CDM Feasibility Study on the Emission Reduction Technologies of Methane and the Utilization of Solid Wastes from Palm Oil Mills in Malaysia

Summary

March 2003

EX CORPORATION

CONTENTS

A. General description of project activity

A.1 Title of the project activity:

FELDA Lepar Hilir Palm Oil Mill Biogas Project in Malaysia

A.2. Description of the project activity:

Wastewater treatment facility is amongst the most important component in the palm oil mill system. This is because the facility is to treatment palm oil mill effluent (POME) that is being generated in large volume during the production of crude palm oil (CPO). Owing to the chemical and physical properties of POME, the most efficient system used in the initial stage of the wastewater plant is the anaerobic treatment. The current system meets the requirement of the palm oil mill operator to safely discharge the treated POME. However, the system releases one of the greenhouse Gases (GHG), CH_4 into the atmosphere as the by-products of anaerobic digestion of POME.

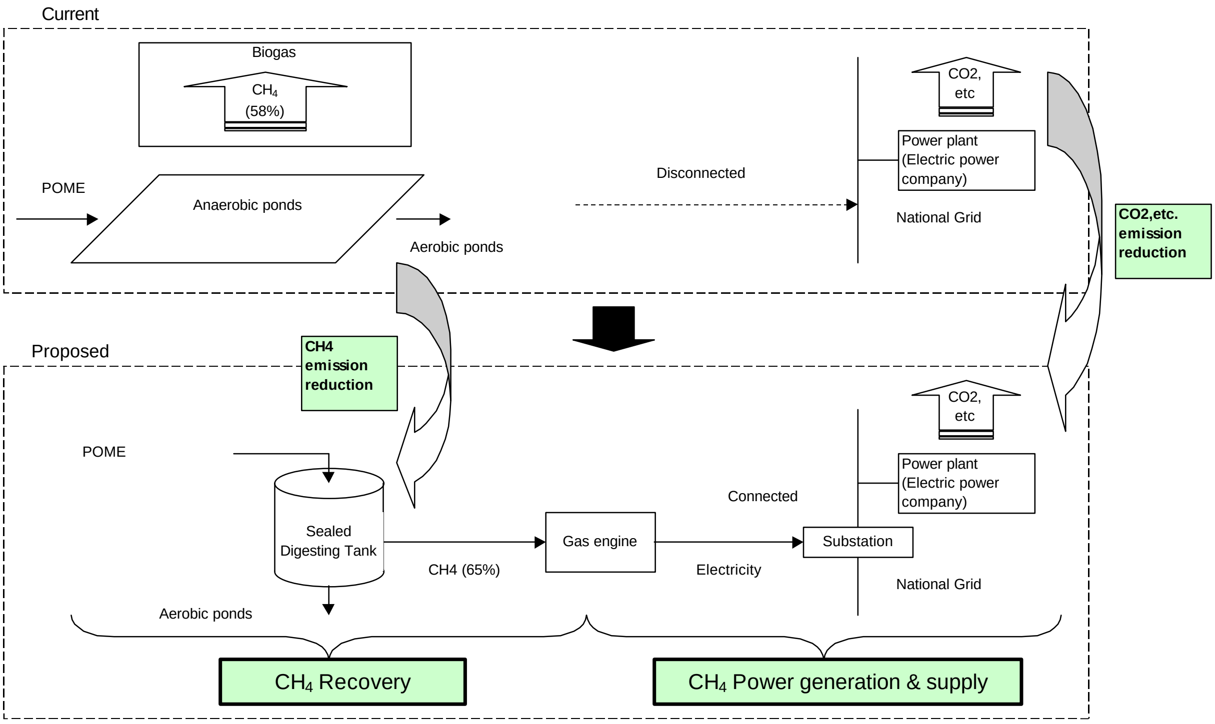

Fig. 1 Schematic diagram of the proposed project activity

(GHG emission reduction by CH_4 recovery)

The proposed project activity is to recover the potential biogas (CH_4) from the POME wastewater treatment facility by replacing the anaerobic lagoons with sealed digesting tanks.

(GHG emission reduction by CH_4 power generation & supply)

Part of the project activity also will generate electric power from the combustion of the CH_4 in the gas turbine. Power generated then is supplied to Tenaga Nasional Berhad (TNB – sole electric power company in Peninsular Malaysia), by the grid connection.

The significance of the project activity is as follows:

1) This project will be a symbol for business collaboration between Japan and Malaysia in the field of the global environmental issues.
2) This project activity will be in accordance with the Malaysian government policy that will facilitate to introduce renewable energy up to 5% of total domestic energy demand by the end of 2005 according to the 8th Malaysia Plan 2001-2005.
3) This project activity will strongly support the sustainable development of the palm oil industry in Malaysia in view of the following 3 aspects.

i) Environment

The project will alleviate the undesirable smell of POME and provide cleaner environment.

ii) Development

The project will generate electricity, activate economy and bring investment.

iii) Social economy

The project will create more opportunity for better jobs.

A.3. Project participants:

Matsushita Electric Industrial Co., Ltd. and FELDA PALM INDUSTRIES SDN BHD are partiers involved in this project activity. EX CORPORATION, Kyushu Institute of Technology and Universiti Putra Malaysia are advisors for the CDM project activity.

The contact for this CDM project activity is Matsushita Electric Industrial Co., Ltd. The project Parties are Malaysia as the host country and Japan as the investing country.

Matsushita Electric Industrial Co., Ltd., the most comprehensive worldwide electric and electronic product manufacturer, Japanese business partner of this venture project

EX Corporation, the Japanese environmental planning consultant company, specializing in waste treatment and greenhouse gas reduction, CDM project activity advisor

Kyushu Institute of Technology, the Japanese university of technology, specializing in cutting-edge engineering filed such as computer science and environmental science, CDM project activity advisor

FELDA PALM INDUSTRIES SDN BHD, the largest Malaysian palm oil-based company, Malaysian business partner of this project

Universiti Putra Malaysia, the Malaysian university specialized in environmental biotechnology particularly in utilization of organic waste, CDM project activity advisor

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1 Host country Party(ies):

Malaysia (Malaysian government ratified the Kyoto Protocol on September 4, 2002.)

A.4.1.2 Region/State/Province etc.:

State of Pahang

A.4.1.3 City/Town/Community etc:

Gambang Town

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

FELDA Lepar Hilir Palm Oil Mill is located 14 km from Gambang town and approximately 40 km away from Kuantan city, the capital of Pahang State.
The mill is a one of the largest FELDA palm oil mills with the CPO production capacity of approximately 3,000-4,000t/month.
Fig.2 shows the location of the mill and Table 1 gives a brief overview of Lepar Hilir palm oil mill.

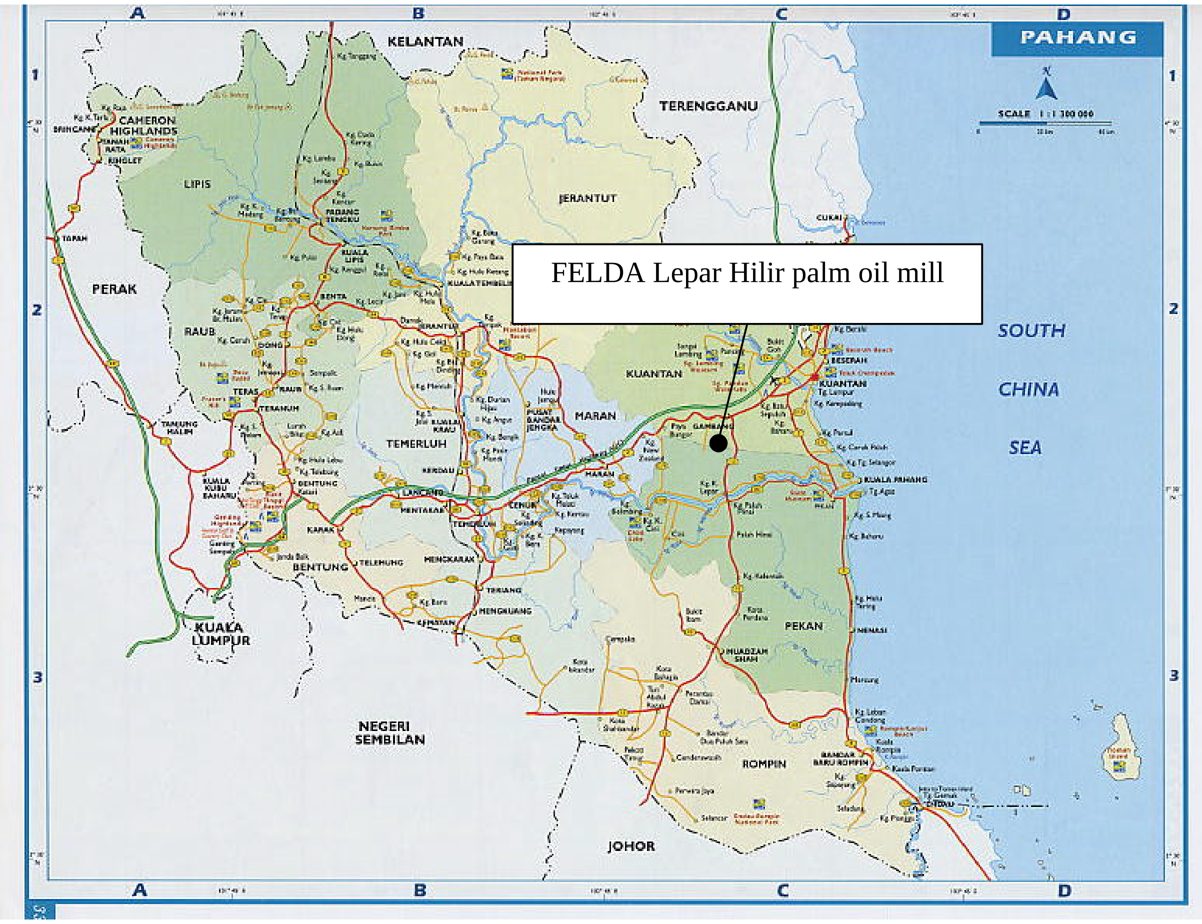

Fig.2 Location map of Lepar Hilir palm oil mill

Table 1 Brief overview of Lepar Hilir palm oil mill

Items	Situation
Address	Karung Berkunci No.3, 26300 Gambang, Pahang State
Commissioned	1986
Possessed plantation area	24,600 hectares
FFB (Fresh Fruit Bunch) processing capacity	54t/h
FFB processed	259,890t (2002)
CPO Production	3,000-4,000t/month
Boiler capacity	18 t-steam/h (2 tubulous boilers in the mill)
Power generation capacity	650 kW (2 back pressure turbines in the mill)
POME treatment method	Anaerobic lagoon method (30,000m^3 x 4 ponds)
COD in POME	40,000-60,000 ppm
BOD treated POME before discharged	Less than 100 ppm
Electricity supply from TNB	None (The mill generates its own electricity from the combustion of oil palm fiber and shells as fuel. This is done inside the 2 steam boilers complemented with 2 steam turbines to generate power. Hence the mill is self-sufficient.)
Nearest TNB substation	TNB Lepar Hilir 3 substation (11 kV) (The substation is about 4km from Lepar Hilir palm oil mill and located in the residential area of the palm oil plantation settlers.)

A.4.2. Category(ies) of project activity

CH_4 recovery
Electricity generation for a system

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

Scientifically, it has been proved that anaerobic digestion of POME will produce a mixture of biogas that is mainly CH_4 and carbon dioxide. Being originated from agricultural products and no chemical is added during the extraction of CPO, POME is the most suitable biowaste in the CH_4 fermentation. It also has been shown that CH_4 emitted from this process has a good potential in the power generation using a gas engine. The power generated then can be supplied to power company by grid connection if the mill is located in close proximity with the power grid or else the power can be consumed locally by the mill, small/medium scale industries or settlers' residential areas. At present there are 2 conventional systems used in treating POME, firstly lagoon system, second is the combination of lagoon and open digesting tanks. However, only a few of the mills are using the later system. The choice of the treatment system is largely depend on the availability of land and financial factor. In the instance of the mill using the combination of lagoon and open digesting tanks, with some modification to seal the tanks, CH_4 could be recovered.

Technically, the power generation process commencing from the CH_4 fermentation up to the combustion of CH_4, we anticipate minimal constraints. This is because mostly of the technologies have been established and proven viable.
Therefore, this project activity will try to make full use of those existing technologies and aim to minimize the additional investment and maximize the cost benefit.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHG) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

This project is based on two complementary activities, as follows:

The collection of biogas generated from POME; and,
The generation and supply of electricity to the regional grid, thus reducing the dependence of fossil fuels for electricity generation.

The baseline scenario is defined as the most likely future scenario in the absence of the proposed CDM project activity. The baseline scenario is the continued uncontrolled release of GHG to the atmosphere, similarly to most palm oil mills in Malaysia.

Recovery of biogas to generate electricity will result in the avoidance of CH_4 emissions to the atmosphere and the reduction of approximately 27,100t-CO_2/y over 10 years. However, we anticipated that the baseline would increase in the future as GHG emission is positively correlated with the production of CPO. In the absence of the proposed project activity it unlikely that such biogas recovery and power generation systems will be implemented. This is because based on the current wastewater treatment system, the properties of the discharge POME is complying with the Department of Environmental regulations. Financial, the system is economically not viable. Moreover, the mill is having a surplus of energy from the fiber and shell using low efficiency boiler system. Even with the implementation of stricter water discharge regulation, the mill operators may only require minimal investment to modify the current wastewater treatment plant to meet the requirement. Thus the GHG emission will continue.

A.4.5. Public funding of the project activity:

The implementation of this project is not dependent on any Official Development Assistance resources or any other resources from any international development-funding agency.

B. Baseline methodology

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

There is no methodology choice available on the UNFCCC website yet. However, as a general approach, "Existing actual or historical emissions, as applicable" and "Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment" are adopted in this project activity.

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

1) Existing actual or historical emissions, as applicable

CH_4 emission from lagoons can be estimated by using empirical formula shown in E.4. and Annex 3.2). Apart from the above estimation, field assessment of CH_4 emission from the actual site as business per usual will also be carried out. This is supported by another field observation at Serting Hilir palm oil mill (the largest mill in FELDA company) to quantify the CH_4 emission more precisely in order to establish the baseline. *(See Annex 3.2))*

2) Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment

With the assistance of CDM, economically the proposed project looks feasible. Firstly the raw materials such as POME, empty fruit bunch and shell are readily at available at the mill itself. Secondly, transportation problem will be automatically alleviated since all the biomass wastes are concentrated *in situ*. In terms of the technology to utilize the biomass for power generation, a combination between Malaysian experience in renewable energy research and Japanese technologies promises an attractive outcome at the end of the project. Moreover with the new policy drawn up by the Malaysian Government to encourage 5% of the electricity power should be generated from renewable energy, the setting up of power generation plant at Lepar Hilir palm oil mill looks viable.

B.3. Description of how the methodology is applied in the context of the project activity:

B.4. 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 (i.e. explanation of how and why this project is additional and therefore not the baseline scenario)

Here we described with no separation of B.3. and B.4.

1) The possibility to recover CH_4 and supply the electric power as baseline scenario

Figure 3 shows the mass balance of the CPO production process in the power generation perspective. This figure also indicates the excessive biomass produced from the mill and their potential for power generation.

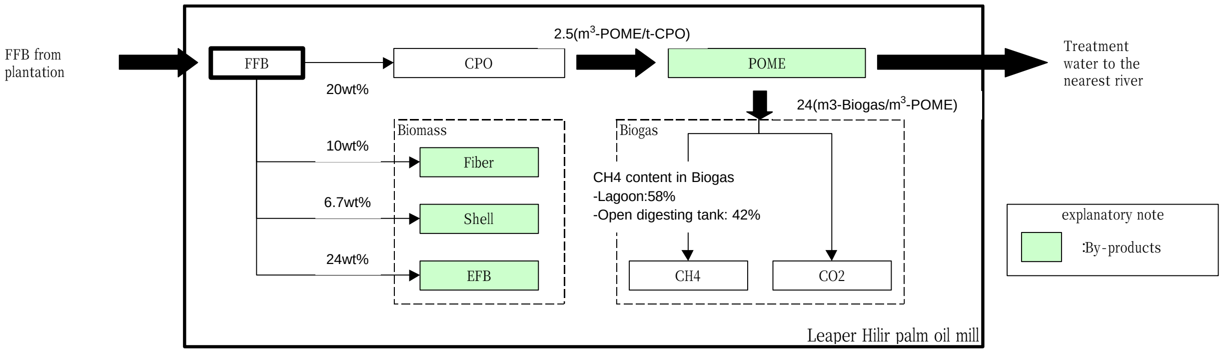

Fig. 3 By-products generated from Lepar Hilir mill

Currently, the power generated for the mill is from the fiber and shell only. Even then the amount used are significantly smaller compared to the actual amount produced annually. *(See fig. 4)*. Apart from producing the electricity to the mill, the steam is also used in the sterilization of fresh fruit bunch. The power generation system comprises of 2 tubulous boilers and 2 back pressure turbines. At the same time, EFB and CH_4 are not being utilized for power generation. Only a small amount of EFB is being returned to the plantation for soil mulching while CH_4 is being released to the atmosphere.

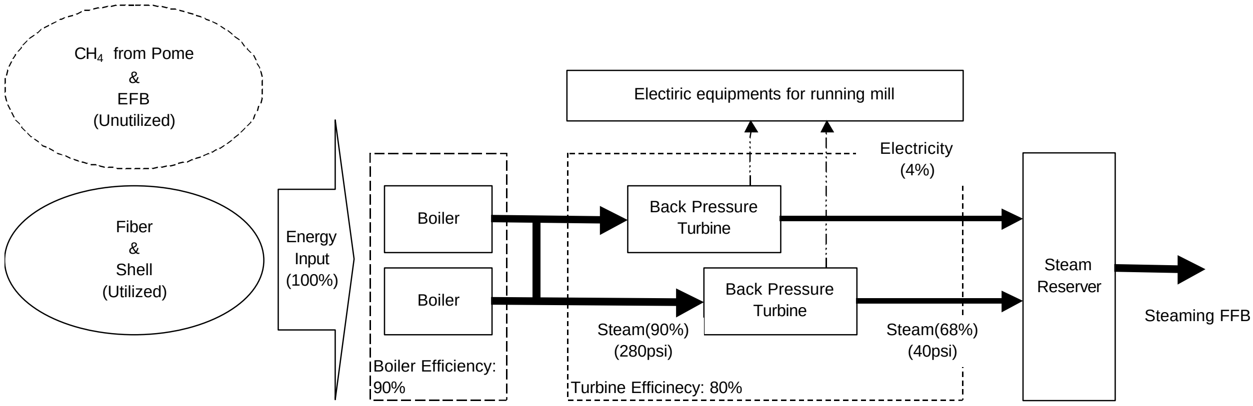

Fig. 4 Energy utilization in Lepar Hilir mill

With the close proximity of the mill to the TNB Lepar Hilir 3 substation (11kV) at approximately 4km, the potential of supplying the electricity from the renewable energy is very promising. On the other hand due to high capital investment, neither CH_4 nor EFB power generation is economically attractive.

Based on our estimation, the Internal Rate of Return (IRR) of CH_4 power generation could not be calculated because of the operating revenue deficit and also the IRR of EFB power generation is very low value at 0.03 %.

Therefore, the possibility of recovering CH_4 and supplying the electric power as baseline scenario becomes unattractive without CDM.

2) The possibility to change the POME treatment method from lagoons to open digesting tanks as baseline scenario

Preliminary studies carried out indicate that the CH_4 content of the biogas mixture depends on the POME treatment methods. Results showed that 58% and 48% of the total biogas is CH_4 were detected from lagoon and open digesting tank methods respectively.

At Lepar Hilir palm oil mill, lagoon system is used to treat POME before safely discharged into the nearest river. There is no concern about implementation of new environmental standard on treated water discharge of below 50 ppm of BOD by the Department of Environment (DOE) to the mill site because it is fairly isolated and quite far away from residential area.

Hence there is little possibility to change the POME treatment method from lagoons to open digesting tanks as baseline.

The baseline scenario for the proposed project can thus be described as follows:

No CH_4 collection and change of the POME treatment method at Lepar Hilir mill and thus unimpeded release of CH_4 to the atmosphere until some future time when the collection of CH_4 becomes economically attractive course of action or change of the POME treatment to meet the stricter treated POME discharge level.

B.5. Description of how the definition of the project boundary related to the baseline methodology is applied to the project activity:

A schematic diagram of the project activity and system boundaries is presented in Fig.5. The project activity comprises FFB transportation from plantations, CH_4 collection system, the equipment for electricity generation and grid connection to the nearest TNB substation, Lepar Hilir 3 (11kV)

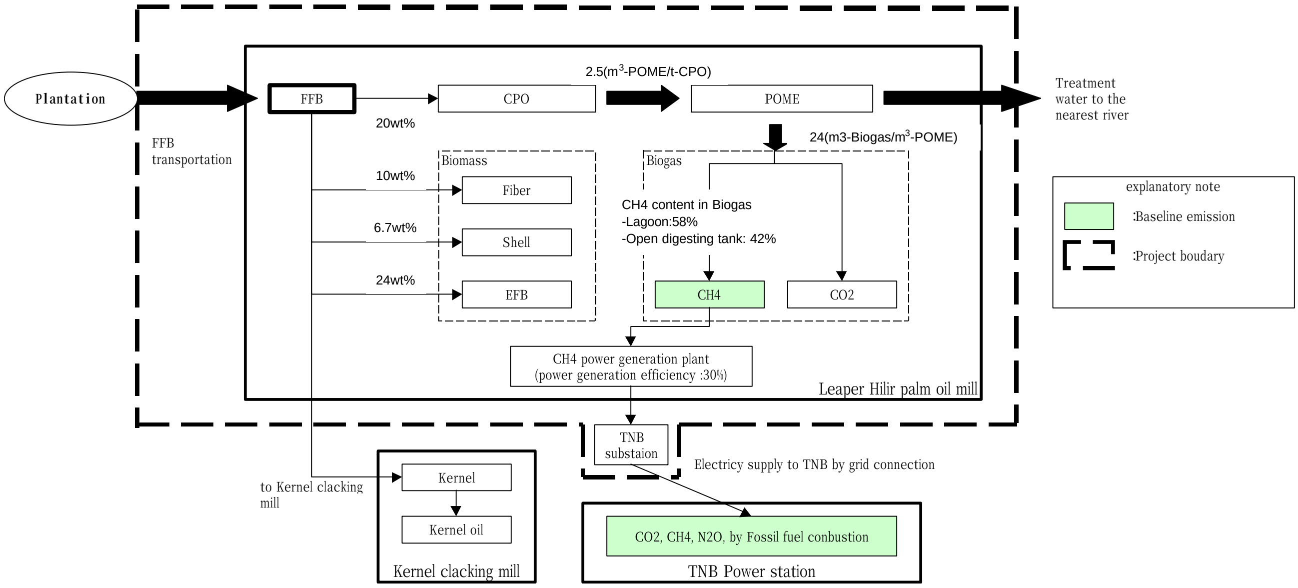

Fig. 5 Diagram of project boundaries

The table 2 shows a summary of the project boundary for the project activity.

Table 2 Summary of project boundary

Emissions	Project Scenario	Baseline Scenario
Direct on-site	100% of CH_4 from POME will be recovered by sealed digesting tanks.	CH_4 emission from lagoons.
	Emissions from electricity use for operation of mill – **excluded**, since it is carbon neutral by biomass such as fiber and shell from FFB	Emissions from electricity use for operation of mill – **excluded**, since it is carbon neutral by biomass such as fiber and shell from FFB
	Emissions from electricity use for back-up and stating mill– it is by diesel fuel but **excluded** because the emission will be negligibly small.	Emissions from electricity use for back-up and stating mill– it is by diesel fuel but **excluded** because the emission will be negligibly small.
	Transportation of FFB to project site – **excluded** because the emission could be negligibly small.	-
Direct off-site	Use of electricity generated from CH_4, reducing CO_2 emissions in the electricity grid.	Emissions associated with use of gird electricity – in the interests of conservatism emission reductions arising from the displacement of more carbon intensive electricity will not be included in the projects volume of CERs
Indirect on-site	Emissions from electricity use for operation of CH_4 power generation system – **excluded**, since it is carbon neutral	-
	Emissions from construction of the project– **excluded** because the emission could be negligibly small.	-
Indirect off-site	-	-

B.6. Details of baseline development

B.6.1 Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:

14/02/2003

B.6.2 Name of person/entity determining the baseline:

Dr. Yoshihito Shirai
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E-mail: shirai@life.kyutech.ac.jp

C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:
C.1.1. Starting date of the project activity:

Estimated as 01/07/2004

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

10 years

C.2 Choice of the crediting period and related information:
C.2.2. Fixed crediting period (at most ten (10) years):
C.2.2.1. Starting date (DD/MM/YYYY):

Estimated as 01/07/2004

C.2.2.2. Length (max 10 years):

10 years

D. Monitoring methodology and plan

D.1. Name and reference of approved methodology applied to the project activity:

There is no methodology choice available on the UNFCCC website yet, but this project requires only a straightforward monitoring methodology.

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

For the evaluation of the effect from this project activity in Lepar Hilir palm oil plant, the following monitoring plan shall be performed. The project activity was laid out partly based on our experience in Serting Hilir palm oil mill.

i) Organization for verifying the effect of the project

Malaysia Methodological Services, the main body overseeing the CDM activity in Malaysia, or Department of Environment (DOE).

ii) Sampling and data collection method

On site sampling, Video analysis, discussion and bench study from mill data, others.

D.3. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

The following data will be collected.

Table 3 Date to be collected in order to monitor emission from the project activity

ID number *(Please use numbers to ease cross-referencing to table D.6)*	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic / paper)	For how long is archived data to be kept?	Comment
D3-1	FFB reception from FELDA plantation	t/year	m	Every FFB reception by truck	100%	Paper	10 years (Project period)	Data will be aggregated monthly and yearly
D3-2	FFB reception from other producers	t/year	m	Every FFB reception by truck	100%	Paper	10 years (Project period)	Data will be aggregated monthly and yearly
D3-3	POME yield from CPO produced	m^3-POME/t-FFB	m	Once a day	100%	Paper	10 years (Project period)	Data will be aggregated monthly and yearly
D3-4	Biogas yield from POME	m^3-Biogas/m^3-POME	m	Once a day	100%	Paper	10 years (Project period)	Data will be aggregated monthly and yearly
D3-5	CH_4 fraction in biogas	m^3-CH_4/m^3-Biogas	m	Once a day	100%	Paper	10 years (Project period)	Data will be aggregated monthly and yearly
D3-6	Gross electricity produced	MWh	m	Once a day	100%	Paper	10 years (Project period)	Data will be aggregated monthly and yearly

D.4. Potential sources of emissions which are significant and reasonably attributable to the project activity, but which are not included in the project boundary, and identification if and how data will be collected and archived on these emission sources.

This project activity leads to transboundary GHG emission from the transportation by the additional FFB to the baseline FFB reception. This emission is however insignificant and negligible as described in B.5.

D.5. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHG within the project boundary and identification if and how such data will be collected and archived.

The following data will be collected.

Table 4 Relevant data necessary for determining the baseline

ID number *(Please use numbers to ease cross-referencing to table D.6)*	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic / paper)	For how long is archived data to be kept?	Comment
D5-1	POME yield from CPO produced	m^3-POME/t-FFB	m	Once a day	100%	Paper	10 years (Project period)	Data will be aggregated monthly and yearly
D5-2	Biogas yield from POME at Serting Hilir	m^3-Biogas/m^3-POME	m	Once a month	100%	Paper	10 years (Project period)	Data will be aggregated monthly and yearly
D5-3	CH_4 fraction in biogas at Serting Hilir	m^3-CH_4/m^3-Biogas	m	Once a month	100%	Paper	10 years (Project period)	Data will be aggregated monthly and yearly

D.6. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored. (data items in tables contained in section D.3., D.4. and D.5 above, as applicable)

Table 5 shows the QA/QC procedures are being undertaken for data monitored.

Table 5 QA/QC procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. D.4-1; D.4-2.)*	Uncertainty level of data (High/Medium /Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
D3-1	Low	Yes	Measurement by truck scale is and will be conducted at every FFB reception
D3-2	Low	Yes	Measurement by truck scale is and will be conducted at every FFB reception
D3-3	Low	Yes	It is and will be required to measure the FFB received and POME discharged once a day and submit the monitoring data once a month to DOE (Department of Environment) in the Ministry of Science, Technology and the Environment, then the measurement of POME is and will be conducted once a day by the flow meter installed just before cooling ponds
D3-4	Low	Yes	Biogas flow meter installed the CH_4 fermentation and storage plant will subject to regular maintenance. POME is monitored by above method
D3-5	Low	Yes	High concentration gas detector installed at the CH_4 fermentation and storage plant will subject to regular maintenance. Biogas is monitored by above method
D3-6	Low	Yes	Meters will be subject to a regular maintenance.
D5-1	Low	Yes	It is and will be required to measure the FFB received and POME discharged once a day and submit the monitoring data once a month to DOE (Department of Environment) in the Ministry of Science, Technology and the Environment, then the measurement of POME is and will be conducted once a day by the flow meter installed just before cooling ponds
D5-2	Low	Yes	High concentration gas detector installed at lagoons in Serting Hilir will be subjected to a regular maintenance as KIT-UPM joint research.
D5-3	Low	Yes	Biogas flow meter installed at lagoons in Serting Hilir will be subjected to a regular maintenance as KIT-UPM joint research.

D.7 Name of person/entity determining the monitoring methodology:

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E. Calculation of GHG emissions by sources

E.1 Description of formulae used to estimate anthropogenic emissions by sources of greenhouse gases of the project activity within the project boundary: (for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)

This project activity assumes the 100% CH_4 recovery and will not count the CO_2 emission from the biogas in accordance with the IPCC guideline as described in B.5. No GHG emissions are expected by the project activity.

E.2 Description of formulae used to estimate leakage, defined as: the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and that is measurable and attributable to the project activity: (for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)

This project activity leads to transboundary GHG emission from the transportation by the additional FFB to the baseline FFB reception. This emission is however insignificant and negligible as described in B.5.

E.3 The sum of E.1 and E.2 representing the project activity emissions:

No GHG emissions are expected by the project activity.

E.4 Description of formulae used to estimate the anthropogenic emissions by sources of greenhouse gases of the baseline: (for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)

Table 6-9 show the formulae formulas and parameters used to estimate the anthropogenic emissions by sources of greenhouse gases of the baseline.

Table6 Formula for estimating CH_4 emission from POME

(The reason to adopt the below formulas is shown in Annex 3 2))

CH_4 emission(t-CO_2 eq. /y)
= CPO production(t) (＝CPO yield (t-CPO /t-FFB) * FFB received (t/y))
* POME yield in the CPO production (m^3-POME/t-CPO)
* Biogas yield from POME (m^3-Biogas/m^3-POME)
* CH_4 fraction in biogas (m^3-CH_4/m^3-Biogas)
* CH_4 density (t-CH_4/m^3-CH_4)
*GWP (CH_4)

Table7 Parameters for estimating CH_4 emission from POME

(The reason to adopt the below parameters is shown in Annex 3 2))

Parameters	Value (2004-2013)	Unit
FFB received	15,000-274,300	t/year
CPO yield	0.2	t-CPO /t-FFB
POME yield in the CPO production	2.5	m^3-POME/t-CPO
Biogas yield from POME	24	m^3-Biogas/m^3-POME
CH_4 gas fraction in biogas	0.58	m^3-CH_4/m^3-Biogas
CH_4 density	0.00071	t-CH_4/m^3-CH_4
GWP (CH_4)	21	-

Table8 Formula for estimating GHG emission by fossil fuel consumption

(Details of the calculation process is shown in Appendix 3.)

GHG emission(t-CO_2 eq./y)＝(CH_4 recovered (t-CH_4/y)
* Heat value of CH_4 (MJ/t-CH_4)
* Conversion coefficient from heat to electricity (kWh/MJ)
* Power generation efficiency (kWh/kWh)
- Electricity demand to operate CH_4 power generation plant (kWh))
* ? (Emission factor of each gases (kg, mg-gas/kWh))
*GWP (each gases)

Table9 Parameters for estimating GHG emission by fossil fuel consumption

(Details of the calculation process are shown in Appendix 3.)

Parameters	Value (2004-2013)	Unit
CH_4 recovered	831-1,519	t-CH_4/year
Heat value of CH_4	55.4*10E+3	MJ/t-CH_4
Conversion coefficient from heat to electricity	0.278	kWh/MJ
Power generation efficiency	0.3	kWh/kWh
Electricity demand to operate CH_4 power generation plant	876	MWh/year
Electricity supply	2,959-6,137	MWh/year
Emission factor of CO_2	0.623	kg-CO_2/kWh
Emission factor of CH_4	2.81	mg-CH_4/kWh
Emission factor of N_2O	3.74	mg-N_2O/kWh
GWP (CO_2)	1	-
GWP(CH_4)	21	-
GWP(N_2O)	310	-

E.5 Difference between E.4 and E.3 representing the emission reductions of the project activity:

In this project activity, no GHG emissions are expected as described in E.1, then the baseline emission equals the emission reductions of the project activity in E.4.

E.6 Table providing values obtained when applying formulae above:

Table 10 shows the result of baseline emission estimation by using the formulas and parameters described in E.4.

Table10 Baseline emissions from the project activity

(Details of the calculation process is shown in Appendix 3.)

Items	Unit/Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total (2004-2013)
Emission reduction by CH4 recovery	t-CO2 eq./y	28,465	27,922	27,587	26,566	25,173	24,202	23,672	21,535	15,566	18,517	239,206
Emission reduction by fossil fuel conversion	t-CO2 eq./y	3,831	3,747	3,696	3,539	3,325	3,175	3,094	2,765	1,847	2,301	31,320
Total Emission reduction	t-CO2 eq./y	32,296	31,670	31,283	30,105	28,498	27,377	26,765	24,300	17,413	20,818	270,526

F. Environmental impacts

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

As the Environment Impact assessment (EIA) in accordance with the Environmental Quality Act 1974 (ACT 127) applied over 10MW power plant, This project activity will generate the maximum electric power of approximately 0.8MW and should not be subjected to the EIA.

F.2. If impacts are considered significant by the project participants or the host Party:.

None

G. Stakeholders comments

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

This project activity was designed based on the result of Clean Development Mechanism feasibility study (F/S) implemented by the Ministry of the Environment JAPAN. The steering committee of the F/S has been held regularly. During committee meeting local stakeholders were invited and their comments were compiled.

G.2. Summary of the comments received:

At the 1st Steering Committee on CDM Project in Malaysian Palm Oil Industry, Mr. Chow Kok Kee, a member of UNFCCC CDM Executive Board, made a statement that this CDM project seems to satisfy the Malaysian criteria of sustainable development for CDM project. Those criteria are as follows:

(1) Environment
The project will alleviate the undesirable smell of POME and provide cleaner environment.

(2) Development
The project will generate electricity, activate economy and bring investment.

(3) Social economy
The project will create more opportunity for better jobs.

At the 2nd Steering Committee, EX CORPORATION presented the CDM F/S on the biogas-biomass power generation at Lepar Hilir and Cini3. At the end of the presentation, it was agreed and understood by the steering committee that the biogas generation project at Lepar Hilir palm oil mill will proceed and be used as a CDM model.

(Details of the 1st & 2nd Steering Committee is shown in Appendix 4, 5, 6)

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

None

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The implementation of this project is not dependent on any Official Development Assistance resources or any other resources from any international development-funding agency.

Annex 3

NEW BASELINE METHODOLOGY

1. Title of the proposed methodology:

As a general approach, "Existing actual or historical emissions, as applicable" and "Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment" are adopted in this project activity.

2. Description of the methodology:

2.1. General approach *(Please check the appropriate option(s))*

? Existing actual or historical emissions, as applicable;

? Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

? The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

2.2. Overall description (other characteristics of the approach):

None

3. Key parameters/assumptions (including emission factors and activity levels), and data sources considered and used:

Baseline emissions of this project activity are as follows: *(see fig.1)*

-CH_4 emission without CH_4 recovery

-GHG from fossil fuel combustion without recovered CH_4 power generation system

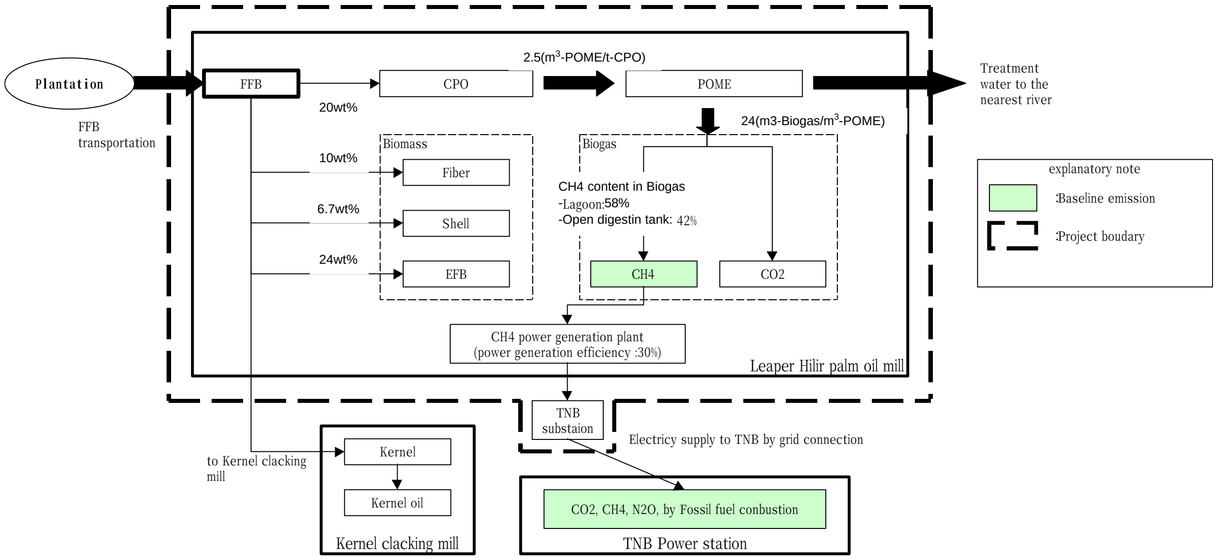


Fig. 1 Framework of baseline

We proposed the project boundary is from the FFB reception at Lepar Hilir mill from plantations until the connection of power generated from the mill to the nearest TNB substation, Lepar Hilir 3 (11kV).

Basic idea of transboundary emission by this project activity is shown in B.5.

In figure 1, estimation of CH_4 emission was based on the amount of FFB received for processing by the mill without any recovery. In addition, GHG emission is also attributed from the fossil fuel combustion.

The CH_4 and GHG emission were derived from formulas that are described later. Using these figures, the calculated the baseline emission can be estimated.

(CO_2 emission from POME is not included in the baseline emission in accordance with the IPCC guideline because it is derived from biomass)

1) Estimation of the amount of FFB received

The amount of FFB received at Lepar Hilir is a sum of the following amount.

- FFB from the FELDA plantation
- FFB form other FFB other producers

a) FFB from the FELDA plantation

FFB are harvested and transported from the plantation estate called Scheme, located around each of the palm oil mill. One Scheme consists of several lots own by several individuals

FFB can be harvested generally after 3 years from planting. The economic life span of the palm trees is ranged from 25 to 30 years before replanting is carried out.

IBRD Report of the Time-series FFB yields data below shows that the largest amount of FFB is harvested about 10 years after planting.

Table 1 Time-series FFB yields data

Elapsed years after planting	4 (First crop)	10	15	20
Crop yields (t/ha)	4.9	21.5	20.2	18.7
Relative yields (%)	23	100	94	87

*Vegetation density: 148trees/ha, Ref.: IBRD

Based on the generally yield profile of the oil palm, FELDA is able to make an approximation of the FFB production, thus forecast the production of CPO at a designated mill. At present, FELDA has estimated the FFB and CPO production up to year 2019 using the Fig.2 model. The model assumes that the economic life is 28 years. The first FFB will commence at the 4^{th} of planting and continues for the next 25 years. In general the yield profile will increase gradually until the production peak at 11^{th} year. Then the yield will decrease at a constant rate until the 25^{th} year. In the last 3 years, the FFB amount shall remain 70 percent of the peak year's figure.

As oil palm is a perennial crop, the FFB yield tend to fluctuate due to variation in the cultivation methods and environmental factors such as manuring, yield cycle rainfall and climate change.

Chew of Applied Agricultural Research Sdn Bhd, shows the possibility of increasing the FFB yield to an average of 24-29t/ha/year by improving the soil nutritional balanced and moisture management.

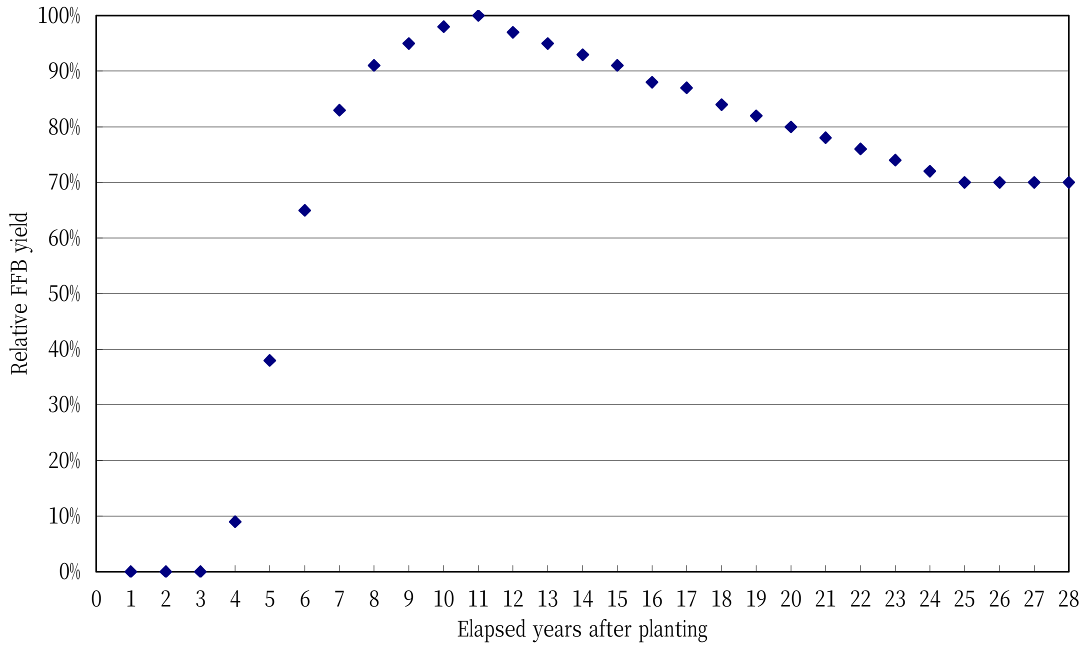


Fig. 2 Time-series FFB yield model (FELDA model)

After considering the entire yield limiting factors, FELDA model in predicting the FFB yield baseline is adopted into the project activity. This largely because the model is considered to be conservative. During the course of the project the actual FFB yield data will be collected from FELDA plantation and will be compared with the estimation made earlier using the model.

Fig. 3 describes the estimated time-series receiving of FFB at Lepar Hilir

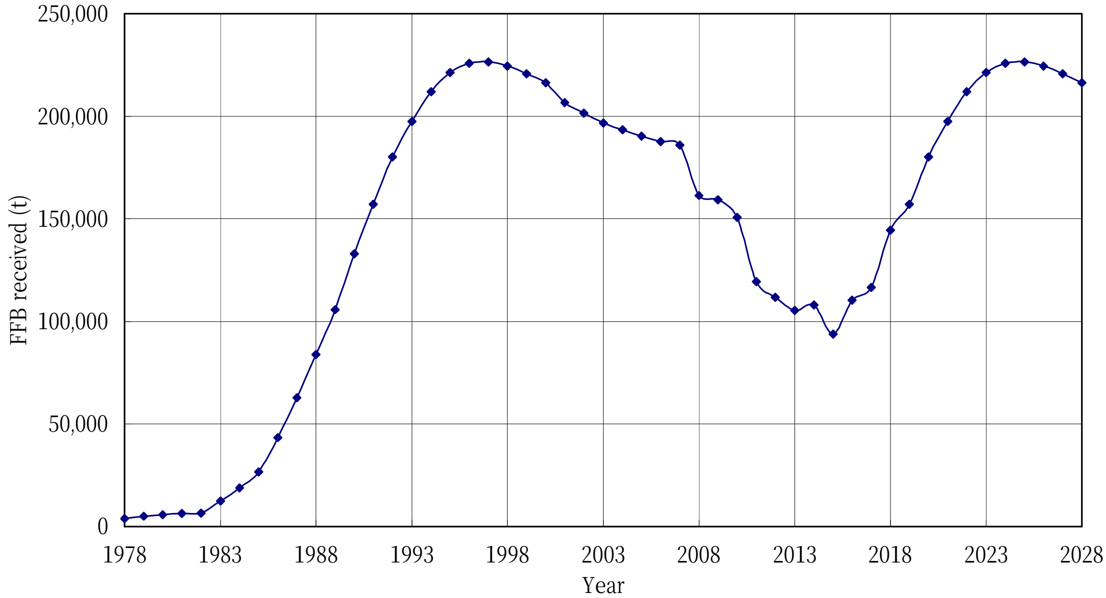


Fig.3 FFB from FELDA plantation (Estimated by the FELDA model)

Table 3 shows the the replanting areas that will be carried out until 2019 at the FELDA plantation from which the FFB is processed at Lepar Hilir.

Table 3 Overview of the replanting at FELDA plantation

Year	2001	2008	2010	2011	2012	2013	2014	2015	2016	2017	2019	Total
Replanting area (ha)	650	2,972	1,140	4,921	1,751	1,931	2,121	4,600	724	2,180	1,589	24,579
Percentage	2.6%	12.1%	4.6%	20.0%	7.1%	7.9%	8.6%	18.7%	2.9%	8.9%	6.5%	100.0%

Based on the FELDA FFB production model (Figure 2) and the replanting pattern (Table 3), the amount of FFB that will be processed in Lepar Hilir Mill is plotted in Figure 3. As shown a constant increase of FFB processed as the oil palm is maturing, follows by drastic decline attributed to the replanting of large hectare of old oil palm areas. It is explained that as in Fig. 2, although not at a constant speed, the receiving rate consecutively increase or decrease right after the initial planting and in the 28th year it falls from 70 % to 0% due to replanting

The highest tonnage of FFB processed will be recorded in 1997 at 230,000t. A staggered decline will be observed after the peak until 2015 where the FFB tonnage is below 100 000 tonnes. After the trough, the FFB yield starts to increase again as more than 60% of the areas have been replanted and more areas are coming to maturity. Lepar Hilir Mill is anticipated to reach it maximum processing capacity is in the 2025 at 230 000 tonnes.

b) FFB form other FFB producers

Currently FELDA is also purchasing FFB from non-FELDA plantations to optimize it's the mill capacity and the decline of CPO production caused by the decrease of FFB processed due to replanting.

The contribution of FFB from non-FELDA plantation is anticipated to continue and increase in the near future as a result of increase in planted areas with no new mill being developed. Especially in Peninsular Malaysia the opening of new mill is being strictly regulated due to few environmental reasons. For this study, the actual figures for the FFB originated non-FELDA plantations sent to Lepar Hilir mill were based on information received from other producers. No data was made available by FELDA. Therefore the estimation is from 2002 through 2012 based on input from the non-FELDA plantations.

Table 4 shows the estimated amount of received FFB from non-FELDA plantations at Lepar Hilir.

Table 4 FFB from other producers (Estimated by FELDA)

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Mean
FELDA	202,040	197,430	192,623	190,462	187,649	185,015	161,592	159,223	149,196	115,735	111,003	
Others	57,850	72,580	81,677	78,608	78,191	70,985	80,988	73,997	78,914	91,785	38,997	73,143
TOTAL	259,890	270,010	274,300	269,070	265,840	256,000	242,580	233,220	228,110	207,520	150,000	

*FFB from FELDA is estimated by the FELDA MODEL. (see Fig.2 and 3)

Similar pattern of FFB processed can also be seen with significant decline in FFB process in the next 5 years. To comfort such decline in FFB receive from the FELDA and non-FELDA plantation, FELDA will make utmost efforts to keep maximizing the mill capacity from other resources. .

In view of the above conditions, the baseline of the amount of FFB in this project is a basically the mean value of the estimated FFB for 11 years from 2002 through 2012.

However, it does not exceed the largest record in the past as the mill has little possibility to receive and process far more FFB than previously.

Fig. 4 shows the estimation of FFB received at Lepar Hilir.

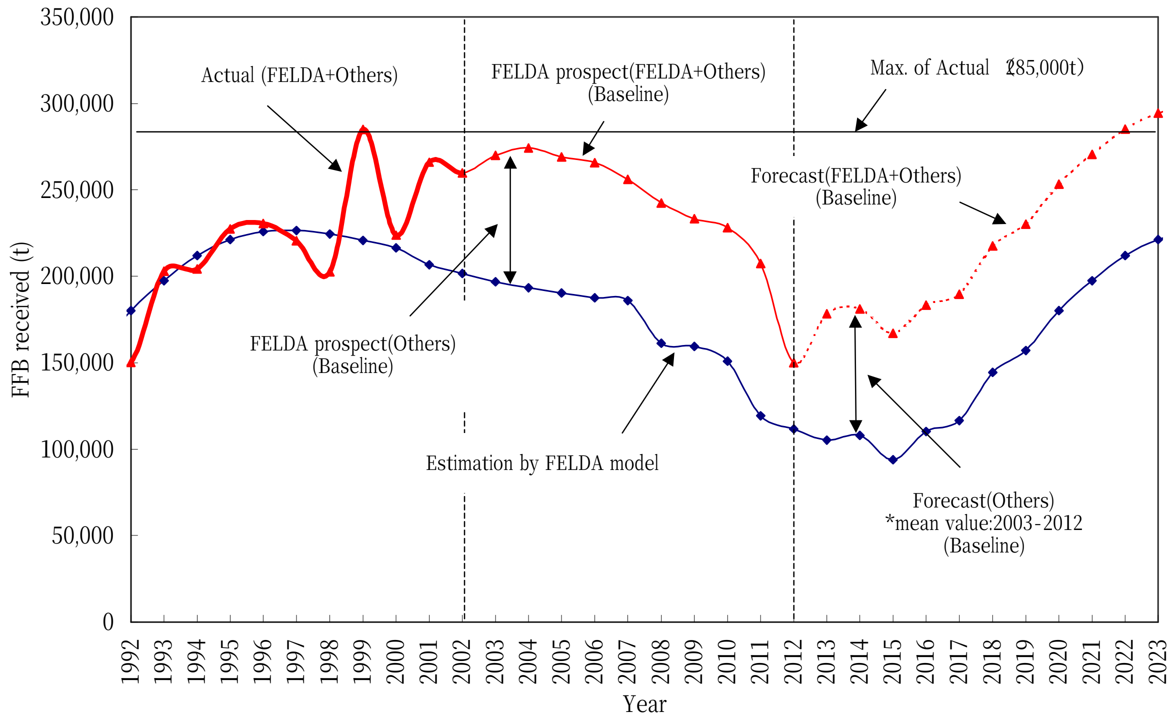


Fig. 4 FFB from FELDA and other producers

2) Estimation of CH_4 emission

a) Equation for CH_4 emission estimation

As for CH_4 emission from POME, the calculation method is adopted from the first national report to the UNFCC secretariat by Malaysian government.

Table 5 Formula for estimating CH_4 emission from POME

CH_4 emission(t-CO_2 eq. /y)
= CPO production(t) (=CPO yield (t-CPO /t-FFB) * FFB received (t/y))
* POME yield in the CPO production (m^3-POME/t-CPO)
* Biogas yield from POME (m^3-Biogas/m^3-POME)
* CH_4 fraction in biogas (m^3-CH_4/m^3-Biogas)
* CH_4 density (t-CH_4/m^3-CH_4)
* GWP (CH_4)

The calculation method is widely used in various research reports by the government such as “Feasibility study on grid connected power generation using biomass cogeneration technology (2000)” by Malaysia Energy Center (PTM), or the monographs by the authorities on palm oil research like Palm Oil Research Institute Malaysia: PORIM. Thus the approach is regarded as the principle formula of the project.

b) Parameters used in the equation

i) POME yield from the CPO production

As reported in various government reports and research publications, the ratio of every 1 tonne of CPO produced the mill will generate 2.5m3 of POME has been widely adopted. However, due to lack of monitoring and different operational conditions of the mills in Malaysia, the ratio may be differed significantly. Therefore, for this project stringent observation is recommended to monitor and record the amount of FFB process and POME discharge respectively. Meanwhile, FFB and CPO relationship is represented by OER (Oil Extraction Rate: CPO acquisition out of FFB) at approximately 20%. Let 20% (0.2 t-CPO/t-FFB), CPO generation rate per POME will be $2.5m^3$-POME/t-CPO and POME generation rate per FFB will be $0.5m^3$-POME/t-FFB. It recaptures the condition when POME was generated as shown in Table 6.

Consequently $0.5m^3$-POME/t-FFB (=$2.5m^3$-POME/t-CPO×0.2 t-CPO/t-FFB) is adopted as the baseline setting data in this project by substituting for the value of Lepar Hilir from conservative viewpoint.

Table 6 shows the examined data at Lepar Hilir, Cini3, and Serting Hilir.

Table 6 FFB received and POME generation (2002)

	Lepar Hilir			Cini3			Serting Hilir		
Month	FFB (t)	POME (m3)	POME/FFB (m3/t)	FFB (t)	POME (m3)	POME/FFB (m3/t)	FFB (t)	POME (m3)	POME/FFB (m3/t)
1	21,250	12,580	0.59	13,390	6,695	0.50	17,930	8,581	0.48
2	17,000	13,287	0.78	11,320	5,660	0.50	19,000	9,152	0.48
3	18,440	13,664	0.74	12,090	6,045	0.50	21,150	9,360	0.44
4	15,910	13,815	0.87	11,100	6,438	0.58	20,300	9,862	0.49
5	14,940	15,041	1.01	13,245	6,675	0.50	22,110	10,960	0.50
6	20,210	15,203	0.75	11,930	5,828	0.49	26,600	13,148	0.49
7	21,490	15,360	0.71	12,265	6,343	0.52	29,290	14,803	0.51
8	24,900	18,945	0.76	17,405	8,664	0.50	32,550	16,307	0.50
9	28,700	16,830	0.59	18,225	9,391	0.52	31,071	15,647	0.50
10	28,850	16,289	0.56	18,000	9,353	0.52	31,090	15,595	0.50
11	24,100	14,877	0.62	14,100	7,470	0.53	28,340	12,558	0.44
12	21,900	12,287	0.56	12,455	6,574	0.53	20,750	10,317	0.50
Total	257,690	178,178	0.69	165,525	85,136	0.51	300,181	146,290	0.49

Source: FELDA PALM INDUSTRIES SDN BHD

As shown in table 6, the ratio between POME and FFB of Lepar Hilir resulted in higher figures because it included not only POME but also the washing water from other facilities. On the other hand, the value for Cini3 and Serting Hilir is fairly close to the mean value of $0.5m^3$-POME/t-FFB. However, it is not obvious whether the washing water is included in POME or not in Cini3 and Serting Hilir as this was not mentioned by the mills.

The project activity adopts the data at the moment, will verify the data by monitoring in the project period. If the monitoring result is different from the data, date back to the start and reset the data.

ii) Biogas yield from POME

It is also stated in a number of government reports and various literatures describing that biogas yield from POME is approximately 20 to 28 (m^3-CH_4/m^3-Biogas). For this project mean value of biogas yield (24 m^3-CH_4/m^3-Biogas) is adopted for estimation. Due to the large differences between upper and lower is about 1.4 times, thus CH_4 can also be generated at 1.4 times more. This may have considerable influence over CDM projects.

At present fieldwork is being conducted to verify this figure for better estimation. If the monitoring result is different from the data, date back to the start and reset the data.

iii) CH_4 gas fraction in biogas

It also has been reported that biogas mixture content is 65% CH_4 and 35 % CO_2. However the data was based on laboratory analysis not as business per usual.

In line with this, KIT(Kyushu Institute of Technology) – UPM(University Putra Malaysia) have been studying the CH_4 fraction in biogas since 2001 at the Serting Hilir mill. The latest measurement in the lagoon and the open digesting tank is shown in Table 7.

Table 7 Measured CH_4 gas fraction in biogas (mean value)

Biogas emission	Mean CH_4 gas fraction and measurement period
Lagoon	58% (13weeks: Nov.-Jan.)
Open digesting tank	42% (27weeks: Jun-Dec.)

Source: Result of KIT-UPM joint research

(Details of the measurement are shown in Appendix 2)

Hence, the result is used for the baseline setting. The project activity adopts the data at the moment and will verify the data by monitoring during the course of the project. If the monitoring result is different from the baseline, the value will be adjusted accordingly.

b) Baseline scenario on the POME treatment method

As described in Chapter 2, a number of mills use anaerobic lagoon in combination with open digesting tanks to treat POME.

Table 7 shows that the CH_4 gas fraction in biogas varies between lagoon and open digesting tank. If any factors are believed to change the treatment method during the project period, it will be needed to reflect the change to the baseline scenario.

i) Basis of POME treatment method selection

In order to meet the effluent discharge standard of the POME into rivers, long retention time (volume/POME) in the lagoon is required to reduce the polluting strength of POME. However in view of land constraint, it is impossible to keep the required retention time thus open digesting tanks is more favorable. In other words, the treatment method is selected depending on the dimension of land availability for the mill construction.

ii) Possibility to change the treatment method

For all that FELDA has no precedent, it will be possible for the future to change the treatment method under consideration from the following two aspects;

- More stringent effluent standard by strengthening environment standard

DOE determines the effluent standard of POME treated water into rivers, generally under 100ppm BOD. DOE plans to set more stringent effluent standard in the sites where environmental impact is much concerned. A strict standard to keep BOD under 20ppm is already been applied to some of FELDA’s mills.

In this instance, there is a possibility that lagoons will be replaced by open digesting tanks in order to meet the more stringent effluent standard.

-Land availability and constraint

With the current rate Malaysian growth, the development of new plantation areas and oil processing mills has lower priority compared to the opening of residential and industrial areas. Thus, land has become a limiting factor particularly in the plantation sector. Thus, land must be maximized for the production of FFB rather than to occupy a number of lagoons for POME treatment. In this scenario, the switching of treatment method from lagoon to open digesting tank may be the only alternative, at present.

At the selected mill, POME at is being treated in lagoon before being released into the river. At the present, the mill is not exposed to any of the above conditions. Thus the baseline of this project remains in lagoon only, or the baseline of CH_4 gas fraction in biogas is 58%.

3) Estimation of GHG emission by fossil fuel combustion

Here, the reduction of GHG emission is estimated in the event it is converted to biomass oriented fuel.

a) Grid connection method to electricity power plant

Electricity generated from biomass oriented fuel can be sold to TNB (Tenaga Nasional Berhad), the only one electric power company in Peninsular Malaysia, by means of connecting to their national grid. Fossil fuel will be converted to biomass oriented fuel in TNB's power plants, and as a result CO_2 emission may be reduced. There are two options to reduce CO_2 emission by connecting to the national grid;

(1) Thermal power base – average reduce CO_2 emission on thermal power, which discharge CO_2 more than any other power supplies.

(2) Mean power base –average reduce CO_2 emission on all the power supplies; e.g. thermal power, water power.

Option (1) is based on the idea that thermal power should firstly be reduced from the viewpoints of the CO_2 emission reduction, though, it is up to the power company to choose the option.

In this project Option (2) is selected as the conservative baseline. Its GHG emission factor is shown in Table 8.

Although the data is rather outdated, as TNB does not release the latest emission factor, it is adopted to the baseline setting at this time.

Table 8 Mean emission factor in all power sources

GHG	Emission Factor
CO_2	0.623 kg-CO_2/kWh
CH_4	2.81 mg-CH_4/kWh
N_2O	3.74mg-N_2O/kWh

Source「Feasibility study on grid connected power generation using biomass cogeneration technology」(2000, PTM)

TNB's national grid substation is located about 4 km from Lepar Hilir mill and it enables to estimate the GHG emission reduction.

b) Power generation efficiency

According to the reports of PTM or PORIM, 1m^3 biogas has the potential to generate approximately 1.8kWh, which is about 25% power generation efficiency of its heat value.

For comparison one of Japanese power companies responded that nearly 35 % power generation efficiency is maximally feasible from the technological terms of present CH_4 power generation. Thus the average of above value, 30 % power generation efficiency, is adopted as the baseline of this project.

4) Other GHG emission

1) Estimation of GHG emission from additional FFB transportation

There is a possibility to increase the amount of FFB received from the baseline amount in this project activity. In this case, following transboundary emissions are expected.

(a) Increase of GHG emission by increasing FFB transportation volume to Lepar Hilir
(b) Decrease of GHG emission by decreasing FFB transportation volume to other mills

(b) is caused by the decrease of FFB amount, which is supposed to be received at the other mills.

If the transportation volume of (1) exceeds that of (2), GHG emission increases. However it is difficult to estimate the difference of the transportation volume because the FFB will be received from many plantations which location and size are different.

This project activity does not take in account of the GHG emission based on the idea that the transportation volume of (1) and (2) is almost the same.

This project activity does not take into account of the GHG emission from the transportation by the additional FFB reception. We estimated the GHG emission based on the assumption as follows:

-Transportation volume increases considerably.
-The amount of FFB reception every year in the project period is past maximum record of FFB reception at Lepar Hilir, about 285,000t-FFB/year.
-Transportation distance is 100km one-way (200km there and back).

As the emission factors in Malaysia are not released, the emission factors in Japan were used by resorting to an expedient. Estimated GHG emission is shown at Fig.5. The GHG emission is about 1% of the baseline emission compared with Fig.6 as described later. As 100km transportation of FFB is physically impossible, the emission from transportation could be negligible.

(Conditions for estimating GHG from additional FFB transportation)

(1) Fuel of trucks: Diesel
(2) Fuel consumption of trucks: 10km/L-Diesel
(3) Load capacity of a truck: 20t-FFB/truck
(4) GHG emission from truck transportation:
(CO_2)Emission factor * Fuel consumption
(CH_4, N_2O)Emission factor * Transportation distance

Table 9 Emission factors used in the estimation

Type of GHG	Emission factor
CO_2	2.64kg-CO_2/L-Diesel
CH_4	0.000014kg-CH_4/km
N_2O	0.000025kg-N_2O/km

Sources: General study reports on the GHG emission estimation, 2002, the Ministry of Environment JAPAN

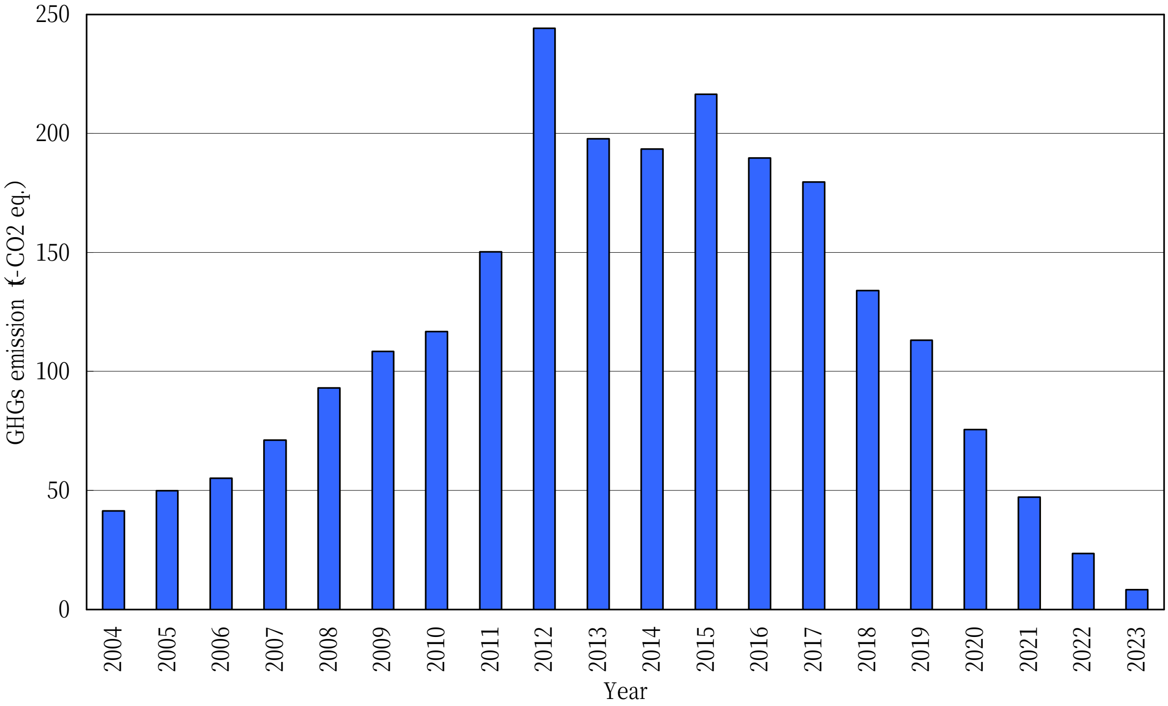


Fig. 5 GHG emission from additional FFB transportation

5) Baseline emision

In line with Chapters 1, 2, and 3 the baseline emission at Lepar Hilir is estimated for the period of 20 years from 2004 through 2023. The figure6 is regarded as the baseline emission for this project.

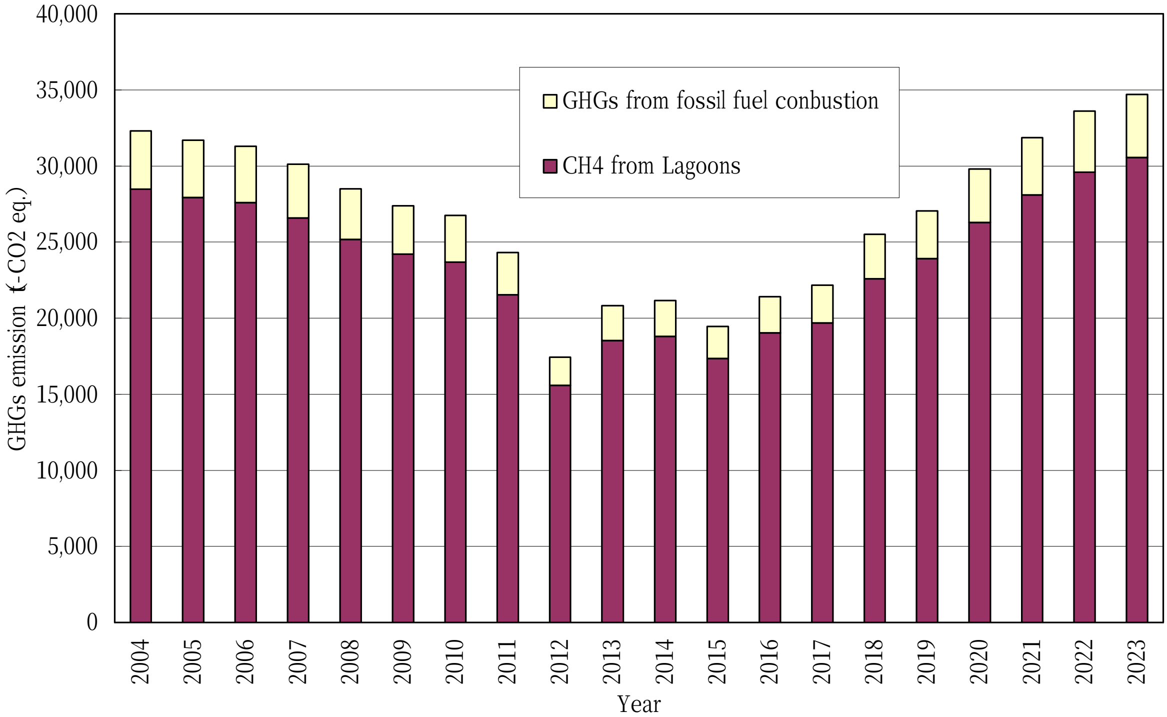


Fig. 6 Baseline emission

(CO_2 emission from POME is not included in the baseline emission in accordance with the IPCC guideline because it is derived from biomass)

4. Definition of the project boundary related to the baseline methodology:

The project boundary cannot be defined in relation to the baseline methodology. The determination of the project boundaries depends on the project circumstances under which a baseline methodology is used. Project boundaries cannot be defined for an abstract baseline methodology.

5. Assessment of uncertainties:

The proposed methodology (methane fraction), which is based on KIT- UPM monitoring results, may cause some discrepancies in the baseline scenario. This is because the Lepar Hilir mill operating factors may be differed to Serting or Serting Hilir mills. Thus this may affect the composition of methane in the biogas mixture emits from the lagoon system. Factors such as differences in wastewater treatment system used, quality of POME discharge from the mill as a result of the activities of the mill, quantity of FFB processed and geographical position of the mill that may influence the baseline scenario.

6. Description of how the baseline methodology addresses the calculation of baseline emissions and the determination of project additionality:

Please refer to Appendix 3 (Calculating table of GHG emission reduction by the project activity) and sections B.3. & B.4.

7. Description of how the baseline methodology addresses any potential leakage of the project activity:

No baseline methodology can address the leakage of the project activity. The leakage can only be confirmed by defining the boundaries, on site monitoring of methane emission and identifying indirect emissions of the baseline and project.

8. Criteria used in developing the proposed baseline methodology, including an explanation of how the baseline methodology was developed in a transparent and conservative manner:

The following criteria were used in developing this methodology:

(a) Availability of information: The methodology permits the determination of a baseline scenario where direct monitoring information on methane fraction in the biogas at Serting & Serting Hilir. This is the only available information with regards to methane emission as business per usual for the proposed project.

(b) Reduction of transaction costs: No additional information must be produced.

The proposed baseline methodology is transparent and conservative in the following reasons:

(c) It uses the conventional understanding of why the proposed course of action is not economically attractive as described in sections B.3. & B 4.

(d) It can be applied in a transparent manner as it relies on direct monitoring that can be checked by KIT-UPM joint research to ensure completeness, correctness, plausibility and conservative assumptions.

9. Assessment of strengths and weaknesses of the baseline methodology:

Strengths: On-site direct monitoring of methane fraction in biogas

Weaknesses: The sites where the direct monitoring (Serting & Serting Hilir) was undertaken are different from the project site (Lepar Hilir)

10. Other considerations, such as a description of how national and/or sectoral policies and circumstances have been taken into account:

The methodology takes national and sectoral regulations into account in that the baseline scenario must be in accordance with the existing regulation on wastewater discharge from palm oil mills.

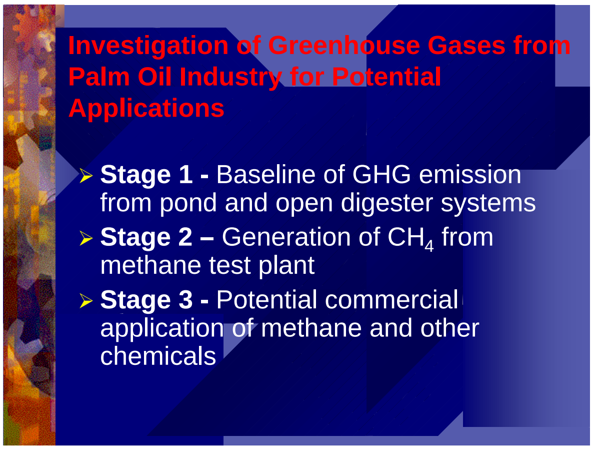
Appendix 1

Abbreviation list

CPO	Crude Palm Oil
DNA	Designated National Authority
DOE	Department of Environment
EFB	Empty Fruit Bunch
FELDA	Federal Land Development Authority
FFB	Fresh Fruit Bunch
GHG	Greenhouse Gases
IRR	Internal Rate of Return
KIT	Kyushu Institute of Technology
OER	Oil Extraction Rate
POME	Palm Oil Mill Effluent
PORIM	Palm Oil Research Institute Malaysia
PTM	Pusat Tenaga Malaysia (Malaysia Energy Center)
TNB	Tenaga Nasional Berhad
UPM	Universiti Putra Malaysia

<u>Appendix 2</u>

Investigation of Greenhouse Gases from Palm Oil Industry for Potential Applications
(Presented by University Putra Malaysia at the 2nd steering committee)



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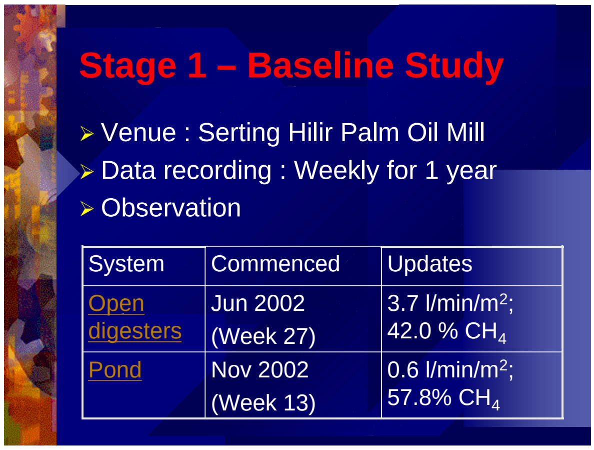

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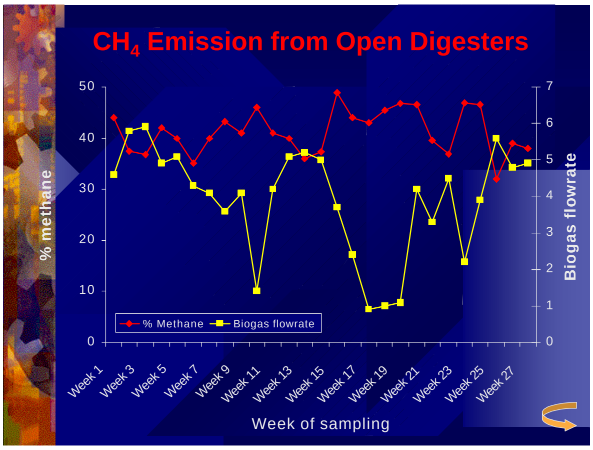

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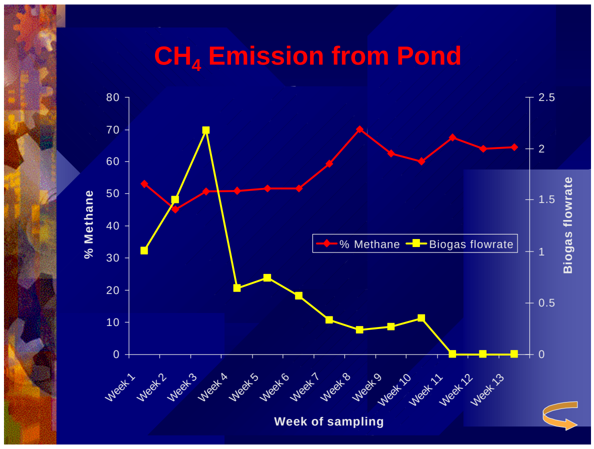

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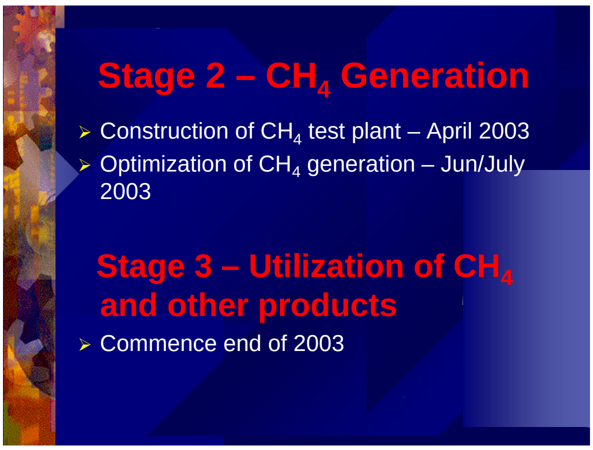

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<u>Appendix 3</u>

Calculating table of GHG emission reduction by the project activity

1. General data

Items	Unit \ Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Coefficient	Unit	Reference
FFB received	t/y	274,300	269,070	265,840	256,000	242,580	233,220	228,110	207,520	150,000	178,438			Baseline FFB received
CPO production	t/y	54,860	53,814	53,168	51,200	48,516	46,644	45,622	41,504	30,000	35,688	0.2	t-CPO/t-FFB	General yield
POME discharge	m3/y	137,150	134,535	132,920	128,000	121,290	116,610	114,055	103,760	75,000	89,219	2.5	m3-POME/t-CPO	PTM F/S(2000)
Biogas generation	m3/y	3,291,600	3,228,840	3,190,080	3,072,000	2,910,960	2,798,640	2,737,320	2,490,240	1,800,000	2,141,255	24	m3-Biogas/m3-POME	Mean value of 20-28
CH4 generation	m3/y	1,909,128	1,872,727	1,850,246	1,781,760	1,688,357	1,623,211	1,587,646	1,444,339	1,044,000	1,241,928	0.58	m3-CH4/m3-Biogas	Measured value in our research
	t/y	1,355	1,330	1,314	1,265	1,199	1,152	1,127	1,025	741	882	0.00071	t-CH4/m3-CH4	Theoretical value
Shell generation	t/y	17,830	17,490	17,280	16,640	15,768	15,159	14,827	13,489	9,750	11,598	0.065	t-Shell/t-FFB	PTM F/S(2000)
Fiber generation	t/y	37,031	36,324	35,888	34,560	32,748	31,485	30,795	28,015	20,250	24,089	0.135	t-Fiber/t-FFB	PTM F/S(2000)
EFB generation	t/y	65,832	64,577	63,802	61,440	58,219	55,973	54,746	49,805	36,000	42,825	0.24	t-EFB/t-FFB	PTM F/S(2000)
CH4 heat value	PJ/y	75	74	73	70	66	64	62	57	41	49	55.4	MJ/kg	Theoretical value
Shell heat value	PJ/y	338	332	328	316	300	288	282	256	185	220	19	MJ/kg	PTM F/S(2000)
Fiber heat value	PJ/y	407	400	395	380	360	346	339	308	223	265	11	MJ/kg	PTM F/S(2000)
EFB heat value	PJ/y	395	387	383	369	349	336	328	299	216	257	6	MJ/kg	PTM F/S(2000)
Total heat value	PJ/y	1,216	1,193	1,179	1,135	1,076	1,034	1,011	920	665	791			

2. CH4 recovery

Items	Unit \ Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Coefficient	Unit	Reference
CH4 emission (baseline)	m3/y	1,909,128	1,872,727	1,850,246	1,781,760	1,688,357	1,623,211	1,587,646	1,444,339	1,044,000	1,241,828	0.58	m3-CH4/m3-Biogas	Measured value in our research
	t/y	1,355	1,330	1,314	1,265	1,199	1,152	1,127	1,025	741	882	0.00071	t-CH4/m3-CH4	Theoretical value
	t-CO2 eq/y	28,465	27,922	27,587	26,566	25,173	24,202	23,672	21,535	15,566	18,517	21	- (GWP)	IPCC Data
CO2 emission (baseline)	m3/y	1,382,472	1,356,113	1,339,834	1,290,240	1,222,603	1,175,429	1,149,674	1,045,901	756,000	899,327	0.42	m3-CO2/m3-Biogas	Measured value in our research
(Excluded, because of carbon neutral)	t-CO2 eq/y	2,710	2,658	2,626	2,529	2,396	2,304	2,253	2,050	1,482	1,763	0.00196	t-CO2/m3-CO2	Theoretical value
GHG emission (baseline)	t-CO2 eq/y	28,465	27,922	27,587	26,566	25,173	24,202	23,672	21,535	15,566	18,517			
CH4 generation (project)	m3/y	2,139,540	2,098,746	2,073,552	1,996,800	1,892,124	1,819,116	1,779,258	1,618,656	1,170,000	1,391,815	0.65	m3-CH4/m3-Biogas	Laboratory data
	t/y	1,519	1,490	1,472	1,418	1,343	1,292	1,263	1,149	831	988	0.00071	t-CH4/m3-CH4	Theoretical value
	t-CO2 eq/y	31,901	31,292	30,917	29,772	28,212	27,123	26,529	24,134	17,445	20,752	21	- (GWP)	IPCC Data
Rate of CH4 recovery		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%			
CH4 emission (project)	t-CO2 eq/y	0	0	0	0	0	0	0	0	0	0			
CO2 emission (project)	m3/y	1,152,060	1,130,094	1,116,528	1,075,200	1,018,836	979,524	958,062	871,584	630,000	749,439	0.35	m3-CO2/m3-Biogas	Laboratory data
(Excluded, because of carbon neutral)	t-CO2 eq/y	2,258	2,215	2,188	2,107	1,997	1,920	1,878	1,708	1,235	1,469	0.00196	t-CO2/m3-CO2	Theoretical value
GHG emission (project)	t-CO2 eq/y	0	0	0	0	0	0	0	0	0	0			
GHG emission reduction (CER)	t-CO2 eq/y	28,465	27,922	27,587	26,566	25,173	24,202	23,672	21,535	15,566	18,517			

3. GHG emission reduction by CH4 power generation and supply

Items	Unit \ Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Coefficient	Unit	Reference
CH4 recovery	t/y	1,519	1,490	1,472	1,418	1,343	1,292	1,263	1,149	831	988			
CH4 heat value	PJ/y	84	83	82	79	74	72	70	64	46	55	55.4	MJ/kg	Theoretical value
	MJ/h	9,607	9,424	9,311	8,966	8,496	8,168	7,989	7,268	5,254	6,250	8,760	h/y	
Rated power (potential base)	KW	2,669	2,618	2,586	2,491	2,360	2,269	2,219	2,019	1,459	1,736	3.6	MJ/KWh	
Generating efficiency	-	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%			Average value of 25%-35%
Rated power	KW	801	785	776	747	708	681	666	606	438	521			
Rated power demand for operation	KW	100	100	100	100	100	100	100	100	100	100			Assumption
Rated power supply to grid	KW	701	685	676	647	608	581	566	506	338	421			
Annual power supply	MWh/y	6,137	6,003	5,921	5,669	5,326	5,087	4,956	4,430	2,959	3,686	8760	h/y	
CO2 emission reduction	t-CO2 eq/y	3,823	3,740	3,689	3,532	3,318	3,169	3,088	2,760	1,843	2,296	0.623	kg-CO2/KWh	PTM F/S(2000)
CH4 emission reduction	t-CH4/y	0	0	0	0	0	0	0	0	0	0	2.61	mg-CH4/KWh	PTM F/S(2000)
	t-CO2 eq/y	0	0	0	0	0	0	0	0	0	0	21	- (GWP)	IPCC Data
N2O emission reduction	t-N2O/y	0	0	0	0	0	0	0	0	0	0	3.74	mg-N2O/KWh	PTM F/S(2000)
	t-CO2 eq/y	7	7	7	7	6	6	6	5	3	4	310	- (GWP)	IPCC Data
GHG emission reduction (CER)	t-CO2 eq/y	3,831	3,747	3,696	3,539	3,325	3,175	3,094	2,765	1,847	2,301			

5. Single-year GHG emission reduction (CER)

Items	Unit \ Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
CH4 recovery	t-CO2 eq/y	28,465	27,922	27,587	26,566	25,173	24,202	23,672	21,535	15,566	18,517	23,921
GHG emission reduction by CH4 power generation & supply	t-CO2 eq/y	3,831	3,747	3,696	3,539	3,325	3,175	3,094	2,765	1,847	2,301	3,132
Total	t-CO2 eq/y	32,296	31,670	31,283	30,105	28,498	27,377	26,765	24,300	17,413	20,818	27,053

6. Accumulated GHG emission reduction (CER)

Items	Unit \ Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
CH4 recovery	t-CO2 eq/y	28,465	56,387	83,975	110,541	135,714	159,916	183,588	205,123	220,689	239,206
GHG emission reduction by CH4 power generation & supply	t-CO2 eq/y	3,831	7,578	11,274	14,813	18,138	21,313	24,406	27,172	29,019	31,320
Total	t-CO2 eq/y	32,296	63,966	95,249	125,354	153,852	181,229	207,994	232,295	249,708	270,526

Appendix 4

Minute of the 1st Steering Committee on CDM Project in Malaysian Palm Oil Industry

Date: 15 October 2002
Time: 9:30-11:30
Venue: Ministry of Science, Technology and the Environment
Attendee: (See Appendix 5)

1. Opening address form the chairperson (Mr. Chow on behalf of Dr. Nadzri)

Mr. Chow was requested to chair the CDM meeting. On behalf of Dr. Nadzri, he apologized to the steering committee as Dr. Nadzri had to attend another urgent meeting. The meeting was initiated by an opening remark by Mr. Chow on the issue of green technology and potential international collaboration in the CDM project.

2. Introduction of participants

Even though it was a second gathering of the steering committee, there were a few new delegates from Malaysian and Japanese sides. Among them were Tokyo Electric Power Company, Mitsubishi Security, Ministry of Primary Industry, Ministry of Energy and Multimedia, SIRIM, Malaysian Energy Center and Economic Planning Unit.

3. Result of 2001 study

The main agenda of the meeting was the presentation of the current findings of the research project carried out at Serting Hilir Palm Oil Mill by Kyushu Institute of Technology and Universiti Putra Malaysia. The presentation was delivered by Professor Shirai. The follow-up discussion was largely arise from this presentation as follows:

3-1 THE ESTABLISHMENT OF GHG BASELINE IN CDM PROJECT

Question: Dr. Yeoh Bee Ghin

i. Why was the CH_4 content or biogas is lower than in the previous report?

Answer: Prof. Shirai & Dr. Ali

- Higher biogas content reported was due the size and nature of the experiment. The earlier studies conducted were mainly at the labscale and in a closed system. Whereas these data were collected during the normal operation of the palm oil mill wastewater treatment plant (open digester and lagoon). Therefore factors such as oxygen contamination and mixing (even though minor) for the open system is inevitable. For the digester system mixing is more vigorous as evident from the active bubbling and recharging of new effluent. While in the lagoon system, large surface area may encourage the introduction of oxygen into the liquid phase.

- Therefore it is important for the CDM project to quantify the actual amount of GHG emission from the palm oil industry as per business as usual.

Question: Dr. Yeoh

ii. Were there any microbiological studies conducted on the CO_2 generation?

Answer: Prof. Shirai

- CO_2 generation was not measured based on microbiological activities because the size of the lagoon and open digesting tank were too huge to study.

Question: Mrs. Wong

iii. Are there any problems for baseline establishment?

Answer: Prof. Shirai

- Major field constraints in establishing the baseline are mainly limited points of sampling and study period.
- Ideally, CH_4 generation should be measured from material balance. This can be achieved using the information from the chemical properties of POME at the intake and discharge points. However, the content of CH_4 should first be verified because of the huge difference between the data obtained in our study (35% in tank case, 45% in lagoon case) and the data used in Malaysian national GHG inventory (65%)
- Therefore more accurate measurement is needed to verify the content. To pursue this objective, we are now in the process of developing a new digital imaging system to measure the GHG emission. The new system is anticipated be more efficient in terms of time required and sampling.

Response: Mr. Chow

- Mr. Chow again emphasized on the usefulness of accurate measurement to set baseline settlement in CDM project.

Question: Dr. Ma

iv. The result of the CH_4 content in biogas seemed to be low, is there any plan in the future to use selective thermophuilic microorganism so that CH_4 could be increased and the hydraulic retention time be reduced?

Answer: Dr. Ali

- What we are interested now is to establish the current situation (business as usual)
- Dr. Ma's idea is very useful and valid mainly for power generation by biogas.

Answer: Prof. Shirai

- It's difficult to use the selective microorganism in the current study as the setting up of baseline is more crucial.

Answer: Prof. Ismail

- Completely different system from the existing open digesting tank should be introduced to the industry in order to use biogas for power generation.

Answer: Prof. Shirai

- Modern technology of CH_4 fermenter will be introduced with the cooperation from Sumitomo Heavy Industry.
- It is anticipated that with the new design the CH_4 content can be improved and retention time and polluting strength be reduced.

Answer: Mr. Subash

- In response to Dr. Ma's question, Mr. Subash stressed that the main objective of the current project is to establish the GHG baseline from the palm oil industry without any modification to the current system. The data collection should represent business as usual which is in the phase of the CDM project.
- Once the GHG baseline has been established and certified then the exploitation of the new $500m^3$ pilot plant in the 2^{nd} phase can be used for power generation.

3-2 Malaysian criteria for sustainable development expected from CDM

Remarks: Mr. Chow

- Malaysian criteria of sustainable development are as follows:
  Environment

The project will alleviate the undesirable smell of POME and provide cleaner environment

Development

The project will generate electricity, activate economy and bring investment.

Social economy

The project will create more opportunity for better jobs.

- This CDM project seems to satisfy those criteria.

4.Possibility of CDM project

Q and A based on the explanation from Prof. Shirai, was as follows;

4-1 PROJECT BOUNDARY

Questions: Mr. Suzuki.

- Proposed a study to investigation on each mill on the productivity and the location of mill to the nearest power grid.in the year 2002-2003?
- Clarification is required on the project boundary whether it covers from the gathering of FFB from the field down to the discharging of palm oil mill effluent?

Remarks: Mr. Chow

- Project boundary should be confined to the wastewater treatment system mainly digesting tank and wastes.

4-2 PROJECT COST ESTIMATION

Answer: Prof. Shirai

- Analysis of the project commercialization in the 2001-2002 studies does not include the CER selling.

Remarks: Mr. Chow

- This study is based on the existing system with no modification to the system.

Remarks: Prof. Shirai

- Modern CH_4 fermentation system will be developed by the Japanese plant manufacturer, namely Sumitomo Heavy Industries and used for the CDM project at Serting Hilir Palm Oil Mill.

Questions: Mr. Chow

- Will the Japanese investors make an investment to the CDM project?

Answer: Dr. Shirai

- It was approximately estimated that US$290,000 is needed for the construction of the closed digester system in Malaysia for the palm oil mills. The figure quoted is practical and based on the current senario in Malaysia (similar figure to the F/S report)
- The cost estimation of this project is significantly low compared with the construction cost in Japan at the same scale.
- For the project to become competitive and attractive to the Japanese investors, the price of CER should be approximately US$4.8-6.1/t-$CO_2$ credit which is within the current market price of US$3-6 /t.
- However, the actual cost will only be finalized once the pilot plant has been commissioned. Therefore the next 1 year (2002-2003) is important in determining the total expenditure of the new CH_4 fermentation system.

Remarks: Mr. Chow

- For the co-generation project for the palm oil industry, the investment required is approximately US$30-40 million dollar. Hence the figure quoted by Prof. Shirai for the CDM project is very favorable to Malaysia.

Remarks: Mr. Subash

- It is also an interest of FELDA to investigate the potential applications of biogas and biomass in the boiler system mainly for power generation.
- However, in the context of CDM project, the GHG reduction is the main primary objective.
- Whereas the exploitations of biogas or biomass for power generation is a secondary issue.
- For the mill to be qualified for independent power plant (IPP), the minimum electricity output is 5MW. This is made possible through the connection to the TNB grid.
- On the other hand, smaller mill may not be able to meet the minimum power generation. Therefore it may consume the electricity generated from the biogas or biomass for their own consumption such as small equipment or for aeration of the lagoon system.

Question: Mr. Chow

- Are there any ideas to bring investment from Japan?

Remark: Prof. Shirai

- Comments from Japanese companies are important.

Answer: Ms. Yoshitaka

- CH_4 emission reduction project is more attractive for the CO_2 reduction project because of the GWP.
- The revenue of CER of $5,000/year for sealing the open digesting tanks is not so huge and does not cover the cost of the project. We assume the structure of project finance of this project is 30% of equity investment and 70% of the investment from local banks or developing banks. $5,000/year of CER revenue will be enhancement of return on the equity investment.
- ROE of biomass project is lower than the ROE of biogas project because CH_4 emission reduction is more effective than CO_2 (21 times).
- Biogas has a potential to be an attractive project to investors.
- About capital cost, Japanese technology is high but expensive. It sometimes doesn't meet the need of developing countries.
- This type of project could be suitable for project developers as well as investors in Malaysia.

Remark: Mr. Suzuki

- Cost estimation in the 2001-2002 studies did not include procedure cost such as PDD cost and monitoring cost.
- Total cost for CDM project will be estimated in the 2002-2003 studies.
- A new joint venture company is expected to incorporated by Japanese and Malaysian companies to operate CDM project.

Remark: Mr. Chow

- More accurate assessment of project cost is needed for investors.
- About CDM project in palm oil industry, co-generation system in palm oil mills is studied.

5.Adjourn

Appendix 5

Minute of the 2nd Steering Committee on CDM Project in Malaysian Palm Oil Industry

Date: 14 February 2003
Time: 9:30-11:30
Venue: Ministry of Science, Technology and the Environment
Attendee: (See Appendix 5)

1.Opening address form the chairperson

The meeting was initiated by an opening remark by Mr. Chow on the issue of utilizing the wastes and POME from palm oil industries in the CDM project.

2.Introduction of participants

Even though it was a second gathering of the steering committee, there were a few new delegates from Malaysian and Japanese sides. Among them were Tenaga Nasional Berhad (TNB), Global environment Centre Foundation (GEC) on behalf of Ministry of the Environment JAPAN, Matsushita Electric Industrial Co., Ltd. (Panasonic), and Sankyu Malaysia

3.Current status report by EX Corporation, Japan

The first agenda of the meeting was the presentation of the result of CDM feasibility study on FELDA palm oil mills by EX Corporation and Kyushu Institute of Technology. Mr. Nakamura with EX Corporation delivered the presentation. The follow-up discussion was largely arise from this presentation as follows:

C1 : How do you take care of the leakage from the open digesting tank? (Mr. Chow)
A1 : New design will include the sealing of the existing digesting tank or closed digesting tank (Prof. Shirai)

C2 : What is the advantage of case 1? Why did the study choose case 1? (Prof. Ismail)
A2 : i. Small investment in case 1 (Mr. Nakamura) ii. CER issue – larger CER because of the CH_4 GWP is 21 times as CO_2 with small investment, but low profit as business because of the small electric generation (Prof. Shirai)

C3 : It is needed to consider the monitoring cost as it will reduce the profit (Mr. Chow)

4.Latest research results by University Putra Malaysia, Malaysia

The second agenda of the meeting was the presentation of the result of Investigation of Greenhouse Gases from Palm Oil Industry for Potential Applications. Mr. Shahrakbah with University Putra Malaysia delivered the presentation. The follow-up discussion was largely arise from this presentation as follows:

C1 : Good potential of CH_4 as renewable energy as presented (Mr. Chow)

C2 : Why CH_4 is higher in the pond ? (Prof. Ismail)
A2 : This is as a result of less mixing in the pond creating better anaerobic level or condition for CH_4 fermentation. Mixing in the digester will introduce oxygen thus reducing the anaerobic level (Dr. Ali)

C3 : Why during lunch time the flowrate is high ? (Mr. Chow)
A3 : This is because the mill will introduce fresh effluent into the tank. This activity will cause a vigorous mixing of the effluent therefore releasing a lot of biogas (Mr. Shah)

C4 : What type of fermenter or system that will be used at the pilot plant ? (Dr. Yeoh)

A4 : Circulation in the tank will be achieved through the recycling of POME and biogas, no mechanical mixing will be installed. (Mr. Morinaga)

C5: What is the temperature of the effluent? (D. Yeoh)

A5 : There will be no temperature control therefore the temperature is at the range of 40oC to 50oC, mesophilic condition (Mr. Shah)

4.Future plan by Kyushu Institute of Technology, Japan

The third agenda of the meeting was the presentation of UPM and KIT Plans under Memorandum of Understanding hopefully with FELDA and Japanese Companies. Dr. Shrai with Kyushu Institute of Technology delivered the presentation. The follow-up discussion was largely arise from this presentation as follows:

C1: How do you realize the future plan? (Mr. Chow)

A1: As foothold, biogas power generation will be started as CDM project soon and then FELDA provided us area for pilot scale experiment to recover CH_4. (Prof. Shirai)

C2: The biogas power generation project will contribute to the regional environment improvement and the cost of project is not expensive for Malaysian side. (Mr. Chow)

C3: Other value-added products such as acetone, butonal and ethanol can also be produced from POME as studied by MPOB. This is in line with future plan of CDM business proposal (Dr. Ma)

A3: Biomass industry has a potential especially palm oil industry as the industry is supported by good network of roads and transportation and also the high concentration of biomass at the mill (Prof. Shirai).

C4: This CDM biogas-biomass power generation is the first step toward to develop green business such as biomass projects in Malaysian palm oil industry. Could TNB purchase the electric power generated in our project at premier price, 0.16RM/kWh? (Mr. Suzuki)

A4: There is a possibility, but cheaper is better. (TNB)

6.CDM certification model project, Japan

Mr. Ueno with Global Environment Centre (GEC) on behalf of the Ministry of Environment Japan (MOE) explained the outline of CDM certification Model project conducted by MOE. FELDA Lepar Hilir palm oil mill biogas project was selected in this model project. The follow-up discussion was largely arise from this presentation as follows:

C1: In April, we will have public comments in Japan about the result of the model project, and if possible, would like to have public comments from Malaysian people throuGHGovernment for example on the Website. (Mr. Suzuki)

C2: It is important to conduct a survey on the public opinion of CDM project. The survey should be conducted at the proposed locality so that the community involved will have the say on the impact of the CDM project on their lives. Views must also represent the stakeholders of the company (Mr. Chow)

C3: KIT will hold the symposium on sustainable palm oil industry and call Dr. Lester Brown, one of the world environment leaders, as panelist. We will have comments about our model project from Dr. Brown as a third party nothing to do with our project. (Prof. Shirai)

C4: Public comments from stakeholders such as employee of the mill, people in local community, FELDA member, administration official, people in the palm oil industry, global environmental specialist, etc. are seems to be needed. (Mr. Chow)

C5: MOSTE will invite the OE and give comments about the project. (MOSTE)

C6: Public comments should be taken from local level rather than national level. (Mr. Subash)

C7: Is it necessary to conduct environment impact assessment (EIA) for biogas power generation project? (Mr. Suzuki)

A7: It's not necessary if the electricity generated is below 10 MW. But the environment impact study is required. (Mr. Subash)

C8: Could you give us the information on Designated National Authority (NDA) of Malaysian government to approve CDM project? (Mr. Nakamura)

A8: Malaysian CDM committee as DNA (Designated National Authority) soon will be set up and MOSTE is appointed as the leading organization in the body. Secretary General of MOSTE is proposed to chair and endorse the CDM project. (Mr. Chow)

C9: It is necessary for OE to register to DNA to do work in this model case? (Ms. Yoshitaka)

A9: The precise role has not determined yet. So it's not necessary so far. (Mr. Chow)

C10 Could you give us your impression about the project effect to Malaysian renewable energy policy? (Mr. Nagai)

A10: The project will contribute to the sustainability of Malaysia. (Mr. Chow)

C11: Are there any possibilities to change the numerical target of renewable energy (5% of all national energy supply)?

A11: No possibilities so far. (Mr. Chow)

7.Baseline issue of the CDM Biogas power generation project

C1: the Ministry of Environment JAPAN told that the baseline scenario of our project that lagoon or open digesting tank system will not be changed in next 10 years as business as usual (BAU) must be logically strengthened. If the baseline set very conservative such as introducing sealed digesting tanks as BAU it is difficult to be CDM project as business. (Prof. Shirai)

C2: Unless some sort of technical assistance for POME digester, the baseline will be the same as current condition, lagoon or open digesting tank system, in next 10 years. (Dr. Ma)

C3: We would like to discuss how we insist and convince our baseline to OE. (Prof. shirai)

C4: Based on the current scenario, the GHG baseline in the pond will not changed for the next 10-15 years. However, this is largely influence by the DO requirement on the treated effluent discharge to the waterways. If the mill is required to reduce the BOD level prior the discharge then new system wastewater treatment system (higher efficiency) must be installed to meet the regulation. In a way, it will affect the GHG. (Mr. Subash)

C5: There are many related projects in Malaysia such as UNDP-PTM project and they all faces the baseline issue that the lagoon or open digesting tank system continues in next 10 – 15 years. (Dr. Yeoh)

C6: Dynamic baseline is unsuitable for CDM project as regular fluctuation will affect the investment and cost of earlier project that is based on the previous baseline. Then the renewable crediting period (at most 7 years per period with 3 periods) are prepared to re consider the baseline 7 years after the settlement. (Mr. Chow)

8.Other Issue

C1: It was suggested that the next CDM meeting is held at the site of the pilot plant in August 2003. This will give better views to all the members about the current conditions of the palm oil industry. (Mr. Chow)

9.Adjourn

Appendix 6

Attendee of the 1st & 2nd Steering Committee on CDM Project in Malaysian Palm Oil Industry

1. Attendee from Malaysia

Name	Title	Attendance	
		1st	2nd
Mr. Chow Kok Kee (Chair Person)	Malaysian Meteorological Service, Director General (Representative of the UNFCCC CDM Executive Board)	*	*
Mr. Lim Cheong Chuan	Ministry of Energy, Communications & Multimedia, International and Sustainable Energy Division, Energy Sector, Principal Assistant Secretary	*	
Mr. Norhana Abdul Majid	Ministry of Primary Industry	*	
Mr. Mohd Fauney Yusoft	Ministry of Science, Technology and the Environment , Department of Environment		*
Dr. Ma Ah Ngan	Palm Oil Research Institute Malaysia (PORIM), Director Engineering & Processing	*	*
Ms. Wong Hwee Kheng	Malaysia Energy Center (PTM), Energy Data Modeling and Consultancy Services, Research Officer	*	
Mr. Nik Mohd Aznizan Nik Ibrahim	Malaysia Energy Center (PTM)		*
Dr. B.G.Yeoh	Sirim Berhad, Environmental and Energy Technology Center, General Manager	*	*
Dr. Mohamed Ismail Abdul Karim	University Putra Malaysia, Institute of Bioscience, Deputy Director	*	*
Dr. Azni Hj.Idris P.M.C	University Putra Malaysia, Waste technology Center, General Manager	*	*
Dr. Jinap Selamat	University Putra Malaysia		*
Dr. Mohd. Ali Hassan	University Putra Malaysia	*	*
Dr. Shahrakbah Yacob	University Putra Malaysia	*	*
Mr. Subash Sunderaj	FELDA Palm Industries Sdn Bhd, Engineering/Special Projects/R&D, Head of Dept.	*	*
Mr. Zulfadhly Bin Zardi	TNB Research, Environment Unit, Researcher		*

2. Attendee from Japan

Name	Title	Attendance	
		1st	2nd
Dr. Yoshihito Shirai	Kyushu Institute of Technology, Graduate School of Life Science and Systems Engineering, Professor	*	*
Dr. Minato Wakisaka	Kyushu Institute of Technology, Graduate School of Life Science and Systems Engineering, Assistant	*	*
Mr. Kazuhiro Morinaga	Sumitomo Heavy Industries, Ltd., Engineering & Environment Group, Air Pollution Control Division, Sales Department, Deputy General Manager	*	*
Mr. Shinich Suzuki	EX Corporation, Environmental and Social Planning Department, General Manager	*	*
Mr. Takashi Nakamura	EX Corporation, Energy and Environmental Planning Division, Researcher	*	*
Mr. Noboru Watanabe	FELDA Palm Industries Sdn. Bhd., Senior Consultant	*	*
Ms. Mari Yoshitaka	Mitsubishi Securities Co., Ltd., Research Group, Clean Energy Finance Committee, Project Manager/Senior Analyst	*	*
Mr. Satoru Fujimagari	Tokyo Electric Power Services Co., Ltd., Malaysia Branch, Managing Director	*	
Mr. Satoru Suetake	Tokyo Electric Power Company, Thermal Power Department, Overseas Project Group, Engineer	*	
Mr. Shoji Nagai	Tokyo Electric Power Company, Thermal Power Department, Overseas Project Group, Manager (TNB region)		*
Mr. Kazunori Yamamoto	Matsushita Electric Industrial Co., Ltd., Environment Auditing Group, Assistant Councilor		*
Mr. Haruki Ogawa	Matsushita Electric Industrial Co., Ltd., Environment Auditing Group, Assistant Councilor		*
Mr. Katumi Tomita	Matsushita Electric Industrial Co., Ltd., Business Promotion Group, Senior Coordinator		*
Mr. Hiroshi Hirata	Matsushita Environmental &Air-conditioning Engineering, Member of the Board, Director		*
Mr. Hirofumi Sakaguchi	Matsushita Environmental &Air-conditioning Engineering, Overseas Sales, General Manager		*
Mr. Toshifumi Noguchi	Matsushita Electric Industrial Co., Ltd., Malaysian Regional Office, Environmental Engineering Division, General Manager		*
Mr. Kazuya Kitae	Matsushita Electric Industrial Co., Ltd., Malaysian Regional Office, Environmental Engineering Division, General Manager		*
Mr. Yakayoshi Kanda	Sankyu (Malaysia) SDN. BHD., Managing Director		*
Mr. Kunihiro Ueno	Global Environment Centre Foundation, Project Division, Research Department, Assistant Manager		*