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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Fundão-Santa Clara Energetic Complex Project (FSCECP)
Version 4
07/07/2011

A.2. Description of the project activity:

The FSCECP consists of a hydroelectric complex, composed by Fundão and Santa Clara Hydroelectric power plants, both located in Jordão River, state of Paraná. The Fundão Hydroelectric power plant is composed of one small scale and other large scale power plants. The Santa Clara Hydroelectric power plant is composed of one small scale and other large scale power plants. The FSCECP is connected to the interconnected S-SE-CO subsystem through three 138 KV transmission lines.

With the implementation of this project, Elejor – Centrais Elétricas do Rio Jordão is able to sell electricity to the Brazilian South-Southeast-Midwest grid, avoiding the dispatch of energy of fossil-fuelled power plants. By that, the initiative avoids CO_2 emissions, also contributing to the regional and national sustainable development.

Elejor is a partnership established between COPEL - Companhia Paranaense de Energia (Energy Company of Parana State) and Paineira Participações S.A.with the objective to implement and operate the FSCECP.

On October 2nd, 2000, COPEL, issued an internal memorandum (Circular – 056/2000), which clearly states the intention of the company for collecting information about the Kyoto Protocol and the CDM, through the creation of a working group, in order to prospect opportunities inside the entire company for developing CDM projects. As Elejor was officially incorporated to COPEL on July 9th, 2001, the CDM initiative was mutually considered and applied by Elejor and COPEL.

A detailed timeline of the consideration and implementation of the project activity is shown below:

Timeline	Date (DD/MM/AAAA)
Date on which decisions were taken to proceed with the investments in FSCECP	17/04/2001
Auction 2/2001 - ANEEL	26/06/2001
Contract of Concession 125/2001 - ANEEL	25/10/2001
PPA UHE Santa Clara/Fundão x Copel (signature)	25/10/2001
Initial Environmental Project - concluded	21/12/2001
UHE/PCH Santa Clara	
Installation License UHE Santa Clara	20/06/2002

Service order UHE/PCH Santa Clara	29/11/2002
Date on which construction commenced UHE/PCH Santa Clara	01/12/2002
First measurement of the construction UHE/PCH Santa Clara	31/12/2002
Previous License PCH Santa Clara	03/05/2004
Installation License PCH Santa Clara	06/05/2004
Installation License UHE Santa Clara - renewed	18/06/2004
Start of commissioning UHE Santa Clara	03/03/2005
Operation License PCH Santa Clara	12/04/2005
Operation License UHE Santa Clara	12/04/2005
Start of commissioning PCH Santa Clara	25/05/2005
Start of operation PCH Santa Clara	14/07/2005
Start of operation UHE Santa Clara	16/07/2005
End of commissioning PCH Santa Clara	27/07/2005
Start of commercialization UHE Santa Clara	31/07/2005
Start of commercialization PCH Santa Clara	13/08/2005
End of commissioning UHE Santa Clara[1]	31/08/2005
PPA PCH Santa Clara x Sadia (signature)	29/11/2005
UHE/PCH Fundão	
Installation License UHE Fundão	20/06/2002
Service order UHE/PCH Fundão	01/03/2004
Date on which construction commenced UHE/PCH Fundão	01/04/2004
First measurement of the construction UHE/PCH Fundão	30/04/2004
Previous License PCH Fundão	03/05/2004
Installation License PCH Fundão	06/05/2004
Installation License UHE Fundão - renewed	18/06/2004
Start of commissioning UHE Fundão	03/02/2006
Operation License PCH Fundão	31/03/2006
Operation License UHE Fundão	31/03/2006
Start of operation UHE Fundão	08/06/2006
End of commissioning UHE Fundão	08/06/2006
Start of commercialization UHE Fundão	23/06/2006
Start of commissioning PCH Fundão	13/09/2006
PPA PCH Fundão x Comerc (signature)	29/09/2006
End of commissioning PCH Fundão	16/11/2006
Start of operation PCH Fundão	17/11/2006
Start of commercialization PCH Fundão	29/12/2006

[1] The turbo generators of UHE Santa Clara entered in operation in different moments, that explains why the start of commissioning is after the start of operation of this plant.

The sponsors of the FSCECP are convinced that hydroelectricity is a sustainable source of energy that brings advantages for mitigating global warming. Using the available natural resources, the FSCECP helps to enhance the consumption of renewable energy. The sale of the CER generated by the project will boost the attractiveness of hydroelectric projects, helping to increase the production of this energy and decrease dependency on fossil fuel.

Furthermore, hydroelectricity also plays an important role on the country's economic development, as this kind of project provides for approximately 10 000 jobs during the construction of reservoirs and dams, construction of new cities in replacement of the projected to be flooded and construction of transmission lines. The Brazilian heavy industry has developed the technology to supply the hydroelectricity projects with equipment to provide the production of high levels of electricity, therefore such heavy industry development also helps the country to create jobs and achieve sustainable development.

Other activities which correspond to the company social and environmental responsibilities are described below:

a) Contribution to the local environmental sustainability:
The construction, installation and certification of FSCECP (two small scale hydro plants and two large scale hydro plants) demand the company to follow strict control of the environmental impacts, bringing direct environmental benefits. One example is the implementation of actions of a document ("Plan of Use and Occupation of Water and Frontiers of Santa Clara Hydro Power Plant's Reservoir" and "Plan of Use and Occupation of Water and Frontiers of Fundão Hydro Power Plant's Reservoir"), developed to establish criteria and parameters to guide the activities and forms of use that could be implemented in the reservoirs and its frontiers. Moreover, the operation of the project itself improves the environmental conditions, once the use of renewable energy sources lower the use of non-renewable ones.

b) Contribution to the improvement of working conditions and employment creation:
Elejor, through Consórcio Construtor Complexo Jordão – CCCJ – hired more than 1.500 employees only during the construction. After the complex's construction, Elejor will need a specialized and dedicated work force for installation, operation and maintenance of the plant. Hence, FSCECP operation contributes not only for direct employment generation, but also for indirect employment, being those mainly from the technology field, as in research and development, as in the production and maintenance of equipments.

c) Contribution to income distribution:
The FSCECP implementation creates an income option through the electricity sale in addition to CERs revenue, ensuring a higher financial and energetic sustainability. New job positions were created during the complex's construction. As workers in the nearby cities live from a local agriculture and are usually low qualified, the project will contribute to income distribution through the creation of employment conditions with better salaries.

e) Contribution to regional integration and cooperation with other sectors:
Elejor used the local potentialities to attend the project's needs, as supply of food, fuel, transportation, security, materials, simple and specialized labor, commercialization of local forest products, rental of equipments and the construction and donation of a bridge to the counties around the project.

Elejor also invested financial resources on environmental education and communication in partnership with local educational network and technical and social assistance to the families removed due to the construction of the reservoir.

An effort among Elejor and the companies involved to execute the Environmental Programs allowed the total application of the company's Environmental Policy, with strong scientific advances to preserve the local fauna and flora, interacting with federal and state research institutions.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Elejor – Centrais Elétricas do Rio Jordão (private and public entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil

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

Paraná

A.4.1.3. City/Town/Community etc:

Candói, Foz do Jordão e Pinhão

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

FSCECP is located in Jordão River at the following coordinates: 25º42' S; 52º00' W.

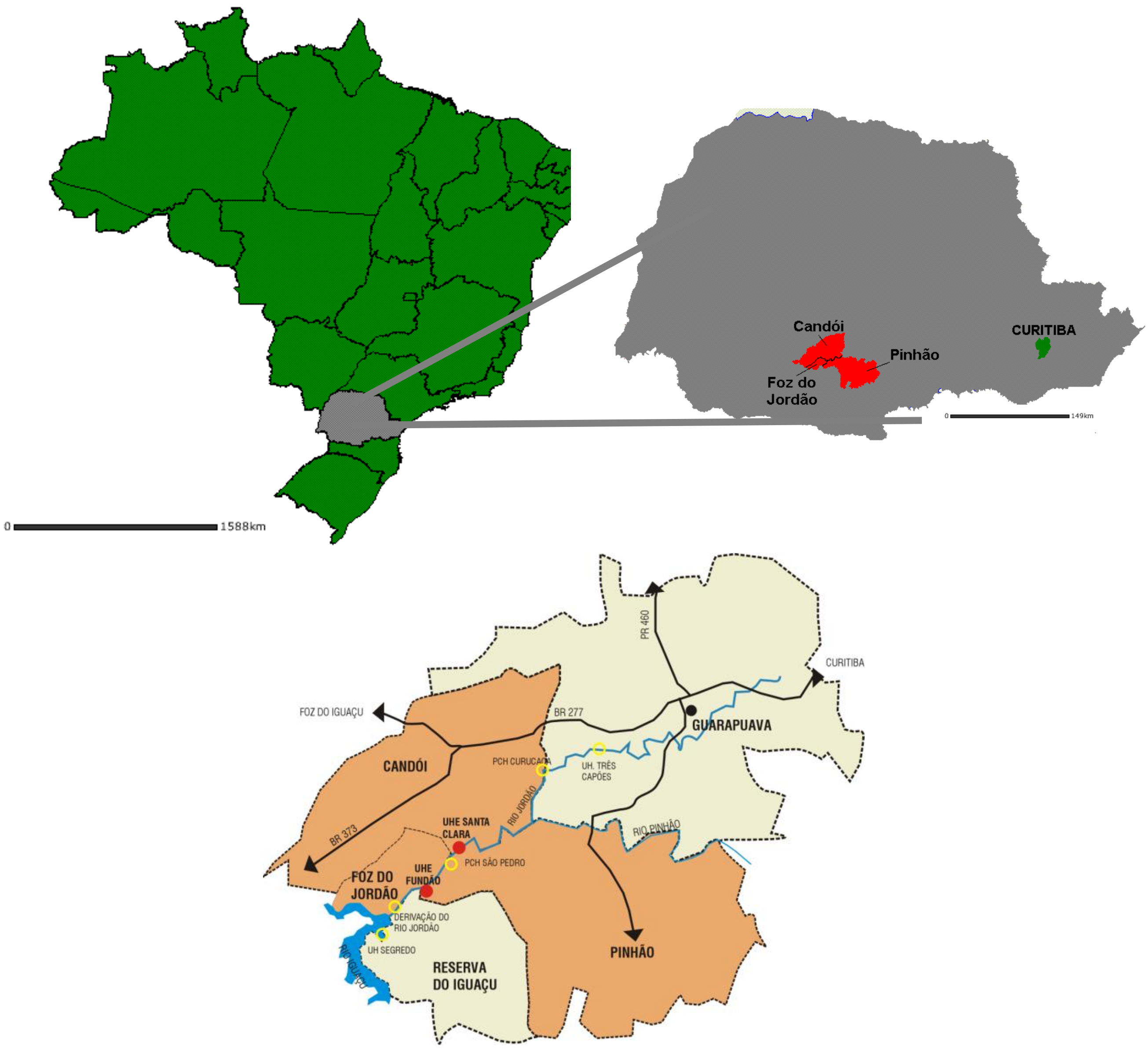

Figure 1. Geographical position of UHE Fundão and UHE Santa Clara

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

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

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

The electricity may be produced from different sources, but the more efficient is de hydraulic, whose efficiency is above 90%. Other advantages are: it does not pollute, it is renewable and allows, through the dams, the control of the river flow, minimizing the flooding effects.

The production of electricity is possible using an unevenness accent on a river, what allows the use of energy associated with the waterfalls and the volume of water that will be stored in the reservoir. The implementation of a power plant on a river evolves the construction of a dam to form a water reservoir, the powerhouse, substation and the transmission lines.

There are two main structures on a dam:

- the penstock: a structure where the water flows to the inside of the powerhouse, through the forced pipes to spin the turbines;
- spillway: a structure where the surplus water flows during intense rainfalls.

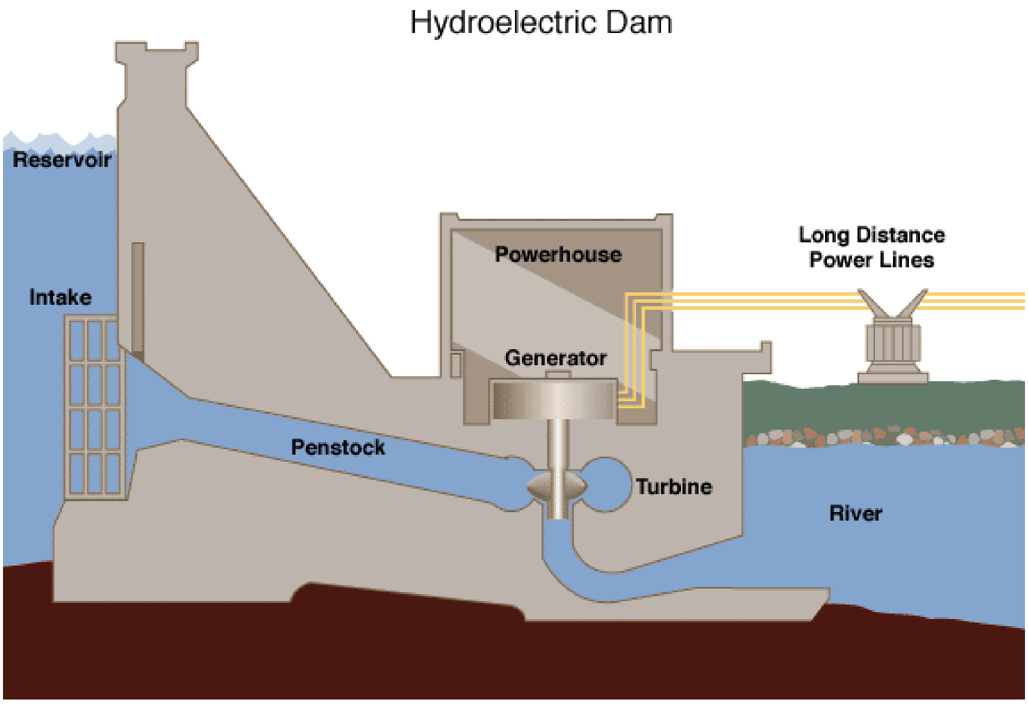

Figure 2. Schematic illustration of a Hydroelectric Power Plant.

Source: NationMaster.com; Available at <**http://www.nationmaster.com/encyclopedia/Image:Hydroelectric-dam.png**>, accessed on November 17th, 2005.

The FSCECP is a two phase project, consisted of construction of two dams, to produce electricity in two different sites.

Phase 1 (2005): the start of operation of the Santa Clara Complex, composed by a Large scale Hydro Power Plant – UHE Santa Clara (120.168 MW) and a Small scale Hydro Power Plant – PCH Santa Clara (3.6 MW);
Phase 2 (2006): the start of operation of the Fundão Complex, composed by a Small scale Hydro Power Plant – PCH Fundão (2.475 MW) and a Large scale Hydro Power Plant – UHE Fundão (120.168 MW).

The four power plants will be able to export about 1,229,000 MWh/year to the national grid. The PCH Fundão and PCH Santa Clara were built at the UHE Fundão and UHE Santa Clara structures respectively, using part of the sanitary flow of each facility to generate electricity.

The Table 1 shows when and which equipments FSCECP will operate:

Table 1: FSCECP Technical Data

	Active
Phase 1 **2005**	One 3.6 MW[2] turbo-generator (PCH Santa Clara)
	Two 60.084 MW[2] turbo-generators (UHE Santa Clara)
Phase 2 **2006**	One 2.475 MW[2] turbo-generator (PCH Fundão)
	Two 60.084[2] MW turbo-generators (UHE Fundão)

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

Years	**Annual estimation of emission reductions in tonnes of CO_2e**
2007 [1]	66,396
2008	265,585
2009	265,585
2010	265,585
2011	265,585
2012	265,585
2013	265,585
2014 [2]	199,189
Total estimated reductions (tonnes of CO_2e)	**1,859,094**
Total Number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**265,584**

[1] the estimative considers from 01/10/2007 to 31/12/2007
[2] the estimative considers from 01/01/2014 to 30/09/2014

A.4.5. Public funding of the project activity:

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

SECTION B. Application of a baseline and monitoring methodology

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

- Version 06 of ACM0002 (19/05/2006) "Consolidated baseline methodology for grid-connected electricity generation from renewable sources";
- Version 03 of the "Tool for the demonstration and assessment of additionality".

[2] As per paragraph 4a of EB59, Annex 9, the determination of the rated/installed capacity was based on the installed/rated capacity of generator.

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

The ACM0002 – version 6 applies to the project activity for the following reasons:

- The FSCECP comprises the construction of the new Santa Clara Hydroelectric power plant and the new Fundão Hydroelectric power plant;
- Both reservoirs (Santa Clara's reservoir and Fundão's reservoir) have power densities (installed power generation capacity divided by the surface area at full reservoir level) greater than 4 W/m^2. The power density of Fundão Complex is higher than 10 W/m^2 (122.643 MW of installed capacity and a flooded area of 2.15 km^2 = 57.04 W/m^2) and the power density of Santa Clara Complex is between 4 and 10 (123.768 MW of installed capacity and a flooded area of 20.14 km^2 = 6.14 W/m^2);
- It's not a fossil fuel switching project;
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available.

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

	Source	Gas	Included?	Justification / Explanation
Baseline	Grid Electricity generation	CO_2	Yes	Project participants shall only account CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to the project activities.
		CH_4	No	
		N_2O	No	
Project Activity	Emissions from the reservoir of Santa Clara power plant	CO_2	Yes	Project emissions shall be considered for Santa Clara's reservoir, as its power density is between 4 and 10 W/m^2. There are no project emissions to be considered for the reservoir of Fundão, as its power density is greater than 10 W/m^2, as described in section B.2.
		CH_4	No	
		N_2O	No	

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

According to ACM0002 – version 6, the baseline is defined as:

> *"Electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the additional of new generation sources, as reflected in the combined margin (CM)….."*

The FSCECP is a grid-connected renewable power generation project. By dispatching renewable electricity to a grid, electricity that would otherwise be produced using fossil fuel is displaced. This electricity displacement will occur at the system's margin, i.e. this CDM project will displace electricity that is produced by marginal sources (mainly fossil fueled thermal plants) which have higher electricity dispatching costs and are solicited only over the hours that baseload sources (low-cost or must-run sources) cannot supply the grid (due to higher marginal dispatching costs or fuel storage – in case of hydro sources – constraints). The FSCECP does not modify or retrofit an existing generation facility. Therefore, its baseline is defined as it is described in ACM0002 – Version 6.

For this project, the baseline emissions are the emissions related to the energy that would be delivered to the grid without the project. The electric grid has an emission factor, therefore, for the energy that would be delivered, in the absence of the project, would be associated with an emission. Those emissions are the baseline emissions for this project. It's assumed that all the energy delivered to the grid, by the project, would be supplied by the electric grid with an emission associated.

The calculations of the emission factor are explained in section B.6.3. The emission factor is determined *ex-ante*, which means that for its calculation, most recently historical data from previous years was used. In this case the emission factor is calculated with data from the years 2003, 2004 and 2005.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

Application of the Tool for the demonstration and assessment of additionality of FSCECP

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

Sub-step 1a: Define alternatives to the project activity
The following alternatives have been considered:

- The proposed project activity undertaken without being registered as a CDM project activity;
- Continuation of current situation (no project activity or other alternatives undertaken).

Sub-step 1b: Consistency with mandatory laws and regulations
The alternatives comply with all mandatory Brazilian electricity generation legal and regulatory requirements.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method
The project activity generates other financial or economic benefits than CDM related income. Therefore, project participants are opting for the benchmark analysis (Option III).

Sub-step 2b – Option III. Apply benchmark analysis
The most appropriate financial indicator for the decision context is the Project Internal Rate of Return (project IRR). For the investment benchmark analysis the IRR is the main indicator for comparing all the scenarios under the analysis.

The relevant benchmark value considered by Elejor to compare the project IRR has been derived from the minimum required rate of return of the Brazilian electrical sector, which corresponds to 12%.

According to CATAPAN[3], "In the specific case of companies from the Brazilian electric sector, the report RE-SEB (COOPERS & LYBRAND, 1997, p. 2473) [4] suggests that the internal rate return on a real

[3] CATAPAN, Edílson; HEDEMANN, Francisco. "Variáveis essenciais a uma metodologia de cálculo do custo de capital". (Essential variables for a capital cost calcultion methodology). PUC-PR. March, 2002.

basis, after taxes over the invested capital in the sector, shall be the following: 12-15% for power generation; 10-12% for energy transmission; and 11-13% for energy distribution”. This means, in general terms, an average value of 12%, which was the investment IRR threshold value adopted by Elejor.

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and III):

Elejor developed a cash flow analysis for the FSCECP in a transparent manner, including all relevant costs and revenues (excluding CER revenues), in order to calculate the suitable financial indicator.

According to Elejor, the investments made in 2001 were referred to:

Investments in 2001 (R$)	
ELEJOR administration	426,798.58
Environmental multiple programs	60,842.82
EP - Owner engineer	161,639.11
Financial Advisors	99,250.00
Legal Advisors	140,000.00
Feasibility Studies	3,636,121.11
Basic Environmental Project	
Geological studies	
Project - Intertechne	1,631,685.64
TOTAL	**6,156,337.26**

As above, the investments made were in studies and preliminary projects and advisors. When developing large scale projects, it is very common to have this kind of expenditures and is also common have project with various studies but not developed due to high level of bureaucracy and economical uncertainties. In addition, in Brazil, before have a License to Install it is necessary a Preliminary License (representing more expenditures).

The assumptions made for the analysis include capital and operating expenses and the IGPM (the inflation rate).

Elejor received financing from BNDES of USD 120 millions (51% of total investment), with a tax rate of TJLP (long term tax rate) plus 4% per year.

[4] COOPERS&LYBRAND Relatório consolidado etapa VII: projeto de reestruturação do setor elétrico brasileiro – RESEB (relatório principal) - *Consolidated report phase VII: restructuring project of the Brazilian electric sector – RE-SEB (main report).* Brasilia, v. II, December, 1997.

The Cash flow for FSCECP was presented to the Designated Operational Entity with detailed financial calculations. It resulted in an IRR (36 years) of 11.237%.

As can be seen, the project is expected to have a low IRR. According to the Elejor's investment IRR threshold of 12%, this would not be an acceptable project. Based on this criteria, the project cannot be considered as financially attractive.

Sub-step 2d. Sensitivity analysis (only applicable to options II and III):
The following sensitivity analysis was performed for the project:
1. Fluctuation of the total investment's cost (CAPEX)
2. Fluctuation of the project's operating costs (OPEX)
3. Fluctuation of the Brazilian inflation (IGPM)

and the impact on the IRR is presented in the Table 2.

Table 2: IRR analysis outcome for the sensitivity analysis

Factor	Fluctuation	IGPM	IRR
CAPEX/OPEX	-10%	0%	12.060%
CAPEX/OPEX	+10%	0%	10.386%
CAPEX/OPEX	-10%	-10%	12.113%
CAPEX/OPEX	+10%	-10%	10.438%
CAPEX/OPEX	-10%	+10%	12.006%
CAPEX/OPEX	+10%	+10%	10.335%

The only critical parameter that could influence the financial attractiveness would be the inflation rate. The sensitivity study presented considered variation of the inflation rate in a range of +/- 10%. Such variation didn´t generate any big deviation of the IRR, from the basic value defined in the cash flow.

The only elements that are not influenced by regulations are the operation expenses, operation and maintenance costs and the contract of environment. All together represents less than 7% of the gross income (energy commercialization), which is the only controllable expenses.

The electricity market in Brazil is strongly regulated by the government. Elejor has a concession contract with the Brazilian Electricity Regulatory Agency (ANEEL) to explore the hydraulic potential of Jordão River, which considers the plants covered by FSCECP. Such contract is valid for 35 years. The Power Purchase Agreement with energy buyer COPEL states that the energy tariff can only be adjusted with the inflation rate.

The power generation was not considered in the sensitivity analysis because such parameter doesn´t influence the financial attractiveness of the project, as it is fixed in the Power Purchase Agreement (PPA).

As can be seen, based on the project´s sensitive aspects, the project would require a significant reduction in investment price (highly unlikely) or would require a significant increase in yield (also highly unlikely) to be just over the Financial Index requirement of 12%.

Based on the sensitivity analysis, it remains quite unlikely that the project will be able to satisfy its requirements without the assistance of revenue from the CERs. Then, this emphasizes the project activity is unlikely to be the most financially attractive.

Step 3. Barrier analysis

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

Climatic Barriers:

As a renewable source of electricity generation from water storage at dams, the hydroelectricity is clearly dependent on the rainfall levels during the year. As in Brazil the seasons has typical characteristics, the winter has a predominant low rainfall level and the summer has a high rainfall level. Thus, the reservoir level is filled during the summer and consumed during the winter.

At the Brazilian electricity model, the main source of energy is water stored at the reservoirs. In 2001-2002, Brazil faced a huge problem of electricity supply due to the lack of rainfall during 2001 summer that did not fill the reservoirs levels. When winter came, the reservoir's levels did not have enough capacity to supply the electricity demand. The Figure 3 shows what happened with the stored "energy levels" at the reservoirs, during January/1997 and January/2000. It can be seen that the reservoirs, projected to support 5 years of seasons with few rain average levels, almost got into collapse after only one season with rain levels below the average (2000/2001 had 74% of historic average rain level). The result was the interruption of electricity supply in 2001 (known as "apagão" or black-out).

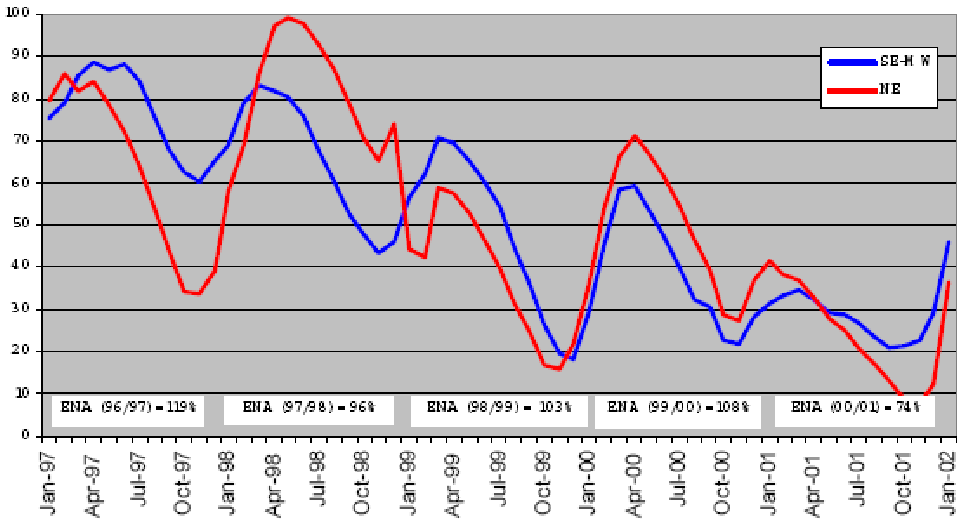

Figure 3. Evolution of stored energy of the SE-CO and NE subsystems and average rain levels – ENA (Source: ONS)

When visiting the project activity site, the Validation Team could confirm that the lack of rain, was a real problem. At that time, both Santa Clara and Fundão Power Plants (120.168 MW from each), weren't generation a single MW due to the lack of a sufficient quantity of water. As Fundão Power Plant is a run-of-river power plant, it depends on the flow that is released from Santa Clara's reservoir (that is additional to the sanitary flow). Therefore, if Santa Clara Power Plant doesn't generate energy, Fundão also won't be able to generate.

It's also important to notice that the fact that Fundão Power Plant generation depends on Santa Clara Power Plants can double the risk of investment. As Fundão Power Plant is not able to store water to guarantee a fixed generation (due to long periods without raining) investors considers the project risky.

Institutional and Political Barriers:
To make a concrete institutional and political barrier analysis, a short vision of the electricity market during the last years is presented.

Up to the beginning of the 90's, the energetic sector was composed almost exclusively by state companies. From 1995 on, due to an increase on international interest taxes and due to the governmental investment deficiency, the solution recommended was the privatization.

The four pillars of the privatization process were:
- built a favorable situation to the competition, with the gradual elimination of the captive client figure. The option of choosing an electric services sponsor, that had began on 1998, and might be available to the whole market on 2006;
- end of the public monopolies, separating and privatizing all the activities of generation, transmission and distribution of electricity;
- free access to the transmission lines; and
- transference of planning and operating responsibilities to the private sector;

Three governmental entities were created: ANEEL (Agência Nacional de Energia Elétrica – National Electric Energy Agency), created to develop the legislation and to rule the market; the ONS (Operador Nacional do Sistema Elétrico – National Electric System Operator) to fiscalize and control the generation, transmission and operation; and the MAE (Mercado Atacadista de Energia Elétrica – Electric Energy Wholesale Market), to define the rules and the commercial procedures of the short period market. By the end of 2000, after 5 years form the privatization process, the results were modest (Figure 4). Despite of the high expectation, the investments on new generation were no followed by the consumption increase.

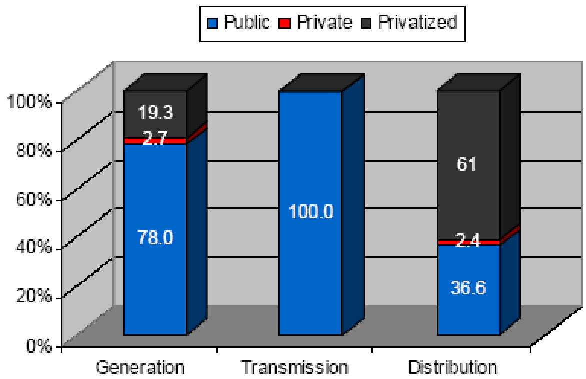

Figure 4. Participation of the private capital on the Brazilian electricity sector on December, 2000

The change of the GDP (Gross Domestic Product) (average increase of 2% during 1980 to 2000) and the increase of the electricity consumption (average increase of 5% during the same period) is well known on developed countries, especially due to the magnifying of the supply services to new areas and infra-structure. They include a generation capacity increase higher that the GDP increase rate, and strong investments on energy efficiency. In the case of Brazil, the increase of the generation installed capacity (average of 4% during the same period) did not follow the consumption's growth, as can be seen on Figure 5.

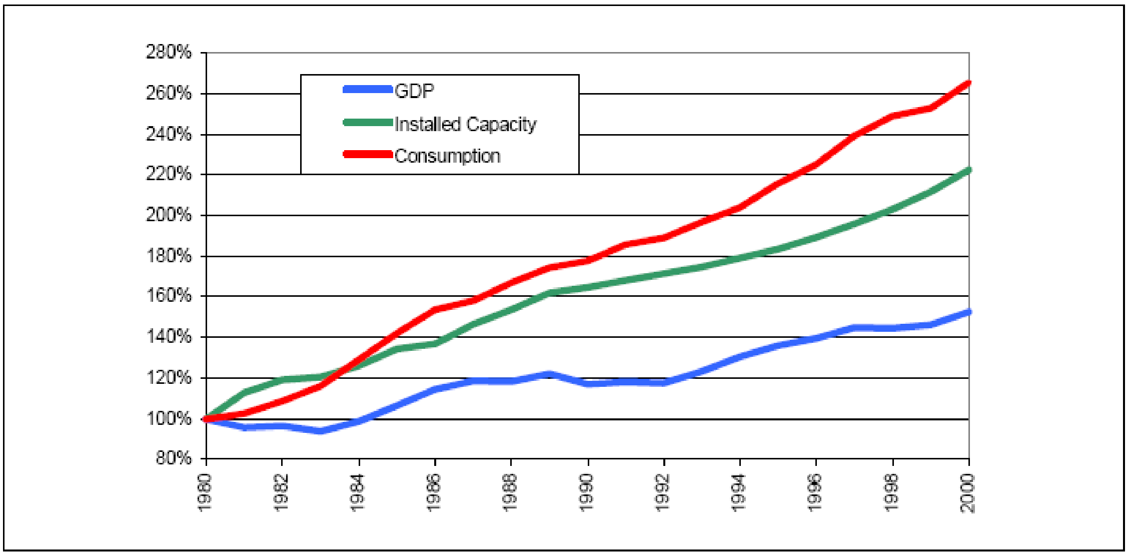

Figure 5. Accumulated GDP variation, installed capacity and consumption (Source: ELETROBRÁS and IBGE)

Without the new installed capacity, the possible alternatives were to improve the energy efficiency or to improve the capacity factor of the power plants. About the energy efficiency, the government created, in 1985, PROCEL – Programa Nacional de Conservação de Energia Elétrica (Brazil's national saving electricity). Despite of program's impressive results, the efficiency reached wasn't high enough. Thus the problem of consumption increased and necessity of new generation capacity persisted. The other alternative (improve the capacity factor of the oldest power plants) was more commonly used.

Conscientious about the difficulties since the final 90's, the Brazilian Government decided that it was strategic important to increase the thermoelectric generation and, consequently, be less dependent on hydroelectricity. The Federal Government signed, in the beginning of 2000, the PPT – Prioritary Thermoelectric Plan, planning, originally, the construction of 47 thermal power plants (using natural gas from Bolivia), achieving 17,500 MW of new installed capacity until December/2003. During 2001 and the beginning of 2002, the plan was reorganized in a way to contemplate 40 power plants and install 13,367 MW until December/2004. In December/2004, 20 power plants were operating, achieving 9,700 MW.

During the interruption of electricity supply of 2001, the government also signed the Emergency Energy Program, with a short-term goal to build 58 mid and small thermal power plants until the end of 2002 (using 76.9% diesel and 21.1% fuel oil), achieving 2,150 MW of energetic capacity (CGE-CBEE, 2002).

It's clear that hydroelectricity is and will be the main source responsible for the electricity production in Brazil. However, most of the hydro resources of the S-SE region were explored and most of the remaining resources are located at the Amazonas Basin, distant from the urban centers and industries (OCDE, 2001). It's also clear that the new adds to the Brazilian electric sector are changing from hydro sources to natural gas sources (Schaeffer et al., 2000). With the discovery of huge reserves of natural gas at Santos Basin in 2003 (Figure 6), the policy to use natural gas to produce electricity is still a possibility and will continue to attract the interest of the private investments at the Brazilian energetic sector.

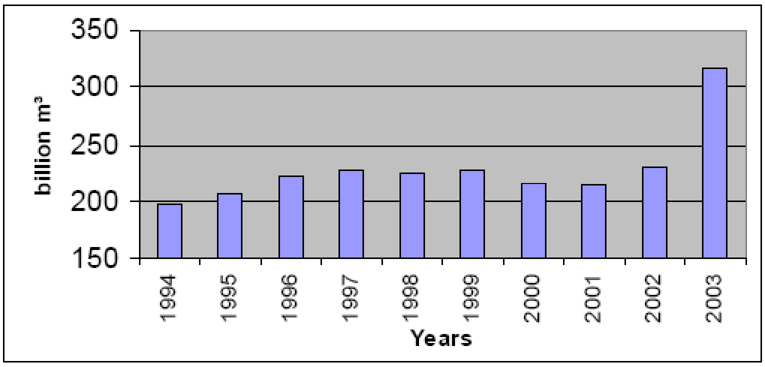

Figure 6. Proved Historical National Reserves of natural gas (Source: Petrobrás)

In 2004, the new government decided to review completely the institutional rules of the electricity market. The Congress approved a new model to the electric sector, in March/2004. The new rules to the electric sector have the following characteristics (OCDE, 2005):

- The demand and the supply of electricity will be coordinated by a pool demand to be estimated by the distribution companies that will have to hire 100% of its electricity projected demand during the 3 to 5 next years. These projections will be evaluated by a new institution denominated Empresa de Planejamento Energético – EPE (Energetic Planning Company), who will estimate the necessary expansion on supply capacity to be sold to the distribution companies through the pool. The electricity price will be negotiated is an average of all long-term hired prices, and will be the same to all distribution companies.

- With the long-term pool's contracts "regulated", there will be a "free" market. Although, in the future, the big consumers (above 10 MW) will have to inform the distribution companies, with a 3 years previous announce if they wish to change from the pool to the free market and a 5 years previous announce to change in the opposite way, a transaction period is visualized when these conditions will be more flexible. If, in the future, the real demand would be higher than the projected, the distribution companies will have to buy electricity at the free market. Otherwise, they will have to sell the surplus electricity at the free market. The distribution companies will be able to transfer to the final consumers the difference between the electricity purchased at the free market and through the pool, if the difference between the projected demand and the real demand stays below 5%. If it stays above this limit, the distribution companies will have to deal with these costs.

- The Government made the option to an institutional configuration more centralized, reinforcing the role of MME – Ministério das Minas e Energia (*Mines and Energy Ministry*) at long-term planning. EPE will present to the MME its portfolio of aimed technologies and a list of strategic and non-strategic projects. MME will present this portfolio to CNEP – Conselho Nacional de Política Energética (*National Council of Energetic Policy*) and, after approval by CNPE, the strategic projects will be auctioned, base on priorities through the pool. The companies may replace the non-strategic projects proposed by EPE, if the proposals would offer the same capacity for a low tariff. Other new institution is CMES – Comitê de Monitoramento do Setor Elétrico (*Electric Sector Monitoring Committee*), in charge of monitoring the tendencies of electricity demand and supply. If problems are identified, CMSE will propose corrective measures to avoid the leak of electricity, as special conditions of price to new projects and the reserve of generation capacity. This Committee will be presided by MME. No other huge privatization is expected at this sector.

Although the new model reduces the market risk, its capacity to incentive the private investment at the electric sector will depend on how the regulatory rules will be implemented. Different challenges are identified:

- The risk of regulatory failure, that might occur due to the significant play of the government on long-term planning, might be avoided against political interference at the new institution;

- Rules during the transition phase might be cleared, to allow the proper return on the actual investors;

- The volatility of prices might increase at the short-term electricity market, occasioning a higher investment risk, although this risk might be softer due to the presence of big consumers. The high hydroelectricity share at the Brazilian sector and the uncertainties about the future rain levels also contribute to a high volatility of the short-term electric market.

- The rules to separate the vertically integrated companies have to be defined, although the new model will force a total separation between generation and distribution. Actually, the distribution companies are allowed to buy up to 30% from its subsidiaries production (self-negotiation).

- Finally, the government's policy to the natural gas sector must be defined inside a specific sectorial structure.

Moreover, the high level of SELIC, the Brazilian Prime Rate (24.90% per year, at the end of 2002), and the high level of guarantees required to finance an energy project – insurance, financial guarantees and financial advisories increase the cost of the project. Also, political insecurities about local elections may cause an elevation on the dollar rate (as it has happened during the last presidential election, in 2002).

Social Barriers:

The construction of the dam caused the flooding of the area of the reservoir and the removal of the population living close to the river course.

In Brazil, the social movement called MAB "Movimento dos Atingidos pelas Barragens" was created to support the population reached by the construction of the reservoir. The movement is against the plans that impose the construction of large dams by the state, private sectors, or international agencies. MAB incentives the fight as a process on which the population join integrally the organization and decide with responsibility the collective future. The main goal of this movement is to fight in favor of these populations and to defend the integrity of the river, fauna and flora and also supports the creation of a new energetic policy. This movement has the sympathy of the other Brazilian social movements.

MAB has an intense activity with the Public Prosecutor's Office and usually sues the construction of the dam, arguing that the local population will lose their lands because of the flooded area and because this population won't have access to the electricity produced by the power plants. In addition, the movement argues that the large hydro-power plants do not bring any environmental benefit.

As an example of MAB's course of action, the office of a company named BAESA – Energética Barra Grande S.A. was invaded by MAB on 15 February 2006. According with BAESA, three people were made hostages. An article about the invasion was published in newspapers, by Mário Menel, Director-president of ABIAPE – Associação Brasileira dos Investidores em Auto-Produção de Energia Elétrica[5].

Elejor had unexpected costs from the environmental programs such as the Fauna and Flora specific monitoring programs, educational programs for the local population (capacitating the teachers from local schools and programs directed to local students) and land acquisition programs.

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

The thermoelectric power plants are not belted by Climatic barriers. They may work along the whole year although they are preferentially dispatched after the hydroelectric units.

According to BEN (Balanço Energético Nacional), the Brazilian energetic balance, the thermoelectric generation, in 2004, has increased 17% while hydroelectric generation has increased only 4.9%[6] in comparison with the year 2003. This shows the feasibility of the construction of new thermoelectric units and that they are in fact a plausible scenario when considering new investments on the energy sector.

In another study from ANEEL (Agência Nacional de Energia Elétrica), the Brazilian National Electric Energy Agency) called "PNE 2030 – Plano Nacional Energético", the long term energetic plan for 2030, it is estimated that Brazil has a potential of 28,000MW for the construction of new thermoelectric power plants. The study also mentions the constructions of 4 thermoelectric power plants that, together, add 1,640 MW (USITESC, Seival, Candiota III and Jacuí)[7].

The construction of thermoelectric new power plants would not face the social barriers that new hydroelectric power plants face, due to the removal of local population that live close to the areas to be flooded.

Furthermore, the construction of a thermoelectric unit in comparison with the construction of a Hydroelectric involves lower investment costs. In summary, the construction of hydroelectric units involves the acquisition of new equipments (turbo generators etc…) and high costs of engineering activities while thermoelectric costs are mainly related to the acquisition of new equipments.

Step 4. Common practice analysis

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

Although the main source of electricity production is made via hydro sources, projects with an installed capacity of more than 200 MW for grid dispatch is not a common practice. Most hydro projects in Brazil have small capacity (ANEEL defines a small-hydro as a hydro power plant with an installed capacity below 30 MW). So, FSCCEP can be considered as the only large hydro project in Brazil which is considering the CDM.

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[5] MENEL, Mário; Truculência e desrespeito às leis do país, published on *O Estado de S. Paulo*, 29 March 2006.

[6] BEN 2005 -Balanço Energético Nacional (Chapter 1: "Análise Energética e Dados Agregados")

[7] PNE 2030 – Plano Nacional Energético para 2030", the Brazilian strategic energetic plan for 2030. The plan has not been concluded already but several meetings have been done. http://www.mme.gov.br/site/menu/select_main_menu_item.do?channelId=8213). Mineral Coal Presentation.

Table 3. Brazilian Capacity Generation[8]

	EOL	PCH	SOL	UHE	UTE	UTN	TOTAL
Operating	12	265	1	155	924	2	**1,359**
Under Construction	3	39		7	15		**64**
Authorized	109	222		22	94		**447**

Legend	
EOL	Wind Power Plant
PCH	Small-Hydro Power Plant
SOL	Solar Photovoltaic Generation Centers
UHE	Hydro Power Plant
UTE	Thermal Power Plant
UTN	Nuclear Power Plant

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

As mentioned previously, from the 148 hydro power plants installed in Brazil, only 46 have installed capacity above 50 MW, and most of these power plants belong to the public sector. So, the initiative of Elejor, a company composed by the public and private sector can't be seen as a sector's common practice.

Step 5. Impact of CDM registration

The frequent political and institutional´s rules changes, for example, the Environmental Licensing Process will be amortized by the expected revenues from CERs.

The climate imposes a significant risk to the project. Every time that the Hydroelectric power plant is not able to generate electric energy, the company isn't able to comply with its PPA (Power Purchase Agreement). If that happens, Elejor has to buy the contractual energy from CCEE (Câmara de Comercialização de Energia Elétrica), the Electric Energy Sales Chamber in Brazil, in the short term market. The prices from electric energy change according to market rules. Therefore, Elejor has to deal with an unexpected cost related to the variation of the prices of the electric energy. The revenues from the commercialization of CERs may also amortize this balance and help Elejor to overcome the risks and to pay in return the financing from BNDES.

In what concerns to social barrier, the revenue from CERs commercialization can cover unexpected costs, such as indenisations to the removed people, acquisition of lands, environmental programs and compensatory measures (environmental monitoring programs and educational programs).

The impact of registration of this CDM project activity will contribute to overcoming all the barriers described in this Tool: climatic, institutional and political, social and investment barriers by reducing the risks of electricity generation and bringing more solidity to the investment itself and, therefore, fostering and supporting the project owners' breakthrough decision to expand their business model.

Finally the project will achieve the aim of anthropogenic GHG reductions.

[8] ANEEL, Capacidade de Geração do Brasil, available on http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp, Accessed on July 21st 2006

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Project Emissions:

The only source of emission of this project activity is an estimative of GHG emissions due to the reservoir of the Santa Clara project. According to ACM0002 – version 6, new hydro electric power projects with reservoirs, with a power density between 4 and 10 W/m^2 must use the formulae below:

$$PE_{y,SantaClara} = \frac{ER_{res} \times EG_y}{1000}$$

where:
PE_y = emissions from the reservoir (tCO_2e/year);
ER_{res} = is the default emission factor for emissions from reservoirs (90 Kg CO_2e /MWh);
EG_y = Electricity produced by the hydro electric power project in year y (MWh)

As the Fundão Complex has a power density higher than 10 W/m^2 (122,643 MW/ 2,15 km^2 = 57.04 W/m^2), there is no emissions due to the reservoir.

Leakage:

According to ACM0002 – version 6: "The main emissions potentially giving rise 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), and land inundation. Project participants do not need to consider these emission sources as leakage in applying this methodology. Project activities using this baseline methodology shall not claim any credit for the project on account of reducing these emissions below the level of the baseline scenario."

Thus, $L_{y\ Santa\ Clara} = L_{y,\ Fundão} = 0$

where:
$L_{y\ Santa\ Clara}$ is the Leakage from the Santa Clara Hydro Power Plant during the year y;
$L_{y,\ Fundão}$ is the Leakage from Fundão Hydro Power Plant during the year y.

Baseline Emissions:

The baseline emissions are the emissions related to the energy that would be delivered to the grid, in the absence of the project. This energy is associated with an emission that is calculated multiplying the energy by an emission factor. It's the same quantity of electric energy that the project will produce and dispatch to the grid:

$BE_{electricity,y} = EF_{electricity} . EG_y$

where:

$BE_{electricity,y}$ Are the baseline emissions due to displacement of electricity during the year y in tons of CO_2;
EG_y Is the net quantity of electricity generated in the plant due to the project activity during the year y in MWh;
$EF_{electricity,y}$ Is the CO_2 baseline emission factor for the electricity.

Combined Margin Emission factor:

For the calculation of the emission factor ($EF_{electricity,y}$):

$$EF_{electricity} = \frac{EF_{OM} + EF_{BM}}{2}$$

where:
EF_{OM} is the Operating Margin emission Factor for the S-SE-CO electric grid;
EF_{BM} is the Build Margin emission Factor for the S-SE-CO electric grid.

- Operating Margin (EF_{OM}): the method (b) Simple Ajusted OM from STEP 1 was chosen because there is no detailed data to apply option (c) Dispatch Data Analysis and the low-cost/must run resources constitute more than 50 % of total grid generation. Detailed data to apply to option (b) is provided by ONS, (Operador Nacional do Sistema) the Brazilian electricity system manager.

$$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_k GEN_{k,y}}$$

where:
Fi,j,y : Is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y;
j,m : Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid;
COEFi,j y : Is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j (or m) and the percent oxidation of the fuel in year(s) y;
GENj,y : Is the electricity (MWh) delivered to the grid by source j (or m).

- Build Margin (EF_{BM}):

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

where:
Fi,m,y : Is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources *m* in year(s) y;
m : Refers to the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently[9];

[9] If 20% falls on part capacity of a plant, that plant is fully included in the calculation.

COEFi,m y : Is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *m* and the percent oxidation of the fuel in year(s) y;
GENm,y : Is the electricity (MWh) delivered to the grid by source *m.*

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

Data / Parameter:	**Baseline emission factor ($EF_{Baseline\ (ex\text{-}ante\ 2003\text{-}2005)}$)**
Data unit:	tCO_2 / MWh
Description:	Combined margin CO_2 emission factor of the grid
Source of data used:	Calculated
Value applied:	0.2611
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data will be archived electronically and according to internal procedures, until 2 years after the end of the first crediting period
Any comment:	Calculated as a weighted average of the OM and BM emission factors.

Data / Parameter:	**Operating margin emission factor ($EF_{OM,\ 2003\text{-}2005y}$)**
Data unit:	tCO_2 / MWh
Description:	CO_2 Operating Margin emission factor of the grid
Source of data used:	Factor calculated with data from ONS
Value applied:	0.4349
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data will be archived electronically and according to internal procedures, until 2 years after the end of the first crediting period
Any comment:	Calculated *ex-ante* (2003-2005) as indicated in B.6.1.

Data / Parameter:	**Build margin emission factor ($EF_{BM,2005}$)**
Data unit:	tCO_2 / MWh
Description:	CO_2 Build Margin emission factor of the grid
Source of data used:	Factor calculated with data from ONS
Value applied:	0.0872
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data will be archived electronically and according to internal procedures, until 2 years after the end of the first crediting period
Any comment:	Calculated *ex-ante* (2005) as indicated in B.6.1.

B.6.3 Ex-ante calculation of emission reductions:

Baseline emission factor:

The baseline methodology ACM0002 considers the determination of the emissions factor for the grid to which the project activity is connected as the core data to be determined in the baseline scenario.

In Brazil, there are two main grids, South-Southeast-Midwest and North-Northeast, therefore the South-Southeast-Midwest Grid is the relevant one for this project.

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

In order to calculate the Operating Margin and Build Margin, daily dispatch data from the Brazilian electricity system manager (ONS) needed to be gathered.

The provided information comprised years 2003, 2004 and 2005, and is the most recent information available at this stage. The ONS data as well as the spreadsheet data with the calculation of emission factors have been provided to the validator (DOE).

Simple Adjusted Operating Margin Emission Factor:

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

$$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_{j} GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_{k} GEN_{k,y}} \quad (tCO_2e/GWh)$$

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

$$\frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_{k} GEN_{k,y}} = 0 \quad (tCO_2e/GWh)$$

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

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

Year	Lambda
2003	0.5312
2004	0.5055
2005	0.5130

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

Year	Electricity Load (MWh)
2003	288,933,290
2004	302,906,198
2005	314,533,592

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

$$EF_{OM,simple\_adjusted,2003} = (1-\lambda_{2003})\frac{\sum_{i,j} F_{i,j,2003}.COEF_{i,j}}{\sum_{j} GEN_{j,2003}} \therefore EF_{OM,simple\_adjusted,2003} = 0.4605 \text{ tCO}_2\text{/MWh}$$

$$EF_{OM,simple\_adjusted,2004} = (1-\lambda_{2004})\frac{\sum_{i,j} F_{i,j,2004}.COEF_{i,j}}{\sum_{j} GEN_{j,2004}} \therefore EF_{OM,simple\_adjusted,2004} = 0.4531 \text{ tCO}_2\text{/MWh}$$

$$EF_{OM,simple\_adjusted,2005} = (1-\lambda_{2005})\frac{\sum_{i,j} F_{i,j,2005}.COEF_{i,j}}{\sum_{j} GEN_{j,2005}} \therefore EF_{OM,simple\_adjusted,2005} = 0.3937 \text{ tCO}_2\text{/MWh}$$

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

$$EF_{OM,simple\_adjusted2003\_2005} = \frac{EF_{OM,simple\_adjusted,2003} * \sum_j GEN_{j,2003} + EF_{OM,simple\_adjusted,2004} * \sum_j GEN_{j,2004} + EF_{OM,simple\_adjusted,2005} * \sum_j GEN_{j,2005}}{\sum_j GEN_{j,2003} + \sum_j GEN_{j,2004} + \sum_j GEN_{j,2005}} = 0.4349$$

Build Margin Emission Factor:

According to the methodology, a Build Margin emission factor needs to be determined as follows:

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

Electricity generation in this case means 20% of total generation in the most recent year (2005), as the 5 most recent plants in operation generate less than such 20%. Calculating such factor one reaches:

$EF_{BM,2005} = 0.0872$ tCO_2/MWh

Combined Margin Emission Factor:

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

$$EF_{electricity,2003\text{–}2005} = 0.5 * 0.4349 + 0.5 * 0.0872 = 0.2611 \ tCO_2/MWh$$

Baseline emissions:

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 ($EF_{electricity,2003\text{-}2005}$) with the electricity generation of the project activity.

$BE_{electricity,y} = EF_{electricity,2003\text{-}2005} * EG_y$

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

$\mathbf{BE_{electricity,y} = 0.2611\ tCO_2/MWh * EG_y}$ (in tCO_2e)

Project Emission reductions:

The project emission reductions are:

$ER_{y,\ Elejor} = BE_{electricity,y,\ Santa\ Clara} - (L_{y,\ Santa\ Clara} + PE_{y,\ Santa\ Clara}) + BE_{electricity,y,\ Fundão} - (L_{y,\ Fundão} + PE_{y,\ Fundão})$

$L_{y,\ Santa\ Clara} = L_{y,\ Fundão} = 0$;

$PE_{y,\ Santa\ Clara} = 90 / 1000 * EG_{y,\ Santa\ Clara}$;

$PE_{y,\ Fundão} = 0$.

Then:

$\mathbf{ER_{y,\ Elejor} = 0.2611 * (EG_{y,\ Santa\ Clara} + EG_{y,\ Fundão}) - 0.09 * EG_{y,\ Santa\ Clara}}$,

where:
$ER_{y,\ Elejor}$: are the emissions reductions of the project activity during the year y in tons of CO_2;
$BE_{electricity,\ y,\ Santa\ Clara}$: Are the baseline emissions due to displacement of electricity during the year y in tons of CO_2;
$BE_{electricity,\ y,\ Fundão}$: Are the baseline emissions due to displacement of electricity during the year y in tons of CO_2;
$PE_{y,\ Santa\ Clara}$: Are the project emissions of the Santa Clara Complex during the year y in tons of CO_2;
$PE_{y,\ Fundão}$: Are the project emissions of the Fundão Complex during the year y in tons of CO_2;
$L_{y,\ Santa\ Clara}$: Are the leakage emissions of the Santa Clara Complex during the year y in tons of CO_2;
$L_{y,\ Fundão}$: Are the leakage emissions of the Fundão Complex during the year y in tons of CO_2.

Table 4. Data used for the estimation of the emission reductions for the first crediting period

Fundão Santa Clara Energetic Complex Project (FSCECP)									
Fundão Hydroelectric Pland									
Item	First Crediting Period								
	2007 [1]	2008	2009	2010	2011	2012	2013	2014 [2]	**Total CERs**
Total Installed Capacity (MW)	122.643	122.643	122.643	122.643	122.643	122.643	122.643	122.643	
Internal Consumption (MW)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Standby (MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Installed Capacity Available for Sale (MW)	121.9	121.9	121.9	121.9	121.9	121.9	121.9	121.9	
Hours of Operation (h)	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	
Energy to be sold to the grid (MWh)	153,625	614,500	614,500	614,500	614,500	614,500	614,500	460,875	
Baseline Carbon Intensity (tCO2e/MWh)	0.2611	0.2611	0.2611	0.2611	0.2611	0.2611	0.2611	0.2611	
Baseline emissions (tCO2e)	40,111	160,446	160,446	160,446	160,446	160,446	160,446	120,334	
Project emissions (tCO2e) [3]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Emission reductions (tCO2e)	40,111	160,446	160,446	160,446	160,446	160,446	160,446	120,334	**1,223,115**
Santa Clara Hydroelectric Plant									
Item	First Crediting Period								
	2007 [1]	2008	2009	2010	2011	2012	2013	2014 [2]	**Total CERs**
Total Installed Capacity (MW)	123.768	123.768	123.768	123.768	123.768	123.768	123.768	123.768	
Internal Consumption (MW)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	
Standby (MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Installed Capacity Available for Sale (MW)	123.0	123.0	123.0	123.0	123.0	123.0	123.0	123.0	
Hours of Operation (h)	2,190	2,190	2,190	2,190	2,190	2,190	2,190	2,190	
Energy to be sold to the grid (MWh)	153,625	614,500	614,500	614,500	614,500	614,500	614,500	460,875	
Baseline Carbon Intensity (tCO2e/MWh)	0.2611	0.2611	0.2611	0.2611	0.2611	0.2611	0.2611	0.2611	
Baseline emissions (tCO2e)	40,111	160,446	160,446	160,446	160,446	160,446	160,446	120,334	
Project emissions (tCO2e) [4]	13,826	55,305	55,305	55,305	55,305	55,305	55,305	41,479	
Emission reductions (tCO2e)	26,285	105,140	105,140	105,140	105,140	105,140	105,140	78,855	**735,980**
Total emission reductions (tCO2e)	66,396	265,585	265,585	265,585	265,585	265,585	265,585	199,189	**1,859,095**

Obs: [1] the estimative of 2007 were considered from 01/10 to 31/12

[2] the estimative of 2007 were considered from 01/10 to 31/12

[3] the estimative of 2007 were considered from 01/10 to 31/12

[4] the estimative of 2007 were considered from 01/10 to 31/12

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

Year	Estimation of project activity emission (tonnes of CO_2e)	Estimation of the baseline emission (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
2007 [1]	13,826	80,222	0	66,396
2008	55,305	320,890	0	265,585
2009	55,305	320,890	0	265,585
2010	55,305	320,890	0	265,585
2011	55,305	320,890	0	265,585
2012	55,305	320,890	0	265,585
2013	55,305	320,890	0	265,585
2014 [2]	41,479	240,668	0	199,189
Total (tonnes of CO_2e)	**387,135**	**2,246,230**	**0**	**1,859,094**

[1] the estimative of 2007 were considered from 01/10 to 31/12
[2] the estimative of 2014 were considered from 01/01 to 30/09

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**Electricity generation (EG_y)**
Data unit:	MWh/year
Description:	Electricity supplied to the grid by the project
Source of data to be used:	Elejor
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,229,000
Description of measurement methods and procedures to be applied:	This data will be archived electronically and according to internal procedures, until 2 years after the end of the crediting period. For details, please refer to Annex 4.
QA/QC procedures to be applied:	These data will be directly used for calculation of emission reductions. Sales record to the grid and other records are used to ensure the consistency.
Any comment:	

B.7.2 Description of the monitoring plan:

The emission factors shall be reviewed and recalculated in the same transparent and conservative way by the time of the renewal of the crediting period and baseline scenario.

The only variable to be monitored in this project activity, during the first crediting period is the total amount of electricity exported to the grid. This variable will be monitored from 2007 up to the end of the crediting period. As the core business of Elejor is to sell energy, the monitoring occurs as common practice in the power plant.

Detailed information on the monitoring plan is presented in Annex 4.

The archiving will occur up to two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

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

Date of completion of the application of the baseline study and monitoring methodology: 22/02/2007.

ECONERGY BRASIL LTDA is responsible entity for application of the baseline study and monitoring methodology.
Contact information:
Avenida Angélica 2530, cj 111
CEP: 01228-200
São Paulo, SP, Brazil
Telephone: +55 (11) 3555-5700
FAX: +55 (11) 3555-5735
URL: http://www.econergy.com.br

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

20/06/2002[10]

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

25y-0m

[10] Date of issuance of Installation License for both UHE Fundão (119 MW) and UHE Santa Clara (119 MW).

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

C.2.1. Renewable crediting period

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

01/10/2007

C.2.1.2. Length of the first crediting period:

7y-0m[11]

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Left blank on purpose.

C.2.2.2. Length:

Left blank on purpose.

SECTION D. Environmental impacts

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

According to the Brazilian laws, the possible environmental impacts are to be analyzed by IAP – Instituto Ambiental do Paraná. The environmental licensing process comprises the development of a RAP – Relatório Ambiental Preliminar (*Preliminary Environmental Report*) for the Fundão and Santa Clara Hydroelectric Power Plants and through a RAS – Relatório Ambiental Simplificado (*Simplified Environmental Report*) to Santa Clara and Fundão Small-Hydro Power Plants. These studies are detailed on the PBA's – Planos Básicos Ambientais.

IAP evaluated these documents and emitted the Environmental Licences for the Santa Clara and the Fundão Complexes. The Table 5 shows the numbers from those licenses:

Table 5. Environmental License Numbers

	Santa Clara Energetic Complex		Fundão Energetic Complex	
Environmental Licences Numbers	Santa Clara Hydroeletric Power Plant	Santa Clara Small Hydroeletric Power Plant	Fundão Hydroeletric Power Plant	Fundão Small Hydroeletric Power Plant
Preliminary Licence	1005	4336	1004	4337
Installation License	1796	1610	1795	1661
Operational License	7093	7094	10328	10331

There will be no transboundary impacts resulting from FSCECP. All the relevant impacts occur within Brazilian borders and have been mitigated to comply with the environmental requirements for project's implementation. Therefore FSCECP will not affect by any means any country surrounding Brazil.

[11] This implicates in 2 renewals of the crediting period and therefore 3 crediting periods.

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

Some technical requirements were requested in the Operation License for the project to comply with, such as:

- Present and implement the Risk Management Plan;
- Rescue and monitor both fauna and flora aquatic or terrestrial;
- Monitor the depleting line;
- Monitor the water quality;
- Sign the Compensatory Measures Compromise Term;
- Maintain the Environmental Education Program;
- Maintain the Communication Social Program;
- Continue with the Archeological Rescue Program;
- Maintain an itinerating museum, with the State Secretariat of Culture and Education;
- Maintain the Development Support to the affected municipalities;
- Continue with the fluviometric monitoring;
- Follow the adaptation and production of the resettled families;
- Send to IAP an annual report about the self-monitoring of the Programs.

These demands are to be complied by Elejor in order that the project operates under the environmental agency's requirements.

SECTION E. Stakeholders' comments

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

As a requirement of the Brazilian Interministerial Commission on Global Climate Change, the Brazilian DNA (Designated National Authority), Elejor invited several organizations and institutions to comment the CDM project being developed. Letters[12] were sent to the following recipients:

- Prefeitura Municipal de Candói – PR / *Municipal Administration of Candói – PR;*
- Câmara Municipal de Candói – PR / *Municipal Legislation Chamber of Candói – PR;*
- Prefeitura Municipal de Pinhão –*Municipal Administration of Pinhão – PR;*
- Câmara Municipal de Pinhão – *Municipal Legislation Chamber of Pinhão – PR;*
- Prefeitura Municipal de Foz do Jordão –*Municipal Administration of Foz do Jordão – PR;*
- Câmara Municipal de Foz do Jordão – *Municipal Legislation Chamber of Foz do Jordão – PR;*
- Ministério Público / *Federal Prosecutor's Office;*
- Fórum Brasileiro de ONGs (FBOMS) / *Brazilian NGO Forum ;*
- IAP – Instituto Ambiental do Paraná/ *Parana's Environmental Institute.*

[12] The copies of these invitations are available from the Project participants.

E.2. Summary of the comments received:

Two comments were received: an e-mail from the Municipal Administration of Pinhão and a letter from the Brazilian NGO Forum.

The Municipal Administration of Pinhão asked for more information about the project regarding the benefits and compensatory measures that the project would bring to the city of Pinhão.

The Brazilian NGO Forum commented that it supported projects under CDM and was aware of the importance of the public stakeholder consultation to the improvement of the project's qualities and sustainability. The FBOMS suggested the adoption of additional sustainability criteria such as the "Gold Standard". It mentioned also that period for stakeholder's comments does not allow a more detailed analysis of the project.

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

Elejor thanked for the comments and answered both letters.

Regarding the comments of the Municipal Administration of Pinhão, Elejor answered that the city of Pinhão was benefited with several measures such as: the creation of employees, environmental quality maintenance in the Jordão river surroundings, educational programs, archaeological patrimony preserving, implementation of ecological stations etc. Elejor enhanced that all the information concerning the compensatory measures are in the Basic Environmental Plans (PBA – Plano Básico Ambiental) of the hydro power plants of Santa Clara and Fundão.

Regarding the comments of FBOMS, Elejor informed that, although all verification processes of CDM projects already take into account the evaluation and monitoring of environmental criteria, it would study the possibility of implement an evaluation-certification system for such criteria.

Elejor also mention in both that it was ready to answer any other doubts that stakeholders could have and that they could contact the company anytime.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Elejor – Centrais Elétricas do Rio Jordão
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URL:	www.elejor.com.br
Represented by:	Sergio Luiz Lamy/ Nilson de Paula Xavier Marchioro
Title:	Electric Engineer/ Agronomist Engineer
Salutation:	Director
Last Name:	Lamy/ Marchioro
Middle Name:	Luiz/ Paula Xavier
First Name:	Sergio/ Nilson
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Personal E-Mail:	lamy@elejor.com.br/ marchioro@elejor.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

The Brazilian electricity system has been historically divided into two subsystems: the North-Northeast (N-NE) and the South-Southeast-Midwest (S-SE-CO). This is due mainly to the historical evolution of the physical system, which was naturally developed nearby the biggest consuming centers of the country.

The natural evolution of both systems continues to demonstrate that integration will happen in the future. In 1998, the Brazilian government announced 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 was established, technical papers continue to divide the Brazilian system in three (Bosi, 2000)[13]:

"… 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, the ACM0002 version 6 suggests using the regional grid definition, in large countries with layered dispatch systems (e.g. state/provincial/regional/national), where DNA guidance is not available. A state/provincial grid definition may indeed in many cases be too narrow given significant electricity trade among states/provinces that might be affected, directly or indirectly, by a CDM project activity.

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.

The Brazilian electricity system nowadays comprises of around 101.3 GW of installed capacity, in a total of 1.482 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 4.5% are diesel and fuel oil plants, 3.2% 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 8.17 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid[14]. This latter capacity is in fact comprised by mainly 5.65 GW of the Paraguayan part of *Itaipu Bi-national*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

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

[14] www.aneel.gov.br

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

However, information on such generating sources is not publicly available in Brazil. The national dispatch center, ONS – National System Operator – 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 specifically contacted and the reason for data collection was explained. After several months of talks, plants' daily dispatch information was made available by ONS.

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[15], which includes capacity available in neighboring countries to export to Brazil and emergency plants that are dispatched only during times of electricity constraints in the system. Such capacity in fact is constituted by plants with 30 MW installed capacity or above, connected to the system through 138kV power lines, or at higher voltages. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23.6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

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

IEA/ONS Merged Data Build Margin (tCO_2/MWh)	ONS Data Build Margin (tCO_2/MWh)
0.205	0.0872

Therefore, considering all the rationale explained, the project developers selected to use 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.

[15] www.aneel.gov.br/arquivos/PDF/Resumo_Gráficos_mai_2005.pdf

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

From the mentioned reference:

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

Therefore only data for plants under construction in 2005 (with operation start in 2003, 2004 and 2005) was estimated. All others efficiencies were calculated. To the best of our knowledge there was no retrofit/modernization of the older fossil-fuelled power plants in the analyzed period (2003 to 2005). For that reason project participants find the application of such numbers to be not only reasonable but the best available option.

The aggregated hourly dispatch data received from ONS was used to determine the lambda factor for each of the years with available data (2003, 2004 and 2005). The Low-cost/Must-run generation was determined as the total generation minus the generation from fossil-fuelled thermal plants generation. All this information has been provided to the validators, and extensively discussed with them, in order to make all points crystal clear.

On the following pages, a summary of the analysis is provided. The Table 6 shows the summarized conclusions of the analysis of the emission factor calculation and Figures 7, 8 and 9 present the load duration curves for the S-SE-CO subsystem.

Table 6: Emission factors for the Brazilian South-Southeast-Midwest Subsystem

Emission Factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [MWh]	Imports [MWh]
2003	0.9823	288,933,290	274,670,644	459,586
2004	0.9163	302,906,198	284,748,295	1,468,275
2005	0.8086	314,533,592	296,690,687	3,535,252
	Total (2003 - 2005) =	906,373,081	856,109,626	5,463,113
	$EF_{OM,simple-adjusted}$ [tCO2/MWh]	$EF_{BM,2005}$	Lambda	
	0.4349	0.0872	*2003*	
	Weights	Default weights	0.5312	
	w_{OM} = 0.50	w_{OM} = 0.50	*2004*	
	w_{BM} = 0.50	w_{BM} = 0.50	0.5055	
	EF_y [tCO2/MWh]	Default EF_y [tCO2/MWh]	*2005*	
	0.2611	0.2611	0.5130	

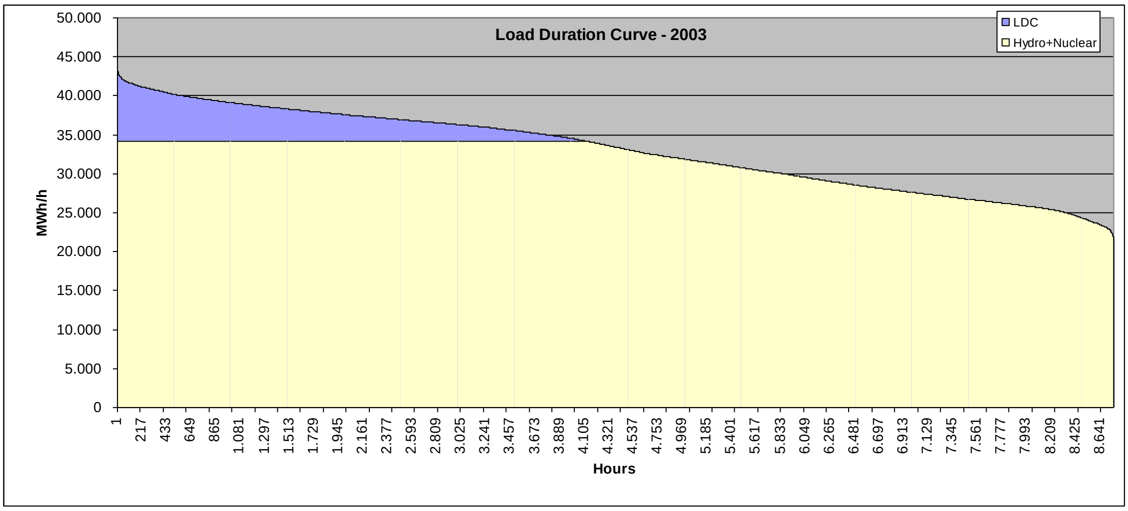

Figure 7. Load duration curve for the S-SE-CO system, 2003

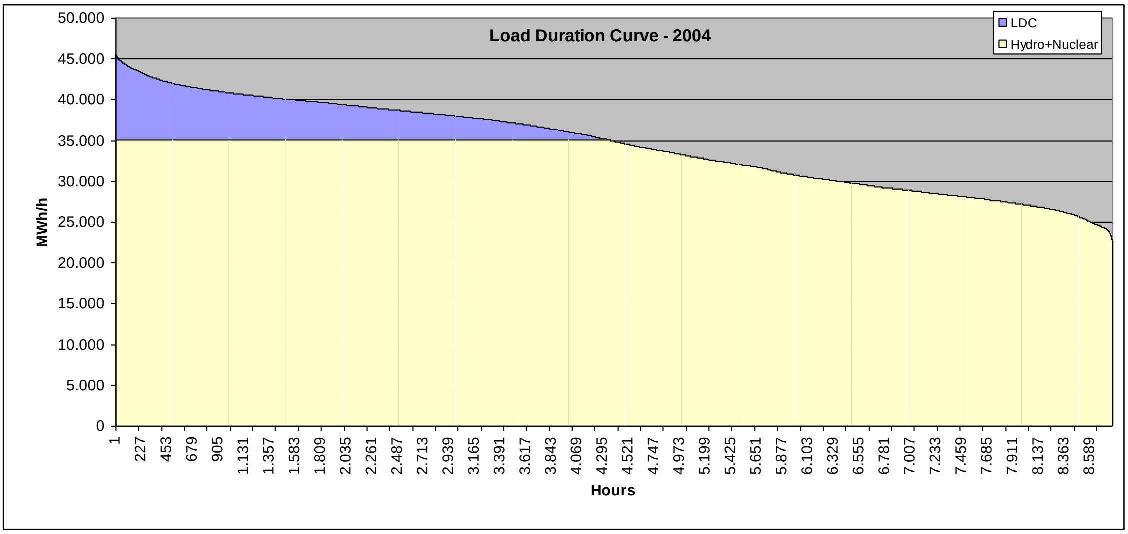

Figure 8. Load duration curve for the S-SE-CO system, 2004

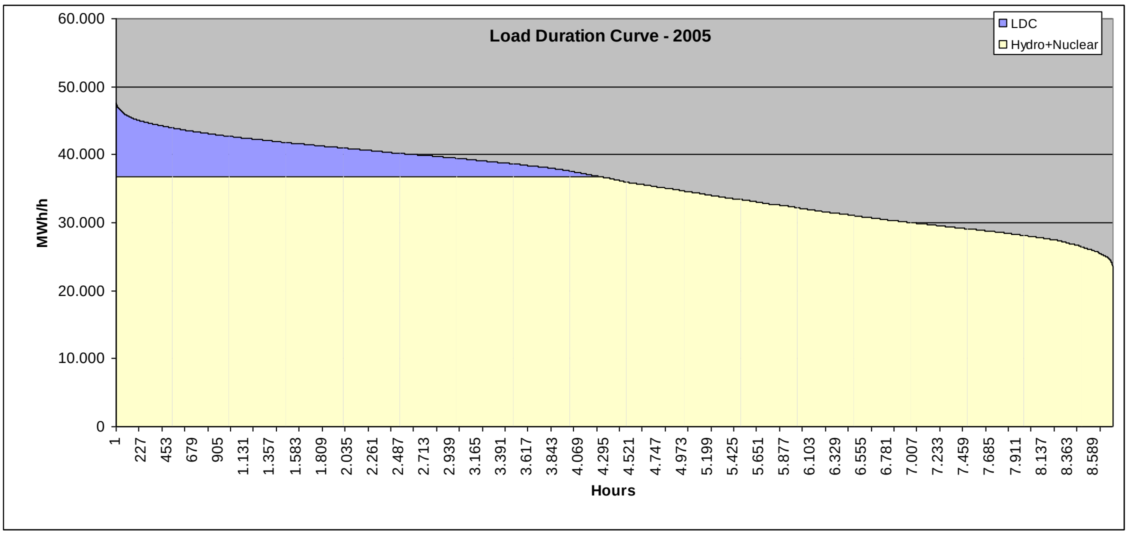

Figure 9. Load duration curve for the S-SE-CO system, 2005

Annex 4

MONITORING PLAN

The quantity of energy exported to the grid will be monitored by COPEL which will operate the hydroelectric complex. COPEL will register these measurements remotely from its headquarters in Curitiba. The person responsible for reading remotely the energy despatched to the grid is Mr. João Miyaoka (engineer of COPEL).

The amount of energy produced and fed into the grid will also be registered in a spreadsheet by Elejor. Mr. Sergio Luiz Lamy (president of Elejor) is responsible for checking the quantity of energy sold to COPEL and Mr. Renato Luiz Dallagranna (accountant of Elejor) responsible for issuing the invoice. The invoices will be issued by Elejor to COPEL, which buys the energy generated by the large scale power plants of Santa Clara and Fundão. The invoices of the energy generated by the small scale power plants of Santa Clara and Fundão and sold to final consumers will also be monitored.

The energy sold to COPEL is previously fixed in the PPA. When the amount of energy generated by Elejor exceeds the contracted amount agreed in the PPA, CCEE[16] , the entity responsible for the accounting process of the energy market, issues a credit receipt (Elejor therefore has a credit with CCEE). When the amount of energy generated doesn’t achieve the expected, CCEE issues a debt receipt (Elejor is therefore in debt with CCEE). These receipts (credit and debt) will be used for cross-check the energy sold to the grid and for verification.

The archiving will occur up to two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. The amount of energy dispatched to the grid will be registered in the spreadsheet "FSCECP.xls", which shall be the instrument for the further Verification. The calibration is under responsibility of COPEL and will be every two years. The procedures for calibration are determined by ONS, the National Operator of the System (Operador Nacional do Sistema), which controls the dispatch of the energy to the S-SE-CO electric grid.

Environmental Impacts will be monitored by the reports requested by the Operational Licenses of Santa Clara Complex and Fundão Complex. The reports listed in the Operational Licence will be used to monitor the environmental impacts.

As mentioned in A.2, the main Social Impact resulted from the FSCECP is the creation of jobs during the construction of the complex. After the construction, Elejor will have to train engineers and operators to ensure the efficient operation of the complex and also workers in order to monitor the environmental programs. Any new request for employment will be monitored by Elejor’s personnel department, including the necessity of training.

[16] Câmara de Comercialização de Energia Elétrica (http://www.ccee.org.br/)