FY2008: Commissioned by the Ministry of the Environment

2008 CDM/JI Feasibility Study

Feasibility Study on Wood Biomass Power Generation CDM Project in East Java, Indonesia

Final Report

Summary

February 2009

Sumitomo Forestry Co., Ltd.

1. Project overview

(1) Host party and region

Probolinggo, East Java, Republic of Indonesia

(2) Project overview

The purpose of the project activity is to reduce greenhouse gas (GHG) emissions. The activity will involve the installation of cogeneration equipment fueled by renewable biomass at PT. Kutai Timber Indonesia (hereinafter, “KTI”), located in the city of Probolinggo in Indonesia’s East Java province.

KTI is a general timber processor engaged in producing plywood, building materials, and particle board (PB). In its plywood and building materials plants, KTI has three boilers (total steam capacity: 31.0t/hr) fired entirely by wood biomass. KTI draws electricity for its plants from Indonesia’s largest electricity network, the Java-Madura-Bali (JAMALI) grid. The plywood/building materials plants and PB plant each use 3.5MW at peak periods.

The new equipment will consist of a cogeneration system with the capacity to generate 4.5MW of electricity and 6.5MW of thermal energy that will displace energy used by the PB plant and thermal energy generated by a single wood biomass boiler used by the building materials plant (steam capacity: 7.0t/hr). (An outline of the equipment is shown in Fig. 1.)

The renewable biomass fuels will be wood biomass and agricultural waste either generated by KTI plants or collected from the surrounding region.

GHG emission reductions equivalent to 12,172t-CO_2 are anticipated annually by implementing the project activity. The project activity will commence in July 2009 with the placing of an equipment order. The crediting period will be a total of 21 years—a seven-year period renewed twice.

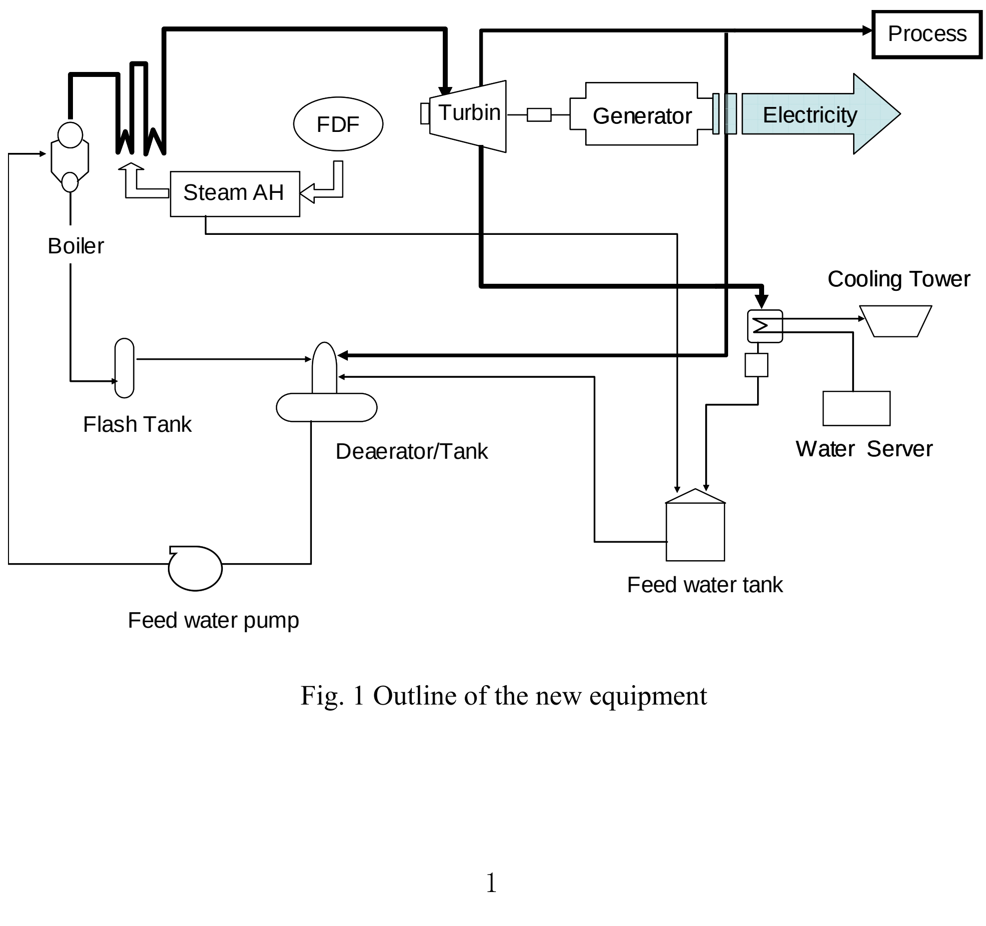

Fig. 1 Outline of the new equipment

2. Details of the study

(1) Issues covered by the study

The following three items are matters essential for implementation of the project activity but were unconfirmed prior to implementation of the feasibility study.

1) Renewable biomass availability

The amount of renewable biomass required for the project activity, in terms of wood biomass volume, is 48,738t-biomass/yr. A reliable framework for collection of renewable biomass is essential for implementation of the project activity. Therefore, we decided to consider the use of other types of renewable biomass in addition to wood biomass.

As the volume of renewable biomass available varies according to the time of year, it was necessary to ascertain the amount available throughout the year.

In the dry season, especially, sugar mills and brick factories in the surrounding region consume large volumes of wood biomass as production reaches a peak period, generating competition over access to wood biomass. We would therefore need an advance understanding of the conditions.

Additionally, we would need to demonstrate that enough renewable biomass will be available in excess of the amount used in the project activity, as stipulated in rules on leakage. (Attachment C to Appendix B, EB28 General guidance on leakage in biomass project activities (version02))

2) Use of water for biomass power generation

In biomass power generation, a large volume of water is consumed by the cooling tower used to cool steam after it passes through the turbine. Therefore, we needed to confirm we could secure enough water for biomass power generation. Seawater utilization was considered in addition to groundwater.

3) Types of contracts with Indonesia's state-owned electricity company (PLN) to provide for emergencies

KTI relies on electricity purchased from the JAMALI grid for power to operate its plants. In the case of implementation of the project activity, an alternative power supply would need to be secured in anticipation of, for example, a breakdown of the new facilities or times of emergency. The contract with PLN needs to be continued beyond project activity implementation, thus necessitating discussions regarding contract provisions.

(2) Framework for study implementation

The feasibility study was implemented by PT. Kutai Timber Indonesia (KTI), a Sumitomo Forestry Group company located in Indonesia. KTI's main responsibilities were as follows.

- Negotiation with Indonesia's state-owned electricity company (PLN)
- Survey of renewable biomass availability
- Survey of water to be used for biomass power generation
- Gathering of information for the environmental impact assessment
- Information exchange with stakeholders
- Research on related laws and regulations
- Selection of equipment specifications, financial planning and setting of the implementation

schedule

- Provision of data related to the project activity, etc.

(3) Details of the study

1) Renewable biomass availability

The volume of agricultural waste available varies according to the time of year. However, a reliable framework for collecting renewable biomass is necessary for implementing the project activity. Through the questionnaires and hearings carried out at the 132 plants and farms, we were able to tabulate data received relating to the volume of biomass generated throughout the year. The data confirmed that a stable quantity is generated each month, even though the amount varies from month to month, and that the amount of renewable biomass available for supply to KTI would be 16,373t-biomass/month (See Table 1).

Table 1 Availability by district (t-biomass/month)

District	Wood biomass		Agricultural waste			
	Purchased	Generated	Chaff	Rice straw	Coconut fiber	Mushroom beds
Probolinggo	1,655	339	—	—	—	—
Lumajang	1,454	125	—	—	1	—
Pasuruan	—	—	109	562	—	—
Sidoarjo	—	—	—	—	—	—
Malang	—	—	—	—	—	—
Mojokerto	—	—	—	—	—	400
Situbondo	—	—	—	—	—	—
Jember	—	—	—	—	—	—
Bondowoso	—	—	—	—	—	—
Gresik	—	—	545	1,385	—	—
Lamongan	—	—	1,364	3,462	—	—
Banyuwangi	—	—	—	—	—	—
Nganjuk	—	—	818	4,154	—	—
Madiun	—	—	—	—	—	—
Sub-total (wood biomass)	3,109	464	—	—	—	—
Availability by type	3,573		2,836	9,563	1	400
TOTAL (dry weight)	**16,373**					

Wood biomass will be the main fuel used for the project activity. The new equipment to be installed at KTI will require 4,062 tons of wood biomass a month (48,738t-biomass/yr ÷ 12 months). Table 1 indicates that the amount of wood biomass available is 3,573 tons/month, meaning a shortage of 489t-biomass/month. We plan to fill this shortage using chaff, available in stable quantities. To produce the same amount of heat as would be produced by 489 tons of wood biomass, 606 tons of chaff are required. The survey concluded the available biomass would be sufficient.

- **Leakage resulting from competing use of renewable biomass**

When collecting renewable biomass, it is necessary to demonstrate that an amount equivalent to 25% of the amount used in the project activity will be available in surplus. If this cannot be demonstrated, it will be inferred that firms already using renewable biomass will have to switch to fossil fuels or other forms of energy. Leakage would need to be calculated in such a scenario.

The amount of renewable biomass available to KTI in stable supply each month is 16,373 tons. Assuming the heat released by renewable biomass used in the project activity was a uniform 2,242kcal/kg-biomass (Note 1), each month 6,913t-biomass would need to be collected.

In that scenario, 9,460t-biomass/month would be available in surplus, equivalent to 137% of the amount used in the project activity; therefore, the surplus requirement of 25% of the amount used in the project activity would be comfortably met.

From the above, we can conclude there is no need to take into account leakage resulting from competing use of renewable biomass.

(Note 1) This is the calorific value of mushroom beds, the lowest calorific value observed in the study. Although mushroom beds will not be used as fuel, this value was applied to ascertain the maximum amount of renewable biomass.

2) Use of water for biomass power generation

Since the KTI plant is situated near the coast, seawater can be used. Although a sufficient supply of water for the cooling tower could thus be secured if a seawater treatment facility were installed, doing so would inflate investment costs. At this stage, in order to keep investment costs down, the plan is to drill two new wells into the existing freshwater layer. At the same time, a separate well will be drilled and have a system for monitoring groundwater levels in accordance with the Ministry of Energy and Mineral Resources Regulation No.1451/K/10/MEN/2000.

3) Types of contracts with Indonesia's state-owned electricity company (PLN) to provide for emergencies

PLN offers the following two contract formats for importing electricity in emergencies.

- **JBST contract**

- Unit purchase price: 1,380 Rp/kWh
- Basic fee not required; payment = (monthly power consumption × 1,380 Rp/kWh)
- Supply in emergencies will take time as PLN does not have a structure in place to supply KTI.

- **Continue with regular contract**

- Pay a basic fee based on capacity; the lower the capacity, the lower the fee
- Preparations for supply are in place; electricity can be immediately supplied in emergencies
- Unit purchase price: on average, 1,120 Rp/kWh (peak)

Although the JBST contract does not require payment of a basic fee, the purchase price is more expensive and electricity would not be supplied immediately in times of emergency. KTI will thus continue its current arrangement.

* For other survey details, see "Reference material 1: Content of site survey"

3. Project establishment

(1) Specification of the project boundary and baseline

1) Baseline

This project activity will generate less than 15MW of electricity and achieve emission reductions less than 60,000t-CO_2 annually. It therefore falls under the definition of a “small-scale CDM project activity.” The project activity will use renewable wood biomass as a fuel, thus conforming to “Type I” small-scale methodology.

Project activities involving the introduction of “renewable biomass-based co-generating systems that produce heat and electricity” with heat generation capacity less than 45MW_{th} must conform to methodology AMS I.C. The baseline for projects displacing electricity imported from a grid is to be calculated as provided for in AMS I.D. (Methodology AMS I.C. paragraphs 1, 2, and 9) (Table 2). This project activity is KTI’s first CDM project. The project activity is thus not a debundled component of a large-scale CDM project activity.

Table 2 Methodologies applied

Title	Reference documentation
Thermal energy for the user with or without electricity	AMS I.C./version 13 EB 38 Valid from 28 Mar 08 onwards
Grid connected renewable electricity generation	AMS I.D./version 13 EB36 Valid from 14 Dec 07 onwards

- **Baseline specifications**

The following are baseline options for projects that involve the installation of cogeneration equipment (See small-scale methodology—AMS I.C. ver.13 paragraph 7).

(a) Electricity is imported from the grid and steam/heat is produced using fossil fuel

(b) Electricity is produced in an on-site captive power plant (with a possibility of export to the grid) and steam/heat is produced using fossil fuel

(c) A combination of (a) and (b)

(d) Electricity and steam/heat are produced in a cogeneration unit, using fossil fuel

(e) Electricity is imported from the grid and/or produced in an on-site captive power plant (with a possibility of export to the grid); steam/heat is produced from renewable biomass

Options (a) - (d) are not economically attractive as they would require modifications to existing boilers or the installation of new equipment. Additionally, switching to fossil fuels for steam/heat production would lead to greater CO_2 emissions than currently generated by the wood biomass boilers. For those reasons, and to avoid the acquisition of excess carbon credits, (a) - (d) should not be the baseline scenario.

Option (e) is the most viable baseline scenario: it is identical to the current system and requires no additional investment. In the absence of the project activity, therefore, it is conceivable that the current system would be maintained. Option (e) should be established as the baseline.

Baseline emissions in the case of option (e), as indicated in AMS I.C. paragraphs 11 and 14, will be the sum of GHG emissions resulting from importing electricity from the grid and GHG emissions resulting from producing steam/heat with the wood biomass boilers.

As only wood biomass is used for the production of steam/heat, the steam/heat portion will not be included for calculating baseline emissions. Only the electrical energy portion will be included. Baseline emissions for electricity imported from the grid shall be calculated in line with AMS I.D. paragraph 9 (a).

2) Project boundary

The project boundary is indicated in Fig. 2. CO_2 will be the only GHG included in the project activity.

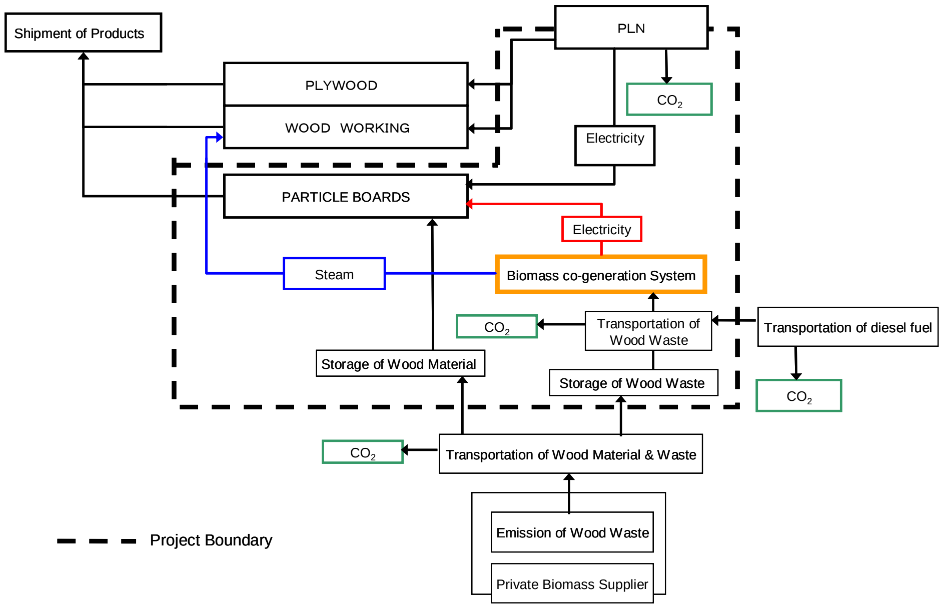

Fig. 2 Project boundary

3) Formula for calculating emission reductions

The following formula will be used to calculate GHG emission reductions.

$ER_{,y} = BE_{,y} - PE_{,y} - L_{,y}$	
$ER_{,y}$	: Annual emission reductions (t-CO_2/yr)
$BE_{,y}$	: Baseline emissions (t-CO_2/yr)
$PE_{,y}$	: Project emissions (t-CO_2/yr)
$L_{,y}$	: Leakage (t-CO_2/yr)

<u>**Baseline emissions ($BE_{,y}$)**</u>

Baseline emissions will be calculated using the following formula.

$BE_{,y} = EG_{,y} \times EF_{\text{-grid}}$	
$BE_{,y}$	: Baseline emissions (t-CO_2/yr)
$EG_{,y}$	: Baseline electricity production (MWh/yr)
$EF_{\text{-grid}}$	: Emission factor for the JAMALI grid (t-CO_2/MWh)

* Baseline electricity production ($EG_{,y}$) shall be defined as the amount of electricity currently imported from the JAMALI grid that will be displaced by electricity generated by the new equipment.

■ **Baseline electricity production ($EG_{,y}$)**

Baseline electricity production ($EG_{,y}$) for this project activity will be measured through the monitoring of actual electricity generation. There is a possibility, however, that natural gas will have to be used to compensate for any shortage of renewable biomass if not enough can be obtained.

As stipulated in AMS I.D. paragraphs 16 and 18, when natural gas is used the electricity production measured needs to be adjusted by deducting the amount of natural gas consumed, applying the parameters of natural gas specific fuel consumption (t-NG/MWh) and quantity of natural gas consumed (Nm^3/yr).

The formula for calculating baseline electricity production is as follows.

$EG_{,y} = \mathrm{MIN}(EG_{\text{-actual},y} - EG_{\text{-system-NG},y},\ EG_{\text{-system-biomass},y})$ $= \mathrm{MIN}(EG_{\text{-actual},y} - (PEC_{\text{-NG},y} \times Den_{\text{-NG}}) / SFC_{\text{-NG}},\ \Sigma[PEC_{\text{-biomass-i},y} / SFC_{\text{-biomass-i}}])$	
$EG_{,y}$	: Baseline electricity production (MWh/yr)
$EG_{\text{-actual},y}$	: Measurement of Baseline electricity production (MWh/yr)
$EG_{\text{-system-NG},y}$	: Electricity production by the cogeneration system using natural gas energy (MWh/yr)
$EG_{\text{-system-biomass},y}$	: Electricity production by the cogeneration system using renewable biomass energy (MWh/yr)
$SFC_{\text{-NG}}$	: Natural gas specific fuel consumption (t-NG/MWh)
$PEC_{\text{-NG},y}$	: Quantity of natural gas consumed (Nm^3/yr)
$Den_{\text{-NG}}$	: Density of natural gas (t-NG/Nm^3)
$SFC_{\text{-biomass-i}}$	: Renewable biomass *i* specific fuel consumption (t-biomass/MWh)
$PEC_{\text{-biomass-i},y}$	: Quantity of renewable biomass *i* consumed (t-biomass/yr)

At this stage, enough renewable biomass is available for electricity production and we do not expect to use natural gas; therefore $\mathbf{EG}_{,y} = \mathbf{EG}_{\text{-actual,y}} = \mathbf{EG}_{\text{-system-biomass,y}}$.

Specific fuel consumption for fuel *i* ($\mathbf{SFC}_{\text{-i}}$) will be determined in advance using the formula below.

- **Specific fuel consumption for fuel *i* ($\mathbf{SFC}_{\text{-i}}$)**

The specific fuel consumption for each fuel used will be calculated using the following formula.

$\mathbf{SFC}_{\text{-i}} = \mathbf{Cp} / (\mathbf{Cal}_{\text{-i}} / 10^3)$	
$\mathbf{SFC}_{\text{-i}}$	: Specific fuel consumption for fuel *i* (t-NG/MWh or t-biomass/MWh)
Cp	: Calorific value required for electricity production (kcal/MWh)
$\mathbf{Cal}_{\text{-i}}$	: Calorific value of fuel *i* used in the project activity (kcal/kg-biomass or kcal/kg-NG)

■ **Emission factor for JAMALI grid ($\mathbf{EF}_{\text{-grid}}$)**

The emission factor for the JAMALI grid ($\mathbf{EF}_{\text{-grid}}$) applied to the project activity shall be 0.891t-CO_2/MWh. That is the emission factor approved by Indonesia's designated national authority (DNA) (Reference material 2, Indonesia's DNA: http://dna-cdm.menlh.go.id/id/database/).

$\mathbf{EF}_{\text{-grid}} = 0.891$ t-CO_2/MWh	
$\mathbf{EF}_{\text{-grid}}$	: The emission factor for the JAMALI grid (t-CO_2/MWh)

<u>**Project emissions ($\mathbf{PE}_{,y}$)**</u>

Project emissions will be calculated using the following formula.

$\mathbf{PE}_{,y} = \mathbf{EM}_{\text{-biomass,y}} + \mathbf{EM}_{\text{-grid,y}} + \mathbf{EM}_{\text{-diesel power plant,y}} + \mathbf{EM}_{\text{-loader,y}}$	
$\mathbf{PE}_{,y}$	: Project emissions(t-CO_2/yr)
$\mathbf{EM}_{\text{-biomass,y}}$	: Emissions resulting from burning renewable biomass (t-CO_2/yr)
$\mathbf{EM}_{\text{-grid,y}}$	: Emissions resulting from importing electricity from the grid (t-CO_2/yr)
$\mathbf{EM}_{\text{-diesel power plant,y}}$	: Emissions resulting from diesel generator operation (t-CO_2/yr)
$\mathbf{EM}_{\text{-loader,y}}$	: Emissions resulting from wheel loader operation (t-CO_2/yr)

■ **Emissions resulting from burning renewable biomass ($\mathbf{EM}_{\text{-biomass,y}}$)**

GHG emissions resulting from burning renewable biomass can be considered to be 0t-CO_2/yr.

$\mathbf{EM}_{\text{-biomass,y}} = 0$t-$CO_2$/yr

■ **Emissions resulting from importing electricity from the grid ($\mathbf{EM}_{\text{-grid,y}}$)**

GHG emissions resulting from importing electricity from the grid will be calculated using the following formula.

$\mathbf{EM}_{\text{-grid,y}} = \mathbf{EG}_{\text{-grid,y}} \times \mathbf{EF}_{\text{-grid,y}}$	
$\mathbf{EM}_{\text{-grid,y}}$	: Emissions resulting from importing electricity from the grid (t-CO_2/yr)
$\mathbf{EG}_{\text{-grid,y}}$	: Electricity imported from the grid (MWh/yr)
$\mathbf{EF}_{\text{-grid,y}}$	: Emission factor for the JAMALI grid (t-CO_2/MWh)

■ **Emissions resulting from diesel generator operation ($\mathbf{EM}_{\text{-diesel power plant,y}}$)**

GHG emissions resulting from diesel generator operation will be calculated using the following formula.

$\mathbf{EM}_{\text{-diesel power plant,y}} = \mathbf{PEC}_{\text{-diesel power plant,y}} \times \mathbf{EF}_{\text{-diesel-}CO_2} \times \mathbf{Cal}_{\text{-diesel}} \times \mathbf{Den}_{\text{-diesel}} / 10^6$	
$\mathbf{EM}_{\text{-diesel power plant,y}}$	: Emissions resulting from diesel generator operation (t-CO_2/yr)
$\mathbf{PEC}_{\text{-diesel power plant,y}}$	: Quantity of diesel consumed by the diesel generator (liters/yr)
$\mathbf{EF}_{\text{-diesel-}CO_2}$	: CO_2 emission factor for diesel (t-CO2/TJ)
$\mathbf{Cal}_{\text{-diesel}}$	: Calorific value of diesel (TJ/Gg)
$\mathbf{Den}_{\text{-diesel}}$	: Density of diesel (kg/liter)

■ **Emissions resulting from wheel loader operation ($\mathbf{EM}_{\text{-loader,y}}$)**

For this project activity, we will measure GHG emissions generated by diesel consumed by wheel loaders that transport renewable biomass and feed it into the new equipment.

The quantity of diesel fed into the wheel loaders, the amount of PB raw material delivered and the amount of renewable biomass fed into the boilers will be monitored to carry out the calculation using the following formula.

$\mathbf{EM}_{\text{-loader,y}} = \mathbf{PEC}_{\text{-fuel-loader for system,y}} \times \mathbf{EF}_{\text{-diesel-}CO_2} \times \mathbf{Cal}_{\text{-diesel}} \times \mathbf{Den}_{\text{-diesel}} / 10^6$	
$\mathbf{EM}_{\text{-loader,y}}$	: Emissions resulting from wheel loader operation (t-CO_2/yr)
$\mathbf{PEC}_{\text{-fuel-loader for system,y}}$	: Quantity of diesel consumed by wheel loaders for transporting/feeding renewable biomass to the cogeneration system (liters/yr)
$\mathbf{EF}_{\text{-diesel-}CO_2}$	: CO_2 emission factor for diesel (t-CO_2/TJ)
$\mathbf{Cal}_{\text{-diesel}}$	: Calorific value of diesel (TJ/Gg)
$\mathbf{Den}_{\text{-diesel}}$	: Density of diesel (kg/liter)

- **Quantity of diesel consumed by wheel loaders for transporting/feeding renewable biomass to the cogeneration system ($\mathbf{PEC}_{\text{-fuel -loader for system,y}}$)**

Quantity of diesel consumed by wheel loaders for transporting/feeding renewable biomass to the cogeneration system will be calculated using the following formula.

$\mathbf{PEC}_{\text{-fuel -loader for system,y}} = \mathbf{PEC}_{\text{-fuel-loader,y}} \times (\mathbf{PEC}_{\text{-biomass,y}} / (\mathbf{PEC}_{\text{-biomass,y}} + \mathbf{PEC}_{\text{-material-PB,y}}))$	
$\mathbf{PEC}_{\text{-fuel -loader for system,y}}$	: Quantity of diesel consumed by wheel loaders for transporting/feeding renewable biomass to the cogeneration system (liters/yr)
$\mathbf{PEC}_{\text{-fuel-loader,y}}$	: Total quantity of diesel consumed by all wheel loaders (liters/yr)
$\mathbf{PEC}_{\text{-biomass,y}}$	: Quantity of renewable biomass consumed by the cogeneration system (t-biomass/yr)
$\mathbf{PEC}_{\text{-material-PB,y}}$	: Quantity of wood biomass consumed as PB raw material (t-biomass/yr)

Leakage ($L_{,y}$)

Although not required under the methodology, leakage resulting from the delivery of fuel will also be recorded for this project activity to avoid acquiring too many credits.

Leakage resulting from the transport of combustion ash will not be included in calculations for this project activity because ash generation is low.

Leakage will be calculated using the following formula.

$L_{,y} = EM_{\text{-Tf-system,y}} + EM_{\text{-biomass competition,y}} + EM_{\text{-Tp-fuel,y}}$	
$L_{,y}$	: Leakage ($t\text{-}CO_2$/yr)
$EM_{\text{-Tf-system,y}}$	: Leakage resulting from transfer of equipment ($t\text{-}CO_2$/yr)
$EM_{\text{-biomass competition,y}}$	: Leakage resulting from competing use of renewable biomass ($t\text{-}CO_2$/yr)
$EM_{\text{-Tp-fuel,y}}$	: Leakage resulting from fuel delivery ($t\text{-}CO_2$/yr)

- **Leakage resulting from transfer of equipment ($EM_{\text{-Tf-system,y}}$)**

No leakage will result from the transfer of equipment for this project activity.

$$EM_{\text{-Tf-system,y}} = 0t\text{-}CO_2/yr$$

- **Leakage resulting from competing use of renewable biomass ($EM_{\text{-biomass competition,y}}$)**

More than 25% of the quantity to be used in the project activity will be available in surplus. There is thus no need to take into account leakage resulting from competing use of renewable biomass (See 2. (3) for details).

$$EM_{\text{-biomass competition,y}} = 0t\text{-}CO_2/yr$$

- **Leakage resulting from fuel delivery ($EM_{\text{-Tp-fuel,y}}$)**

The implementation of the project activity will lead to an increase in diesel consumption by trucks used to transport renewable biomass for use as a fuel in power generation and diesel consumption by tank trucks used to deliver fuel for powering wheel loaders. The resulting GHG emissions will be counted as leakage.

This will be calculated using the following formula.

$EM_{\text{-Tp-fuel,y}} = (PEC_{\text{-Tp-fuel-biomass,y}} + PEC_{\text{-Tp-fuel-loader,y}}) \times EF_{\text{-diesel-}CO_2} \times Cal_{\text{-diesel}} \times Den_{\text{-diesel}} / 10^6$	
$EM_{\text{-Tp-fuel,y}}$	: Leakage resulting from fuel delivery ($t\text{-}CO_2$/yr)
$PEC_{\text{-Tp-fuel-biomass,y}}$	: Quantity of diesel consumed by trucks transporting renewable biomass for the cogeneration system (liters/yr)
$PEC_{\text{-Tp-fuel-loader,y}}$	: Quantity of diesel consumed by tank trucks transporting fuel for wheel loaders that transport/feed renewable biomass to the cogeneration system (liters/yr)
$EF_{\text{-diesel-}CO_2}$	: CO_2 emission factor for diesel ($t\text{-}CO_2$/TJ)
$Cal_{\text{-diesel}}$	: Calorific value of diesel (TJ/Gg)
$Den_{\text{-diesel}}$	: Density of diesel (kg/liter)

- **Quantity of diesel consumed by trucks transporting renewable biomass for the cogeneration system ($PEC_{\text{-Tp-fuel-biomass,y}}$)**

This will be calculated using the following formula.

$PEC_{\text{-Tp-fuel-biomass,y}} = (PEC_{\text{-biomass-outside,y}} + (PEC_{\text{-biomass-outside,y}} \times PWC_{\text{-biomass}})) / ATp_{\text{-biomass}} \times D_{\text{-biomass}} / M_{\text{-biomass}}$	
$PEC_{\text{-Tp-fuel-biomass,y}}$	: Quantity of diesel consumed by trucks transporting renewable biomass for the cogeneration system (liters/yr)
$PEC_{\text{-biomass-outside,y}}$	: Quantity of renewable biomass used by the cogeneration system obtained outside the project boundary (t-biomass/yr)
$ATp_{\text{-biomass}}$	: Average load of a renewable biomass collection truck (t-biomass/vehicle/trip)
$D_{\text{-biomass}}$	: Average distance travelled by a renewable biomass collection truck (km/vehicle/trip)
$M_{\text{-biomass}}$	: Renewable biomass collection truck mileage (km/liter)
$PWC_{\text{-biomass}}$	: Renewable biomass moisture content (%)

- ✓ **Quantity of renewable biomass used by the cogeneration system and obtained outside the project boundary ($PEC_{\text{-biomass-outside,y}}$)**

This will be calculated using the following formula.

$PEC_{\text{-biomass-outside,y}} = PEC_{\text{-biomass,y}} - PEC_{\text{-biomass-inside,y}}$	
$PEC_{\text{-biomass-outside,y}}$	: Quantity of renewable biomass used by the cogeneration system obtained outside the project boundary (t-biomass/yr)
$PEC_{\text{-biomass,y}}$	: Quantity of renewable biomass consumed by the cogeneration system (t-biomass/yr)
$PEC_{\text{-biomass-inside,y}}$	: Quantity of renewable biomass used by the cogeneration system obtained within the project boundary (t-biomass/yr)

- **Quantity of diesel consumed by tank trucks transporting fuel for wheel loaders that transport/feed renewable biomass to the cogeneration system ($PEC_{\text{-Tp-fuel-loader,y}}$)**

This will be calculated using the following formula.

$PEC_{\text{-Tp-fuel-loader,y}} = PEC_{\text{-fuel-loader for system,y}} / ATp_{\text{-diesel}} \times D_{\text{-diesel}} / M_{\text{-diesel}}$	
$PEC_{\text{-Tp-fuel-loader,y}}$	: Quantity of diesel consumed by tank trucks transporting fuel for wheel loaders that transport/feed renewable biomass to the cogeneration system (liters/yr)
$PEC_{\text{-fuel-loader for system,y}}$	: Quantity of diesel consumed by wheel loaders for transporting/feeding renewable biomass to the cogeneration system (liters/yr)
$ATp_{\text{-diesel}}$	: Load per diesel delivery truck (liters/vehicle/trip)
$D_{\text{-diesel}}$	: Distance travelled per diesel delivery truck (km/vehicle/trip)
$M_{\text{-diesel}}$	: Diesel delivery truck mileage (km/liters)

(2) Monitoring plan

KTI has already acquired ISO 9001 certification for its plywood/building materials plants. Certification of the PB plant is expected in 2009, which means the plant will be certified before project implementation. Therefore, controls will be upheld through the monitoring frameworks described in ISO procedures. The requirement that calibration of measuring equipment be performed once a year will be included in the procedures.

The PB Production Division will tabulate parameters such as production cost and electricity usage for the PB plant at the end of each month and file a monthly report that the general manager of the Administration Division will confirm and deliver to the company president. Reporting for this project activity will follow the same format. With implementation of the project activity, a Biomass Power Plant Section (hereinafter, “BPP Section”) will be newly established within the PB Production Division.

The BPP Section will use data reported at the end of each month to compute GHG emission reductions. The management structure relating to this project activity is detailed in Fig. 3.

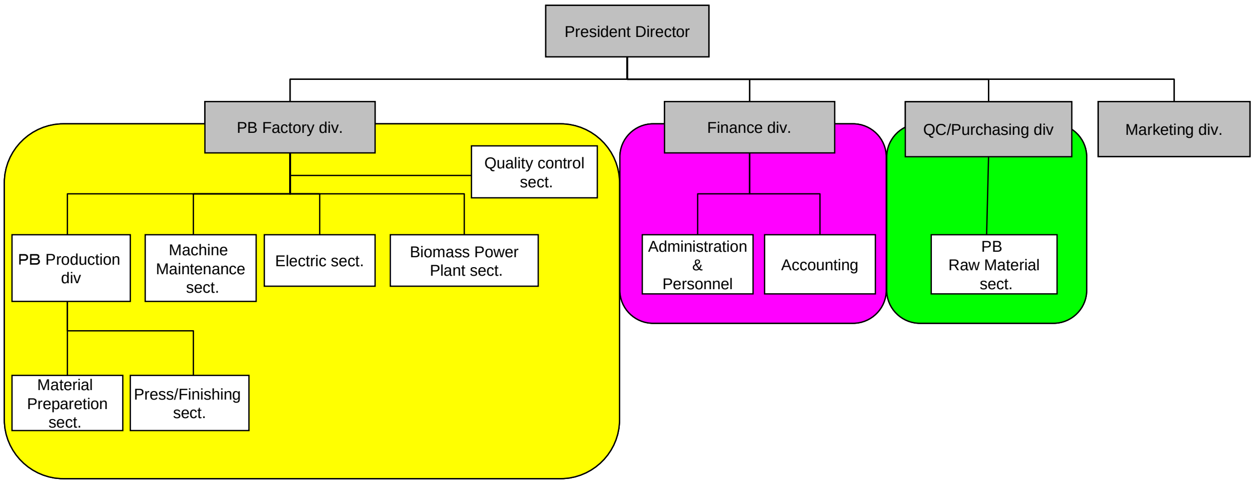

Fig. 3 Management Structure

(3) GHG emission reductions

Table 3 below shows the results of advance calculations made using the formula stipulated under (1) 3).

Table 3 Estimated GHG emission reductions in the first crediting period

Year	Estimation of baseline emissions ($t\text{-}CO_2$)	Estimation of project activity emissions ($t\text{-}CO_2$)	Estimation of leakage ($t\text{-}CO_2$)	Estimation of overall emission reductions ($t\text{-}CO_2$)
2011	14,819	189	2,458	12,172
2012	14,819	189	2,458	12,172
2013	14,819	189	2,458	12,172
2014	14,819	189	2,458	12,172
2015	14,819	189	2,458	12,172
2016	14,819	189	2,458	12,172
2017	14,819	189	2,458	12,172
TOTAL	**103,733**	**1,323**	**17,206**	**85,204**

(4) Duration of the project activity and crediting period

The crediting period will be a seven-year period renewed twice for a total of 21 years. The project activity will commence in July 2009 following completion of this feasibility study and authorization by the Executive Committee. The project activity implementation plan is shown in Table 4 below.

Table 4 Project implementation schedule

Year	Month	Activity
2009	February	Completion of GEC report and feasibility study
	May - July	Executive Committee Meeting (Sumitomo Forestry Co., Ltd.)
	July	On authorization by the Executive Committee: Ordering of equipment and start of site preparation
	November	Start of foundation work
2010	Around November -	Trial operation
2011	January	Start of commercial operation

(5) Environmental impact and other indirect effects

The State Ministry of Environment Decree No.11/2006 states that biomass power generation facilities with capacity of 10MW or greater are considered to be in a business category to which the AMDAL method of environmental impact assessment shall be applied. The cogeneration system to be installed through this project activity will have a capacity of 4.5MW and therefore AMDAL is not required. Instead of AMDAL, KTI will manage this project activity through the environmental management and monitoring documentation (DPPL) currently carried out.

The results of surveys of the following DPPL criteria are to be submitted to Probolinggo City twice yearly.

- Air pollution
- Noise
- Vibration
- Water pollution
- Flood prevention
- Soil contamination
- Harmful substances
- Health of employees and local residents

(5) Stakeholder comments

Comments were obtained from stakeholders. The following is a summary.

- Renewable biomass suppliers
- Life & Environment Division, Probolinggo Municipal Government
- State-owned gas company (PT. PGN)
- State-owned electricity company (PT. PLN)
- Climate Change Division, State Ministry of Environment

■ **Renewable biomass suppliers**

We visited and gathered information from four companies that supply wood waste and chaff—types of biomass of which there is a stable supply. Prices for chaff differ according to the time of year, and are lowest from March to May when there is a surplus. Some agricultural waste is currently not collected and could be collected through a collection company.

■ **Life & Environment Division, Probolinggo Municipal Government**

KTI's biomass power generation project will increase the income of local residents and contribute to the local economy. Probolinggo's Life & Environment Division will thus be able to offer support.

■ **State-owned gas company (PT. PGN)**

PGN plans to raise the capacity of its gas supply and expects to be able to supply gas to KTI by April 2011. The company's policy is to provide gas at a cheaper per-calorie rate than diesel.

- **State-owned electricity company (PT. PLN)**

  Other companies besides KTI are switching to captive power generation, which PLN does not interfere with. PLN wishes to purchase any surplus electricity generated.

  PLN has a plan to raise its electricity generation capacity to 10,000MW by 2011. Electricity prices will likely rise to 900-1,300Rp/kWh in the future.

- **Climate Change Division, State Ministry of Environment**

  KTI's project activity is not expected to be subject to domestic laws and regulations in Indonesia and may therefore proceed as a CDM project.

(7) Framework for project activity implementation

KTI, as the site of the project activity, will be responsible for its implementation and management.

Sumitomo Forestry will carry out CDM-related procedures. Major responsibilities are shown in Table 5 below.

Table 5 Responsibilities pertaining to project activity implementation

Sumitomo Forestry (CDM procedures)	KTI (project implementation/management)
PDD form preparation	Funds procurement
Procedures for DOE assessment	Equipment specs selection/ordering
Application/explanation to Japan DNA	Equipment installation
CDM project focal point	Application/presentation to Indonesia DNA
Purchase of credits	Monitoring

(8) Funding plan

We are considering borrowing the entire capital investment amount. The investment is expected to be around $8.2 million, which we plan to finance with a bank loan.

This project activity is not assisted by public funding.

(9) Economic analysis

The internal rate of return (IRR) of the project activity was estimated using the following assumed parameter values.

<u>IRR estimation values</u>

- Investment funds: US$8.2 million
- Activity duration: 20 years
- Investment recovery period: 10 years

The outcome of CER price and IRR estimates calculated based on the above assumptions are shown in Table 6.

Even with the revenue from CER sales, the IRR would be expected to fall below the weighted average cost of capital, making the project activity an unworkable investment (See Reference material 3).

Table 6 Estimated IRR at varying CER price settings

With/without CERs	CER price		
	US$30	US$20	US$10
With	3.6%	1.9%	0%
Without		-2.1%	

A sensitivity analysis was carried out using variations in parameters with a major influence on the IRR— renewable biomass purchasing costs (roughly 80% of total costs), and the price of electricity purchased from the grid. It was confirmed that the IRR increases (maximum: 10.9%) with lower renewable biomass purchasing costs and higher electricity bills from PLN.

(10) Demonstration of additionality

1) Investment barriers

Installation of the cogeneration system is expected to require an investment of around US$8.2 million, all of which is expected to be borrowed from a bank. An estimate conducted assuming a CER price of US$20/t-$CO_2$ indicated an IRR of 1.9% with the inclusion of CER revenue and an IRR of -2.1% with no CER revenue (Table 6). Even with the revenue from CER sales, the IRR would be expected to fall below the weighted average cost of capital, making the project activity an unworkable investment (See 3. (11) for details on the likelihood of establishing the project activity, and outstanding issues).

2) Barriers due to prevailing practice

- **Renewable biomass power generation**

In Indonesia, government subsidies for petroleum products were reduced from 2001, forcing an escalation of prices for those products. Many companies were subsequently compelled to adopt alternative energy sources and switched to boilers fueled by abundant coal deposits.

The use of renewable biomass is consistent with Indonesian state policy as it helps to reduce GHG emissions and contributes to the nation’s sustainability. There are, however, many barriers to its use. Compared to coal, for example, the use of renewable biomass for power generation demands much labor and time as large volumes of renewable biomass need to be collected from an extremely wide range of sources. Stability of supply, too, is affected by availability, which fluctuates with economic conditions and the time of year. Also, initial investment for biomass power generation facilities is about 15% higher than for coal-fired power generation facilities.

- **Energy used by timber processing plants on Java producing plywood**

Seven timber processing plants, including KTI, currently produce plywood on the island of Java. These seven plants effectively use raw material waste generated during the plywood production process as a fuel for boilers that produce steam and thermal energy required for the drying process.

Concerning electricity usage, the environments of all seven plants allow them access to the JAMALI grid, Indonesia's largest electricity network, from where they draw their electricity.

In light of the above practices, KTI would be the first to introduce efficient cogeneration facilities for producing heat and electricity.

The project activity is thus said to have additionality.

(11) Likelihood of establishing project activity, and outstanding issues

An estimate of project feasibility performed under current conditions does not support establishing the project activity as the IRR was shown to fall below the weighted average cost of capital.

Parameters with a major influence on the results of the feasibility estimate are electricity prices set by PLN and renewable biomass purchasing costs. The activity would be potentially workable were PLN's electricity prices to rise and renewable biomass purchasing costs to fall. Information received from PLN points to a likely increase in electricity prices in the near future. It is thus necessary to negotiate to keep renewable biomass purchasing costs down and secure collection routes so that the activity can be implemented.

4. Benefits for the host country

(1) Evaluation of pollution prevention initiatives in the host country

The prevention of air pollution through installation of the new equipment and the effective use of renewable biomass are two benefits to be created through the project activity.

1) Emissions of particulate matter

Actual emissions of particulate matter from the boiler chimney during 2008 were between 215mg/m^3 and 950mg/m^3, and emissions were observed to briefly exceed the 350mg/m^3 standard prescribed by the province of East Java (source: East Java Provincial Regulation No. 39/2008). The boiler to be substituted for this project activity, in particular, occasionally emits black smoke due to incomplete combustion caused by, for example, a shortage of oxygen during combustion or low internal temperatures. The new equipment will have a combustion system that does not emit black smoke from incomplete combustion, as well as a dust collector. It will thus restrict emissions of particulate matter to 120mg/m^3 (design specification).

Additionally, emissions of particulate matter are curbed better when using natural gas as a fuel in co-firing instead of coal, thereby tying to greater prevention of air pollution.

2) Effective use of renewable biomass

The survey of renewable biomass availability found that some agricultural waste, such as chaff, goes unused and undergoes simple incineration.

Utilizing unused agricultural waste as fuel is not only an effective use of resources, it prevents smoke pollution otherwise caused by simple incineration and also helps to avoid methane emissions.

Reference materials

Reference material 1: Content of site survey

Reference material 2: Information about emission factor for the JAMALI grid

Reference material 3: Feasibility calculation sheet

Reference material 1

Content of site survey

(1) Inspection of plant having wood biomass power generation equipment

- Information gathering related to operational problems and equipment selection

(2) Survey related to equipment to be installed

- Specifications for new equipment
- Location for installing equipment

(3) Survey of renewable biomass availability

- Hearings and questionnaires to renewable biomass suppliers
- Confirmation of frameworks for renewable biomass supply
- Calorific value testing

(4) Survey related to water supply for cooling during power generation and for boilers

- Seawater survey
- Groundwater survey

(5) Survey related to air pollution

- Survey of particulate matter emissions from existing boilers
- Surveys conducted as required for environmental management and observation (DPPL)

(6) Survey of ash emissions from existing boilers

(7) Information gathering related to natural gas supply

(8) Confirmation of monitoring frameworks

(9) Information gathering related to changes to contract with state electricity company (PLN)

(10) Survey of environmental laws and regulations

(11) Survey of energy usage by plywood plants on Java

(12) Requesting comments from stakeholders

<u>Targeted stakeholders</u>

- Renewable biomass suppliers
- Life & Environment Division, Probolinggo Municipal Government
- PT. PGN (state-owned gas company)
- PT. PLN (state-owned electricity company)
- Climate Change Division, State Ministry of Environment

(13) Feasibility survey

- For funding plan: size of investment, activity duration, etc.
- For economic analysis

KEMENTERIAN NEGARA LINGKUNGAN HIDUP
REPUBLIK INDONESIA

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Jakarta, 19 Januari 2009

Nomor : B-277/Dep.III/LH/01/2009
Lamp. : -
Perihal : Informasi terbaru baseline faktor emisi untuk proyek CDM pada sistem ketenagalistrikan Sumatera dan J JAMALI

Kepada Yth. :
(Daftar tujuan surat terlampir)
di
Tempat

Menindaklanjuti surat dari Direktur Jenderal Listrik dan Pemanfaatan Energi, Departemen Energi dan Sumber Daya Mineral (No: 37833/21/600.5/2008) tanggal 24 Desember 2008 perihal Baseline Faktor Emisi Sistem ketenagalistrikan Sumatera dan Updating baseline Faktor Emisi Sistem ketenagalistrikan JAMALI, maka bersama ini disampaikan bahwa informasi terbaru untuk baseline faktor emisi pada sistem ketenagalistrikan Sumatera dan JAMALI adalah sebagai berikut:

a. Sistem ketenagalistrikan Sumatera : **0,743 tCO_2 eq/MWH;**
b. Sistem ketenagalistrikan JAMALI : **0,891 tCO_2 eq/MWH**

Sehubungan dengan hal tersebut di atas, maka secara resmi informasi tersebut dapat digunakan oleh para pemangku kepentingan dalam mengembangkan proyek CDM di Indonesia.

Demikian kami sampaikan atas perhatiannya diucapkan terima kasih.

Deputi MENLH Bidang Peningkatan Konservasi SDA dan Pengendalian Kerusakan Lingkungan / Ketua KN-MPB,

KEMENTERIAN NEGARA LINGKUNGAN HIDUP REPUBLIK INDONESIA

Dra. Masnellyarti Hilman, MSc.

Tembusan Yth.:
- Menteri Negara LH (sebagai laporan)

Reference material 3

Calculation for Project Feasibility Study at PT. KTI

Renewable Biomass Captive Power Generation Project —Alternative Facilities		
Electricity generation capacity	4.5	MW
Thermal generation capacity	6.5	MW_{th}
Annual electricity consumption	16,632	MWh/year
Electricity usage in manufacturing	2.1	MW
Electricity consumption in power generation	0.875	MW
Total electricity production	2.98	MW
Steam production (employing heat)	55,440	t-steam/year
Ash emission rate	1.5	% of fuel
Ash disposal expenses	10	US$/ton
CO_2 reductions	12,172	ton/year
Project activity energy requirement	185,984,037	Mcal/year

discount % 0%

Biomass fuel type		Unit price (Rp/wet-kg)	Unit price ($/ton)	Unit price (Rp/dry-kg)	Calorific value (kcal/kg-biomass)	Consumption dry-ton/year	Energy generation Gcal
- Wood biomass	Purchased	180	18	342	3,816	37,308	142,367
	Generated in own plants	135	13.5	257	3,816	5,568	21,247
Other types of renewable biomass							
- Chaff		250	25	275	3,081	7,272	22,405
- Rice straw		100	10	130	3,368	0	0
- Coconut fiber		250	25	425	4,141	0	0
- Mushroom beds		150	15	450	2,242	0	0
		Energy shortage					0
		Total project activity calorie requirement (calories					185,984

Investment (US$) 8,200,000
(Power generation equipment + gas supply infrastructure)

Subject		year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
No. of operating days		(days/year)		330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330
Electricity imported from grid (before activity implementation)		MWh		16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632	16,632
Electricity imported from grid (after activity implementation)		MWh	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Reduction in electricity imported from grid				16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582	16,582
Annual CO_2 reduction (tons/year)				12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172	12,172
Credit price (US$/ton)			0.0	0.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Purchase price of electricity from grid (US$/MWh)		112 US$/MWh 3% (Annual % price increase)	112	115	119	122	126	130	134	138	138	138	138	138	138	138	138	138	138	138	138	138	138
Price of diesel oil (US$/liter)		0.5 US$/l 5% (Annual % price increase)	0.50	0.53	0.55	0.58	0.61	0.64	0.67	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Price of natural gas (US$/$Nm^3$)		0.2 US/Nm^3 3% (Annual % price increase)	0.20	0.21	0.21	0.22	0.23	0.23	0.24	0.25	0.25	0.26	0.27	0.28	0.29	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.36
Wood biomass purchasing costs (US$/ton)		1,275,933 US$	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031	1,419,031
Chaff purchasing costs (US$/ton)		199,980 US$	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980	199,980
Rice straw purchasing costs(US$/ton)		1% (Annual % price increase)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coconut fiber purchasing costs(US$/ton)		1% (Annual % price increase)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mushroom beds purchasing costs(US$/ton)		1% (Annual % price increase)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Estimated exchange rate (Rp./US$)		10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Gains	Cost reductions from decrease in electricity imported from grid (US$/year)		0	1,912,900	1,970,290	2,029,405	2,090,294	2,153,007	2,217,594	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121	2,284,121
	Revenue from credits		0	0	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440	243,440
Expenses	Biomass purchasing costs for power generation (US$/year)			1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011	1,619,011
	CDM project expenses (US$)		100,000	100,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
	Ash disposal expenses (US$/year)				6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687	6,687
	Natural gas consumption expenses (US$/year)	0 Nm^3		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Diesel oil consumption expenses (US$/year)	60,000 liter		31,500	33,060	34,740	36,480	38,280	40,200	42,240	44,340	46,560	48,900	51,360	53,940	56,640	56,640	56,640	56,640	56,640	56,640	56,640	56,640
	Depreciation (US$)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SG&A expenses (US$)	0.5%		41,000	41,205	41,411	41,618	41,826	42,035	42,245	42,456	42,668	42,881	43,095	43,310	43,527	43,745	43,964	44,184	44,405	44,627	44,850	45,074
	Labor expenses (US$) 24 persons 200 US$ 12 months	5.0% (Labor expenses % increase)		**57,600**	60,480	63,504	66,679	70,013	73,514	77,190	81,050	85,103	89,358	93,826	98,517	103,443	108,615	114,046	119,748	125,735	132,022	138,623	145,554
	Insurance (US$)	0.3%		24,600	24,674	24,748	24,822	24,896	24,971	25,046	25,121	25,196	25,272	25,348	25,424	25,500	25,577	25,654	25,731	25,808	25,885	25,963	26,041
	Corporation taxes (US$) (with CER)			0	0	0	0	0	0	0	0	0	0	142,902	143,934	144,883	146,590	148,258	149,883	151,460	152,983	154,446	155,844
	Corporation taxes (US$) (without CER)			0	0	0	0	0	0	0	0	0	0	102,874	106,912	103,827	108,715	113,743	118,912	121,750	119,775	117,704	115,534
Investment for CDM project (US$)		-8,200,000	**(8,200,000)**																				
Gains from biomass power generation each FY (incl. CDM project establishment costs; US$)			**(100,000)**	**39,189**	**398,613**	**452,744**	**508,437**	**565,734**	**624,616**	**685,142**	**678,896**	**672,336**	**665,452**	**515,332**	**506,738**	**497,870**	**490,696**	**483,301**	**475,677**	**467,815**	**459,706**	**451,341**	**442,710**
Total profit from project activity (incl. CDM project establishment costs; US$)			**(100,000)**	**(60,811)**	**337,801**	**790,545**	**1,298,982**	**1,864,716**	**2,489,331**	**3,174,473**	**3,853,369**	**4,525,705**	**5,191,156**	**5,706,488**	**6,213,226**	**6,711,096**	**7,201,791**	**7,685,092**	**8,160,769**	**8,628,584**	**9,088,289**	**9,539,630**	**9,982,340**
Investment recovery period (incl. CDM project establishment costs; US$)		23 years 6 months	**(8,300,000)**	**(8,534,711)**	**(8,417,744)**	**(8,242,786)**	**(8,006,361)**	**(7,704,837)**	**(7,334,482)**	**(6,891,378)**	**(6,439,897)**	**(5,980,078)**	**(5,511,970)**	**(5,178,533)**	**(4,842,687)**	**(4,504,626)**	**(4,162,584)**	**(3,816,648)**	**(3,466,920)**	**(3,113,513)**	**(2,756,554)**	**(2,396,179)**	**(2,032,543)**
Unit cost of biomass power generation (incl. CDM project establishment costs; US$/kWh)				**0.129**	**0.119**	**0.122**	**0.126**	**0.129**	**0.133**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**	**0.137**
IRR (witl (with CER)		1.9%	**(8,300,000)**	**39,189**	**398,613**	**452,744**	**508,437**	**565,734**	**624,616**	**685,142**	**678,896**	**672,336**	**665,452**	**515,332**	**506,738**	**497,870**	**490,696**	**483,301**	**475,677**	**467,815**	**459,706**	**451,341**	**442,710**
Gains from biomass power generation each FY (excl. CDM project establishment costs; US$)			**0**	**139,189**	**185,173**	**239,304**	**294,997**	**352,294**	**411,176**	**471,702**	**465,456**	**458,896**	**452,012**	**341,920**	**330,320**	**325,486**	**315,131**	**304,376**	**293,208**	**284,085**	**279,474**	**274,643**	**269,580**
Total profit from the project activity (excl. CDM project establishment costs; US$)			**0**	**139,189**	**324,361**	**563,665**	**858,662**	**1,210,956**	**1,622,131**	**2,093,833**	**2,559,289**	**3,018,185**	**3,470,196**	**3,812,116**	**4,142,436**	**4,467,922**	**4,783,052**	**5,087,428**	**5,380,636**	**5,664,721**	**5,944,194**	**6,218,837**	**6,488,417**
Investment recovery period (excl. CDM project establishment costs; US$)		32 years 9 months	**(8,200,000)**	**(8,331,411)**	**(8,421,176)**	**(8,459,771)**	**(8,443,946)**	**(8,370,302)**	**(8,235,347)**	**(8,035,411)**	**(7,835,124)**	**(7,634,787)**	**(7,434,724)**	**(7,338,150)**	**(7,249,989)**	**(7,163,753)**	**(7,085,027)**	**(7,014,457)**	**(6,952,726)**	**(6,898,081)**	**(6,846,245)**	**(6,797,528)**	**(6,752,266)**
Unit cost of biomass power generation (excl. CDM project establishment costs; US$/kWh)				**0.121**	**0.122**	**0.122**	**0.124**	**0.127**	**0.131**	**0.135**	**0.135**	**0.135**	**0.134**	**0.134**	**0.134**	**0.134**	**0.134**	**0.134**	**0.134**	**0.134**	**0.134**	**0.134**	**0.134**
IRR (without CER)		-2.1%	**(8,200,000)**	**139,189**	**185,173**	**239,304**	**294,997**	**352,294**	**411,176**	**471,702**	**465,456**	**458,896**	**452,012**	**341,920**	**330,320**	**325,486**	**315,131**	**304,376**	**293,208**	**284,085**	**279,474**	**274,643**	**269,580**

Depreciation (US$)		Depreciation period: 10 years		820,000	820,000	820,000	820,000	820,000	820,000	820,000	820,000	820,000	820,000	0	0	0	0	0	0	0	0	0	0