

Sustainable Waste Management in Palm Oil Mills

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Country Profile - Indonesia

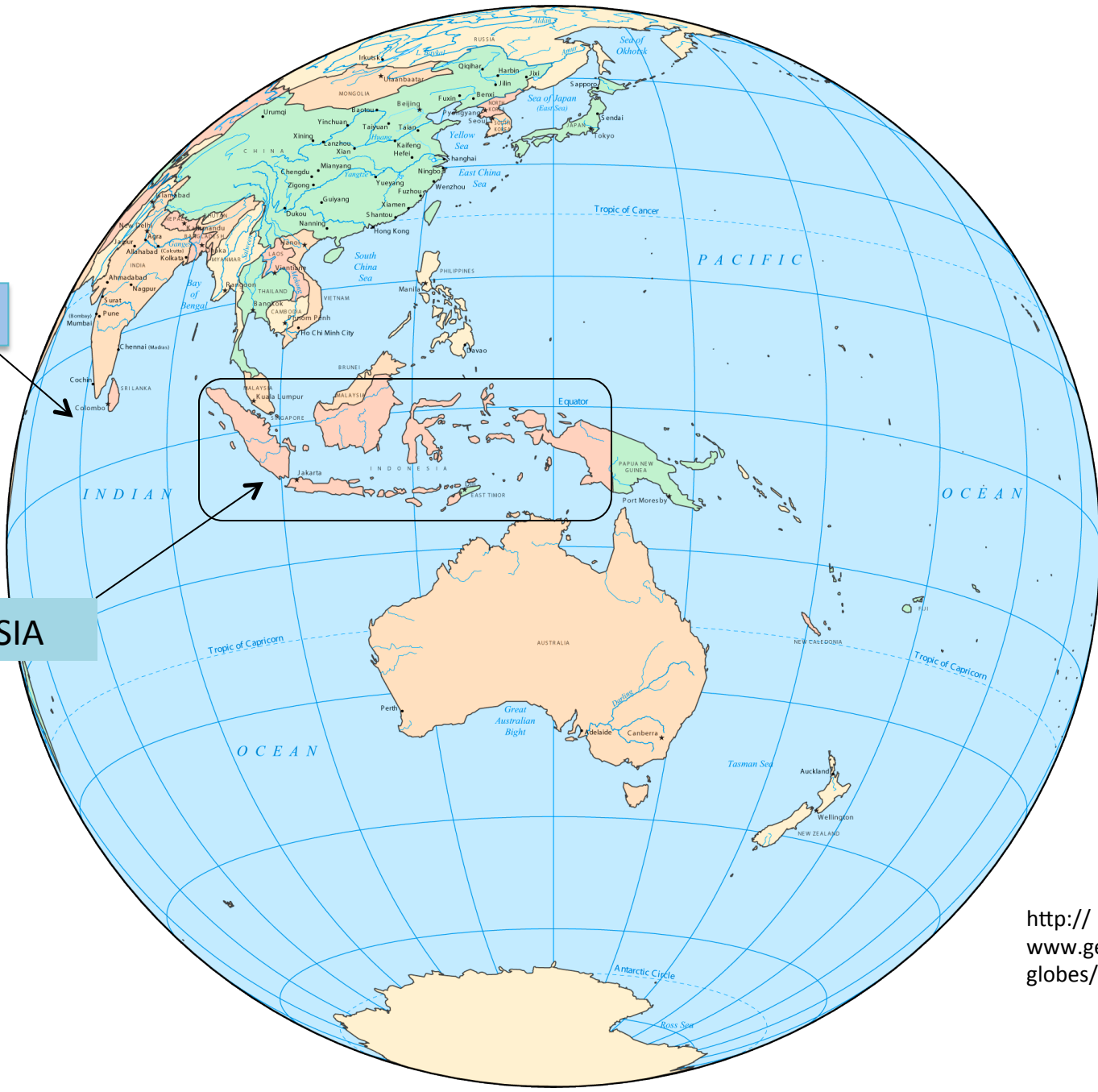
- Area : 1,904,000 km²
- Population : 246.9 millions (2012)
- Growth rate : 5.6 % (2013)
- GDP per capita : USD 3,420 (2012)

(source: <http://data.worldbank.org/country/indonesia>)



MALDIVES

INDONESIA



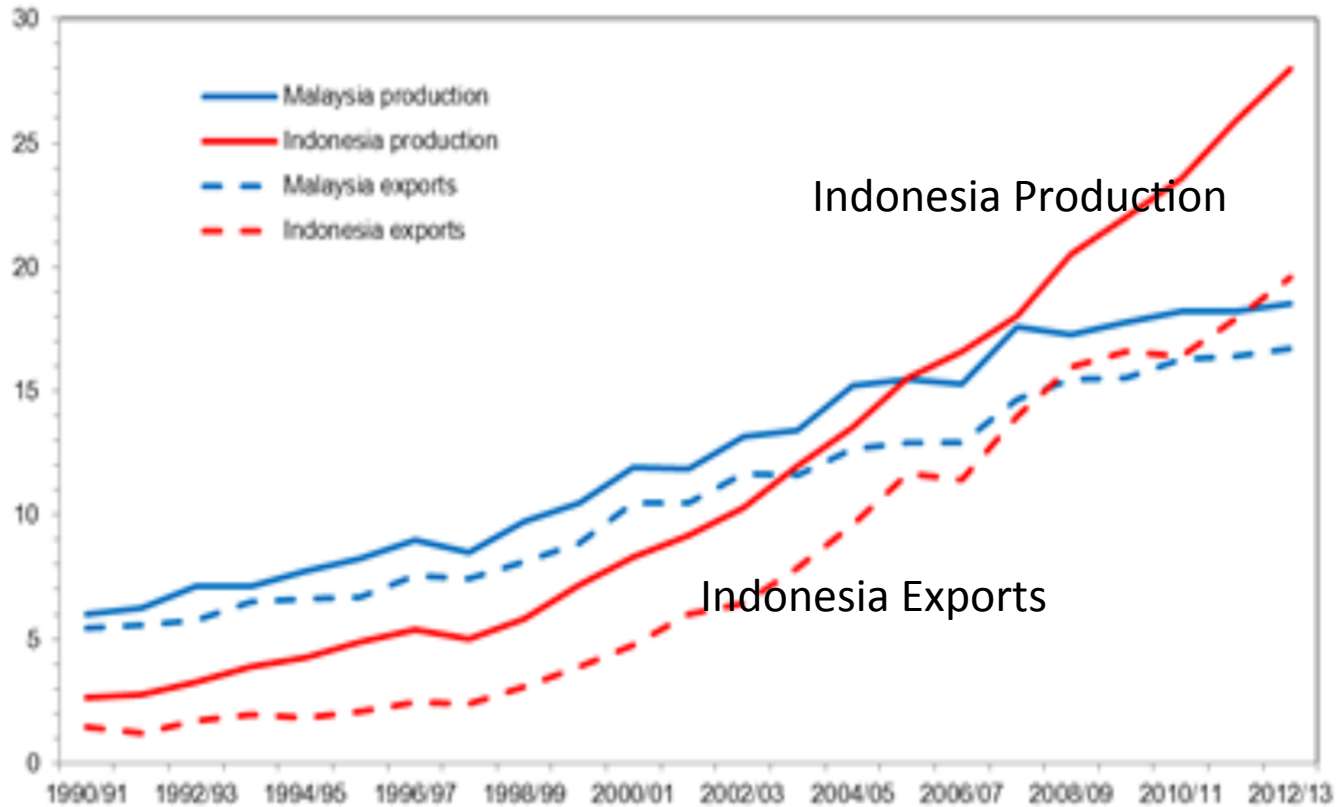
<http://www.geographicguide.net/globes/pacific-islands.htm>

Palm Oil In Indonesia

- **Largest Crude Palm Oil (CPO) producer in the world since 2006**
- **45.5 % of the world's CPO are from Indonesia**

Production and exports of Malaysian and Indonesian palm oil, marketing years 1990/91 to 2012/13

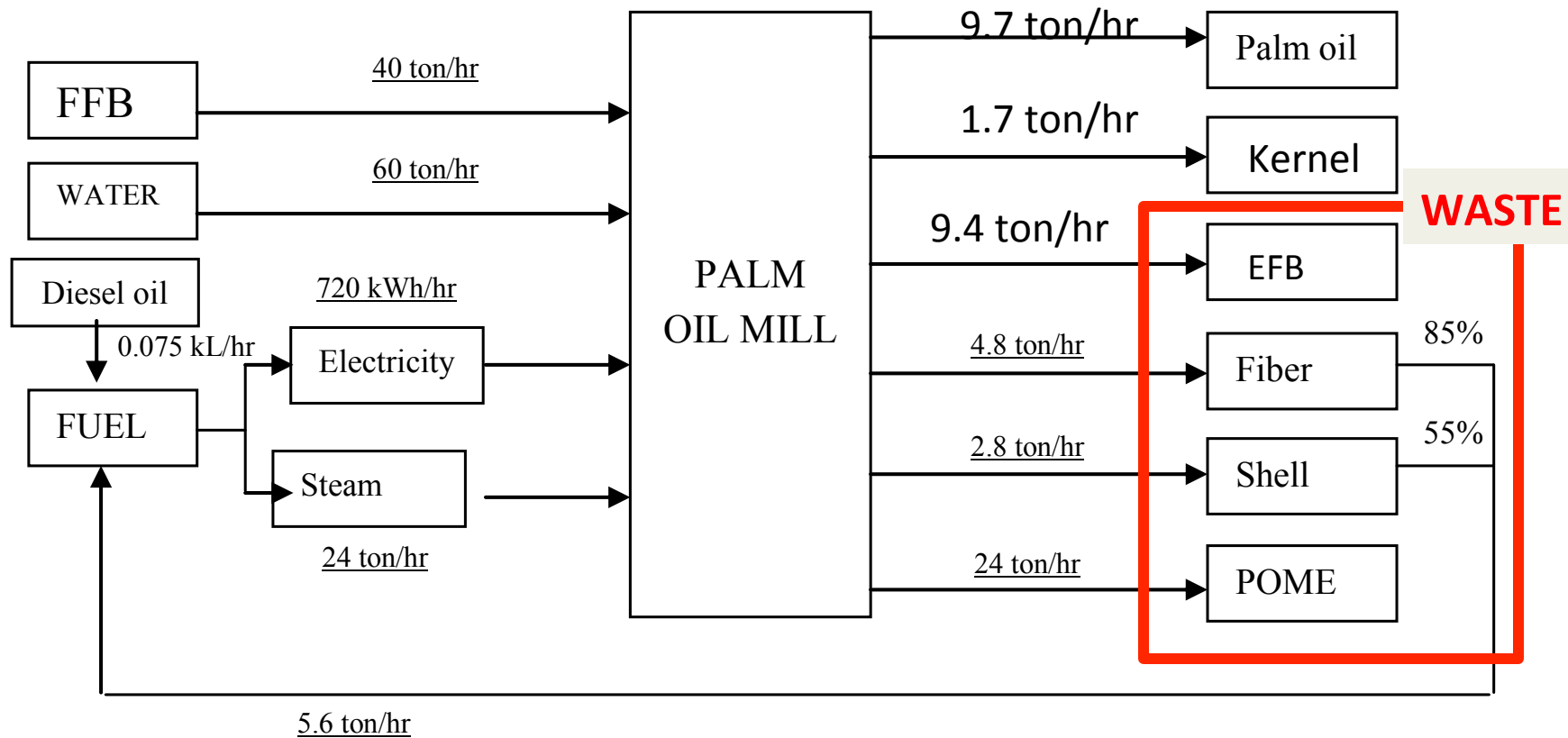
Million metric tons



Source: USDA, Economic Research Service using data from USDA, Foreign Agricultural Service.

Source: <http://ers.usda.gov/>

Mass Balances for 40 ton FFB/hour



FFB – Fresh Fruit Bunches; POME – Palm Oil Mill Effluents; EFB – Empty Fruit Bunches

Waste from Palm Oil Activities



Plantation



FFB



POM



Oil palm trunk



Oil palm frond



root

Biomass waste



EFB



Palm kernel shell

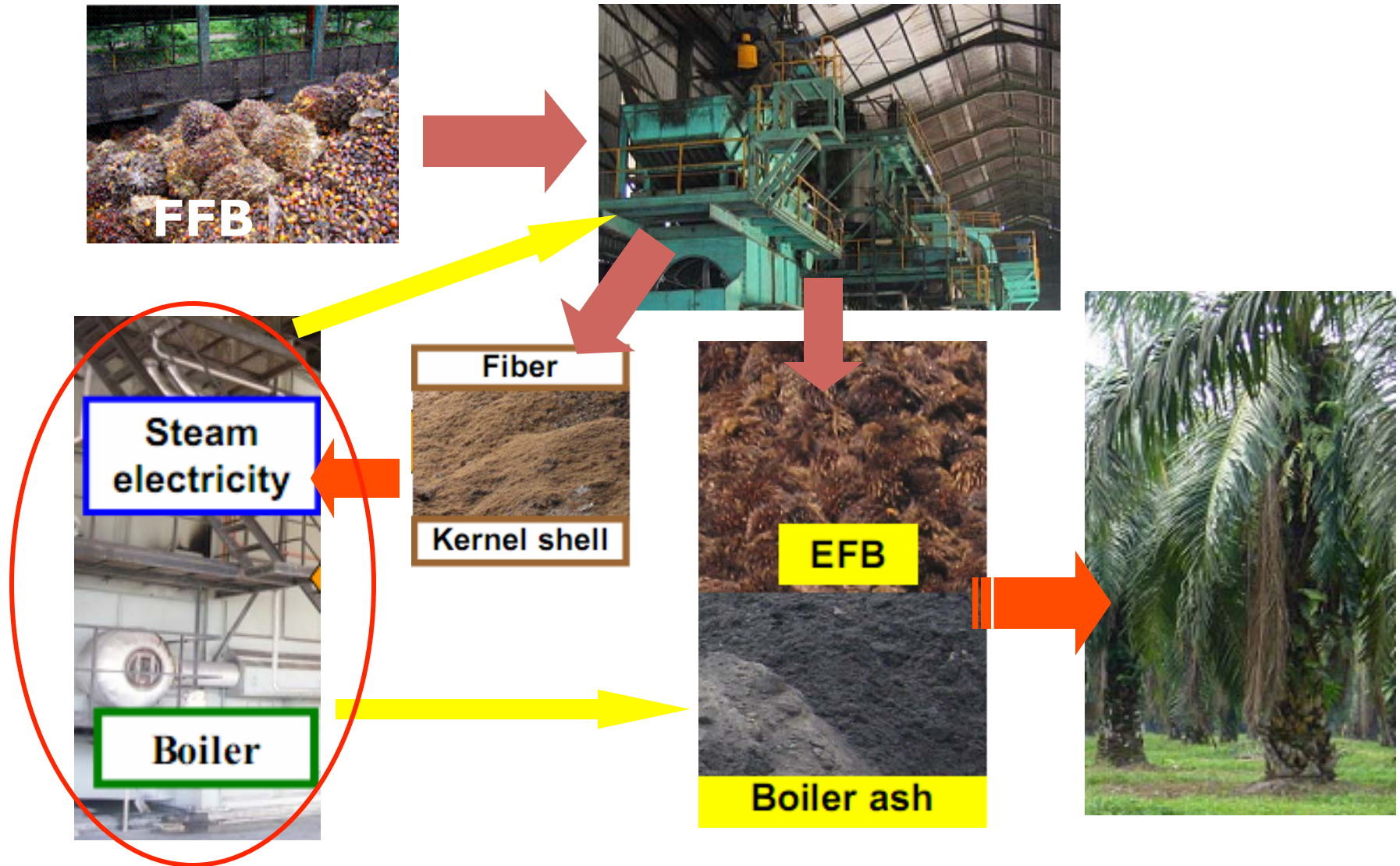


Waste POME

FFB-Fresh Fruit Bunches
POM – Palm Oil Mill
EFB – Empty Fruit Bunches

Current Practices in Indonesia POM

BIOMASS UTILIZATION IN PALM OIL MILL



Open Anaerobic Ponds



The anaerobic ponds emit a **huge amount of the strong greenhouse gas**, i.e. methane and the **effluent of the ponds contains nutrients** responsible for pollution of surface and ground water

Land Application for Palm Oil Mill Effluents

- **POME**, either in fresh or treated form, contains a **high level of plant nutrient**. When the **BOD level is brought down to below 5,000** mg/l, the treated POME is **allowed to utilize for land application in oil palm plantations**. Studies by various groups have demonstrated that such an application has been **beneficial to oil palm**, besides the saving on fertilizer cost extensively.
- However, **controlling the ground and surface water pollution** is the key factor for successful of the land application.

SUSTAINABLE WASTE MANAGEMENT

Possible Options

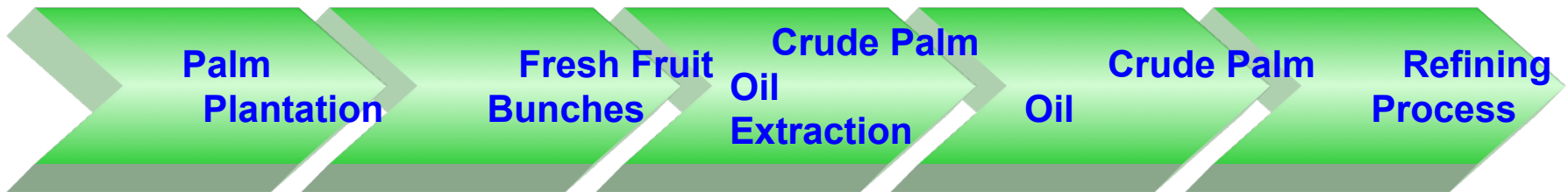
Biogas from POME → existing energy system or for electricity generation

Dewatered EFB → heat and/or electricity or organic diesel

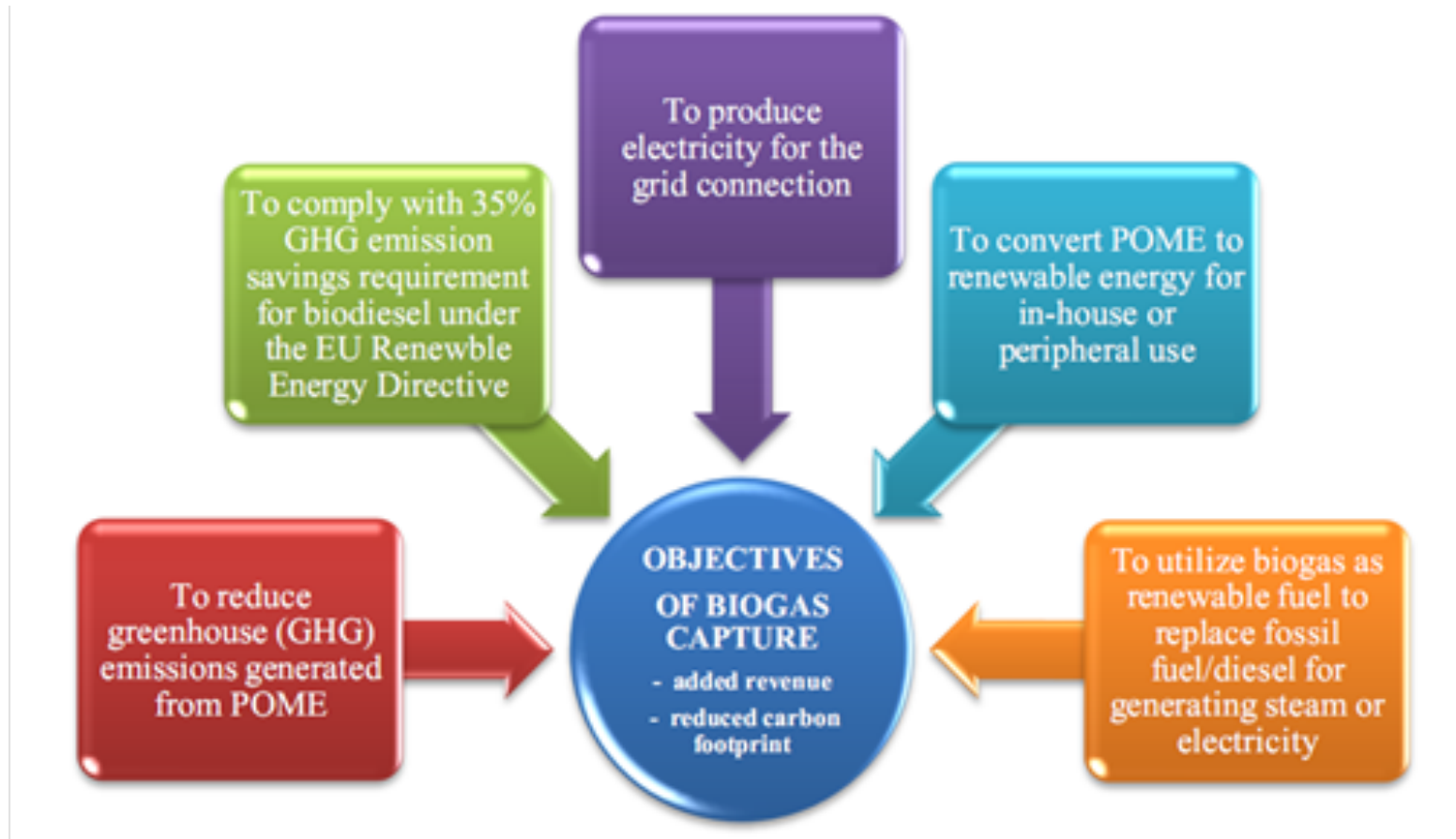
EFB → incineration → mulch or fertilizer

EFB → co-composting with POME

The recovered remnant oil → supplement for CPO production or used to produce bio-diesel



Electricity Generation from POME

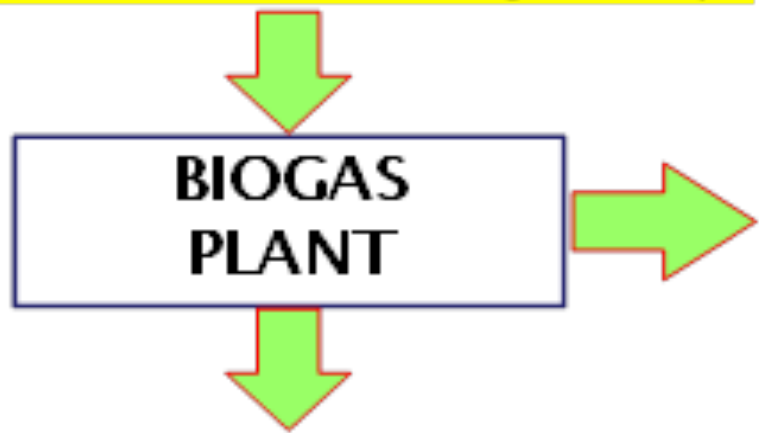


The benefit of methane capture from POME and their impact to reduce global and local environmental burden

The potential of electricity production and CO₂e emission reduction from POME at palm oil mill with capacity 45 tons of FFB/hour

INPUT

Capacity	45	Ton FFB/h
	900	Ton FFB/day
COD Influent	45000	mg/l
Flow rate	630	m ³ /day
COD load	28350	kg COD/day



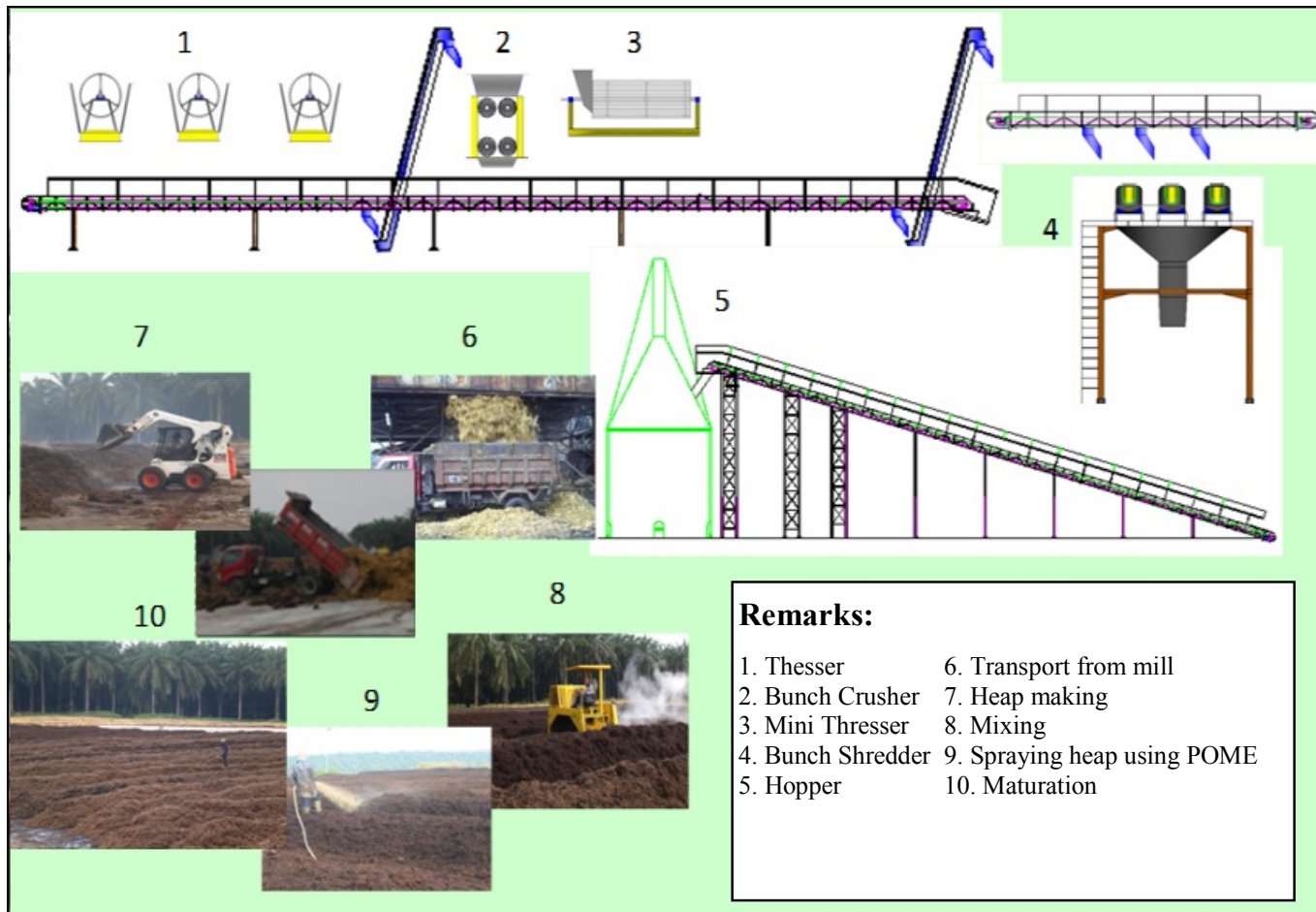
BIOGAS Production

CH ₄ Production	8930.25	m ³ /day
CH ₄ Concentration	65	%
Biogas Production	13739	m ³ /day
	572	m ³ /h
LHV	23	MJ/m ³
Potential electricity production	3.66	MW
Eff. Conversion	35	%
Electricity production	1.28	MW
CO ₂ e Emission Reduction	133.95	tons CO ₂ /day

OUTPUT

COD Effluent	4500	mg/l
COD removal	90	%
Flow rate	630	m ³ /day
kg DOD rem	25515	kg CODr/day

Integrated Solution for zero-waste effluent and palm oil solid waste



EFB-POME compost production




Parameters	Unit	Amount
FFB	Ton	1
Volume of POME	m ³	0.7
EFB	ton	0.23
Volume water in FFB (moisture 60%)	m ³	0.138
Total POME spraying to EFB heap (3 m ³ of POME/ton EFB)	m ³	0.690
Total water evaporated, assumption Evaporation rate 51 l/tonEFB/day ^{*) **}	m ³	0.657
Total non evaporated water	m ³	0.171
Total weight of compost (65% of EFB)	ton	0.150
Total water in compost (moisture 60%)	m ³	0.90
Total Leached production	m ³	0.081
Total un-utilized POME	m ³	0.010
Total wastewater produced	m ³	0.091
	%	13.06
*) Schuchardt et.al., 2002.		
**) Assumption: effective evaporation conducted for 8 weeks (56 days)		

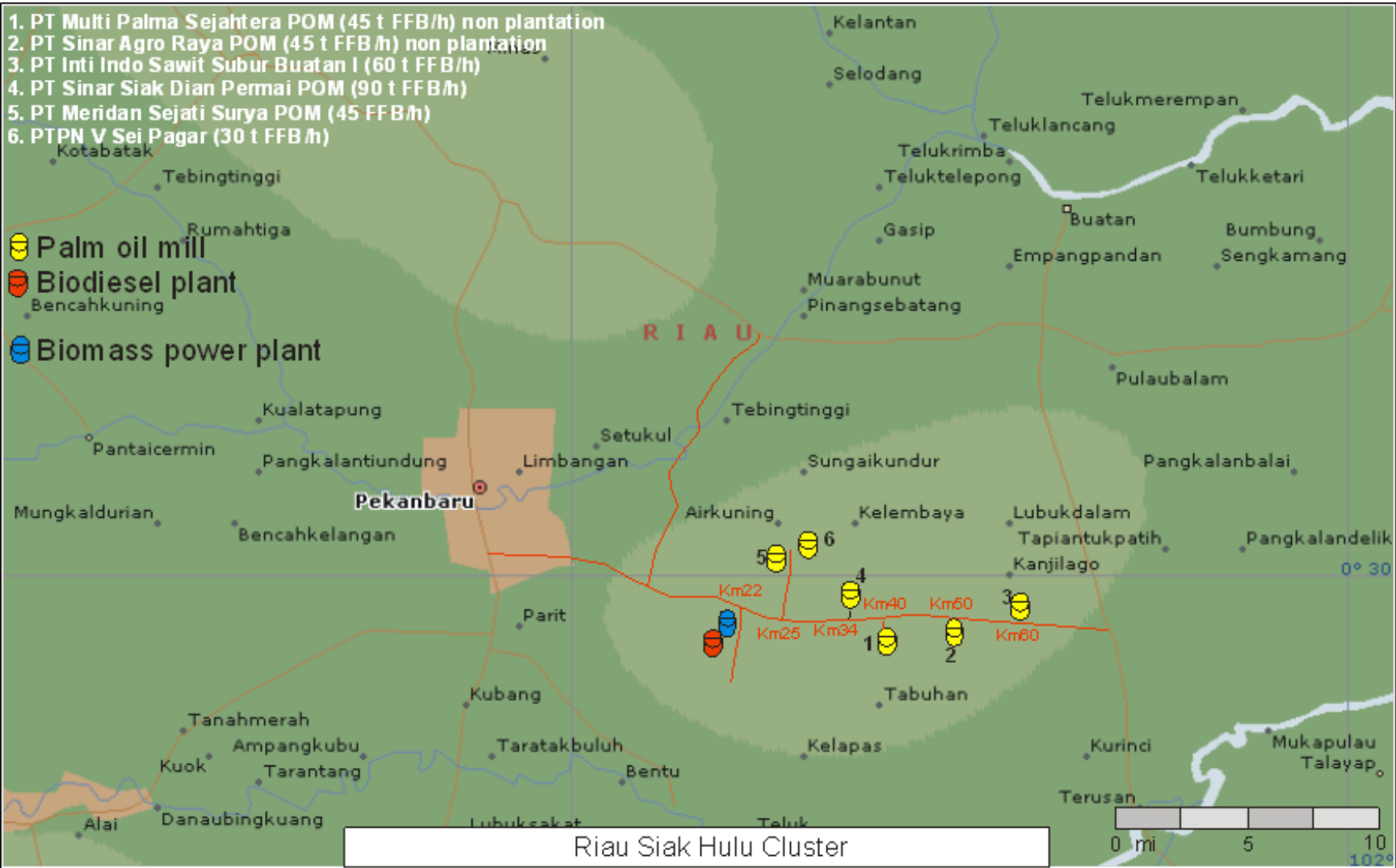
EFB-POME co-composting plant shown that about 13.06% of POME still remain and need to be treated or utilized for land application

**Palm Oil Industries as
an Eco-Industrial Cluster
Case Study: Riau Siak Hulu Cluster**

Source: IGES Report, 2008

1. PT Multi Palma Sejahtera POM (45 t FFB/h) non plantation
2. PT Sinar Agro Raya POM (45 t FFB/h) non plantation
3. PT Inti Indo Sawit Subur Buatan I (60 t FFB/h)
4. PT Sinar Siak Dian Permai POM (90 t FFB/h)
5. PT Meridan Sejati Surya POM (45 FFB/h)
6. PTPN V Sei Pagar (30 t FFB/h)

-  Palm oil mill
-  Biodiesel plant
-  Biomass power plant



Riau Siak Hulu Cluster

POTENTIAL SOURCES OF RAW MATERIAL IN SIAK HULU (IGES Study, 2008)

No	Palm Oil Mill	FFB, ton/year
1	Indo Sawit	210,000
2	Sinar Agro	150,000
3	Multi Palma Sejahtera	150,000
4	Sinar Siak Dian Permai	250,000
5	Sei Pagar PTPN V	150,000
6	Meridan Sejati Surya	150,000
Total		1,530,000

CPO : 336,600 ton/year

Solid waste

EFB : 351,900 ton/year

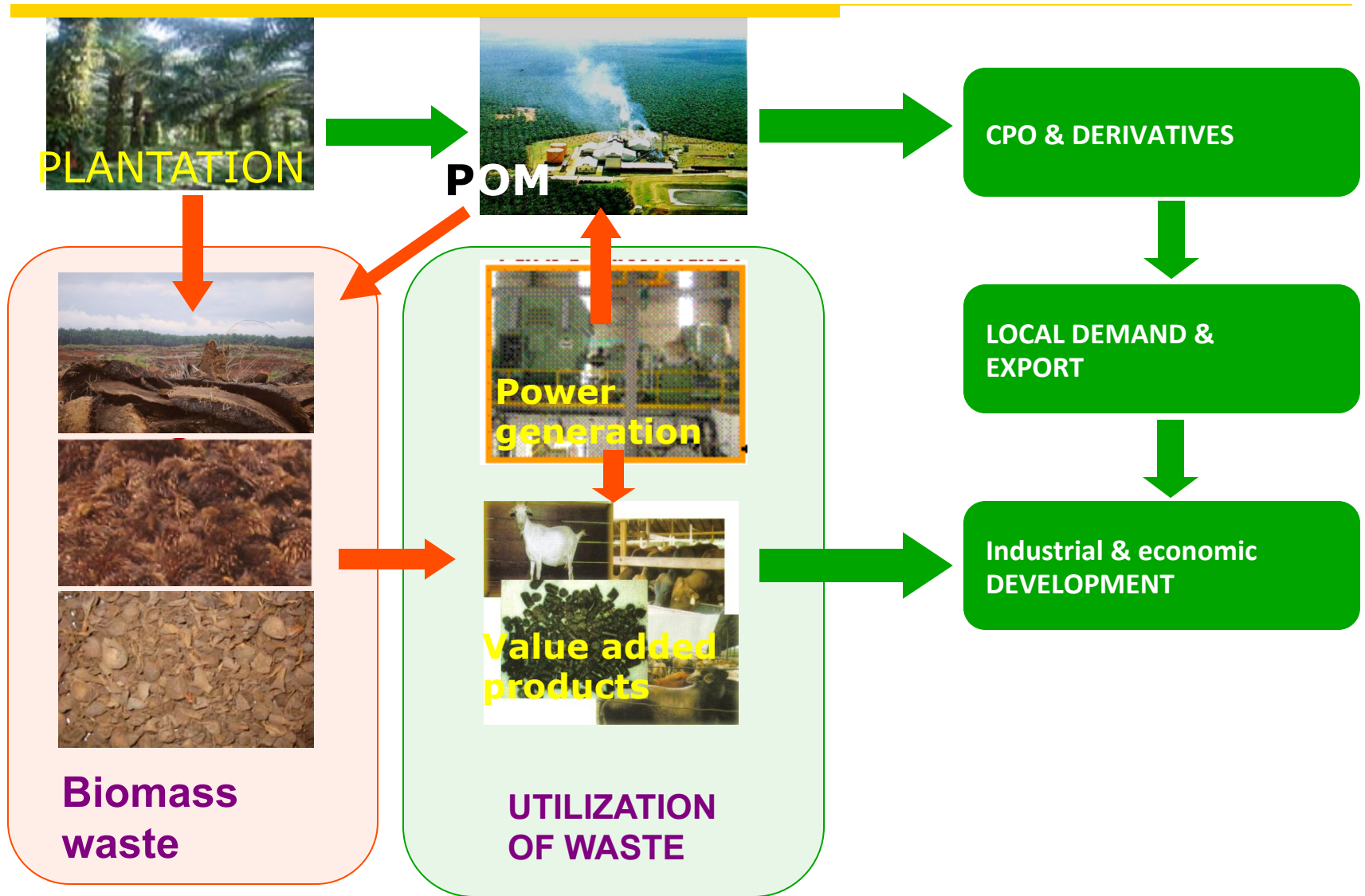
PKS : 91,800 ton/year

MF : 198,900 ton/year

Liquid waste

POME : 918,000 ton/year

The Possible Eco-Industrial Cluster



Conclusions

- The **benefits of POME utilization for biogas** production and composting are the **renewable energy production**, saved POME treatment cost in pond systems, total utilization of the POME nutrients, reduced cost for EFB transport and utilization, and higher FFB yields in the plantation. With **the process of mulch or compost production from EFB in combination of POME**, with or without biogas production before, **it is possible to realize a sustainable process in palm oil mills with zero waste**.
- In palm industries cluster, significant amount of biomass waste generated and disposed leading to environment and local health issue. Introduction of **new technologies, cluster management system, market orientation** are essential for a successful transformation of these biomass waste

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Thank You.....