



**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:**

Southeast Caeté Mills Bagasse Cogeneration Project (SECMBCP)

Version 2.

Date of the document: December 07<sup>th</sup>, 2005.

**A.2. Description of the project activity:**

The Southeast Caeté Mills Bagasse Cogeneration Project (SECMBCP), corresponding to the 2 Southeast Caeté Sugar and Alcohol Mills, from the Carlos Lyra Group, in Brazil. The 2 southeast selected units are: **Usina Caeté S/A – Unidade Delta** (Delta Branch) and **Usina Caeté S/A – Unidade Volta Grande** (Volta Grande Branch). Thus, this project name, called as “Southeast Caeté Mills Bagasse Cogeneration Project (SECMBCP)”, is the unification of “Delta Bagasse Cogeneration Project (DBCP)” and “Volta Grande Bagasse Cogeneration Project (VGBCP)”.

This project activity consists of increasing the efficiency in the bagasse (a renewable fuel source, residue from sugarcane processing) cogeneration facilities at 2 Brazilian Southeast Caeté sugar mills. With the implementation of this project, the mills have been able to sell electricity to the national grid, avoiding the dispatch of same amount of energy produced by fossil-fuelled thermal plants to that grid. By that, the initiative avoids CO<sub>2</sub> emissions, also contributing to the regional and national sustainable development.

Usina Caeté S/A (Delta and Volta Grande) are sugarcane mills from Carlos Lyra Group, a Brazilian private company. The Delta mill, located in Delta within the “Triângulo Mineiro” Region in Minas Gerais State (MG), is the newest sugar and alcohol factory of Carlos Lyra Group. Volta Grande mill, located in Conceição das Alagoas, is the first factory of the Group located outside of the Northeast region of Brazil. It started operating in May 1996. Both mills are located in Minas Gerais State (MG), at Southeast region of Brazil.

The SECMBCP activity participants 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 SECMBCP activity helps to enhance the development of a renewable energy source. 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.

Additional contribution to the national sustainable development includes the fact that bagasse cogeneration also supports the country’s economic development, as sugarcane-based industry provides approximately 1 million jobs and represents one of the major agribusiness products within the trade balance of the country. Furthermore, bagasse-based power project activities contribute to support the competitive model of the Brazilian electric sector.

Bagasse cogeneration is important for the energy strategy of the country. Cogeneration is an alternative that allows postponing the installation and/or dispatch of electricity produced by fossil-fuelled 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.

### **Contribution of the Project Activity to Sustainable Development:**

The 2 Southeast Caeté mills, of Carlos Lyra Group, also believe that sustainable development will be achieved not only by the implementation of a renewable energy production facility, but also by carrying out activities which corresponds to the company social and environmental responsibilities, as described below.

#### **a) Contribution to the local environmental sustainability:**

Saving the environment has always been a target for Carlos Lyra Group. Follow bellow a list of some environmental actions developed by the two southeast Caeté sugar mills:

- Environmental good practices presentations programs;
- Partnership with IEF - Instituto Estadual de Floresta (Forest State Institute);
- Tree's plantation activity assisted by IEF;
- Plague biological control;
- Closed water circuit for water reutilization inside the industrial process;
- Vinasse utilization as organic fertilizer avoiding chemical compost;

Moreover, the Caeté mills of Carlos Lyra Group, develops several environmental initiatives, such as the creation of a Private Natural Patrimony Reserve (from Portuguese: RPPN – Reserva Particular de Patrimônio Natural), where reforestation (including the plantation of thousands of native species), preservation and environmental programs are promoted.

It is important to highlight that if there is a possibility to consider future revenues for selling CERs originated by its reforestation project, then an expansion or even a improvement of its reforestation, preservation and environmental programs could be made through the development of another forestation/reforestation specific CDM project.

#### **b) Contribution to the improvement of working conditions and employment creation:**

The efforts of resources application in projects that result in a well being of employees and local residents have always been a priority for Carlos Lyra Group, especially for Delta and Volta Grande mills.

The two southeast Caeté mills, Delta and Volta Grande, also implement investments in theirs employee's security and health care areas:

*Investments in employee's security area:*

- Professional qualification of theirs collaborators: through specific trainings and process modifications;
- Respiratory Protection Program;
- Environmental Risks Protection Program;
- Noise Control Program.

*Investments in health care area:*

- Several campaigns against some sorts of diseases, diabetes, cholesterol control and AIDS;
- Blood Donation Program;
- Physic activities for the mill's employees.

The implementation of the Southeast Caeté Mills Bagasse Cogeneration Project (SECMBCP), in Delta and Volta Grande mills, requested the extension of employees' numbers, as temporary as permanent, for both mills.

**c) Contribution to income generation:**

With the SECMBCP implementation it is allowed the creation of a new income option through the electricity sale in addition to CERs revenue, ensuring a higher financial and energetic sustainability, contributing to the expansion of sugar and alcohol production and also the extension of sugar cane agriculture, providing consequently the creation of new job opportunities during sugar cane harvest period as well as for the industrial process operation.

**d) Contribution to technological capacity building:**

The sugar and alcohol sector had always explored biomass (bagasse) in an inefficient way, using low pressure boilers, considered as a simple operational and maintenance technology. Despite the fact that all the bagasse was available for the industries own consumption of power generation and self-supply, the inefficient procedures for bagasse burning forbids that additional electric energy was able to be produced for sale. But, investments made in a more efficient technology, such as higher pressure boilers, have been allowing the industries of sugar and alcohol sector to increase their internal installed capacity and then enhancing the amount of electricity available for sale.

More detailed information about the technology to be employed by the project activity is provided into the A.4.3 section of this document.

**e) Contribution to regional integration and cooperation with other sectors:**

The creation of new opportunities for the mills of sugar and alcohol sector, through the cogeneration project using bagasse for electricity generation and sale in addition to CERs revenue, promoted a higher interaction between the sugar-cane and Brazilian power sectors.

**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)	Usina Caeté S/A – Unidade Delta (Brazilian private entity)  Usina Caeté S/A – Unidade Volta Grande (Brazilian private entity)	No



	Econergy Brasil Ltda. (Brazilian private entity)	
<p>(*) 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.</p>		

**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.:**

Minas Gerais

**A.4.1.3. City/Town/Community etc:**

**Usina Caeté S/A – Unidade Delta** (Delta Branch), is located in Delta – Minas Gerais State;  
**Usina Caeté S/A – Unidade Volta Grande** (Volta Grande Branch), is located in Conceição das Alagoas – Minas Gerais State.

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

Usina Caeté S/A – Unidade Delta (Delta Branch), is located at number 750 of Av. José Agostinho Filho, inside of Delta city, within “Triângulo Mineiro” Region in the western of Minas Gerais State, about 500 km away from the state capital, Belo Horizonte. Usina Caeté S/A – Unidade Volta Grande (Volta Grande Branch), is located at km 43 of MG-427 Highway, inside of Conceição das Alagoas city, within “Triângulo Mineiro” Region in the western of Minas Gerais State, about 600 km away from the state capital, Belo Horizonte. Both mills are shown in Figure 1.





**Figure 1. Geographical position of Delta and Conceição das Alagoas cities**

**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:**

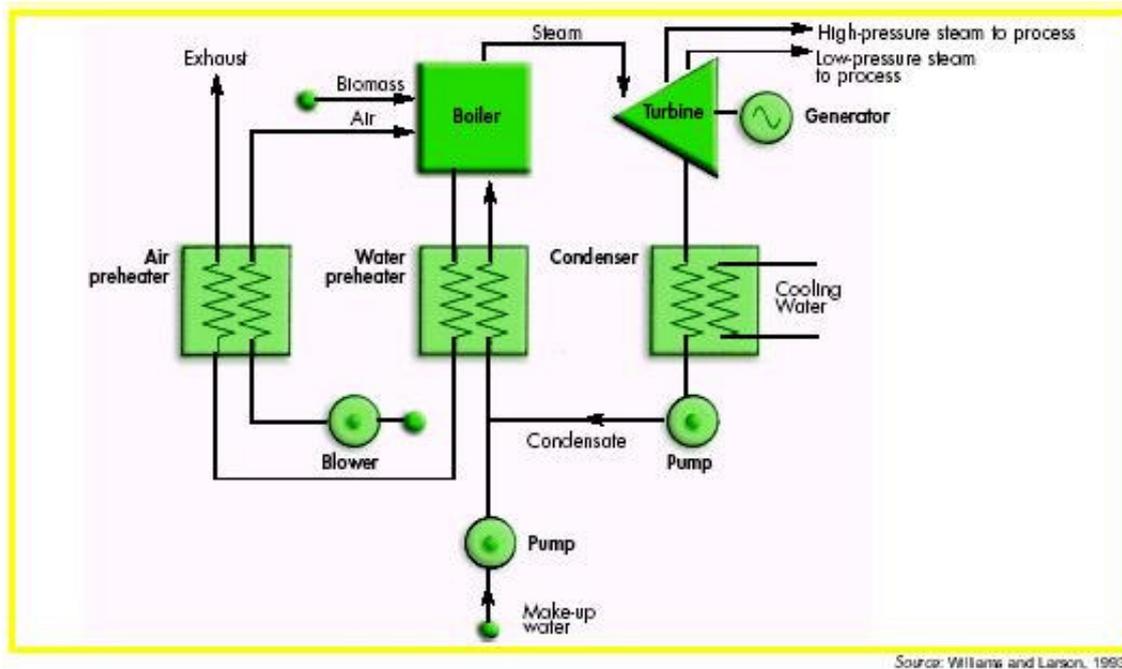
The predominant technology in all parts of the world today for generating megawatt (MW) levels of electricity from biomass is the steam-Rankine cycle, which consists of direct combustion of biomass in a boiler to generate steam, which is then expanded through a turbine. Most steam cycle plants are located 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 coolant<sup>1</sup>.

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<sup>1</sup> Williams & Larson, 1993 and Kartha & Larson, 2000, p.101



**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.

Using steam-Rankine cycle as the basic technology of its cogeneration system, to start its activities and for achieving an increasing amount of surplus electricity to be generated, the two Caeté mills (Delta and Volta Grande) implemented this project activity (SECMBCP).

Therefore, two PPAs (Power Purchase Agreement) were firming. The first one was firming with CEMIG, (from 04<sup>th</sup> March, 2002 to 31<sup>st</sup> December, 2014) and the second one with ELETROBRÁS (from 28<sup>th</sup> December, 2004 to 26<sup>th</sup> August, 2026) through PROINFA (Brazilian Renewable Sources Incentive Program). The first PPA considers the total amount of electric energy generated by both mills (Delta and Volta Grande) that will be sold to CEMIG. Thus, the year of beginning for the increasing amount of electricity generated and available for sale by both mills, as well as the implementation of this project activity (SECMBCP), was 2002. Moreover, the second PPA considers the total amount of electric energy generated only by Volta Grande mill, which will be sold to ELETROBRÁS until 2026.

The Delta project is divided in two phases: Phase 1 (2002) and Phase 2 (2003). This project consists of installation of one new 42 bar boiler, in Phase 1 (2002), achieving a total of 5 MW capacity available for



sale. In Phase 2 (2003), an additional 15 MW condensing turbo-generator were installed, aiming to achieve a total of 11,5 MW available for sale.

The exhibit below shows when and with which equipments Delta project took place:

**Table 1. Delta project activity implementation for cogeneration**

<b>DELTA</b>	<b>ACTIVE / ACTIVATING</b>	
<b>Before the Expansion Plan</b>  <b>(2001)</b>	<b>One 15 MW backpressure turbo generator</b>	
	<b>Two 21 kgf/cm<sup>2</sup> pressure boilers</b>	
<b>Phase 1</b>  <b>(2002)</b>	<b>One 15 MW backpressure turbo generator</b>	
	<b>One 42 kgf/cm<sup>2</sup> pressure boiler</b>	<b>Two 21 kgf/cm<sup>2</sup> pressure boilers</b>
<b>Phase 2</b>  <b>(2003)</b>	<b>One 15 MW condensing turbo generator</b>	<b>One 15 MW backpressure turbo generator</b>
	<b>One 42 kgf/cm<sup>2</sup> pressure boiler</b>	<b>Two 21 kgf/cm<sup>2</sup> pressure boilers</b>

The Volta Grande project is also divided in two phases: Phase 1 (2003) and Phase 2 (2006). This project consists of installation of one new 16 MW backpressure turbo-generator, in Phase 1 (2003), achieving a total of 9 MW capacity available for sale. In Phase 2 (2006), an additional 30 MW backpressure turbo-generator and a new 65 bar boiler will be installed, aiming to achieve a total of 34 MW available for sale. But, it is important to highlight that 2002 is the year considered for the beginning of Volta Grande project, when the mill had achieved a total of 3 MW capacity available for sale to CEMIG, promoted by its PPA, as previously explained.

The exhibit below shows when and with which equipments Volta Grande project took place:

**Table 2. Volta Grande project activity implementation for cogeneration**

<b>VOLTA</b>	<b>ACTIVE / ACTIVATING</b>
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GRANDE			
Before the Expansion Plan (2002)	One 9 MW backpressure turbo generator		
	One 21 kgf/cm <sup>2</sup> pressure boiler	One 42 kgf/cm <sup>2</sup> pressure boiler	
Phase 1 (2003)	One 16 MW condensing turbo generator	One 9 MW backpressure turbo generator	
	One 21 kgf/cm <sup>2</sup> pressure boiler	One 42 kgf/cm <sup>2</sup> pressure boiler	
Phase 2 (2006)	One 30 MW backpressure turbo generator	One 16 MW condensing turbo generator	One 9 MW backpressure turbo generator
	One 65 kgf/cm <sup>2</sup> pressure boiler	One 21 kgf/cm <sup>2</sup> pressure boiler	One 42 kgf/cm <sup>2</sup> pressure boiler

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 will not be able to produce the steam required by both the sugar production process and power-generation. In order to avoid power-generation interruptions, the cogeneration expansion plan in SECMBCP includes investments in the sugar production process that reduce the steam consumption in the sugar and ethanol production processes. This efficiency improvement is necessary in order to drive as much steam as possible to the cogeneration project. Consequently, the greater the quantity of electricity production that is sought, the higher the investment cost per MWh produced.

The investment to increase efficiency is dependent also on the expansion of sugar production. Therefore the financial support from CERs will be helpful to improve the mill competitiveness and so to enhance the sustainability of the rural areas in Brazil.

**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:**

#### *Cogeneration Facility*

By dispatching renewable electricity to the grid, electricity that would otherwise be produced using fossil fuel is displaced. This electricity displacement will occur at 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 base load 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 is currently installed in the state of São Paulo only<sup>2</sup>. The energy produced from these facilities is almost all consumed for their on purposes. Because of constraints that limit 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.<sup>3</sup>

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 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 sponsors need an extra incentive to invest in electricity production due to the fact that it is a product that can never be stored in order to speculate with 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 Caeté mills of Carlos Lyra Group, which is investing to expand their electric power generation capacity and to operate in a more rationale way under the above mentioned new electric sector circumstances.

<b>period:</b>	<b>A.4.4.1.</b>	<b>Estimated amount of emission reductions over the chosen <u>crediting</u></b>
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Years	Annual estimation of emission reductions in tonnes of CO <sub>2</sub> e
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<sup>2</sup> São Paulo. Secretary of Energy, 2001.

<sup>3</sup> Nastari, 2000.



2002	7.722
2003	19.436
2004	19.201
2005	20.559
2006	48.454
2007	48.454
2008*	48.454
<b>Total estimated reductions</b> (tonnes of CO <sub>2</sub> e)	212.280
<b>Total number of crediting years</b>	7
<b>Annual average over the crediting period of estimated reductions</b> (tonnes of CO <sub>2</sub> e)	30.326

\*It's admitted that the Project's 1<sup>st</sup> Crediting Period will be considered from June 15<sup>th</sup>, 2002 to June 15<sup>th</sup> 2009. However, the table above doesn't consider the year 2009 due to uncertainties about the beginning of its harvest season, when the electricity generated by the cogeneration system become operational.

#### **A.4.5. Public funding of the project activity:**

There is no public funding from Parties included in Annex I in this project activity.

### **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 SECMBCP due to the fact that (i) the bagasse is produced and consumed in the same facility; (ii) the project would never be implemented by the public sector, as well as it would not be implemented in the absence of CDM, as shown in the additionality chapter bellow; (iii) there is no increase on the bagasse production due to the project activity itself and (iv) there will be no bagasse storage for more than one year.

#### **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 the 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
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1. $EG_y$	Electricity supplied to the grid by the Project.	Obtained throughout project activity lifetime.	MWh	Delta and Volta Grande
2. $EF_y$	CO <sub>2</sub> emission factor of the Grid.	0,2677	tCO <sub>2</sub> e/MWh	Calculated
3. $EF_{OM,y}$	CO <sub>2</sub> Operating Margin emission factor of the grid.	0,4310	tCO <sub>2</sub> e/MWh	This value was calculated using data information from ONS, the Brazilian electricity system manager.
4. $EF_{BM,y}$	CO <sub>2</sub> Build Margin emission factor of the grid.	0,1045	tCO <sub>2</sub> e/MWh	This value was calculated using data information from ONS, the Brazilian electricity system manager.
10. $\lambda_y$	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 two Southeast Caeté mills.**

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

(a) The starting date of Delta and Volta Grande projects falls after 1<sup>st</sup> January 2000, which are evidenced by the Environmental Operation Licenses of Usina Caeté S/A – Filial Delta (Delta Branch) and Usina Caeté S/A – Filial Volta Grande (Volta Grande Branch), both issued by FEAM – Fundação Estadual do Meio Ambiente (Environment State Foundation) on the 13<sup>th</sup> of August, 2002.

(b) There are some e-mails switched between Mr. Marcelo Junqueira, from Econergy Brazil, and various members of Carlos Lyra Group, that could be used as evidences that the subject about carbon credits, Kyoto Protocol and the Clean Development Mechanism concepts were considered before the beginning of the SECMBCP. Follow below some of these e-mails.

- On April 7<sup>th</sup>, 2001, Mr. Marcelo Junqueira, from Econergy Brasil, had sent an e-mail to Mr. Robert Carlos Lyra, President of Carlos Lyra Group, commenting about their meeting in Canaplan (a consulting company into the sugar and alcohol sector) and a previous conversation by phone. He had also mentioned about environmental benefits that could be obtained



considering the development of carbon credits projects into the Carlos Lyra Group's mills. Mr. Junqueira finishes his e-mail presenting a budget, attached to e-mail, about the development of CDM projects in Carlos Lyra Group's sugar mills.

- Specifically about the two Southeast Caeté mills, Delta and Volta Grande, in August 16<sup>th</sup>, 2001, Mr. Mauro Côbo, from juridical department of Carlos Lyra Group, had sent an e-mail to Mr. Marcelo Junqueira, from Eenergy Brasil, commenting about the interest about the development of cogeneration projects in those two mills and also his intention in proceeding with the negotiations.
- On October 29<sup>th</sup>, 2001, Mr. Rodrigo Munhoz, International Business department of Carlos Lyra Group had sent an e-mail to Mr. Marcelo Junqueira, from Eenergy Brasil, presenting himself and the company's sugar mills. He wrote that he had watched a presentation in October 25<sup>th</sup>, 2001, made by Junqueira, in a seminar about carbon credits and cogeneration projects. He asked for more information and the possibility to develop this kind of project in their mills.

After the initial contacts, Mr. Marcelo Junqueira, from Eenergy Brazil, had participated of some meetings with Carlos Lyra Group's directors and had also visited the two Southeast Caeté mills, Delta and Volta Grande, both located in Minas Gerais State.

### **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 prior the implementation of this project activity. One was to continue the current situation of the sugar mill, focusing only on the production of sugar and alcohol, therefore driving the investments to enhance the efficiency and increase 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 of electricity for 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.
3. Non applicable.
4. All 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)<sup>4</sup>, "large scale cogeneration program in sugar-alcohol sector has not yet occurred, due to several barriers, mainly economic, political and institutional", these barriers include:

#### **I. Technological Barriers**

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<sup>4</sup> COELHO, Suani T. *Mecanismos para implementação da cogeração de eletricidade a partir de biomassa: um modelo para o Estado de São Paulo*. São Paulo: Programa interunidades de pós-graduação em energia, 1999.



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 to 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)<sup>5</sup> considers it 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 to COELHO (1999), acquiring electricity other than hydroelectric would not be a priority, arguing that since bagasse based electricity is generated only during the harvest season, no reliable energy could be offered. Suggestions from electricity sector specialists stress this difficulty, pointing to the need to develop a complementary energy source for the part of the year the cogeneration plant cannot operate, such as a small hydro power plant. This is however a very tough task, considering a plant with a similar electricity output would be required. And moreover the economics of both cogeneration and small hydro power are totally different, in a way that the pricing structure for the energy would need to be different, adding therefore another barrier to the negotiation with the electricity distributor. Natural gas cogeneration has been studied as such complementary source as well, though this would be very undesirable in terms of greenhouse gas emissions.

However, the biggest advantage of bagasse based electricity is that it is produced during the period where hydroelectric plants face difficulties due to the low level of rainfall. As a result, COELHO (1999) suggests that there is a significant prejudice and conservativeness of the distributors when deciding whether to purchase bagasse based energy or not.

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 secure market in the future. Moreover, it is a fact that "the sugar mills are essentially managed by families, which difficult the association with

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<sup>5</sup> 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.



external financial agents”, that would allow the sector to be more competitive and diversifying its investment.

The Brazilian government enforced recently law 10.762, from the 11<sup>th</sup> of November 2003, which is a revision of law 10.438, from the 26<sup>th</sup> of April 2002. The latter created an incentive program for renewable energy, called PROINFA. According to 10.438/02, the Brazilian government would buy, under favourable conditions, electricity from three main sources of energy: biomass, wind and small hydropower. Total capacity to be contracted was 3.300 MW, divided equally between the three sources.

Power purchase agreements between project developers and Eletrobras happened only recently, after many discussions on the terms of implementation were held. In fact, after two call for projects, the biomass capacity could not be fully contracted. Out of the 1.100 MW, only 685,24 MW were reached. This shows clearly that PROINFA cannot be considered a government incentive towards bagasse-based energy, as only a fraction of projects saw benefits in having a contract with the Brazilian government. Therefore, it can be concluded that institutional barriers for bagasse cogeneration projects persist as for now.

Therefore, the company’s decision to sign a long-term PPA with the local distributor undoubtedly represented a significant risk that the mill was willing to take, partially thanks to the expected CDM revenue.

### III. Economic and Investment Barriers

From the point of view of the economic agents, the excessive level of guarantees required to finance the projects is a common barrier to achieving 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) making it much more difficult to obtain long-term financing from a commercial bank and/or a development bank. Some other financing barriers occur simply due to prohibitively high transaction costs, which include the bureaucracy to secure the environmental license.

“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”<sup>6</sup> 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

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<sup>6</sup> Joel Swisher personal communication with Rolls Royce Power Ventures project manager. Mark Croke, August 26, 1997. Swisher J. 1997 pg. 76.



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/MWh<sup>7</sup>.

COELHO (1999) also highlights as one of the major problems of selling surplus energy to the grid as being the economic value paid to the sugar mills which not enough to remunerate the capital invested in the expansion of a cogeneration project. Furthermore, “the fee for accessing the grid does not contribute to 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**: as the fixed costs are high and usually installations do not tend to be large, there is a huge economic barrier towards implementation of these sort of projects, as returns will low comparing with such fixed costs, (b) **availability of long-term financing**: traditionally, infrastructure projects have had a wide 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 generating a contradiction: the objective of 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.

#### IV. Cultural Barrier

Due to the nature of the business in the sugar industry the marketing approach is narrowly focused on commodity type of transaction. Therefore, the electricity transaction based on long-term contract (Power Purchase Agreement) represents a significant breakthrough in 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. According to WALTER (1994)<sup>8</sup>, they have in many cases demonstrated the will to undertake investments in new technologies, but without sufficient financial and entrepreneurial capacity to complete such projects.

**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).**

3. As exposed above, the other alternative to this project activity was to maintain 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 sales), there is no impediment for sugar mills to maintain (or even invest in) its core business.

#### Step 4. Common practice analysis.

<sup>7</sup> “Como se pode observar, os custos unitários das fontes alternativas de energia ainda são altos comparados ao custo marginal de expansão do sistema, hoje calculado em US\$33/MWh”. IN: Brazil, Ministry of Mines and Energy, 2001, pg. 80.

<sup>8</sup> WALTER, A.C.S. *Viabilidade e perspectivas da co-geração e geração termelétrica no setor sucro-alcooleiro*, 1994. Thesis (Doctorate). UNICAMP, Campinas.

**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 utilizing 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 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, other similar project activities are under implementation, for instance Cia Energética Santa Elisa, Moema, Equipav, Nova América. Added together, similar projects in the sugar industry in Brazil account to approximately 10% of the sugar industry. The additional 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, majority of similar projects 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 as 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 overcoming all the barriers described in this Tool: technological, institutional and political, economic and investment and cultural barriers. The registration will enhance the security of the investment itself and, will foster and support the project owners' breakthrough decision to expand their business activities. Along these lines, the project activity is already engaged in a deal 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.

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

Registration will also have an impact on other sugarcane industry players, who will see the feasibility of implementing renewable energy commercialization projects in their facilities with the CDM. Moreover, hard-currency inflows are highly desirable in a fragile and volatile economy as is the Brazilian one.



**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 SECMBCP, the South and Southeast subsystem of the Brazilian grid is considered as a boundary, since it is the system to which Caeté mills are connected and therefore receives all the bagasse-based produced electricity.

**Bagasse cogeneration plant:** the bagasse cogeneration plants 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: 07/12/2005.
2. Name of person/entity determining the baseline

ECONERGY BRASIL (Contact information in Annex 1), which is a project participant, is responsible for the technical services related to GHG emission reductions, and is therefore, on behalf of two Caeté mills, from Carlos Lyra Group, the developers 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:**

15/06/2002

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

25y-0m.<sup>9</sup>

**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:**

<sup>9</sup> 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.



15/06/2002

**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. Due to the great similarity of the project, the same methodology was chosen in order to monitor the emissions reduction of this project activity.

The methodology considers monitoring emissions reductions generated from cogeneration projects with sugarcane bagasse. The energy produced by the project could be electricity exported to a grid-connected system and/or energy used to substitute fossil fuel off-grid connected. And that is exactly the case with SECMBCP: the project exploits a by-product from the sugarcane milling process (bagasse) to produce and commercialize renewable electricity connected to a regional Brazilian grid. The methodology is therefore fully applicable to SECMBCP, and justification for choosing it.

Furthermore, besides being a methodology to be used in conjunction with the approved baseline methodology AM0015 (“Bagasse-based cogeneration connected to an electricity grid”), the same applicability conditions are described and justified in item B1.1 of this document.

**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:**

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 CO<sub>2</sub> equ.)**

Left blank on purpose.

**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 <sub>y</sub>	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 <sub>y</sub>	CO <sub>2</sub> emission factor of the Grid.	Calculated	tCO <sub>2</sub> e/MWh	C	At the validation and yearly after registration	0%	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.
3. EF <sub>OM,y</sub>	CO <sub>2</sub> Operating Margin emission factor of the grid.	Factor calculated from ONS, the Brazilian electricity system manager.	tCO <sub>2</sub> e/MWh	C	At the validation and yearly after registration	0%	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.
4. EF <sub>BM,y</sub>	CO <sub>2</sub> Build Margin emission factor of the grid.	Factor calculated from ONS, the Brazilian electricity system manager.	tCO <sub>2</sub> e/MWh	C	At the validation and yearly after registration	0%	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.
10. λ <sub>y</sub>	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 yearly after registration	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 CO<sub>2</sub> 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><i>F<sub>i,j(or m),y</sub></i> Is the amount of fuel <i>i</i> (in a mass or volume unit) consumed by relevant power sources <i>j</i> in year(s) <i>y</i>  <i>j, m</i> Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid  <i>COEF<sub>i,j(or m),y</sub></i> Is the CO<sub>2</sub> emission coefficient of fuel <i>i</i> (tCO<sub>2</sub> / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources <i>j</i> (or <i>m</i>) and the percent oxidation of the fuel in year(s) <i>y</i>, <i>a</i>  <i>GEN<sub>j(or m),y</sub></i> Is the electricity (MWh) delivered to the grid by source <i>j</i> (or <i>m</i>)</p>
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$EF_{electricity} = w_{OM} EF_{OM} + w_{BM} EF_{BM} \text{ (tCO}_2\text{e/GWh)}$ $BE_{electricity,y} = EF_{electricity} \cdot EG_y$	<p><math>BE_{electricity,y}</math> Are the baseline emissions due to displacement of electricity during the year y in tons of CO<sub>2</sub></p> <p><math>w_{OM}</math>, <math>w_{BM}</math> Are the weights given to the operating margin (OM) and the build margin (BM) in the emission factor calculation.</p> <p><math>EG_y</math> 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><math>EF_{electricity,y}</math> Is the CO<sub>2</sub> 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 <i>(Please use numbers to ease cross-referencing to table D.3)</i>	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<sub>2</sub> equ.):**

Left blank on purpose.



**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 <i>(Please use numbers to ease cross-referencing to table D.3)</i>	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<sub>2</sub> equ.)**

Left blank on purpose.

**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<sub>2</sub> equ.)**

$ER_y = BE_{thermal, y} + BE_{electricity, y} - PE_y - L_y$ $BE_{thermal, y} = 0$ $PE_y = 0$ $L_y = 0$ $BE_{electricity, y} = EF_{electricity} \cdot EG_y$	<p>ER<sub>y</sub>: are the emissions reductions of the project activity during the year y in tons of CO<sub>2</sub></p> <p>BE<sub>electricity,y</sub>: Are the baseline emissions due to displacement of electricity during the year y in tons of CO<sub>2</sub></p> <p>BE<sub>thermal,y</sub>: Are the baseline emissions due to displacement of thermal energy during the year y in tons of CO<sub>2</sub></p> <p>PE<sub>y</sub>: Are the project emissions during the year y in tons of CO<sub>2</sub>.</p> <p>L<sub>y</sub>: Are the leakage emissions during the year y in tons of CO<sub>2</sub>.</p>
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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<sub>y</sub>). 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 BRASIL (Contact information in Annex 1), which is a project participant, is responsible for the technical services related to GHG emission reductions, and is therefore, on behalf of two Caeté mills, from Carlos Lyra Group, the developers 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, is not monitored.

Thus,  $PE_y = 0$

**E.2. Estimated leakage:**

This project activity did not sell bagasse prior to its implementation.

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 (At the end of 2005 ONS supplied raw dispatch data for the whole interconnected grid in the form of daily reports<sup>10</sup> from Jan. 1, 2002 to Dec. 31, 2004, the most recent information available at this stage).

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<sup>10</sup> *Acompanhamento Diário da Operação do Sistema Interligado Nacional*. ONS-CNOS, Centro Nacional de Operação do Sistema. Daily reports on the whole interconnected electricity system from Jan. 1, 2002 to Dec. 31, 2004.



### 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:

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

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.

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



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

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

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:

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

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

Year	Estimation of project activity emission reductions (tonnes of CO <sub>2</sub> e)	Estimation of the baseline emission reductions (tonnes of CO <sub>2</sub> e)	Estimation of leakage (tonnes of CO <sub>2</sub> e)	Estimation of emission reductions (tonnes of CO <sub>2</sub> e)
2002	7.722	0	0	7.722
2003	19.436	0	0	19.436
2004	19.201	0	0	19.201
2005	20.559	0	0	20.559
2006	48.454	0	0	48.454
2007	48.454	0	0	48.454
2008*	48.454	0	0	48.454
<b>Total</b> (tonnes of CO <sub>2</sub> e)	212.280	0	0	212.280

\*It's admitted that the Project's 1<sup>st</sup> Crediting Period will be considered from June 15<sup>th</sup>, 2002 to June 15<sup>th</sup> 2009. However, the table above doesn't consider the year 2009 due to uncertainties about the beginning of its harvest season, when the electricity generated by the cogeneration system become operational.

**SECTION F. Environmental impacts**

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

The possible environmental impacts were analyzed by the State Secretary of Environment and Sustainable Development (*Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustentável*) through COPAM (*Conselho Estadual de Política Ambiental*) – State of Minas Gerais Environmental Agency and FEAM (*Fundação Estadual do Meio Ambiente*) – Environmental State Foundation. Delta and Volta Grande mills are in compliance with the environmental legislation and have been issued an Installation and Operation Licenses for the current installed facilities.

Regarding the out-of-boundary impacts, the SECMBCP project activity will not affect the expansion of the national electricity grid supply due to its small size in power generation capacity. Since Carlos Lyra Group has always cared also about other environmental issues, including preservation of local environment, in a constant improvement of preservation areas, adequate treatment of effluents and other residues, and is therefore in compliance with any applicable environmental regulation in Brazil, no other environmental impact assessment or documentation should be necessary for SECMBCP project activity.

The table below illustrates the Environmental Licensing Historic.

DOCUMENT	DATE OF APPROVAL	VALIDITY
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<b>DELTA</b>	Operational License	13/08/2004	13/08/2006
<b>VOLTA GRANDE</b>	Operational License	13/08/2004	13/08/2006

Table 3. Historic of SECMBCP Environmental Licensing

**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 official Operating License of both Delta and Volta Grande mills was issued by FEAM (Environment State Foundation) in 13<sup>th</sup> August, 2002. However, Delta and Volta Grande mills must comply with some demands from the environmental agency in order to proceed with the operation of the project, being:

- Execute the self-monitoring program defined by FEAM;
- Present the industrial activities follow-up report at the end of each crop season;
- Present, at the end of each crop season, the preventive maintenance report of vinasse and waste water transportation pipeline, according material characteristics presented by the manufacturer;
- Present, at the end of each crop season, information that shows total agrochemicals consumed and the final destination of the chemicals packages.

#### **SECTION G. Stakeholders' comments**

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

As a requirement of the Brazilian Interministerial Commission on Global Climate Change, the Brazilian DNA, the two Southeast Caeté mills invited several organizations and institutions to comment the CDM project being developed. Letters<sup>11</sup> were sent to the following recipients:

- Prefeitura Municipal de Delta – MG / *Municipal Administration of Delta – MG*;
- Prefeitura Municipal de Conceição das Alagoas – MG / *Municipal Administration of Conceição das Alagoas – MG*;
- Prefeitura Municipal de Uberaba – MG / *Municipal Administration of Uberaba – MG*;
- Prefeitura Municipal de Igarapava – MG / *Municipal Administration of Igarapava – MG*;
- Câmara dos Vereadores de Delta – MG / *Municipality Chamber of Delta – MG*;
- Câmara dos Vereadores de Conceição das Alagoas – MG / *Municipality Chamber of Conceição das Alagoas – MG*;

<sup>11</sup> The copies of these invitations are available from the Project participants.



- FEAM – Fundação Estadual de Meio Ambiente / *Environmental State Foundation*;
- FBOMS – Fórum Brasileiro de ONGs / *Brazilian NGO Fórum*;
- Conselho Superior do Ministério Público / *Superior Board of Public Ministry*;
- IEF – Instituto Estadual de Floresta / *Forest State Institut*;
- IBAMA – Instituto Brasileiro do Meio Ambiente / *Brazilian Environment Institute*;
- IGAM – Instituto Gama de Assessoria a Órgãos Públicos / *Gama Institute of Public Organizations Assistance*;
- FAEMG – Federação da Agricultura e Pecuária do Estado de Minas Gerais / *Agriculture and Livestock Federation of Minas Gerais State*;
- SEPLAN MG – Secretaria Estadual de Planejamento e Gestão / *State Secretary of Planning and Management*;
- EMATER – Instituto de Assistência Técnica e Extensão Rural / *Rural Extension and Technical Assistance Institute*;
- DNIT – Departamento Nacional de Infra-Estrutura de Transportes / *National Department of Transport Infra-Structure*;
- DER – Departamento de Estradas e Rodagens / *Roads and Highways Department*.

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

Three comments were received by the listed local stakeholders, as showed below:

- Prefeitura Municipal de Igarapava – MG / *Municipal Administration of Igarapava – MG*;
- FBOMS – Fórum Brasileiro de ONGs / *Brazilian NGO Forum*;
- DNIT – Departamento Nacional de Infra-Estrutura de Transportes / *National Department of Transport Infra-Structure*;

In the first case, a letter was sent by Mr. Francisco Tadeu Molina (Municipal Mayor of Igarapava).

In the second case, a letter was sent by Ms. Esther Neuhaus (Executive Manager of FBOMS).

In the third case, a letter was sent by Mr. Elias João Barbosa (Supervisor of DNIT).

The letters sent by Prefeitura Municipal de Igarapava and DNIT contains several positive comments about SECMBCP. They enhance the importance of the Global Climate Change associated with the Global Warming Potential and the contribution, by the Southeast Caeté Mills Bagasse Cogeneration Project, for the mitigation of Greenhouse Gases effects.



The letter sent by FBOMS express gratitude for the correspondence dispatched by Carlos Lyra Group. FBOMS also recognizes their role, as one of several institutions listed in the “Resolução n° 1”, created by the Brazilian DNA – Designed National Authority (CIMGC – Comissão Interministerial de Mudança Global do Clima), that must invited for comments. They highlight their support in transparency mechanisms of analysis process and approval of CDM projects. They mention the importance of consulting local stakeholders for comments in order to provide the improvement of sustainability and the quality of projects collaborating with the implementation of international climate exchange regime. Furthermore, FBOMS affirms it is waiting for a Brazilian Federal Government manifestation, by means of CIMGC, about how the comments and analysis made by FBOMS integrants for CDM projects are considered into the final decision of this sort of projects. Therefore, they emphasize their interest in technical information evaluation, but a lack of a more detailed analysis of the project, does not means their approval of the same.

<b>G.3. Report on how due account was taken of any comments received:</b>
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Regarding the comments made by Prefeitura Municipal de Igarapava and DNIT, a letter was sent from Carlos Lyra Group for each of the institution, expressing their gratitude for the considerations and also the Carlos Lyra Group concern in providing any additional information if its necessary.

Regarding the comments made by FBOMS, a letter was sent from Carlos Lyra Group expressing their gratitude for the considerations about the SECMBCP and also the Carlos Lyra Group concern in providing any additional information if its necessary.

Annex 1**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY****Project Participant – 1:**

Organization:	<b>Econergy Brasil Ltda.</b>
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:	<a href="mailto:junqueira@econergy.com.br">junqueira@econergy.com.br</a>
URL:	<a href="http://www.econergy.com.br">http://www.econergy.com.br</a>
Represented by:	Marcelo Schunn Diniz Junqueira
Title:	Mr.
Salutation:	
Last Name:	Diniz Junqueira
Middle Name:	Schunn
First Name:	Marcelo
Department:	Director
Mobile:	+55 (11) 8263-3017
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Direct tel:	+55 (11) 3219-0068 ext 25
Personal E-Mail:	<a href="mailto:junqueira@econergy.com.br">junqueira@econergy.com.br</a>

**Project Participant – 2:**

Organization:	<b>Usina Caeté S/A – Unidade Delta</b> (Delta Branch)
Street/P.O.Box:	Av José Agostinho Filho, 750
Building:	
City:	Delta
State/Region:	Minas Gerais
Postfix/ZIP:	38108-000
Country:	Brasil
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FAX:	+55 (34) 3319-6468
E-Mail:	<a href="mailto:gesliana@gclnet.com.br">gesliana@gclnet.com.br</a>
URL:	<a href="http://www.carloslyra.com.br">www.carloslyra.com.br</a>
Represented by:	Sebastião Lima da Costa
Title:	Superintendente Industrial
Salutation:	Doutor
Last Name:	Costa
Middle Name:	Lima
First Name:	Sebastião
Department:	Industrial
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Direct FAX:	+55 (34) 3319-6468
Direct tel:	+55 (34) 3319-6463
Personal E-Mail:	<a href="mailto:sebastiaol@gclnet.com.br">sebastiaol@gclnet.com.br</a>

**Project Participant – 3:**

Organization:	<b>Usina Caeté S/A – Unidade Volta Grande</b> (Volta Grande Branch)
Street/P.O.Box:	Rodovia MG-427, km 43 – Fazenda Cachoeira – Zona Rural
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City:	Conceição das Alagoas
State/Region:	Minas Gerais
Postfix/ZIP:	38120-000
Country:	Brasil
Telephone:	+55 (34) 3319-6239
FAX:	+55 (34) 3319-6228
E-Mail:	<a href="mailto:gesliana@gclnet.com.br">gesliana@gclnet.com.br</a>
URL:	<a href="http://www.carloslyra.com.br">www.carloslyra.com.br</a>
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## Annex 2

### INFORMATION REGARDING PUBLIC FUNDING

There is no Annex I public funding involved in SECMBCP project activity.

## Annex 3

### BASELINE INFORMATION

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)<sup>12</sup>:

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

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

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

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

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

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



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 methodology AM0015 asks 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](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. 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.

<b>IEA/ONS Merged Data Build Margin (tCO<sub>2</sub>/MWh)</b>	<b>ONS Data Build Margin (tCO<sub>2</sub>/MWh)</b>
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 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**



Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fossil fuel conversion efficiency (%) [2]	Carbon emission factor (tCO <sub>2</sub> /MWh) [3]	Fraction carbon oxidized [3]	Emission factor (tCO <sub>2</sub> /MWh)
1	S-SE-CO	H	Jauu	Sep-2003	121.5	1	0.0	0.00
2	S-SE-CO	H	Chaparrá	Sep-2003	120.0	1	0.0	0.00
3	S-SE-CO	G	Três Lagoas	Aug-2003	306.0	0.3	15.3	99.5%
4	S-SE-CO	H	Furnil (MG)	Jan-2003	180.0	1	0.0	0.00
5	S-SE-CO	H	Itaipua I	Sep-2002	156.1	1	0.0	0.00
6	S-SE-CO	G	Aracaju	Sep-2002	494.5	0.3	15.3	99.5%
7	S-SE-CO	G	Canas	Sep-2002	160.8	0.3	15.3	99.5%
8	S-SE-CO	H	Praju	Sep-2002	81.0	1	0.0	0.00
9	S-SE-CO	G	Novo Proletariado	Jun-2002	384.3	0.3	15.3	99.5%
10	S-SE-CO	O	PCT CGTEE	Jun-2002	5.0	0.3	20.7	99.0%
11	S-SE-CO	H	Rosal	Jun-2002	55.0	1	0.0	0.00
12	S-SE-CO	G	Ibitira	May-2002	226.0	0.3	15.3	99.5%
13	S-SE-CO	H	Caná Brava	May-2002	465.3	1	0.0	0.00
14	S-SE-CO	H	Sta. Clara	Jan-2002	60.0	1	0.0	0.00
15	S-SE-CO	H	Machadinho	Jan-2002	1,140.0	1	0.0	0.00
16	S-SE-CO	G	Juiz de Fora	Nov-2001	87.0	0.26	15.3	99.5%
17	S-SE-CO	G	Macaé Merchant	Nov-2001	522.6	0.24	15.3	99.5%
18	S-SE-CO	H	Lajeado (ANEL res. 402/2001)	Nov-2001	902.5	1	0.0	0.00
19	S-SE-CO	G	Eletrobrás	Oct-2001	379.0	0.24	15.3	99.5%
20	S-SE-CO	H	Porto Estrela	Sep-2001	112.0	1	0.0	0.00
21	S-SE-CO	G	Curubá (Marão Covas)	Aug-2001	529.2	0.3	15.3	99.5%
22	S-SE-CO	G	W. Arjona	Jan-2001	194.0	0.25	15.3	99.5%
23	S-SE-CO	G	Uruguaiara	Jan-2000	639.9	0.45	15.3	99.5%
24	S-SE-CO	H	S. Carina	Jan-1999	1,240.0	1	0.0	0.00
25	S-SE-CO	H	Canas I	Jan-1999	82.5	1	0.0	0.00
26	S-SE-CO	H	Canas II	Jan-1999	72.0	1	0.0	0.00
27	S-SE-CO	H	Varanava	Jan-1999	210.0	1	0.0	0.00
28	S-SE-CO	H	Porto Primavera	Jan-1999	1,540.0	1	0.0	0.00
29	S-SE-CO	D	Curubá (Marão Covas)	Oct-1998	523.2	0.27	20.2	99.0%
30	S-SE-CO	H	Sideral	Sep-1998	60.0	1	0.0	0.00
31	S-SE-CO	H	PCH ENAE	Jan-1998	28.0	1	0.0	0.00
32	S-SE-CO	H	PCH CEFE	Jan-1998	25.0	1	0.0	0.00
33	S-SE-CO	H	PCH ENERSUL	Jan-1998	43.0	1	0.0	0.00
34	S-SE-CO	H	PCH CEP	Jan-1998	15.0	1	0.0	0.00
35	S-SE-CO	H	PCH ESCOLA	Jan-1998	62.0	1	0.0	0.00
36	S-SE-CO	H	PCH CELESC	Jan-1998	50.0	1	0.0	0.00
37	S-SE-CO	H	PCH OEMAT	Jan-1998	145.0	1	0.0	0.00
38	S-SE-CO	H	PCH CELG	Jan-1998	15.0	1	0.0	0.00
39	S-SE-CO	H	PCH CERJ	Jan-1998	59.0	1	0.0	0.00
40	S-SE-CO	H	PCH COPEL	Jan-1998	70.0	1	0.0	0.00
41	S-SE-CO	H	PCH CEMIG	Jan-1998	84.0	1	0.0	0.00
42	S-SE-CO	H	PCH CPFL	Jan-1998	55.0	1	0.0	0.00
43	S-SE-CO	H	S. Mesa	Jan-1998	1,275.0	1	0.0	0.00
44	S-SE-CO	H	PCH EPÁULO	Jan-1998	26.0	1	0.0	0.00
45	S-SE-CO	H	Guilherme Anselm	Jan-1997	140.0	1	0.0	0.00
46	S-SE-CO	H	Corumbá	Jan-1997	375.0	1	0.0	0.00
47	S-SE-CO	H	Miranda	Jan-1997	408.0	1	0.0	0.00
48	S-SE-CO	H	Novo Ponte	Jan-1994	510.0	1	0.0	0.00
49	S-SE-CO	H	Sagrado (Gov. Ney Braga)	Jan-1992	1,290.0	1	0.0	0.00
50	S-SE-CO	H	Taquaruçu	Jan-1989	554.0	1	0.0	0.00
51	S-SE-CO	H	Maraó	Jan-1988	210.0	1	0.0	0.00
52	S-SE-CO	H	Itá, Francisca	Jan-1987	125.0	1	0.0	0.00
53	S-SE-CO	H	Itá	Jan-1987	1,450.0	1	0.0	0.00
54	S-SE-CO	H	Rosana	Jan-1987	369.2	1	0.0	0.00
55	S-SE-CO	N	Aringa	Jan-1985	1,874.0	1	0.0	0.00
56	S-SE-CO	H	L. Imbuá	Jan-1985	607.5	1	0.0	0.00
57	S-SE-CO	H	Itaipu 60 Hz	Jan-1983	6,300.0	1	0.0	0.00
58	S-SE-CO	H	Itaipu 50 Hz	Jan-1983	5,375.0	1	0.0	0.00
59	S-SE-CO	H	Embarcação	Jan-1982	1,193.0	1	0.0	0.00
60	S-SE-CO	H	Novo Avanhandava	Jan-1982	347.4	1	0.0	0.00
61	S-SE-CO	H	Gov. Bento Munhoz - GBM	Jan-1980	1,676.0	1	0.0	0.00
62	S-SE-CO	H	S. Sarriego	Jan-1980	1,420.0	1	0.0	0.00
63	S-SE-CO	H	Bumbara	Jan-1980	2,290.0	1	0.0	0.00
64	S-SE-CO	O	Igarapé	Jan-1978	131.0	0.3	20.7	99.0%
65	S-SE-CO	H	Itauba	Jan-1978	512.4	1	0.0	0.00
66	S-SE-CO	H	A. Vermelha (José E. Moraes)	Jan-1978	1,298.3	1	0.0	0.00
67	S-SE-CO	H	S. Simão	Jan-1978	1,710.0	1	0.0	0.00
68	S-SE-CO	H	Capivara	Jan-1977	640.0	1	0.0	0.00
69	S-SE-CO	H	S. Osório	Jan-1975	1,078.0	1	0.0	0.00
70	S-SE-CO	H	Marmbondo	Jan-1975	1,440.0	1	0.0	0.00
71	S-SE-CO	H	Promissão	Jan-1975	264.0	1	0.0	0.00
72	S-SE-CO	C	Pres. Médici	Jan-1974	446.0	0.26	26.0	98.0%
73	S-SE-CO	H	Volta Grande	Jan-1974	385.0	1	0.0	0.00
74	S-SE-CO	H	Porto Colombia	Jan-1973	320.0	1	0.0	0.00
75	S-SE-CO	H	Passo Fundo	Jan-1973	220.0	1	0.0	0.00
76	S-SE-CO	H	Passo Real	Jan-1973	158.0	1	0.0	0.00
77	S-SE-CO	H	Ita Sotavento	Jan-1973	3,444.0	1	0.0	0.00
78	S-SE-CO	H	Mascarenhas	Jan-1973	131.0	1	0.0	0.00
79	S-SE-CO	H	Gov. Parigot de Souza - GPS	Jan-1971	252.0	1	0.0	0.00
80	S-SE-CO	H	Cherentes	Jan-1971	414.0	1	0.0	0.00
81	S-SE-CO	H	Aiquara	Jan-1971	424.0	1	0.0	0.00
82	S-SE-CO	H	Sã Carvalho	Apr-1970	78.0	1	0.0	0.00
83	S-SE-CO	H	Estrelito (Luz Carlos Barreto)	Jan-1969	1,050.0	1	0.0	0.00
84	S-SE-CO	H	Itaipua	Jan-1969	1,131.0	1	0.0	0.00
85	S-SE-CO	H	Jupia	Jan-1969	1,551.2	1	0.0	0.00
86	S-SE-CO	O	Alcântara	Jan-1968	65.0	0.26	20.7	99.0%
87	S-SE-CO	G	Campos (Roberto Silveira)	Jan-1968	30.0	0.24	15.3	99.5%
88	S-SE-CO	G	Santa Cruz (RJ)	Jan-1968	766.0	0.31	15.3	99.5%
89	S-SE-CO	H	Parabuna	Jan-1968	85.0	1	0.0	0.00
90	S-SE-CO	H	Limoeiro (Armando Sales de Oliveira)	Jan-1967	32.0	1	0.0	0.00
91	S-SE-CO	H	Guadalupe	Jan-1966	80.4	1	0.0	0.00
92	S-SE-CO	C	J. Lacerda C	Jan-1965	363.0	0.25	26.0	98.0%
93	S-SE-CO	C	J. Lacerda B	Jan-1965	262.0	0.21	26.0	98.0%
94	S-SE-CO	C	J. Lacerda A	Jan-1965	232.0	0.18	26.0	98.0%
95	S-SE-CO	H	Bianá (Alvaro de Souza Lima)	Jan-1965	143.1	1	0.0	0.00
96	S-SE-CO	H	Furnil (RJ)	Jan-1965	216.0	1	0.0	0.00
97	S-SE-CO	C	Figueira	Jan-1963	20.0	0.3	26.0	98.0%
98	S-SE-CO	H	Furnas	Jan-1963	1,216.0	1	0.0	0.00
99	S-SE-CO	H	Barr Bonita	Jan-1963	140.8	1	0.0	0.00
100	S-SE-CO	C	Charqueadas	Jan-1962	72.0	0.23	26.0	98.0%
101	S-SE-CO	H	Jurumirim (Armando A. Laydner)	Jan-1962	97.7	1	0.0	0.00
102	S-SE-CO	H	Jacuí	Jan-1962	180.0	1	0.0	0.00
103	S-SE-CO	H	Peraira Passos	Jan-1962	99.1	1	0.0	0.00
104	S-SE-CO	H	Tres Marias	Jan-1962	396.0	1	0.0	0.00
105	S-SE-CO	H	Euclydes da Cunha	Jan-1960	108.8	1	0.0	0.00
106	S-SE-CO	H	Camargo	Jan-1960	46.0	1	0.0	0.00
107	S-SE-CO	H	Santa Branca	Jan-1960	55.1	1	0.0	0.00
108	S-SE-CO	H	Cachoeira Dourada	Jan-1959	658.0	1	0.0	0.00
109	S-SE-CO	H	Safo Grande (Luiz N. Garcia)	Jan-1958	70.0	1	0.0	0.00
110	S-SE-CO	H	Safo Grande (MG)	Jan-1956	102.0	1	0.0	0.00
111	S-SE-CO	H	Mascarenhas de Moraes (Rovato)	Jan-1956	478.0	1	0.0	0.00
112	S-SE-CO	H	Itaipua	Jan-1955	52.0	1	0.0	0.00
113	S-SE-CO	C	S. Jerônimo	Jan-1954	20.0	0.26	26.0	98.0%
114	S-SE-CO	O	Caroba	Jan-1954	36.2	0.3	20.7	99.0%
115	S-SE-CO	O	Pratiranga	Jan-1954	472.0	0.3	20.7	99.0%
116	S-SE-CO	H	C. Canastra	Jan-1953	42.5	1	0.0	0.00
117	S-SE-CO	H	Nilo Peçanha	Jan-1953	378.4	1	0.0	0.00
118	S-SE-CO	H	Fontes Nova	Jan-1940	130.3	1	0.0	0.00
119	S-SE-CO	H	Henry Borden Sub.	Jan-1926	420.0	1	0.0	0.00
120	S-SE-CO	H	Henry Borden Ext.	Jan-1929	499.0	1	0.0	0.00
121	S-SE-CO	H	L. Pombos	Jan-1924	189.7	1	0.0	0.00
122	S-SE-CO	H	Jaguari	Jan-1917	11.8	1	0.0	0.00
				<b>Total (MW) =</b>	<b>64,478.6</b>			

Summary table



Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	$EF_{OM}$ [tCO <sub>2</sub> /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
	<b>Total (2001-2003) =</b>	<b>861.776.699</b>	<b>818.118</b>	<b>3.535.256</b>
	$EF_{OM, simple-adjusted}$ [tCO <sub>2</sub> /MWh]	$EF_{BM, 2004}$	Lambda	
	0,4310	0,1045	$\lambda_{2002}$	
	Alternative weights	Default weights	0,5053	
	$w_{OM} = 0,75$	$w_{OM} = 0,5$	$\lambda_{2003}$	
	$w_{BM} = 0,25$	$w_{BM} = 0,5$	0,5312	
	$EF_{CM}$ [tCO <sub>2</sub> /MWh]	Default $EF_{OM}$ [tCO <sub>2</sub> /MWh]	$\lambda_{2004}$	
	0,3494	0,2677	0,5041	

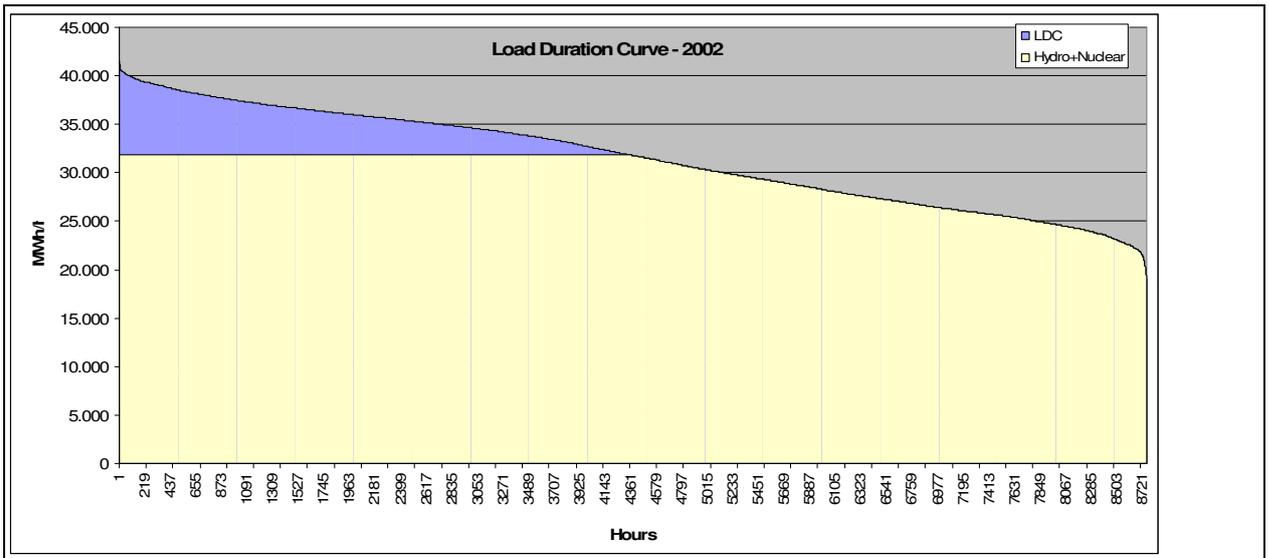


Figure 3: Load duration curve for the S-SE-MW system, 2002

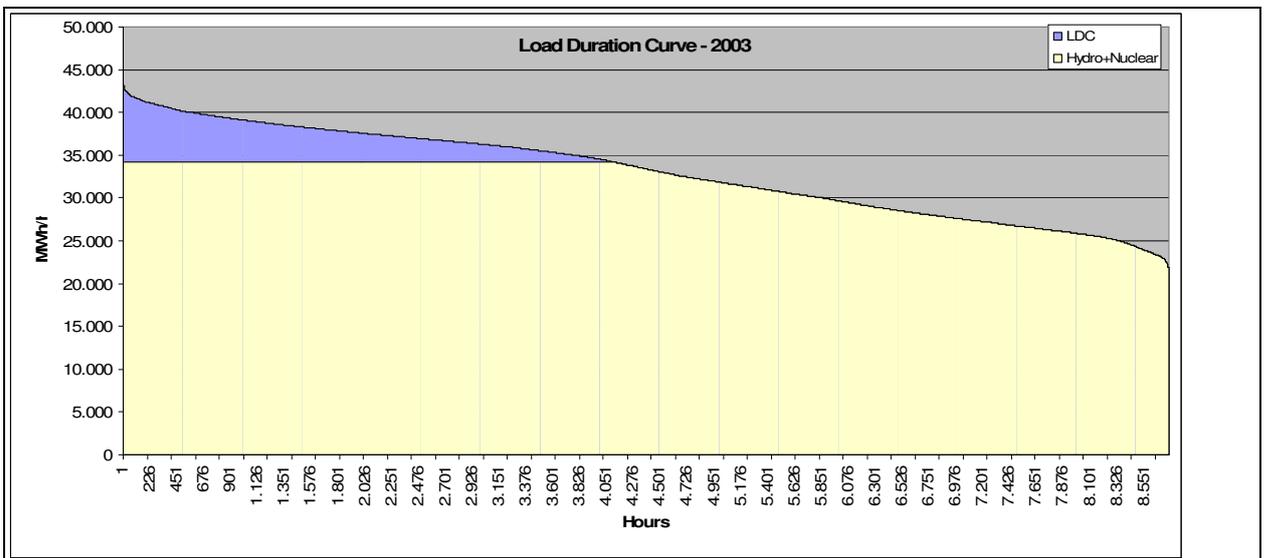


Figure 4: Load duration curve for the S-SE-MW system, 2003

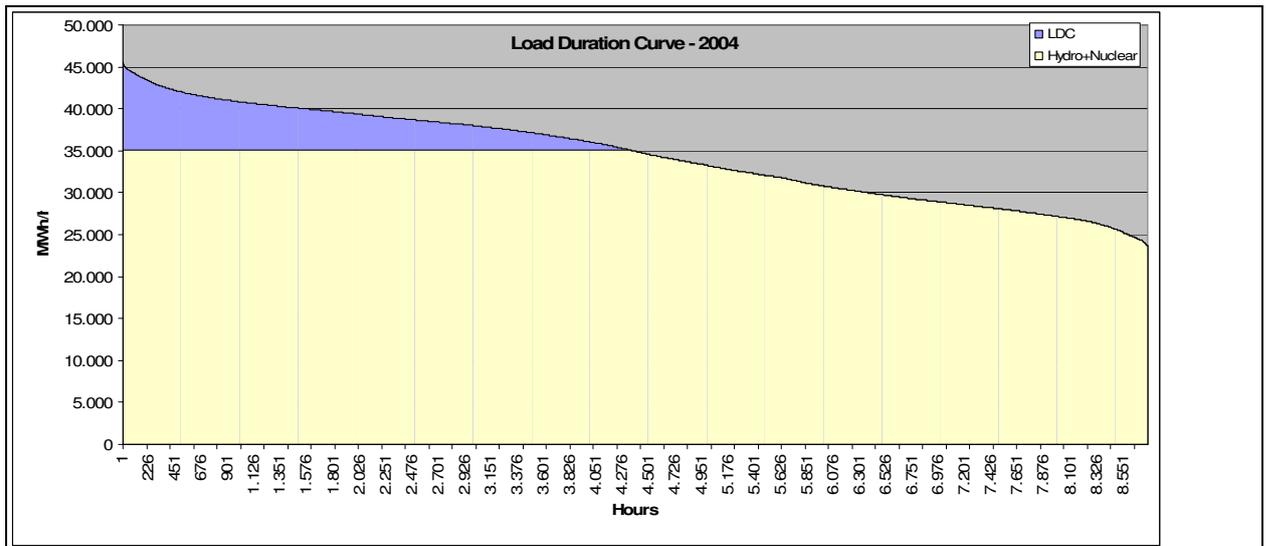


Figure 5: Load duration curve for the S-SE-MW system, 2004

Delta Bagasse Cogeneration Project (DBCP)										
Emission Reductions from Cogeneration (Grid Connected)	Item	Before 2001	Phase 1 2002	Phase 2					Total CERs	
			2003	2004	2005	2006	2007	2008		
	Total installed capacity (MW)	15	15	30	30	30	30	30	30	
	Stand by capacity (MW)	0	0	0	0	0	0	0	0	
	Internal consumption (MW)	8,5	9,5	10	11	11	11	11	11	
	Capacity available for sale (MW)	0	5,5	20	19	19	19	19	19	
	Operating hours (h)	3.590	3.833	4.288	4.580	4.500	4.500	4.500	4.500	
	Estimated energy to be sold to the grid (MWh)	0	17.971	42.991	40.768	42.000	42.000	42.000	42.000	
	Baseline emission factor (tCO <sub>2</sub> /MWh)	0,2677	0,2677	0,2677	0,2677	0,2677	0,2677	0,2677	0,2677	
	<b>Emission Reduction (tCO<sub>2</sub>e) from Cogeneration</b>	<b>0</b>	<b>4.811</b>	<b>11.509</b>	<b>10.914</b>	<b>11.243</b>	<b>11.243</b>	<b>11.243</b>	<b>11.243</b>	
									<b>72.207</b>	
Volta Grande Bagasse Cogeneration Project (VGBCP)										
Emission Reductions from Cogeneration (Grid Connected)	Item	Before 2001	Beginning 2002	Phase 1			Phase 2			Total CERs
			2003	2004	2005	2006	2007	2008		
	Total installed capacity (MW)	9	9	25	25	25	55	55	55	
	Stand by capacity (MW)	0	0	0	0	0	0	0	0	
	Internal consumption (MW)	2,8	5,6	7,5	8	8,5	19	19	19	
	Capacity available for sale (MW)	0	3,4	17,5	17	16,5	36	36	36	
	Operating hours (h)	3.214	3.398	4.309	4.523	4.500	4.500	4.500	4.500	
	Estimated energy to be sold to the grid (MWh)	0	10.873	29.614	30.958	34.800	139.000	139.000	139.000	
	Baseline emission factor (tCO <sub>2</sub> /MWh)	0,2677	0,2677	0,2677	0,2677	0,2677	0,2677	0,2677	0,2677	
	<b>Emission Reduction (tCO<sub>2</sub>e) from Cogeneration</b>	<b>0</b>	<b>2.911</b>	<b>7.928</b>	<b>8.287</b>	<b>9.316</b>	<b>37.210</b>	<b>37.210</b>	<b>37.210</b>	
									<b>140.073</b>	
<b>Total Emission Reductions from 2002-2008 (tCO<sub>2</sub>)</b>			<b>7.722</b>	<b>19.436</b>	<b>19.201</b>	<b>20.559</b>	<b>48.454</b>	<b>48.454</b>	<b>48.454</b>	<b>212.280</b>

It's admitted that the Project's 1<sup>st</sup> Crediting Period will be considered from June 15<sup>th</sup>, 2002 to June 15<sup>th</sup> 2009. However, the table above doesn't consider the year 2009 due to uncertainties about the beginning of its harvest season, when the electricity generated by the cogeneration system become operational.

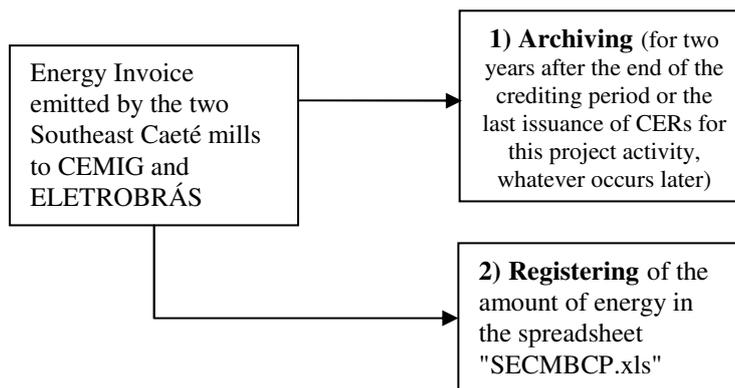
Table 4. Data of Delta and Volta Grande Bagasse Cogeneration Project (DBCP / VGBCP)



#### Annex 4

### MONITORING PLAN

According to the section D of this document, the variables that will be monitored in this project activity are the quantity of energy exported to the grid by the two southeast Caeté mills (Delta and Volta Grande), from year 2002 up to the end of the last crediting period. The monitoring will occur as follows:



**Figure 6: Monitoring procedures for SECMBCP**

The quantity of energy exported to the grid will be monitored through the energy invoice emitted by the two Southeast Caeté mills to CEMIG and ELETROBRÁS, the energy distributors. 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 "SECMBCP.xls", which shall be the instrument for the further Verification.