United Nations Framework Convention on Climate Change
Side Event
1 December 2010 Cancun, Mexico

Climate Change Strategies for Mitigation of GHG Emissions in the Oil Palm Industry

Tan Sri Bernard Dompok
Minister of Plantation Industries and Commodities
Malaysia

1

Outline of Presentation

- Malaysia's commitment to reduce GHG
- 5 principles and 10 strategies of the National Climate Change Policy 2010
  - Malaysian Oil Palm Industry
- Climate Change Mitigation Strategies
  - Upstream (nursery, plantations)
  - Midstream/Downstream (palm oil mills etc)
- GHG values from LCA studies
- Conclusion

Malaysia's Commitment to Climate Change Mitigation

Malaysia's Commitment to GHG reduction was announced by Our Prime Minister at COP 15

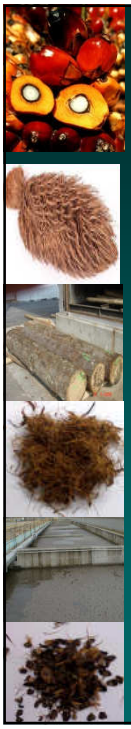
(*Source: http://www.demotix.com/photo/207416/malaysian-prime-minister-Cop15207416)*

4

Extract from Speech by Prime Minister of Malaysia at COP 15 on December 17 2009

- *"…. I would like to announce here in Copenhagen that Malaysia is adopting an indicator of a voluntary reduction of up to 40% in terms of emission intensity of GDP by the year 2020 compared to 2005 levels….*

  …..This indicator is conditional on receiving the transfer of technology and finance of adequate and effective levels from the Annex I partners, that correspond to what is required in order to achieve this indicator; and shall not take carbon tariffs and border adjustment measures against products, services and investment …",



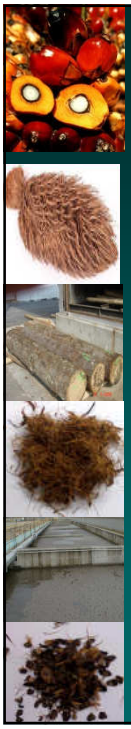
MALAYSIA NATIONAL CLIMATE CHANGE POLICY 2010

Strategic Thrusts of the National Policy on Climate Change (2010) to achieve target

No	Principles	No	Strategies
1	Sustainable development	1	Harmonize adaptation and mitigation
		2	Institute low-carbon economy
		3	Support climate-resilient investment
2	Conserve environment & natural resources	4	Balance adaptation and mitigation
		5	Consolidate energy policy with RE & EE
3	Coordinate implementation	6	Integrate cross-cutting issues in policies
		7	Support knowledge-based R&D decisions
4	Effective participation	8	Stakeholder collaborate & coordination
		9	Increase community awareness
5	Common & differentiated role	10	Strengthen international involvement

(Source: National Policy on Climate Change, 2010)

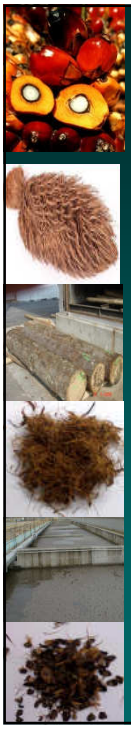
7



Malaysian Oil Palm Industry

Malaysian Oil Palm Industry Statistics 2009

- World's 2nd largest producer and exporter of palm oil
- Produced 17.56 million tonnes crude palm oil
- Exported 22.4 million tonnes palm oil and its products worth RM49.6 billion
- Total oil palm planted area 4.69 million ha
- 80-90% palm oil used in food applications
- 10-20% palm oil used in non-food applications



Climate Change Mitigation Strategies of The Oil Palm Industry

Climate Change Mitigation Strategies

Upstream

- Increasing fresh fruit bunch yield
- Implementing good agricultural practices (CoPs)
- Non-encroachment into forest reserves

Downstream

- Increasing oil extraction rate (OER)
- Renewable Energy and energy efficiency
- Biogas trapping and utilisation
- Methane avoidance

Increasing Fresh Fruit Bunch (FFB) Yield

- **National Key Economic Areas (NKEA) - palm oil sector: to increase current GNI of RM53 billion to RM178 billion by 2020**
- **Target under the NKEA - palm oil sector: to increase FFB yield from 19.2 tonnes/ha/yr to 26 tonnes/ha/yr by 2020.**
- **To be achieved by systematic replanting with high yielding planting materials.**
- **Increasing yield will reduce the need to open up new areas whether in Malaysia or elsewhere, hence avoiding GHG emissions from land use change.**

IMPLEMENTING NEW TECHNOLOGY AND GOOD AGRICULTURAL PRACTICES (GAP) FOR OIL PALM

Technology and Good Agricultural Practices (GAP) to reduce GHG emissions

- Reduction (optimization) of fertilizer inputs.
- Accumulation of soil carbon in replanting.
- Recycling of oil palm biomass.
- Implementing zero burning.
- Planting of leguminous cover crops.
- Integrated Pest Management

EXAMPLES OF TECHNOLOGIES RECOMMENDED FOR REDUCTION OF FERTILIZER INPUTS

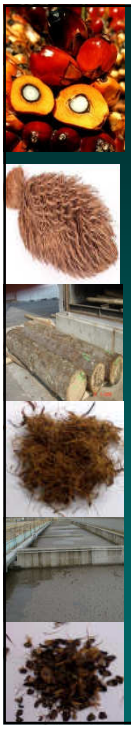
1) *Innovative Replanting Technique for Oil Palm*
   - Developed by MPOB, the young palms are planted directly into residue rows
   - Improve accessibility and efficiency of nutrient utilization
   - Reduce 50% of fertilizer inputs up to 5 years after replanting

2) *Oil Palm Efficient Nutrient System (OPENS)*
   - Assist in determining the right amount and type of fertilizer requirement

3) *Precision Agriculture – Variable Rate Technology (VRT)*
   - Uses precise information of location and agronomic conditions of the field to increase production by accurate and efficient use of fertilizer inputs.
   - Reduce fertilizer inputs 10-15%

4) *Use of empty fruit bunches (EFB)Mulching for Oil Palm*
   - Application at 60 t/ha able to obtain similar yield as estate fertilizer rate.

5) *Use of POME in Oil Palm Plantation*
   - POME used as inorganic fertilizer replacement reduces the production cost.



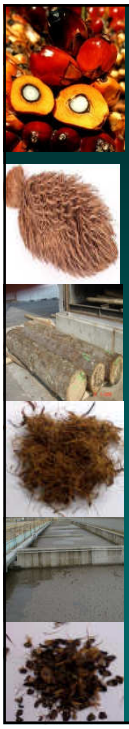
ACCUMULATION OF SOIL CARBON THROUGH MINIMAL TILLAGE IN REPLANTING

Comparison of C stock between forest and oil palm

Comparison of Soil N, C & C/N ratios with minimum tillage

Generation	Parameters	Weeded circle	Avenue	Frond pile	Intact forest
1st 30 year old	Total C (%)	1.44	0.81	2.15	1.36
	Total N (%)	0.13	0.08	0.19	0.11
	C:N	11.08	10.88	11.32	12.36
2nd 8 Year old Sri Gading	Total C (%)	1.81	1.67	2.08	1.49
	Total N(%)	0.14	0.14	0.17	0.16
	C:N	12.99	11.93	12.24	9.31
2nd 8 Year old Kluang	Total C (%)	1.89	1.63	1.88	1.49
	Total N (%)	0.14	0.14	0.14	0.16
	C:N	11.82	11.64	13.43	9.31
3rd 27 Year old Layang Layang	Total C (%)	2.40	1.93	2.35	1.30
	Total N (%)	0.21	0.18	0.21	0.12
	C:N	11.43	10.72	11.19	10.83

(Source: Chan 2009, Khalid 2009, Chan and Haniff 2010)



RECYCLING OF OIL PALM BIOMASS

Recycling of Biomass with Zero Burning

- Reduced need for mineral fertilizers and therefore reduces GHG emissions from production and use of fertilizers.
- Avoids GHG emissions from burning of tree residues during replanting.

Biomass from The Field

- **Regular pruning of Fronds**
- **On replanting : Trunks and Fronds**

Pruned fronds stacking -mulching

EFB Mulching

Normal application : 30 – 60t /ha
Reduce production cost

Benefits of Mulching
- improve soil structure
  - aeration, water holding capacity
- improve soil pH
- improve nutrient status
- Cation Exchange Capacity (CEC)
- root growth and development
- increase microbial activities
- reduce leaching
- improve oil palm growth

Guidelines for the Implementation of The ASEAN Policy on Zero Burning (2003)

The Zero Burning Technique for Replanting Oil Palm to Oil Palm (felling and shredding/chipping)

Alternative Approach # 1 – Zero Burning by Pulverization

Alternative # 2 – Windrowing without Shredding of Palms

Alternative Approach # 3 – Planting of Young Palms on Residue Piles
(Introduced by MPOB – TOT Seminar 2001)

Zero burning - Innovative technique of replanting
Young palms planted onto residue rows
Improved accessibility and efficiency of nutrient

Benefits:-

- **Sustainable practice**
- **Environment – free from smoke pollution and trans- boundary haze**
- **Nutrient recycling – conserving soil fertility**
- **Reduce chemical fertilizer inputs**
- **Maintaining biodiversity of soil fauna and microbial communities**
- **Moisture conservation**
- **Improved soil quality**

Innovative replanting technique – Young palms planted into residue rows
Improved accessibility & efficiency of nutrient
Able to reduce 50% of fertilizer input

FERTILIZER EQUIVALENT OF OIL PALM BIOMASS AT REPLANTING

(TONNES / HA.)

A/S	CIRP	MOP	KIES.
3.06	0.37	2.77	1.0

Theoretically can supply N,K, Mg for 5-6 years and P for 2 years

PRODUCTION OF COMPOST FROM EFB AND EFFLUENT – ASIA GREEN




Planting of leguminous cover crops

Typically established within OP plantations as natural cover crops

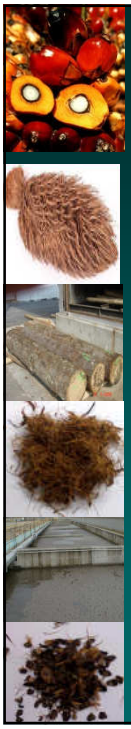
Benefits:-

- **Prevent erosion**
- **Enhance soil fertility**
- **Water / moisture conservation**
- **Provides nitrogen – N fixation**
- **Improve soil quality**

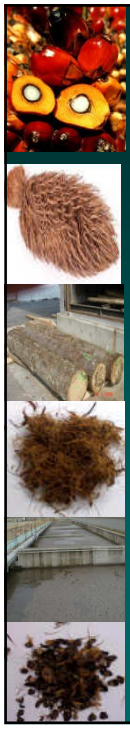
Legumes covering the terraces to prevent erosion

Integrated Pest Management

- Management of pests, diseases, weeds and introduced species
- An effective integrated pest Management systems exists
- Use of natural predators, beneficial plants
- Use of natural biopesticides like Metarhizzium, Bt etc to reduce pesticides
- Use of agrochemical is minimal hence reducing GHG emissions from their production and application.



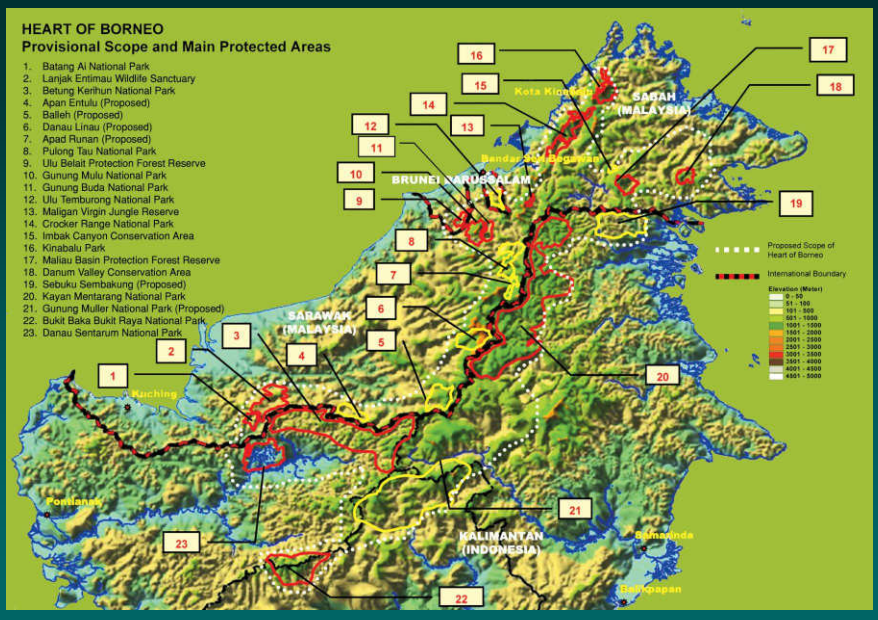
CONSERVATION OF HIGH CARBON STOCK FOREST AND BIODIVERSITY

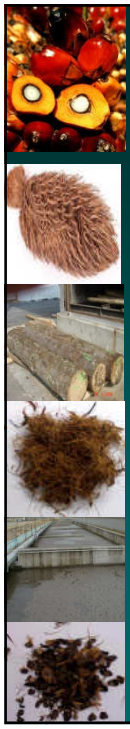


Forested Areas

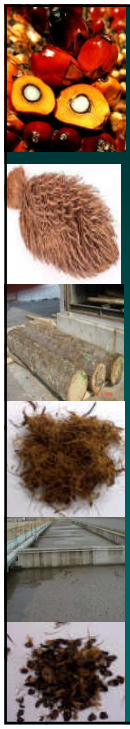
- Pledge by Malaysia in UN Rio Earth Summit 1992.
  - At least 50% of total land area will be forest.
- Current forest Area – 56%

HEART OF BORNEO – MAIN PROTECTED AREAS



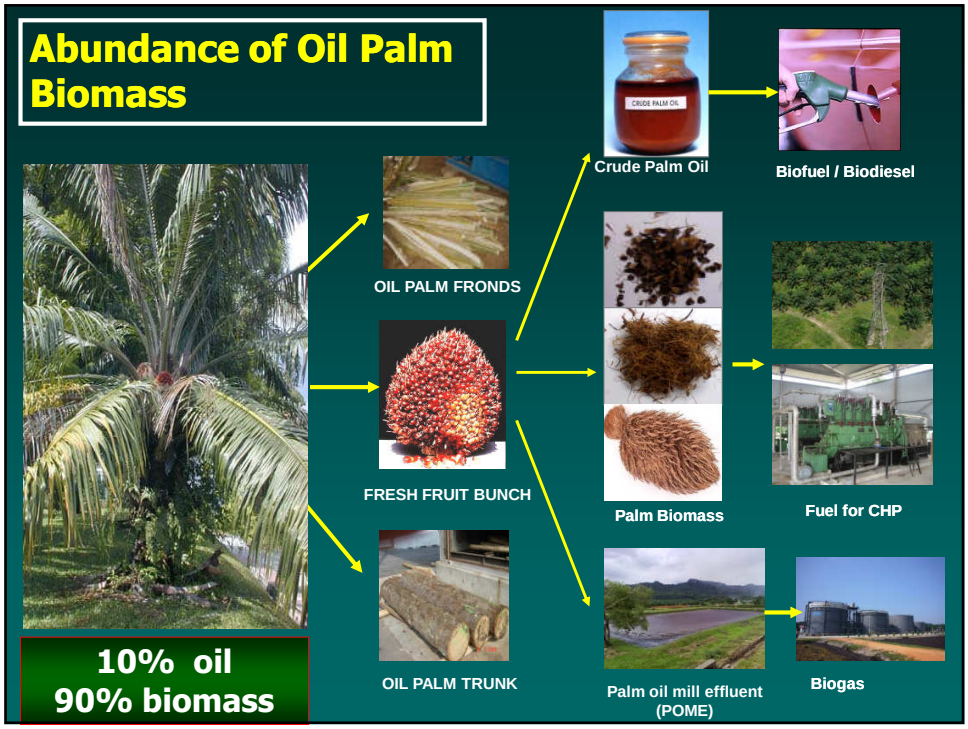


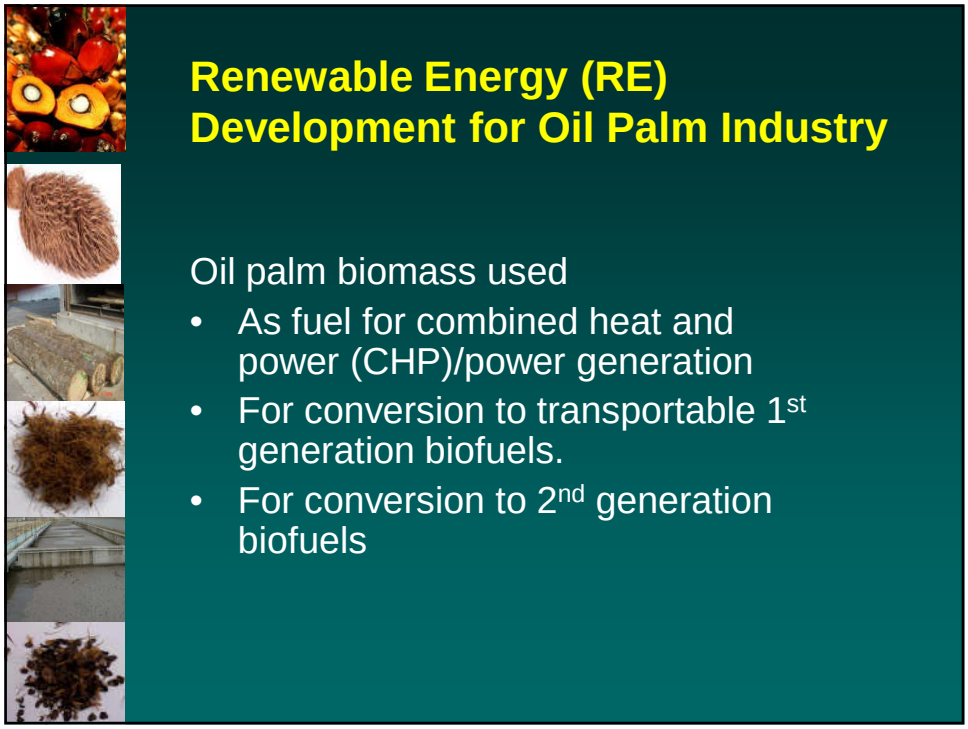
CLIMATE CHANGE MITIGATION STRATEGIES
- DOWNSTREAM -

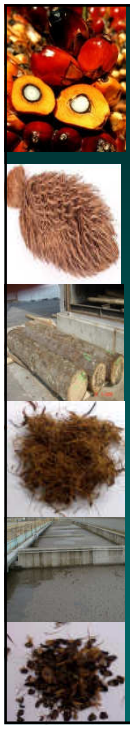


Increasing Oil Extraction Rate (OER)

- Target under NKEA – palm oil sector: initiatives to increase National OER from 20.49% to 23% by 2020.
- Coupled with projected increased of FFB yield from 19.2 to 26 tonnes FFB/ha/yr, this translates to an oil increase from 4 tonnes to 6 tonnes oil/ha/yr in 2020.
- This will reduce GHG emissions from land use change.

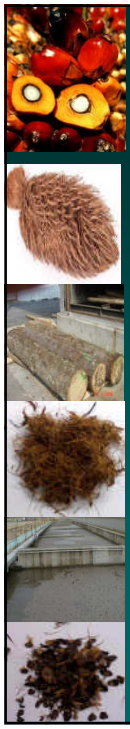

Abundance of Oil Palm Biomass
10% oil
90% biomass
OIL PALM FRONDS
FRESH FRUIT BUNCH
OIL PALM TRUNK
Crude Palm Oil
Biofuel / Biodiesel
Palm Biomass
Fuel for CHP
Palm oil mill effluent (POME)
Biogas


Renewable Energy (RE) Development for Oil Palm Industry
Oil palm biomass used
• As fuel for combined heat and power (CHP)/power generation
• For conversion to transportable 1st generation biofuels.
• For conversion to 2nd generation biofuels



Oil Palm Biomass as Fuel for CHP/Power

- All palm oil mills use palm residue (palm shell and mesocarp fibre) for CHP generation for process steam and electricity for the mill.
- EFB and biogas from POME also used to generate power for on-grid and off-grid purpose.

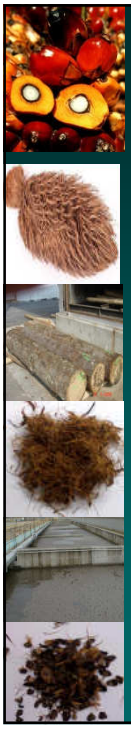


RE Target for On-Grid Connection

- **Malaysia plans to generate 8% or 2,560 MW of the National Grid load from RE, <u>most of which will be from Palm Oil Biomass or Biogas</u>.**
- **So Palm Oil Industry has a significant role to play in the future for supplying the electricity to the national grid**

Biomass*	**56.0%**
Municipal Solid Wastes (MSW)	5.1%
Mini Hydro	20.2%
Solar	7.8%
POME and others	**10.9%**

*** Mostly from oil palm**



Current Biomass Utilisation

EFB:

Mulching	41%
Multiple applications including mulching	39%
Fiber processing	3%
Biofertiliser/composting	3%
Boiler fuel	3%
Incineration	10%
Others	1%

POME:

Biogas Trapping Facility*	7%
Open ponding	73%
Open digester	6%
Tertiary Treatment	6%
Compost	<1%
Others	~7%

* Under Planning : 54 (13.0%)
Under Construction : 15 (3.6%)

Max RE Potential* from EFB and POME

	tonne/ year (mil.)	Peninsular (MW)	Johor	Kedah	Kelantan	Melaka	N. Sembilan	Pahang	Perak	P. Pinang	Selangor	Terengganu	Sabah (MW)	Sarawak (MW)	Total
EFB	20	626	183	19	17	7	36	168	120	3	42	31	330	109	1065
POME	58	159	46	5	4	2	9	43	30	1	11	8	84	27	270
Installed Capacity	-	20,000											720	950	21,670
Current Demand	-	12,500											720	950	14,170

* Assuming 100% EFB & POME are utilized. Total MW will reduced *proportionately according to actual % utilisation of EFB & POME*.

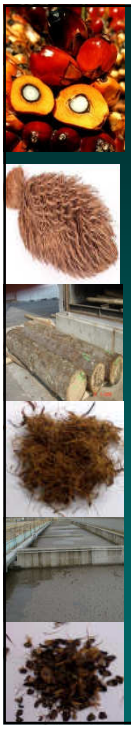
Biomass Energy Plant

Electricity Generation from EFB – internal consumption (palm oil refinery)

ENCO Boiler, 30 T/H, 29 Bar Gauge at PGEO Plant in Lumut, Perak

Small Renewable Energy Programme (SREP)

- Launched on 11 May 2001
- Selling of electricity to TNB at 21 cents/ kWh.

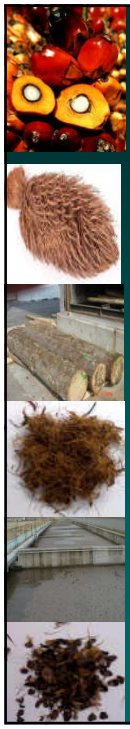


TSH Bioenergy Cogeneration Plant

Electricity Generation from EFB – 1st Grid-Connected Biomass Energy Plant

(Babcock & Wilcox Volund Boiler)

Source: (FSDP Special Issue- CoGen3)

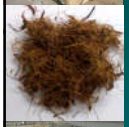


Trapping of Methane at Palm Oil Mills

- Under NKEA – palm oil sector: all palm oil mills to have methane trapping facilities by 2020
- 16 – 20 million tonnes of carbon dioxide equivalent per year mitigated

POME as A RE Source

- Potential yield: 1 m^3 of completely digested POME produces 28 - 38 m^3 biogas
- Biogas is made up of 60-70 % CH_4, 30-40 % CO_2 and trace H_2S
- Based on discharged POME containing 1.54 million ton COD:
  GHG emission : 16 – 20 million tons CO_2 eq.
  Recovered energy: 539 million Nm^3 CH_4



RE Potential from Biogas and Other Gases

	Biogas	Natural Gas	Liquid Petroleum Gas
Gross CV	19,800 - 25,700 kJ/NM^3	37,900 kJ/NM^3	100,000 kJ/NM^3
Specific gravity	0.847 – 1.002	0.584	1.5
Ignition Temp, ^{o} C	650 - 750	650 - 750	450 - 500
Combustion air required M^3/M^3	9.6	9.6	13.8

Biogas Capture from POME

United Plantations Berhad - Jenderata Palm Oil Mill, Perak
– internal consumption

Biogas Capture from POME

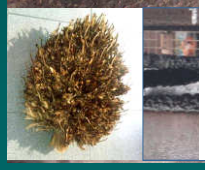
Electricity Generation from Biogas – 1st Grid-Connected Biogas Plant

Bell Eco Power Sdn. Bhd., Batu Pahat

Avoidance of Methane

Utilisation of POME:

-Co-Composting: EFB co-compost with POME, decanter cake and boiler ash



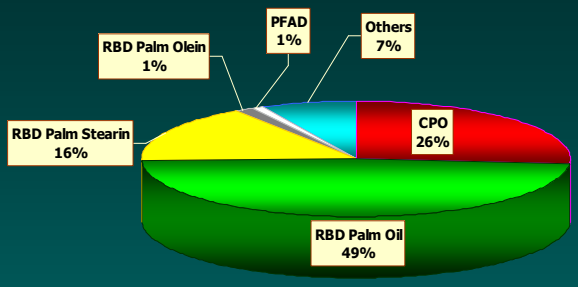
Utilisation of Non-oil Component:

- Sampling of non-oil phase after the screw press
- The low oil fraction showed that it can be used as a food source

Windrows of EFB

First Generation Biofuels – Palm Biodiesel

Feedstock Used For Palm Biodiesel Production



Others:

Used Frying Oil

Residual Oil from SBE

Spent Bleaching Earth (SBE)

National Biofuel Policy

- Launched in 2006
- Among strategic thrusts are to produce palm biodiesel for export and for local use.
- Will result in GHG emissions reduction

Status of Malaysian Biodiesel Industry (October 2010)

Implementation Phase	No.	Capacity (T/Year)
In Operation	2	160,000
Not In Operation	16	2,111,600
Completed Construction	11	978,900
Under Construction	9	1,470,000
Pre-Construction / Planning	23	2,071,400
Total Approved License	61	6,791,900

Production And Exports Of Biodiesel

	2006 *	2007	2008	2009
Palm Oil Utilized for Biodiesel	55,399	128,194	188,683	228,112
Production	54,981	129,715	171,555	222,217
Export	47,986	95,013	182,108	227,457

* Aug - Dec 2006

Development of Palm Biodiesel

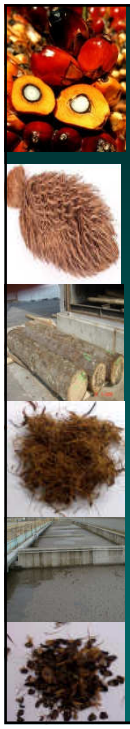
New Biodiesel Co. Ltd., Thailand

Sime Darby Winter-grade
Palm Biodiesel Plant, Selangor

Local Implementation of B5 Programme

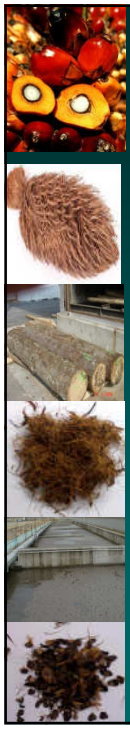
- Implemented in 4000 vehicles of Army and Kuala Lumpur City Hall since February 2009.
- From 1 June 2011, will be implemented in Central Region of West Malaysia (Putrajaya, Kuala Lumpur, Federal Territory, Negeri Sembilan, Melaka)
- When implemented in whole country will involve 500,000 tonnes biodiesel per annum.
- Result in GHG emissions reduction of 1.5 million tonnes $CO_{2\ eq}$ per year.

Crude Palm Oil and Medium Fuel Oil Blends as Boiler Fuel



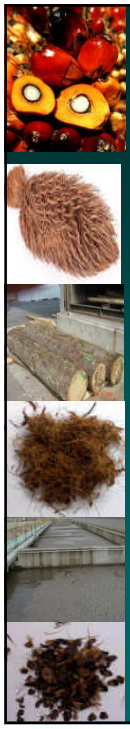
Potential Cracked Hydrocarbon from Palm Stearin and PFAD

- Thermal cracking
  - lower yield, higher acid value (corrosive products)
- Catalytic cracking
  - nickel exchanged zeolite 13X & H-Mordenite
- Hydrocraking
  - less tarry compounds, higher FFA (expensive technology)
- Findings:
  - Cracked products: saturated & unsaturated hydrocarbons C5–C17
  - Potential use as gasoline substitute

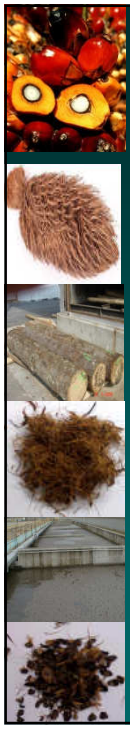


Palm Aviation Fuel

- The US Specifications for Aviation Turbine Fuel (ASTM D1655) was taken as the reference standard
- Freezing point of aviation fuel
  - - 47° C max (Jet A-1)
  - - 40° C Jet A
  - - 50° C Jet B
- A few palm esters have been identified as potential aviation fuel
- Patent filed



Second Generation Biofuels – Palm Lignocellulosic Biomass



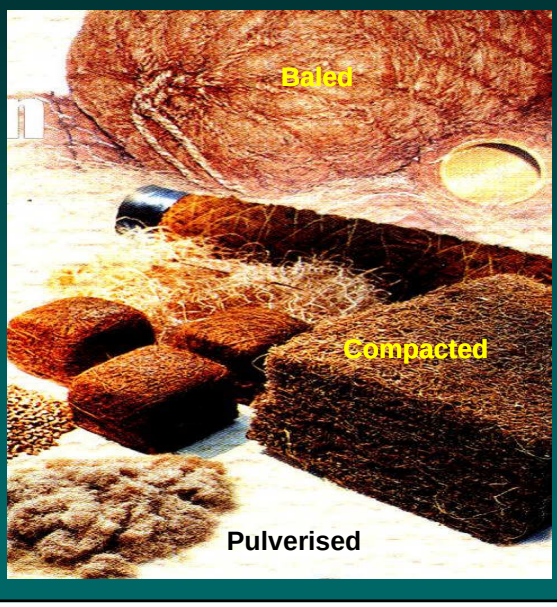
Net Calorific Value of Various Dried Oil Palm Biomass

Sample	Average	Range (MJ/kg)
Oil palm Biomass		
EFB	18.88	18.00 - 19.92
Mesocarp fibre	19.06	18.80 - 19.58
Shell	20.09	19.50 - 20.75
Oil palm frond	15.72	15.40 - 15.95
Oil palm trunk	17.47	17.00 - 17.80
POME	16.99	16.10 - 17.65
Palm Oil		
Crude Palm Oil	39.36	39.33 - 39.38
Palm Kernel Oil	37.98	37.8 - 38.20
Other Commercial Fuels		
Bagasse, Cereal Straw	19.4 17.3	-
Illinois bituminuous, Coal (Anthracite) North Dakota lignite, Coal (lignite) Reed Sedge peat	28.3 27.0 14.0 15.0 2.8	-

Palm Biomass as Solid Fuels

Briquettes

Pellets



Solid Fuel: Briquette Fuel from EFB

- Briquetting is a process of converting low bulk density biomass into uniform and higher density solid fuels at high pressure and temperature.
- Two types of biomass used: EFB fibre and palm shell

Transfer of Technology Seminar, 2010

Characteristics:

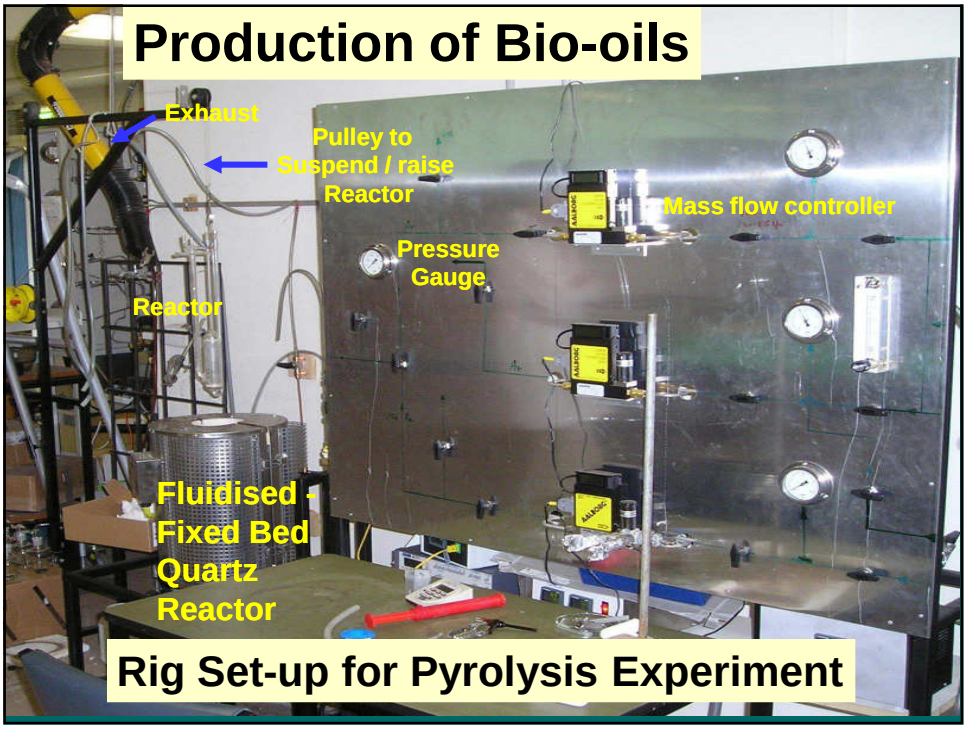
- Calorific Value 17895 – 18235 kJ/kg
- Moisture content < 6.0%
- Ash content < 6.0%
- Specific Density 1100 – 1300 kg/m^3

Gasification Technology - Production of Syngas

MPOB Technology, Labu
CO : 18.5% , H_2 : 10.9% & CH_4 : 3.4%
Optimisation: H_2 (40%); CO (30%); CH_4 (10%)

Ipalm Gasification pilot plant, Johor
Capacity: 30 kW, Fuel: EFB briquettes

Production of Bio-oils

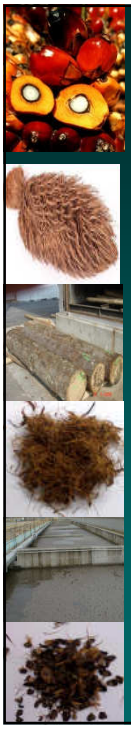


Rig Set-up for Pyrolysis Experiment

Calorific Values of Char and Volatiles at various Pyrolysis Temperatures

Temperature (°C)	Calorific Value (MJ/kg)	
	Volatiles	Char
200	-	18.71
300	18.32	22.33
500	21.41	22.94
600	21.17	22.98
700	20.41	22.98

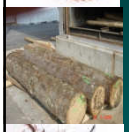
Original *Biomass 17.28 MJ/kg*



Commercialization of 2nd Generation Biofuel

- Under NKEA – palm oil sector: one initiative is to set up commercial bio-oil plant using EFB as feedstock.
- Plant will generate electricity for grid connection.






Bioethanol Production from Palm Biomass (3 stages)

Stage 1: pre-treatment**

Fractionation of lignocellulosic component of EFB by using chemical thermo-mechanical digestion process

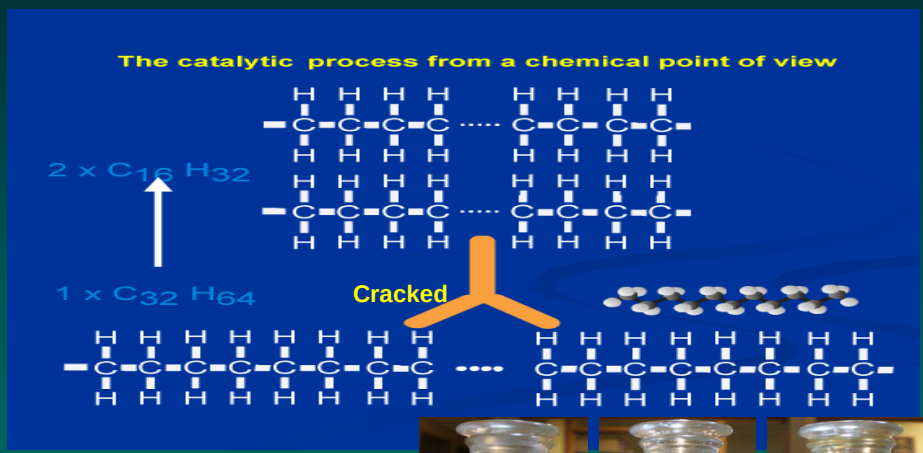
Stage 2: Sugars hydrolysis & extraction

Production of fermentable sugars from palm biomass (EFB) as bioethanol feedstock

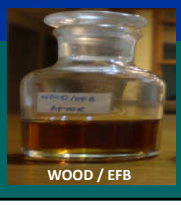
Stage 3: Fermentation

Fermentation of sugars from EFB to bioethanol

Production of Synthetic Diesel from Oil Palm Biomass via Catalytic Depolymerisation Process (CDP)

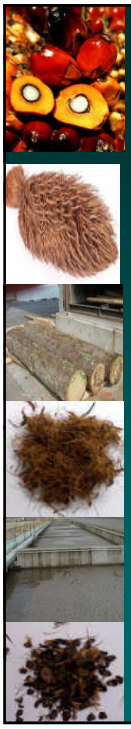


The catalyst cracks the long molecular chains of the hydrocarbons and shortens them in a specific way
The CH2-Molecule structure remains and the molecule length is only reduced (optimally on C15)


WOOD / EFB


MALAYSIAN MUNICIPAL SOLID WASTE


ORGANIC WASTE WITH USED OIL



CDM - Palm Oil Industry

Climate Change Mitigation Projects:

- Palm Biomass-Based Cogeneration
- Biogas Recovery & Utilization from palm oil mill effluent (POME)
- Methane Avoidance – Composting

Voluntary Emission Reduction Project (VER)

- Biodiesel from Palm Oil

CDM Project List (Energy Project)

Year	No. of Projects	Estimated ER (tCO2e)
2002	3	152,072
2003	2	62,190
2004	9	900,758
2005	25	2,823,171
2006	21	2,621,098
2007	45	4,404,648
2008	50	4,312,507
2009	21	1,374,931
TOTAL (PINs and PDDs)	176	16,651,375

Current Status of CDM Projects in Palm Oil Sector

As of 2009, there are 129 CDM projects for palm oil sector:

Type of project	No. project	Registered
Methane recovery (Biogas project)	53	28
Biomass cogeneration plant (EFB)	36	15
Methane avoidance through composting	40	21
	129	64

CERs Issued

List of Projects for Palm Oil Sector Being Issued with CERs (tonne of CO_2 equivalent)

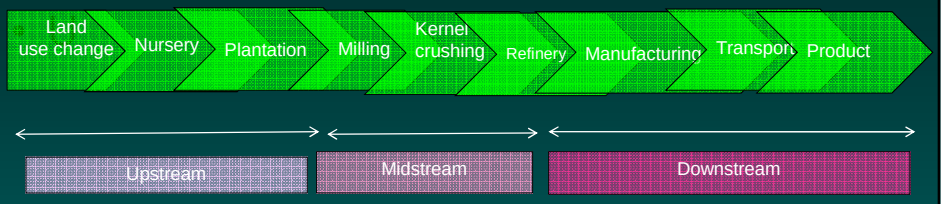
No	Company	Sector	Type	CERs (tonne of CO_2 eq.)	Involvement of Annex I Party
1	Enco Energy	Palm oil refinery	Biomass	42,545	Denmark
2	Lafarge	Cement factory	Biomass	366,260	France
3	SEO	Palm oil refinery	Biomass	86,102	Canada
4	Felda Sahabat	Palm oil mill	Biomass	12,775	United Kingdom of Great Britain and Northern Ireland
5	LDEO	Palm Oil refinery	Biomass	62,814	Canada
	Total			570,496	

GHG emissions at each stage of palm oil supply chain Using LCA Approach

Stage	Functional unit	CO_2 equivalent (kg)	CO_2 equivalent Without biogas capture	CO_2 equivalent With 85% biogas capture
Nursery	Per tonne of crude palm oil	0.067 kg	NA	NA
Plantation	Per tonne crude palm oil	368.28 kg	NA	NA
Mill	Per tonne crude palm oil	–	**970.58 kg**	**505.76 kg**
Refinery	Per tonne refined palm oil	–	1113.73 kg	625.67 kg
Biodiesel plant	Per MJ biodiesel	–	33.19 g	21.20g

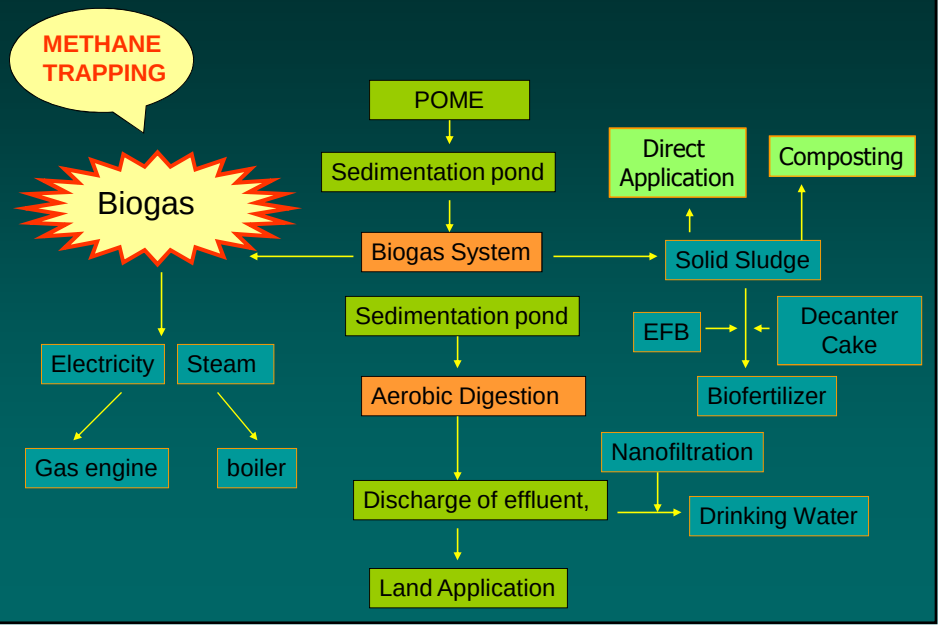
(Source: MPOB 2010 LCA Study)

Oil Palm Industry Commitment to improve Carbon Management using LCA approach



Year	Methane capture	GHG emissions $tCO_2/tCPO$ with allocation	
2008	**No**	2.45	(Source: Jannick 2008)*
2009	**No**	1.72	(Source: Choo *et al* 2009)
	Yes	1.24	
2010	**NO**	0.97	*(Source: MPOB 2010)*
	Yes	0.51	

Towards Zero Waste /Emission



CONCLUSION

- **Malaysia will work towards fulfilling its pledge to reduce GHG emissions up to 40% of emission intensity of GDP by 2020 as compared to 2005 levels.**
- **The oil palm industry will play its part by implementing climate change mitigation strategies over its whole production chain.**

THANK YOU