Outlook of Palm Biodiesel in Malaysia

Dato' Dr. Choo Yuen May , Puah Chiew Wei and Dato' Dr. Mohd. Basri Wahid

Malaysian Palm Oil Board

Ministry of Plantation Industries and Commodities, Malaysia

Worldwide Biodiesel Development (1)

- **Europe – Biofuels Directive (5.75% of biofuel in 2010 which is 10.2 million T), 4.8 million T production in 2006.**
- **US – Program 20 in 10 (Achieving 20% displacement of petroleum with biofuels in 10 years (2017), ~1 million T production in 2006.**
- **China – Infancy stage, non-edible feedstock, estimated 250,000 T production capacity in 2007 and 2 million T production in 2020.**
- **Australia – Tallow and UFO feedstock, estimated 80,000 T produced in 2006.**

Worldwide Biodiesel Development (2)

Leading Asian countries

a) **Thailand** – Mandate for B2 in diesel pool as of 2 April 2008. Beyond 2009, B5 nationwide. Moving to B10.

b) **Philippines** – Coconut feedstock; 11 BD plants with capacity of 300,000 TPA; mandated blending of 1% for all diesel fuel.

c) **Indonesia** – Palm and coconut feedstock; fuel authority allowed 10% blends of biodiesel; production in 2006 is 170,000 T; national target: 2.4 million T in 2010 and 4.2 million T in 2015.

d) **South Korea** – Any imported feedstocks, 30,000 T produced in 2005, voluntary blending of biodiesel by oil companies – 150,000T from July 2006 – June 2008; B5 for private cars and B20 for fleet vehicles.

Common Raw Materials for Biodiesel Production and Their Oil Yield

	Yield (tonne / ha / yr)
Palm Oil (Malaysia)	3.93*
Rapeseed (EU)	1.33**
Soyabean (USA)	0.46**
Sunflower (Argentina)	0.66**
Jatropha	1.44***
Coconut (Philippines)	0.66****

Highest Yield & Most Economical Oil

Source: * MPOB (2006) ** Khoo (2001)
*** Steffan Preusser (2006) **** Oil World (2006)

Feedstock for Production of Biodiesel

Rapeseed oil

Soybean oil

Sunflower oil

Palm oil

Availability of Palm Oil as Feedstock for Biodiesel, Malaysia (2007)

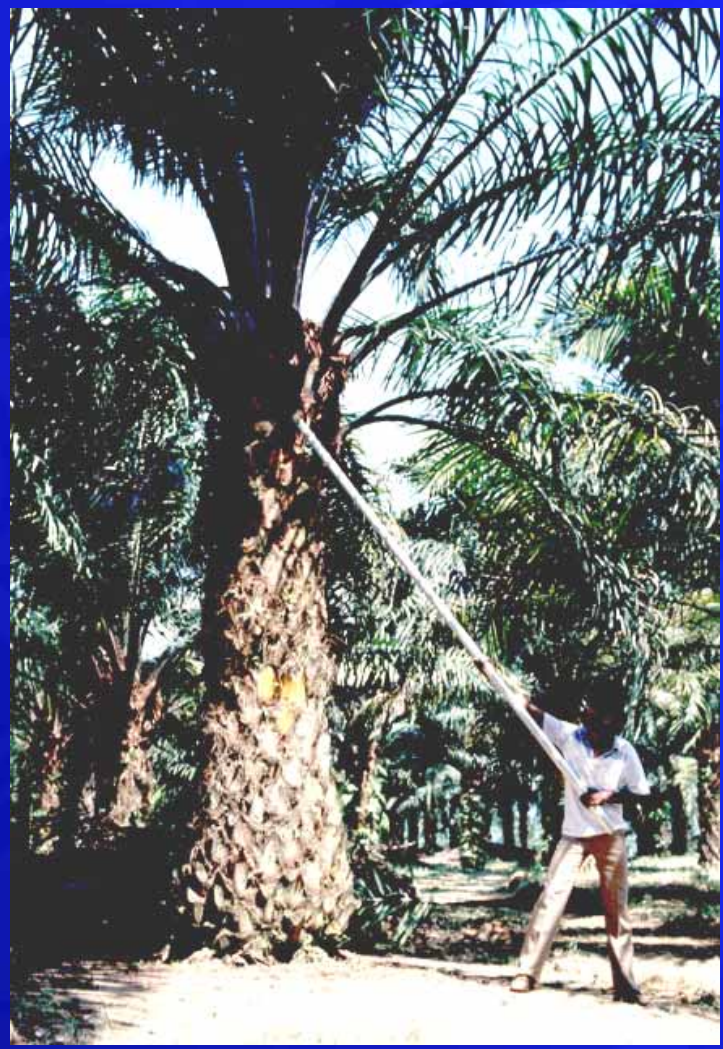
- Malaysia and Indonesia: World's largest producers of palm oil
- Malaysia: World's largest exporter of palm oil
- Production 15.8 million tonnes
- Exports 13.4 million tonnes
- Export value of oil palm products: RM45 billion

Feedstock Selection

- Availability
  - Regional production
  - Productivity
- Price
- Characteristics of oil
  - Stability
  - Cold flow properties

Oil Palm Plantation

Plantation

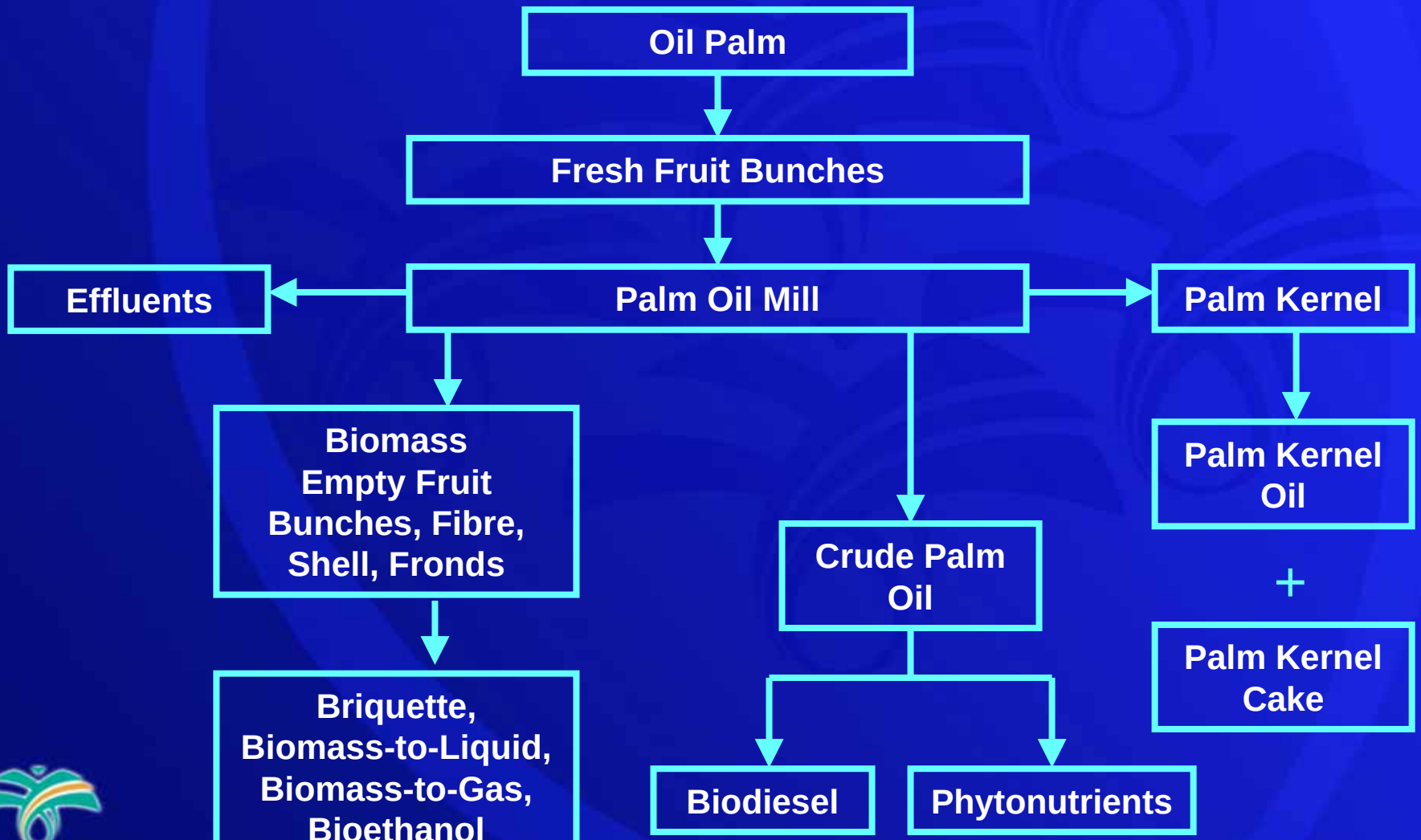


Palm Tree

Fresh Fruit Bunch

Palm Oil Mill

Potential Sources of Renewable Energy from Oil Palm



Crude Palm Kernel Oil

Crude Palm Oil

Palm Kernel

Palm Mesocarp

Empty Fruit Bunches

Palm Fibre

Palm Shell

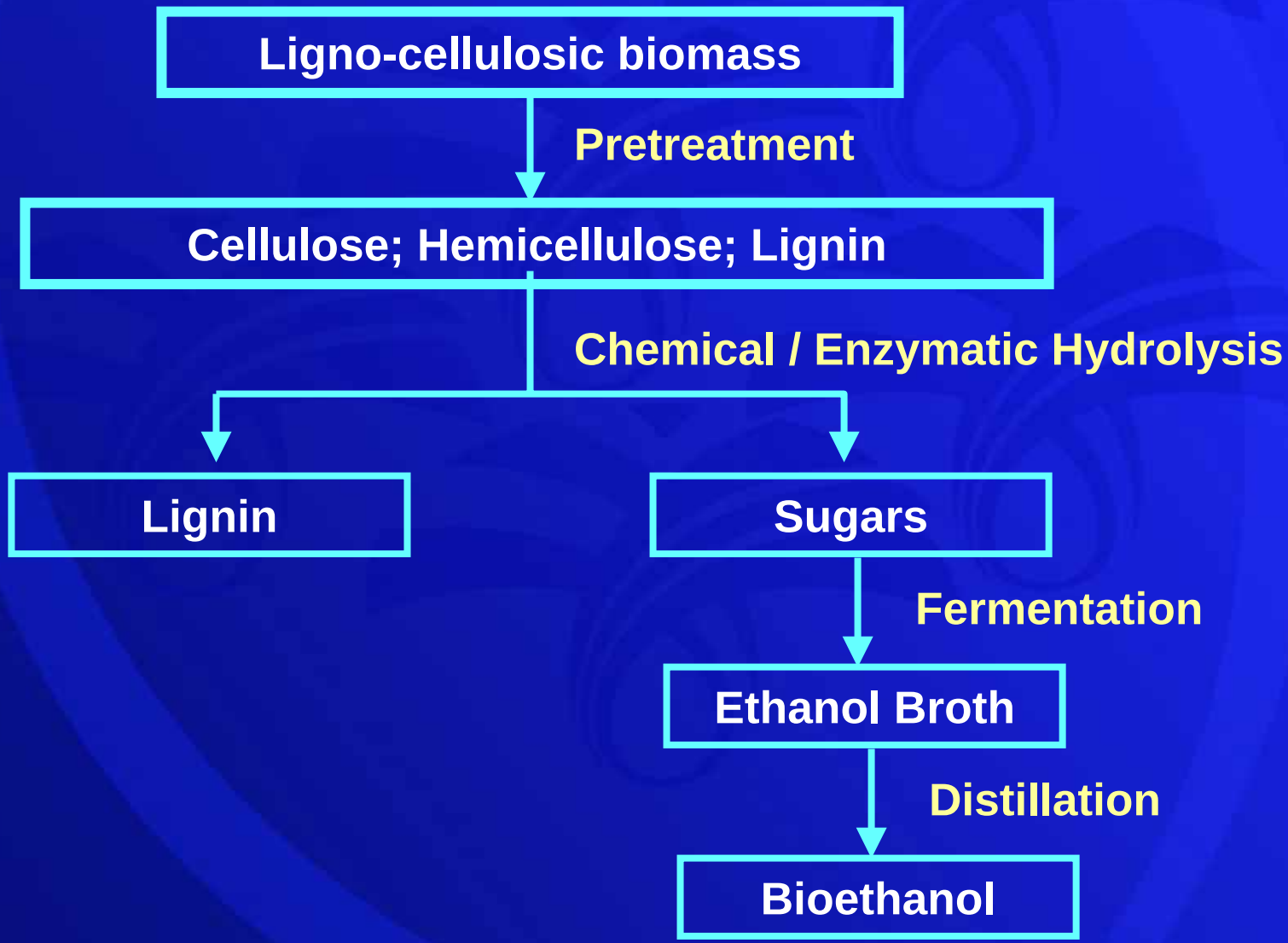
Palm Kernel Cake

Palm Fronds

Palm Briquettes

- A clean, uniform and quality fuel
- Improves handling, physical, chemical and combustion characteristics
- Save cost in biomass disposal and storage, turn waste into wealth

Conversion to Bioethanol



Biogas

- Product from Anaerobic Digestion of POME
- Good Energy Resource but Untapped

3,000 tpy Palm Biodiesel Pilot Plant at MPOB

Palm Biodiesel (Methyl Esters)

Crude / Distilled Palm Oil Methyl Esters

RBD Palm Oil Methyl Esters

RBD Palm Olein Methyl Esters

Field Trials using Mercedes Benz (OM352) Diesel Engines Mounted on Passenger Buses (each bus covered 300,000 km)

MPOB EXPERIENCE: PALM BIODIESEL (PALM OIL METHYL ESTERS) AS DIESEL SUBSTITUTE

- No engines modification is required
- Results in terms of engine performance, fuel consumption, exhaust emission, repair and maintenance were promising
- Cetane number / Diesel Improver (62.4 c.f 37.7 for petroleum diesel from Europe)

Recent Trials using Palm Biodiesel on Commercial Trains

- **Trials conducted by Prignitzer Eisenbahn (PE) Arriva in Germany, since September 2004.**

Development of MPOB Palm Biodiesel Technology (From Research to Commercialization)

- 1st commercial small scale plant (3,000 TPA) started production by August 2002 (Carotino Sdn. Bhd.)
- Scaling up to 60,000 TPA in 2005.
- Scaling up from 60,000 TPA to 120,000 TPA in 2006

Small scale commercial Plant, 3,000 TPA (Carotino)

Development of Winter Grade Palm Biodiesel (2001)

Low Pour Point Palm Biodiesel

(Pour Point: 0°C to -20°C)

- Scaling up to 30,000 TPA in 2005
- Commercial production: 2006

Seasonal Pour Point Requirement of Biodiesel

Season	Pour Point (° C)
Spring	-10
Summer	0
Autumn	-10
Winter	-20

Key Fuel Characteristics of Normal Palm Biodiesel and Low Pour Point Palm Biodiesel

Property	Normal Palm Biodiesel	Low Pour Point Palm Biodiesel	Petroleum Diesel
Density at 15°C (kg/L) ASTM D4052	0.875	0.882	0.853
Sulfur Content (% wt) IP 242	< 0.04	< 0.04	0.10
Viscosity @ 40°C (cSt) ASTM D445	4.5	4.5	4.0
Pour Point (°C) ASTM D97	+15	-21	+15
Flash Point (°C) ASTM D93	174	153	98
Cetane Number ASTM D613	62.4	57	55.2
Gross Heat of Combustion (kJ/kg) ASTM D2332	40,335	39,160	45,800
Conradson Carbon Residue (% wt) ASTM D198	0.02	0.01	0.14

Fuel Properties of Palm Biodiesel vis-à-vis EN14214 & ASTM D6751

Properties	Unit	EN 14214:2003		ASTM D6751:06		Palm Biodiesel
		Min	Max	Min	Max	
Methanol Content	% (m/m)	-	0.2	-	-	<0.2
Monoglycerides	% (m/m)	-	0.8	-	-	0.3 – 0.5
Diglycerides	% (m/m)	-	0.2	-	-	<0.15
Triglycerides	% (m/m)	-	0.2	-	-	<0.1
Free Glycerol	% (m/m)	-	0.02	-	0.02	<0.01
Total Glycerol	% (m/m)	-	0.25	-	0.24	<0.01
Na + K	mg/kg	-	5.0	-	5.0	<5
Ca + Mg	mg/kg	-	5.0	-	-	<4
Phosphorus	mg/kg	-	10.0	-	10	<10
Distillation Temperature	°C	-	-	-	360	<360

EN14214:2003 European Standard for Biodiesel
ASTMD6751:06 Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels

Fuel Properties of Palm Biodiesel vis-à-vis EN14214 & ASTM D6751

Properties	Unit	EN 14214:2003		ASTM D6751:06		Palm Biodiesel
		Min	Max	Min	Max	
Ester Content	% mass	96.5	-	-	-	>98.5
Density at 15°C	g/cm^3	0.860	0.900	-	-	0.87 – 0.88
Viscosity at 40°C	cSt	3.5	5.0	1.9	6.0	4.4
Flash Point	°C	120	-	130	-	> 160
Sulphur Content	% mass	-	0.001	-	0.0015	<0.001
Carbon Residue (on 10% distillation residue)	% mass	-	0.3	-	0.05	0.02
Cetane Number	-	51.0	-	47.0	-	62.4
Oxidative Stability, 110°C	hours	6.0	-	-	-	>6
Copper Strip Corrosion (3h at 50°C)	rating	1	-	-	3	1a

EN14214:2003 European Standard for Biodiesel
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Fuel Properties of Palm Biodiesel vis-à-vis EN14214 & ASTM D6751

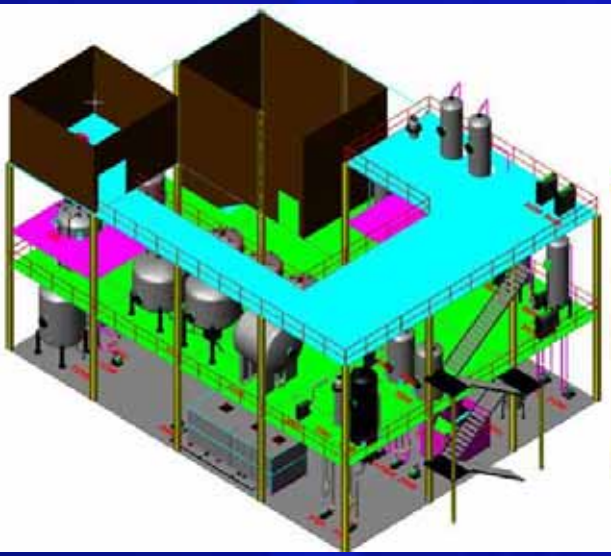
Properties	Unit	EN 14214:2003		ASTM D6751:06		Palm Biodiesel
		Min	Max	Min	Max	
Sulphated Ash Content	% mass	-	0.02	-	0.02	<0.01
Basic Sediment and Water	% mass	-	0.05	-	0.05	<0.05
Acid Value	mg KOH/g	-	0.5	-	0.5	0.3 – 0.5
Pour Point	°C	Report		Report		15 (Normal Grade)
Iodine Value	-	-	120	-	-	52
Content of Linolenic Acid Methyl Esters	% (m/m)	-	12	-	-	<0.5
Content of Polyunsaturated Methyl Esters (more than 3 double bonds)	% (m/m)	-	1	-	-	<0.1

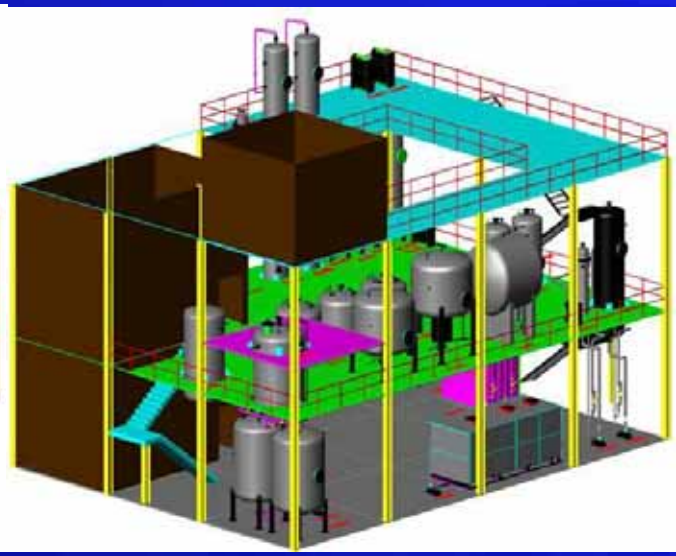
EN14214:2003 European Standard for Biodiesel
ASTMD6751:06 Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels

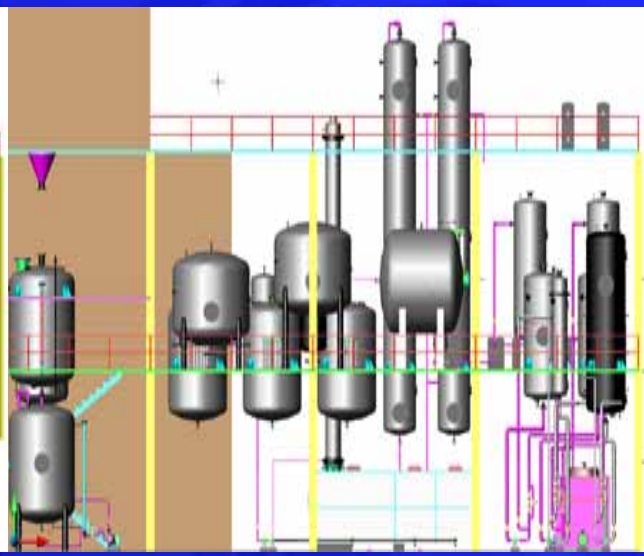
Highlights of MPOB Biodiesel Technology

- Overall yield: 98%
- Products meeting full EN 14214 and ASTM D6751 specifications
- The only plant design optimized for palm oil and palm oil products as feedstocks
- Simple and proven technology – more than 20 years of experience
- Low pressure & temperature process
- Use cheaper catalyst, NaOH
- Short commissioning time
- Technical support from MPOB

MPOB COMMERCIAL PALM BIODIESEL PLANTS







MPOB

CAROTINO

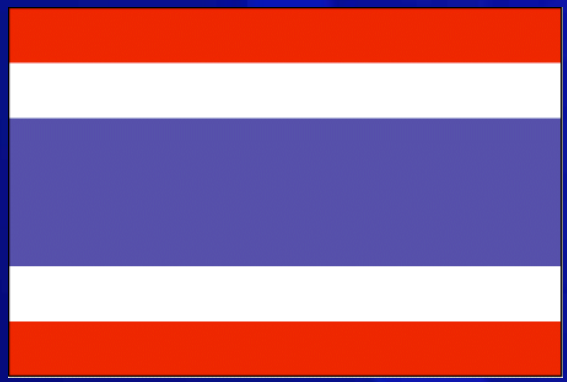
Golden Hope

FIMA
KUMPULAN FIMA BERHAD

Three (3) demonstration plants were built using MPOB Technologies. Each plant consists of a 60,000 TPA normal biodiesel plant and a 30,000 TPA winter fuel plant.

OTHER PLANTS USING MPOB TECHNOLOGY

Pulau Indah, Klang, Selangor Darul Ehsan
Capacity : 120,000 tonnes/year
Pasir Gudang, Johor Darul Takzim
Capacity : 120,000 tonnes/year



Surat Tani, Thailand
Capacity: 60,000 tonnes/year

enertech

ENERTECH Co. Ltd.
Pyeongtaek, SOUTH KOREA
Capacity: 60,000 tonnes/year
Status : Commissioned

MPOB – CAROTINO PALM BIODIESEL PLANTS

Normal-grade Palm
Biodiesel Plant 60,000 TPA

Winter-grade Palm Biodiesel
Plant 30,000 TPA

Launching of World 1st Integrated Commercial Normal and Winter-grade Biodiesel Plant at Carotino Sdn. Bhd. (August 2006)




MPOB – Golden Hope Biodiesel Plant, Malaysia

Normal-grade Palm Biodiesel Plant 60,000 TPA

Winter-grade Palm Biodiesel Plant 30,000 TPA

Estimated Cost for the Production of Palm Biodiesel

Oil	~ 70%
Chemicals	~ 10%
Depreciation	~ 7%
Labour	~ 5%
Maintenance	~ 5%
Utilities	~ 3%
	100%

BIODIESEL PRODUCTION - CHALLENGES

- Rise in palm oil prices ~ RM1400 in 2006 to ~ RM3200 in 2007
- Margins have thinned, in fact become negative

(1) Cost of RBD palm oil	USD1000/tonne
(2) Selling price of biodiesel	USD 950/tonne
(3) Cost of production of palm biodiesel	USD1120/tonne (USD1000 + USD 120)

Palm biodiesel is not economically viable with today's RBD palm oil price

Environmental Impact of Palm Biodiesel

- Environment-friendly – great reduction in CO_2, CO, total unburnt hydrocarbon, SO_2, particulates and air toxics
- Biodegradable
- Renewable
- Improved air quality and greenhouse gas mitigation – reduction in health care costs
- In-line with Clean Development Mechanism (CDM) of 1997 Kyoto Protocol.

Production and Consumption of Palm Biodiesel: A Closed Carbon Cycle

Palm Biodiesel

Vehicles Consumption

Carbon Dioxide Emission

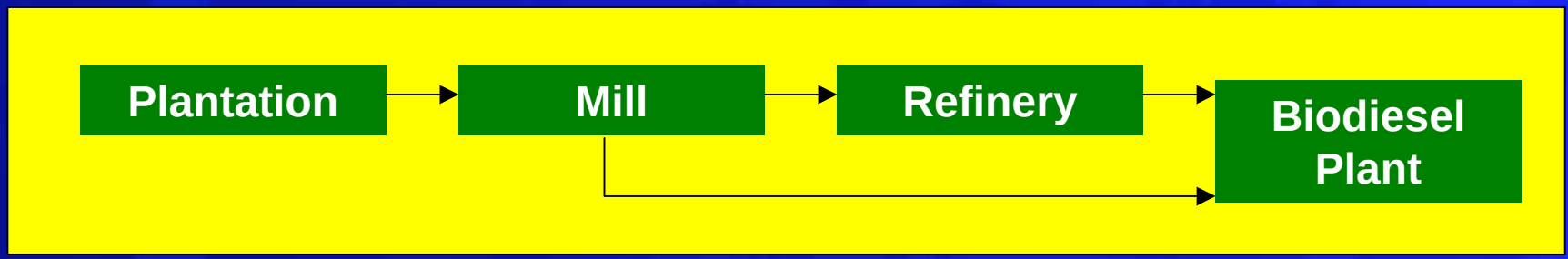
The Way Forward

(1) Vertical Integration of Palm Biodiesel Production

(2) Production of Value-Added Products from Palm Biodiesel

(3) Production of C16/C18 mixed and C18:1/2 Methyl Esters

(1) Vertical Integration of Palm Biodiesel Production



- More efficient – reduce operation cost
- Excess energy in the mill – use for refinery and biodiesel production
- For long term sustainability of palm biodiesel production, integration is a practical approach.

(2) Production of Value-Added Products from Palm Biodiesel (Methyl Esters)

PALM PHYTONUTRIENTS

Crude Palm Oil (CPO)

CPO Methyl Esters (Palm Diesel)

Distillation

Distilled Methyl Esters (Palm Diesel) (C16/C18 mixed)

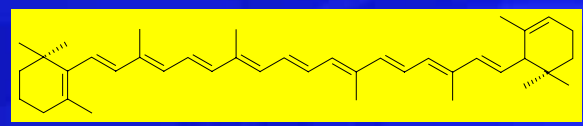
Feedstock for value-added oleochemical products

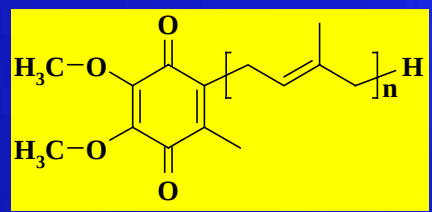
Phytonutrients Concentrate Containing Carotenes, Tocols, Phospholipids (Lecithin), Sterols, Coenzyme Q and Squalene

Carotenes
Tocols
Sterols
Squalene
Coenzyme Q
Phospholipids (Lecithin)

Value-Added Products from Palm Oil Methyl Esters

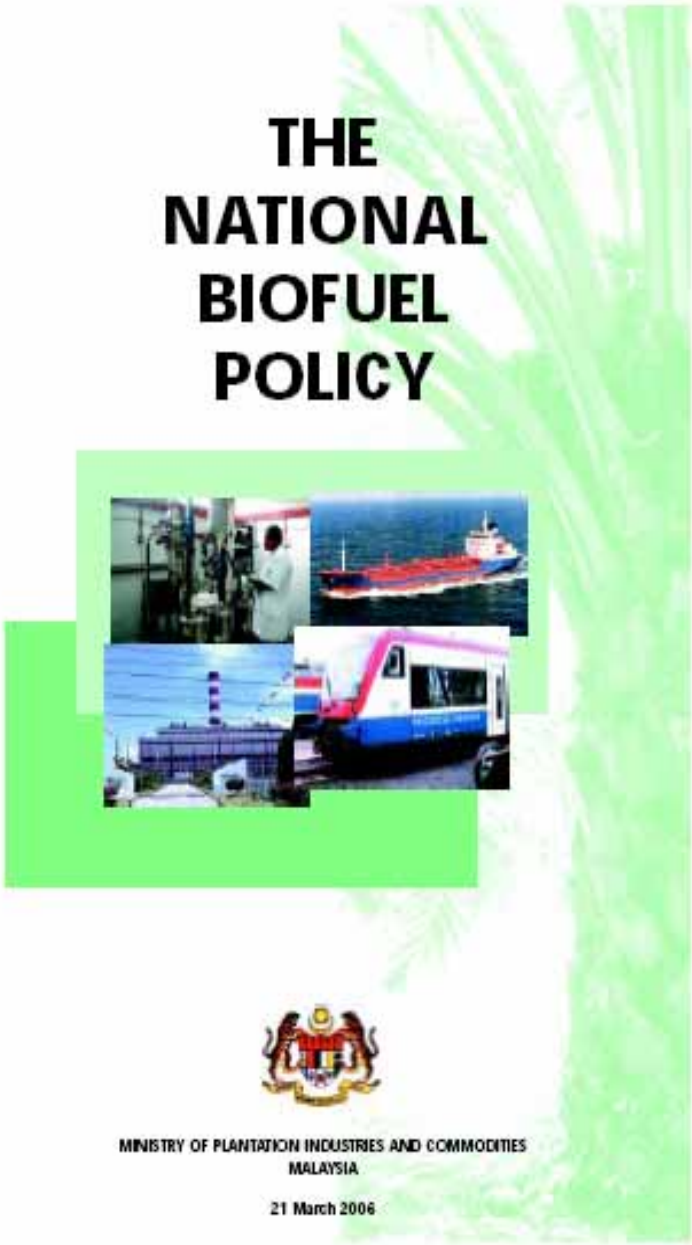
- For every 1 tonne of methyl esters burnt as fuel, we also burn away:
  - 0.6 kg Carotenoids
  - 0.8 kg Vitamin E
  - 0.5 kg Phytosterols
  - 0.4 kg Squalene
  - 0.05 kg Coenzyme Q
  - 0.06 kg Phospholipids





For every 1 tonne of methyl esters burnt as fuel, the value of phytonutrients burnt away is:

~US 970/tonne
(RM 3,200/tonne)



STRATEGIC THRUSTS

THRUST 1 : USE OF BIOFUEL FOR TRANSPORT

THRUST 2 : USE OF BIOFUEL FOR INDUSTRY

THRUST 3 : DEVELOPMENT OF HOME GROWN BIOFUEL TECHNOLOGIES

THRUST 4 : PRODUCTION OF BIOFUEL FOR EXPORT

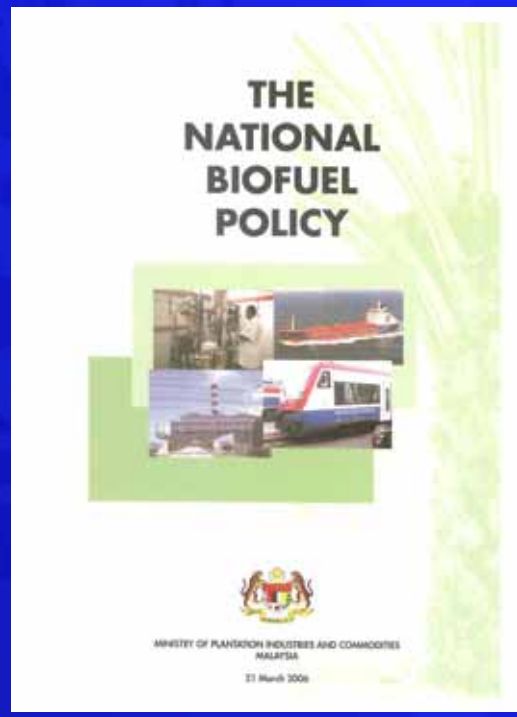
THRUST 5 : BIOFUEL FOR CLEANER ENVIRONMENT

- **National Biofuel Policy released 21 March 2006**

The National Biofuel Policy

The National Biofuel Policy envisions:

- **Use of environmental friendly, sustainable and viable sources of energy to reduce the dependency on depleting fossil fuels**
- **Enhanced prosperity and well-being of the stakeholders in the agriculture and commodity based industries through stable and remunerative prices**



National Biofuel Policy released 21 March 2006

The National Biofuel Policy
Five (5) Strategic Thrusts

Thrust 1: Biofuel for Transport

Thrust 2: Biofuel for Industry

Thrust 3: Biofuel Technologies

Thrust 4: Biofuel for Export

Thrust 5: Biofuel for Cleaner Environment

The National Biofuel Policy

Five (5) Strategic Thrusts

Thrust 1: Biofuel for Transport

Diesel for land and sea transport will be a blend of 5% processed palm oil and 95% petroleum diesel. This B5 diesel will be made available throughout the country. As this sector is the main user of diesel which is highly subsidized, it will be given priority in this policy.

The National Biofuel Policy
Five (5) Strategic Thrusts

Thrust 2: Biofuel for Industry

B5 diesel will also be supplied to the industrial sector including for firing boilers in manufacturing, construction machinery and generators.

The National Biofuel Policy
Five (5) Strategic Thrusts

Thrust 3: Biofuel Technologies

Research, development and commercialization of biofuel technologies (including technologies for extraction of minor components therein) will be effected and adequately funded by both the government and private sectors including venture capitalists to enable increased use of biofuel.

The National Biofuel Policy
Five (5) Strategic Thrusts

Thrust 4: Biofuel for Export

Worldwide interest reflects the important role of biofuels in energy for sustainable development. Malaysia will have an edge to supply the growing global demand for biofuel. The establishment of plants for producing biofuel for export will be encouraged and facilitated.

The National Biofuel Policy
Five (5) Strategic Thrusts

Thrust 5: Biofuel for Cleaner Environment

The use of biofuel will reduce the use of fossil fuels, minimize the emission of green house gases (carbon dioxide), carbon monoxide, sulphur dioxide and particulates. Increased use of biofuel will enhance the quality of the environment.

LEGAL FRAMEWORK

- Malaysian Biofuel Industry Act 2006 passed by Parliament in 2007
- Contains provision to mandate blending of biofuel with diesel through regulations made by Minister
- Drafting of regulations under way
- No decision yet on implementation. Need to consider type of biofuel, percentage, subsidies required etc.

Malaysia-Indonesia Joint Collaboration

- **Malaysian – Indonesian pact agrees to use 40% (~6 million tonnes) of current palm oil production (15 million tonnes) for the production of palm biodiesel.**

KL-Jakarta pact on CPO allocation for biodiesel

■ **By Ooi Tee Ching**
bt@nstp.com.my

MALAYSIA and Indonesia have agreed to set aside 40 per cent of their respective production of crude palm oil (CPO) in a year for biodiesel.

"The Indonesian and Malaysian governments have each agreed to commit 6 million tonnes of our respective yearly 15 million tonnes production of CPO as feedstock for biofuel and biodiesel manufacturing," Plantation Industries and Commodities Minister Datuk Peter Chin Fah Kui said.

The commitment should provide biodiesel investors with some assurance of adequate raw material supply, he said at a press conference outlining Malaysia-Indonesia bilateral co-operation on commodities in Putrajaya yesterday.

This is a follow-up of Chin's meeting with Indonesia's Agriculture Minister Dr Anton Apriyantono in Medan, Sumatra, three days ago.

"This 6 million tonnes of CPO is a moral pledge between our Governments. There are no legal implications on either countries should biodiesel usage fall below or shoot above this level," Chin said.

Once the Biofuel Industry Bill is tabled in Parliament on August 21 2006 and later enforceable, the Statistics Department will be measuring the quantity and value of biodiesel shipped out of the country.

Three weeks ago, Malaysia imposed a temporary freeze on the issue of biodiesel licences on rising concerns that the sudden hunger for biodiesel projects may eat into CPO reserves that are meant for food and oleochemical producers.

"The Government is committed to encourage more production of CPO through replanting of high-yielding clones, instead of expansion of plantation area. By 2010, we aim for a yearly CPO production of 18 million tonnes gathered from a total of 5 million ha of planted area," Chin said.

Yesterday, in anticipation of positive news on biodiesel development, traders made their call. The benchmark third-month October contract on Bursa Malaysia Derivatives closed 3.3 per cent higher at RM1,591 a tonne.

Meanwhile, the Indonesian Government recently expressed interest in buying Malaysia's high-yielding clones. Chin said Malaysia's policy only allows clones to be supplied to Malaysian joint venture companies operating in Indonesia.

The move is an assurance of adequate raw material supply, says Chin

Source: New Straits Times

Malaysian Government Incentives

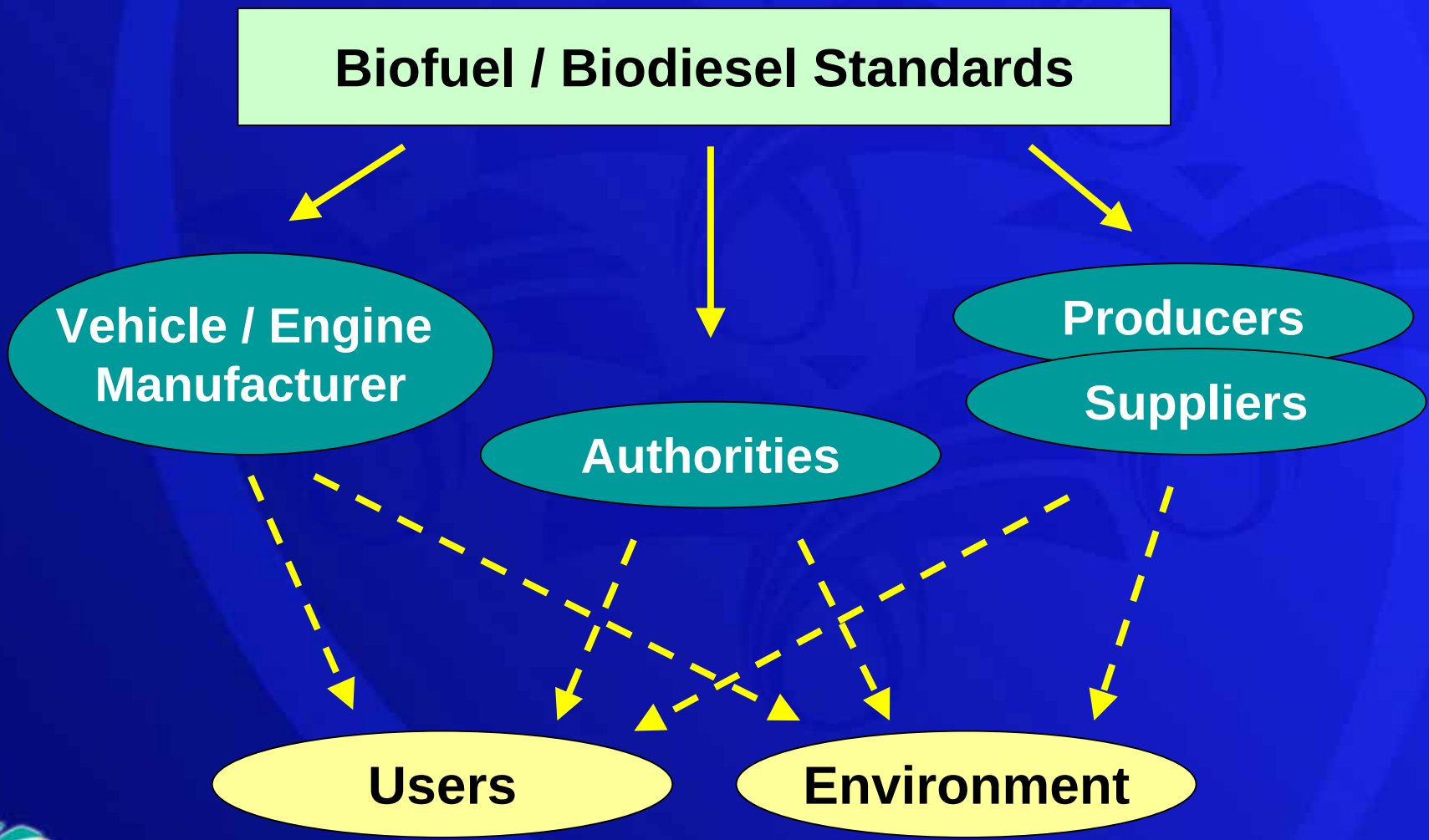
- Promotion and Investment Act 1986
- Tax incentives – Pioneer Status (5 yrs)

  (a) Pay tax on 30% of its statutory income

  (b) Sabah, Sarawak and eastern corridor of Peninsular Malaysia – 100% tax exemption on statutory income

- 100% tax exemption on statutory income for 10 years for commercialization of R&D findings by Public Sector

Malaysian Biofuels Standards



Malaysian Biofuels Standard

- Undertaken by SIRIM Berhad, under TC on Petroleum Fuels.
- Members of TC: Oils and Gas Companies, MAA, MPOB, Government Agencies, MOMG and biodiesel manufacturers.
- Malaysian Standard on Methyl Esters (similar to EN 14214); published in end of 2007.

Representation of Malaysia in Regional Biodiesel Standardization Committees

- Working Group of the Standardization of Biodiesel Fuel for Vehicles in East Asia
- APEC Biofuels Task Force: Guidelines of Biodiesel Standards in APEC
- Joint Working Group between ISO/TC 28 and ISO/TC 34/SC 11: Input/Output Quality of Feedstocks and Fatty Acids Esters Used in Biodiesel

CONCLUSION

- Biofuels contribute to reduction of greenhouse gases.
- Solid, liquid and gaseous biofuels can be produced from various palm sources.
- MPOB palm biodiesel technologies (normal and winter grades) have been well proven.
- Both normal and winter grades palm biodiesel produced using MPOB technologies meet EN14214 and ASTM D6751 specifications.

CONCLUSION

- MPOB palm biodiesel technology provides and opportunity to recover value-added palm phytonutrients.
- Palm oil methyl esters (C16 and C18 mixed) can be used as feedstock for various oleochemicals applications.
- Biodiesel production is economically viable with integration of phytonutrients production.
- Create more business opportunities.

Acknowledgement

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5. MPOB Technology Licensees, Lipochem Sdn. Bhd. and Oiltek Sdn Bhd.

Thank You

Please log on to MPOB website for more information on biodiesel development (www.mpob.gov.my) or contact email: choo@mpob.gov.my