CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03.1 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

KUNAK BIO ENERGY PROJECT

Version 4.3, 04/03/2007

A.2. Description of the project activity:

The project activity is to install a power generation plant at the TSH Kunak Palm Oil Mill utilising biomass waste for power generation and further export to the electricity grid. This will reduce the grid system's dependency on fossil fuel resources and reduce the emissions of GHG emissions.

The bio energy plant will be fuelled with biomass waste from the existing palm oil extraction process. This biomass is abundantly available and was earlier incinerated, but since the ban on open air burning entered into force the biomass has to be disposed in land fills and to a lesser extent in the plantations.

From the palm oil milling process three types of biomass waste is generated; Fibres, Shells and Empty Fruit Bunches (EFB). In the baseline most fibres and shells are used in the power and steam production at the mill. This process is based on a 25 t/hour steam boiler with low efficiency (70%) in order to use as much of the biomass waste as possible.

The project is to install a highly efficient bio energy plant, where the biomass waste can be used to generate useful electricity and steam, which will not only supply the palm oil mill itself, but also export excess electricity to the electricity distribution grid. The plant will be able to utilise waste products from the milling process such as fibres, shells and Empty Fruit Bunches. There is a significant contribution in reducing the methane emission from the landfills previously used for deposition of biomass wastes.

The CDM project consists of two parts:

1) Export of CO_2-neutral electricity to the electricity distribution grid, where it will replace conventional electricity generation which is highly dependent on fossil fuel in the grid system thereby reducing GHG emission in the electricity grid system.

2) Avoid methane emissions from landfill sites where biomass waste, mainly EFB was deposited.

Electricity will be supplied to Sabah Electricity Sdn. Bhd. (SESB) under a 21-year renewable energy purchase agreement (REPA).

The project is a part of the Government of Malaysia's Small Renewable Energy Programme (SREP), which is to facilitate the development of electricity generation on small scale renewable energy plants. This programme allows electricity export to the grid with a capacity of up to 10 MW_e. In the future up to 5 MW may be sold directly to a nearby industry. This should still be considered as grid connected since the baseline for the industry will be to buy the electricity from the grid.

Environmental sustainability

The project will have a positive impact on the environment as it will reduce power production based on fossil fuels and lead to an increased sustainability in the power generation sector. Furthermore the power plant will be equipped with high-efficient technologies that reduce the fuel consumption per unit output and increase the combustion efficiency. Pollution control equipment will be installed in order to ensure minimum emissions of particulates etc. from the plant.

The project will lead to reduced disposal of waste products from the palm oil mill and increase utilisation the energy content of waste products.

Social sustainability

The power plant will create new jobs in the area since it is a green field project. There will be a need for both skilled and unskilled labour. The workforce will have to be trained to operate the new plant and new qualified staff will be employed.

The Kunak Bio Energy project will contribute to improving the stability of the power supply in the area since the other power production facilities are diesel generators.

The Kunak Bio Energy project will also increase business opportunity for local suppliers in transportation, maintenance and repair, parts supply, food and other services.

Economic sustainability

The project will lead to economic sustainability as the fuel source is a sustainable, indigenous resource, which reduces fuel imports and negative impact on the foreign exchange. The project will also have a positive impact on the economic performance of the palm oil mill as its energy production will become more reliable and efficient, which will enable a more reliable crude palm oil production in general. In a wider scale the Kunak Bio Energy project is an important demonstration project setting a new standard for the palm oil sector.

Additional to a business-as-usual scenario

The project is additional to a business-as-usual scenario as it was the first cogeneration plant fired mainly with EFB from palm oil process to supply electricity to the grid system in Malaysia. The business as usual scenario for the power generation sector is to add capacity based on gas, coal and oil fired units, and this practise is expected to continue in the future.

The business-as-usual for new palm oil mills is still to install a biomass cogeneration plant to produce steam and power for the mills own use, but not for electricity export. Hence the project is additional to both the business-as-usual scenario for the development in the power generation sector and the palm oil industries.

A.3. Project participants:

The project owner is TSH Bio-Energy Sdn Bhd. Contact for the CDM project activity is Finance and Accounting Department, TSH Resources Berhad.

Table A.1: Project participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Malaysia (host)	Private Entity: TSH Bio-Energy Sdn Bhd	No
Switzerland	Private Entity: Climate Cent Foundation	No
United Kingdom	Private Entity: EDF Trading Limited	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.		

Project Owner

TSH Bio-Energy Sdn. Bhd.

TSH Bio-Energy Sdn. Bhd, a subsidiary of TSH Resources Berhad (TSH), will be the project owners and will invest the equity portion of the project.

TSH is a company listed on the Main Board of the Malaysia Securities Exchange Berhad under the Industrial Products Sector. TSH was incorporated under the Malaysian Companies Act, 1965 on 7 August 1979.

The principal activities of TSH are investment holdings and sustainable forest management. The principal activities of its subsidiaries are oil palm plantation, palm oil milling, manufacturing of cocoa products, and manufacture of Ekowood®, engineered solid wood flooring and its distribution in Europe, e.g. the UK, France, Spain, German, and the USA (Collectively referred to as "TSH Group").

TSH Group enjoys an A+ credit rating, which indicates a strong credit standing and has a shareholders' fund worth more than RM200 million. The asset size of the TSH Group is RM360 million.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party (ies):

Malaysia

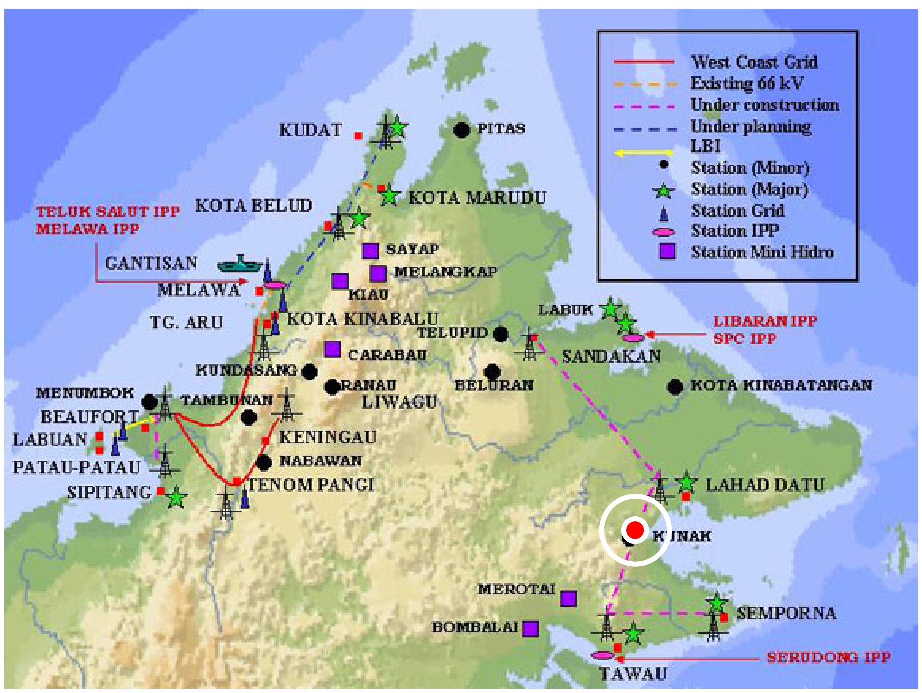
A.4.1.2. Region/State/Province etc.:

State of Sabah

A.4.1.3.	City/Town/Community etc:

Kunak

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):



TSH Kunak Palm Oil, KM 56, Tawau-Kunak Highway, 91000 Tawau, Sabah, Malaysia

The project is located within the premises of the TSH Kunak Palm Oil Mill. The mill itself is located 28km from Kunak town, which is populated with 7000 inhabitants.

A.4.2. Category (ies) of project activity:

The project falls under sectoral scope 01 energy industries - renewable energy.

A.4.3. Technology to be employed by the project activity:

The main components of the cogeneration plant are the biomass fired steam boiler, the turbine and the fuel preparation system.

Biomass fired steam boiler

The biomass steam boiler is very efficient with an expected energy conversion efficiency of 85%. It has an automatic combustion control system that ensures the effectiveness of biomass combustion and control of emission. Emission control is using a multicyclone system and complies with the prevailing emission regulation standards in Malaysia. In fact, the system performs much better than the existing palm oil mill boilers which are manually operated.

The boiler receives dewatered biomass from the palm oil mill and generates steam for electricity generation in the steam turbine.

Steam turbine

The steam turbine receives superheated steam at 50 bar_g, 402ºC from the boiler. It is used to drive a 14 MW_e generator. About 35 tons/h of low-pressure steam is extracted from the turbine for palm oil processing. This steam extraction and electricity generation allows the current inefficient energy system to be decommissioned. The plant is contracted to export a minimum of 64,000 MWh of electricity to the distribution grid every year. In the calculation of the emission reductions an export of 70,000 MWH hours has been used as assumption for the utilisation. That is equivalent to 80% load factor.

Fuel preparation system

The bio energy plant requires a steady supply of biomass. To achieve this objective, a fuel preparation system is designed with storage capacity of up to 7 days. Since the main source of fuel comprises empty fruit bunches which contains about 60% moisture content when it exits from the palm oil mill, a special dewatering facility is incorporated in the design. The fuel preparation station also cut the dewatered fibres into consistent length for ease of feeding into the boiler. The fluid from the dewatering process is channelled back to the palm oil mill where the residual crude palm oil is recovered.

Table A.2 Key data for the project:

Power generation capacity	14 MW_e		
In house power demand	4 MW_e		
Scheduled export capacity	10 MW_e		
	Minimum	**Average**	**Maximum**
Annual export to the grid system	64,000 MWh	70,000 MWh	80,000 MWh
Annual consumption of biomass	253,138 Tonnes	276,869 Tonnes	316,422 Tonnes

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

Table A.3: The total GHG emission reductions are estimated to tCO2eqv over the crediting period.

Years	Annual estimation of emission reductions in tonnes of CO_{2eqv}
Year 2005	17,625
Year 2006	37,322
Year 2007	123,564
Year 2008	152,433
Year 2009	171,784
Year 2010	184,756
Year 2011	193,451
Total estimated reductions (tonnes of CO_{2eqv})	880,935
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_{2eqv})	125,848

A.4.5. Public funding of the project activity:

N/A

SECTION B. Application of a baseline methodology

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

ACM0006: "Consolidated baseline methodology for grid-connected electricity generation from biomass residues" version 04

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

The consolidated methodology ACM0006 is applicable in the following circumstances:

"This methodology is applicable to grid-connected and *biomass residue* fired electricity generation project activities, including cogeneration plants.

The project activity may include:

- The installation of a new biomass power generation plant at a site where currently no power generation occurs (**greenfield power projects**); or
- The installation of a new biomass power generation unit, which is operated next to existing power generation capacity fired with either fossil fuels or the same type of biomass residue as in the project plant (**power capacity expansion projects**); or
- The improvement of energy efficiency of an existing power generation plant (**energy efficiency improvement projects**), e.g. by retrofitting the existing plant or by installing a new plant that replaces the existing plant; or
- The replacement of fossil fuels by biomass in an existing power plant (**fuel switch projects**).

The project activity may be based on the operation of a power generation unit located in an agro-industrial plant generating the biomass residues or as an independent plant supplied by biomass residues coming from the nearby area or a market."

The Kunak Bio Energy Project falls clearly under this definition as:

- The project is **connected to the power grid.**
- The predominant **fuel is biomass waste** from the palm oil mill. Fossil fuels are only used for start up and back up purposes.
- The project **does not affect the production capacity** at the palm oil mill and does not lead to any increase in processing capacity or changes in products.

- The biomass fuel will typically only **be stored up to a week** – and thus far less than the maximum allowed one year of storage.

- The biomass used as for fuel is **not undergoing major pre-treatment** – the empty fruit bunches are only undergoing a de-watering process to improve the fuel properties. The energy needed for the pre treatment is supplied from the biomass energy plant and is thus also CO_2-neutral.

- The project is **a green field power project** because it generates 10MW of power supplying to the grid replacing fossil fuel. No power was produced for sale to the grid before the establishment of Kunak Bio Energy Project.

B.3. Description of how the sources and gases included in the project boundary

Table B.1: Sources and gasses included in the project boundary

	Source	Gas	Remarks
Baseline	Grid electricity generation	CO_2	Yes, by using the calculations prescribed by the ACM006
		CH_4	No, for the purpose of simplification – this is conservative
		N_2O	No, for the purpose of simplification – this is conservative
	Disposal of biomass	CO_2	No, biomass is considered carbon neutral
		CH_4	Yes, methane emissions from previously land-filled biomass waste products are calculated and considered part of the baseline emissions. Methane emissions from waste products used for mulching and as fuels are not calculated. This makes the calculation conservative.
		N_2O	No, for the purpose of simplification – this is conservative
Project	Renewable electricity generation	CO_2	No, biomass is considered carbon neutral
		CH_4	Yes, methane emissions from the utilisation of the biomass as fuel are calculated and included in the project emissions
		N_2O	No, for the purpose of simplification. It is assumed that N_2O emissions will be lower than the present, inefficient system
	On-site fossil fuel for back up and start and stop	CO_2	Yes, the emissions from using fossil fuels for start-ups
		CH_4	No, for the purpose of simplification. It is assumed that CH_4 emissions to be very small.
		N_2O	No, for the purpose of simplification. It is assumed that N_2O emissions to be very small.
	Transportation of biomass and ash	CO_2	Yes, emissions from transportation of biomass residues to the project plant by vehicles
		CH_4	No, for the purpose of simplification. It is assumed that N_2O emissions to be very small.
		N_2O	No, for the purpose of simplification. It is assumed that N_2O emissions to be very small.
	Storage of biomass	CO_2 CH_4 N_2O	No, the biomass will only be stored for a short period of time – up to one week. Emissions will not be different from the emissions from the current storage of biomass waste before final disposal.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The identification of the baseline scenario follows the recommendations in the ACM0006 and the baseline for power generation, heat generation and biomass handling will establish separately.

The evaluated baseline scenarios for **power** generation are summarised in following table B.2

Table B.2 Possible baseline scenarios for power generation

Number	Description	Evaluation
P1	The proposed project activity not undertaken as a CDM project activity	There are significant financial barriers against the implementation of the proposed project without the contribution from CDM. This will dealt with in more detail below.
P2	The proposed project activity (installation of a power plant), fired with the same type of biomass but with a lower efficiency of electrical generation (e.g. an efficiency that is common practice in the relevant industry sector)	The Kunak Bio Energy Project is the first of its kind in Malaysia in supplying electricity to the grid. (And two years after it started operating it is still the only grid connected power plant based on palm oil waste)
P3	The generation of power in an existing plant, on-site or nearby the project site, using only fossil fuels	There has been no plans of establishing other than biomass power production on the site
P4	The generation of power in existing and/or new grid-connected power plants	The power would most likely have been produced by existing or new grid connected power stations in the Sabah grid.
P5	The continuation of power generation in an existing power plant, fired with the same type of biomass as (co-)fired in the project activity, and implementation of the project activity, not undertaken as a CDM project activity, at the end of the lifetime of the existing plant	The existing power stations in the North Sabah grid are all diesel engines or fuel oil fired plant – not being able to utilise the biomass fuels. There are also significant barriers to transport the very bulky biofuels to existing power stations and no off site biomass power stations have been seriously considered.
P6	The continuation of power generation in an existing power plant, fired with the same type of biomass as (co-)fired in the project activity and, at the end of the lifetime of the existing plant, replacement of that plant by a similar new plant	The existing power stations in the North Sabah grid are all diesel engines or fuel oil fired plant – not being able to utilise the biomass fuels. There are also significant barriers to transport the very bulky biofuels to existing power stations and no off site biomass power stations have been seriously considered.

The conclusion for baseline scenario for power production is that P4 is the most likely baseline scenario for electricity delivered to the grid (10 MW) from the Kunak Bio Energy Project.

For **heat generation** the following alternative scenarios have been evaluated.

Table B.3 Possible scenarios for heat generation

Number	Description	Evaluation
H1	The proposed project activity not undertaken as a CDM project activity	Since the biomass resources are plentiful in the project area there is not incentive to increase the boiler efficiency for heat generation without the CDM project.
H2	The proposed project activity (installation of a cogeneration power plant), fired with the same type of biomass but with a different efficiency of heat generation (e.g. an efficiency that is common practice in the relevant industry sector)	The common industry practice is to produce process heat using a low efficiency boiler. This is also the historical situation at the Kunak Palm Oil mill.
H3	The generation of heat in an existing cogeneration plant, on-site or nearby the project site, using only fossil fuels	It is not likely that the palm oil mill would have changed from biomass to fossil fuels for heat generation.
H4	The generation of heat in boilers using the same type of biomass residues	Heat is today produced in boilers using same type of biomass residues. It is most likely that this would have continued in absence of the project.
H5	The continuation of heat generation in an existing cogeneration plant, fired with the same type of biomass as in the project activity.	There is no cogeneration plant at the project site.
H6	The generation of heat in boilers using fossil fuel	It is unlikely that fossil fuels will be used for generating heat due to the readily available biomass residue at the palm oil mill.
H7	The use of heat from external sources, such as district heat	There are no external sources of process steam available in the area.
H8	Other heat generation technologies (e.g. heat pumps or solar energy)	Given the abundance of biofuels available it is not considered likely that other renewable energy sources would become competitive for steam production

The conclusion is that the most likely baseline scenario for the delivery of process steam for the palm oil mill would be H4 – continuation of the use of existing biomass fired boilers with low efficiency. The heat generation from the Kunak Bio Energy Project is thus NOT included in the CDM project.

The evaluated baseline scenarios for the **use of biomass** are summarised in the table B.4 below

Table B.4 Possible baseline scenarios for use of biomass

Number		
B1	The biomass is dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes	Most of the empty fruit bunches are left to decay in a dumpsite of > 5 meters depth in a ravine near the palm oil mill
B2	The biomass is used for heat and/or electricity generation at the project site	Biomass needed for the steam production for the palm oil mill is used as fuel in the existing palm oil mill
B3	The biomass is used for power generation, including cogeneration, in other existing or	The existing power stations in the North Sabah grid are all diesel engines or fuel oil

	new grid connected power plants	fired plant – not being able to utilise the biomass fuels. There are also significant barriers to transport the very bulky biofuels to existing coal fired power stations in Peninsular Malaysia for co firing. No such projects have been seriously considered.
B4	The biomass is used for heat generation in other existing or new boilers at other sites	There is an abundance of biomass resources from the palm oil mills so there is much less demand from the industry in the area
B5	The biomass is used for other energy purposes, such as the generation of biofuels	The technologies for using the EFB, fibre and shell for generation of biofuels such as ethanol are still not developed to a commercial scale. There have only be laboratory experiments and there may be opportunities in a long term, but they are not available today
B6	The biomass is used for non-energy purposes, e.g. as fertilizer or as feedstock in processes	Some of the empty fruit bunches have been used for mulching in the plantations. The typical application is 40 t EFB/ha/year and TSH has 200 ha of plantation in the Kunak area where mulching is possible.

The baseline scenario for the use of biomass consists of a number of different applications including fuel for the steam needs of the palm oil mill, mulching in the plantation and dumping at a dumpsite. The following tables quantify the baseline application of the biomass waste from the palm oil mill:

Table B.5 Annual generation of biomass waste from the Kunak palm oil mill

	Abr.	Moisture	Fraction	Production	Lower Heating Value	Annual energy
		% m.c.	of FFB	t/year	GJ/ton	TJ
Fresh fruit bunches	FFB	50.5%	100.0%	290,000	12.4	
Empty fruit bunches	EFB	60.0%	23.0%	66,700	5.3	354
Mezocarb fibres		37.0%	12.7%	36,830	11.1	409
Kernel shells	PKS	12.0%	5.7%	16,443	17.3	284
Kernels	PK	12.7%	5.4%	15,544	21.1	
Crude Palm Oil	CPO	0.1%	19.8%	57,275	39.3	
Effluent	POME	93.0%	60.0%	174,000	-	
Total		-	126.5%	366,792	-	1,047

(Main source: "Danida/PTM 2005: Renewable Energy Resources" that can be downloaded from www.eib.org.my. Heating value for EFB recalculated to match local conditions.)

The reason for the total amount of products and waste products to be higher than 100% of the incoming Fresh Fruit Bunches (FFB) is that a significant amount of water is added during the process. This water is mainly found in the palm oil mill effluent (POME). The products from the palm oil mill consist of the Crude Palm Oil and the Palm Kernels. The waste products that can be used as fuels include the EFB,

mesocarb fibres and the palm kernel shells. The total energy content of the biomass waste amounts to 1047 TJ.

Energy needs in the baseline
In the baseline scenario, a 25t/hour boiler was used supplying a maximum of 25t/hour steam to the Kunak Palm Oil Mill. Given a total steam need of 25t/hour and the energy need of 2.702 GJ/t steam (the evaporation heat) this leads to an energy need of 67.6GJ/hour. With a boiler efficiency of 70%, the energy need from steam production is 96.5GJ/hour. With 6570 full load hours (75% of max load), the total energy need is 634 TJ per year.

This fuel need was covered by the palm kernel shells (PKS) and the mesocarb fibre. To reach the 634 TJ needed, the fuel required is all the PKS (284 TJ) and most of the mesocarp fibre (350 TJ). This leaves 5,340 t/yr mesocarb fibres for dumping.

Energy needs in the project case
In the project a 80t/hour new boiler will be used to generate superheated steam at 50 barg 402 degree Celcius to drive a 14MW generator (steam turbine) to generate electricity. Subsequently, about 35 tonnes per hour of low pressure steam is extracted from the steam turbine for the Kunak Palm Oil Mill processing and 45 t steam/hour will be channelled to the condenser.

The fuel need for the new boiler is 260 GJ/hour based on 80 t steam per hour. This leads to an energy need of 3.25 GJ/t steam for the super heated steam. The measured steam need per MWh at the Kunak mill is 6.02 t steam/MWh. Subsequently the energy need per MWh power produced is (6.02*3.25) 19.565 GJ/MWh.

With an annual production of 98,000 MWh (14 MW*7000 hours) the total energy need will be 1917 TJ/year. This is an increase of (1917 – 634 TJ) 1283 TJ per year compared to the baseline.

The total amount of biomass waste produced from the Kunak palm oil mill is calculated in table B5 to be 1047 TJ. As the total of biomass fuel needed is 1917 TJ/year and the Kunak palm oil mill can only supply up to 1047 TJ, the lacking amount of biomass fuel is 870 TJ to be imported from other palm oil mills. With an expected mix of the fuel in the biomass boiler of 60% EFB, 25% fibre and 15% palm kernel shells, the import need will be 156,896 t biomass wastes of which 150,360 t will be EFB.

Use of EFB for mulching
It is common practice in palm oil plantations to use the EFB as fertiliser and leave it for mulching in the plantation. This is left in a layer of less than 0.5 meters, so the degradation is expected to be mainly aerobic. The application in TSH plantation is 40 t EFB/ha/year. The total area of plantation where EFB was used for mulching is around 200 ha. Thus, 8,000 t EFB/year is used for mulching in the baseline scenario. Not all areas of the plantation are suitable for mulching, for example hilly areas are not being suitable for mulching.

The biomass wastes not used for energy purposes or for mulching are deposited at a local dumpsite as open burning is prohibited by Malaysian law.

Summary of the utilisation of biomass waste in the baseline scenario

Table B.6 Summary of baseline scenario for utilisation of biomass waste

t/year	Annual production at Kunak mill	Import	Total Fuel Required
Mesocarb Fibre	36,830	6,354	43,184
Palm Kernel Shells	16,443	182	16,625
EFB	66,700	150,360	217,060
Total	119,973	156,896	276,869

t/year	Total Fuel Required	Use as fuel in baseline	Mulching in baseline	Dumpsite in baseline
Mesocarb Fibre	43,184	31,490	0	11,694
Palm Kernel Shells	16,625	16,443	0	182
EFB	217,061	0	8,000	209,061
Total	276,869	47,933	8,000	220,936

The estimated total fuel consumption in the Kunak Bio Energy plant is 276,869 t biomass per year. To be conservative there will only be claimed methane avoidance for the EFB deposited in the baseline and not for the fibre and shell.

Summary of choice of scenario
The project belongs to scenario 3 in the ACM0006 – a greenfield project – since no power was produced for sale to the grid before the establishment of the Kunak Bio Energy Project. This is consistent with the combination of baseline options P4, H4 and B1 + B4. The production of power and heat for the use at the palm oil mill is kept outside the project boundary since it was produced using biomass waste also in the baseline scenario. This is a conservative assumption since the efficiency of the boiler is improved compare to the baseline situation.

For the biomass baseline 220,936 t of the biomass used for the boiler would have been dumped in the baseline, while the 47,933 t would have been used as fuel in the existing boiler and 8,000 t would have been used as fertiliser in the palm oil plantations. For the calculation of the avoided methane emissions only the 209,061 t of EFB will be used.

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 CDM project activity (assessment and demonstration of additionality):

This section elaborates the additionality of this project. The consolidated additionality assessment tool approved by the UNFCCC CDM Executive Board was used. The additionality test includes the following steps:

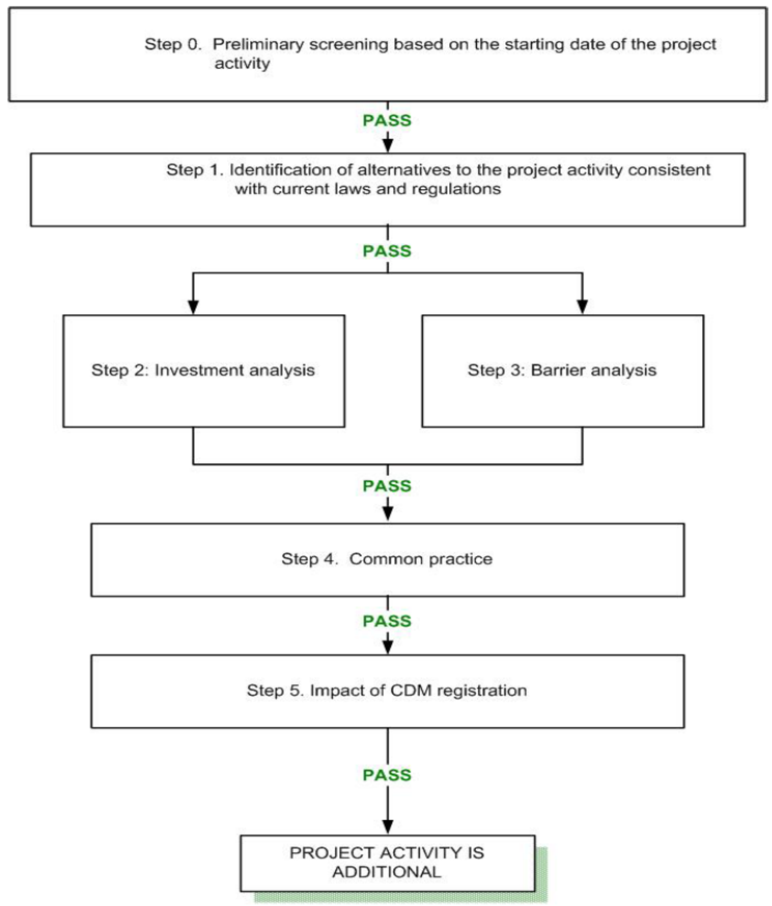


Figure B.1: Consolidated Additionality Assessment Tool Steps

(Source: UNFCCC CDM EB. (2006 "Tools for demonstration and assessment of additionality.)

Each step of the assessment of additionality for the project activity is elaborated below:

Step 0: Starting date

The project activity was commissioned by January 01, 2005. The project was seriously considering use of the CDM well ahead of the commissioning date since the first application for national approval (including a Project Idea Note) was submitted already in September 2002.

First agreement with a buyer from an Annex 1 party was signed in April 2003 and the first conditional letter of national approval was given in August 2003. The first PDD was validated in 18 June 2004 and final national approval was given in December 2004. All this happened before the plant was commissioned.

The first PDD was submitted for registration on December 2, 2005. Due to commercial reasons in relation to the buyer of the CERs this first PDD was withdrawn in 22 December 2005.

A revised PDD was validated in 22 November 2005 and given final national approval on 04 July 2006.

The present PDD represents the third version of the PDD. A new PDD was developed because the first versions did not take into consideration the methane avoidance from the landfill. The project is exactly identical through the different versions.

The project thus clearly complies with the requirements in the additionality tool to: "Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and/or other corporate) documentation that was available at, or prior to, the start of the project activity".

Further the project want to claim retroactive carbon credits from the start of project operations on January 1st 2005 for the emission reduction from the power grid. These emission reductions were included in the originally validated PDD. These emission reductions amount to 17,486 t CERs for 2005 and 36,812 t CERs for 2006 (See detailed calculations in Annex 5).

The project qualifies for retroactive credits since it fulfils the criteria:

a) The starting date of the project must be between 1 January 2000 and 18 November 2004
Project construction started in August 2003 and is thus clearly with the time limits.

b) The PDD must have been submitted for validation before 31. December 2005
The first validation report was dated 18. June 2004 and the project submitted for registration on 2. December 2005 (but later with drawn because of a commercial dispute). Both these dates are before the 31. December 2005.

c) The project must be submitted for registration before 31 March 2007.
This is also expected to be achieved.

Step 1: Identification of alternatives consistent with laws and regulations

The different baseline scenarios are discussed in great detail in the paragraphs above. The discussion boils down to two main alternatives i.e.

- The baseline scenario including on site production of steam and power for own use and the depositing in a dumpsite of most of the biomass waste. It is worth noticing that a (technically) possible scenario of uncontrolled burning of the EFB would be illegal according to Malaysian law and that the Department of Environment are imposing serious fines for breaking that ban.
- The project scenario where 10 MW power is produced for export to electricity grid and all biomass waste is burned under controlled conditions in a modern boiler.

Step 2: Investment analysis

2a Choice of analytical method

The "Tools for demonstrating and assessment of additionality" suggests three options for an investment analysis in the additionality assessment: Simple investment analysis, Investment comparison analysis and Investment Benchmark analysis. Since the project has an additional source of revenue (sale of electricity to Sabah electricity) compared with the baseline, the simple investment analysis can not be used and since

there is only one alternative in the financial analysis the investment comparison analysis is not relevant. The remaining method is the Investment Benchmark Analysis.

2b Investment Benchmark Analysis

The palm oil sector is generally very profitable. There are a large number of profitable investments to be made in the sector both upstream (in plantations and palm oil mills) and downstream - in processing of Crude Palm Oil to more refined products including vitamins, nutraceuticals, functional foods and bio diesel. In the internal comparison of investment options the Internal Rate of Return (IRR) is often used as benchmark. Here the project IRR is used.

The abundance of attractive investment options means that the expectations for IRR in the projects is usually high compared to other sectors. Expectations of IRR of 20% are not unusual[1]. Here it is chosen to use 15% IRR as a reasonable benchmark for the palm oil sector.

The most important assumptions are shown in the table. The input assumptions are relatively certain since the project has already been implemented and the power purchase agreement signed. This locks the main parameters. The calculation of IRR is shown for a ten years period.

Table B.7 Main assumptions for financial analysis

Parameter	**Value**
Capital costs	50,412,000 MYR
Power price (fixed for 20 years)	0.2125MYR/kWh
Fixed Operating Costs (year 1)	2,420,000 MYR
Interest rate for loan financing	7 % per year
Inflation	3 % per year
CER price	10 Euro/t CER

The actual cost and income data for 2005 and 2006 have been included in the IRR calculations. With 7000 full load hours the IRR is 4.5% without CDM and 17.7% with CDM. This shows that for the basic project scenario is the IRR significantly below the benchmark of 15% and the inclusion of CDM brings the IRR above the benchmark.

2c Sensitivity analysis
For the sensitivity analysis the main uncertainty is the amount of power produced from the project. For sensitivity the IRR is also shown for 4000 full load hours (load factor 45%), 6400 full load hours (load factor 73%) and 8000 full load hours (91% load factor). The latter is very close to the theoretical maximum production of the plant taking into account the need for periodical maintenance of the plant.

[1] Ministry of Water, Energy and Communication / Malaysia Energy Centre / DANIDA. 2005. Study on the CDM Potential in Waste Sectors in Malaysia. (Unpublished).

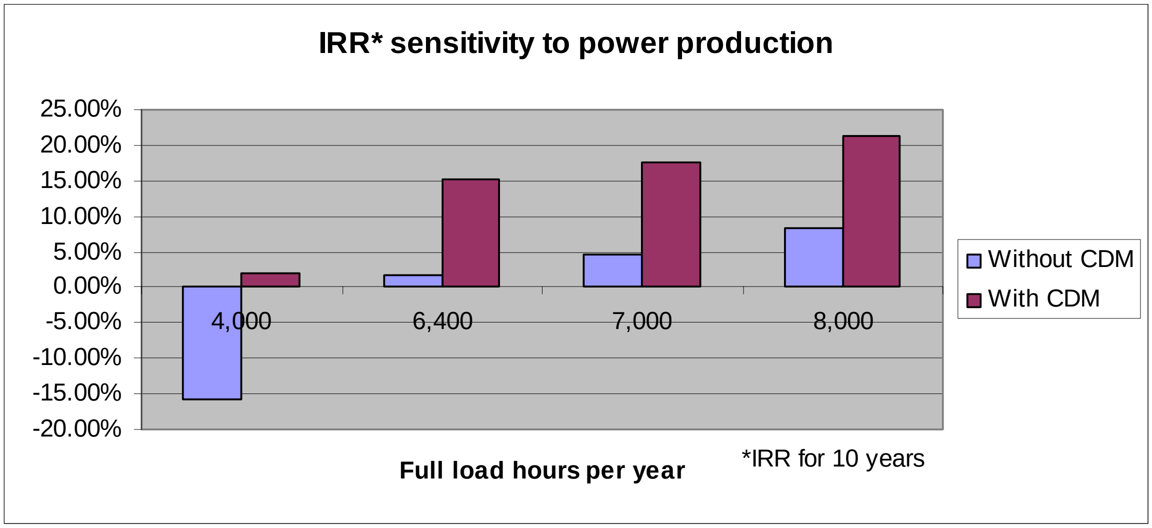


Figure B.2: Sensitivity analysis of the IRR of the Kunak Bio Energy Project

The conclusion of the financial analysis is that the IRR is very sensitive to the annual power production. For all analysed cases is the IRR below 10%. This is clearly below the investment barrier. Even in the event of a maximum production the IRR at 8.5% is well below the level of the benchmark of 15% IRR. In the case of reduced production the IRR falls below zero and the project becomes unviable with out CDM.

The income from CDM contributes significantly to increase the IRR towards the investment benchmark with 6400 full load hours being the minimum to achieve the investment benchmark of 15%. The income from CDM also secures that the IRR stays positive in the low production case.

If the IRR is calculated for 20 years in the base case of 7000 full load hours the result is 11.2% without CDM and 22.0% with CDM. Even with 20 years investment horizon is it necessary with the income from sale of CERs to make the project viable.

There is thus no doubt that the income from CDM has a significant impact of the viability of the project and that the project would not be able to achieve the benchmark IRR without the extra income from the sale of CERs.

Step 3: Barrier assessment

Almost all palm oil mills in Malaysia have their own power plant to supply electricity and steam for the milling process. Most mills are located away from the electricity generation grid system, so in general own power generation has been cheaper than electricity supply from the grid.

The power plants dedicated to the palm oil milling process are mainly fuelled with the fibres and shells and only a few are using the empty fruit bunches as this requires an additional dewatering process to reduce the water content of the fuel. Furthermore the available amount of fibres and shells in a palm oil mill is more than sufficient for the generation of the required power and steam. In fact most mills have abundant waste biomass and operate power plants at low efficiencies to be able to burn the shells and fibres to reduce the need for waste disposal.

The project activity was the first project in Malaysia to utilise all the biomass waste products from the palm oil milling process, including empty fruit bunches, for generation of power and steam and supply excess electricity to the electricity grid system.

Sub-step 3a: Barriers that would prevent the implementation of type of the proposed project activity

Investment barrier

The project is a pioneer in utilisation of waste from palm oil mills for electricity supply connected to the grid. It is part of the Small Renewable Energy Programme launched by the Malaysian government to facilitate interconnection of small power producers to the grid system. However, there are currently only very weak incentives for these small power producers to offset the generally higher costs of renewable energy production as compared to conventional power production based on fossil fuel.
Some of the investment barriers are:

- The renewable energy purchase agreement (REPA) has a fixed price for 21 years of supply and this price is not indexed. This means that the effective price of electricity sold to the grid from the bio-energy plant will decline over time.
- The cost of biomass fuel is low at the moment, as the renewable energy market is limited. If the market for renewable energy increases in Malaysia or other uses of the waste emerge, the costs of production increases as a result of the sacrifice of alternative revenues for the project owner.
- There are no special grant schemes available in Malaysia for renewable energy projects and the project has to be finance on the behalf of the financial strength of the project owner.
- The project uses new technologies that have not been implemented in Malaysia before. The technological risk is higher than conventional projects as the know-how and support facilities in manufacturers etc. will be established together with the project.

The above barriers leads to an investment barrier and increased risk for the project owner compared to establishing a conventional power plant for his palm oil mill.

Technological barrier

The project was the first of its kind in Malaysia utilising a high pressure boiler fired with biomass from the palm oil mill for export of electricity to the grid. The boiler was manufactured through a joint venture between a local and a Danish company. Parts of the boiler will be manufactured in Denmark, while the bulk of the work, including assembly, took place in Malaysia supervised by the Danish partner. The project has lead to technology transfer and increasing the manufacturing capacity of more efficient, high pressure boilers in Malaysia.

- As the technology is not readily available in Malaysia and the capacity to design and manufacture does not exist, there is a technology barrier that leads to higher risk and higher costs for the project than in a situation where conventional technologies was to be used. This risk is very real as the production of the Kunak Bio Energy plant in the first year was significantly below expectations.
- The prevailing practice in the palm oil industry is to use shell and fibres for steam generation. Empty fruit bunches are more difficult to utilise as they have to be dewatered and shredded before they can be used as fuel. The technology to prepare the empty fruit bunches is new. The large scale dewatering technology has not been used in Malaysia before and forms a certain technological risk for the project.

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

The investment and technology barriers mentioned above do not apply to the baseline scenario consisting of a low efficiency boiler for steam production, landfilling of the biomass wastes and production of power by utility owned diesel generators.

The barrier formed by the terms of the REPA is not relevant to a utility owned plant since the utility is financing the CAPEX and OPEX from the internal sources. The technology is well-known globally, readily available and the financing is done more on the utility balance sheet that through project financing.

The use of low efficiency biomass boilers is the common practise in the palm oil sector. The technology is thus readily available and the operational risks known and low compared to a high efficiency boiler. The low efficiency boiler at the same time only have to rely on the most "easy" of the available fuel sources, fibre and shells. The investment costs are lower for this solution and financing is thus not a barrier.

Landfilling is the de facto accepted way of disposing of the biomass wastes from the palm oil mills after the ban on open burning and the policy to avoid incinerators for destruction of the waste. The waste products are deposited in ravines or other available space close to the mill. The investment costs are almost zero for such solutions and the operational costs reduced to short truck drives.

Step 4: Common practice

Sub-step 4a: Analyze other activities similar to the proposed project activity:
It is common among palm oil mills to utilise part of their biomass wastes (mainly kernel shells and fibre) in low efficient boilers to supply steam and in some case power for the plants own needs. There are no official statistics for this use of biomass since it is not entering the market.

The Kunak Bio Energy Project goes clearly beyond the business as usual in the palm oil sector by investing in a high efficient boiler dedicated to supplying electricity to the grid. The Kunak Bio Energy project was the first of its kind in Malaysia.

In the Eight Malaysia Plan covering the period 2001-2005 the Malaysian Government has in principle embraced a Fifth Fuel Policy introducing renewable energy as a new fuel for the power sector to supplement the existing fuel sources coal, natural gas, oil and hydro. The incentives put in place to implement the policy through the so called Small Scale Renewable Energy Programme (SREP) were not sufficient to get any significant implementation of biomass projects. In fact only two projects were implemented by the end of 2005[2]. The Kunak Bio Energy Project and a landfill gas project.

It is thus very clear that the Kunak Bio Energy Project has been a deviation from the common practice in the palm oil industry.

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[2] Economic Planning Unit (2006): Ninth Malaysia Plan, Chapter 19: Energy

Sub-step 4b: Discuss any similar options that are occurring
As mentioned in 4a there are no other similar projects to Kunak Bio Energy plant. Still in late 2006[3] there are no other SREP projects grid connected than the two abovementioned. A few projects are now under development but that is only based on the availability of extra revenues from CDM.

Step 5: Impact of registration of the CDM project

As described under step 2 the income from sale of CERs have an important influence on the financial viability of the project. The IRR increases with more than 10%-point in the base case and brings the IRR above the investment benchmark. The contribution from CDM is even more pronounced in reducing the risk from years with lower production than the expected.

The CDM has thus had a significant impact on the viability of the Kunak Bio Energy Project and can be said to have had a major importance for the implementation of this ground breaking project.

Summary

It can be concluded that there are significant barriers to implementing small scale biomass power plants in Malaysia. That is shown for the Kunak project in step 2 and 3 and it is strongly supported by the fact that the Kunak project was the first of this type of projects being implemented in Malaysia. The development of the Kunak project as CDM project was instrumental to make the project viable.

It can thus be concluded that the Kunak Bio Energy Project is additional to what would have happened in the absence of the CDM.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The first methodological choice is to decide on the appropriate baseline methodology. Here it is chosen to use the ACM0006. Justification for the choice is given under B2.

Second choice is the baseline scenario which is described in detail in B4 above. The conclusion is that this project should be evaluated under scenario 3:

"*The project activity involves the installation of a new cogeneration plant at a site where currently no power generation occurs. The power generated by the project plant is fed into the grid or would in the absence of the project activity be purchased from the grid. The biomass would in the absence of the project activity (a) be used for heat generation in boilers at the project site and (b) be dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes. This may apply, for example, where the quantity of biomass that was not needed for heat generation was dumped, left to decay or burned in an uncontrolled manner prior to the project implementation*"

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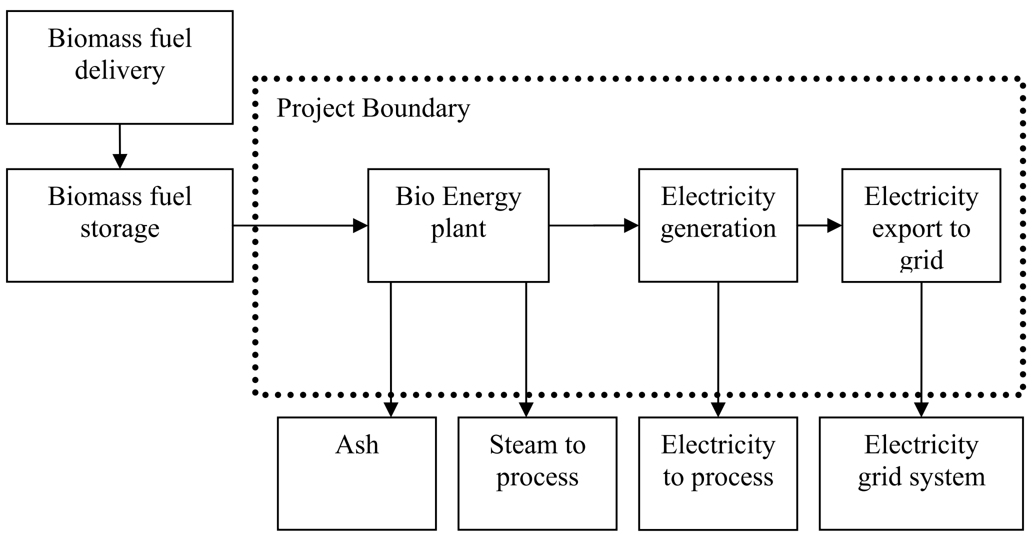
[3] Speech the Minister of Energy, Water and Communication at the "National Renewable Energy Forum" September 21, 2006. Can be downloaded from the ministry homepage www.ktak.gov.my

This scenario is relevant since the existing production of heat and power for own use at the palm oil mill is left out of the project boundary.

According to the applied methodology, the project boundary encompasses the physical and geographical site of the renewable generation source.

The physical site is the bio-energy plant itself, incl. fuel feeding system, boiler system and steam turbine and generation system. The first interface of the project boundary is at the fuel feeding system, so fuel storage system is excluded. Another interface is the ash and waste water disposal. The third interface is the connection point to the electricity grid, where electricity is exported to the grid system, which forms the baseline boundary.

Figure B.3: Project Boundary



The emissions generated within the project boundary occur from the combustion of the biomass fuel. As this is a renewable energy source the CO_2 emissions are defined as being zero. Biomass energy sources emit an amount of CO_2, which equals the amount of CO_2 taken up during the growing of the biomass source and CO_2 emission is therefore neutral.

The emission reductions in the year, y, will be calculated using the formula (1) in the ACM0006:

$$ER_y = ER_{heat,y} + ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y \quad \textbf{(1)}$$

Where:

ER_y are the emissions reductions of the project activity during the year y in tons of CO_2,

$ER_{electricity,y}$ is the emission reductions due to displacement of electricity during the year y in tons of CO_2,

$ER_{heat,y}$ are the emission reductions due to displacement of heat during the year y in tons of CO_2,

$BE_{biomass,y}$ are the baseline emissions due to natural decay or burning of anthropogenic sources of biomass during the year *y* in tons of CO_2 equivalents,

PE_y are the project emissions during the year *y* in tons of CO_2, and

L_y are the leakage emissions during the year *y* in tons of CO_2.

Emission reductions from heat

$ER_{heat,y}$ is set to zero, as process steam was also produced by biomass in the baseline scenario.

Project emissions

Project emissions include CO_2 emissions from transportation of biomass to the project site (PET_y) and CO_2 emissions from on-site consumption of fossil fuels due to the project activity ($PEFF_y$) and, where this emission source is included in the project boundary and relevant, CH_4 emissions from the combustion of biomass ($PE_{Biomass,CH4,y}$):

$$PE_y = PET_y + PEFF_{CO2,y} + GWP_{CH4} \cdot PE_{Biomass,CH4,y} \quad \textbf{(2)}$$

Where:

PET_y are the CO_2 emissions during the year *y* due to transport of the biomass to the project plant in tons of CO_2,

$PEFF_{CO2,y}$ are the CO_2 emissions during the year *y* due to fossil fuels co-fired by the generation facility in tons of CO_2,

GWP_{CH4} is the Global Warming Potential for methane valid for the relevant commitment period,

$PE_{Biomass,CH4,y}$ are the CH_4 emissions from the combustion of biomass during the year *y*.

Biomass fuel transportation:

The bio energy plant will consume biomass fuels, partly from the adjacent Kunak Palm Oil Mill, partly from other palm oil mills in the region.

Each truck will transport an average of 20 tons of palm oil waste to the Kunak Bio Energy Plant with a fuel use of 39 liter diesel/100 km. The total amount of biomass used for the CDM project is 276,869 t biomass fuel per year. Of these the 119,973 t/year will supplied from the Kunak Palm Oil mill. The remaining 156,896 t biomass will be imported from other palm oil mills.

The formula to calculate the emissions from the transport is

$$PET_y = \frac{\sum_k BF_{k,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2,y} \quad \textbf{(2a)}$$

Where,

PET_y = CO_2 emissions during the year y due to transport of the biomass residues to the project site (t CO_2/year)

TL_y = Average truck load of the trucks used (tons) during the year y

$BF_{k,y}$ = Quantity of biomass residue type k combusted in the project plant during the year y (tons)

AVD_y = Average round trip distance (from and to) between the biomass residue fuel supply sites and the site of the project site during the year y (km)

$EF_{km,CO2,y}$ = Average CO_2 emission factor for the trucks measured during the y (t CO_2/km)

With 156,896 tons of biomass waste that will be imported to the Kunak Mill to be used as fuel annually ($BF_{k,y}$) and average 20 ton per truck (TL_y), it will be 7845 trips to bring fuel to the project site. The average distance to the palm oil mills is 63 km, so the round trip will be 126 km. This is the actual value for 2006 (AVDy = 125 km). With an efficiency of 39 litre diesel per 100 km then the fuel use per km will be 0.39 litre. The emission of CO_2 from one litre of diesel is 2.7 kg/l (calculated from IPCC default values for diesel). That leads to an emission factor of 1.053 kg/km ($EF_{km,CO2,y}$= 0.001053 t/km)

PETy = 156,896/20 *126*0.001053 t CO_2/year = 1041 t CO_2/year.

Transportation of ash:

Ash is a waste product from the bio energy plant and is to be transported back to the plantations as potash for application to the field. This will be done by trucks and result in emission of CO_2 from the combustion of diesel oil. These emissions are handled in the preceding calculations because the transport of the fuel is calculated as return trips. The ash will be brought back to the plantations in these return trips. There will much less ash than EFB so the transport needs will be even less than the return trips.

Use of fossil fuels

Fossil fuels are only expected to be used as start-up and backup fuel for the biomass plant. The actual diesel use in 2006, 82,992 litre, is used as estimate for the following years. This is conservative assumption since the operation pattern in 2006 was still affected by the initial technical difficulties. The operation in the year to come is expected to be using less diesel. The diesel consumption will be monitored and the Project emissions will be calculated as:

$$PEFF_y = \sum FF_{project\ plant,i,y} \cdot COEF - \sum FF_{baseline} \cdot COEF$$

Where:

$FF_{project\ plant,i,y}$ is the quantity of fossil fuel type *i* combusted in the biomass power plant during the year *y*,

$\sum FF_{baseline}$ is the average of diesel consumed in the three years before the Kunak Bio Energy Plant was commissioned (see table above)
And

$COEF_{CO2,i}$ is the CO_2 emission factor of the diesel. The emission factor for diesel is calculated as 2.7 kg CO_2/litre.

The emissions from use of diesel for back up in the baseline ($\sum FF_{baseline}$) is thus 82,992*2.7/1000 = 224 t CO_2 per year.

Methane emissions from burning of biomass

The combustion of biomass can lead to methane emissions. The formula for calculating the emissions is:

$PE_{Biomass,CH4,y} = EF_{CH4} \cdot \sum BF, \cdot NCV$
where:

$BF_{i,y}$ is the quantity of biomass type *i* used as fuel in the project plant during the year *y* in a volume or mass unit,
NCV_i is the net calorific value of the biomass type i in terajoules (TJ) or MWh per mass or volume of biomass,
EF_{CH4} CH_4 emission factor for the combustion of biomass in the project plant tons CH_4 per TJ or MWh.

The amount of methane emission from energy production based on biomass is set at a level of 30 kg/TJ according to the default value in the 2006 IPCC guidelines. According the ACM006 the level of uncertainty for such emissions is 300% and therefore a conservativeness factor of 1.37. The value used in the formula will thus be 41.1 kg/TJ. The energy used in the plant will be 1917 TJ/year (see calculation on p 15) and this will amount to a total of 1655 tonnes CO_{2eqv}/year.

The emission of N_2O is assumed to be minor and is not considered in the calculations.

Emission Reductions from electricity production

The emission reductions from electricity production to the grid are calculated from the following formula:

$ER_{electricity,y} = EG_y \cdot EF_{electricity,y}$ **(8)**

Where:

$ER_{electricity,y}$ are the emission reductions due to displacement of electricity during the year *y* in tons of CO_2,

EG_y is the net quantity of increased electricity generation as a result of the project activity (incremental to baseline generation) during the year *y* in MWh,

$EF_{electricity,y}$ is the CO_2 emission factor for the electricity displaced due to the project activity during the year *y* in tons CO_2/MWh.

As the electricity production is less than 15 MW the ACM0006 allows to calculate the $EF_{electricity,y}$ by using an average Operating Margin as defined in ACM0002 – step 1 d). The carbon emission coefficient is determined by the emissions from the electricity generation in the grid system that the bio-energy plant is to export its electricity to.

The Sabah electricity grid system consists of two major grids; the West Coast Grid and East Coast Grid. The project will be connected to the East Coast Grid, which was commissioned in 2003 and interconnects the cities of Tawau, Semporna and Sandakan (See map in A.4). The supply to the grid is solely from diesel or fuel oil fired power plants.

The base years for the calculation are 2002-04, for which the latest statistics are available. Information has been obtained from SESB (Sabah Electricity Sdn. Bhd).

Table B.8 Power stations and fuels in Sabah

No	Area	Technology	Fuel Type	Capacity [MW]	Annual Generation [GWh]	CO_2-emission $[tCO_2]$[1]
1.	Tawau	DG/GT	Diesel	64.5	110	88,000
2.	Sandakan	DG/GT	Diesel	73	12	9,600
3.	Kunak	DG	Diesel	6.6	17	13,600
4	Lahad Datu	DG	Diesel	31.6	138	110,400
5.	Kota Kinabatangan	DG	Diesel	3.5	9	7,200
6.	Sandakan	DG	MFO	60	290	232,000
7.	Sandakan	DG	MFO	34	126	100,800
Total				273	702	561,600

[1] The emission coefficient for the grid system is obtained from Table I.D.1 in appendix B, which prescribes emission factors for diesel generator systems. The system is supplied by power plants with a capacity higher than 200 kW and the table prescribe an emission coefficient of 0.8 $kgCO_{2eqv}/kWh$.

The table above shows that all units connected to the transmission grid are either diesel or medium fuel oil fired. It is considered that all or some of these units will be in operation for at least the crediting period and that the project activity will displace diesel fired units throughout the crediting period. The baseline is therefore static for the crediting period using an emission coefficient of 0.8 kg CO_{2eqv}/kWh. This is in accordance with the national power sector baseline study undertaken by Pusat Tenaga Malaysia in collaboration with TNB, SESB, Energy Commission etc.[4] [5]

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[4] PTM April 2006: Study on grid connected electricity sector baselines in Malaysia

[5] PTM in January 2007 confirmed in a letter that data for 2005 is not yet available (Annex 8)

The project proponent has chosen to use ex-ante calculation of the power baseline (in accordance with ACM0002 version6) based on the latest 3 years of available data.

EG_y corresponds to the net quantity of electricity generation exported to the grid from in the project plant ($EG_y = EG_{project\ plant,y}$)

Baseline emissions due to natural decay of the biomass in a dumpsite

The EFB and parts of the fibre used as fuel in the Kunak Bio Energy Plant would have been deposited in a dumpsite as described in B4 above. The method to calculate the emissions is given in the "*Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site*"**.**

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x-1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-kj\cdot(y-x)} \cdot (1-e^{-kj})$$

Where:

$BE_{CH4,SWDS,y}$ = Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity of the end of the year y (tCO_2e)

φ = Model correction factor to account for model uncertainties (0.9)

f = Fraction of methane captured at the SWDS and flared, combusted or used in another manner. In this case this value is zero.

GWP_{CH4} = Global Warming Potential (GWP) of methane, valid for the relevant commitment period. The present value is 21.

OX = Oxidation factor (reflecting the amount of the methane from SWDS that is oxidised in the soil or other material covering the waste). In the present case this is zero.

F = Fraction of methane in the SWDS gas (volume fraction) (default 0.5)

DOCj = Fraction of degradable organic carbon (by weight) in the waste type j

DOCf = Fraction of DOC that can be decompose (IPCC default 0.5)

MCF = Methane Correction Factor (fraction – see table below)

Wj,x = Amount of organic waste type j prevented from disposal in the SWDS in the year x (tonnes)

k j = Decay rate for the waste type j

j = Waste type distinguished into the waste categories. In the present project there is only one waste type: palm oil mill biomass waste

x = Year during the crediting period: x runs from the first year of the first crediting period (x-1) to the year y for which avoided emissions are calculated (x=y)

y = Year for which methane emissions are calculated

The MCF is determined from the IPCC 2006 guidelines for waste after the following table:

Type of site	**Methane correction factor (MCF) default values**
Managed	1.0
Unmanaged – deep (≥5m waste)	0.8
Unmanaged – shallow (<5m waste)	0.4

Table B.9: IPCC default values for the methane correction factor (MCF)

In the present case the dumpsite is unmanaged and > 5 meters deep. Therefore the MCF to be used is 0.8.

For determining the decay constant k the guidance from IPCC 2006 is suggested as described in the table B.10 below.

Table B.10: IPCC (2006) Default values for the decay factor

Data / Parameter:	k_j
Data unit:	-
Description:	Decay rate for the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 3.3)

Waste type *j*		**Boreal and Tenperate (MAT<20ºC)**		**Tropical (MAT>20ºC)**	
		Dry (MAP/PET<1)	**Wet (MAP/PET>1)**	**Dry (MAP<1000m m**	**Wet (MAP> 1000mm**
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
	Wood, wood products and straw	0.02	0.03	0.025	0.035

Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0.06	0.185	0.085	0.40

NB: MAT – mean annual temperature, MAP – Mean annual precipitation
If a waste type, prevented from disposal by the proposed CDM project activity, can not clearly be attributed to one of the waste types in the table above, project participants should choose among the waste types that have similar characteristics that waste type where the values of DOC_j and k_j result in a conservative estimate (lowest emissions), or request a revision of / deviation from this methodology.

Malaysia clearly qualifies under the tropical, moist and wet conditions. The mean annual temperature is around 26 degrees and the mean annual precipitation is 2000-4000 mm depending on location, both above the benchmarks of MAT of 20 degrees and MAP of 1000 mm.

There are only limited data for the degradation of the EFB in landfills, most analysis are for aerobic conditions – like Rosnani et al. from laboratory data that showed the decay of half the EFB volume in 15 weeks in a controlled experiment[6]. This is much faster than the implied half life of the decay rate for food waste of 0.4 (k = ln(2)/t1/2) of 1.7 years. The fast decay rate for EFB is linked to a number of factors such as high moisture content, high content of cellulose and hemi-cellulose and a remaining content of CPO and other easily degradable substances.

It is thus deemed defendable to classify EFB and other palm oil waste as food waste.

The project proponent will undertake field tests to allow a better quantification of the decay constant to be reported in the monitoring report and thus revise the estimate of the baseline emissions of methane based on the calculations.

Waste type *j*	**DOCj (% wet waste)**	**DOCj (% dry waste)**
Wood and wood products	43	50
Pulp, paper and cardboard (other than sludge)	40	44
Food, food waste, beverages and tobacco (other than sludge)	15	38

[6] Rosenani, AB; Basran,RD; Zaharah, AR; Zauyah, S. *A Lysimetric Study on the Effect of N and P Fertilizer Application on Decomposition and Nutrient Release of Oil Palm Empty Fruit Bunches.* Department of Soil Science, Faculty of Agriculture, University Pertanian Malaysia.

Textiles	24	30
Garden, yard and park waste	20	49
Glass, plastic, metal, other inert waste	0	0

Table B11: Values for DOCj

The parameters for food waste are chosen to the consistent with the choice of decay factor. However, the project proponent may in the monitoring report seek approval to use a different value for DOCj with citation from research paper that contains documentation of organic carbon content of oil palm biomass waste from field experiment undertaken.

Assessment of Leakage:

No significant leakages are foreseen as a result of the project. All the equipment for the bio energy plant is new and is not transferred from another activity and do not result in any leakage.

The methodology ACM006 prescribes that an assessment of the risk of leakage from diversion of the use of biomass from existing use towards the CDM project activity. Three methods are suggested:

L1 is only applicable when all biomass fuel originates from the project entity. This approach is not applicable in this case since the project will import part of the biomass fuel.

L2 should demonstrate that there is produced at least 25% more biomass waste in the region than is used by the CDM project activity.

L3 should demonstrate that producers of biomass waste are not able to sell their product.

Here it is chosen to follow approach L2 because more direct data are available for this approach.

Because of the structure of the available data it is chosen to use districts as demarcation of the study area. Kunak district borders three other districts: Lahad Datu, Semporna and Tawau. These districts cover a distance up to 150 km from the Kunak Jaya Refinery and Kernel Crushing plant.

Table B12 Number of palm oil mills in neighbouring districts

Lahad Datu	31
Tawau	12
Kunak	8
Semporna	3
Total	54

Data in Table 12 have been extracted from "Directory of the Malaysian Palm Oil Processing Sectors, (MPOB 2006)" based on post codes for the palm oil mills. The average amount of FFB processed has been estimated from "Malaysian Oil Palm Statistics 2005" (MPOB 2006). The publication gives information on the total amount of FFB processed per state – it is not possible to extract data on district level. The number of palm oil mills in table 12 has been used as proxy to calculate the processed FFB – assuming that all 112 palm oil mills in Sabah have the same average production. Since the four selected districts covers close to 50% of the mills in Sabah it seems like a justifiable approximation.

The total amount of FFB processed in Sabah in 2005 was 24,998,052 tonnes. The gives an average per mill of 223,197 t FFB per mill/year. The four districts included in this analysis have 54 mills and thus the total processed FFB in four districts is 12,053,632. Of this 23% will be EFB, 2,772,105 t EFB/year

No statistics is available describing the use of EFB for mulching. The TSH practice is used to estimate the use for mulching in the region. Of the total production of 66,700 t EFB produced at the Kunak Palm Oil Mill in the baseline 8000 t was used for mulching (200 ha of each 40 t/ha). This leads to an utilisation of 12% of the EFB for mulching.

2005	Calculation	Amount t/year
Total available FFB	Total Sabah production proportioned with number of mills in four districts	12,053,632
Total available EFB	23% of FFB	2,772,105
Used for mulching	12% of EFB	332,653
Used in Kunak Mill	Actual amount used	28,908
Total used EFB	(Kunak + mulching)	361,561
Excess in percentage	100 % - (Total used/Total available)	87%

Table B 13: Status of use of EFB in East Sabah in 2005

The benchmark is that there should be at least 25% biomass more than used by the project activity. Even with the uncertainty in the analysis the benchmark is clearly fulfilled and thus no leakage is expected.

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

Data / Parameter:	**$EF_{grid,y}$ Baseline emissions from electricity grid**
Data unit:	kg CO_2/kWh
Description:	The average Operational Margin is allowed to be used as baseline for the emissions from the power grid as the project is less than 15 MW
Source of data used:	Sabah Electricity Supply Board
Value applied:	0.8 kg CO_2/kWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data are collected from the best available source – the local utility company
Any comment:	The value is calculated based on the latest 3 years of available data, 2002-2004, and the project participant chose to use this value through the first crediting period. Data for 2005 were not available at the time of finalisation of the PDD, but they would substantially be the same as 2004.

Data / Parameter:	**Φ**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Value applied:	0.9
Any comment:	Oonk et el.(1994) have validated several landfill gas models based on 17 realized landfill gas projects. The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reduction in a conservative manner, a discount of 10% is applied to the model results.

Data / Parameter:	**f – Fraction of methane captured and flared**
Data unit:	Fraction
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The landfill sites where the EFB had been dumped are unmanaged and not covered by any oxidation covering material
Any comment:	

Data / Parameter:	**OX**
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	Conduct a site visit at the solid waste disposal site in order to assess the type of cover of the solid waste disposal site. Use the IPCC 2006 Guidelines for National Greenhouse Gas Inventories for the choice of the value to be applied.
Value applied:	0
Any comment:	The dumpsite is not managed and thus not covered with oxidizing material

Data / Parameter:	**F – Fraction of methane in landfill gas**
Data unit:	Fraction
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually	The IPCC default value is generally accepted as a reasonable number – and since the dumping of the biomass has already stopped will it not be possible to measure the value.

applied :	
Any comment:	This factor reflects the fact that some degradable organic carbon does not degrade or degrades very slowly under anaerobic conditions. A default value of 0.5 is recommended by IPCC.

Data / Parameter:	**MCF**
Data unit:	Fraction
Description:	Methane Correction Factor
Source of data used:	IPCC
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value for unmanaged dumpsite of more than 5 meters depth. The landfills used for EFB in conjunction with the Kunak Mill are clearly more than 5 meters deep
Any comment:	

Data / Parameter:	**Biomass used for mulching in baseline**
Data unit:	T biomass/year
Description:	
Source of data used:	TSH – own calculation
Value applied:	8000 t/year
Justification of the choice of data or description of measurement methods and procedures actually applied :	The amount is calculated using TSH Plantation standard of 40 t EFB/ha/year for the 200 ha plantation in Kunak.
Any comment:	

Data / Parameter:	**NCV_{diesel}**
Data unit:	GJ/t
Description:	Net caloric value of diesel used in the base line
Source of data used:	IPCC default value
Value applied:	43.33
Justification of the choice of data or description of measurement methods and procedures actually applied :	The net-emissions from diesel are expected to be zero or at least very low. The uncertainty uncured by using default values will thus be minimal and not justify spending resources on measurements
Any comment:	

Data / Parameter:	$EF_{CO2,FF,diesel}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor for diesel
Source of data used:	IPCC default value
Value applied:	74.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	The net-emissions from diesel are expected to be zero or at least very low. The uncertainty uncured by using default values will thus be minimal and not justify spending resources on measurements
Any comment:	With a density of 0.84 t/m^3 the EF per litre diesel can be calculated as Density*NVC*EF/1000 = 2.7 kg CO_2/litre

Data / Parameter:	**Biomass use as fuel in baseline**
Data unit:	Tons biomass/year
Description:	Biomass used on site for heat and power generation in the baseline
Source of data used:	Data calculated from TSH
Value applied:	47,933 t biomass
Justification of the choice of data or description of measurement methods and procedures actually applied :	The amount is calculated based on the energy balance of existing palm oil mill
Any comment:	

Data / Parameter:	GWP_{CH4}
Data unit:	t CO_{2e}/t CH_4
Description:	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data used:	Decisions under UNFCCC and the Kyoto Protocol
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	A value of 21 is to be applied for the first commitment period of the Kyoto Protocol. The first crediting period for the project runs out in 2011 thus this value will be valid through all the period.
Any comment:	

Data / Parameter:	**EF_{CH4} Methane emission from burning of biomass in boiler**
Data unit:	Kg/TJ
Description:	
Source of data used:	IPCC 2006

Value applied:	41.1 kg methane/TJ (calculated as the original 30 kg methane/TJ * conservativeness factor of 1.37)
Justification of the choice of data or description of measurement methods and procedures actually applied :	The methane emission is relatively uncertain, and thus is a high conservativeness factor used in calculating the annual emissions. Despite this are the emissions very low compared to the total amount of CERs generated in the project (less than 1%) and it is not deemed necessary to measure the amount.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

The calculations of emission reductions include the following components:

$ER_y = ER_{heat,y} + ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y$ **(1)**

Where:

ER_y are the emissions reductions of the project activity during the year y in tons of CO_2,

$ER_{electricity,y}$ are the emission reductions due to displacement of electricity during the year y in tons of CO_2,

$ER_{heat,y}$ are the emission reductions due to displacement of heat during the year y in tons of CO_2,

$BE_{biomass,y}$ are the baseline emissions due to natural decay or burning of anthropogenic sources of biomass during the year y in tons of CO_2 equivalents,

PE_y are the project emissions during the year y in tons of CO_2, and

L_y are the leakage emissions during the year y in tons of CO_2.

Of these $ER_{heat,y}$ and L_y are estimated to be zero.

$ER_{electricity,y}$ are calculated from the expected annual supply of electricity to the grid and the grid emission factor. The electricity delivered to the grid can be up to 80,000 MWh with a grid emission factor of 0.8 t CO_2/MWh. This leads to a maximum emission reduction from power production of 64,000 t CO_2 per year. The actual supply of power delivered to the grid will be measured and reported in the monitoring report and used in calculating the actual amount of emission reductions achieved. In the CER calculation a load factor of 80% or 7000 full load hours is used. This gives emission reductions of 56,000 t CO_2 per year.

$BE_{biomass,y}$ is calculated by using the first order decay model. The main parameters in the model are fixed as:

F fraction of methane in the landfill gas (default 0.5)

DOCj per cent of degradable organic carbon (by weight) in the waste type j (0.15)

DOCf fraction of DOC dissimilated to landfill gas (IPCC default 0.5)

MCF Methane Correction Factor (unmanaged dumpsite of more than 5 meters depth: 0.8)

Aj,x amount of organic waste type j land filled in the year x (209,061 tonnes EFB/year with 80% utilisation of capacity of electricity production)

k j decay rate for the waste stream type j (0.4)

Conservativeness factor: 0.9

The results are shown in the table B.14 below.

Project emissions

The emissions of methane from the burning of biomass are calculated as 1891 t CO2/year. This is based on a use of 2191 TJ of energy for the power plant and an emission factor of 41.1 kg methane/TJ (including a conservativeness factor).

Emissions from the use of diesel as back up fuel are expected to be the same as in 2006 i.e. 82,992 litre diesel per year. With an emission factor of 2.7 kg CO_2/litre this gives project emissions of 224 t CO_2/year.

Due to technical challenges in the first two years where the operation was often interrupted by starts and stops the diesel use in 2005 was 191,829 litre and in 2006 it was 82,992 litre. With the same emission factor this gives project emissions of 518 t CO_2 and 224 t CO_2, respectively.

Table B.14: Computation of the avoided methane emissions

Avoided methane estimate	2005	2006	2007	2008	2009	2010	2011
Deposited year 1	5,790	3,881	2,602	1,744	1,169	784	525
Deposited year 2		26,582	17,819	11,944	8,006	5,367	3,598
Deposited year 3			57,895	38,808	26,014	17,438	11,689
Deposited year 4				57,895	38,808	26,014	17,438
Deposited year 5					57,895	38,808	26,014
Deposited year 6						57,895	38,808
Deposited year 7							57,895
Total unadjusted	5,790	30,464	78,316	110,392	131,893	146,306	155,967
Conservativeness adjusted	5,211	27,417	70,484	99,353	118,704	131,676	140,371

The calculation of avoided methane emissions starts from 2005 when the project commissioned. The emission reductions from avoided methane emissions for 2005 and 2006 are however not included in the CER calculations for 2005 and 2006 as the project only claims retroactive credits on the displacement of fossil fuel for power supplied to the electricity grid.

Table 15 Summary of the calculations of baseline and project emissions

	2005	2006	2007	2008	2009	2010	2011
Baseline power	19,486	39,626	56,000	56,000	56,000	56,000	56,000
Avoided methane			70,484	99,353	118,704	131,676	140,371
Methane from burning biomass	-1,103	-1,510	-1,655	-1,655	-1,655	-1,655	-1,655
Emissions from transport	-240	-570	-1,041	-1,041	-1,041	-1,041	-1,041
Emissions from diesel back up	-518	-224	-224	-224	-224	-224	-224
Calculated emission reductions	17,625	37,322	123,564	152,433	171,784	184,756	193,451

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

Table B.16; Summary of the ex ante estimation of the emission reductions

Year	Total Baseline Emissions, E_{BL} (t CO_2e)	Total Project Emissions, E_{PA} (t CO_2e)	Total Leakage Emissions, E_{LE} (t CO_2e)	**Emissions Reduction, ER (t CO_2e)**
2005	19,486	1,860	0	17,625
2006	39,626	2,304	0	37,322
2007	126,484	2,920	0	123,564
2008	155,353	2,920	0	152,433
2009	174,704	2,920	0	171,784
2010	187,676	2,920	0	184,756
2011	196,371	2,920	0	193,451
TOTAL	899,699	18,763	0	880,935
Average	128,528	2,680	0	125,848

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**Power production sold to the grid, $EG_{project\ plant,y}$**
Data unit:	MWh/year
Description:	The sale of electricity to the grid of Sabah Electricity Supply Board
Source of data to be used:	Direct measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The estimated sale to the grid is 70,000 MWh reflecting 7000 full load hours of the 10 MW export capacity of the biomass plant.
Description of measurement methods and procedures to be applied:	The project owner will appoint the energy plant manager to record the kWh supply of electricity to the grid system monthly. The readings will follow the same periods as the billing period in the renewable energy purchase agreement under which electricity is supplied to the grid, meaning that the readings will be for each calendar month. According to the Renewable Energy Purchase Agreement the project owner will keep records on electricity supply to the grid system, properly stored and maintained at its offices at the site, for a minimum of seven years and for such additional time period as may be required by Law or by Government Authority

	having jurisdiction over the project owner and project activity.
QA/QC procedures to be applied:	The project owner and the electricity company (SESB) will jointly read the main metering equipment at the Interconnection Point within five Business Days after the end of each calendar month.
Any comment:	The data for power sales are part of a commercial agreement with the power company and will thus be cross checked by the parties to the PPA.

Data / Parameter:	**Use of diesel in the Kunak Bio Energy Plant**
Data unit:	Litre diesel/year
Description:	Diesel is used as backup and start up fuel
Source of data to be used:	Measuring of the volume of diesel used in the biomass power plant through establishing of a flow meter at the diesel back up
Value of data applied for the purpose of calculating expected emission reductions in section B.5	82,992 litre – as actual use in 2006. This is conservative since the operation was more irregular in 2006 as expected in the future.
Description of measurement methods and procedures to be applied:	Measurements will be continuous based on the flow of diesel from the storage tank to the diesel back up.
QA/QC procedures to be applied:	Cross check with the annual energy balance of the biomass power plant and with the invoices for purchased diesel
Any comment:	

Data / Parameter:	$BF_{,y}$ **Amount of biomass fuel used in the Kunak Bio Energy Project**
Data unit:	Tonnes biomass/year
Description:	The amount of biomass fuel used in the boiler is used to calculate the amount of avoided methane emissions from dumping of the same material in the baseline.
Source of data to be used:	Measurements and calculations
Value of data applied for the purpose of calculating expected emission reductions in section B.5	For the 7000 full load hours a total of 276,869 t biomass fuel is needed.
Description of measurement methods and procedures to be applied:	A major part of the biomass will be purchased from other palm oil mills and it will be of major economic importance to establish the amount of biomass. The biomass waste products from other palm oil mills will be weighed upon arrival at the power plant. The biomass residues from the Kunak Mill will for practical reasons not be weighed directly, but calculated from the amount of Fresh Fruit Bunches (FFB) handled in the Kunak plant. The amounts of EFB, fibre and shell can be calculated using the standard ratio of 23%, 12.7% and 5.7% of the FFB processed.
QA/QC procedures to be applied:	The amount of biomass purchased from other mills is part of a commercial transaction the best effort will be done to establish the correct amount. For the remaining biomass from the Kunak Palm Oil Mill, the calculation will be based on standard ratios for the different waste products and cross checked with production of Crude Palm Oil from the mill.
Any comment:	The amount of biomass can be cross checked with the electricity produced for sale to the grid – by using values for energy content of the biomass and the efficiency of the boiler

Data / Parameter:	NCV_{EFB}
Data unit:	GJ/ton of biomass residue
Description:	Net caloric value of Empty Fruit Bunches
Source of data:	Laboratory test
Value applied:	17 MJ/kg (dry matter) – recalculated to 5.3 MJ/kg at 60% moisture content
Description of measurement methods and procedures actually applied :	Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measure the NCV based on dry biomass. Measurements done at least every six months, taking at least three samples for each measurement.
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass.
Any comment:	

Data / Parameter:	**NCV_{shell}**
Data unit:	GJ/ton of biomass residue
Description:	Net caloric value of palm kernel shell
Source of data:	Measurements
Value applied:	20 MJ/kg – recalculated to 17.3 MJ/kg at 12% moisture content
Description of measurement methods and procedures actually applied :	Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measure the NCV based on dry biomass. Measurements done at least every six months, taking at least three samples for each measurement.
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass.
Any comment:	

Data / Parameter:	**NCV_{fibre}**
Data unit:	GJ/ton of biomass residue
Description:	Net caloric value of mezocarp fibre
Source of data:	Measurements
Value applied:	19 MJ/kg – recalculated to 11.1 MJ/kg at 37% moisture content
Description of measurement methods and procedures actually applied :	Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measure the NCV based on dry biomass. Measurements done at least every six months, taking at least three samples for each measurement.
QA/QC procedures:	Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass.
Any comment:	

Data / Parameter:	***DOCf***
Data unit:	Fraction
Description:	Fraction of DOC dissimilated to landfill gas
Source of data to be used:	Project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.5 The value is applied from the IPCC 2006 guidelines
Description of measurement methods	The project developer will undertake a desk study and if necessary field studies to be able to deliver a specific value for DOCf applicable for EFB under

and procedures to be applied:	Malaysian conditions – as suggested in the IPCC 2006 guidelines.
QA/QC procedures to be applied:	The QA/QC procedure for the field test will be determined in collaboration with the scientific institution. The data obtained will be compared to IPCC default values
Any comment:	

Data / Parameter:	**k_j - Decay constant for the Empty Fruit Bunches**
Data unit:	Dimensionless
Description:	The rate of decay of the Empty Fruit Bunches is an important parameter in calculating the avoided methane emissions from the dumping of the EFB in the baseline scenario. Credible data from field conditions does not exist.
Source of data to be used:	A relevant field experiment will be conducted in collaboration with a respected scientific institution to determine the decay constant for the EFB
Value of data applied for the purpose of calculating expected emission reductions in section B.5	An IPCC default value of 0.4 has been used in ex ante calculations. There are only limited data for the degradation of the EFB in landfills, most analysis are for aerobic conditions – like Rosnani et al. from laboratory data that showed the decay of half the EFB volume in 15 weeks in a controlled experiment[7]. This is much faster than the implied half life of the decay rate for food waste of 0.4 (k = ln(2)/t1/2) of 1.7 years. The fast decay rate for EFB is linked to a number of factors such as high moisture content, high content of cellulose and hemi-cellulose and a remaining content of CPO and other easily degradable substances.
Description of measurement methods and procedures to be applied:	The methods for measuring the decay constant will be decided in collaboration with the scientific institution engaged for the purpose.
QA/QC procedures to be applied:	The QA/QC procedure for the field test will be determined in collaboration with the scientific institution
Any comment:	The decay constant will be measured before the first monitoring report will be submitted and the new value will be used for the ex post calculation of the avoided methane emissions in stead of the default value used in the ex ante calculations.

Data / Parameter:	***DOCj*** per cent of degradable organic carbon (by weight) in the waste type j
Data unit:	Fraction
Description:	Weight fraction of the organic carbon that is degradable. The fraction is used in the calculation of the avoided methane emissions from burning of the biomass.
Source of data used:	IPCC
Value applied:	0.15

[7] Rosenani, AB; Basran,RD; Zaharah, AR; Zauyah, S. *A Lysimetric Study on the Effect of N and P Fertilizer Application on Decomposition and Nutrient Release of Oil Palm Empty Fruit Bunches.* Department of Soil Science, Faculty of Agriculture, University Pertanian Malaysia.

Justification of the choice of data or description of measurement methods and procedures actually applied :	The value for food waste is used as EFB seems to be closest to food waste in relation to the decay properties. See argument in relation to decay factor above. Since the decay factor for food waste is used then DOCj for food is also used.
Any comment:	The project entity will prepare a study on a project specific DOC_j before the first monitoring report will be submitted and the new value will be used for the ex post calculation of the avoided methane emissions in stead of the default value used in the ex ante calculations.

Data / Parameter:	-
Data unit:	Tons
Description:	Quantity of EFB that are utilized (used for mulching and energy generation) in the defined geographical region
Source of data:	Survey or statistics
Value applied:	361,561 t EFB
Description of measurement methods and procedures actually applied :	Annually collection of data from small scale renewable energy projects and CDM projects using EFB as fuel or feedstock in the districts of Lahad Datu, Kunak, Tawau and Semporna. If possible data on amount of used EFB is collected directly. Where only power production data are available estimates of the fuel use are calculated by default values from PDDs or generic information. The mulching is assessed to the 12% of the available amount of EFB.
QA/QC procedures:	Comparison with earlier data
Any comment:	Element in evaluation of the leakage based on approach L_2

Data / Parameter:	-
Data unit:	Tons
Description:	Quantity of available EFB in the region
Source of data:	Calculations are based on annual production statistics from MPOB for the districs of Lahad Datu, Kunak, Tawau and Semporna
Value applied:	2,772,105 t EFB
Description of measurement methods and procedures actually applied :	Annually calculations of the amounts of EFB is based on the default relation between FFB and EFB of 23%
QA/QC procedures:	Comparison with earlier data
Any comment:	Element in evaluation of the leakage based on approach L_2

Data / Parameter:	**AVD_Y**
Data unit:	Km
Description:	Average round trip distance (from and to) between biomass fuel supply sites and the project sites
Source of data:	The distance to each biomass supplier is checked through measuring.

	Invoices from the different biomass suppliers are used to give the amount of biomass from each supplier. The value applied is the weighted average distance fro 2006
Value applied:	126 km
Description of measurement methods and procedures actually applied :	The average distance can then be calculated as the weighted average of distance to the mills. The sampling will be continuous.
QA/QC procedures:	Check consistency of distance records provided by the truckers by comparing recorded distances with other information from other sources (e.g. maps)
Any comment:	

Data / Parameter:	**N_Y**
Data unit:	
Description:	Number of truck trips for the transportation of biomass
Source of data:	The weighing of incoming trucks are used to measure the annual number of trucks arriving at the plant
Value applied:	7845
Description of measurement methods and procedures actually applied :	Continuously
QA/QC procedures:	Check consistency of the number of truck trips with the quantity of biomass combusted with other information from other sources (e.g. maps)
Any comment:	

Data / Parameter:	**TL_Y**
Data unit:	Tons
Description:	Average load of the trucks used for the transportation of biomass
Source of data:	Data from the weighing of incoming trucks are used to calculate the average weight of the truck loads arriving at the plant
Value applied:	20 t/truck
Description of measurement methods and procedures actually applied :	Determined by averaging the weights of each truck carrying biomass to the project plant. Continuously, aggregated annually
QA/QC procedures:	Check consistency of the number of truck trips with the quantity of biomass combusted, e.g. by the relation with previous years.
Any comment:	

Data / Parameter:	**$EF_{km,CO2,y}$**
Data unit:	tCO_2/km

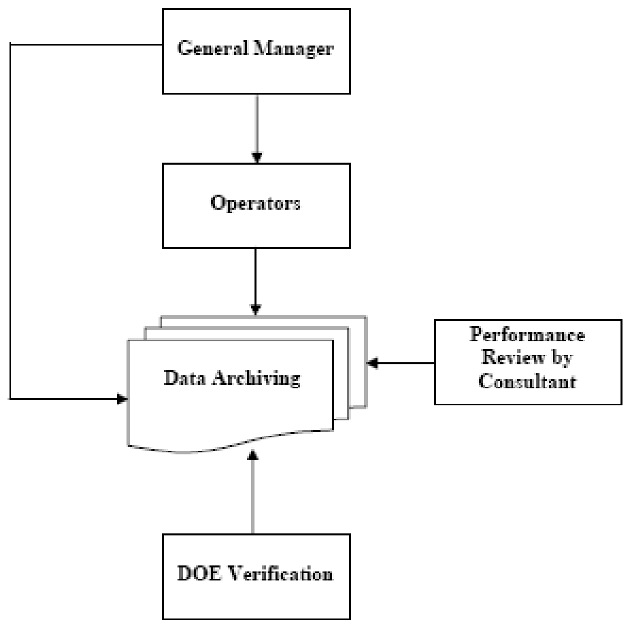
Description:	Average CO_2 emission factor for the trucks during the year y
Source of data:	Sample measurement of the fuel type, fuel consumption and distance travelled for all truck types will be conducted. CO_2 emissions from fuel consumption shall be calculated based on methodology. For NCV and EF_{CO2} , reliable national default values or IPCC default value values can be used.
Value applied:	0.001053 tCO_2/km
Description of measurement methods and procedures actually applied :	Annual monitoring.
QA/QC procedures:	The results will be cross-checked with emission factors referred to in the literature
Any comment:	

Data / Parameter:	**Moisture content of the biomass residues**
Data unit:	% Water content
Description:	Moisture content of each biomass residue type *k*
Source of data to be used:	On-site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	EFB: 60% Fibre: 37% Shells: 12%
Description of measurement methods and procedures to be applied:	Measurements are undertaken for representative samples of the incoming biomass waste, mean values calculated at least annually
QA/QC procedures to be applied:	Comparison with other measurements and with default values from literature
Any comment:	

B.7.2 Description of the monitoring plan:

The figure below outlines the operational and management structure that TSH will implement to monitor emission reductions and any leakage effects generated by the project activity. TSH will form an operational and management team, which will be responsible for monitoring of all the parameters aforementioned. This team composes of a general manager and a group of operators. A group of operators, who are under the supervision of the general manager, will be assigned for monitoring of different parameters on a timely basis as well as recording and archiving data in an orderly manner.

Monitoring reports will be forwarded to and reviewed by the general manager on a monthly basis in order to ensure the Project follows the requirements of the monitoring plan.



DATA / PARAMETERS	UNIT	MONITORING BY	QA/QC CROSSCHECK BY	COMMENT
$EG_{project\ plant,y}$ Net quantity of electricity generated in the project plant during the year y	MWh/yr	Plant Engineer	Plant Manager	Compare with receipts of electricity sales and the quantity of fuels fired
$EF_{grid,y}$ CO_2 emission factor for grid electricity	tCO_2/MWh	Plant Manager	General Manager	Decided at the start of the project activity
$FF_{project\ plant,diesel,y}$ Quantity of diesel combusted in the biomass residue fired power plant during the year y	t/year	Plant Supervisor	Plant Engineer	Including diesel co-fired in the project plant
FF baseline Average of diesel consumed in the three years before the Kunak Bio Energy Plant was commissioned	ton	Plant Supervisor	Plant Manager	Quantity shell be cross-checked with quantity of electricity generated and any fuel purchased receipts
$EF_{CO2,FF,i}$ CO_2 emission factor for diesel	tCO_2/GJ	Plant Engineer	Consultant	Use IPCC default value

$BF_{,y}$ Quantity of biomass fuel combusted in the project plant during the year y	Tons	Plant Supervisor	Plant Engineer	Fuel purchased will be weighed wheras biomass from the plant will be calculated based on production at the mill.
NCV_k Net caloric value of biomass residue type k	GJ/ton	Plant Engineer	Plant Manager	Compare the measured data with previous years data, valued used in national GHG inventory, and IPCC default value
$EF_{CH4,BF}$ CH_4 emission factor for combustion of biomass residues in the project plant	tCH_4/GJ	Plant Engineer	Consultant	Use IPCC default value
DOCj Per cent of degradable organic carbon (by weight) in the waste type j	%	Plant Manager	General Manager	The value for food waste is used as EFB seems to be closest to food waste in relation to the decay properties. The value could be measured and reported as part of the ex post calculation of the avoided methane emission
DOCf Fraction of DOC dissimilated to landfill gas	%	Plant Manager	General Manager	Need to consider providing evidence justifying a higher DOC_f in the monitoring report
kj Decay rate for the waste type j		Plant Manager	General Manager	A similar characteristic of waste type was chosen from IPCC 2006 Guidelines. Provide reliable local or national data for EFB decay rate. Research will be carried out.
Quantity of biomass residue that **utilized** in the defined geographical region	tons	Plant Manager	General Manager	Need information from survey or statistics for rule out leakage
Quantity of available biomass residues in the region	tons	Plant Manager	General Manager	Survey or statistics data
Moisture content of the biomass residues	% water content	Plant Supervisor	Plant Engineer	If dry biomass, monitoring of this parameter Is not necessary

Data archived will also be verified regularly by the DOE. The performance of the Project will be reviewed and analyzed by the consultant on a regular basis.

A full manual of procedures for implementing the monitoring plan has been developed and is implemented in the Kunak Bio Energy Plant.

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

The baseline study and monitoring plan was finalised on 12/03/2007 and has been developed by:

Soeren Varming (Managing Director)
HV Carbon Sdn. Bhd.
609 Block E, Phileo Damansara I
46350 Petaling Jaya
Malaysia
Email: sv@svcarbon.com
Phone: +601 9262 7970

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The project activity started upon the host country approval of the project idea in August 2003. In the same period the preparation of this project design document started. The project activity became operational 1st January 2005.

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

The expected operational lifetime of the project is 21 years, which is equal to the electricity purchase agreement entered with the electricity distribution company.

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

C.2.1. Renewable crediting period

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

01/01/2005

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

According to the Malaysian regulations renewable energy projects are not required to prepare an Environmental Impact Assessment. This has been confirmed by the Malaysian Department of Environment. Thus no EIA has been prepared.

The project must comply with the environmental regulations of the country and obtain the necessary approvals before commissioning and during operation of the project.

The project will apply modern, efficient technologies and the environmental impact will be managed better than in the existing situation, as the biomass waste will be used for energy production to the highest possible extent, which includes efficient combustion of the biomass.

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:

Environmental sustainability

The project will have a positive impact on the environment as it will reduce power production on fossil fuels and lead to an increased sustainability in the power generation sector. Furthermore the power plant will be equipped with high-efficient technologies that reduce the fuel consumption per unit output and increase the combustion efficiency. Pollution control equipment will be installed in order to ensure minimum emissions of particulates etc. from the plant. This leads to the air pollution from the plant being well below the situation in similar palm oil mills with traditional equipment.

The project will lead to reduced disposal palm oil waste in the surroundings of the mill. The reduced deposition of waste will reduce the generation of methane and also of other gasses like H_2S from the anaerobic degradation. This will be a benefit for both the global environment, but also for the local environment where foul smell will be avoided.

SECTION E. Stakeholders' comments

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

The initial stakeholder consultation involved authorities and government agencies. As the project is developed under the Small Renewable Energy Programme, information regarding the project was prepared early in the development stage to qualify for this programme and to apply for licensing approvals.

The CDM project development has also been through a consultation process with relevant agencies on state and local level and Ministry of Natural Resources and Environment and Ministry of Energy, Communications and Multimedia. The initial approach was acknowledged through a validation of the first PDD produced by the project

In relation with the development of this PDD a stakeholder meeting was arranged at the project site to fulfil the requirement directly. It is of cause not ideal to have the stakeholder meeting after the implementation of the project, but it can be seen as a check that the expected local benefits were actually harvested.

Written invitations for the stakeholder meeting were hand delivered to local residents. Since the closest neighbours to the mill is the staff quarters the invitation was also placed on the notice board of the staff. Local authorities including the Department of Environment and NGO were mailed.

E.2. Summary of the comments received:

The overall comments of the stakeholders are positive and encouraging. Based on the correspondence there are no significant concerns reported on the present bio-energy project. The tabulation below gives an overview of the correspondence and comments received from the initial hearing of government agencies.

No.	**E.2.1**
Type	Letter
Date	25th March 03
From	Perunding AME SDN.BHD.
To	Department of Environmental. Ministry of Natural Resources and Environment. Federal Government Administrative Centre
Brief Description	Acquiring weather the proposed SREP plant is exempted from the Environmental Impact Assessments Act (EIA Report)
Reply	The SREP plant project does not constitute under the Environmental Impact Assessments Act (EIA Report) but must ascertain written approval from Ketua Pengarah Alam Sekitar Sekeliling

No.	**E.2.2**
Type	Letter
Date	22nd April 02
From	Department of Environment. Ministry of Natural Resources and Environment. Federal Government Administrative Centre
To	TSH Bio-energy Sdn. Bhd.
Brief Description	Notifying that the SREP plant project does not fall under “Section 34A under Quality Surrounding Environment Act 1974”.
Reply	The SREP plant project does not constitute under the “Section 34A under Quality Surrounding Environment Act 1974”. However it is govern under ruling 36 and 38. Quality Surrounding Environment (Clean Air) 1978 which stipulated that the SREP project must get the written approval letter from the Director General of Surrounding Environments.

No.	E.2.3
Type	Letter
Date	28th August 2003
From	Designated National Authority for CDM, Ministry of Natural Resources and Environment.
To	TSH Bio-energy Sdn. Bhd.
Brief Description	Notifying that the project idea has been approved under the condition that 1) an annex 1 partner is identified and 2) that the aspect of methane avoidance is considered in the project design document.
Reply	The present PDD is the response to the approval letter from the Designated National Authority. 1) Climate Cent Foundation has been identified as the partner and future buyer of certified emission reductions. 2) The PDD has now been restructured to take into account the avoided methane emissions from dumping of the EFB in the baseline scenario.

No.	E.2.4
Type	Progress Report
Date	10th Sept 03
From	TSH Bio-Energy Sdn. Bhd.
To	Suruhanjaya Tenaga
Brief Description	Progress Report on SREP plant project for the month of June, July, August 2003. It is a formal report with a standard format given by Suruhanjaya Tenaga to TSH Bio-Energy Sdn. Bhd. This is to monitor the progress in stages.

No.	E.2.5
Type	Letter
Date	14th Oct 03
From	Suruhanjaya Tenaga
To	TSH Bio-Energy Sdn Bhd.
Brief Description	Suruhanjaya Tenaga award the Licence to provide electricity to TSH Bio-Energy Sdn. Bhd. The licence is valid for one year renewable basis per year.

A stakeholder's meeting was held on 21 November 2006 involving TSH management and staff members and 23 external stakeholders. They represented local residents, planters, Tawau Town Board Representatives, the Department of Environment (DoE) and a non-governmental organisation called Partners of Community Organisations (PACOS). Invitation letters with a description of the project were sent out two weeks earlier to a total of 27 people with and a follow up was done to confirm attendance. The stakeholder meeting was held at 9.30am at the TSH premises in Kunak, Sabah.

The following is a list of the attendees:

Department/Organisation	Representatives
Department of Environment	1

Department/Organisation	Representatives
Villagers/Residents	18
PACOS	1
Planter	2
Tawau Town Board Representative	1
TOTAL	23

<u>Presentation</u>

Mr. Soeren Varming first introduced participants to the Clean Development Mechanism as one of the mechanisms to address the reduction of greenhouse gas emissions. He informed participants that so far, Malaysia has registered 12 CDM projects, mostly involving biomass power plants.

Mr. Goh Kun Teck then proceeded to explain the project description and activities, which he described were in line with the Government's policy to have five percent of total energy generated from renewable energy sources. The TSH biomass energy plant is the first such project in Malaysia and began operations in February 2005. It supplies about 10MW for the Sabah Electricity Supply Board (SESB) grid that can meet the demands of about 30,000 households annually. The project consumes about 280,000 tonnes of biomass waste from the oil palm mills as fuel. In addition to supplying to the grid, energy is also used as process steam and for the cooling system. The benefits of the project were also explained in detail.

E.2.2 Summary of the comments received

The following issues were raised by the participants. They were addressed by Mr. Soeren Varming, TSH Mr. Goh Kun Teck and TSH Mr. William Tan.

From	Question	*Response*
Local resident	Can TSH supply electricity to the nearby residents (at the check post)?	TSH generates the electricity that is supplied to the grid, and SESB is then responsible for distribution. TSH cannot supply directly to domestic users because the electricity must be stepped down from 33kv/11kv to 220v for domestic use.
Tawau Department of Environment	What is the share of electricity sold to the grid and for the factory's consumption?	The percentage varies, but on average, 70 percent is supplied to SESB. Any plans to increase that capacity will have to depend on the demand from SESB. It is also a question of economic feasibility.
	How many mills send their empty fruit bunches (EFB) to TSH as biomass?	There are about 14 mills that supply the EFB from the nearby areas, and usually it is only part of the EFBs from each mill.
PACOS	You've explained that the project is good to minimise emissions of GHG. What if the methane is not used to produce energy, what will the impact be on the environment and human beings?	The risk is that methane build ups can lead to an outbreak of fires. There is also the bad smell from the anaerobic process from the hydrogen sulphide. Large amounts of EFB also can lead to pest problems. The gases produced are not poisonous but they can cause fires.
	Apart from methane, what other gases can be emitted from the EFB?	Hydrogen sulphide because there is sulphur in EFB and CO2, as well as some other complex organic compounds.
Palm Oil Millers	What about the noise and air pollution from this project?	As you may have noticed, the noise level is typical of any plants and we have measured that the emissions are less than 200mg/m3 in terms of air pollution. We don't have soot

From	Question	*Response*
		emission and in general, we meet quite high standards in reference to DoE standards.
	Is the energy generated using biomass stable, or will there be a need for a back up?	It is generally stable. We are only supplementing the grid and any shut downs will not affect the grid. If we need to shut down the plant for scheduled maintenance, we will inform SESB ahead of time.

Conclusion

The meeting was adjourned at 10.00am and participants were informed that they could also submit questions on the project to TSH within a week.

General observation
Participants did not raise any objections to the project and demonstrated a keen interest in its environmental and social impacts.

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

See the comments to the individual documents above and response to the questions raised during the stakeholder meeting. No issues have required further action by the project proponent.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	TSH Bio Energy Sdn. Bhd.
Street/P.O.Box:	No. 8, Jalan Semantan
Building:	Level 11, Menara TSH
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State/Region:	Wilayah Persekutuan
Postfix/ZIP:	50490
Country:	Malaysia
Telephone:	+603-2084 0888
FAX:	+603-2084 0808
E-Mail:	limfookhin@tsh.com.my
URL:	www.tsh.com.my
Represented by:	Mr. Lim Fook Hin
Title:	Executive Director
Salutation:	Mr.
Last Name:	Hin
Middle Name:	Fook
First Name:	Lim
Department:	Finance
Mobile:	019-3206354
Direct FAX:	+603-2084 0808
Direct tel:	+603-2084 0888
Personal E-Mail:	

Alternative Contact for TSH Bio Energy Sdn. Bhd.:

Represented by:	Joanne Chan Wai Yee
Title:	Senior Manager – Strategic Planning
Salutation:	Dr.
Last Name:	Yee
Middle Name:	Wai
First Name:	Chan, Joanne
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Direct tel:	+603-2084 0808

Organization:	Climate Cent Foundation
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City:	Zurich
State/Region:	
Postfix/ZIP:	8032

Country:	Switzerland
Telephone:	+41-44-387 99 04
FAX:	+41-44-387 99 09
E-Mail:	
URL:	http://www.climatecent.ch
Represented by:	
Title:	Director Carbon Procurement
Salutation:	Mr.
Last Name:	Marioni
Middle Name:	
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Department:	
Mobile:	+41-79-829 71 08
Direct FAX:	Same as above
Direct tel:	Same as above
Personal E-Mail:	Renato.marioni@stiftungklimarappen.ch

Organization:	EDF Trading Limited
Street/P.O.Box:	71, High Holborn
Building:	
City:	London
State/Region:	
Postfix/ZIP:	WC 1V 6 ED
Country:	United Kingdom
Telephone:	+44 20 7061 4366
FAX:	
E-Mail:	
URL:	http://www.climatecent.ch
Represented by:	
Title:	Environmental Products Manager
Salutation:	Mr.
Last Name:	Mark
Middle Name:	Not applicable
First Name:	Meyrick
Department:	Environmental Products
Mobile:	Not available
Direct FAX:	Same as above
Direct tel:	Same as above
Personal E-Mail:	mark.meyrick@edftrading.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

NO PUBLIC FUNDING WAS INVOLVED

Annex 3

BASELINE INFORMATION

See calculations in section B6

Annex 4

MONITORING INFORMATION

See the monitoring plan in section B7

Annex 5: Calculation of emission reductions in 2005 and 2006

Data available for calculations

In the following the preliminary emission reductions from Kunak Bio Energy Plant are calculated based on the actual data for power production, fuel use and transport. These calculations shall be replaced by a proper monitoring report used for claiming the CERs.

	Power for grid MWh	EFB fuel Tonnes	Shell Fuel Tonnes	Fibre fuel Tonnes
2005	24,357	28,908	20,728	68,975
2006	49,532	103,989	24,385	69,933

These tonnes of fuel can be calculated into energy amounts by using the heating values for each individual fuel.

	EFB	Shell	Fibre	Total TJ/year
Heating value GJ/t	5.3	17.3	11.1	
Energy 2005	153,211 GJ	358,588 GJ	765,627 GJ	1277
Energy 2006	551,143 GJ	421,863 GJ	776,262 GJ	1749

Biomass waste produced at Kunak Palm Oil Mill in baseline

Biomass Waste	t/year
EFB	66,700
Fibre	36,830
Shell	16,443

The diesel consumption for the Kunak Bio Energy Plant has been as follows

Litre/year	2005	2006
Actual diesel used	191,829	82,992

Calculations

Emission reductions from power production

The emission factor for the East Sabah grid is 0.8 t CO2/MWh

Year	Power produced (MWh)	Emission reductions (t CO2-eq)
2005	24,357	19,486
2006	49,532	39,626

Project emissions from methane emissions

The emission factor for methane is 41.1 kg methane/TJ fuel. The GWP for methane is 21.

Year	Fuel use in TJ	Project emissions – methane from biomass burning (t CO2-eq)
2005	1277	1103
2006	1749	1510

Project emissions from transportation of biomass

The average trip distance – round trip – for the transportation of biomass to the Kunak Bio Energy Plant was 125 km in 2006. This number is based on the actual number of trips (4316 trips) and the actual distance to the mills involved. The raw data is in attached spread sheet. The average fuel use for the truck has been 0.39 litre/km.

For 2005 the same average distance of trips has been applied. The transported amount is calculated as the difference between the available fuel in baseline and the actual used fuel and the number of truck trips is calculated by using an average truck load of 20 t/truck.

Transport of biomass in 2005

Biomass	Used t/year	Baseline t/year	Transported t/year	Number of trips	Distance travelled Km/year	Fuel used Litre/year
EFB	28,908	66,700	0			
Shell	20,728	16,443	4,285	214	26,779	10,444
Fibre	68,975	36,830	32,145	1,607	200,909	78,354
Total			36,430	1,822	227,688	88,798

For 2006 actual numbers are used for distance travelled. This leads to a total fuel use in 2006 of 211,206 litres of diesel.

Emissions from transport of biomass fuel can then be calculated by multiplying with the emission factor 2.7 kg CO2/litre of diesel. In 2005 the emissions are 240 t CO2-eq and for 2006 they are 570 t CO2-eq.

Project emissions from use of diesel for back up

Diesel is used as back up fuel and for start and stop of the biomass boiler. In the early years of implementing the project the biomass boiler and the fuel preparation equipment has had some operational problems leading to many start stops. Therefore the diesel consumption has been larger than expected.

The emission factor for diesel is 2.7 kg CO2/litre.

Litre/year	2005	2006
Actual diesel used	191,829	82,992
Project emissions t CO2/year	518	224

Emission reductions in 2005 and 2006

Year	Power	Methane	Transport	Back up	Total reduction
2005	19,486	1103	240	518	17,625
2006	39,626	1510	570	224	37,322

Annex 6: Calculation of heating values of biomass fuel

Most biomass wastes have similar heating value when measured as dry matter. Values are typically in the order of 17-20 MJ/kg depending on the chemical properties of the specific waste type. (Danida 2005, own measurements)

The variation of the experienced heating value can mostly be explained by the difference in moisture content of waste. The moisture content will vary with the origin of the waste and on different forms of storage and treatment the waste will undergo before it is used as fuel.

An analysis has been carried out for EFB from the Kunak Mill – see Annex 7. The Gross calorific value was measured to 4137 kcal/kg. The conversion is 1000 kcal = 4.19 MJ so the analysis result can be converted to 17 MJ/kg. This value is used in the following to calculate the Net Calorific Value (NCV) of EFB.

The actual heating value can be calculated as dry matter heating value minus the energy needed to evaporate the water content. The evaporation energy is 2.45 MJ/kg (Danida 2005). As example can be used EFB with a measured heating value of 17 MJ/kg and an experienced moisture content of 60%. The actual heating value can be calculated as

*(Fraction of dry matter (1-moisure content)*heating value of dry matter – moisture content*evaporation energy of water*)

0.4*17 – 2.45*0.6 = 5.3 MJ/kg

Based on this procedure the heating value has been recalculated for the moisture content experienced for the Kunak Palm Oil Mill. The moisture content can be different between different palm oil mills depending on specific treatment in the mill and the handling of the waste products.

In the Kunak Mill the moisture content and the corresponding calculated heating value is shown in the table. The heating value calculated as described above, with dry heating value of EFB of 17 MJ/kg (measured), 20 MJ/kg for shell and 19 MJ/kg for fibre. The slightly higher heating value for the two latter is based on their lower ash content than the EFB.

	EFB	Shell	Fibre
Dry matter heating value MJ/kg	17	20	19
Moisture content	60%	12%	37%
In situ heating value MJ/kg	5.3	17.3	11.1

After the EFB has arrived to the power station it will be shredded and dried to a moisture content of around 50% to improve the fuel quality. This leads to a heating value around 7.3 MJ/kg. For calculation of the amount of EFB that would have been landfilled it is the “raw” EFB that is relevant however.

Comparison between calculated and actual use of biomass in Kunak Bio Energy Plant

The fuel need for the new boiler is 260 GJ/hour based on 80 t steam per hour. This leads to an energy need of 3.25 GJ/t steam for the super heated steam.

The measured steam need per MWh at the Kunak mill is 6.02 t steam/MWh. This is somewhat higher than the value for optimal operation that was given by the boiler supplier (5.72 t steam/MWh). In the following it is chosen to use the actual amount of steam as this is measured and it takes into account the fact that the plant has not been operating at its optimum during 2006.

The energy need per MWh power produced can thus be calculated to be (6.02*3.25) 19.565 GJ/MWh.

The actual power production in 2006 was 69,109 MWh of which 49,532 MWh were delivered to SESB. The rest was used internally.

This leads to a total fuel need of 1,352,118 GJ.

The actual use of biomass fuel was

	EFB	**Shell**	**Fibre**
Ton used in Kunak project 2006	**103,989**	**24,385**	**69,933**
NCV used in PDD	**5.3**	**17.3**	**11.1**
Energy content - theoretical	**551,143**	**421,861**	**776,256**

The total energy supplied to the Kunak Bio Energy Plant was thus 1,749,260 GJ. The calculated energy content in the fuel is more the 20 % higher than the expected energy need (calculated above as 1,352,118 GJ). That indicates that the used heating values are high.

This leads again to an underestimate of the amount of biomass to be used in the boiler and this to a too low estimate of the amount of methane that will be avoided from being emitted.

It can thus be concluded that the heating values used are conservative.

Annex 7: Measurement of heating value for EFB

SGS

YOUR REF: -
DATE RECEIVED: SEPT 15, 2006
DATE REPORTED: SEPT 21, 2006

Report No. : **LPME/1132/06**
Company : **Messrs. TSH Resources Sdn. Bhd.**
Suite 701, Block E, Phileo Damansara 1, No. 9
Jalan 16/11, Off Jalan Damansara,
46350 Petaling Jaya, Selangor Darul Ehsan, Malaysia.

ANALYSIS REPORT

One (1) sample said to be 2^{ND} **PRESS FRESH A**, contained in a polythene bag, was received from M/s. TSH Resources Sdn. Bhd.

On analysis of the sample, the following results were obtained :-

TEST PARAMETERS		**TEST METHODS**	**RESULTS**	
Total Moisture, (ARB)	%	OVEN DRY	52.8	(Five two decimal eight)
Inherent Moisture, (ADB)	%	OVEN DRY	7.4	(Seven decimal four)
Gross Calorific Value, (ADB)	kcal/kg	BOMB CALORIMETER	4137	(Four one three seven)

Note : =1) ARB (As Received Basis)
2) ADB (Air Dried Basis)

SGS LABORATORY SERVICES (M) SDN. BHD.

ONG HAI CHING
B.Sc. (HONS) AMIC
LAB. DIV. MANAGER

Pg: 1 of 1

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Member of the SGS Group

Annex 8: Letter from PTM regarding availability of data for power baseline

Malaysia Energy Centre

(A not-for-profit company administered by the Ministry of Energy, Water and Communications, Malaysia)

Our Reference: PTM/PARM/(A)/QR:RECORDS-SECRETARIAT (V.2)/139
Date : 25 January 2007

MR. SOREN VARMING
Director
HV Carbon
501 Block B Cameron Towers
Gasing Heights
46000 Petaling Jaya
Selangor

Sir,

INFORMATION ON THE CDM ELECTRICITY BASELINE FOR THE YEAR 2005

With regards to the abovementioned, PTM is currently preparing the CDM electricity baseline for the year 2005. For your information, PTM is in the midst of acquiring more data from Energy Commission as some of the data submitted earlier were not captured during the previous exercise. A series of meetings and discussions were held with the Energy Commission in the hope of speeding up the data collection process.

2. Nevertheless, the updated version of the methodology also required extensive data information on power plants. This is where the data collection activities need to be refined further and hence, more time will be required.

3. We appreciate your request for the required information but we do apologise that the baseline for year 2005 is not available with us right now. However, the baseline for the year 2004 is available and can be used for your current purpose.

Thank you

Yours sincerely,

AZMAN ZAINAL ABIDIN
Deputy Director
Policy Analysis and Research Management Division
Pusat Tenaga Malaysia

QUALITY SYSTEM SIRIM CERTIFIED TO MS ISO 9001 Registration No.: AR 2238

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