CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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Title: Jaguari Mirim River Hydroelectric Plants
Version: 03
Date: 21/07/2008

Revision history
Version 01: GSP PDD submitted on March 26, 2008
Version 02: PDD submitted to DOE revision on 19/06/2008
Version 03: PDD submitted on July 21, 2008

A.2. Description of the small-scale project activity:

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The Jaguari Mirim River Hydroelectric Plants project (hereafter referred to as "the project") includes two run-of-river hydroelectric plants with total installed capacity of 7.0 MW[1]. The small hydroelectric plants[2] include SHP São Joaquim (3.0 MW) and SHP São José (4.0 MW) located at the Jaguari Mirim River, in the State of São Paulo, Brasil. Both existing plants are not operational (they were deactivated more than 40 years ago) and require significant investments in new equipment and facilities for energy generation. The hydroelectric plants are considered run-of-river given that they do not require accumulating water for operation. The reservoir is used solely to assure adequate water flow at the intake point. In this way, the hydropower systems use water at a rate no greater than that which runs down the river.

The purpose of this project is to generate electricity with renewable water sources, and to displace part of the electricity from fossil fuel-fired plants connected to the south/southeast/midwest grid. In this way, greenhouse gas ("GHG") emission reductions can be achieved. The estimated annual GHG emission reductions are 8,634 tCO_2e by the project. The basic technical studies were completed in November 2006, and the project proponent plans to initiate technical works at the project site in April 2008. The operation start date is expected to be October 2009.

The proposed project activity will contribute to sustainable development by the:

- Use of renewable hydro resources available in the region;
- Creation of local employment opportunities during the construction and operating phases.
- Promotion of incentives to rural infrastructure development by improving access roads and electricity transmission lines; and,
- Reduction of environmental pollutants such as CO_2, SO_2, NOx, and dust derived from fossil fuel-fired plants.

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1 http://www.aneel.gov.br/aplicacoes/ResumoEstadual/GeracaoTipoFase.asp?tipo=5&fase=1&UF=SP:S%C3%83%C6%92O%20PAULO

2 Under the Brazilian legislation (Article 26, Law 9.427, from 26/12/96, modified by article 4º, Law 9648, from 27/05/98; and, articles 2 and 3 of ANEEL Resolution nº 394, from 04/12/98), all the hydropower plants from 1 MW up to 30 MW of installed capacity and with a reservoir smaller than 3 square kilometers are considered to be small hydroelectric plants.

A.3. Project participants:

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Name of the 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)	AES Tietê S.A.	No
Netherlands	AES Carbon Exchange Limited	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. Further contact information of project participants is provided in Annex 1.

A.4. Technical description of the small-scale project activity:

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A.4.1. Location of the small-scale project activity:

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The project activity will be located at the municipality of São João da Boa Vista, in the State of São Paulo, south-eastern region of Brazil.

A.4.1.1. Host Party(ies):

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Brazil

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

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South-eastern region of Brazil, São Paulo State

A.4.1.3. City/Town/Community etc:

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Municipality of São João da Boa Vista

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

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The project is located at the Jaguari Mirim River, an easterly flowing river in the State of São Paulo. Both plants are situated downstream from the city of São João da Boa Vista (4 km downstream for SHP São José, and 14 km downstream for SHP São Joaquim). The GPS coordinates for the two plants, taken from the location of each power house, is as follows: SHP São José (46°48'57"W; 21°56'17"S), and SHP São Joaquim (46°53'34"W; 21°52'26"S). Figure 1.0 shows the geographic location of the project.

Figure 1 – Location of the Small Hydropower Plants

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

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1. Type and category(ies) of the small-scale project activity

According to the categorization of the Appendix B to the simplified modalities and procedures for small-scale CDM project activities, the project type and category are defined as follows:

Type I: Renewable energy projects
Category I.D.: Grid connected renewable electricity generation

2. Technology of the small-scale project activity

The proposed project will use the potential energy by virtue of a height drop in the Jaguari Mirim River by diversion weirs for running tubular Kaplan S type hydro turbines to generate power. The basic engineering plan for both plants completed by MEK Engenharia in November 2006[3] included the technical specifications provided by the table below. The equipment and technology used in this project has been successfully applied to similar projects in Brazil and around the world. The turbines for SHP São Joaquim (01 turbine) and SHP São José (02 turbines) will be supplied by Hacker Industrial Ltda and Semi Industrial Ltda, respectively[4]. The generators for both plants (01 generator for SHP São Joaquim, and 02 generators for SHP São José) will be supplied by Flessak Eletro Industrial Ltda.[5]

Parameter	SHP São José	SHP São Joaquim
Average flow rate (m^3/s)	14.3	16.8
Reservoir area (km^2)	0.01	0.083
Power density (W/m^2)	400	36.14
Reservoir volume(10^6 m^3)	0.08	0.59
Head (m)	21.32	15.20
Installed capacity (kW)	4,000	3,000
Turbine	2 Kaplan S, horizontal axis, 450 rpm	1 Kaplan S, horizontal axis, 300 rpm
Generator	2.30 MVA, 450 rpm, 4.16 kV	3.4 MVA, 300 rpm, 4.16 kV
Nominal turbine flow rate (m3/s)	10.40	11.8

The small hydro plants will be operated remotely, by the COG Bauru (Centro de Operação da Geração) of AES Tietê S.A. The project time schedule includes the commissioning for the two small hydro plants by October 2009 as indicated by the timetable below.

Timetable	Q3* 2006	Q4 2006	Q1 2007	Q2 2007	Q3 2007	Q4 2007	Q1 2008	Q2 2008	Q3 2008	Q42008	Q1 2009	Q2 2009	Q3 2009
Engineering Design													
Site investigations	X												
Hydrology studies	X												
Basic technical studies completion		X											
Economic Feasibility													
Cost Assumptions				X									
Financial model					X								
Board Approval considering CERs						X							
EPC Contract													
Proposals submission							X						
Contract negotiation							X						
Notice to proceed							X						
Units Comissioning													
Civil works								X	X	X	X	X	
Operations License (LO)												X	
Start of operations													X

* Means 3rd quarter, 2006

Figure 2 – Project Timetable

Based on completed discharge studies, the estimated assured energy for SHP São José is 1.89 MW (given a capacity factor of 47%), and for SHP São Joaquim is 1.59 MW (given a capacity factor of 53%). Thus, total estimated assured energy for both plants is 30,543 MWh per year.

[3] Consolidação do Projeto Básico – PCH São Joaquim, Relatório Técnico, MEK Engenharia, Novembro 2006; Consolidação do Projeto Básico – PCH São José, Relatório Técnico, MEK Engenharia, Novembro 2006.

[4] Contract No DC/PCH/004/2008 and No DC/PCH/005/2008

[5] Contract No DC/PCH/008/2008

Technical know-how will be transferred to local operation and maintenance teams by formal training programs and manuals. Plant operators will be responsible to follow corporate best practices identified for similar small hydro plants in Brazil and elsewhere. Project equipment will be entirely supplied by national manufacturers.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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The project applies a renewable crediting period. The first 7-year renewable crediting period is expected to start on October 1st, 2009 till September 30th, 2016. Emission reductions to be achieved by the project during the first crediting period are shown in the table below.

Years	Annual estimation of emission reduction in tonnes of CO_2 e
2009 (October 1st – Dec. 31st)	2,158
2010 (January 1st – Dec. 31st)	8,631
2011 (January 1st – Dec. 31st)	8,631
2012 (January 1st – Dec. 31st)*	8,655
2013 (January 1st – Dec. 31st)	8,631
2014 (January 1st – Dec. 31st)	8,631
2015 (January 1st – Dec. 31st)	8,631
2016 (Jan. 1st-Sept. 30th)	6,473
Total Emission Reductions (tonnes of CO_2 e)	**60,441**
Total number of crediting years	**7**
Annual Average over the crediting period of estimated reductions (tonnes of CO_2 e)	8,634

*2012 is a leap year.

A.4.4. Public funding of the small-scale project activity:

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This project has not received any public funding from Annex I parties to the Convention.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According to Appendix C of the simplified modalities and procedures for the small-scale CDM project activities, the proposed small-scale project activity shall be deemed to be debundled component of a large scale project activity if there is a registered small-scale CDM project activity or a request for registration by another small-scale project activity:

- By the same project participants;
- In the same project category and technology / measure; and,
- Registered within the previous 2 years; and
- Whose project boundary is within 1km of the project boundary of the proposed small-scale activity at the closest point.

As for the proposed project, there is no other project meeting the above conditions. Therefore, the project is not a debundled component of any larger scale 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 small-scale project activity:

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AMS-I.D. Grid connected renewable electricity generation, version 13

For more information regarding the methodology, please refer to the link:
http://cdm.unfccc.int/methodologies/SSCmethodologies/ approved.html.

B.2 Justification of the choice of the project category:

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The project activity utilizes hydropower for electricity generation, which falls under the category of renewable energy technologies. Since the capacity of the proposed project is 7.0 MW, not exceeding the threshold capacity of 15 MW, the project can be regarded as a small-scale CDM project activity. The power generated will be exported to the south/southeast/midwest grid. Therefore, according to small-scale CDM modalities, the project activity falls under Type-I Renewable Energy Projects and Category I.D. Grid connected renewable electricity generation[6]. The project activity does not consist of a combined heat and power (co-generation) system.

B.3. Description of the project boundary:

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The project boundary includes the physical sites as well as the reservoir area for the two plants. The spatial extent of the project boundary includes the project site and all power plants connected physically to the south/southeast/midwest electricity system. The north-northeastern system is not included given the model adopted by the Brazilian Ministry of Science and Technology (MCT), Brazilian Ministry of Energy and Mines (MME), and the National System Operator (ONS) to calculate emission factors since January 2006. The boundaries of the subsystems are defined by the transmission capacity. Given transmission constraints, the south/southeast/midwest electricity system is considered a boundary. The net imported electricity from countries such as Argentina and Uruguay was included in the project boundary.

The only greenhouse gas to include in the project boundary is the carbon dioxide released by the thermal power plants already installed and operating in the south/southeast/midwest electricity system.

B.4. Description of baseline and its development:

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[6] According to the definition of Small Scale renewable energy project activity in the Paragraph 6 of the Decision 17/cp.7 in the document. FCCC/CP/2001/13/ADD/2, and the Appendix B to the decision 21/cp.8 of the document FCCC/CP/2002/7/Add.3, of simplified procedures for small-scale activities: Type I.D – Renewable Electricity Generation for a Grid, as "This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal, and biomass, that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel or non-renewable biomass fired generating unit.

The realistic and credible alternatives to the project activity are:

1. The installation of a new run-of-the-river hydropower plant with an installed capacity of 7 MW without being realized as a CDM project activity;
2. The construction of a fossil fuel-fired power plant with equivalent amount of annual electricity output;
3. The construction of a power plant using other sources of renewable energy with equivalent amount of annual electricity output; and,
4. Continuation of the current situation: electricity would continue to be generated by the existing generation mix operating in the grid.

All four baseline scenario alternatives are in line with regulatory or legal requirements.

Of the four baseline scenarios:

- Scenario 1 has been considered, and the barriers related to this alternative are explained in section B.5;
- Scenario 2 has been excluded based on AES Tietê commitment to increase renewable energy generation and on the unfavorable economics of investing in a small thermal unit within the State of São Paulo;
- Scenario 3 or other renewable energy sources (such as wind, solar, and geothermal power) has been excluded based on the unavailability of these resources within the State of São Paulo, as well as, the difficulties and barriers of technology and investment. The economic return for a renewable power plant equivalent in the size of the proposed project activity should be unfavorable; and,
- Scenario 4 or the continuation of the existing energy generation mix is considered to be the practical and feasible baseline scenario not facing prohibitive barriers.

According to the small scale methodology AMS-I.D version 13, the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO2e/kWh) calculated in a transparent and conservative manner as:

(a) A combined margin (CM) consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system" version 01.

Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered; or,

(b) The weighted average emissions (in kgCO2/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Option (a) is selected for this project.

From the four options given in "Tool to calculate the emission factor for an electricity system" version 01:
(a) Simple OM,

(b) Simple adjusted OM,
(c) Dispatch Data Analysis,
(d) Average OM

The option (b) simple adjusted OM is chosen given the methodological restrictions included in the "Tool to calculate the emission factor for an electricity system" version 01 for the other two options. The simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of the total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production. This is not the case for the project electricity system being considered. Low-cost/must-run resources constitute more than 50% of the total grid generation. The dispatch data analysis (option c) was not applied given that the dispatching information is not publicly available in Brazil. The simple adjusted OM was preferred over the average OM method (option d).

For the simple adjusted OM, the emission factor is calculated using the ex ante option: a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM SSC-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period.

Thus, the baseline for this project is the combined margin (CM) for the south/southeast/midwest grid calculated according to the "Tool to calculate the emission factor for an electricity system" version 01 considering a simple adjusted OM. The electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the CM calculations. In the absence of the project, electricity would continue to be generated by the existing generation mix, operating in the grid.

Baseline emissions were calculated based on the following variables and official data sources for the south/southeast/midwest grid.

Variables	**Unit**	**Sources[7]**
Installed capacity	MW	ANEEL
Fuel type per plant	-	ONS
Fuel emission factor	tC/TJ	IPCC (2006)
Fraction carbon oxidized	%	IPCC (1996)
Operation start date	-	ANEEL
Power output per plant	MWh	ONS
Load data for lambda calculations	-	ONS
Power supplied to the grid by the project in year y	MWh	MEK Engenharia (2006)

The calculations for the CM were prepared and consolidated by AgCert, EcoAdvance, Ecoinvest, Econergy, Ecosecurities and MGM International, and are based on the 2004-2006 period.

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 small-scale CDM project activity:

[7] ANEEL (Agencia Nacional de Energia Elétrica), IPCC (Intergovernmental Panel on Climate Change, ONS (Operadora Nacional do Sistema).

The approved methodology AMS-I.D version 13 prescribes the use of Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities for determining whether the project is additional. The Attachment A asks the project proponents to justify the additionality by showing that the project activity (and so the GHG emission reduction) faced prohibitive barriers such as: investment barrier, technological barrier, and other barriers.

The proposed project faces a combination of these barriers including: institutional barrier (e.g. non-market failures), investment barrier for small scale renewable energy projects, and barrier due to prevailing practice. The project, therefore has been proposed as a CDM project to overcome these barriers.

Institutional barrier

During the 1990s, a market-oriented reform was introduced in the Brazilian electricity sector with an objective to attract and increase private investment. This policy was in line with recommendations by multilateral agencies such as the IMF aimed at modifying the role of the State in the Brazilian economy. Eletrobras´ 10-Year Expansion Plan (2000-2009) published in 1999 emphasized the need for private investment to diversify the country's energy matrix (hydro-based), mainly by inducing investments in gas-based thermal generation. In 2000 the federal government launched the "Thermoelectric Priority Plan" (Plano Prioritário de Termelétricas, PPT) [8] in order to provide required emphasis on thermal power generation.

A new institutional framework was established with the conception of the Brazilian Electricity Regulatory Agency (Agência Nacional de Energia Elétrica, ANEEL) in 1996 with a mission to provide favorable conditions for the electricity market to develop in a balanced environment amongst agents. ANEEL´s responsibility includes: to regulate and supervise the generation, transmission, distribution and commercialization of electric power; to mediate conflicting interests among agents; to grant, permit and authorize electric-power facilities and services; to warrant fair electricity rates; to enforce investment by the regulated entities; and to encourage competition among the operators and to ensure universal access to services. Two additional institutions, the National Power System Operator (Operador Nacional do Sistema Elétrico, ONS) and the Wholesale Energy Market (Mercado Atacadista de Energia Elétrica, MAES) were also conceived to control generation, transmission and operation and to define rules and commercial procedures for the short term market, respectively.

Despite these new market-oriented regulatory framework, market and regulatory risks remained significant resulting in a low rate of private investment and in the consequent 2001-2002 power shortage. The institutional changes performed did not properly address important specificities of the Brazilian power sector in terms of its complexity and cost structure. Following the energy crisis, sector specialists claimed that the reform process was inadequate, mainly because it had failed to guarantee security-of-supply.

In 2004, the newly elected government decided to completely review the institutional rules of the electricity market. The Congress approved a new model to the electric sector in March/2004, and new regulations for the electric sector have been created (OCDE, 2005). According to the model, the demand and supply of electricity is coordinated by a "pool demand" to be estimated by the distribution companies that have to contract 100% of its electricity projected demand during the next 3 to 5 years. These

[8] Federal Decree 3,371 of February 24th, 2000, and Ministry of Mines and Energy Directive 43 of February 25th, 2000.

projections are evaluated by a new institution denominated Empresa de Planejamento Energético – EPE (Energetic Planning Company). EPE estimates the necessary expansion on supply capacity to be sold to the distribution companies through the pool. The negotiated electricity price is an average of all long-term contracted prices, and is the same for all distribution companies.

A “free market” was also established in parallel to the regulated long-term pool demand contracts. Large consumers (above 10 MW) have to inform the distribution companies with a 3-year notice that it wishes to change from the pool to the free market (or a 5-year notice vice-versa). These conditions are expected to become more flexible in the future. If real demand is higher than the projected supply, 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 demand 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 an option for a centralized institutional system, reinforcing the role of MME – Ministério das Minas e Energia (Mines and Energy Ministry) at long-term planning. EPE is responsible for preparing for MME a portfolio of aimed technologies and a list of strategic and non-strategic projects. MME will present this portfolio to CNPE – Conselho Nacional de Política Energética (National Council of Energetic Policy) and, after approval by CNPE, the strategic projects will be auctioned, based 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 lower tariff. Another institution created is the CMSE - Comitê de Monitoramento do Setor Elétrico (Electric Sector Monitoring Committee), in charge of monitoring the tendencies of electricity demand and supply.

Although the new model was designed to reduce market risk, its capacity to provide incentives for private investment still depends on how these regulatory rules are actually played out. Risks currently faced by potential private investors include:

- Government failure (or non-market failure), due to the more significant role of the government on long term planning, and political interference on new institutions created[9];
- Lack of transparent and flexible rules for the transition phase between the regulated and free electricity markets;
- Price volatility in the near term given the sectoral dependency on hydroelectric power (and thus, on rainfall levels) and uncertainties regarding the natural gas business; and,
- Lack of definite rules on the separation of vertically integrated companies (generators and distributors).

Investment barrier for small scale renewable energy projects

These and other uncertainties constitute a real barrier for additional private investment within the Brazilian electricity market, especially for small scale generation projects given the economies of scale achieved by larger projects. Specifically related to small hydro projects, market and non-market failures are negatively affecting price incentives. In June 2007 a public energy auction for renewable sources (i.e.

[9] The fifth anual ANEEL evaluation report produced by the US Chamber for Commerce in Brazil (AMCHAM), indicated that the level of government interference in the agency´s decision-making process has substantially increased in 2007 relative to 2006 (26 percentage points). For a full report refer to http://www.amcham.com.br.

wind, SHPs, and biomass) was conducted with a ceiling price of R$134.99 for small hydro projects. This ceiling price was considered insufficient by the power sector as an appropriate reference value for this type of renewable resource[10]. Besides non-competitive prices, high interest rates and taxes, and difficulties in obtaining environmental licenses hinders potential construction of small hydro plants. Project developers need to balance these risks against alternative investment options, as well as, the high level of guarantees required to finance this renewable resource. This investment barrier is exemplified by the various programs and incentive schemes previously organized by the federal government, but never successfully implemented.

A program called SHP-COM, for example, was structured at the beginning of 2001 by Eletrobras in partnership with BNDES. The main goal of SHP-COM was to support and encourage the construction of small hydro plants in Brazil. It included the financing of the project activity by BNDES and the commercialization of power by Eletrobras. In case the proposed project activity received approval by both agencies, there would be two contracts to be signed: (i) a financial agreement with BNDES, and (ii) a Power Purchase Agreement (PPA) with Eletrobras. The program was not successful because of the required guarantees and the clauses of the contracts (i.e., the project was not considered as a project finance basis and the lender demanded for direct guarantees from the developer, other than the project itself).

In 2002, the federal government launched the PROINFA[11] (Programa de Incentivo às Fontes Alternativas de Energia Elétrica) program to increase the share of renewable energy generation within the Brazilian energy matrix. The program planned to add 3,300 MW of installed capacity of small-hydro power plants, wind-power, and biomass, offering long-term contracts with special conditions, lower transmission costs, and lower interest rates from the local development banks. In 2005, the BNDES presented the last and final version of its financing incentive line to PROINFA, which is different from the one first considered for the program and that was not considered sufficiently attractive by potential entrepreneurs in terms of required guarantees and adequate pricing for generated energy. The program's objective of generating 3,300 MW by the end of 2007 from renewable energy sources was not met[12]. In December 2007, 40 renewable energy plants were operational with a capacity to generate a total of 1,048 MW, or 32% of the objective. Another 105 projects in the program's pipeline had the potential to add 2,346 MW if concluded. Of these 105 projects, 58 have started construction and 48 are facing significant problems. Based on contractual obligations established with ANEEL, 65 of the total number of power plants in the pipeline are officially delayed and may suffer penalties. The 1st PROINFA phase contracted a total of 1,195 MW from 63 small hydro projects. The table below illustrates the current status of this total number of plants.

Status	Quantity	Power (MW)	%
In operation	13	245.9	20.63%
Expected to enter operation in 2007	10	209.6	15.87%
Expected to enter operation in 2008	34	671.3	53.97%
Restrictions for operation in 2008	6	69.1	9.52%
Total	63	1195.9	

Source: III Conferência de SHP Mercado e Meio Ambiente – Pequenas Centrais Hidrelétricas Perspectivas e Desafios. Energest, 10/10/2007.

[10] Revista Brasil Energia n. 320, Julho 2007

[11] The PROINFA program was instituted by Law nº 10.438/2002 and revised by Law nº10.762/2003. More information can be obtained by the following website: http://www.mme.gov.br/programs_display.do?prg=5

[12] Source: Folha de São Paulo (Dezembro 2007). Programa de Fonte Alternativa esta Atrasado.

From the 50 small hydro plants that are still not operational, more than half (28) are not in time with the project schedule presented to ANEEL. The project participants did not apply to PROINFA, and therefore, does not have access to the benefits of the program. In any case, these results demonstrate that the incentives provided by PROINFA have been insufficient for project developers to reduce market risk and find available financing. The main reason for the reduced number of renewable energy project activities enrolled within both SHP-COM and PROINFA is the financial burden. Both processes of negotiating a PPA with the utility (i.e. Eletrobras) and obtaining funding from BNDES have proven to be very cumbersome. The developers perceive BNDES as requiring excessive guarantees in order to provide financing. Although this might be the Bank's role as a financing institution to mitigate risk, it is understood as a market barrier.

Specialists diverge on the possibility of creating favorable market conditions for new investments in completely liberalized electricity markets (Banks, 2003 and Watts 2001). The lack of consensus regarding the possibility of competitive markets to ensure long term security of supply stems from the following. The attractiveness of investments depends on the competitiveness of the new projects. However, this competitiveness depends on the costs structure of the power sector. In some countries, new generation projects have much lower costs than the established generation capacity based on inefficient coal based or oil-based thermal power plants. However, the power sector in other countries is based on cheap nuclear or hydro-based generation capacity (e.g. Brazil). In those countries, in general the new projects for electricity generation have higher costs than the installed capacity.

When the marginal cost of expansion tends to grow the task of implementing a free market for electricity proves to be a challenge. This is the case for Brazil. Since the new capacity tends to cost more than the installed capacity, new projects have difficulties in getting PPA contracts. On the other hand, government tends to hesitate in letting all electricity produced to be priced at the marginal costs level. Shortage in electricity supply drives government and regulators to further interfere in the market. Given that long-run marginal cost is increasing, distribution companies and free-consumers have no interest in contracting the bulk of the electricity needed in spot markets knowing that this price tends to increase. Price increases tend to create strong opposition to market liberalization.

Barrier due to prevailing practice

In terms of adding new energy to the system, the latest Brazilian energy balance and outlook report[13] specifies that Brazil´s installed capacity increased 5.9% from the period 2005-2006 to 419.3 TWh. Around 74% of electricity supply is matched by hydropower sources and 12.3% from thermal power sources. Small hydro plants make up less than 2% of total national supply. Thermal power supply (including natural gas, coal, and nuclear) increased at a rate of almost 10%, whilst hydropower increased by 3.3%. A recent study published by ANEEL estimates that Brazil will have to install an additional load of 28,000MW of new thermoelectric power plants in order to meet increasing electricity demand[14.] The 10-yr Electric Energy Expansion Plan (2006-2015)[15] prepared by the Ministry of Mines and Energy

[13] Balanço Energético Nacional 2007. Available at: http://www.mme.gov.br/site/menu/select_main_menu_item.do?channelId=1432&pageId=14131

[14] PNE 2030 – Plano Nacional Energético para 2030", the Brazilian strategic energetic plan for 2030. The plan has not yet been concluded but several meetings have been done.

[15] http://www.mme.gov.br/site/menu/select_main_menu_item.do?channelId=7622

(MME) in 2006 estimated that small scale renewable energy sources will have a share of 4% (1% increase in 10 years) in December 2015 within the Brazilian electric energy matrix.

CDM approval and barrier analysis

Despite the financial and institutional hurdles faced by the project, AES Tietê S.A. decided to make the investment as part of the company's global effort to increase its renewable energy generation portfolio in Brazil and elsewhere, and reduce greenhouse gas emissions Although from the financial standpoint, large scale energy projects (e.g. large hydroelectric dams or thermal power generation) are more attractive, the company decided to approve the project based on additional criteria such as the type of energy source and CER revenues. It is important to consider that AES Tietê has an alternative option to invest in large scale projects in order to obtain higher returns, and to meet its capacity expansion obligation within the State of São Paulo. According to the concession contract established between ANEEL and AES Tietê, the company is required to expand its capacity potential in 15% of current capacity (2.54 thousand MW) or around 400 MW.[16] Given the economies of scale achieved by larger scale projects, AES Tietê would be better off allocating human and financial resources in order to meet this legal obligation at lower costs. The fact that AES Tietê is committed to increase its portfolio of renewable energy, by funding projects that may generate CERs, has been critical for Board approval before the project's starting date (as included in the 169th director's meeting memo, dated 13/11/2007).

Common practice analysis

In spite of all government incentives for private investment in renewable energy projects, the share of small hydro power plants within the Brazilian electricity market is still insignificant. Based on data available on July 15, 2008, there were 158 small hydropower plant projects in Brazil approved between 1998 and 2008, which have not yet started construction; and SHPs in operation, generate 2% of the total electric power in the country.

In order to complete the additionality argument, a common practice analysis was performed based on publicly available information provided by ANEEL. In the State of São Paulo, where the Jaguari Mirim Hydroelectric Plants are located, there are 38 small hydro power plants in operation, which correspond to approximately 0.65% of the total electricity generated in the State. For the south-southeast-midwest grid[17], there are 284 small hydro power plants in operation, which correspond to approximately 2% of the total electricity generated for the grid (as of July 15, 2008)[18]. The tables below summarize the installed capacity in the State of São Paulo, and south-southeast-midwest grid respectively, including: hydro (CGH, UHE), wind (EOL), small hydros (SHPs), thermal (UTE), and nuclear (UTN) sources.

[16] Contrato de Concessão Nº 92 / 99 – ANEEL – TIETÊ and Edital Nº SF/002/99 Alienação de ações do capital social da Companhia de Geração de Energia Elétrica Tietê. Setembro 1999.

[17] Includes the States of Distrito Federal, Espírito Santo, Goiás, Mato Grosso, Mato Grosso Do Sul, Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, São Paulo and Tocantins.

[18] Source: http://www.aneel.gov.br/aplicacoes/ResumoEstadual/CapacidadeEstado.asp?cmbEstados=SP:SÃO%20PAULO

State of São Paulo Enterprises in Operation			
Type	**Quantity**	**Power (kW)**	**%**
CGH	22	14.141	0,07%
EOL	0	0	0,00%
PCH	38	141.894	0,65%
UHE	48	17.772.160	81,85%
UTE	345	3.783.725	17,43%
UTN	0	0	0,00%
Total	**453**	**21.711.920**	100%

South-Southeast-Midwest Enterprises in Operation			
Type	**Quantity**	**Power (kW)**	**%**
CGH	206	109.254	0,11%
EOL	8	167.900	0,17%
PCH	284	2.003.519	2,03%
UHE	171	79.390.530	80,39%
UTE	600	15.079.765	15,27%
UTN	2	2.007.000	2,03%
Total	**1271**	**98.757.968**	100%

For the total of 38 small hydro plants in operation within the State of São Paulo, 36 began operation either earlier than or in the 1960s[19]. They were built during a different historical context, including a set of barriers not comparable to the ones faced by modern projects. One of the two remaining plants – SHP Mogi Guaçu built in 1994 by the public utility CESP[20] – was acquired by AES Tietê S.A. during the privatization of hydro plants in the State of São Paulo in the 1990s. Since 1977, CESP helped to develop the State of São Paulo generation capacity. In 1991 CESP began the construction of SHP Mogi Guaçu with public funding. SHP Areal began operation in 1988 and although is part of ANEEL´s database for the State of São Paulo, it is located within the State of Minas Gerais. Prior to the 1960s (from the post-war period of 1946 to the creation of Eletrobras in 1962), the Brazilian development model was centered on the planning functions of the State. The role of the State within this period was one of significant interference in the productive and financial sectors. BNDES constituted the main financial vehicle for electricity companies (mostly state-owned) to obtain necessary guarantees and credit to import and install generation, transmission, and distribution equipment. Therefore, market-based instruments applied to meet a growing demand for energy were comparatively insignificant.

Additional small hydro projects in Brazil are still under development, and waiting for better financing opportunities. Most developers who funded their projects outside of PROINFA have taken CDM as

[19] CSPE – Comissão de Serviços Públicos de Energia, "Pequenas Centrais Hidrelétricas no Estado de São Paulo", 2004; http://www.aneel.gov.br, and http://www.cmsenergy.com.br/site/Default.aspx?tabid=147

[20] Companhia Energética de São Paulo

decisive factor for completing their projects. The Brazilian government has endorsed that the projects under the PROINFA program are also eligible to participate in the CDM process, in accordance with the decision of the UNFCCC about eligibility of projects derived from public policies. The legislation which created PROINFA took into account possible revenues from the CDM in order to proceed with the program[21]. Therefore, similar activities (within or outside PROINFA) consider additional incentives provided by the CDM as a necessary condition to overcome financial hurdles.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Emission reductions are calculated based on the "Tool to calculate the emission factor for an electricity system" version 01. A combined margin (CM) approach based on a simple adjusted OM was selected. The methodological tool uses derived margin parameters that were applied in the context of the project to determine appropriate emission factors. It is also referred in the "Tool to calculate project emissions from electricity consumption" version 01.

The emission reduction ERy by the project activity during a given year y is the difference between the baseline emissions (BEy), project emissions (PEy) and emissions due to leakage (Ly), as follows:

$$ERy = BEy - PEy - Ly \qquad (1)$$

Following AMS-I.D (version 13) methodology, no project emission is taken into consideration. The power density for SHP São José and São Joaquim is respectively, 400 and 36.14 W/m^2.

The methodology requires calculating leakage if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity. Since neither case is true for the project activity, there is no leakage to be considered. Therefore, both the project and leakage emissions are considered to be zero, PEy=0 and Ly=0.

Thus the baseline emissions at each year y (BEy in tCO2) are the product of the baseline emissions factor (EFy in tCO2/MWh), times the electricity supplied by the project activity to the grid (EGy in MWh) minus the baseline electricity supplied to the grid in case of modified or retrofit facilities (EG baseline in MWh), as follows:

$$BEy = (EGy - EGbaseline) \times EFy) \qquad (2)$$

The baseline emission factor (EFy) is calculated through the Combined Margin (CM) method, that is a way to weight the contribution from the operation of existing thermal power plants and the contribution from the addition of new thermal power plants to the system, through the operating margin (OM) and the build margin (BM) factors respectively.

The "Tool to calculate the emission factor for an electricity system" version 01 indicates that the emission factor of the grid is determined by the following steps after the identification of the relevant electric power system, and the selection of an operating margin (OM) method:

[21] Decree Number 5.025 (March 30th, 2004).

- Calculate the operating margin emission factor according to the selected method
- Identify the cohort of power units to be included in the build margin (BM)
- Calculate the build margin emission factor
- Calculate the combined margin (CM) emissions factor

Step 1. Calculate the operating margin emission factor

In order to determine the combined margin emission factor, the simple adjusted operating margin method has been selected from the four options proposed in the methodology, since the low-cost/must-run resources constitute more than 50% of total grid generation and the dispatching information is not publicly available in Brazil.

The data vintage adopted for this project is the *ex-ante*: the full generation weighted average for the most recent 3 years for which data are available at the time of SSC-PDD submission.

The simple adjusted operating margin emission factor (tCO2e/MWh) is a variation of the simple operating margin emission factor[22], where the power sources (including imports) are separated in low-cost/must-run power sources (k) and other power sources (j). It is calculated based on data on fuel consumption and net electricity generation of each power plant/ unit (option A) as follows:

$$EF_{grid,OM\text{-}adj,y} = (1-\lambda_y)\times\frac{\sum_{i,j} FC_{i,j,y}\cdot NCV_{i,y}\cdot EF_{CO2,i,y}}{\sum_j EG_{j,y}} + \lambda_y \times \frac{\sum_{i,k} FC_{i,k,y}\cdot NCV_{i,y}\cdot EF_{CO2,i,y}}{\sum_k EG_{k,y}} \quad (3)$$

where

$EF_{grid,\ OM\ simple,\ y}$	Simple adjusted operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$FC_{i,j,\ y}/\ FC_{i,k,\ y}$	Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,\ y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,\ y}$	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
EG_y	Net electricity generated and delivered to the grid by all power sources serving the system in year *y* (MWh)
Λ_y	Lambda factor: fraction of time during low-cost/must-run sources are on the margin
i	All fossil fuel types combusted in power sources in the project electricity system in year *y*
y	The three most recent years for which data is available at the time of submission of the CDM SSC-PDD to the DOE for validation (*ex ante* option)
k	Power plants/units which are either low-cost or are must-run

[22] The simple operating margin emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO_2e/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants.

j	Remaining power plants/units

On the other hand, the lambda factor (λ) is the determined as:

$$\lambda_y = \frac{number\ of\ hours\ per\ year\ for\ which\ low-\cos t/must-run\ sources\ are\ on\ m\arg in}{8{,}760\ hours\ per\ year} \qquad (4)$$

According to the methodological tool, the number of hours during low-cost/must-run sources is on the margin are obtained through the following procedure (see Figure 5 below):

Step i) Plot a Load Duration Curve

Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8,760 hours in the year, in descending order.

Step ii) Organize Data by Generating Sources

Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources.

Step iii) Fill Load Duration Curve

Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/must-run resources.

Step iv) Determine the "Number of hours per year for which low-cost/must-run sources are on the margin"

First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8,760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and lambda is equal to zero. Lambda is the calculated number of hours divided by 8,760.

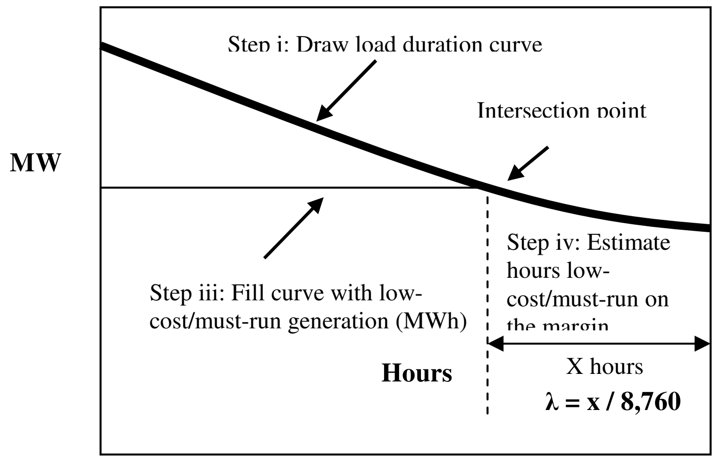

Figure 5: Illustration of lambda calculation for simple adjusted operating margin emission factor

Step 2. Identify the cohort of power units to be included in the build margin

The sample group m used to calculate the BM consists of either:

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

According to the methodological tool, from these two options, the sample group that comprises the larger annual generation should be used. An ex-ante calculation of the build margin emission factor, based on the most recent information available on plants already built for sample group m at the time of SSC-PDD submission, has been selected for this project activity. This option does not require the monitoring of the emission factor during the crediting period.

Step 3. Calculate the build margin emission factor (EFBM)

The build margin emissions factor is the generation-weighted average emission factor (tCO2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (5)$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

The CO_2 emission factor of power unit m ($EF_{EL,\ m,y}$) is determined as per Option B2 described in step 3(a) of the “ Tool to calculate an emission factor for an electricity system” version 01, according to the following equation:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}} \quad (6)$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$EF_{CO2,m,i,y}$	Average CO_2 emission factor of fuel type i used in power unit m in year y (tCO_2/GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit m in year y (%)
y	Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option) or the applicable year during monitoring (ex post option), following the guidance on data vintage in step 2

Step 4. Calculate the combined margin emission factor (*EF_{grid}*)

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \qquad (7)$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build margin emissions factor (%)

The same default value of 0.5 is used for wOM and wBM for the first crediting period.

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

The operating margin and build margin emission factors are calculated *ex-ante*, based on the most recent 3 years for which data are available, and on the most recent information available on plants already built at the time of this PDD, respectively.

Data / Parameter:	***GEN_j/GEN_k***
Data unit:	MWh
Description:	Electricity delivered to the grid by power sources j/k
Source of data used:	ONS, the national dispatch center (daily reports)
Value applied:	See Annex 3 below
Justification of the choice of data or description of measurement methods and procedures actually applied :	The national dispatch center supplies the raw dispatch data for the whole Brazilian interconnected grid. This data source is relevant for the calculation of the baseline.

Any comment:	These data are available in an excel spreadsheet presented to the DOE during the validation process.

Data / Parameter:	***Power Plants (Built Margin)***
Data unit:	N/A
Description:	New Electric Power Plants added to the Electric System
Source of data used:	National Agency of Electric Power (ANEEL) - Agência Nacional de Energia Elétrica. (http://www.aneel.gov.br/).
Value applied:	Data collected in December 2006
Justification of the choice of data or description of measurement methods and procedures actually applied :	ANEEL is a Federal Agency which is in charge to regulate and supervise the Electric Generation, Transmission, Distribution and the commercialization of Electric Energy
Any comment:	These data are available in an excel spreadsheet presented to the DOE during the validation process.

Data / Parameter:	***Load Duration Curve***
Data unit:	MW vs. hrs
Description:	Chronological load data for each hour of a year
Source of data used:	Operador Nacional do Sistema Elétrico, Centro Nacional de Operação do Sistema, Acompanhamento Diário da Operação do Sistema Interligado Nacional (daily reports)
Value applied:	See Annex 3 below
Justification of the choice of data or description of measurement methods and procedures actually applied:	See Section B.6
Any comment:	These data are available in an excel spreadsheet presented to the DOE during the validation process.

Data / Parameter:	***Electricity Imports***
Data unit:	MWh
Description:	Net electricity imported by the south/southeast/midwest connected electricity system
Source of data used:	Data provided by ONS (the national dispatch center)
Value applied:	See annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	These data are from an official source, and are made public available.
Any comment:	These data are available in an excel spreadsheet presented to the DOE during the validation process.

Data / Parameter:	$EF_{OM,y}$
Data unit:	tCO_2/MWh
Description:	CO_2 Operating Margin emission factor of the grid in a year *y*
Source of data used:	Data for *EFOM,y* calculation were provided by ONS (National dispatch center). Calculated according to the “Tool to calculate the emission factor for an electricity system” version 01.
Value applied:	0.4749
Justification of the choice of data or description of measurement methods and procedures actually applied:	According to the methodological tool, version 01 the option chosen for the calculation of the emission factor in this project is option (b): simple adjusted operating margin factor. This choice is due to the fact that, in Brazil, even though most of the energy produced in the country comes from hydroelectric power, most of these low costs investments in hydro electrics are exhausted. Therefore, the possibility of investments in non-renewable sources arises, such as thermoelectric power plants. (See Annex 3)
Any comment:	These data are available in an excel spreadsheet presented to the DOE during the validation process.

Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO_2/MWh
Description:	CO_2 Build Margin emission factor of the grid in a year *y*.
Source of data used:	Data for *EFBM,y* calculation were provided by ONS (National dispatch center).
Value applied:	0.0903
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according to the “Tool to calculate the emission factor for an electricity system” version 01. (See Annex 3).
Any comment:	These data are available in an excel spreadsheet presented to the DOE during the validation meeting.

Data / Parameter:	***Reservoir Area***
Data unit:	Square meter
Description:	Surface area at full reservoir level
Source of data used:	Satellite images
Value applied:	São José – 0.01 km^2 São Joaquim - 0.71 km^2
Justification of the choice of data or description of measurement methods and procedures actually applied:	Reservoir area was estimated by MEK Engenharia and included in the basic engineering plan for each small hydro plant. It was estimated based on complete energy and technical studies for the Jaguari Mirim River.
Any comment:	-

Data / Parameter:	*λ*
Data unit:	No unit
Description:	Fraction of time during which low-cost/must-run sources are on the margin.
Source of data used:	Data provided by ONS
Value applied:	λ*2004*=0,4937, λ*2005*=0,5275, λ*2006*=0,4185
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated according to the "Tool to calculate the emission factor for an electricity system" version 01. (See Annex 3).
Any comment:	These data are available in an excel spreadsheet presented to the DOE during the validation process.

Data / Parameter:	***EFy***
Data unit:	tCO_2/MWh
Description:	Emission factor for the Brazilian South/Southeast/Midwest interconnected grid
Source of data used:	Data for EFy calculation were provided by ONS (the national dispatch center)
Value applied:	0.2826
Justification of the choice of data or description of measurement methods and procedures actually applied:	These data are from an official source, and are made public available. The calculation for this combined margin is based on the "Tool to calculate the emission factor for an electricity system" version 01. (See Annex 3).
Any comment:	These data are available in an excel spreadsheet presented to the DOE during the validation process.

Data / Parameter:	$F_{i,j}$ /$F_{i,k}$
Data unit:	Energy units
Description:	Amount of fuel i consumed by relevant power sources j/k

Source of data used:	Value determined using the fossil fuel conversion efficiencies from Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A. F. Simoes, H. Winkler and J.-M. Lukamba. “Road testing baselines for greenhouse gas mitigation projects in the electric power sector.” OECD and IEA information paper, October 2002. Where plant-specific efficiency data are not available, the following values are used: ▪ Combined cycle gas turbine power plants: 50% ▪ Open cycle gas turbine power plants: 32%, ▪ Sub-critical coal power plants: 33% ▪ Oil based power plant sub-critical oil boiler: 33%. Source: CDM-EB-2005.11.29-DOEs request for guidance on average plant efficiencies. Decision of the CDM EB responding to DNV “Request for guidance: Application of AM0015 (and AMS-I.D) in Brazil, dated 7 October 2005.
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	See Section B.6
Any comment:	This is used to determine the grid emission factor.

Data / Parameter:	$F_{i,m}$
Data unit:	Energy units
Description:	Amount of fuel i consumed by power sources m

Source of data used:	Value determined using the fossil fuel conversion efficiencies from Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A. F. Simoes, H. Winkler and J.-M. Lukamba. "Road testing baselines for greenhouse gas mitigation projects in the electric power sector." OECD and IEA information paper, October 2002. Where plant-specific efficiency data are not available, the following values are used: • Combined cycle gas turbine power plants: 50% • Open cycle gas turbine power plants: 32%, • Sub-critical coal power plants: 33% • Oil based power plant sub-critical oil boiler: 33%. Source: CDM-EB-2005.11.29-DOEs request for guidance on average plant efficiencies. Decision of the CDM EB responding to DNV "Request for guidance: Application of AM0015 (and AMS-I.D) in Brazil, dated 7 October 2005.
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	See Section B.6
Any comment:	This is used to determine the grid emission factor.

Data / Parameter:	CEF_i
Data unit:	tCO_2/energy unit
Description:	Carbon dioxide emission factor per unit energy of fuel i
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 1, Table 1.4, Pages 1.23 and 1.24
Value applied:	Natural Gas: 56.10 Diesel: 74.10 Residual Fuel Oil: 77.40
Justification of the choice of data or description of measurement methods and procedures actually applied:	According to the methodology, if local values are not available, country-specific values are preferable to IPCC world-wide default values. In this case, there is not a reliable local/national factor, thus, the IPCC default value is considered.
Any comment:	This is used to determine the grid emission factor.

Data / Parameter:	$OXID_i$

Data unit:	-
Description:	Oxidation factor of fuel i
Source of data used:	IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Volume 3 (1996), Table 1-6, Page 1.29.
Value applied:	Natural Gas: 0.995 Diesel: 0.99 Residual Fuel Oil: 0.99
Justification of the choice of data or description of measurement methods and procedures actually applied :	The oxidation factor of a fuel is taken from the 1996 Revised IPCC Guidelines.
Any comment:	This is used to determine the grid emission factor.

B.6.3 Ex-ante calculation of emission reductions:

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As mentioned above, since project emissions and leakage emissions are zero, emission reductions are the same as baseline emissions, as follows:

$$ER = EG \times EF_{grid}$$

The project is expected to generate around 30,543 MWh of energy per year. For the leap year 2012, the amount of energy will sum up to 30,626 MWh.

As mentioned above, the emission factor of the grid is determined using the "Tool to calculate the emission factor for an electricity system" version 01, consisting of the combination of the operating margin and the build margin factors. As is shown in Annex 3 below, the operating margin emission factor results to be 0.4749 tCO2/MWh and the build margin emission factor 0.0903 tCO2/MWh. Thus, the resulting grid emission factor is:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \text{ x } W_{OM} + EF_{grid,BM,y} \text{ x } W_{BM} = 0.4749 \text{ x } 0.5 + 0.0903 \text{ x } 0.5 = \mathbf{0.2826\ tCO_2/MWh}$$

Thus, the annual emission reduction results to be:

ER = **30,554** MWh/year x 0.2826 tCO_2/MWh = **8,634 tCO_2/year.**

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

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***Ex-ante* estimation of emission reductions during the first 7-year crediting period**

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of Leakage (tCO_2e)	Estimation of Overall reductions (tCO_2e)
2009 (October 1st – Dec. 31st)	0	2,158	0	2,158
2010	0	8,631	0	8,631
2011	0	8,631	0	8,631
2012*	0	8,655	0	8,655
2013	0	8,631	0	8,631
2014	0	8,631	0	8,631
2015	0	8,631	0	8,631
2016 (Jan. 1st-Sept. 30th)		6,473		6,473
Total (tonnes of tCO_2e)	**0**	**60,441**	**0**	**60,441**

Note: 2012 is a leap year.

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

The project is a grid-connected renewable power generation project activity which meets all the applicable criteria stated in the "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories AMS.I.D. (version 13)". The monitoring section of AMS.I.D states that the monitoring shall consist of metering the electricity generated by the renewable technology.

B.7.1 Data and parameters monitored:

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Net electricity generated by the renewable technology delivered to grid in the year y
Source of data to be used:	Electronic records from the energy metering. The meter currently selected is model Q1000 supplied by Schlumberger.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	30,543 (2012: 30,626)
Description of measurement methods and procedures to be applied:	Net electricity supplied to the grid will be measured by the project (seller) and by the electricity buyer through an electricity meter connected to the grid and through sales receipt. Net electricity supplied to the grid will be measured every five minutes. This data will be hourly recorded by the seller and sent to the Electricity Trade Chamber (CCEE – Câmara de Comercialização de Energia

	Elétrica).
QA/QC procedures to be applied:	The uncertainty level of the data is low, and the equipment will be regularly calibrated (see section B.7.2).
Any comment:	This data will be used to calculate the emission reductions obtained through the project activity. Data will be archived electronically until two years after finishing the crediting period.

Data / Parameter:	***Reservoir Area***
Data unit:	Square meter
Description:	Surface area at full reservoir level
Source of data to be used:	Satellite images
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable to the calculation of the emission reduction calculation
Description of measurement methods and procedures to be applied:	Measurement to be done at the start of the project in order to ensure there is no increase in the area occupied by the reservoir.
QA/QC procedures to be applied:	To be done only once at the start of operation for each small hydro plant.
Any comment:	

B.7.2 Description of the monitoring plan:

>>
The following parameters will be monitored:

Electricity generation from the proposed project activity;
Data needed to recalculate the operating margin emission factor, if needed, based on the choice of the method to determine the operating margin (OM), consistent with "Tool to calculate the emission factor for an electricity system" version 01;
Data needed to recalculate the build margin (BM) emission factor, if needed, consistent with "Tool to calculate the emission factor for an electricity system" version 01;

Given that the emission factor is calculated ex-ante, the only parameter to be monitored is the electricity generated by the project. The project will proceed with the necessary measures for power control and monitoring. Together with the information produced by both ANEEL and ONS, it will be possible to monitor the grid power mix in order to recalculate the combined margin at any renewal of the crediting period.

Before the first crediting period, the Monitoring Plan will be prepared covering the aspects to warrant the quality and the reliability of the monitoring process, including essentially the following items:

-Procedures for training, periodical update and eventual substitution of operators and other personnel involved in the monitoring process;

-Procedures for quality assurance and calibration of measuring equipment;
-Procedures for archiving and back-up of monitored data;
-Procedures for recording activities related to above mentioned subjects.

The entity responsible for the operations and maintenance process will be AES Tietê S.A. at the Centro de Operação da Geração (COG) located in the municipality of Bauru, in the State of São Paulo. AES Tietê will be responsible for data collection, management, and archive. The company's Environmental Team will be responsible for monitoring emission reductions and preparing reports for verification audits.

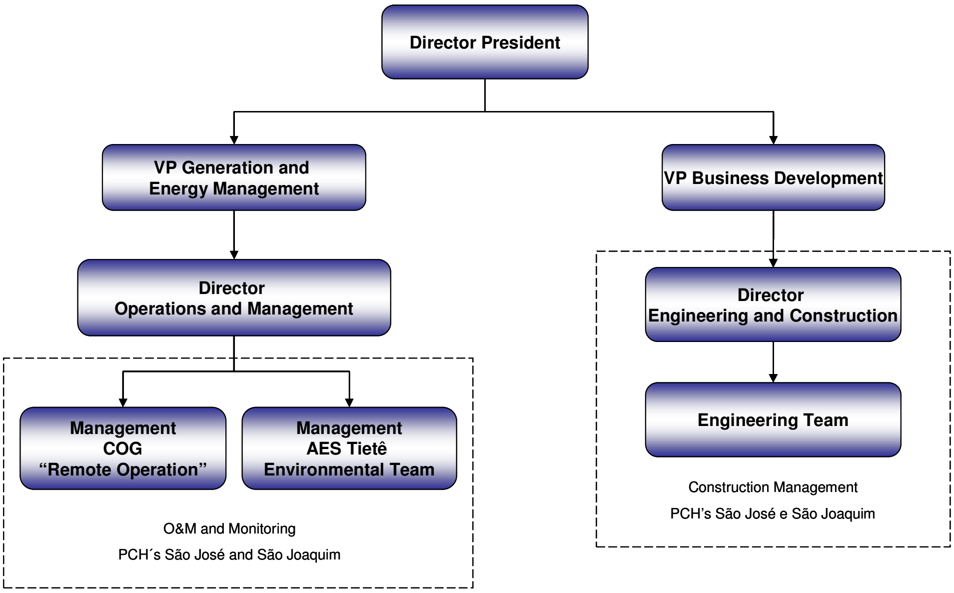

Figure 3 Project organization

The Monitoring Plan will be based on the internal corporate procedure entitled "Procedimentos para Estabelecimento de Fronteiras e Responsabilidades sobre o Sistema de Medição para Faturamento (SMF) da AES Tietê S.A. (MED-001)". The procedure serves as a guideline for power control and monitoring according to procedures pre-defined by ONS[23] and approved by ANEEL. As with other small hydro plants operated by AES Tietê within the State of São Paulo, SHP São José and SHP São Joaquim will be equipped with the following equipment for the SMF:

- Capacity potential transformers
- Electricity current transformers
- Protected cables
- Measuring panels for billing
- Measuring devices
- Ancillary circuits

[23] ONS control and monitoring procedures may be viewed at http://www.ons.org.br/procedimentos/index.aspx. These include normative documents which define necessary requirements for electricity sector agents to operate within the national integrated electricity system.

Each small hydro plant will send on-line data to Bauru's COG equipped as AES Tietê "Central de Medição" or Measuring Headquarters with the objective to collect, monitor, archive, generate reports, error logs, and failure reports for measuring devices. Preventive maintenance is periodically performed for the SMF according to the "Plano Anual de Manutenção Preventiva" (Annual Preventive Maintenance Plan) developed by the responsible agent at Bauru's COG. Corrective measures for the SMF are applied by the responsible agent at Bauru's COG and these include the:

- Elaboration of equipment failure reports;
- Correction of components, equipments, modules and systems; and,
- Notify the ONS and CCEE agents for corrective actions taken place.

Measuring devices are calibrated by the Wh consumption comparative method, with artificial load, with monophasic or triphasic tests, within labs or in the field, according to standards traced to the "Instituto Nacional "de Metrologia, Normalização e Qualidade Industrial – INMETRO". The standard used for calibration should be the one already performed by Bauru's COG responsible agent for the SMF or by the contracted lab. The standard(s) applied has to include a calibration certificate valid for the event period. Calibration periodicity will be at least once per year. The calibrated measuring device with errors outside the specified limits by the applied standard(s) should be substituted. As with other currently operating small hydro plants, ONS and CCEE may request regular inspections to the SMF.

Net electricity supplied to the grid will be measured every five minutes. This data will be hourly recorded by Bauru's COG and sent to the Electricity Trade Chamber (CCEE – Câmara de Comercialização de Energia Elétrica). The meter currently selected is model Q1000 supplied by Schlumberger. The meter specifications include bi-directional measurement of electricity, which means that it has the capacity to register imported and exported electricity from a determined source. The accuracy associated with the Q1000 electricity meter is 0.2%.

Bauru's COG responsible agent for the SMF will also send periodic monitoring reports to AES Tietê Environmental Team that will include the following information:

- Net electricity generated by the small hydro plant for that period;
- Equipment failure reports; and,
- Corrective action reports.

AES Tietê Environmental Team will be responsible for consolidating the necessary information for the verification audits by accredited DOEs.

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

>>

Date of completion: 04/03/2008
Name of the responsible person/entity:

Demóstenes Barbosa Silva, Samy Hotimsky
AES Tietê S.A. (project participant)

Rua Lourenço Marques, 158, 2º Floor
CEP 04547-100, São Paulo - Brazil
Tel. (55 11) 2195-2303

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:

>>
12/02/2008

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

>>
30 years and 0 months

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

>>
Renewable crediting period

C.2.1. Renewable crediting period

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

>>
01/10/2009

The crediting period will start on October 01st, 2009, or on the date of registration of the CDM project activity, whichever is later.

C.2.1.2. Length of the first crediting period:

>>
7 years and 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>N/A

C.2.2.2. Length:

>>N/A

SECTION D. Environmental impacts

>>

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

Although small hydropower plants are supposed to receive quicker environment impact assessment, the Brazilian federal legislation establishes the following step process.

Prior to the EPC (Engineering Procurement and Construction) process, a hydro power plant should receive a previous environment assessment in order to receive a previous permit: LP (Licença Previa). With this previous permit in hand the project owner should detail the project and, having the detailed project, submit it to the same Environment Agency responsible for the previous permit. From this second round environmental assessment, the positive result is an installation permit: LI (Licença de Instalação) which establishes the requirements for the construction of the hydro power plant. These requirements refer, normally, to cares to be present during the construction phase as much as programs to be designed for specific purposes like fish stock preservation, riparian areas recuperations etc. The final necessary permit to be issued is the operating permit (Licença de Operação: LO).

CONAMA resolution 001/86 article 2º XI determines that a power plant (for either non-renewable or renewable sources) with power capacity above 10 MW requires an EIA (Environmental Impact Assessment) and respective RIMA (Environmental Impact Report). This is not the case for both the SHP São Joaquim and SHP São José. For the State of São Paulo, resolution SMA – 042 from 29/12/1994 and resolution SMA 054 from 30/11/2004 includes the necessary steps to obtain environmental licenses. The DAIA[24] (Departamento de Avaliação de Impacto Ambiental) department at the CETESB makes the decision to either (i) neglect an environmental license request because of technical or legal requirements, (ii) request an EIA/RIMA for the project based on a Preliminary Environmental Report (RAP), or (iii) do not request an EIA/RIMA for the project and issue a LP based on a RAP. The DAIA specifies that for any type of development activity, a RAP has to be evaluated. For both small hydro plants, the DAIA issued an LP based on both RAPs presented in 2003[25], and did not request a more complete EIA study.
The RAP reports presented to DAIA included the following environmental impacts (considered minor) during the construction and operation phases: vegetation losses, erosive processes and silting, and impacts on water quality including enhanced turbidity, organic and nutrient deposition, and potential oil contamination due to onsite construction works. Mitigation measures for environmental impacts for both the construction and operation phases were agreed between the project developer and the environmental agency. These measures will be monitored by the AES Tietê project development team.
The power plants have the following LP and LI licenses issued by DAIA/CETESB according to the RAPs evaluated by the agency:

- LP São José #00672 (issued on 12/12/2003)
- LP São Joaquim #00674 (issued on 12/12/2003)

- LI São José #00352 (issued on 19/07/2005)

[24] More information may be obtained from http://www.cetesb.sp.gov.br/licenciamentoo/daia/daia.asp.

[25] Relatório Ambiental Preliminar – RAP Volume I – Texto. SHP São José (Setembro/2003) LIMIAR Engenharia Ambiental; Relatório Simplificado para Licenciamento Ambiental Volume I/II. SHP São Joaquim Agosto/2003) LIMIAR Engenharia Ambiental.

- LI São Joaquim #00353 (issued on 19/07/2005)

These (LI) licenses remain valid during a period of 05 years.

No transboundary environmental impacts are expected from this project activity.

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:

>>

The proposed project includes two run-of-river small hydropower plants, and therefore, the environmental impact is considered non-significant as compared to other types of power generation alternatives. The licenses (LIs) for the two small hydro plants were granted by DAIA/CETESB accordingly.

SECTION E. Stakeholders' comments

>>

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

>>

The Resolution number 1, issued by CIMG (Comissão Interministerial de Mudança Global do Clima) or the Brazilian DNA, established that the consultation must be performed by the project sponsor at least with the following entities:

Municipality and Alderman Chamber
State and Municipal Environmental Agencies
Brazilian Forum of NGOs
Community Associations
Public Ministry

Stakeholders were invited by mail to participate in this process on 26th of March 2008, and by postal on 29th of March 2008. The invited stakeholders were the following:

Prefeitura Municipal de São João da Boa Vista
Câmara Municipal de São João da Boa Vista
Associação Comercial e Empresarial de São João da Boa Vista
Promotoria de Justiça de São João da Boa Vista
Departamento de Engenharia e Meio Ambiente de São João de Boa VistaMinistério Público Federal, Procuradoria da República no Município de São João da Boa Vista
Companhia de Tecnologia de Saneamento Ambiental - CETESB
Secretaria de Estado do Meio Ambiente - SMA
Comitê de Bacia Hidrográfica do Rio Mogi Guaçu
Fórum Brasileiro de ONGs e Movimentos Sociais para o Meio Ambiente the local stakeholders are above (São João da Boa Vista)

The following documents were made publicly available at http://www.aestiete.com.br to all potential stakeholders:

Executive Summary
Project Design Document (PDD)
Annex III (according to Resolution Nº 1 of the CIMGC)

E.2. Summary of the comments received:

>>
A comment was received from a stakeholder who sent an email message about the project through AES Tietê website. The stakeholder asked if another deactivated small hydro plant, Santa Inês, would also be part of the project activity.

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

>>
A response by the project developers was sent by email to the stakeholder.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Represented by:	Demostenes Barbosa Silva
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Represented by:	
Title:	Vice President
Salutation:	Mr.
Last Name:	Rotsaert

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding will be used in this project activity.

Annex 3

BASELINE INFORMATION

The basic data and baseline calculation are presented on a spreadsheet made available to the DOE during the validation process. In this worksheet we can see all the formulas, data and results that compose the Emission Factor adopted in the present project.

The table bellow presents the conclusion of the spreadsheet:

Prepared by AgCert, EcoAdvance, Ecoinvest, Econergy, Ecosecurities and MGM

Source: Operador Nacional do Sistema Elétrico, Centro Nacional de Operação do Sistema, Acompanhamento Diário da Operação do SIN (daily reports from Jan. 1, 2006 to Dec. 31, 2006)

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid

Baseline	EF_{OM} [tCO_2/MWh]		λ_y		Generation [MWh]
2006	0,8071		0,4185		315.192.117
2005	0,9653		0,5275		315.511.628
2004	0,9886		0,4937		301.422.617
	$EF_{OM, simple-adjusted}$ [tCO_2/MWh]		$EF_{BM,2006}$		Default EF_y [tCO_2/MWh]
	0,4749		0,0903		0,2826
	Alternative weights		Default weights		
	w_{OM} =	0,75	w_{OM} =	0,5	Alternative EF_y [tCO_2/MWh]
	w_{BM} =	0,25	w_{BM} =	0,5	0,379

$EF_{OM,average}$ [tCO_2/MWh]		Imports (MWh) net intl	Imports (MWh) net national
2006	0,0585	0	3.865.158
2005	0,0546	0	0
2004	0,0596	0	0

Annex 4

MONITORING INFORMATION

According to the ”Tool to calculate the emission factor for an electricity system” version 01, where project participants select to calculate emission factors on an ex-ante basis, at least EGY shall be monitored together with all parameters required to recalculate the combined margin at any renewal of a crediting period.

The “Tool to calculate the emission factor for an electricity system” describes the procedure and equations for calculating emission reductions from monitored data. For this specific project, the methodology is applied through a spreadsheet model as part of the Monitoring Protocol. As specified on section B.7.2, the entity responsible for monitoring activities will be AES Tietê S.A.

AES Tietê environmental staff must complete the electronic worksheets on a monthly basis. The spreadsheet automatically provides annual totals in terms of GHG reductions achieved by the project. The model contains a series of worksheets with different functions:

- Data entry sheets (Electricity Generation and Grid Emission Factor)
- Result sheet (Emission Reduction)

There are cells where the user is allowed to enter data. All other cells contain computed values that cannot be modified by the staff.

A color-coded key is used to facilitate data input. The key for the code is as follows:

- ***Input Fields:*** Pale yellow fields indicate cells where project operators are required to supply data input, as is needed to run the model;
- ***Result Fields:*** Green fields display result lines as calculated by the model.

All electronic data will be backed up on a daily basis, and two electronic copies of each document will be kept in different locations (the COG and AES Head Office in São Paulo, Brazil). These data will be archived for two years following the end of the crediting period.

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