



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

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

Moema Bagasse Cogeneration Project (MBCP).

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

This project activity consists of increasing efficiency in the bagasse (a renewable fuel source, residue from sugarcane processing) cogeneration facility at **Usina Moema Açúcar e Álcool Ltda** (Moema), a Brazilian sugar mill. With the implementation of this project, the mill has been able to sell electricity to the national grid, avoiding that fossil-fuelled thermal plants dispatch the same amount of energy to that grid. By that, the initiative avoids CO<sub>2</sub> emissions, also contributing to the regional and national sustainable development.

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

The sponsors of the MBCP 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 Moema project activity helps to enhance the consumption of renewable energy. Besides that, it is used to demonstrate the viability of electricity generation as a side-business source of revenue for the sugar industry. It is worthy to highlight that out of approximately 320 sugar mills in Brazil, the great majority produces energy for on-site use only, and not for grid supply, which is mainly due to the low-efficiency cogeneration equipment installed on those sugar mills.

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

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

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

**Social Contribution**

Nowadays Moema is listed among the fifty major sugarcane enterprises in Southern Brazil. In the 2002/2003-harvesting season, it crushed 2.6 million tones of sugarcane, producing 94.5 million liters of ethanol and 216 thousand tones of sugar. For the 2003/2004-harvest season, the estimates are an enhancement to 3.3 million tones of sugarcane, 125 million liters of ethanol and 250 thousand tones of sugar.



The total number of employees at Moema were 2,711 directly and many more indirectly during the 2001/2002 crop season. Surely Moema is the most important job creator in that 4,161 people city where the company is located.

Furthermore, to encourage the company's employees to be deeply engaged with the results of the company, Moema has always developed human resources and social services. The employees' contribution to increase the quality of the products is heavily dependent on their quality of life. The company offers its employees and their relatives a program called Plano de Benefícios Assistenciais, assisting them with medical care, educational support, transport, leisure activities and other services they may need. Besides, Moema donates sugar and money to many social work entities. In 2000, they invested R\$ 429,000.00 in these programs.

Moema's industrial processes are also a matter of care for the company, and quality is on top of that care. The company has defined programs for eventual certification of all its processes in compliance with ISO norms as a way to incorporate technology. The result was the company's certification with the ISO 9002 in September 1999 by Bureau Veritas Quality International. In a process of continuous improvement of its processes and internal procedures, Moema is currently in a process for further certification of its activities. The procedures for electricity cogeneration are to be certified, and the company is also adapting itself to comply with the ISO 14000 series for the environmental practices.

Increasing the firm's annual revenues due to CERs commercialization therefore adds substantial value to the employees of the firm, its sugarcane providers, their families and the local community.

### **Environmental Contribution**

MBCP project activity participants believe that electricity cogeneration with bagasse is a sustainable source of energy that brings not only advantages for mitigating global warming, but also creates a competitive advantage for the agricultural production in the sugarcane industry in Brazil. Using the available natural resources in a more rationale way, the project activity may help to enhance development of a renewable energy source that has significant potential in Brazil, besides demonstrating the viability of electricity generation as a source of revenue for the sugar industry. It is worth to highlight that of approximately 320 sugar mills in Brazil, the great majority produces energy solely for on-site use, which is the *Business-as-usual* case for the sugarcane industry.

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

<b>A.3. <u>Project participants:</u></b>
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**Usina Moema Açúcar e Alcool Ltda** (Moema), a Brazilian private company.  
**Econergy Brasil Ltda**, Brazilian private company.  
**Swedish Energy Agency**.

**A.4. Technical description of the project activity:****A.4.1. Location of the project activity:****A.4.1.1. Host Party(ies):**

Brazil

**A.4.1.2. Region/State/Province etc.:**

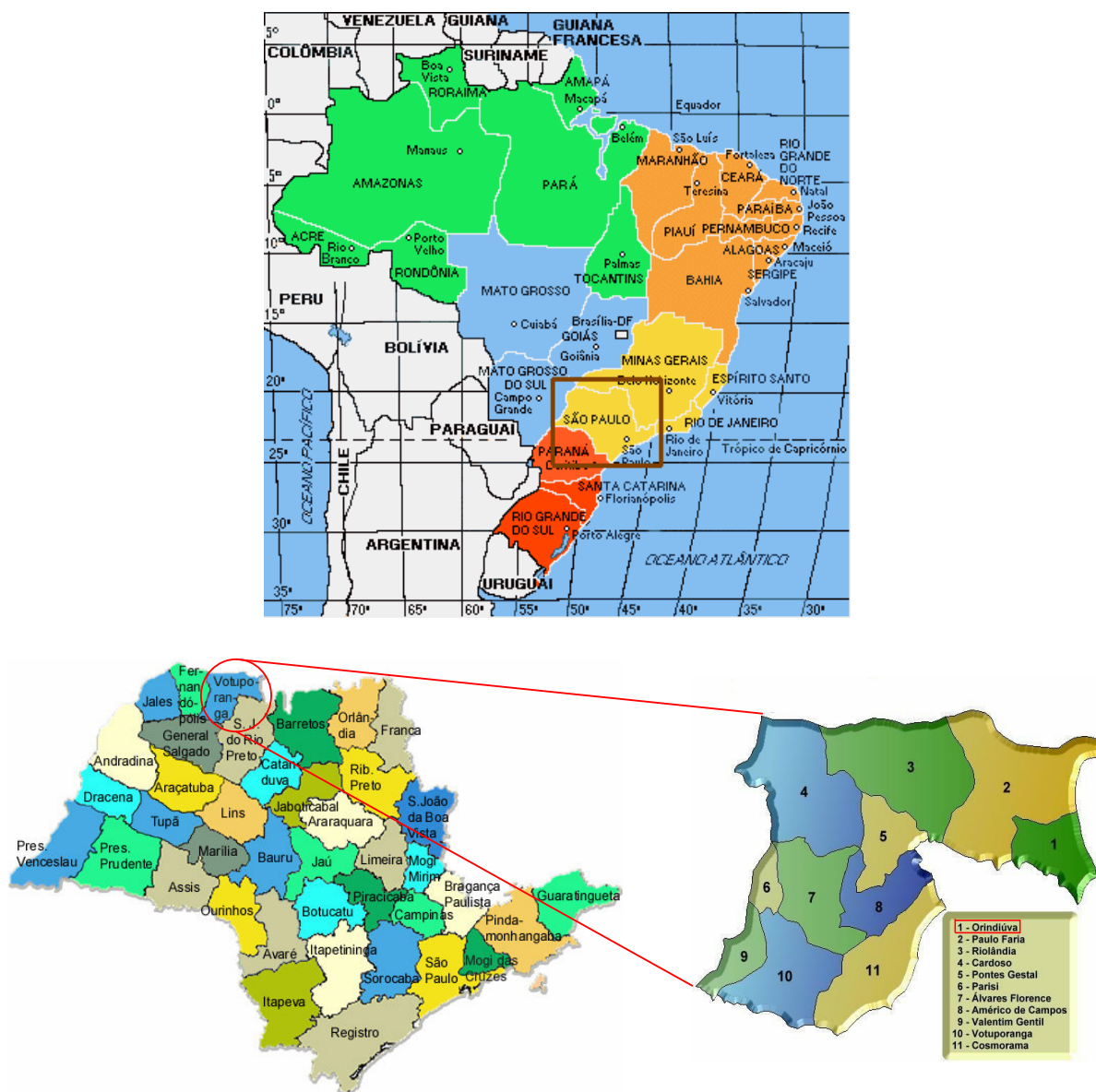
São Paulo

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

Orindiúva

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

Orindiúva is located northeast in the State of São Paulo, about 400 km far from the state capital, São Paulo, in the agricultural region of Votuporanga, as can be seen in Figure 1.



Source: Elaborated from Coordenadoria de Assistência Técnica Integral (CATI) – [www.cati.sp.gov.br](http://www.cati.sp.gov.br)

Figure 1: Geographical position of the city of Orindiúva (#1)

**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:**

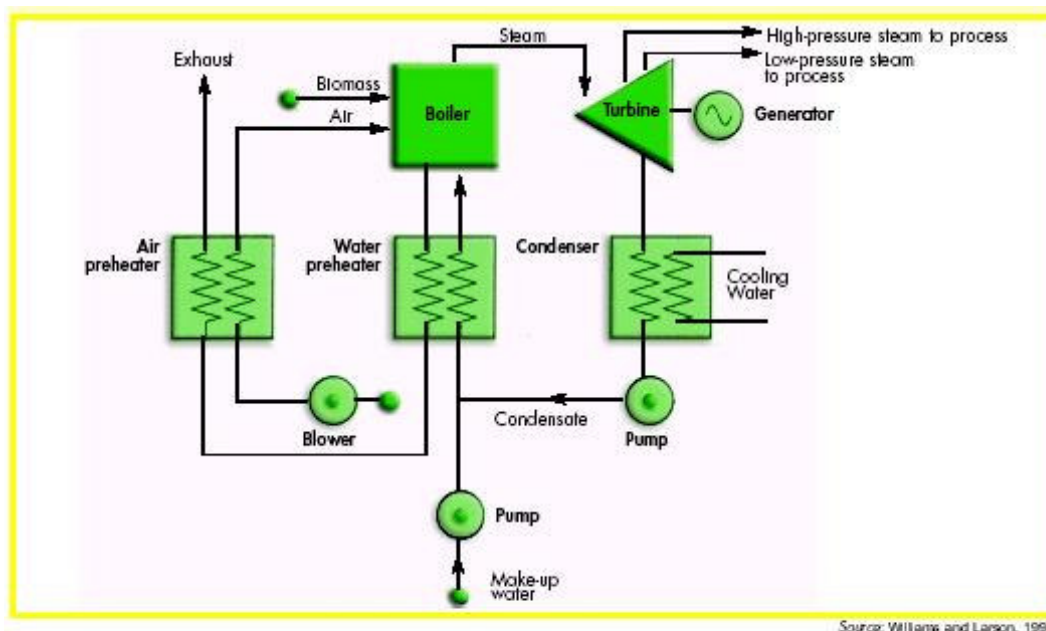
The predominant technology in all parts of the world today for generating megawatt (MW) levels of electricity from biomass is the steam-Rankine cycle, which consists of direct combustion of biomass in a boiler to raise steam, which is then expanded through a turbine. Most steam cycle plants are located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

The steam-Rankine cycle involves boiling pressurized water, with the resulting steam expanding to drive a turbo-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 (see 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 are, the more efficient, sophisticated, and costly, the cycle is.

Using steam-rankine cycle as the basic technology of its cogeneration system, for achieving an increasing amount of surplus electricity to be generated, Moema began its efforts:

MBCP aims to expand the surplus electricity generation of the mill's cogeneration system and to add value to bagasse from its sugar milling process. Using own financial resources and capital from BNDES<sup>2</sup>, the Brazilian Development Bank, Moema has invested so far a total of R\$ 14 million<sup>3</sup> for expanding its total installed power generation capacity, plus other electricity generation-related investments.

The investment of R\$ 13 million comprehends the acquisition of a new boiler providing 150 ton of steam per hour at 415 °C and 44 bar, a backpressure turbo generator of 12 MW, a 27 km transmission line, an energy sub-station and other construction costs in order to be able to sell the surplus of energy. The purchased equipment increased Moema's total capacity to 24 MW, with 7.5 MW for internal consumption purposes and 12.5 MW for commercialization of electricity. The mill decided to let a 4 MW turbo generator in stand by, so that it could be used in emergency situations to comply with its supplying commitments.

<sup>2</sup> Banco Nacional para o Desenvolvimento Econômico e Social.

<sup>3</sup> US\$ 4.8 million, as of 26<sup>th</sup> of December, 2003 (R\$ 2.92/US\$ 1).



In the year 2001, Moema started supplying the grid through a five-year (until November, 2005) power purchase agreement with Elektro<sup>4</sup>, with a supplying capacity of 12.5 MW, whose 54,4 % has to be firm energy and the other 45,6 % depends on Moema's decision to supply or not according to price settings. In may the 15<sup>th</sup>, 2002, when the verifier visited the project, MBCP was using 9.5 MW for commercialization and had two 4 MW generators turned off due to the low energy price on the Brazilian market at that time. In 2001, it supplied the grid with 49,533 MWh during the harvest season, ranging approximately from April to December.

Table 1 shows how Moema's infrastructure will be updated according to MBCP, while figure 3 shows an energy balance diagram for Moema.

	Active / Activating				Stand by
Before the Expansion Plan 2000	Three 4 MW backpressure turbo generators				
	Four 21 Bar boilers				
2001	One 12 MW backpressure turbo generator	Two 4 MW backpressure turbo generators			One 4 MW backpressure turbo generator
	One 44 bar boiler	Four 21 Bar boilers			

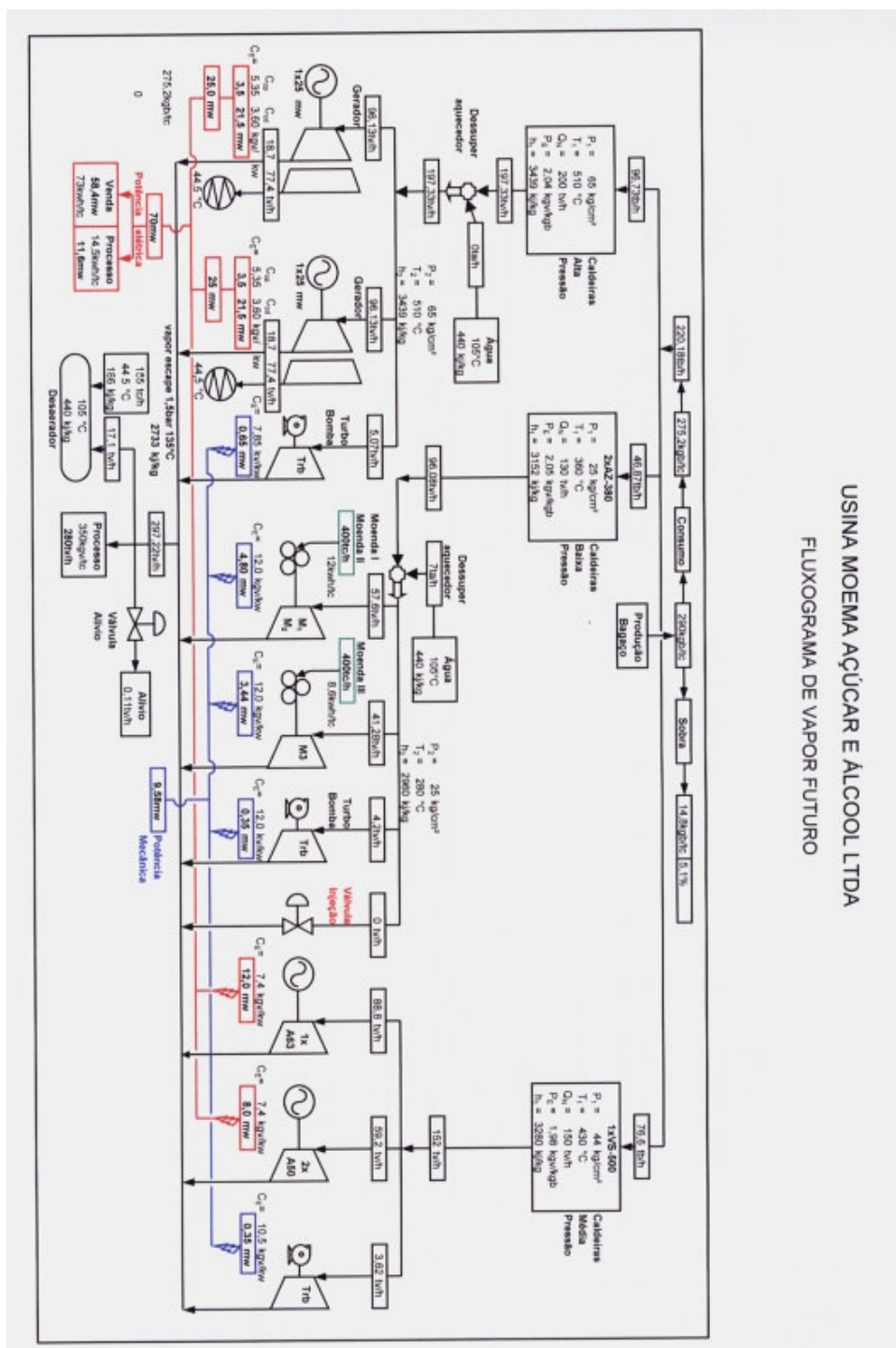
**Table 1: MBCP's Cogeneration equipment upgrades**

<sup>4</sup> Elektro - Eletricidade e Serviços S.A., is a leading energy distributor located in Campinas – SP

<sup>5</sup> São Paulo. Secretary of Energy, 2001.



### Figure 3: Energy Balance Diagram





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

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

Bagasse is a fibrous biomass by-product from sugarcane processing, which accounts for about 25 percent on weight of fresh cane and approximately one third of the cane's energy content. In a typical Brazilian sugarcane mill, burning bagasse for generation of process heat and power production is a practice already established. It is estimated that over 700 MW of bagasse-based power capacity are currently installed in the state of São Paulo only<sup>5</sup>. The energy produced from these facilities is almost all consumed for their on purpose. Because of constraints that limited the access of independent power producers to the electric utilities market, there is no incentive for sugarcane mills to operate in a more efficient way. Low-pressure boilers, very little concern with optimal use and control of steam, crushers mechanically activated by steam, energy intensive distillation methods, are a few examples of inefficient methods applied to the sugar industry as normal routine.<sup>6</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 a considerable complementary energy and make the bagasse cogeneration electricity attractive for any potential purchasers.

Nevertheless, some barriers pose a challenge for implementation of this kind of projects. In most cases, the sponsors' culture in the sugar industry is very much influenced by the commodities – sugar and ethanol – market. Therefore, they need an extra incentive to invest in electricity production due to the fact that it is a product that can never be stored in order to speculate in price. The Power Purchase Agreement requires different negotiation skills, which is not the core of the sugar industry. For instance, when signing a long-term electricity contract, the PPA, a given sugar mill has to be confident that it will produce sufficient biomass to supply its cogeneration project. Although it seems easy to predict, the volatility of sugarcane productivity may range from 75 to 95 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 Moema, which is investing to expand its electric power generation capacity and to operate in a more rationale way under the above mentioned new electric sector circumstances.

This project activity is expected to reduce **85.552 tCO<sub>2</sub>e** over 7 years.

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<sup>6</sup> Nastari, 2000.

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

This project activity is to reduce **85.552 tCO<sub>2</sub>e** over 7 years.

1st Crediting Period	20/05/2001	2002	2003	2004	2005	2006	2007	19/05/2008	Total CERs
Total CO <sub>2</sub> emissions reductions, tCO <sub>2</sub> e/year	12.499	11.908	9.971	12.045	12.450	12.450	12.450	1.779	<b>85.552</b>

Emission reductions produced until 2004. Data for 2005 and on are estimates.

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

There is no Annex I public funding involved in MBCP.

**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 MBCP due to the fact that (i) the bagasse is produced and consumed in the same facility – Moema -; (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 following; (iii) there is not increase on the bagasse production due to the project activity itself/ and (iv) there will be not 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
1. $EG_y$	Electricity supplied to the grid by the Project.	Obtained throughout project activity lifetime.	MWh	Project owner
2. $EF_y$	CO <sub>2</sub> emission factor of the Grid.	0,249	tCO <sub>2</sub> e/MWh	Calculated
3. $EF_{OM,y}$	CO <sub>2</sub> Operating Margin emission factor of the grid.	0,404	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.	0,094	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.	$\lambda_{2001} = 0,520$ $\lambda_{2002} = 0,505$ $\lambda_{2003} = 0,531$	-	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 MBCP.**

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

a) The MBCP was implemented after January 2000 as evidenced on the Resolution 178 from National Energy Agency (ANEEL) on 01 June 2000, which authorizes Moema to establish its cogeneration as an Independent Energy Producer. This resolution was publicized on the Official Journal (Diário Oficial) of 02 June 2000 on its section 1 pag 17.

b) Some of the Moema sugar mill's shareholders are also shareholder of Vale do Rosário sugar mill, which evidence that the CDM was seriously considered in the decision of the MBCP activity. Mr. Ricardo Brito, who is executive of the Vale do Rosário sugar mill and is also the person that has been stimulating the use of CDM as source of revenue for cogeneration with bagasse in the sugar industry by participating on capacity building events since 1999, is also an executive of Moema. Mr. Brito attended a seminar at the São Paulo Business School (EAESP/FGV) in 1999 as Moderator on the panel discussing projects eligibility, certification and generation of CERs (Qualificação de Projectos, Certificação e



Geração de Créditos)<sup>7</sup>, looking for a better understanding of the CDM procedures and the feasibility for using it as a source of funding to support the expansion of cogeneration on the sugar industry. The other participants in the panel, as well as the EAESP/FGV might serve as alive evidence that the CDM has been considered in the project activity.

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

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

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

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

2. The alternative, which is to continue with the BAU situation before the decision of implementing this CDM project activity is consistence with the applicable laws and regulations.

3. Non applicable.

4. Both the project activity and the alternative scenario 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. and 2. According to COELHO (1999)<sup>8</sup>, “large scale cogeneration program in sugar-alcohol sector has not yet occurred, due to several barriers, mainly economic, political and institutional”, such as:

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

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

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<sup>7</sup> In this panel there were also Mrs. Sandra Brown, from Winrock International, Mr. Norm Anderson from BP Amoco, Mr. Peter Avram-Waganoff from IPRO Industrieprojekt GmbH, Mr. Manoel Regis Lima Verde Leal from Copersucar and Mr. Adwin Aalders from SGS.

<sup>8</sup> Coelho, S. T. *Mecanismos para Implementação da Cogeração de Eletricidade a partir de biomassa. Um Modelo para os Estado de São Paulo*. Programa Interunidades de pós-graduação em Energia. São Paulo, Agosto de 1999.



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

Moreover, SWISHER (1997)<sup>9</sup> considers difficult to convince the local distributor that the energy to be acquired, generally generated during the harvest season, is sufficiently reliable to be accounted in the distributor's planning.

## II. Institutional and Political Barriers

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

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

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

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

Since 1997, according to SWISHER (1997), the announcement of a Cogeneration Decree has been awaited, and that was supposed to have this positive influence on corporate decision-making with respect to biomass project implementation. The original Cogeneration Decree proposal, which was never approved, called for mandatory purchase by the regional utilities - “*concessionárias*” - from cogenerating and self-generating facilities<sup>10</sup>. Instead of renewable energy, the government expansion plan for electric energy, approved in August is based on fossil fuel – Natural Gas. This expansion plan called Thermoelectricity Priority Plan (PPT) became a reality right before the energy crisis. The Thermoelectricity Priority Plan beneficiaries, which were mainly natural gas thermal plants, through the Ministry of Mines and Energy (MME) Decree 3,371 from December 2000, counted on guaranteed, long term and attractive price conditions on Natural Gas supply and Energy sales, together with financing

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<sup>9</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*. Prepared for Global Environment Facility (GEF) Secretariat, Washington DC, 1997.

<sup>10</sup> Presidential Decree on the co-generation of electric energy, draft of 5 August 1997.



from the national development bank BNDES. And though the PPT plan is not likely to be fully implemented, the public-sector policies for renewable energy are not considered reliable enough by the executives of the private sector to support cogeneration expansion in the sugar mills. This assumption is clearly shown in the following list of rules and/or regulations to the energy sector that have been set in the last 10 years:

- **March 1993:** Law 8.631 sets a tariff regulation for electric energy;
- **February 1995:** Law 8.987 establish public concession for energy;
- **July 1995:** Law 9.074 regulates concession for electric energy sector;
- **December 1996:** Law 9.427 creates National Energy Agency (ANEEL);
- **August 1997:** Law 9.478 sets the National Council for Energy Planning (CNPE);
- **October 1997:** Decree 2.335 regulates the ANEEL task;
- **December 1997:** Implements ANEEL;
- **May 1998:** Law 9.648 establishes the Spot Market for Electric Energy (MAE) and the Operator National System (ONS);
- **July 1998:** Decree 2.655 regulates MAE and ONS tasks;
- **December 2000:** Decree 3.371 regulates the Thermoelectricity Priority Plan (PPT);
- **April 2002:** Law 10.438 sets the Program for Incentive Alternative Energy (PROINFA), stating that contracts shall be signed within 24 months from its date and that there will be different economic values for the acquisition of 3,300MW of electricity capacity from renewable sources by the state owned Eletrobrás, for plants starting operations before December 30, 2006;
- **August 2002:** MP 64 is a presidential act to change the constitution in order to permit the energy sector regulation including the PROINFA;
- **December 2002:** Resolution 4.541 from ANEEL regulates the implementation of PROINFA, stating that economic values would be defined within 90 days;
- **March 2003:** Decree 4.644 postponed for 180 days, from its date, the economic value and operational guidelines announcement;
- **June 2003:** Decree 4.758 indefinitely postponed the date for the economic value and operational guidelines announcement and revoked the above mentioned Decree 4.644.
- **November 2003:** Law 10.762 of 11 November/03 revised Law 10.438 of 26 April 2002 institutes PROINFA.
- **March 2004:** Decree 5.025 regulates the Law 10.438 as of 26 April 2002.

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



### III. Economic and Investment Barriers

“There are several reasons for the Brazilian utilities' reluctance to offer higher prices for co-generated power. One important reason stems from their assumption that their costs are geographically uniform – i.e., that there is essentially a single value for their avoided cost in the industrial sector. If this cost value does not indicate that sufficient savings are available from buying co-generated power, and then there is little economic motivation, under either a public monopoly or a privatized competitive structure, for a utility to pay enough for co-generation to satisfy potential investors' financial criteria”<sup>11</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 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>12</sup>.

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

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

### IV. Cultural Barrier

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

There are also questions regarding the managerial capacity of the companies that comprise the Brazilian sugarcane industry. In many cases, they have demonstrated the will to undertake investments in new technologies, but without sufficient financial and entrepreneurial capacity to complete such projects, according to WALTER (1994)<sup>13</sup>.

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<sup>11</sup> Joel Swisher personal communication with Rolls Royce Power Ventures project manager. Mark Croke, August 26, 1997. Swisher J. 1997 pg. 76.

<sup>12</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>13</sup> Walter, A.C.S. *Viabilidade e Perspectivas da Co-geração e Geração Termelétrica no Setor Sucro-alcooleiro*. Tese de Doutorado. UNICAMP, Campinas, 1994.



**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).**

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

**Step 4. Common practice analysis.****Sub-step 4a: Analyze other activities similar to the proposed project activity**

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

Similar project activities have been implemented by leading companies in this industry, mainly after Vale do Rosário started to implement its project that clearly served as a sector benchmark. However, these are few examples in a universe of about 320 sugar mills. Currently, the other similar project activities under implementation are, for example, Santa Cândida, Equipav, Nova América. All together the similar projects in the sugar industry in Brazil are restricted to approximately 10% of the sugar industry, since the other 90% are still burning their bagasse for on-site use only in the old-fashioned inefficient way. That clearly shows that just a small part of this sector is willing to invest in cogeneration projects. Moreover, the majority of the similar projects, which are currently being implemented, are carried out as CDM project activities. So far, Econergy Brasil has reported at least 26 CDM bagasse cogeneration projects in Brazil.

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

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

**Step 5. Impact of CDM registration**

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

In addition to the benefits and incentives mentioned in the text of the Tool for demonstration and assessment of additionality, published by the CDM-EB, will be experienced by the project activities such as: the project will achieve the aim of anthropogenic GHG reductions; financial benefit of the revenue obtained by selling CERs will bring more robustness to the project's financial situation; and its likely to attract new players and new technology (there are companies currently developing new type of boilers –



extra-efficient – and the purchase of such equipment is to be fostered due to CER sales revenue) and reducing the investor's risk.

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

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

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

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

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

1. Date of completing the final draft of this baseline section

30/06/2005.

2. Name of person/entity determining the baseline

ECONERGY (for further information, please refer to Annex 1), which is a participant in this project, is responsible for the technical services related to GHG emission reductions, and is therefore, in behalf of Moema, the developer of this document, and all its contents.

**SECTION C. Duration of the project activity / Crediting period**

**C.1 Duration of the project activity:**

**C.1.1. Starting date of the project activity:**

20/05/2001

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

25y-0m.<sup>14</sup>

<sup>14</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.

**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:**

20/05/2001

**C.2.1.2. Length of the first crediting period:**

7y-0m

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

NA

**C.2.2.2. Length:**

NA

**SECTION D. Application of a monitoring methodology and plan****D.1. Name and reference of approved monitoring methodology applied to the project activity:**

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

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

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

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

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

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

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

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

**D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO<sub>2</sub> equ.)**

NA

**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

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1. $EG_y$	Electricity supplied to the grid by the Project.	Readings of the energy metering connected to the grid and Receipt of Sales.	MWh	<i>M</i>	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.
2. $EF_y$	CO <sub>2</sub> emission factor of the Grid.	Calculated	tCO <sub>2</sub> e/MWh	<i>C</i>	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. $EF_{OM,y}$	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	<i>C</i>	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. $EF_{BM,y}$	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	<i>C</i>	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. $\lambda_y$	Fraction of time during which low-cost/ must-run sources are on the margin.	Factor calculated from ONS, the Brazilian electricity system manager.	index	<i>C</i>	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.

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**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.)**

$EF_{OM, simple\_adjusted, y} = (1 - \lambda_y) \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}} \text{ (tCO}_2\text{e/GWh)}$ $EF_{BM} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}} \text{ (tCO}_2\text{e/GWh)}$ $EF_{electricity} = \frac{EF_{OM} + EF_{BM}}{2} \text{ (tCO}_2\text{e/GWh)}$ <p><math>BE_{electricity,y} = EF_{electricity} \cdot EG_y</math></p>	<p><math>F_{i,j(or m),y}</math> Is the amount of fuel <math>i</math> (in a mass or volume unit) consumed by relevant power sources <math>j</math> in year(s) <math>y</math></p> <p><math>j,m</math> Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports<sup>4</sup> from the grid</p> <p><math>COEF_{ij(or m) y}</math> Is the CO<sub>2</sub> emission coefficient of fuel <math>i</math> (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 <math>j</math> (or <math>m</math>) and the percent oxidation of the fuel in year(s) <math>y</math>, <math>a</math></p> <p><math>GEN_{j(or m),y}</math> Is the electricity (MWh) delivered to the grid by source <math>j</math> (or <math>m</math>)</p> <p><math>BE_{electricity,y}</math> Are the baseline emissions due to displacement of electricity during the year <math>y</math> in tons of CO<sub>2</sub></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 <math>y</math> 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.2.3. Treatment of leakage in the monitoring plan**

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

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

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

**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.)**

NA

**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.)**

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

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

$$PE_y = 0$$

$$L_y = 0$$

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

ER<sub>y</sub>: are the emissions reductions of the project activity during the year y in tons of CO<sub>2</sub>

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>

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>

PE<sub>y</sub>: Are the project emissions during the year y in tons of CO<sub>2</sub>.

L<sub>y</sub>: Are the leakage emissions during the year y in tons of CO<sub>2</sub>.

**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

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



**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, which is a participant in this project, is the responsible for the technical services related to GHG emission reductions, and is therefore, in behalf of Moema, the developer of this document, and all its contents



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

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

Thus,  $PE_y = 0$

**E.2. Estimated leakage:**

No leakage is considered to happen in this project activity no bagasse used to be sold, therefore:  $L_y = 0$

**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 2001, 2002 and 2003, and is the most recent information available at this stage (At the end of 2004 ONS supplied raw dispatch data for the whole interconnected grid in the form of daily reports<sup>15</sup> from Jan. 1, 2001 to Dec. 31, 2003, the most recent information available at this stage).

**Simple Adjusted Operating Margin Emission Factor Calculation**

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

<sup>15</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, 2001 to Dec. 31, 2003.

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

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

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

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 2001, 2002 and 2003.

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
2001	0,5204
2002	0,5053
2003	0,5312

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

Year	Electricity Load (MWh)
2001	263.706.242
2002	275.402.896
2003	288.493.929

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

$$EF_{OM, simple\_adjusted, 2001} = (1 - \lambda_{2001}) \frac{\sum_{i,j} F_{i,j,2001} \cdot COEF_{i,j}}{\sum_j GEN_{j,2001}} \therefore EF_{OM, simple\_adjusted, 2001} = 0,3524 \text{ tCO}_2\text{/MWh}$$

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

$$EF_{OM, simple\_adjusted, 2003} = (1 - \lambda_{2003}) \frac{\sum_{i,j} F_{i,j,2003} \cdot COEF_{i,j}}{\sum_j GEN_{j,2003}} \therefore EF_{OM, simple\_adjusted, 2003} = 0,4396 \text{ tCO}_2\text{/MWh}$$



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

$$EF_{OM, simple\_adjusted\ 2001-2003} = 0,404\ \text{tCO}_2/\text{MWh}$$

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 (2003), as the 5 most recent plants built generate less than such 20%. Calculating such factor one reaches:

$$EF_{BM, 2003} = 0,094\ \text{tCO}_2/\text{MWh}$$

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:

$$EF_{electricity, 2001-2003} = 0,5 * 0,404 + 0,5 * 0,094 = 0,249\ \text{tCO}_2/\text{MWh}$$

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 ( $EF_{electricity, 2001-2003}$ ) with the electricity generation of the project activity.

$$BE_{electricity, y} = EF_{electricity, 2001-2003} \cdot EG_y$$

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

$$BE_{electricity, y} = 0,249\ \text{tCO}_2/\text{MWh} \cdot EG_y\ (\text{in tCO}_2\text{e})$$

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

The emissions reduction of this project activity is

$$ER = BE_{electricity, y} - (L_y + PE_y) = 0,249\ \text{tCO}_2/\text{MWh} \cdot EG_y - 0 \rightarrow ER = 0,249\ \text{tCO}_2/\text{MWh} \cdot EG_y$$

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



Moema Bagasse Cogeneration Project										
Grid-Connected Emission Reduction	Item	20/5/2001	2002	2003	2004	2005	2006	2007	19/5/2008	Total CERs
	Installed Capacity, MW	24	24	24	24	24	24	24	24	
	Electric energy to be sold to ELEKTRO, MWh/year	50.198	47.824	40.045	48.373	50.000	50.000	50.000	7.143	
	Baseline emission factor tCO2e/MWh	0,249	0,249	0,249	0,249	0,249	0,249	0,249	0,249	
	Total CO <sub>2</sub> emissions reductions, tCO2e/year	12.499	11.908	9.971	12.045	12.450	12.450	12.450	1.779	85.552
Electricity produced until 2004. Data for 2005 and on are estimates.										

## SECTION F. Environmental impacts

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

The possible environmental impacts of MBCP are to be analyzed by the State Secretary of Environment (*Secretaria de Estado do Meio Ambiente*) through a report called “Preliminary Environmental Report” (RAP – *Relatório Ambiental Preliminar*) prepared by the company and sent to the state environmental agency (*Companhia de Tecnologia de Saneamento Ambiental – CETESB*). The environmental authorities have issued a preliminary working license, in order to be able to check whether the project is in compliance with the demands from the Secretary and the environmental agency, and to later issue the definitive working license. The latest version can be obtained within the company’s management department.

There will be no transboundary impacts resulting from MBCP. All the relevant impacts occur within Brazilian borders and have been mitigated to comply with the environmental requirements for project’s implementation.

### 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 impacts from MBCP are not considered significant.

The secretary of environment and CETESB already analyzed the most relevant impacts from the project activity, and issuance of the definite working license is expected to be issued soon, after the authorities check the compliance of the project with the requirements for its operation.

## SECTION G. Stakeholders’ comments

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

Invitations for comments by local stakeholders are required by the Brazilian Designated National Authority as part of the procedures for analyzing CDM projects and issuing letters of approval. This



procedure has been followed by Moema to take its GHG mitigation initiative to the public. Letters<sup>16</sup> were sent to the following recipients:

- Prefeitura do Município de Paulo de Faria / *Municipal Administration of Paulo de Faria*
- Prefeitura do Município de Icem / *Municipal Administration of Icem*
- Prefeitura do Município de Orindiuva / *Municipal Administration of Orindiuva*
- Câmara Municipal de Vereadores do Município de Paulo de Faria / *Municipal Legislation Chamber of Paulo Faria*
- Câmara Municipal de Vereadores do Município de Icem / *Municipal Legislation Chamber of Icem*
- Câmara Municipal de Vereadores do Município de Orindiuva / *Municipal Legislation Chamber of Orindiuva*
- Ministério Público da Comarca de Paulo de Faria / *Public Ministry*
- Fórum Brasileiro de ONGs / *Brazilian NGO Forum*
- Companhia de Tecnologia de Saneamento Ambiental (CETESB) / *State Environmental Agency*
- Rotary Club de Fronteira – MG / *Rotary Club of Fronteira –MG*
- Associação dos Fornecedores de Cana de Orindiuva / *Cane Suppliers Association of Orindiuva*

In the case of MBCP, Moema took to the public the initiative of expanding its cogeneration facilities in order to supply electricity to the grid. The company published similar announcements in three newspapers. It first informed interested parties that it had the intention to install the facilities for MBCP and any comments should be done within a month after the publications. Later, Moema published in two newspapers it had received the license from CETESB.

Copies of the newspapers where the announcements were published are shown in figure 4 and figure 5.

<b>G.2. Summary of the comments received:</b>
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No comments were received for MBCP.

<b>G.3. Report on how due account was taken of any comments received:</b>
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Since no comments were sent to SMA regarding MBCP, Moema proceeded with the project as initially planned.

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<sup>16</sup> The copies of these invitations are available in hold of Project participants.



Figure 4: Announcement in a local newspaper requesting stakeholders to comment on Moema's initiative of expanding its cogeneration facilities

Figure 5: Announcements of the awarded installation license for MBGP

Annex 1**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

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## Annex 2

### INFORMATION REGARDING PUBLIC FUNDING

There is no Annex I public funding involved in MBCP 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>17</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

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<sup>17</sup> Bosi, M. *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study*. International Energy Agency. Paris, 2000.



the interconnection between SE and NE was concluded, i.e., if project proponents are to be coherent with the generation database they have available as of the time of the PDD submission for validation, a situation where the electricity flow between the subsystems was even more restricted is to be considered.

The Brazilian electricity system nowadays comprises of around 91,3 GW of installed capacity, in a total of 1.420 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 5,3% are diesel and fuel oil plants, 3,1% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw and biogas), 2% are nuclear plants, 1,4% are coal plants, and there are also 8,1 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid. (<http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp>). This latter capacity is in fact comprised by mainly 6,3 GW of the Paraguayan part of *Itaipu Binacional*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

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

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

In that regard, project proponents looked for a plausible solution in order to be able to calculate the emission factor in Brazil in the most accurate way. Since real dispatch data is necessary after all, the ONS was contacted, in order to let participants know until which degree of detail information could be provided. After several months of talks, plants’ daily dispatch information was made available for years 2001, 2002 and 2003.

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. Such capacity in fact is constituted by plants with 30 MW installed capacity or above, connected to the system through 138kV power lines, or at higher voltages. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76,4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23,6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.



In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International Energy Agency database built when carrying out the study “Road-Testing Baselines For Greenhouse Gas Mitigation Projects in the Electric Power Sector”, published in October 2002. Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only, as the table below shows the build margin in both cases.

IEA/ONS Merged Data Build Margin (tCO <sub>2</sub> /MWh)	ONS Data Build Margin (tCO <sub>2</sub> /MWh)
0,205	0,0937

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

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

From the mentioned reference:

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

Therefore only data for plants under construction in 2002 (with operation start in 2002 and 2003) was estimated. All others efficiencies were calculated. To the best of our knowledge there was no retrofit/modernization of the older fossil-fuelled power plants in the analyzed period (2001 to 2003). For that reason project participants find the application of such numbers to be not only reasonable but the best available option.

The aggregated hourly dispatch data got from ONS was used to determine the lambda factor for each of the years with data available (2001, 2002 and 2003). 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 122 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 (y, m, d)	Installed capacity (MW) [1]	Fossil fuel conversion efficiency (%) [2]	Carbon emission factor (kg CO <sub>2</sub> /kWh) [3]	Fraction carbon avoided (%) [4]	Emission factor (kg CO <sub>2</sub> /kWh) [5]
1	S-SE-CD	H	Jatui	Sep-2003	121.5	1	0.0	0.000
2	S-SE-CD	H	Guaporé	Sep-2003	120.0	1	0.0	0.000
3	S-SE-CD	G	Três Lagoas	Aug-2003	305.0	0.3	15.3	99.5%
4	S-SE-CD	H	Furni (MG)	Jan-2003	190.0	1	0.0	0.000
5	S-SE-CD	H	Itaoua I	Sep-2002	156.1	1	0.0	0.000
6	S-SE-CD	G	Aracuaia	Sep-2002	484.5	0.3	15.3	99.5%
7	S-SE-CD	G	Canaas	Sep-2002	191.6	0.3	15.3	99.5%
8	S-SE-CD	H	Piraju	Sep-2002	81.0	1	0.0	0.000
9	S-SE-CD	G	Nova Primavera	Jun-2002	384.9	0.3	15.3	99.5%
10	S-SE-CD	O	POI COTTE	Jun-2002	4.0	0.3	20.7	99.5%
11	S-SE-CD	H	Rosai	Jun-2002	55.0	1	0.0	0.000
12	S-SE-CD	G	Itaipu	May-2002	226.0	0.3	15.3	99.5%
13	S-SE-CD	H	Celso Bastos	Mar-2002	468.8	1	0.0	0.000
14	S-SE-CD	H	Sta. Clara	Jan-2002	60.0	1	0.0	0.000
15	S-SE-CD	H	Machadinho	Jan-2002	1,140.0	1	0.0	0.000
16	S-SE-CD	G	Jatui de Fora	Nov-2001	87.0	0.28	15.3	99.5%
17	S-SE-CD	G	Macaé Merchant	Nov-2001	922.6	0.24	15.3	99.5%
18	S-SE-CD	H	Lapaço (ANEEL res. 492/2001)	Nov-2001	992.5	1	0.0	0.000
19	S-SE-CD	G	Estremoz	Oct-2001	475.0	0.24	15.3	99.5%
20	S-SE-CD	H	Porto Estreito	Sep-2001	112.0	1	0.0	0.000
21	S-SE-CD	G	Cuiabá (Mario Covas)	Aug-2001	529.2	0.3	15.3	99.5%
22	S-SE-CD	G	W. Arinos	Jan-2001	194.0	0.25	15.3	99.5%
23	S-SE-CD	G	Unicuitania	Jan-2000	639.9	0.45	15.3	99.5%
24	S-SE-CD	H	S. Cavacas	Jan-1999	1,240.0	1	0.0	0.000
25	S-SE-CD	H	Canaas I	Jan-1999	82.5	1	0.0	0.000
26	S-SE-CD	H	Canaas II	Jan-1999	72.0	1	0.0	0.000
27	S-SE-CD	H	Igarapava	Jan-1999	210.0	1	0.0	0.000
28	S-SE-CD	D	Porto Primavera	Jan-1999	1,540.0	1	0.0	0.000
29	S-SE-CD	D	Cuiabá (Nery Gessi)	Oct-1998	529.2	0.27	20.2	99.5%
30	S-SE-CD	H	Sobera	Sep-1998	60.0	1	0.0	0.000
31	S-SE-CD	H	POI EMAE	Jan-1998	25.0	1	0.0	0.000
32	S-SE-CD	H	POI CEEB	Jan-1998	25.0	1	0.0	0.000
33	S-SE-CD	H	POI ENERSUL	Jan-1998	43.0	1	0.0	0.000
34	S-SE-CD	H	POI CEB	Jan-1998	15.0	1	0.0	0.000
35	S-SE-CD	H	POI EXELSA	Jan-1998	60.0	1	0.0	0.000
36	S-SE-CD	H	POI CELESC	Jan-1998	50.0	1	0.0	0.000
37	S-SE-CD	H	POI CEMAT	Jan-1998	145.0	1	0.0	0.000
38	S-SE-CD	H	POI CELG	Jan-1998	15.0	1	0.0	0.000
39	S-SE-CD	H	POI CERU	Jan-1998	55.0	1	0.0	0.000
40	S-SE-CD	H	POI COPEL	Jan-1998	70.0	1	0.0	0.000
41	S-SE-CD	H	POI CEMIG	Jan-1998	84.0	1	0.0	0.000
42	S-SE-CD	H	POI CPFL	Jan-1998	55.0	1	0.0	0.000
43	S-SE-CD	H	S. Mesa	Jan-1998	1,275.0	1	0.0	0.000
44	S-SE-CD	H	POI EPARAO	Jan-1998	25.0	1	0.0	0.000
45	S-SE-CD	H	Guaraná Alomem	Jan-1997	140.0	1	0.0	0.000
46	S-SE-CD	H	Corumbá	Jan-1997	375.0	1	0.0	0.000
47	S-SE-CD	H	Miranda	Jan-1997	425.0	1	0.0	0.000
48	S-SE-CD	H	Nova Ponte	Jan-1994	510.0	1	0.0	0.000
49	S-SE-CD	H	Sagredo (Gov. Nery Brasil)	Jan-1992	1,250.0	1	0.0	0.000
50	S-SE-CD	H	Matucuru	Jan-1989	254.0	1	0.0	0.000
51	S-SE-CD	H	Matozo	Jan-1988	210.0	1	0.0	0.000
52	S-SE-CD	H	D. Francisco	Jan-1987	125.0	1	0.0	0.000
53	S-SE-CD	H	Ita	Jan-1987	1,450.0	1	0.0	0.000
54	S-SE-CD	H	Rozana	Jan-1987	269.2	1	0.0	0.000
55	S-SE-CD	N	Angra	Jan-1985	1,874.0	1	0.0	0.000
56	S-SE-CD	H	T. Imilim	Jan-1985	807.5	1	0.0	0.000
57	S-SE-CD	H	Itaipu 92 Hs	Jan-1983	6,300.0	1	0.0	0.000
58	S-SE-CD	H	Itaipu 50 Hs	Jan-1983	5,375.0	1	0.0	0.000
59	S-SE-CD	H	Emborcação	Jan-1982	1,192.0	1	0.0	0.000
60	S-SE-CD	H	Nova Aventureira	Jan-1982	347.4	1	0.0	0.000
61	S-SE-CD	H	Gov. Bento Munhoz - GBM	Jan-1980	1,676.0	1	0.0	0.000
62	S-SE-CD	H	S. Santiago	Jan-1980	1,420.0	1	0.0	0.000
63	S-SE-CD	H	Ijuatuba	Jan-1980	2,280.0	1	0.0	0.000
64	S-SE-CD	O	Itaipu	Jan-1978	131.0	0.3	20.7	99.5%
65	S-SE-CD	H	Itaipu	Jan-1978	512.4	1	0.0	0.000
66	S-SE-CD	H	A. Veneza (Jose E. Moraes)	Jan-1978	1,582.0	1	0.0	0.000
67	S-SE-CD	H	S. Simão	Jan-1978	1,710.0	1	0.0	0.000
68	S-SE-CD	H	Cachoeira	Jan-1977	840.0	1	0.0	0.000
69	S-SE-CD	H	S. Duílio	Jan-1975	1,073.0	1	0.0	0.000
70	S-SE-CD	H	Mamborê	Jan-1975	1,440.0	1	0.0	0.000
71	S-SE-CD	H	Promissão	Jan-1975	254.0	1	0.0	0.000
72	S-SE-CD	C	Novo Amapá	Jan-1974	446.0	0.26	26.0	98.0%
73	S-SE-CD	H	Volta Grande	Jan-1974	385.0	1	0.0	0.000
74	S-SE-CD	H	Porto Colômbia	Jan-1973	320.0	1	0.0	0.000
75	S-SE-CD	H	Passo Fundo	Jan-1973	220.0	1	0.0	0.000
76	S-SE-CD	H	Passo Real	Jan-1973	155.0	1	0.0	0.000
77	S-SE-CD	H	Ita Solheira	Jan-1973	3,444.0	1	0.0	0.000
78	S-SE-CD	H	Mascarenhas	Jan-1973	131.0	1	0.0	0.000
79	S-SE-CD	H	Gov. Fagundes de Souza - GPS	Jan-1971	252.0	1	0.0	0.000
80	S-SE-CD	H	Chavantes	Jan-1971	414.0	1	0.0	0.000
81	S-SE-CD	H	Jalisco	Jan-1971	454.0	1	0.0	0.000
82	S-SE-CD	H	S. Gervásio	Apr-1970	78.0	1	0.0	0.000
83	S-SE-CD	H	Estreito (Luz Carlos Borassi)	Jan-1969	1,050.0	1	0.0	0.000
84	S-SE-CD	H	Itaipu	Jan-1969	131.5	1	0.0	0.000
85	S-SE-CD	H	Jatui	Jan-1969	1,351.2	1	0.0	0.000
86	S-SE-CD	O	Alegrete	Jan-1968	66.0	0.26	20.7	99.5%
87	S-SE-CD	G	Campos (Roberto Silveira)	Jan-1968	30.0	0.24	15.3	99.5%
88	S-SE-CD	G	Santa Cruz (RJ)	Jan-1968	766.0	0.31	15.3	99.5%
89	S-SE-CD	H	Parabuna	Jan-1968	85.0	1	0.0	0.000
90	S-SE-CD	H	Limoeiro (Almeida Sales de Oliveira)	Jan-1967	32.0	1	0.0	0.000
91	S-SE-CD	H	Cacendo	Jan-1966	89.4	1	0.0	0.000
92	S-SE-CD	C	J. Lacerda C	Jan-1965	363.0	0.26	26.0	98.0%
93	S-SE-CD	C	J. Lacerda B	Jan-1965	262.0	0.21	26.0	98.0%
94	S-SE-CD	C	J. Lacerda A	Jan-1965	232.0	0.18	26.0	98.0%
95	S-SE-CD	H	Barão (Alvaro de Souza Lima)	Jan-1965	143.1	1	0.0	0.000
96	S-SE-CD	H	Furni (RJ)	Jan-1965	216.0	1	0.0	0.000
97	S-SE-CD	C	Foz de Iguaçu	Jan-1963	20.0	0.3	26.0	98.0%
98	S-SE-CD	H	Foz de Iguaçu	Jan-1963	1,218.0	1	0.0	0.000
99	S-SE-CD	H	Barra Bonita	Jan-1963	140.8	1	0.0	0.000
100	S-SE-CD	C	Chavantes	Jan-1962	72.0	0.23	26.0	98.0%
101	S-SE-CD	H	Juiz de Fora (Alfredo A. Lyndre)	Jan-1962	97.7	1	0.0	0.000
102	S-SE-CD	H	Jatui	Jan-1962	180.0	1	0.0	0.000
103	S-SE-CD	H	Pereira Passos	Jan-1962	99.1	1	0.0	0.000
104	S-SE-CD	H	Três Marias	Jan-1962	395.0	1	0.0	0.000
105	S-SE-CD	H	Eucledes da Cunha	Jan-1960	108.8	1	0.0	0.000
106	S-SE-CD	H	Catalinópolis	Jan-1960	48.0	1	0.0	0.000
107	S-SE-CD	H	Santa Branca	Jan-1960	56.1	1	0.0	0.000
108	S-SE-CD	H	Cachoeira Dourada	Jan-1959	658.0	1	0.0	0.000
109	S-SE-CD	H	São Grande (Lucas N. Garcia)	Jan-1958	70.0	1	0.0	0.000
110	S-SE-CD	H	São Grande (MG)	Jan-1958	102.0	1	0.0	0.000
111	S-SE-CD	H	Mascarenhas de Moraes (Pavão)	Jan-1958	478.0	1	0.0	0.000
112	S-SE-CD	H	Itaipu	Jan-1958	25.0	1	0.0	0.000
113	S-SE-CD	C	S. Jerônimo	Jan-1954	20.0	0.26	26.0	98.0%
114	S-SE-CD	O	Caribá	Jan-1954	36.2	0.3	20.7	99.5%
115	S-SE-CD	O	Pitimbu	Jan-1954	472.0	0.3	20.7	99.5%
116	S-SE-CD	H	Carabá	Jan-1953	42.5	1	0.0	0.000
117	S-SE-CD	H	Nilo Peçanha	Jan-1953	378.4	1	0.0	0.000
118	S-SE-CD	H	Fontes Novas	Jan-1940	130.3	1	0.0	0.000
119	S-SE-CD	H	Henry Borden Sub.	Jan-1920	420.0	1	0.0	0.000
120	S-SE-CD	H	Henry Borden Ext.	Jan-1920	469.0	1	0.0	0.000
121	S-SE-CD	H	I. Pombo	Jan-1914	199.7	1	0.0	0.000
122	S-SE-CD	H	Jatui	Jan-1917	11.8	1	0.0	0.000
Total (MW) =				64,478.6				

\* Subsystem S - south, SE-CD - Southeast-Midwest

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

[1] Agência Nacional de Energia Elétrica. Banco de Informações de Geração. <http://www.aneel.gov.br>; data collected in November 2004.

[2] Bassi, M. A., Laurence, P., Maldonado, R., Schaffner, A. F., Simoes, H. and J.M. Lukens. Road testing baselines for GHG mitigation projects in the electric power sector. OECD/IEA Information paper, October 2002.

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

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

[5] Agência Nacional de Energia Elétrica. Superintendência de Fiscalização dos Serviços de Geração. Resumo Geral dos Novos Empreendimentos de Geração. <http://www.aneel.gov.br>; data collected in November 2004.



## Summary table

Baseline (including imports)	Emission factors for the Brazilian South-Southeast-Midwest interconnected grid			
	$EF_{OM}$ [tCO <sub>2</sub> /MWh]	Load [MWh]	LCMR [MWh]	Imports [MWh]
2001	0.7350	263.706.242	244.665.786	5.493.162
2002	0.8504	275.402.896	258.720.232	1.607.395
2003	0.9378	288.493.929	274.649.425	459.586
	Total (2001-2003) =	827.603.067	778.035.443	7.560.143
	$EF_{OM, simple-adjusted}$ [tCO <sub>2</sub> /MWh]	$EF_{BM, 2003}$	from ONS-Lambda SSECO 2001-2003.xls	
	0,4043	0,0937	$\lambda_{2001}$	
	Default weights		0,5204	
	$w_{OM} = 0,5$		$\lambda_{2002}$	
	$w_{BM} = 0,5$		0,5053	
	$EF$ [tCO <sub>2</sub> /MWh]		$\lambda_{2003}$	
	0,2490		0,5312	

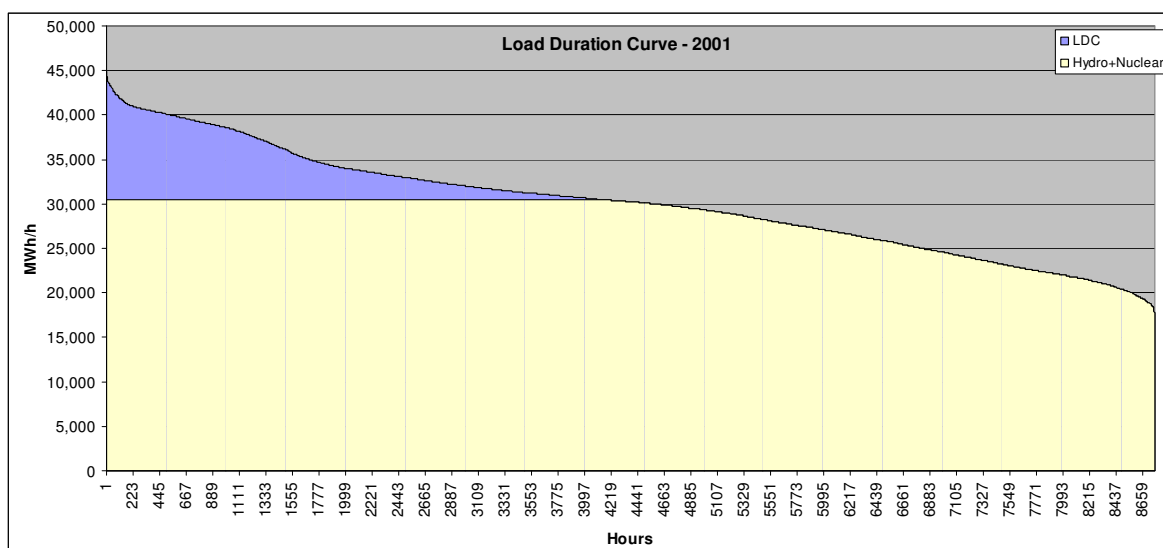


Figure 6: Load duration curve for the S-SE-MW system, 2001

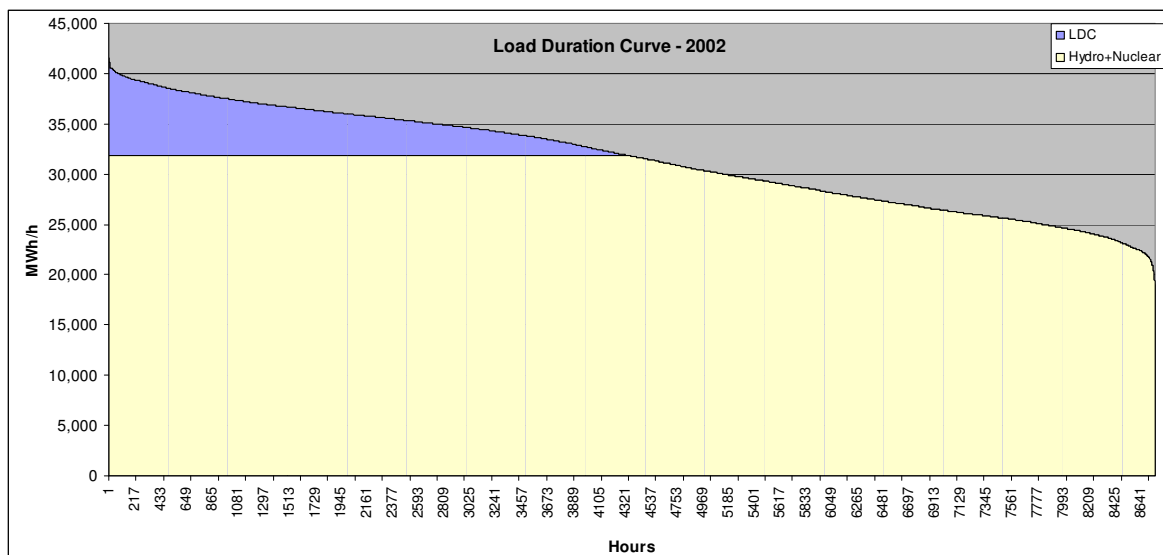


Figure 7: Load duration curve for the S-SE-MW system, 2002

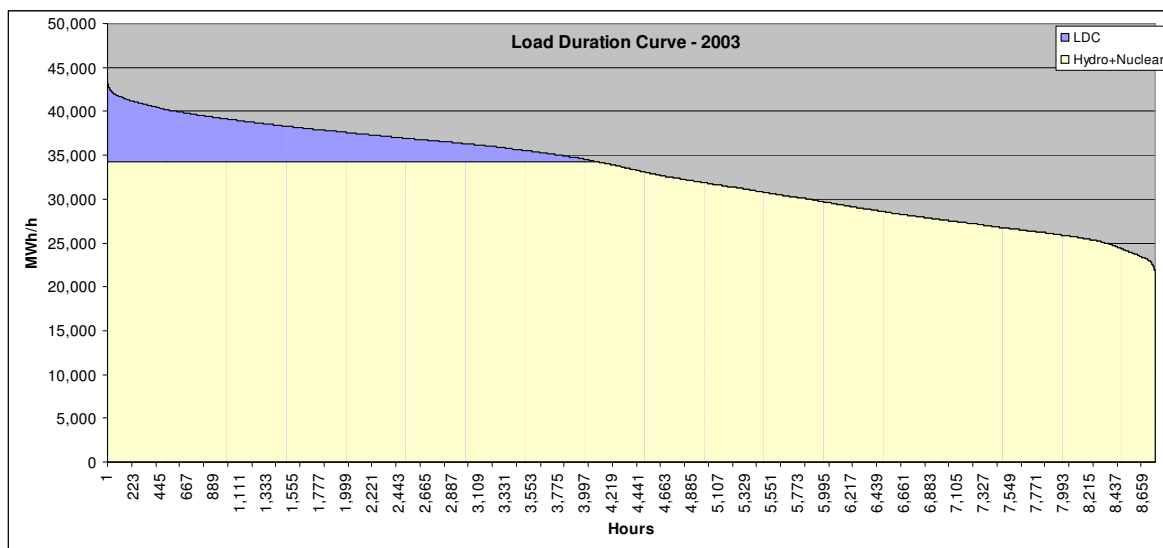
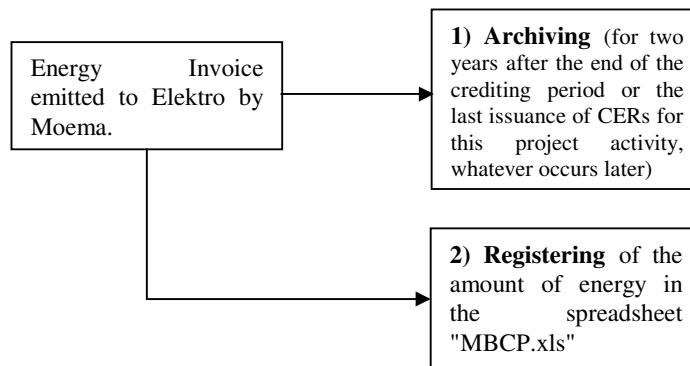


Figure 8: Load duration curve for the S-SE-MW system, 2003

**Annex 4****MONITORING PLAN**

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



**Figure 9: Monitoring procedures for MBCP**

The quantity of energy exported to the grid will be monitored through the energy invoice emitted by Elektro, the energy distributor, which is the electricity buyer. 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 "MBCP.xls", which shall be the instrument for the further Verification.