	-	c	At the validation and baseline renewal	n.a.	Electronic and Paper	Data is available upon request. Factors are calculated according to AM0015 (2004). Data will be archived during the credit period according to internal procedures.

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

From ACM0015 (2004), 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).

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

Equation 1

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

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

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

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

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

A more detailed description of the formulae used to estimate baseline emissions can be seen in Section E below.

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

Not applicable.

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

Not applicable.

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

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

Not applicable.

D.2.3. Treatment of leakage in the monitoring plan

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

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

Not applicable.

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

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

Not applicable.

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

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

$$ER_y = BE_y - PE_y - L_y \qquad \textbf{Equation 4}$$

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

$$BE_y = EG_y \cdot EF_y \qquad \textbf{Equation 5}$$

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

$$PE_y = PES_y + PEFF_y \qquad \textbf{Equation 6}$$

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

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

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

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

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

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

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

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

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Brazil

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources

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

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

E.2. Estimated leakage

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

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

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

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

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

According to the selected approved methodology (AM0015, 2004), the baseline emission factor is calculated as (EF_y) 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, the project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly the connected electricity system is defined as that 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 ZLBC project is located in the State of São Paulo and is integrated to the South-Southeast-Midwest (S-SE-CO) connected electricity system.

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

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

Dispatch data analysis operating margin should be the first methodological choice. Since not enough data was supplied by the Brazilian national dispatch center, the choice is not currently available. The simple operating margin can only be used where low-cost/must-run resources[13] constitute less than 50% of total grid generation in: 1) average of 5 most recent years, or 2) based on long-term normals for hydroelectricity production. Table 5 shows the share of hydroelectricity in the total electricity production for the Brazilian S-SE-CO interconnected system. However, the results show the non-applicability of the simple operating margin to the ZLBC Project.

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

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

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

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

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

$$EF_{OM,simple-adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y}\cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum F_{i,k,y}\cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$ **Equation 11**

Where:

- λ_y is the share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin.
- $F_{i,j,y}$ is the amount of fuel *i* (in mass or volume unit) consumed by relevant power sources *j* (analogous for sources *k*) in year(s) *y*,
- *j* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid. For imports from connected electricity system located in another country, the emission factor is 0 (zero).
- *k* refers to the low-operating cost and must-run power sources.
- $COEF_{i,j}$ is the CO_{2e} coefficient of fuel *i* (tCO_{2e}/mass or volume unit of the fuel), taking into account the carbon dioxide equivalent emission potential of the fuels used by relevant power sources *j* (analogous for sources *k*) and the percent oxidation of the fuel in year(s) *y* and,
- $GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j* (analogous for sources *k*),

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

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

Where:

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

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

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

Where:

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

Non-low-cost/must-run resources in Brazilian S-SE-CO interconnected system are thermo power plants burning coal, fuel oil, natural gas and diesel oil. These plants result in non-balanced emissions of greenhouse gases. The product $\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}$ for each one of the plants was obtained from:

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

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

$$Hence,\ F_{i,k,y} \cdot COEF_{i,k} = \frac{GEN_{i,k,y} \cdot EF_{CO2,i} \cdot OXID_i \cdot 44/12 \cdot 3.6 \times 10^{-6}}{\eta_{i,k,y}}$$ **Equation 16**

Where variable and parameters used are:

- $\sum_{i,j} F_{i,j,y}$ is given in [kg], $COEF_{i,j}$ in [tCO_2e/kg] and $F_{i,k,y} \cdot COEF_{i,k}$ in [tCO_2e]
- $GEN_{i,k,y}$ is the electricity generation for plant k, with fuel i, in year y, obtained from the ONS database, in MWh
- $EF_{CO2,i}$ is the emission factor for fuel i, obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, in tC/TJ.
- $OXID_i$ is the oxidization factor for fuel i, obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, in %.
- 44/12 is the carbon conversion factor, from tC to tCO_2.
- 3.6×10^{-6} is the energy conversion factor, from MWh to TJ.
- $\eta_{i,k,y}$ is the thermal efficiency of plant k, operating with fuel i, in year y, obtained from PCF (2003).
- NCV_i is the net calorific value of fuel i [TJ/kg].

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

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}}$ [tCO2/MWh]	λ_y
2002	*0.8504*	*0.5053*
2003	*0.9378*	*0.5312*
2004	*0.8726*	*0.5041*

Table 6 - Share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin in the S-SE-CO system for the period 2002-2004 (ONS-ADO, 2005).

With the numbers from ONS, the first step was to calculate the lambda and the emission factors for the simple operating margin. The λ_y factors are calculated as indicated in methodology AM0015, with data obtained from the ONS database. Figure 17, Figure 18 and Figure 19 present the load duration curves and λ_y determination for years 2002, 2003 and 2004, respectively. The results for years 2002, 2003 and 2004 are presented in Table 6.

Finally, applying the obtained numbers to calculate $EF_{OM,simple\text{-}adjusted,2001\text{-}2003}$ 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 11:

- $EF_{OM,simple\text{-}adjusted,2001\text{-}2003}$ = 0.4310 tCO_{2e}/MWh

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

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

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (AM-0015) for plants *m*, based on the most recent information available on plants already built . The sample group m consists of either

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

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

Applying the data from the Brazilian national dispatch center to Equation 17:

- $EF_{BM,2003}$ = 0.1256 tCO_{2e}/MWh

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

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$ **Equation 18**

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

$$EF_{CM,2001-2003} = 0.5 \times 0.4043 + 0.5 \times 0.0937$$ **Equation 19**

- $EF_{BM,2003} = 0.2783tCO_2/MWh$

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

$$BE_{,y} = EF_{CM,2001-2003} \times EG_y$$ **Equation 20**

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

$$BE_y = 0.2490 \times EG_y$$ **Equation 21**

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

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

$$ER_y = BE_y - PE_y - L_y = 0.249 \times EG_y - 0 - 0$$ **Equation 22**

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

The full implementation of the ZLBC Project connected to the Brazilian South-Southeast-Midwest electricity interconnected grid will avoid an estimated yearly emission of around 67,073tCO_2e, and a total reduction of about 390,218 tCO_2e over the first 7-year crediting period (up to and including June 2008, see Table 7)

Years	Estimation of project activity emissions reductions (tonnes of CO_2e)	Estimation of baseline emissions reductions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
Year* 1 - (2001)	0,0	28.340	0,0	28.340
Year 2 - (2002)	0,0	25.487	0,0	25.487
Year 3 - (2003)	0,0	46.142	0,0	46.142
Year 4 - (2004)	0,0	61.085	0,0	61.085
Year 5 - (2005)	0,0	67.073	0,0	67.073
Year 6 - (2006)	0,0	67.073	0,0	67.073
Year 7 - (2007)	0,0	67.073	0,0	67.073
Year** 8 - (2008)	0,0	27.947	0,0	27.947
Total (tonnes of CO_2e)	0,0	390.218	0,0	390.218

* From June 2001
** Until June 2008

Table 7 – Yearly estimated emission reductions of the ZLBC Project

SECTION F. Environmental impacts

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

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

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

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

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

- The preliminary license ("*Licença Prévia*" or L.P.),
- The construction license ("*Licença de Instalação*" or L.I.); and
- The operating license ("*Licenca de Operação*" or L.O.).

The BGL power plant has the authorization issued by ANEEL to operate as an independent power producer (*ANEEL Resolution 546 of October 8th, 2002*). AZL has formal requested to ANEEL to operate as independent power producer. This requisition is being analyzed under the process number 48100.001996/97-93, at ANNEL.

Moreover, the power plants have the following licenses emitted the environmental agency of the state of Sao Paulo (CETESB, http://www.cetesb.sp.gov.br/):

- BGL - Operating License – nº 7001294 emitted in 28/09/2004.
- AZL - Operating License – nº 7001311 emitted in 15/10/2004.

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

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

Representatives of the municipalities of Lençóis Paulista and Macatuba, where the facilities are located, participated on the public hearing process.

Besides the public discussion for the environmental licensing, the project invited local stakeholders for comments on the CDM Zillo Lorenzetti Bagasse Cogeneration Project. Several organizations and entities were invited for comments on the project:

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

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

G.2. Summary of the comments received

ZL group and the sugar mills did not receive any comments on the project.

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

No comments were received. The project was developed as planned, including the requests made by the State of Sao Paulo Environmental Agency.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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State/Region:	São Paulo
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Represented by	
Title:	Director
Salutation:	Mr.
Last Name:	Paulo Cesar
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Country:	Brazil
Telephone:	
FAX:	
Represented by	
Title:	Director
Salutation:	Mr.
Last Name:	Paulo Cesar
First Name:	Ferrari
Department:	Financial
Personal E-Mail:	pferrari@zilloren.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

BGL				
Years	Total Installed Capacity (MW)	Self-Consumption (MW)	For Export (MW)	Electricity for the grid (MWh)
Year 1_2001	25,14	10,50	14,69	62.659
Year 2_2002	26,70	10,50	16,25	57.780
Year 3_2003	60,84	19,40	41,44	130.208
Year 4_2004	60,84	19,40	41,44	167.181
Year 5_2005	60,84	19,40	41,44	195.965
Year 6_2006	60,84	19,40	41,44	195.965
Year 7_2007	60,84	19,40	41,44	195.965

AZL				
Years	Total Installed Capacity (MW)	Self-Consumption (MW)	For Export (MW)	Electricity for the grid (MWh)
Year 1_2001	22,07	11,85	10,22	39.172
Year 2_2002	22,07	11,85	10,22	33.801
Year 3_2003	22,07	11,85	10,22	35.591
Year 4_2004	22,07	11,85	10,22	52.312
Year 5_2005	22,07	11,85	10,22	45.043
Year 6_2006	22,07	11,85	10,22	45.043
Year 7_2007	22,07	11,85	10,22	45.043

Table 8 – ZLBCP – Electricity generation evolution

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

Nevertheless, even after the interconnection had been established, technical papers still divided the Brazilian system in two (Bosi, 2000)[14]:

"… where the Brazilian Electricity System is divided into three separate subsystems:

(i) The South/Southeast/Midwest Interconnected System;

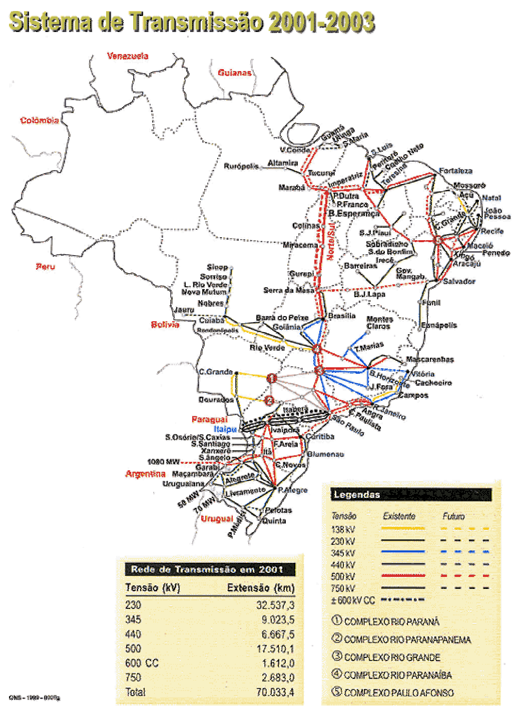
[14] Bosi, M. *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study*. International Energy Agency. Paris, 2000.

(ii) The North/Northeast Interconnected System; and

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

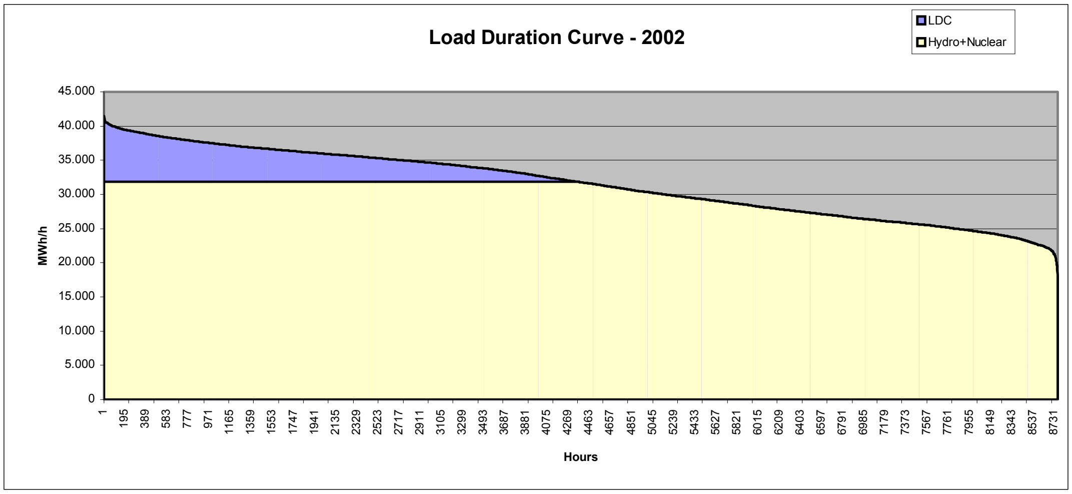


Figure 17: 2002 Load Duration Curve S/SE/MW (source: ONS – Operador Nacional do Sistema)

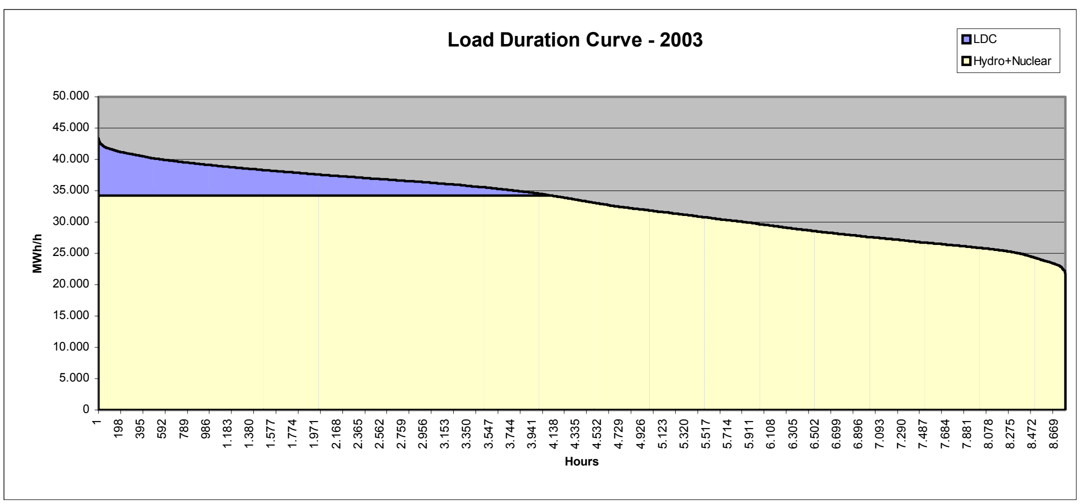


Figure 18: 2003 Load Duration Curve S/SE/MW (source: ONS – Operador Nacional do Sistema)

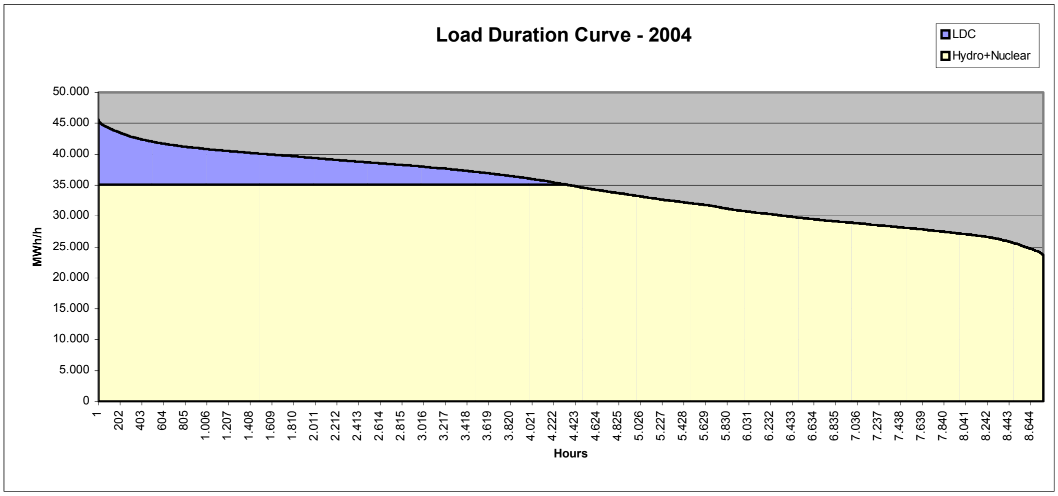


Figure 19: 2004 Load Duration Curve S/SE/MW (source: ONS – Operador Nacional do Sistema)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Annex 4

MONITORING PLAN

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

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

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