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

CONTENTS

Revision history of this document

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

SECTION A. General description of small-scale project activity

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

Penha Renewable Energy Project - fossil fuel switch to renewable biomass for steam generation in the paper production industry (hereafter referred to simply as "Penha Project").
PDD version number: 1
Date: 25 August 2007

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

The project consists of displacing fossil fuel by using renewable biomass for thermal energy (steam) generation at Penha's Paper Production facility located in Santo Amaro – state of Bahia, in Brazil.

Background:
Industria de Papéis da Bahia (IPB) was established in 1970 with funding from SUDENE (Superintendência de Desenvolvimento do Nordeste), a former government developement agency. IPB started operations producing cellulose from bamboo, relying on oil-fired boilers to supply the steam necessary for the process. Cellulose production continued until the company went bankrupt in 1998. At the time of closure, the company was owned by the investment group Econômico.

Production was restarted in 2000 by Química Fina, a São Paulo based company that distributed anthraquinone, a catalyst used in the paper pulp industry which improves the delignification process of the pulp. After the acquisition, Química Fina opted for producing recycled paper, rather than bamboo-based cellulose. In order to begin production, the existing oil-fired boilers were retrofitted and reactivated. At the same time, the company started experimenting with biomass (eucalyptus and pine) supplied by a nearby company-owned farm as fuel for one of the boilers. This farm was created with aid from a special reforesting fund, nonetheless, the area was harvested unsustainably and the eucalyptus and pine forests were depleted by 2003.

Once the company-owned biomass resources were not longer available, the company faced three scenarios:

1) operate exclusively with oil-fired boilers;
2) purchase biomass of the market or;
3) harvest the existing bamboo plantations that were formerly used in cellulose production.

Since bamboo grew in five surrounding farms, totaling approximately 3.000 acres, the company started testing bamboo as fuel for one of the boilers. This approach was preferred in order to avoid issues with the quality and source of biomass in the market, which would compromise the sustainability of the process.

Química Fina tested this renewable biomass fuel in one of their boilers between 2003 and 2005. It was observed that, when burned, the bamboo — rich in silica — forms a silicate inside the boiler. In the long term, silicate damages the boiler and reduces its lifespan. This issue first developed in the boiler's burning base, which would constantly get stuck, causing several non-scheduled stops in production. Between 2003 and 2005, the boiler had to be remodeled 3 times a year on average because of the silicate accumulation. In order to keep using bamboo as a fuel, and due to the lack of investment in further research, the company chose to remove the burning base and burn the bamboo biomass directly on the ground. The bamboo feeding system was now manually operated, significantly increasing the operational risks in a work environment with poor health conditions, and lowering productivity. In addition, due to the inadequate ratio of biomass and oxygen, the combustion efficiency was compromised. The damage caused to the boiler prior to the removal of the grill was such that the vapor produced was not enough to support production, both in quality and quantity. In 2005, the company was acquired by Grupo Penha Ind. Papel e Embalagens Ltda (*Penha*), which started a study on improvements and alternatives to solve the reduction in efficiency.

After its negative experience with using biomass fuel, the company strived to find a better solution that would allow the continuous use of bamboo and also contemplated the acquisition of a new traditional oil-fuelled boiler, instead of using the bamboo. The use of biomass was treated as a priority, even thought, it required further research and development. In addition, to attend the necessity of using the biomass, the company's reforestation sector had to be re-structured, since the bamboo farms had never been managed sustainably.

By combining the Company's group focus on sustainability with the opportunities inherent to a potential Clean Development Mechanism (CDM) project, Penha sought out suppliers and invested in creating and structuring a 'foresting' area within the company for proper management of the bamboo farms.

Since the technology for utilizing bamboo as fuel had to be developed and customized, the project activity faces several types of barriers: 1) barriers to investment, 2) technological barriers, 3) common practice barriers and 4) other barriers.

One of the most relevant technological barriers to this activity consists of the development of a technology suitable for the use of bamboo as fuel and its sustainable production.

In 2005, *Penha* took over the factory in which this project is being developed. However, several tests and studies, aimed at making the use of bamboo biomass in steam boilers feasible, were being carried out at the factory since 2003.

When *IPB* was taken over by *Química Fina*, a biomass-fueled boiler was rented, using pine and eucalyptus from an afforested area. The exploration of this area took place between 2000 and 2003, when the area was exhausted due to unsustainable harvesting. In 2003, the factory started to use bamboo as a fuel for the biomass-fueled boiler, although the combustion of bamboo biomass caused silicate to form inflicting permanent damage to the boiler. The boiler used in the aforementioned tests was completely scrapped sold by *Penha*. The search for a new boiler demanded, besides additional tests at the factory, a partnership with potential suppliers. In 2005 the company singled out *Bremmer* among its several suppliers.

Bremmer, designed and adapted a boiler to run efficiently on bamboo biomass by using a rotating burning base system. The new boiler was tested in another company's unit factory (*Perdigão*), located in the state of Goiás, and the boiler was approved. It was through this process that, in 2006, the company acquired a biomass-fired boiler to replace an oil-fired one and kept the second oil-fired boiler as a backup.

However, the boiler demands a much more rigorous maintenance and operation schedule than the one previously utilized by *Penha*. The boiler is scheduled for bimonthly maintenance stops, so that the silicate can be removed and the boiler performance can be evaluated.

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* Ind. Papel 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 1 – Party (ies) and entities private/public involved in the *Penha* Project activity.

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

The Boiler:
The project consists of the utilization of renewable biomass as fuel for steam production that would otherwise be achieved by an oil-fired boiler. After having invested on research and development, Penha contacted *H. Bremmer & Filhos Ltda.*(Bremmer), a boiler manufacturer, to supply a technology suitable for burning bamboo, the type of biomass fuel selected. The HBFS-25 boiler has the generation capacity of 25 tonnes of steam per hour, large enough to meet the current demand of the facility in Santo Amaro, Bahia state. This boiler will be fueled with bamboo biomass under the following operating conditions:

Bamboo Calorific Value	(kcal/kg)	2.600
Moisture Content		35%
Density	(kg/m^3)	170
Expected CO_2 in the exhaust gas	%	14
Excess Air	%	45
Efficiency	%	85,16
Heat Output	(kcal/h)	17,235,062
Fuel Input	(kg/h)	6.628
Fuel Input	(m^3/h)	39

Table 2 – Bamboo-fired Boiler Combustion Parameters

In order to generate the steam necessary for paper production, air dried bamboo chips will be combusted in a horizontal boiler with a mix circuit of water-tube and fire-tube, model HBFS 25, manufactured by Bremmer. Figure 1 shows the schematic of the new biomass-fueled boiler.

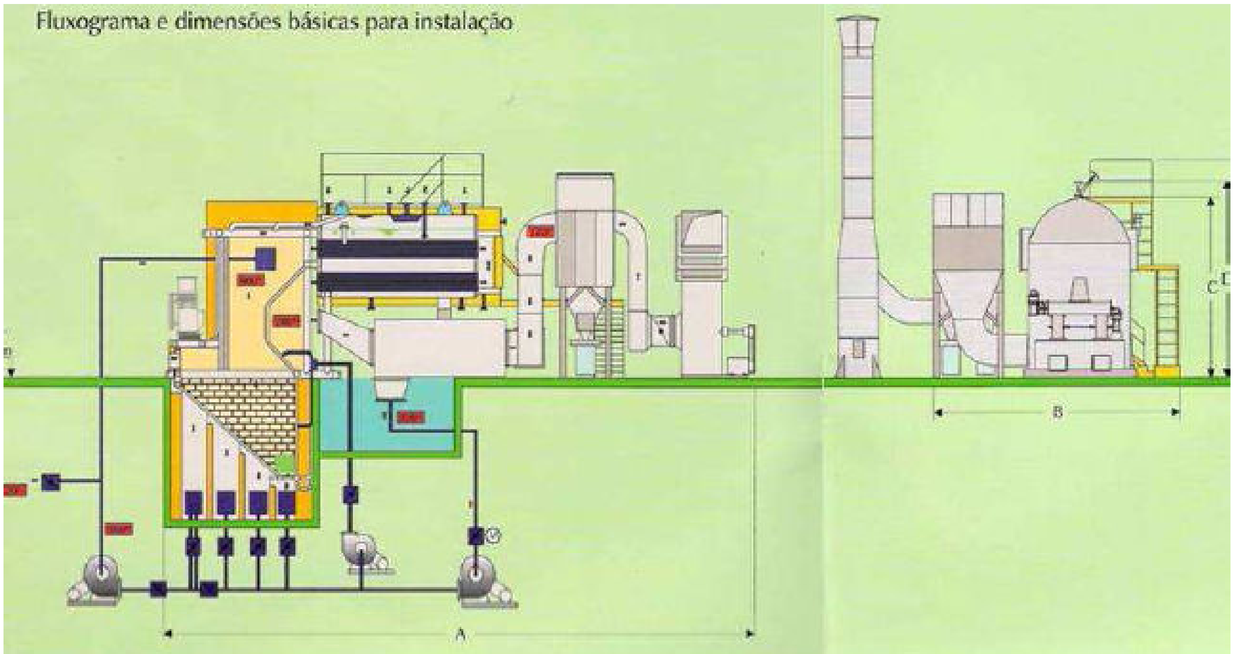


Figure 1: Bremmer Biomass-fueled boiler model HBFS 25
Source: H. Bremmer & Filhos Ltda.

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.

Some advantages of this system include:

- Fully automated operation
- Low-noise emissions
- Short maintenance shutdowns
- Adjustable fuel feed-rate and speed at the burning grill
- Allows burn of biomass fuels with high moisture content

Utilization of bamboo as a renewable fuel

To ensure the proper operation of the biomass-fueled boiler it became necessary to guarantee a constant supply of bamboo. *Penha* owns five farms which, combined, give a total of 3.000 acres currently dedicated to bamboo plantations. Following is a list of the farms:

- Capanema farm, 579 planted bamboo acres, located in the municipality of Santo Amaro, 2 km away from the factory's production yard.
- Subaé farm, 455 planted bamboo acres, located in the municipality of Santo Amaro, 15 km away from the factory's production yard.
- São Lorenço farm, 859 planted bamboo acres, located in the municipality of São Francisco do Conde, 15 miles away from the factory's production yard.
- Montel Alto farm, 957 planted bamboo acres, located in the municipality of São Francisco do Conde , 30 km from the factory's production yard.
- Tororó farm, 149 planted bamboo acres, located in the municipality of Cachoeira, 40 km from the factory's production yard.

The farms and the company are located in a low-income area with a generalized lack of skilled labor and sources of formal employment. Thus the use of unskilled, untrained labor without any employment benefits is very common. One of the challenges that *Penha* faced while establishing a sustainable source of renewable fuel was creating a business model that would encompass the local labor force through employment links, with benefits and under and compliance with labor regulations.

In order to achieve a steady and sustainable bamboo production necessary for generating 25 tons/hour of steam, the company developed three different suppliers, who would handle, cut and transport the bamboo to the *Penha's* facility in Santo Amaro. These suppliers have agreed on their contracts to maintain and promote sustainable work methods, legislation compliance and employment benefits, as well as training and qualification programs that follow *Penha's* management philosophy.

After receiving the bamboo on site, it remains on an area for several weeks in order to dry off. The bamboo biomass is ready to be used as fuel once it has reached an ideal level of dryness: not too dry so it will not damage the blades of the chipper and dry enough so it will burn with maximum efficiency.

The air-dried bamboo is fed to a chipper that turns the bamboo branches into small pieces to facilitate handling and improve combustion efficiency. After the chipper, bamboo chips are transported by a conveyor belt to a storage area.

Transporting the bamboo chips from the storage area to the boiler is automatic. When the level of bamboo chips inside the bin that feeds them directly into the boiler is low, a conveyor that connects the storage area to this feeder is then activated, replenishing the stock. The temperature of the boiler is continuously controlled and monitored and their work-plan schedules a bimonthly shut down of the boiler for cleaning and prevention against the accumulation of silicate. During these maintenance periods, in case they do not coincide with a stop in production, an oil-fueled boiler will be used as a back up.

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.:

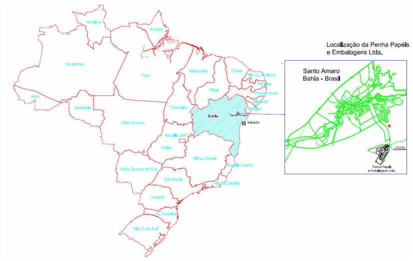
Northeast, Bahia

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

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

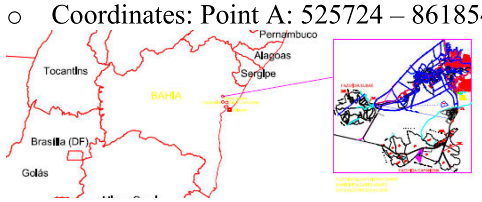
A.4.1.4.Details of physical location, including information allowing the unique identification of this small-scale project activity:

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

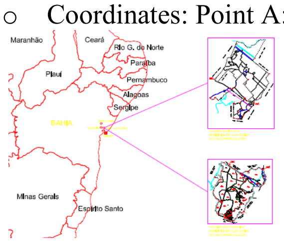


Bamboo farms:

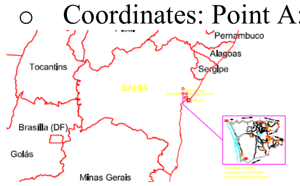
- Capanema farm, total area of 740 acres, 579 acres of planted bamboo, located in the municipality of Santo Amaro.
  - Coordinates: Point A: 530185 – 8608736; Point B: 529513 – 8607942.
- Subaé farm, total area of 1.278 acres, 455 acres of planted bamboo, located in the municipality of Santo Amaro.
  - Coordinates: Point A: 525724 – 8618544; Point B: 527720 – 8616711.



- São Lorenço farm, total area of 1.313 acres, 859 acres of planted bamboo, located in the municipality of São Francisco do Conde.
  - Coordinates: Point A: 537849 – 8612025; Point B: 534697 – 8612354
- Monte Alto farm, total area of 1.326 acres, 957 acres of planted bamboo, located in the municipality of São Francisco do Conde.
  - Coordinates: Point A: 542169 – 8602587; Point B: 545540 – 8600540



- Tororó farm, total area of 700 acres, 149 acres of planted bamboo, located in the municipality of Cachoeira.
  - Coordinates: Point A: 504267 – 8606018; Point B: 505034 – 8603398



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

The Penha Project is a small scale project which involves renewable energy technologies that supply thermal energy applied directly to Penha's production processes.

The applied baseline methodology is AMS-I.C: 'Thermal Energy for the User with or without Electricity', Type I – Renewable Energy Projects, version 11, which states, as a condition of its applicability, that the thermal energy generation capacity of the project does not exceed 45 MW.

Technical Description of Project:

Boiler Capacity:	25	Tonnes of Vapor/hour
Steam Enthalpy:	667.1	kcal/kg
Operating Pressure:	15	kg/cm^2
Steam Temperature:	200	ºCelsius
Biomass Requirement:	2909	Tonnes/hour

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

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

Gcal to MW = 1,163

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

Hence, the installed capacity is lower than 45 MW.

The 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 and Penha has no plans to expand its production, thus there is no foreseeable increase in the amount of steam produced. In any case, the biomas-fueled boiler has maximum potential of 25 tonnes of steam per hour, or 19.4 MW, as specified by the manufacturer.

The project activity consists of displacing fossil fuels by using renewable biomass as fuel for thermal (steam) generation. This will be done by commissioning a steam boiler that is specifically designed for biomass fuel as a substitute for oil.

For this project activity emission reductions are the same as baseline emissions. In the baseline scenario the amount of steam necessary for production would be generated by burning fossil fuels (7A oil), thus releasing 75.59 tCO2/TJ to the atmosphere. Instead, the new boiler will generate the same amount of steam by burning renewable biomass.

Baseline emissions will be calculated by multiplying the net quantity of steam supplied by the project activity by the fossil fuel emission factor and dividing it by the fossil fuel calculated efficiency.

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

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Years	Estimation of annual emission reductions intonnes of CO2 e
2008	30,018
2009	30,018
2010	30,018
2011	30,018
2012	30,018
2013	30,018
2014	30,018
Total estimated reductions (tonnes of $CO_{2\ e}$)	210.124,2
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period (t$CO_{2\ e}$)	30,018

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 will supply 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 11

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

The selected small-scale methodology, I. C. "Thermal Energy for the User with or without Electricity", determines that the following must be taken into consideration in this project: 1) technology/measure , 2) boundary, 3) baseline, 4) project emissions and, 5) leakages.

An analysis of the proposed methodology will reveal its applicability to the project developed by *Penha*, according to the aforementioned parameters.

This methodology applies to renewable energy technologies that supply uses with thermal energy that displaces fossil fuels, stating that thermal generation capacity shall be less than 45 MW. As specified by the Bremmer, the boiler contemplated in the project activity has a thermal capacity of 19.4 MW.

By utilizing renewable biomass for generating thermal energy, emissions reductions from displacing fossil fuels would total 30,018.tCO2/year, as emissions from the bamboo renewable biomass are considered zero.

The CDM project was an important part of the decision making process, proof that *Penha*'s intentions were in fact to prioritize emission reductions. Both, the thermal generation capacity and the emissions avoided by utilizing renewable biomass as fuels, comply with the applicability conditions of this methodology. Thus, we can conclude that while regarding technology, the methodology can be applied.

Penha considers the project range not to be limited to the industrial plant located in the municipality of Santo Amaro, BA, but to also encompass the five farms located in the surrounding areas, which will produce the biomass used at plant. Regarding this item, the project has a well-defined range, attending the methodology.

The project baseline is the generation of steam, for the production of recycled paper, using a 7A oil fueled boiler. In other words, the amount of fossil fuels necessary to generate the same amount of steam produced by a biomass-fueled boiler. The amount of fossil fuel is calculated by dividing the amount of steam required by the fossil fuel efficiency.

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.

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.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 by the user. Thus, the project encompassed the storage of bamboo fuel, the biomass boiler, the thermal energy generated for paper production.

B.4. Description of baseline and its development:

The process of generating steam, necessary for the production of recycled paper, is performed by boilers, which are common in the paper and cellulose industry. Different type of fuels can be burned inside a boiler. Water passing inside a pipe traps the heat generated from the fuel combustion, turning into steam at different pressures and temperatures according the boiler design. Fossil fuels are considered to be the first choice in fuel for steam boilers, and its use is considered a common practice in the market.

Penha's initiative to use the biomass from bamboo leads to a reduction in GHG emissions, as it substitutes the use of fossil fuels in the same context. *Penha*'s main objective in its bamboo forest management is achieving a sustainable supply of biomass. During the growth period of all sources of biomass, carbon is incorporated into the plant's physical structure. In other terms, the carbon is 'sequestered' by biomass growth. When this biomass is burned, the carbon returns to the atmosphere, creating a zero-sum emission cycle. The emission reduction calculations were based on the amount of steam generated by the boiler. In other words, the steam generated will be the base for calculating the amount of 7A oil that would have been burned to produce that same amount of steam.

For this project, *Penha* expects a total of 30,018 tCO2/year in certified emission reductions.

If the project were not to be implemented, the factory would follow the common practice of the pulp and paper industry in Brazil, which is generating thermal energy by using an oil-fueled boiler.

The implementation of a biomass fueled boiler would not happen if it weren't for the incentives created by the carbon credits, since the existing technological difficulties, especially the formation of silicate inside the boiler, would considerably increase the implementation and maintenance costs of this system. The implementation of the biomass-fueled boiler required additional investments other than the purchase of said boiler, including the bamboo chipper, a storage silo and an automatic boiler feeding system, through treadmills. Another complicating factor is the need to establish a sustainable relationship with the workforce that will work on the farms.

For the baseline of the *Penha* project the applied methodology suggests establishing a comparative parameter between the base line scenario and the project scenario.

For this project, this parameter is the total steam generated. For one tonne of steam generated by a biomass-fueled boiler, the total GHGs emission is zero, as biomass is considered to be a carbon neutral fuel, since the bamboo forests reabsorb the emissions generated by the combustion. In the baseline scenario, for every tonne of steam generated by the oil-fueled boiler, 0.232 tonnes of CO_{2e} are emitted, according to calculations made using 7A oil and the Low Heating Value (LHV) specified by the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

Although the methodology does not require a project additionality analysis, it has been shown that it covers the following areas of interest: 1) barriers to investment, 2) technological barriers, 3) common practice barriers and 4) other barriers.

The initial condition to showing the additionality in the project is to show that there are no mandatory policies or regulations that demand the fuel substitution. The activity in this project complies with this first condition. There are no public policies that demand such fuel substitution for developing this type of project in other companies of the same segment or in the same region. 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.

The project depends on the decision to invest in a new steam boiler, to be installed at the *Penha*'s factory located in the municipality of Santo Amaro, state of Bahia. Without the incentives created by the CDM, the company would still be working with an oil-fueled boiler, following the market's common practice.

Also, by displacing fossil fuels, additional environmental benefits are gained such as reductions in the SOx and NOx emissions from combustion and VOC and CH4 fugitive emissions from fuel storage and handling. Potential ground and water contamination by hydrocarbons is also avoided by reducing the amount of fuel utilized and transported, hence reducing the risks of spills.

(a) Barriers to investment:

Penha's factory already owned an oil-fueled boiler as well as the structure required for its operation. The commissioning a new biomass-fueled boiler demands a series of additional investments, which would not have been necessary in case the oil-fueled boiler was still operating. These investments consisted of: 1) a PBK 350/700 wood chipper for processing the bamboo biomass and 2) 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 silo must have enough capacity to store biomass fuel for the duration of the rain season, which lasts for four months. We can consider the acquisition value of a new biomass-fueled boiler similar to an oil-fueled boiler (conservative scenario). Even so, the company would have additional infrastructure costs in order to make feasible the use of biomass. Budgets estimate these costs to be of approximately R$840.000,00 (eight hundred and forty thousand reais); in other words, an investment 21% higher than it would have been required to acquire a new oil-fueled boiler, if the acquisition cost of the boilers (biomass and oil) are the same.

(b) Technological barriers:

In 2005, *Penha* took over the factory in which this project is being developed. However, several tests and studies aimed at making the use of bamboo biomass in steam boilers feasible were being carried out at the factory since 2003.

When *IPB* was taken over by *Química Fina*, a biomass-fueled boiler was rented. The company then used pine and eucalyptus from an afforested area, which was once used to provide raw materials for the production of cellulose, to feed the boiler. The exploration of this area took place between 2000 and 2003, when the area was exhausted due to unsustainable harvesting. In 2003, the factory started to use bamboo as a fuel for the biomass-fueled boiler, which until then, had only been fed pine and eucalyptus. The results following this fuel switch were not very encouraging, since the combustion of bamboo biomass causes silicate to form and cause permanent damage to the boiler. The boiler used in the aforementioned tests was completely scrapped and sold by *Penha*.

The search for a new boiler demanded, besides additional tests at the factory, a partnership with potential suppliers. In 2005 the company singled out *Bremmer* among its several suppliers, since they offered a boiler that had a rotating burning bottom, which theoretically would solve or mitigate the problem of silicate accumulation. However, this renewable biomass fueled boiler demands a much more rigorous maintenance and operation than the one developed by *Penha*. The boiler is scheduled for bimonthly maintenance stops, so that the silicate can be removed and the boiler performance can be evaluated.

(c) Common practice barriers

It is not common practice for Brazilian industries to use bamboo in biomass-fueled boilers and this is the only project of this kind found in Brazil during the development of this document. Since this is a technology unique to our project, there are no available boilers that are completely adapted to this particular source of biomass.

(d) Other barriers

The question of biomass supply clashes with a cultural problem particular to this region. Even though the company owns the farms where the bamboo forests are located, the exploitation of this resource has to be contracted from outside the company. When bamboo was used as a raw material for cellulose production, the bamboo harvesting was organized by subcontracts from the local workforce, where the payment is proportional to either the amount of bamboo each individual harvests or the amount of time they spend at work. This subcontracting is done through informal contracts, which has often caused several labor suits and *Penha* share the responsibilities connected to the delivery of bamboo to the factory.

Penha had to go through a process of deconstructing this model of bamboo exploration and at same time, create and train companies that can deliver the bamboo sticks directly to the company's production yard in a sustainable work manner. Incentives lead to the creation of three companies, which would be responsible for growing, harvesting and transporting the bamboo. These companies work under corporate rules regarding management and sustainability followed by *Grupo Penha*.

Communities surrounding the farms also establish different barriers. A significant economical activity in this region is the fabrication of bamboo skewers. This particular market is stimulated by buyers that come from Salvador, the state's capital. These skewers fulfill several purposes; nonetheless they are mostly used for making 'cheese skewers', a popular snack in Salvador's beaches.

Capanema farm, one of the farms owned by *Penha*, which has as its one and only purpose the cultivation of bamboo aimed at producing biomass for the factory, has been continuously invaded by men and women from the district of São Braz. These invaders enter the bamboo forests, cut and collect bamboo in a disorderly and random way. They only collect 30% of the bamboo they cut, leaving the rest of it laying on the ground. *Penha*, through its Legal and Forest Management Departments, has been organizing meetings and reports that try to inform the communities that such acts are illegal and constitute crime against private property. The communities have been contacted and those involved have recognized their mistake.

The company has developed several social programs in an attempt to mitigate the impacts on the involved communities. These projects are directly connected to the process of implementation of the biomass-fueled boilers. These projects are currently implemented or under implementation.

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 a professionalizing program regarding the use of bamboo at communities.

The aforementioned details have shown that there are several barriers to the implementation of this project as it is designed. Therefore, the most feasible baseline scenario is the one in which 7A oil will be used to fuel the steam boiler and that the scenario that uses bamboo biomass, the proposed CDM project activity, is clearly not the baseline scenario.

B.6. Emission Reductions:

B.6.1. Explanation of methodological choices:

The project consists steam generation, using renewable biomass as fuel instead of 7A 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 baseline emissions calculation is as follows:

(1) $\mathbf{BE_y = HG_y * EF\_FF / \eta_{th}}$

Where:

$\mathbf{BE_y}$	Baseline emissions during year *y* measured in (t CO_{2eq})
$\mathbf{HG_y}$	Net quantity of steam/heat supplied by the project activity during the year *y* in TJ
EF_FF	the CO_2 emission factor per unit of energy of the fuel that would have been used if the baseline plant in (tCO_2 / TJ), obtained from IPCC default emission factors
η_{th}	the efficiency of the plant using fossil fuel that would have been used in the absence of the project activity

According to the IPCC, the Lower Heating Value and CO_2 emission factor for 7A oil is 40,19 MJ/kg and 75,59 tonnes of CO_2/ TJ, respectively.

Where the historical fossil fuel efficiency is calculated as follows:

(2) $\mathbf{\eta_{th} = Q_{,y} / (CFF_y * LHV\_FF)}$

Where:

$\mathbf{Q_y}$	Steam generation for each month *y*, measured in (tonnes)
$\mathbf{CFF_y}$	Correlated historical oil consumption for each month *y*, measured in (tonnes)
LHV_FF	IPCC recommended Lower Heating Value in MJ/kg of fossil fuel

In order to calculate the historical fossil fuel consumption, a statistical analysis for determining the amount of steam generated historically by fuel oil and biomass separately was developed. This analysis was based on *Penha*'s monthly steam production data from 2003, 2004, 2005 and 2006. The obtained values were corrected for associated statistical errors. Data and calculations supporting these values can be found in Annex 3. The fossil fuel utilized in steam production was calculated as follows:

(3) $\mathbf{CFF_y = Q_y * (1\text{-}STD\_HIST) / FF\_HIST}$

Where:

FF_HIST	Statistical value for the steam to oil ratio of the boiler = 10,44 kg ST/kg FO
STD_HIST	Standard Deviation for the statistical model = 19.6 %

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.

Since the total project emissions (**PE_y**) are considered zero, the emission reductions (**ER_y**) are equal to the baseline emissions (**BE_y**):

(5) $$ER_y = BEy - 0$$

$$ER_y = BEy$$

Calculations regarding emission reductions for this project:

(6) $$ER_{,y} = BE_y - PE_y$$

Where:

ER_y	Emissions reduced by the project p, during year *y,* measured in (tCO_{2eq} / year)
PE_y	Emissions on the project activity during year *y*, measured in (tCO_2)

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

Data / Parameter:	**Q_y**
Data Unit:	Tonnes
Description:	Steam generation for each month *y*
Source of data used:	Data available at the company from monitored historical data
Value applied:	According to the information available at Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	Reference, so from this data, the baseline scenario steam generation from biomass and 7A oil can be calculated
Any comment:	

Data / Parameter:	**CFF_y**
Data Unit:	Tonnes
Description:	Correlated oil consumption for each month *y*
Source of data used:	Data available at the company from monitored historical data
Value applied:	According to the information available at Annex 3
Justification of the	Reference, so from this data, the fossil fuel efficiency for the baseline scenario

choice of data or description of measurement methods and procedures actually applied:	can be calculated.
Any comment:	

Data / Parameter:	**FF** $_y$
Data Unit:	Tonnes
Description:	Fossil Fuel consumption for each month *y*
Source of data used:	Data available at the company from monitored historical data
Value applied:	According to the information available at Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	Reference, so from this data, the relationship between historical oil consumption of 7A oil and steam generation in the baseline scenario can be established.
Any comment:	

Data / Parameter:	**BF** $_y$
Data Unit:	Tonnes
Description:	Biomass consumption for each month *y*
Source of data used:	Data available at the company from monitored historical data
Value applied:	According to the information available at Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied:	Reference, so from this data, a correlation between historical biomass and steam generation in the baseline scenario can be established.
Any comment:	

Data / Parameter:	**EF_FF**
Data Unit:	tCO_2 /TJ
Description:	CO_2 emission factor of the 7A 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 1-3 on page 1.23) of the Reference Manual
Value applied:	75.59
Justification of the choice of data or description of measurement methods and procedures	Reference, so from this data, the fossil fuel efficiency for the baseline scenario can be calculated.

actually applied:	
Any comment:	

Data / Parameter:	**LHV_FF**
Data Unit:	MJ/kg
Description:	IPCC recommended Lower Heating Value in MJ/kg of fossil fuel
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-3 on page 1.23) of the Reference Manual
Value applied:	40.19
Justification of the choice of data or description of measurement methods and procedures actually applied:	Reference, so from this data, the fossil fuel efficiency for the baseline scenario can be calculated.
Any comment:	

Data / Parameter:	**FF_HIST**
Data Unit:	kg steam/kg oil
Description:	Statistical value for the steam to oil ratio of the boiler = 10,44
Source of data used:	Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 1-3 on page 1.23) of the Reference Manual
Value applied:	10.44
Justification of the choice of data or description of measurement methods and procedures actually applied:	Reference, so from this data, the correlated historical fuel consumption for the baseline scenario can be calculated.
Any comment:	

Data / Parameter:	$\mathbf{E_{med}}$
Data Unit:	%
Description:	Average error for this model
Source of data used:	According to the information available at Annex 3
Value applied:	(19,6 +- 2,4) %
Justification of the choice of data or description of measurement methods and procedures actually applied:	Value calculated from the statistical model aimed at estimating the total steam generated given the total mass of oil and biomass. It is applied in the calculation of the correlated historical fuel consumption.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

The fossil fuel efficiency was calculated from the correlated oil consumption according to historical data available from Penha's steam production.

Year	Gross Paper Production (tonne)	Steam Generation (tonne)	Correlated Heavy Oil Consumption (tonne FO)	Heavy Oil Efficiency (tonne ST/TJ FO)
	PPy	**Qy**	**CFFy**	**η_FO**
2003	48145.5	122652.0	9445.6	323.1
2004	56336.1	118337.4	9113.3	323.1
2005	41901.4	93969.8	7236.8	323.1
2006	62622.0	141669.1	10910.1	323.1

Based on the historical steam generation and the gross paper production, the biomass fuel consumption (**Q_BIO**) is shown in the following table:

Year	Average Paper Production	Steam Generation Capacity	60% Steam Consumption HGy	60% Steam Consumption HGy	Forecasted Biomass Consumption Q_BIO	Forecasted Biomass Consumption Q_BIO
	(tonne/year)	**(tonne ST/year)**	**(tonne ST/year)**	**(TJ ST/year)**	**(tonne BIO/year)**	**(tonne BIO/TJ)**
	PPy					
2008	56,348	216,000.0	129,600.0	362.0	43,636.4	120,6
2009	56,348	216,000.0	129,600.0	362.0	43,636.4	120,6
2010	56,348	216,000.0	129,600.0	362.0	43,636.4	120,6
2011	56,348	216,000.0	129,600.0	362.0	43,636.4	120,6
2012	56,348	216,000.0	129,600.0	362.0	43,636.4	120,6
2013	56,348	216,000.0	129,600.0	362.0	43,636.4	120,6
2014	56,348	216,000.0	129,600.0	362.0	43,636.4	120,6
TOTAL	**394,434.8**	**1.512.000,0**	**907,200.0**	**2,533.8**	**305,454.5**	

Baseline emissions, equal to the emission reductions, are calculated for the crediting period based on the fossil fuel efficiency obtained from the historical data.

Year	Steam Generation Capacity	60% Steam Consumption	60% Steam Consumption	Forecasted Heavy Oil Consumption	Heavy Oil Efficiency	Baseline Emissions
	(tonne ST/year)	(tonne ST/year)	(TJ ST/year)	(tonne/year)	(tonne ST/TJ)	(tCO2/year)
	Qy	Qy	HGy	FFy	η_FO	BEy
2008	216,000.0	129,600.0	362.0	12,413.8	323.1	30,018
2009	216,000.0	129,600.0	362.0	12,413.8	323.1	30,018
2010	216,000.0	129,600.0	362.0	12,413.8	323.1	30,018
2011	216,000.0	129,600.0	362.0	12,413.8	323.1	30,018
2012	216,000.0	129,600.0	362.0	12,413.8	323.1	30,018
2013	216,000.0	129,600.0	362.0	12,413.8	323.1	30,018
2014	216,000.0	129,600.0	362.0	12,413.8	323.1	30,018
TOTAL	**1,512,000.0**	**907,200.0**	**2,533.8**	**86,896.6**		**210,124.2**

Thus, emission reductions from avoiding fossil fuel combustion amount to 210,124.2 tCO2 in the crediting period.

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

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

Year	Estimation of project activity emissions (tCO_2 e)	Estimation of Baseline emissions (tCO_2 e)	Estimation of Leakage (tCO_2 e)	Estimation of overall emission reductions (tCO_2 e)
2008	0	30,018	0	30,018
2009	0	30,018	0	30,018
2010	0	30,018	0	30,018
2011	0	30,018	0	30,018
2012	0	30,018	0	30,018
2013	0	30,018	0	30,018
2014	0	30,018	0	30,018
Total (tonnes of CO2 e)	**0**	**210,124.2**	**0**	**210,124.2**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**Q_y**
Data Unit:	Tonnes
Description:	Amount of steam generated by a biomass-fueled boiler in the project scenario during month *y*

Source of data used:	Information measured at the beginning of the production system cycle
Value of data:	Monthly
Description of measurement methods and procedures to be applied	Information gathered on the monitoring system at the beginning of the production line, paper machine 1 and paper machine 2, by a steam flow meter.
QA/QC procedures to be applied	Information controlled constantly, which will be used as a base for calculating total emission reduction. The quality of the production process will be evaluated by a correlation control regarding the total paper production
Any comment:	

Data / Parameter:	**PP_y**
Data Unit:	Tonnes
Description:	Gross paper production at the site during month *y*
Source of data used:	Information measured at the end of the production process, as the product leaves the production line
Value of data:	Monthly
Description of measurement methods and procedures to be applied	Information gathered on the monitoring system at the end of the production line, paper machine 1 and paper machine 2 . This item is ontrolled constantly, and will be used for correlating with the amount of thermal energy generated.
QA/QC procedures to be applied	Typical quality procedures of the production process
Any comment:	

Data / Parameter:	**EF_x**
Data Unit:	t CO_2 / t of oil
Description:	CO_2 emission factor of fossil fuel to be used in emergency situations in boiler *i*
Source of data used:	Data from technical reports.
Value of data:	75,59
Description of measurement methods and procedures to be applied	Verify periodically technical reports that contain emission factors. (IPCC)
QA/QC procedures to be applied	
Any comment:	

Data / Parameter:	**BF_x**
Data Unit:	Tonnes
Description:	Amount of renewable biomass consumed at the boiler
Source of data used:	Data measured at the entrance of the boiler's feeding system
Value of data:	Monthly
Description of measurement methods and procedures to be	Information gathered at the biomass transportation phase, from the storage yard to the feeding silo, by weighing it.

applied	
QA/QC procedures to be applied	The scale used is monitored daily to verify calibration and proper functioning.
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

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

Calculations were conducted and finished from January to June 2007, concluded 30/06/2007

Contact information:

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Position	Director
Phone	55 11 3372 9595
Fax	55 11 3372 9577

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:

November 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:

01/11/2007

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.

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.

Here follow the stakeholders that received the letters:

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

E.2. Summary of the comments received:

By the present time, no comments had been received.

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

By the present time, no comments had been received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Penha Papeis e Embalagens
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E-Mail:	
URL:	www.penha.com.br
Represented by:	Masaru Kodato
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Salutation:	Sr.
Last Name:	Kodato
Midle Name:	
First Name::	Masaru
Departament:	
Mobile:	
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Direct tel.:	
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Represented by:	Carlos Henrique Delpupo
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Personal E-Mail:	cdelpupo@keyassociados.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project has received no public funding.

Annex 3

BASELINE INFORMATION

1) Historical consumption of 7A oil, biomass (bamboo) and steam generation, as well as information on the amount of steam required and total paper production.

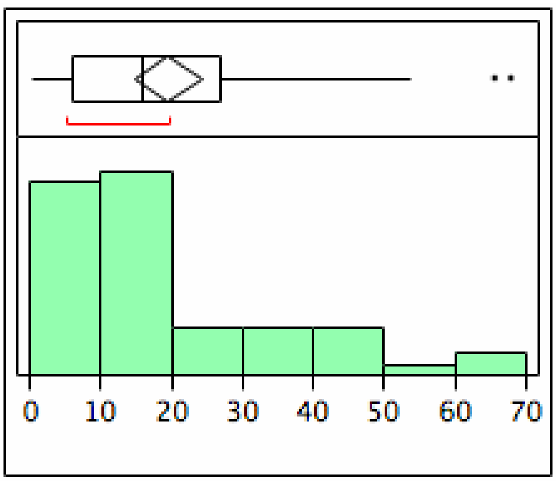
	Month	Gross Paper Production (tonne)	Heavy Oil Consumption (tonne)	Biomass Consumption (tonne)	Steam Generation (tonne)	Steam Generation (TJ ST)	Steam / Paper Ratio
2003	Janeiro	2.652,1	41,8	2.739,3	6.421,9	17,9	2,4
	Fevereiro	3.617,0	56,8	1.718,7	8.391,9	23,4	2,3
	Março	3.868,4	217,4	3.397,4	8.493,6	23,7	2,2
	Abril	4.044,7	42,5	2.983,7	9.294,5	26,0	2,3
	Maio	4.159,8	42,0	2.258,8	11.248,7	31,4	2,7
	Junho	4.350,3	35,1	1.904,1	11.406,6	31,9	2,6
	Julho	4.244,8	98,2	5.327,2	10.291,7	28,7	2,4
	Agosto	3.608,6	29,5	2.146,7	10.324,8	28,8	2,9
	Setembro	3.918,1	248,0	1.520,9	9.815,4	27,4	2,5
	Outubro	4.232,2	158,8	1.332,5	12.416,2	34,7	2,9
	Novembro	4.536,4	754,8	428,5	11.628,0	32,5	2,6
	Dezembro	4.913,0	833,4	---	12.918,7	36,1	2,6
2004	Janeiro	4.186,9	694,0	---	3.182,5	8,9	0,8
	Fevereiro	3.849,1	622,9	659,2	9.841,5	27,5	2,6
	Março	4.144,1	503,2	1.630,8	10.631,9	29,7	2,6
	Abril	4.363,8	617,1	1.355,1	9.267,3	25,9	2,1
	Maio	4.964,1	602,3	1.921,8	10.491,9	29,3	2,1
	Junho	4.735,6	523,0	2.199,0	10.338,4	28,9	2,2
	Julho	4.888,0	793,4	663,3	9.966,6	27,8	2,0
	Agosto	5.094,7	626,1	1.753,5	10.685,1	29,8	2,1
	Setembro	5.009,6	410,5	1.911,7	11.623,0	32,5	2,3
	Outubro	4.894,5	358,6	1.892,7	10.202,3	28,5	2,1
	Novembro	5.250,3	379,5	2.004,4	11.813,3	33,0	2,3
	Dezembro	4.955,4	395,5	2.432,8	10.293,6	28,8	2,1
2005	Janeiro	5.110,5	444,4	2.262,6	10.986,1	30,7	2,1
	Fevereiro	4.129,5	423,5	1.805,9	8.949,8	25,0	2,2
	Março	3.575,6	324,7	1.472,7	7.743,9	21,6	2,2
	Abril	2.467,4	130,0	1.992,6	5.326,3	14,9	2,2
	Maio	2.580,6	258,2	1.297,5	8.445,2	23,6	3,3
	Junho	1.589,1	78,9	1.100,4	3.416,5	9,5	2,1
	Julho	2.202,9	307,3	1.029,9	4.736,2	13,2	2,2
	Agosto	2.064,9	107,1	1.327,2	4.439,5	12,4	2,2
	Setembro	4.543,0	441,8	1.293,3	9.767,4	27,3	2,1
	Outubro	4.843,0	323,7	2.188,1	10.412,5	29,1	2,1
	Novembro	4.010,9	471,9	1.310,0	8.644,6	24,1	2,2
	Dezembro	4.784,1	360,9	2.343,9	11.102,0	31,0	2,3
2006	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**

Statistical analysis and determination of error in formula (3) of this document

For the statistical analysis of the historical data, a linear regression was used. It can be interpret as a least-square fitting of a plane where the dimensions are the biomass consumption and oil consumption; and the response was the generated steam.

This approach was chosen because it is ease to reproduce and linear regression is a well established and wide used statistical tool. All the graphics and calculations are demonstrated above.

Distributions
Model Error [%]



Quantiles

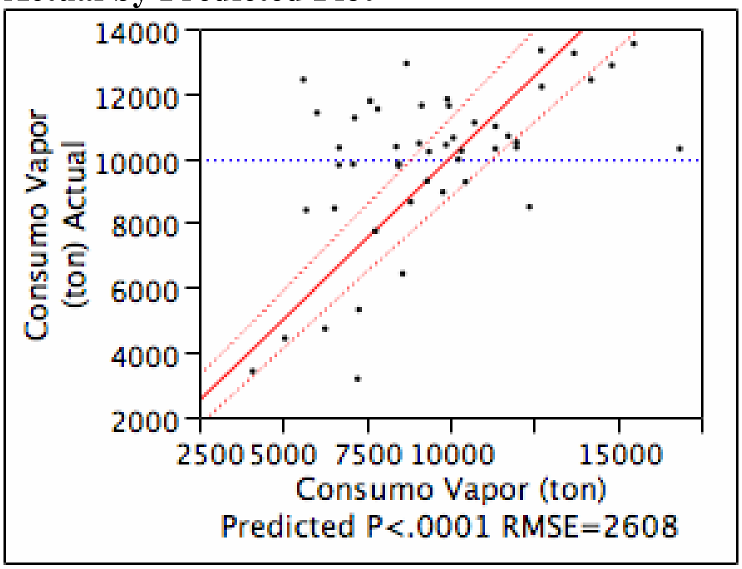
100.0%	maximum	67,979
99.5%		67,979
97.5%		67,470
90.0%		41,525
75.0%	quartile	27,016
50.0%	median	15,939
25.0%	quartile	6,139
10.0%		2,732
2.5%		0,198
0.5%		0,190
0.0%	minimum	0,190

Moments

Mean	19,55487
Std Dev	16,588382

Std Err Mean	2,3943268
upper 95% Mean	24,371634
lower 95% Mean	14,738106
N	48

Response Steam Consumption (tonnes)
Whole Model
Actual by Predicted Plot



Summary of Fit

RSquare	.
RSquare Adj	.
Root Mean Square Error	2.608,017
Mean of Response	9.929,756
Observations (or Sum Wgts)	48

Analysis of Variance

Source	**DF**	**Sum of Squares**	**Mean Square**	**F Ratio**
Model	2	4708213053	2,3541e+9	346,1030
Error	46	312880591	6801752	**Prob > F**
C. Total	48	5021093644		<,0001

Tested against reduced model: Y=0

Parameter Estimates

Term	**Estimate**	**Std Error**	**t Ratio**	**Prob>|t|**

Term	Estimate	Std Error	t Ratio	Prob>|t|
Oil Consumption (tonnes)	10,435067	1,189669	8,77	<,0001
Biomass Consumption (tonnes)	2,9730395	0,208376	14,27	<,0001

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Oil Consumption (tonnes)	1	1	523309711	76,9375	<,0001
Biomass Consumption (tonnes)	1	1	1384609777	203,5666	<,0001

Prediction Expression

Oil Consumption (tonnes)

Power Details

Test

Oil Consumption (tonnes)

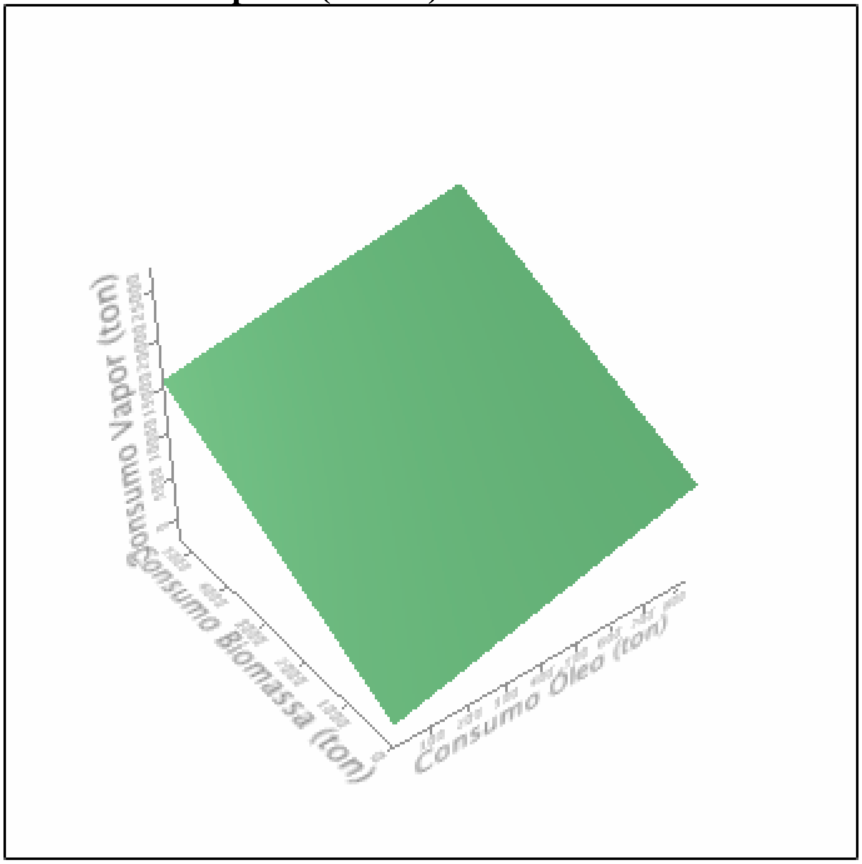
Biomass Consumption (tonnes)

Power Details

Test

Biomass Consumption (tonnes)

Steam Consumption (tonnes)



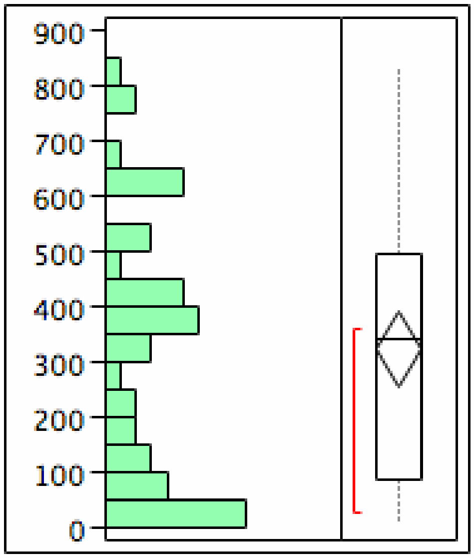
Response Grid Slider

12500

Independent Variables

X	Y		Value	Grid
	X	Oil Consumption (tonnes)	418,545	
X		Biomassa Consumption (tonnes)	2663,601	

Oil Consumption Distribution (tonnes)



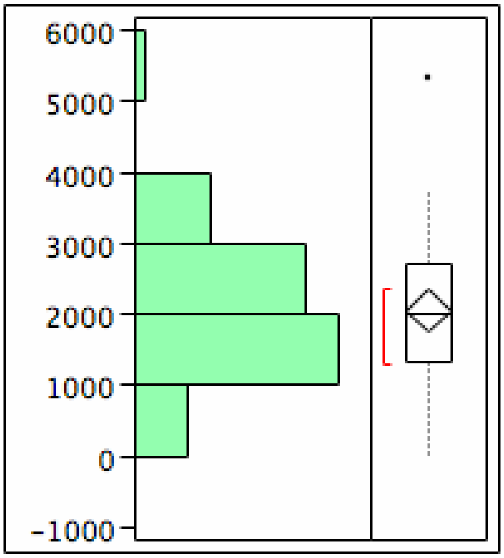
Quantiles

100.0%	maximum	833,39
99.5%		833,39
97.5%		824,38
90.0%		632,92
75.0%	quartile	495,34
50.0%	median	341,64
25.0%	quartile	88,49
10.0%		41,44
2.5%		9,50
0.5%		3,71
0.0%	minimum	3,71

Moments

Mean	324,2036
Std Dev	236,48171
Std Err Mean	34,133194
upper 95% Mean	392,87073
lower 95% Mean	255,53647
N	48

Biomass Consumption Distribution (tonnes)



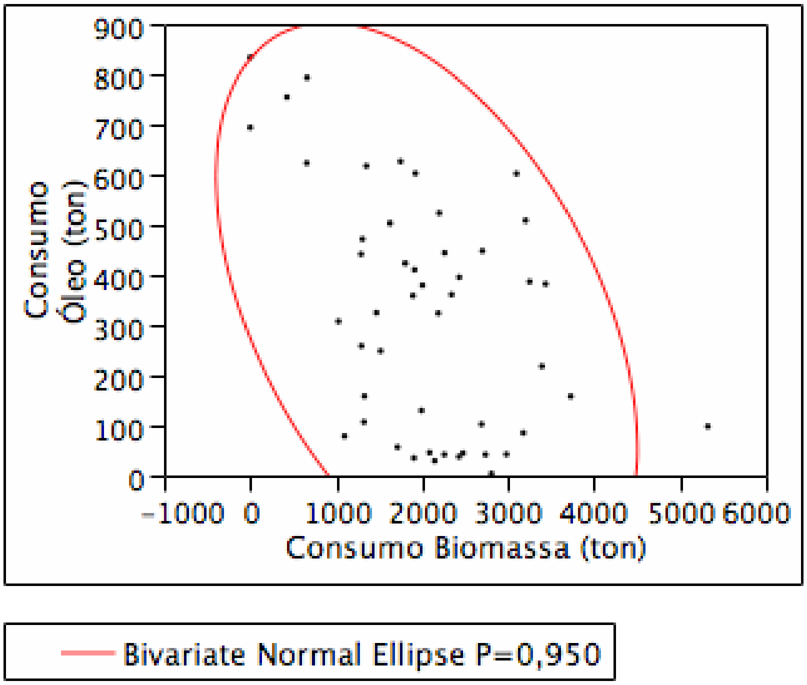
Quantiles

100.0%	maximum	5327,2
99.5%		5327,2
97.5%		4967,3
90.0%		3268,1
75.0%	quartile	2700,7
50.0%	median	1998,5
25.0%	quartile	1338,2
10.0%		662,9
2.5%		0,0
0.5%		0,0
0.0%	minimum	0,0

Moments

Mean	2056,5653
Std Dev	1001,1745
Std Err Mean	144,5071
upper 95% mean	2347,2761
lower 95% Mean	1765,8546
N	48

Bivariate Fit of Oil Consumption (tonnes) by Biomass Consumption (tonnes)



Correlation

Variable	Mean	Std Dev	Correlation	Signif. Prob	Number
Biomass Consumption (tonnes)	2056,565	1001,175	-0,46922	0,0008	48
Oil Consumption (tonnes)	324,2036	236,4817			

Annex 4

MONITORING INFORMATION

Listed below is the complete production process of biomass, highlighting the crucial values that will be closely monitored, due to the nature of the process.

The bamboo (*Bambusa* vulgaris) is cultivated, with a distance of 8.0 meters between double lines in five farms owned by *Penha Papéis*. Each farm is approximately 15 Km away from each other. The harvesting is realized when the bamboo plant reaches 3 or more years of age. The harvesting is manual, performed by rural workers that use rudimentary tools, such as axes and machetes. After they are harvested, the bamboo trees are cut into smaller sections, approximately 2.40m long. After it is cut, the bamboo is collected by the workers, who use animals to transport and pile the pieces at the access ways near each forest. The material is then loaded into trucks by an equipment called 'motocana'. Each truck transports 45 cubic meters of bamboo in each trip.

The trucks reach the entrance of the factory, where they are 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. This data is then put into the system, with free access.

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

The trucks are then unloaded at the storage yards, where the 'motocana' is once again used. The bamboo then goes through a drying period of 30 days.

After this 30-days period the bamboo is reloaded into a truck and transported to the area where the PBK 350 X 700 wood chipper is located. The trucks are then unloaded from the truck using 'motocana' and loaded into a treadmill that transports the bamboo to the chipper. All the bamboo reaches the entrance of the chipper, going through a process crushes and slices the bamboo. The pieces then pass through a 50 x 60 chain sieve, reaching a granulometry of 6.0 cm on average. After chopped, the bamboo chips are loaded into a treadmill system, which deposits them at another storage yard.

This yard has 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 be a strategic source of biomass, holding enough bamboo chips to fuel the steam boiler for at least 40 days.

The biomass processing system counts with the participation of 26 employees, who work in three rotating teams. These teams are composed of: 01 supervisor working under administrative regime, 01 equipment operator, 04 helpers, 02 machine operators ('motocanas' and cranes, working on feeding the chipper) and 04 front loader operators that are responsible for turning over the bamboo chips at the storage yard.

The wood chips are then loaded into dump trucks, with capacity of 30 cubic meters, weighing on average 7.0 tonnes, in the case of bamboo. This load is once again weighed and the load is dumped into a pit, equipped with a screw-feeder, which receives and doses the amount of biomass that is released into the feeding treadmill system. This treadmill system is equipped with monitoring systems, which feeds the vertical silo; model SEC D/100 (Industrial DUJUA), with biomass. This silo has a volume of 100 cubic meters.

An electric equipment called end of line, which determines the minimum and maximum levels of biomass in the silo, controlling the feeding of biomass into the boiler. The maintenance of this device only happens when the system is damaged. The status of the device can be inferred from the functioning of the treadmills. The responsible for observing this process is the boiler operator and his assistant.

Volume control within the silo can happen either manually or automatically. The boiler operators are responsible the manual control, yet it only happens when there are unusual problems, such as electric or compressed air issues.

The weighing of the biomass is done through scales, where an employee that works for the warehouse registers the weigh. The collected data is compiled in electronic databases, located at public folders in the internal server, which are updated daily. These folders are labeled 'ADM', 'Utilities annalist', 'utility/chipper', 'daily control – H-BREMER boiler consumption'. The measuring unit used is the 'ton'.

The PBK 350/700 wood chipper, from *Bruno Industrial*, receives a daily scheduled maintenance for replacing the blades, as well as weekly lubrication as recommended by the supplier. The equipment has a nominal capacity of 55 sterile meters per hour.

The maintenance of other equipments and vehicles is supervised by the utilities annalist, who requests from the service provider a 24 hours a day perfect performance. The front loader is owned by *Penha Papéis* and is subject to daily maintenance.

The steam generation is monitored from the moment the steam generated in the boiler reaches the steam detectors in the Paper Machine 1 and Paper Machine 2. The leakage integrators will read the steam production. The reading is performed every 24 hours and is responsibility of the mass production operator. The data is then forwarded to the Process Quality Control chief, who stores them in the process control, available in a public folder. The information is stored in the Control and Process Department (DECOP) under the folder 'BEL'.

The maintenance of all other equipment happens every 3 months, the calibration is electronic and under the responsibility of the company that installed the steam and condensation systems of machines 1 and 2. This maintenance is carried out every month by the company *WALTERME*.