CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Santa Cruz S.A. - Açúcar e Álcool - Cogeneration Project.
Version: 1.
Date (DD/MM/YYYY): 29/08/2007.

A.2. Description of the project activity:

The primary objective of the Santa Cruz S.A.-Açúcar e Álcool – Santa Cruz Cogeneration Project is to supply Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy's share of total the Brazilian and the Latin America and the Caribbean region's electricity consumption. One fundamental goal of the project is the efficient use of resources, particularly indigenous resources, while minimizing impact on the environment.

Santa Cruz S.A.-Açúcar e Álcool – Santa Cruz Cogeneration Project consists on the installation of a modernized equipment using bagasse more efficiently to cogeneration electricity (Figure 1). Through this expansion, replacing old equipment, the sugar mill will generate power surplus, eliminating the consumption of electrical energy from the grid and also allowing for the delivery of surplus energy to the grid. Besides reducing greenhouse gases emissions, the Project also creates social and economical benefits that constitute a real contribution to Brazil's sustainable development.

The Santa Cruz Plant has its administrative headquarters in the situated Santa Cruz Farm in the city of Américo Brasiliense, central region of the State of São Paulo, distant approximately 280 kilometers of the São Paulo capital. Initially 970 hectares had been planted that, in the first harvest, had relieved two million liters of aguardente – tradition Brazilian alcohol drink. In the decade of 70 the sugar production grew with the sprouting of the pro-sugar. In 1976 the Santa Cruz Plant adhered to the pro-alcohol and the alcohol production gained great impulse. The investments had been constant aiming at the growth. The alcohol production arrived the 180 million liters for harvest, and the plant passed for the biggest growth of its history.

Today the Santa Cruz is one of the 25 biggest plants of the country. It cultivates about 43,500 hectares of sugar cane. Currently, it possess capacity installed to produce and to process little more than three million tons of sugar cane for harvest, being produced hydrate alcohol, ethanol, sugar, electric energy and dry leavening, using around 3,500 collaborators and constituted 100% of national capital.

The Santa Cruz processes daily about 18,000 tons of sugar cane, producing 30 thousand bags of sugar. The first harvest of the plant in 1947 relieved less than the amount produced per day currently. The alcohol production reached 1 (one) million of liters per day.

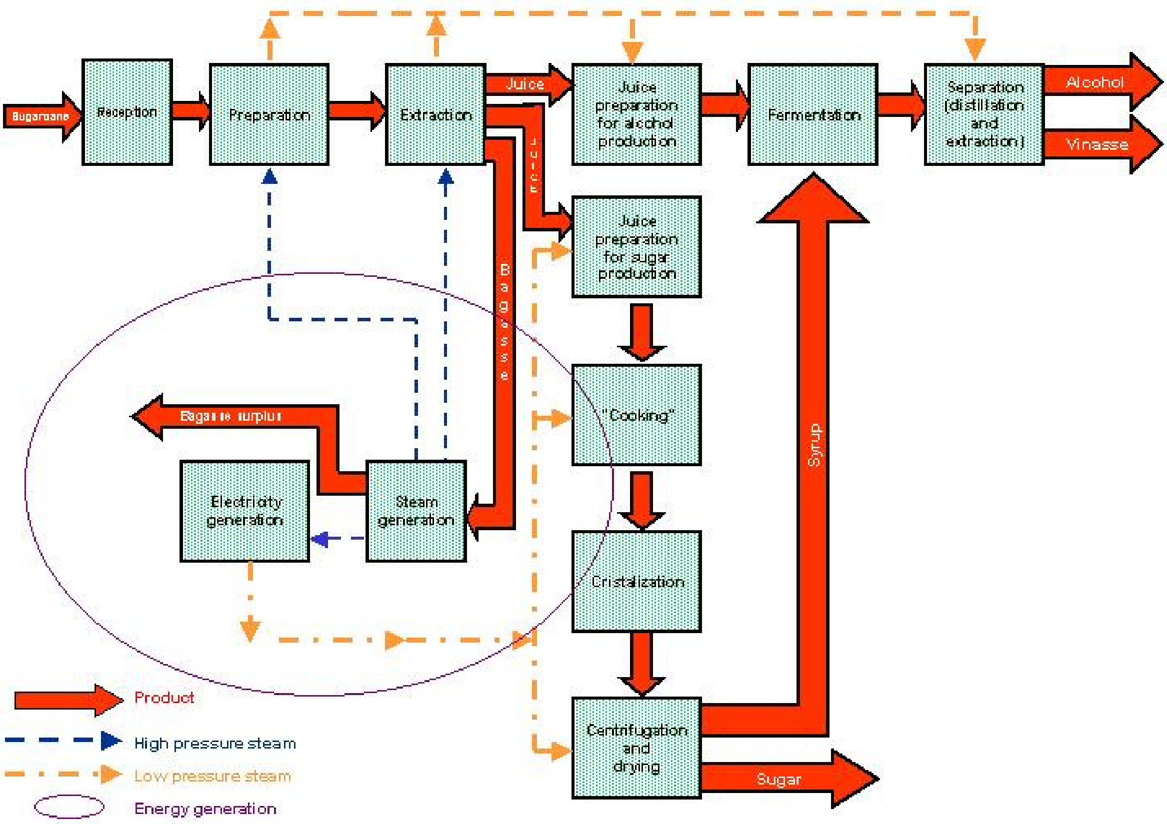

Figure 1 - Flowchart of the electricity generation inside a Sugar and Alcohol Production (Source: Codistil)

The Project can be seen as an example of a solution by the private sector to the Brazilian electricity crisis of 2001, contributing to the sustainable development of the country. Santa Cruz Project thus comes to prove that with the commercialization of CERs, it is viable to develop a generation project in Brazil. This will have a positive effect for the country beyond the evident reductions in GHG.

The revenues obtained from the sale of the CERs will also help Santa Cruz to support the community. Santa Cruz has a strong social responsibility evidenced in numerous initiatives, including: working with local communities on environmental education projects, sustainable development practice, hiring of local manpower, influencing directly 8 boundary municipalities of the region, such as Américo Brasiliense, Santa Lúcia, Rincão, Araraquara, Ibaté and São Carlos. This revenue distribution and social efforts must be added to the environmental benefits when evaluating the contribution to sustainable development of this project activity.

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

Figure 2: Santa Cruz S.A-Açúcar e Álcool unit view

A.3. Project participants:

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

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Santa Cruz S.A.-Açúcar e Álcool (Private entity)	No
	Ecoinvest Carbon Brasil Ltda. (Private entity)	
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

Santa Cruz is located in Américo Brasiliense, state of São Paulo, southeast of Brazil.

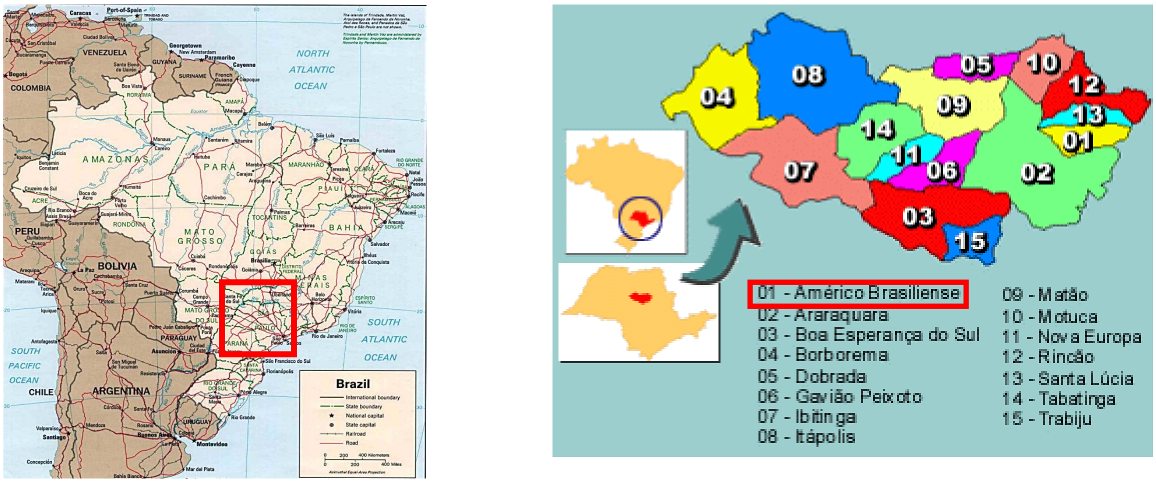

Figure 3 – Political division of Brazil showing the state of São Paulo and the city of Américo Brasiliense (Source: www.citybrazil.com.br)

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:

Américo Brasiliense

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

Santa Cruz S.A. – Açúcar e Álcool is located in Américo Brasiliense – coordinates N (m) 7591422 and E (m) 802293 , in the central part of São Paulo state, at some 280 km from São Paulo, capital of the state, Brazil, specially at Km 70 from SP 255 Highway. Américo Brasiliense has 26,593 inhabitants and 123.8 km^2.

São Paulo is located on southeast of Brazil and its economic is diversified. The industries metal-mechanics, alcohol and sugar, textile, automobilist and aviation, the sectors of service and finance, and the orange culture, sugar cane and coffee form the base of a economy which reaches at 36,6% of the brasilian PIB. In addition, the state offer good infrastructure for investments, due highways good conditions.

The state of São Paulo, being the most industrialized been of the federation, is the producing and also consuming the majority of national energy. São Paulo possesses more hydroelectric power plants than any other Brazilian state, also counting with a thermoelectric power plant also known for being the greater of Latin América.

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

Type: Energy and Power.

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

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

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

Biomass power conversion technologies for power production can be classified into one of the three following categories: direct combustion technologies, gasification technologies, and pyrolysis. Direct combustion technologies, such as the used in Usina Santa Cruz, are probably the most widely known option for simultaneous power and heat generation from biomass. It involves the oxidation of biomass with excess air in a process that yields hot gases that are used to produce steam in boilers. The steam is used to produce electricity in a Rankine cycle turbine. Rankine cycle configurations could also be classified into two: condensing and backpressure, depending on the proportion of the steam used for industrial processes and where in the turbine that steam is obtained. Typically, electricity only is produced in a “condensing” steam cycle, while electricity and steam are co-generated in an “extracting” steam cycle.

Santa Cruz Cogeneration Project, a greenhouse gas (GHG) free power generation project, will result in GHG emissions reductions by displacing electricity generation from fossil-fuel thermal plants that would have otherwise dispatched to the grid.

Santa Cruz utilizes bagasse as biomass. All this biomass is a by product in different agricultural processes. In the absence of the project, the bagasse would have been used for power generation for internal use (and with a lower efficiency).

For the estimation of emission reductions from electrical energy, a baseline emission factor is calculated as a combined margin of the operating and build margin emission factors. To determine these two factors, the project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly, the connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

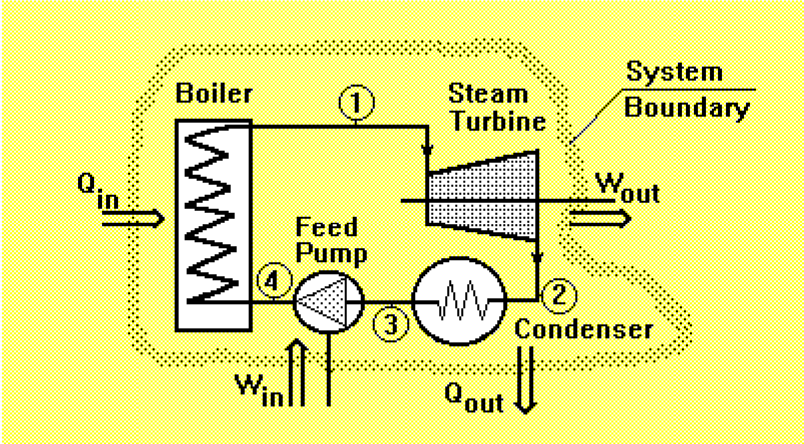

Figure 4 - Rankine Cycle

The project replaces old equipment and will operate with a new configuration, in two phases, the fisrt phase, starting in 2008, and the second, in 2009 (see description of equipments in the Table below). The old equipments will be replaced by the new ones. At full capacity, Usina Santa Cruz S.A. – Açúcar e Álcool is expected to generate yearly 333,786 MWh power surpluses, operating at full capacity during the season. The purchasers of the energy contracted in regulated environment (energy auction) have already been established. Besides that, an energy surplus not sold in the auction will be negotiated in the free market with purchasers not yet established.

Technical Description:

Baseline

Boilers

Boiler 1
Model – V 2/4 UA
Manufacturer - Dedini
Pressure – 21 Kgf/cm²
Temperature – 300°C
Capacity – 45 Ton/h.
Steam enthalpy – 3000 KJ/Kg
Specific production - 2 kg steam/kg bagasse
Efficiency – 80%
Year of installation – 1972
Year of deactivation – 2009

Boiler 2
Model – V2/4 UA
Manufacturer - Dedini
Pressure – 21 Kgf/cm²
Temperature – 300o.C
Capacity – 45 Ton/h.

Project

First phase – 2008

Boiler

Boiler 1
Model – IPLAN 2B 150/65-480
Manufacturer - IPLAN
Pressure – 65 Kgf/cm²
Temperature – 480 °C
Capacity –150 Ton/h.
Steam enthalpy – 3360 KJ/Kg
Specific production - 2.23 kg steam/kg bagasse
Efficiency – 87%
Year of installation – 2008

Turbine

Turbine 1
Type: Backpressure
Manufacturer: Siemens

Steam enthalpy – 3000 KJ/Kg
Specific production - 2 kg steam/kg bagasse
Efficiency – 80%
Year of installation – 1974
Year of deactivation – 2008

Boiler 3
Model – V2/4 UA
Manufacturer - Dedini
Pressure – 21 Kgf/cm²
Temperature – 300o.C
Capacity – 45 Ton/h.
Steam enthalpy – 3000 KJ/Kg
Specific production - 2 kg steam/kg bagasse
Efficiency – 80%
Year of installation – 1974
Year of deactivation – 2008

Boiler 4
Model – TVPE
Manufacturer - Conterna
Pressure – 21 Kgf/cm²
Temperature – 300o.C
Capacity – 80 Ton/h.
Steam enthalpy – 3000 KJ/Kg
Specific production - 2 kg steam/kg bagasse
Efficiency – 80%
Year of installation – 1977
Year of deactivation – 2009

Boiler 5
Model – TVPE
Manufacturer - Conterna
Pressure – 21 Kgf/cm²
Temperature – 300o.C
Capacity – 80 Ton/h.
Steam enthalpy – 3000 KJ/Kg
Specific production - 2 kg steam/kg bagasse
Efficiency – 80%
Year of installation – 1977
Year of deactivation – 2009

Boiler 6
Model – TVPE

Power: 25 MW
Efficiency – 87,9%
Year of installation – 2008

Generator

Generator 1:
Manufacturer: Siemens
Power: 25 MW
Type: Tri phases synchronic
Tension: 13,800 volts
Efficiency – 98,10%
Year of installation: 2008

Second phase - 2009

Boilers

Boiler 2
Model – IPLAN 2B 150/65-480
Manufacturer - IPLAN
Pressure – 65 Kgf/cm²
Temperature – 480 ^{o}C
Capacity –150 Ton/h.
Steam enthalpy – 3360 KJ/Kg
Specific production - 2.23 kg steam/kg bagasse
Efficiency – 87%
Year of installation – 2009

Boiler 3
Model – IPLAN 2B 150/65-480
Manufacturer - IPLAN
Pressure – 65 Kgf/cm²
Temperature – 480 ^{o}C
Capacity –150 Ton/h.
Steam enthalpy – 3360 KJ/Kg
Specific production - 2.23 kg steam/kg bagasse
Efficiency – 87%
Year of installation – 2009

Turbines

Turbine 2
Type: Backpressure

Manufacturer - Conterna
Pressure – 21 Kgf/cm²
Temperature – 300o.C
Capacity – 90 Ton/h.
Steam enthalpy – 3000 KJ/Kg
Specific production - 2 kg steam/kg bagasse
Efficiency – 80%
Year of installation – 1981
Year of deactivation – 2009

<u>Boiler 7</u>
Model – TVPE
Manufacturer - Conterna
Pressure – 21 Kgf/cm²
Temperature – 300o.C
Capacity – 90 Ton/h.
Steam enthalpy – 3000 KJ/Kg
Specific production - 2 kg steam/kg bagasse
Efficiency – 80%
Year of installation – 1982
Year of deactivation – 2008

Turbines

<u>Turbine 1</u>
Type: Backpressure
Manufacturer: Dedini
Power: 3 MW
Year of installation – 1979
Year of deactivation – 2009

<u>Turbine 2</u>
Type: Backpressure
Manufacturer: NG
Power: 6 MW
Year of installation – 1986

<u>Turbine 3</u>
Type: Backpressure
Manufacturer: NG
Power: 2 MW
Year of installation – 2003
Year of deactivation – 2009

<u>Turbine 4</u>

Manufacturer: Siemens
Power: 25 MW
Efficiency – 87,9%
Year of installation – 2009

<u>Turbine 3</u>
Type: Backpressure
Manufacturer: Siemens
Power: 25 MW
Efficiency – 81,6%
Year of installation – 2009

Generators

<u>Generator 2:</u>
Manufacturer: Siemens
Power: 25 MW
Type: Tri phases synchronic
Tension: 13,800 volts
Efficiency – 98,10%
Year of installation: 2009

<u>Generator 3:</u>
Manufacturer: Siemens
Power: 25 MW
Type: Tri phases synchronic
Tension: 13,800 volts
Efficiency – 98,10%
Year of installation: 2009

Type: Backpressure
Manufacturer: NG
Power: 1,2 MW
Year of installation – 1974
Year of deactivation – 2008

Generators

Generator 1:
Manufacturer: ABB
Power: 3 MW
Type: Tri phases synchronic
Tension: 13,800 volts
Year of installation: 1979
Year of deactivation – 2009

Generator 2:
Manufacturer: Siemens
Power: 6 MW
Type: Tri phases synchronic
Tension: 13,800 volts
Year of installation: 1986

Generator 3:
Manufacturer: Mausa
Power: 2 MW
Type: Tri phases synchronic
Tension: 13,800 volts
Year of installation: 2003
Year of deactivation – 2009

Generator 4:
Manufacturer: Mausa
Power: 1,2 MW
Type: Tri phases synchronic
Tension: 13,800 volts
Year of installation: 1974
Year of deactivation – 2008

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

The chosen crediting period for this project is the renewable crediting period of 7 years. The estimated amount of emission reductions of the project can be seen at Table 1.

Years	Annual estimation of emission reductions in tonnes of CO2 e
2007	20,101
2008	54,990
2009	61,080
2010	61,080
2011	61,080
2012	61,080
2013	61,080
Total Estimated Reductions (tonnes of CO2 e)	**380,493**
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	54,356

Table 1 – Estimated emission reductions for the first crediting period

A.4.5. Public funding of the project activity:

There is no public funding involved on the Santa Cruz S.A. – Açúcar e Álcool Cogeneration Project.

The Project is being financed by the Brazilian Development Bank, BNDES - *Banco Nacional de Desenvolvimento Econômico e Social*, which is a federal owned company subordinated to the Ministry of Development, Industry and Foreign Trade, MDIC - *Ministério do Desenvolvimento, Indústria e Comércio Exterior*. Despite of being a state-owned bank, BNDES is one of the unique sources of long-term financing in the country and is the preferable debt source for the private sector in Brazil.

This project does not receive any public funding and it is not a diversion of ODA.

SECTION B. Application of a baseline methodology

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

ACM0006 – "Consolidated baseline methodology for grid-connected electricity generation from biomass residues", version 6, EB33

ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 6, dated on 19/05/2006.

"Tool for the demonstration and assessment of additionality", Version 3, EB29.

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

The ACM0006 methodology is applied to the Santa Cruz S.A. – Açúcar e Álcool Cogeneration Project because this is an "Energy efficiency project": this project replaces equipment in an existing sugar cane mill. It uses one type of biomass: bagasse, a byproduct of the production of sugar. The replacement increases the power generation capacity.

The project complies with all the conditions limiting the applicability of the methodology:

(i) *No other biomass types than biomass residues are used in the project plant and these biomass residues are the predominant fuel used in the project plant. Biomass is defined as a by-product, residue or waste stream from agriculture, forestry and related industries.*

The primary fuel in the project plant is a biomass consisting of sugar cane bagasse. The bagasse used in the Santa Cruz S.A. – Açúcar e Álcool Cogeneration Project comes from the production of sugar carried in the same facility where the project is located.

(ii) *The implementation of the project shall not result in an increase of the processing capacity of raw input or other substantial changes in the process:*

Any increases in the bagasse production are due to Santa Cruz S.A. - Açúcar e Álcool Cogeneration Project natural expanding business and could not be attributed to the implementation of the cogeneration project. The graph below shows that the production for the sugar mill has had an incrementing trend for years (see figure 5), long before the implementation of the project activity. This project does not have an impact in processing capacity; Santa Cruz S.A. - Açúcar e Álcool will not increase their installed capacity because of this project, but due to the recent and remarkable expansion of the sugar, and mainly, of the ethanol market in Brazil. The offer of ethanol in the Brazilian market is not supplying the rapid increasing demand caused by the use of flex-fuel cars, which can run on gasoline, ethanol or any blend of the two.

	Unit	Harvest 2002	Harvest 2003	Harvest 2004	Harvest 2005	Harvest 2006
Sugar Cane	Ton	2,356,294	2,586,512	2,903,399	2,952,890	3,277,091
Sugar	Ton	152,025	163,690	177,525	196,513	229,496
Alcohol	Liters	116,396,001	130,429,064	131,239,567	133,626,120	158,098,810

Figure 5 - Santa Cruz S.A. - sugar cane, sugar and alcohol production

(iii) The biomass used by the project facility should not be stored for more than one year:

The sugar mills generally store a small amount of bagasse for the next season in order to start plant operations when the new crop season/ harvest begins. The bagasse is stored from the end of the harvest season in the end of November until the beginning of the following harvest season, in May. The volume of bagasse stored between seasons is less than 5% of the total amount of bagasse generated during the year or during the harvest period.

(iv) No significant energy quantities, except for transportation of the biomass, are required to prepare the biomass residues for fuel consumption:

The biomass used in this project is not transformed in any way before being used as a fuel.

B.3. Description of the sources and gases included in the project boundary

<table>
<tr><th></th><th>Source</th><th>Gas</th><th></th><th>Justification/Explanation</th></tr>
<tr><td rowspan="12">Baseline</td><td rowspan="3">Grid electricity generation</td><td>CO_2</td><td>Included</td><td>Main emission source</td></tr>
<tr><td>CH_4</td><td>Excluded</td><td>Excluded for simplification. This is conservative</td></tr>
<tr><td>N_2O</td><td>Excluded</td><td>Excluded for simplification. This is conservative</td></tr>
<tr><td rowspan="3">Heat generation</td><td>CO_2</td><td>Included</td><td>Main emission source</td></tr>
<tr><td>CH_4</td><td>Excluded</td><td>Excluded for simplification. This is conservative</td></tr>
<tr><td>N_2O</td><td>Excluded</td><td>Excluded for simplification. This is conservative</td></tr>
<tr><td rowspan="3">Uncontrolled burning or decay of surplus biomass residues</td><td>CO_2</td><td>Excluded</td><td>It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector</td></tr>
<tr><td>CH_4</td><td>Excluded</td><td>Project participants decided to not include this emission source, because case B4 of ACM0006 is not the most likely baseline scenario</td></tr>
<tr><td>N_2O</td><td>Excluded</td><td>Excluded for simplification. This is conservative. Note also that emissions from natural decay of biomass are not included in GHG inventories as anthropogenic sources</td></tr>
<tr><td rowspan="7">Project Activity</td><td rowspan="3">On-site fossil fuel consumption</td><td>CO_2</td><td>Excluded</td><td>There are no emissions due to fossil fuel consumption</td></tr>
<tr><td>CH_4</td><td>Excluded</td><td>Excluded for simplification. This emission source is assumed to be very small</td></tr>
<tr><td>N_2O</td><td>Excluded</td><td>Excluded for simplification. This emission source is assumed to be very small</td></tr>
<tr><td rowspan="3">Off-site transportation of biomass residues</td><td>CO_2</td><td>Excluded</td><td>Bagasse is produced inside the mills. No off-site transportation of bagasse is necessary</td></tr>
<tr><td>CH_4</td><td>Excluded</td><td>Excluded for simplification. This emission source is assumed to be very small</td></tr>
<tr><td>N_2O</td><td>Excluded</td><td>Excluded for simplification. This emission source is assumed to be very small</td></tr>
<tr><td>Combustion of biomass</td><td>CO_2</td><td>Excluded</td><td>It is assumed that CO_2 emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector</td></tr>
</table>

	residues for electricity and / or heat generation	CH_4	Excluded	This emission source is not included because CH_4 emissions from uncontrolled burning or decay of biomass in the baseline scenario are not included
		N_2O	Excluded	Excluded for simplification. This emissions source is assumed to be very small
	Storage of biomass residues	CO_2	Excluded	It is assumed that CO_2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector
		CH_4	Excluded	Excluded for simplification. Since bagasse is stored for not longer than one year, this emission source is assumed to be small
		N_2O	Excluded	Excluded for simplification. This emissions source is assumed to be very small
	Waste water from the treatment of biomass residues	CO_2	Excluded	It is assumed that CO2 emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector.
		CH_4	Excluded	This emission source shall be included in cases where the waste water is treated (partly) under anaerobic conditions.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be small.

B.4 Description of how the baseline scenario is identified and description of the identified baseline scenario:

Santa Cruz S.A - Açúcar e Álcool Cogeneration Project uses bagasse for the generation of heat and electricity. The project activity involves the replacement of an existing biomass residue fired power plant by a new biomass residue fired power plant. The replacement increases the power generation capacity. In the absence of the project activity, the existing plant would also be replaced by a new biomass residue fired power plant (referred to as "reference plant"), however, this reference plant would have a lower efficiency of electricity generation than the project plant (e.g. by using a low-pressure boiler instead of a high-pressure boiler). The same type and quantity of biomass residues as in the project plant would be used in the reference plant.

The scenario of ACM0006 under which the project is analyzed was identified after the study of the alternatives for the different components of the project. The result of that analysis of components gave the following results: a) the power generated by the project plant would in the absence of the project activity be generated (a) in the reference plant (alternative P5) and – since power generation is larger in the project plant than in the reference plant – (b) partly in power plants in the grid (alternative P4). The new project plant has the same technical lifetime as the reference plant; b) biomass: in the absence of the project, the biomass residues would have used for heat and/or electricity generation at the project site (alternative B4); c) Heat: in the absence of the project activity, the heat generated by the project plant would in the absence of the project activity be generated in the reference plant; the efficiency of heat generation in the project plant is smaller or the same compared to the reference plant (alternative H2). The identified alternatives for the different components of the project activity correspond to scenario 18.

Emission reductions from heat are not considered because the heat efficiency of the new plant is higher than the heat efficiency of the pre-project equipment and, for conservativeness reasons, they are excluded, i.e., ERthermal,y = 0. Heat efficiency for the 7 boilers of the baseline is 6,000 KJ/Kg bagasse; for the boilers of the project, heat efficiency is 7,493 KJ/Kg bagasse.

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	Before	After
Specific production	2 kg steam/kg bagasse	2.23 kg steam/kg bagasse
Steam Enthalpy	3,000 kJ/kg steam	3,360 kJ/kg steam

Biomass residues decay was non-existent, nor have biomass been burned in an uncontrolled manner, as biomass residues were used in the past to generate electricity at the project site, for internal consumption. For scenario #18, BEbiomass, y=0.

B.5. 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 (assessment and demonstration of additionality):

In order to determine if the project activity is additional, the additionality tool version 03 approved by the Executive Board is applied. The following steps are applied:

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

Sub-step 1a. Define alternatives to the project activity

To define the alternatives to the project activity, there are two-sided analysis, taking into consideration the perspective of the project owner and the perspective of the country.

From the project owner's perspective, the cogeneration project allows the company to export electricity to the grid. Without the project, the plant would operate with low energy efficiency and could not export electricity to the grid.

From the country's perspective, the alternative for producing a similar amount of energy, as the one Usina Santa Cruz – Açúcar e Álcool is to provide, would be to use current generation system, which is electricity supplied by large hydro and thermal power stations. Brazil is increasingly depending on thermal plants. The most recent energy auction in Brazil, which took place in July 26, 2007, resulted in an increase of 1.781,8 MW into National Electric System, all of them from oil thermo plants (source: http://www.epe.gov.br/Lists/LeilaoA32007/DispForm.aspx?ID=44).

During a period of restructuring the entire electricity market, as is the current Brazilian situation, investment uncertainty is the main barrier for small renewable energy power projects. In this scenario, these projects compete with existing plants and with new projects, in which thermal plants usually attract the attention of financial investors.

Sub-step 1b. Consistency with mandatory laws and regulations

The usage of electricity from the grid is in complete compliance with all applicable legal and regulatory requirements. The use of thermal electricity in the generation system is not only in compliance with regulations but also of increasing importance. The proposed project activity is not the only alternative in compliance with regulations.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

Additionality is demonstrated through an investment benchmark analysis (option III)

Sub-step 2b and 2c– Option III - benchmark analysis

The financial indicator identified for cogeneration project as the case of Santa Cruz is the project IRR, and the benchmark is derived from the company internal benchmark (weighted average capital cost of the company - WACC).

Calculation of the Weighted Average Cost of Capital (WACC)

The rate used to discount the business cash flow is also known as the weighted-average cost of capital (WACC). It converts the future cash flow into a present value to all investors, considering that both creditors and shareholders expect compensation towards the opportunity cost of investing resources in a specific business instead of investing such resources in other business of equivalent risk.

The basic principle to be followed when calculating the WACC is the consistency of both the valuation method and the definition of the discounted cash flow. The formula used to estimate the company's WACC after taxes is:

$WACC = [(Kd \times (1-t) \times Pd)+(Ke \times (1-Pd))]$ Equation A

Where:

WACC= Weighted-average cost of capital
Kd= Cost of Debt (third-party capital)
t = Marginal corporate income tax
Pd= Debt as a percentage of total capitalization
Ke= Cost of Equity (own capital)

Considering that Santa Cruz - Açúcar e Álcool is being financed with their own capital and with other debtors, we have adopted the case of a leveraged company to calculate the firm's WACC.

Cost of debt (Kd) is 10.17% per year. It is the financing line of BNDES offered to Santa Cruz - Açúcar e Álcool (10.17% TJLP).

The company has a total *Debt as a percentage of total capitalization* (Pd) of 54.83%. The average of the *marginal corporate income tax* (t) is 34% per year (these data are presented in the spreadsheet “Santa Cruz - Cash flow with sensitivity analysis.xls”, page “WACC”, at F29 and L22.

Estimating the *Cost of Equity* (Ke) was done using the parameters observed in global financial markets, allowing the application of the CAPM (Capital Asset Pricing Model) model. Given these assumptions, the cost of capital in Brazil should be close to a global cost of capital ,adjusted for local inflation and capital structure. It should be noted that, concerning the calculation of the inflation differential, we have used an estimation of the compounded difference between the local inflation rate and the US inflation rate, over ten years. Also, for calculation purposes, we have used a Beta - which measures systemic equity risk within the company’s industry - typical of the environmental services sector. Thus, in order to calculate Santa Cruz - Açúcar e Álcool’ cost of equity, we have used the following parameters[1]:

Cost of Equity(Ke) – Santa Cruz - Açúcar e Álcool		
10-year BB Credit risk premium over US Treasuries[2]	**Plus**	1.52%p.a.
10-year US/Brazil inflation differential	**Plus**	4.65%p.a.
Adjustment of Market Equity Risk with Beta of 1,04[3]	**Plus**	10.34%p.a.
International Market Equity Risk Premium		5.50%p.a.
Santa Cruz - Açúcar e Álcool Cost of Equity with Brazilian Country Risk		16.51%p.a.

Applying Ke=16.51% to the Equation A above:

WACC = [(10.17% x (1 - 34%) x 54.83% + (16.51%p.a. x (1- 54.83%)] = 11.13%p.a.

Thus, Santa Cruz’s – Açúcar e Álcool Weighted Average Cost of Capital is equal to 11.13% p.a.., and this figure will be used to discount the company’s cash flow throughout this study.

Financial Indicator, Internal rate of return (IRR)

Santa Cruz’s cash flow (see annexed spreadsheet “Santa Cruz - Cash flow with sensitivity analysis.xls”) shows that the IRR of the project without CERs, 9.30%, is lower than the WACC 11.13%. This evidences that project activity is not financially attractive to the investor.

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1 Copeland et al.; Measuring and Managing the Value of Companies; Third Edition.

2 Source: Bloomberg

3 Considering that Santa Cruz - Açúcar e Álcool is not listed in their stock exchanges, PPs decided to use similar sugar mills as the benchmark. Therefore PPs took the weighted average of the Beta of the two sugar mills listed in the Bovespa (Cosan and São Martinho).

Sub-step 2d: Sensitivity analysis

A sensitivity analysis was conducted by altering the following parameters:

- Increase in project revenue
- Reduction in running costs

Those parameters were selected as being the most likely to fluctuate over time. Financial analyses were performed altering each of these parameters by 5%, and assessing what the impact on the project IRR would be. See results in the Table below. The 5% variation was chosen from the average annual Brazilian inflation.

For the calculation, see annexed spreadsheet "Santa Cruz - Cash flow with sensitivity analysis.xls", rows 7 and 8.

Table: Sensitivity analysis

Scenario	**% change**	**IRR (%)**
Original	-	9.30
Increase in project revenue	5%	10.36
Reduction in O&M project costs	5%	10.01

Therefore, the IRR of the project activity without being registered as a CDM project is below the WACC benchmark, evidencing that the project activity is not financially attractive to the investor.

Step 3. Barrier Analysis:

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

Institutional Barriers

An article written in 2004 by two professors of Energy Planning at the Universidade Federal do Rio de Janeiro analyzes Brazilian energy regulations and identifies four fragilities that can undermine their suitable implementation. Those fragilities refer to:

1) The guarantee of the purchase of electricity. Some points are still to be clarified, regarding:

   a) Minimum and maximum limits for the purchase of energy;
   b) the possibility of the ONS - Electrical System Operator to determine production increase or decrease, depending on the demand variation;
   c) Payment for the availability of production capacity, in periods when there is abundant energy offer.

2) The definition of the role of the three different regulatory agents: MME – Ministry of Mines and Energy, ANEEL - Brazilian power regulatory agency - *Agência Nacional de Energia Elétrica*

and Eletrobrás – Brazilian Electricity Company – *Centrais Elétricas Brasileiras*. There are coordination problems among these institutions, due to an unclear division of their functions. This leads to investor's insecurity, because they have three different interlocutors, instead of one.

3) Juridical problems in the public calls legislation. Some rules are not totally compatible with the legislation, what might even lead to contract annulations.

4) The way the energy price is presently established, through the calculation of an average price for each type of energy source, penalizes projects with a lower cost-benefit rate. The authors suggest that the prices should be set according to the characteristics of each project.

Link to this article (with an abstract in English): http://www.seeds.usp.br/pir/arquivos/congressos/CBPE2004/Artigos/PROINFA%20E%20CDE%20-%20QUESTIONAMENTOS%20SOBRE%20A%20LEGISLA%C7%C3O%20E%20REGULA.pdf

Core Business Barrier

The history of the sugarcane industry has demonstrated that the industry is a traditional stable business and has consistently helped to support the country's economy. It has historically enjoyed governmental support such as fixed prices and subsidies. Another characteristic of this sector is the specialization in commodity (sugar and ethanol) transactions. In addition to all those barriers mentioned above, it is important to understand that the sale of electricity from cogeneration represents only a small share of total annual revenues of sugar mills. As a consequence, sugar mills prefer investing in equipment related to their core business, the production of sugar and molasses. In general, the revenues of selling electricity in a cogeneration project represent less than 10 % of the total revenues of a sugar mill. For the Santa Cruz – Açúcar e Álcool cogeneration project, the sale of electricity represents 7.5 % of the total net revenues.

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

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

Step 4. Common practice analysis

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

Currently in Brazil, there are more than 320 sugar mills producing sugar, ethanol and electricity to supply their own energy consumption, but less than 20% have developed expansion programs for their power plants.

The potential to generate electricity for commercialization (exporting to the grid), is estimated at around 8.7 GW, for 2012-2013[4]. This potential has always existed and has grown as the sugarcane industry has grown. However, the investments to expand the sugar mills' power plants have only occurred since 2000. Although a flexible legislation allowing independent energy producers has existed since 1995, it was only after 2000 that sugar producers started to study this proposed project activity as an investment alternative for their power plants in conjunction with the introduction of the CDM.

Coopersucar is one of the biggest cooperatives of the sector in Brazil (*Jornal da Cana* – Sugarcane branch newspaper, October, 2006). Among Coopersucar member plants, considering the plants that do not have CDM projects, only 10% have increased their capacity in order to export energy to the grid in 2006[5]. Thus, the project activity shall not be considered as common practice in Brazil.

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

There is a rising demand for energy in Brazil, but it is not being attended by biomass plants. The most recent energy auction in Brazil, which took place in July 26, 2007, resulted in an increase of 1.781,8 MW into National Electric System, **all of them** from oil thermo plants (source: http://www.epe.gov.br/Lists/LeilaoA32007/DispForm.aspx?ID=44).

This situation stresses that the project activity shall not be considered as common practice.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

ACM0006 - "Consolidated baseline methodology for grid-connected electricity generation from biomass residues", version 6, EB33, was chosen.

The chosen methodology is applicable to biomass-based cogeneration projects connected to the grid. The methodology considers emission reductions generated from cogeneration projects using sugarcane bagasse. This fits perfectly the operation at Santa Cruz S.A. - Açúcar e Álcool Cogeneration project, so the choice of methodology is justified.

The equations which will be used in calculating emission reductions are the following:

[4] UNICA - *União da Indústria de Cana-de-Açúcar* – Union of the Sugarcane Industry (www.portalunica.com.br)

[5] Copersucar - Cooperativa Produtores de Cana-de-açúcar, Açúcar e Álcool do Estado de São Paulo (São Paulo State Sugarcane, sugar and alcohol producers cooperatives). Data available only to cooperative members.

$ER_y = ER_{thermal,y} + ER_{electricity,y} - PE_y - L_y$ **Equation 1**

Where:

ER_y are the emission reductions of the project activity during year y
$ER_{electricity,y}$ are the emissions reductions due to displacement of electricity in year y
$ER_{thermal,y}$ are the emissions reductions due to displacement of thermal energy in year y. As stated in section B.4, this term is zero.
PE_y are project emissions in year y (zero for this project activity)
L_y are the leakage emissions in year y (zero for this project activity)

Estimate of project emissions:

No activities increasing GHG emissions were identified. Therefore, no calculation of estimate of GHG emissions is necessary. The project emissions (PE_y) are zero.

Estimated leakage emissions:

The main source of leakages in the ACM0006 methodology is considered to be the increase of fossil fuel consumption due to the diversion of the biomass. No diversion of biomass occurs, therefore no leakages are present. For the reasons explained, leakages (L_y) are considered to be zero.

Estimated emissions reductions due to the displacement of electricity:

The amount of electricity to be considered for the displacement of power from the grid is calculated using the equation below. This equation corresponds to the chosen scenario #18 of the ACM0006 methodology:

$$EG_y = EG_{projectplant,y} * \left(1 - \frac{\varepsilon_{el,baselineplant}}{\varepsilon_{el,projectplant,y}}\right)$$ **Equation 2**

EG_y is determined based on the average net efficiency of electricity generation in the reference plant that would be installed in the absence of the project activity and that would have a lower efficiency of electric generation than the project plant ($\varepsilon el,baseline\ plant = \varepsilon el,reference\ plant$), and the average net efficiency of electricity generation in the project plant after project implementation, $\varepsilon_{el,project\ plant,y}$, shown in Equation 2, where:

EG_y is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* in MWh,
$EG_{project\ plant,y}$ is the net quantity of electricity generated in the project plant during the year *y* in MWh,
$\varepsilon_{el,baseline\ plant}$ is the average efficiency of electricity generation in the baseline plant (MWhel/MWhbiomass)
$\varepsilon_{el,project\ plant,y}$ is the average net energy efficiency of electricity generation in the project plant, expressed in

$MWh_{el}/MWh_{biomass}$. by dividing the electricity generation during the year *y* by the sum of all fuels (biomass residue types *k* and fossil fuel types *i*), expressed in energy units, as follows:

$$\varepsilon_{el,project\ plant,y} = \frac{EG_{project\ plant,y}}{\sum_k NCV_k \cdot BF_{k,y} + \sum_i NCV_i \cdot FF_{project\ plant,i,y}}$$

where:

εel,project plant,y = Average net energy efficiency of electricity generation in the project plant
EGproject plant,y = Net quantity of electricity generated in the project plant during the year *y* (MWh)
BFk,y = Quantity of biomass residue type *k* combusted in the project plant during the year *y* (tons of dry matter or liter)
NCVk = Net calorific value of the biomass residue type *k* (GJ/ton of dry matter or GJ/liter)
NCVi = Net calorific value of fossil fuel type *i* (GJ / mass or volume unit)
FFproject plant,i,y = Quantity of fossil fuel type *i* combusted in the biomass residue fired power plant during the year *y* (mass or volume unit per year)9

For the first crediting period, the emissions reductions due to displacement of electricity ($ERelectricity_y$ in tCO_2e) will be calculated as follows:

$$ERelectricity_y = 0.2611 \times EG_y$$ **Equation 3**

The emission reduction by the project activity (ER_y in tCO_2e) during a given year (*y*) is the difference between the emissions reductions due to displacement of electricity ($ERelectricity_y$), project emissions (PE_y) and due to leakage (L_y), as follows:

$$ER_y = ERelectricity,_y - PE_y - L_y = 0.2611\ x\ EG_y - PE_y - 0$$ **Equation 4**

b) ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", Version 6, dated on 19/05/2006.

Since the power generation capacity of the project plant is of more than 15 MW, *EFgrid,y* should be calculated as a combined margin (CM), following the guidance in the section "Baselines" in the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002).

The calculation of emissions reductions from the displacement of electricity form the grid includes a calculation for baseline emission factor (EF_y) that is equal to a combined margin (CM) consisting of a weighted average of the operating margin (*OM*) and build margin (*BM*) factors. The methodology thus starts with the calculation of the OM and BM emission factors and concludes with the calculation of the electricity baseline emission factor. ACM0002 follows a three-step approach, namely:

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

Dispatch data analysis operating margin should be the first methodological choice. Since not enough data was supplied by the Brazilian national dispatch center, the choice is not currently available. The simple operating margin can only be used where low-cost/must-run resources[6] constitute less than 50% of total grid generation in: 1) average of 5 most recent years, or 2) based on long-term normals for hydroelectricity production. The share of hydroelectricity in the total electricity production for the Brazilian South-Southeast-Midwest interconnected system is much higher than 50% (see table 8 below), resulting in the non-applicability of the simple operating margin to the project.

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

Table 8 - Share of hydroelectricity generation in the Brazilian S-SE-MW interconnected system, 1999 to 2003 (ONS, 2004).

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

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

$$EF_{OM,simple-adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$ **Equation 5**

Where:

- λ_y is the share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin.
- $F_{i,j,y}$ is the amount of fuel *i* (in mass or volume unit) consumed by relevant power sources *j* (analogous for sources *k*) in year(s) *y*,
- *j* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid. For imports from connected electricity system located in another country, the emission factor is 0 (zero).
- *k* refers to the low-operating cost and must-run power sources.

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

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

The most recent numbers for the interconnected S-SE-MW system were obtained from the Brazilian national dispatch center, ONS (from the Portuguese *Operador Nacional do Sistema Elétrico)* in the form of daily consolidated reports (ONS-ADO, 2004). Data from 120 power plants, comprising 63.6 GW installed capacity and around 828 TWh electricity generation over the 3-year period were considered. With the numbers from ONS, **Erro! Fonte de referência não encontrada.**6 is calculated, as described below:

$$EF_{OM-LCMR,y} = \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{j,k}} \qquad \textbf{Equation 6}$$

Where:

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

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

$$EF_{OM,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \qquad \textbf{Equation 7}$$

Where:

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

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

These plants result in non-balanced emissions of greenhouse gases. The product $\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}$ for each one of the plants was obtained from:

$$F_{i,k,y} = \frac{GEN_{i,k,y} \cdot 3.6\times10^{-6}}{\eta_{i,k,y} \cdot NCV_i} \qquad \textbf{Equation 8}$$

$$COEF_{i,k} = NCV_i \cdot EF_{CO2,i} \cdot 44/12 \cdot OXID_i \qquad \textbf{Equation 9}$$

$$\textit{Hence, } F_{i,k,y} \cdot COEF_{i,k} = \frac{GEN_{i,k,y} \cdot EF_{CO2,i} \cdot OXID_i \cdot 44/12 \cdot 3.6\times10^{-6}}{\eta_{i,k,y}} \qquad \textbf{Equation 10}$$

Where variable and parameters used are:

- $\sum_{i,j} F_{i,j,y}$ is given in [kg], $COEF_{i,j}$ in [tCO_2e/kg] and $F_{i,k,y} \cdot COEF_{i,k}$ in [tCO_2e]
- $GEN_{i,k,y}$ is the electricity generation for plant *k*, with fuel *i*, in year *y*, obtained from the ONS database, in MWh
- $EF_{CO2,i}$ is the emission factor for fuel *i*, obtained from the Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in tC/TJ.
- $OXID_i$ is the oxidization factor for fuel *i*, obtained from the Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in %.
- 44/12 is the carbon conversion factor, from tC to tCO_2.
- 3.6 x 10^{-6} is the energy conversion factor, from MWh to TJ.
- $\eta_{i,k,y}$ is the thermal efficiency of plant *k*, operating with fuel *i*, in year *y*, obtained from PCF (2003).
- NCV_i is the net calorific value of fuel *i* [TJ/kg].

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

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$ [tCO_2/MWh]	λ_y [%]
2003	0.9823	0.5312
2004	0.9163	0.5055
2005	0.8086	0.5130

Table 9 - Share of hours in year *y* (in %) for which low-cost/must-run sources are on the margin in the S-SE-MW system for the period 2003-2005 (ONS-ADO, 2005).

With the numbers from ONS, the first step was to calculate the lambda and the emission factors for the simple operating margin. The λ_y factors are calculated as indicated in methodology ACM0002, with data obtained from the ONS database. Figure 15, Figure 16 and Figure 17 (see above, in Annex 3) present the load duration curves and λ_y determination for years 2003, 2004 and 2005, respectively. The results for years 2003, 2004 and 2005 are presented in Table 9.

Finally, applying the obtained numbers to calculate $EF_{OM,simple\text{-}adjusted,2002\text{-}2004}$ as the weighted average *of* $EF_{OM,simple\text{-}adjusted\ 2003}$, $EF_{OM\ simple\text{-}\ adjusted,2004}$ *and* $EF_{OM,simple\text{-}adjusted,2005}$ and λ_y to Equation 7:

- $EF_{OM,simple\text{-}adjusted,2003\text{-}2005}$ = 0.4349 tCO_{2e}/MWh

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

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

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (ACM-0002) for plants *m*, based on the most recent information available on plants already built. The sample group m consists of either:

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

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

Applying the data from the Brazilian national dispatch center to the equation above:

$EF_{BM,2005}$ = 0.0872 tCO_{2e}/MWh

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

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

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

$$EF_y = 0.5 \times 0.4332 + 0.5 \times 0.0962$$

EF_y = 0.2611 tCO_2/MWh

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**$EF_{grid,y}$**
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor for grid electricity during the year *y*
Source of data used:	The latest approved version of ACM0002 to calculate the grid emission factor: version 6, May 19, 2006. For the first crediting period, the emission factor $EF_{OM,y}$ will be calculated *ex-ante*.
Value applied::	0.2611
Justification of the choice of data or description of measurement methods and procedures actually applied	According to ACM0002, version 6, May 19, 2006, the calculation of emissions reductions from the displacement of electricity form the grid included a calculation for baseline emission factor (EF_y) that is equal to a combined margin (CM) consisting of a weighted average of the operating margin (*OM*) and build margin (*BM*) factors.
Any comment:	

Data / Parameter:	**$EFBM_{grid,y}$**
Data unit:	tCO_2/MWh
Description:	CO_2 build margin emission factor for grid electricity during the year *y*
Source of data used:	The latest approved version of ACM0002 to calculate the grid emission factor: version 6, May 19, 2006.
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**$EFOM_{grid,y}$**
Data unit:	tCO_2/MWh
Description:	CO_2 operating margin emission factor for grid electricity during the year *y*
Source of data used:	The latest approved version of ACM0002 to calculate the grid emission factor: version 6, May 19, 2006.
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**εel, reference plant**
Data unit:	MWh_{el} / $MWh_{biomass}$
Description:	Average net energy efficiency of power or heat generation in the reference power plant that would use the biomass residues fired in the project plant in the absence of the project activity
Source of data:	Use the efficiency of electricity or heat generation, as identified as part of the baseline scenario selection procedure. Consider commonly installed new biomass residue fired power plants that are common practice for new plants in the respective industry sector in the country or region. Choose the efficiency in a conservative manner, i.e. choose a higher efficiency within a plausible range of efficiencies that are reached by new plants in the relevant sector, document relevant sources of information (relevant studies, measurements and/or expert judgments) in the CDMPDD and justify the choice.
Measurement procedures (if any):	εel, reference plant = 0.034. See calculation in section B.6.3.
Any comment:	Applicable to scenario 18

B.6.3 Ex-ante calculation of emission reductions:

The Tables below show data estimated on energy export and bagasse consumption of the Project since year 2005:

Year	Energy exported (MWh)
2008 (*)	53,914
2009 (*)	186,624
2010 (*)	209,952
2011 (*)	209,952
2012 (*)	209,952
2013 (*)	209,952
2014 (*)	209,952

Year	Energy consumed (MWh)
2008 (*)	87,091
2009 (*)	97,978
2010 (*)	97,978
2011 (*)	97,978

2012 (*)	97,978
2013 (*)	97,978
2014 (*)	97,978

Year	Auxiliary systems (MWh)
2008 (*)	12,441.6
2009 (*)	13,996.8
2010 (*)	13,996.8
2011 (*)	13,996.8
2012 (*)	13,996.8
2013 (*)	13,996.8
2014 (*)	13,996.8

Year	Bagasse consumption (tones)
2008 (*)	745,364
2009 (*)	867,036
2010 (*)	867,036
2011 (*)	867,036
2012 (*)	867,036
2013 (*)	867,036
2014 (*)	867,036

(*) estimated

From these values, EGy is calculated, according to the equations in section B.6.1, as shown in the annexed spreadsheet "Santa Cruz_calculation CERs_2007.08.24.xls", with the results shown below:

Year	EG projectplant, y (MWh)	$\varepsilon_{el, project, y}$ (non dimensional)	EGy (MWh)
2008 (*)	128,563	0.0847	76,985
2009 (*)	270,605	0.1533	210,607
2010 (*)	293,933	0.1666	233,935
2011 (*)	293,933	0.1666	233,935
2012 (*)	293,933	0.1666	233,935
2013 (*)	293,933	0.1666	233,935
2014 (*)	293,933	0.1666	233,935

Calculation of $\varepsilon_{el, reference plant, y}$

The reference plants were found first through a comparison between the existing sugar mills in Brazil in harvest 2006/2007 and the existing sugar mills in harvest 2004/2005, in the site of Unica – *União da Indústria de Cana-de-Açúcar* – Sugarcane Industry Union (http://www.portalunica.com.br/portalunica/?Secao=referência&SubSecao=estatísticas&SubSubSecao=ranking). The list of the new plants, which are present only in the list of 2006/2007, is presented in annexed file "Brazil new sugar mills 2006 2007.xls".Then, among these new plants, a research was conducted to find out which of them do not export or export a small amount of energy to the grid, i.e., new plants that have a lower efficiency of electricity generation than the project plant.

Plant A (started operations in June/2006) – efficiency: 3.09%
Plant B (started operations in May/2006) – efficiency: 3.47%
Plant C (started operations in April/2005) – efficiency: 3.63%

Taking the average efficiency of these plants:

εel, reference plant = 0.034

Finally, emissions reductions will be as follows:

Year	ERy (t CO2)
2008 (*)	20,101
2009 (*)	54,990
2010 (*)	61,080
2011 (*)	61,080
2012 (*)	61,080
2013 (*)	61,080
2014 (*)	61,080
Total	**380,493**

B.6.4 Summary of the ex-ante estimation of emission reductions:

The full implementation of–the Santa Cruz S.A - Açúcar e Álcool project connected to the Brazilian South-Southeast-Midwest electricity interconnected grid will avoid an average estimated yearly emission of around 54,356 tCO_2e, and a total reduction of about 380,493 tCO_2e over the first 7 years crediting period (up to and including 2014, see Table 2):

Years	Estimation of project activity emissions reductions (tonnes of	Estimation of baseline emissions reductions (tonnes of	Estimation of leakage (tonnes of	Estimation of emissions reductions (tonnes of

	CO_{2e})	CO_{2e})	CO_{2e})	CO_{2e})
Year 1 (2008)	0	20,101	0	20,101
Year 2 (2009)	0	54,990	0	54,990
Year 3 (2010)	0	61,080	0	61,080
Year 4 (2011)	0	61,080	0	61,080
Year 5 (2012)	0	61,080	0	61,080
Year 6 (2013)	0	61,080	0	61,080
Year 7 (2014)	0	61,080	0	61,080
Total (tonnes of CO_{2e})		**380,493**		**380,493**

Table 2 - Estimation of emission reductions

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**EGproject plant$_y$**
Data unit:	MWh
Description:	Net quantity of electricity generated in the project plant during the year y
Source of data to be used:	Readings of the energy metering connected to the project plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	293,933 MWh at the end of the first crediting period
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	The consistency of metered net electricity generation should be cross-checked with receipts from electricity sales (if available) and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years).
Any comment:	

Data / Parameter:	**EG$_y$**
Data unit:	MWh
Description:	Net quantity of increased electricity generation as a result of the project activity during the year y
Source of data to be used:	Calculated according to equation 2, in section B.6.1
Value of data applied for the purpose of calculating expected emission reductions in section B.5	233,935 MWh at the end of the first crediting period
Description of	Calculated quarterly. Data will be archived during the crediting period and two

measurement methods and procedures to be applied:	years after.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**εel,project plant,y**
Data unit:	Non dimensional
Description:	Electric energy efficiency
Source of data to be used:	Net energy efficiency of electricity generation in the project plant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1666 at the end of the crediting period
Description of measurement methods and procedures to be applied:	Calculated quarterly. Data will be archived during the crediting period and two years after.
QA/QC procedures to be applied:	Data is being calculated by Santa Cruz, as in annexed spreadsheet "Santa Cruz_calculation CERs_2007 08 24.xls"
Any comment:	

Data / Parameter:	$\mathbf{FC_{bagasse}}$
Data unit:	Metric tones
Description:	Quantity of bagasse combusted in the project plant during the year *y*
Source of data to be used:	Weight on-site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See table in section B.6.3
Description of measurement methods and procedures to be applied:	Monitored continuously, with an annual energy balance. Adjust for the moisture content in order to determine the quantity of dry biomass. The quantity shall be crosschecked with the quantity of electricity (and heat) generated and any fuel purchase receipts (if available). Data will be archived during the crediting period and two years after.
QA/QC procedures to be applied:	Crosscheck the measurements with an annual energy balance that is based on purchased quantities and stock changes.
Any comment:	

Data / Parameter:	$\mathbf{NCV_{bagasse}}$
Data unit:	MWh/tones

Description:	Net calorific value of bagasse
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant international standards.
Monitoring frequency:	In case of measurements: At least every six months, taking at least three samples for each measurement. In case of other data sources: Review the appropriateness of the data annually.
QA/QC procedures:	Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, possibly collect additional information or conduct measurements.
Any comment:	

B.7.2 Description of the monitoring plan:

As per the procedures set by the approved monitoring methodology ACM0006 , data that will be monitored during the life of the contract are the net quantity of electricity generated at the project plant ($EG_{project\ plant,y}$) and the quantity of bagasse (and its NCV). The project owner will continuously measure these values.

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

The measurement of the energy generated to the grid will be done by two three-fase four wire electronic redundant meters. They will be installed in metallic panels inside Companhia Bioenergética Santa Cruz 1 and 2 control room.

The calibration of the instruments will be done according to the regulations of ANEEL, *Procedimentos de Distribuição de Energia Elétrica no Sistema Elétrico Nacional – PRODIST – Módulo 5 – Sistemas de Medição*, document PND1A-DE8-0550, of October 20, 2005 (http://www.aneel.gov.br).

The methodology considers monitoring emissions reductions generated from cogeneration projects using sugarcane bagasse. The monitoring plan, for emissions reductions occurring within the project boundary, is based on monitoring the amount of electricity supplied to the grid. The electricity baseline emission factor is determined ex-ante and will only be updated at renewal of the crediting period.

Santa Cruz S.A. - Açúcar e Álcool is responsible for the project management, monitoring and reporting as well as for organising and training of the staff in the appropriate monitoring, measurement and reporting techniques. The person in charge for the project monitoring and reporting is Rudinei Sergio Pestana, Integrated Management Coordinator. Staff will also be trained on the operation of boilers and electric generators.

General maintenance and maintenance of equipment and installations will be done yearly, according to the internal procedures of Santa Cruz S.A - Açúcar e Álcool and the manufacturers' recommendations. The established procedures reflect good monitoring and reporting practices.

Santa Cruz S.A. - Açúcar e Álcool will monitor the emission of SOx, NOx and CO, following the CONAMA (*Conselho Nacional do Meio Ambiente* – Environment National Counsil) regulation n. 382, of 26/12/2006, and the production of solid residues at the combustion of bagasse in the boilers, as well as the production of liquid residues.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

The baseline and monitoring studies were conducted according to approved methodology ACM0006 – "Consolidated baseline methodology for grid-connected electricity generation from biomass residues", version 5, EB31. They were completed on July, 30th, 2007, by Ricardo Besen of Ecoinvest Carbon Brasil Ltda.

Ecoinvest Carbon Brasil Ltda.
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Brazil

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E-mail: ricardo.besen@ecoinvestcarbon.com

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:

(DD/MM/YYYY): 01/01/2008.

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

25y-0m

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

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

01/04/2008

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

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C.2.2.2. Length:

This section is left blank on purpose.

SECTION D. Environmental impacts

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

The plant possesses preliminary and construction licenses. The licenses were issued by the São Paulo Environmental Agency, *CETESB – Companhia de Tecnologia de Saneamento Ambiental*, and are available for consultation under request, as well as the environmental studies.

In the processes, reports containing investigation of the following aspects were prepared:

- Impacts to climate and air quality.
- Geological and soil impacts.
- Hydrological impacts (surface and groundwater).
- Impacts to the flora and animal life.
- Socioeconomic (necessary infrastructure, legal and institutional, etc.).

In Brazil, the sponsor of a project that involves construction, installation, expansion or operation, even with no new significant environmental impact, must obtain new licenses. The licenses required by the Brazilian environmental regulation are (Resolution n. 237/97):

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

Santa Cruz S.A - Açúcar e Álcool has the authorization issued by ANEEL to operate as an independent power producer. Moreover, the power plant has the licenses emitted by *CETESB – Companhia de Tecnologia de Saneamento Ambiental* the environmental agency of the state of São Paulo (*Operating License - nº 28001421 dated of 03/13/2006 and valid until 03/13/2008*).

Santa Cruz S.A. - Açúcar e Álcool – cogeneration project has signed a power purchase agreement that is also contingent to the compliance of all environmental regulations.

D.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:

After the assessment of the preliminary environmental report by the state environmental authority some minor requirements were made in order to issue the licenses. The project sponsors are fulfilling all the requirements, thus, the environmental impact of the project activity is not considered significant and no full environmental impact assessment, such as EIA/RIMA, was required.

SECTION E. Stakeholders' comments

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

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

Additionally, the Brazilian Designated National Authority for the CDM, *Comissão Interministerial de Mudanças Globais do Clima*, requires the compulsory invitation of selected stakeholders to comment the PDD sent to validation in order to provide the letter of approval.

The organizations and entities invited for comments on the project were:

- *Prefeitura Municipal de Américo Brasiliense* (Américo Brasiliense City Hall)
- *Câmara Municipal de Américo Brasiliense* (Municipal Assembly of Américo Brasiliense)
- *Secretaria do Meio Ambiente de Américo Brasiliense* (Environmental Agency of Américo Brasiliense)
- *Associação Comunitária Cultural Cidade Doçura* (Local Cultural Association Cidade Doçura)
- *CETESB – Companhia de Tecnologia de Saneamento Ambiental* (Environmental Agency of the State of São Paulo)
- *Ministério Público de São Paulo* (State Attorney for the Rights of Citizens of the State of São Paulo)
- *FBOMS – Fórum Brasileiro de ONGs e Movimentos Sociais para o Desenvolvimento e Meio Ambiente* (Brazilian Forum of NGOs and Social Movements for the Development and Environment)

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

E.2. Summary of the comments received:

Neusa Maria B. Dotoli, from Américo Brasiliense City Hall, praised the social and economic benefits brought by Santa Cruz to the city. No major issues were commented.

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

All comments received from stakeholders during the process for obtaining the Environmental License and Operational Permit were incorporated into the project. Usina Santa Cruz S.A. - Açúcar e Álcool obtained Construction License following the requests made by CETESB – Companhia de Tecnologias de Saneamento Ambiental the environmental agency, and signed a PPA with CPFL – Companhia Paulista de Força e Luz, thus providing enough evidence that due account of stakeholders comment was taken.

All comments from local stakeholders were positive.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Santa Cruz S.A. – Açúcar e Álcool
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URL:	www.usinasantacruz.com.br
Represented by:	
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Salutation:	Mr.
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Middle Name:	
First Name:	Marcos
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FAX:	+55 (11) 3063-9069
E-Mail:	
URL:	
Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Martins Jr.
Middle Name:	de Mathias
First Name:	Carlos
Department:	

Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	cmm@ecoinvestcarbon.com

Annex 2 – Information regarding public Funding

No public funding is involved in the present project.

This project is not a diverted ODA from an Annex 1 country.

Annex 3 – Baseline Information

Years	Total installed capacity (MW)	Installed capacity for internal use (MW)	Installed capacity used to export to the grid (MW)	Capacity factor %	Hours of operation during the year	MWh y t
Year 1_2008	25	12	13	90%	4,608	
Year 2_2009	75	19	40	90%	5,184	
Year 3_2010	75	21	45	90%	5,184	
Year 4_2011	75	21	45	90%	5,184	
Year 5_2012	75	21	45	90%	5,184	
Year 6_2013	75	21	45	90%	5,184	
Year 7_2014	75	21	45	90%	5,184	

Table 3 – Santa Cruz S.A - Açúcar e Álcool – Electricity generation evolution

The Brazilian electricity system (figure below) has been historically divided into two subsystems: the North-Northeast (N-NE) and the South-Southeast-Midwest (S-SE-CO, From the Portuguese *Sul-SudEste-Centro-Oeste*). 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):

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

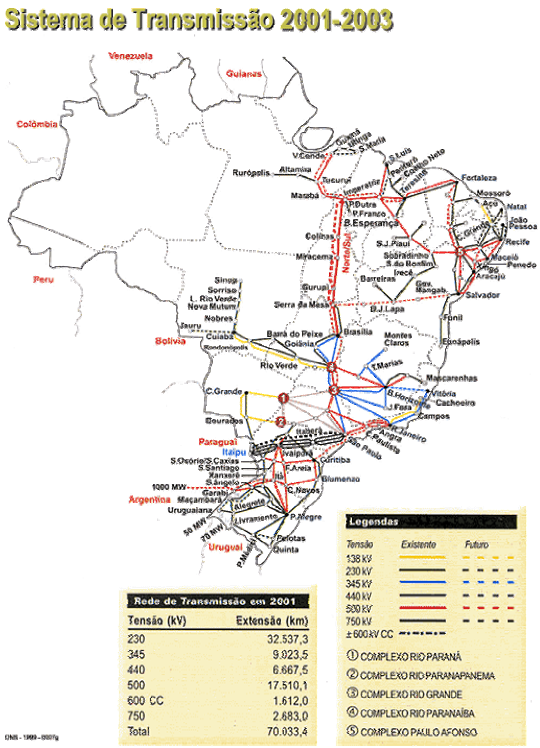
i) The South/Southeast/Midwest Interconnected System;

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."



Rede de Transmissão em 2001

Tensão (kV)	Extensão (km)
230	32.537,3
345	9.023,5
440	6.667,5
500	17.510,1
600 CC	1.612,0
750	2.683,0
Total	70.033,4

Figure 13 - Brazilian Interconnected System (Source: ONS)

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

The Brazilian electricity system nowadays comprises of around 91.3 GW of installed capacity, in a total of 1,420 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 5.3% are diesel and fuel oil plants, 3.1% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw and biogas), 2% are nuclear plants, 1.4% are coal plants, and there are also 8.1 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid. (http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp). This latter capacity is in fact comprised by mainly 6.3 GW of the Paraguayan part of *Itaipu Binacional*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

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

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

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

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

In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International Energy Agency database built when carrying out the study from Bosi *et al.* (2002). Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only (Table 4.

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

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

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

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

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [MWh]	Imports [MWh]
2003	0.9823	288,933,290	274,670,644	459,586
2004	0.9163	302,906,198	284,748,295	1,468,275
2005	0.8086	314,533,592	296,690,687	3,535,252
	Total (2003-2005) =	**906,373,081**	**856,109,626**	**5,463,113**
	$EF_{OM,simple-adjusted}$ [tCO2/MWh]	$EF_{BM,2005}$	Lambda	
	0.4349	0.0872	λ_{2003}	
	Alternative weights	Default weights	0.5312	
	w_{OM} = 0.75	w_{OM} = 0.5	λ_{2004}	
	w_{BM} = 0.25	w_{BM} = 0.5	0.5055	
	Alternative EF_y [tCO2/MWh]	Default EF_y [tCO2/MWh]	λ_{2005}	
	0.3480	**0.2611**	0.5130	

Table 5 – Emission factors for the Brazilian South-Southeast-Midwest interconnected grid (simple adjusted operating margin factor)

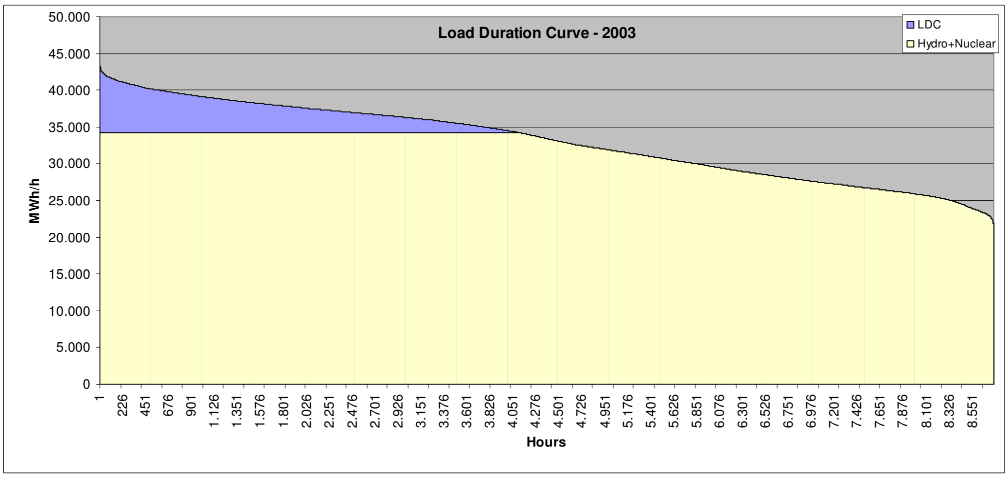


Figure 14 - Load duration curve for the S-SE-CO system, 2003

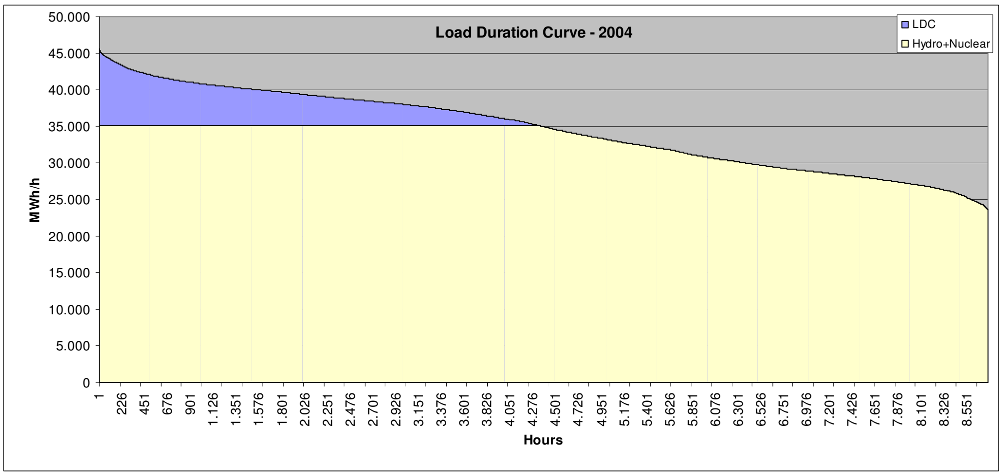


Figure 15 - Load duration curve for the S-SE-CO system, 2004

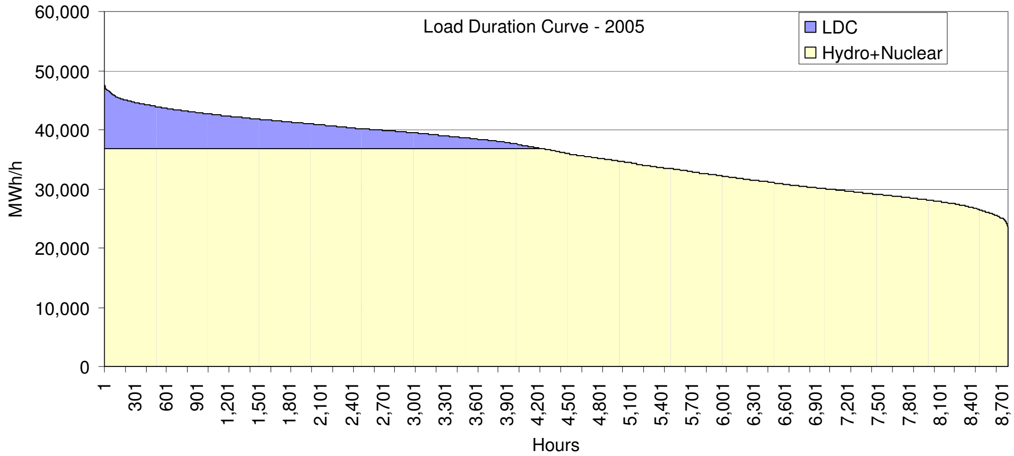


Figure 16 – Load duration curve for the S-SE-CO system, 2005

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

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

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

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

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

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

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

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

Table 6 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 1

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

* Subsystem: S - south, SE-CO - Southeast-Midwest
** Fuel source (C, bituminous coal; D, diesel oil; G, natural gas; H, hydro; N, nuclear; O, residual fuel oil).
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[2] Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A.F. Simoes, H. Winkler and J.M. Lukamba. *Road testing baselines for GHG mitigation projects in the electric power sector.* OECD/IEA information paper, October 2002.
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[5] Agência Nacional de Energia Elétrica. Superintendência de Fiscalização dos Serviços de Geração. *Resumo Geral dos Novos Empreendimentos de Geração* (http://www.aneel.gov.br/, data collected in november 2004).

Table 7 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 2

Annex 4 – Monitoring Plan

This section is intentionally left blank (see section B.7.2 for monitoring plan).