

Bioenergy project development in Asia and Oceania

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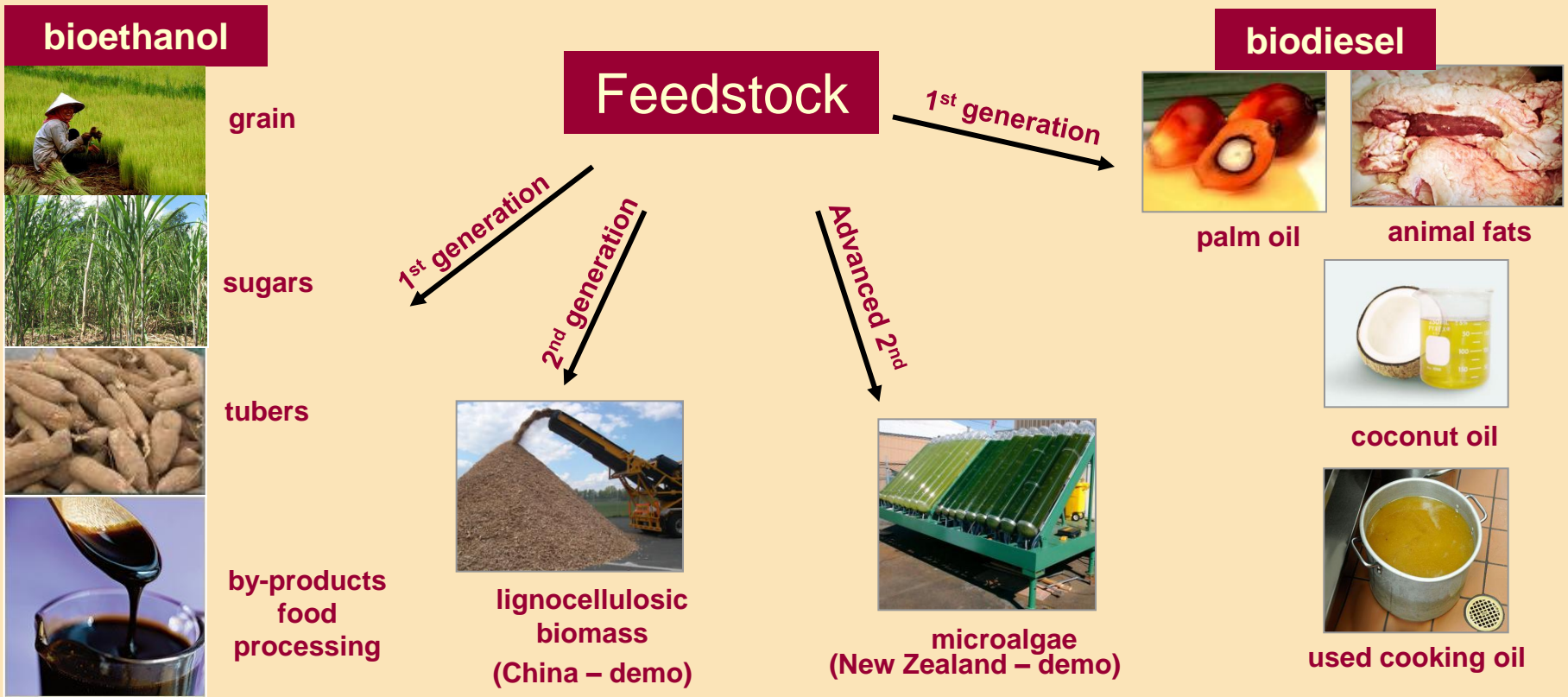
Nations with Biofuel Initiatives in Asia-Oceania



Maps used with permission

Asia – Oceania Scenario

- Biofuel industry – ethanol & biodiesel
- Leading nations ethanol = China, Australia, Thailand
- Leading nations biodiesel = Indonesia, Malaysia, China, Australia
- Emerging nations = Japan, Korea, Myanmar, Sri Lanka, Philippines



- **Main Issue for Biofuel in Asia - Oceania**

**To achieve energy without conflict
of interests for water, land, food**

Thailand

- Established biofuels industry
- 9 ethanol plants – 435 million L/year
- 9 biodiesel plants – 655 million L/year
- 90 % ethanol produced from cane molasses; 10 % from cassava
- 40 % (420K tonnes) of annual palm oil produce – biodiesel production
- Gasohol (E10) – 20 % of petrol sales
- E20 – available in 40 petrol stations in Bangkok
- B2 – all petrol stations in Thailand (2% biodiesel : 98% diesel)
- B5 – 976 stations in Bangkok (5% biodiesel: 95% diesel)



Thailand

Commitment:

- Promote investments; tax-waiver
- Gasohol 2.0 - 2.5 Baht/L cheaper than petrol
- All government vehicles uses gasohol...!!
- Reduced excise - tax for cars with 20% of fuel ethanol mixture
- Strategic Plan on Biodiesel Promotion and Development (2005)
- Target: reducing 10 % diesel consumption by 2012
- Workplan: Increase palm oil plantation, community-based biodiesel production
- Mandate: B2 (2008), B5 (2011), B10 (2012)

Feedstock:



Cane molasses



Cassava

**Palm
oil**



Jatropha



biodiesel



Used cooking oil

Vietnam

Commitment:

- 500 million L fuel ethanol and 50 million L of biodiesel by 2020
- Setting up of biofuel plants and R&D
- Tax-incentive & low-interest
- Collaboration 1: Local sugar co. & Singapore's institution – ethanol plant with 63 million L/ year capacity; feedstock = sugarcane molasses
- Collaboration 2: Local petro-subsiary & Japan Corp – ethanol plant with 100 million L/year capacity; feedstock = cassava
- Future plans – 3 new plants

Feedstock:

Cassava



Sugarcane



Rice



bioethanol

biodiesel

Catfish oil



Used cooking oil



Rubber seed



Jatropha oil

China

- Conflict between crops to feed the nation OR for fuel
- 4 ethanol biorefinery plants – 1.02 million ton/year (early 2006)
- 4 new ethanol biorefinery plants – 0.91 million ton/year (end 2006)
- Dozens of biodiesel plants – 3 million ton/year (estimated)
- 1,500 million ton/year forest residues – potential to generate 370 million tonnes of ethanol

National policy:

- Biofuel development MUST NOT:
 - a) use grain as feedstock
 - b) does not pollute/ destroy the environment
 - c) compete with arable land

MAIN
ISSUE.. !!



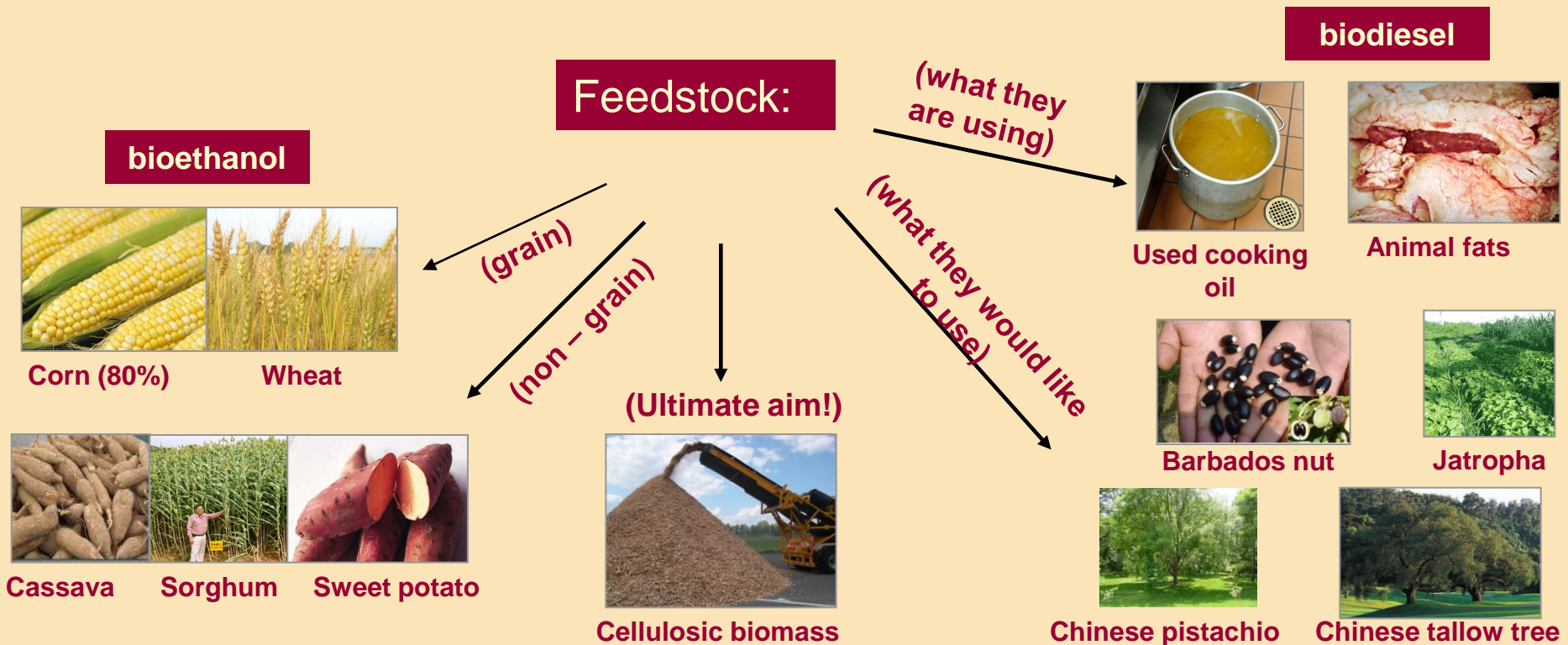
VS.



China

Commitment:

- To build lignocellulosic ethanol pilot plants – 15,000 ton/year
- E10 is used in 5 provinces, 27 cities, 30 % of stations
- Gasohol consumption = 20% national gasoline consumption (2005)
- Biodiesel – 300,000 ton/year (2010), 2 million ton/year (2020)
- Fuel ethanol – 3 million ton/year (2010), 10 million ton/year (2020)



Australia

- Biofuel production capacity in Australia is forecast to reach 365 million litres in 2009/10, surpassing the Federal Government target of 350 million litres, according to the USDA Foreign Agricultural Service.

Current ethanol production facilities (Million Liters – ML)

Production facility/location	Principle feedstocks
Manildra Group – Nowra NSW	Waste wheat starch
CSR Distilleries – Sarina Qld	Molasses
Dalby Biorefinery	Grain

Source: ABARE, 2008

Current and Proposed Biodiesel production capacity (Million Liters – ML)

Biodiesel Capacity	Principle Feedstock
Biodiesel Ind – Rutherford NSW	Tallow and used cooking oil
Biodiesel Producers	Barnawatha
Smorgan Fuels – Laverton Vic	Tallow and used cooking oil
Eco-tech Biodiesel – Narangba Qld	Tallow and used cooking oil

Source: Post Estimate

Indonesia

Commitment:

- In 2009, Indonesia announced its plans to invest 200 trillion Rupiah (US\$22 billion) over the next five years to promote the use of alternative fuels (biodiesel, ethanol)

Feedstock:



Cassava



Palm oil



Sugar cane



Jatropha

Sri Lanka



Commitment:

- ProBios project – Promotion of Biofuels for Sustainable Development in South and South East Asia
- ProBios project – part of EuropeAid’s (EU) programme to promote clean energy and sustainability
- Replace 20 % fossil fuel by 2020
- 400, 000 acres of land allocated for sugarcane and oil seed plantations by 2020

Feedstock:



Oil seeds - biodiesel



Sugar cane - bioethanol

Myanmar

- Myanmar = largest jatropha-growing country in the world (90 % of world's jatropha plantation)

Commitment:

- The Myanmar government promotes plantation of Jatropha as a national project
- Biofuel initiative:
 - Between local company & Japan Bio Energy Development Co. Ltd.
 - 2009 target:
 - a) Sell jatropha seeds, as much as 5,000 ton/y
 - b) Sell Jatropha-derived biofuels including export,



Feedstock: = Jatropha

Philippines

- 7 biodiesel plants – 257 million L/year (> local demand; export)
- Feedstock = coconut oil
(Philippine biggest coconut oil producer in the world 1,400 million L/ year)
- Bioethanol – only recently; feedstock = sugarcane

Commitment:

- Increase sugarcane farming areas from 350,000 ha to 600,000 ha
- B1 (5% biodiesel; 99% diesel) and E10 available throughout Philippines
- Philippines Biofuels Act (2007)
- Incentives for production of biofuels (special loan policies for investors)

Feedstock:

biodiesel



Jatropha



Coconut oil

bioethanol



Sugarcane



Sweet sorghum



Cassava

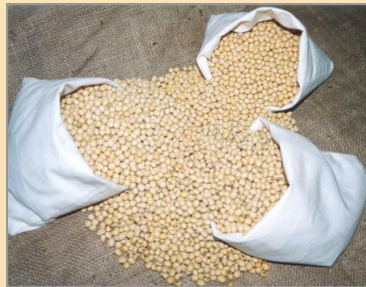
Korea

- 15 biodiesel plants – 625 million L/year
- feedstock = imported soybean (80%) & used cooking oil (20%)
- Negligible activity on bioethanol (lack of available feedstock)

Commitment:

- To increase local source for biodiesel feedstock – up to 500,000 ha of land allocated for plantation of winter canola
- B5 (5% biodiesel : 95% diesel) and B20 available nationwide
- E3 (3% ethanol : 97% gasoline) and E5 – market testing
- Mandate B3 by 2012
- Korean Std. for biodiesel – on par with EN14214 European Biodiesel Std (USDA 2007)

Feedstock:



Soybean



Used cooking oil



Winter canola

Japan

- Bioethanol – 30,000 L/ year from molasses, wheat, corn, sorghum, wood residues
- Biodiesel – 3 million L/year from used cooking oil
- 2006 – palm oil-based biodiesel developed
- E3 expected available in 1000 stations nationwide in 2009

Commitment:

- Japan – Brazil alliance on ethanol trading (2008)
- Biomass Nippon Strategy – Kyoto Protocol
- By 2010, **Japan will:**
 - a) reduce 60% (of 1990 level) CO₂.
 - b) consume 500,000 kL of ethanol/year in transportation sector
- By 2030, Japan targets to reduce reliance on fossil fuel to 80% for transportation



Hong Kong

- 1st biodiesel plant - 4.3 million L/ annum
- 2nd plant – 114 million L/ annum (projected)
- Domestic consumption and export to Europe
- Current feedstock = used cooking oil & animal fats
- Future feedstock = restaurant sewage

Commitment:

- Duty-free policy on the use of biodiesel
- The Environmental Protection Dept. developed specifications for biodiesel – ensure quality, boost user's confidence

Feedstock:



Used cooking
oil



Animal fats



Restaurant sewage

Taiwan

- 5 biodiesel plants – 42.1 million L/year
- Target – 100 million L/year
- No bioethanol industry – target 2 plants 100 million L/year
- B1 – 300 stations, E3 – 8 stations

Commitment:

- City buses uses B1
- B1 available nationwide (2008) and B2 by 2010
- Incentives for motorists who switches to bioethanol
- Tax exemptions

Feedstock:



Used cooking oil



Soybean

New Zealand

Commitment:

- Biofuel Sales Obligation will be set at 3.4% of the annual energy content of total annual gasoline and diesel sales by 2012 - Prime Minister Helen Clark
- New Zealand currently has a voluntary target for the use of biofuels in New Zealand of least 2 Petajoules a year by 2012 (around 65 million liters of biodiesel or bioethanol - 1%).

Feedstock:

- Biofuel industry – infancy stage
- Plan to import with gradual evolution to local biofuel industry
- Source:



animal fat



milk solids waste



sugar beet

SOUTH EAST ASIA – THE BIOBASED ARABIA?



‘Saudi Arabia produces 11 mil barrels per day. SEA has the potential to produce 14 mil barrels per day of renewable biofuels.....’

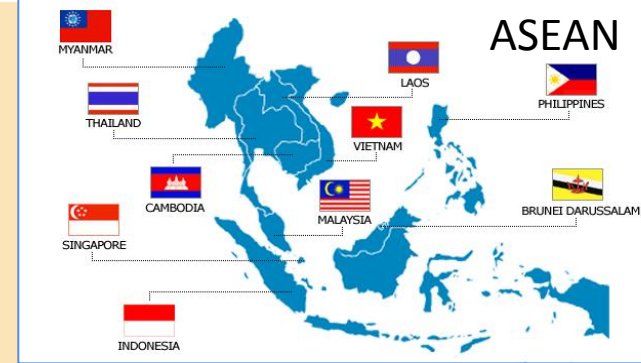
Per Dahlen,Portelet Asia
Biodigest.com (11 March 2010)

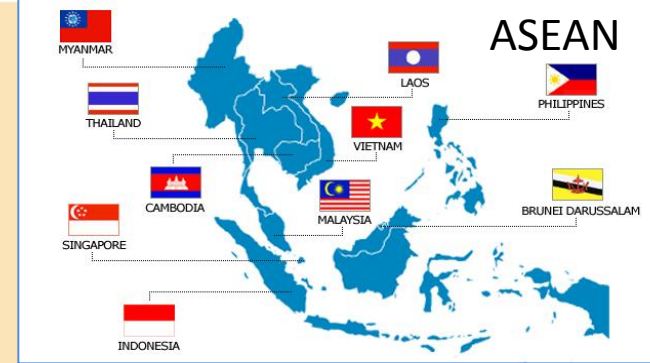
Location in the tropics with abundance of available land, water and cheap labour can turn SEA as biofuel producing power house...

SOUTH EAST ASIA – THE BIOBASED ARABIA?

To explore the full potential of biofuels in SEA, analyses of localised issues are as follows:

- **Crude oil prices** – steady increase. Expected net importer of 50% oil requirements by 2020.
- **Environmental and Sustainability Issues**- tighter rules set by US and Europe for imported biofuels. Green trade barriers.
- **Advancement of biotechnology** – engineering microbes to produce useful products. Use of GMO specifically for industrial purposes rather than food?
- **2nd generation technology (?)** is ready. May half the cost of production of biofuels.
- **Biomass waste** from oil palm, sugar and rice industries etc. Only 25-30% end up as end-products.





SOUTH EAST ASIA – THE BIOBASED ARABIA?

- **Dedicated energy crops** – cassava and sweet sorghum etc.
With current land use for oil palm and jatropha , SEA needs only 4.5 mil hectares of additional land for energy crops in order to be fully oil independence.
WWF and FAO estimates that SEA has 17.5 mil hectares of additional land available for energy crops. Or only 25% of this additional land is required to be oil independent.
- **Source of food, fuel and employment** for 0.5 billion population – this effort will create 5-20 million people.
- **Financing and government support**

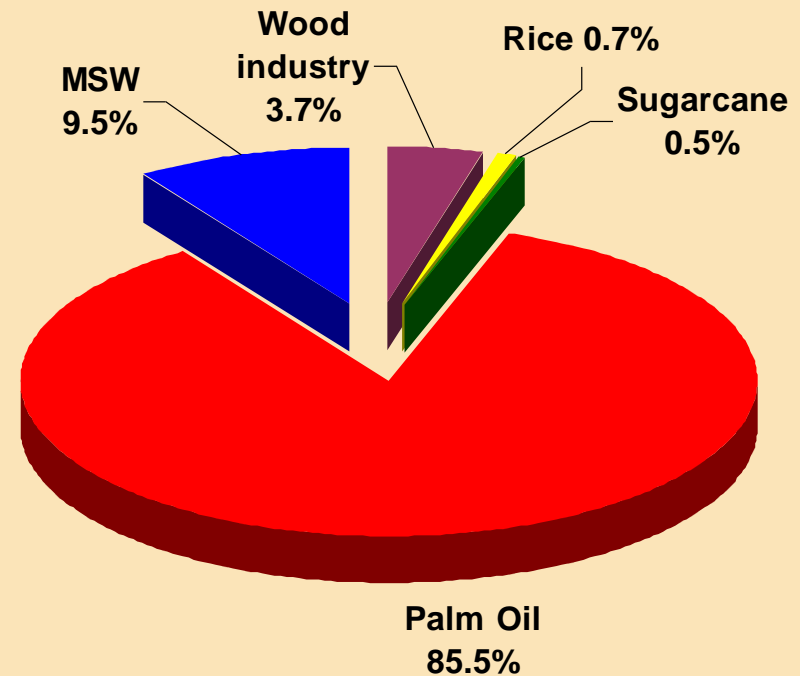
THE MALAYSIA SCENARIO

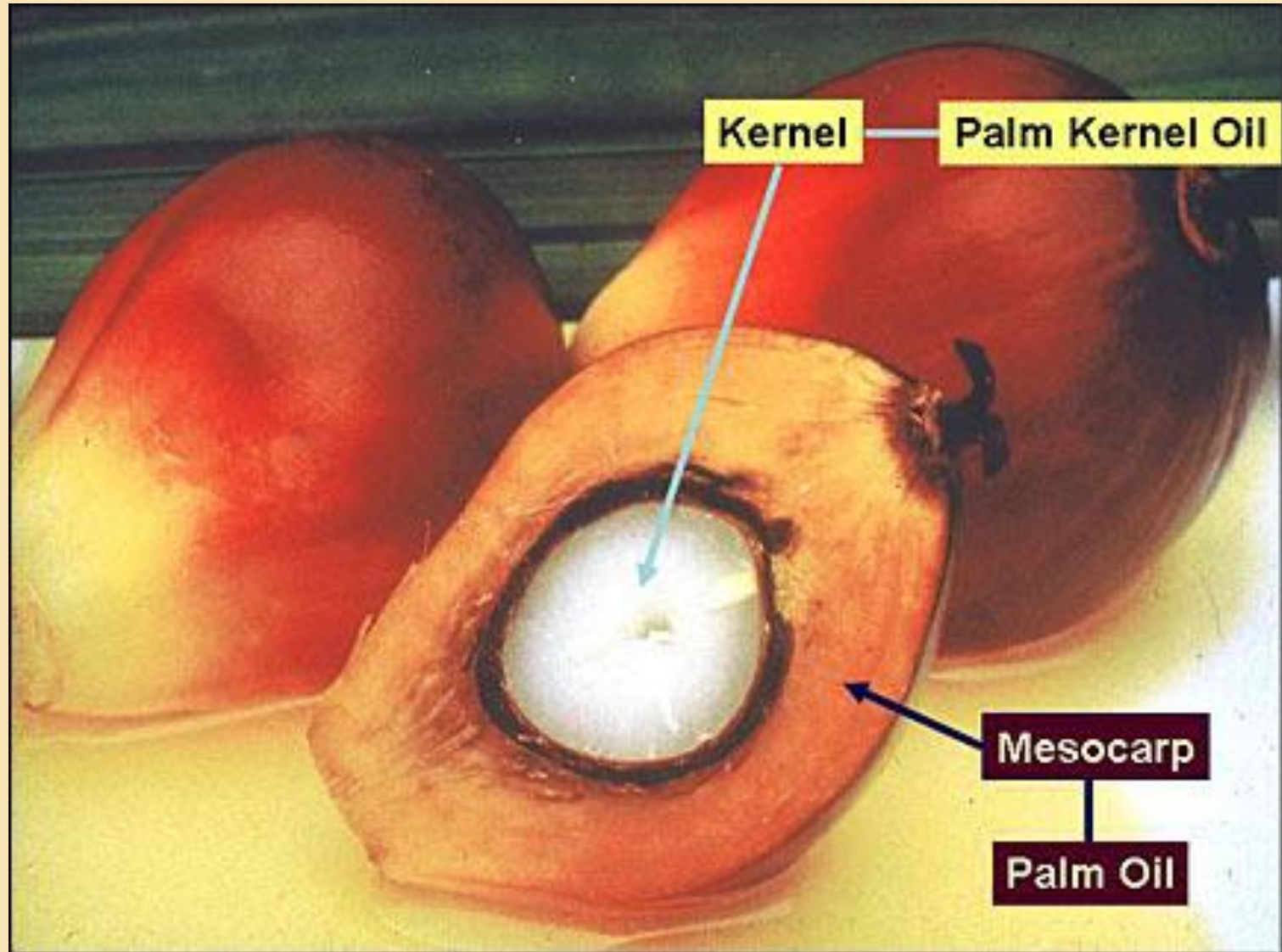


Biomass in Malaysia

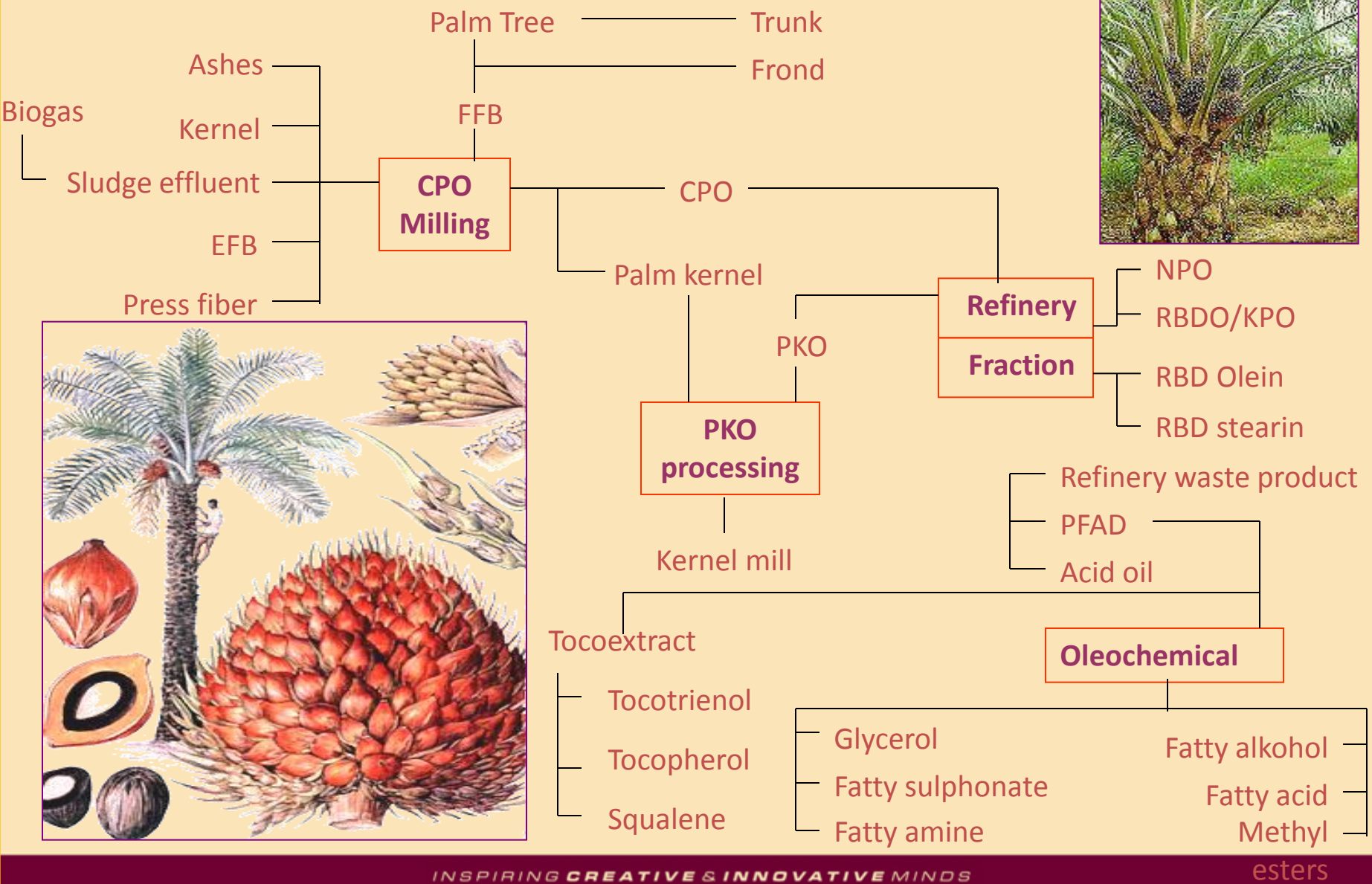
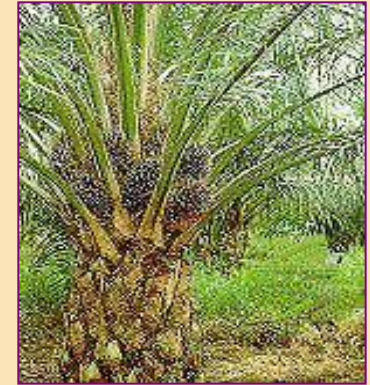


- Biomass – organic matter available on a renewable basis, including forest and mill residues, wood wastes, agricultural crops and wastes, animal wastes and MSW
- Abundant in Malaysia
> 70 million tonnes collected / year
- Production of biomass throughout the year
 - high sunlight intensity/time and high rainfall
- Main contributor of biomass is the palm oil industry, mainly ligno-cellulosics





PRODUCT FROM AN OIL PALM TREE



Distribution of the Malaysian Oil Palm Business and Ownership in 2006

OWNERSHIP OF PLANTED AREA

Private Estates	: 59%
Government/State Schemes	: 30%
Smallholders	: 11%

PENINSULAR MALAYSIA

2.34 mil ha	: 56%
249 mills	: 63%
36 refineries	: 71%
17 oleochemical plants	: 100%

SARAWAK

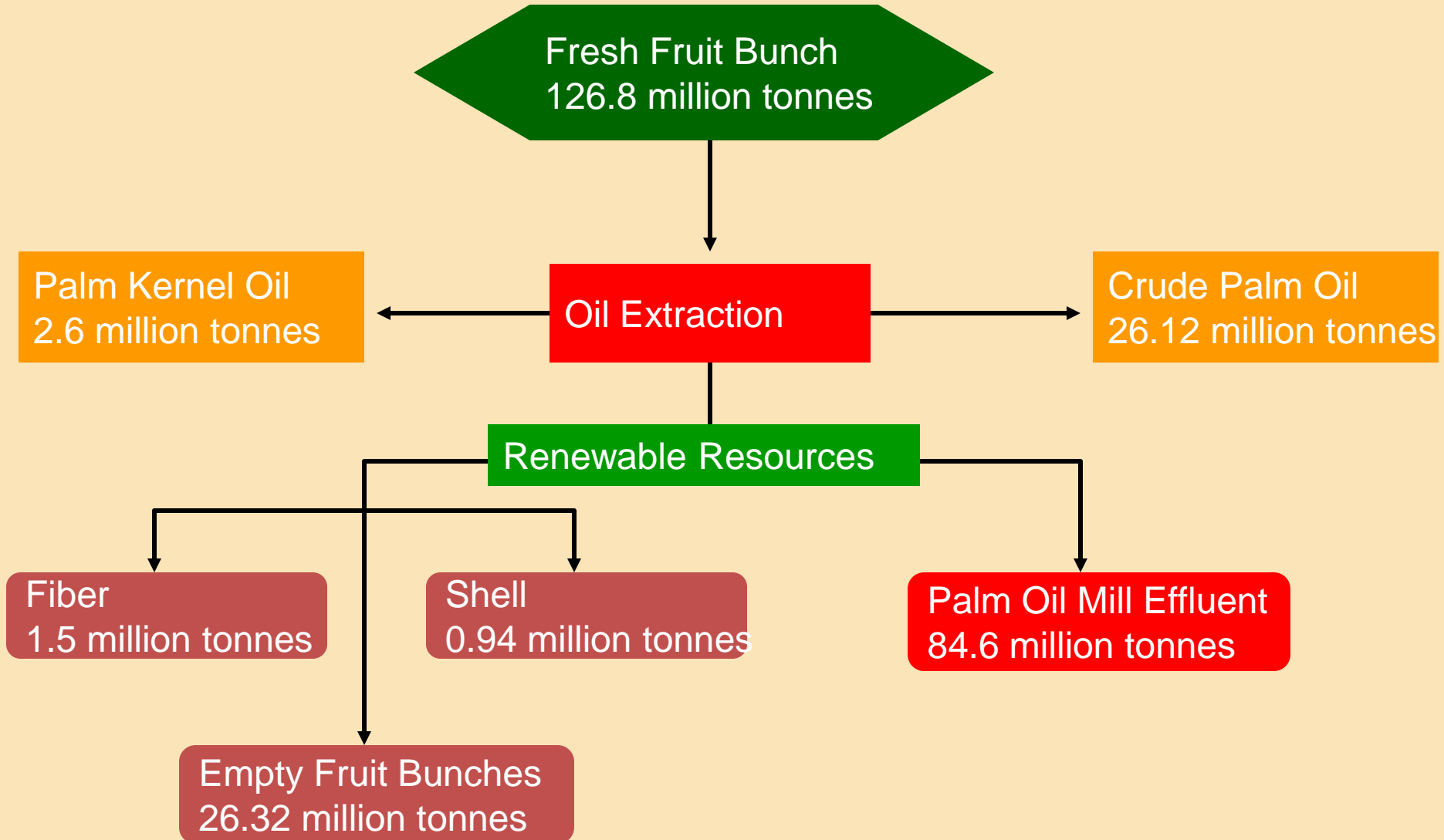
0.59 mil ha	: 14%
36 mills	: 9%
4 refineries	: 8%

SABAH

1.24 mil ha	: 30%
112 mills	: 28%
11 refineries	: 21%

Source: MPOB (2007c)

Malaysian Palm Oil Industry

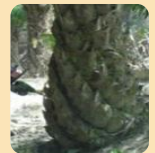


MALAYSIA ENERGY DEMANDS

- Malaysia final energy consumption is projected to grow at an annual rate of 4.8% (2000–2030)
- Transport sector will grow the fastest during the next 25 years with an annual growth projected at 5.3%
- Industrial sector will grow at 4.8% of annual rate
- Other sectors (residential, commercial and agricultural sectors) will have 4.2 % annual growth
- Malaysia will require triple the amount of energy consumed in year 2000, reaching 128Mtoe in year 2030

Biofuel in Malaysia

- Palm Oil (PO) - 1st generation: oil → Biodiesel (BD)
- 2nd generation:
 - PO Lignocellulose (LC) wastes: trunks, fronds, empty fruit bunches, shells, roots and fiber
 - LC → Bioethanol (BE)
- Other 2nd Generation:
 - LC → Bioethanol (BE)
 - Sago/Nipah/Tapioca: Small Pilot Scale
 - Jatropha
- Municipal Solid Waste (landfill)

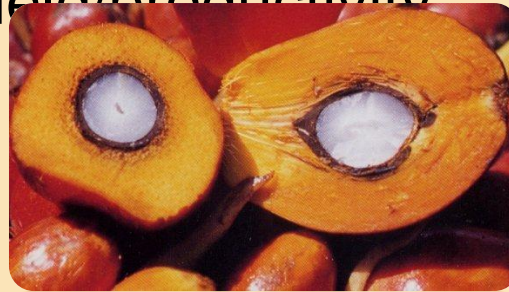


Biofuel in Malaysia

- Mainly exported: US, EU
- Marginal Profit:
 - Depends on prices of CPO & Crude Oil
 - Depends on policies abroad and Malaysian Gov.
- Technologies
 - Direct oil extraction + transesterification → Biodiesel (BD)
 - Fermentation of sugar-rich crop → Bioethanol (BE)
 - Pyrolysis Oil (Diesel Equivalent) → pyrolysis of wood
 - HTU Oil (Diesel Equivalent) → hydrothermal upgrading (HTU) of wet biomass
 - Liquid biofuels → methanol, DME, Fischer-Tropsch liquid from synthesis gas (gasification of biomass)

Palm Oil

- Global production rate: 40 Mil. MTs (2007)
- Malaysia: Key World Exporter (45.5%-2009)
- As rich mine: Pharma, Food, Feed and Fuel industries (Sarmidi *et al.*, 2009)
- M'sia PO Estates: 3.8 million hec. (2004)
- Export (2009): 15.9 Mil.T
- Export (2008) : US\$18.1 billion
 - From 4.5 mil. ha. land (~1.9% world oil crop **land-233mil. ha**) (2008)
- Challenges: Need to ↑ yield/productivity



Challenges for CPO for Biofuel

- Govt limit 5mil hectares for oil palm
 - Limited land in peninsular
 - Plenty land in Borneo, but lots of issue (conservation etc.)
 - Urgent Need to ↑ yield or productivity
 - Aim: 4T/ha/annum → 8T/ha/annum (Theoretical max.: 17T/ha/annum)
- Source: 25/05/2009 (Bernama)
- **Strategies:** genome sequencing, better extraction tech., better plant management
 - Increased production cost
 - Shortage of labor
 - High price of CPO as food oil
 - Lack of attractive insentives

Malaysian Government Biofuel Policy

- **Policy: National Biofuels Policy - 2005**
 - Aim: major global biodiesel (BD) producer
 - Short term: B5 (voluntary basis, guided by MPOB)
 - Long term: Increased use of B5-phase by phase
- **BD Project licenses approved: 92 (30 Oct., 2007)**
- **Act: The Malaysian Biofuel Industry Act 2007**
- **Enforcement: Malaysian Biofuel Industry (Licensing) Regulations 2008**

Latest M'sian Policy

- Oct 2008: B5 Mandate
 - Gov. vehicles – 2009
 - Industrial and transportation sect.: 2010.
- Still not compulsory
- Challenges:
 - Demand for biofuel: not urgent
 - Plenty of Crude Oil + Natural Gas
 - Higher Production Cost of biofuel (>USD100/barrel) than Crude oil (~USD80/barrel)
 - 'Feel good' situation in the industry

- The Petroleum Development Act, 1974
- The National Petroleum Policy, 1975
- The National Energy Policy, 1979
- The Four-Fuel Diversification Strategy, 1981
- The Five-Fuel Diversification Strategy, 1999

REVISED POLICIES & PROGRAMMES

- 1) The Fifth-Fuel Diversification Policy
- 2) Small Renewable Energy Power Programmes (SREP)
- 3) Biomass-Based Power Generation and Cogeneration (BioGen) Programme
- 4) Malaysia Electricity Supply Industry Trust Account (MESITA)
- 5) Renewable Energy Business Fund (REBF)

STRATEGIC THRUSTS

THE NATIONAL BIOFUEL POLICY



MINISTRY OF PLANTATION INDUSTRIES AND COMMODITIES
MALAYSIA

21 March 2006

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

New Business Potential of Palm Oil Industry



Concentration of biomass "business as usual"

Bioplastics (Polylactate)



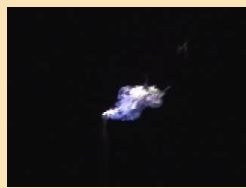
Fermentation & esterification of lactic acid



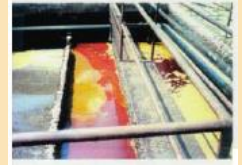
Empty Fruit Bunch > 14 million t/yr

Saccharification of cellulose

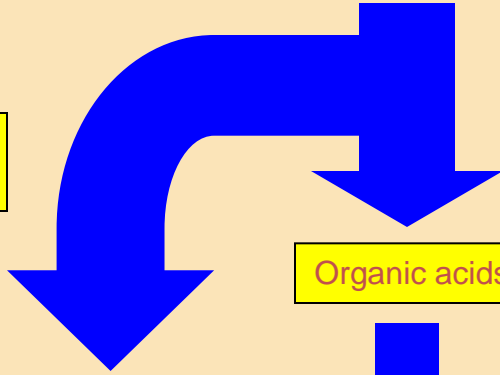
Sugar



Electricity



Palm Oil Mill Effluent > 45 million t/yr



Organic acids



Bioplastics (PHA)



500 m³ Biogas Pilot Plant

Methane Production from POME



HOLDING TANK
Continuous feeding



BIOREACTOR
Methane fermentation



GAS SCRUBBER
Biogas polishing



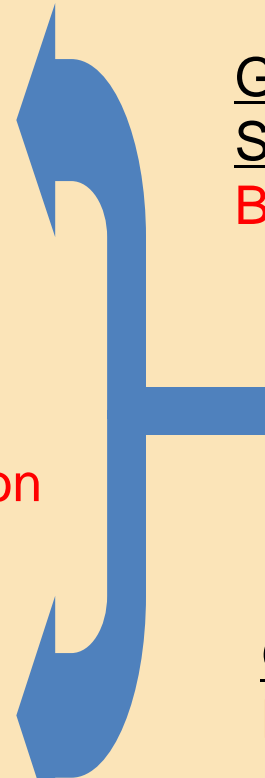
Sludge recycle



SETTLING TANK
Sludge separation



GAS UTILIZATION



GAS STORAGE
Methane storage



Palm Oil Industry - POME

- Palm oil mill effluent (POME) – 45 million tonnes/year (2.5-3.0 x CPO)
 - POME treatment facility – anaerobic, facultative and aerobic
 - Open tanks and lagoons
 - Treatment for safe discharge, BOD 25,000ppm down to 100ppm
 - Extensive and efficient system (> 70% of total mill area)
 - Biogas emission - 28m³ /m³ POME*, with 65% methane content
 - Untapped renewable energy





Biogas Pilot Plant Performance

Process parameters	Open Digesters	Biogas Pilot Plant
COD removal	81%	97%
Treatment time (days)	20	10
Methane utilization	Not collected	Available
Methane production (kg/kg COD)	0.109	0.20
Methane content (%)	36	55
Biogas production (m ³ /tonne POME)	28*	20
Solid discharge (g/L)	20	8



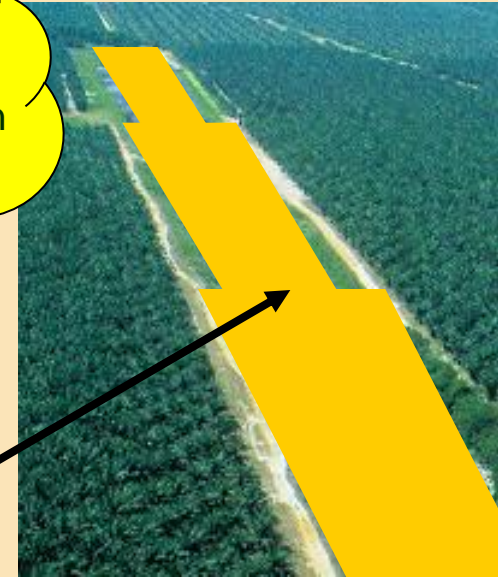
Novel Business Using Biomass Energy from Palm Oil Industry in Malaysia



CDM provides profitable area for novel business to which biomass energy can be supplied from palm oil industry with a very good price



for novel business



CDM provides a complete methane fermentation system and change lagoon area into a profitable area.

CDM provides electricity using the methane fermentation system for novel business with a competitive price.

1. CDM can reduce GHG by sealing the lagoons.
2. Prevention of undesirable smell by modern treatment.
3. Local employment can be encouraged from new business.

Based on the economic growth in Malaysia, the development of new oil palm plantation in the tropical rainforest will soon be no longer economically viable.

In order to meet the increasing demand for palm oil in the future, palm oil industry must cooperatively stay with other industries and people >>> 3P **Profit, People, Planet**

TSH Bio Energy Project

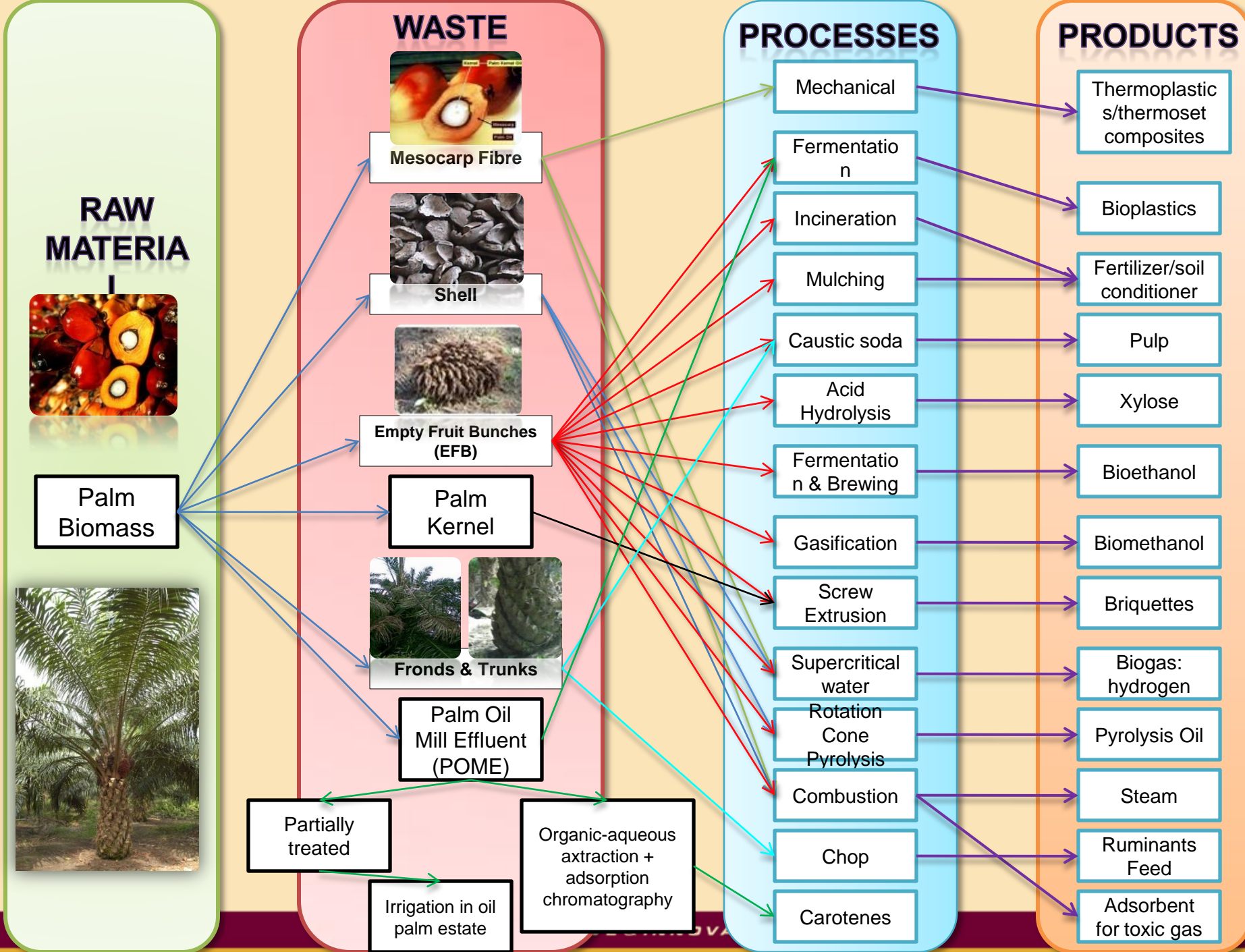
- ☀ Located in Kunak, Sabah

- ☀ Generation Capacity of 14 MW
(10 MW to be sold to SESB)

- ☀ Fuel to be used – oil palm residues (EFB, shells and fibres)

- ☀ Expected 40,000-50,000 tonnes CO₂ mitigation annually





WASTE



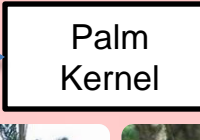
Mesocarp Fibre



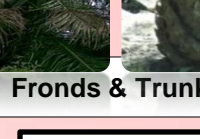
Shell



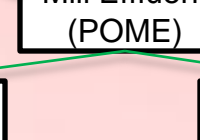
Empty Fruit Bunches (EFB)



Palm Kernel



Fronds & Trunks



Palm Oil Mill Effluent (POME)

PROCESSES

Mechanical

Fermentation

Incineration

Mulching

Caustic soda

Acid Hydrolysis

Fermentation & Brewing

Gasification

Screw Extrusion

Supercritical water

Rotation Cone Pyrolysis

Combustion

Chop

Carotenes

PRODUCTS

Thermoplastics/thermoset composites

Bioplastics

Fertilizer/soil conditioner

Pulp

Xylose

Bioethanol

Biomethanol

Briquettes

Biogas: hydrogen

Pyrolysis Oil

Steam

Ruminants Feed

Adsorbent for toxic gas

Partially treated

Irrigation in oil palm estate

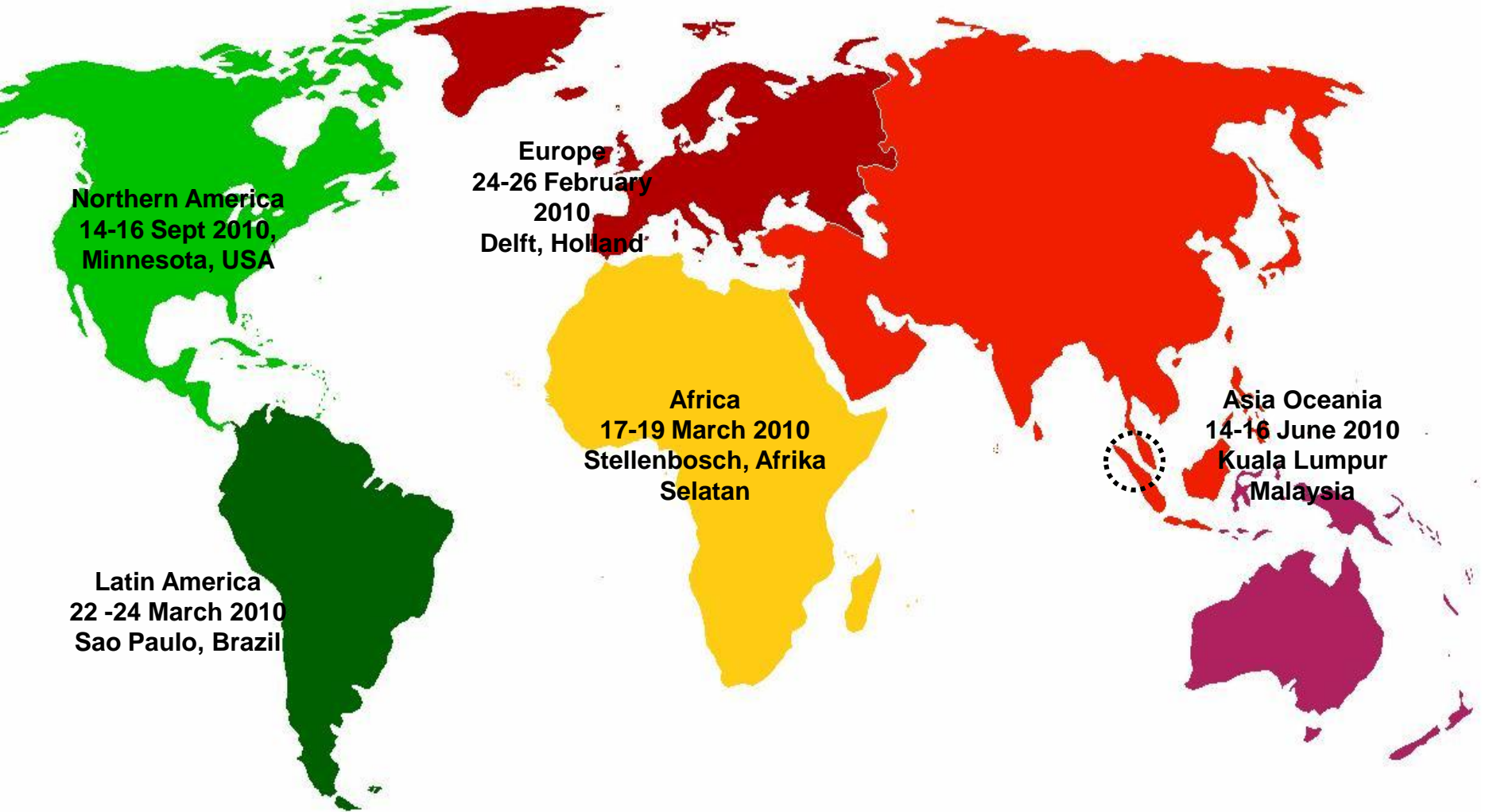
Organic-aqueous extraction + adsorption chromatography

RAW MATERIALS



Palm Biomass



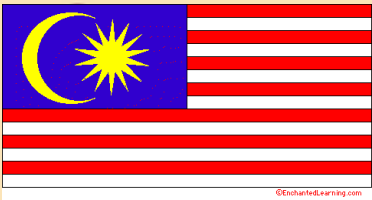
WORLDWIDE CONVENTIONS ON THE GLOBAL SUSTAINABILITY BIOENERGY PROJECT FOR 2010



**“ASIA OCEANIA CONVENTION – GLOBAL
SUSTAINABILITY BIOENERGY PROJECT 2010”
at the RENAISSANCE HOTEL, KUALA LUMPUR
On the 14th – 16th JUNE 2010**

**ORGANIZED BY:
CHEMICAL ENGINEERING PILOT PLANT (CEPP)
&
RESEARCH ALLIANCE IN BIOTECHNOLOGY,
UNIVERSITI TEKNOLOGI MALAYSIA
&
MINISTRY OF ENERGY, GREEN TECHNOLOGY AND WATER**

<http://cepp.utm.my/gsbasia/index.php>



SELAMAT DATANG KE MALAYSIA

(Welcome to Malaysia)

