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 JAYA BIO ENERGY PLANT, MALAYSIA

Version 1.4.1, 21/02/2007

A.2. Description of the project activity:

The project activity is to install an biomass energy plant at the new TSH-Wilmar Kunak Jaya Palm Oil Refinery and Kernel Crushing Plant utilising biomass waste for steam and power generation. This will reduce the energy 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 nearby palm oil mills and saw mills. 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. The wood waste was deposited and partly used for land reclamation close to the site.

The project is to install a highly efficient bio energy plant, where the biomass waste can be used to generate useful electricity and steam. The plant will be able to utilise waste products from palm oil mills Empty Fruit Bunches (EFB), but also smaller amounts of palm kernel cake from the refinery and wood waste from nearby saw mills. 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 three parts:

1) Production of CO_2-neutral electricity that will replace conventional electricity generation based on fossil fuel and thereby reducing GHG emission in the electricity production.

2) Production of heat using biomass fuels instead of Medium Fuel Oil.

3) Avoided methane emissions from landfill sites where EFB was deposited.

Sustainable development

The project will contribute to the use of sustainable renewable energy sources in the electricity generation system and support the country's fifth fuel policy that promotes the use of renewable energy.

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 and other pollutants from the plant.

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

Social sustainability

The project will generate new jobs for people from the surrounding area since the biomass energy plant is more labour intensive than buying power from grid or operating a MFO-fired boiler. The workers will need to be trained in using the state of the art machinery.

The Kunak Jaya 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 foreign exchange. The project will also have a positive impact on the economic performance of the refinery as energy production will be more reliable and efficient, enabling a more reliable production at the refinery and kernel crushing plant.

Additional to a business-as-usual scenario

The project is additional to a business-as-usual scenario as it will be among the first cogeneration plants fired mainly with EFB from palm oil process to supply electricity and steam to a palm oil refinery in Malaysia. The business-as-usual scenario for the power generation is to buy power from the grid.

A.3. Project participants:

The project owner is TSH-Wilmar (BF) Sdn Bhd. The contact for the CDM project activity is the Finance and Accounting Department at 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-Wilmar (BF) Sdn Bhd	Yes
Switzerland	Private Entity: Climate Cent Foundation	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-Wilmar (BF) Sdn. Bhd.

TSH- Wilmar (BF) Sdn. Bhd. is a 50%-50% joint venture company between TSH Resources Berhad (TSH) and Wilmar Group International. This company will be the project owner 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 with distribution in Europe, e.g. the UK, France, Spain, Germany, and the USA. They are collectively referred to as the "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

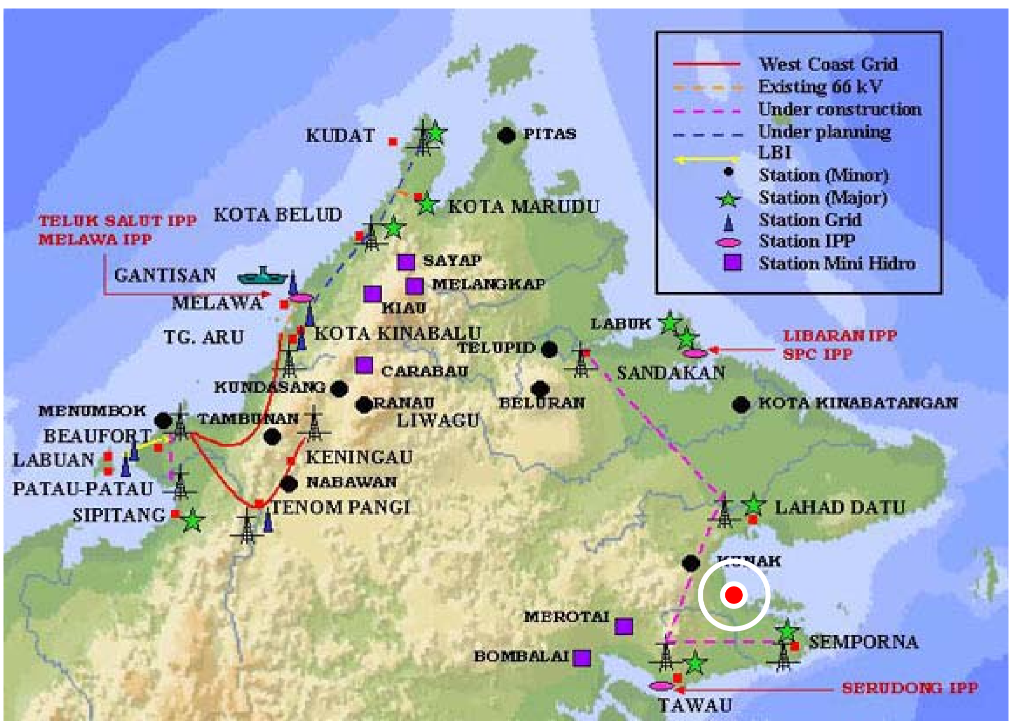
A.4.1.2. Region/State/Province etc.:

State of Sabah

A.4.1.3. City/Town/Community etc:

Kunak Jaya

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



The Kunak Palm Oil Refinery and kernel crushing plant is at KM 1, Kampung Kunak Jaya, 91207 Kunak, Sabah.

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:

TSH has evaluated the most appropriate technology for the new cogeneration plant. The proposed project consists of installing two biomass fired steam boilers and a condensing steam turbine.

The installation of boilers will consist of a new Vickers boiler installation producing 45 bar (g) super heated steam at 450ºC at a capacity of 52 tonnes per hour using biomass waste as fuel. It has an automatic combustion control system that ensures the effectiveness of biomass combustion and control of emission. Emission is mitigated using multi-cyclone system and the emission control complies with the prevailing emission regulation standards in Malaysia. The steam will be used to run the 10 MWe full condensing and multi stage Siemens steam turbine. The plant is constructed to supply at least 65,700 MWh of electricity for consumption of the refinery and kernel crushing plant every year.

Another biomass boiler is a 30t/hour steam generation boiler which will be supplied by Mc Kenzie. This boiler is designed to produce 20 bar saturated steam for the needs of the refinery.

The commissioning programme for the new installation will include adequate training and familiarisation of the new technology among the relevant operators and maintenance staff. This is important to minimise maintenance costs and dependency on the foreign suppliers of the equipment.

The bio-energy plant requires a steady supply of biomass. The source of fuel comprises 80% of EFB, 10% palm kernel cake and 10% wood waste. The EFB will have to go through a de-watering process to reduce the size and moisture content so that they are suitable as fuel. The wood waste will be processed by a wood chipper. In the future, mesocarp fibre and palm kernel shell (PKS) may also be used as alternative fuel in this project.

Table A.2 Key data for the project:

	Average	**Maximum**
Annual steam production	538,740 t steam	656,000 t steam
Annual power production	65,700 MWh	80,000 MWh
Annual consumption of biomass	302,846 Tonnes	368,762 Tonnes

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

Table A.3: The total GHG emission reductions in tCO_{2eqv} over the crediting period

Years	**Annual estimation of emission reductions in tonnes of CO_{2eqv}**
Year 2007 (32 weeks)	96,140
Year 2008	184,337

Year 2009	220,748
Year 2010	245,156
Year 2011	261,516
Year 2012	272,483
Year 2013	279,834
Year 2014 (20 weeks)	109,441
Total estimated reductions (tonnes of CO_{2eqv})	1,669,656
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_{2eqv})	238,522

As the project has the expected registration date May 15th 2007 only 32 weeks have been included for 2007 and subsequently 20 weeks have been added in 2014 to get a seven year crediting period.

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 version_4: "Consolidated baseline methodology for grid-connected electricity generation from biomass residues"

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

The consolidated methodology ACM0006-version_4 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 Jaya Bio Energy Project falls clearly under this definition as:

- The predominant **fuel is biomass waste:** empty fruit bunches from nearby palm oil mills, palm kernel cake from the refinery and wood waste from neighbouring wood industry. In the future, other substituting oil palm biomass such as mesocarp fibre and palm kernel shell may be used as fuel in this project to complement or replace wood waste and palm kernel cake. Fossil fuels are only used for start up and back up purposes.

- The project **does not affect the production capacity** at the palm oil refinery and kernel crushing plant and does not lead to any increase in processing capacity or changes in products.

- The biomass used for 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 for fuel is **not undergoing major pre-treatment** – only the empty fruit bunches will undergo a de-watering process to improve the fuel properties.

- The project is **a green field power project** since there was no power or steam production on site before the 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 ACM0006
		CH_4	No, for the purpose of simplification – this is conservative
		N_2O	No, for the purpose of simplification – this is conservative
	Heat generation	CO_2	Yes, by using the calculations prescribed by the ACM0006
		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.

		N_2O	No, for the purpose of simplification – this is conservative
Project	Combustion of biomass residues for renewable electricity and/or heat generation	CO_2	No, CO_2 emissions from biomass are 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.
	On-site fossil fuel and electricity consumption due to the project activity (stationary or mobile)	CO_2	Yes, the emissions from using fossil fuels for start-ups or when biomass humidity is too high at the project site. Electricity used for the wood chipper is calculated as project emissions
		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.

B4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The identification of the baseline scenario has followed the recommendation in the ACM0006 and has established the baseline separately for power generation, heat generation and biomass handling.

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 be 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 Jaya Bio Energy Project is one of the first of its kind in Malaysia in supplying electricity to industrial processes based on EFB. Reducing the efficiency would not have made the project more likely.
P3	The generation of power in an existing plant, on-site or nearby the project site, using only fossil fuels	There could have been established a diesel fired power plant at the site to supply the electricity. There would be reliability issues with this solution that make it less likely than P4. Since the grid also get its power from diesel plant then the baseline will be the same in the two cases
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. The only option for cofiring would be to transport the very bulky EFB to existing coal fired power stations in Peninsular Malaysia. There are significant practical barriers to such a solution and no such projects 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. The only option for cofiring would be to transport the very bulky EFB to existing coal fired power stations in Peninsular Malaysia. There are significant practical barriers to such a solution and no such projects have been seriously considered.

The most likely baseline scenario for electricity production on site are P3 (on site power production) or P4 (buying power from the grid). Since both use diesel, the baselines in terms of savings per kWh produced, are the same. As such, the use of the grid (P4) is selected as the baseline.

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	There are significant barriers to establishing combined heat and power production from biomass
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	Cogeneration is only relevant with the technical parameters in the CDM project. It has not been possible to optimise a design that would be feasible without CDM.

	(e.g. an efficiency that is common practice in the relevant industry sector)	
H3	The generation of heat in an existing cogeneration plant, on-site or nearby the project site, using only fossil fuels	There are no existing boilers as this is a greenfield project
H4	The generation of heat in boilers using the same type of biomass residues	Using biomass to generate steam has investment barriers since building a biomass plant or purchasing a biomass boiler to generate steam is an expensive option and it is more expensive compared to using MFO.
H5	The continuation of heat generation in an existing cogeneration plant, fired with the same type of biomass as in the project activity.	This is a green field project, so there is no possibility of continuation of an existing production.
H6	The generation of heat in boilers using fossil fuels	This is an alternative. MFO would be used for steam generation if the biomass power plant is not implemented.
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)	It is not considered likely that other renewable energy sources would become competitive for steam production in industrial scale

The conclusion is that the most likely baseline scenario for the delivery of process steam for palm oil refinery and kernel crushing plant is producing steam with Medium Fuel Oil (MFO).

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

Table B.4 Possible baseline scenarios for use of biomass

Number	Description	Evaluation
B1	The biomass residues are dumped or left to decay under mainly aerobic conditions. This applies, for example, to dumping and decay of biomass residues on fields	'Biomass residues from nearby palm oil mills e.g. empty fruit bunches are transported to landfills for depositing
B2	The biomass residues are dumped or left to decay under clearly anaerobic conditions. This applies, for example, to deep landfills with more than 5 meters. This does not apply to biomass residues that are stock-piled or left to decay on fields.	Most of the empty fruit bunches are left to decay in landfills of more than 5- meters depth
B3	The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposes	Open burning is prohibited in Malaysia
B4	The biomass residues are used for heat and/or electricity generation at the project site	There are serious barriers against using biomass for industrial heat and power – see

		heat baseline above
B5	The biomass is used for power generation, including cogeneration, in other existing or new grid connected power plants	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 coal fired power stations in Peninsular Malaysia. No such projects have been seriously considered.
B6	The biomass residues are 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
B7	The biomass residues are used for other energy purposes, such as the generation of biofuels	The technologies for using the EFB for generation of biofuels such as ethanol are still not developed to a commercial scale. There are only laboratory experiments and there may be opportunities in a long term, but they are not available today
B8	The biomass is used for non-energy purposes, e.g. as fertilizer or as feedstock in processes (e.g. in pulp and paper industry)	The EFB used for mulching in TSH plantations are accounted for in the Kunak Bio Energy Project

The most likely baseline scenario for the use of biomass is B1, which is dumping at a dumpsite.

Energy needs in the project case
The project installs one boiler for steam production only with a steam production capacity of 30 t steam per hour at 20 barg(g). The boiler efficiency is expected to be 80%. The energy need per ton steam is expected to be 2.36[1] GJ/t steam.. With a load factor of 75% this leads to an annual steam production of 197,100 t steam and an annual fuel need of 581,445 GJ.

The project also installs a 52 t steam/hour boiler to provide superheated steam 45 barg(g) and 450^{o}C for a 10 MW steam turbine. This turbine needs 2.88[2] GJ/t steam. Also this boiler has an efficiency of 80%. With a load factor of 75% this leads to an annual steam production of 341,640 t steam and a power production of 65,700 MWh. The annual fuel need will be 1,229,904 GJ.

Adding the fuel needs for the two boilers lead to total energy need for the Kunak Jaya Bio Energy Plant of 1,811,349 GJ or 1811 TJ.

The expected energy mix is 80% Empty Fruit Bunches, 10% palm kernel cake and 10% wood waste. With an energy content of 5.3 GJ/ton, 16 GJ/ton and 10 GJ/ton respectively, the total amount fuel is expected to be 302,846 t fuel per year at 75% load. The fuel need in the maximal load case will be 2206 TJ and 368,762 t biomass.

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[1] Keenan & Keyes: Thermodynamic properties of steam. Wiley

[2] Keenan & Keyes: Thermodynamic properties of steam. Wiley

Summary of choice of baseline scenario

The most likely baseline scenario is scenario 2 in the ACM0006: "*The project activity involves the installation of a new biomass residue fired power plant at a site where no power was generated prior to the implementation of the project activity. 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 residues would in the absence of the project activity be dumped or left to decay under anaerobic conditions in dumpsites of 5-6 meters depth. In case of cogeneration plants, the heat would in the absence of the project activity be generated in boilers fired with fossil fuels, or by other means not involving the biomass residues. This may apply, for example, where prior to the project implementation heat has been generated in boilers using fossil fuels*."

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:

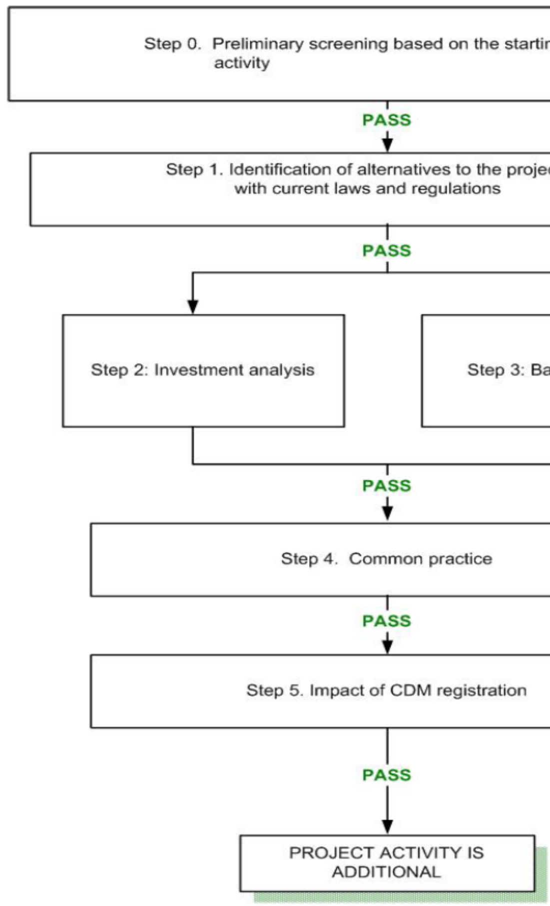

Figure B 1: Consolidated Additionality Assessment Tool Steps

(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 will be commissioned by April 01, 2007. The project was seriously considering use of the CDM well ahead of the commissioning date. At the Board meeting in January 2006 it was decided to proceed with the project. A contract was entered with the CDM consultant in July 2006 before start of the construction in August 2006.

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 project – a biomass fired cogeneration system co-financed by CDM and
- The baseline consisting of a hypothetical boiler fired with MFO and electricity supplied from the electricity grid and biomass waste deposited in landfills.

Both alternatives are consistent with existing legislation.

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 and steam to the refinery) 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 is 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[3]. 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 as the project is close to implementation. The calculation of IRR is shown for a ten-year period.

Table B.5 Main assumptions for financial analysis

Parameter	Value
Capital costs	42,760,000 MYR
Power price (first five years)	0.2125MYR/kWh
Power price (year 6 and onwards)	0.2338 MYR/kWh
Fixed Operating Costs (year 1)	7,925,000 MYR
Fuel costs	7,757,000 MYR
Interest rate for loan financing	7 % per year
Inflation	3 % per year
CER price	10 USD/t CER

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

For the sensitivity analysis the main uncertainty is the amount of power produced from the project. The base assumption is that the plant will be operational in 6570 full load hours (equivalent to a load factor of 75%). For the sensitivity analysis the IRR is also shown for 4000 full load hours (load factor 45%) 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.

Table B 6: Sensitivity analysis of the IRR of the Kunak Jaya Bio Energy Project

Options	Full load hours	IRR without CDM (%)	IRR with CDM (%)
High production	8000	14.6	36.6
Base Case	6570	3.2	28.3
Low production	4000	Not defined	8.3

The conclusion of the financial analysis is that the IRR is very sensitive to the annual power production. Under realistic assumption of a load factor of 75% the IRR without CDM is only 3%. This is clearly below the investment benchmark. Only in the event of a sustained maximum theoretical production, the IRR is approaching the level of 15%. In the case of reduced production the IRR falls below zero and the project becomes non-viable without CDM.

The income from CDM contributes significantly to bringing the IRR above the investment benchmark of 15% in the base case.

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.

This project is located at a palm oil refinery and kernel crushing plant. These processes only produce few waste products useful for energy production. Only the palm kernel cake can be used for energy production, but the palm kernel cake has a high nutrient content and can also be sold to the market as animal feed.

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

<u>Investment barrier</u>

The project is a pioneer in utilisation of waste from palm oil mills for electricity supply for a palm oil refinery and kernel crushing plant. Since the project is not delivering power to the grid there are no government incentives for such investments in Malaysia. The Malaysian government only supports grid connected renewable energy projects through the SREP (Small Renewable Energy Project).

This means that the project developer will have to carry the whole burden of the extra financial costs of a biomass boiler – compared to conventional fossil fuel boilers. The costs of a biomass boiler are 2-3 times higher than similar fossil fuel fired boilers.

The experience from Kunak Bio Energy Project shows that there are significant operational risks involved in establishing an EFB fired biomass plant. In the Kunak project the first two years did not live up to the expectations in relation to power production. These operational problems aggravates the risks of the higher investment costs for biomass boilers – as the income stream in the first years is very important for the IRR of the investment.

Technological barrier

The project is one the first of its kind in Malaysia utilising a high pressure boiler fired with EFB and used for production of electricity. The boilers will be manufactured by international boiler manufactures and delivered in Malaysia. The project will thus lead to technology transfer and increasing experience with more efficient, high pressure boilers in Malaysia. There are significant technological risks involved in the project:

- 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 similar 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 large scale dewatering technology is still under development in Malaysia before and forms a certain technological risk for the project.

Fuel supply risk

No market has so far been established for EFB and it has been very difficult to enter into long term fuel supply contracts.[4] This is partly due to the fact that the palm oil millers are starting to see there EFB as a potential source of income – instead of a waste product. Most of the possible alternative uses of EFB (pulp and paper production, medium density fibre board, composting and power production) are not realised as commercial viable alternatives in large scale. They all still have high financial and technical risks, but the prospect of possible alternative uses being commercialised has been enough to deter palm oil millers from entering into long term fuel supply contracts for EFB. This lack of long term contracts for the fuel supply – and for the price of fuel further increases the barriers to implementing the proposed project.

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[4] Danida/EPU 2006: Barrier Analysis for the Supply Chain of Palm Oil Processing Biomass (Empty Fruit Bunch) as Renewable Fuel

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 fossil fuel fired boilers for steam production, landfilling of the biomass wastes and production of power by utility owned diesel generators.

The investment costs of a fossil fuel fired boilers are significant lower than high efficient biomass boilers. The operational uncertainties are also minimal since there is a long term experience with the operations and maintenance of medium fuel oil operated boilers.

Landfilling is the de facto accepted way of disposing of the EFB 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 palm oil mills. 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:
Energy consumption in industry accounts for close to 40% of total energy consumption in Malaysia.

A broad variety of fuels is used currently, by far dominated by fossil fuels, and only to a very small extent – less than 0.5%, and not accounted for in official energy statistics.

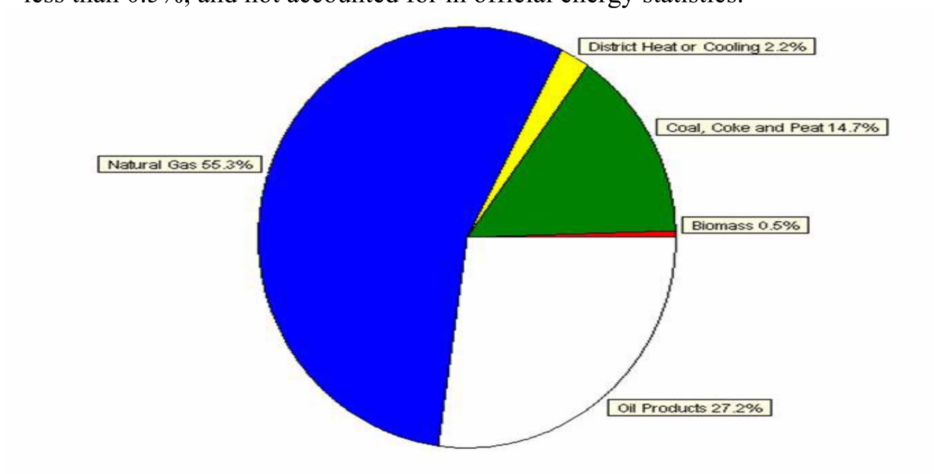


Figure B2 Distribution of fuels used in the total industrial sector in Malaysia, 2003. Source: National Energy Balance, PTM

The statistics shows clearly that the energy use in industry in Malaysia is dominated by use of fossil fuels. Very few companies have been using biomass as fuel. Most of the biomass fuel has been palm kernel shells used in i.e. cement industry whereas the use of EFB has been very limited (and mainly confined to CDM projects).

The statistics show clearly that the use of biomass and even more EFB in industrial appliances is very limited in Malaysia – out side the palm oil mills.

Sub-step 4b: Discuss any similar options that are occurring
Two similar projects to the present have been seen recently – Lahad Datu Edible Oil and Sandakan Edible Oil – both refineries are in the process of replacing existing fossil fuel fired boilers with biomass fired boilers. Both the mentioned projects have been registered as CDM projects and have as such only been implemented because of the extra income from the sale of CERs.

There is thus no reason to believe that similar projects to the proposed will implemented with out the use of CDM to reduce the risks involved in the implementation of high efficient biomass boilers for power production in Malaysia.

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 25%-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 will thus have a significant impact on the viability of the Kunak Jaya Bio Energy Project and can be said to have a major influence in the implementation of this ground breaking project. The increased income of the project makes the project owner more willing to pursue the project despite the technical risks involved – because the potential upside for the income is attractive when the revenue from the sale of CERs is taken into account.

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 Jaya project in steps 2 and 3 and it is strongly supported by the fact that the Kunak Jaya project is the one of the first of this type of projects being implemented in Malaysia. The development of the Kunak Jaya project as CDM project is instrumental to make the project viable.

It can thus be concluded that the Kunak Jaya 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.

The second choice is the baseline scenario described in detail in B4 above. The conclusion is that this project should be evaluated under scenario 2:

"The project activity involves the installation of a new biomass residue fired power plant at a site where no power was generated prior to the implementation of the project activity. 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 residues would in the absence of the project activity be dumped or left to decay or burnt in an uncontrolled manner without utilizing it for energy purposes. In case of cogeneration plants, the heat would in the absence of the project activity be generated in boilers fired with fossil fuels, or by other means not involving the biomass residues. This may apply, for example, where prior to the project implementation heat has been generated in boilers using fossil fuels".

This scenario is relevant since it is a greenfield project where the baseline is that:

- Power would have been purchased from the grid
- Heat would have been generated from MFO
- Biomass could have been left to decay in dumpsites of more than 5 meters depth.

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, including a 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 actual plant layout is shown in figure B-3, while a schematic presentation is in Figure B-4.

Figure B 3 – Site plan for Kunak Jaya Refinery, Kernel crushing plant and Bio Energy Plant

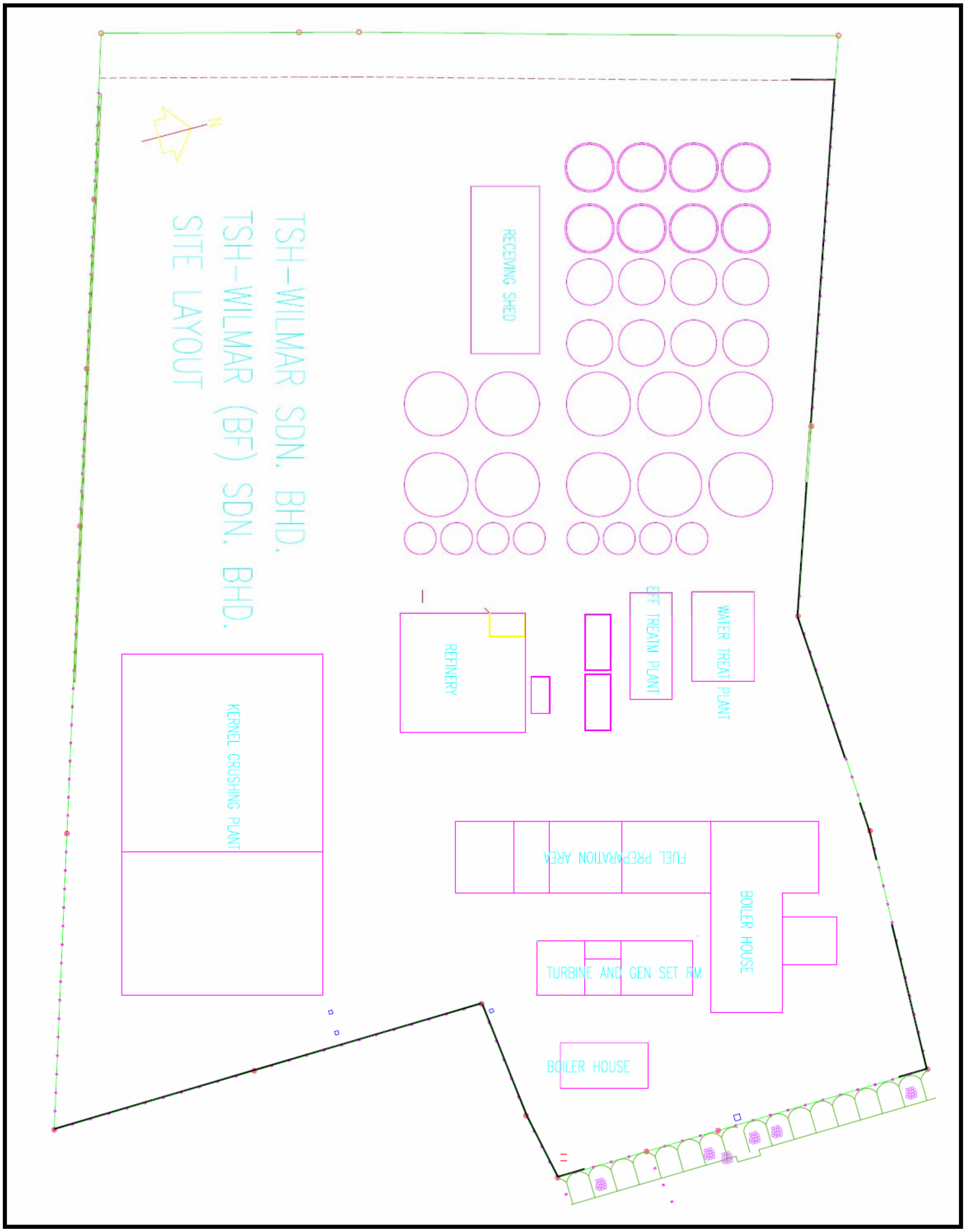
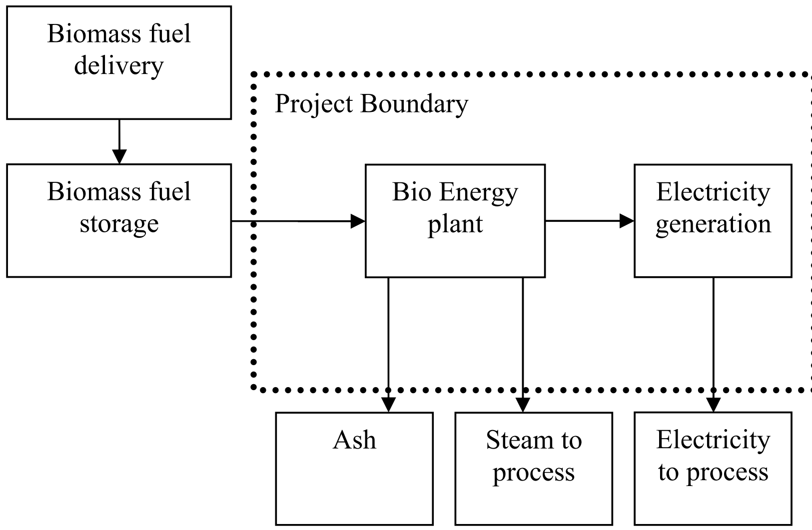

TSH–WILMAR SDN. BHD.
TSH–WILMAR (BF) SDN. BHD.
SITE LAYOUT
RECEIVING SHED
REFINERY
EFF TREATM PLANT
WATER TREAT PLANT
KERNEL CRUSHING PLANT
FUEL PREPARATION AREA
BOILER HOUSE
TURBINE AND GEN SET RM
BOILER HOUSE

Figure B4: Project Boundary



The emissions generated within the project boundary occur from the combustion of the biomass fuel, which comprises empty fruit bunches (EFB), palm kernel cake and wood. In the future, oil palm biomass wastes such as mesocarp fibre and palm kernel shell may also be used as alternative fuel. As all of these are renewable energy sources 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 = Emissions reductions of the project activity during the year *y* in tons of CO_2,

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

$ER_{heat,y}$ = Emission reductions due to displacement of heat during the year *y* in tons of CO_2,

$BE_{biomass,y}$ = 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 = Project emissions during the year *y* in tons of CO_2, and

L_y = Leakage emissions during the year *y* in tons of CO_2.

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 ($PE_{Biomass,CH4,y}$). It also includes electricity used for production of wood chips:

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

Where:

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

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

$PE_{EC,y}$ = CO_2 emissions during the year y due to electricity consumption at the project site that is attributable to the project activity (tCO_2/yr)

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

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

Biomass fuel transportation:

The bio energy plant will consume EFB, which is a waste product obtained from palm oil mills in the surroundings. The fuel will be transported from four palm oil mills (Mill A 21km, Mill B 34km, Mill C 29km and Mill D 35km from the refinery) with an average distance to Kunak Jaya Bio Energy Plant of 30 km.

Each truck will transport an average of 20 tons of palm oil waste to the Kunak Jaya Plant with a fuel use of 39 liter diesel/100 km. The total amount of biomass fuel used for the CDM project is 302,846 t biomass fuel per year. Of these the 29,434 t/year will be palm kernel cake and wood waste from the immediate vicinity of the plant (less than 1 km) and there will be no net-transport emissions from there. The remaining 273,411 t biomass will be EFB from 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 273,411 tons of EFB to be used as fuel annually ($BF_{k,y}$) and average 20 ton per truck (TL_y), it will be 13,671 trips to bring fuel to the project site. The average distance to the palm oil mills is 30 km, so the round trip will be 60 km. (AVDy = 60 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 = 273,411/20 *60*0.001053 t CO_2/year = 864 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. After the implementation of the Kunak Jaya Bio Energy Plant the diesel consumption will be monitored and the Project emissions will be calculated as:

CO_2 emissions from combustion of respective fuels are calculated as follows:

$$PEFFy = \Sigma\, (FF_{project\ plant,i,\ y} + FF_{project\ site,i,y}) \cdot NCV_i \cdot COEF \quad \mathbf{(2b)}$$

Where:

$FF_{project\ plant,i,y}$ = Quantity of fossil fuel type *i* combusted in the biomass power plant during the year *y* (t)

$FF_{project\ site,i,,y}$ = Quantity of fossil fuel type i combusted at the project site for other purposes that are attributable to the project activity during the year y (t)

NCV_i = Net caloric value of fossil fuel type i (GJ/t)

$EF_{CO2,FF,i}$ = CO_2 emission factor of the fuel type *i* (tCO_2/GJ)

The annual fuel use in a similar project, the Kunak Bio Energy Plant, has 83,000 litre diesel for back up in 2006. This seems to be a conservative value since the Kunak plant was not running optimal in 2006. With

an emission factor of 2.7 kg CO2/litre the annual project emissions from fossil fuel would be 224.1 ton/year.

Electricity consumption at the project site

CO_2 emissions from the electricity consumption at the project site will be from the wood chipper. The wood chipper will be preparing the waste wood from neighbouring sawmill. The energy consumption from the wood chipper is 5 kWh/ton wood. The total amount of wood waste is 18,113 t/year. This will result in a total energy consumption of 90567 kWh. With the emission factor used for electricity (0.8 kg CO2/kWh) this will give project emissions of 72 t/year.

$PE_{EC,y} = 72\ t/year$

Methane emissions from burning of biomass

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

$$PE_{Biomass,CH4,y} = EF_{CH4,BF} \cdot \Sigma BF_{k,y} \cdot NCV_k \quad \textbf{(2c)}$$

Where:

$BF_{k,y}$ = Quantity of biomass type *k* used as fuel in the project plant during the year *y* in a volume or mass unit,
NCV_k = Net calorific value of the biomass type k in terajoules (TJ) or MWh per mass or volume of biomass,
$EF_{CH4,BF}$ = 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 to the ACM0006 the level of uncertainty for such emissions is larger than 100% and therefore a conservativeness factor of 1.37 is used. The value used in the formula will thus be 41.1 kg CH_4 /TJ. The energy used in the plant will be 1811 TJ and this will amount to a total of 1563 tonnes CO_{2eqv}/year.

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

Emission reductions from heat

The calculation formula for emission reductions from heat is:

$$\frac{ER_{heat,y} = Q_y \cdot EF_{CO2,BL,heat,i}}{\varepsilon_{boiler}} \quad \textbf{(3)}$$

Where,

Q_y = Quantity of generated heat that displaces heat generation in fossil fuel fired boilers

ε_{boiler} = Efficiency of boiler in the absence of the project activity

$EF_{CO2,BL,heat,i}$ = CO2 emission factor of the fuel type that would be used in the absence of the project activity

The steam production is 30 t steam/hour. With 6570 hours of use the amount of steam supplied to the refinery will be 197,100 t steam/year. With an energy content of 2.36 GJ/ton steam and a boiler efficiency of 90%[5] the annual fuel need is 516,840 GJ. The IPCC emission factor for MFO is 74 kg CO_2/GJ.

$ER_{heat,y}$ = $Qy/Q_{project\ plant,y} * EF_{CO2,BL,heat,i}$/Boiler efficiency

= 516,840*0.074/0.9

= 38,246 t CO_2/year

Emission Reductions from electricity production

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

$$ER_{electricity,y} = EG_y \cdot EF_{electricity,y} \quad \textbf{(4)}$$

Where:

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

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

$EF_{electricity,y}$ = 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.

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[5] Normally the efficiency in industrial steam boilers using MFO is 80-85% (Ref: Danida/REEE Component: Biomass boiler in Paper Industry. Can be downloaded from www.eib.org.my). For the baseline boiler it is chosen to use 90% efficiency to be conservative.

The base years for the calculation are 2002-04, for which the latest statistics are available. Information has been obtained from SESB.

Table B.6 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] Since actual fuel use data has not been available the emission coefficient for the grid system is obtained from Table I.D.1 in AMS I.D, 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 $kgCO_2$/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.[6]

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 produced for onsite use at the refinery and kernel crushing plant from the project activity ($EG_y = EG_{project\ plant,y}$). The baseline is that this electricity would have been imported from the grid.

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

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

The EFB and wood waste used as fuel in the Kunak Jaya Bio Energy Plant would have been deposited in a landfill as described in B4 above. The *"Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site (version 1-EB26)"*has been used for the calculations.The method below is used to evaluate the yearly methane generation potential in the landfill. The quantity of methane projected to be formed during a given year is estimated using a first order decay model based on the discrete time estimate method proposed in the IPCC Guidelines:

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

(**5**)

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 at 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

GWP_{CH4} = Global Warming Potential (GWP) of methane, valid for the relevant commitment period

OX = Oxidation factor (reflecting the amount of the methane from SWDS that is oxidised in the soil or other material covering the waste)

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 as illustrated in the table below

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

EFB is not included in the IPCC default figures and there is thus a need to make an assessment of the appropriate values.

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

Table B.7: IPCC default values for the methane correction factor (MCF)

Type of site	**Methane correction factor (MCF) default values**
Managed	1.0
Unmanaged – deep (≥5m waste)	0.8
Unmanaged – shallow (<5m waste)	0.4
Default value – uncategorised SWDSs	0.6

In the present case the landfills are 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.11 below.

Table B.8: IPCC (2006) Default values for the decay factor

Waste type *j*		**Boreal and Temperate (MAT<20ºC)**		**Tropical (MAT>20ºC)**	
		Dry (MAP/PET<1)	**Wet (MAP/PET>1)**	**Dry (MAP<1000mm)**	**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

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 analyses are for aerobic conditions (Rosenani et. al. showed from laboratory data 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.

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 results of the study.

Table B 9: IPCC (2006) Default values for DOCj

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

The parameters for food waste are chosen to the consistent with the choice of decay factor.

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.

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 ACM0006 prescribes 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 most of the biomass fuel (all except the palm kernel cake).

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

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

Here it was decided 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 B.10 Number of palm oil mills in neighbouring districts

Lahad Datu	31
Tawau	12
Kunak	8
Semporna	3
Total	54

Data in Table B.9 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 10 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, the approximation is justifiable.

The total amount of FFB processed in Sabah in 2005 was 24,998,052 tonnes. In order to simulate the growth in the palm oil production in Sabah, a 3.5% p.a. growth rate is used to project a production for 2007 of 26,775,382 tonnes FFB. The gives an average of 239,066 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 12,909,559. Of this 23% will be EFB, or 2,969,199 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 a utilisation of 12% of the EFB for mulching.

2007	Calculation	Amount t/year
Total available FFB	Total Sabah production proportioned with number of mills in four districts	12,909,559
Total available EFB	23% of FFB	2,969,199
Used for mulching	12% of EFB	356,304
Used in Kunak Mill		248,069
Used in Kunak Jaya		273,411
Total used EFB	(Kunak, Kunak Jaya + mulching)	877,784
Excess in percentage	100 % - (Total used/Total available)	70%

Table B.11: Use of EFB in eastern Sabah

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 there will be no leakage.

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 :	Since the East Sabah grid only use diesel and MFO fired production – and since the actual fuel consumption is not know to the project participants the IPCC default value has been used. This gives the same result as the Danida/PTM study on baselines for power sector in Malaysia.
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
Justification of the choice of data or description of measurement methods and procedures actually applied :	
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
Justification of the choice of data or description of measurement methods and procedures actually applied :	
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 applied :	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.
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 landfills of more than 5 meters depth. The landfills used for EFB in East Sabah are more than 5 meters depth.
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 a high conservativeness factor is used in calculating the annual emissions. Despite this, the emissions are 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:	

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 relatively small. The uncertainty incurred by using default values will thus be minimal and not justify spending resources on measurements
Any comment:	

Data / Parameter:	ε_{boiler}
Data unit:	-
Description:	Average net efficiency of heat generation in the boiler(s) when fired with fossil fuels
Source of data used:	TSH
Value applied:	90%
Justification of the choice of data or description of measurement methods and procedures actually applied :	. The 90% reflects a very modern boiler with economizer as opposed to most industrial boilers used in Malaysia. The 90% efficiency is also higher than the implemented biomass boiler. This makes the assumption very conservative.
Any comment:	

Data / Parameter:	**$EF_{CO2,BL,heat,I}$ CO_2 Emission factor for Medium fuel Oil**
Data unit:	Kg CO_2/GJ MFO
Description:	The emission of CO_2 from burning of one GJ of MFO
Source of data used:	IPCC 2006 Guidelines (Volume 2, Table 2.2)
Value applied:	74 kg CO_2/GJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	The emission factor for MFO is a standard value and therefore there is no need to make measurement of it at the site.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

The calculations of emission reductions include the following components:

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

Where:

ER_y = Emissions reductions of the project activity during the year *y* in tons of CO_2,

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

$ER_{heat,y}$ = Emission reductions due to displacement of heat during the year *y* in tons of CO_2,

$BE_{biomass,y}$ = 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 = Project emissions during the year *y* in tons of CO_2, and

L_y = Leakage emissions during the year *y* in tons of CO_2.

Of these L_y are estimated to be zero.

$ER_{heat,y}$ is calculated and the result shows the emission from heat generation is 38,246 t CO2/year.

$ER_{electricity,y}$ are calculated from the expected annual supply of electricity to the grid and the grid emission factor. The electricity delivered to the refinery and kernel crushing plant 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. For the further use in the calculations a lower load factor of 6570 hours is used as a conservative estimate of the actual production. This leads to estimated emission reductions of 52,560 t CO_2 per year. The actual supply of power delivered to the end user will be measured and reported in the monitoring report and used in calculating the actual amount of emission reductions achieved.

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

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

DOC_j = Per cent of degradable organic carbon (by weight) in the waste type j

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

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

$A_{j,x}$ = Amount of organic waste type j land filled in the year x

k_j = Decay rate for the waste type j

Conservativeness factor: 0.9

Table B12: A summary of the parameters for EFB:

	$A_{j,x}$ Amount of organic waste	DOC_j Per cent of degradable organic carbon	k_j Decay rate	MCF methane correction factor
EFB	273,411	0.15	0.4	0.8

Table B.13: Computation of the avoided methane emissions from EFB

Avoided methane estimate	2007	2008	2009	2010	2011	2012	2013	2014
Deposited year 1	46,595	31,233	20,936	14,034	9,407	6,306	4,227	1,626
Deposited year 2		75,716	50,754	34,021	22,805	15,287	10,247	3,941
Deposited year 3			75,716	50,754	34,021	22,805	15,287	5,880
Deposited year 4				75,716	50,754	34,021	22,805	8,771
Deposited year 5				,	75,716	50,754	34,021	13,085
Deposited year 6						75,716	50,754	19,521
Deposited year 7							75,716	29,122
Avoided methane	46,595	106,949	147,406	174,525	192,704	204,889	213,058	83,959
Incl conservativeness	41,935	96,254	132,666	157,073	173,434	184,400	191,752	75,563

Project emissions

The emissions of methane from the burning of biomass are calculated as 1563 t CO_2/year. This is based on a use of 1811 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 relatively small. Here the emissions are calculated to 224.1 ton CO2/year using data from Kunak Bio Energy Plant 2006 as background for the estimate, but the use of diesel will be monitored and the actual project emissions will be reported in the monitoring report and used for the calculation of emission reductions.

The transport of biomass fuel to the power plant has been calculated as 864 t CO_2/year based on an average distance to the palm oil mills supplying the fuel of 30 Km, 20 ton trucks and an average fuel use of 0.39 litre diesel per km.

Power for the preparation of wood fuel is 5 kWh/t and with a total amount of wood fuel of 18,113 t/year gives and energy consumption of 90,567 kWh. With en EF for electricity of 0.8 kg/kWh that becomes 72 t CO_2/year.

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

Table B.15; 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)**
2007 (32 weeks)	97,816	1,676	0	96,140
2008	187,061	2,724	0	184,337
2009	223,472	2,724	0	220,748
2010	247,879	2,724	0	245,156
2011	264,240	2,724	0	261,516
2012	275,207	2,724	0	272,483
2013	282,558	2,724	0	279,834
2014 (20 weeks)	110,489	1,048	0	109,441
TOTAL	1,688,720	19,065	0	1,669,656
Average	241,246	2,724	0	238,522

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$EG_{project\ plant,y}$ Power production**
Data unit:	MWh/year
Description:	The sale of electricity to the palm oil refinery and kernel crushing plant
Source of data to be used:	Direct measurement
Value applied :	The estimated sale to the industries is 65,700 MWh reflecting 6570 full load hours use of the 10 MW 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 monthly. The readings will follow the same periods as the billing period in the agreement under which electricity is supplied to the industries, meaning that the readings will be for each calendar month.
QA/QC procedures to be applied:	The project owner and the palm oil refinery 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:	**$FF_{project\ plant,i,y}$ Use of diesel in the Kunak Jaya 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 applied :	The diesel used for back up is expected to be like the Kunak Bio Energy Plant in 2006 83,000 liter/year. This was a year with some operational challenges for the plant so the diesel consumption was higher than the expected long term consumption. The Kunak plant is also bigger 14 MW, so the number used is expected to be conservative.
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:	**$BF_{k,y}$ Amount of biomass used as fuel in the Kunak Jaya 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
Value applied:	302,846 t per year is the expected biomass amount need for 75% load factor of the power station
Description of measurement methods and procedures to be applied:	The biomass waste products will be weighed upon arrival at the power plant. 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.
QA/QC procedures to be applied:	Since the data for the amount of biomass is part of a commercial transaction the best effort will be done to establish the correct amount.
Any comment:	The amount of biomass can be cross checked with the electricity produced– by using values for energy content of the biomass and the efficiency of the boiler

Data / Parameter:	**DOC*f***
Data unit:	Fraction
Description:	Fraction of DOC dissimilated to landfill gas
Source of data used:	IPCC
Value applied:	0.5
Description of measurement methods and procedures actually applied :	The default value has been reduced during revision of IPCC guidelines. The value is used as a global average. This seems to be excessively conservative for the present project since the DOC_f is linked to temperature.
QA/QC procedures to be applied:	
Any comment:	The project entity will prepare a study on a project specific DOC_f 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:	**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 applied:	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 Rosenani et al. from laboratory data that showed the decay of half the EFB volume in 15 weeks in a controlled experiment[8]. 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:	**DOC_j** 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 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value applied:	0.15
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
QA/QC procedures to	

8 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.

be applied:	
Any comment:	The value could be measured and reported as part of the ex post calculation of the avoided methane emission

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:	Decisions under UNFCCC and the Kyoto Protocol (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
Value applied:	21
Description of measurement methods and procedures actually applied :	Annual monitoring needed.
QA/QC procedures:	
Any comment:	

Data / Parameter:	**NCV_{EFB}**
Data unit:	GJ/ton of biomass residue
Description:	Net caloric value of EFB
Source of data:	Measurements
Value applied:	17 MJ/kg as dry matter – recalculated to 5.3 MJ/kg at 60% moisture content Since the plant is not in operation yet generic data has to be used. Source: TSH experience from Kunak Bio Energy Plant
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_{pkc}**
Data unit:	GJ/ton of biomass residue
Description:	Net caloric value of palm kernel cake
Source of data:	Measurements
Value applied:	18 MJ/kg as dry matter – recalculated to 16 MJ/kg at 10% moisture Since the plant is not in operation yet generic data has to be used. Source: Data from MPOB and plant managers experience.
Description of measurement methods	Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measure the NCV based on dry biomass.

and procedures actually applied :	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_{wood}**
Data unit:	GJ/ton of biomass residue
Description:	Net caloric value of wood
Source of data:	Measurements
Value applied:	19 MJ/kg as dry matter – recalculated to 10 MJ/kg at 42% moisture content. Since the plant is not in operation yet generic data has to be used. Source: Danida/MEWC/EPU: Renewable Energy Resources
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:	**$EF_{km,CO2,y}$**
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
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:	**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.
Value applied:	60
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:	13,671
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
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:	**$Q_{project\ plant,y}$**
Data unit:	GJ
Description:	Quantity of the steam generated for the refinery
Source of data:	On-site measurement
Value applied:	197,100 GJ
Description of measurement methods and procedures actually applied :	Continuously
QA/QC procedures:	Check consistency of the net heat generation by cross-checked with receipts from sales (if available) and the quantity of the fossil fuels
Any comment:	

Data / Parameter:	-
Data unit:	Tons
Description:	Quantity of EFB that are utilized (used for energy generation) in the defined geographical region
Source of data:	Survey or statistics
Value applied:	877,784
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.
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 biomass residues type k in the region
Source of data:	Calculations are based on annual production statistics from MPOB on state level recalculated to cover the districts of Lahad Datu, Kunak, Tawau and Semporna
Value applied:	2,969,199
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:	**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% Wood waste: 42% Palm Kernel cake: 10% Since the plant has not started operating, the actual moisture content of the fuel used can not be used. Therefore generic values have been used at this point - for EFB, it is taken from the experience of TSH Kunak Mill, for wood waste, it is taken from Danida/PTM Renewable Energy Resources and for palm kernel cake it is taken from the experience of the plant manager from other refineries.
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:	

Data / Parameter:	$PE_{EC,y}$ = power consumption on site for wood chopper
Data unit:	kWh/year
Description:	The power used for preparation of the wood waste to become fuel for the power plant
Source of data to be used:	A meter will be mounted to measure the consumption of the wood chopper
Value of data applied for the purpose of calculating expected emission reductions in section B.5	83,089 kWh/year calculated as 5 kWh/ton of wood waste and a total use of 16680 t wood waste
Description of measurement methods and procedures to be applied:	Power meter to be read once a month and the records stored electrically. The monthly readings will be compared with the annual total.
QA/QC procedures to be applied:	The power meter will be verified annually and the annual consumption compared with the amount of wood fuel used.
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 all the parameters aforementioned. This team comprises a general manager and a group of operators. The group of

operators, under the supervision of the general manager, will be assigned to monitor 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.

Table B.16 Monitoring plan by Parameter and Person In-charge

DATA / PARAMETERS	UNIT	MONITORING BY	QA/QC CROSSCHECK BY	COMMENT
GWP_{CH4} Global Warming Potential (GWP) of methane	t CO_{2e}/t CH_4	Plant Manager	General Manager	Decisions under UNFCCC and the Kyoto Protocol (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
TL_y Average truck load of the trucks used for transportation of biomass	tons	Plant Supervisor	Plant Manager	Check the consistency of the number of truck trips with the quantity of biomass combusted
N_y Number of truck trips for biomass transportation	Number	Plant Supervisor	Plant Manager	Check the consistency of the number of truck trips with the quantity of biomass combusted
$BF_{k,y}$ Amount of biomass used in the Kunak Jaya Bio Energy Project	Tons	Plant Supervisor	Plant Engineer	Fuel purchase receipts need to be attached, if available
AVD_y Average round trip distance (from and to)	km	Plant Supervisor	Plant Manager	Check consistency of distance records provided by the trucks by comparing recorded distances with other information from other sources
$EF_{km,CO2,y}$ Average CO_2 emission factor for the trucks	tCO_2/km	Plant Engineer	Plant Manager	Calculated based on IPCC default values
$FF_{project\ plant,i,y}$ Quantity of diesel combusted in the biomass residue fired power plant during the year y	t/year	Plant Supervisor	Plant Engineer	Including fossil fuels co-fired in the project plant
$EF_{CO2,FF,diesel}$ CO_2 emission factor for diesel	tCO_2/GJ	Plant Engineer	Consultant	Use IPCC default value
NCV_k Net caloric value of biomass residue type k	GJ/ton	Plant Engineer	Plant Manager	Compare the measured data with previous years data, values used in national GHG inventory, and IPCC default value

$Q_{project\ plant,y}$ Net quantity of heat generated from firing biomass in the project plant	GJ	Plant Engineer	Plant Manager	Check consistency of the net heat generation by cross-checked with receipts from sales (if available) and the quantity of the fuels
$EG_{project\ plant,y}$ 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 (if available) and the quantity of fuels fired
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
DOCj Per cent of degradable organic carbon (by weight) in the waste type j		Plant Manager	General Manager	The value for food waste is chosen for EFB. This is to be consistent with the choice for decay rate. Measurements may be conducted to verify in monitoring report
kj Decay rate for 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 will be measured and reported as part of the ex post calculation of the avoided methane emission
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	
Power consumption for wood chipper	kWh/year	Plant Engineer	Plant manager	

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.

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 completed 12/03/2007 and has been developed by:

Soeren Varming (Managing Director)
HV Carbon Sdn. Bhd.
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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 construction in August 2006.

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:

15/05/2007

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable

C.2.2.2. Length:

Not applicable

SECTION D. Environmental impacts

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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 (cf. Annex 6). 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.

The project will lead to reduced disposal and indiscriminate incineration of waste at the palm oil mill and increase the self-sufficiency in the power supply.

Social sustainability

The project will require more skilled staff than the existing plant. The workforce will be trained to operate the new plant and new qualified staff will be employed.

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 foreign exchange. The project will also have a positive impact on the economic performance of the palm oil refinery and kernel crushing plant as their energy production will become more reliable and efficient, which will enable a more reliable crude palm oil production in general.

SECTION E. Stakeholders' comments

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

A stakeholder's meeting was held on 21 November 2006 involving TSH management and staff members and 13 external stakeholders. They represented local residents, a village head, planters, representatives of the Kunak District Office and Forestry Office and a primary school principal. Invitation letters with a description of the project were sent out two weeks earlier to a total of 20 people with and a follow up was done to confirm attendance. The stakeholder meeting was held at 2pm at the TSH premises in Kunak, Sabah.

The following is a list of the attendees:

Department/Organisation	***Representatives***
Kunak District Forestry Office	1
Villagers	6
Planter	1
Kunak District Office	3
Local primary school – headmistress	1
SE Chemist	1
TOTAL	13

Written invitations for the stakeholder meeting were hand delivered to local residents. Local authorities including the Department of Environment and NGO were mailed.

E.2. Summary of the comments received:

Presentation

Mr. Soeren Varming first introduced participants to the CDM 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. Tay Chong Leong explained to the participants that the project was intended to generate 10 MW electricity to the palm oil refinery and kernel crushing plants. The energy will not be sold to SESB. They expect to use approximately 300,000 tonnes of biomass waste. He told participants that the project is expected to be operational in the first quarter of 2007. The benefits of the project were also explained in detail from the environmental, social and economic aspects.

Summary of the comments received

The following issues were raised by the participants. They were addressed by Mr. Tay Chong Leong. Questions were mainly posed on the environmental impact of the project and how the project could help create job opportunities in the local area.

From	*Question*	**Response**
1. Kunak District Forestry Office	What are the possibilities of pollution?	The project will make use of an efficient boiler where the combustion process is more complete. In addition, the project reduces dumping of waste as empty fruit bunches (EFB) and wood waste can be used.
	Will training be provided for the employees?	This is also a new venture for us. So we will provide training as we go along and we have consultants who can help us. Overall, it is a good opportunity for the people of Kunak Jaya to upgrade their skills.
	When will the project be completed?	January/February 2007.
2. Planter	What is the anticipated labour force for the plant?	We expect between 70 – 80 jobs for the plant. There will also be supporting jobs created, for example, in support services like food provision, transportation and maintenance.
	What are the potential problems with traffic as there are often many heavy vehicles bringing in the EFBs?	We expect about 15 to 20 trucks to bring in the waste every day (EFBs and wood waste from a nearby wood factory). We are working with the Works Department to upgrade the main Kunak Jaya road so that the heavy vehicles will not block public access. We have also designed our factory in a way that trucks will be parked in our compound and not on the public road.
	Where does most of the waste come from?	Economically, it is better if we get them from nearby mills. This will also help the local mills.
3. Headmistress SRK Kunak Jaya (primary school)	Commented that the benefits of the project are obvious in terms of the environment and in providing job opportunities for the locals. She said she has also given up part of the school area to expand the public road and was thankful to TSH for upgrading their fence and guard post. She said she was happy with the safety aspect considered as there are 600 pupils in her school who could be exposed to the heavy vehicles plying	

From	*Question*	Response
	the road.	

The meeting was adjourned at 3.30pm 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 but wanted assurances about the traffic issue and the safety of the nearby school pupils due to the presence of heavy vehicles in the vicinity.

Comments received from the global stakeholder consultation

Two comments were received during the global stakeholder meeting:

Comment 1:
The Project KUNAK JAYA BIO ENERGY PLANT has been added with a comment (2007-01-18) by Dr. Anwar Ahmad, Dabur Ayuvet Ltd.

Subject: CDM

"The project activity and methodology is socio-economic development. This techniques is applicable all sectors leke methane reduction, waste treatment, electricity generation, employment development, Global warming reductions."

Response to comment 1:
The project proponent fully agrees to the view point that the Kunak Jaya Bio Energy project contributes to the sustainable development in Malaysia.

Comment 2:
The Project KUNAK JAYA BIO ENERGY PLANT has been added with a comment today (2006-12-24) by g. hamaliuk, phascon technologies

Subject: Kunak Raya Bioenergy

From the other biomass energy plant projects in both Sabah and Peninsular Malaysia, the heat value of the EFB is between 8.4 and 12.1 GJ/t. Why is this project using only 4.2 GJ/t? I would suggest attaching a third party analysis certification to this PDD to substantiate this figure, since the measurement is not in the proposed Monitoring Plan. Is the measurement of each waste to be used in the boilers in the Monitoring Plan?? Does the proponent suggest using Mesocarp Fibres and wood waste in the Methane Avoidance calculation? This would not be appropriate, as there is a good market for both Fiber and wood waste, so they would not be landfilled.

In any case, wood waste does not have the same k factor as food wastes.

Response to comment 2:

The NVC (net calorific value) of biofuels is heavily dependent on the moisture content at which they are measured. Therefore it can be difficult to compare NVC values with out knowing the moisture content. The ACM0006 requires measurements of NVC to be done as dry weight. A laboratory test of the NVC of EFB has been included in the documentation provided to the validator showing a value of 17 MJ/kg. When this value is recalculated to the in situ moisture content (60%) of EFB in the Kunak Mill this gives an actual NVC of 5.3 MJ/kg. This value has been used in the final calculations in the PDD. NVC and moisture content will be measured for each fuel during monitoring.

The calculations in the final version of the PDD have taken into account the specific values for wood waste in methane formation. During the site validation it was shown that the wood waste from the nearby saw mills are actually landfilled. Mesocarp fiber is not used as fuel in the Kunak Jaya Plant, but experience shows that also excess mesocarp fibre are landfilled to a in the East Sabah region.

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

Since there were no objections, there was no need to change the project or the project implementation.

On the traffic problem, the company has set aside an area within the complex where the trucks can be parked while waiting to unload the EFB or wood waste. This will ensure that the heavy vehicles do not obstruct traffic or pose threats to the pedestrians. Participants were satisfied with this measure.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	TSH-Wilmar (BF) Sdn. Bhd.
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Personal E-Mail:	Renato.marioni@stiftungklimarappen.ch

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding was obtained for the project

Annex 3

BASELINE INFORMATION

See description in B6

Annex 4

MONITORING INFORMATION

See description in B7

Annex 5: Calculation of heating values of biomass fuel and fuel needs for the plant

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 nearby Kunak Palm Oil Mill – see Annex 6. 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. Wood and palm kernel cake has 19 and 18 MJ/kg respectively.

	EFB	Shell	Fibre	Wood	Palm Kernel Cake
Dry matter heating value MJ/kg	17	20	19	19	18
Moisture content	60%	12%	37%	42%	10%
In situ heating value MJ/kg	5.3	17.3	11.1	10	16

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.

Calculation of energy need in the Kunak Jaya Bio Energy Plant

There are two boilers in the Kunak Jaya Bio Energy Plant. A 45 barg boiler to produce steam for the power production and a 20 barg boiler for process steam.

For power 45 barg		
Steam capacity	52	Ton/hour
Full load hours	6,570	Hours/year
Annual steam production	341,640	Ton/year
Steam energy	2.88	GJ/t steam
Energy year	983,923	GJ/year
Boiler efficiency	0.80	%
Fuel use/year	1,229,904	GJ/year

	For steam 20 barg		
	Medium Fuel Oil	**Biomass**	
Steam capacity	30	30	Ton/hour
Full load hours	6,570	6,570	Hours/year
Annual steam	197,100	197,100	Ton/year
Steam energy	2.36	2.36	GJ/t steam
Energy year	465,156	465,156	GJ/year
Boiler efficiency	0.9	0.8	%
Fuel use/year	516,840	581,445	GJ/year

The total need for biomass fuels will this be 1,229,904 + 581,445 = 1,811,349 GJ/year.

Based on a fuel mix of 80/10/10 of EFB/palm kernel cake/wood the projected fuel consumption per year will be as below

	NCV		Fuel mix		
Empty fruit bunches	5.3	GJ/tons	80 %	273,411	T/year
Palm kernel cake	16	GJ/tons	10 %	11,321	T/year
Wood waste	10	GJ/tons	10 %	18,113	T/year
Total				302,846	T/year

Annex 6: 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 **2ND 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 7: Letter from PTM regarding availability of data for power baseline

Ptm
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

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