CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

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>.

SECTION A. General description of the small-scale project activity

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

Santa Lúcia II Small Hydro Plant
CDM Small Scale Project
PDD VERSION 02
Date: May 02, 2006

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

The Santa Lúcia II Plant is a small run of river hydro plant (7.6 MW), therefore without any reservoir, that generates no environmental impact. It is also different from most Brazilian SHPs (small hydro plants), existing and planned for, in that it is located in an isolated system in the western portion of the State of Mato Grosso that was originally supplied by a diesel powered thermal plant.

Maggi Energia S.A. is the sole owner of Santa Lúcia II and has a vast experience in generating electricity using alternative energy sources such as hydro and biomass. Santa Lúcia II had its project started during 2001, all construction and installations from January 2002 until January 2003. Commercial operation started in April, 2003. During the last two years it generated a total of almost 80 GWh.

The project is located more than 480 km from Cuiabá, the capital of the State of Mato Grosso, in the county of Sapezal. The region's main economical activities are agriculture (soy and rice), wood industry and diary. This is one of the fastest growing regions in the country, mainly because of the activities of the export oriented agribusiness and the electricity market is deemed to grow at 5% pa.

The most important aspect of this project is the displacement of fossil fuels by renewable energy sources in the generation of electricity in isolated systems. Within the scope of the Plano de Universalização de Energia Elétrica (federal government plan that is in charge of linking all households to the grid), the local distribution company – CEMAT (Centrais Elétricas Mato-Grossenses) built and operates the Sapezal Thermal Plant since 1999. With an installed capacity of 9.9 MW, it is composed of seven diesel generators and burned an average of 8.000 m3 of diesel oil per year, emitting more than 20,000 tCO_2 e per year.

The Santa Lúcia II Project improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. Small scale hydropower run-of-river plants provide local distributed generation, in contrast with the business as usual large hydropower and natural gas fired plants built in the last 5 years.

This specially the case this Project where the region is developing at a very high rate when compared with the national average and where electric demand is also growing at a faster pace. Sustaining this rhythm requires new power supply sources even after integrating the region in the national grid.

This indigenous and cleaner source of electricity will also have an important contribution to environmental sustainability by reducing carbon dioxide emissions that would have occurred otherwise in the absence of the project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation by fossil fuel sources (and CO_2 emissions), which would be emitted in the absence of the project.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Private entity – Maggi Energia S.A.	NO
	Private entity – C-Trade Comercializadora de Carbono Ltda – project developer	

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

Santa Lúcia II uses water from the Juruena River to generate electricity with 7.6 MW installed capacity. It is located right next to its sister plant, Santa Lúcia I, to tap all the flow of the river. This run-of-river project does not have any dam or water storage, and therefore makes complete use of the water flow. Figure 1, below, shows the two plants separated by a small island and the absence of any reservoir. The river flows from the upper to the bottom of the photo.

Figure 1 – Photograph of the twin plants: Santa Lúcia II (left) and Santa Lúcia I (right)

Santa Lúcia II has five sets of turbine-generators. As there is almost no head, Francis Vertical Open Flume turbines, being the most adequate technology as of today, were employed.

Turbines		
HISA - Hidraulica Industrial	Francis Vertical Open Flume	
quantity	1	4
Capacity (HP)	1,694	2,118
Rotations (rpm)	136.3	127.2
Flow (m^3 / s)	13.3	16.7
Year of fabrication	2000	2000

Generator		
WEG	Type SSA 500	Type SSA 560
Quantidade	1	4
Rotations (rpm)	1,200	1,200
Nominal Voltage (V)	480	480
Year of fabrication	2001	2002

Table 1 – Turbine and Generator Specification

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.:

State of Mato Grosso

A.4.1.3. City/Town/Community etc:

Sapezal

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

The project is located in the mid-west of Brazil, state of Mato Grosso, near the city of Sapezal (latitude 13° 32’ 36” South and longitude 59º 01' 48" West).
The Juruena River is part of the Parecis basin and is subsidiary of Teles Pires, Tapajós and Amazon Rivers.

The maps below locate the project in Brazil, Mato Grosso and in the western part of the state:

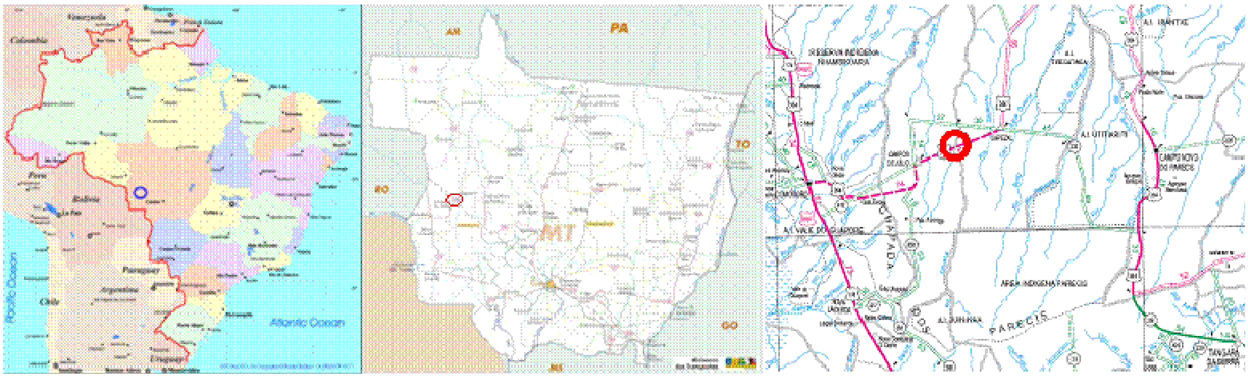

Figure 2 – Location maps of the project

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

Small-scale project activity.
Type 1: Renewable energy projects.
Category I.D.: Renewable energy generation for a grid.
Santa Lúcia II uses the renewable hydro potential of the Juruena River to supply electricity to the small regional grid around Sapezal displacing diesel oil used in the Sapezal Thermal Pant.
It has an installed capacity of 7.6 MW (below the eligibility limit of 15 MW for small scale projects). The equipment used in the project was developed and manufactured in Brazil.

A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

Santa Lúcia II generates electricity using hydropower without emitting greenhouse gases, will result in GHG emissions reductions as the result of the displacement of generation from the Sapezal Thermal Plant, fossil-fuel thermal plant that would have otherwise supplied the region.

Kartha et al. (2002) stated that, "the crux of the baseline challenge for electricity projects clearly resides in determining the 'avoided generation', or what would have happened without the CDM or other GHG-mitigation project. The fundamental question is whether the avoided generation is on the 'build margin' (i.e. replacing a facility that would have otherwise been built) and/or the 'operating margin' (i.e. affecting the operation of current and/or future power plants)."

Here there is a particularity in this project. In January, 2006, a transmission link was completed, connecting the Sapezal sub-system to the National Grid. The baseline emission factor is calculated using solely the operating margin, displacing the thermal plant dispatch in order to cover the period between the start of operations (2003) up to December, 2005. As project's installed capacity is smaller than the thermal plant's (9.9 MW), it is safe to say that all the electricity generated avoids diesel oil related emissions.

From January, 2006 onwards, the baseline must be modified and the whole Brazilian South-Southeast-Midwestern Grid must be taken into account. The map below shows the existing National Grid termination at Jauru, and its extension to Sapezal and the location of the project.

Figure 3 – National Grid termination at Jauru at project location

For the purpose of determining the build margin and the operating margin emission factors, the project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly a connected electricity system is defined as one that is connected by transmission lines to the project and in which power plants can be dispatched without significant transmission constraints.

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

Please indicate the chosen crediting period and provide the total estimation of emission reductions as well as annual estimates for the chosen crediting period. Information on the emission reductions shall be in indicated using the following tabular format.	
For type (iii) small-scale projects the estimation of project emissions is also required.	
Years	Annual estimation of emission reductions in tonnes of CO2 e
2003	5,622
2004	31,761
2005	29,791
2006	19,975
2007	19,975
2008	19,975
2009	19,975
2010	14,981
Total (tCO_2e)	162,055
Total number of crediting years	21 y (3x7 years)
Annual average of estimated emission reductions over the crediting period (tones of CO2 e)	23,151

Note: There is a transmission line being built that will link the Sapezal sub-system to the national grid from January, 2006 onwards. From this date forward, the baseline emission factor changes from the pure diesel oil emission factor used in the calculation of the table above to a lower value reflecting the South-Southeast-Midwestern electric system.

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

No public funding from Annex I parties were sought for project activities.

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

Santa Lúcia II is not part of a larger project activity.

SECTION B. Application of a baseline methodology:

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

AMS type I, renewable energy projects.
Santa Lúcia II employs renewable energy technology to supply electricity to a local grid.

B.2 Project category applicable to the small-scale project activity:

Category I.D – 'Grid connected renewable electricity generation'.
Santa Lúcia II employs renewable energy technology to supply electricity to a local.

> *"**Technology/measure:***
> *1. This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal, and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel or non-renewable biomass fired generating unit."*

Santa Lúcia II displaces energy generation from the Sapezal Thermal Plant.

Baseline calculations are done according to Appendix B of the simplified modalities and procedures for small-scale CDM project activities (Type I - Renewable Energy Projects - I.D. 'Grid connected renewable electricity generation'):

> *6. For a system where all generators use exclusively fuel oil and/or diesel fuel, the baseline is the annual kWh generated by the renewable unit times an emission coefficient for a modern diesel generating unit of the relevant capacity operating at optimal load as given in Table I.D.1.*

Table I.D.1 gives a value of emission factors for diesel generator systems of 0.8 kg CO_2e/kWh.

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

The region comprising Sapezal and neighbouring counties was supplied by a diesel fuelled thermal plant up to 2003. All the electricity produced by SHP Santa Lúcia II would have been otherwise generated by the thermal plant, therefore increasing anthropogenic emissions. The plant, with an installed capacity of 7.6 MW, fulfils all requisites of a Small-scale CDM project.

To prove the project's additionality, CDM / EB' "*Tool for the demonstration and assessment of additionality"*. UNFCCC, CDM Executive Board 16th Meeting Report, 22 October 2004, Annex 1, will be used.

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

The project of Santa Lúcia II started in 2001, construction lasted from January, 2002 to April, 2003 and commercial operation started in October 2003, therefore after January 1st, 2000.

Maggi Energia S.A. is part of Grupo Maggi, a holding company with several agricultural, industrial and logistic activities in the central and north-western regions of the country. The holding company has closely followed the evolution of the negotiations within UNFCCC and, specially, the succession of the CDM meetings.

The decision to build Santa Lúcia II took into account the possibility of obtaining revenues from the carbon market. Back in 2001, there were only tentative analysis on how such market would operate and what would be the level of prices. Nevertheless, there are internal documents proving that the company seriously considered this possibility in order to reach the decision to move forward with the project.

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

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

SHP Santa Lúcia II is a plant built next to its sister plant, Santa Lúcia I (see photo, page 4). Both plants were projected to supply Grupo Maggi's activities in the region. As stated before, the region was an isolated electric system, not linked to the Brazilian National Grid up to January, 2006, and the main source of supply of electricity is a 9.9 MW diesel fired Sapezal Thermal Plant.

The older plant, Santa Lúcia I, added another 5 MW capacity to the subsystem and, together with the thermal plant, would have generated enough power for the region up to 2004.

The most likely alternative would have been not to build Santa Lúcia II since there were plans for linking the region to the National Grid in 2004 and energy demand would have been supplied from the rest of the country.
Not building Santa Lúcia II would have spared the Group's much needed financial resources for other activities.

Sub-step 1b. Enforcement of applicable laws and regulations:

Both the project activity and the alternative scenario are in compliance with all applicable laws and regulations.

Step 2. Investment analysis

The proposed project activity is the economically or financially less attractive than the other alternative without the revenue from the sale of certified emission reductions (CERs).

Sub-step 2a. Determine appropriate analysis method

Benchmark analysis (Option III) will be used.

Sub-step 2b – Option III. Apply benchmark analysis

Identify the financial indicator:
- IRR will be used.

The benchmark is to represent standard returns in the market:

- Brazilian Prime Rate, known as SELIC (Sistema Especial de Liquidação e de Custódia – Special System of Settling and Custody) will be used.

Sub-step 2c. Calculation and comparison of financial indicators

CDM's "Tool for the demonstration and assessment of additionality" was approved after the project started operations so, in order to comply with the tool, the financial analysis shown below was performed using the original assumptions for investment, revenues from sales of electricity and operational costs for the scenario without CDM related revenues.
For the scenario that includes the revenues from sales of CERs, the emission coefficient used in this PDD was applied as well as an average market price for CER of US$ 10.00 / tCO_2.

The table below shows the assumptions:

Santa Lúcia II Project - Assumptions			
description	value	unit	comments
Investment	6,860	thou USD	75% in 2002 and 25% in 2003
Annual Operational Cost	138	thou USD	2% of investment
1st year electric generation	35	GWh	
Annual production growth	5	%	
Maximum generation output	40	GWh	
Electricity price	37	USD/MWh	R$ 100 / MWh
Average exchange rate	2.7	R$/USD	
Period	12	years	average loan period
Emission coefficient	0.8	tCO2/MWh	
CER price	10	USD/tCO2	

Table 2 – Financial analysis: assumptions

Investment value was obtained from EPC bids for the plant.
Operational costs follow regional practices.
The 12 year analysis period corresponds to the average length of loans in the electric sector.

Electricity price was projected from official estimates. It must be recalled that during 2001, Brazil passed through a severe rationing of electricity. A long draught and the lack of investments in the sector due to instabilities in the economy made the government force an overall cut of 15% in demand. During this period, projected electricity prices reached an average of 45 USD/MWh compared with an average of less than half during the previous period. The value used in the analysis should be seen as a conservative projection during that time.

Electricity sales increase at a 5% rate during the first four years following projected demand growth in the region. The upper limit of 40 GWh/y is the plant maximum output at a 65% capacity factor.

These assumptions render IRR values of 15.4% without CER revenues and 18.5% including them.

The benchmark rate employed is called SELIC, the Brazilian Prime Rate, which is the measure of value of value in the short-term credit market. The government has maintained a very high value for this reference rate as a monetary tool to stabilize the economy. The average annual SELIC value during 2001 was 17.38%.

This shows that without CER revenues, the project would reach lower rates of return than the benchmark rate. Including these revenues, the project is still worst than the benchmark.

Full documentation and spreadsheets are available for the validation team and project participants but not to the public.

Sub-step 2d. Sensitivity analysis

The three main variables that might affect the project's finance are:

- Electricity revenues
- CER revenues
- Operational Costs

Investment was not analysed because the adopted value was the actual investment made.
Electricity generation growth has an upper limit given by the plant's capacity. Actual market grew at about the same rate that was predicted, so the first few years do not affect the analysis.

The table below summarizes the sensitivity results:

Sensitivity	base	-10% electricity price	10% electricity price	-10% carbon price	10% carbon price	-10% oper. costs	10% oper. costs
electricity price	37.00	33.30	40.70	37.00	37.00	37.00	37.00
carbon price	10.00	10.00	10.00	9.00	11.00	10.00	10.00
operational costs	138.49	138.49	138.49	138.49	138.49	124.64	152.34
IRR without	0.154	0.128	0.179	0.154	0.154	0.157	0.152
IRR with carbon	0.185	0.161	0.207	0.182	0.187	0.187	0.182
diff	0.030	0.033	0.028	0.028	0.033	0.030	0.031

In all but one scenario, CER revenues cause the project's IRR to pass from below benchmark rate to above it.

As expected, the project is more affected by the electricity price, reducing the IRR from 15.4% to 12.8% when prices fall 10%. Even then, CER revenues increase IRR by about 3%. Although an IRR value of 16.1% with the CER revenues is below the benchmark rate (SELIC 17.38%), the project is still much more attractive than without them. As CER prices could raise in the next years, and compensate a less likely scenario of loss of revenues from electricity sales.

The sensitivity analysis demonstrates the importance of CER revenues in the feasibility of the project.

Step 3. Barrier analysis

(not used)

Step 4. Common practice analysis

Brazilian electric sector expansion was created during the 60's and 70's fundamentally based on state-owned large hydro plants. It was only during the 90's, with the privatization of the sector that central planning started to loose force. Central planning, as carried out in Brazil, always sought the large plants as means of keeping control of the system and allocating scarce resources (monetary and workforce) in best projects. As of now, less than 1.5% of the country's installed capacity is located in small (less than 30MW) plants. One of the side effects was the absence of market driven players seeking alternative sources. It is felt that the traditional players (privatized utilities) are still seeking larger plants and that both the new player and the regulatory agencies are still in the learning process of dealing with a more decentralized system. By the end of 2004, only 9 new small-hydro projects were authorized by the regulatory agency.

In order to stimulate other alternatives, Brazilian government launched a program called Proinfa (Programa de Incentivo as Fontes Alternativas de Energia Elétrica – Alternative Sources for Electric Energy Incentive Program) that sought to increase the share of small hydro, biomass cogeneration and wind plants. Basically, it offers a better-than-market purchase price and long-term contracts for electricity and lower interest rates in loans from the federal development bank (BNDES). Even with these conditions, the program attracted fewer projects than intended to. Even now, part of the projects that were included in the program is retracting from it, basically due to the cumbersome process in obtaining finance from BNDES. As other similar projects, despite its attractiveness, the Santa Lúcia II project did not apply for participation in Proinfa.

It must also be said that several of the projects being developed have included CER revenues in their feasibility studies. As of now, there are more than 15 plants with CDM projects in different stages of development showing that CER revenues are an important aspect of these projects.

In this sense, it is possible to affirm the projects such as Santa Lúcia II are not widely observed and commonly carried out in the country.

Step 5. Impact of CDM registration

It is clear from the Investment Analysis shown in Step 2, above, that CER revenues are one of the crucial points in the project's feasibility.

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

The immediate boundary where environmental impacts may occur is defined by the plant site, on the Juruena River.

Up to 2005, the boundary of project activities was the comprised by the transmission system based at the Sapezal Substation and connected to both the SHPs Santa Lúcia I and II and the Sapezal Thermal Plant, serving the county of Sapezal.

As stated before, the transmission line linked the Sapezal Substation to the Jauru Substation (part of National Grid) early 2006. Therefore, the boundary must be extended to comprise the South-Southeast-Midwest part of the National Integrated System. The national grid is divided in two main subsystems, as shown in the figure below. Transmission constraints in the link between these two systems limit the energy throughput between them so that they must been seen as separate systems according to large-scale approved CDM consolidated methodology ACM0002.

Figure 4 – Brazilian National Integrated Grid showing the two subsystems

B.5. Details of the baseline and its development:

Baseline calculations are done according to Appendix B of the simplified modalities and procedures for small-scale CDM project activities (Type I - Renewable Energy Projects - I.D. 'Grid connected renewable electricity generation'):

> *6. For a system where all generators use exclusively fuel oil and/or diesel fuel, the baseline is the annual kWh generated by the renewable unit times an emission coefficient for a modern diesel generating unit of the relevant capacity operating at optimal load as given in Table I.D.1. (Table I.D.1 gives a value of emission factors for diesel generator systems of 0,8 kg CO2equ/kWh).*

This remains valid up to January, 2006, when the transmission line linking the Sapezal Substation to the National Grid was completed. Up to then, in the absence of SHP Santa Lúcia II, all energy generated would have been generated at the diesel fired thermal plant..

After January, 2006, when linked to the National Grid, the baseline must be recalculated so as to reflect operating and built margins for the South-Southeast-Midwest subsystem.

> *"The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kgCO2e/kWh) calculated in a transparent and conservative manner:*
>
> *(a) The average of the "approximate operating margin" and the "build margin", where:*

(i) The "approximate operating margin" is the weighted average emissions (in kgCO2e/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

(ii) The "build margin" is the weighted average emissions (in kgCO2e/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants";

or

(b) The weighted average emissions (in kgCO2e/kWh) of the current generation mix.

This project uses option (a) since the expansion of Brazilian electric system calls for an ever increasing share of fossil-fuelled thermal plants.

As thermal plants use fossil, these plants will have higher operational costs than hydro plants and will be most likely displaced by the latter.

Date of completion of baseline calculations: 26/04/2006.
Responsible for baseline calculations:
Sergio A. W. Ennes
C-Trade Comercializadora de Carbono Ltda
(project participant – contact information listed in Annex 1).

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

C.1.1. Starting date of the small-scale project activity:

Commercial operations started in October, 2003.

C.1.2. Expected operational lifetime of the small-scale project activity:

30 y – 0 m

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

C.2.1. Renewable crediting period:

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

01/10/2003

C.2.1.2. Length of the first crediting period:

7y – 0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Application of a monitoring methodology and plan:

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

Monitoring methodology follows the guidelines of Appendix B of the simplified modalities and procedures for small-scale CDM project activities: Type I - Renewable Energy Projects - I.D. 'Grid connected renewable electricity generation'. Monitoring consists in measuring the electricity generated by the plant.

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

Project is a small run-of-river hydro plant, with 7.6 MW of installed capacity (below the 15 MW threshold of small-scale CDM projects), that displaced diesel fired electricity generation from a nearby thermal plant up to January, 2006 and displaces the thermal plants linked to the Brazilian National Integrated Grid afterwards. This fulfils requirements of Type I Category I.D. CDM small-scale projects.

D.3 Data to be monitored:

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
1	Electricity Generation	Electricity generation of the Project delivered to grid	MWh	M	15 minutes measurement and monthly recording	100%	Electronic and paper	During the credit period and two years after	The electricity delivered to the grids monitored such by the project (seller) as the energy buyer. Energy metering connected to the grid and receipt of sales
2	CO_2 emission factor	CO_2 emission factor of the grid	tCO_2/ MWh	C	Annually	0%	Electronic	During the credit period and two years after	Data will be archived according to internal procedures.
3	CO_2 emission factor	CO_2 operating margin emission factor of the grid	tCO_2/ MWh	C	Annually	0%	Electronic	During the credit period and two years after	Data will be archived according to internal procedures.
4	CO_2 emission factor	CO_2 built margin emission factor of the grid	tCO_2/ MWh	C	Annually	0%	Electronic	During the credit period and two years after	Data will be archived according to internal procedures.

Note: Items 2, 3 and 4 will be applicable only after the system is linked to the Brazilian National Grid. Until then, the emission factor is given by Table I.D.1 of Appendix B of the simplified modalities and procedures for small-scale CDM project activities (0,8 kg CO_2equ/kWh).

D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

Data *(Indicate table and ID number)*	Uncertainty level of data (High /Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.3.1	*low*	*Measured value according to internal procedures and validated by ONS*
D.3.2	*low*	*Calculated (no monitoring necessary)*
D.3.3	*low*	*Calculated from official ONS data (no monitoring necessary)*
D.3.5	*low*	*Calculated from official ONS data (no monitoring necessary)*

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

No additional structure is necessary to monitor emission reductions. Electricity generation is the core business of SHP Santa Lúcia II. All measurements comply with national regulations for the electric sector that describe the technical specifications of measuring, reporting and storing the data. The most important value used to determine emission reductions is the amount of electricity being generated. This value passes through a double check (one automated and one manual reading by the operator in the control room).

On the control panel there are two redundant instruments, specified and audited by national regulators, which reads and records the amount of electricity being generated. Both are linked to CCEE (Câmara de Comercialização de Energia Elétrica – Electric Energy Commerce Chamber), a national clearinghouse for trades in the electric sector. Both instruments are also linked to the supervisor system, through which the operator controls the plant. The supervisor system also records generation and stores the information electronically. The reports from in the supervisor system are used for emitting fiscal documents regarding electricity sales to clients.

The responsible engineer for the plant operation and maintenance will collect the electric power meter data from hour to hour. The collecting and filing data are made daily in Excel spreadsheet for generation monitoring effect.

The electric power generation meters calibration will be executed regularly by the concessionary (utility) Cemat in agreement with own norms and procedures comply with national regulatory specifications by ONS.

Maintenance and trouble-shooting procedures comply with national regulatory specifications.

D.6. Name of person/entity determining the monitoring methodology:

Sergio Augusto Weigert Ennes / C-Trade Comercializadora de Carbono Ltda
(Project developer and participant listed in Annex 1 with contact information)

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

E.1.1 Selected formulae as provided in appendix B:

Baseline calculations are done according to Appendix B of the simplified modalities and procedures for small-scale CDM project activities (Type I - Renewable Energy Projects - I.D. 'Grid connected renewable electricity generation'):

> *For a system where all generators use exclusively fuel oil and/or diesel fuel, the baseline is the annual kWh generated by the renewable unit times an emission coefficient for a modern diesel generating unit of the relevant capacity operating at optimal load as given in Table I.D.1.*

The emission coefficient, as given by Table I.D.1 is 0.8 kgCO_2e / kWh.

This remains valid up to January, 2006, when the transmission line linking the Sapezal Substation to the National Grid was completed. Up to then, in the absence of SHP Santa Lúcia II, all energy generated would have been generated at the diesel fired thermal plant.

After January, 2006, when linked to the National Grid, the baseline must be recalculated so as to reflect operating and built margins for the South-Southeast-Midwest subsystem.

When linked to the National Grid, baseline must be recalculated so as to reflect operating and built margins for the South-Southeast-Midwest subsystem.

> *"The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kgCO2e/kWh) calculated in a transparent and conservative manner:*
>
> *(a) The average of the "approximate operating margin" and the "build margin", where:*
>
> *(i) The "approximate operating margin" is the weighted average emissions (in kgCO2e/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;*
>
> *(ii) The "build margin" is the weighted average emissions (in kgCO2e/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants";*

As of today, the emission coefficient would be 0.5364 kgCO_2e / kWh,

E.1.2 Description of formulae when not provided in appendix B:

Not applicable.

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

Project emissions are zero.

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

As there is no reservoir, there are no methane or carbon dioxide emissions related to electricity generation, which are usually accounted as leakage in hydro plant projects.

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

Zero.

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

Up to December, 2005, the region of Sapezal was not linked to the Brazilian National Grid. Up to this date, the electric system was an isolated system, supplied by a diesel-fired thermal plant. Therefore the emission coefficient, EF_y, is given by Table I.D.1 of Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

$$EF_y = 0.8 \text{ kgCO}_2\text{e/kWh} \quad (1)$$

After the link was completed, the baseline emission coefficient is changed in order to reflect the Brazilian South-Southeast-Midwest Grid, as described in Sections B.4 and B.5.

The emission coefficient is calculated as a weighted sum of the coefficients associated with the "approximate operation margin" and the "build margin".

Using the same assumptions and the notation developed in the Consolidated Methodology ACM002 "*Consolidated Methodology for grid-connected electricity generation from renewable sources*", both coefficients are obtained as:

- Operation margin:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,k} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad (2)$$

where:

$F_{i,k,y}$ = *the amount of fuel annual (in a mass or volume unit) consumed by relevant power sources j in year(s) y (j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid),*

$COEF_{i,j\,y}$ = the CO_2 emission coefficient of fuel annual (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y,

$GEN_{j,y}$ = the electricity (MWh) delivered to the grid by source j, and

The CO_2 emission coefficient, $COEF_{i,}$ is obtained as:

$$COEF_{i,} = NCV_i \,.\, EF_{i,CO2} \,.\, OXID_i; \quad (3)$$

where:
NCV_i = net calorific value (energy content) per mass or volume unit of a fuel i;
$OXID_i$ = oxidation factor of the fuel (1996 Revised IPCC Guidelines for default values);
$EF_{i,CO2}$ = CO2 emission factor per unit of energy of the fuel i.

- Build margin:

The "build margin" emission factor ($EF_{BM,y}$) is the weighted average emissions (in $kgCO_2e/MWh$) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants.

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y}.COEF_{i,m}}{\sum_{m} GEN_{m,y}} \quad (4)$$

*where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described above for plants **m**.*

The combined emission coefficient is weighted average of the operation and build margins:

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y} \quad (5)$$

The baseline emission factor EF_y is the average of the operating margin factor ($EF_{OM,y}$) and the build margin factor ($EF_{BM,y}$),

$EF_y = 0.5 * EF_{OM,y} + 0.5 * EF_{BM,y}$

The National Dispatch Center (*Operador Nacional do Sistema Elétrico, Centro Nacional de Operação do Sistema, Acompanhamento Diário da Operação do Sistema Iterligado Nacional*, daily reports from Jan. 1, 2002 to Dec. 31, 2004) supplied the raw dispatch data for the whole Brazilian interconnected grid. The following data sources were relevant for the calculation of the baseline:

• 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 still divided the Brazilian system in two (Bosi, 2000):

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

(i) The South/Southeast/Midwest Interconnected System;

(ii) The North/Northeast Interconnected System; and

(iii) The Isolated Systems (which represent 300 locations that are electrically isolated from the interconnected systems)"

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

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

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

The Brazilian electricity system nowadays comprises of around 91.3 GW of installed capacity, in a total of 1,420 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 5.3% are diesel and fuel oil plants, 3.1% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw and biogas), 2% are nuclear plants, 1.4% are coal plants, and there are also 8.1 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid. (Aneel, 2005. http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp). This latter capacity is in fact comprised by mainly 6.3 GW of the Paraguayan part of Itaipu Binacional, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

The Small Scale Approved Methodology I.D asks project proponents to account for "all generating sources serving the system". In that way, when applying this methodology, project proponents in Brazil should search for, and research, all power plants serving the Brazilian system.

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

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

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to ANEEL, in fact, ONS centralized dispatched plants accounted for 75,547 MW of installed capacity by 31/12/2004, out of the total 98,848 MW installed in Brazil by the same date (Aneel, 2005. http://www.aneel.gov.br/arquivos/PDF/Resumo_Gráficos_mai_2005.pdf), which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76.4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23.6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in noninterconnected 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 amount of fuel consumed by relevant fossil-fuel-fired plants, are the ones collected in a research made by the International Energy Agency (Bosi et. al., 2002).

The emission coefficients of each fuel are the ones indicated by the IPCC (1996).

Using the above mentioned data, the numbers in Table 2 (in section E.2) and Table 4 (below) arise from the calculation of the baseline and the amount of emission reduction over the chosen crediting period.

EFy=0.5x0.9472 + 0.5x0.1256=0.5364. (6)

Brazilian South-Southeast-Midwest interconnected system baseline calculation

SSC Emission Factors for the Brasilian South-Southeast-Midwest interconnected grid		
Small-scale baseline (without imports)	**OM (tCO2e/MWh)**	Total Generation (MWh)
2002	0.9394	276,731,024
2003	0.9680	295,666,969
2004	0.9431	301,422,617
	Average OM (2002-2004) tCO2e/MWh	Total = 873,820,610
		BM 2004 (tCO2e/MWh)
		0.1256
	0.9472	
	OM*0.5+BM*0.5(tCO2e/MWh)	
	0.5364	

Source: Operador Nacional do Sistema Elétrico, Centro Nacional de Operação do Sistema, Daily Reports from Jan. 1, 2002 to Dec. 31, 2004.

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

The emission reductions by the project activity, ER_y during a given year y is the product of the baseline emissions factor, EF_y , times the electricity supplied by the project to the grid, EG_y, as follows:

$$ER_y = EF_y \cdot EG_y \qquad (7)$$

E.2 Table providing values obtained when applying formulae above:

The table below shows the projected emission reduction values before and after linking SHP Santa Lúcia II with the National Grid.

Years	Annual estimation of emission reductions in tonnes of CO2 e
2003	5,622
2004	31,761
2005	29,791
2006	19,975
2007	19,975
2008	19,975
2009	19,975
2010	14,981
Total (tCO_2e)	162,055

Table 3 – Projected emission reductions from project activities

SECTION F.: Environmental impacts:

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

As for the regulatory permits, Maggi Energia received the authorization issued by ANEEL to operate as an independent power producer, which gives the right to operate SHP Santa Lúcia II. There are two documents related to this authorization:

- Resolução no. 531, issued on Dec.7, 2001 authorizing Maggi Energia to explore Santa Lúcia II with 7.028 MW of installed capacity, and
- Despacho no. 1.123, issued on Dec. 31, 2004 changing the authorized installed capacity to 7.6 MW.

The resolution CONAMA 279 of June 2001 establishes that hydropower plants of less than 10 MW does not need an Environmental Impact Assessment (EIA).

However the legislation requests the announcement of the issuance of the licenses (LP, LI and LO) in the local state official journal (*Diário Oficial do Estado*) and in the regional newspaper to make the process public and allow stakeholders' comments.

Legislation does require the issuance of the following permits:

- Preliminary permit (Licença Prévia or L.P.) – issued during the design phase of the project, containing basic requirements to be met during the construction and operation.
- Construction permit (Licença de Instalação or L.I.) and,
- Operating permit (Licença de Operação or L.O.).

The project has the necessary environmental licenses. The operating permits and licenses were issued by FEMA-MT, the state environmental agency of the State of Mato Grosso.

SECTION G. Stakeholders' comments:

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

For projects that do not require an EIA, public audiences are not required. On the other hand, the legislation requests the announcement of the issuance of the licenses (LP, LI and LO) in the local state official journal (*Diário Oficial do Estado*) and in a local newspaper to make the process public and allow stakeholders' comments.

Brazilian DNA (Interministerial Commission on Global Climate Change – CIMGC/MCT) released Resolution #1 defining the necessary procedures of stakeholder communications for projects in Brazil. This Resolution was released in September, 2003, just before the plant started to operate.

In order to comply with this resolution, Maggi Energia issued letters to stakeholders, describing the project and inviting comments from the following stakeholders:

- Environment Secretary of the State of Mato Grosso;

- Fórum Brasileiro de Mudanças Climáticas;
- Fórum Brasileiro de ONGs e Movimentos Sociais para o Meio Ambiente e Desenvolvimento;
- Commercial Association of the county of Sapezal;
- Mayor, President of the County Hall of the county of Sapezal;
- Secretary in charge of Environment of the county of Sapezal and
- State Attorney for the Public Interest of the State of Mato Grosso

G.2. Summary of the comments received:

No comments were received.

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

No comments were received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

(project developer)

Organization:	C-Trade Comercializadora de Carbono Ltda.
Street/P.O.Box:	Av. Rio Branco, 1 - 9o Andar, Bloco B
Building:	
City:	Rio de Janeiro
State/Region:	Rio de Janeiro
Postfix/ZIP:	20090-003
Country:	Brazil
Telephone:	++55.11.3259.4033
FAX:	++55.11.3159.0828
E-Mail:	
URL:	
Represented by:	
Title:	Executive Director
Salutation:	Mr.
Last Name:	Ennes
Middle Name:	Augusto Weigert
First Name:	Sergio
Department:	
Mobile:	++55.11.8384.0022
Direct FAX:	
Direct tel:	
Personal E-Mail:	sergio.ennes@luminaenergia.com.br

(plant administrator)

Organization:	MAGGI ENERGIA S.A.
Street/P.O.Box:	Av. Presidente Médici, 4269
Building:	
City:	Rondonópolis
State/Region:	Mato Grosso
Postfix/ZIP:	78.705-000
Country:	Brazil
Telephone:	++55.66.411.7243
FAX:	++55. 66.411.3000
E-Mail:	
URL:	www.grupomaggi.com.br
Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Rubert
Middle Name:	Anselmo
First Name:	Roberto
Department:	
Mobile:	++55.66.9999.4804
Direct FAX:	
Direct tel:	
Personal E-Mail:	rubert@grupomaggi.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from Annex I parties were or will be sought for project activities.

Annex 3 – Bibliography

01. MME – Plano Decenal 2003-12:
Sumário Executivo do Plano Decenal de Expansão 2003/2012
Comitê Coordenador do Planejamento da Expansão dos Sistemas Elétricos
Ministério de Minas e Energia
www.ccpe.gov.br / www.mme.gov.br

02. Ministério de Minas e Energia, 2003
Balanço Energético Nacional 2003
Secretaria de Energia
www.mme.gov.br

03. ONS – Southeast and Midwest maps:
http://www.ons.org.br/ons/download/DU_Rede%20Oper.S-SE-CO.R36_06-09-04.pdf

04. Bosi, M. 2001
An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study
OECD and IEA Information Paper COM/ENV/EPOC/IEA/SLT (2001)4
http://www.oecd.org/env/cc/

05. Kartha, S., Lazarus, M. and Bosi, M., 2002
Practical Baseline Recommendations for Greenhouse Gas Mitigation Projects in the Electric Power Sector
OECD and IEA Information Paper COM/ENV/EPOC/IEA/SLT (2002)1
http://www.oecd.org/env/cc/

06. Bosi, M. and Laurence, A., 2002
Road Testing Baselines for Greenhouse Gas Mitigation Projects in the Electric Power Sector
OECD and IEA Information Paper COM/ENV/EPOC/IEA/SLT (2002)6
http://www.oecd.org/env/cc/

07. OECD, 2005
Economic Survey of Brazil 2005
OECD, ISBN 92-64-00747-4, February, 2005
http://www.oecd.org

08. PDD - Ecoinvest, 2005
Rialma Com[panhia Energética S.a. Santa Edwiges II Small Hydro Power Plant – Small Scale CDM Project– February 2006.
http://cdm.unfccc.int/

09. Operador Nacional do Sistema Elétrico,
Planejamento Anual da Operação Energética – Ano 2004
ONS RE 3/036/2004
http://www.ons.org.br/ons/planejamento/index.htm

10. CDM Executive Board
Approved Consolidated Baseline Methodology ACM0002 – "Consolidated Methodology for grid-connected electricity generation from renewable sources" version 03
UNFCCC, CDM Executive Board

21st Meeting Report, September 28-30, 2005, Annex 8
http://cdm.unfccc.int/EB/Meetings