UTILIZATION OF BIOMASS IN MALAYSIA
– Potential for CDM Business –

Mohamed Ali Hassan
Shahrakbah Yacob
Baharuddin Abdul Ghani
alihas@biotech.upm.edu.my

Faculty of Biotechnology
UNIVERSITY PUTRA MALAYSIA
www.upm.edu.my
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
Malaysian Palm Oil Industry

Fresh Fruit Bunch 67.5 million tonnes

Palm Kernel Oil 1.6 million tonnes

Oil Extraction

Crude Palm Oil 13.9 million tonnes

Renewable Resources

Fiber 0.8 million tonnes

Shell 0.5 million tonnes

Palm Oil Mill Effluent 45 million tonnes

Empty Fruit Bunches 14 million tonnes
## Potential Power Generation from Oil Palm Residues at Palm Oil Mills in Malaysia

<table>
<thead>
<tr>
<th>Type of Industry</th>
<th>Production (Thousand Tonne)</th>
<th>Residue</th>
<th>Residue product Ratio (%)</th>
<th>Residue Generated (Thousand Tonne)</th>
<th>Potential Energy PJ</th>
<th>Potential Electricity Generation (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil palm</td>
<td>59800</td>
<td>EFB at 65%MC</td>
<td>21.14</td>
<td>12641</td>
<td>57</td>
<td>521</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fiber</td>
<td>12.72</td>
<td>7607</td>
<td>108</td>
<td>1032</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shell</td>
<td>5.67</td>
<td>3390</td>
<td>55</td>
<td>545</td>
</tr>
<tr>
<td>Total Solid</td>
<td></td>
<td></td>
<td></td>
<td>16670</td>
<td>220</td>
<td>2098</td>
</tr>
<tr>
<td>POME (3.5m³ per ton of CPO /65% of FFB)</td>
<td></td>
<td></td>
<td></td>
<td>38870</td>
<td></td>
<td>320</td>
</tr>
</tbody>
</table>

Data is for the year 2002.
Problems Associated with Biomass

- Increasing demand for food leads to increased biomass/waste generation
  - problem with waste treatment and disposal
- Open dumping/landfill and wastewater treatment facility
  - uncontrolled released of greenhouse gases/global warming
  - groundwater contamination from leachate
- Indiscriminate dumping
  - environmental pollution
- Burning of biomass
  - emission of smoke & haze hazard
  - emission of toxic chemicals such as dioxins
- No special incentives or provisions to utilize these residues
- Biomass business not economically feasible & long payback period
• Energy policy promotes Renewable Energy (RE) as the 5th fuel with the target 5% of total electricity generation by 2005

• Under 8MP (2001 – 2005) and OPP3 (2001 – 2010), the government will intensify and accelerate the development and utilization of biomass for RE
Barriers of Biomass Utilization

• Policy barriers
  – limited incentives on biomass utilization

• Supply & demand perspectives
  – no reliable data on actual potential of biomass
  – slow implementation of 5th Fuel Policy (RE, including biomass)
  – limited effort to regulate and enforce biomass programs

• Environmental perspective
  – current technologies are inefficient and polluting

• Financial & technical barriers
  – high initial investment
  – limited local technologies and equipment
  – poor financial support, no record on biomass industry

• Institutional barrier
  – limited coordination among the local agencies

• Unwillingness of the industry to change and to be proactive
Major Challenges of Biomass Energy in Malaysia

- Fuel Security
- Electricity Sales Price
- Renewable Energy Power Purchasing Agreement
- Financing Assistance
- Lack of Promotion
- Conventional vs Renewable Energy Power Plant
- Subsidy for Conventional Energy
ENVIROMENTAL ISSUES

- Uncontrolled anthropogenic release of greenhouse gases (GHG)
  - increased heat trapped in the atmosphere

- Detrimental effects to global climate
  - increase in sea level, submerging of lowlands, deltas and islands
  - changing weather patterns
  - increase moisture precipitation and evaporation
  - frequent rainstorms and drier soils
  - decline in soil moisture – low crop yield
  - change in water supplies – unpredictable weather

- Adversely affecting the WORLD FOOD PRODUCTION
  and the WORLD ECOSYSTEM
ENERGY REQUIREMENT

• Global scenario:
  – rising fossil fuels prices
  – rapid depletion of fossil fuel reserves
  – deep water oil production – rising cost
  – complications in oil recovery – rising cost
  – political uncertainties in oil producing countries

• Malaysian scenario:
  – growing demand - becoming developed nation by 2020
  – limited fossil fuel reserves for only 30 – 40 years
  – expected to be a net oil importer from 2040
Use of Biomass as Alternative?

- Paradigm shift towards BIOMASS
  - Not waste
  - Renewable energy
  - Sustainable
  - Environmentally friendly
  - Abundant supply, all year round
  - Untapped energy

- Uncertainties of BIOMASS
  - Technological proven?
  - Economically feasible?
  - Constant supply?
  - Quality and quantity?
  - Availability & distribution? (worldwide export/import)
Proposed Biomass CDM Business

- BIOMASS GENERATION
- Power Generation
  - Energy
- Biomass Industry
  - New Bioproducts
- Mitigation Methods
  - CDM Projects

- Greenhouse Gas Emission
- Environmental Pollution
- Global Warming
- Climate Change
- Hazard
Malaysian CDM Policy

- Kyoto Protocol, ratified in September 2002
- Ministry of Natural Resources and Environment (NRE, formerly under MOSTE) as Designated National Authority (DNA) – May 2003
- Formulation of the CDM approval structure
- Endorsement of national CDM criteria
- National criteria for small renewable energy projects (SREP) endorsed
- www.ptm.org.my/CDM_website/
CDM Institutional Framework

MINISTRY OF NATURAL RESOURCES & ENVIRONMENT (NRE)
(Functions as Designated National Authority)

NATIONAL STEERING COMMITTEE ON CLIMATE CHANGE
• Chaired by Secretary General (NRE)
• Members from Governments, private sectors & NGOs

NATIONAL COMMITTEE ON CDM
• Chaired by Deputy Secretary General (NRE)
• Members from Governments, private sectors & NGOs

Technical Committee on Energy

Technical Committee on Forestry
National CDM Criteria

- CDM projects must be in accordance with sustainable development policies of the Government;

- CDM projects must fulfill all conditions underlined by the CDM Executive Board;

- Implementation of CDM projects must involve participation between Malaysia and Annex 1 Party/Parties;

- CDM projects must provide technology transfer benefits and/or improvement in technology; and

- CDM projects must bring direct benefits towards achieving sustainable development.
The Way Forward in Malaysia

- Government will participate in CDM towards realizing its sustainable development goals
  - energy projects have been placed as top priority for CDM implementation

- Importance of biomass utilization for electricity generation
  - striking a balance between fuelling economic activities and environmental improvement

- The way forward
  - to mobilize market forces by setting up policies, regulatory framework, appropriate incentives, etc.
CDM Simulation Project

JOINT RESEARCH COLLABORATION BETWEEN MALAYSIA-JAPAN

- Government institutions
  - University Putra Malaysia & Kyushu Institute of Technology
- Private sectors
  - FELDA Palm Industries & Sumitomo Heavy Industries

BENEFITS ACHIEVED

- Actual transfer of technology
- Improvement of current POME wastewater treatment
- Mitigation measures of greenhouse gases emission
- Generation of renewable energy from methane
- Promote sustainable development of palm oil industry
<table>
<thead>
<tr>
<th>Process parameters</th>
<th>Open Digesters</th>
<th>Biogas Pilot Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>COD removal (polluting strength)</td>
<td>81%</td>
<td>97%</td>
</tr>
<tr>
<td>Treatment time (days)</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Methane utilization</td>
<td>Not collected</td>
<td>√</td>
</tr>
<tr>
<td>Methane production (kg/kg COD)</td>
<td>0.109</td>
<td>0.20</td>
</tr>
<tr>
<td>Methane content (%)</td>
<td>36</td>
<td>55</td>
</tr>
<tr>
<td>Biogas production (m³/tonne POME)</td>
<td>(28*)</td>
<td>20</td>
</tr>
<tr>
<td>Solid discharge (g/L)</td>
<td>20</td>
<td>8</td>
</tr>
</tbody>
</table>
## Electricity Generation (1000 kWh)

<table>
<thead>
<tr>
<th>Estimated Costs, RM (million)</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Construction of Biogas Tanks (3500t x 3 units)</td>
<td>4.6</td>
</tr>
<tr>
<td>Downstream processing (Gas scrubber &amp; storage)</td>
<td>3.4</td>
</tr>
<tr>
<td>Gas turbine @1000 kWh (Methane productivity)</td>
<td>3.8</td>
</tr>
<tr>
<td>Total plant cost</td>
<td>11.8</td>
</tr>
<tr>
<td>Yearly maintenance and operation cost (5% of plant cost)</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**Benefits/Revenues generated:**

- Internal office use and external lighting
  - reduce diesel cost/usage during mill's non-operating hours
- Aeration system to remove remaining BOD
  - increase POME treatment efficiency/environmental benefits
  - reduce large land requirement (>70% of total mill area)
- Estimated sale of CER @€ 19.60 per tonne CO₂ per year – RM 1.8 million

(Assumption: mill capacity of 60t FFB/hr and 320 days of operation)
Steam Co-generation

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<tr>
<td>Construction of Biogas Tanks (3500t x 3 units)</td>
<td>4.6</td>
</tr>
<tr>
<td>Downstream processing &amp; boiler modifications</td>
<td>1.5</td>
</tr>
<tr>
<td>Total plant cost</td>
<td>6.1</td>
</tr>
<tr>
<td>Yearly maintenance and operation cost</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Benefits/Revenues generated:

- Additional income from shell sale revenue @RM40/tonne
  - reduce 50% shell usage inside the boilers
  - potential daily revenue – RM 2480 (60 tonnes shell)
- Reduce black smoke emission from boilers
  - increase air quality/environmental benefits
- Estimated sale of CER @€ 19.60 per tonne CO\(_2\) per year – RM 1.8 million

(Assumption: mill capacity of 60t FFB/hr and 320 days of operation)
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**

- **Palm Oil Mill Effluent**
  - >45 million t/yr

- **Sugar**

- **Organic acids**

- **Bioplastics (PHA)**
  - 500 m³ Biogas Pilot Plant

- **Electricity**

**Flowchart:**
- Start with biomass concentration.
- Move to bioplastics production.
- Proceed to empty fruit bunch processing.
- Saccharification of cellulose.
- Palm oil mill effluent.
- Organic acids production.
- Bioplastics synthesis.
- Electricity generation.
- Biogas pilot plant.
Novel Business Using Biomass Energy from Palm Oil Industry in Malaysia

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.
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)