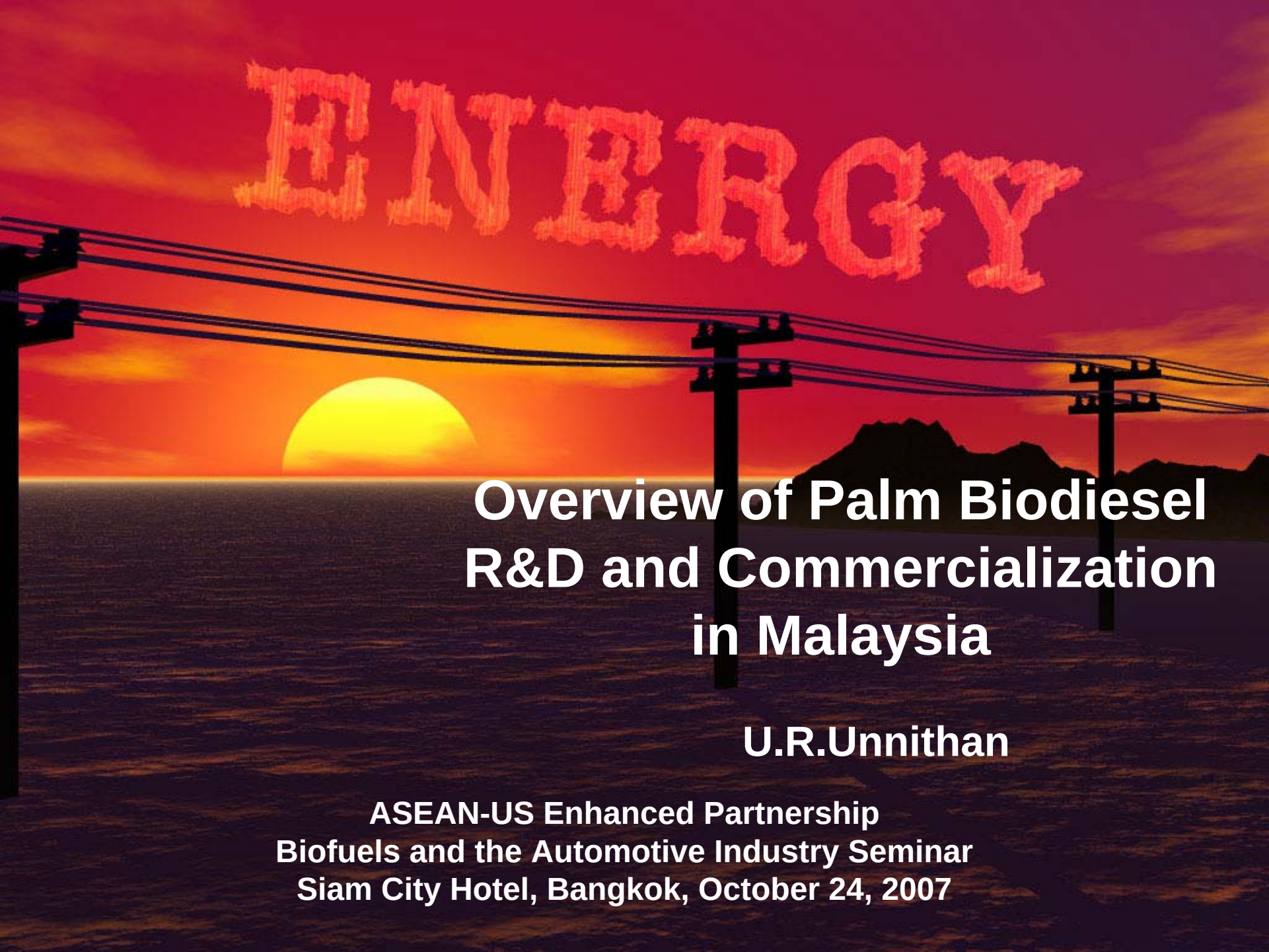


Overview of Palm Biodiesel R&D and Commercialization in Malaysia

U.R.Unnithan

ASEAN-US Enhanced Partnership
Biofuels and the Automotive Industry Seminar
Siam City Hotel, Bangkok, October 24, 2007

MALAYSIAN PALM BIODIESEL STORY

- Malaysian Palm Oil Board (MPOB) commenced the Palm Biodiesel R&D Project in 1982.
- Production Technology for Methyl Ester
- Evaluation as Diesel Substitute
- Low Pour Point Palm Diesel (Winter Fuel)
- Recovery of Co-Products: Phytonutrients
- Commercialization of R&D findings
- Marketing Challenges
- New Research Initiatives

Palm Diesel Pilot Plant at MPOB
(3,000 tonnes per year)

EXHAUSTIVE ENGINE FIELD TRIAL

PHASE I : 1986- 1989

31 engines of various makes

1. Garbage trucks
2. Lorries
3. Army trucks
4. Taxis
5. Mini-tractors
6. Generating sets
7. Land cruiser
8. Cars
9. Water pump
10. Vans
11. Stationary engine Testbeds

EXHAUSTIVE FIELD TRIAL (cont.)

PHASE I I : 1990 - 1994

- Stationary engine testing by Mercedes Benz
- 36 Buses mounted with Mercedes Benz engines
- Fuel Test
  - 100% palm diesel
  - 50% palm diesel + 50% petroleum diesel
  - 100% petroleum diesel (as control)
  - Each bus covered 300,000 km.
  - No modification of diesel engine required.
- MPOB vehicles
  Fuel tested: 100% crude palm stearin methyl esters

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


ENERGY

SUMMARY OF FIELD TRIAL

- No modification of diesel engine required.
- Good Performance of engine : easy starting, no knocking, smooth running
- Cleaner exhaust gas emission :
  - reduction of hydrocarbon(30%), CO(20%), (74%)CO_2,(99%)SO_2 content.
  - More environmentally friendly.
- Engine oil: still usable after recommended mileage.
- Cetane number / Diesel Improver (62.4 compared to 37.7 for petroleum diesel from Europe)
- Lower Ignition delay

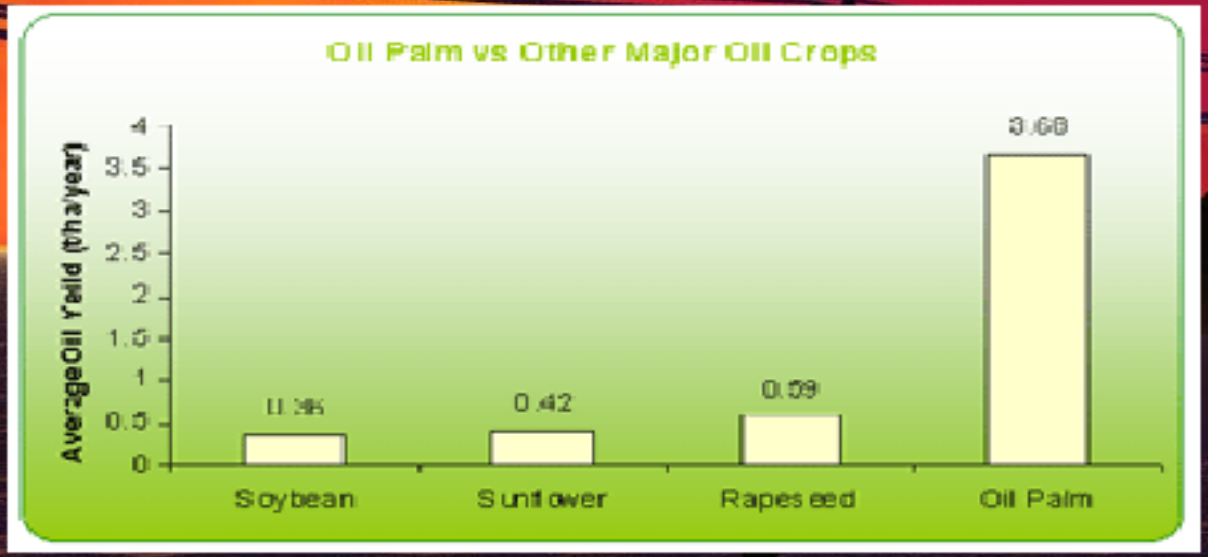
Why use Palm Biodiesel ?

- Made from renewable resources
- Biodegradable
- Reduces emissions of **carbon monoxide** (CO) by approximately 50% and **carbon dioxide** by 78.45% compared to petroleum diesel
- Free of Sulphur
- Non-toxic

Why Choose Palm Biodiesel?

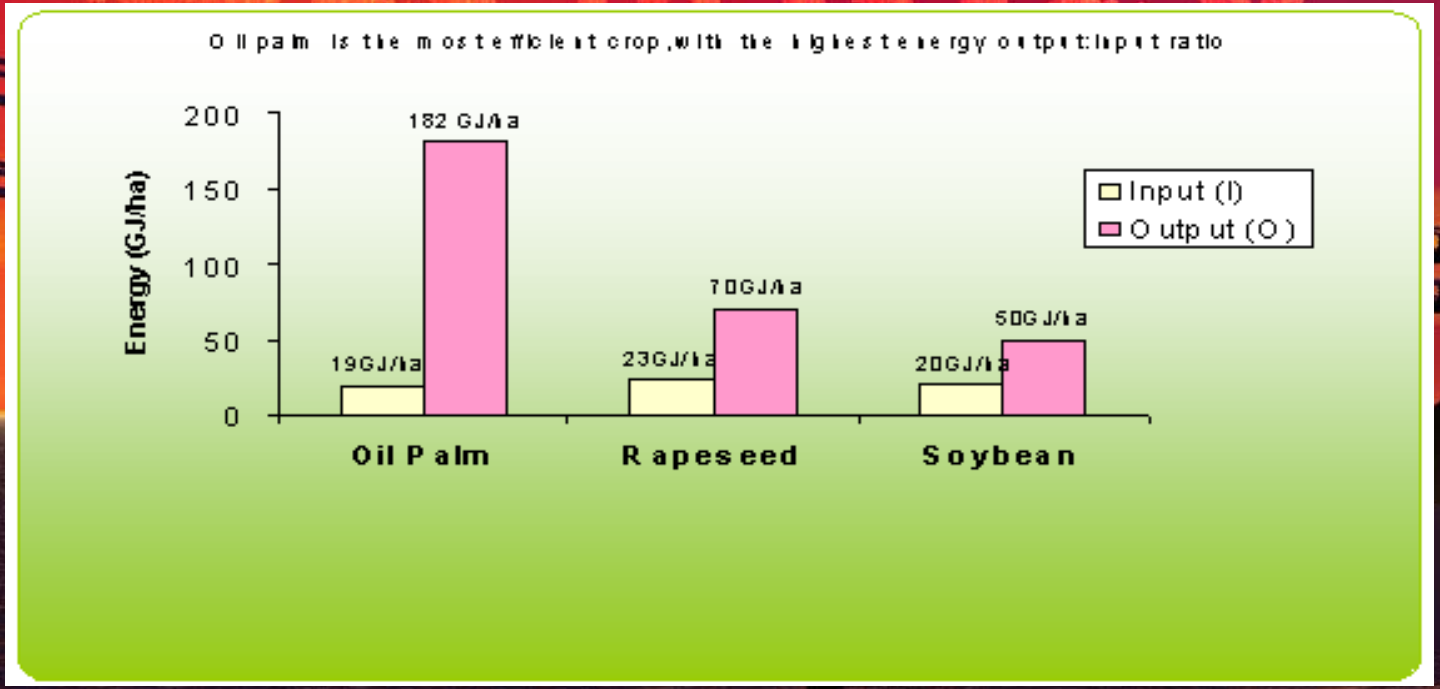
- Palm oil is the most productive oil bearing plant species.
- The yield of Palm Oil per unit area is 10 times more than other oilseeds. Average 3.68 t/ha/year compared to 0.36t/ha/year for Soybean and 0.59t/ha/year for Rapeseed (Source MPOC)
- Palm oil is less susceptible to the vagaries of weather compared to other crops.

Sustaining the Earth



Source: Malaysian Palm Oil Council, Oil Palm ….Tree of Life, 2006

Energy Balance for Palm, Soybean & Rapeseed Oils



O/I	Oil Palm	Rapeseed	Soybean
GJ/ha	9.6	3.0	2.5

In absolute terms, oil palm also requires the lowest input of pesticides, fertilizers and fuel for unit production of oil.

Source: UP Berhad

TRIALS OF PALM BIODIESEL ON COMMERCIAL TRAINS

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

Extraction of Neutraceuticals

Crude Palm Oil (CPO)

CPO Methyl Esters
(Palm Bio Diesel)

Distillation

Distilled Methyl Esters
(Palm Bio Diesel)

Excellent Qulaity Biodiesel & Feedstock for value-added oleochemical products

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

Carotenes
Vitamin E
Sterols
Squalene
Coenzyme Q
Phospholipids
(Lecithin)

R&D Commercialization

- MPOB Technology based pilot plant built by CAROTINO in 2002- primarily for Neutraceutical extraction. Palm Methyl Ester was a by-product then!!!
- Stabilized pilot plant and started commercial production by August 2002(3,000 TPA)

Carotino PME Pilot Plant

MPOB's Biodiesel Commercialization Initiative

- 3 Licenses awarded to build 60,000 mt/yr Palm Biodiesel Plants based on MPOB Technology- CAROTINO, Golden Hope and FIMA.
- Construction of first Plant started by CAROTINO in December 2005 and commissioned in June 2006

The World's First Integrated Palm Biodiesel Plant.

- Carotino together with MPOB commercialized The World's First Integrated Palm Biodiesel Plant by end June 2006.
- The Honourable Prime Minister of Malaysia Dato' Seri Abdullah Haji Ahmad Badawi officially opened the Plant on Aug 15, 2006
- Bulk Shipments started in Aug 2006

Current Status

- Regular-grade Biodiesel plant Meets EN 14214 & ASTM D 6751Specifications

MPOB/CAROTINO
60,000 TPA Palm Biodiesel Plant

Winter-grade Palm Diesel Technology

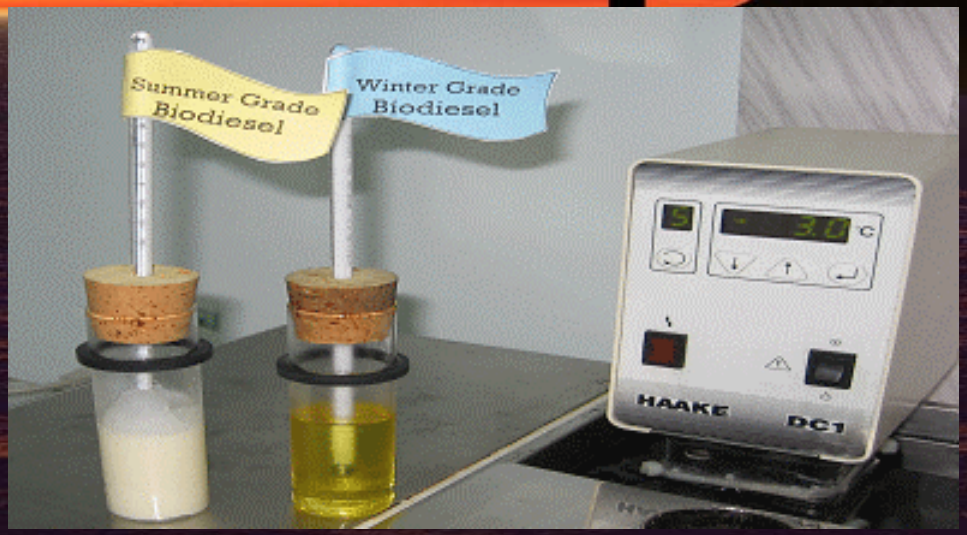
- MPOB developed technology for -15°C to -21°C CFPP palm diesel.
- Carotino signed winter-grade fuel technology with MPOB in 2005.
- Joint Pilot Plant trials between Carotino and MPOB carried out in early 2006.

Current Status of the 30,000 TPA Winter Grade PME Plant

- Plant Successfully Commissioned in July 2006 to produce Winter Grade Palm Biodiesel(- 6 Deg C , -15 Deg C & -21 Deg C Pour Point)
- First of its kind in the World.
- Exports of Winter grade PME started in Nov 2006

MPOB/Carotino 30,000 TPA Winter-grade PME Plant

Regular & Winter Grade Palm Biodiesel



Commercial Winter Grade Palm Biodiesel

Palm Biodiesel-Marketing Challenges

- High Crude Palm Oil Prices (US$850/MT now!!!)
- Lack of subsidy and mandate for blending in the local market.
- Distortions in export markets due to Tariff & Non-Tariff Barriers(import duty 4.6% in to US, US$300/mt tax credit on biodiesel exports)
- Cheaper sources of raw material
- Change in Specification
- Raw material availability
- Foreign Exchange Risk(1 US$=3.8 RM in June 2006, now 3.37)

New Research Initiatives in Biofuels

- Development of new additives to improve cold flow property of Palm Biodiesel and to improve Lubricity.
- Production of value added products from Glycerine
- Further downstream purification of valuable anti-oxidants in Natural Palm Oil to Pharmaceutical grade standards
- Biomass to Liquid Technologies-currently under evaluation

Thank you