

NATIONAL KEY ECONOMIC AREAS (NKEA)

NATIONAL BIOGAS IMPLEMENTATION (EPP5)

BIOGAS CAPTURE AND CDM PROJECT IMPLEMENTATION FOR PALM OIL MILLS



Updated: June 2011

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Disclaimer:

Information contained herein are given in good faith to assist the oil palm industry in considering and evaluating biogas projects. Readers are advised to check to confirm facts, figures and other information contained herein and seek independent professional advice. We welcome any feedback to constantly improve this booklet.

1.0 INTRODUCTION

1.1 Purpose

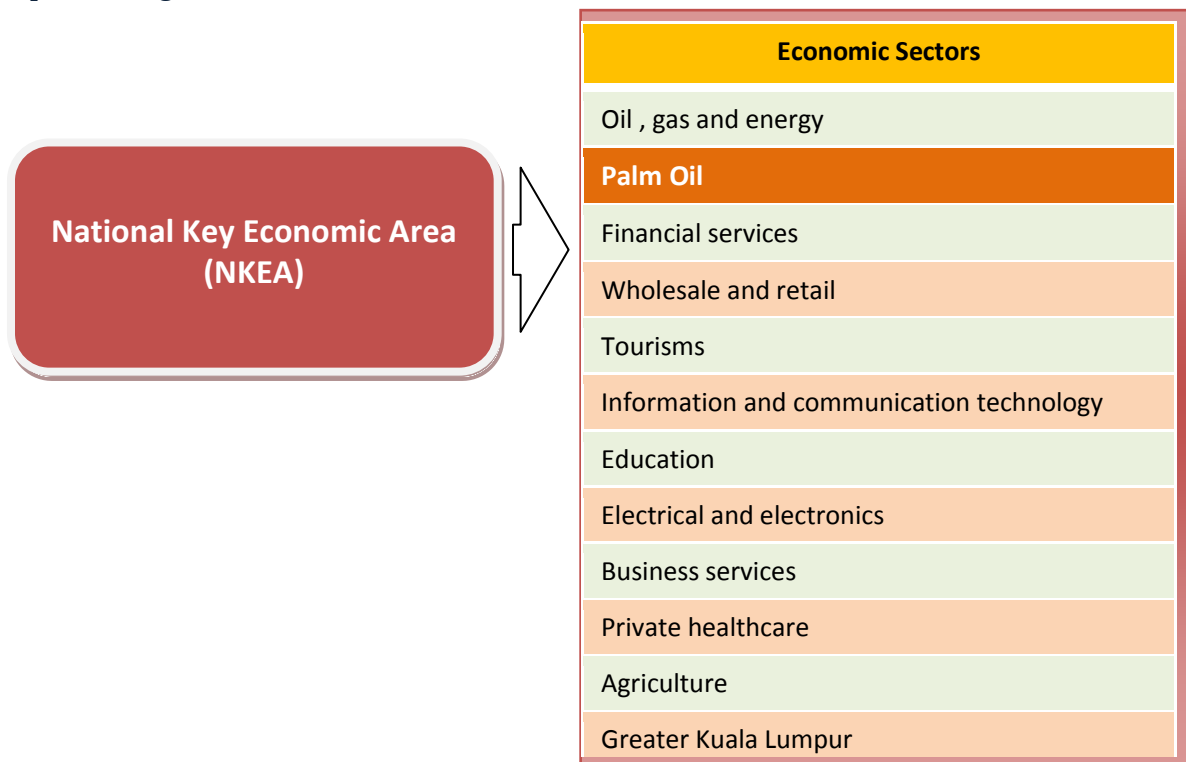
The purpose of this document is:

- To encourage palm oil mills in Malaysia to implement biogas trapping and utilisation
- To inform palm oil millers on the benefits of biogas trapping and provide the relevant information to facilitate planning and implementation.

The importance of biogas trapping is evident from its inclusion as one of the eight Entry Point Projects (EPPs) of the palm oil sector under the National Key Economic Areas (NKEA).

1.2 National Key Economic Areas (NKEA)

Malaysia is to focus on 12 NKEAs to boost the economy and achieve a high income status by 2020. These 12 NKEAs are the core of the Economic Transformation Programme (ETP) and will receive prioritised government support including funding, top talent and Prime Ministerial attention. In addition, policy reforms such as the removal of barriers to competition and market liberalisation will be carried out. There will be dedicated attention from the Prime Minister and fast-track mechanisms to resolve disputes or bottlenecks in implementing the NKEAs.



1.3 NKEA: Palm Oil

Malaysia's palm oil industry is one of the important industries of the nation and it is the fourth largest contributor to the national economy. It currently accounts for RM53 billion in Gross National Income (GNI). The Palm Oil NKEA is targeted to increase by RM125 billion to reach RM178 billion by 2020. As a major contributor to economic growth, the Palm Oil NKEA programme plans to implement eight core Entry Point Projects (EPPs) spanning the palm oil value chain. The palm oil core EPPs are as follows;

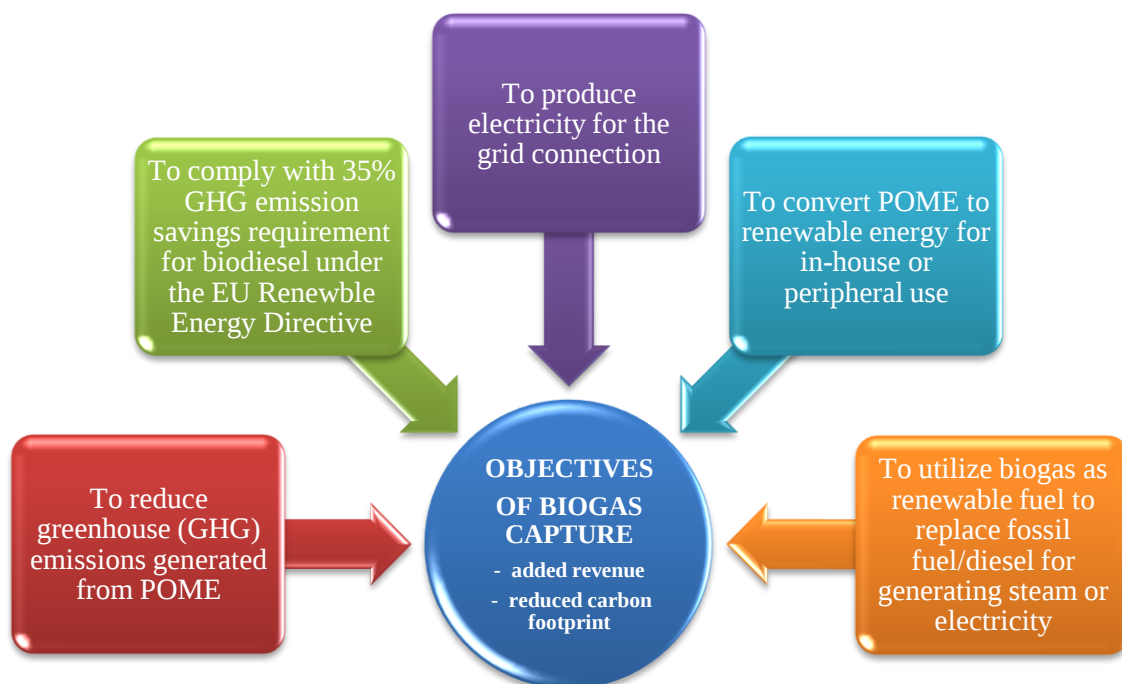
Palm Oil NKEA Programme		
Upstream productivity and sustainability	EPP 1	Accelerated replanting to clear backlog of old, low yielding palms
	EPP 2	Increase the national fresh fruit bunches (FFB) yield
	EPP 3	Improve workers' productivity through the introduction or scale up new techniques
	EPP 4	Increase national average oil extraction rate (OER)
	EPP 5	Build biogas facilities at mills across Malaysia
Downstream expansion and sustainability	EPP 6	Shift Malaysia's focus towards high value oleo derivatives
	EPP 7	Emphasise early commercialisation of second generation biofuels
	EPP 8	Expedite growth in food & health-based downstream segment

EPPs No.5 aims to achieve the installation of biogas facilities in all palm oil mills in Malaysia by 2020.

2.0 EPP 5: BUILD BIOGAS FACILITIES AT MILLS ACROSS MALAYSIA

2.1 Biogas as Potential Renewable Energy (RE): Why embark on biogas capture?

It is important for the palm oil industry to capture biogas from palm oil mill effluent (POME). The reasons and benefits of biogas capture are many. These include additional revenues from sale of surplus energy and carbon credits. Furthermore, reducing the carbon footprint through biogas capture enables competitive market access of palm products particularly palm biodiesel to environmentally-sensitive markets such as the European Union and the United States.



2.2 Benefits of Biogas Capture

- Reduces GHG emissions i.e methane and CO₂
- Reduces land use for POME treatment
- Generates additional revenue in the palm oil milling process

- Eligible for Clean Development Mechanism (CDM) application
- The CDM project transforms GHG emission reduction into cash through sale of carbon credits
- Reduces global and local environmental impact
- Encourages technology innovation and R&D

Reduces dependence on fossil fuel, and enhances fuel diversity and security of energy supply.

2.3 How to Capture Biogas?

Biogas capturing from POME has attract great attention across the palm oil industry due to the vast potential of methane recovery for use as a clean renewable fuel as well as for the mitigation of GHG emissions which is recognized by the CDM scheme under the Kyoto Protocol for certified emission reductions (CER) or carbon credits.

Biogas capturing from POME can be carried out using a number of various local or foreign technologies. The closed-tank anaerobic digester system with continuous stirred-tank reactor (CSTR), the methane fermentation system employing special microorganisms and the reversible flow anaerobic baffled reactor (RABR) system are among the technologies offered by the technology providers.



Ponding system for palm oil mill effluent (POME) treatment and covered lagoon technology

2.4 Comparison of Biogas Capture Technologies

Name of technology provider	System	Life term (years)	HRT (days)	Final discharge		Volume of biogas generated
				BOD (mg/L)	COD (mg/L)	
Keck Seng flow stirred tank reactor (CSTR)	Continuous	>20	18	250-500	8000-12,000	~0.35 Nm ³ per kg of COD
Majurutera stirred tank reactor (CSTR)	Complete	10	-	-	-	20 m ³ per tonne of POME
BEE	High efficiency methane fermentation system	20-25	9	50-270	1400-2500	>26-30 m ³ per m ³ of POME
SIRIM (pilot scale)	Reversible flow anaerobic baffled reactor (RABR)	>20	10-15	-	6000	0.23 Nm ³
UPM-FELDA-Kyushu Institute of Biogas Technology	Semi-commercial closed anaerobic digester	25	10	-	2000	20 m ³ of biogas / m ³ of POME
Ronser Bio-Tech and Shanghai-Jiaotong University on zero-discharge treatment technology	AnaEG (Combination of UASB and EGSB technologies)	>20	4	-	2000	> 0.5 Nm ³ per reduced COD volume (based on 90% COD removal rate)
Biotech Asian International Sdn Bhd	Covered lagoon biodigester		22	-	-	23m ³ /tonne POME

Several systems to generate biogas from POME have been developed using both local and foreign technology. The technologies are summarised as follows;

2.5 Total Potential of Biogas from POME

The estimated potential energy generated from biogas in Malaysia is 1.88 million MWhr of electricity which is equivalent to 261 MW of the potential power based on 21% efficiency in a steam plant (based on yield of FFB in 2009).

Material	Production Rate	Quantity
FFB (mil. tonnes)		85.71
Effluent	67% of EFB	57.42 million tonne = 57.42 million m ³
Biogas	28 m ³ m ⁻³	1607.76 million m ³
Biogas CV at 35°C Total heat value	20 MJ m ⁻³ 1607.76 x 20 million MJ = 32155.2 million MJ	32155.2 million MJ 8.93 million MWhr *1MWhr = 1 MJ/3600
Power Output	21% of heat output	8.93 million MWhr x 21% = 1.88 million MWhr
Power plant size	Plant operates 300 days year ⁻¹ = 7200 hr year ⁻¹	1 880 000 / 7200 = 261.11 MW

2.6 Utilization of Biogas

Biogas can be used for all applications in place of natural gas. Since most boilers do not require high quality gas specifications, the use of biogas in boilers is most encouraged and has been increasing rapidly. Stationary engines of pumps, generators and power tools are also a popular option for the utilization biogas. In vehicle fuel, upgrading of the biogas quality is necessary. Upgrading the biogas includes the reduction of H₂S concentration and CO₂. Connecting the electricity generated to the national electricity grid is another profitable way of utilizing the biogas, which is in tune with the target set in the Malaysian Fifth Fuel Policy of achieving 5% of national grid-connected electricity generation from renewable sources.

2.7 Technical Configurations of Biogas Utilization in Palm Oil Mills

There are various ways of utilizing POME biogas in palm oil mills. With the proper technical configuration and system, biogas generated from the POME can be directly converted into useful energy either for heat, electricity or both. The setting up of biogas plants in palm oil mills would be useful to mills that require additional power for other plants in the palm oil mill such as the EFB fibre plant or kernel crushing plant, as well as for grid-connection under the Small Renewable Energy Power (SREP) Programme

The biogas can be also upgraded and stored as a natural gas for utilization in vehicles used in the palm oil mills. Options of biogas utilization in palm oil mills are briefly described in the following section.

2.8 Option for Utilization

2.8.1 For Combined Heat and Power (CHP) for production of steam and electricity (direct thermal and electricity generation)

Palm biogas can be co-fired with oil palm biomass in the existing palm oil mill boiler. Steam produced from this co-firing process is used to generate electricity using the steam turbine and low pressure steam that leaves the turbine will be used for the milling process. The boiler will require some modifications especially the feeding part of the biogas into the boiler chamber. The use of biogas which is an efficient fuel with high CV will significantly reduce or eliminate the usage of palm shell. The use of mesocarp fibre may also be reduced. The excess palm biomass in particularly palm shell may be sold to other industries that require solid fuel for their CHP plant. An example of a CHP plant is the plant in Ulu Kanchong Palm Oil Mill.

ULU KANCHONG PALM OIL MILL BIOGAS PLANT FOR CO-FIRING IN BIOMASS BOILER

The biogas plant of Ulu Kanchong Palm Oil Mill (UKPOM) is a collaboration project between the owner Gan Teng Siew Realty Sdn Bhd (GSTR) and Biotec International Asia Sdn Bhd (807700-A)- (BIA) as a technology provider. Biotec International, the parent company of BIA was founded in 1984 in Belgium. The Ulu Kanchong biogas project is BIA's first biogas plant in South East Asia. Biotec is an established technological provider with activities in integrated organic matter management and environmental solutions for tropical agro-industrial effluent. The scope of business and R&D activities includes effluent treatment, biogas capture, energy use and consultation for Clean Development Mechanism based projects.

Biotec started construction of the biogas plant for UKPOM in 2009. The plant was built using covered lagoon technology (Figure 1) commissioned in February 2010 and started its commercial operation since June 2010. The plant consists of three main systems,- palm oil mill effluent (POME) cooling system; biodigester system which based on Biotec Covered Lagoon technology and biogas utilization system. The plant was designed to cater for POME produced from the processing of 350,000 tonnes fresh fruit bunches (FFB) or equivalent to 280,000 tonnes of POME/year. The general technical description of the plant is illustrated and summarized in Figure 2.



Figure 1: Covered lagoon biodigester installed at the mill

Technical Configuration and Performance of the System

Bio-digester system

A covered lagoon type of anaerobic biodigester was installed at the mill with the objectives to reduce the investment cost and ease the operation procedure. The lagoons are sealed at their bottom with a waterproof liner (geomembrane). The plant is also equipped with mixing and sludge purging systems to ensure that the POME is evenly distributed, mixed and discharged. The top geomembrane captures and stores the biogas generated during the anaerobic digestion of POME.

The system offers an efficient operation, a larger gas storage and less maintenance and operation costs. The COD removal of the system is approximately at 90% efficiency and treated effluent of the biogas plant is sent to the existing open lagoon system for further degradation and polishing, with the final discharge registering BOD of 40 to 80 ppm. Average biogas production from the system is 25 Nm³ (or 15 Nm³ of methane) for every tonne FFB processed. Five percent purged sludge from the anaerobic digester can be transferred and used as fertiliser after a sufficient retention time.

Biogas Utilization System – Co firing and Flaring

Biogas produced is channelled and co-fired with palm biomass in the boiler using three units of burners. This direct and low cost investment of biogas utilization reduces the use of oil palm biomass in particular palm shell. Shell displacement is about 2.9% of total FFB processed. Additional income is made via the selling of the palm shell and fibre.

In terms of environmental impact, the utilization of biogas has improved the boiler's smoke opacity to less than 20% consistently as compared to about 40%. In addition, more than 50% reduction of the dust and particulate concentration in the flue gas emitted from the boiler is achieved. A unit of stainless steel flare was also installed in order to combust excess biogas especially during the maintenance period of boiler and mill.

General Description of the UKPOM Biogas Plant

- A joint venture project between GTSR & BIA
- Designed capacity for 350,000 TFFB/year with methane production of 5.25 mil Nm³/ year
- Capacity of covered lagoon bio-digester : 32,000 m³
- Could cater flowrate of POME 1200 m³/day with min. 27 days of hydraulic retention time
- 90% of methane produced is combusted in the biomass boiler while 10% is flared
- 3 units of burner with capacity 1000 Nm³/hr installed at the boiler
- Max. flow rate of biogas to boiler is 1.800 Nm³/hr
- Max. flow rate of biogas to flare is 1.800 Nm³/hr
- Average biogas yield : 25 Nm³/tonne FFB

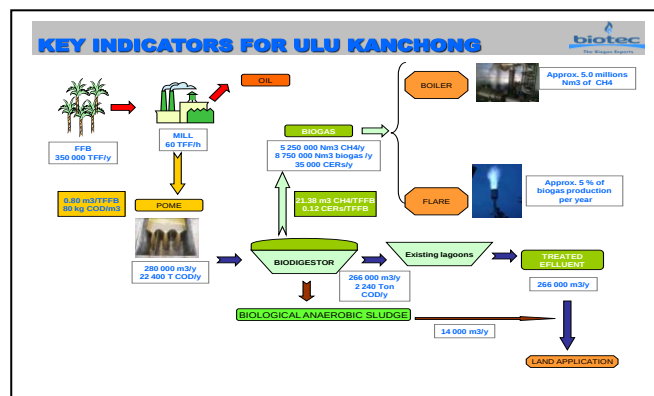


Figure 2 : Process flow diagram of biogas plant



Figure 3: 3 x 100 m³/hr biogas burner and flaring unit installed at the mill

Table 1: Economic Analysis of UKPOM Biogas Plant
(based at 250,000 t FFB/ year)

Item	Cost
Investment cost (include biogas plant and boiler adaptation)	RM7,000,000
O& M Cost (include CDM monitoring and verification)	RM475,000/year
Revenues (based on the selling of Shell @ RM130/t, fibre @ RM30/and CER @ Euro 10/ton)	RM2,100,000/year
Payback Period	4.3 years
Internal Rate of Return, IRR % (with CDM)	23

2.8.2 Steam generation only (thermal energy generation)

Production of steam using biogas as fuel can be carried out either by firing the biogas (with or without other fuels) using either high or low pressure boiler. One of efficient ways to produce heat or steam from biogas is by using a package boiler. As the package boiler is designed to use natural gas and fuel oil, the utilization of biogas in a package boiler is considered as a direct and simplest method to produce energy from biogas without major modifications required. Biogas can also be co-fired with natural gas and fuel oil and as such would reduce the consumption of these much more expensive fuels. The existing boiler at palm oil mills may also be used to generate steam with co-firing approach but again some modifications are required. An example of the use of biogas in package boilers is Keck Seng (M) Sdn. Bhd.

BIOGAS PLANT OF KECK SENG'S INTEGRATED PALM OIL COMPLEX FOR STEAM PRODUCTION & UTILIZATION

Keck Seng (Malaysia) Berhad, (KS) operates an integrated palm oil mill complex located in Masai, Johor. The complex consists of a palm oil mill, kernel crushing plant, palm oil refinery and other plants for downstream activities (**Figure 1**). Due to highly energy demand mainly from refinery processing and a vision to maximize the use of in-house renewable energy sources, KS has installed and operates a biogas plant to cater for the energy requirement of the whole complex.

An anaerobic digester system was designed, built and commissioned in 1984 for the treatment of high-strength palm oil mill effluent (POME). To date, the total tank capacity of the biogas plant is 10,400 m³ consisting of 2 floating and 2 fixed roof tanks (**Figure 2 and 3**). The flowrate of each plant is 500 m³/day. The biogas generated is used as fuel for boilers and chillers for the refinery. After years of successful operation, KS licensed its unique anaerobic digester system for biogas generation and capture to Novaviro Technology Sdn Bhd, to commercialise the system.

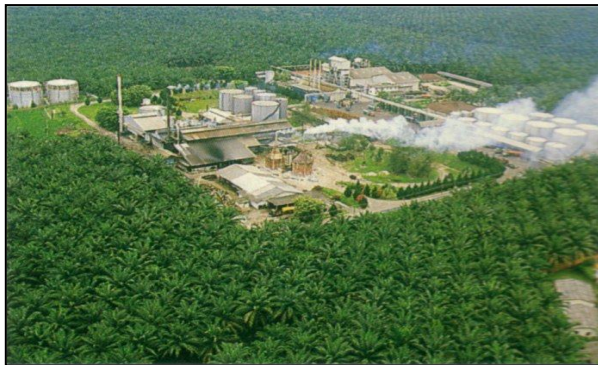


Figure 1 : Keck Seng (M) Bhd – integrated palm oil complex



Figure 2 : Floating top closed anaerobic digester at KS

Technical Configuration & Economic Analysis of Biogas Utilization

- Average yield of biogas generated from the system is 28 m³/tonne POME
- Biogas generated is used as fuel for boilers and vapour absorption chillers of the refinery.
- Diesel displacement of high pressure boiler (**Figure 4**) about 4000 l/day and MFO saving for package steam boiler (**Figure 5**) of 2500 l/day.
- Displacement of electrically powered chillers by biogas –operated vapour absorption chillers. Significant saving in electricity consumption from 700 kW to 23.5kW only.
- Saving made from diesel and MFO.
- Saving made from the displacement of electrical powered chillers (annual consumption of 3,850,000Wh / year)
- GHG saving

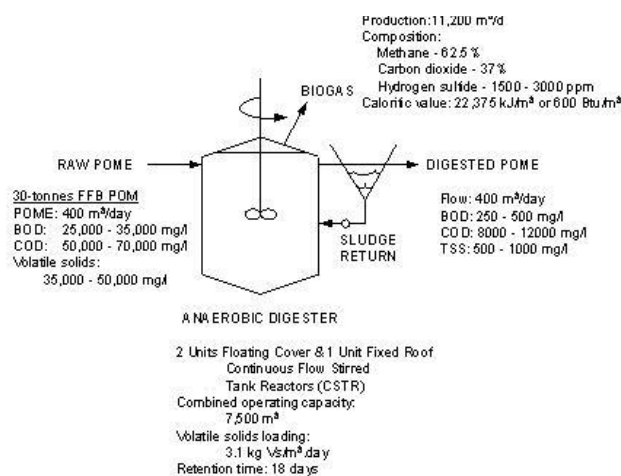


Figure 3 : Design specification of anaerobic digestion of Keck Seng



Figure 5 : Mechmar boiler –steaming capacity 20 000 lb/hr at 150psi

2.8.3 Electricity generation

An internal combustion engine such as a gas engine or a diesel engine can be coupled to an alternator to use biogas for electricity generation. Generating electricity using a gas engine is proven with thermal efficiency ranging from 35 to 42%. The electricity energy may be for internal uses or grid connection. The biogas can also be used in a diesel genset and this may reduce the diesel consumption up to 70%. However, this approach requires some engine modification including to the feeding parts, air intake device and fuel setting. An example of power generation for internal use is the Tee Teh Palm Oil Mill, Rompin, Pahang.

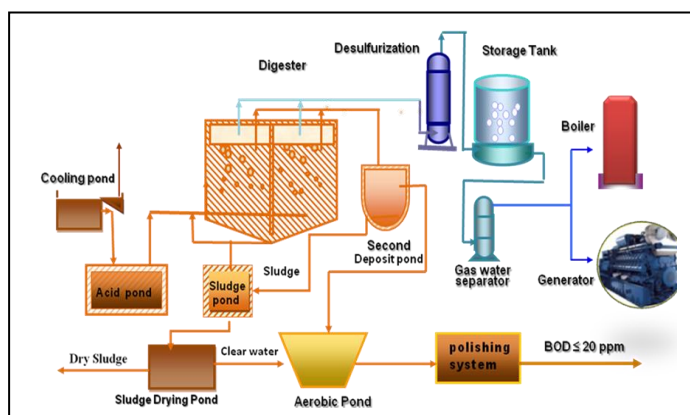
Biogas Environmental Engineering Sdn. Bhd. (BEE) High Efficient Methane Fermentation System for Electricity Generation

Biogas Environmental Engineering Sdn Bhd (BEE) is a company engaged and specialized in research, engineering design, construction and management of methane renewable energy development and environmental protection. The company core business is utilization of anaerobic digestion technology to process industrial organic waste water from food and beverage industries, concentrated animal farm operations and palm oil mills.

A biogas harnessing system developed in collaboration between Biogas Environmental Engineering Sdn. Bhd. (BEE) and Malaysian Palm Oil Board (MPOB) has been installed, and is currently in operation at Tee Teh Palm Oil Mill, Rompin, Pahang (Figure 1). The biogas harnessing system is a highly efficient methane fermentation system using the USR employing specialty microorganisms. The biogas system consists of a cooling pond, two acidification ponds, a concrete-steel digester tank or an enameled assembly tank, a biogas floating storage tank and a discharging pond (Scheme 1). Evaluation/monitoring of the biogas system performance over a year with sampling of 42 sets of wastewater showed that the system is technically mature, and is highly efficient, with a COD/BOD removal rate of 90-95% and a biogas production rate of 27-30 m³ per m³ of POME (Table 1).



Figure 1. Biogas storage tank and high efficient methane fermentation system



Scheme 1. Biogas system for POME

Technical Characteristics

- 1) Life span of materials used i.e. steel concrete or enamel tank is more than 30 years;
- 2) High loading factor 6-8 kg COD/m³d, thus implies:
 - a. Shorter HRT compared to other systems (CSTR system, COD loading factor 3-4 kg COD/m³d);
 - b. Smaller volume of digester tank is required to treat POME, and hence a lower construction cost.
- 3) COD, BOD reduction rate of 90%-95% (assessment by MPOB)
- 4) The quality of biogas produced is good:
 - ❖ H₂S content: 217 - 1418 ppm - Other systems has higher H₂S
 - ❖ CH₄ content > 60%
 - ❖ Water content is low
- 5) The system, with less moving parts, is easier to operate at a stable level; reinforced concrete steel or enamel sheet are better erosion-resisting materials, thus very much lower the maintenance cost.

Table 1. Performance characteristic of the biogas system

Parameter	Performance characteristics
Raw effluent	
COD (ppm)	44 000 - 83 000
BOD (ppm)	14 000 - 34 000
Final discharge	
COD (ppm)	1400 - 2500
BOD (ppm)	50 - 270
Composition of biogas	
Methane (%)	56 - 64
Carbon dioxide (%)	35 - 41
Hydrogen sulphide (ppm)	217 - 1418
Volume of biogas (m ³ m ⁻³ POME)	26.6 - 30.0

Biogas Utilization-Electricity Generation

The biogas captured is led through the biogas piping system from the top of the anaerobic digester tank to the biogas storage tank. The gas is first run through the splitter of gas and water to remove the condensate water, and then directed to the gas engine for electricity generation after desulfurization. The combustion chamber of the gas generator installed at Tee Teh Palm Oil Mill (Figure 2) showed evidence of having been in operation for > 10000 h without any damage. The gas generator is in 24 h operation and the electricity generated is supplied to the workers' quarters of the mill.



Figure 2. Condition of the combustion chamber of a gas generator using biogas for > 10000 h

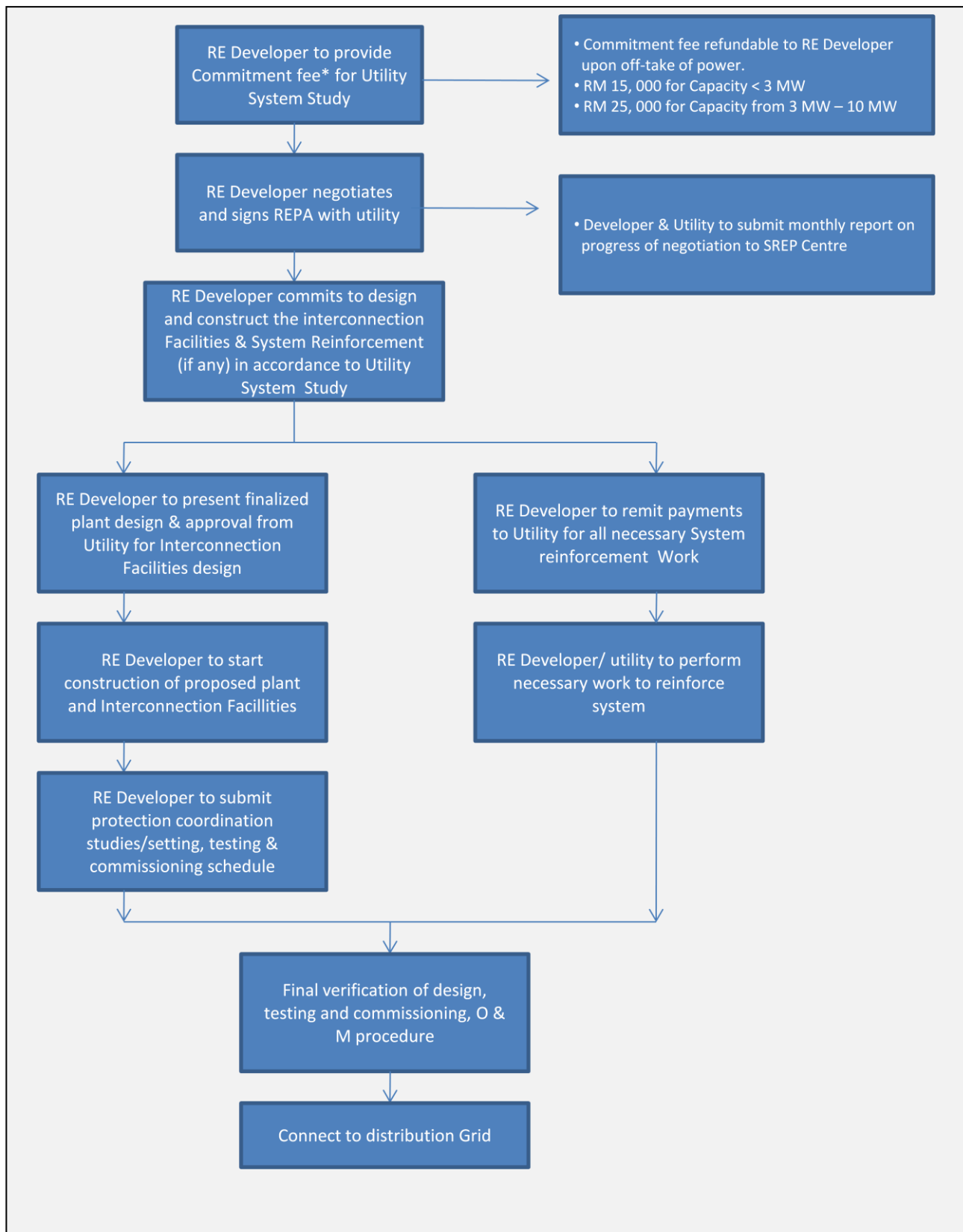
Economic Analysis

The investment cost for the installation of the biogas trapping facility is estimated to be RM 4-6 million, depending on the capacity of the palm oil mill. A payback period of 2-4 years can be achieved with revenues from on-grid electricity generation amounting to 1-1.5 MW, sale of saved palm fibre, biofertilizer production, and savings from reduced diesel consumption.

Economic Analysis of Biogas and Energy Production from a Typical 60 tonne FFB / hour Palm Oil Mill (based on electricity sales)

Material	Production Rate / Conversion factor	Quantity
FFB		60 t/hr or 432, 000 t/yr
Effluent	@ 65% of FFB processed	39 t/hr or 39 m ³ /hr
Biogas	@ 28 m ³ / m ³ POME	1092 m ³ /hr
Potential energy from biogas	@ 20000 kJ/m ³	21840000 kJ/hr or 6067 kJ/s or kW
Power Output / size of power plant	@ 30% of thermal efficiency	1.8 MW
Potential electricity to the grid	@ 80% utilization factor x 7200 hrs/year (300 days x 24 hrs)	10,368,000 kWhr /yr
Potential electricity sales	@ RM 0.21/kWh	RM 2.18 million /yr or RM 45.72 million for 21 yrs.
Total CAPEX	@ RM 9 million / MW	RM 16.2 million
Total OPEX/ year	@ 4% / year of CAPEX	RM 648,000 / year
Net profit per year	(Annual electricity sales – OPEX)	RM 1.532 million per year
Payback period	RM 16.2 / 1.532	10.6 yrs
Internal rate of Return (IRR)	-	9%

Flow Chart for Applying Connection to Utility's Distribution System



2.8.4 Other potential applications

Biogas generated from POME can also be upgraded and used for other potential applications especially for external usages include the following:

- Use as a compressed natural gas (CNG) which can be an alternative for natural gas vehicles (NGV). This CNG can be used as alternative fuel for vehicles used in palm oil mills such as forklift, lorry etc
- Feeding into natural gas (NG) pipeline or bottling and transporting for industrial use.
- For other operational units that require energy such as vapour absorption chiller, hot water and hot air production; biodiesel plant, EFB fibre plant and kernel crushing plant
- For future 2nd generation biofuel projects such as production of hydrogen, biomethane etc

2.9 Incentives for Renewable Energy (RE)

Commercial and industrial business entities which are involved in the energy business using renewable energy (RE) resources for generation of electric power eligible to apply for fiscal incentives.

Pioneer Status (PS)

- The PS provides exemption from income tax (25% from 2009 onwards) on 100% of statutory income for 10 years.
- Accumulated losses and unabsorbed capital allowances incurred during the pioneer period can be carried forward and deducted against post pioneer income of the company.

Investment Tax Allowance (ITA)

- Under ITA, 100% of qualifying capital expenditure incurred within 5 years can be utilized against 100% of the statutory income for each year of assessment.
- Unutilised allowances can be carried forward to subsequent years until fully utilised.

Eligible Activities for PS and ITA

- Companies intending to sell all the energy generated to its related companies or any other companies are eligible for;
 - (1) PS with tax exemption of 100% of statutory income for 10 years
 - (2) ITA of 100% for 5 years to be offset against 100% of the statutory income
- Companies intending to generate RE for own consumption are eligible for;
 - (1) ITA of 100% for 5 years to be offset against 100% of the statutory income
- Companies intending to sell all the energy generated to its related companies or any other companies and for its own used are eligible for;
 - (1) PS with tax exemption of 100% of statutory income for 10 years for energy sold
 - (2) ITA of 100% for 5 years to be offset against 100% of the statutory income for the whole project

Import Duty and Sales Tax Exemption

- Companies generating RE can also apply for import duty and sales tax exemption on imported machinery, equipment, materials, spare parts and consumables used directly in the generation process and that are not produced locally.
- Exemption of tax on revenue from sale of CERs

2.10 Technology Providers for Biogas Implementation

Company	Address	Contact Number
Biogas Environmental Engineering Sdn. Bhd.	28-3, Jalan 1/116B Sri Desa Entrepreneurs Park, Off Kuchai Lama, 58200 Kuala Lumpur, Malaysia.	Tel.: +603-7984 2422 Fax: +603-7984 2896
Ronser Bio-Tech Sdn. Bhd.	C708, Metropolitan Square, Jalan PJU 8/1, Bandar Damansara Perdana, 47820 Petaling Jaya, Selangor, Malaysia.	Tel.: +603-7728 8999 Fax: +603-7725 3300
Sirim Bhd. (Environment and Bioprocess Technology Centre)	1, Persiaran Dato' Menteri Section 2, P.O. Box 7035, 40911 Shah Alam, Selangor, Malaysia.	Tel.: +603-5544 6552 +603-5544 6556 Fax: +603-5544 6590
Custom-Craft Sdn. Bhd.	No.5, Jln Kipas 34/9 Bukit Kemuning, Light Ind. Park, Seksyen 34, 40000 Shah Alam, Selangor, Malaysia.	Tel.: +603-5880 7611 Fax: +603-5880 7616
Eco-Ideal Consulting Sdn. Bhd.	Suite C-7-2, Wisma Goshen, Plaza Pantai, Jln 4/83A Off Jln Pantai Baharu, 59200 Kuala Lumpur, Malaysia.	Tel.: +603-22848102 Fax: +603-22848102
Biogas International Sdn. Bhd.	24-2, Medan Setia 2, Plaza Damansara, Bukit Damansara, 50490 Kuala Lumpur, Malaysia.	Tel.: +603-20925626 Fax: +603-20931241
Varec Biogas	29-A, Jalan Kenari 17E, Bandar Puchong Jaya, Puchong, 47100 Selangor, Malaysia.	Tel.: +603-8076 5778 Fax: +603-8076 5773
Enviro-LIFT Services Sdn. Bhd.	6B, Jalan Astaka L U8/L Bukit Jelutong Business and Technology Centre, 40150 Shah Alam, Selangor, Malaysia.	Tel: +603-78463682 Fax: +603-78463615
Elco Management Consultants Sdn. Bhd.	No 11-3 B Jalan PJU 1/3C, Sunwaymas Commercial Centre, 47301 Petaling Jaya, Selangor, Malaysia.	Tel.: +607-352 9002 Fax: +607-352 8002
Q2 Engineering Sdn. Bhd.	Unit 8-01, Block E, Phileo Damansara 1 No. 9, Jalan 16/11, Off Jalan Damansara, 46350 Petaling Jaya, Selangor, Malaysia.	Tel.: +603-7665 3788 Fax: +603-7665 3799
CST Engineering Sdn. Bhd.	8, Jalan Pendidik U/31, Hicom Glenmarie Industrial Park, 40000 Shah Alam, Selangor, Malaysia.	Tel.: +603-5569 5514 Fax: +603-5569 5529
Kim Loong Resources Berhad	Unit No. 203, 2nd Floor, Block C, Damansara Intan, No. 1, Jalan SS 20/27, 47400 Petaling Jaya, Selangor, Malaysia.	Tel.: +603-7118 2688 Fax: +603-7118 2693

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Green & Smart Sdn. Bhd.	No. 40-2, Jalan Tun Sambanthan 3, Brickfields, 50470 Kuala Lumpur, Malaysia.	Tel.: +603-2260 1477 Fax: +603-2260 1478
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Rhodia Sdn. Bhd.	Level 3, Block B Peremba Square Saujana Resort, Seksyen U2, 40150 Shah Alam Biopower Climate Care Sdn Bhd Level 41, Vista Tower, The Intermark 182 Jalan Tun Razak 50400 Kuala Lumpur	Tel.: +603-2690 1506 Fax: +603-2690 1301

3.0 CLEAN DEVELOPMENT MECHANISM (CDM)

The Clean Development Mechanism (CDM) is a scheme under the Kyoto Protocol, United Nations Framework Convention on Climate Change (UNFCCC) which helps developing countries achieve sustainable development through the sale of certified emission reductions (CER), or carbon credits, to developed and industrialized countries. The CDM scheme was introduced by Kyoto Protocol;

- To stream fund and technology to developing countries so they can meet sustainable development targets,
- To encourage the developed country to invest in carbon emission reduction projects that meet the Protocol's target

3.1 Benefits of CDM project in Malaysia

For Malaysia, the CDM is facilitated by Conservation and Environmental Management Division (CEMD) of the Ministry of Natural Resources and Environment (NRE) as Designated National Authority (DNA). Malaysia's DNA and CEMD serve as a secretariat for evaluation of CDM projects via the establishment of a National Committee on CDM (NCCDM) and two Technical Committees i.e The Technical Committee on Energy and The Technical Committee on Forestry. The CDM project activities bring the following benefits;

- Helps developed countries meet their emission reduction targets under the Kyoto Protocol
- Helps the palm oil industry meet increasingly stringent sustainability requirements.
- The CDM project transforms reduction of emission of CO₂ and methane into cash flow
- The CDM approval mechanisms are able to create new commodity in the form of CERs

3.2 Estimated CER from Biogas CDM Projects

Reduction of 1 tonne of CO₂ equivalent generates 1 tonne CER.

Estimated CERs generated for a 60 t/hr mill = 30,000 – 40,000 tonnes CO₂ eq

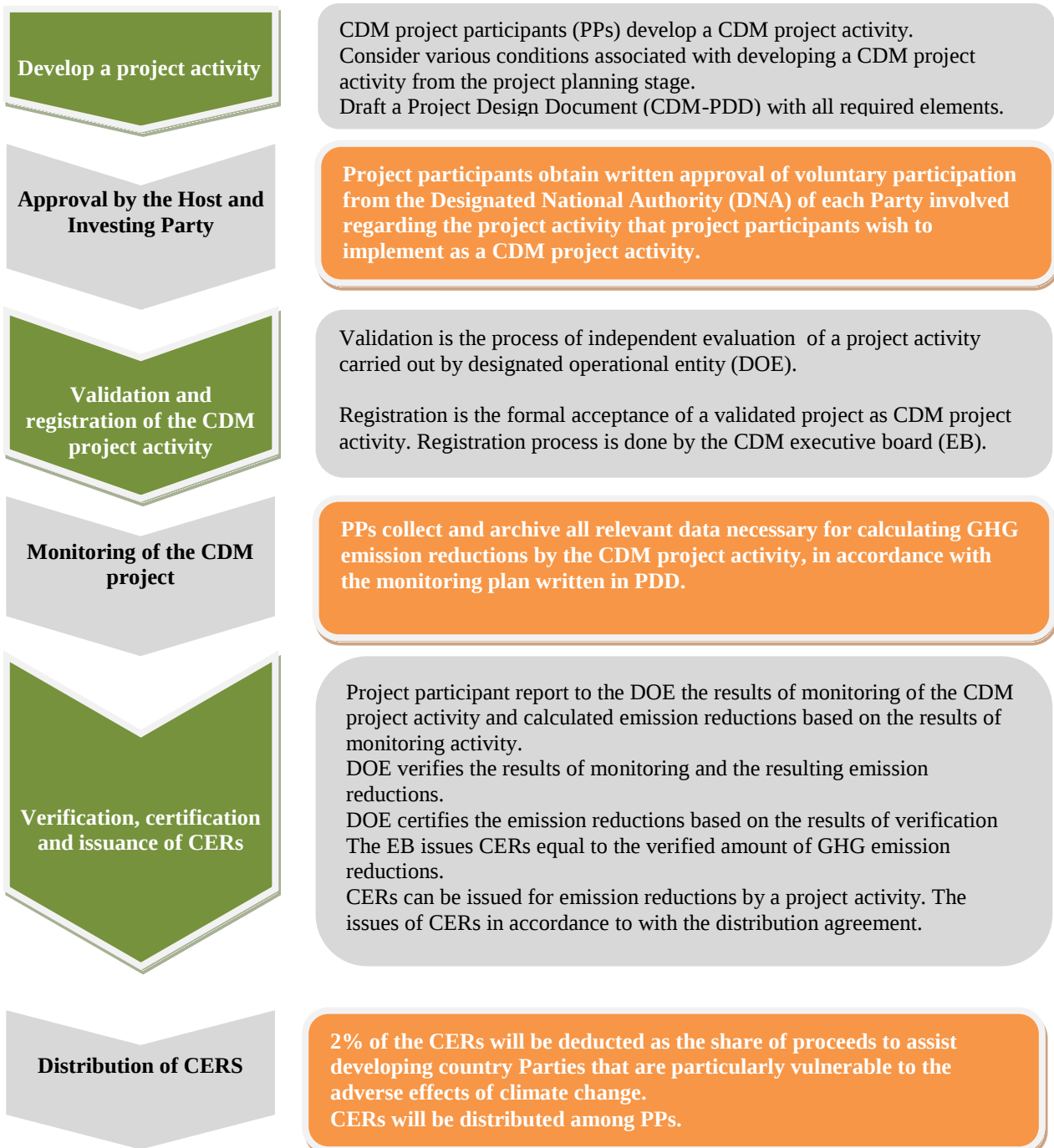
Estimated revenue generated for each mill = RM1.5 million per year
(based on €10/tCO₂e) (for 21 years)

Mills are advised to consult an established and reliable CDM consultant to assist in CDM applications.

3.3 National project CDM criteria

Criterion 1	Project must support the sustainable development policies of Malaysia and bring direct benefits towards achieving sustainable development
Criterion 2	Project implementation must involve participation of Annex I party/Parties as CER buyer. In addition they are encouraged to participate as equity or technology provider
Criterion 3	Project must provide technology transfer benefits and/or improvement of technology, including enhancement of local technology
Criterion 4	Project must fulfil all conditions underlined by the CDM Executive Board as follow:- i. Voluntary participant ii. Real, measurable and long-term benefits related to mitigation of climate change; and iii. Reductions in emissions that are additional to any that would occur in the absence of the certified project activity
Criterion 5	Project proponent should justify the ability to implement the proposed CDM project activity

CDM PROJECT CYCLE



3.4 List of CDM Consultants in Malaysia

No.	CDM CONSULTANT	COMPANY	CONTACT
1	Mr. Ilango S. Bharathi.	YTL SV Carbon Sdn. Bhd. Level 4 Annex Block Lot 10 Shopping Centre 50, Jalan Sultan Ismail 50250 Kuala Lumpur, Malaysia.	Tel.: +603-2144 7200 Fax: +603-2144 7573 Mobile: +6017-202 6456 ilango@ytl.com.my
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