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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

USJ Açúcar e Álcool S/A – Usina São Francisco Cogeneration Project.
Version: 4.
Date (DD/MM/YYYY): 18/07/2006.

A.2. Description of the project activity:

The primary objective of the Usina São Francisco 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.

Usina São Francisco Cogeneration Project consists in the construction of a sugar mill, which will be operational in May 2006, capable of generating power surplus for sale (Figure 1) and, at the same time, generating carbon credits contributing to the sustainable development. During the 2009 to 2012 season, it's predicted an expansion that will double the mill's generating capacity.

The cogeneration project will generate enough energy not only for powering the sugar mill (thus eliminating the consumption of energy from the grid for the expanding capacity of the facility), but also for delivering surplus energy to the national grid. This electricity given to the grid will displace energy that the government would have provided with a strong use of fossil fuels. This displacement of energy thus creates a reduction of greenhouse gases emissions. This project also creates social and economical benefits that constitute a real contribution to Brazil's sustainable development.

This renewable energy project is owned by U.S.J. – Açúcar e Álcool S/A, a sugar cane based distillery originally founded in 1944 and has more than 40,000 hectares harvest with sugar cane. Today, U.S.J. – Açúcar e Álcool S/A has two facilities: one in Quirinópolis, state of Goiás, where the project is going to be implemented, and the other in Araras, state of São Paulo. During the last 2004/2005 crop season, U.S.J. – Açúcar e Álcool S/A processed about 3,208,095 tonnes of sugar cane, produced 100,359 litters of alcohol and 260,350 tonnes of sugar, in Araras.

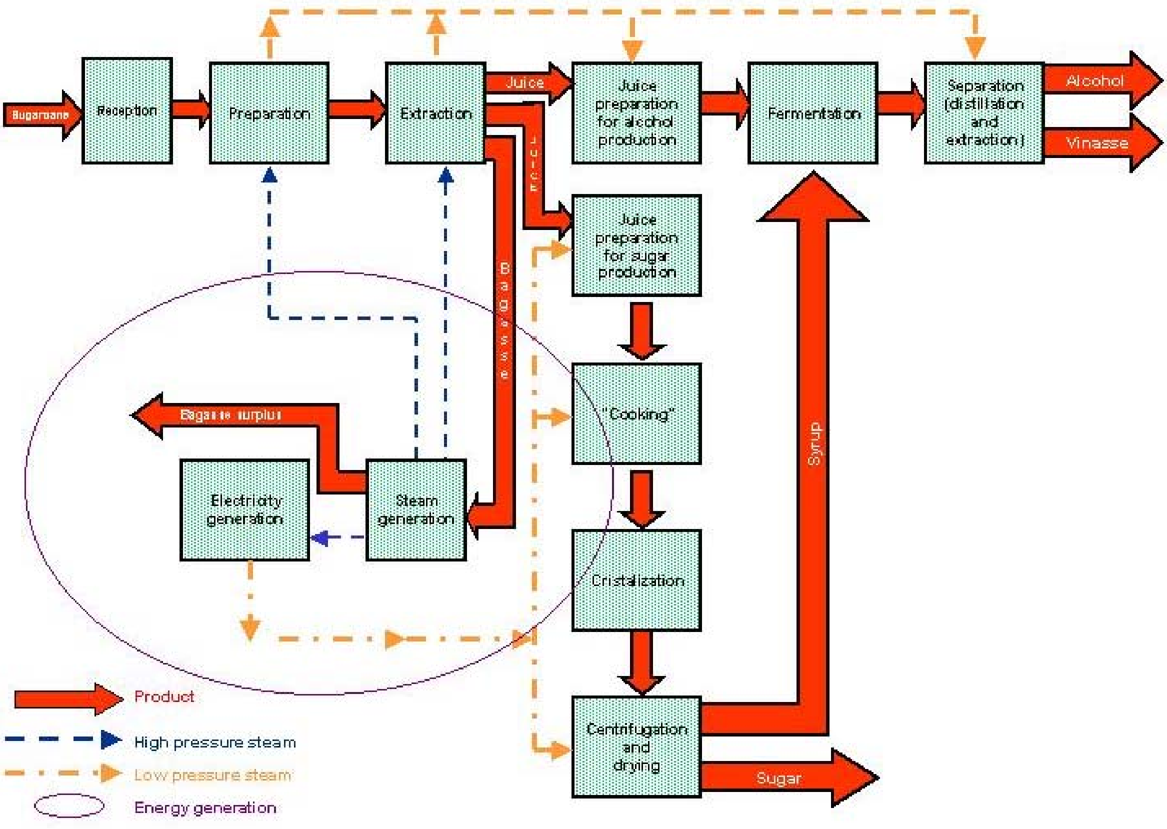

Figure 1 - Flowchart of the electricity generation inside a Sugar and Alcohol Production (Source: Codistil)

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. Usina São Francisco Cogeneration 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 USJ Group, the owner of the project, to continue supporting the community. Usina São João has a strong social responsibility evidenced in numerous initiatives, including: promoting projects in partnership with Araras University, state of São Paulo, contributing in education, health, culture, sport and leisure areas. One example of these initiatives is "Usina do Saber". The project selects deprived children offering transportation to the schools with headquarters in the residential area of the company. Besides, the São João make donations to funds as Fundo Municipal dos Direitos da Criança e do Adolescente of Araras and Conchal cities. Usina São João also has the ISO 9.001/2000 – BVQI certification for sugar cane juice extraction and production, handling, storage, commercialization and dispatch of sugars. This revenue distribution and social efforts must be added to the environmental benefits when evaluating the contribution to sustainable development of this project activity. At Usina São Francisco in Quirinópolis (GO), it is in course the final stage definition of a partnership with SENAI. Such partnership will result in the implementation of technical courses related to agribusiness, with prominence in courses about "sugar and alcohol production", which will use the industrial labs of the Quirinópolis facility directly as integral part on the professional education process. Foment to regional contributions in health, culture, sport and leisure areas are also being developed. With the definitive structure and operation of Quirinópolis facility, many of the success projects describe above, already implemented in Araras facility, will have full adaptation to Quirinópolis facility.

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)	U.S.J. – Açúcar e Álcool S/A (Private entity)	No
	Ecoinvest Carbon (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:

Usina São Francisco is located in Quirinópolis, state of Goiás, central of Brazil.

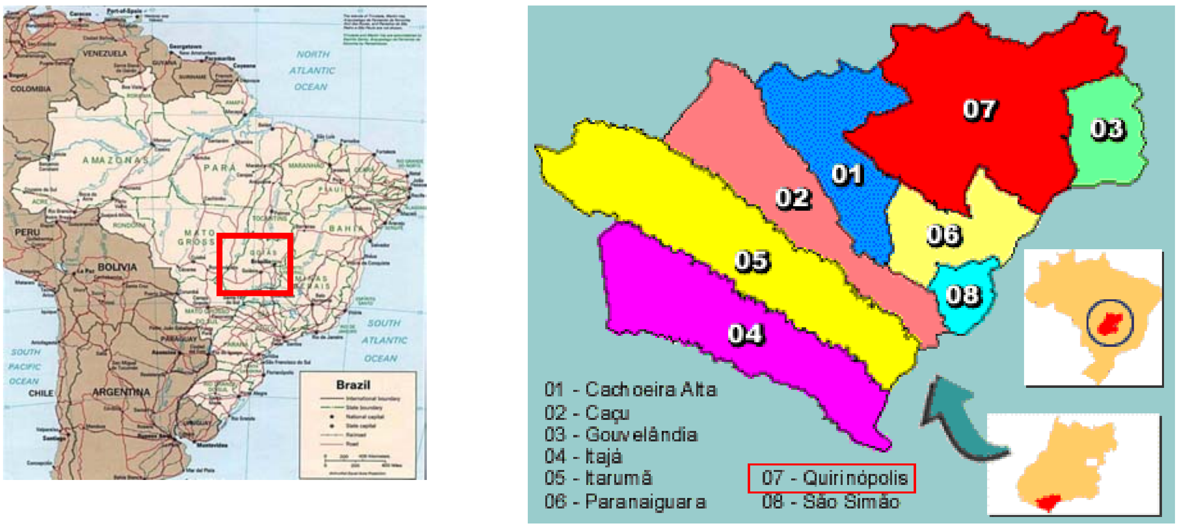

Figure 2 – Political division of Brazil showing the state of Goiás and the city of Quirinópolis (Source: www.citybrazil.com.br)

A.4.1.1. Host Party(ies):

Brazil.

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

Goiás.

A.4.1.3. City/Town/Community etc:

Quirinópolis.

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

Usina São Francisco is located in Quirinópolis, at some 284 km from Goiania, capital of Goiás, Brazil. Quirinópolis has 37,913 inhabitants and 3,780 km^2.

Goiás has 246 municipalities and economic is based on cattle raising. The number of cows was estimated in 2000 to be around 18 million, four for each inhabitant. Sugarcane, soybeans, corn, tomato, rice, cotton, manioc, and beans are the most important agriculture items. Minerals are also important with the state being a major producer of nickel, manganese, cobalt, iron, gold, and silver. The strongest growing area in the state has been in industry and commerce.

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 São Francisco, 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.

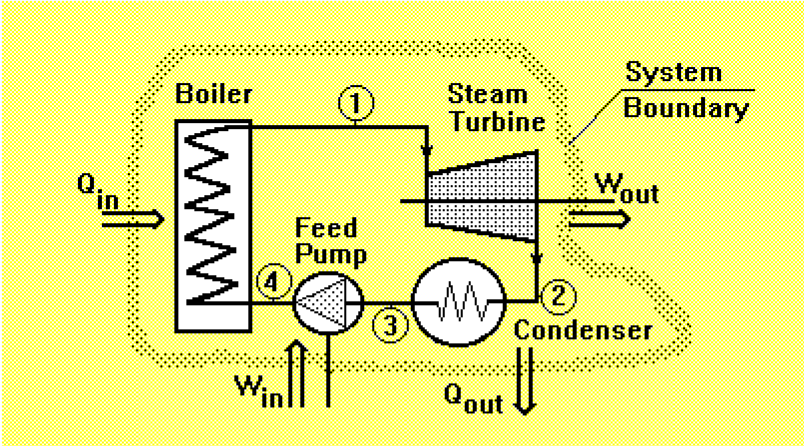

Figure 3 - Rankine Cycle

The project will operate with a configuration using 1 boiler, 1 generator and 1 turbo-generator. During the season from 2009 to 2012, it's predicted an expansion through installation of more equipment, doubling Usina São Francisco capacity. Usina São Francisco is expected to generate an annual average of 215,401 MWh power surplus at the end of the first crediting period, operating at full capacity during the season. It will displace energy from the grid by both avoiding the consumption of power from the grid in the project and by delivering clean energy to the grid.

Technical Description:

Season from 2006 to 2008		**Season from 2009 to 2012**	
Boiler		***Boiler***	
Quantity	**1**	Quantity	**2**
Manufacturer	Caldema	Manufacturer	Caldema
Type	AMD-83-8GI-PSE	Type	AMD-83-8GI-PSE
Manufactured Year	2006	Manufactured Year	2006/2009
Pressure	67,6 Kgf/Cm2	Pressure	67,6 Kgf/Cm2
Temperature	480º C	Temperature	480º C
Leakage	250 TVH	Leakage	250 TVH
Generator		***Generator***	
Quantity	**1**	Quantity	**2**
Manufacturer	WEG	Manufacturer	WEG
Type	SPW 1250	Type	SPW 1250
Manufactured Year	2006	Manufactured Year	2006/2009
Generator Power	50 MVA	Generator Power	50 MVA
Frequency	1,800 rpm	Frequency	1,800 rpm
Nominal Tension	13,8 kV	Nominal Tension	13,8 kV
Turboredutor		***Turboredutor***	
Quantity	**1**	Quantity	**2**
Manufacturer	TGM/RENK	Manufacturer	TGM/RENK
Type	TM 35000 A	Type	TM 35000 A

Manufactured Year	2006	Manufactured Year	2006/2009
Generator Power	40 MW	Generator Power	40 MW
Temperature	480ºC	Temperature	480ºC
Pressure	65,0 Kgf/cm2	Pressure	65,0 Kgf/cm2

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

Usina São Francisco 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.

Usina São Francisco 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 on the old cogeneration plant (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 dates, 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.

The estimated emission reductions of CO2 for the first crediting period are 266,866 tonnes.

A.4.4.1. 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 CO_2**
2006 (starting on July 1)	1,861
2007	14,579
2008	20,237
2009	38,234
2010	49,413
2011	57,017
2012	57,017
2013 (until June 30)	28,508
Total Estimated Emissions	266,866
Total number of crediting years	7

Annual average over the crediting period of estimated reductions	38,124

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 Usina São Francisco 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, May 19th, 2006, version 3.

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

The ACM0006 methodology is applied to the Usina São Francisco Cogeneration Project because this is a greenfield power project: Usina São Francisco is a new biomass power generation plant at a site where currently no power generation occurs. It uses one type of biomass: bagasse, a byproduct of the production of sugar. The power generated by the project plant would in the absence of the project activity be purchased from the grid.

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

The project falls under methodology ACM0006 for grid-connected electricity generation using biomass. It reduces emissions by displacing electricity from the grid. It 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 Usina São Francisco 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 will be due to Usina São Francisco Cogeneration Project natural expanding business and can not be attributed to the implementation of the cogeneration project. The Table below shows that the cogeneration project does not have an impact in processing capacity: in 2006/2007 harvest, it will process 500,000 tonnes of sugar cane, with 40 MW installed capacity; in 2007/2008 harvest, it will process 1,500,000 tonnes of sugar cane, with the same installed capacity; in 2008/2009, it will process 2,200,000 tonnes of sugar cane, with the same installed capacity.

Harvest	Installed Capacity	Sugar cane processing (tonnes)
2006-2007	40 MW	500,000
2007-2008	40 MW	1,500,000
2008-2009	40 MW	2,200,000

Usina São Francisco will generate approximately 60 MWh yearly (for sale and internal use) per million tonnes of sugar cane processed. See Table 6 in Annex 3 for Usina São Francisco's electricity generation evolution.

(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. In Usina São Francisco, the bagasse will be stored from the end of the harvest season in the Brazilian Midwest region, in November, until the beginning of the following harvest season, in April. The volume of bagasse stored between seasons is foreseen to be insignificant, 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.

Usina São Francisco Cogeneration Project uses bagasse for the generation of heat and electricity. The project activity is a new biomass power generation plant at a site where currently no power generation occurs. This corresponds to baseline scenario 4:

- In the absence of the project activity, a new biomass power plant ("reference plant") would be installed instead of the project activity at the same site and with the same thermal firing capacity, but with a lower electric efficiency than the project plant. The generation of power would continue in existing power plants.
- In the absence of the project activity, the same quantity and type of biomass would be used in the reference plant.
- The heat generated by the project plant would, in the absence of the project activity, be generated by the reference plant, with a lower efficiency (common practice in the sugar cane sector in Brazil)
- Emission reductions from heat are not considered because the thermal efficiency of the project plant is larger than the heat efficiency of the reference plant. For conservativeness reasons, they are excluded, i.e., $ER_{heat,y}$=0.

According to the approved methodology ACM0002 (May 19th, 2006, version 6), the baseline emission factor is calculated as (EF_y) as a combined margin (*CM*), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, the project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly the connected electricity system is defined as that electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

From ACM0002, a baseline emission factor (EF_y) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to the following three steps:

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

Dispatch data analysis operating margin should be the first methodological choice. Since not enough data was supplied by the Brazilian national dispatch center, the choice is not currently available. The simple operating margin can only be used where low-cost/must-run resources[1] 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 2 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 2 - 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 1**

Where:

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

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

The most recent numbers for the interconnected S-SE-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, Equation 2 is calculated, as described below:

$$EF_{OM-LCMR,y} = \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{j,k}}$$ **Equation 2**

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, $EF_{OM,y} = 0$.

$$EF_{OM,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$ **Equation 3**

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:

$$F_{i,k,y} = \frac{GEN_{i,k,y} \cdot 3.6 \times 10^{-6}}{\eta_{i,k,y} \cdot NCV_i}$$ **Equation 4**

$$COEF_{i,k} = NCV_i \cdot EF_{CO2,i} \cdot 44/12 \cdot OXID_i \qquad \textbf{Equation 5}$$

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

Where variable and parameters used are:

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

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

Year	$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$ **[tCO_2/MWh]**	λ_y **[%]**
2002	0.8548	0.5053
2003	0.9421	0.5312
2004	0.8763	0.5041

Table 3 - 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 2002-2004 (ONS-ADO, 2005).

With the numbers from ONS, the first step was to calculate the lambda and the emission factors for the simple operating margin. The λ_y factors are calculated as indicated in methodology ACM0006, with data obtained from the ONS database. Figure 14, Figure 15 and Figure 16 (Annex 3) present the load duration curves and λ_y determination for years 2002, 2003 and 2004, respectively. The results for years 2002, 2003 and 2004 are presented in Table 3.

Finally, applying the obtained numbers to calculate $EF_{OM,simple\text{-}adjusted,2002\text{-}2004}$ as the weighted average *of* $EF_{OM,simple\text{-}adjusted\ 2002}$, $EF_{OM\ simple\text{-}\ adjusted,2003}$ *and* $EF_{OM,simple\text{-}adjusted,2004}$ and λ_y to Equation 1:

- $EF_{OM,simple\text{-}adjusted,2002\text{-}2004}$ = 0.4332 tCO_{2e}/MWh

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

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$ **Equation 7**

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method (ACM-0006) for plants *m*, based on the most recent information available on plants already built. The sample group m consists of either:

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

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

Applying the data from the Brazilian national dispatch center to Equation 7:

$EF_{BM,2004} = 0.0962\ tCO_{2e}/MWh$

- **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 8**

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:

$$EF_y = 0.5 \times 0.4332 + 0.5 \times 0.0962$$ **Equation 9**

$EF_y = 0.2647\ tCO_2/MWh$

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

In order to determine if the project activity is additional, the additionality tool approved by the Executive Board is applied[2]. The following steps are applied:

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

Not applicable

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.

[2] http://cdm.unfccc.int/EB/Meetings/016/eb16repan1.pdf

From the country's perspective, the alternative for producing a similar amount of energy, as the one Usina São Francisco 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 (mainly natural gas fired).

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

Sub-step 1b. Enforcement with applicable 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.

SATISFIED/PASS – Proceed to Step 2

Step 2. Investment analysis

Not applicable.

Step 3. Barrier Analysis

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

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

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

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

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

At the end of 2000, after five years of privatization, the results were modest (Figure 5). Despite high expectations, investments in new generation did not follow the increase in consumption.

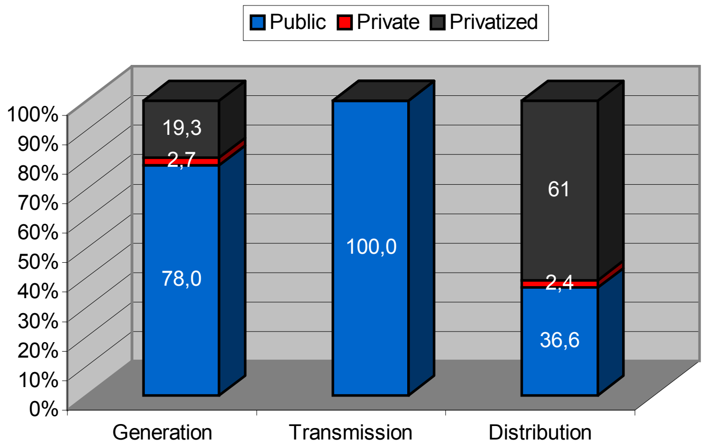

Figure 5 - Participation of private capital in the Brazilian electricity market in December 2000 (Source: BNDES, 2000).

The decoupling of GDP (average of 2% increase in the period of 1980 to 2000) from electricity consumption increase (average of 5% increase in the same period) is well known in developing countries, mainly due to the expansion of the supply services to new areas and the growing infra-structure. The necessary measures to prevent bottlenecks in services were taken. These include an increase of generation capacity higher than the GDP growth rate and strong investments in energy efficiency. In the Brazilian case, the increase in the installed generation capacity (average of 4% in the same period) did not follow the growth of consumption as can be seen in Figure 6.

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

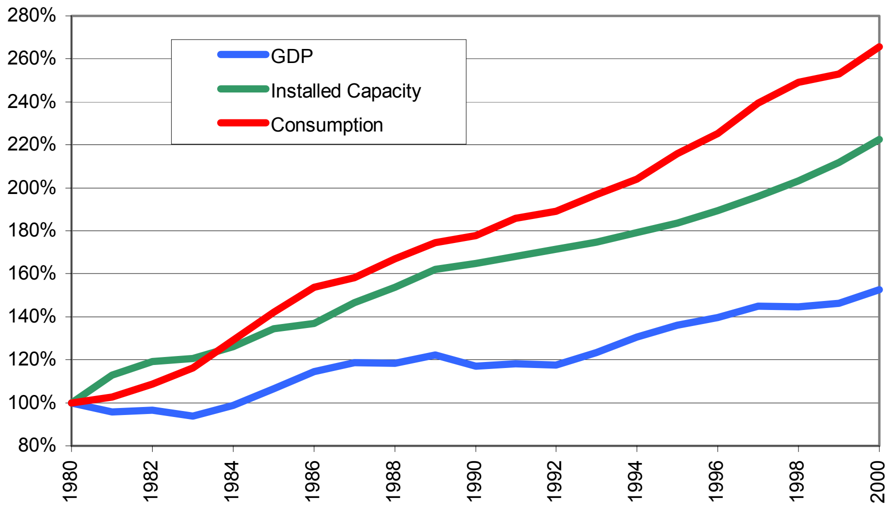

Figure 6 - Cumulated variation of GDP, electricity supply (installed capacity) and demand (consumption). Source: Eletrobrás, IBGE

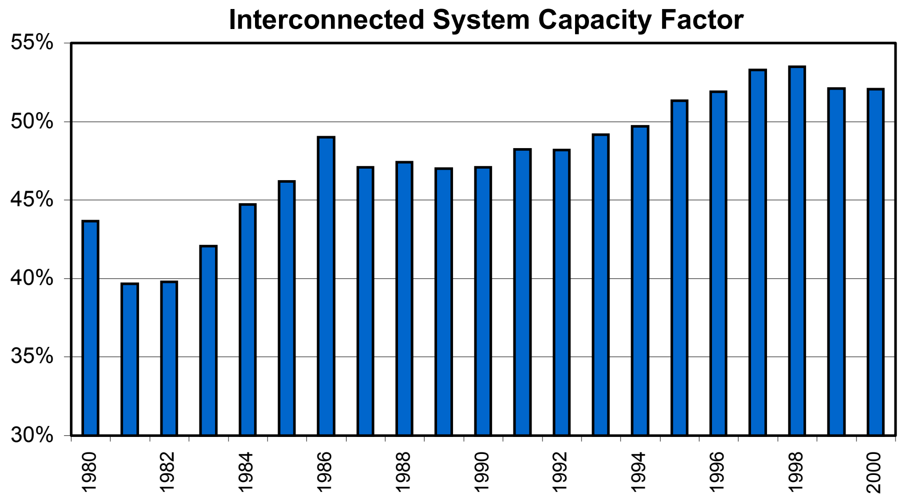

Figure 7 - Evolution of the rate of generated energy to installed capacity (Source: Eletrobrás)

The remaining alternative, to increase the capacity factor of the old plants, was actually the most widely used, as can be seen in Figure 7.

To understand if such increase in capacity factor brought positive or negative consequences one needs to analyze the availability and price of fuel. In the Brazilian electricity model the primary energy source is the water accumulated in the reservoirs. Figure 8 shows what happened to the levels of "stored energy" in the reservoirs from January 1997 to January 2002. It can be seen that reservoirs which were planned to withstand 5 years of less-than-average rainy seasons, almost collapsed after a single season of low rainfall (2000/2001 experienced 74% of the historical average rain. This situation depicts a very intensive use of the country's hydro resources to support the increase in demand without increase of installed capacity. Under the situation described there was still no long-term solution for the problems that finally caused shortage and rationing in 2001.

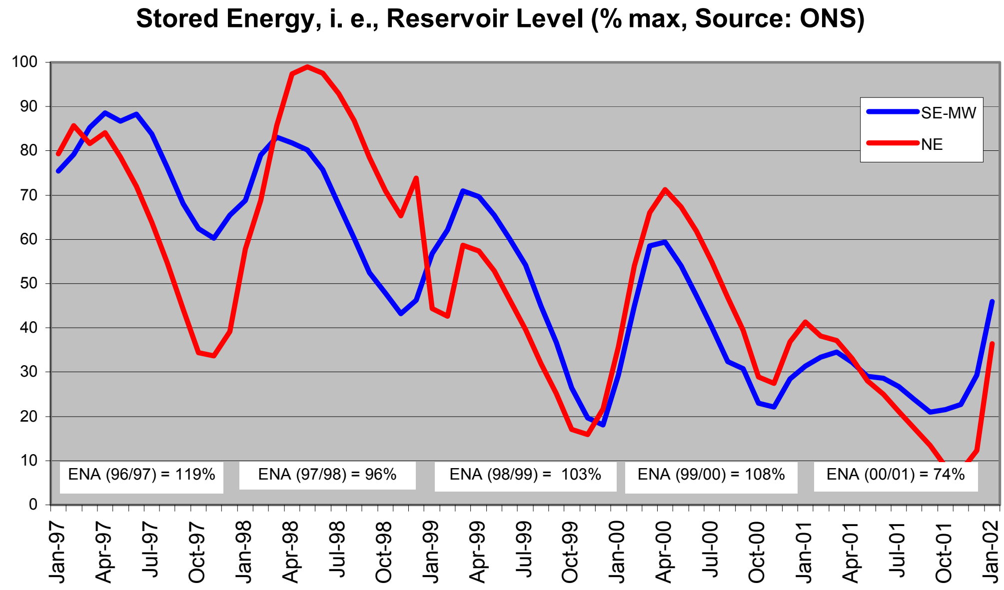

Figure 8 - Evolution of the water stored capacity for the Southeast/Midwest (SE-MW) and Northeast (NE) interconnected subsystems and intensity of precipitation in the rainy season (ENA) in the southeast region compared to the historic average (Source: ONS)

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

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

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

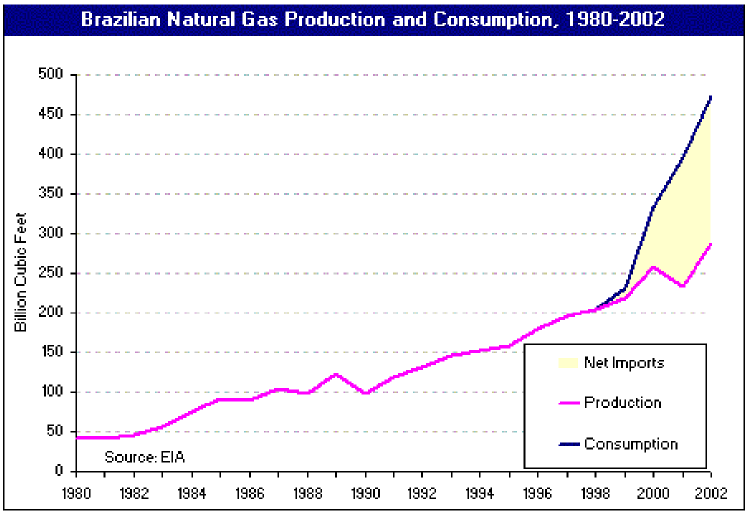

Figure 9 – Historical Brazilian Natural Gas Consumption and Production (Source: EIA[3])

With discoveries of vast reserves of natural gas in the Santos Basin in 2003 (Figure 10) the policy of using natural gas to generate electricity remains a possibility and it still will continue to have interest from private-sector investments in the Brazilian energy sector.

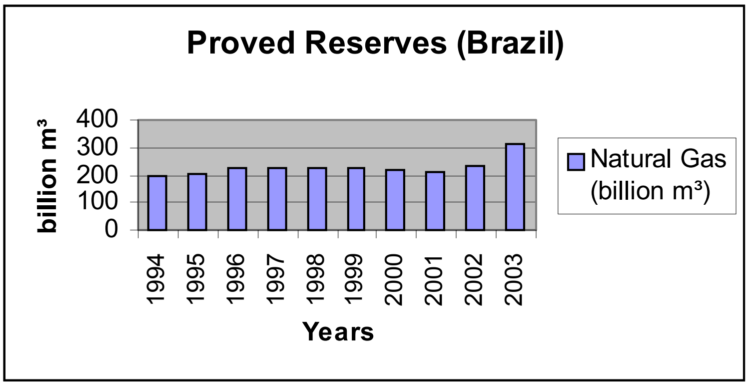

Figure 10 - National Historical Proved Reserves of Natural Gas (Source: Petrobrás)

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

- Electricity demand and supply will be coordinated through a "Pool" Demand will be estimated by the distribution companies, which will have to contract 100 per cent of their projected electricity demand over the following 3 to 5 years. These projections will be submitted to a new institution (*Empresa de Pesquisa Energética*, EPE), which will estimate the required expansion in supply capacity to be sold to the distribution companies through the Pool. The price at which electricity will be traded through the Pool is an average of all long-term contracted prices and will be the same for all distribution companies.

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

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

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

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

Investment Barrier

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

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

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

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

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

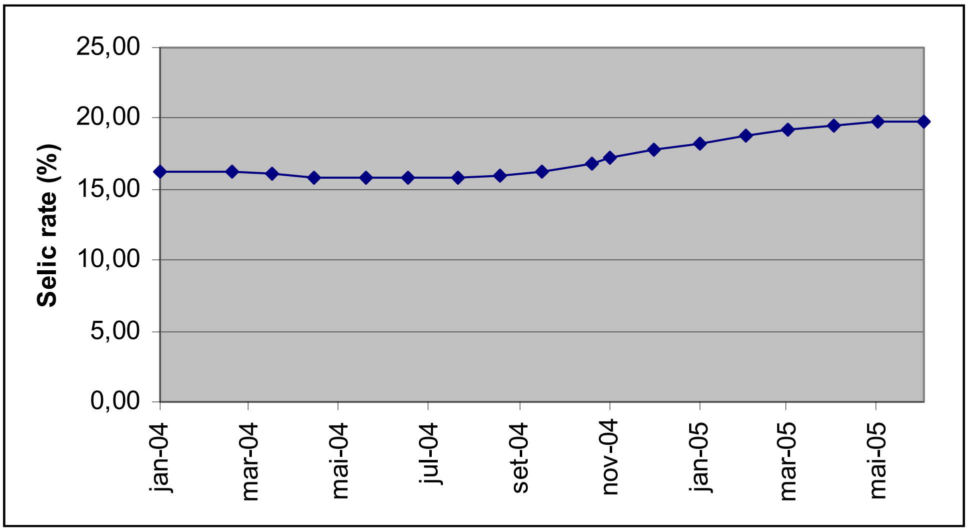

Figure 11 - SELIC rate (source: *Banco Central do Brasil*)

The most liquid government bond is the LFT (floating rate bonds based on the daily Central Bank reference rate). As of January 2004, 51.1% of the domestic federal debt was in LFTs and had duration of one day. This bond rate is almost the same as the CDI - Interbank Deposit Certificate rate that is influenced by the SELIC rate, defined by COPOM[4].

The SELIC Rate has been oscillating since 1996 from a minimum of 15% p.a. in January 2001 to a maximum of 45% p.a. in March 1999. Figure 11 shows SELIC Rate after January, 2004.

To finance construction of the sugar mill, project sponsor took advantage of the financing lines of BNDES. This financial support was meant to cover 80% of the project costs with a rate of TJLP (BNDES Long Term Interest Rate – 10%) plus a 3% spread risk for a term of 10-year and 3,5-year grace period. It is important to state that, due to a considerable equipment prices increase recently (mainly due to the steel price increase), BNDES's financial support will correspond to only 50% of the project costs.

4 COPOM – Comitê de Politica Monetária (Monetary Policy Committee).

This investment analysis takes a look at the factors relating to potential certified emission reductions (CERs) and the incentives derived from them in the project investment decision taking process. Thus, in taking the decision to undertake the project, the investment profitability studies considered the potential monetization of CO2 credits that the project would produce.

The Project was set up with an expected financial IRR – Internal Rate of Return of approximately 12% per year. The project's IRR is very similar to the SELIC rate in effect at the time of financing, although the project is a riskier investment as compared to Brazilian government bonds. The inclusion of the revenues from CERs makes the project's IRR increase from 4.9% to 12.5% (information about the project's IRR under request). Such increase in return would partially compensate for the additional risk investor would take with this project.

In addition to the increase of 760 basis points, CERs revenues would bring the project additional benefits due to the fact that they are generated in hard currencies (dollar or euro). The CDM incentive allows Usina São Francisco to hedge its debt cash flow against currency devaluation. Moreover, the CER Free Cash Flow, in dollars or euro, could be discounted at an applicable discount interest rate, thus increasing the project leverage.

It is important to notice that the direct comparison between the SELIC rate and the IRR is not accurate and the idea is not to introduce a benchmark analysis, but to set a parameter as a reference. Given an energy project is a riskier investment than a government bond, it is necessary to have a much higher financial return, compared to the SELIC reference rate. Given the circumstances, rationale and distortions of the Brazilian economy, it is not straightforward to define the meaning of this difference of rates, and a developer might feel more comfortable than others, depending on the situation.

The high level of guarantees required to finance an energy project in Brazil is a barrier for developing new projects. Insurance, financial guarantees, financial advisories are requirements which increase the cost of the project and are barriers to project achievability.

Other financial barriers are related to the power purchase agreement (PPA). The PPA is required in order to obtain long-term financing from a bank and the lack of adequate commercial agreements from the energy buyers may influence directly the negotiation between the bank and the project developer. Most of the utilities in Brazil do not have a satisfactory credit risk thus representing a barrier to obtain long-term funding.

The law nº 10,438, enacted in April 2002, created the Proinfa - *Programa de Incentivo às Fontes Alternativas de Energia Elétrica* (Program of Incentives to Alternative Energy Sources). Among others, one of this initiative's goals is to increase the renewable energy sources share in the Brazilian electricity market, thus contributing to a greater environmental sustainability. In order to achieve such goals, the Brazilian government has designated the federal state-owned power utility Eletrobras - *Centrais Elétricas Brasileiras S/A* to act as the primary offtaker of electric energy generated by alternative energy facilities in Brazil, by entering into long-term PPAs (Power Purchase Agreements) with alternative energy producers, at a guaranteed price of at least 80% of the average energy supply tariff charged to ultimate consumers. The creation of Proinfa indicates that, without specific support, the renewable sources and the small projects would hardly be implemented otherwise.

The existence of Proinfa is a proof that a sound incentive is necessary to promote the construction of renewable energy projects in Brazil and there is room for CDM projects. Proinfa legislation proposed to increase the capacity of renewable energy power generation to about 3,300 MW by 2006, but from the 1,100 MW it reserved to biomass energy sources, only 685.24 MW have been contracted so far. According to a Brazilian energy magazine[5], there are two main reasons for this: 1) the average IRR for the investment in the production of sugar cane/ethanol is 3% higher than the average IRR for the investment in cogeneration; 2) entrepreneurs have considered the tariff of R$ 97.24/MWh (as of June 2004) not profitable. In 2005, BNDES presented the last final version of its financing incentive line to

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[5] Brasil Energia, n. 299, October, 2005. P.83

Proinfa, which is different from the one first considered for the program, that was considered insufficient. It means that for the last 5 years, the government had to present a new proposition (or incentive) per year, in order to convince the developers to invest in renewable energy projects.

Usina São Francisco did not apply for Proinfa, because there was not enough time to fulfill to all the application requirements and, for this reason, does not count with the benefits of the program and has more difficulties in competing in the Brazilian electricity market. In the most recent energy auction, which took place on December 16th, 2005, in Rio de Janeiro, Usina São Francisco agreed to sign PPAs with a group of energy purchasers, selling approximately 70% of its energy surplus. The PPAs, with the duration of 15 years, will be signed by April, 2006.

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

The conclusion is that CDM incentives play an important role in overcoming financial barriers.

Usina São Francisco Cogeneration 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.

Institutional Barrier

As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created to try to organize and to provide incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period, electricity prices surpassed R$ 600/MWh (around USD 200/MWh) and the forecasted marginal price of the new energy reached levels of R$ 120 – 150/MWh (around USD 40). In the middle of 2004, the average price was bellow R$ 50/MWh (less than USD 20/MWh). This relatively high volatility of the electricity price in Brazil, although in the short term, contributes to difficult the analysis of the market by the developers.

Cultural Barrier

The history of the sugarcane industry has demonstrated that the industry is a traditional and 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. But there is a cultural barrier, which is a considerable obstacle: the generation of electricity to sell to the grid and the electricity negotiation in the energy market is something relatively new to this industry. That can be in part overcome with the Clean Development Mechanism.

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

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

Step 4. Common Practice Analysis

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

Some sugar mills have optimized their power plants in order to export electricity; but numerous risks and barriers have prevented the implementation of the proposed project activity among the majority of the sugar mills. In the Midwest Region, less than 20% of the mills have developed expansion programs for their power plants.

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

One of the points to be considered when analyzing a renewable energy project investment in Brazil is the possibility to participate in the Proinfa from the Federal Government, which is considered one of the more viable financing alternatives for these projects and provides long-term PPAs and special financing conditions. The participation on the Proinfa does not interfere on the MDL participation, because the Brazilian government has endorsed that the projects under the Proinfa will also be eligible to participate in the CDM, in accordance with the decision of the UNFCCC about eligibility of projects derived from public policies.

Both processes of negotiating a PPA with utility companies and obtaining funding from BNDES have been very cumbersome. . The developers perceive BNDES requiring excessive guarantees in order to provide financing. Although this might be the Bank role as a financing institution to mitigate risk, it is understood as a market barrier. Other risks and barriers are related to the operational and technical issues associated with small cogeneration projects, including their capability to comply with the PPA contract and the potential non-performance penalties. Moreover, traditional sugar producers would prefer concentrating investments on their traditional business (sugar and ethanol) than venturing in new projects with new risks and low returns (see Investment Barrier) where they have little or no know-how.

Regardless of the risks and barriers mentioned above, the main reason for the reduced number of similar project activities is the economic cost. Project feasibility requires a PPA contract with a utility company, but utilities do not have the incentives or motivation to buy electricity generated by small cogeneration projects.

The power sector suffered with more than one year (2003-2004) without regulation, and even today the legislation is not clear yet for all the investors and players. The prevailing business practice in Brazil, as far as obtaining financing and financial guarantees to the projects, is a barrier to investment in renewable energy projects. The access of long-term funding for renewable energy projects is difficult, mainly because of the guarantees needed and the lack of a real project finance structure. The high cost of capital in Brazil is a barrier for projects to be developed.

Because of reasons mentioned above, less than 20% of the sugar mills in the Midwest region have developed similar activities to that of Usina São Francisco, and some of the new projects have taken into consideration CDM in their decision to expand their cogeneration plant.

Step 5. Impact of CDM Registration

The sugarcane plantation is part of the country's colonization period. The commercialization of sugarcane has become part of the Brazilian culture was introduced during the 16th century when the Portuguese colonized the country. Brazil became the first producer and exporter of sugar in the world. Since then, sugarcane has been an important part of the Brazilian agricultural industry.

Currently in Brazil there are more than 5 million hectares of land producing sugarcane and there are more than 320 sugar mills producing sugar, ethanol and electricity to supply their own energy consumption. Consequently the potential to generate electricity for commercialization (exporting to the grid), is estimated at around 6-8 GW in the short term and 15-22 GW in the long term. In 2003, only 619 MW were generated for commercialization[6]. 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

[6] http://www.portalunica.com.br (Union of the Sugar Industry in São Paulo)

only occurred since 2000. Although a flexible legislation allowing independent energy producers has existed since 1995, it was only after 2000 that sugar producers started to study this proposed project activity as an investment alternative for their power plants in conjunction with the introduction of the CDM.

The CDM has made it possible for mills to set up their cogeneration plants and export excess electricity to the grid by helping to overcome financial barriers through the financial benefits obtained from CDM revenues. Additionally, CDM has helped to overcome institutional and cultural barriers since the CDM has made the project sponsors take more seriously into consideration the generation of renewable electricity.

Therefore, the registration of the proposed project activity will have a strong impact in paving the way for similar projects to be implemented in Brazil, which may bring about among other things development in technologies.

This kind of activity will be encouraged once this project activity gets registered.

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

The project boundaries are defined by the emissions targeted or directly affected by the project activities, construction and operation. It encompasses the physical, geographical site of the bagasse power generation source, which is represented by the sugarcane mills, the sugarcane plantation that supplies biomass to the mill, the region located close to the power plants facilities and the interconnected grid. Please refer to Figure 12 to understand the project boundary and the activities included in it.

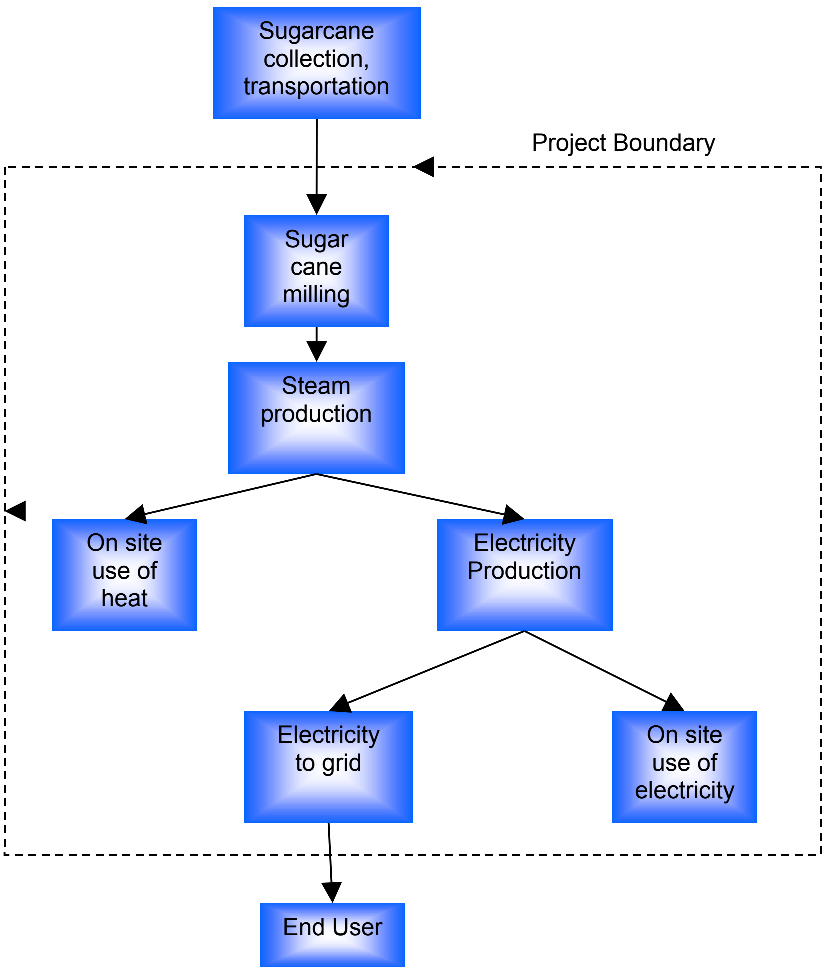

Figure 12 – Usina São Francisco Cogeneration Project Boundary

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

- Northeast: The electricity for this region is basically supplied by the São Francisco River. There are seven hydro power plants at the river with total installed capacity around 10.5 GW.
- South/Southeast/Midwest: The majority of the electricity generated in the country is concentrated in this subsystem. These regions also concentrate 70% of the GDP generation in Brazil. There are more than 50 hydro power plants generating electricity for this subsystem.
- North: 80% of the Northern region is supplied by diesel. However, in the city of Belém, capital of the state of Pará where the mining and aluminum industries are located, electricity is supplied by Tucuruí, the second biggest hydro plant in Brazil.

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

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

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

The baseline study was conducted according to approved methodology ACM0006 – "Consolidated baseline methodology for grid-connected electricity generation from biomass residues".

Date of completing the final draft of this baseline section (DD/MM/YYYY): 26/05/2006.

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Ecoinvest is the Project Advisor and also a Project Participant.

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): 01/07/2006.

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:

(DD/MM/YYYY): 01/07/2006.

C.2.1.2. Length of the first crediting period:

7y-0m.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

Approved monitoring methodology ACM0006 – Consolidated baseline methodology for grid-connected electricity generation from biomass residues, May 19th, 2006, version 3.

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

The chosen monitoring methodology is applicable to biomass-based cogeneration projects connected to the grid. The methodology considers monitoring emission reductions generated from cogeneration projects using sugarcane bagasse as fuel. This fits perfectly the operation at Usina São Francisco Cogeneration project, so the choice of methodology is justified.

The applicability conditions expressed in the monitoring methodology are identical to those of the ACM0006 baseline methodology. Such conditions are met by the Usina São Francisco project as described in Section B.2 of this document.

The main data to be considered in determining the emissions reductions is the electricity exported to the grid. The emissions reduction is reached by applying an emission factor through the electricity dispatched to the grid, which is verified and monitored by the power plant that sells the electricity.

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

The project emissions (*PE_y*) are zero.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Bagasse cogeneration is considered a clean technology. Therefore, the project's emissions (PEy) are zero and no formulas for calculation of direct emissions are necessary.

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

ID number (Please use numbers to ease cross-referencing to table D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	Comment
1. EGy	Electricity supplied to the grid by the project	Readings of the energy metering connected to the grid and Receipt of sales	MWh	(m)	15-minutes-measurement and monthly recording	100%	Electronic and paper.	The electricity delivered to the grid is monitored by the Project by receipt of sales. Data shall be archived for 2 years following the end of the crediting period.

2. EFy	Emission Factor	Calculated	tCO2/MWh	(c)	At the validation	0%	Electronic	Data is available under request. Factors were calculated according to the Approved monitoring methodology ACM0006
3. EFom,y	Emission factor	Calculated	tCO2/MWh	(c)	At the validation	0%	Electronic	Data is available under request. Factors were calculated according to the Approved monitoring methodology ACM0006
4. EFBM,y	Emission factor	Calculated	tCO2/MWh	(c)	At the validation	0%	Electronic	Data is available under request. Factors were calculated according to the Approved monitoring methodology ACM0006
5. λy	Fraction of time during which low-cost/must-run sources are on the margin	Calculated	Non dimensional	(c)	At the validation	0%	Electronic	Data is available under request. Factors were calculated according to the Approved monitoring methodology ACM0006

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

For the generation of electricity using bagasse, the chosen scenario is #4 "Greenfield Power Project". Under this scenario, emissions reductions are only calculated from the displacement of electricity from the grid.

According to the selected approved methodology (ACM0002), the baseline emission factor is calculated as (EF_y) as a combined margin (*CM*), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, the project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly the connected electricity system is defined as that electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

From ACM0002, a baseline emission factor (EF_y) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to the following three steps:

- **STEP 1** - Calculate the operating margin emission factor(s).

$$EF_{OM,simple-adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$ **Equation 10**

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

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}}$$ **Equation 11**

- **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 12**

Where the weights are by w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{OM} = 0.5$).
A more detailed description of the formulae used to estimate baseline emissions can be seen in Section B.2.

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

Not applicable.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Not applicable.

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

Not applicable.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

No leakages were identified for this project. Table D.2.3.1 above remains in blank.

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

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

$$ER_y = ER_{electricity,y} + ER_{heat,y} - PE_y - L_y$$ **Equation 13**

Where the baseline emissions are the product of the electricity supplied by the project to the grid (EG_y in *MWh*) times the baseline emission factor (EF_y in tCO_2e/MWh), since $ER_{heat,y} = 0$ (see section B.2), as follows:

$$ER_y = ER_{electricity,y} = EG_y \cdot EF_y$$ **Equation 14**

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

$$PE_y = PES_y + PEFF_y = 0$$ **Equation 15**

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

$$L_y = 0$$ **Equation 16**

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

Data *(Indicate table and ID number e.g. 3.1; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	Low	Data is being monitored by Usina São Francisco
2	Low	Data acquired from ONS and ANEEL and does not need to be monitored.
3	Low	Data acquired from ONS and ANEEL and does not need to be monitored.
4	Low	Data acquired from ONS and ANEEL and does not need to be monitored.
5	Low	Data acquired from ONS and ANEEL and does not need to be monitored.

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

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

The project owner will continuously measure the energy delivered to the grid.

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

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Ecoinvest is the Project Advisor and also a Project Participant.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

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

$$PE_y = 0$$ **Equation 17**

E.2. Estimated leakage:

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

$$L_y = 0$$ **Equation 18**

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

$$PE_y + L_y = 0 \; tCO_2e$$ **Equation 19**

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

The baseline emissions are proportional to the electricity delivered to the grid throughout the project's lifetime. Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor with the electricity generation of the project activity.

$$ER_{electricity,y} = EF_y \times EG_y$$ **Equation 20**

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

$$ER_{electricity,y} = 0.2647 \times EG_y$$ **Equation 21**

Years	Energy (MWh) EGy
Total 2006 (starting on July 1)	7,032
Total 2007	55,076
Total 2008	76,454
Total 2009	144,441
Total 2010	186,677
Total 2011	215,401
Total 2012	215,401
Total 2013 (until June 30)	107,701

Table 4 – Usina São Francisco – Net electricity generation of the project activity

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

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

$$ER_y = Erelectricity_{,y} + Erheat_{,y} – PE_y – L_y = 0.2647 \times EG_y + 0 – 0 – 0 \quad \textbf{Equation 22}$$

In scenario 4, EG_y corresponds to the net quantity of electricity annual generation as a result of the project activity (see table 4 above). For this project, as seen above (equations 17 and 18), PE_y=0, L_y =0. And, as seen in B.2, $Er_{heat,y}$=0. We conclude that ER_y = Erelectricity,y=0.2647 X Eg_y.

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

The full implementation of the Usina São Francisco project connected to the Brazilian South-Southeast-Midwest electricity interconnected grid will avoid an average estimated yearly emission of around 38,124 tCO_2e, and a total reduction of about 266,866 tCO_2e over the first 7 years crediting period (up to and including 2013, see Table 5):

Years	Estimation of project activity emissions reductions (tonnes of CO_2e)	Estimation of baseline emissions reductions (Er_y) (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emissions reductions (tonnes of CO_2e)
Year 1 (2006) (starting on July 1)	0	1,861	0	1,861
Year 2 (2007)	0	14,579	0	14,579
Year 3 (2008)	0	20,237	0	20,237
Year 4 (2009)	0	38,234	0	38,234
Year 5 (2010)	0	49,413	0	49,413
Year 6 (2011)	0	57,017	0	57,017
Year 7 (2012)	0	57,017	0	57,017
Year 8 (2013) (until June 30)	0	28,508	0	28,508
Total (tonnes of CO_2e)	0	266,866	0	266,866

Table 5 – Yearly estimated emission reductions of the Usina São Francisco Project

SECTION F. Environmental impacts

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

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

As the Usina São Francisco project is a power plant construction based on energy efficiency, the fast-track procedure can be used (Preparation of a Preliminary Environmental Report – “Relatório

Ambiental Preliminar," RAP). The process has been completed and a report containing an investigation of the following aspects has been produced:

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

In Brazil, the sponsor of a project 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.).

(i)The Usina São Francisco has the authorization issued by ANEEL to operate as an independent power producer (*ANEEL Resolution 359 of 14/11/2005)*. Moreover, the power plant has the licenses emitted by *Agência Ambiental do Estado de Goiás*, the environmental agency of the state of Goiás (*Construction License – nº 369/2005*).

In 2009, it is predicted the conclusion of the expansion that will result in 80 MW of total installed power. At this time, the developer commits to attend all the legal requirements applicable.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

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

SECTION G. Stakeholders' comments

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

Public discussion with local stakeholders is compulsory for obtaining the environmental construction and operating licenses, and once the project already received the licenses, the project has consequently gone through a stakeholder comments process. The legislation also requests the announcement of the issuance of the licenses (LP, LI and LO) in the 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 (copies of these invitations under request) 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 Quirinópolis* (Quirinópolis City Hall)
- Câmara Municipal de Quirinópolis (Municipal Assembly of Quirinópolis)
- *Agência Ambiental de Goiás* (Environmental Agency of the State of Goiás)
- *Ministério Público do Estado de Goiás* (State Attorney for the Rights of Citizens of the State of Goiás)
- *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)
- *Secretaria do Meio Ambiente de Quirinópolis* (Environmental Agency of Quirinópolis)
- *Sindicato Rural de Quirinópolis* (Rural Workers' Union of Quirinópolis)

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

G.2. Summary of the comments received:

No comments were received.

G.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 São Francisco obtained Construction License following the requests made by *Agência Ambiental do Estado de Goiás*, the state environmental agency.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Represented by:	
Title:	Director
Salutation:	Mr.
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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

INFORMATION REGARDING BASELINE

Years	Total installed capacity (MW)	Capacity factor of boilers	Electric generation (MW)	Installed Capacity (MW) to internal use	Installed Capacity (MW) to export to the grid	Capacity Factor %	Hours of operation during the year	MWh year exported to the grid
Year 1_2006	40	25%	10.11	6.56	3.55	84%	2,360	7,032
Year 2_2007	40	68%	27.23	8.58	18.65	84%	3,516	55,076
Year 3_2008	40	69%	27.55	8.68	18.87	84%	4,824	76,454
Year 4_2009	80	65%	51.56	12.04	39.52	84%	4,351	144,441
Year 5_2010	80	81%	64.85	13.69	51.16	84%	4,344	186,677
Year 6_2011	80	89%	70.98	14.36	56.62	84%	4,529	215,401
Year 7_2012	80	89%	70.98	14.36	56.62	84%	4,529	215,401
Year 8_2013	80	89%	70.98	14.36	56.62	84%	4,529	107,701

Table 6 – Usina São Francisco – 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."

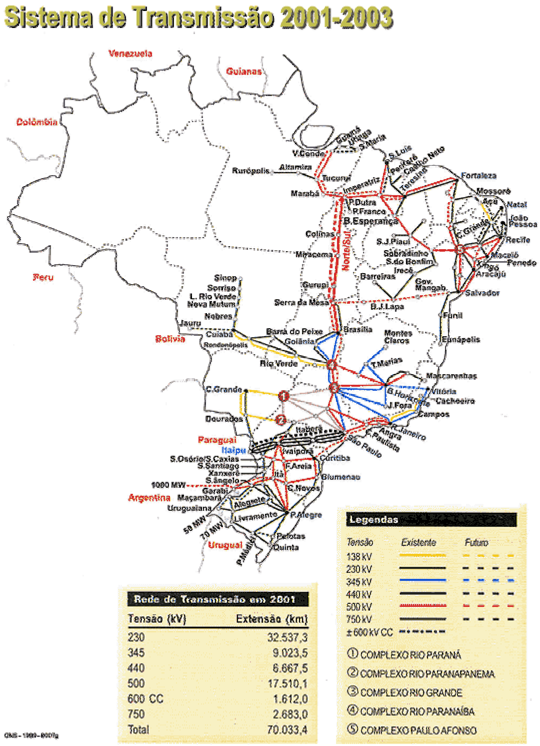

Figure 13 - Brazilian Interconnected System (Source: ONS)

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 7).

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

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

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

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	**EF_{OM} [tCO2/MWh]**	**Load [MWh]**	**LCMR [GWh]**	**Imports [MWh]**
2002	0,8548	275.402.896	258.720	1.607.395
2003	0,9421	288.493.929	274.649	459.586
2004	0,8763	297.879.874	284.748	1.468.275
	Total (2002-2004) =	**861.776.699**	**818.118**	**3.535.256**
	$EF_{OM, simple-adjusted}$ [tCO2/MWh]	**$EF_{BM,2004}$**	**Lambda**	
	0,4332	0,0962	λ_{2002}	
	Alternative weights	**Default weights**	0,5053	
	w_{OM} = 0,75	w_{OM} = 0,5	λ_{2003}	
	w_{BM} = 0,25	w_{BM} = 0,5	0,5312	
	Alternative EF_{CM} [tCO2/MWh]	**Default EF_{OM} [tCO2/MWh]**	λ_{2004}	
	0,3490	**0,2647**	0,5041	

Table 8 – Emission factors for the Brazilian South-Southeast-Midwest interconnected grid (simple adjusted operating margin factor)

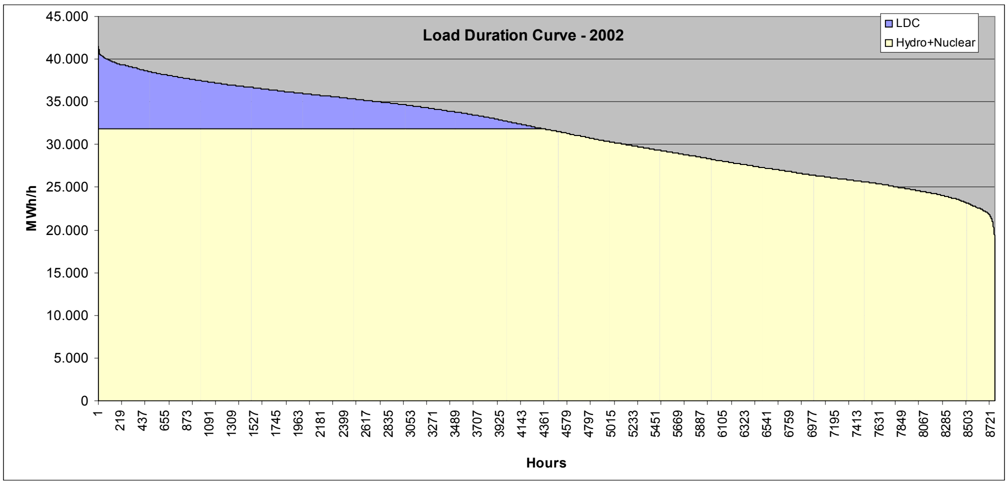

Figure 14 - Load duration curve for the S-SE-CO system, 2002

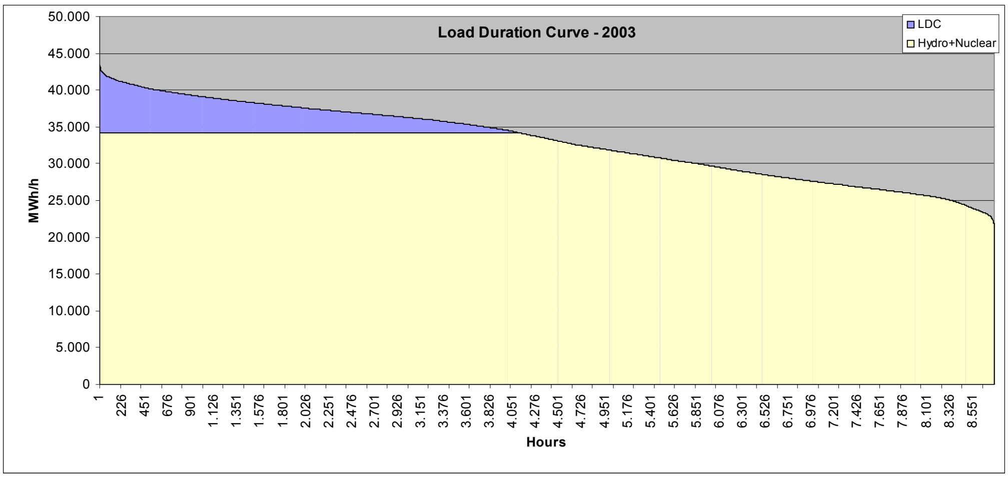

Figure 15 - Load duration curve for the S-SE-CO system, 2003

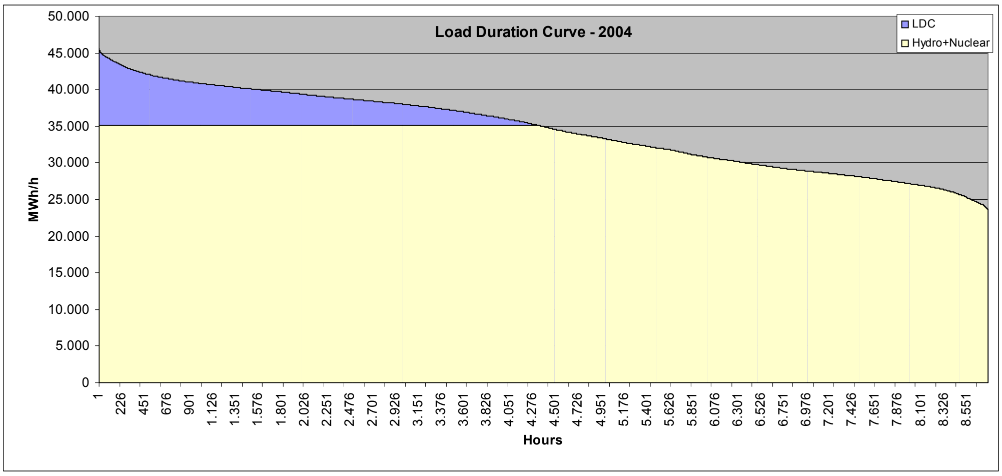

Figure 16 – Load duration curve for the S-SE-CO system, 2004

	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.

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Table 9 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 1

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

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

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

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

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

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Table 10 – Power plants database for the Brazilian South-Southeast-Midwest interconnected grid, part 2

Annex 4

MONITORING PLAN

As per the procedures set by the Approved monitoring methodology ACM0006 - Monitoring methodology for emissions reductions from grid connected bagasse cogeneration projects.

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

The calibration of instruments will be done according to the internal procedures of Usina São Francisco and the regulations of CCEE.

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 reliability of this monitoring parameter is assured through second-party verification of the amount of electricity sold by Usina São Francisco. The electricity baseline emission factor is determined ex-ante and will only be updated at renewal of the crediting period. The recording frequency of the data is appropriate for the project.

Usina São Francisco are 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 monitoring plan is straightforward and no specific procedures beyond the established QA/QC procedures will be necessary. The established procedures reflect good monitoring and reporting practices. The maintenance and installation.of monitoring equipment will be done according to the internal procedures of Usina São Francisco.

Usina São Francisco will monitor the emission of SOx, NOx and CO and the production of solid residues at the combustion of bagasse in the boilers, following the CONAMA resolutions 005/89, 003/90 and 008/90.

Usina São Francisco will also monitor environmental aspects, such as water quality, erosion, noise level. Project "Margem Verde", a reforestation programm, has already planted 70,000 trees, and its maintenaince will be monitored.

There will be also monitoring of Social Programmes, such as the "Usina do Saber" project, which selects deprived children and offers transportation to the schools with headquarters in the residential area of the company. The health of their workers will also be monitored periodically.

Annex 5

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