# プロジェクト設計書

## （Project Design Document）

**CLEAN DEVELOPMENT MECHANISM**
**SIMPLIFIED PROJECT DESIGN DOCUMENT**
**FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)**
**Version 02**

**CONTENTS**

**Revision history of this document**

| Version Number | Date | Description and reason of revision |
|---|---|---|
| 01 | 21 January 2003 | Initial adoption |
| 02 | 8 July 2005 | • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>. |

## SECTION A. General description of the small-scale project activity

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

>>
Grid EFB Connected Power Generation Project in Terengganu States, Malaysia

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

>>
Purpose
This project activity aims at greenhouse gas (GHG) emission reduction by utilization of empty fruit bunches (EFB) , which are a waste product generated by crude palm oil (CPO) mills, to generate power and sell it to the national grid. The project is located at Sungai Tong mill in Terengganu State, Malaysia which is owned by TDM plantation Sdn Bhd, a 100% subsidiary company of TDM Bhd, of which Terengganu State government owns 80%.

Background
Fresh Fruit Bunches (FFB) are brought to the CPO mills from plantations, then generally soaked by vapor and CPO is extracted. In this milling process, an enormous amount of solid by-products; EFB, fiber, and shell are generated. Among the by-products, fibers and shells which have relatively high energy value are usually utilized on site as boiler fuel. However, EFB has not been utilized because of its lower energy value, its bigger size (much bigger than fiber and shell) and high kalium content which may cause scale inside the boiler furnace. The Malaysian Environmental Quality Act of 1974 was amended in 1998 and prohibits open burning. Any person who contravenes this shall be liable to a fine or imprisonment, or both. EFB used to be combusted in incinerators at the CPO mills, but this no longer allowed by the Department of Environment, in order to prevent air pollution. Due to the above situations, EFB has been disposed in the plantations and left to decay anaerobically.

Contribution to Sustainable Development
The Malaysian Government regards renewable energy as a fifth source of energy after coal, oil, natural gas and hydro power, and has been promoting its utilization. This project activity aims to achieve sustainable development in Malaysia as well as GHG emission reduction through the following components:

a)GHG emission reduction through methane avoidance from EFB decay
The project will achieve 371,073 $tCO_{2eq}$/y of methane emission avoidance through controlled combustion of EFB for generating power. The project will utilize the EFB generated at Sungai Tong mill site (68,100t/y) and carried from neighboring mills (26,900t/y) which would otherwise have been disposed in plantations and left to decay anaerobically. Disposal of EFB has been regarded as a very serious problem in Malaysia not only because it results in high costs, but also it can pose various environmental problems such as water pollution, fire hazards, insect pests, odor and also lack of land availability. Thus, this project activity contributes to sustainable development in the host country.

b) GHG emission reduction through EFB power generation for the grid
The project will provide renewable electricity with a capacity of 7MW and 5.66 MW which will be exported to the national grid. It will displace 45,280 MWh of grid electricity annually which is equivalent to 12,762 toe. The project will be implemented from April 2008 under the national scheme called SREP (Small Renewable Energy Programme) which the Malaysian Government has been promoting. A 21 year contract between the Tenaga National Berhad power company in Peninsula Malaysia will be assumed for the Renewable Electricity Purchase Agreement(REPA) for this project.

## A.3. Project participants:

>>

| Please list project participants and Party(ies) involved and provide contact information in Annex 1. Information shall be indicated using the following tabular format. | | |
|---|---|---|
| **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) | TDM Plantations Sdn Bhd | No |
| Japan | Gas and Power Investment CO., LTD (GPI) | 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. | | |
| **Note:** *When the PDD is filled in support of a proposed new methodology (forms CDM-NBM and CDM-NMM),* at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified. | | |

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

### A.4.1. Location of the small-scale project activity:

#### A.4.1.1. Host Party(ies):

>>

Host party of this project is Government of Malaysia.

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

>>

The project is located in Terengganu State.

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

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The physical address is of the project site is:

2150 Setiu, Terengganu, Malaysia

#### A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):

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The project is located in the premises of the TDM Sungai Tong Palm Oil Mill. The mill is located approximately 30km from Kuala Terengganu town which has 898,825population. There is a 33/11kv grid distribution substation 1.5km from the mill, to which the project will be transmitting the electricity.


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

>>

This project falls within categories I.D. and III.E. in Appendix B as described below.

- Type I.D. Renewable electricity generation for a grid
  This project activity involves the installation of new power generation units with a capacity of 7.0MW, of which 5.66MW will be exported to the national grid. The source of power is EFB which is biomass waste generated in the palm oil milling process. The project falls within category I.D. because it satisfies the definitions given in the simplified baseline and monitoring methodology for the category as follows:

  - renewable energy generation units, such as photovoltaics, hydro,tidal/wave, wind, geothermal, and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit(I.D. Version 08 Paragraph 1)
  - Project activities adding renewable energy capacity should consider the following cases:
    1) Adding new units;
    2) Replacing old units for more efficient units.
    To qualify as a small scale CDM project activity, the aggregate installed capacity after adding the new units (case 1) or of the more efficient units (case 2) should be lower than 15 MW (I.D. Version 08 Paragraph 4)

- Type III.E. Avoidance of methane production from biomass decay through controlled combustion
  This project uses EFB as fuel for renewable power generation which is currently unutilized and disposed of in plantations and left to decay anaerobically. By utilization of EFB, the project will result in avoidance of methane generation. Annual emissions from this project are expected to be 367 $tCO_2$ Thus, the project activity falls within III.E. because it satisfies the definitions given in the simplified baseline and monitoring methodology for the category as follows:

  Project that avoids the production of methane from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site without methane recovery. Due to the project activity, decay is prevented through controlled combustion. (III.E. Version 08 Paragraph 1)
  - Total annual project activity related emissions shall be less than equal to 15 kilo tonnes of $CO_2$ equivalent annually. (III.E. Version 08 Paragraph 4)

[Description of technologies to be applied to the project activity]
One of the technological features of the project is the EFB preprocessing technology, in particular the dewatering system. Existing EFB power plants usually apply dry systems for EFB preprocessing. Dry systems usually utilize waste heat from existing boilers which supply energy to CPO mills. This system often faces energy scarcity because the energy can be supplied only while the CPO mill operates. The advantage of the dewatering system is that it allows stable operation of the system because its energy is supplied by the EFB power plant which operates 24 hours a day.

Another feature is the EFB boiler which equipped the technology bi-drum, natural circulated, water tube boiler whose combustion system is called travelling stoker firing. This boiler can combust the fuel like EFB whose combustion response is low.
This boiler can also be built with the parts that are available locally and operation will be conducted by local counterpart staff. It is important for the success of the project that plant operation can be done locally at low cost, because if the project requires frequent support from outside, it will increase running costs and lower project viability. The boiler also does not need special treatment against air pollutants or toxic wastes.

Therefore, this project activity can make a contribution to sustainable development in the host country as well as GHG emissions reduction.

**A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:**

In Malaysia, open burning of EFB is banned by the Environmental Quality Act 1974 which was amended in 1998. Any person who contravenes this shall be liable to a fine or to imprisonment, or to both. Meanwhile, there is no legislation or regulation that prohibits EFB disposal in the plantations, nor is there expected to be in the future.

Moreover, although much research has been done on the effective material utilization of EFB, there have been almost no commercially successful projects to date. Also there is almost no EFB power generation project which runs successfully without CDM, due mainly to technological and financial barriers. Under this situation, palm oil producers near Sungai Tong mill have continued to dispose of EFB and leave it to decay anaerobically in their plantations. In this manner, in the absence of this project activity, EFB disposal will continue and an enormous amount of methane will be generated.

In light of the above, the project, which will utilize EFB for power generation, will result in a reduction of 186,952 $tCO_{2eq}$/y in methane emissions from EFB decay, and a total reduction of 371,073 $tCO_{2eq}$/y in carbon dioxide emissions during the 7 year crediting period.

For the purpose of conservativeness and transparency in calculation, only EFB from mills that currently leave EFB at their own disposal sites (mostly their plantations) is counted as a source of methane generation in the baseline scenario. In other words, EFB from mills where they do not dispose of EFB at their plantations will be omitted in the estimate of methane emission avoidance.

**A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:**

>>

The expected GHG emission reduction during the first crediting period (1 April 2008-30 March 2015) by the project is shown as follows:

Table GHG emission reduction

| Year | Baseline emissions | | Project emissions | Leakage emission | Annual estimation of emission reductions in tonnes of $CO_{2e}$ |
|---|---|---|---|---|---|
| | Biomass decay ($tCO_{2eq}$/y) | Displaced electricity ($tCO_{2eq}$/y) | Transportation increase ($tCO_{2eq}$/y) | ($tCO_{2eq}$/y) | Emission reduction ($tCO_{2eq}$/y) |
| Year 1 | 6,986 | 26,670 | 367 | 0 | 33,289 |
| Year 2 | 13,812 | 26,670 | 367 | 0 | 40,115 |
| Year 3 | 20,484 | 26,670 | 367 | 0 | 46,787 |
| Year 4 | 27,004 | 26,670 | 367 | 0 | 53,307 |
| Year 5 | 33,376 | 26,670 | 367 | 0 | 59,679 |
| Year 6 | 39,602 | 26,670 | 367 | 0 | 65,905 |
| Year 7 | 45,688 | 26,670 | 367 | 0 | 71,991 |
| Total | 186,952 | 186,690 | 2,688 | 0 | 371,073 |

**A.4.4. Public funding of the small-scale project activity:**

>>

This project does not involve any public funding as described in Annex 2.

**A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:**

>>

The project activity is not a debundled component of a larger project activity and will not be applied to register another project activity under the following conditions (Appendix C1 of the Simplified Modalities and Procedures for Small-Scale CDM project activities):

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point

## SECTION B. Application of a baseline methodology:

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

>>
The project is applicable to the following two categories:

Type I.D. Renewable electricity generation for a grid, and
Type III.E. Avoidance of methane production from biomass decay through controlled combustion

### B.2 Project category applicable to the small-scale project activity:

>>
This project activity is applicable to the project activity categories Type I.D. and Type III.E. as described in A.4.2.

1)I.D.
For baseline emission calculation, option (b) of the paragraph 7 of Type I.D. using the data obtained by TNB/Energy Commission. The figures and assumptions used in the GHG emission reduction calculation for this project are provided in the table below:

| parameter | unit | description | data source/comment |
|---|---|---|---|
| $BE_{y,grid}$ | t _$CO_{2eq}$/y | Annual baseline emission from a grid | calculated based on I.D. |
| $Electricity_y$ | kW | power generation capacity of the plant | 5.66 |
| $T_y$ | h/y | Operating hours of the plant | 8,000 |
| $CEF_y$ | $kgCO_{2eg}$ /kWh | $CO_2$ emission factor of grid electricity | calculated based on I.D. |

2)III.E.
Baseline emission calculation of methane generation potential is based on Type III.E. The concrete calculation method is described in E.1.1.4. The figures and assumptions used in the GHG emission reduction calculation for this project activity is provided in the table below:

| parameter | unit | description | data source/comment |
|---|---|---|---|
| $PE_{y,decay}$ | t _$CO_{2eq}$/y | Project activity direct emissions in the year "y" | calculated based on III.E. |
| $PE_{y,comb}$ | t _$CO_{2eq}$/y | Emissions through combustion of non-biomass carbon in the year "y" | calculated based on III.E. |
| $PE_{ytransp}$ | t _$CO_{2eq}$/y | Emissions through incremental transportation in the year "y" | calculated based on III.E. |
| $PE_{y,power}$ | t _$CO_{2eq}$/y | Emissions through electricity or diesel consumption in the year "y" | calculated based on III.E. |
| $Q_y$ | t/y | quantity of waste combusted in the year "y" (Increased amount only) | 26,900 Calculated by quantity of EFB(95,000t/y) combusted minus EFB generated at the project mill(68,100t/y) |
| $Q_{y,ash}$ | t/y | quantity of combustion residues produced in the year "y" | 2,708 Calculated by ash content of EFB(7.5%DM) and amount of combustion (95,000t/y, water content 62% |
| $CT_y$ | t/truck | average truck capacity for waste transportation | 5 Assumed in a conservative manner |

| | | | |
|---|---|---|---|
| $CT_{y,ash}$ | t/truck | average truck capacity for combustion residues transportation | 5<br>Assumed in a conservative manner |
| $DAF_w$ | km/truck | average incremental distance for waste transportation | 60<br>Assumed in a conservative manner based on the distance for the furthest mill from which EFB may be carried(30km for one-way) |
| $DAF_{w,ash}$ | km/truck | average distance for combustion residues transportation | 20<br>Assumed in a conservative manner |
| $EF_{CO2eq}$ | $tCO_2$/km | CO2 equivalent emission factor from fuel use due to transportation | Calculated by $EF_{CO2}$, $EF_{CH4}$, $EF_{N2O}$, $GWP_{CH4}$ and $GWP_{N2O}$ |
| $EF_{CO2}$ | $tCO_2$/km | CO2 emission factor from fuel use due to transportation (tCO2/km, IPCC default values or local values can be used.) | $1.1*10^{-3}$<br>IPCC guideline default value for "heavy duty diesel vehicle" |
| $EF_{CH4}$ | $tCH_4$/km | CH4 emission factor from fuel use due to transportation (tCH4/km, IPCC default values or local values can be used.) | $6.0*10^{-8}$<br>IPCC guideline default value for "heavy duty diesel vehicle" |
| $EF_{N2O}$ | $tN_2O$/km | N2O emission factor from fuel use due to transportation (tN2O 2/km, IPCC default values or local values can be used.) | $3.1*10^{-8}$<br>IPCC guideline default value for "heavy duty diesel vehicle" |
| $GWP_{CH4}$ | - | Global warming potential of $CH_4$ | 21<br>(IPCC default value) |
| $GWP_{N2O}$ | - | Global warming potential of $N_2O$ | 310<br>(IPCC default value) |
| F | - | fraction of methane in the landfill gas | Default□0.5□ |
| $DOC_j$ | - | per cent of degradable organic carbon (by weight) in the waste type j | Default□0.3□<br>Pease see the table below |
| $DOC_F$ | - | fraction of DOC dissimilated to landfill gas | IPCC default□0.77□ |
| MCF | - | Methane Correction Factor | IPCC default□1.0□ |
| $A_{j,x}$ | t/y | amount of organic waste type j land filled in the year x | 85,100<br>Assumed by the power capacity (7.0MW) |
| $k_j$ | - | decay rate for the waste stream type j | IPCC Default□0.023□for and straw waste |
| J | - | waste type distinguished into the waste categories (from A to D), as illustrated in the table below | D. Assumed as wood and straw waste |
| Y | - | year for which LFG emissions are calculated | |
| $MB_y$ | t/y | Methane generation potential | calculated based on III.E. |
| $MD_{y,reg}$ | t/y | methane emissions that would have to be removed to comply with national or local safety requirement or legal regulations | calculated based on III.E. |

Table. Waste stream decay rates (kj) and associated IPCC default values for DOCj

| Waste stream A to E | Per cent $DOC_j$ (by weighr) | Decay-rate ($k_j$) |
|---|---|---|
| A□Paper and textiles | 40 | 0.023 |
| B□Garden and park waste and other (non-food) putrescibles | 17 | 0.023 |
| C□Food waste | 15 | 0.231 |
| D□Wood and straw waste 1) | 30 | 0.023 |
| E□Inert material | 0 | 0 |

1) Excluding lignin-C

**B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:**

>>

This project will not result in a BAU scenario because of the following barriers:

-Investment barrier

Usually EFB power generation system needs larger investment compared to the systems that burn either conventional biomass or fossil fuel. The IRR(Internal Rate of Return) of this project without CER sales is 0.5%(14years: 2 crediting periods). The financial viability of the project will be improved when it is conducted under CDM and supplementary revenue is available, But without such support, the project activity without CER sales is not commercially viable.

-Technical barrier

Malaysian Government is actively promoting biomass power generation, however, very few EFB power generation projects have been implemented partially due to the difficulty in achieving a stable operation of the power system. It is obvious that this project which has higher risk is difficult to be implemented without incentives for CER acquisition by invest country. Therefore, it is apparent that there is a technological barrier for implementing this project activity.

-Barrier due to prevailing practice

There is no legislation or regulation that enforces EFB power generation or controlled combustion of EFB in Malaysia. Meanwhile, EFB open burning is banned by the Environmental Quality Act 1974 which was amended in 1998. Thus it is obvious that EFB combustion cannot be a natural course of action. Moreover, there is no EFB power generation implemented in Malaysia which did not assume to be a CDM projects Difficulties in operation have restricted the growth of this form of power generation.

**B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the small-scale project activity:**

>>

The project boundary for each case is illustrated in the following figures. The boundary includes the physical and geographical sites where EFB would have been disposed and the avoided methane emission occurs in absence of the proposed project activity, where the treatment of EFB combustion takes place, and in the itineraries between the transportation of EFB and combustion residues occurs.

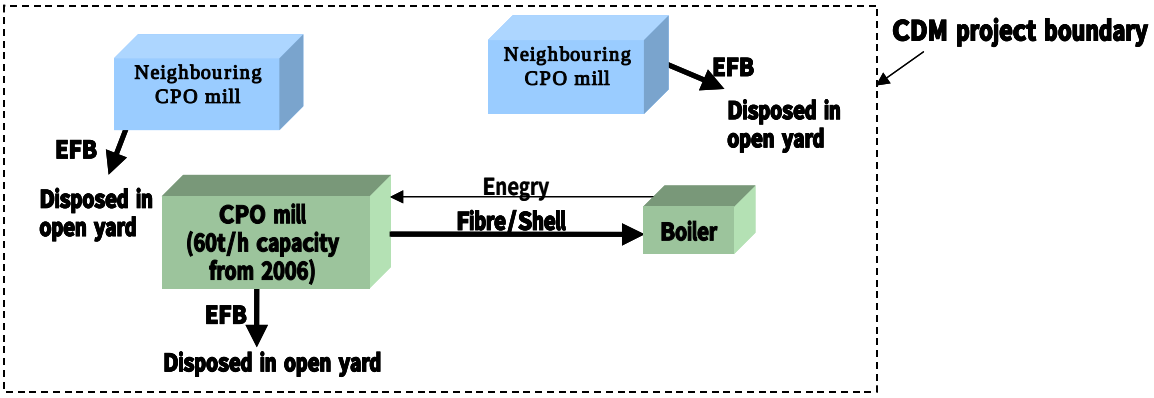


Fig. Project Boundary of Baseline Scenario

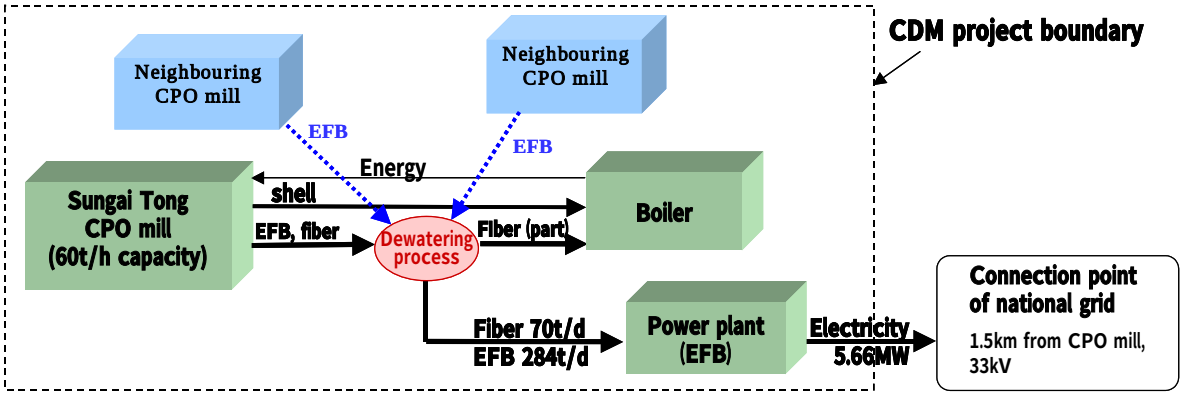


Fig. Project Boundary of Project Scenario

**B.5. Details of the baseline and its development:**

>>

The baseline for renewable electricity generation for the grid is based on Type I.D. of annex B of the simplified modalities and procedures for small-scale CDM project activities (version 08) The baseline emission coefficient (measured in kg $CO_2$equ/kWh) of grid electricity is determined in a transparent and conservative manner, that is the weighted average emissions (in kg $CO_2$equ/kWh) of the current generation mix.

The baseline for avoidance of methane emissions through controlled combustion of EFB is based on methodology AMSIII.E. of annex B of the simplified modalities and procedures for small-scale CDM project activities (version 08). Baseline methane emissions from EFB decay are calculated in a transparent and conservative manner based on first-order decay model.

Date of completion:
8 March 2006

Name of person/entity determining the baseline:
Ms. Ai Kawamura
Consultant
Sustainable Society Group
EX CORPORATION (City & Environment Planning, Research & Consulting)
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Email: Kawamura@exri.co.jp

## SECTION C. Duration of the project activity / Crediting period:

### C.1. Duration of the small-scale project activity:

>>

### C.1.1. Starting date of the small-scale project activity:

>>

The definition of the starting date of the project activity is the implementation of construction.

Starting date: 01/05/2007

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

>>

21 years

Power purchase agreement between electric company (TNB) will be valid for 21 years based on small renewable power programme which is promoted by the Government of the host country.

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

>>

### C.2.1. Renewable crediting period:

>>

21 years

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

>>

The definition of the starting date of the first crediting period is the commencement of EFB power generation plant.

Starting date: 01/04/2008

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

>>
7 years

### C.2.2. Fixed crediting period:

>>

### C.2.2.1. Starting date:

>>

### C.2.2.2. Length:

## SECTION D. Application of a monitoring methodology and plan:

>>

### D.1. Name and reference of approved monitoring methodology applied to the small-scale project activity:

>>

This project is applicable to the following two monitoring methodologies:

Type I.D. Renewable electricity generation for a grid, and
Type III.E. Avoidance of methane production from biomass decay through controlled combustion

### D.2. Justification of the choice of the methodology and why it is applicable to the small-scale project activity:

>>

As described in A.4.2., justification for application of small scale methodologies (Type I.D. and Type III.E.) to this project activity is given below:

- Type I.D. Renewable electricity generation for a grid
  - This project installs renewable biomass energy generation unit that supplies electricity to an electricity distribution system that is supplied by at least one fossil fuel fired generating unit.
  - The total output of the power plant to be installed does not exceed 15 MW.

- Type III.E. Avoidance of methane production from biomass decay through controlled combustion
  - This project avoids the production of methane from biomass that would have otherwise been left to decay anaerobically in a solid waste disposal site without methane recovery. Due to the project, decay is prevented through controlled combustion.
  - Measures will both reduce anthropogenic emissions by sources, and directly emit less than 15 kilo tonnes of carbon dioxide equivalent annually.

**D.3 Data to be monitored:**

>>

| ID | Data variable | Unit | Measured (m), calculated (c), estimated (e), | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | For how long is archived data kept? | Comment |
|---|---|---|---|---|---|---|---|---|
| 1 | Amount of biomass combusted | t/y | M | Daily | 100% | Electronic electronic | Minimum 2 years after last CER issuance | |
| 2 | Amount of biomass transported from other mills | t/y | M | Daily | 100% | Electronic | Minimum 2 years after last CER issuance | |
| 3 | Composition of biomass | - | M | Once a year | 100% | Electronic | Minimum 2 years after last CER issuance | |
| 4 | Amount of auxiliary fuel used | t/y | M | Daily | 100% | Electronic | Minimum 2 years after last CER issuance | This project activity will not involve auxiliary fuel for running the system. |
| 5 | Amount of non-biomass carbon in the waste combusted | t/y | M | Daily | 100% | Electronic | Minimum 2 years after last CER issuance | This project activity will not involve non-biomass carbon. |
| 6 | Average truck capacity | t/vehicle | M | Once a year | 100% | Electronic | Minimum 2 years after last CER issuance | |
| 7 | Amount of power consumed and/or generated | MWh | M | Daily | 100% | Electronic | Minimum 2 years after last CER issuance | This project activity will not involve any power or power generation utilizing fossil fuel. |
| 8 | Distance for transporting | Km | M | Once a year | 100% | electronic | Minimum 2 years after last CER issuance | |
| 9 | If EFB is utilized in neighboring CPO mills | - | M | Once a year | 100% | Electronic | Minimum 2 years after last CER issuance | If EFB in other mills are utilized and not disposed in plantation areas, BaU scenario that EFB is left to decay in plantation may not be valid. |
| 10 | Electricity | MWh | M | Daily | 100% | electronic | Minimum 2 years after last CER issuance | |

**D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:**

>>

| ID | Uncertainty level of data (High/Medium/Low) | Explain QA/QC procedures planned for these data, or why such procedures are not necessary. |
|---|---|---|
| 1 | Low | Amount of biomass will be measured by a scale. Scale will undergo maintenance / calibration subject to appropriate industry standards. |
| 2 | Low | Amount of biomass transported from other mills will be measured by a scale. Scale will undergo maintenance / calibration subject to appropriate industry standards. |
| 3 | Low | Composition of biomass will be analyzed in an outside laboratory. The laboratory should be recognized as a reliable organization. |
| 4 | Low | Amount of auxiliary fuel used should be measured by a meter. Meters will undergo maintenance / calibration subject to appropriate industry standards |
| 5 | Low | Amount of non-biomass carbon in the waste combusted should be measured by a meter. Meters will undergo maintenance / calibration subject to appropriate industry standards |
| 6 | Low | Average truck capacity will be monitored utilizing scale. Scale will undergo maintenance / calibration subject to appropriate industry standards. |
| 7 | Low | Amount of power consumed and/or generated will be monitored meter. Meters will undergo maintenance / calibration subject to appropriate industry standards. |
| 8 | Low | Distance for transporting will be checked using map data. |
| 9 | Low | If EFB is utilized in neighboring CPO mills will be monitored by Quality control for the existence and enforcement of relevant regulations and incentives is beyond the bounds of the project activity, In stead, the DOE will verify the evidence collected. |
| 10 | Low | Electricity will be measured by meter. Flow meters will undergo maintenance / calibration subject to appropriate industry standards. |

**D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:**

>>

Basically, the actor that is responsible for monitoring work of emission reductions and any leakage effects generated by the project activity, including project management, registration, measurement and reporting, is the SPC. To assure the credibility of monitoring results, the SPC must have the monitoring record validated by the third party, where appropriate. The monitoring equipment should be properly calibrated and maintained throughout the project period. The project participants conduct proper operation in terms of monitoring, maintenance of equipment, as well as management.

With regard to monitoring methods and emergency preparedness activities that are not included in the current SOP's, a manual will be prepared and training will be held for the workers who actually conduct monitoring work.

Given these conditions, the management structure of this project is concluded as established and reliable.

Table Management structure of monitoring work

| Actor to be responsible | Roles in monitoring work |
|---|---|
| SPC | ・ Monitoring, measurement<br>・ Registration<br>・ Where appropriate, reporting to third party who can authorize the data<br>・ Calibration and maintenance of equipment |

**D.6. Name of person/entity determining the monitoring methodology:**

>>

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Consultant
Sustainable Society Group
EX CORPORATION (City & Environment Planning, Research & Consulting)
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Email: Kawamura@exri.co.jp

## SECTION E.: Estimation of GHG emissions by sources:

### E.1. Formulae used:

>>

### E.1.1 Selected formulae as provided in appendix B:

>>

The detail description of emission reduction calculation by the project is given by E.1.1.1. to E.1.1.5. as follows:

### E.1.1.1 Formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

>>

**a) Electricity generation for a grid**

Project emission due to electricity generation is not required to be calculated based on Type I.D.

**b) EFB combustion**

Project emission due to electricity generation is calculated based on Type III.E as follows:

$$\underset{(t\_CO_{2eq}/y)}{PE_{y,decay}} \quad \underset{(t\_CO_{2eq}/y)}{PE_{y,comb}} + \underset{(t\_CO_{2eq}/y)}{PE_{y,transp}} + \underset{(t\_CO_{2eq}/y)}{PE_{y,power}}$$

Description of parameters used for calculation

| parameter | unit | description | data source/comment |
|---|---|---|---|
| $PE_{y,decay}$ | $t\_CO_{2eq}/y$ | Project activity direct emissions in the year "y" | calculated based on III.E. |
| $PE_{y,comb}$ | $t\_CO_{2eq}/y$ | Emissions through combustion of non-biomass carbon in the year "y" | calculated based on III.E. |
| $PE_{ytransp}$ | $t\_CO_{2eq}/y$ | Emissions through incremental transportation in the year "y" | calculated based on III.E. |
| $PE_{y,power}$ | $t\_CO_{2eq}/y$ | Emissions through electricity or diesel consumption in the year "y" | calculated based on III.E. |

**[Emissions through combustion of non-biomass carbon ($PE_{y,comb}$)]**

This item includes emissions through combustion of the non-biomass carbon content of the biomass and consumptions of auxiliary fuel for the incineration process. However, this item is not necessary for calculation because the project does not involve these fuels for combustion.

**[Emissions through incremental transportation ($PE_{y,trasp}$)]**

Emissions through incremental EFB transportation can be calculated by the following formula.

$$\underset{(t\_CO_{2eq}/y)}{PE_{y,transp}} \quad \underset{(t/y)}{Q_y} \div \underset{(t/truck)}{CT_y} \times \underset{(km/truck)}{DAF_w} \times \underset{(tCO_2/km)}{EF_{CO2eq}}$$

$$\underset{(t/y)}{Q_{y,ash}} \div \underset{(t/truck)}{CT_{y,ash}} \times \underset{(km/truck)}{DAF_{w,ash}} \times \underset{(tCO_2/km)}{EF_{CO2eq}}$$

$$17{,}000 \div 5 \times 60 \times 1.1*10^{-3}$$

$$+ \quad 2{,}425 \div 5 \times 20 \times 1.1*10^{-3}$$

357 + 10

367

Where, $EF_{CO2eq}$ is calculated as follows;

| $EF_{CO2eq}$ ($tCO_2/km$) | $EF_{CO2}$ ($tCO_2/km$) | $EF_{CH4}$ ($tCH_4/km$) | × | $GWP_{CH4}$ | | |
|---|---|---|---|---|---|---|
| | | | | $EF_{N2O}$ ($tN_2O/km$) | × | $GWP_{N2O}$ |
| | $1.1*10^{-3}$ ($tCO_2/km$) | $6.0*10^{-8}$ ($tCH_4/km$) | × | 21 | | |
| | | | | $3.1*10^{-8}$ ($tN_2O/km$) | × | 310 |
| | $1.1*10^{-3}$ ($tCO_2/km$) | $1.26*10^{-5}$ ($tCO_2/km$) | | $9.61*10^{-6}$ ($tCO_2/km$) | | |
| | $1.1*10^{-3}$ ($tCO_2/km$) | | | | | |

The quantity of combustion residues is estimated as 2,708t/y and it will distributed to the plantations as fertilizer, so incremental transportation requirements are minimal. However, to be conservative, the incremental distance is assumed to be 20km. With regard to the transportation increment of EFB combusted, for the EFB generated in the project mill does not require additional transportation because it is generated and combusted on site. The incremental distance for EFB carried from other mills (26,900t/y) is assumed to be 60km (30km for one-way) because there are CPO mills within 30km where EFB is available. Emissions through incremental transportation are estimated as 367 (t $_CO_{2eq}$/y).

Description of parameters used for calculation

| parameter | unit | Description | data source/comment |
|---|---|---|---|
| $Q_y$ | t/y | quantity of waste combusted in the year "y" (Increased amount only) | 26,900 |
| $Q_{y,ash}$ | t/y | quantity of combustion residues produced in the year "y" | 2,708 Calculated by ash content of EFB(7.5%DM) and amount of combustion (95,000t/y, water content 62%□ |
| $CT_y$ | t/truck | average truck capacity for waste transportation | 5 |
| $CT_{y,ash}$ | t/truck | average truck capacity for combustion residues transportation | 5 |
| $DAF_w$ | km/truck | average incremental distance for waste transportation | 60 |
| $DAF_{w,ash}$ | km/truck | average distance for combustion residues transportation | 20 |
| $EF_{CO2eq}$ | $tCO_2/km$ | CO2 equivalent emission factor from fuel use due to transportation | Calculated |

| | | | |
|---|---|---|---|
| $EF_{CO2}$ | $tCO_2/km$ | CO2 emission factor from fuel use due to transportation (tCO2/km, IPCC default values or local values can be used.) | $1.1*10^{-3}$ □IPCC guideline default value for "heavy duty diesel vehicle" |
| $EF_{CH4}$ | $tCH_4/km$ | CH4 emission factor from fuel use due to transportation (tCH4/km, IPCC default values or local values can be used.) | $6.0*10^{-8}$ □IPCC guideline default value for "heavy duty diesel vehicle" |
| $EF_{N2O}$ | $tN_2O/km$ | N2O emission factor from fuel use due to transportation (tN2O 2/km, IPCC default values or local values can be used.) | $3.1*10^{-8}$ □IPCC guideline default value for "heavy duty diesel vehicle" |
| $GWP_{CH4}$ | - | Global warming potential of $CH_4$ | 21 (IPCC default value) |
| $GWP_{N2O}$ | - | Global warming potential of $N_2O$ | 310 (IPCC default value) |

**[Emissions through electricity or diesel consumption ($PE_{y,power}$)]**

This item includes emissions through grid-based electricity or diesel power generation facility for plant operation and also for the equipments for air pollution control required by regulations, however, this item is not necessary for calculation because this project activity does not involve these forms of power combustion.

**[Project activity direct emissions($PE_{y,decay}$)**
Amount of methane avoided through EFB combustion is calculated by the following equation:

| $PE_{y,decay}$ ($t\_CO_{2eq}/y$) | $PE_{y,comb}$ ($t\_CO_{2eq}/y$) | + | $PE_{y,transp}$ ($t\_CO_{2eq}/y$) | + | $PE_{y,power}$ ($t\_CO_{2eq}/y$) |
|---|---|---|---|---|---|
| | 0 | + | 367 | + | 0 |
| | 367 | | | | |

**E.1.1.2 Formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities**

>>

Leakage does not need to be considered because this project activity does not involve the equipment which may cause leakage emission defined in Type I.D. and III.E.

**E.1.1.3 The sum of E.1.1.1 and E.1.1.2 represents the small-scale project activity emissions:**

>>

Based on E.1.1.1. and E.1.1.2., project activity emissions are 367 $tCO_{2eq}/y$.

**E.1.1.4 Formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:**

>>

**a) Electricity generation for a grid($BE_{y,grid}$)**
Baseline emission due to electricity generation is calculated based on Type I.D.

Baseline emissions are obtained as the amount of renewable electricity generated(kWh) multiplied by the emission factor($kgCO_{2eg}$/kWh) which is calculated in a conservative and transparent manner as shown below:

Baseline emissions from grid electricity generation are calculated by the following equation:

| $BE_{y,grid}$ | | $Electricity_y$ | | $T_y$ | | $CEF_y$ |
|---|---|---|---|---|---|---|
| ($t\_CO_{2eq}/y$) | | (kW) | × | (h/y) | × | ($kgCO_{2eg}$ /kWh) |

Description of parameters used for calculation

| parameter | unit | description | data source/comment |
|---|---|---|---|
| $BE_{y,grid}$ | $t\_CO_{2eq}/y$ | Annual baseline emission from a grid | calculated based on I.D. |
| $Electricity_y$ | kW | power generation capacity of the plant | 5.66 |
| $T_y$ | h/y | Operating hours of the plant | 8,000 |
| $CEF_y$ | $kgCO_{2eg}$ /kWh | $CO_2$ emission factor of grid electricity | calculated based on I.D. |

Each item will be calculated by the following steps based on the parameters above.

**[$CO_2$ emission factor of grid electricity $CEF_y$ ]**
As described in B.2. option (b) The weighted average emissions of the current generation mix are applied to the for the calculation of the $CO_2$ emission factor of grid electricity.

According to PTM (Pusat Tenaga Malaysia), the latest figure for □$CEF_y$□ calculated by them is 0.631. However, this figure has not been officially authorized by the Malaysian DNA. Therefore, $CEF_y$ for this project activity is calculated as follows:

Table Calculation of $CO_2$ emission factor

| | Electricigy generation for a grid | | | Ratio | CEF | Efficiency | Oxydation ratio | Energy conversion factor | CO2 emission factor | Weighted average CO2 emission factor |
|---|---|---|---|---|---|---|---|---|---|---|
| | TNB (a) | IPP (b) | Total (c)=(a)+(b) | (d) | (e) | (f) | (g) | (h) | (i)=(e)/(f)*(g)*(h)*44/12*1000 | (j)=(d)*(i) |
| Type | GWh | GWh | GWh | % | tC/TJ | % | - | TJ/kWh | kgCO2/kWh | kgCO2/kWh |
| Hydro | 4,710 | | 4,710 | 5.9% | - | - | - | 0.0000036 | - | - |
| Natural Gas(Gas turbin) | 3,404 | 273 | 3,677 | 4.6% | 15.3 | 28% | 0.995 | 0.0000036 | 0.718 | 0.033 |
| Natural Gas(combined cycle) | 9,747 | 38,642 | 48,389 | 60.7% | 15.3 | 41% | 0.995 | 0.0000036 | 0.490 | 0.298 |
| Thermal(Natural gas/oil) | 3,838 | | 3,838 | 4.8% | 15.3 | 35% | 0.995 | 0.0000036 | 0.574 | 0.028 |
| Coal | 18,966 | | 18,966 | 23.8% | 26.2 | 35% | 0.980 | 0.0000036 | 0.968 | 0.230 |
| Others | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | | | | 0.589 |

Note1:(a),(b), (f) Tenaga National Berhad and Energy commission (Actual data in 2004)
Note2:(e),(g) 1996 IPCC Guidelines for Greenhouse Gas Inventories Reference Manual
Note3:IPCC default for Natural gas is used for Thermal(Natural gas / Oil) for the purpose of conservativeness

Once the official $CEF_y$ is released, the above figure will be displaced by the official one.

**[Baseline emission (renewable power generation)]**
In this project activity, amount of EFB combusted will be stabilized through EFB purchase from neighbouring mills. Therefore, the power generation capacity is assumed to be constant at 5.66MW.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $CO_{2e}$emissions from a grid (t_$CO_{2eq}$) | □ | power generation capacity (MW) | × | Operating hours of the plant □h/y□ | × | $CO_2$ Emission factor of a grid electricity (kg_$CO_2$/kWh) | | |
| | □ | 5.660 | × | 8,000 | × | 0.589 | | |
| | □ | 26,670 | | | | | | |

**b) EFB combustion($BE_{y,decay}$)**
Baseline emissions are the amount of methane from the decay of the biomass content of the waste treated in the project activity. Baseline emissions due to electricity generation are calculated based on Type III.E.

**[Methane generation potential $MB_y$, ]**
Based on the instruction in the Type III.E.Methane generation potential ($MB_y$) is abtained by the following equation define in the Type III.G.(Land fill methane recovery)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $MB_y$ (t/y) | | 16/12 | × | F | × | $DOC_F$ | × | MCF |
| | × | $\sum_{x=1}^{y}\sum_{j=A}^{D} A_{j,x}$ | × | $DOC_j$ | × | $(1 - e^{-kj})$ | × | $e^{-kj\cdot(y-x)}$ |
| | | 16/12 | × | 0.5 | × | 0.77 | × | 1.0 |
| | × | $\sum_{x=1}^{y}$ 95,000 | × | 0.3 | × | $(1-e^{-0.023})$ | × | $e^{-0.023\cdot(y-x)}$ |

Description of parameters used for calculation

| parameter | unit | Description | data source/comment |
|---|---|---|---|
| F | - | fraction of methane in the landfill gas | Default□0.5□ |
| $DOC_j$ | - | per cent of degradable organic carbon (by weight) in the waste type j | Default□0.3□<br>Pease see the table below |
| $DOC_F$ | - | fraction of DOC dissimilated to landfill gas | IPCC default□0.77□ |
| MCF | - | Methane Correction Factor | IPCC default□1.0□ |
| $A_{j,x}$ | t/y | amount of organic waste type j land filled in the year x | 95,000 |
| $k_j$ | - | decay rate for the waste stream type j | Default□0.023□<br>Pease see the table below |
| j | - | waste type distinguished into the waste categories (from A to D), as illustrated in the table below | D. Assumed as wood and straw waste<br>Pease see the table below |
| x | - | year since the landfill started receiving wastes: x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y) | |

| | | | |
|---|---|---|---|
| y | - | year for which LFG emissions are calculated | |

Table. Waste stream decay rates (kj) and associated IPCC default values for DOCj

| Waste stream A to E | Per cent $DOC_j$ (by weighr) | Decay-rate ($k_j$) |
|---|---|---|
| A□Paper and textiles | 40 | 0.023 |
| B□Garden and park waste and other (non-food) putrescibles | 17 | 0.023 |
| C□Food waste | 15 | 0.231 |
| D□Wood and straw waste 1) | 30 | 0.023 |
| E□Inert material | 0 | 0 |

1) Excluding lignin-C

Baseline emissions will be Methane generation potential□$MB_{y,}$□ excluding methane emissions that would have to be removed to comply with national or local safety requirements or legal regulations. Methane emissions that would have to be removed to comply with national or local safety requirements or legal regulations will not occur in this project activity because there is no such a law or regulation to force EFB combustion. Therefore, $BE_{y,decay}$ is calculated only $MB_y$ as shown in the equation below:

$$\underset{(t\_CO_{2eq}/y)}{BE_{y,decay}} \quad \underset{(t/y)}{MB_y} \times GWP\_CH_4 \quad \underset{(t/y)}{MD_{y,reg}} \times GWP\_CH_4$$

Description of parameters used for calculation

| parameter | unit | description | data source/comment |
|---|---|---|---|
| $MB_y$ | t/y | Methane generation potential | calculated based on III.E. |
| $MD_{y,reg}$ | t/y | methane emissions that would have to be removed to comply with national or local safety requirement or legal regulations | calculated based on III.E. |
| $GWP\_CH_4$ | - | Global warming potential for methane | 21 (IPCC default) |

Table Annual total baseline emissions

| Year | Annual emissions($tCO_{2eq}/y$) |
|---|---|
| 1 | 6,986 |
| 2 | 13,812 |
| 3 | 20,484 |
| 4 | 27,004 |
| 5 | 33,376 |
| 6 | 39,602 |
| 7 | 45,688 |
| 8 | 51,634 |
| 9 | 57,446 |
| 10 | 63,125 |
| 11 | 68,676 |
| 12 | 74,100 |
| 13 | 79,401 |
| 14 | 84,581 |
| Total | 665,915 |

**E.1.1.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:**

Eission reduction achieved by the project activity during the first crediting period(7 years) is 371,073t_$CO_{2eq}$

$$\underset{(t\_CO_{2eq})}{ER} \quad \underset{(t\_CO_{2eq})}{BE_{,dacay}} \quad \underset{(t\_CO_{2eq})}{BE_{,grid}}$$

$$\left( \underset{(t\_CO_{2eq})}{PE_{,dacay}} + \underset{(t\_CO_{2eq})}{Leacage_{,decay}} + \underset{(t\_CO_{2eq})}{Leacage_{,grid}} \right)$$

| Year | Baseline emissions | | Project emissions | Leakage emission | | Annual estimation of emission reductions in tonnes of $CO_{2e}$ |
|---|---|---|---|---|---|---|
| | $BE_{,dacay}$ ($tCO_{2eq}/y$) | $BE_{,grid}$ ($tCO_{2eq}/y$) | $PE_{,dacay}$ ($tCO_{2eq}/y$) | $Leacage_{,decay}$ ($tCO_{2eq}/y$) | $Leacage_{,grid}$ ($tCO_{2eq}/y$) | ER ($tCO_{2eq}/y$) |
| Year 1 | 6,986 | 26,670 | 367 | 0 | 0 | 33,289 |
| Year 2 | 13,812 | 26,670 | 367 | 0 | 0 | 40,115 |
| Year 3 | 20,484 | 26,670 | 367 | 0 | 0 | 46,787 |
| Year 4 | 27,004 | 26,670 | 367 | 0 | 0 | 53,307 |
| Year 5 | 33,376 | 26,670 | 367 | 0 | 0 | 59,679 |
| Year 6 | 39,602 | 26,670 | 367 | 0 | 0 | 65,905 |
| Year 7 | 45,688 | 26,670 | 367 | 0 | 0 | 71,991 |
| Total | 186,952 | 186,690 | 2,688 | 0 | 0 | 371,073 |

**E.1.2 Description of formulae when not provided in appendix B:**

>>

Not applicable.

**E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:**

>>

Not applicable.

**E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities**

>>

Not applicable.

**E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:**

>>

Not applicable.

**E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:**

>>

Not applicable.

**E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:**

>>

Not applicable.

**E.2 Table providing values obtained when applying formulae above:**

>>

## SECTION F.: Environmental impacts:

### F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>

No significant adverse environmental impact will arise from the project due to following reasons:

- No exploitation or destruction of natural resources and ecosystem arise from the project, since the project is carried out within the site of the existing project factory.
- The project is expected to contribute to reduction of water pollutant emissions from EFB by combusting it to generate power. Furthermore, it will also contribute to the mitigation of air pollutants and greenhouse gas emissions through replacement of national grid electricity generated by fossil fuel combustion.

The Malaysian Government requires environmental impact assessment (EIA) to be conducted for the development of power plants with installed capacity of more than 10MW. However, since the installed capacity of power plant in the project is only 7.0MW, EIA is not required for the project.

## SECTION G. Stakeholders' comments:

### G.1. Brief description of how comments by local stakeholders have been invited and compiled:

>>

Comments are collected by individual interviews.
*(Stakeholders' comments are to be invited once the project plan goes more in detail.)*

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

>>

TDM Plantation Sdn. Bhd.
At the current situation, the cost of EFB disposal is considered very high in terms of both financial and environmental aspect. However, they do not know any effective measure to utilize EFB. They showed their grate expectation for EFB power generation as a effective measure to solve the current problem and also increase their profit..

TNB Bhd.
Their recognition that renewable electricity supply from Sungai Tong mill to the grid is in accordance with the National Policy to promote renewable energy utilization was confirmed. There is a plan to build a school near Sungai Tong and it is expected that the electricity demand around the area will increase. Therefore, TNB is ready to receive the electricity from this project.

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

>>

## Annex 1

## CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Host country participant

| | |
|---|---|
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Annex I country participant

| | |
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## Annex 2

## INFORMATION REGARDING PUBLIC FUNDING

This project does not involve any public funding.

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