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

CONTENTS

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:

ARS Small Hydroelectric Power Plant (hereafter referred to as "ARSSHP")

Version 01
09 March 2007

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

The ARSSHP project involves the implementation of Small Hydroelectric Power Plant in the Von Den Steinen river. The River is located in the Nova Ubiratã municipality at Mato Grosso State, midwest region of Brazil. The ARSSHP is sited in the mid-west region of Brazil, where thermoelectric sources supply an important portion of the electricity consumed in the state.
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The main objective of the project is to help meet Brazil's rising demand for energy due to economic growth and to contribute to the environmental, social, and economic sustainability by increasing renewable energy's share of the total Brazilian electricity consumption.

ARSSHP, with a power loading of 5.8 MW, uses the renewable hydro potential of the Von Den Steinen River to supply electricity to the Brazilian South/Southeast/Midwest interconnected grid. Since 2003 ANEEL (National Agency of Electric Energy) issued commercial exploration licenses for at least tree thermoelectric plants connected to that grid (UTE Rio Claro at Mato Grosso State, UTE Santa Terezinha Paranacity at Paraná State and UTE Viralcool at São Paulo State)(*Boletim Energia*, number 97, 2003), contributing to increase the greenhouse gas (GHG) emission factor of Brazil's energy system. The project activity will reduce these emissions by avoiding electricity generation through further fossil fuel combustion (and CO_2 emissions), which would generate (and release) CO2 in the atmosphere.

ARSSHP improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. The implementation of the project will result in an increase of energy supply in an opportune period, enabling the maintenance of the growing rate of midwest region, of the order of 4% a year from 1985 to 2002 (National Integration Ministry - *Ministerio de Integração Nacional, Plano Estratégico de Desenvolvimento do Centro-Oeste*) and reducing the risk of electricity deficit. The hydroelectric potential in commercial operation at the present time is insufficient to cover the market demand, mainly in the summer season, forcing the State to import more than 94% of its energy demand from the South-Southeast-Midwest interconnected grid (National Integration Ministry - *Ministerio de Integração Nacional, Plano Estratégico de Desenvolvimento do Centro-Oeste*).

Small-scale hydropower run-of-river plants such as ARSSHP provide local distributed generation, in contrast with the business as usual large hydropower and natural gas fired plants built in the last 5 years, and these small-scale projects provide site- benefits, including:

- Increased reliability with shorter and less extensive outages;
- Lower reserve margin requirements;
- Improved power quality;
- Reduced lines losses;
- Reactive power control;

- Mitigation of transmission and distribution congestion; and
- Increased system capacity with reduced T&D investment.

A strong indication that ARSSHP contributes to the country's sustainable development goals is that the project is in accordance with the April 2002 law nº 10,438 of PROINFA (*Programa de Incentivo as Fontes Alternativas de Energia Elétrica*). PROINFA is a Brazilian federal program that gives incentive to alternative sources of electricity (wind, biomass, and a small scale hydropower plant). Among other factors, this initiative goal is to increase the renewable energy source share in the Brazilian electricity profile in order to contribute to a greater environmental sustainability through giving these renewable energy sources better economic advantages. The Brazilian government has committed a large monetary fund in order to develop this plan. Although FAXSHP is eligible for PROINFA, it had not applied to a Power Purchase Agreement (PPA) through PROINFA, and therefore, does not have access to the benefits of the program.

A.3. Project participants:

Table 1: Project participants

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)	Tecnovolt Centrais Elétricas Ltda (private)	No
(*) In accordance with CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a party involved may not have provided its approval. At the time of requesting registration, the approval by the party(ies) involved is not required		

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

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

A.4.1.1. Host Party(ies):

Brazil

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

Mato Grosso State (Midwest part of Brazil)

A.4.1.3. City/Town/Community etc:

Municipality of Nova Ubiratã

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

The ARSSHP is located in the kilometer 91 of the Von Den Steinen river in the Fazenda Itapira, municipality of Nova Ubiratã, Mato Grosso State, Brazil, (Figure 2). The Coordinates are 13º05'57" South, 54º49'08"West.

Figure 2 – Municipality of Nova Ubiratã in the state of Mato Grosso - Midwest part of Brazil.

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

According to the list of the small-scale CDM project activity categories contained in Appendix B of the Simplified M&P for the Small-Scale CDM Project Activities, the ARSSHP project corresponds to:

Type I: Renewable Energy Projects

Category D: Energy Generation for a System.

The ARSSHP, with a power loading of 5.8MW, is introduced in the regional context as a low impact plant whose dam, designed to function as run of river.

Run-of-river schemes do not include significant water storage, and must therefore make complete use of the water flow. A typical run-of-river scheme involves a low-level diversion dam and is usually located on swift flowing streams. According to Eletrobrás (1999), run-of-river projects are defined as "the projects where the river's dry season flow rate is the same or higher than the minimum required for the turbines". A low-level diversion dam raises the water level in the river sufficiently to enable an intake structure to be located on the side of the river. The intake consists of a trash screen and a submerged opening with an intake gate. Water from the intake is normally taken through a pipe (called a penstock) downhill to a power station constructed downstream of the intake and at as low a level as possible to gain the maximum head on the turbine.

The equipment and technology used in the ARSSHP project has been successfully applied to similar projects in Brazil and around the world. The equipment used in the project was developed and manufactured locally.

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

Table 2: Estimated emission reductions through the first 7-year crediting period

Year[1]	Estimation of annual emission reductions in tonnes of CO_2e
2008	11,962
2009	11,962
2010	11,962
2011	11,962
2012	11,962
2013	11,962
2014	11,962
Total estimated reductions (tonnes of CO_2e)	**83,734**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	11,962

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

No public funding has been involved in financing this project activity.

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

[1] It is defined as the time period between january and december.

In accordance with Appendix C of the Simplified M&P for the Small-Scale CDM Project Activities, the ARSSHP project is not a debundled component of a larger CDM project activity.

The project activity is an independent hydro power plant generating electricity and supplying to the grid, unrelated to any other CDM project activity in the region, existing or planned. The project proponent has not another registered small-scale CDM project activity, or an application to register another small-scale CDM project activity:

- in the same project category;
- registered within the previous 2 years; or
- whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

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:

As mentioned above, according to the list of the small-scale CDM project activity categories contained in Appendix B of the Simplified M&P for the Small-Scale CDM Project Activities, the ARSSHP project corresponds to:

Type I: Renewable Energy Projects
Category D: Electricity Generation for a System

Thus, the methodology used in this project activity is AMS-I.D: Grid Connected Renewable Electricity Generation (Version 10).

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

The ARSSHP qualifies under this project category since:

- The project activity is a run of river hydroelectric power plant.
- The project activity supplies electricity to the Brazilian South/Southeast/Midwest interconnected grid.

The ARSSHP has a plate power capacity of 5.8 MW, which is lower than 15 MW, and thus, the project activity qualifies as a small-scale project activity and will remain under the limits of small-scale project activity types during every year of the crediting period.

B.3. Description of the project boundary:

The project boundary encompasses the physical, geographical site of the hydropower generation source, which is represented by the Von Den Steinen river basin close to the power plant facility and the interconnected grid.

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

1. Northeast: the electricity for this region is basically supplied by the São Francisco River. With a total of 10.5 GW installed capacity.
2. South/Southeast/Midwest: the majority of the electricity generation and consumption in the country is concentrated in this region. This region also concentrated 70% of the GDP generation in Brazil.
3. North: 80% of the Northern region is supplied by diesel.

The boundaries of the subsystems are defined by the electricity transmission capacities of the 3 sub systems listed above. The transmission lines between the sub systems have a limited capacity and the exchange of electricity between those sub systems is difficult. The lack of sufficient transmission lines forces the use of most of the electricity generated in each own sub systems. Thus the South/Southeast/Midwest interconnected sub system of the Brazilian grid, where the project activity is located, is included in the spatial extent of the project boundary.

Part of the electricity consumed in the country is imported from other countries. Argentina, Paraguay, and Uruguay supply about 10% of the electricity consumed in Brazil[2]. Brazil also exported, sometimes, energies to these countries.

B.4. Description of baseline and its development:

According to the project category, and the corresponding methodology, the baseline is the energy produced by the renewable generating unit (MWh) multiplied by an emission coefficient (tCO_2e/MWh) calculated in a transparent and conservative manner as:

a) A combined margin (CM) emission factor, consisting of the combination of operating margin (OM) and build margin (BM) emission factors according to the procedures prescribed in the approved methodology ACM0002. 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 tCO_2e/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

For this project activity, the first option (option a) is selected. Thus, Version 06 of the approved methodology ACM0002 is used to determine the grid emission factor. Historically, most generation in Brazil has been hydroelectric. However, the less expensive hydroelectric resources are exhausted. Gas-fired power plants require much lower capital cost, thus representing low financial risk for investment. Brazil also has thermal power plants using coal, fuel oil, and diesel. Since fossil fired power plants have higher operating cost compared to hydro, these are likely to be displaced by generation from any hydro added to the system. Thus, it is reasonable to choose the first option for calculating the grid emission factor.

[2] Source: *Balanço Energético Nacional* - BEN, 2005

ACM0002 indicates that the emission factor of the grid is determined by the following three steps:

1. Calculate the operating margin emission factor
2. Calculate the build margin emission factor
3. Calculate the combined margin emission factor by working out the weighted average of the operating margin emission factor and the build margin emission factor

Step 1. Calculate the operating margin emission factor (EF_{OM})

The operating margin refers to actual generation mix of the national grid.

Four different procedures are suggested by the methodology for determining the operating margin emission factor. These are:

(a) Simple Operating Margin
(b) Simple Adjusted Operating Margin
(c) Dispatch Data Analysis Operating Margin
(d) Average Operating Margin.

For this project activity, 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.

According to the methodology, the simple adjusted operating margin emission factor can be calculated using one of the following data vintages:

- The full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission (*ex-ante*).
- The year in which project generation occurs, if the operating margin emission factor is updated based on data monitored (*ex-post*).

In this particular case, the *ex-ante* vintage is selected among the two options proposed by the methodology. As a consequence, the operating margin emission factor is calculated *ex-ante* and it is considered fixed along the crediting period.

Step 2. Calculate the build margin emission factor (EF_{BM})

According to the methodology, the build margin emission factor can be calculated using one of the following options:

- Option 1: calculation *ex-ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission.
- Option 2: for the first crediting period, *ex-post* annual update for the year in which actual project generation and associated emission reductions occur, and for the subsequent crediting periods, calculation *ex-ante* as described in Option 1.

In this particular case, Option 1 is selected among the two options proposed by the methodology. As a consequence, the build margin emission factor is calculated *ex-ante* and it is considered fixed along the crediting period.

Step 3. Calculate the combined margin emission factor (EF_{grid})

The baseline emission factor is calculated as the weighted average of operating margin emission factor and the build margin emission factor.

In this case, for weighting these two factors, the default value of 50% will be considered for both, the operating margin and the build margin emission factors.

Baseline data sources

The national dispatch center supplied the raw dispatch data for the whole Brazilian interconnected grid.

The information on each generating source is not publicly available in Brazil. The National Power System Operator (*Operador Nacional do Sistema Elétrico*, ONS) argues that dispatching information is strategic to the power agents and therefore cannot be made available. On the other hand, ANEEL, the electricity agency, provides information on power capacity and other legal matters on the electricity sector, but no dispatch information can be got through this entity.

In that regard, project proponents looked for a plausible solution in order to be able to calculate the emission factor in Brazil in the most accurate way. Since real dispatch data is necessary after all, the ONS was contacted, in order to let participants know until which degree of detail information could be provided. After several months of talks, plants' daily dispatch information was made available for years 2003, 2004, and 2005.

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 December 31st, 2004, out of the total 98,848 MW installed in Brazil by the same date[3]. Total capacity includes the amount available in neighboring countries to export to Brazil and emergency plants that are dispatched only during periods of electricity constraints in the system. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23.6% are plants that do not have their dispatch coordinated by ONS, since either they operate based on power purchase agreements, which are not under control of the dispatch authority, or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

The following table summarizes the key data necessary for the *ex-post* determination of baseline emissions:

[3] Source: http://www.aneel.gov.br/arquivos/PDF/Resumo_Gráficos_mai_2005.pdf

Table 3: Key data

Data	Source
Electricity generation of ARSSHP	Tecnovolt Centrais Elétricas Ltda
Electricity generation of the power plants serving the system	Operador Nacional do Sistema Elétrico, Centro Nacional de Operação do Sistema, Acompanhamento Diário da Operação do Sistema Interligado Nacional (daily reports)
Capacity additions to the system	Agência Nacional de Energia Elétrica, Banco de Informações da Geração
Fossil fuel conversion efficiencies	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.
Emission factors and oxidation factors of fuels	IPCC Guidelines for National GHG Inventories

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:

In accordance with Attachment A of Appendix B of the Simplified M&P for the Small-Scale CDM Project Activities, a barrier analysis should be carried out in order to demonstrate project additionallity. However, the project proponent prefers to use the latest version of the "Tool for the demonstration and assessment of additionality" approved by the Executive Board (currently this version is number 03). This Tool is more complete than the one specified in attachment A of appendix B of the Simplified M&P for the Small-Scale CDM Project Activities. This tool considers some important steps necessary to determine that the project activity is additional and demonstrates how the emissions reductions would not occur in the absence of the project activity.

The project activity had been initiated in December 19th, 2002, 05/01/2003 as stated in the Resolution nº 71 of March the 8th of 2001 issued by ANEEL, which authorizes Agro Rio Von Den Steinen Ltda. (ARS) to be established as an Independent Power Producer[4]. However, the ARSSHP is now planned to start supplying electricity to the grid by January 2008.

[4] See the resolution in the following link:
http://www.aneel.gov.br/cedoc/res2001071.pdf

The incentive from the CDM was fully considered during the planning stage of the project as mentioned on meeting reports of which participated the sponsor and his partners. The investment data table also states that the incentive of carbon credits has been considered during the implementation of this hydro plant.

The following are the steps necessary for the assessment of the project additionality.

Step 1 – Identification of alternatives to the project activity consistent with current laws and regulation

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

The identified realistic alternatives to the project activity are the following:

1. Implementation of the project activity without incentives from the CDM
2. Continuation of the current trend of the Brazilian interconnected grid

Alternative 1 involves a 5.8 MW hydro power plant not undertaken as a CDM project. As it is explained below, this alternative faces prohibitive barriers that prevent its implementation.

The Brazilian interconnected electricity system will need to increase its electric installed capacity every year in order to guarantee forecasted demand increase. According to the electric system regulation and market conditions, nowadays it is easier and faster to install a thermal power plant than a hydro power plant in Brazil. Therefore, Alternative 2 involves the installation of a new thermal power plant in the Brazilian electricity system in order to supply the ever-increasing country electricity demand.

Sub-step 1b – Consistency with mandatory laws and regulations:

All the alternatives are in compliance with applicable legal and regulatory requirements.

Step 2 – Investment analysis

For this project activity, this option is not selected.

Step 3 – Barrier analysis

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

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

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

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

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

At that time, three entities were created, the Brazilian Electricity Regulatory Agency (*Agência Nacional de Energia Elétrica*, ANEEL) set up to develop the legislation and to regulate the market; the National Power System Operator (*Operador Nacional do Sistema Elétrico*, ONS) to supervise and control the generation, transmission, and operation; and the Wholesale Energy Market (*Mercado Atacadista de Energia Elétrica*, MAE) to define rules and commercial procedures of the short-term market.

At the end of 2000, after five years of the privatisation process, results were modest. Despite high expectations, investments in new generation did not follow the increase in consumption.

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

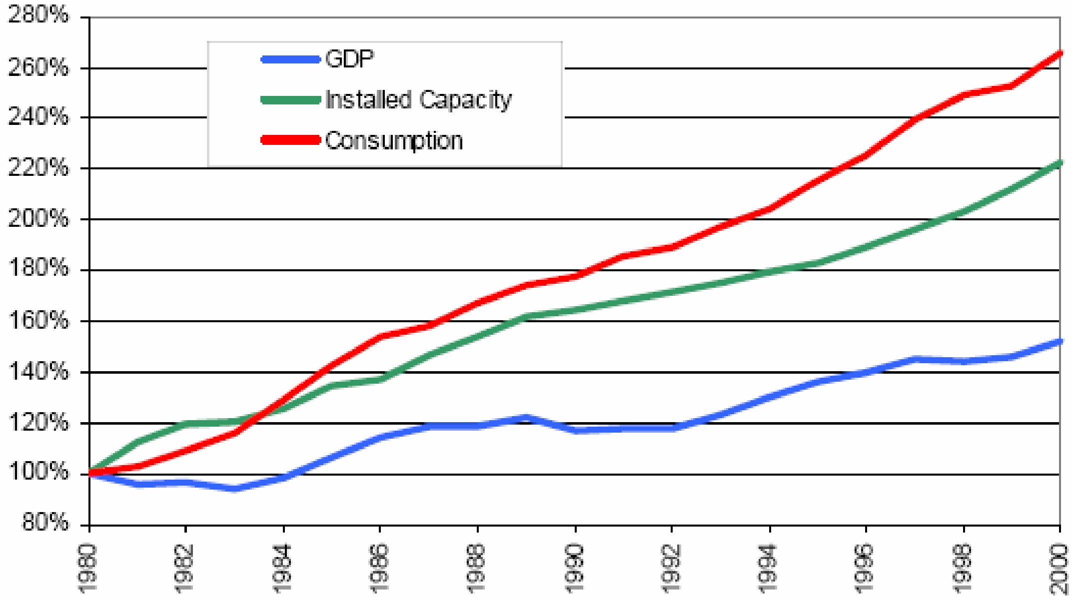

Figure 4: Cumulative variation of GDP, electricity supply (installed capacity), and demand (consumption)[5]

Without new installed capacity, the only alternatives were energy efficiency improvements or higher capacity utilization (capacity factor). Regarding energy efficiency, the government established in 1985 a program named PROCEL (National Electricity Conservation Program). Although the objectives of the program were commendable the results were limited, mainly due to insufficient investment and poorly managed strategies.

The remaining alternative, to increase the capacity factor of the old plants was the most widely used. To understand if such increase in capacity factor brought positive or negative consequences, it is necessary to analyze the availability and price of fuel. In the Brazilian electricity system, the primary energy source is water accumulated in reservoirs. Such reserve, which were planned to withstand 3 years of less-than-average rainy seasons, almost collapsed after single season of low rainfall (2000/2001 experienced 74% of historical regional average rainfall). This situation depicts a very intensive use of the country's hydro resources to support the increase in demand without enough increase of the installed capacity. Under the situation described, there was no short-term solution for the problems that finally caused shortage and rationing in 2001.

Aware of the difficulties since the end of the 1990's, the Brazilian government signalized that it was strategically important for the country to increase thermoelectric generation and consequently be less dependent of hydropower. With that in mind, the federal government launched in the beginning of the year 2000 the Thermoelectric Priority Plan (*Plano Prioritário de Termelétricas*, PPT)[6] originally planning the construction of 47 thermo plants using mainly natural gas imported from Bolivia, totaling 17,500 MW of new installed capacity by December 2003. During 2001 and the beginning of 2002, the

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[5] Source: Eletrobrás (http://www.eletrobras.gov.br/) and IBGE (http://www.ibge.gov.br/)

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

plan was reduced to 40 plants and 13,637 MW to be installed by December 2004[7]. Until December 2004, 20 plants totaling around 9,700 MW were operational.

During the rationing of 2001, the government also launched the Emergency Energy Program with the short-term goal of building 58 small to medium thermal power plants until by the end of 2002 (using 76.9% of diesel oil and 21.1% of residual fuel oil) totaling 2,150 MW power capacity mainly to remain most of the time in standby and be used under potentially new critical rainfall periods[8].

It is clear that hydroelectricity is and will continue to be the main source for electricity base load in Brazil. However, most, if not all-medium and large hydro resources in South and Southeast of the country have been exploited, and most of the remaining reserves are located in the Amazon basin, far from the industrial population center[9]. Clearly, new additions to Brazil's electricity power sector are shifting from hydro to natural gas plants[10]. With discoveries of vast reserves of natural gas in the Santos Basin in 2003, the policy of using natural gas to generate electricity remains a possibility and it will continue to generate interest from private-sector investors in the Brazilian energy sector.

In power since January 2003, the newly elected government decided to fully review the electricity market institutional framework. A new model for the electricity sector was approved by Congress in March 2004. The new regulatory framework for the electricity sector has the following key features[11]:

- Electricity demand and supply will be coordinate through a "Demand Pool" to be estimated by the distribution companies, which will have to contract 100 per cent of their project electricity demand over the following 3 to 5 years. These projections will be submitted to a new institution, the Energy Research Company (*Empresa de Pesquisa Energética*, EPE) that will estimate the required expansion in supply capacity to be sold to the distribution companies through the "Demand Pool". The price at which electricity will be traded through the Pool is an average of all long-term contracted prices and will be the same for all distribution companies.
- In parallel to the "regulated" long-term Pool contracts, there will be a "free" market. Although in the future, large consumers (above 10 MW) will be required to give distribution companies a 3-year notice if they wish to switch from the Pool to the free market and 5-year notice for those moving in the opposite direction a transition period is envisaged during which these condition will be made more flexible. These measures should reduce market volatility and allow distribution companies to better estimate market size. If actual demand turns out to be higher than projected, distribution companies will have to buy electricity in the free market. Distribution companies will be able to pass on to end consumers the difference between the cost of electricity purchased in the free market and through the Pool if the discrepancy between projected and actual demand is bellow 5 per cent. If it above this threshold, the distribution company will bear the excess cost.
- The government opted for a more centralized institutional set-up, reinforcing the role of the Ministry of Mines and Energy in long-term planning. EPE will submit to the Ministry its desired technological portfolio and the list of strategic and non-strategic projects. In turn, the Ministry will submit this list of projects to the National Energy Policy Council (*Conselho Nacional de Política Energética*, CNPE). Once approved by CNPE, the strategic projects will be auctioned on

[7] Federal Law 10,438 of April 26th, 2002, Article 29
[8] Source: CGE-CBBEE, 2002
[9] Source: OECD, 2001
[10] Source: Schaeffer *et al.*, 2000
[11] Source: OECD, 2005

a priority basis through the Pool. Companies can replace the non-strategic projects proposed by EPE, if their proposal offers the same capacity for a lower tariff. Another new institution is the Electric Sector Monitoring Committee (*Comitê de Monitoramento do Setor Elétrico*, CMSE), which will monitor trends in power supply and demand. If any problem is identified, CMSE will propose corrective measures to avoid energy shortages, such as special price conditions for new projects and reserve of generation capacity. The Ministry of Mines and Energy will host and chair this committee. No major further privatizations are expected in the sector.

Although the new model reduces market risks, its ability to encourage private investment in the electricity sector will depend on how the new regulatory framework is implemented. Several challenges are noteworthy in this regard.

- The risk of regulatory failure that might arise due the fact that the government will have a considerable role to play in a long-term planning should be avoided by enhancing the Ministry of Mines and Energy's technical capabilities, while insulating the new institutions from political interference.
- Rules will need to be designed for the transition from the current to the new model to allow current investments to be rewarded adequately.
- Because of its small size, price volatility may increase in the short-term electricity market, in turn bringing about higher investment risk, albeit this risk will be attenuated by the role of large consumers. The high share of hydropower in Brazil's energy mix and uncertainty over rainfall also contribute to higher volatility of the short-term electricity market.
- Although the new model will require total separation between generation and distribution, regulations for the unbundling of vertically integrated companies still have to be defined. Distribution companies are currently allowed to buy up to 30 per cent of their electricity from their own subsidiaries (self-dealing).

The government's policy for the natural gas sector needs to be defined within a specific sectoral framework.

The considered barriers are the following:

Investment Barrier (Long-term funding)

The high level of guarantees required to finance an energy project in Brazil is a barrier for developing new projects. Insurance, financial guarantees, financial advisories are requirements that increase the cost of the project and are barriers to the project finance ability. Also, the project is generally not financed on a project finance basis, and then the developer is exposed to an extra financing risk.

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

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

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

Interest rates for local currency financing are significantly higher than US Dollar rates. The National Development Bank (BNDES) is the only supplier of long-term loans, but it requires excessive guarantees in order to provide financing. Debt financing from BNDES are made primarily through commercial banks. The credit market is dominated by shorter maturities (90-days to 01-year) and long-term credit lines are available only to the strongest corporate borrowers and for special government initiatives. Credit is restricted to the short-term in Brazil or the long-term in dollars offshore.

Financial domestic markets with maturity of one year or greater practically do not exist in Brazil. Experience has shown that in moments of financial stress the duration of savings instruments contracted drops to levels close to one day with a massive concentration in overnight banking deposits. Savers do not hold long-term financial contracts due to the inability to price-in the uncertainty involved in the preservation of purchasing power value[12].

The lack of local long-term financing results from the reluctance of creditors and savers to lengthen the term of their investments. It has made savers opt for the most liquid investments and to place their money in short-term government bonds instead of investing in long-term opportunities that could finance infrastructure projects.

The most liquid government bond is the LFT (floating rate bonds based on the daily Central Bank reference rate). As of January 2004, 51.1% of the domestic federal debt was in LFTs and had duration of one day. This bond rate is almost the same as the CDI rate that is influenced by the SELIC rate, defined by the Monetary Policy Committee (*Comitê de Politica Monetária,* COPOM).

The SELIC rate has been very volatile ranging from a minimum of 15% p.a. in January 2001 to a maximum of 45% p.a. in March 1999.

Institutional Barrier

As described above, since 1995 government electricity market policies have been continuously changing in Brazil. Too many laws and regulations were created with the aim of providing incentives for new investments in the energy sector. The results of such regulatory instability were the contrary to what was trying to be achieved. During the rationing period electricity prices surpassed 600 R$/MWh (around 200 US$/MWh) and the forecasted marginal price of the new energy reached levels of 120/150 R$/MWh (around 45 US$/MWh). In the middle of 2004 the average price was bellow 50 R$/MWh (less than 20 US$/MWh). This relatively high volatility of the electricity price in Brazil, although in the short term, contributes to difficult the analysis of the market by the developers.

Barrier due to prevailing practice

[12] Source: Arida et al., 2004

The prevailing business practice in Brazil as far as obtaining financing and financial guarantees to project is a barrier to investment in renewable energy projects in the country. Given the various programs and incentives, which were considered along the last years, but never successfully implemented, it is easy to notice the difficulty and barriers to implement small hydro projects in the country. An indication of this barrier is exemplified by the Program called PCH-COM, structured by the end of 2000 and beginning of 2001. In 2001, Eletrobrás, in partnership with BNDES, launched the PCH-COM program, which had as its main goal to support and encourage the construction of small hydropower plants. This program consisted in the financing of the project by BNDES and the commercialization of the power by Eletrobrás. The operation of the program consisted on the analysis of the project by both BNDES and Eletrobrás. In case the project was approved, there would have been two contracts to be signed: the financing one with BNDES and the Power Purchase Agreement (PPA) with Eletrobrás. The program was not successful because of the guarantees needed 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) and despite ARSSHP wanted to participate in the program, it was not able to meet BNDES requirements, guarantees, performance bonds, and insurance policies, which were in excess of the shareholder equity structure.

After that, the government created, in 2002, the PROINFA program, which foresees raising the share of renewable energy power generation by adding 3,300 MW installed capacity of small-hydro power plants, wind-power, and biomass, offering long-term contracts with special conditions, lower transmission costs, and smaller interest rates from the local development banks. In 2005, the BNDES presented the last final version of its financing incentive line to PROINFA, which is different from the one first considered for the program that was not considered sufficient.
ARSSHP is not assessing PROINFA, and therefore, does not have access to the benefits of the program.

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

Common practice in Brazil has been the construction of large-scale hydroelectric plants and, more recently, of thermal fossil fuel plants, with natural gas, which also receive incentives from the government.

Already, 21.3% of the power generated in the country comes from thermal power plants, and this number tends to increase in the short term, since 41% of the projects approved between 1998 and 2005 are thermal power plants (compared to only 14% of small hydropower plants)[13].

These numbers show that incentives for the construction of thermal power plants have been more effective than those for small hydropower plants.

Therefore, it is clear that the identified barriers do not prevent the continuation of the current trend of the Brazilian interconnected grid.

Step 4 – Common practice analysis

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

[13] Source: Agência Nacional de Energia Elétrica (ANEEL)

Due to all the difficulties exposed, and in spite of all government incentives, there are 265 approved small hydropower plant projects in Brazil[14], between 1998 and 2005, which have not started construction yet. And only 1.43% of the power generated in the country comes from small hydropower plants. Also, from the 3.4GW under construction in the country, only 738 MW are small hydro. In 2004, only 9 small-hydro projects, a total of just 5.22 MW, were authorized by the regulatory agency[15]. Many other small hydroelectric projects are still under development, waiting for better investment opportunities[16].

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

One of the points to be considered when analyzing a small hydro project investment is the possibility to participate in the PROINFA. Although some projects started construction independently from PROINFA, the program is considered a milestone for financing renewable energy sources power generation, by providing long-term PPAs and special financing conditions. ARSSHP is not participating in the program and is addressing the market risk as it structures this project.

Both process of negotiating a PPA, with utility companies and obtaining funding from BNDES, have proved to be highly cumbersome. BNDES also requires excessive guarantees in order to provide financing. Other risks and barriers are related to the operational and technical issues associated with small hydro power plants, including their capability to comply with the PPA contract and the potential non-performance penalties.

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

Most of the developers, which funded their projects outside of PROINFA, have taken CDM as decisive factor for completing their projects. Therefore, to the best of our knowledge the vast majority of similar projects being developed in the country are participating in PROINFA and those not are participating in the CDM. Additionally, the Brazilian government has stated that the projects under PROINFA will also be eligible to participate in the CDM. The legislation that created PROINFA took into account possible revenues from the CDM in order to implement the program.

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

As mentioned above, common practice in Brazil has been the construction of large-scale hydroelectric plants and, more recently, of thermal fossil fuel plants, with natural gas, which also receive incentives from the government. Already 21.3% of the power generated in the country comes from thermal power

[14] Source: Agência Nacional de Energia Elétrica (ANEEL)
[15] Source: Agência Nacional de Energia Elétrica (ANEEL)
[16] Source: Agência Nacional de Energia Elétrica (ANEEL)

plants, and this number tends to increase in the short term, since 41% of the projects approved between 1998 and 2005 are thermal power plants (compared to only 14% of small hydropower plants)[17].

These numbers show that incentives for the construction of thermal power plants have been more effective than those for small hydropower plants. The use of natural gas has been increasing in Brazil since the construction of GASBOL (the Brazil-Bolivia pipeline). Besides, obtaining the licenses required by the Brazilian environmental regulation takes much longer for hydropower plants (years) than for thermal (two months).

The recent nationalization of the natural gas industry by the Bolivian government might change this situation, but perspectives are not clear so far. In the most recent energy auction, which took place on December 16th, 2005, in Rio de Janeiro, 20 concessions for new power plants were granted, of which only two are for small hydropower plants (28 MW). From the total of 3,286 MW sold, 2,247 MW (68%) will come from thermal power plants, from which 1,391 MW come from natural gas fired thermal power plants, i.e., 42% of the total sold[18].

In summary, this project cannot be considered common practice and therefore is not a business as usual type scenario.

Conclusions

As defined by ANEEL[19], small hydro power plants are power plants with installed capacity greater than 1 MW and up to 30 MW, and with reservoir area lower than 3 km². Generally, it consists of a run-of-the-river hydro plant, which has a minimum environmental impact. This is not the business-as-usual scenario in a country where large hydro and thermal fossil fuel projects are preferable. With the financial benefit derived from the CERs, it is anticipated that other project developers would benefit from this new source of revenues and would then decide to develop such projects. An increase of approximately 100 to 200 basis points, derived from CERs, would be an important factor in determination to start such project. Thus, the proposed project activity results to be additional.

CDM has made it possible for some investors to set up small hydro plants and sell electricity to the grid. The registration of the proposed project activity will have a strong impact in paving the way for similar projects to be implemented in Brazil.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to the project category and the corresponding methodology, project emissions are zero and leakage is to be considered only when the energy generating equipment is transferred from another activity. This is not the case of ARSSHP. The energy conversion equipment for the project was manufactured new for specific site conditions. Therefore, there is no leakage associated to the project activity.

[17] Source: Agência Nacional de Energia Elétrica (ANEEL)
[18] Source: Rosa, Luis Pinguelli. Brazilian. Newspaper "Folha de São Paulo", December 28, 2005.
[19] Resolution n. 394, December 4th, 1998.

Then, emission reductions obtained during the year y (ER_y, in tCO_2e/year) are equal to baseline emissions calculated by multiplying the combined margin emission factor (EF_{grid}, in tCO_2e/MWh) by the electricity generated by the proposed project activity during the year y (EG_y, in MWh), as follows:

$$ER_y = EG_y \times EF_{grid} \quad (1)$$

The combined margin (CM) emission factor consists of the combination of operating margin (OM) and build margin (BM) emission factors according to the procedures prescribed in the approved methodology ACM0002.

ACM0002 indicates that the emission factor of the grid is determined by the following three steps:

1. Calculate the operating margin emission factor
2. Calculate the build margin emission factor
3. Calculate the combined margin emission factor by working out the weighted average of the operating margin emission factor and the build margin emission factor

Step 1. Calculate the operating margin emission factor (*EF_{OM}*)

As mentioned above, 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 simple adjusted operating margin emission factor (tCO_2e/MWh) is a variation of the simple operating margin emission factor[20], where the power sources (including imports) are separated in low-cost/must-run power sources (*k*) and other power sources (*j*), as follows:

$$EF_{OM} = (1-\lambda)\frac{\sum_{i,j} F_{i,j} \times COEF_i}{\sum_j GEN_j} + \lambda \frac{\sum_{i,k} F_{i,k} \times COEF_i}{\sum_k GEN_k} \quad (2)$$

where

λ	Lambda factor: fraction of time during low-cost/must-run sources are on the margin
$F_{i,j}/F_{i,k}$	Amount of fuel *i* consumed by relevant power sources *j*/*k* (in energy unit)
GEN_j/GEN_k	Electricity delivered to the grid by power sources *j*/*k* (MWh)
$COEF_i$	CO_2 emission coefficient for fuel *i*. (tCO_2e/energy unit)

The CO_2 emission coefficient $COEF_i$ is obtained as follows:

$$COEF_i = CEF_i \times OXID_i \quad (3)$$

[20] 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.

where

CEF_i	CO_2 emission factor per unit of energy of the fuel i (tCO_2e/energy unit)
$OXID_i$	Oxidation factor of fuel i (%)

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

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

According to the methodology, the number of hours during low-cost/must-run sources are 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

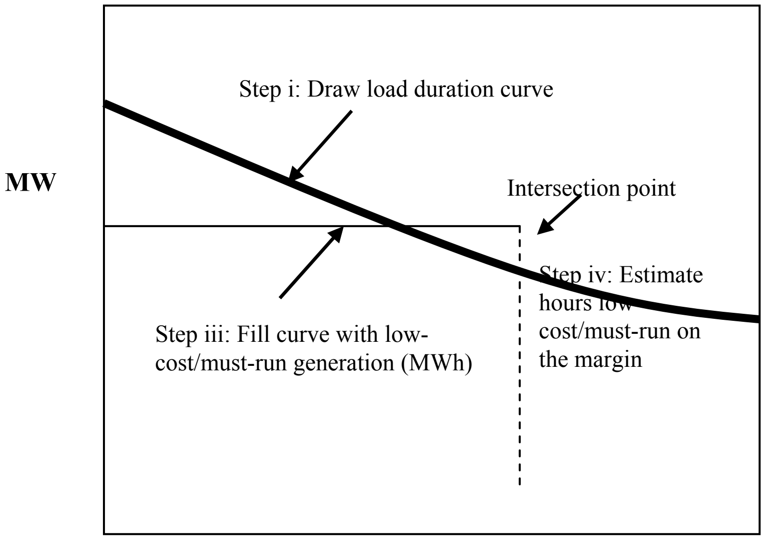
Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources.

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.



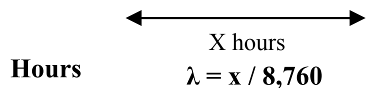


Figure 5: Illustration of lambda calculation for simple adjusted operating margin emission factor

Step 2. Calculate the build margin emission factor (*EF_{BM}*)

The build margin emission factor of each crediting period is calculated as follows:

$$EF_{BM} = \frac{\sum_{i,m} F_{i,m} \times COEF_i}{\sum_{m} GEN_m} \qquad (5)$$

where $F_{i,m}$, $COEF_i$ and GEN_m are analogous to the variables described above for the operating margin emission factor determination.

The sample group *m* consists of either:

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

According to the methodology, from these two options, the sample group that comprises the larger annual generation should be used.

Step 3. Calculate the combined margin emission factor (*EF_{grid}*)

The baseline emission factor is calculated as the weighted average of operating margin emission factor and the build margin emission factor. For weighting these two factors applying the default value of 50% for both, the operating margin and the build margin emission factors, the combined margin emission factor is obtained as follows:

$$EF_{grid} = \frac{(EF_{OM} + EF_{BM})}{2} \qquad (6)$$

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

Table 5: Data available at validation

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): Operador Nacional do Sistema Elétrico, Centro Nacional de Operação do Sistema, Acompanhamento Diário da Operação do Sistema Interligado Nacional.
Value applied:	See Annex 3 below
Justification of the choice of data or description of measurement methods and procedures actually applied :	See Section B.4
Any comment:	This is used to determine the grid emission factor.

Data / Parameter:	***GEN_m***
Data unit:	MWh
Description:	Electricity delivered to the grid by the power sources *m*
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) Capacity additions to the system are provided by Agência Nacional de Energia Elétrica, Banco de Informações da Geração.
Value applied:	See Annex 3 below
Justification of the choice of data or description of measurement methods and procedures actually applied:	See Section B.4
Any comment:	This is used to determine the grid emission factor.

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 below
Justification of the choice of data or description of measurement methods and procedures actually applied:	See Section B.4
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 below
Justification of the choice of data or description of measurement methods and procedures actually applied:	See Section B.4
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 methodology states that the oxidation factor of a fuel should be taken from the 1996 Revised IPCC Guidelines.
Any comment:	This is used to determine the grid emission factor.

Data / Parameter:	***Load Duration Curve***
Data unit:	MW vs. hs
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.4
Any comment:	This is used to determine the grid emission factor.

B.6.3 Ex-ante calculation of emission reductions:

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 FAXSHP is expected to generate around 21,725MWh per year, as shown in the following table:

Table 6: Expected annual electricity generation

Plant capacity **(A)**	5.8 MW
Annual hours **(B)**	8,760 hr/year
Capacity factor **(C)**	0.902
Electricity generation (A) x (B) x (C)	**45,815 MWh/year**

As mentioned above, the emission factor of the grid is determined using the Version 06 of the methodology ACM0002 as a combined margin emission factor, 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 0.4349 tCO_2/MWh and the build margin emission factor 0.0872 tCO_2/MWh. Thus, the resulting grid emission factor is:

$$EF_{grid} = \frac{(EF_{OM} + EF_{BM})}{2} = \frac{(0.4349 + 0.0872)}{2} \text{ tCO}_2\text{/MWh} = \mathbf{0.2611\ tCO_2/MWh}$$

Thus, the annual emission reduction results to be:

ER = 21,725 MWh/year x 0.2611 tCO_2/MWh = **11.962 tCO_2/year**

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

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

Year[21]	**Estimation of project activity emissions (tCO_2e)**	**Estimation of baseline emissions (tCO_2e)**	**Estimation of Leakage (tCO_2e)**	**Estimation of Overall reductions (tCO_2e)**
2008	0	11.962	0	11.962
2009	0	11.962	0	11.962
2010	0	11.962	0	11.962
2011	0	11.962	0	11.962
2012	0	11.962	0	11.962
2013	0	11.962	0	11.962
2014	0	11.962	0	11.962
Total (tonnes of tCO_2e)	**0**	**83.734**	**0**	**83.734**

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

B.7.1 Data and parameters monitored:

Table 8: Data to be monitored

Data / Parameter:	***EG_y***
Data unit:	MWh
Description:	Electricity generated by the renewable technology in the year y
Source of data to be used:	Tecnovolt Centrais Elétricas Ltda
Value of data	45,815
Description of measurement methods and procedures to be applied:	Electricity delivered to the grid will be monitored by the project (seller) and by the electricity buyer through electricity meter connected to the grid and through sales receipt. This data will be measured each 15 minutes and recorded monthly.
QA/QC procedures	The uncertainty level of the data is low, and the equipment will be regularly

[21] It is defined as the time period between january and december.

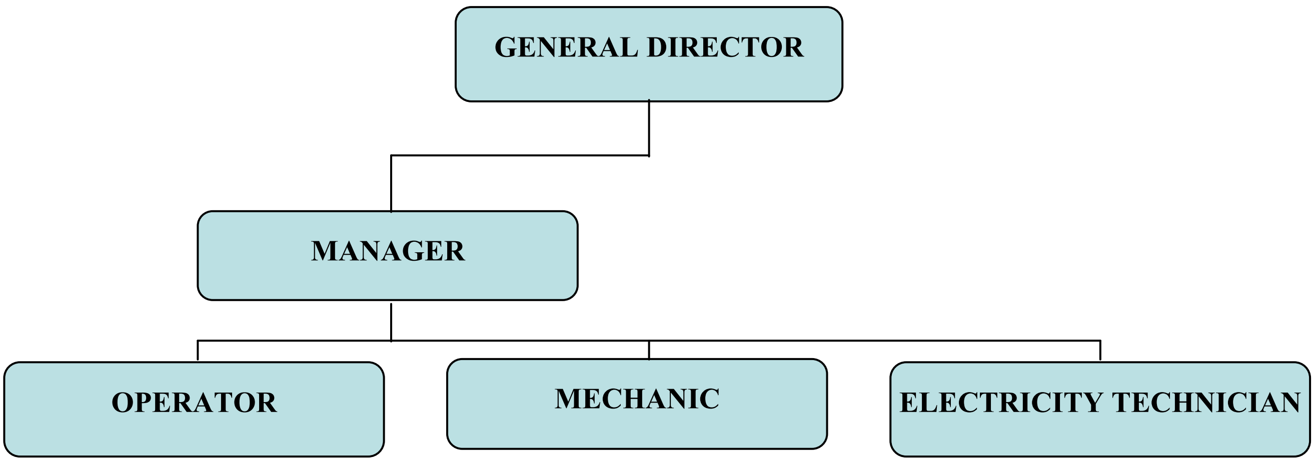
to be applied:	calibrated.
Any comment:	This data will be used to calculate the emission reductions obtained through the project activity. Data will be archived electronically until two years after finishing the crediting period.

B.7.2 Description of the monitoring plan:

According to Type I, Category D of small-scale project activity categories contained in appendix B of the Simplified M&P for CDM Small-Scale Project Activity, monitoring shall consist of metering the electricity generated by the renewable technology.

ARSSHP will assign a qualified person to compile the necessary data according to the approved methodology to accurately calculate emission reductions. The data will be compiled in a manner amenable to third party audit and deliverable to the DOE for validation and certification purposes.

The operational and management structure to be implemented is the following:



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: 01/12/2005 (revised on 09/04/2007)

Name of the responsible person/entity:

- Osvaldo Stella Martins PhD
- João M. Franco and Marisa Zaragozi, MGM International SRL

Av. Luis Carlos Berrini, 1297 cj.121
CEP 04571-010, São Paulo - Brazil
Tel. (55 11) 5102 3844

Osvaldo Stella Martins and João M. Franco and Marisa Zaragozi are not project participants.

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:

The project activity had been initiated in December 19th, 2002, 05/01/2003 as stated in the Resolution nº 71 of March the 8th of 2001 issued by ANEEL, which authorizes Agro Rio Von Den Steinen Ltda. (ARS) to be established as an Independent Power Producer[22]. However, the ARSSHP is now planned to start supplying electricity to the grid by January 2008.

Thus, the starting date of the project activity can be considered as:

01/01/2008

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

25 years

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:

01/01/2008

C.2.1.2. Length of the first crediting period:

7 years

[22] See the resolution in the following link:
http://www.aneel.gov.br/cedoc/res2001071.pdf

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:

As for the environmental permits, the proponent of any project that involves the construction, installation, expansion, and operation of any polluting or potentially polluting activity or any activity capable of causing environmental degradation is required to secure a series of permits from the respective state environmental agency. In addition, any such activity requires the preparation of an environmental assessment report, prior to obtaining construction and operation permits. Three types of permits are required. The first is the preliminary permit (*Licença Ambiental Prévia*, LP) issued during the planning phase of the project and which contains basic requirements to be complied with during the construction, and operating stages. The second is the construction permit (*Licença Ambiental de Instalação*, LI) and, the final one is the operating permit (*Licença Ambiental de Operação*, LO).

The preparation of an Environmental Impact Assessment is compulsory to obtain the construction and the operation licenses. In the process, a report containing an investigation of the following aspects was prepared:

- Impacts to climate and air quality;
- Geological and soil impacts;
- Hydrological impacts (surface and groundwater);
- Impacts to the flora and animal life;
- Socio-economical (necessary infra-structure, legal and institutional, etc.)

From the environmental process perspective there are two types of small hydro projects: (a) those ones that only have to prepare a Preliminary Environmental Assessment (*Relatório Ambiental Preliminar*, RAP) and (b) those ones that have to further set up assessments called Environmental Impact Study (*Estudo de Impacto Ambiental*, EIA) and Environmental Impact Assessment (*Relatório de Impacto Ambiental*, RIMA). Later on, the local environmental agency can request another assessment called Environmental Basic Project (*Projeto Básico Ambiental*, PBA) for both types of project.

In order to start the process of obtaining environmental licenses every hydro project has to confirm that the following will not occur:

- Inundation of Indian lands and slaves historical areas;
- Inundation of environmental preservation areas;

- Inundation of urban areas;
- Inundation of areas where there will be urban expansion in the foreseeable future;
- Elimination of natural patrimony;
- Expressive losses for other water uses;
- Inundation of protected historic areas; and
- Inundation of cemeteries and other sacred places.

The process starts with a previous analysis (preliminary studies) by the local environmental department. After that, if the project was considered environmentally feasible, the sponsors have to prepare the Preliminary Environmental Assessment, which is basically composed by the following information:

- Reasons for project implementation;
- Project description, including information regarding the reservoir and the utility;
- Preliminary Environmental Diagnosis, mentioning main biotic, and anthropic aspects;
- Preliminary estimative of project impacts; and
- Possible mitigation measures and environmental programs.

The result of a successful submission of those assessments is the preliminary license, which reflects the environmental local agency positive understanding about the environmental project concepts.

To get the construction license, it will be necessary to present either: (a) additional information into previous assessment; or (b) a new more detailed simplified assessment; or (c) the PBA, according environmental local agency decision at the preliminary license issued. The operation license will be obtained as result of pre-operational tests during the construction phase, carried out to verify if all exigencies made by environmental local agency were satisfied.

All documents related to operational and environmental licensing are public and can be obtained at the state environmental agency (FEMA/MT).

Given the project is below the environmental legislation criteria of a small-scale size up to 15 MW, it has a fast-track environmental assessment process due to its reduced impact.

The power plant has all the licenses emitted by the environmental agency of the State of Mato Grosso (FEMA):
(LI): installation licensing (number 397/2003), issued on decemberr 29, 2003. Since to it expires in 01 year, this licensing was renovated .

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 environmental impacts associated with the project activity are modest because the regional topography allows the dam to be naturally contained in a valley. Furthermore, this valley has a low demographic and land use rate.

SECTION E. Stakeholders' comments

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

Researches made with the local community demonstrated no opposition to the construction of the plant. This information was considerate in the decision to continue with the project, mainly by the fact that the displacement of households generates expectation of unquietness as well as voluptuous investment demands, making plants with low installation capacity not feasible.

Public discussion with local stakeholders is mandatory for obtaining the environmental construction and operating licenses, and once the project was awarded with those mandatory licenses, it is clear the project has gone through the stakeholders' comments process.

The Resolution number 1, issued by 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

The invitation letters were sent to the stakeholders listed above, during November 2006. The copies of the letters and the acknowledgement of receipt (called AR in Brazil) will be shown to the DOE during the validation process.

With the purpose to facilitate the comments of the invited persons, the following questionnaire was sent to the stakeholders:

1. Do you believe that the socio-economic situation of the region will improve due to the implementation of the project?
2. Is the implementation of project able to improve the environmental situation in the region?
3. How does the development of the project affect you (positively or negatively) or your environment?
4. Would you recommend private companies or authorities to develop projects of this nature?
5. Do you think the project will contribute to the Brazilian Sustainable Development?
6. Any additional comments you would like to make.

The following documents were publicly available at a website available to all potential stakeholders[23]:

- Presentation on the ARS Project
- Executive Summary of ARS Project
- General Concepts on Greenhouse Effect and the Kyoto Protocol

This webpage was initiated on January 7th, 2007, and is indicated in the letter inviting stakeholder comments

[23] http://www.flessak.com.br

E.2. Summary of the comments received:

The entities and persons who commented on the project were:

- Municipality of Faxinal dos Guedes: Mr.Claudemir Basquera (assessor)
- Municipal Environmental Agency (Mr. Osmar Rosseto)

All the presented comments were positive, emphasizing the project will be one more source of employment and resources for the municipality, besides supplying electric energy for the region.

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

Since all stakeholders consulted so far, support the project, no modifications to project design were necessary.

However, despite the acceptance of the project, we emphasize that the environmental aspects will be carefully observed with the objective to manage any eventual environmental impact.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Table 9: Non-Annex I project participant

Organization:	Tecnovolt Centrais Elétricas Ltda
Street/P.O.Box:	Av. Duque de Caxias, 282 Francisco Beltrão-PR
Building:	
City:	Nova Ubiratã
State/Region:	Mato Grosso
Postfix/ZIP:	
Country:	Brazil
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	Director
Salutation:	
Last Name:	Flessak
Middle Name:	
First Name:	Edson
Department:	
Mobile:	
Direct FAX:	
Direct tel:	55 46 35201060
Personal E-Mail:	edson@flessak.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding has been involved in financing this project activity.

Annex 3

BASELINE INFORMATION

Calculation of the grid emission factor

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

The natural evolution of both systems is increasingly showing that integration is to happen in the future. In 1998, the Brazilian government was announcing the first leg of the interconnection line between S/SE/CO and N/NE. With investments of around US$ 700 million, the connection had the main purpose, in the government's view, at least, to help solve energy imbalances in the country: the S/SE/CO region could supply the N/NE in case it was necessary and vice-versa.

Nevertheless, even after the interconnection had been established, technical papers, such as *Bosi* (2000) still divided the Brazilian system in two, since a very small fraction of electricity consumed in each of the regions can really be exchanged through the installed transmission line:

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

(i) The South/Southeast/Midwest Interconnected System;
(ii) The North/Northeast Interconnected System; and
(iii) The Isolated Systems (which represent 300 locations that are electrically isolated from the interconnected systems)"

Moreover, Bosi (2000) gives a strong argumentation in favor of having so-called *multi-project baselines*:

"For large countries with different circumstances within their borders and different power grids based in these different regions, multi-project baselines in the electricity sector may need to be disaggregated below the country-level in order to provide a credible representation of 'what would have happened otherwise".

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

The Brazilian electricity system nowadays comprises of around 91.3 GW of installed capacity, in a total of 1,420 electricity generation plants. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 5.3% are diesel and fuel oil plants, 3.1% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw, and biogas), 2% are nuclear plants, 1.4% are coal plants, and there are also 8.1 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela, and Paraguay) that may dispatch electricity to the Brazilian grid[24]. This latter capacity is in fact comprised by mainly 6.3 GW of the Paraguayan part of Itaipu Binacional, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

Thus, for the proposed project activity, the South/Southeast/Midwest interconnected sub system of the Brazilian grid, where the project activity is located, is included in the spatial extent of the project boundary.

ACM0002 indicates that the emission factor of the grid is determined by the following three steps:

1. Calculate the operating margin emission factor
2. Calculate the build margin emission factor
3. Calculate the combined margin emission factor by working out the weighted average of the operating margin emission factor and the build margin emission factor

Step 1. Calculate the operating margin emission factor (*EF_{OM}*)

The simple adjusted operating margin emission factor (tCO_2e/MWh) is a variation of the simple operating margin emission factor[25], where the power sources (including imports) are separated in low-cost/must-run power sources (*k*) and other power sources (*j*), as follows:

$$EF_{OM} = (1-\lambda)\frac{\sum_{i,j} F_{i,j} \times COEF_i}{\sum_j GEN_j} + \lambda \frac{\sum_{i,k} F_{i,k} \times COEF_i}{\sum_k GEN_k} \qquad (2)$$

where

λ	Lambda factor: fraction of time during low-cost/must-run sources are on the margin
$F_{i,j} / F_{i,k}$	Amount of fuel *i* consumed by relevant power sources *j*/*k* (in energy unit)
GEN_j / GEN_k	Electricity delivered to the grid by power sources *j*/*k* (MWh)
$COEF_i$	CO_2 emission coefficient for fuel *i*. (tCO_2e/energy unit)

In the case of the South/Southeast/Midwest interconnected sub system of the Brazilian grid, all the low-cost/must-run plants produce zero net emissions, and thus:

$$\frac{\sum_{i,k} F_{i,k} \times COEF_i}{\sum_k GEN_k} = 0$$

[24] Source: http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp

[25] 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.

The CO_2 emission coefficient $COEF_i$ is obtained as follows:

$$COEF_i = CEF_i \times OXID_i \quad (3)$$

where

CEF_i — CO_2 emission factor per unit of energy of the fuel i (tCO_2e/energy unit)
$OXID_i$ — Oxidation factor of fuel i (%)

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

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

The dispatch data provided by the ONS[26] is treated as to allow calculation of the operating margin emission factor for the most three recent years with available information, which are 2003, 2004, and 2005.

The electricity generation and imports corresponding to each year are provided in the table below.

Table 10: Electricity generation and imports (MWh)

Year	Electricity load	Electricity generation by low-cost/must-run power sources	Imports
2003	288,933,290	274,670,644	459,586
2004	302,906,198	284,748,295	1,468,275
2005	314,533,592	296,690,687	3,535,252

[26] *Operador Nacional do Sistema Elétrico*, *Centro Nacional de Operação do Sistema*, *Acompanhamento Diário da Operação do Sistema Interligado Nacional* (daily reports from January 1st, 2003 to December 31st, 2005)

The lambda factors are calculated as explained above in Section B.6.1. The table below presents the values obtained:

Table 11: Lambda factors

Year	λ
2003	0.5312
2004	0.5055
2005	0.5130

Using the appropriate information for fossil fuel conversion efficiencies and CO_2 emission coefficients, the operation margin emission factors for each year is calculated and the mean average among the three years results to be 0.4349 tCO_2/MWh.

Step 2. Calculate the build margin emission factor (EF_{BM})

The build margin emission factor of each crediting period is calculated as follows:

$$EF_{BM} = \frac{\sum_{i,m} F_{i,m} \times COEF_i}{\sum_m GEN_m} \qquad (5)$$

where $F_{i,m}$, $COEF_i$ and GEN_m are analogous to the variables described above for the operating margin emission factor determination.

The sample group *m* consists of either:

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

According to the methodology, from these two options, the sample group that comprises the larger annual generation should be used.

Using the information related to the new electric power plants added to the system provided by ANEEL[27], data provided by the ONS corresponding to year 2005, and the appropriate information for fossil fuel conversion efficiencies and CO_2 emission coefficients, the build margin emission factor is calculated and results to be 0.0872 tCO_2/MWh.

[27] *Agência Nacional de Energia Elétrica*, *Banco de Informações da Geração*

Step 3. Calculate the combined margin emission factor (*EF_{grid}*)

The baseline emission factor is calculated as the weighted average of operating margin emission factor and the build margin emission factor. For weighting these two factors applying the default value of 50% for both, the operating margin and the build margin emission factors, the combined margin emission factor is obtained as follows:

$$EF_{grid} = \frac{(EF_{OM} + EF_{BM})}{2} \qquad (6)$$

Thus, the resulting grid emission factor is:

$$EF_{grid} = \frac{(EF_{OM} + EF_{BM})}{2} = \frac{(0.4349 + 0.0872)}{2}$$ tCO_2/MWh = **0.2611 tCO_2/MWh**

The data and the spreadsheet with the calculation of the emission factor will be shown to the DOE during the validation process.

Annex 4

MONITORING INFORMATION

The methodology describes the procedure and equations for calculating emission reduction from monitored data. For this specific project, the methodology is applied through a spreadsheet model. The staff responsible for project monitoring 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 sheet (*Electricity Generation*)
- 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 the monitored data will be archived for two years following the end of the crediting period.

Annex 5

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