**CLEAN DEVELOPMENT MECHANISM**
**PROJECT DESIGN DOCUMENT FORM (CDM-PDD)**
**Version 03 - in effect as of: 28 July 2006**

## CONTENTS

Abbreviations:

| | |
|---|---|
| BM | Build Margin |
| CM | Combined Margin |
| COD | Chemical Oxygen Demand |
| DOC | Degradable Organic Carbon |
| DOE | Designated National Entity |
| EIA | Environmental Impact Assessment |
| EFB | Empty Fruit Bunch |
| GHG | Greenhouse gas |
| GWP | Global Warming Potential |
| IPCC | Intergovernmental Panel on Climate Change |
| IRR | Internal Rate of Return |
| LULUCF | Land use, land-use change and forestry |
| MCF | Methane Correction Factor |
| MGGE | Mas Gading Green Energy Sdn. Bhd |
| MGE | Mukah Green Energy Sdn. Bhd |
| MPOB | Malaysia Palm Oil Board |
| O&M | Operation and Maintenance |
| OM | Operating Margin |
| SESCO | Sarawak Electricity Supply Corporation |
| SWDS | Solid Waste Disposal Site |

## SECTION A. General description of project activity

### A.1 Title of the project activity:

Construction and operation of two 11.5MW biomass power plants in Kuching and Mukah, Sarawak, Malaysia (the "Project", or the "Project Activity").

(Version 02; 20/05/2008[1])

### A.2. Description of the project activity:

The Project is a bundled project which involves the construction and operation of two 11.5MW biomass power plants in Sarawak, Malaysia. The power plants, to be built in Kuching and Mukah, will each be built to the same specifications. The plants are expected to export 10MW of power to the Sarawak Grid, and Sarawak Energy, the grid operator, has agreed to purchase all the electricity produced by the two plants.

The power plants are to be fuelled using empty fruit bunches (EFBs) obtained from Malaysia's palm oil industry as the feedstock. The EFBs will be brought to the site by truck from the surrounding palm oil plantations, of which there are many, and where the EFBs are disposed of in solid waste disposal sites. To improve the quality of EFBs as a fuel, the moisture content will be reduced by mechanically shredding and pressing them before combustion. Each plant will process approximately 36 tonnes per hour of EFB feedstock. Once the EFBs have been mechanically treated to reduce moisture content, this will equate to approximately 23 tonnes per hour of processed biomass for combustion in the boiler.

The Project will bring about carbon emission reductions in two ways:

- By preventing the disposal of EFBs at solid waste disposal sites where they are liable to breakdown anaerobically; and
- The exported electricity generated by the combustion of the EFBs will displace grid-connected fossil-based power generation.

Emissions reductions are expected to be in the region of 400 kt$CO_2$/year for the first crediting period.

Construction of the two plants will follow the same timetable. Construction of the Mas Gading plant in Kuching will begin in March 2008, and construction of the Mukah plant will begin in April 2008. The Project Developer intends to bring both plants online by December 2009.

**Sustainable Development Benefits**

The Project will have the following sustainable development benefits:

[1] The original PDD was published in February 13, 2008 for public comment. Dou to the revision to "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site" applied, the PDD was revised and re-submitted for public comment.

*1. Environmental*

- The Project will generate electricity from biomass. Biomass is a carbon-neutral fuel, and is very low in sulphur content when compared to fossil fuels. Therefore, the plant will assist in the reduction of $SO_x$ emissions as well as reducing greenhouse gas emissions from Malaysia's grid power generation.

- The Project will prevent around 567,648 tonnes of EFBs per annum, 283,824 tonnes at each site, being disposed of at solid waste disposal sites (SWDS). The palm oil industry in Malaysia has difficulty in disposing of the EFBs it produces, and huge quantities of EFBs are disposed of in SWDS on land around the palm oil mills. On top of the fact that methane emissions occur from the anaerobic decay of the waste when so disposed, these SWDS are frequently unmanaged, or minimally managed, leading to problems with leachate entering groundwater, as well as the waste of large areas of land for this unproductive purpose.

*2. Economic*

- Despite having large hydrocarbon resources, due to increasing domestic demand, Malaysia is about to become a net importer of petroleum products. This was the main driver behind the government's adoption of the Fuel Diversification Policy, part of the Third Outline Plan for 2001 - 2010 (OPP3). Under this policy, biomass was identified as the country's fifth fuel resource, and with the launch of the Small Renewable Energy Power Programme, the country sought to encourage the growth of renewable power generation from sources such as biomass to 5% of total generation. In terms of the macro-economic situation, increased use of biomass resources will help to improve Malaysia's trade balance, whilst minimizing dependence on imported fossil fuels.

- By using a waste source (EFBs) to generate a valuable product (electricity), the Project will be creating a new and sustainable economic resource.

- The construction and operation of the plants will inject new money into the local economies in which they lie. Biomass power plants are relatively labour intensive, due to the pre-treatment of the biomass fuel before injection into the boiler, so the local benefits in terms of the number of new jobs created will be significant.

*3. Social*

- As mentioned above, the project will provide a significant number of jobs, both in the construction phase and the operation phase. As well as for the operation of the plant itself, further jobs will be created due to the need for transport contractors to bring the EFBs to the Project power plants from the surrounding palm oil mills, and the subsequent removal and distribution of ash.

## A.3. Project participants:

| Name of Party involved (*) ((host) indicates a host Party) | Private and/or public entity(ies) project participants (*) (as applicable) | Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|

| | | |
|---|---|---|
| Malaysia (host) | Mas Gading Green Energy Sdn. Bhd. | No |
| Malaysia (host) | Mukah Green Energy Sdn. Bhd. | No |
| Japan | Agritech Marketing Co., Ltd. | 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. | | |

**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.:**

Sarawak

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

Mas Gading Green Energy Sdn. Bhd., Kuching
Mukah Green Energy Sdn Bhd, Mukah

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

Both plants are located in the Malaysian State of Sarawak, on the Isle of Borneo.

Map of Malaysia

Map of Sarawak Regions

The site for the Mas Gading Green Energy Sdn. Bhd. plant is located at the following coordinates: Longitude 1.28208 / Latitude110.07686

The site for the Mukah Green Energy Sdn. Bhd. plant is located at the following coordinates: Longitude: 2.57932 / Latitude 112.18609

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

The category applicable to this Project is "Energy industries (renewable / non-renewable sources)", Sectoral Scope 1.

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

The technology to be used is state-of-the-art and will allow the plant to be operated solely on EFBs. The technology utilized will be standard thermal power plant cycle with a Dynamic Watercooled Stepgrate (DWS) tail end type boiler supplied by Vyncke Energietechniek N.V of Belgium. The combustion grate type DWS is a unique concept from Vyncke especially suitable for fuels with high moisture content and low ash melting points. This is the case with EFB waste due to the high potassium content in the ash derived. The boiler is specially designed to operate for up to 8000 hours a year while maintaining resistance to fouling, slagging, erosion and corrosion.

The power plant shall comprise of a biomass fired boiler and combustion system, a fully condensing steam turbine, generator, surface condenser, cooling tower, biomass fuel treatment and handling system, ash handling system, water treatment and waste water treatment system, centralised control system, fire-fighting and protection system, instrumentation and compressed air system, steam and water circuit equipment, piping, civil and structural works, overhead cranes, electrification at site and other necessary electrical systems including a diesel generator intended as a back-up system, power transformer, switchgear and the overhead transmission line.

The characteristics of EFB waste – a high-moisture, low-calorie content biomass – make it difficult to use as fuel for power generation. Advanced technologies and additional measures such as pre-treatment of the EFBs consisting of shredding and oil-water pressing to reduce the moisture content to below 48% are required. A specially designed drying zone between the point of fuel feeding and the dynamic part of the stepgrate will ensure further drying of the fuel in the combustion room.

It is noteworthy that palm oil milling factories prefer the use of fibre and shells for boiler fuel due to their more favourable characteristics and little use has been made of EFBs.

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

| Years | Annual estimation of emission reductions in tonnes $CO_2$e |
|---|---|
| Year 1 | 223,018 |
| Year 2 | 298,492 |
| Year 3 | 362,164 |
| Year 4 | 415,882 |
| Year 5 | 461,200 |
| Year 6 | 499,420 |
| Year 7 | 531,676 |
| **Total estimated reductions (tonnes $CO_2$)** | 2,791,852 |
| **Total number of crediting years** | **7** |

| Annual average over the crediting period of estimated reductions (tonnes $CO_2$) | 398,836 |
|---|---|

### A.4.5. Public funding of the project activity:

The project will not receive any public funding from an Annex I country.

## SECTION B. Application of a baseline and monitoring methodology

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

The Project will use Approved Consolidated Methodology ACM0006, “Consolidated methodology for electricity generation from biomass residues”, Version 06.

As determined in ACM0006, the PDD refers to the following methodology and tools:

- ACM0002, “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (Version 07)
- Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site (Version 03)
- Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion (Version 01)
- Tool to estimate the baseline, project and /or leakage emissions from electricity consumption (Version 01)
- Combined tool to identify the baseline scenario and demonstrate additionality (Version 02.1)

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

| Applicability condition | The Project |
|---|---|
| This methodology is applicable to biomass residue fired electricity generation project activities, including cogeneration plants. | The boilers to be installed under the Project activity are designed to have EFBs as their primary source of biomass. Other types of biomass residue may be combusted as a secondary energy source. Small amounts of fossil fuel may be combusted as a contingency measure. Monitoring will be carried out of fuels combusted by the Project. |
| The project activity may include the following activities or combinations of these activities:<br><br>• The installation of a new biomass residue fired power plant at a site where currently no power generation occurs (**greenfield power projects**); or<br>• The installation of a new biomass residue fired | The Project will involve the construction of two biomass residue fired power plants on greenfield sites, with no existing power generation facilities. |

| | |
|---|---|
| power plant, which replaces or is operated next to existing power plants fired with either fossil fuels or the same type of biomass residue as in the project plant (**power capacity expansion projects**); or<br>• The improvement of energy efficiency of an existing power plant (**energy efficiency improvement projects**), e.g. by retrofitting the existing plant or by installing a more efficient plant that replaces the existing plant; or<br>• the replacement of fossil fuels by biomass residues in an existing power plant (**fuel switch projects**). | |
| No other biomass types other than *biomass residues*, as defined above, are used in the project plant and these biomass residues are the predominant fuel used in the project plant (some fossil fuels may be co-fired). | The primary fuel to be combusted under the Project activity is EFBs. These are a waste product from palm oil mills, where the fruit of the oil palm is processed into crude palm oil and a number of by-products. It may be necessary to use some other biomass residues, if the supply of EFBs is short – e.g. in the off-peak season for crude palm oil production. In addition, small quantities of fossil fuel may be consumed as a contingency measure. |
| For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards), the implementation of the project shall not result in an increase of the processing capacity of raw input (e.g. sugar, rice, logs, etc.) or in other substantial changes (e.g. product change) in this process. | EFBs are a waste product of the palm oil industry. The disposal of EFBs has been causing well-documented environmental problems for a number of years. The palm oil mills that will supply EFBs to the Project activity are operating at the greatest capacity that availability of fresh oil palm fruit will allow. In most cases, this means operation at full capacity. These mills already have a huge incentive to operate to maximum capacity due to the high price of crude palm oil on the global market. The small additional income available to the mills from selling EFBs could not be seen as a major change in the economics of their operation, and therefore a change in the output or processes is highly unlikely. |
| The biomass residues used by the project facility should not be stored for more than one year. | The Project will not store biomass for more than one year. This will be confirmed through monitoring. The Project also has a strong incentive to use each shipment of biomass delivered to the site within a short time: the calorific value of EFBs declines rapidly over time. |
| No significant energy quantities, except from transportation or mechanical treatment of the biomass residues, are required to prepare the biomass residues for fuel combustion, i.e. projects that process the | The EFBs (and any secondary biomass fuels) will be treated mechanically before injection to the boiler. However, no other significant treatment processes will be carried out. The energy for this |

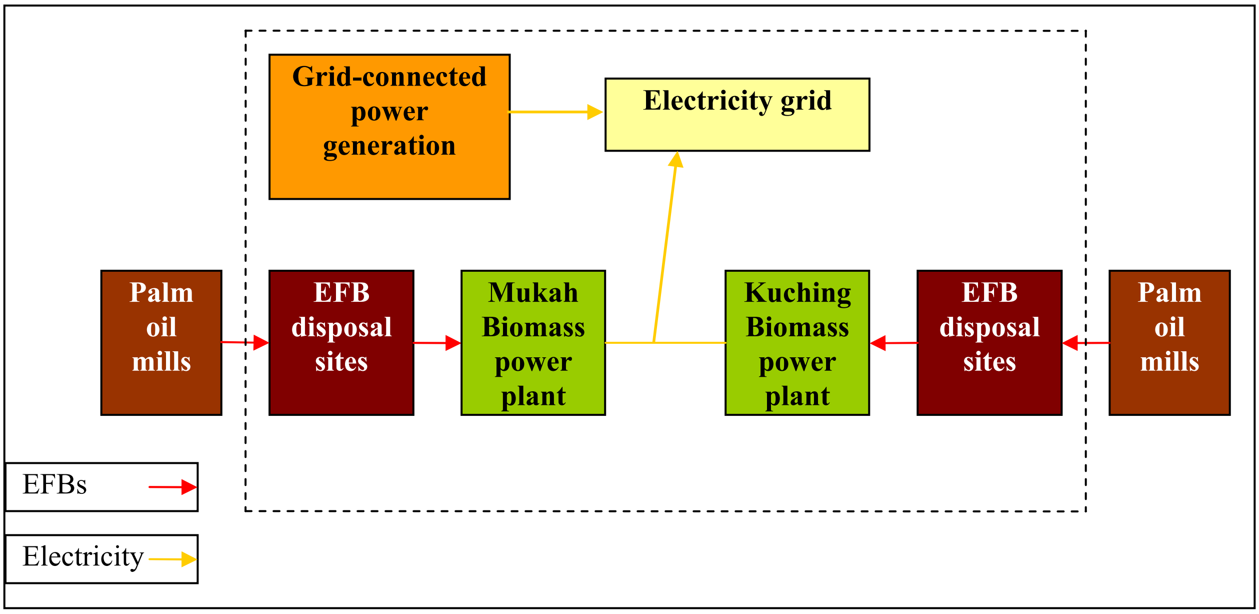
| | |
|---|---|
| biomass residues prior to combustion (e.g. esterification of waste oils). | treatment process will be supplied by the Project itself. |
| The methodology is only applicable for the combinations of project activities and baseline scenarios identified in Table 2 of the methodology, ACM0006. | This applicability is addressed in Section B.4 below. |

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

| | Source | Gas | Included? | Justification / Explanation |
|---|---|---|---|---|
| Baseline | Electricity generation | $CO_2$ | Yes | Main emission source |
| | | $CH_4$ | No | Excluded for simplification. This is conservative. |
| | | $N_2O$ | No | Excluded for simplification. This is conservative. |
| | Heat generation | $CO_2$ | No | Not relevant as the project will not be producing heat for other users |
| | | $CH_4$ | No | Not relevant as the project will not be producing heat for other users |
| | | $N_2O$ | No | Not relevant as the project will not be producing heat for other users |
| | Uncontrolled burning or decay of surplus biomass residues | $CO_2$ | No | It is assumed that $CO_2$ emissions from surplus biomass residues do not lead to any changes of carbon pools in the LULUCF sector. |
| | | $CH_4$ | Yes | Main emission source |
| | | $N_2O$ | No | Excluded for simplification. This is conservative. |
| Project activity | On-site fossil fuel and electricity consumption due to the project activity (stationary or mobile) | $CO_2$ | Yes | Although fossil fuel will only be consumed as a contingency measure, any such consumption will be monitored. The electricity requirements of the plant will be met by the plant itself. However, electricity consumption from the grid will be monitored to ensure this is the case. |
| | | $CH_4$ | No | Excluded for simplification. This emission source is expected to be very small. |
| | | $N_2O$ | No | Excluded for simplification. This emission source is expected to be very small. |
| | Off-site transportation of biomass residues | $CO_2$ | Yes | Transport of EFBs in trucks will result in significant emissions of carbon dioxide. Ash from the boilers will be transported back to the plantations on the return leg of the trucks that brought the EFBs to the power plants, therefore, emissions from the transport of ash are included in the calculation of emissions from the transport of EFBs. |

| | | | | |
|---|---|---|---|---|
| | | $CH_4$ | No | Excluded for simplification. This emission source is expected to be very small. |
| | | $N_2O$ | No | Excluded for simplification. This emission source is expected to be very small. |
| | Combustion of biomass residues for electricity and / or heat generation | $CO_2$ | No | It is assumed that $CO_2$ emissions from surplus biomass do not lead to changes of carbon pools in the LULUCF sector. |
| | | $CH_4$ | Yes | As $CH_4$ emissions from decaying biomass are included, $CH_4$ emissions from combustion of biomass in the Project must also be included. |
| | | $N_2O$ | No | Excluded for simplification. This emission source is expected to be very small. |
| | Storage of biomass residues | $CO_2$ | No | It is assumed that $CO_2$ emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector. |
| | | $CH_4$ | No | Excluded for simplification. Since biomass residues are stored for not longer than one year, this emissions source is assumed to be small. |
| | | $N_2O$ | No | Excluded for simplification. This emission source is expected to be very small. |
| | Wastewater from the treatment of biomass residues | $CO_2$ | No | It is assumed that $CO_2$ emissions from surplus biomass residues do not lead to changes of carbon pools in the LULUCF sector. |
| | | $CH_4$ | No | The wastewater will not be treated under anaerobic conditions; therefore, it will not be necessary to include this item. |
| | | $N_2O$ | No | Excluded for simplification. This emission source is expected to be very small. |

The following diagram shows the spatial extent of the project boundary:




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

As determined in ACM0006, the baseline scenario is identified using the "Combined tool to identify the baseline scenario and demonstrate additionality" (henceforth referred to as the "Combined tool"). The latest version, Version 02.1, is used. Note that due to use of the "Combined tool", additionality, which is typically dealt with under Section B.5 of the PDD, is covered here in Section B.4. Because the relevant situations faced by both the plants is very similar, and they of the same specification, additionality is dealt with for one mill, with the outcome applied to both.

**STEP 1. Identification of alternative scenarios**

*Sub-step 1a. Define alternative scenarios to the proposed CDM project activity*

The methodology lists the following scenarios as realistic and credible alternatives to be considered for power generation, and for disposal of the biomass residues.

For ***power*** generation:

P1 The proposed project activity not undertaken as a CDM project activity.

P2 The continuation of power generation in an existing biomass residue fired power plant at the project site, in the same configuration, without retrofitting and fired with the same type of biomass residues as (co-)fired in the project activity.

P3 The generation of power in an existing captive power plant, using only fossil fuels.

P4 The generation of power in the grid.

P5 The installation of a **new** biomass residue fired power plant, fired with the same type and with the same annual amount of biomass residues as the project activity, but with a lower efficiency of electricity generation (e.g. an efficiency that is common practice in the relevant industry sector) than the project plant and therefore with a lower power output than in the project case.

P6 The installation of a **new** biomass residue fired power plant that is fired with the same type but with a higher annual amount of biomass residues as the project activity and that has a lower efficiency of electricity generation (e.g. an efficiency that is common practice in the relevant industry sector) than the project activity. Therefore, the power output is the same as in the project case.

P7 The **retrofitting** of an existing biomass residue fired power, fired with the same type and with the same annual amount of biomass residues as the project activity, but with a lower efficiency of electricity generation (e.g. an efficiency that is common practice in the relevant industry sector) than the project plant and therefore with a lower power output than in the project case.

P8 The **retrofitting** of an existing biomass residue fired power that is fired with the same type but with a higher annual amount of biomass residues as the project activity and that has a lower efficiency of electricity generation (e.g. an efficiency that is common practice in the relevant industry sector) than the project activity.

P9 The installation of a **new** fossil fuel fired captive power plant at the project site.

In identifying realistic and credible alternatives for power generation, P2, P3, P7 and P8 are excluded because the Project will be displacing grid-generated electricity not electricity generated from a captive power plant, and both Project sites are greenfield sites, therefore, no retrofitting is plausible. In the context of the Project activity, P9 would describe a new fossil fuel fired captive power plant at the project site and connected to the grid. In this PDD, P4 is considered to cover new and existing plants connected to the grid, therefore, this scenario is already covered, and P9 is considered superfluous.

For the use of the ***biomass residues***, the realistic and credible alternative scenarios to be considered are:

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.

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.

B3 The biomass residues are burnt in an uncontrolled manner without utilizing it for energy purposes.

B4 The biomass residues are used for heat and/or electricity generation at the project site

B5 The biomass residues are used for power generation, including cogeneration, in other existing or new grid-connected power plants

B6 The biomass residues are used for heat generation in other existing or new boilers at other sites

B7 The biomass residues are used for other energy purposes, such as the generation of biofuels

B8 The biomass residues are used for non-energy purposes, e.g. as fertilizer or as feedstock in processes (e.g. in the pulp and paper industry)

In the Project's absence, the sites would be greenfield sites so there would not be any energy demand without the Project, hence ruling out B4.

The use of EFB for power generation is not a realistic alternative scenario, for in order to utilize them as a fuel, the initial investment is required for the pre-treatment equipment and special boiler to combust a biomass with characteristics of EFB, thus ruling out B5 and B6. This is further demonstrated in the leakage section where it is shown that a large excess of EFBs would remain and would continue to be treated in solid waste disposal sites in the Project scenario. This large excess also shows that alternative energy or non-energy uses for the EFBs, options B7 and B8, are not widespread in the area.

As described above, plausible alternative scenarios for the Project are P1, P4, P5 and P6 for power generation and B1, B2 and B3 for the biomass residues.

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

The relevant Malaysian laws and regulations are listed in Annex 5.

All alternative scenarios identified in *Sub-step 1a* for power generation are consistent with Malaysia's laws and regulations.

For treatment of biomass residues, the Environmental Quality act of 1974 in its 1998 amendment imposes a general ban on open-air burning of the biomass wastes including the EFB. Therefore, all scenarios identified above, apart from B3, are considered in Step 2.

**STEP 2: Barrier analysis**

*Sub-step 2a. Identify the barriers that would prevent the implementation of alternative scenarios*

**(1) Investment barriers**

The equipment costs for grid-connected biomass power plants are significantly higher than those for GHG-intensive conventional fossil fuel power plants. Furthermore, as described by Hitam[2], the generation cost per kWh for renewable energy using biomass is between US$ 0.07 to 0.15 per kWh, and the cost of conventional power generation from fossil fuels as is within the range US$ 0.04 to 0.06 per kWh. The increased initial capital costs and final generation costs continue to make biomass generation unattractive to prospective investors, as is shown by the predominance of fossil fuel-powered power stations in Malaysia (see graph on Malaysia's fuel mix in B.6.1 below).

**(2) Technological barriers**

[2] Sustainable Energy Policy and Strategies: A Pre-requisite for the Concerted Development and Promotion of the Renewable Energy in Malaysia, S. Hitam, 1999, available at: http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN003226.pdf

In terms of technology, the Project represents the first case of applying suspension-fired technology to the EFB in the regions.
The palm oil milling process produces three types of biomass waste: EFB, mesocarp fibre and palm shells. Of this, most palm oil mills consume the fibre and shells as boiler fuel for their in-house energy requirements. Due to its high moisture content, EFB is a difficult fuel to handle and its use is minimal apart from the small amount used as soil conditioner. The Project is expected to become the first in the region to use EFB as its sole fuel for grid power generation.

While the Project will use technology that has been applied and proven elsewhere, equity partners and financial institutions inevitably perceive a greater risk in pioneering technologies. As the technology is new to the regions, there also remains a slight yet real risk for the project proponents in that there is performance uncertainty.

This technological barrier adds to the investment barrier in making the Project unattractive to implement in the absence of the CDM.

**(3) Barriers due to prevailing practice**

Using biomass waste as fuel for electricity generation is not a standard energy generation practice in Malaysia. Even though the recent Small Renewable Energy Power Programme[3] has strongly promoted it, Malaysia currently sources nearly all of its power from fossil fuels and hydro.

As described in *Sub-step 1a*, there are currently no regulations for the management of EFB waste, except for the general ban on open-air burning as stipulated in the 1998 amendments to the Environmental Quality Act of 1974. The sheer volume of EFBs produced by the palm oil mill industry is too great for the EFBs to be disposed of by mulching because dispersing the untreated EFBs in the plantations is costly and time consuming, and EFBs do not break down easily in an untreated state. Whilst composting may be technically feasible it is not common practice. By far the most widespread method in Malaysia for the handling of EFBs is by disposal in solid waste disposal sites, and this is particularly true in Sarawak. As there is also no standard alternative method to manage the large volume EFB waste from palm oil mills, it is obvious that without an additional incentive such potential CER revenue, the most likely scenario is for EFB waste to be dumped and allowed to decompose under clearly anaerobic conditions in solid waste disposal sites (SWDS), resulting in significant uncontrolled emission of GHGs.

**(4) Other barriers**

[3] The Government of Malaysia has implemented a policy in 2001 called the Small Renewable Energy Power Programme, to encourage private entities generating power with renewable fuels to sell part or all of its output to regional grids.

As described by Rahman Mohamed and Lee in their review of energy for sustainable development in Malaysia[4], the use of biomass as a source of energy is not long established in Malaysia. Prevailing barriers to implementation include:

- The logistics of ensuring a sufficient continuous supply of biomass;
- The necessary processing of the biomass residues (particularly in the case of EFBs given their high moisture content);
- The necessary technology to utilize EFBs is still not that developed.

Furthermore, despite reports of the technical feasibility of the utilization of biomass for power generation, it has not long been implemented on a large scale. One of the reasons for this is a problem with the supply chain in regards to the country's main biomass producers, the palm oil industry. Given the current high price for crude palm oil, palm mill owner's are disinterested in diversifying into the sale of surplus biomass as fuel because the prospective returns do not match the attractiveness of their core business returns. Essentially, this leads to great difficulties for prospective biomass power generation developers in securing the long-term supply contracts that are so vital for the plants as smooth operation is wholly dependent on a secure supply[5].

The additional revenue from the sale of CERs will increase the Project's return to a more acceptable level, enabling the implementation of the Project. Without this extra source of income, the low return combined with the real and perceived risks involved make the Project unattractive to investors.

*Sub-step 2b. Eliminate alternative scenarios which are prevented by the identified barriers.*

Options P1 especially apply technical barriers and common practice barriers mentioned above in *Sub-step2a*. Investment barriers concerning Option P1 will be further discussed in Step 3.

Option P4 is the current situation: power is generated by the Sarawak Grid. None of the above barriers apply as grid power demand is currently almost all met by fossil fuel based power plants.

The barriers described above are considered significant enough to prevent the implementation of P5 and P6. They are therefore hereby excluded from further analysis.

As described above, the volume of EFBs produced by the mills is too great for option B1, the dumping of biomass so that it decomposes under aerobic conditions. The land requirements and the labour costs associated with the disposal of more than half a million tonnes of EFBs per year in this manner would not be feasible. On the other hand, B2, the current predominant practice of disposal at solid waste disposal sites, remains a viable option.

For ***power generation***, the remaining options aside from the Project activity are, therefore:

P1 The Project not undertaken as a CDM project activity

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[4] Energy for sustainable development in Malaysia: Energy policy and alternative energy, Rahman Mohamed and Lee, 2006

[5] Energy Outlook, Renewable Energy and Energy Efficiency Component, Economic Planning Unit, Ministry of Energy, Water and Communications, Malaysia, 2005, available at: http://eib.org.my/upload/files/Energy%20Outlook%20of%20Malaysia.doc

P4 The generation of power in the grid

For the use of the ***biomass residues***, the realistic and credible alternative scenarios to be considered are:

B2 The biomass residues are dumped or left to decay under clearly anaerobic conditions.

**STEP 3: Investment Analysis**

Due to high initial costs associated with the planning, engineering, and construction of each plant, the Project does not represent an attractive investment opportunity in the absence of additional revenue from the sale of CERs. This PDD uses the IRR benchmark of 15% adopted by the Malaysian Government's DNA in its report entitled, "Study on Clean Development Mechanism Potential in the Waste Sectors in Malaysia"[6] which referred to similar projects to the Project Activity. An IRR is calculated for one plant and the results applied to both plants because the plants are of the same specification and have the same estimated costs and benefits. As can be seen from the financial data displayed below[7], the Project IRR for a plant is not high enough to justify investment, considering the risks involved. With the CER revenue incorporated into the IRR calculation, the additional revenue stream provides enough of an incentive for the Project developer to proceed.

| Item | Assumptions/Sources | Value |
|---|---|---|
| **Financial Details** | | |
| **Costs** | | |
| Initial capital cost (equipment and plant costs) | Supplied by Project developer based on quotes and current prices | 85,000,000MYR |
| Fuel cost/year (EFBs) | Based on average local price | 4,000,000 MYR/year |
| O&M cost/yr | Supplied by Project developer based on quotes and current prices | 3,500,000 MYR/year |
| **Revenues** | | |
| Electricity tariff | Average local price (including tax) | 0.210 MYR/kWh |
| Electricity sales | Assuming that 10MW net will be exported for 365 days a year, at a load factor of 90% (78,840 MWh/year) | 16,556,400 MYR/year |
| **Project life** | Minimum projected life | 21 years |
| **Project IRR for operations** | | 8.86% |

The IRR for one plant is estimated to be 8.86%, which is much lower than the benchmark of 15%. The low IRR, compared to the hurdle rate, indicates that the Project is not financially attractive without an additional revenue stream, such as that obtained through the CDM. The relatively low return does not justify the risks associated with implementing a new biomass power project.

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[6] http://cdm.eib.org.my/upload/articles1016,article,1154653437,Report_WasteSector_Summary%20report.pdf

[7] The necessary financial documents will be made available to the DOE at the validation.

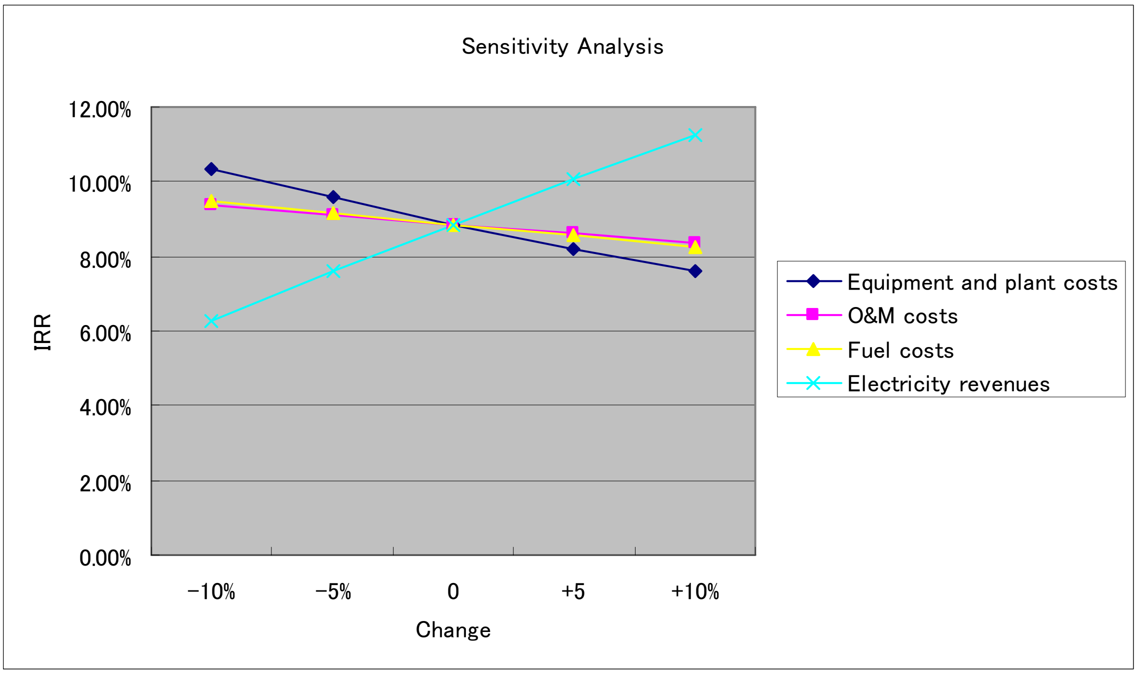
***Sensitivity Analysis***

The following sensitivity analysis is performed to confirm the conclusion regarding the financial attractiveness of the Project is robust:

1) The costs for equipment and plant is 10% lower than expected (Project IRR =10.34%)
2) O&M costs will be 10% lower than expected (Project IRR = 9.38%)
3) Fuel costs are 10% lower than expected (Project IRR = 9.46%)
4) The average tariff for electricity is 10% higher than expected (Project IRR = 11.26%)

The following table and diagram give the results of the sensitivity analysis for each scenario

| Changes | -10% | -5% | 0 | +5 | +10% |
|---|---|---|---|---|---|
| Equipment and plant costs | 10.34% | 9.57% | 8.86% | 8.21% | 7.61% |
| O&M costs | 9.38% | 9.12% | 8.86% | 8.60% | 8.34% |
| Fuel costs | 9.46% | 9.16% | 8.86% | 8.56% | 8.26% |
| Electricity revenues | 6.29% | 7.60% | 8.86% | 10.08% | 11.26% |




As can be seen from the above analysis, in the absence of the CDM revenue stream the Project is not likely to lead to significant enough returns to warrant investment. Even under the favourable conditions supposed in the sensitivity analysis, the IRR of the Project Activity is significantly lower than the benchmark of 15%.

Investment in the Project Activity without CDM, scenario P1, is therefore not likely to happen and energy will most likely be generated from existing and new grid-connected power stations. The above IRR calculations show that the Project Activity is not feasible without some form of additional revenue such as that available through the CDM. Without CDM registration, therefore, EFBs would most likely continue to be disposed of at SWDS (option B2), resulting in significant GHG emissions from their anaerobic decay.

This PDD identifies the baseline as:

P4 The generation of power in the grid; and

B2 The biomass residues are dumped or left to decay under clearly anaerobic conditions.

This corresponds to scenario 2 in the methodology.

**STEP 4: Common practice analysis**

As mentioned in the baseline analysis above, EFBs are predominantly disposed of in solid waste disposal sites in Sarawak. Under the Malaysian Government's Small Renewable Energy Power Programme (2001), set-up to promote renewable energy projects in a country dominated by fossil fuel generation, projects of up to 10MW of capacity are encouraged to sell their electricity output to state-owned electricity utilities. As of 2005, 50 applications had been received, of these 28 applications were for biomass projects, and of these biomass projects over half were for projects utilizing palm oil waste[8].

Under the program, only two projects had been commissioned by 2005, a landfill gas plant at Selangor, and a biomass plant in Sabah.

It is clear that from the above that SREP is still in its infancy, and whilst it may go some way towards achieving the Malaysian Government's goal of 5% total generation from renewable sources,[9] biomass energy projects would only make up a small part of that, the Projects would not have been long established, and that 5% can not be considered common to begin with, therefore, it can be said that the Project activity is not common practice in Malaysia.

That the Project is not common practice satisfies the final requirement of the combined tool, therefore, it can be said that the project is additional.

**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): >>**

Due to use of the "Combined tool", as required by ACM0006, the issue of additionality was covered under Section B.4 above.

**B.6. Emission reductions:**

**B.6.1. Explanation of methodological choices:**

[8] http://www.bcse.org.au/docs/International/BCSE%20Malaysia%20Final%20V2.pdf

[9] Malaysian Government, Fuel Diversification Strategy

As described above, the Project activity comes under scenario 2 in the methodology, ACM0006: biomass power generation and exporting of the power to the grid, replacing a baseline scenario of dumping of biomass at a solid waste disposal site.

Total emission reductions will be calculated for each plant individually, in line with the methodology ACM0006, and then totalled. The calculations to be used are as follows:

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

Where:

$ER_y$ = Emissions reductions of the project activity during the year *y* ($tCO_2$/yr)
$ER_{electricity,y}$ = Emission reductions due to displacement of electricity during the year *y* ($tCO_2$/yr)
$BE_{biomass}$ = Baseline emissions due to natural decay or burning of anthropogenic sources of biomass residues during the year *y* ($tCO_2$/yr)
$PE_y$ = Project emissions during the year *y* ($tCO_2$/yr)
$L_y$ = Leakage emissions during the year *y* ($tCO_2$/yr)

**<u>Project emissions ($PE_y$)</u>**

Of the potential project emissions listed in the methodology, the following are relevant to the Project, as described in section B.3:

- $CO_2$ emissions from transportation of biomass residues to the project site ($PET_y$)
- $CO_2$ emissions from on-site consumption of fossil fuels due to the project activity ($PEFF_y$)
- $CO_2$ emissions from electricity consumption ($PE_{EC,y}$)
- $CH_4$ emissions from the combustion of biomass residues ($PE_{Biomass,CH4,y}$)

The waste water system serving the plant is designed so that no waste water will be allowed to break down anaerobically. The waste water will be routed to a neutralization pit from where it will be sent to an evaporation pond. Cooling tower and boiler blow down will be taken to a small guard pond for treatment before being sent to the evaporation pond or being reused in the plant.

Emissions from the anaerobic breakdown of biomass in waste water are therefore ignored.

Project emissions are calculated as follows:

$$PE_y = PET_y + PEFF_y + PE_{EC,y} + (GWP_{CH4} \cdot PE_{Biomass,CH4,y})$$

Where:

$PET_y$ = $CO_2$ emissions during the year *y* due to transportation of the biomass residues to the project plant ($tCO_2$/yr)
$PEFF_y$ = $CO_2$ emissions during the year *y* due to fossil fuels co-fired by the generation facility or other fossil fuel 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 residues during the year *y* ($tCH_4$/yr)
$PE_{EC,y}$ = $CO_2$ emissions from on-site consumption of electricity

**Carbon dioxide emissions from combustion of fossil fuels for transportation of biomass residues to the project plant ($PET_y$)**

For the calculation of emissions that result from the transport of EFBs from the palm oil mills to the biomass power plant, this PDD selects the following option from the methodology:

Option 1: Emissions are calculated on the basis of distance and the number of trips (or the average truck load).

$$PET_y = \frac{\sum_k BF_{T,k,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2,y}$$

Where:

$BF_{T,k,y}$ = Quantity of biomass residue type k that has been transported to the project site during the year y (tonnes)

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

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

$EF_{km,CO2,y}$ = Average $CO_2$ emission factor for the trucks measured during the year y ($tCO_2$/km)

The Project activity will also lead to the creation of ash from the boilers. The ash is a useful organic fertilizer and the palm oil mills supplying the plant will receive the ash and distribute it on plantation land. The transportation of the ash to the plantations will be handled by the trucks bringing EFBs to the power plant. Because the ash will be carried on the return leg, when the trucks are returning to the palm oil mills, there will be no increase in distance traveled by trucks over and above that already included in the calculation to estimate emissions from the transport of EFBs. There are therefore no additional emissions considered from the transport of the ash.

**Carbon dioxide emissions from on-site consumption of fossil fuels ($PEFF_y$)**

The proper and efficient operation of the biomass residue-fired power plant may require the use of some fossil fuels as a contingency measure. The resulting $CO_2$ emissions are calculated as described in the latest version of the tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion (version 1), using the following formula:

$$PEFF_y = \sum_i FC_{i,y} \times COEF_{i,y}$$

Where:

$FC_{i,y}$ = Quantity of fossil fuel type *i* combusted in the boiler during the year *y* ($m^3$/yr)

$COEF_{i,y}$ = $CO_2$ emission coefficient of fuel type *i* in year *y* ($tCO_2/m^3$)

*i* = Fuel types combusted in the boiler during the year *y*

The $CO_2$ emission coefficient $COEF_{i,y}$ will be calculated according to the preferred option in the tool, option A, based on the chemical composition of fossil fuel type *i*, using the following approach:

$COEF_{i,y}$ = $w_{C,i,y,i} \times \rho_{i,y} \times 44/12$

Where:

$w_{C,i,y,i}$ = Weighted average mass fraction of carbon in fuel type *i* in year *y* (tC/t fuel)
$\rho_{i,y}$ = Weighted average density of fuel type *i* in year *y* ($t/m^3$)
44/12 = Fuel types combusted in the boiler during the year *y*

**$CO_2$ emissions from on-site consumption of electricity ($PE_{EC,y}$)**

It is necessary to dry and shred the EFBs prior to combustion, in order for the combustion process to be operated efficiently. This processing of the EFBs will require electricity. The Project generators are expected to supply the whole plant with electricity, with the excess being exported to the Sarawak Grid, therefore, this PDD assumes that emissions from this source are zero.

The amount of electricity imported from the grid will be monitored to ensure that this is the case, and the data will be made available for review by the DOE, as necessary.

Should any electricity be imported from the grid, the associated emissions will be calculated as directed in the tool to estimate the baseline, project and /or leakage emissions from electricity consumption. Scenario A, Electricity consumption from the grid, applies to the project activity, therefore, the following formula is applied:

$$PE_{EC,y} = \sum_{j} EC_{PJ,j,y} \cdot EF_{EL,j,y} \cdot (1 + TDL_{j,y})$$

Where:

$PE_{EC,y}$ = Project emissions from electricity consumption in year y ($tCO_2/yr$)
$EC_{PJ,j,y}$ = Quantity of electricity consumed by the project electricity consumption source *j* in year y (MWh/yr)
$EF_{EL,j,y}$ = Emission factor for electricity generation for source *j* in year y ($tCO_2/MWh$) (Option A1 in Scenario A is chosen.)
$TDL_{j,y}$ = Average technical transmission losses for providing electricity to source *j* in year y

**Methane emissions from combustion of biomass residues ($PE_{Biomass,CH4,y}$)**

Emissions from this source are calculated as follows:

$$PE_{Biomass,CH4,y} = EF_{CH4,BF} \cdot \sum_{k} BF_{k,y} \cdot NCV_k$$

Where:

$BF_{k,y}$ = Quantity of biomass residue type *k* combusted in the project plant during the year *y* (tonnes of dry matter)
$NCV_k$ = Net calorific value of the biomass residue type *k* (GJ/ton of dry matter)
$EF_{CH4,BF}$ = $CH_4$ emission factor for the combustion of biomass residues in the project plant ($kgCH_4/TJ$)

This PDD calculates $EF_{CH4}$ using the following standard IPCC default data from table 4 and table 5 of the methodology[10]; assuming that EFBs are best characterized as garden waste, in line with previous decisions by the Executive Board:

| **A**<br>**Waste type** | **B**<br>**Default emission factor (kg $CH_4$/TJ)** | **C**<br>**Assumed uncertainty** | **D**<br>**Conservativeness factor** | **E**<br>**Conservative EF, B×D (kg $CH_4$/TJ)** |
|---|---|---|---|---|
| EFBs (garden waste) | 30 | 300% | 1.37 | 41.1 |

Applying the conservativeness factor to the default IPCC emission factor, a conservative emission factor of 41.1 kg $CH_4$/TJ is obtained.

**Emission reductions due to displacement of electricity ($ER_{electricity,y}$)**

Emission reductions due to the displacement of electricity are calculated by multiplying the net quantity of increased electricity generated with biomass residues as a result of the project activity ($EG_y$) with the $CO_2$ baseline emissions factor for the electricity displaced due to the Project ($EF_{electricity,y}$), as follows:

$$ER_{electricity,y} = EG_y \times EF_{electricity,y}$$

Where:

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

$EF_{electricity,y}$ = $CO_2$ emission factor for the electricity displaced due to the project activity during the year y ($tCO_2$/MWh)

**Determination of $EF_{electricity,y}$**

The electricity generated by the Project Activity will displace electricity from other power generation plants connected to the Sarawak Grid. Under the Project Activity, electricity is not be generated from fossil fuels on-site. The emission factor for the displacement of electricity, therefore, corresponds to the grid emission factor ($EF_{electricity,y} = EF_{grid,y}$), and has been determined *ex ante* as directed in the tool to calculate the emission factor for an electricity system, as follows:

***STEP 1. Identify the relevant electric power system***

The grid to which the power plants will provide electricity is the Sarawak Grid. The power plants have signed contractual agreements with Sarawak Energy, the company that manages the grid, to this end.

***STEP 2. Select an operating margin (OM) method***

Dispatch data is unavailable for the Sarawak Grid; therefore, this PDD selects option (a), the Simple OM method, to calculate this parameter.[11] As shown in the figure below, low-cost/must-run

[10] Originally from 2006 IPCC Guidelines, Volume 2, Chapter 2, Tables 2.2 to 2.6

resources constitute less than 50% of total grid generation, and are predicted to constitute less than 50% for the medium term.

FUEL MIX IN ELECTRICITY GENERATION, 2000-2010

| | Year | Oil | Coal | Gas | Hydro | Others | Total (GWh) |
|---|---|---|---|---|---|---|---|
| | | % of Total | | | | | |
| Malaysia | 2000 | 4.2 | 8.8 | 77.0 | 10.0 | 0.0 | 69,280 |
| | 2005 | 2.2 | 21.8 | 70.2 | 5.5 | 0.3 | 94,299 |
| | 2010 | 0.2 | 36.5 | 55.9 | 5.6 | 1.8 | 137,909 |
| TNB | 2000 | 2.3 | 8.7 | 79.6 | 9.4 | 0.0 | 63,634 |
| | 2005 | 0.5 | 22.5 | 71.9 | 4.9 | 0.2 | 86,242 |
| | 2010 | 0.1 | 38.1 | 56.8 | 3.4 | 1.6 | 126,718 |
| SESB | 2000 | 47.3 | - | 31.4 | 21.3 | - | 2,299 |
| | 2005 | 42.6 | - | 43.0 | 13.6 | 0.8 | 3,447 |
| | 2010 | 0.5 | 18.5 | 47.2 | 26.5 | 7.3 | 4,808 |
| SESCO | 2000 | 11.2 | 15.1 | 59.4 | 14.3 | - | 3,347 |
| | 2005 | 4.7 | 25.0 | 58.9 | 11.4 | - | 4,610 |
| | 2010 | 3.0 | 21.2 | 44.1 | 31.7 | - | 6,383 |

Source: Tenaga National Berhad, Sabah Electricity Sdn. Bhd. and Syanikat SESCO Berhad[12]

***STEP 3. Calculate the operating margin emission factor according to the selected method***

The simple OM emission factor is calculated as the generation-weighted average $CO_2$ emissions per unit net electricity generation ($tCO_2/MWh$) of all generation power plants serving the system, not including low-cost/must-run power plants/units. It is calculated based on data on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (option C) because the necessary data for option A or option B is not available, nuclear and renewable power generation are considered as low-cost/ must-run power sources and the quantity of electricity supplied to the grid by these sources is known. Electricity imports are treated as one power plant.

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{grid,y}}$$

Where:

[11] The fact that the low-cost/must-run resources constitute less than 50% of total grid generation in the exporting grid is shown in annex 3. In calculating the simple operating margin emission factor of the exporting grid, the ex-ante option is applied.

[12] http://www.epu.jpm.my/rm9/english/Chapter19.pdf

| | |
|---|---|
| $EF_{grid,OMsimple,y}$ | Simple operating margin $CO_2$ emission factor in year y ($tCO_2/MWh$) |
| $FC_{i,y}$ | Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit) |
| $NCV_{i,y}$ | Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit) |
| $EF_{CO2,i,y}$ | CO2 emission factor of fossil fuel type i in year y ($tCO_2/GJ$) |
| $EG_{grid,y}$ | Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units in year y (MWh) |
| i | All fossil fuel types combusted in power sources in the project electricity system in year y |
| y | The three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex-ante option) |

***STEP 4. Identify the cohort of power units to be included in the build margin***

Of the two options presented for the identification of the cohort of power units, *m*, option (a), the set of five power units that have been built most recently, is selected because it comprises the larger annual generation of the two options.

There are no CDM-registered projects connected to the Sarawak Grid.

Option 1, ex-ante calculation of the build margin emission factor for the first crediting period is selected. For the second crediting period, the build margin emission factor will be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period will be used. Under this option, no monitoring of the emission factor is necessary during the crediting period.

***STEP 5. Calculate the build margin emission factor***

The build margin emission factor is the generation-weighted average emission factor ($tCO_2/MWh$) of all five power units identified in Step 4 above, during the most recent year for which power generation data is available. It is calculated as follows

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

| | |
|---|---|
| $EF_{grid,BM,y}$ | Build margin $CO_2$ emission factor in year y ($tCO_2/MWh$) |
| $EG_{m,y}$ | Net quantity of electricity generated and delivered to the grid by power unit *m* in year y (MWh) |
| $EF_{EL,m,y}$ | $CO_2$ emission factor of power unit in year y ($tCO_2/MWh$) |

m Power units included in the build margin
y Most recent historical year for which power generation data is available

***STEP 6. Calculate the combined margin emission factor***

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where:
$EF_{gird,BM,y}$ Build margin $CO_2$ emission factor in year y ($tCO_2/MWh$)
$EF_{gird,OM,y}$ Operating margin $CO_2$ emission factor in year y ($tCO_2/MWh$)
$w_{OM}$ Weighting of operating margin emissions factor (%)
$w_{BM}$ Weighting of build margin emissions factor (%)

The following default values will be applied for $w_{OM}$ and $w_{BM}$:

- $w_{OM}$ = 0.5 and $w_{BM}$ = 0.5 for the first crediting period, and $w_{OM}$ = 0.25 and $w_{BM}$ = 0.75 for the second and third crediting period.

The BM for the Sarawak Grid is 0.947 $tCO_2/MWh$, and the OM is 0.81 $tCO_2/MWh$. Giving each an equal weighting, the combined margin for the Sarawak Grid is 0.878 $tCO_2/MWh$ (tables are shown in Annex 3).

**Baseline emissions due to natural decay or uncontrolled burning of anthropogenic sources of biomass residues ($BE_{biomass}$)**

For scenario 2 projects, baseline emissions due to uncontrolled burning or decay of the biomass residues ($BE_{Biomass,y}$) should be determined consistently with the most plausible baseline scenario for the use of the biomass residues, using the following two steps:

**Step 1. Determination of the quantity of biomass residues used as a result of the project activity ($BF_{PJ,k,y}$)**

The amount of EFBs prevented from being disposed of in SWDS is, as described in the methodology, equal to the amount of EFBs disposed of by the Project Activity:
$BF_{PJ,k,y} = BF_{k,y}$

**Step 2. Estimation of methane emissions, consistent with the baseline scenario for the use of biomass residues**

The baseline scenario identified in section B.4 for the biomass is B2, “anaerobic decay of the biomass residues”. Therefore, in line with the methodology, baseline emissions from this source are calculated using the latest version of the tool to determine methane emissions avoided from dumping waste at a solid waste disposal site, according to the following formula:

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

Where:

| | |
|---|---|
| $\varphi$ | is the model correction factor to account for model uncertainties (0.9) |
| f | is the fraction of methane captured at the SWDS and flared, combusted or used in another manner |
| $GWP_{CH4}$ | is the global warming potential (GWP) of methane |
| OX | is the oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste |
| 16/12 | is the conversion factor for carbon (C) to methane ($CH_4$) |
| F | is the fraction of methane in the SWDS gas (volume fraction) (0.5) |
| $DOC_f$ | is the fraction of degradable organic carbon (DOC) that can decompose |
| MCF | is the methane correction factor |
| $W_{j,x}$ | is the amount of organic waste type *j* prevented from disposal in the SWDS in the year x (tonnes) |
| $DOC_j$ | is the fraction of degradable organic carbon (by weight) in the waste type *j* |
| $k_j$ | is the decay rate for the waste type *j* |
| j | is the waste type category |
| x | is the 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 |
| y | is the year for which methane emissions are calculated |

The EFBs that would have been disposed of at a SWDS in the absence of the Project Activity come under the category "garden waste", as directed by the Meth Panel and Executive Board.

**Leakage**

The main potential source of leakage for this project activity is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the project activity.

For scenario 2 projects, the project developer must demonstrate that the use of the biomass residues does not result in increased fossil fuel consumption elsewhere. This PDD selects option $L_2$ from the methodology and demonstrates that there is an abundant surplus of unutilized biomass residue in the region of each mill in the project activity. For this purpose, it is demonstrated that the quantity of available biomass residue of type *k*(EFBs) in the region is at least 25% larger than the quantity of biomass residues of type *k* (EFBs) that are utilized (e.g. for energy generation or as feedstock), including the project plant.

If leakage effects cannot be ruled out by the above method, then leakage emissions will be calculated as follows:

$$L_y = EF_{CO2,LE} \cdot \sum_k BF_{PJ,k,y} \cdot NCV_k$$

Where:

| | |
|---|---|
| $L_y$ | = Leakage emissions during the year y ($tCO_2$/yr) |
| $EF_{CO2,LE}$ | = $CO_2$ emission factor of the most carbon intensive fuel used in the country ($tCO_2$/GJ) |
| $BF_{PJ,k,y}$ | = Incremental quantity of biomass residue type k used as a result of the project activity |

in the project plants during the year y (tonnes)

k = Types of biomass residues for which leakage effects could not be ruled out

$NCV_k$ = Net calorific value of the biomass residue type k (GJ/ton of dry matter)

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

| **Data / Parameter:** | **$GWP_{CH4}$** |
|---|---|
| Data unit: | $tCO_2e/tCH_4$ |
| Description: | Global warming potential for $CH_4$ |
| Source of data used: | 2006 IPCC Guidelines |
| Value applied: | 21 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | 21 for the first commitment period. Shall be updated according to any future COP/MOP decisions. |
| Any comment: | - |

| **Data / Parameter:** | **$EF_{grid,y}$** |
|---|---|
| Data unit: | $tCO_2/MWh$ |
| Description: | Emission factor for the grid in year y |
| Source of data used: | Calculated as the combined margin emission factor, using the procedures in the latest approved version of the consolidated baseline methodology for grid-connected electricity generation from renewable sources. |
| Value applied: | 0.878 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Calculated as described in section B.6.1 |
| Any comment: | - |

| **Data / Parameter:** | **$EF_{CH4,BF}$** |
|---|---|
| Data unit: | $tCH_4/GJ$ |
| Description: | $CH_4$ emission factor for the combustion of biomass residues in the project plant |
| Source of data used: | Calculated as described in the methodology |
| Value applied: | 41.1 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | The following data from the 2006 IPCC Guidelines, as given in the methodology, was used in the calculation. |

| **Waste type** | **Default emission factor (kg $CH_4$/TJ)** | **Assumed uncertainty** | **Conservativeness factor** |
|---|---|---|---|
| EFBs (garden | 30 | 300% | 1.37 |

| | | | | | |
|---|---|---|---|---|---|
| | waste) | | | | |
| Any comment: | To be updated in line with the latest version of the IPCC Guidelines | | | | |

| **Data / Parameter:** | **$NCV_i$** |
|---|---|
| Data unit: | GJ/kg |
| Description: | Net calorific value of the fossil fuel type *i* |
| Source of data used: | 2006 IPCC Guidelines |
| Value applied: | - |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | This PDD assumes that no fossil fuel will be combusted in the Project Activity. However, if as a contingency some fossil fuel is used, the relevant NCV data will be taken from the latest version of the IPCC Guidelines. |
| Any comment: | |

| **Data / Parameter:** | $\varphi$ |
|---|---|
| Data unit: | Fraction |
| Description: | Model correction factor to account for model uncertainties |
| Source of data used: | The latest version of the methane avoidance tool (see EB39 report, Annex 9) |
| Value applied: | 0.9 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Default value suggested in the tool. |
| Any comment: | - |

| **Data / Parameter:** | **f** |
|---|---|
| Data unit: | Fraction |
| Description: | Fraction of methane captured at the SWDS and flared, combusted or used in another manner |
| Source of data used: | The latest version of the methane avoidance tool (see EB39 report, Annex 9) |
| Value applied: | 0 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | No methane would be captured at the SWDS in the baseline scenario. |
| Any comment: | - |

| **Data / Parameter:** | **OX** |
|---|---|
| Data unit: | Fraction |
| Description: | Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste |

| | |
|---|---|
| Source of data used: | The latest version of the methane avoidance tool (see EB39 report, Annex 9) |
| Value applied: | 0 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Value selected as directed in the methodological tool for uncovered solid waste disposal sites. |
| Any comment: | - |

| **Data / Parameter:** | **F** |
|---|---|
| Data unit: | Fraction |
| Description: | Fraction of methane in the SWDS gas (volume fraction) |
| Source of data used: | The latest version of the methane avoidance tool (see EB39 report, Annex 9) |
| Value applied: | 0.5 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Value applied as per the instructions in the methodological tool |
| Any comment: | - |

| **Data / Parameter:** | **$DOC_f$** |
|---|---|
| Data unit: | Fraction |
| Description: | Fraction of degradable organic carbon (DOC) that can decompose |
| Source of data used: | The latest version of the methane avoidance tool (see EB39 report, Annex 9) |
| Value applied: | 0.5 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Value applied as per the instructions in the methodological tool |
| Any comment: | |

| **Data / Parameter:** | **MCF** |
|---|---|
| Data unit: | Fraction |
| Description: | Methane correction factor |
| Source of data used: | The latest version of the methane avoidance tool (see EB39 report, Annex 9) |
| Value applied: | 0.8 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Value for deep, unmanaged landfill site selected according to the guidance in the methodological tool. |

| | |
|---|---|
| Any comment: | - |

| **Data / Parameter:** | **$DOC_j$** |
|---|---|
| Data unit: | Fraction |
| Description: | Fraction of degradable organic carbon (by weight) in the waste type j |
| Source of data used: | The latest version of the methane avoidance tool (see EB39 report, Annex 9) |
| Value applied: | 0.20 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | The waste type is expected to be consistent (EFBs). In accordance with Paragraph 24 of EB39 Meeting Report[13], wood was chosen for waste type of the EFB. |
| Any comment: | - |

| **Data / Parameter:** | **$k_j$** |
|---|---|
| Data unit: | Decay rate |
| Description: | Decay rate for the waste type j |
| Source of data used: | The latest version of the methane avoidance tool (see EB39 report, Annex 9) |
| Value applied: | 0.17 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | The waste type is expected to be consistent (EFBs). In accordance with Paragraph 24 of EB39 Meeting Report, garden waste was chosen for waste type of the EFB. |
| Any comment: | - |

### B.6.3 Ex-ante calculation of emission reductions:

Monitoring will be carried out for each plant individually, and the data used in the monitoring report to calculate actual emission reductions for each plant separately. However, for the sake of simplicity and given that the two biomass power plants in this project are each to be constructed to the same specifications, this PDD calculates the emission reductions for one plant as a reference. Total emissions are then calculated at the end by multiplying each of the results by 2.

**Emission reductions ($ER_y$)**

Emission reductions are calculated using the following formula:

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

**Project emissions ($PE_y$)**

Project emissions are calculated as follows:

[13] http://cdm.unfccc.int/EB/039/eb39rep.pdf

$PE_y$ = $PET_y$ + $PEFF_y$ + ($GWP_{CH4}$ · $PE_{Biomass,CH4,y}$)

For year 1, $PE_y$ = 1,064 + 0 + (21 × 64)

= 2,408 $tCO_2e$ /year

**Carbon dioxide emissions from combustion of fossil fuels for transportation of biomass residues to the project plant ($PET_y$)**

As described in section B.6.1, this PDD selects option 1 from the methodology. Assuming an average of 15 tonnes of unprocessed EFBs is to be carried by each truck on each trip, and an average distance of 72 km, emission reductions are calculated as follows:

$$PET_y = \frac{\sum_k BF_{T,k,y}}{TL_y} \cdot AVD_y \cdot EF_{km,CO2,y}$$

$PET_y$ = (283,824/15) × 72 × (0.782/1000)

= 1,064$tCO_2$/year

**Carbon dioxide emissions from on-site consumption of electricity ($PE_{EC,y}$)**

Assuming conservatively, there may be as many as 2 start-up operations a year consuming approximately 700kW of electricity in total for one plant. However, the electricity will be very minimal and considered negligible. In the event of electricity import from the grid, this amount will be metered and be monitored.

There also will be on site electricity consumption of approximately 2,074MWh/year by the project during the pre-treatment process for the EFB. The press machines are used for dewatering. The bunch shredders are used for shredding EFB for the proper size to combust in the boiler.

Press machines: 210kW x 16 hours x 365 days x 90% = 1,104MWh
Bunch shredders: 123kW x 24 hours x 365 days x 90% = 970MWh
Total: 2,074 MWh/year

It is deemed negligible and further more the energy consumed by these equipments will be net of the gross energy produced by the biomass project.
Therefore, there will be no project emission from on-site consumption of electricity by the project activity. All on-site consumption of electricity will be monitored *ex-post*.

**Carbon dioxide emissions from on-site consumption of fossil fuels ($PE_{FFy}$)**

Whilst there will be contingency plans in place for the use of fossil fuels in the boiler, the boiler is fully expected to operate only on biomass. Any fossil fuel use will be monitored and the emissions from the use thereof will be estimated in accordance with the calculations in section B.6.1.

For the sake of simplicity, however, this PDD assumes that GHG emissions from this source are zero.

**Methane emissions from combustion of biomass residues ($PE_{Biomass,CH4,y}$)**

Each plant is expected to combust around 181,332 tonnes of processed EFBs per annum. Using the NCV information provided by the Project developer (8.59 GJ/ton), and the conservative emission factor calculated in section B.6.1 (41.1kg $CH_4$/TJ), emissions from this source are calculated as follows:

$$PE_{Biomass,CH4,y} = EF_{CH4,BF} \cdot \sum_k BF_{k,y} \cdot NCV_k$$

$$= (41.1/1000) \times 181{,}332 \times 8.59$$

$$= 64\ tCH_4/year$$

**Emission reductions due to displacement of electricity ($ER_{electricity,y}$)**

It is estimated that one plant will produce in the region of 78,840 MWh per year. Assuming a grid emission factor of 0.900 $tCO_2$/MWh, emissions reductions from this source are calculated as follows:

$$ER_{electricity,y} = EG_y \times EF_{electricity,y}$$

$$= 78{,}840 \times 0.878$$

$$= 69{,}187\ tCO_2/year$$

**Baseline emissions due to natural decay or uncontrolled burning of anthropogenic sources of biomass residues ($BE_{biomass}$)**

**Step 1**

Note that this PDD makes a distinction between processed and unprocessed EFBs. In order to be combusted in the Project boilers, EFBs must be shredded and dried. EFBs so treated are termed "processed EFBs" and it is estimated that each biomass power plant will combust 181,332 tonnes of processed EFBs per year. This drying and shredding greatly reduces the weight of a given amount of EFBs. The actual weight of this amount of raw, unprocessed EFBs is calculated as 283,824 tonnes, on the basis of the water content of the biomass before and after. Therefore, as described in section B.6.1, the total biomass residue used in one plant is considered the amount of biomass prevented from being disposed of at SWDS (283,824 tonnes/year).

**Step 2**

The amount of methane that would have been produced in year y in the absence of the construction of each plant under the Project Activity is calculated as follows:

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

Emissions from this are source shown below for the first crediting period (calculated using an Excel spreadsheet which will be made available for review at validation):

| Year | $CH_4$ Emissions (t/y) | $CO_2e$ (t/y) |
|---|---|---|
| 1 | 2,130 | 44,730 |
| 2 | 3,927 | 82,467 |
| 3 | 5,443 | 114,303 |
| 4 | 6,722 | 141,162 |
| 5 | 7,801 | 163,821 |
| 6 | 8,711 | 182,931 |
| 7 | 9,479 | 199,059 |
| **Average** | **6,316** | **132,639** |
| **Total** | **44,213** | **928,473** |

**Total baseline emissions**

Total baseline emissions for one plant are calculated in the following table:

| Year | Displaced GHG emissions from SWDS | Displaced GHG emissions from electricity production | Total |
|---|---|---|---|
| | ($tCO_2e$/year) | ($tCO_2e$/year) | ($tCO_2e$/year) |
| 1 | 44,730 | 69,187 | 113,917 |
| 2 | 82,467 | 69,187 | 151,654 |
| 3 | 114,303 | 69,187 | 183,490 |
| 4 | 141,162 | 69,187 | 210,349 |
| 5 | 163,821 | 69,187 | 233,008 |
| 6 | 182,931 | 69,187 | 252,118 |
| 7 | 199,059 | 69,187 | 268,246 |

**Leakage from increased fossil fuel use due to the replacement of biomass fuel with fossil fuel ($L_{y,fossil}$)**

Option $L_2$ is selected to show there is no leakage as regards an increase in the use of fossil fuel.

The availability of EFBs is assessed by using data provided by the Project Proponent that was obtained from the palm oil mills located in the region of each mill and which can be found in Annex 3.

The methodology requires that there is an excess of 25% or more of the biomass feedstock required by each plant in the project in its respective region, otherwise leakage effects must be calculated as described in section B.6.1.

Each plant is estimated to consume 283,824 tonnes of EFBs per year. For there to be no leakage, therefore, there must be at least 354,780 tonnes of EFBs (i.e. 283,824 × 1.25) available in the region of a plant.

For the Mas Gading Green Energy Sdn. Bhd. Plant, there are 395,000 tonnes of EFBs available in the region for use in the biomass power generation plant and that would otherwise be disposed of in SWDS.

For the Mukah Green Energy Sdn. Bhd. Plant, there are 380,000 tonnes of EFBs available in the region for use in the biomass power generation plant and that would otherwise be disposed of in SWDS.

There is, therefore, an excess of greater that 25% in each region and so, as described in the methodology, leakage from this source can be ignored.

This figure will be monitored each year to ensure that the surplus remains above 25%.

Save for an increase in fuel use for biomass transportation and the possible use of fossil fuels under contingency plans, the greenhouse gas emissions from both of which are included as project emissions, the use of EFBs in the Project activity will not lead to an increase in the use of fossil fuels.

This PDD, therefore, assumes that leakage emissions are zero.

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

**Estimated emission reductions for one plant are as follows:**

| Year | Estimation of baseline emissions ($tCO_2e$) | Estimation of project emissions ($tCO_2e$) | Estimation of leakage ($tCO_2e$) | Estimation of emission reductions ($tCO_2e$) |
|---|---|---|---|---|
| Year 1 | 113,917 | 2,408 | 0 | 111,509 |
| Year 2 | 151,654 | 2,408 | 0 | 149,246 |
| Year 3 | 183,490 | 2,408 | 0 | 181,082 |
| Year 4 | 210,349 | 2,408 | 0 | 207,941 |
| Year 5 | 233,008 | 2,408 | 0 | 230,600 |

| | | | | |
|---|---|---|---|---|
| Year 6 | 252,118 | 2,408 | 0 | 249,710 |
| Year 7 | 268,246 | 2,408 | 0 | 265,838 |
| TOTAL | 1,412,782 | 16,856 | 0 | 1,395,926 |

**Total estimated emission reductions for both plants are as follows:**

| Year | Estimation of baseline emissions ($tCO_2e$) | Estimation of project emissions ($tCO_2e$) | Estimation of leakage ($tCO_2e$) | Estimation of emission reductions ($tCO_2e$) |
|---|---|---|---|---|
| Year 1 | 227,834 | 4,816 | 0 | 223,018 |
| Year 2 | 303,308 | 4,816 | 0 | 298,492 |
| Year 3 | 366,980 | 4,816 | 0 | 362,164 |
| Year 4 | 420,698 | 4,816 | 0 | 415,882 |
| Year 5 | 466,016 | 4,816 | 0 | 461,200 |
| Year 6 | 504,236 | 4,816 | 0 | 499,420 |
| Year 7 | 536,492 | 4,816 | 0 | 531,676 |
| TOTAL | 2,825,564 | 33,712 | 0 | 2,791,852 |

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

### B.7.1 Data and parameters monitored:

| **Data / Parameter:** | **$BF_{k,y}$** |
|---|---|
| Data unit: | Tonnes of dry matter |
| Description: | Quantity of biomass residue type *k* combusted in the project plant during the year *y* |
| 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 | 181,332 tonnes of processed EFBs/plant/year, giving a total of 362,664 tonnes of processed EFBs per year for the Project Activity. |
| Description of measurement methods and procedures to be applied: | Monitored continuously using a weight meter and an annual energy balance will be prepared. Measurements adjusted for moisture content in order to determine dry weight. The quantity shall be crosschecked with the quantity of electricity generated. |
| QA/QC procedures to be applied: | Crosscheck the measurements with an annual energy balance that is based on the quantities obtained and stock changes. |
| Any comment: | - |

| **Data / Parameter:** | **$BF_{T,k,y}$** |
|---|---|
| Data unit: | Tonnes of dry matter |
| Description: | Quantity of biomass residue type *k* that has been transported to the project site |

| | |
|---|---|
| | during the year *y* |
| 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 | A total of 362,664 tonnes of processed EFBs per year.<br>[181,332 tonnes of processed EFBs per plant per year]<br>(as determined in B.6.1, Baseline emissions due to natural decay or uncontrolled burning of anthropogenic sources of biomass residues, Step 1) |
| Description of measurement methods and procedures to be applied: | Monitored continuously using a weight meter and an annual energy balance will be prepared. Adjust for the moisture content in order to determine the quantity of biomass. The quantity shall be crosschecked with the quantity of electricity generated. |
| QA/QC procedures to be applied: | Crosscheck the measurements with an annual energy balance that is based on the quantities obtained and stock changes. |
| 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 site |
| Source of data to be used: | Records by project participants on the origin of the biomass |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 71.92<br>Estimated from the EFB supplier data contained in Annex 3. |
| Description of measurement methods and procedures to be applied: | Continuously |
| QA/QC procedures to be applied: | 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: | number |
| Description: | Number of truck trips for the transportation of biomass |
| 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 | 18,921.6 |
| Description of measurement methods | Monitored continuously. |

| | |
|---|---|
| and procedures to be applied: | |
| QA/QC procedures to be applied: | Check consistency of the number of truck trips with the quantity of biomass combusted, e.g. in relation to previous years |
| Any comment: | - |

| **Data / Parameter:** | **$TL_y$** |
|---|---|
| Data unit: | tonnes |
| Description: | Average truck load of the trucks used for transportation of biomass |
| 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 | 15 tonne equivalent of wet matter |
| Description of measurement methods and procedures to be applied: | Determined by averaging the weights of each truck carrying biomass to the project plant. Monitored continuously, aggregated annually. |
| QA/QC procedures to be applied: | - |
| 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 to be used: | UNEP study http://www.unepfi.org/fileadmin/documents/ghg_indicator_2000.pdf |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 0.782 |
| Description of measurement methods and procedures to be applied: | Monitor at least annually. |
| QA/QC procedures to be applied: | Cross-check measurement results with emission factors referred to in the literature. |
| Any comment: | - |

| **Data / Parameter:** | **$EF_{CO2,FF,i}$** |
|---|---|
| Data unit: | $tCO_2/GJ$ |
| Description: | $CO_2$ emission factor for fossil fuel type *i* |
| Source of data to be used: | Data from the supplier, national data or 2006 IPCC Guidelines, in that order of preference. |

| | |
|---|---|
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | -<br>This PDD assumes no additional fossil fuel will be combusted under the Project Activity. |
| Description of measurement methods and procedures to be applied: | - |
| QA/QC procedures to be applied: | Documents detailing the emission factor to be checked against IPCC defaults. |
| Any comment: | - |

| **Data / Parameter:** | $\mathbf{FF_{project\ plant,i,y}}$ |
|---|---|
| Data unit: | $m^3$ per year |
| Description: | Quantity of fossil fuel type *i* combusted in the project plant during the year *y* |
| 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 | 0 |
| Description of measurement methods and procedures to be applied: | Monitor continuously using volume meters. |
| QA/QC procedures to be applied: | Cross-check the measurements with an annual energy balance that is based on purchased quantities and stock changes. |
| Any comment: | The only use of fossil fuels at the plant will be as a contingency fuel for the boilers. This PDD assumes the value is 0 for the sake of simplicity. |

| **Data / Parameter:** | $\mathbf{EG_{project\ plant,y}}$ |
|---|---|
| Data unit: | MWh/yr |
| Description: | Net quantity of electricity generated in the project plant during the year *y* |
| 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 | 78,840 |
| Description of measurement methods and procedures to be applied: | Monitored continuously. |
| QA/QC procedures to | The consistency of metered net electricity generation should be cross-checked |

| | |
|---|---|
| be applied: | with receipts from electricity sales and the quantity of fuels fired (e.g. check whether the electricity generation divided by the quantity of fuels fired results in a reasonable efficiency that is comparable to previous years) |
| Any comment: | - |

| **Data / Parameter:** | **$NCV_k$** |
|---|---|
| Data unit: | GJ/t on of dry matter |
| Description: | Net calorific value of biomass residue type *k* |
| Source of data to be used: | Results provided by the project developer. |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 8.59 GJ/tonne of processed EFBs |
| Description of measurement methods and procedures to be applied: | Measurements shall be made at least every six months, and taking three samples each time. Measurements shall be carried out at reputed laboratories and according to relevant international standards. Measurements will be made for the NCV based on dry biomass. |
| QA/QC procedures to be applied: | 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 measurements results differ significantly from previous measurements or other relevant sources, conduct additional measurements. Ensure that the NCV is determined on the basis of dry biomass. |
| Any comment: | - |

| **Data / Parameter:** | **$EF_{burning,CH4,k,y}$** |
|---|---|
| Data unit: | $tCH_4/GJ$ |
| Description: | $CH_4$ emission factor for uncontrolled burning of the biomass residue type *k* during the year *y* |
| Source of data to be used: | Information provided by the Project developer. |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 0 |
| Description of measurement methods and procedures to be applied: | The Project developer will provide data that shows that the biomass would all have been disposed of at SWDS in the absence of the Project activity. |
| QA/QC procedures to be applied: | Check the measurement methods. |
| Any comment: | - |

| **Data / Parameter:** | **-** |
|---|---|

| | |
|---|---|
| Data unit: | Tonnes |
| Description: | Quantity of biomass residues of type k that are utilized (e.g. for energy generation or as feedstock) in the defined geographical region |
| Source of data to be used: | Surveys or statistics |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Only the amount consumed by the project. |
| Description of measurement methods and procedures to be applied: | Annually monitored. |
| QA/QC procedures to be applied: | Crosschecked with purchase receipt. |
| Any comment: | Applicable to leakage section. |

| **Data / Parameter:** | **-** |
|---|---|
| Data unit: | Tonnes |
| Description: | Quantity of available biomass residues of type k in the region |
| Source of data to be used: | Malaysia Palm Oil Board |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 6,992,602 tonnes of FFB |
| Description of measurement methods and procedures to be applied: | Annually monitored. |
| QA/QC procedures to be applied: | This involves the use of official data from the Malaysia Palm Oil Board. Quality control of this data is beyond the control of project developer. |
| Any comment: | Applicable to leakage section. |

| **Data / Parameter:** | $EC_{PJ,j,y}$ |
|---|---|
| Data unit: | MWh |
| Description: | Quantity of electricity consumed by the project electricity consumption source *j* in year |
| Source of data to be used: | On-site measurements |
| Value of data applied for the purpose of calculating expected emission reductions in | 0 |

| | |
|---|---|
| section B.5 | |
| Description of measurement methods and procedures to be applied: | Use electricity meters. The quantity shall be cross-checked with electricity purchase receipts. Monitored continuously, aggregated at least annually. |
| QA/QC procedures to be applied: | Crosscheck the measurement results with invoices for purchased electricity if available. |
| Any comment: | The Project is fully expected to provide its own electricity. However, this will be monitored as part of the monitoring plan for QA/QC purposes. |

| **Data / Parameter:** | **$TDL_{j,y}$** |
|---|---|
| Data unit: | - |
| Description: | Average technical transmission losses for providing electricity to source *j* in year y |
| Source of data to be used: | As per too to estimate the baseline, project and/or leakage emissions from electricity consumption, recent, accurate and reliable data available within the host country will be used. |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Actual measurement or be based on references from utilities, network operators or other official documentation whichever is available. |
| Description of measurement methods and procedures to be applied: | To be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses. (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation. |
| QA/QC procedures to be applied: | In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years. |
| Any comment: | - |

| **Data / Parameter:** | **$W_{j,x}$** |
|---|---|
| Data unit: | Tonnes |
| Description: | Amount of organic waste type *j* prevented from disposal in the SWDS in the year x |
| Source of data to be used: | Actual measurements |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Equivalent to the amount of EFBs to be consumed by the project. |
| Description of measurement methods | Monitored continuously using a weight meter and an annual energy balance will be prepared. Measurements adjusted for moisture content in order to determine |

| | |
|---|---|
| and procedures to be applied: | dry weight. The quantity shall be crosschecked with the quantity of electricity generated. |
| QA/QC procedures to be applied: | Crosscheck the measurements with an annual energy balance that is based on the quantities obtained and stock changes. |
| Any comment: | - |

| **Data / Parameter:** | **x** |
|---|---|
| Data unit: | - |
| Description: | the 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 |
| Source of data to be used: | - |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | - |
| Description of measurement methods and procedures to be applied: | - |
| QA/QC procedures to be applied: | - |
| Any comment: | - |

| **Data / Parameter:** | **y** |
|---|---|
| Data unit: | - |
| Description: | is the year for which methane emissions are calculated |
| Source of data to be used: | - |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | - |
| Description of measurement methods and procedures to be applied: | - |
| QA/QC procedures to be applied: | - |
| Any comment: | - |

| **Data / Parameter:** | $\mathbf{EF_{CO2,LE}}$ |
|---|---|
| Data unit: | $tCO_2/GJ$ |
| Description: | $CO_2$ emission factor of the most carbon intensive fuel used in the country |
| Source of data to be | Latest IPCC Guidelines |

| | |
|---|---|
| used: | |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 0 |
| Description of measurement methods and procedures to be applied: | - |
| QA/QC procedures to be applied: | - |
| Any comment: | - |

| **Data / Parameter:** | **$WC_{i,y,i}$** |
|---|---|
| Data unit: | tC/t fuel |
| Description: | Weighted average mass fraction of carbon in fuel type *i* in year *y* |
| Source of data to be used: | National Publication or IPCC Guidelines |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 0 |
| Description of measurement methods and procedures to be applied: | - |
| QA/QC procedures to be applied: | - |
| Any comment: | - |

| **Data / Parameter:** | **$\rho_{i,y}$** |
|---|---|
| Data unit: | $t/m^3$ |
| Description: | Weighted average density of fuel type *i* in year *y* |
| Source of data to be used: | National Publication or IPCC Guidelines |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 0 |
| Description of measurement methods and procedures to be applied: | - |
| QA/QC procedures to | - |

| | |
|---|---|
| be applied: | |
| Any comment: | - |

### B.7.2 Description of the monitoring plan:

**Purpose**

The monitoring methodology clearly describes how to identify and collect the necessary data. Below is a summary list of the main items to be monitored. The items will be monitored separately for each plant, and the respective plant manager will be responsible for monitoring at their sites. Plant managers will also be responsible for transferring the data to the CDM project manager who will be responsible for preparing an annual report. The emissions reductions for each plant will be calculated separately and will be collated to calculate the total emissions reductions for the Project Activity.

**Monitoring framework**

The figure below outlines the operational and management structure that Group will be implemented to monitor emission reductions and any leakage effects generated by the Project Activity. An environmental management team will be established at each plant will be responsible for the monitoring of all the aforementioned parameters. Each team will be composed of a general manager and a group of operators. The group of operators, under the supervision of the general manager, will be assigned for the monitoring of different parameters on a timely basis and will perform the recording and archiving of 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. The two project plants will coordinate and assign one CDM project manager amongst them who is responsible for overall management of the Project including the monitoring activities.

The performance of the Project will be reviewed and analyzed by consultants on a regular basis.

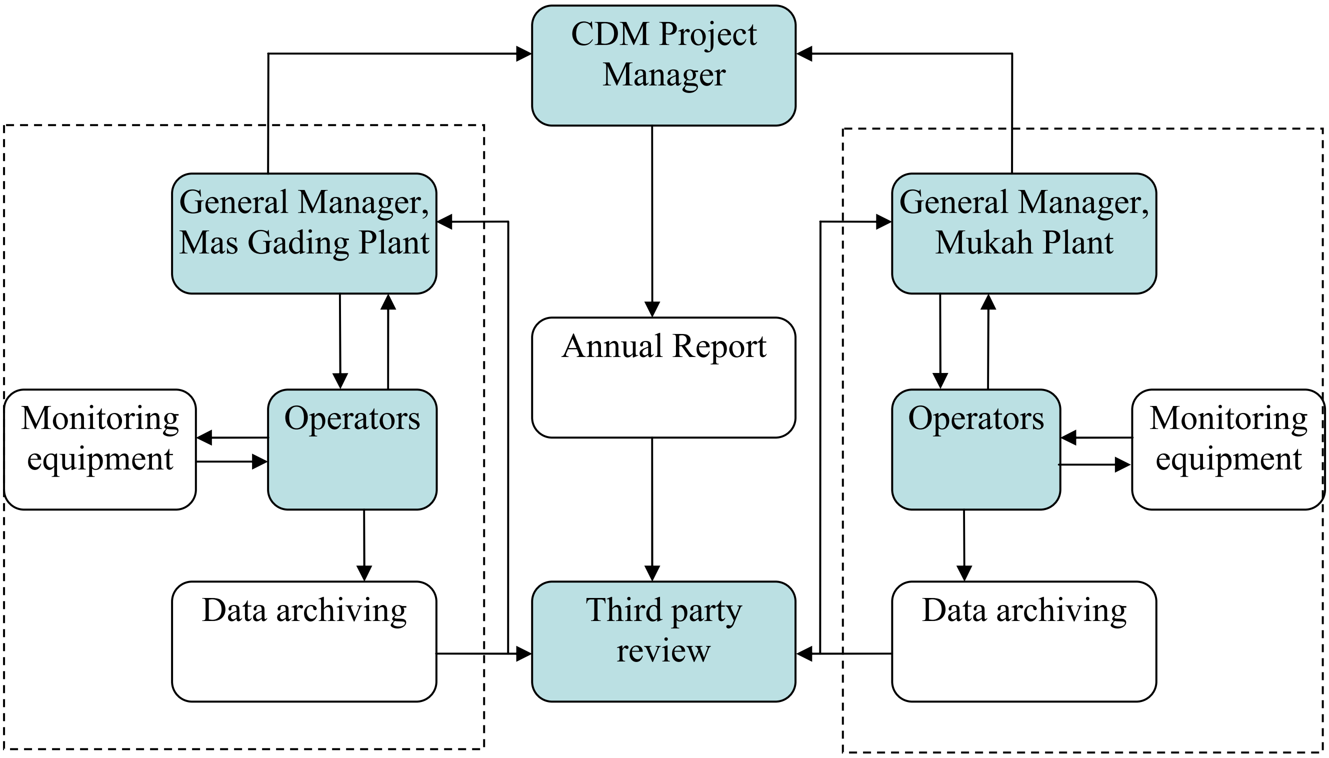



Figure: Operational and management structure for monitoring the Project Activity.

**Monitoring equipment and installation**

The Project Activity requires the monitoring of the following items:

- Electricity demand of the biomass power plants and other local loads at each site throughout the Project.
- Amount of EFBs transported to and from each site, and the distances involved.
- Amount of EFBs processed and combusted in the boiler.
- Regulations and/or policy that could influence the use of EFBs and generation of power in the region.
- Project electricity generation, including:
  - Each plant's electricity imports and exports.
  - Electricity demand and generation of the proposed project activity.
  - Confirmation to meet applicability conditions.
- Volume of EFBs produced in the region of each plant (for leakage calculation)

All the items to be monitored under the Project Activity will be monitored individually for each plant and aggregated annually.

**Calibration**

Regular calibration will be necessary for all meters and instruments. The necessary calibration will be performed as per industry practices, by a suitably skilled technician at the required frequency (at least once a year). A certificate of calibration will be provided for each piece of equipment after completion.

**Data management**

All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the crediting period. 100% of the data should be monitored if not indicated otherwise in Section B.7.1 above.

**Monitoring report**

A monitoring report in line with CDM regulations and the requirements of this monitoring methodology will be issued annually by the CDM project manager.

The monitoring report will contain a summary of the whole monitoring plan, and will describe the implementation of the monitoring plan in that particular year, present the relevant results and data, and calculate emission reductions for the period.

The report will include, separately for each plant as necessary:

- Quality assurance reports for the monitoring equipment;
- Calibration reports for the monitoring equipment (including relevant standards and regulations);
- Any maintenance and repair of monitoring equipment;
- The qualifications of the persons responsible for the monitoring and calculations;
- The tests performed and data obtained;
- Emission reduction calculations;
- A summary of the monitoring plan in that particular year;
- Any other information relevant to the monitoring plan.

**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)**

Baseline study completed 20/05/2008 by:

Joseph Cairnes and Atsuko Nuibe
Clean Energy Finance Committee,
Mitsubishi UFJ Securities Co., Ltd.
8th Floor, Mitsubishi Building,
Marunouchi 2-5-2, Chiyoda-ku,
Tokyo, 100-0005, JAPAN.

## 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:

26/10/2007

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

21 years

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

#### C.2.1. Renewable crediting period

The option of the seven-year renewable crediting period is selected for the Project.

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

01/01/2010

##### C.2.1.2. Length of the first crediting period:

Seven (7) years

#### C.2.2. Fixed crediting period:

##### C.2.2.1. Starting date:

N/A

##### C.2.2.2. Length:

N/A

## SECTION D. Environmental impacts

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

The legislation relating to Environmental Impact Assessments (EIA) in Malaysia is the Environmental Quality Order of 1987, which is based on the Environment Quality Act of 1974. According to this Order[14], the implementation of an EIA is required only for the following types of activities:

- Construction of steam-based-generation power stations that burn fossil fuels and have a capacity of more than 10 megawatts.
- Dams and hydroelectric power schemes with either or both of the following:
  - dams over 15 metres high and ancillary structures covering a total area in excess of 40 hectares.
  - reservoirs with a surface area in excess of 400 hectares.
- Construction of combined cycle power stations.
- Construction of nuclear-fuelled power stations.

Therefore, power plants with 11.5MW generation capacity are not required to carry out EIA under Malaysian regulations.

**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:**

The entire plant water system will be designed as "Zero Waste Water Discharge System".

The waste water will be routed to a neutralization pit from where it will be sent to the evaporation pond. Cooling tower and boiler blow down will be taken to a small guard pond for treatment before being sent to the evaporation pond or being reused in the plant on every 5-6 year basis.

The ash from the boilers of each plant will be transported back to the plantations in the trucks that bring the EFBs from the palm oil mills. The ash is a useful organic fertilizer and the palm oil mills will distribute it in the plantations.

The Project will have an overwhelmingly positive impact on the environment by reducing EFB waste that is currently dumped and left to rot, emitting large amounts of methane in the decomposition process. Not only is methane a GHG but also a safety hazard due to its flammability. Moreover, the reduction in the amount of rotting EFBs will reduce the pungent odours and vermin problems that result from such a method of disposal.

## SECTION E. Stakeholders' comments

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

Separate stakeholder meetings were held for the Mas Gading and Mukah plants. The stakeholder meeting for Mas Gading was held from 3p.m. on the 15th December 2007. The stakeholder meeting for Mukah was originally held from 10a.m. on the 19th December 2007. However, later it was found that

[14] Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987.

For full list of applicable laws and regulations see Annex 5.

there were few local stakeholders who misunderstood about the project, biomass power plant, which is environmentally friendly with advanced technology. For this reason, the project participants had held another stakeholders meeting from 5:30p.m.on the 4th April 2008 to further explain about the project to gain their understanding and the support.

All meetings were organised with assistance from elected local representatives in each area.

Approximately fifty-five people attended the Mas Gading stakeholder consultation. Just over seventy people for the Mukah's first consultation and twenty for the second consultation respectively. The stakeholder meetings both followed the following format that was designed to inform the participants and invite them to share their views on the developments:

1) Meeting called to order.
2) Introduction to project.
3) Consultant engineer discussed:
    - The background of the project;
    - The benefits to the local community;
    - The project implementation and parties involved;
    - The power plant;
    - The project and Government Policy.
4) Question and answer session.

## E.2. Summary of the comments received:

**Questions and answers from the stakeholder meeting for the Mas Gading plant:**

| | Questions | Answers |
|---|---|---|
| 1 | When do you plan to construct the power plant and commence operation? | We plan to commence construction in this coming March 2008 and to begin operation in November 2009. |
| 2 | How do you handle the waste of the power plant, such as ash and wastewater? | Ash from burning the EFBs can be used as fertilizer for palm tree plantations. The waste water will be treated before it is disposed of in the river. The disposition of wastewater will occur every 5-6 years only. The project will comply with the Environmental Act of Malaysia, which ensures the acceptable level of environmental impact. |
| 3 | How many people will be employed during the construction and operation phases of the plant? | During the construction period, possibly more than 100 skilled and unskilled workers will be hired by the construction contractors. During operation, MGGE will employ around 35 workers |

| | | |
|---|---|---|
| | | with various skills. |
| 4 | What will the salary rate be for people involved in plant operation? | The salary rate will be adjusted according to the market. |

NB. No negative comments were made regarding the Mas Gading plant.

**Questions and answers from the 1st stakeholder meeting for the Mukah plant:**

| | Questions | Answers |
|---|---|---|
| 1 | Where is the exact location of the proposed power plant? | In Matadeng, Mukah, close to the Mukah coal fire power. |
| 2 | Why was this site chosen? | Because 1) the electricity supply in this area is facing shortages. Even though this project is small, it can help stabilize the system; and 2) there are many of EFB wasted around this area since there are many palm oil mills. We can make good use of this renewable biomass for electricity and better for the environment. |
| 3 | When do you plan to construct the power plant and commence operation? | We plan to commence construction in this coming April and to begin operation in December 2009. |
| 4 | To whom you sell electricity? | MGE will sell electricity to SESCO, through its transmission line, which will benefit to stability of electricity system in this area. |
| 5 | How do you generate electricity from EFB? | 1) Burn the EFB to boil water<br>2) Boil water will create steam<br>3) Steam pressure will turn the turbine<br>4) The turbine will generate electricity |
| 6 | How do you handle ash after burning EFB? | Ash from burning EFB can be used as fertilizers for plantation of palm trees. |
| 7 | How do you handle the air, water, noise and smell? | The project will comply with the Environmental Act of Malaysia, which ensures the minimum and accepted level of environmental impact. |
| 8 | Will the people of Mukah be paying more for electricity? | No. The power generated will be sold to SESCO, which in turn will sell it to the people of Mukah at |

| | | |
|---|---|---|
| | | their rates. |
| 9 | What benefits will the community get from the project? | The local residents will have job opportunities during construction and operation. Also local business will have opportunities for goods supply and service. |
| 10 | How many people will be employed? | During construction period, it may be more than 100 skilled and unskilled workers to be hired by the construction contractors. During operation period of 21 years, MGE will hire around 20 various skilled workers. |

**Questions and answers from the 2nd stakeholder meeting for the Mukah plant:**

| | Questions | Answers |
|---|---|---|
| 1 | Will the Company purchase the land from the local land owner or will the Company use the government enforcement to acquire the land because previous project has acquired the land by government force? | The Company is planning to purchase the land from individual owners here without using government enforcement. However, in order to do the above said, the company need support and cooperation from local people. Therefore, please help us and support our project development in order for us to help you in other way. |
| 2 | Will there be any employment for local people? | Yes. The Company will prioritize to employ the local people as much as possible. However, for some positions, such as boiler engineer, chemical engineer and etc., which require special knowledge and/or licenses, shall be selected fairly. |

NB. No negative comments were made regarding the Mukah plant.

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

Detailed summaries of both stakeholder meetings were prepared, including the issues highlighted and the answers given. No follow up was necessary because all questions were answered satisfactorily during the meeting by the technical experts present, by referring to the current project plans.

**Annex 1**

**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

| | |
|---|---|
| Organization: | MAS GADING GREEN ENERGY SDN BHD |
| Street/P.O.Box: | NO.5B.BLOCK 2, 2ND FLOOR, JALAN TINJU 13/50 , SEKSYEN 13 |
| Building: | WORLDWIDE BUSINESS CENTRE |
| City: | SHAH ALAM |
| State/Region: | SELEANGOR DARUL EHSAN |
| Postfix/ZIP: | 40675 |
| Country: | MALAYSIA |
| Telephone: | 603-55127818 |
| FAX: | 603-55127817 |
| E-Mail: | - |
| URL: | - |
| Represented by: | Zaharah Taib |
| Title: | Madam |
| Salutation: | Not available |
| Last Name: | Taib |
| Middle Name: | - |
| First Name: | Zaharah |
| Department: | Managing Director |
| Mobile: | - |
| Direct FAX: | 603-55127818 |
| Direct tel: | 603-55127817 |
| Personal E-Mail: | zarahtaib@naluriventures.com |

| | |
|---|---|
| Organization: | MUKAH GREEN ENERGY SDN BHD |
| Street/P.O.Box: | NO.5B.BLOCK 2, 2ND FLOOR, JALAN TINJU 13/50 , SEKSYEN 13 |
| Building: | WORLDWIDE BUSINESS CENTRE |
| City: | SHAH ALAM |
| State/Region: | SELEANGOR DARUL EHSAN |
| Postfix/ZIP: | 40675 |
| Country: | MALAYSIA |
| Telephone: | 603-55127818 |
| FAX: | 603-55127817 |
| E-Mail: | - |
| URL: | - |
| Represented by: | Zaharah Taib |
| Title: | Madam |
| Salutation: | Not Available |
| Last Name: | Taib |
| Middle Name: | - |
| First Name: | Zaharah |
| Department: | Managing Director |

| | |
|---|---|
| Mobile: | - |
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| Direct tel: | 603-55127817 |
| Personal E-Mail: | zarahtaib@naluriventures.com |

| | |
|---|---|
| Organization: | Agritech Marketing Co., Ltd. |
| Street/P.O.Box: | 2554-63 Hongyotoku |
| Building: | - |
| City: | Ichikawa |
| State/Region: | Chiba |
| Postfix/ZIP: | 272-0103 |
| Country: | Japan |
| Telephone: | +81-47-307-4833 |
| FAX: | +81-47-307-5676 |
| E-Mail: | Hideyuki_ito@amc-apex.com |
| URL: | http://www.amc-apex.com |
| Represented by: | Hideyuki Ito |
| Title: | President |
| Salutation: | Mr. |
| Last Name: | Ito |
| Middle Name: | none |
| First Name: | Hideyuki |
| Department: | - |
| Mobile: | +81-90-3501-6879 |
| Direct FAX: | +81-47-307-4833 |
| Direct tel: | +81-47-307-5676 |
| Personal E-Mail: | - |

**Annex 2**

**INFORMATION REGARDING PUBLIC FUNDING**

The financial plans for the Project do not involve any public funding from Annex I countries.

## Annex 3

## BASELINE INFORMATION

### Build margin

**Existing Power Plant Unit Information (the 5 most recently built units)**

| Unit name | Commissioning | Fuel Type | Capacity | Generation | Fuel | | MMBTU to GJ conversion factor (for natural gas *) | NCV of fuel (TJ/Gg) | Oxidation | IPCC EF of fuel | $CO_2$ Emissions |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month/Year | | (MW) | (MWh) | Consumption | | (MMBTU to GJ) | | Factor | *(tCO2/TJ)* | *($tCO_2$)* |
| SPC2 Unit 4 | JUL. '04 | COAL | 55 | 333,611 | 236,581 | tons | n/a | 19.9 | 1 | 89.5 | 421,363 |
| SPC2 Unit 3 | MAY '04 | COAL | 55 | 292,673 | 207,550 | tons | n/a | 19.9 | 1 | 89.5 | 369,657 |
| SPC Unit 1 | JAN. '99 | GAS | 105 | 1,292,609 | 16,529,772 | mmbtu | 1 | | 1 | 54 | 946932.7837 |
| SPC Unit 2 | JAN. '99 | GAS | 105 | | | | | | | | |
| SPC1 Unit 2 | MAY '98 | COAL | 50 | 312,707 | 210,899 | tons | n/a | 19.9 | 1 | 89.5 | 375,622 |
| | | | | 2,231,600 | | | | | | | 2,113,576 |
| | | | | | | Build margin | = | Total emissions / Total generation | | | |
| | | | | | | | = | 0.9471122 | | | |

### Operating margin

| Plant type | Generation (GWh) | | |
|---|---|---|---|
| | 2005 | 2006 | 2007 |
| Hydroelectric | 526.97 | 353.74 | 420.31 |
| Natural gas | 2,715.90 | 2,969.03 | 3,174.24 |
| Heavy oil | | | |
| Diesel oil | 18.94 | 74.25 | 107.35 |
| Lignite | | | |
| Imported coal | 1,291.15 | 1,237.49 | 1,413.03 |
| Renewable energy | | | |
| Imported | | | |
| **Total** | 4,552.96 | 4,634.51 | 5,114.93 |

**Generation data for the Sarawak Grid**

| **Plant type (2005)** | **Data received** | Density t/m3 | EF kg/TJ | NCV MJ/t or GJ/MMBTU | CO2 emissions |
|---|---|---|---|---|---|
| Hydroelectric | | | | | |
| Natural gas | 35,973,119.70 mmBTU | | 54300 | 1.055 | 2,060,774.12 |
| Heavy oil | | | | | |
| Diesel oil | 11,498,831.87 litres | 0.85 | 72600 | 41400 | 29,377.15 |
| Lignite | | | | | |
| Imported coal | 815,336.73 tons | | 89500 | 19900 | 1,452,155.48 |
| Renewable energy | | | | | |
| Imported | | | | | |
| **Total** | | | | | 3,542,306.75 |

| **Plant type (2006)** | **Data received** | Density t/m3 | EF kg/TJ | NCV MJ/t or GJ/MMBTU | CO2 emissions |
|---|---|---|---|---|---|
| Hydroelectric | | | | | |
| Natural gas | 39,226,776.27 mmBTU | | 54300 | 1.055 | 2,247,164.72 |
| Heavy oil | | | | | |
| Diesel oil | 28555667.81 litres | 0.85 | 72600 | 41400 | 72,953.85 |
| Lignite | | | | | |
| Imported coal | 861,112.52 tons | | 89500 | 19900 | 1,533,684.45 |
| Renewable energy | | | | | |
| Imported | | | | | |

| | | | |
|---|---|---|---|
| **Total** | | | 3,853,803.02 |

| **Plant type (2007)** | **Data received** | Density t/m3 | EF kg/TJ | NCV MJ/t or GJ/MMBTU | CO2 emissions |
|---|---|---|---|---|---|
| Hydroelectric | | | | | |
| Natural gas | 41,224,986.57 mmBTU | | 54300 | 1.055 | 2,361,635.19 |
| Heavy oil | | | | | |
| Diesel oil | 36,414,867.64 litres | 0.85 | 72600 | 41400 | 93,032.49 |
| Lignite | | | | | |
| Imported coal | 957,784.64 tons | | 89500 | 19900 | 1,705,862.33 |
| Renewable energy | | | | | |
| Imported | | | | | |
| **Total** | | | | | 4,160,530.01 |

**Calculation of operating margin (total emissions/total generation)**

| Years | Generation (MWh) | CO2 Emission (tonnes) | |
|---|---|---|---|
| 2007 | 5,114,933.79 | 4,160,530.01 | |
| 2006 | 4,634,506.99 | 3,853,803.02 | |
| 2005 | 4,552,957.16 | 3,542,306.75 | |
| Average Operating Margin for 3 years | | | 0.81 |

**Data on EFB suppliers for each plant**

## EFB Suppliers (Mas Gading Green Energy Sdn. Bhd.)

| Mill Name | Parent/ Holding | Factory Location | FFB Mill Capacity (ton/hr) | EFB Mill Capacity (ton/year) | Distance P/P-Mill (km) |
|---|---|---|---|---|---|
| | | | | | |
| Felda Palm Industries Sdn Bhd - KKS Sa | FELDA | Lundu | 60 | 60,000 | 43 |
| Kilang Kelapa Sawit Bau | SALCRA | Lundu | 40 | 40,000 | 25 |
| Serian POM Sdn Bhd | SALCRA / Asia | Serian | 60 | 60,000 | 105 |
| Gedong Oil Mill | | Gedong | 60 | 60,000 | 100 |
| RH Lundu POM Sdn Bhd | | Lundu | 45 | 45,000 | 33 |
| FELCRA Samarahan POM | FERCRA | Samarahan | 45 | 45,000 | 50 |
| Melor Gemilang | | Serian | 45 | 45,000 | 105 |
| Lubuk Antu OPM | SALCRA | Merindun | 40 | 40,000 | 180 |
| **Total Volume** | | | | **395,000** | |
| **Average distance** | | | | | **76.57** |

## EFB Suppliers (Mukah Green Energy Sdn. Bhd.)

| Mill Name | Parent/ Holding | Factory Location | FFB Mill Capacity (ton/hr) | EFB Mill Capacity (ton/year) | Distance P/P-Mill (km) |
|---|---|---|---|---|---|
| | | | | | |
| Judan POM | Solar Green So | Oya | 60 | 60,000 | 60 |
| Kilang Kelapa Sawit Kanowit | | Kanowit | 60 | 60,000 | 115 |
| Mukah OPM | | Mukah | 60 | 60,000 | 45 |
| Retus POM | Retus Plantn S | Mukah | 40 | 40,000 | 105 |
| Rinwood Sago POM | Rinwood Sago | Mukah | 80 | 80,000 | 28 |
| RH Selangau Palm Oil Sdn Bhd | | Selangau | 40 | 40,000 | 53 |
| Sarawak POM | | Balingan | 40 | 40,000 | 23 |
| **Total Volume** | | | | **380,000** | |
| **Average distance** | | | | | **61.29** |

## Annex 4

## MONITORING INFORMATION

Monitoring described in full in section B.7.2 above.

## Annex 5

**Malaysian laws and regulations relevant to the energy and palm oil industries:**

Environmental Quality Act, 1974
Environmental Quality (Licensing) Regulations 1977
Environmental Quality (Prescribed Premises) (Crude Palm Oil) Regulations 1977
Environmental Quality (Clean Air) Regulations 1978
Environmental Quality (Sewage and Industrial Effluents) Regulations 1979
Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 (Amendment 1995)
Environmental Quality (Scheduled Wastes) Regulations 1989

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