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Methane Capture and Use Potential at Palm Oil Mills in Indonesia

Methane Expo 2013
Vancouver, Canada
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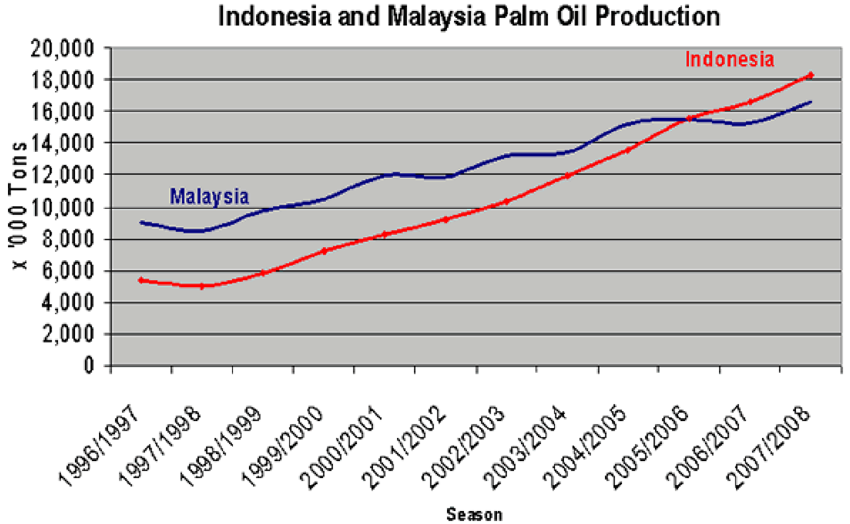
List of Abbreviations

- BOD Biochemical Oxygen Demand
- CH_4 Methane
- COD Chemical Oxygen Demand
- CO_2 Carbon Dioxide
- CO_2e Carbon Dioxide Equivalent
- CPO Crude Palm Oil
- EFB Empty Fruit Bunch
- FFB Fresh Fruit Bunch
- GHG Greenhouse Gas
- POME Palm Oil Mill Effluent

Indonesia palm oil production

- ~2 million km^2; 17,500+ islands; ~250 million people (2012 est.)
- GHG emissions: 1.8 billion tons CO_2e (2005)
- 1st palm oil producer in the world (2nd = Malaysia)
- 2012 production = ~25 million tons CPO (~18 million tons for export)
- Main plantation areas:
  - Sumatra (~65%)
  - Borneo (~30%)



Indonesia

Source: CIA World Factbook

Indonesia palm oil sector structure

RSPO
Roundtable on Sustainable Palm Oil

An International Multi Stakeholder Organization and Certification Scheme for Sustainable Palm Oil

- Organizations:
  - Indonesia Palm Oil Board (IPOB)
  - Indonesian Palm Oil Association (GAPKI)
  - Indonesian Sustainable Palm Oil (ISPO)
  - Mills are members of RSPO
- Structure:
  - 50% State-Owned Companies
  - 50% private
  - ~600 mills (~400 in Sumatra)

Representative mills in Indonesia

- Nominal production capacity of 30, 45, 60 and 90 tons/hr
- Process between 200,000 and 600,000 tons/yr of FFB
- Privately owned mill have higher productivity levels.

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- Palm oil production and relevant factors
- Generation, characteristics and management of products, subproducts and wastes
- Methane use potential scenarios
- Transaction options in Indonesia
- Key barriers and conclusions

Palm oil fruit

Fresh Fruit Bunch (FFB)
~ 100 fruits/FFB

Empty Fruit Bunch (EFB)

Mesocarp → palm oil + fiber

Endocarp → shell

Kernel → kernel oil

Indonesia palm oil products, sub-products and waste generation

General characteristics:

- CPO = 20-25% of FFB w/w (product)
- POME = 45-65% of FFB m^3/t (effluent) or ~2.4 m^3 POME/ton CPO
- EFB = 20% of FFB w/w (EFB = 20% stalk + 80% spikelets) (used as fertilizer or incinerated)
- Fibers = 10-13% of FFB w/w (can be used in boilers)
- Shells = 5-7% of FFB w/w (can be used in boilers)
- Biomass = 35-40% of FFB w/w
- Also biomass at the plantation: fronds, trunks

Characteristics and management of POME

POME characteristics:

Parameter	Average	Range
pH	4.1	3.3-4.6
POME – COD (mg/L)	50,000	30,000-80,000
POME – BOD (mg/L)	25,000	15,000-40,000
TS (mg/L)	45,000	16,000-95,000
TSS (mg/L)	20,000	1,500-50,000

- POME characteristics are unique for each mill and depend on production levels, extraction process, and characteristics of the FFB
- Multiple conventional anaerobic lagoons with depth greater than 3m, often 4-6 m

Direct methane emissions from POME in Indonesia

Production - CPO	25 million tons/year
Wastewater generation	2.5 m^3 per ton of CPO
Chemical Oxygen Demand	50 kg/m^3
Lagoon use	95%
Methane conversion factor	0.8
Max methane producing capacity	0.25 kg CH_4/kg COD
Direct methane emissions	**~ 12.5 million tons of CO_2e**

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Methane use scenarios

The methane captured can be used to generate:

- thermal energy in boilers
- electricity for the mill and/or to sell to the local grid

Viability depending on mill's characteristics:

- electricity versus thermal energy needs
- shell generation
- capacity of the existing boiler
- distance to the grid

Scenario 1: Use existing boilers

- Cost of digester and new burner: ~US$ 1.1 million
- O&M expenses: ~US$ 130,000
- Annual net revenues: ~ US$400,000
- Almost two thirds of the revenues come from selling the shells which are currently burned in boilers

Scenario 2: Sell electricity to LV grid

- Total investment cost: ~US$2.6 million
- O&M expenses: ~US$ 450,000
- Price to sell electricity: 0.147 USD/kWh
- Electricity generation: ~7,500 MWh/year
- Net revenues: US$ 1 million per year

Scenario 3: Sell electricity to MV grid (20kV)

- Total investment cost: ~US$ 2.9 million
- O&M expenses: ~US$ 450,000
- Price to sell electricity: 0.108 USD/kWh
- Electricity generation: ~7,500 MWh/year
- Net annual revenues: ~US$ 600,000

Summary of analysis

Scenario		
1 - use biogas in existing burner and sell shells	Total cost	1,050,000
	IRR	37%
	NPV	3,187,736
2 - use biogas to generate electricity and sell to the low voltage grid (interconnect to nearest town)	Total cost	2,615,862
	IRR	37%
	NPV	7,886,289
3 - use biogas to generate electricity and sell to the medium voltage grid (interconnect with nearest 20 kV line)	Total cost	2,897,181
	IRR	19%
	NPV	3,663,249

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Alternative transaction options for biogas projects in Indonesia

1. **The POM owner develops and finances the project by himself** and utilizes expert consultants/EPC contractor to design, build, and operate the facility over time on a fee for services basis
2. **The IPP developer Builds, Owns, and Operates the facility for 10-15 years before Transferring (BOOT) the plant back to the POM owner** and assuming all technology risks and responsibilities for arranging financing typically on a project finance basis
3. **The IPP developer enters into a Joint Venture (JV) arrangement with the POM owner** whereby the mill owner provides land, access to the site, use of the waste stream, and a corporate guarantee in return for a negotiated share of the profits.
4. **Special Purpose Biogas Company** established to develop, own and operate multiple, bundled biogas project opportunities on a project finance basis
5. **Joint Venture Investment Company in Concert with an owner of multiple POMs** to develop bundled biogas project assets

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Key barriers and challenges to biogas projects from POME

- Incomplete legal and regulatory framework
- Limited models of successful biogas projects and successful projects to prove concept
- Project developers and financial institutions lack understanding of each other’s requirements and constraints
- Not their primary line of business - dilution of facility resources
- Bad experience, particularly with covered lagoons - failure of some CDM projects
- Access to the grid - revenue stream is key in making the project feasible

Conclusions

- Large replication potential in Indonesia (1st palm oil producer in the world, current use of open lagoons for POME)
- Viability of biogas projects – Best option depends on mills characteristics:
  - generate electricity for the mill or sell to the local grid (low- or medium-voltage)
  - generate thermal energy in boilers
- Need to bundle viable projects

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Indonesian Government to Revoke Palm Oil Licenses Without Sustainable Credentials

March 11, 2013

A view of cleared land designated for a palm oil plantation in Pelalawan, Riau province, Indonesia, on this Aug. 10, 2010 file photo. (Bloomberg Photo/Dimas Ardian)

The Indonesian government is ready to revoke the licenses of palm oil companies in the country if they do not have an Indonesian Sustainable Palm Oil certificate by 2014, a high-level official at the Agriculture Ministry said on Thursday.

"Because it is a mandatory, there will be sanctions. We could revoke the licenses of palm oil companies that do not have the ISPO," said Gamal Nasir, director general for plantations at the ministry.

The Indonesian government introduced the ISPO several years ago, setting a standard to ensure that palm oil producers will not add to deforestation and destruction of carbon-rich peat lands because of their activities.

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