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

CONTENTS

Annexes

Revision history of this document

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

SECTION A. General description of small-scale project activity

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

Project title: Penha Renewable Energy Project
PDD version number: 2
Date: March 24, 2008

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

The project activity consists of displacing fossil fuel by using renewable biomass[1] for thermal energy (steam) generation at Penha Papeis e Embalagens Ltda (*Penha*), a recycled paper manufacturer. The project activity is located at *Penha*'s facility in Santo Amaro – state of Bahia, in Brazil. The project aims at reducing green-house gas emissions by burning renewable biomass instead of oil, as fuel in a decisions scenario to implement a new boiler. Biomass emissions are considered carbon neutral due to its biogenic origin.

The project follows decision 17.CP7, at CMP.1, item G – Validation and Registration, at paragraph 46:

"46. The baseline may include a scenario where future anthropogenic emissions by sources are projected to rise above current levels, due to the specific circumstances of the host Party."

Steam is used along the recycled paper production process as a source of heat for drying. Drying operations are critical in achieving the required quality of paper products; therefore steam supply is a very important component of *Penha's* operations.

In the second semester of 2005 Penha Group acquired the Paper Production facility of Santo Amaro from Economic Group. When Penha Group arrived at the facility there were 2 boilers to steam production. One of them was an oil-fired boiler CBC that was in use at that time and the second one was and wood-fired MEPAN boiler scrapped and not operational. The MEPAN boiler was installed by the previous facility owner since there were surrounding company-owned eucalyptus forests that were used as biomass source. That biomass source started declining at 2002 until 2003. When the eucalyptus forests started to decline in 2002 due to unsustainable management, a few tests burning bamboo as fuel were carried out on the MEPAN boiler. Bamboo is very rich in silica. As a result, bamboo used in the fuel tests formed a silicate which damaged the MEPAN boiler. This issue first developed on the burning base, which would constantly become clogged. The damage caused to the boiler was such that the steam produced was not enough to support production, both in quality and quantity, ending with the boiler lifetime.

When Penha arrived in 2005, only the oil fired boiler was operational and was not enough to supply the facility. Penha had 3 possibilities to provide the supply of steam to it's operation. One is to install a new oil-fired boiler, the second one was to install a wood based boiler buying biomass from local market and third was to develop a boiler able to use bamboo as biomass. As will be demonstrated in sections B4 and B5 of this document the most plausible scenario was to use oil-fired boiler and the scenario considering bamboo as renewable biomass is additional.

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[1] This methodology applies the definition of renewable biomass provided in Annex 18 EB23, http://cdm.unfccc.int/EB/023/eb23_repan18.pdf

H. Bremmer & Filhos Ltda.(*Bremmer*), a boiler manufacturer, was contracted to study a solution to technical limitations of bamboo used as fuel to the boiler.

During the development of bamboo based boiler, the damaged MEPAN boiler was sold as scrap and the biomass boiler burning Pinus from the market was rented from *Bremmer* to temporarily generate complementary steam necessary for production, along with the CBC oil-fired boiler. Since the renewable wood was not available at Penha's existent forests, local market can not provide long term contracts to supply wood for Penha's operation and bamboo faces important barriers to it's usage, the common practice would be the usage of oil boiler to steam generation.

Meanwhile, a technology that avoided silicate formation was being tested. In 2006 *Bremmer*, designed and adapted a boiler that ran efficiently on bamboo biomass by using a rotating burning base system. The result was a boiler with generation capacity of 25 tonnes of steam per hour, large enough to meet the current demand of the facility of 10 to 14 tonnes of steam per hour. At the same time, Penha started it's CDM project. *Bremme*r specified the operational design parameters presented at table 1 below:

Bamboo Calorific Value	(kcal/kg)	2,600
Efficiency	%	85,16
Heat Output	(kcal/h)	17,235,062
Fuel Input	(kg/h)	6,628
Boiler Capacity	25	Tonnes of Steam/hour
Steam Enthalpy	667.1	kcal/kg
Operating Pressure	15	kg/cm^2
Steam Temperature	200	ºCelsius

Table 1 – *Bremmer's* specifications for the Bamboo-fired Boiler
Source: H. Bremmer & Filhos Ltda – HBFS-25 Technical Information

The process to generate the steam necessary for paper production commences with the bamboo processing. After harvesting, bamboo is received at *Penha's* for weighting, chipping and temporary storage. Air dried bamboo chips are then combusted in the horizontal *Bremmer* HBFS 25 boiler with a mix circuit of water-tube and fire-tube. Figure 1 shows the schematic of the new biomass-fueled boiler.

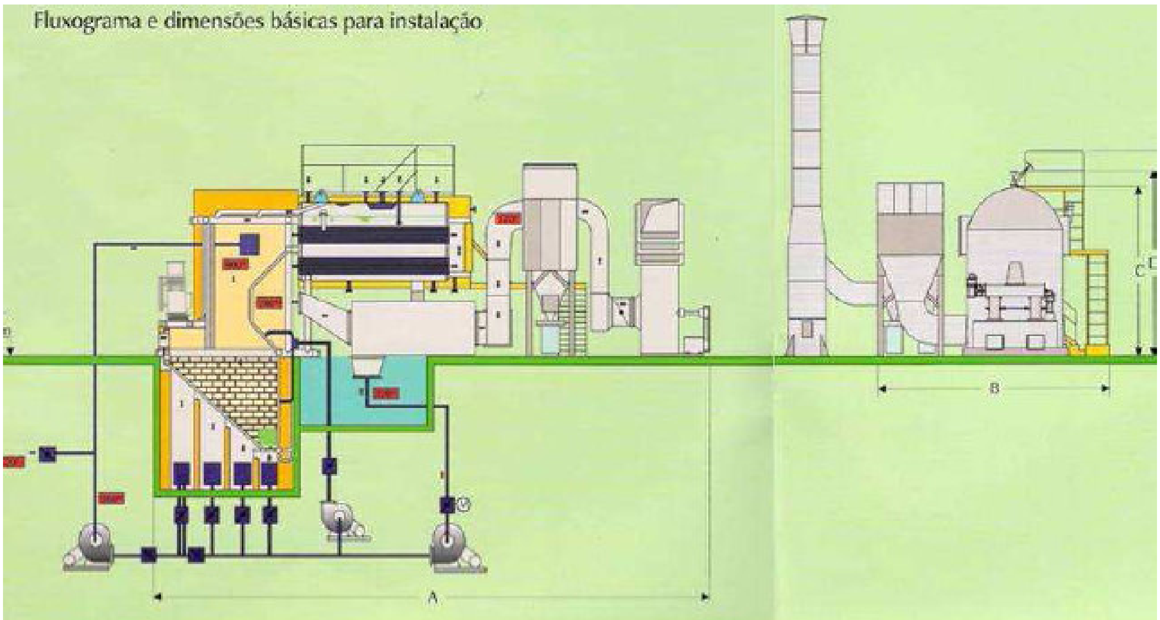

Figure 1: *Bremmer* Biomass-fueled boiler model HBFS 25
Source: H. Bremmer & Filhos Ltda.

An automated conveyor belt feeds the biomass fuel into a continuous water-cooled burning grill. The boiler is dimensioned according to the energy content of the biomass, achieving complete combustion when fed at a constant rate with bamboo chips. The system is equipped with primary and secondary combustion air intakes. A fan blows the primary combustion air through the burning grill thus gasifying the biomass fuel. Secondary combustion air is pre-heated and blown at a calculated rate over the fuel to create turbulence and facilitate a complete combustion. Biomass fuel moves through the grill by a series of pneumatic chains rotating at adjustable speeds. Ashes are collected and landfilled, and the steam produced by the boiler is distributed through the plant for drying applications.

A bimonthly stop of the *Bremmer* boiler is necessary for inspecting and cleaning silicate built-up. These maintenance stops are scheduled along with plant's monthly preventive maintenance shut-downs. During any unscheduled stopped, an oil-fired boiler (CBC boiler) will be used for steam generation.

Penha's Forest Management Department supervises the activities of the bamboo suppliers and provides safety training and monitors working conditions of the bamboo harvesters. Over 300 harvesters are formally employed by the bamboo suppliers. Since *Penha* is located in a very poor region of Bahia State, this project contributes strongly to the development of the region, and brings sustainable development to the Santo Amaro municipality and other cities nearby.

A potential 4th scenario, considering the utilization of gas was not considered since it was not available at Santo Amaro city to industrial usage and its cost is too high.

The project activity also contributes to sustainable development by avoiding oil consumption for steam generation. Since bamboo emissions are carbon neutral, green-house gas emissions from oil are displaced. Oil combustion is also a source of sulfur dioxide and metals emissions which have an adverse effect on human health and the environment.

Specifically considering social aspects, the project bring positive impacts as growth of employment, support to the development of local entrepreneurship, local workforce training at industrial and countryside areas, partnership with SESI to supply educational courses and introduction of safety training program at agricultural activities.

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 a project participant (Yes/No)**
Brazil (Host)	**Penha Papeis e Embalagens Ltda**	**NO**
	Key Associados	**NO**
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Table 2 – Party (ies) and entities private/public involved in the *Penha* Project activity.

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.:

Northeast, Bahia

A.4.1.3. City/Town/Community etc.:

Santo Amaro, BR 420 Highway – Km 16, Pitinga Farm

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

Factory located at BR 420 Highway, Km 16, Pitinga Farm S/N

Bamboo fields:

- Capanema farm, total area of 740 acres, 579 acres of planted bamboo, located in the municipality of Santo Amaro.
- Subaé farm, total area of 1.278 acres, 455 acres of planted bamboo, located in the municipality of Santo Amaro.

- São Lorenço farm, total area of 1.313 acres, 859 acres of planted bamboo, located in the municipality of São Francisco do Conde.
- Monte Alto farm, total area of 1.326 acres, 957 acres of planted bamboo, located in the municipality of São Francisco do Conde.

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

Type (i): Renewable energy projects.
Category C: Thermal energy for the user.

The project is a small scale project activity and falls under the category I.C according to the Annex II of the Simplified Modalities and Procedures for Small-Scale CDM project activities – "Thermal energy for the user".

This methodology applies to renewable energy technologies that supply user with thermal energy that displaces fossil fuels, stating that thermal generation capacity shall be less than 45 MW.

The *Bremmer* boiler is expected to run at 15 tonnes of steam per hour, about 60% of its capacity, with an average gross paper production average of 6 tonnes of paper per hour, during 2008. *Penha* has no immediate plans to expand its production, thus there is no foreseeable increase in the amount of steam produced. In any event, the biomass-fueled boiler maximum capacity is 25 tonnes of steam per hour, or 19.4 MW, as specified by the manufacturer. Capacity calculations are included in section B.2 of this document.

Environmental and Safety Information

Penha's facility in Santo Amaro complies with environmental and safety regulations and has all pertaining operating licenses. Aspects of potential environmental and safety implications are discussed as follows:

Land Use
No change in land use is expected, as the area of bamboo is already planted, and steam generation occurs within the constructed area of the plant and the implementation of a forestry management at bamboo production. As required by the Brazilian Forestry Code, *Penha's* bamboo fields maintain the required percentage of forested areas.

Air Pollution
Even though there are no regulations regarding emissions from point sources in Brazil, emission control technologies for particulate matter are in place and operating at the exit of the biomass boiler. In addition, since the project activity consists of burning renewable biomass, CO_2 emissions are considered zero, resulting in lesser GHG emissions. Burning biomass is also expected to avoid SO_x, NO_x and hydrocarbons emissions from dislocated fossil fuels, as well as VOC and CH4 fugitive emissions from fuel storage and handling. Ashes collected from the burning base and the pollution control system are collected in steel drums and disposed of in a managed landfill.

Water Pollution
The project activity does not interfere with water reservoirs, underground water or waterways. Water used in by the boiler is re-circulated, aiming at reducing water consumption for steam generation.

Noise Pollution and Vibration
The project activity does not generate noise impacts or vibration to area residents, as the boiler is located within a building that shelters the equipment and provides an acoustic barrier. Noise levels inside the building are clearly signaled and *Penha*'s staff is required to use appropriate PPE when working around the area.

Soil Quality
There are no impacts on agricultural or other soils due to the implementation of this project activity.

Flora/Fauna
There are no foreseeable effects on flora or fauna due to the project activity, since it takes place within *Penha's* facility. No records of endemic or endangered species exist for the area of the project activity or the bamboo fields.

Environmental Impact Monitoring
The project activity does not generate environmental impacts that need to be monitored and an environmental impact assessment has not been requested by any local or regional environmental authorities.

Social Impacts
The company has developed several social programs regarding bamboo exploitation. These programs are directly related to the project activity, and include the following:

1. 300 direct jobs have been created. These projects are related to bamboo harvesting, farm security and radio communication.
2. Partnership with SESI (Serviço Social da Indústria) for education programs.
3. Partnership with SENAR (Serviço Nacional de Aprendizagem Rural).
4. Possible partnership with UNEB (Universidade do Estado da Bahia).
5. Creating awareness programs regarding the use of bamboo in the surrounding communities.

Utilization of bamboo as a renewable fuel

In order to keep a steady operation of the biomass-fired boiler it became necessary to guarantee a constant supply of bamboo. *Penha* owns five farms which, combined, give a total of 3,000 hectares dedicated solely to bamboo plantations.

Bamboo is a group of woody perennial evergreen plants in the true grass family *Poaceae*, subfamily *Bambusoideae*, tribe *Bambuseae*. The bamboo species utilized as biomass is the *Bambusa vulgaris*.

Species from the Poaceae family are not restricted or protected under the Brazilian Forestry Code, nor are non-native, exotic species such as *Bambusa vulgaris*.

Thus, although an environmental license for harvesting the bamboo is not required, this activity is closely monitored by *Penha*. To this effect, a Forest Management Department within *Penha* was specifically created to ensure that bamboo plantations were harvested in a sustainable way.

The company developed three suppliers to harvest, transport and deliver the bamboo biomass to be used in the process. An explanation to the sustainable management of the bamboo is provided below:

Current Area of Bamboo Plantation (total)	2.851	hectare
Plantation Density	150	ton/hectare
Bamboo Consumption	33,252	ton/year
Bamboo Consumption	120	ton/day
Required Area of Bamboo for Harvesting	292	hectare/year
Years to Bamboo Growth for harvesting (maximum)	3	years
Area Required for Sustainable Harvesting	**876**	**hectare**

Table 3 – Bamboo consumption calculations for sustainable management
Source: Penha - Foresty Management Department

Bamboo over 3 years old becomes more difficult to harvest due to its size and hardness, therefore a 3-year period is recommended for rotation. This would require only 876 hectares for sustainable harvesting out of the over 3,000 hectares available.

In addition, *Penha* has an Integrated Management System (IMS) currently in place at other locations, including an ISO 9000 certification. *Penha* is in the process of implementing this system for its Santo Amaro Facility. This IMS covers quality, safety and environmental issues.

As a conclusion, there are no environmental aspects considered significant for the implementation and operation of the project activity. It is inferred that the project activity does not have any implications that could adversely impact the environment.

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

Years	**Estimation of annual emission reductions intonnes of CO2 e**
2008	29,526
2009	29,526
2010	29,526
2011	29,526
2012	29,526
2013	29,526
2014	29,526
Total estimated reductions (tonnes of $CO_{2\,e}$)	**206,682**
Total number of crediting years	**7**
Annual average of the estimated reductions over the crediting period (t$CO_{2\,e}$)	**29,526**

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

There is no current funding from Annex 1 countries involved in the project.

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

The described project activity is unique within *Penha*'s operation and is not a part of a larger project. Current production at *Penha* is based solely on steam supplied by the above mentioned boilers. There is neither other source of thermal energy nor consumption of renewable fuels of which this project activity could be part of. *Penha*'s project activity supplies the entire amount of steam necessary for production, displacing fossil fuel as the main fuel utilized at their facility in Santo Amaro City, Bahia State.

SECTION B. Application of baseline and monitoring methodology

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

The applied baseline methodology is AMS-I.C: 'Thermal Energy for the User with or without Electricity', Type I – Renewable Energy Projects, version 13.

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

The applied baseline methodology is AMS-I.C: 'Thermal Energy for the User with or without Electricity', Type I – Renewable Energy Projects, version 13, which states, as a condition of its applicability, that the thermal energy generation capacity of the project does not exceed 45 MW.

Project Thermal Capacity Calculation:

Based on data provided by the manufacturer, the net installed thermal capacity for the new boiler is calculated as follows:

Operating Pressure: 15 kg/cm^2
Steam Temperature: 200 ºCelsius
Steam enthalpy: 667.1 kcal/kg (at 200 ºC, 16 bar)
Boiler Steam Production: 25 ton/h

Boiler Thermal Capacity = (25 ton/h)*(667.1 kcal/kg)*(1000 kg/ton)/(10^6 Gcal/kcal) = 16.7 Gcal/h

Conversion Factor Gcal to MWh = 1.163

Boiler Thermal Capacity = (16.7 Gcal/h)*(1.163 MWh/Gcal) = 19.4 MW

Hence, the installed capacity is lower than 45 MW.

B.3. Description of the project boundary:

For the proposed project activity, the project boundary is from the point of fuel storage to the point where the thermal energy is utilized. Thus, the project encompassed the storage of bamboo fuel, the biomass boiler, and the thermal energy generated for paper production.

B.4. Description of baseline and its development:

To demonstrate the baseline scenario in a transparent manner, the steps from the Tool for Assessment and Demonstration of Additionality (Version 3) are considered.

The application of the steps, considering barrier analysis, was implemented at item B.5 bellow of this document and the conclusion achieved made possible define the baseline and project scenario as bellow.

The possible scenarios for the baseline scenario and for the proposed project activity are:

1. Steam Generation from fossil fuels.
2. Steam Generation from biomass other than bamboo.
3. Steam Generation from bamboo, without the incentive of CDM.

Selection of Baseline Scenario

The following table summarizes the results from the barrier analysis for each identified scenario. As shown in this table, Scenario 1 does not face any barriers. Scenario 2 faces four important barriers. Scenario 3 faces three significant barriers.

Table 4: Summary of Barrier Analysis

Identified Barriers		Scenario 1	Scenario 2	Scenario 3
		Oil based boiler	**Renewable wood**	**Renewable bamboo**
1	Laws and regulations	No	Yes	No
2	Technical barriers	No	Yes	Yes
3	Biomass exploitation	No	Yes	Yes
4	Socio-economical	No	Yes	Yes

The barrier analysis clearly shows that the most probable scenario would be steam generation from fossil fuels. Scenario 2 faces all barriers analyzed and scenario 3 faces three of four barriers analyzed. Thus, the proposed activity, scenario 3 (steam generation from bamboo), can be selected and the project activity.

Considering the baseline scenario and the project scenario above, the simplified baseline for renewable energy projects, as specified in the selected small scale methodology I. C. “Thermal Energy for the User with or without Electricity”, is calculated from the fuel consumption that would have been consumed in the absence of the project activity times an emission factor for that displaced fossil fuel.

IPCC default values for emission factors and heating values, as well as other parameters used in the baseline calculations, are presented in the following table:

Variable	Emission Factor	Value	Units	IPCC ID	Reference
NCV_{FO}	Net calorific value for fuel oil	43.3	MJ/kg FO	IPCC ID:17144	(a) Source: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories(Table 1-3 on page 1.23 of the Reference Manual)
$EF\ C_{FO}$	Carbon emission factor for fuel oil	20.0	tC/TJ FO	IPCC ID:17174	(b) Source: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories(Table 1-4 on Page 1-24 of the Reference Manual)
$OXID_{FO}$	Oxidation Factor for fuel oil	0.99	Not Applicable	IPCC ID:110711	(c) Source: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual Vol 3. Table 1-6, page 1.29
η_{FO}	Efficiency of the plant using fossil fuel	0.89	Not Applicable	-------	CBC Industrias Pesadas S.A. oil-fired boiler technical information sheet

Table 5 – IPCC Emission factors utilized in the baseline calculations

In order to convert the carbon emissions for fuel oil to CO_2 emissions, it has to be multiplied by a factor of 44/12. Thus, the utilized fuel oil emission factor is obtained as follows:
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EF $CO_{2,FO}$ = 20.0 tC/TJ FO x 44/12
EF $CO_{2,FO}$ = 73.33 tCO2/TJ FO

Where:

EF $CO_{2,FO}$ = the CO_2 emission factor per unit of energy of the fuel that would have been used in the absence of the project activity in (tCO_2 / TJ), obtained from IPCC default emission factors.

The emissions of this project are considered null, since biomass is a renewable fuel. During its growth period, the bamboo planted in the farms surrounding the factory reabsorbs all the carbon emitted during the bamboo combustion.

Efficiency of the baseline plant (η_{FO}) was determined as the efficiency of the existing oil-fired CBC boiler, as specified in the manufacturer's technical manual. The efficiency utilized is 89%.

The methodology considers leakage if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity. Since neither of these options apply to Penha's project activity no leakage will be taken into account.

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:

To demonstrate additionality of this project activity, the steps from the Tool for Assessment and Demonstration of Additionality (Version 3) were followed. Technological, common practice and other barriers were identified and evaluated.

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

Step 1.a – Define alternatives to the project activity:

Possible scenarios for the proposed project activity are:

1) Steam Generation from fossil fuels. No biomass is harvested for generating steam.
   In the absence of the project activity steam generation would be carried out by oil-fired boilers. Aside from *Penha's* long-term experience with oil-fired boilers for steam generation, fossil fuels are considered to be one of the most commonly used technologies due to their burning efficiency, low maintenance and the relative simplicity of storing and handling fossil fuels when compared to biomass fuels.

2) Steam Generation from biomass other than bamboo.
   In this scenario steam generation is achieved by using other types of biomass such as wood, wood-waste, sawdust, rice husks, bagasse etc.

3) Steam Generation from bamboo, without the incentive of CDM.
   This scenario considers the use of bamboo as fuel for steam generation without the incentive of the Clean Development Mechanism.

Step 1.b - ***Consistency with mandatory applicable laws and regulations:***

1) Oil fired boiler.

The fist alternative scenario, steam generation by an oil-fired boiler, can be considered business as usual – there are no restrictions or applicable laws against consuming fossil fuels for steam generation. Furthermore, no pertinent environmental licenses have any demands regarding reducing GHG emissions, or, more specifically, one that demands that the company switches the fuel used in the boiler.

2) Biomass other than bamboo.

Utilizing other types of biomass such as wood, wood-residues, bagasse, etc, is not subject to any regulations other than environmental licenses for its exploitation. Wood has to be gathered from reforested, sustainable areas, and a license has to be granted by environmental authorities for this activity. Since there are no sustainable wood forests managed by Penha, this option implies in achieve wood supply from the market, facing risks of no renewable biomass and even not legal biomass being supplied to the company, exposing Penha to legal risks.

To corroborate this fact the study “Fatos e Números do Brasil Florestal (Facts and Numbers of Forestry Brazil - 2006” from “Sociedade Brasileira de Silvicultura – SBS (Brazilian Forestry Society)” state that “ National production of wood to be used as fuel originated from native forests in 2005 totalized 45,4 Mm^3. State of Bahia is the main producer of this wood (non renewable biomass) representing 26,1% of the total, followed by the states of Ceará (10%), Pará (8,2%), Maranhão (6,2%) and Paraná (6,2%)”. Planted forests to fuel production, as informed at the same report, is concentrated at Rio Grande do Sul (36,3%) and São Paulo (19,2%). The main usage of the wood (native and planted) is charcoal (43%), household consumption (29%), industries (19%), agribusiness (8%) and other applications (1%).[2]

Penha has also contacted biomass supplier at the region evaluating possible long term contracts in buying biomass, receiving a negative guarantee of long term supply for wood as demonstrated by documents.

3) Steam Generation from bamboo, without the incentive of CDM

For the third scenario, harvesting of the bamboo (*Bambusa vulgaris*.) does not require any permits or environmental licenses, since it is cataloged as being from the *Poaceae* family. Species belonging to this category are not restricted or protected under the Brazilian Forestry Code, nor are non-native or exotic species such as *Bambusa vulgaris*.

Hence, all three alternatives are in accordance with mandatory applicable laws and regulations, but wood supply faces regulatory risks, which are not totally impeditive but bring high legal risks to the company, representing a barrier to this scenario.

Step 2. Investment analysis

Not considered under the analysis, since step 3 was chosen.

Step 3. Barrier analysis

Sub-Step 3a. Identify barriers that would prevent the implementation of the project activity

For the proposed project activity, the following barriers were identified:

- Technical barriers
- Biomass exploitation infrastructure
- Depredation due to socio-economical conditions of the area

Technical barrier related to specialized combustion technology

1) Oil fired boiler.

No technical barriers were identified to this scenario.

2) Biomass other than bamboo.

[2] MME, 2006 – Destaques de Energia em 2004

The commissioning of a new biomass-fueled boiler demanded a series of process modifications, which would not have been necessary in the event the oil-fueled boiler continued operating (*Penha*'s facility already owned the structure required for the operation of this oil-fired boiler). Considering a scenario of Penha investing in its own forest, process modifications would consist of implementing, aside from the biomass boiler, the following items:

a) A weighting and monitoring system for receiving the wood: A system for monitoring and documenting the wood received at *Penha* had to be implemented by the Forest Management Department. This system would be responsible for quantifying the amount of wood and consequently, determining the amount to be paid to the harvesting companies;

A transportation and feeding system of biomass to the boiler, which consists of a conveyor equipped with monitoring system and a biomass storage system, a vertical silo. The wood storage area should be dimensioned to store biomass fuel for the duration of the rain season, which lasts for approximately four months.

3) Steam Generation from bamboo, without the incentive of CDM

The usage of bamboo as fuel to the steam boiler faces technical barriers associated to the high content of silica at it's constitution, forming silicate inside of the boiler, which damaged it. This issue first develops on the burning base, which would constantly become clogged. The damage caused to the boiler was such that the steam produced was not enough to support production, both in quality and quantity.

Penha in collaboration with H. Bremmer & Filhos Ltda (the technology provider) carried out a series of tests with this type of biomass until a unit was designed and adapted to run on bamboo biomass by using a rotating burning base system. *Penha* took the decision to implement this new technology in spite of the precedent of complications using that type of fuel at their facility.

This renewable biomass fueled boiler demands a much more rigorous maintenance and operation than the oil-fired CBC boiler owned by *Penha*. The boiler is scheduled for bimonthly maintenance stops, so that the silicate can be removed and the boiler performance can be evaluated.

On the other hand, the commissioning of a new biomass-fueled boiler demanded a series of intricate process modifications, which would not have been necessary in the event the oil-fueled boiler continued operating (*Penha*'s facility already owned the structure required for the operation of this oil-fired boiler). These process modifications consisted of implementing, aside from the biomass boiler, the following items:

b) A weighting and monitoring system for receiving the bamboo: A system for monitoring and documenting the bamboo received at *Penha* had to be implemented by the Forest Management Department. This system is responsible for quantifying the amount of bamboo and consequently, determining the amount to be paid to the harvesting companies;

c) A PBK 350/700 wood chipper for processing the bamboo biomass;

d) A transportation and feeding system of biomass to the boiler, which consists of a conveyor equipped with monitoring system and a biomass storage system, a vertical silo model SEC

D/100. The bamboo storage area had to be dimensioned to store biomass fuel for the duration of the rain season, which lasts for approximately four months.

Technical and safety training was also an important component for the development of the project activity and it was required for all personnel involved with biomass harvesting, processing and boiler operation. Harvesters received safety and fire abatement training from *Penha's* Forestry Management Department.

The difficulties to develop, install, operate and maintain a biomass-fired boiler and this extra infrastructure for monitoring, handling and processing biomass are superior to the difficulties of continuing using an oil-fueled boiler. Thus, without the CDM incentives, these technical and technological barriers could have prevented the use of biomass as fuel.

Biomass exploitation infrastructure

1) Oil fired boiler.

No barriers related to biomass exploitation infrastructure were identified to this scenario.

2) Biomass other than bamboo.

To guarantee the supply of renewable biomass, Penha needs to chose between establish its own planted forest or buy renewable wood from the market.

Implementation of Penha's own forest faces barrier since the eucalyptus forest that has a faster growing when compared with pinus, would take at least 6 years to be implemented, with advanced investment. As mentioned at step 1.b above, there is no guarantee of supplying renewable wood by the market during this period. The maximum guarantee that Penha achieved was 6 to 8 months, which is not enough to make this scenario feasible.

Also, the implementation of new planted forest faces the same barriers explained bellow to bamboo scenario with complications since it would be necessary the extraction of bamboo and starting new forest plantation.

Supply renewable wood by the market faces barriers as exposed at step 1.b. There are no suppliers of sustainable biomass that can guarantee long term contracts in the region.

3) Steam Generation from bamboo, without the incentive of CDM

Even though the company owns the farms where the bamboo forests are located, the exploitation of this resource had to consider the following:

a) Developing suppliers to harvest the bamboo in a fashion that guarantees bamboo supply and good working conditions while preserving the plantations;
b) Developing a Forest Management Department to monitor the sustainable exploitation of the bamboo;

The issue of the sustainable harvesting of the bamboo clashes with a cultural problem particular to this region. When bamboo was used as a raw material for cellulose production, bamboo harvesting was done by subcontracting individuals who organized and employed local workforce. Payment to this workforce was proportional to either the amount of bamboo each individual harvests or the amount of time they spend at work. These workers were employed through informal contracts with not job securities or benefits.

Penha had to go through a process of deconstructing this model of bamboo harvesting and at same time, create and train third-party companies that could deliver the bamboo stalks directly to the company's production yard under safe and healthy conditions for the workers. Incentives lead to the creation of three companies, which would be responsible for growing, harvesting and transporting the bamboo. These companies work under management and sustainability principles established by *Penha*.

In order to monitor all these activities a Forest Management Department was created within *Penha*'s organization. This department supervises bamboo exploitation from the identification of the harvesting areas to the receiving and processing of the bamboo stalks. The Forest Management Department is responsible for making sure that the process is sustainable and that environmental, safety and health regulations are followed.

Depredation due to socio-economical conditions of the area

1) Steam Generation from fossil fuels.

No barriers related to depredation due to socio-economical conditions were identified to this scenario.

2) Steam Generation from biomass other than bamboo.

The scenario of planted forest faces similar barriers as bamboo scenario explained bellow. A possible alternative would be buying renewable wood from the market, but as explained above, this options is not feasible as a project scenario.

3) Steam Generation from bamboo, without the incentive of CDM.

Communities surrounding the farms established a different barrier. Due to the lack of job opportunities, a type of economical activity in this region is the fabrication of hand-made bamboo skewers. This market is encouraged by merchants that come from Salvador, the state's capital. These skewers fulfill several purposes; nonetheless they are mostly used for making "*espetinhos*", a popular snack in Salvador's beaches. Local inhabitants of Santo Amaro and the areas surrounding the farms also use bamboo for building and reinforcing their dwellings and fences.

This situation originates continuous invading of the bamboo farms by men and women from the district of São Braz. The trespassers cut and collect bamboo in a disorderly and random way, utilizing only about a third of the bamboo stalks and leaving the rest lying on the ground. *Penha*, through its Legal and Forest Management Departments, has been organizing meetings to inform the communities that such acts are illegal and constitute crime against private property, although no legal action has been or is being considered. *Penha*'s intentions are that the jobs created help improve the local economy and eventually stop this scavenging practice.

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

The following table that is the same table 4 presented at section b.5 of this document summarizes the results from the barrier analysis for each identified scenario. As shown in this table, Scenario 1 does not face any barriers. Scenario 2 faces four important barriers. Scenario 3 faces three significant barriers.

Table 4: Summary of Barrier Analysis

Identified Barriers		Scenario 1	Scenario 2	Scenario 3
		Oil based boiler	**Renewable wood**	**Renewable bamboo**
1	Laws and regulations	No	Yes	No
2	Technical barriers	No	Yes	Yes
3	Biomass exploitation	No	Yes	Yes
4	Socio-economical	No	Yes	Yes

As demonstrating above, scenario 1 is the baseline scenario and scenario 3 is the project scenario.

Step 4. Common Practice Analysis

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

It is not a common practice in Brazilian facilities to use bamboo in biomass-fueled boilers and it was not possible to identify other project of this kind in Brazil during the development of this document. To the best of *Penha's* and *Bremmer's* knowledge there are no other bamboo areas suitable for this type of exploitation or of other boiler using bamboo as fuel for steam generation. Common types of biomass sources include wood, wood residues, bagasse and others. Since these resources do not require a specifically developed combustion technology, and there are no records of other bamboo exploitation projects, the project activity is considered the first of its kind and represents a risk for investing as the rest of the industry can still run with more common, better understood fuel technologies.

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

It was not possible to identified similar cases in Brazil of bamboo exploitation as biomass fuel. To the best of *Penha*'s knowledge the common practice of the paper industry is to consume either fossil fuels or other types of biomass such as wood-residues, which less monitoring and processing requirements.

As a result, project scenario is considered additional.

B.6. Emission Reductions:

B.6.1. Explanation of methodological choices:

The project consists steam generation, using renewable biomass as fuel instead of fuel oil. As per the methodology, the baseline emissions displaced by the project activity are calculated according to the amount of oil necessary to produce the same amount of steam that would be produced annually with the biomass-fueled boiler. The reasons for choosing the methodology AMS I.C are:

⇒ The project activity consists of biomass-based thermal generation;

⇒ Thermal generation capacity is specified by the manufacturer, is less than 45 MW.

⇒ The project activity is not a co-fired system.

As per the selected methodology, baseline emissions for thermal generation shall be calculated as described below:

$$BEy = HGy * EF\ CO_{2,FO} * OXID_{FO} / \eta_{FO}$$

Where:

BEy	=	Baseline emissions in year y
HGy	=	Net quantity of steam/heat supplied by the project activity in year y in TJ
EF $CO_{2,FO}$	=	Emission factor per unit of energy of the fuel that would have been used in the baseline plant in (tCO_2/TJ). A default IPCC emission factor was utilized, as explained in section B.4 of this document.
$OXID_{FO}$	=	IPCC default oxidation factor for fossil fuels (OXID = 0.99)
η_{FO}	=	the efficiency of the plant using fossil fuel that would have been used in the absence of the project activity.

And,

$$HGy = P_{steam,y} * Enthalpy * 0.0041868 MJ/kcal/1000$$

Where:

$P_{steam, y}$	=	Steam produced by the biomass boiler in year y, in metric tonnes
Enthalpy	=	Heat content of the steam produced by the biomass boiler, as specified by the Manufacturer (Enthalpy = 667.1 kcal/kg steam)
0.0041868	=	Conversion factor for mega joules to kilocalories

Efficiency of the baseline plant was determined as the efficiency of the existing oil-fired CBC boiler, as specified in the manufacturer's technical manual. The efficiency utilized is 89%.

There are no project emissions (PEy). Leakage is considered only when the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity. Since this is not the case, leakage will not be considered.

Thus, emission reductions (ERy) are calculated as follows:

$$ERy = BEy - PEy - Leakage$$

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

Data / Parameter:	$\mathbf{P_{steam,\,y}}$
Data Unit:	Tonnes/year
Description:	Steam generated during each year y
Source of data used:	Data estimated from historical steam consumption at the facility
Value applied:	129,600
Justification of the choice of data or description of measurement methods and procedures actually applied:	Estimated steam consumed at the site, based on 60% of the biomass-boiler capacity.
Any comment:	

Data / Parameter:	**Enthalpy**
Data Unit:	Kcal/kg
Description:	Steam enthalpy of the biomass-fired boiler
Source of data used:	Data as supplied by the boiler manufacturer
Value applied:	667.1
Justification of the choice of data or description of measurement methods and procedures actually applied:	Reference, so from this data, the amount of steam, in thermal units, can be estimated for each year y.
Any comment:	

Data / Parameter:	$\boldsymbol{\eta_{FO}}$
Data Unit:	%
Description:	Efficiency of the CBC oil-fired boiler
Source of data used:	Data as supplied by the boiler manufacturer
Value applied:	89
Justification of the choice of data or description of measurement methods and procedures actually applied:	Efficiency, determined as the most likely scenario in the absence of the project activity, for the baseline emission calculations.
Any comment:	

Data / Parameter:	$\mathbf{EF\ C_{FO}}$

Data Unit:	tC /TJ
Description:	Carbon emission factor of fuel oil that would be burned in the absence of this project
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories(Table 1-4 on Page 1-24 of the Reference Manual)
Value applied:	20.0
Justification of the choice of data or description of measurement methods and procedures actually applied:	For conservativeness a default IPCC emission factor for fuel oil was selected in the baseline emission calculation.
Any comment:	

Data / Parameter:	**EF $CO_{2,FO}$**
Data Unit:	tCO_2 /TJ
Description:	Carbon dioxide emission factor of fuel oil that would be burned in the absence of this project
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories(Table 1-4 on Page 1-24 of the Reference Manual) and conversion factor for C to CO_2 of 44/12.
Value applied:	73.33
Justification of the choice of data or description of measurement methods and procedures actually applied:	For conservativeness a default IPCC emission factor for fuel oil was selected in the baseline emission calculation. **EF $CO_{2,FO}$ =** 20.0 tC/TJ FO x 44/12 **EF $CO_{2,FO}$** = 73.33 tCO2/TJ FO
Any comment:	

Data / Parameter:	**NCV_{FO}**
Data Unit:	%
Description:	IPCC recommended Net Calorific Value in MJ/kg of fossil fuel
Source of data used:	According to the information available at Annex 3
Value applied:	43.3
Justification of the choice of data or description of measurement methods and procedures actually applied:	For conservativeness a default IPCC net calorific value for fuel oil was selected in the baseline emission calculation.
Any comment:	

Data / Parameter:	**$OXID_{FO}$**
Data Unit:	%
Description:	IPCC recommended oxidation factor for fuel oil
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Reference Manual Vol 3. Table 1-6, page 1.29

Value applied:	99
Justification of the choice of data or description of measurement methods and procedures actually applied:	For conservativeness a default IPCC oxidation value for fuel oil was selected in the baseline emission calculation.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions, equal to the emission reductions, are calculated for the crediting period based on the amount of steam generated by the project activity, the emission factor of the fossil fuel and the efficiency of the oil-fired boiler.

Baseline emissions in the year *y* are calculated as follows:

$$BEy = HGy * EF\ CO_{2,FO} * OXID_{FO} / \eta_{FO} \qquad \textbf{(1)}$$

Where:

$\mathbf{EF\ CO_{2,FO}}$ = 73.33 tCO_2/TJ

And:

$$HGy = P_{steam,y} * Enthalpy * 0.0041868 \text{MJ/kcal}/1000 \qquad \textbf{(2)}$$

$\mathbf{P_{steam,y}}$ = 216,000 tonne/year
Enthalpy = 667.1 kcal/kg

From equation (2)

HGy = 129,600 tonne/year * 667.1 kcal/kg tCO_2*0.0041868 MJ/kcal / 1000
HGy = 362.0 TJ/year

Emission reductions are then calculated from equation (1)

BEy = 362.0 TJ/year * 73.33 tCO_2*0.99/TJ / 89%
BEy = 29,526 tCO_2/year

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

Year	Project scenario GHG emissions estimative (tCO_2e)	Baseline scenario GHG emissions estimative (tCO_2e)	Leakage estimative (tCO_2e)	Total GHG emission reduction (tCO_2e)
2008	0	29,526	0	29,526
2009	0	29,526	0	29,526
2010	0	29,526	0	29,526
2011	0	29,526	0	29,526
2012	0	29,526	0	29,526
2013	0	29,526	0	29,526
2014	0	29,526	0	29,526
Total (tCO_2e)	**0**	**206,682**	**0**	**206,682**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$P_{steam, y}$
Data Unit:	Tonnes
Description:	Amount of steam generated by a biomass-fueled boiler in the project scenario during year *y*
Source of data used:	Data will be measured by an electronic steam flow meter. Measurements will be made at the exit of the bamboo-fired boiler
Value of data:	Continuous data
Description of measurement methods and procedures to be applied	Information gathered on the monitoring system at the exit of the biomass-fueled boiler by a steam flow meter with digital output.
QA/QC procedures to be applied	Data will be archived electronically. Steam flow meter will be calibrated annually by the equipment manufacturer. For additional data consistency, steam values can be compared with quantity of paper produced during year *y.*
Any comment:	

Data / Parameter:	$P_{paper, y}$
Data Unit:	Tonnes
Description:	Gross paper production during year *y*
Source of data used:	Production records. Information measured at the end of the production system cycle
Value of data:	Daily values
Description of measurement methods and procedures to be	Information gathered from the monitoring system at the end of the production line, consisting of paper machine 1 and paper machine 2. This item is measured constantly, and will be used for additional data

applied	consistency of the amount of thermal energy generated.
QA/QC procedures to be applied	Data quality is assured by the Penha's integrated quality management system, which monitors quality of the final product.
Any comment:	

Data / Parameter:	**EF $CO_{2,FO}$**
Data Unit:	tCO_2 /TJ
Description:	Carbon dioxide emission factor of fuel oil that would be burned in the absence of this project
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories(Table 1-4 on Page 1-24 of the Reference Manual) and conversion factor for C to CO_2 of 44/12.
Value applied:	73.33
Justification of the choice of data or description of measurement methods and procedures actually applied:	For conservativeness a default IPCC emission factor for fuel oil will be selected in the baseline emission calculation. **EF $CO_{2,FO}$ =** 20.0 tC/TJ FO x 44/12 **EF $CO_{2,FO}$** = 73.33 tCO2/TJ FO
Any comment:	

Data / Parameter:	**$FC_{BIOMASS,y}$**
Data Unit:	Tonnes
Description:	Amount of renewable biomass consumed at the boiler in year *y*
Source of data used:	Biomass consumption records. Measurements will be taken by volume and will be measured density of the bamboo chips.
Value of data:	Daily values
Description of measurement methods and procedures to be applied	Information gathered at the biomass processing stage, from bamboo reception to the storage yard and the feeding silo.
QA/QC procedures to be applied	Bamboo received at the plant will be monitored volumetrically and by weight, and the amount paid to the harvesters will be determined from these measurements. Density of bamboo chips will be checked periodically with a known volume container and a calibrated scale.
Any comment:	

Data / Parameter:	**$SF_{BIOMASS,y}$**
Data Unit:	Tonnes per m^3 of steam
Description:	Specific renewable biomass consumption to generate the steam at the boiler in the year *y*
Source of data used:	Calculated based on biomass consumption records and steam produced at renewable biomass boiler records.
Value of data:	Daily values
Description of measurement methods and procedures to be applied	Specific sheet will be considered to make the calculation based on steam generation and biomass consumption data.

QA/QC procedures to be applied	The quality of the data will be based on QA/QC procedures to steam generation data and to renewable biomass (bamboo) consumption data. The calculation procedure will be formalized at internal document.
Any comment:	

B.7.2 Description of the monitoring plan:

According to the applied small scale methodology type I, category C., the monitoring plan for the *Penha* project includes monitoring:

a) the amount of thermal energy produced where the simplified baseline is based
b) the amount of biomass fuel input

Additional information of the monitoring plan is included in Annex 4 of this document.

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

Application of the baseline and monitoring methodology was concluded on 30/09/2007
Contact information:

Company	KeyAssociados
Address 1	Av. Paulista, 1294, 5º andar
Address 2	Bela Vista, São Paulo, SP, Cep
Country	Brazil
Contact Name	Carlos Henrique Delpupo
Email	cdelpupo@keyassociados.com.br
Position	Director
Phone	55 11 3372 9595
Fax	55 11 3372 9577

KeyAssociados is a project participant.

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

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

30/08/2006

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

25 years, according to the suppliers.

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:

01/08/2008 or on the registering date of the project.

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

C.2.2.2. Length:

SECTION D. Environmental impacts

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

The project activity does not generate environmental impacts that need to be monitored.

Harvesting of the bamboo (*Bambusa vulgaris.*) does not require any permits or environmental licenses, since it is cataloged as being from the *Poaceae* family. Species belonging to this category are not restricted or protected under the Brazilian Forestry Code, nor are non-native, exotic species such as *Bambusa vulgaris*.

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.

SECTION E. Stakeholders' comments

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

Letters were sent to the local stakeholders regarding the project activity.

Following is a list of the contacted stakeholders:

Santo Amaro City

Major:	João Roberto Pereira de Melo
Chamber of Deputy's President:	Osvaldo de Souza
Secretary of Tourism and Environment:	José Carlos Rocha Lima
Secretary of Agriculture and Fisheries:	Francisco de Assis Pereira dos Santos

São Francisco do Conde City

Major:	Antônio Pascoal Batista
Chamber of Deputy's President:	Sônia batista
Secretary of Agriculture, Fisheries and Environment:	Mária Amélia Seabra Martins

Cachoeira City

Major:	Fernando Antônio da Silva Pereira
Chamber of Deputy's President:	Wilson Souza do Lago
Secretary of Public Works and Environment:	Antônio Claudio Reis Andrade
Secretary of Industry, Commerce and Agriculture:	Udsom Torres

Ministério Público Federal
Procuradoria da república no Estado da Bahia
Procurador-Chefe: Dr. Danilo Pinheiro Dias
NTC – Environment: Dra. Andréa Cardoso Leão

Ministério Público do Estado da Bahia
Procuradoria-Geral de Justiça
Procurador-Chefe
Dr. Lidivaldo Reaiche Raimundo Britto

CRA – Centro de Recursos Ambientais
Elizabeth Maria Souto Wagener

SEAGRI – Secretaria da Agicultura do Estado da Bahia
Geral Simões

SEMARH – Secretaria Estadual de Meio Ambiente e Recursos Hídricos
Juliano Matos

EBDA – Empresa Baiana de Desenvolvimento Agrícola

Grupo Germem
José Augusto Saraiva

Grupo Gambá
Urbano Paschoal

Brazilian Forum of NGO's

E.2. Summary of the comments received:

At the time of project validation no comments had been received.

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

At the time of project validation no comments had been received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Penha Papeis e Embalagens Ltda
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E-Mail:	
URL:	www.penha.com.br
Represented by:	Masaru Kodato
Title:	Assistant to Director
Salutation:	Sr.
Last Name:	Kodato
Midle Name:	
First Name::	Masaru
Departament:	
Mobile:	
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Organization:	Penha Papeis e Embalagens Ltda
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project has received no public funding.

Annex 3

BASELINE INFORMATION

1) Historical consumption of fuel oil, biomass (bamboo) and steam generation, as well as information on the amount of steam required and total paper production.

	Month	Gross Paper Production (tonne)	Fuel Oil Consumption (tonne)	Biomass Consumption (tonne)	Steam Generation (tonne)	Steam Generation (TJ ST)	Steam / Paper Ratio
2003	Janeiro	4,614.8	85.2	3,180.4	10,229.2	28.6	2.2
	Fevereiro	4,181.7	102.5	2,693.1	10,459.8	29.2	2.5
	Março	4,880.0	158.5	3,727.8	12,197.2	34.1	2.5
	Abril	5,359.9	448.2	2,703.3	13,324.6	37.2	2.5
	Maio	5,562.3	601.8	3,101.2	13,526.7	37.8	2.4
	Junho	5,144.5	508.3	3,207.6	12,861.2	35.9	2.5
	Julho	4,963.1	382.2	3,440.7	12,407.7	34.7	2.5
	Agosto	5,272.8	386.6	3,253.8	13,234.0	37.0	2.5
	Setembro	5,054.3	45.8	2,086.8	9,789.2	27.3	1.9
	Outubro	6,121.4	37.7	2,429.5	11,761.2	32.8	1.9
	Novembro	6,080.1	44.8	2,476.5	11,521.9	32.2	1.9
	Dezembro	5,387.3	3.7	2,808.6	10,356.3	28.9	1.9
	Average	**5,218.5**	**233.8**	**2,925.8**	**11,805.8**	**33.0**	**2.3**

Annex 4

MONITORING INFORMATION

Description of biomass harvesting and monitoring activities

Bamboo (*Bambusa* vulgaris) is cultivated in five farms owned by *Penha*. Each farm is approximately 15 km away from each other. Harvesting is carried out when the bamboo reaches a minimum of 3 years of age. Harvesting is performed manually by workers that use rudimentary tools, such as axes and machetes. After harvested, the bamboo stalks are cut into smaller sections, approximately 2.0m long. Bamboo is then collected by the workers, who pile up the pieces at the access ways near each forest. The material is then loaded into trucks. Each truck transports an average of 45 cubic meters of bamboo per trip.

Trucks arriving at the entrance of the factory must be identified. At the entrance the driver is registered, as well as the license plate and time of arrival. The truck then receives clearance and heads to the scale, where an employee that works in the warehouse registers the weight of the transported bamboo, emitting a ticket printed by a computer connected to the scale. Weight data is inputted into *Penha's* server, accessible through *Penha's* information system.

The drivers are oriented to head to one of two storage areas, where the load is measured in meters. This measurement will determine the amount paid to the harvesting companies for the bamboo delivered from the farm to the factory.

Trucks are then unloaded at the storage yards, where a wood loader tractor is used to feed a PBK 350 X 700 wood chipper. Bamboo stalks are processed by crushing and slicing, and afterwards, passed through a 50 x 60 chain sieve, reaching an average granulometry of 6.0 cm.

Storage yards have a total area of 2.700 m2 and a capacity to hold 4.000 tonnes of biomass. The purpose of this storage yard is to stock up enough bamboo chips to fuel the steam boiler for at least 40 days.

This biomass processing system consists of 26 employees, who work in three rotating shifts. Work shifts are composed of: one supervisor from *Penha*, and third party personnel: one equipment operator, four helpers, two machine operators (wood loaders and cranes) and four front loader operators that are responsible for handling bamboo chips at the storage yard.

After drying, bamboo chips are loaded into standard size bins with a known volume and weight. To verify the amount of biomass burned in the boiler, a record of the number of bins is kept and a determination of the average density of the biomass is performed periodically by weighing loaded and empty bins in a calibrated scale. The bins are dumped into a pit, equipped with a screw-feeder, which receives and doses the amount of biomass that is released into the biomass feeding system. This conveying system is system has adjustable speeds to feed a vertical silo; model SEC D/100 (Industrial DUJUA), with biomass. This silo has a volume of 100 cubic meters.

A level sensor monitors the minimum and maximum levels of biomass in the silo, controlling the rate of biomass feed to the boiler. Biomass feed rate can also be inferred from the speed of the conveyors. The person responsible for proper operation of the biomass feed is the boiler operator and his assistant.

Weighing of the biomass is performed on calibrated scales. An employee of the warehouse area registers the weigh and the data is compiled in electronic databases, located at public folders in *Penha's* internal server. This information is updated daily. Folders are labeled 'ADM', 'Utilities annalist', 'utility/chipper', 'daily control – H-BREMER boiler consumption'. The measuring units used are metric tonnes.

The PBK 350/700 wood chipper, from *Bruno Industrial*, is scheduled for daily maintenance consisting of blade sharpening and replacing, as well as weekly lubrication as recommended by the supplier. The equipment has a nominal capacity of 55 cubic meters of bamboo stalks per hour.

The maintenance of other third party equipment and vehicles is supervised by the utilities annalist, who requests from the service provider a 24 hour a day non-stop performance. The front loader is owned by *Penha* and is subject to daily maintenance.

Steam generation is monitored from the biomass boiler exit and also when it reaches the steam monitors located on Paper Machine 1 and Paper Machine 2. Readings from the paper machines are the responsibility of the production operator. Data is forwarded to the Process Quality Control chief, who stores them in the process control log, accessible from *Penha's* server. The information is stored in the Control and Process Department (DECOP) under the folder 'BEL'.

Data from the steam monitor at the boiler exit is recorded at the boiler control room, and is responsibility of the boiler operator and his assistant. This monitor only measures the amount of steam leaving the biomass boiler. In case the backup oil-fired boiler is activated due to maintenance of the biomass boiler, steam production will not be measured by this monitor but by the monitors at the paper machines.

Calibration of the steam monitors is yearly and performed electronically. This calibration and maintenance are responsibility of *WALTERME*, the company that installed the monitors.

Calibration certificates as well as maintenance records for the equipment utilized in the project activity will be kept at the project site for a minimum of 9 years.

All data collected from monitoring the project activity will be compiled and checked by Mr. Paulo Sergio, head of the Forestry Management Department at *Penha*.

Since most of the parameters are recorded both manually and electronically any missing or inconsistent data can be checked and if judged necessary, adjusted. In the case of steam monitoring electronically recorded data will be compared with paper production for consistency and quality assurance. Under no circumstances data used in the emission reduction calculations from any determined period of time will be constructed if either paper or electronic records are not available.

Quality assurance of the data is performed by comparing monthly values gathered from each area of the project. Should data show any inconsistency or unexpected values an investigation will be performed and documented to determine if the abnormal values must be discarded from the monitored data. This procedure will be carried out by Mr. Paulo Sergio.

The following table describes the variables and equipment considered in the monitoring plan of the project activity:

Data to be collected in order to monitor emissions reduction, and how this data will be archived:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. $\mathbf{P}_{\mathbf{steam,\ y}}$	*Amount of steam generated by a biomass-fueled boiler in the project scenario during year y*	*Monitored in the project activity from steam meter located at the biomass boiler exit.*	*Metric tons*	*M*	*Continuous*	*100%*	*Electronic*	-
2. $\mathbf{P}_{\mathbf{paper,\ y}}$	*Gross paper production during year y*	*Production records. Information measured at the end of the production process, as the product leaves the production line*	*Metric tons*	*M*	*Daily*	*100%*	*Paper / Electronic*	-
3. $\mathbf{FC}_{\mathbf{BIOMASS,y}}$	*Amount of renewable biomass (bamboo chips) consumed at the boiler in year y*	*Information gathered at the biomass processing stag. Measurements from bamboo reception at the storage yard and the feeding silo.*	*Metric tons*	*M*	*Daily*	*100%*	*Paper / Electronic*	
4. $\mathbf{SC}_{\mathbf{BIOMASS,y}}$	*Specific consumption of biomass (bamboo chips) in year y*	*Calculated considering total renewable biomass consumption(FCbiomass,y) divided by the steam produced by the biomass boiler(Psteam,y).*	*Metric tons of biomass / Metric tons of steam*	*C*	*Daily*	*100%*	*Paper / Electronic*	

Monitoring Plan Traning

Penha will implement an internal procedure with the monitoring plan until February 2008. The procedure will consider any inconsistency or unexpected values and the level of investigation that will be performed and documented to determine if the abnormal values must be discarded from the monitored data. After this, Penha will provide a training course to key people involved in project activities. That will be done in March 2008.