



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

CONTENTS

- A. General description of project activity
- B. Application of a baseline methodology
- C. Duration of the project activity / Crediting period
- D. Application of a monitoring methodology and plan
- E. Estimation of GHG emissions by sources
- F. Environmental impacts
- G. Stakeholders' comments

Annexes

- Annex 1: Contact information on participants in the project activity
- Annex 2: Information regarding public funding
- Annex 3: Baseline information
- Annex 4: Monitoring plan

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

Santa Cândida Bagasse Cogeneration Project (SCBCP).

Version 2 B

Date of the document: December 02nd, 2005.

The only changes made to this version of the PDD compared to the PDD version Rev.1 dated 18/08/2005 referred to in the letter of approval of the DNA of Brazil are related to the recalculation of the build margin emission factor with the plant efficiencies recommended by the CDM Executive Board at its 22nd meeting.

A.2. Description of the project activity:

This project activity consists of increasing the efficiency of the cogeneration facility at **Santa Cândida Açúcar e Alcool Ltda** (Santa Cândida), a Brazilian sugar mill. With the implementation of this project, the mill has been able to sell electricity to the national grid, avoiding that fossil-fuelled thermal plants dispatch the same amount of energy to that grid. By that, the initiative avoids CO₂ emissions, also contributing to the regional and national sustainable development.

By investing to increase steam efficiency in the sugar and alcohol production and increase the efficiency at burning the bagasse (more efficient boilers), Santa Cândida generates surplus steam and uses it exclusively for electricity production (through turbo-generators).

The sponsors of the SCBCP are concerned that bagasse cogeneration is a sustainable source of energy that brings not only advantages for mitigating global warming, but also creates a sustainable competitive advantage for the agricultural production in the sugarcane industry in Brazil. Using the available natural resources in a more efficient way, the Santa Cândida project activity helps to enhance the consumption of renewable energy. Besides that, it is used to demonstrate the viability of electricity generation as a side-business source of revenue for the sugar industry. It is worthy to highlight that out of approximately 320 sugar mills in Brazil, the great majority produces energy for on-site use only, and not for grid supply, which is mainly due to the low-efficiency cogeneration equipment installed on those sugar mills.

Furthermore, bagasse cogeneration also plays an important role on the country's economic development, as Brazil's sugarcane-based industry provides for approximately 1 million jobs and represents one of the major agribusiness products within the trade balance of the country. The Brazilian heavy industry has developed the technology to supply the sugarcane industry with equipments to provide expansion for the cogeneration, therefore such heavy industry development also helps the country creating jobs and achieving the sustainable development.

Bagasse cogeneration is important for the energy strategy of the country. Cogeneration is an alternative to postpone the installation and/or dispatch of thermal energy generation utilities. The sale of the CER generated by the project will boost the attractiveness of bagasse cogeneration projects, helping to increase the production of this energy and decrease dependency on fossil fuel.



Santa Cândida also believes that sustainable development will be achieved not only by the implementation of a renewable energy production facility, but carrying out activities which corresponds to the company social and environmental responsibilities, as described below:

Social Contribution

Santa Cândida currently employs directly circa 2000 workers in its plant site and has around 920 outsourced people. The company also participates with 60% of the costs of medical, hospital, pharmaceutical, odontological, besides other assistances for its employees. It also offers free transportation for the employees and it is now contributing with financial and human resources for the construction of a 55.000 m² recreation club for the employees. The main social programs that are also being developed by Santa Cândida:

- Social Development Program: the program aims to teach women and their dependents information of handcraft production for it may turn into a source of financial contribution for the family;
- Influenza Vaccination Program: this project has already benefited 2.383 people in 9 municipalities around the plant site;
- Blood Donation Program: the partnership with Amaral Carvalho de Jaú Foundation has since 2002 received blood from 121 donators;
- Food Basket Distribution: 126 Social Entities, in 6 municipalities, have already received food contribution;
- School Material Distribution: school material donation for APAE (Association of Parents and Friends of Autist) and Association of Bocaina of Childhood Protection (Associação Bocainense de Proteção à Infância);
- Educative Assistance: scholarships conceded to 641 employees (graduation, post-graduation or specialization courses);
- Uterus Cancer Prevention Campaign: the campaign aims to foster women employees and wife of workers to early detect and prevent the gynaecological cancer;
- Alcoholism Control Program: psychological assistance for chemical dependents and Social and Psychological control assistance weekly held.

Environmental Contribution

Besides reducing the GHG emissions by the construction of its projects, Santa Cândida has also been developing its Environmental Management System and the following environmental programs are being executed:

- Water monitoring: the natural water resources (deep and superficial layers) around the plant are having its physical, chemical and biological behaviour being monitored by Santa Cândida. The volume of water used in the process is controlled, keeping the volume rate of used water per ton of sugar cane processed one the lowest in the market;



- Residues: Industrial residues are rationally used as natural fertilizers. Packages of chemical fertilizers are given back to the producers for they can responsibly dispose them;
- Gases: Emissions of particulates and other law-regulated gases are intensively controlled;
- Modern soil use and maintenance procedures;
- Maintenance of an own nursery of native species for reforestation with 40,77 hectares and 67.923 trees planted;
- 15.000 fishes were released in the Jacaré Pepira River.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	<ul style="list-style-type: none"> • Private entity Santa Cândida Açúcar e Alcool Ltda. • Private entity Econergy Brasil Ltda. 	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

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.:

São Paulo.

A.4.1.3. City/Town/Community etc:

Bocaína.

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

Bocaína is located northwest in the State of São Paulo, about 340 kilometers (km) far from the state



capital, São Paulo, as can be seen in the following figure. The region holds an ample availability of manpower, and communication and transport infrastructures.

Figure 1: Geographical position of the city of Bocaína.

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

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

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

The predominant technology in all parts of the world today for generating megawatt (MW) levels of electricity from biomass is the steam-Rankine cycle, which consists of direct combustion of biomass in a boiler to generate steam, which is then expanded through a turbine. Most steam cycle plants are located at industrial sites, where the waste heat from the steam turbine is recovered and used for meeting

industrial-process heat needs. Such combined heat and power (CHP), or cogeneration, systems provide greater levels of energy services per unit of biomass consumed than systems that generate electric power only.

The steam-Rankine cycle involves heating pressurized water, with the resulting steam expanding to drive a turbine-generator, and then condensing back to water for partial or full recycling to the boiler. A heat exchanger is used in some cases to recover heat from flue gases to preheat combustion air, and a de-aerator must be used to remove dissolved oxygen from water before it enters the boiler.

Steam turbines are designed as either "backpressure" or "condensing" turbines. CHP applications typically employ backpressure turbines, wherein steam expands to a pressure that is still substantially above ambient pressure. It leaves the turbine still as a vapor and is sent to satisfy industrial heating needs, where it condenses back to water. It is then partially or fully returned to the boiler. Alternatively, if process steam demands can be met using only a portion of the available steam, a condensing-extraction steam turbine (CEST) might be used. This design includes the capability for some steam to be extracted at one or more points along the expansion path for meeting process needs ([Figure 2](#)). Steam that is not extracted continues to expand to sub-atmospheric pressures, thereby increasing the amount of electricity generated per unit of steam compared to the backpressure turbine. The non-extracted steam is converted back to liquid water in a condenser that utilizes ambient air and/or a cold water source as the coolant¹.

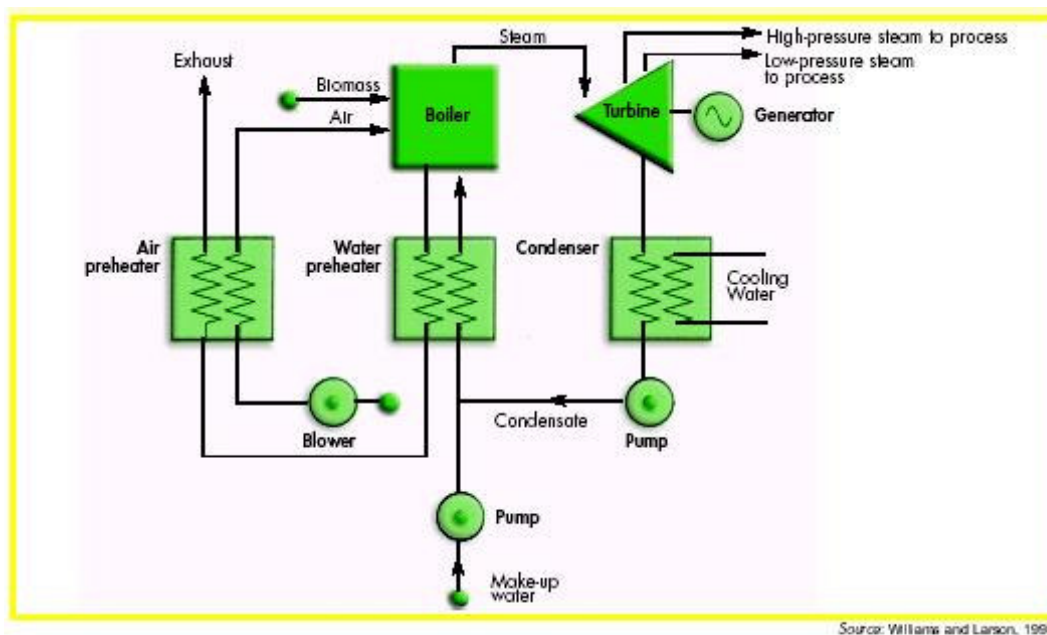


Figure 2: Schematic diagram of a biomass-fired steam-rankine cycle for cogeneration using a condensing-extraction steam turbine

The steam-Rankine cycle uses different boiler designs, depending on the scale of the facility and the characteristics of the fuel being used. The initial pressure and temperature of the steam, together with the pressure to which it is expanded, determine the amount of electricity that can be generated per kilogram of steam. In general, the higher the peak pressure and temperature of the steam, the more efficient, sophisticated, and costly the cycle is.

¹ Williams & Larson, 1993 and Kartha & Larson, 2000, p.101



Using steam-rankine cycle as the basic technology of its cogeneration system, for achieving an increasing amount of surplus electricity to be generated, Santa Cândida began its efforts in two phases, which are:

<p>► Phase 1 (2002): In this first phase, a new boiler of 42 kgf/cm² (150 ton of steam per hour) was added to the existing two 21 kgf/cm² boilers (70 ton and 100 ton of steam per hour at 450 °C each, respectively). With the new boiler, the steam production was increased from 156 ton/h to 268 ton/h. A new back-pressure turbo generator of 15 MW was installed, increasing the installed capacity from 5,6 MW to 20,6 MW. In the year 2002, 7,4 MW was dedicated for internal consumption and 9,3 MW for export to the grid.</p>	<p>► Phase 2 (2003): On the second phase in 2003, another 12 MW condensing-type turbo-generator was purchased, totalling 32,6 MW of installed capacity. In this year, 7,7 MW is being consumed in its own operation and 14,5 MW is being exported to the grid. The electric energy is sold through a ten-year Power Purchase Agreement (PPA) with CPFL².</p>
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Besides the investment in energy generation, there was an investment in the new technology for the process: single stages turbines were changed by multiple stage turbines, the steam originated from the boiling sugarcane juice had its use optimized and so was the water-pre-heating system before it enters the boilers. The water consumption of the process was then reduced, enabling to increase the sugarcane crushing capacity in 60% with no additional water catchment. The consumption of steam to process will be reduced from 520 kg of steam per ton of cane to 460 kg of steam per ton of cane, allowing that more spare steam is supplied for electric energy generation purposes and thus, more electric energy exported to the grid.

After the second phase, Santa Cândida operates with 3 boilers (66 ton – 21 kgf/cm²; 100 ton – 21 kgf/cm²; 150 ton – 42 kgf/cm²) and 3 turbo-generators (15MW; 12MW; 2 MW). The evolution of the efficiency of the process is shown in the table below:

Table 1: Efficiency increase in Santa Cândida's steam consumption (kg of steam / ton of sugar cane processed)

1998	1999	2000	2001	2002	2003	2004
500	500	500	500	460	460	430

Below, is a table which summarizes the energy produced and expected for the coming years of Santa Cândida:

Table 2: Historical and Expected Energy Generation Data for Santa Cândida.

	1999	2000	2001	2002	2003	2004 ³
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² CPFL is a leading energy distributor.

³ The mill sold this year the two backpressure turbo-generators (one of 1,6 and one of 2 MW) which were in stand-by.



Total Capacity Installed (MW)	5,6	5,6	5,6	20,6	32,6	29,0
Exported Energy (MWh)	0	0	0	7625	66700	66700

Moreover, the technology for expanding the electricity availability from biomass in the sugar industry is for the local utility companies an advantage, as the baseload for the utilities in Brazil is supported mainly through generation and the sugarcane crop, coincidentally, supplies electricity during the dry season.

The

Figure 3 to 4 below show the detailed location of the project activity installed equipments on Santa Cândida's site and installed electric engines.

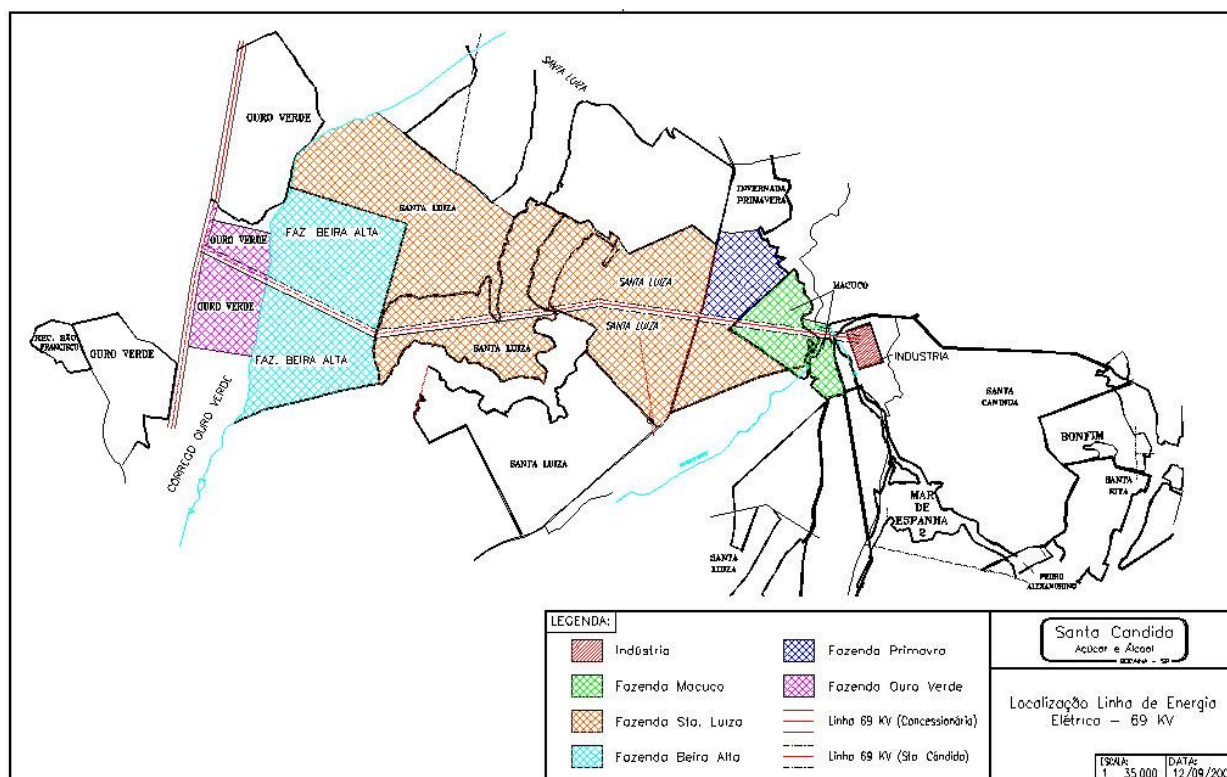


Figure 3: Location of the 69 kV Transmission Line

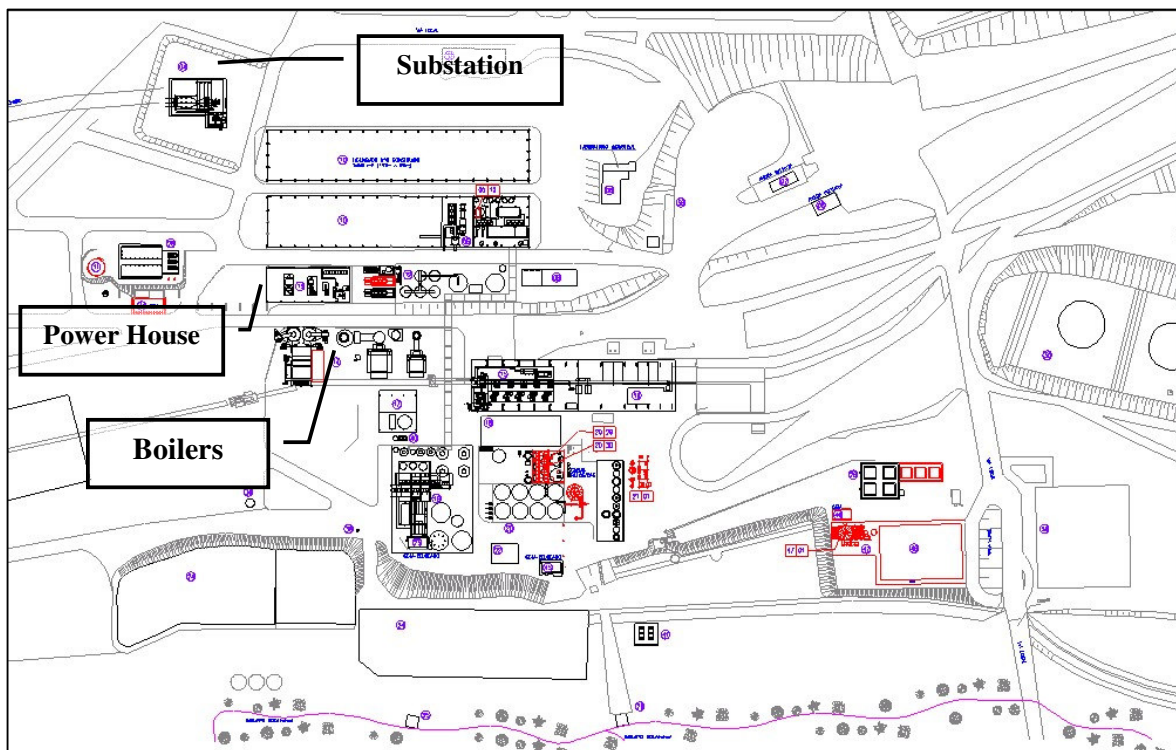


Figure 4: Location of installed equipments for bagasse cogeneration Santa Cândida



Table 3 shows project activity implementation schedule for bagasse cogeneration project.

Table 3: Santa Cândida Bagasse Cogeneration Project Technical Data

	Active / Activating			Stand-by	
Before the Expansion Plan 2001	2 backpressure turbo-generator (2 MW)	1 backpressure turbo-generator (1,6 MW)			
	2 boilers (21 bar)				
Phase 1 2002	1 backpressure turbo-generator (15 MW)	2 backpressure turbo-generator (2 MW)	1 backpressure turbo-generator (1,6 MW)		
	1 boiler (42 bar)	2 boiler (21 bar)			
Phase 2 2003	1 condensing- type turbo- generator (12 MW)	1 backpressure turbo-generator (15 MW)	1 backpressure turbo-generator (2 MW)	1 backpressure turbo- generator (2 MW)	1 backpressure turbo- generator (1,6 MW)
		1 boiler (42 bar)	2 boiler (21 bar)		

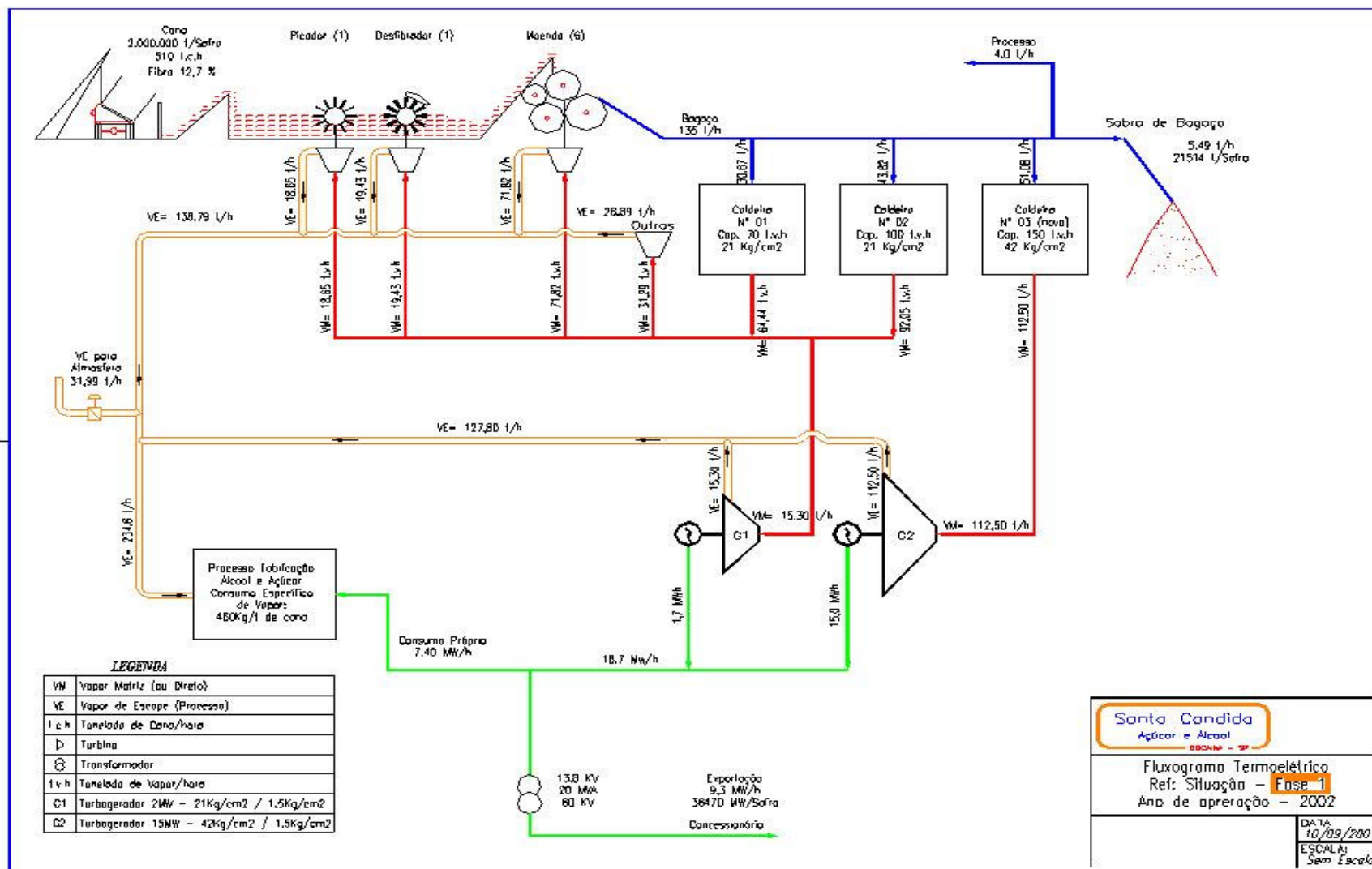


Figure 5: Energy Balance Diagram Document for Phase 1

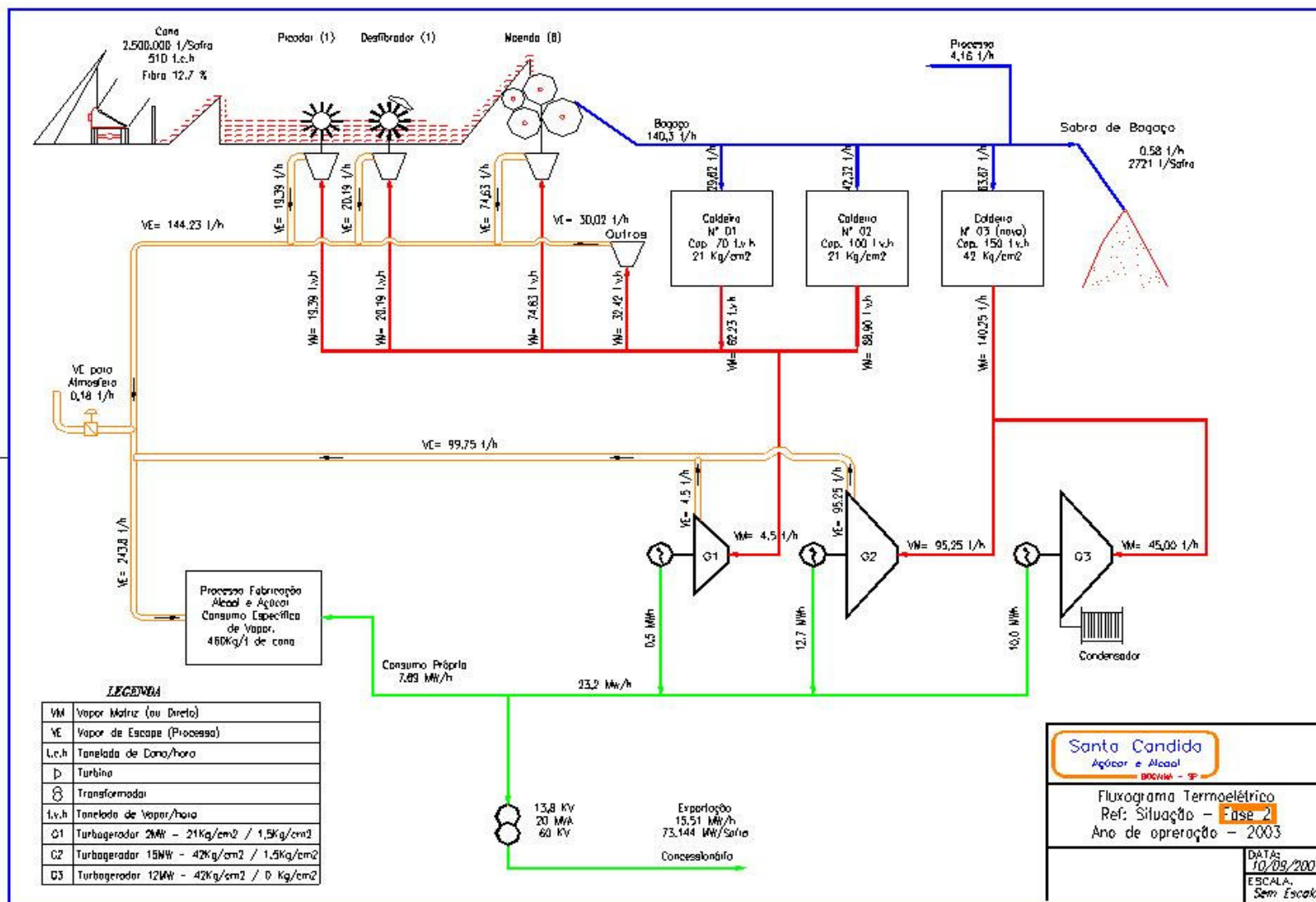


Figure 6: Energy Balance Diagram Document for Phase 2



Further, as bagasse cogeneration requires a constant bagasse supply to the sugar mill's boilers, if there is an interruption in bagasse supply, for example due to an interruption in sugarcane supply to the mill, the boilers would not be able to produce the steam required by both the sugar/ethanol production process and the power-generation. Therefore, in order to avoid power-generation interruptions, the cogeneration expansion plan in SCBCP includes investments in the sugar/ethanol production process that reduce the steam consumption in the sugar and ethanol production processes. This fine-tune improvement is necessary in order to drive as much steam as possible to the cogeneration project. Consequently, the greater the quantity of electricity production, the higher the investment per MWh produced is sought.

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 sectoral policies and circumstances:

By dispatching renewable electricity to a grid, electricity that would otherwise be produced using fossil fuel is displaced. This electricity displacement will occur in the system's margin, i.e. this CDM project will displace electricity that is produced by marginal sources (mainly fossil fueled thermal plants), which have higher electricity dispatching costs and are solicited only over the hours that baseload sources (low-cost or must-run sources) cannot supply the grid (due to higher marginal dispatching costs or fuel storage – in case of hydro sources – constraints).

Bagasse is a fibrous biomass by-product from sugarcane processing, which accounts for about 25 percent on weight of fresh cane and approximately one third of the cane's energy content. In a typical Brazilian sugarcane mill, burning bagasse for generation of process heat and power production is a practice already established. It is estimated that over 700 MW of bagasse-based power capacity are currently installed in the state of São Paulo only⁴. The energy produced from these facilities is almost all consumed for their on purpose. Because of constraints that limited the access of independent power producers to the electric utilities market, there is no incentive for sugarcane mills to operate in a more efficient way. Low-pressure boilers, very little concern with optimal use and control of steam, crushers mechanically activated by steam, energy intensive distillation methods, are a few examples of inefficient methods applied to the sugar industry as normal routine.⁵

The Brazilian electric sector legislation currently recognizes the role of independent power producers, which has triggered interest in improving boiler efficiency and increasing electricity generation at mills, allowing the production of enough electricity not only to satisfy sugar mills' need but also a surplus amount for selling to the electricity market. Furthermore, the ever increasing electricity demand opens an opportunity for some bagasse cogeneration power plants in Brazil. Additionally, the feature of electricity generation from sugarcane coinciding with dry months of the year, when hydroelectric generation system - the most important electricity source in the country - is under stress, should provide a considerable complementary energy and make the bagasse cogeneration electricity attractive for any potential purchasers.

Nevertheless, some barriers pose a challenge for implementation of this kind of projects. In most cases, the sponsors' culture in the sugar industry is very much influenced by the commodities – sugar and ethanol – market. Therefore, they need an extra incentive to invest in electricity production due to the

⁴ São Paulo. Secretary of Energy, 2001.

⁵ Nastari, 2000.



fact that it is a product that can never be stored in order to speculate in price. The Power Purchase Agreement requires different negotiation skills, which is not the core of the sugar industry. For instance, when signing a long-term electricity contract, the PPA, a given sugar mill has to be confident that it will produce sufficient biomass to supply its cogeneration project. Although it seems easy to predict, the volatility of sugarcane productivity may range from 75 to 120 ton of sugarcane per hectare annually depending on the rainfall. So, the revenue from GHG emission reductions and other benefits associated with CDM certification offer a worthy financial comfort for the sugar mills, like Santa Cândida, which is investing to expand its electric power generation capacity and to operate in a more rationale way under the above mentioned new electric sector circumstances.

This project activity is to reduce **69.041 tCO₂e** over 7 years.

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

Years	Annual estimation of emission reductions in tonnes of CO ₂ e
2002	2.423
2003	10.205
2004	5.917
2005	13.920
2006	13.920
2007	13.920
2008	13.920
Total estimated reductions (tonnes of CO₂e)	74.225
Total Number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO₂e)	10.604

A.4.5. Public funding of the project activity:

No public funding was requested.

SECTION B. Application of a baseline methodology

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

AM0015: Bagasse-based cogeneration connected to an electricity grid.



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

This methodology is applicable to SCBCP because all the bagasse utilized by Santa Cândida is produced internally as a by-product from sugarcane processing (alcohol and sugar production); the clean development mechanism encouraged the project owners to proceed with the project, as the CDM has been since the initial designing phase considered a desirable benefit sought by the project's sponsors; bagasse production shall change only if sugar or alcohol production is also increased and this project activity is based only in the efficient use of bagasse, not in its increase, therefore this project activity does not increase the bagasse production; and finally, no bagasse will be stored for more than one year. Actually, the maximal period over which bagasse will be stored is during off-season (approximately 6 months).

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

The project activity follows the steps provided by the methodology taking into account the (b) Simple Adjusted OM calculation for the STEP 1, since there would be no available data for applying to the preferred option – (c) *Dispatch Data Analysis OM*. For STEP 2, the option 1 was chosen. The following table presents the key information and data used to determine the baseline scenario.

ID number	Data type	Value	Unit	Data Source
1. EG_y	Electricity supplied to the grid by the Project.	Obtained throughout project activity lifetime.	MWh	Project owner
2. EF_y	CO ₂ emission factor of the Grid.	0,2677	tCO ₂ e/MWh	Calculated
3. $EF_{OM,y}$	CO ₂ Operating Margin emission factor of the grid.	0,4310	tCO ₂ e/MWh	This value was calculated using data information from ONS, the Brazilian electricity system manager.
4. $EF_{BM,y}$	CO ₂ Build Margin emission factor of the grid.	0,1045	tCO ₂ e/MWh	This value was calculated using data information from ONS, the Brazilian electricity system manager.
10. λ_y	Fraction of time during which low-cost must-run sources are on the margin.	$\lambda_{2002} = 0,5053$ $\lambda_{2003} = 0,5312$ $\lambda_{2004} = 0,5041$	-	This value was calculated using data information from ONS, the Brazilian electricity system manager.

**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:****Application of the Tool for the demonstration and assessment of additionality of Santa Cândida.****Step 0. Preliminary screening based on the starting date of the project activity**

1. (a) The starting date of this project activity occurred in year 2002, in the beginning of this year's harvest season, which is evidenced by the purchase of the major equipment - the boiler - in 20 April 2001.

1. (b) Mr. Guilherme Dumit, responsible for this project, attended to two specialization courses: "Curso de Especialização em Engenharia de Controle da Poluição Ambiental, LATU – SENSU. Faculdade de Saúde Pública da Universidade de São Paulo – USP" (Specialization course of Environmental Pollution Control of Public Health Faculty in University of São Paulo), from February to December in year 1999 and, from February to December in year 2000, "Curso de Especialização em Gestão Ambiental, LATU – SENSU. Faculdade de Saúde Pública da Universidade de São Paulo – USP e Faculdade de Arquitetura e Urbanismo – FAU" (Specialization course of Environmental Management of the Public Health Faculty and Architecture and Urbanism Faculty in University of São Paulo). Both courses treated in detail, as one of the main themes, of the Kyoto Protocol and the upcoming carbon market. Therefore, he was since that time having in mind the potential revenue stream that could come from the existence of CDM, i.e. the CERs sales, and contacts with current CDM players. Moreover, Santa Cândida is associated to UNICA⁶, which was sponsor of the seminar "Fonte de recursos para projeto: o CDM – Clean Development Mechanism" (Source of resources for Projects: CDM – Clean Development Mechanism), which took place in São Paulo, April 7th, 2000. By that time the CDM source of funding was presented by Ms Sandra Brown from Winrock International, Mr. Gylvan Meira Filho from IPCC, Mr. Bernard Grimm from TÜV Süddeutschland, Mr. Edwin Aalders from SGS, Mr. Ricardo Britto Santos Pereira from UNICA and Mr. Leal Lima from Copersucar.

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. There were only two possibilities to implement this project activity: one was to continue the current situation of the sugar mill, focusing only on the production of sugar and alcohol and invest in enhancing the efficiency and increasing the scale of its core business. The other option was the project activity undertaken, which is the investment made to increase steam efficiency and production for electricity sales purposes by acquiring high-efficiency boilers and turbo-generators.

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

2. As it can be seen in section F, this project activity complies with all environmental laws and also complies with other applicable laws and regulatory requirements. As the other alternative was to continue with the situation before the decision of implementing this CDM project activity, it is considered that it would comply with all applicable requirements.

⁶ União da Agroindústria Canavieira de São Paulo



3. Non applicable.
4. Both alternatives are in compliance with all regulations.

Step 3. Barrier analysis

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

1+2. According to COELHO (1999)⁷, “large scale cogeneration program in sugar-alcohol sector has not yet occurred, due to several barriers, mainly economic, political and institutional”, such as:

I. Technological Barriers

Technological barriers represent a very important issue for increasing bagasse cogeneration in Brazil, for despite of the fact that Rankine-cycle is a well known technology, the cogeneration units operate with low-efficiency and are not competitive comparing to other generation options. In this way there is a tricky issue about technology and economic value for such technology. Although this technology is well developed, the economic value for its application is not for projects on the scale similar to the sugar mills in Brazil. COELHO (1999) justifies that by highlighting that the unitary costs (\$/installed MW) are significantly influenced by scale-effect. As the bagasse cogeneration unit should have a small scale due to the high cost for transportation of the fuel (bagasse), investments are high. Therefore, as a lower cost of capital is wanted, the result is a simplified installation and lower efficiency.

COELHO (1999) also states that the great majority of the sugar mills still rely on inefficient technology, such as on 22 bar pressure boilers, even in the state of São Paulo, the most industrialized in Brazil. Moreover, when there is a necessity to change equipments, it is usual not consider purchasing high-efficiency boilers due to conservativeness, lack of knowledge or even lack of interest to generate surplus steam for electricity sales purposes.

Moreover, SWISHER (1997)⁸ considers difficult to convince the local distributor that the energy to be acquired, generally generated during the harvest season, is sufficiently reliable to be accounted in the distributor's planning.

II. Institutional and Political Barriers

From the electric sector point of view, according COELHO (1999), acquiring electricity other than hydroelectric would not be a priority, arguing that for the electricity is generated only during the harvest season, no firm energy could be offered. However, the biggest advantage of the bagasse based electricity is that it is produced during the period where hydroelectric plants face difficulties due to the low level of rains. As a result, COELHO (1999) suggests that there is a significant prejudice and conservativeness of the distributors when deciding whether to purchase or not bagasse based energy.

⁷ COELHO, Suani T. *Mecanismos para implementação da cogeração de eletricidade a partir de biomassa*: Um Modelo para os Estado de São Paulo. São Paulo: Programa Interunidades de Pós-graduação em energia, 1999.

⁸ SWISHER, J. *Using Area-Specific Cost Analysis to Identify low Incremental-cost Renewable Energy Options*: A Case Study of Co-generation Using Bagasse in the State of São Paulo. Washington DC: Prepared for Global Environment Facility (GEF) Secretariat, 1997.



From the sugar mill point of view, save rare exceptions, COELHO (1999) says that the great majority of sugar mills do not consider investments in cogeneration (for electricity sale) as a priority. The sector “even in the new political context, does not seem to have motivation to invest in a process that it sees with mistrust and no guarantees that the product will have a safe market in the future. Moreover, it is a fact that “the sugar mills are essentially managed by families, which hurdles the association with external financial agents”, and allowing the sector to be more competitive and diversifying its investment.

From the point of view of the economic agents, the excessive level of the guarantees required to finance the projects, commonly is a barrier to achieve a financial feasibility stage, deeply discussed in SWISHER (1997).

Other barriers have more to do with the lack of adequate commercial contractual agreements from the energy buyers (i.e. bankable long-term contracts and payment guarantee mechanisms for non-creditworthy local public-sector and private customers) and that influences directly making more difficult to obtain a long-term financing from a bank and/or development bank. Some other financing barriers occur simply due to prohibitively high transaction costs, which include the bureaucracy to secure the environmental license.

Since 1997, according to SWISHER (1997), the announcement of a Cogeneration Decree has been awaited, and that was supposed to have this positive influence on corporate decision-making with respect to biomass project implementation. The original Cogeneration Decree proposal, which was never approved, called for mandatory purchase by the regional utilities - “*concessionárias*” - from cogenerating and self-generating facilities⁹. Instead of renewable energy, the government expansion plan for electric energy, approved in August is based on fossil fuel – Natural Gas. This expansion plan called Thermoelectricity Priority Plan (PPT) became a reality right before the energy crisis. The Thermoelectricity Priority Plan beneficiaries, which were mainly natural gas thermal plants, through the Ministry of Mines and Energy (MME) Decree 3,371 from December 2000, counted on guaranteed, long term and attractive price conditions on Natural Gas supply and Energy sales, together with financing from the national development bank BNDES. And though the PPT plan is not likely to be fully implemented, the public-sector policies for renewable energy are not considered reliable enough by the executives of the private sector to support cogeneration expansion in the sugar mills. This assumption is clearly shown in the following list of rules and/or regulations to the energy sector that have been set in the last 10 years:

- **March 1993:** Law 8.631 sets a tariff regulation for electric energy;
- **February 1995:** Law 8.987 establish public concession for energy;
- **July 1995:** Law 9.074 regulates concession for electric energy sector;
- **December 1996:** Law 9.427 creates National Energy Agency (ANEEL);
- **August 1997:** Law 9.478 sets the National Council for Energy Planning (CNPE);
- **October 1997:** Decree 2.335 regulates the ANEEL task;
- **December 1997:** Implements ANEEL;

⁹ Presidential Decree on the co-generation of electric energy, draft of 5 August 1997.



- **May 1998:** Law 9.648 establishes the Spot Market for Electric Energy (MAE) and the Operator National System (ONS);
- **July 1998:** Decree 2.655 regulates MAE and ONS tasks;
- **December 2000:** Decree 3.371 regulates the Thermoelectricity Priority Plan (PPT);
- **April 2002:** Law 10.438 sets the Program for Incentive Alternative Energy (PROINFA), stating that contracts shall be signed within 24 months from its date and that there will be different economic values for the acquisition of 3.300MW of electricity capacity from renewable sources by the state owned Eletrobrás, for plants starting operations before December 30, 2006;
- **August 2002:** MP 64 is a presidential act to change the constitution in order to permit the energy sector regulation including the PROINFA;
- **December 2002:** Resolution 4.541 from ANEEL regulates the implementation of PROINFA, stating that economic values would be defined within 90 days;
- **March 2003:** Decree 4.644 postponed for 180 days, from its date, the economic value and operational guidelines announcement;
- **June 2003:** Decree 4.758 indefinitely postponed the date for the economic value and operational guidelines announcement and revoked the above mentioned Decree 4.644.
- **November 2003:** Law 10.762 of 11 November/03 revised Law 10.438 of 26 April 2002 institutes PROINFA.
- **March 2004:** Decree 5.025 regulates the Law 10.438 as of 26 April 2002.

For this CDM project analysis purposes, by the time the project started there were no institutional incentive like PROINFA to be considered. Therefore, the company's decision on signing a long-term PPA with the local distributor undoubtedly represented a significant risk that the mill was willing to risk.

Although PROINFA entered into force in the year 2004, it does not affect the current PPAs, because PROINFA is planned to buy energy from project that will generated electricity by January 2006 only. Therefore, the project activity does not have its operating phases eligible for the PROINFA.

In addition to the above paragraph, only 572 MW of biomass cogeneration projects were licensed and selected by PROINFA, although the total amount expected to be contracted by Eletrobras was 1.100 MW. That clearly shows the economic value proposed by PROINFA for biomass is not enough to foster such projects to fly. The conclusion about PROINFA is that it is still uncertain whether or not, and how much, it will benefit small renewable energy production.

III. Economic and Investment Barriers

“There are several reasons for the Brazilian utilities' reluctance to offer higher prices for co-generated power. One important reason stems from their assumption that their costs are geographically uniform – i.e., that there is essentially a single value for their avoided cost in the industrial sector. If this cost value does not indicate that sufficient savings are available from buying co-generated power, and then there is



little economic motivation, under either a public monopoly or a privatized competitive structure, for a utility to pay enough for co-generation to satisfy potential investors' financial criteria"¹⁰ as stated by SWISHER (1997). In fact, the economic cost is the reason that Brazilian utilities do not buy cogeneration electricity energy, at least, while the energy sector regulation does not guarantee them the right to pass such cost through the end user tariff. The cost of cogeneration electricity ranges from US\$ 35 to US\$ 105 per MWh, according to the Expansion Plan 2001-2010 from Brazil Government, which is described as higher than the marginal cost for electricity expansion in the system – US\$ 33/MWh¹¹.

COELHO (1999) also highlights one of the major problems of selling surplus energy to the grid as being the economic value paid to the sugar mills as not enough to remunerate the capital invested in the expansion of a cogeneration project. Furthermore, "the fee for accessing the grid does not contribute for making feasible the sale of the surplus energy to the distributors".

Summarizing, SWISHER (1997) considers that the main difficulties are found in: (a) **small sizes of projects and installation costs**: in addition to the high cost for installation, the fix cost component is high and cannot be absorbed by the global economic project. (b) **availability of long-term financing**: traditionally, infrastructure projects use to have a wider access to long-term financing, situation that has changed after the electric sector privatization. (c) **lack of guarantees**: besides technical guarantees, investors require commercial guarantees establishing a paradox: privatization is to foster a market based economy but banks still require governmental guarantees to ensure long-term investments in the private sector, (d) **lack of local funding**: lack of familiarity with project finance tools and due to the high interest rates in Brazil.

Moreover, it is important to note that the electricity commercialization business is responsible for a very small part of the total revenues of the mill – 2,24% for the fiscal year of 2004.

IV. Cultural Barrier

Due to the nature of the business in the sugar industry the marketing approach is narrowed focused on commodity type of transaction. Therefore, the electricity transaction based on long-term contract (Power Purchase Agreement) represents a significant breakthrough on their business model. In this case, the electricity transaction has to represent a safe investment opportunity from both economical and social-environmental perspective for convincing the sugar mills to invest in.

There are also questions regarding the managerial capacity of the companies that comprise the Brazilian sugarcane industry. In many cases, they have demonstrated the will to undertake investments in new technologies, but without sufficient financial and entrepreneurial capacity to complete such projects, according to WALTER (1994)¹².

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity).

¹⁰ Joel Swisher personal communication with Rolls Royce Power Ventures project manager, Mark Croke, August 26, 1997. Swisher J. 1997 pg. 76.

¹¹ "As can may be seen, the unit costs of the alternative sources of energy are still high compared to the marginal cost of expanding the system, nowadays calculated as US\$33/MWh". Translation by Econergy Brasil. IN: BRAZIL, Ministry of Mines and Energy, 2001, pg. 80.

¹² WALTER, A.C.S. *Viabilidade e perspectivas da co-geração e geração termelétrica no setor sucro-alcooleiro*, 1994. Thesis (Doctorate). UNICAMP, Campinas



3. As exposed above, the other alternative to this project activity was to keep the current situation and focus strictly in its core business which is the production of sugar and alcohol. Therefore, as the barriers mentioned above are directly related to entering into a new business (electricity sale), there is no impediment for sugar mills to maintain (or even invest in) its core business.

Step 4. Common practice analysis.

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

1. The sugar sector, historically, always exploited its biomass (bagasse) in an inefficient manner by making use low-pressure boilers. Although they consume almost all of their bagasse for self-energy generation purposes, it is done in such a manner that no surplus electric energy is available for sale, and no sugar company has ventured in the electricity market until the recent years.

A similar project activity was implemented by the leading company in this industry – Cia Açucareira Vale do Rosário. However, this is a single example in a universe of about 320 sugar mills. Currently, there are other similar project activities under implementation, for instance Cia Energética Santa Elisa, Moema, Equipav, Nova América and others. These projects are restricted to by approximately 10% of the sugar industry, since the other 90% are still burning their bagasse for on-site use only in the old-fashioned inefficient way. That clearly shows that just a small part of this sector is willing to invest in cogeneration projects. Moreover, the majority of the similar projects, which are currently being implemented, are carried out as CDM project activities (so far, Econergy has reported at least 26 CDM bagasse cogeneration projects in Brazil).

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

2. This project activity type is not considered as a widely spread activity in Brazil for only a small portion of the existing sugar mills in the country actually produce electricity for sale purposes. Also, most of the existing similar activities are being developed as CDM project activities.

Step 5. Impact of CDM registration

The impact of registration of this CDM project activity will contribute to overcome all the barriers described in this Tool: technological, institutional and political, economic and investment and cultural barriers by bringing more solidity to the investment itself and, therefore, fostering and supporting the project owners' decision to the breakthrough on their business model. In this way, the project activity is already engaged in negotiation to sell its expected CERs.

Moreover, the CDM project registration must influence other similar projects to move toward the use of CER sales as economic benefits, therefore there would also be a benefit by having all of those followers working strictly on the sustainable environmental management, as this is requested by any project intending to registry.

In addition to the benefits and incentives mentioned in the text of the Additionality Tool published by the CDM-EB, will also be experienced by the project activities such as: the project will achieve the aim of anthropogenic GHG reductions; financial benefit of the revenue obtained by selling CERs will bring more robustness to the project's financial situation; and its likely to attract new players and new



technology (there are companies currently developing new type of boilers – extra-efficient – and the purchase of such equipment is to be fostered due to CER sales revenue) and reducing the investor's risk.

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

The definition of the project boundary related to the baseline methodology is applied to the project activity in the following way:

Baseline energy grid: For SCBCP, the South-Southeast and Midwest subsystem of the Brazilian grid is considered as a boundary, since it is the system to which Santa Cândida is connected and therefore receives all the bagasse-based produced electricity.

Bagasse cogeneration plant: the bagasse cogeneration plant considered as boundary comprises the whole site where the cogeneration facility is located.

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:

1. Date of completing the final draft of this baseline section: 02/12/2005.
2. Name of person/entity determining the baseline:

ECONERGY (Contact Information in Annex 1), which is a participant in this project, is responsible for the technical services related to GHG emission reductions, and is therefore, in behalf of Santa Cândida, the developer of this document, and all its contents.

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:

11/06/2002

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

25y-0m.¹³

¹³ Specialists from the Brazilian National Agency of Electric Power (ANEEL - Agência Nacional de Energia Elétrica) suggest using 25 years of lifetime for steam turbines, combustion turbines, combined cycle turbines and nuclear power plants, according to Bosi, 2000, p. 29.

**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:**

11/06/2002

C.2.1.2. Length of the first crediting period:

7y-0m

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

Left blank on purpose.

C.2.2.2. Length:

Left blank on purpose.

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 monitoring methodology was designed to be applied to the Vale do Rosario CDM Project, however, due to the great project similarity, the same methodology was chosen in order to monitor the emissions reduction of this project activity.

The applicability of the methodology is described in the paragraph B1.1 of this document.

**D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario**

There is no project emission to be considered in this project activity.

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

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

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

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

ID number (Please use numbers to ease cross-referencing to table D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. EG _y	Electricity supplied to the grid by the Project.	Readings of the energy metering connected to the grid and Receipt of Sales.	MWh	M	Monthly	100%	Electronic and paper	Double check by receipt of sales. Will be archived according to internal procedures, until 2 years after the end of the crediting period.

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2. EF_y	CO ₂ emission factor of the Grid.	Calculated	tCO ₂ e/MWh	C	At the validation and baseline renewal	0%	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.
3. $EF_{OM,y}$	CO ₂ Operating Margin emission factor of the grid.	Factor calculated from ONS, the Brazilian electricity system manager.	tCO ₂ e/MWh	C	At the validation and baseline renewal	0%	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.
4. $EF_{BM,y}$	CO ₂ Build Margin emission factor of the grid.	Factor calculated from ONS, the Brazilian electricity system manager.	tCO ₂ e/MWh	C	At the validation and baseline renewal	0%	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.
10. λ_y	Fraction of time during which low-cost/ must-run sources are on the margin.	Factor calculated from ONS, the Brazilian electricity system manager.	index	C	At the validation and baseline renewal	0%	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

$EF_{OM, simple_adjusted, y} = (1 - \lambda_y) \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}} \quad (\text{tCO}_2\text{e/GWh})$	<p>$F_{i,j(or\ m),y}$ Is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y</p> <p>j,m Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports⁴ from the grid</p> <p>$COEF_{i,j(or\ m),y}$ Is the CO₂ emission coefficient of fuel i (tCO₂ / mass or volume unit of the</p>
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$EF_{BM} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}} \text{ (tCO}_2\text{e/GWh)}$ $EF_{electricity} = \frac{EF_{OM} + EF_{BM}}{2} \text{ (tCO}_2\text{e/GWh)}$ $BE_{electricity,y} = EF_{electricity} \cdot EG_y$	<p>fuel), taking into account the carbon content of the fuels used by relevant power sources j (or m) and the percent oxidation of the fuel in year(s) y, a</p> <p>$GEN_{j(or m),y}$ Is the electricity (MWh) delivered to the grid by source j (or m)</p> <p>$BE_{electricity,y}$ Are the baseline emissions due to displacement of electricity during the year y in tons of CO_2</p> <p>EG_y Is the net quantity of electricity generated in the bagasse-based cogeneration plant due to the project activity during the year y in MWh, and</p> <p>$EF_{electricity,y}$ Is the CO_2 baseline emission factor for the electricity.</p>
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D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

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

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

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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**D.2.3. Treatment of leakage in the monitoring plan****D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity**

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

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D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

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D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

$$ER_y = BE_{\text{thermal}, y} + BE_{\text{electricity}, y} - PE_y - L_y$$

$$BE_{\text{thermal}, y} = 0$$

$$PE_y = 0$$

$$L_y = 0$$

$$BE_{\text{electricity}, y} = EF_{\text{electricity}} \cdot EG_y$$

ER_y : are the emissions reductions of the project activity during the year y in tons of CO₂

$BE_{\text{electricity}, y}$: Are the baseline emissions due to displacement of electricity during the year y in tons of CO₂

$BE_{\text{thermal}, y}$: Are the baseline emissions due to displacement of thermal energy during the year y in tons of CO₂

PE_y : Are the project emissions during the year y in tons of CO₂.

L_y : Are the leakage emissions during the year y in tons of CO₂.

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

Data (Indicate table and ID number e.g. 3.-1.; 3.2.)	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	Low	These data will be directly used for calculation of emission reductions. Sales record and other records are used to ensure the consistency.
2	Low	Data does not need to be monitored
3	Low	Data does not need to be monitored
4	Low	Data does not need to be monitored
10	Low	Data 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

The structure for monitoring this project activity will basically consist of registering the amount of energy sold to the grid (EG_y). There are two operations that the project operators must perform in order to ensure data consistency, despite of the fact that this will actually consist of the monitoring of one single variable.

1. The monthly readings of the calibrated meter equipment must be recorded in an electronic spreadsheet
2. Sales receipt must be archived for double checking the data. In case of inconsistency, these are the data to be used.

Moreover, according to the law, the meter equipment shall be periodically calibrated to comply with the regulations for independent power producers connected to the regional grid.

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

ECONERGY , which is not a participant in this project, is the responsible for the technical services related to GHG emission reductions, and is therefore, in behalf of Santa Cândida, the developer of this document, and all its contents.

**SECTION E. Estimation of GHG emissions by sources****E.1. Estimate of GHG emissions by sources:**

This project activity does not burn any additional quantity of fossil fuel due to the project implementation, the variable PE_y , presented in the methodology, does not be monitored.

Thus, $PE_y = 0$

E.2. Estimated leakage:

This project activity has not affected the average amount of bagasse usually sold previous to the implementation of the project. Moreover, the average amount of bagasse usually sold by from 1998 to 2003 is 26.766 tons, with a standard deviation of 18.719 tons. Therefore, this number is barely 5% of the total bagasse produced, which may be neglected.

Thus, $L_y = 0$

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

$L_y + PE_y = 0$

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

The baseline methodology considers the determination of the emissions factor for the grid to which the project activity is connected as the core data to be determined in the baseline scenario. In Brazil, there are two main grids, South-Southeast-Midwest and North-Northeast, therefore the South-Southeast-Midwest Grid is the relevant one for this project.

The method that will be chosen to calculate the Operating Margin (OM) for the electricity baseline emission factor is the option (b) *Simple Adjusted OM*, since the preferable choice (c) *Dispatch Data Analysis OM* would face the barrier of data availability in Brazil.

In order to calculate the Operating Margin, daily dispatch data from the Brazilian electricity system manager (ONS) needed to be gathered. ONS does not regularly provide such information, which implied in getting it through communicating directly with the entity.

The provided information comprised years 2002, 2003 and 2004, and is the most recent information available at this stage.

Simple Adjusted Operating Margin Emission Factor Calculation

According to the methodology, the project is to determine the Simple Adjusted OM Emission Factor ($EF_{OM, \text{ simple adjusted}, y}$). Therefore, the following equation is to be solved:



$$EF_{OM, simple_adjusted, y} = (1 - \lambda_y) \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}} \quad (\text{tCO}_2\text{e/GWh})$$

It is assumed here that all the low-cost/must-run plants produce zero net emissions.

$$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}} = 0 \quad (\text{tCO}_2\text{e/GWh})$$

Please refer to the methodology text or the explanations on the variables mentioned above.

The ONS data as well as the spreadsheet data with the calculation of emission factors have been provided to the validator (DOE). In the spreadsheet, the dispatch data is treated as to allow calculation of the emission factor for the most three recent years with available information, which are 2002, 2003 and 2004.

The Lambda factors were calculated in accordance with methodology requests. More detailed information is provided in Annex 3. The table below presents such factors.

Year	Lambda
2002	0,5053
2003	0,5312
2004	0,5041

Electricity generation for each year needs also to be taken into account. This information is provided in the table below.

Year	Electricity Load (MWh)
2002	275.402.896
2003	288.493.929
2004	297.879.874

Using therefore appropriate information for $F_{i,j,y}$ and $COEF_{i,j}$, OM emission factors for each year can be determined, as follows.

$$EF_{OM, simple_adjusted, 2002} = (1 - \lambda_{2001}) \frac{\sum_{i,j} F_{i,j,2002} \cdot COEF_{i,j}}{\sum_j GEN_{j,2002}} \therefore EF_{OM, simple_adjusted, 2002} = 0,4207 \text{ tCO}_2/\text{MWh}$$

$$EF_{OM, simple_adjusted, 2003} = (1 - \lambda_{2003}) \frac{\sum_{i,j} F_{i,j,2003} \cdot COEF_{i,j}}{\sum_j GEN_{j,2003}} \therefore EF_{OM, simple_adjusted, 2003} = 0,4397 \text{ tCO}_2/\text{MWh}$$



$$EF_{OM, simple_adjusted, 2004} = (1 - \lambda_{2004}) \frac{\sum_{i,j} F_{i,j,2004} \cdot COEF_{i,j}}{\sum_j GEN_{j,2004}} \therefore EF_{OM, simple_adjusted, 2004} = 0,4327 \text{ tCO}_2/\text{MWh}$$

Finally, to determine the baseline *ex-ante*, the mean average among the three years is calculated, finally determining the $EF_{OM, simple_adjusted}$.

$$EF_{OM, simple_adjusted\ 2002-2004} = 0,4310 \text{ tCO}_2/\text{MWh}$$

According to the methodology used, a Build Margin emission factor also needs to be determined.

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

Electricity generation in this case means 20% of total generation in the most recent year (2004), as the 5 most recent plants built generate less than such 20%. Calculating such factor one reaches:

$$EF_{BM, 2004} = 0,1045 \text{ tCO}_2/\text{MWh}$$

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. That gives:

$$EF_{electricity, 2002-2004} = 0,5 * 0,4310 + 0,5 * 0,1045 = 0,2677 \text{ tCO}_2/\text{MWh}$$

It is important to note that adequate considerations on the above weights are currently under study by the Meth Panel, and there is a possibility that such weighing changes in the methodology applied here.

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 ($EF_{electricity, 2002-2004}$) with the electricity generation of the project activity.

$$BE_{electricity, y} = EF_{electricity, 2002-2004} \cdot EG_y$$

Therefore, for the first crediting period, the baseline emissions will be calculated as follows:

$$BE_{electricity, y} = 0,2677 \text{ tCO}_2/\text{MWh} \cdot EG_y \text{ (in tCO}_2\text{e)}$$

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

The emissions reductions of this project activity are:

$$ER = BE_{electricity, y} - (L_y + PE_y) = 0,2677 \text{ tCO}_2/\text{MWh} \cdot EG_y - 0 \rightarrow ER = 0,2677 \text{ tCO}_2/\text{MWh} \cdot EG_y$$

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

Year	Estimation of project activity emission reductions (tonnes of CO ₂ e)	Estimation of the baseline emission reductions (tonnes of CO ₂ e)	Estimation of leakage (tonnes of CO ₂ e)	Estimation of emission reductions (tonnes of CO ₂ e)
2002	2.423	0	0	2.423
2003	10.205	0	0	10.205
2004	5.917	0	0	5.917
2005	13.920	0	0	13.920
2006	13.920	0	0	13.920
2007	13.920	0	0	13.920
2008	13.920	0	0	13.920
Total (tonnes of CO ₂ e)	74.225	0	0	74.225

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

The environmental impacts were analyzed by the State Secretary of Environment (SMA – *Secretaria de Estado do Meio Ambiente*) through CETESB (*Companhia de Tecnologia de Saneamento Ambiental*) – state of São Paulo environmental agency, before issuing an Installation Licence to the Sugar Mill through the environmental report submitted to SMA. As Santa Cândida complies with all of the requirements for mitigating the any possible impact, it was issued a pre-operating license. The renewal of this license was asked to CETESB, however it the renewed one is not available yet.

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:



Santa Cândida contracted “Projec – Engenharia Ambiental” to develop a *Preliminar Environmental Report* which was necessary for the Installation License to be issued. The impacts that CETESB considered relevant were:

1. The company shall not emit pollutants (odors and particulate) to the atmosphere, at a level that could be perceptible outside the limits of the project property.
2. Smoke emissions shall comply to Article 31 of State Law 997/76
3. The liquid effluents of the project shall be treated attending to articles 11 and 18 of State Law 997/76, approved by Decree 8468/76, altered by Decree 15425/80, as well as to CONAMA Resolution 20/86.
4. The project’s noise level shall comply with the standards established by NBR 10151.
5. The project shall dispose its industrial solid residues in a way that will not cause any environmental damage.
6. The company shall meet the requirements of Previous License 00527 as of 26/07/02.

Santa Cândida, however, complied with all these requirements and is waiting for the definitive version of the operating license.

SECTION G. Stakeholders’ comments

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

Santa Cândida communicated the local stakeholders regarding the installation and operation of the new thermal electric unit by making several publications in local and official newspapers.

Also, as a requirement of the Brazilian Interministerial Commission on Global Climate Change, the Brazilian DNA, Santa Cândida invited several organizations and institutions to comment the CDM project being developed. Letters¹⁴ were sent to the following recipients:

1. Companhia de Tecnologia de Saneamento Ambiental (CETESB), the state environmental agency;
2. Municipality of Jaú Environmental Council (Condema);
3. Municipality of Jaú municipal chamber;
4. Municipality of Bocaina city hall;
5. Municipality of Bauru and Region chemical industries workers association;
6. Municipality of Jaú credit cooperative;
7. Municipality of Bocaina municipal chamber;
8. Municipality of Jaú cane suppliers association;
9. Brazilian NGO Fórum;
10. Municipality of Bariri rural workers association;
11. Municipality of Jaú rural workers association;
12. Municipality of Dourados rural employees association;
13. Municipality of Bocaina rural workers association;
14. Municipality of Jaú attorneys;
15. Municipality of Jaú and Region road transport workers association;
16. State of São Paulo Environmental Secretary;
17. Municipality of Jaú city hall.

¹⁴ The copy of these invitations, as well as the answers, are available in hold of Project participants.

**G.2. Summary of the comments received:**

From the above stakeholder contacted, the following comments were received:

1. CETESB stated it should not make comments on the project as greenhouse gases emission reduction projects are not bound to have environmental licenses, and suggested to submit the project to the state environmental secretary, which was actually performed by the project developer;
2. Condema congratulated the project developer for the initiative, stating that such kind of project is fundamental to guarantee a better quality of life in the region;
3. Municipality of Jaú municipal chamber made comments on the management practices adopted by the project developer, practices that enhance the social and environmental qualities of the region, and that its CDM project is very good. The environmental and social responsibilities of the entities involved in the project are also highlighted, not to mention their compromise towards sustainable development;
4. Municipality of Bocaina mayor replied mentioning that sugar mills always used to generate their own electricity, and only recently governmental bodies recognized the feasibility to allow for participation of renewable energy from sugarcane in the energy matrix. Moreover, energy from bagasse burning is produced when hydropower generation is critical, due to climatic reasons. Therefore, there was nothing to point out from the developers' initiative, since the sugarcane activity allows for energy production in three ways: sugar, ethanol and electricity;
5. Municipality of Bauru and Region chemical industries workers association congratulated the developer for the initiative;
6. Municipality of Jaú credit cooperative made some congratulations on the project and stated that the Kyoto Protocol deserves their support;
7. Municipality of Bocaina municipal chamber congratulated the project developers for the initiative;
8. Municipality of Jaú cane suppliers association made no comments;
9. The Brazilian NGO Fórum made no comments;
10. Municipality of Bariri rural workers association made no comments;
11. Municipality of Jaú rural workers association made no comments;
12. Municipality of Dourados rural employees association made no comments;
13. Municipality of Bocaina rural workers association made no comments;
14. Municipality of Jaú attorneys made no comments;
15. Municipality of Jaú and Region road transport workers association made no comments;
16. State of São Paulo Environmental Secretary made no comments;
17. Municipality of Jaú city hall made no comments.

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

From the comments received, Santa Cândida found reasonable to end the process without further considerations.

Annex 1**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY.****1.1 Project Developer Responsible for the CDM Project Activity**

Organization:	Econergy Brasil Ltda.
Street/P.O.Box:	Rua Pará, 76 cj 41
Building:	Higienópolis Office Center
City:	São Paulo
State/Region:	SP
Postfix/ZIP:	01243-020
Country:	Brazil
Telephone:	+ 55 (11) 3219-0068
FAX:	+55 (11) 3219-0693
E-Mail:	-
URL:	http://www.econergy.com.br
Represented by:	
Title:	Mr.
Salutation:	
Last Name:	Diniz Junqueira
Middle Name:	Schunn
First Name:	Marcelo
Department:	-
Mobile:	+55 (11) 8263-3017
Direct FAX:	Same above
Direct tel:	+ 55 (11) 3219-0068 ext 25 and/or mobile
Personal E-Mail:	junqueira@econergy.com.br

**1.2 Project Activity Host Company**

Organization:	Santa Cândida Açúcar e Álcool Ltda
Street/P.O.Box:	Fazenda Santa Cândida s/n
Building:	
City:	Bocaina
State/Region:	SP
Postfix/ZIP:	17240-000
Country:	Brazil
Telephone:	+55 (14) 3666-9000
FAX:	+55 (14) 3666-9037
E-Mail:	santacandida@netsite.com.br
URL:	-
Represented by:	
Title:	Mr.
Salutation:	
Last Name:	Dumit
Middle Name:	Canto
First Name:	Guilherme
Department:	
Mobile:	
Direct FAX:	Same above
Direct tel:	Same above
Personal E-Mail:	gdumit@santacandida.com.br

Annex 2**INFORMATION REGARDING PUBLIC FUNDING**

No public funding was requested.

Annex 3**BASELINE INFORMATION**

Detailed information on the electricity configuration at Santa Cândida sugar mill, as well as expected energy sales and emission reductions generation are presented below:

Santa Cândida Bagasse Cogeneration Project									
	Item	(Phase 1) 2002	(Phase 2) 2003	2004	2005	2006	2007	2008	Total CERs
Grid-Connected Emission Reduction	Installed Capacity, MW	20,6	29	29	29	29	29	29	
	Internal Consumption (MW)	7,4	7,7	7,7	7,7	7,7	7,7	7,7	
	Standby (MW)		3,6	2,0	2,0	2,0	2,0	2,0	
	Installed capacity available for sale (MW)	13,2	17,7	19,3	19,3	19,3	19,3	19,3	
	Total estimated days of cogeneration	150	90	48	112	112	112	112	
	Hours of operation (h/year)	3.601	2.154	1.145	2.694	2.695	2.696	2.697	
	Electric energy to be sold to CPFL, MWh/year	9.051	38.121	22.102	52.000	52.000	52.000	52.000	
	Baseline emission factor tCO ₂ e/MWh	0,2677	0,2677	0,2677	0,2677	0,2677	0,2677	0,2677	
	Total CO ₂ emissions reductions, tCO ₂ e/year	2.423	10.205	5.917	13.920	13.920	13.920	13.920	74.225

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)¹⁵:

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

¹⁵ Bosi, M. *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study*. International Energy Agency. Paris, 2000.



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

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

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

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_Gr%C3%A1ficos_mai_2005.pdf), which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Such capacity in fact is constituted by plants with 30 MW installed capacity or above, connected to the system through 138 kV power lines, or at higher voltages. 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 “Road-Testing Baselines For Greenhouse Gas Mitigation Projects in the Electric Power Sector”, published in October 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, as the table below shows the build margin in both cases.

IEA/ONS Merged Data Build Margin (tCO ₂ /MWh)	ONS Data Build Margin (tCO ₂ /MWh)
0,205	0,1045

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 fossil fueled plants efficiencies were also taken from the IEA paper. This was done considering the lack of more detailed information on such efficiencies from public, reliable and credible sources.

From the mentioned reference:

The fossil fuel conversion efficiency (%) for the thermal power plants was calculated based on the installed capacity of each plant and the electricity actually produced. For most of the fossil fuel power plants under construction, a constant value of 30% was used as an estimate for their fossil fuel conversion efficiencies. This assumption was based on data available in the literature and based on the observation of the actual situation of those kinds of plants currently in operation in Brazil. The only 2 natural gas plants in combined cycle (totaling 648 MW) were assumed to have a higher efficiency rate, i.e. 45%.



Therefore only data for plants under construction in 2002 (with operation start in 2002, 2003 and 2004) was estimated. All others efficiencies were calculated. To the best of our knowledge there was no retrofit/modernization of the older fossil-fuelled power plants in the analyzed period (2002 to 2004). For that reason project participants find the application of such numbers to be not only reasonable but the best available option.

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.

On the following pages, a summary of the analysis is provided. First, the table with the 130 plants dispatched by the ONS are provided. Then, a table with the summarized conclusions of the analysis, with the emission factor calculation displayed. Finally, the load duration curves for the S-SE-MW system are presented.

ONS Dispatched Plants



PROJECT DESIGN DOCUMENT FORM (CDM PDD) - Version 02



CDM – Executive Board

page 41

Subsystem*	Fuel source**	Power plant	Operation start [R, 4, 5]	Installed capacity [MW] [1]	Fossil fuel conversion efficiency [%] [2]	Carbon emission factor (kgCO ₂ /t) [3]	Fraction carbon oxidized [4]	Emission factor (kgCO ₂ /MWh) [5]
1	S-SE-CD	H	Jauru	Sep-2003	121.5	1	0.0	0.000
2	S-SE-CD	H	Guaporé	Sep-2003	120.0	1	0.0	0.000
3	S-SE-CD	G	Trib. Lapaes	Aug-2003	306.0	0.3	15.3	89.5%
4	S-SE-CD	H	Furni MG	Jan-2003	190.0	1	0.0	0.000
5	S-SE-CD	H	Niquira I	Sep-2002	156.1	1	0.0	0.000
6	S-SE-CD	G	Araucária	Sep-2002	484.5	0.3	15.3	89.5%
7	S-SE-CD	G	Canasvi	Sep-2002	190.6	0.3	15.3	89.5%
8	S-SE-CD	H	Piraju	Sep-2002	81.0	1	0.0	0.000
9	S-SE-CD	G	Novo Pratinópolis	Jun-2002	384.9	0.3	15.3	89.5%
10	S-SE-CD	O	POI COITEL	Jun-2002	4.0	0.3	20.7	99.0%
11	S-SE-CD	H	Rosário	Jun-2002	55.0	1	0.0	0.000
12	S-SE-CD	G	Itirapina	May-2002	255.0	0.3	15.3	89.5%
13	S-SE-CD	H	Cana Brava	May-2002	465.9	1	0.0	0.000
14	S-SE-CD	H	Sta. Clara	Jan-2002	60.0	1	0.0	0.000
15	S-SE-CD	H	Machadinho	Jan-2002	1,140.0	1	0.0	0.000
16	S-SE-CD	G	Juiz de Fora	Nov-2001	37.0	0.28	15.3	89.5%
17	S-SE-CD	G	Mucuri	Nov-2001	822.8	0.24	15.3	89.5%
18	S-SE-CD	H	Lajeado (AMEL res. 402/2001)	Nov-2001	362.5	1	0.0	0.000
19	S-SE-CD	G	Estrela	Oct-2001	373.0	0.24	15.3	89.5%
20	S-SE-CD	H	Porto Estrela	Sep-2001	112.0	1	0.0	0.000
21	S-SE-CD	G	Cuiabá (Mario Covas)	Aug-2001	329.2	0.3	15.3	89.5%
22	S-SE-CD	G	W. Arinos	Jan-2001	194.0	0.28	15.3	89.5%
23	S-SE-CD	G	Unicovlers	Jan-2001	639.9	0.45	15.3	89.5%
24	S-SE-CD	H	S. Carlos	Jan-1999	1,240.0	1	0.0	0.000
25	S-SE-CD	H	Canasvi I	Jan-1999	82.5	1	0.0	0.000
26	S-SE-CD	H	Canasvi II	Jan-1999	75.0	1	0.0	0.000
27	S-SE-CD	H	Igarapava	Jan-1999	210.0	1	0.0	0.000
28	S-SE-CD	H	Porto Primavera	Jan-1999	1,540.0	1	0.0	0.000
29	S-SE-CD	O	Cuiabá (Nery Góes)	Oct-1998	120.2	0.27	20.7	97.5%
30	S-SE-CD	H	Sobradinho	Sep-1998	60.0	1	0.0	0.000
31	S-SE-CD	H	POI EMAL	Jan-1998	28.0	1	0.0	0.000
32	S-SE-CD	H	POI CEE	Jan-1998	25.0	1	0.0	0.000
33	S-SE-CD	H	POI ENERSUL	Jan-1998	43.0	1	0.0	0.000
34	S-SE-CD	H	POI CEB	Jan-1998	15.0	1	0.0	0.000
35	S-SE-CD	H	POI ESSELSA	Jan-1998	62.0	1	0.0	0.000
36	S-SE-CD	H	POI CELESC	Jan-1998	50.0	1	0.0	0.000
37	S-SE-CD	H	POI CEMAT	Jan-1998	145.0	1	0.0	0.000
38	S-SE-CD	H	POI CELG	Jan-1998	15.0	1	0.0	0.000
39	S-SE-CD	H	POI CERJ	Jan-1998	59.0	1	0.0	0.000
40	S-SE-CD	H	POI COPEL	Jan-1998	70.0	1	0.0	0.000
41	S-SE-CD	H	POI CEMIG	Jan-1998	84.0	1	0.0	0.000
42	S-SE-CD	H	POI COPEL	Jan-1998	55.0	1	0.0	0.000
43	S-SE-CD	H	S. Mesa	Jan-1998	1,278.0	1	0.0	0.000
44	S-SE-CD	H	POI EAPAL	Jan-1998	24.0	1	0.0	0.000
45	S-SE-CD	H	Guilherme Anomim	Jan-1997	140.0	1	0.0	0.000
46	S-SE-CD	H	Cumtuba	Jan-1997	478.0	1	0.0	0.000
47	S-SE-CD	H	Minicaba	Jan-1997	439.0	1	0.0	0.000
48	S-SE-CD	H	Novo Ponte	Jan-1994	510.0	1	0.0	0.000
49	S-SE-CD	H	Sagrado (Gov. Ney Braga)	Jan-1992	1,260.0	1	0.0	0.000
50	S-SE-CD	H	Itaipu	Jan-1989	564.0	1	0.0	0.000
51	S-SE-CD	H	Manso	Jan-1988	210.0	1	0.0	0.000
52	S-SE-CD	H	D. Francisco	Jan-1987	125.0	1	0.0	0.000
53	S-SE-CD	H	Itaipu	Jan-1987	1,450.0	1	0.0	0.000
54	S-SE-CD	H	Rosana	Jan-1987	363.2	1	0.0	0.000
55	S-SE-CD	N	Angra	Jan-1985	1,874.0	1	0.0	0.000
56	S-SE-CD	H	Itaipu	Jan-1985	807.5	1	0.0	0.000
57	S-SE-CD	H	Itaipu 50 Hz	Jan-1983	6,300.0	1	0.0	0.000
58	S-SE-CD	H	Itaipu 50 Hz	Jan-1983	5,375.0	1	0.0	0.000
59	S-SE-CD	H	Emborcação	Jan-1982	1,192.0	1	0.0	0.000
60	S-SE-CD	H	Novo Aventureiras	Jan-1982	347.4	1	0.0	0.000
61	S-SE-CD	H	Gov. Bento Munhoz - GBM	Jan-1980	1,678.0	1	0.0	0.000
62	S-SE-CD	H	S. Saracá	Jan-1980	1,420.0	1	0.0	0.000
63	S-SE-CD	H	Itaipu	Jan-1980	2,280.0	1	0.0	0.000
64	S-SE-CD	O	Itaipu	Jan-1978	131.0	0.3	20.7	99.0%
65	S-SE-CD	H	Itaipu	Jan-1978	512.4	1	0.0	0.000
66	S-SE-CD	H	A. Vemethys (Jose E. Moraes)	Jan-1978	1,365.2	1	0.0	0.000
67	S-SE-CD	H	S. Simão	Jan-1978	1,710.0	1	0.0	0.000
68	S-SE-CD	H	Capitão	Jan-1977	840.0	1	0.0	0.000
69	S-SE-CD	H	S. Odebre	Jan-1975	1,073.0	1	0.0	0.000
70	S-SE-CD	H	Marmbondo	Jan-1975	1,440.0	1	0.0	0.000
71	S-SE-CD	H	Promissão	Jan-1975	254.0	1	0.0	0.000
72	S-SE-CD	C	Pin. Medici	Jan-1974	448.0	0.26	26.0	98.0%
73	S-SE-CD	H	Volta Grande	Jan-1974	380.0	1	0.0	0.000
74	S-SE-CD	H	Porto Colombia	Jan-1973	320.0	1	0.0	0.000
75	S-SE-CD	H	Passo Fundo	Jan-1973	220.0	1	0.0	0.000
76	S-SE-CD	H	Passo Frio	Jan-1973	158.0	1	0.0	0.000
77	S-SE-CD	H	Ita Solheira	Jan-1973	3,444.0	1	0.0	0.000
78	S-SE-CD	H	Mascarenhas	Jan-1973	131.0	1	0.0	0.000
79	S-SE-CD	H	Gov. Pargol de Souza - GPS	Jan-1971	252.0	1	0.0	0.000
80	S-SE-CD	H	Chavantes	Jan-1971	414.0	1	0.0	0.000
81	S-SE-CD	H	Itaipu	Jan-1971	424.0	1	0.0	0.000
82	S-SE-CD	H	S. Caralho	Apr-1970	78.0	1	0.0	0.000
83	S-SE-CD	H	Estrela (Luz Carlos Barreto)	Jan-1969	1,050.0	1	0.0	0.000
84	S-SE-CD	H	Itaipu	Jan-1969	1,071.2	1	0.0	0.000
85	S-SE-CD	O	Alegrete	Jan-1968	66.0	0.26	20.7	99.0%
86	S-SE-CD	G	Campos (Roberto Silveira)	Jan-1968	30.0	0.24	15.3	89.5%
87	S-SE-CD	G	Santa Cruz (RJ)	Jan-1968	766.0	0.31	15.3	89.5%
88	S-SE-CD	H	Parabuna	Jan-1968	85.0	1	0.0	0.000
89	S-SE-CD	H	Linsolito (Miguel Sales de Oliveira)	Jan-1967	32.0	1	0.0	0.000
90	S-SE-CD	H	Caracora	Jan-1966	262.4	1	0.0	0.000
91	S-SE-CD	C	J. Lacerda C	Jan-1965	363.0	0.25	26.0	98.0%
92	S-SE-CD	C	J. Lacerda B	Jan-1965	262.0	0.21	26.0	98.0%
93	S-SE-CD	C	J. Lacerda A	Jan-1965	232.0	0.18	26.0	98.0%
94	S-SE-CD	H	Batim (Alvaro de Souza Lima)	Jan-1965	143.1	1	0.0	0.000
95	S-SE-CD	H	Furni (RJ)	Jan-1965	216.0	1	0.0	0.000
96	S-SE-CD	C	Figueira	Jan-1963	20.0	0.3	26.0	98.0%
97	S-SE-CD	H	Furni	Jan-1963	1,216.0	1	0.0	0.000
98	S-SE-CD	H	Barragem Bonita	Jan-1963	140.8	1	0.0	0.000
99	S-SE-CD	C	Chavantes	Jan-1962	72.0	0.23	26.0	98.0%
100	S-SE-CD	H	Juruaçu (Amendo A. Laidner)	Jan-1962	97.7	1	0.0	0.000
101	S-SE-CD	H	Jacui	Jan-1962	180.0	1	0.0	0.000
102	S-SE-CD	H	Petropolis	Jan-1962	36.1	1	0.0	0.000
103	S-SE-CD	H	Itaipu	Jan-1962	385.0	1	0.0	0.000
104	S-SE-CD	H	Eutides da Cunha	Jan-1960	158.8	1	0.0	0.000
105	S-SE-CD	H	Camargo	Jan-1960	46.0	1	0.0	0.000
106	S-SE-CD	H	Santa Branca	Jan-1960	56.1	1	0.0	0.000
107	S-SE-CD	H	Cachoeira Dourada	Jan-1959	658.0	1	0.0	0.000
108	S-SE-CD	H	São Grande (Luz R. Gervasio)	Jan-1958	70.0	1	0.0	0.000
109	S-SE-CD	H	São Grande (MG)	Jan-1958	102.0	1	0.0	0.000
110	S-SE-CD	H	Mascarenhas de Moraes (Rauito)	Jan-1956	478.0	1	0.0	0.000
111	S-SE-CD	H	Itaipu	Jan-1955	36.0	1	0.0	0.000
112	S-SE-CD	C	S. Jerônimo	Jan-1954	26.0	0.26	26.0	98.0%
113	S-SE-CD	O	Caribá	Jan-1954	36.2	0.3	20.7	99.0%
114	S-SE-CD	O	Pratinópolis	Jan-1954	472.0	0.3	20.7	89.5%
115	S-SE-CD	H	Canasvi	Jan-1953	45.5	1	0.0	0.000
116	S-SE-CD	H	Nilo Peçanha	Jan-1953	378.4	1	0.0	0.000
117	S-SE-CD	H	Fontes Novas	Jan-1940	136.3	1	0.0	0.000
118	S-SE-CD	H	Henry Borden Sub.	Jan-1936	420.0	1	0.0	0.000
119	S-SE-CD	H	Henry Borden Ext.	Jan-1936	469.0	1	0.0	0.000
120	S-SE-CD	H	L. Pombo	Jan-1924	199.7	1	0.0	0.000
121	S-SE-CD	H	Jacui	Jan-1917	11.8	1	0.0	0.000
122	S-SE-CD	H	Jacui	Jan-1917	11.8	1	0.0	0.000
				Total (MW) = 64,478.6				

* Subsystem S - south, SE-CD - Southeast Midwest
 ** Fuel source G: biomass cog. D: diesel oil, G: natural gas, H: hydro, N: nuclear, O: residual fuel oil.
 [1] Agência Nacional de Energia Elétrica, Banco de Informações de Geração (http://www.aneel.gov.br), data collected in november 2004.
 [2] Bassi, M. A., Laurence, P., Medonaco, R., Schaffner, A. F., Simoes, H. and Winkler, J.M. Lubiana, Road testing baselines for GHG mitigation projects in the electric power sector. OECD/IEA information paper, October 2002.
 [3] Intergovernmental Panel on Climate Change, Revised 1996 Guidelines for National Greenhouse Gas Inventories.
 [4] Operador Nacional do Sistema Elétrico, Centro Nacional de Operação do Sistema, Acompanhamento da Geração de Emissões de GWP (daily reports from Jan. 1, 2001 to Dec. 31, 2003).
 [5] Agência Nacional de Energia Elétrica, Superintendência de Fiscalização dos Serviços de Geração, Relatório Geral das Novas Empreendimentos de Geração (http://www.aneel.gov.br), data collected in november 2004.



Summary table

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	EF_{OM} [tCO ₂ /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
$EF_{OM, simple-adjusted}$ [tCO ₂ /MWh]		$EF_{BM, 2004}$	Lambda	
0.4310		0.1045	λ_{2002}	
Alternative weights		Default weights	0.5053	
$w_{DM} = 0.75$		$w_{DM} = 0.5$	λ_{2003}	
$w_{RM} = 0.25$		$w_{RM} = 0.5$	0.5312	
EF_{CM} [tCO ₂ /MWh]		Default EF_{OM} [tCO ₂ /MWh]	λ_{2004}	
0.3494		0.2677	0.5041	

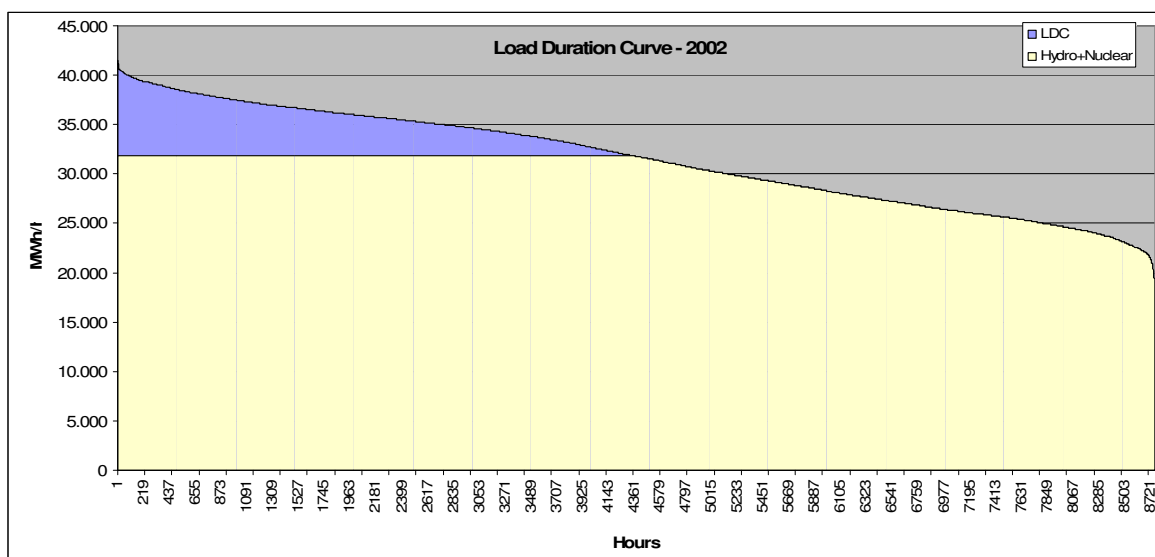


Figure 7. Load duration curve for the S-SE-MW system, 2002

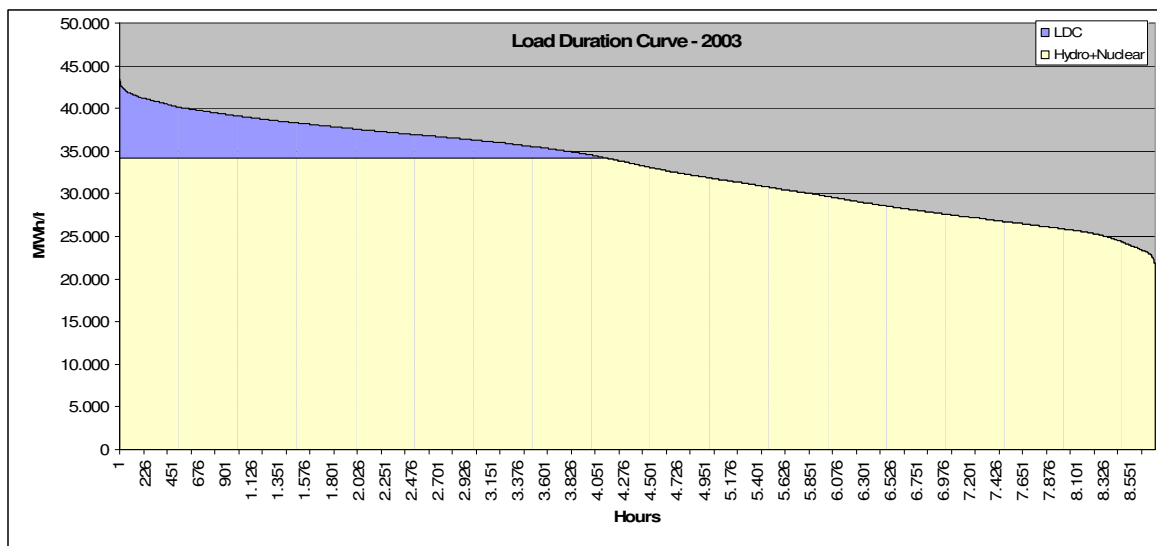


Figure 8. Load duration curve for the S-SE-MW system, 2003

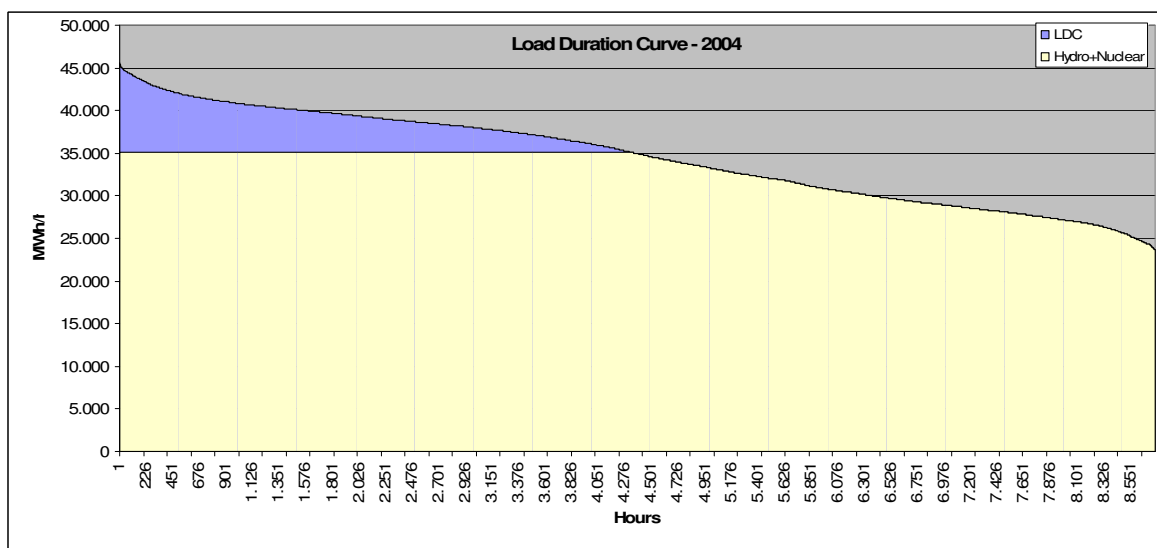


Figure 9. Load duration curve for the S-SE-MW system, 2004



Annex 4

MONITORING PLAN

According to the section D of this document, the unique variable that will be monitored in this project activity is the quantity of energy exported to the grid, from year 2002 up to the end of the last crediting period. Since no leakage nor any off-grid emissions change were identified in this project activity, there will be no need to monitor the variables for these cases. The monitoring will occur as follows:

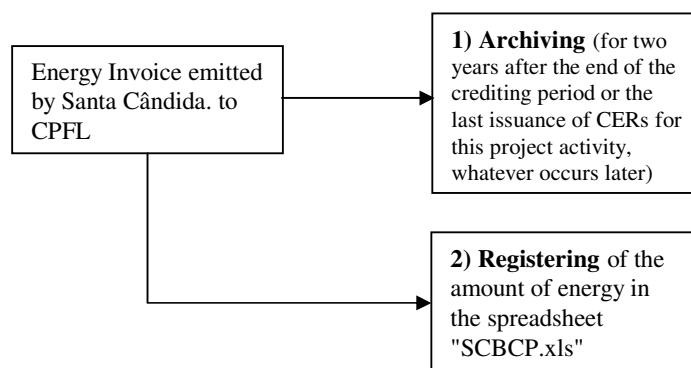


Figure 10: Monitoring procedures for Santa Cândida

The quantity of energy exported to the grid will be monitored through the energy invoice emitted to CPFL, the energy distributor, by Santa Cândida. The archiving will occur up to two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. The amount of energy will be registered in the spreadsheet "SCBCP.xls", which shall be the instrument for the further Verification.