بسم الله الرحمن الرحيم

PALM COMPLEX MODEL AND SUSTAINABLE BIOMASS BUSINESS IN MALAYSIA

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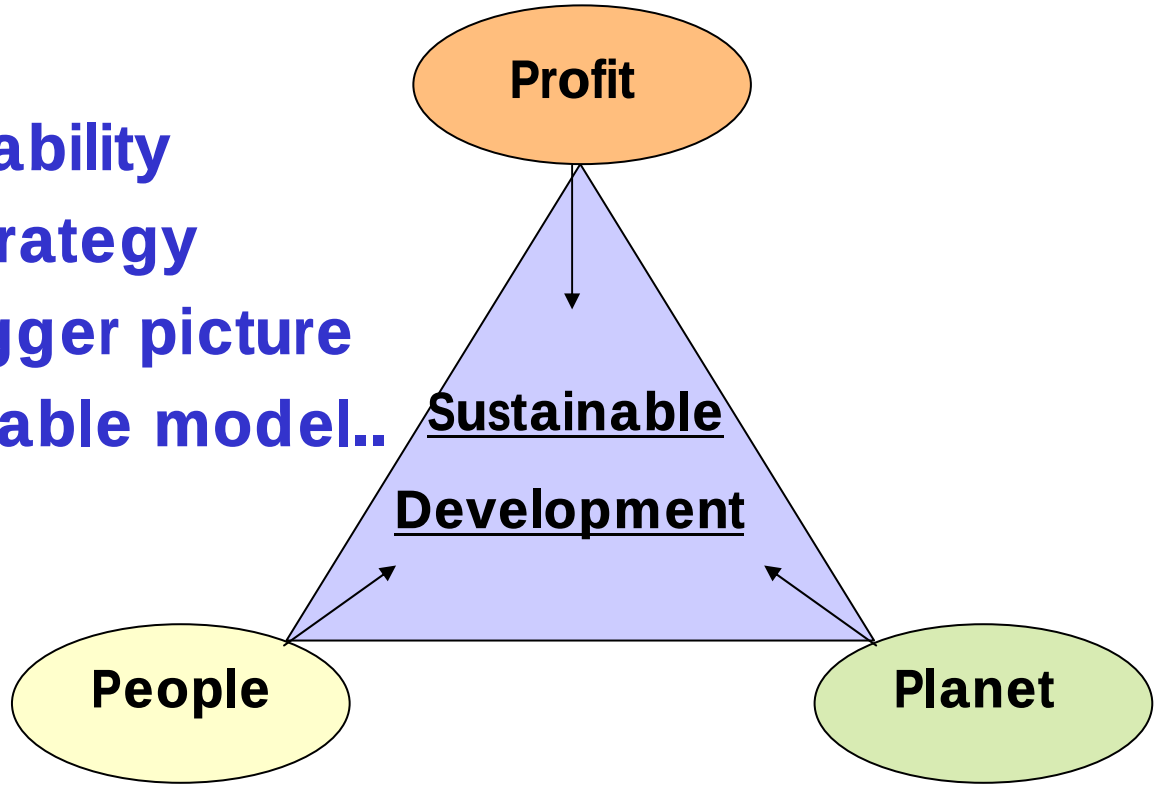
Sustainability.. the 3Ps

- Merging the 3Ps
- Towards sustainability

  >>> win-win-win strategy
- Consider the bigger picture
- Develop sustainable model..

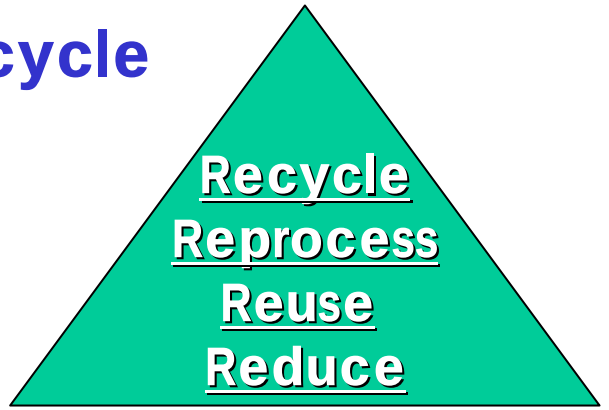


Biomass

Problem → Profit

Waste Management and Utilisation

- The 4 stages of waste management
  1. no treatment
  → 2. treatment to meet discharge standards
  3. incorporate 4R strategies
  4. zero-emission
- 4Rs – reduce, reuse, reprocess, recycle
- Concept of zero-emission
- w2w.. from waste to wealth
- b2b.. from biomass to business!

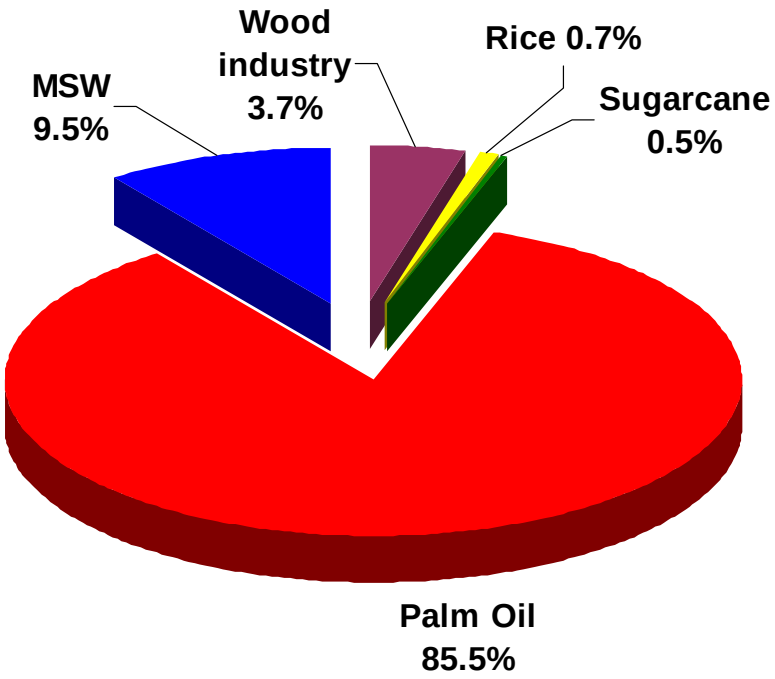


Palm Biomass Resources in Malaysia

- ~~Wastes?~~ → **Biomass**
  = renewable organic matter

- **Palm biomass available at the mills**
  ~ 50 million tonnes collected / yr

- **Available throughout the year**
  - **business as usual**
  - **automatically collected**



Oil Palm Tree and Its Products

- Oil palm tree, 3-10 meters high
- Requires constant sunshine and rain
- Fresh fruit bunch (~ 20 kg each)

  → Oil + Biomass
- Contains 20% crude palm oil and 3% palm kernel oil
- Introduced from West Africa in 1911
- First commercial planting in 1917
- #1 commodity in 1970

Palm Oil Industry and Malaysian Socio Economy

- Now 4 million hectares of oil palm (10% of Malaysia land area)
- 400 mills throughout Malaysia (self-sufficient in energy.. excess)
- Highest oil yielding crop in the world
- Excellent R&D by PORIM/MPOB
- Palm oil - Malaysia's gift to the world
- USD 13 billion export in 2007
- More than 500,000 people employed
- Poverty alleviation
- Land ownership & stable income
- FELDA's success story!

- Sustainable Development
  - 3Ps: Profit, People and Planet
  - "win-win-win"

Malaysian Palm Oil Industry*

Fresh Fruit Bunch
70 million tonnes

Palm Kernel Oil
2 million tonnes

Oil Extraction

Crude Palm Oil
16 million tonnes

Renewable Resources

Fiber
9 million tonnes

Shell
4 million tonnes

Palm Oil Mill Effluent
50 million tonnes

Empty Fruit Bunches
16 million tonnes

* approximate material balance (wet basis), 2007

Current Wastewater Treatment System

Biogas (Methane)

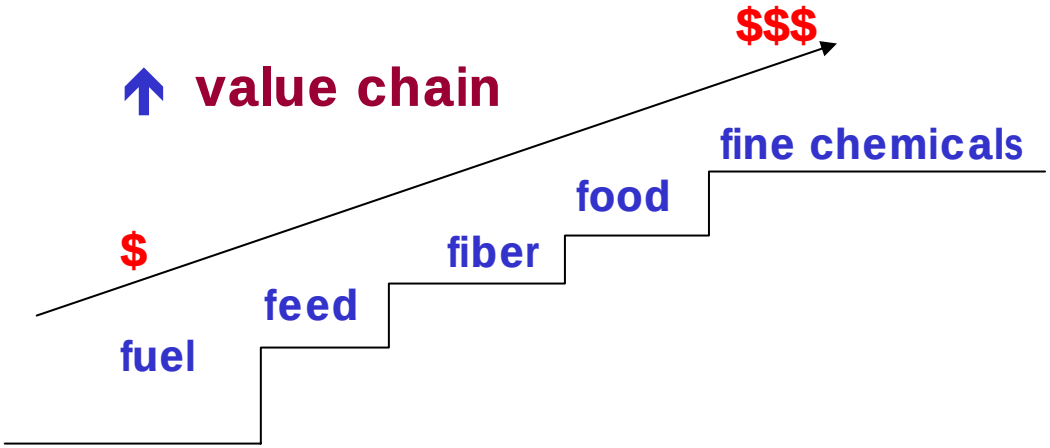
- Anaerobic treatment for palm oil mill effluent
- Proven system… treatment for safe discharge
- Very high methane emission
- Methane released, not utilized

Potential Power Generation from Oil Palm Residues at Palm Oil Mills in Malaysia

Type of Industry	Production (Million Tonne)	Residue	Residue product Ratio (%)	Residue Generated (Million Tonne)	Potential Energy PJ	Potential Electricity Generation (MW)
Oil palm	59.8	EFB @ 65% MC	21.14	12.641	57	**520**
		Fiber	12.72	7.607	108	1032
		Shell	5.67	3.390	55	545
	Total Solid			16.670	220	2098
	POME (3.5t/tCPO or 65% of FFB)			38.870		**320**

Utilisation of Palm Biomass

- **Paradigm shift towards biomass**
  - Not waste
  - Renewable
  - Sustainable
  - Under-utilised resource >>> $$$
- **Uncertainties of biomass**
  - Technological proven ?
  - Economically feasible ?
  - Quality and quantity ?
  - Availability & distribution ?



Palm Complex Model and Sustainable Biomass Business

Concentration of biomass
"business as usual"

Empty Fruit Bunch
> 15 million t/yr

Palm Oil Mill Effluent
> 50 million t/yr

"zero emission"

sustainable model

Saccharification of cellulose

Bio-acids $$$

Bioplastic (PLA) $$$
Bioethanol $$$

Sugars

Fermentation in bioreactors (Compost as by-product) $$$

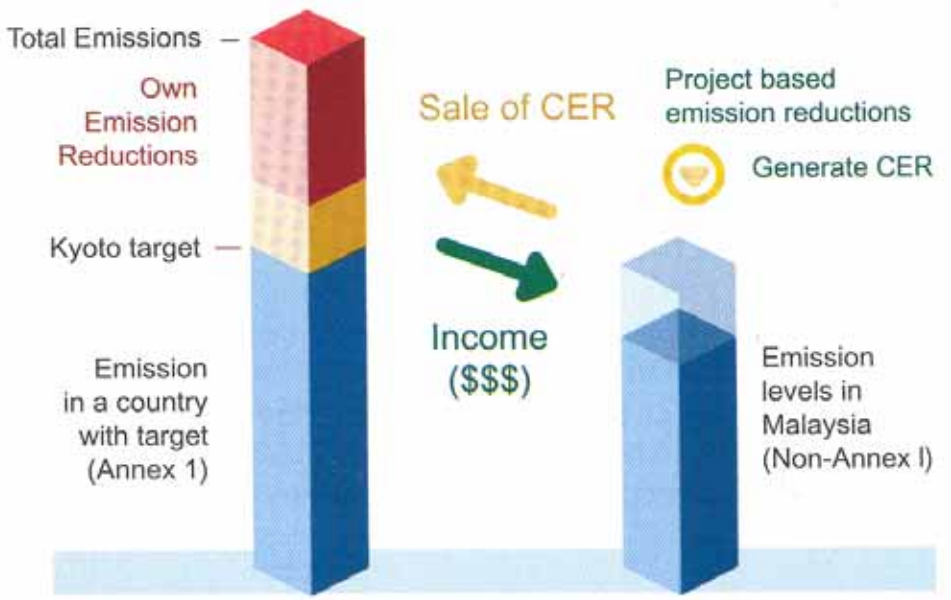
Energy $$$

Biogas (+ Biohydrogen)

Bioplastics (PHA) $$$

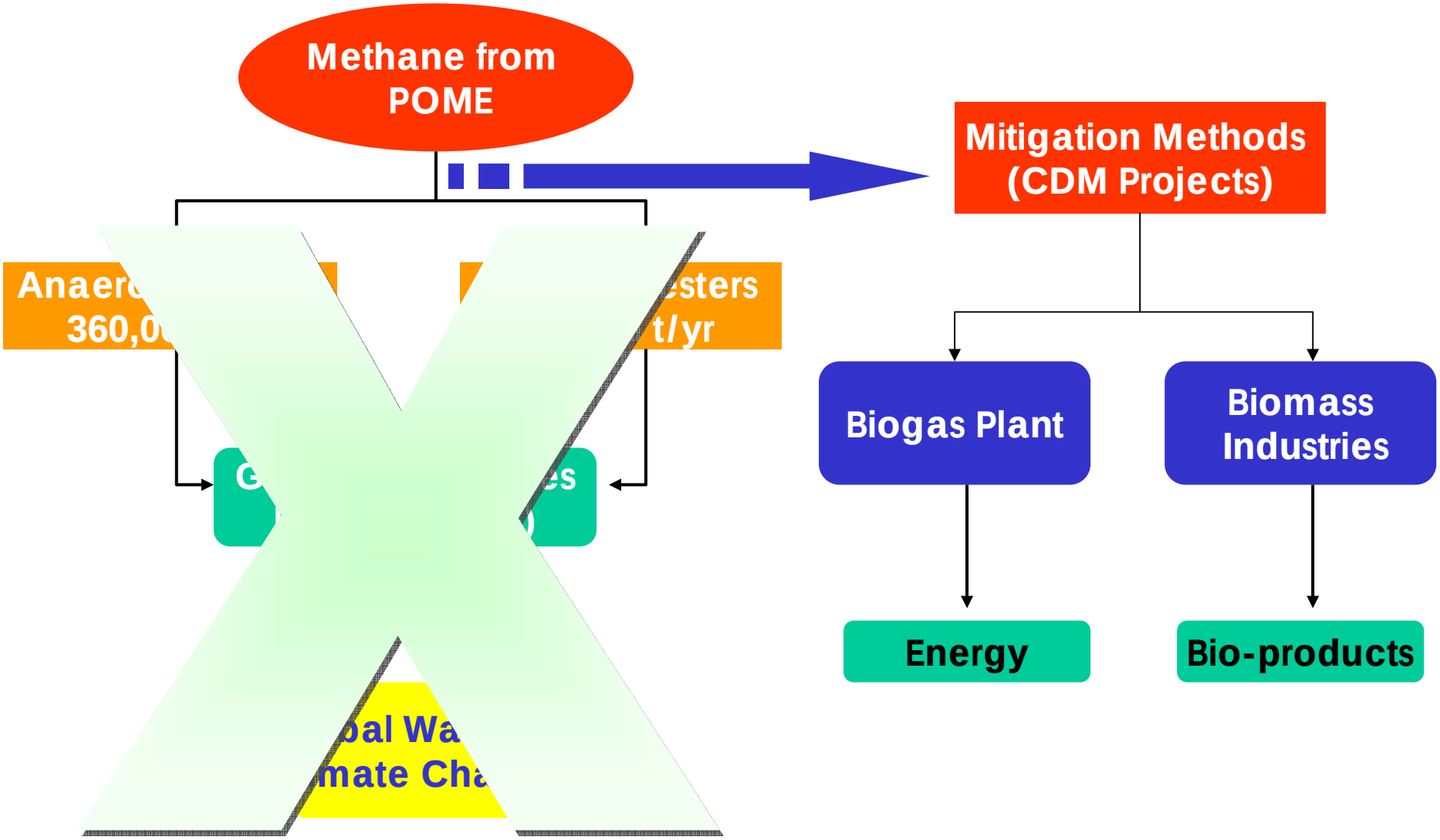
CDM Project and Carbon Credit

- Target of CDM is reduction of GHG emission in developing countries by developed countries (5% of 1990 level)
- Claim the certified emission reduction (CER)
- Developed countries (Annex 1) shall :
  - provide new and additional financial resources
  - transfer of technology
- The CER can be traded in the carbon market as carbon credit **$$$**

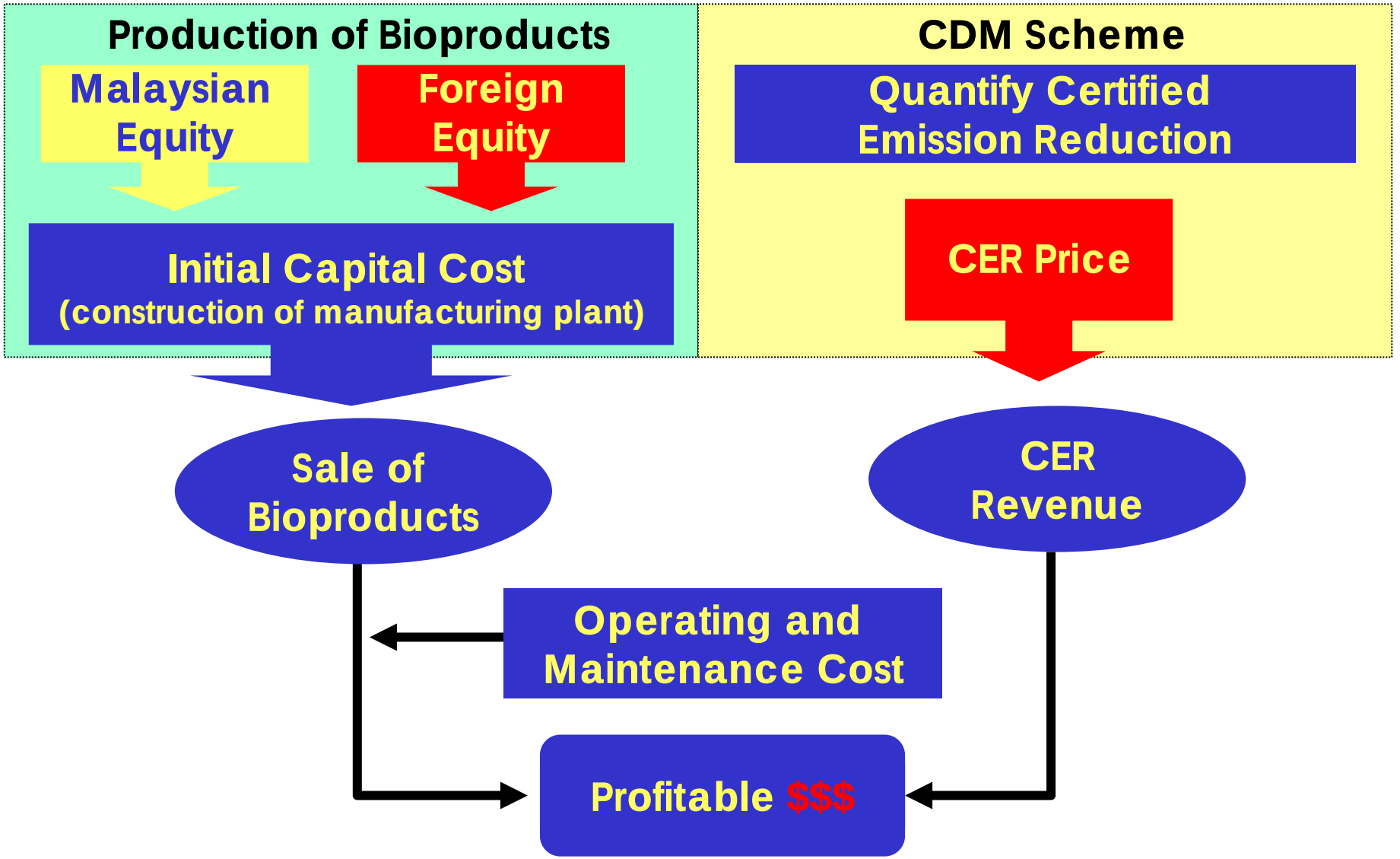


Source: PTM

Methane Emission Mitigation



CDM Biomass Business for Palm Oil Industry



CDM Simulation Project (FELDA-UPM-KIT)

JOINT RESEARCH COLLABORATION, 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

Electricity Generation (1MW to Grid)

Estimated Costs, RM (million)	
Construction of Biogas Tanks (3500t x 3 units)	4.6
Downstream processing (Gas scrubber & storage)	2.0
Gas turbine @ 1000 kW	2.4
Total plant cost	9.0
Yearly maintenance and operation cost (5% of plant cost)	0.5

Benefits/Revenues :

- Internal office use and external lighting
  - reduce diesel cost/usage during mill's non-operating hours
- Sale of renewable electricity to TNB @ RM0.21/kWh ~ RM 1 million/yr
- Aeration system to remove remaining BOD
  - increase POME treatment efficiency >>> zero emission!
  - reduce large land requirement (~70% of total mill area)
- Estimated sale of CER @ € 10 per tonne CO_2 ~ RM 1 million/yr

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

Steam Co-generation

Estimated Costs, RM (million)	
Construction of Biogas Tanks (3500t x 3 units)	4.6
Downstream processing & boiler modifications	1.5
Total plant cost	6.1
Yearly maintenance and operation cost	0.3

Benefits/Revenues :

- Additional income from shell @ RM60/tonne
  - reduce 50% shell usage inside the boilers
  - potential revenue ~ RM 1 million/yr
- Reduce black smoke emission from boilers
  - increase air quality/environmental benefits
- Estimated sale of CER @ € 10 per tonne CO_2 ~ RM 1 million/yr

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

Sustainable Palm Biomass Business Model in Palm Oil Industry

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

CDM provides electricity from methane fermentation system for novel business >>> zero emission, w2w and b2b!

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

Based on the economic growth in Malaysia, the development of new oil palm plantations in the tropical rainforest is no longer economically viable.
In order to meet the increasing demand for palm oil in the future, palm oil industry must be sustainable with the environment and people >>> 3P (Profit, People, Planet)