

# DEVELOPMENT OF LIFE CYCLE INVENTORY FOR CRUDE PALM OIL PRODUCTION

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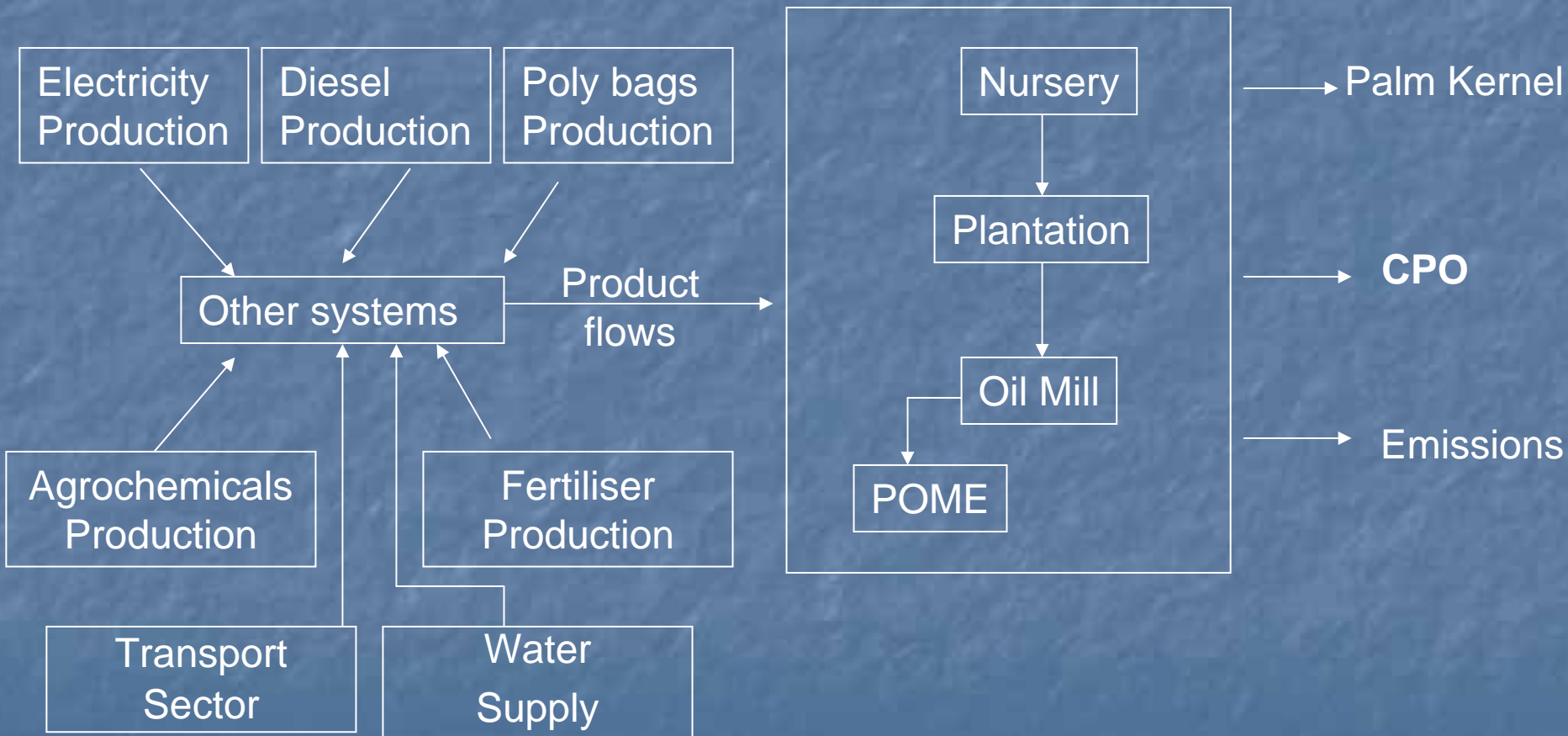
SECOND BIOMASS-ASIA WORKSHOP

12<sup>th</sup> – 14<sup>th</sup> December 2005

BANGKOK



# SYSTEM BOUNDARY FOR LCI FOR CPO PRODUCTION



# Sub-unit: Nursery

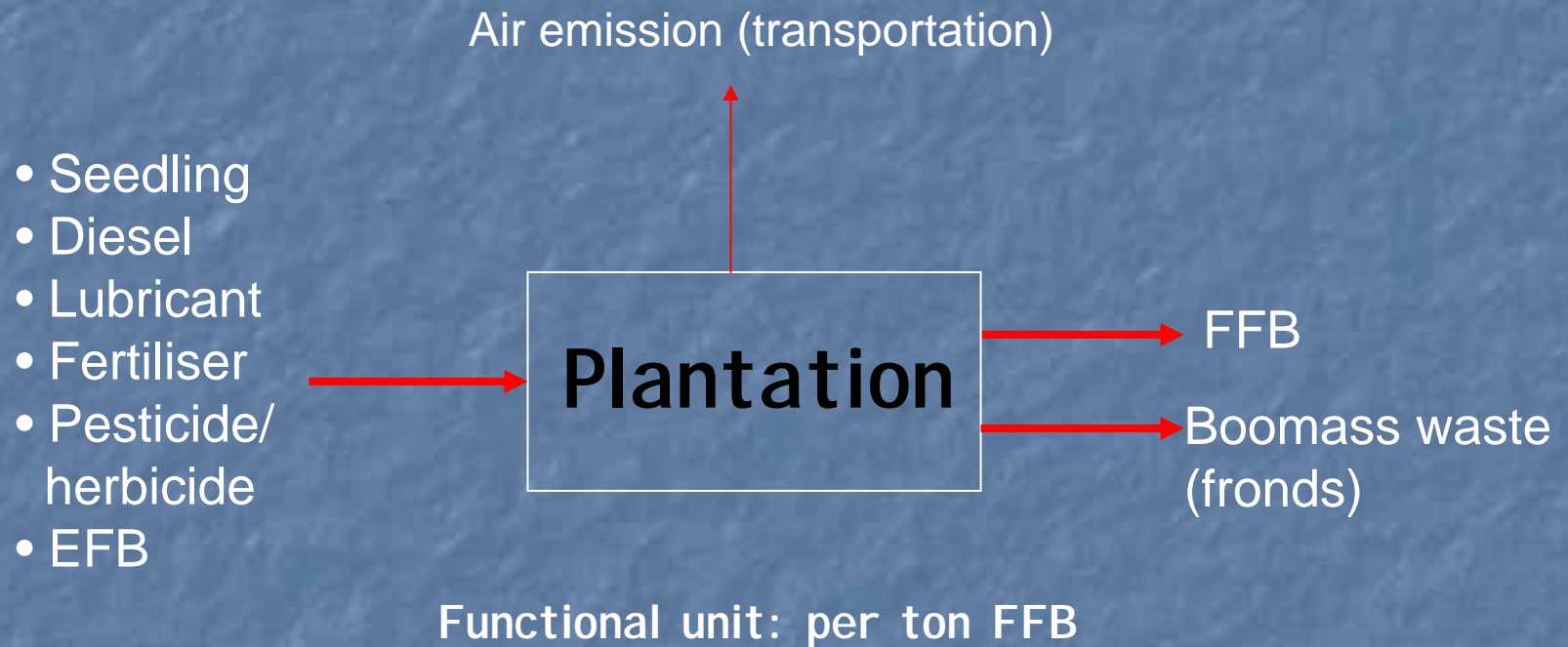
- Seed
- Electricity/heat
- Water
- Fertiliser
- Poly-bags



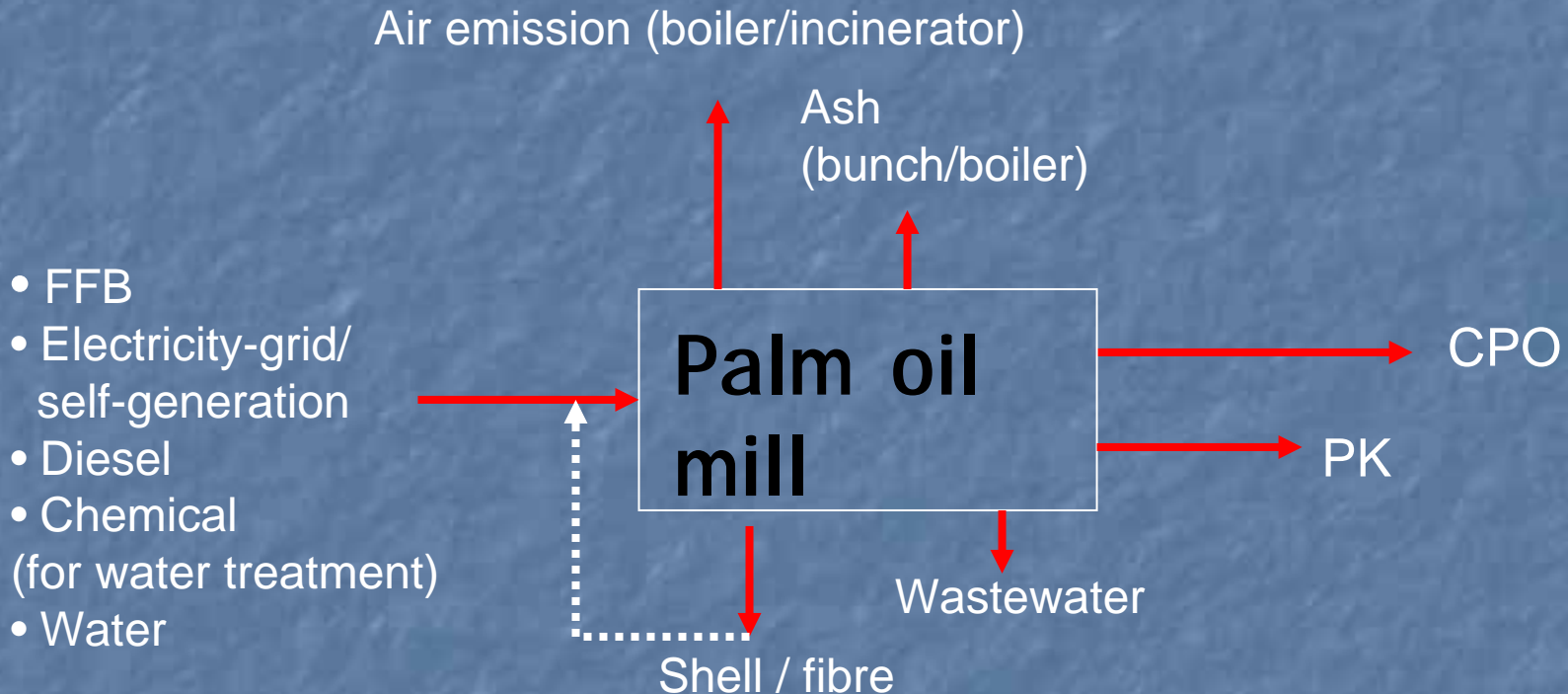
Functional unit: per seedling



# Sub-unit: Plantation



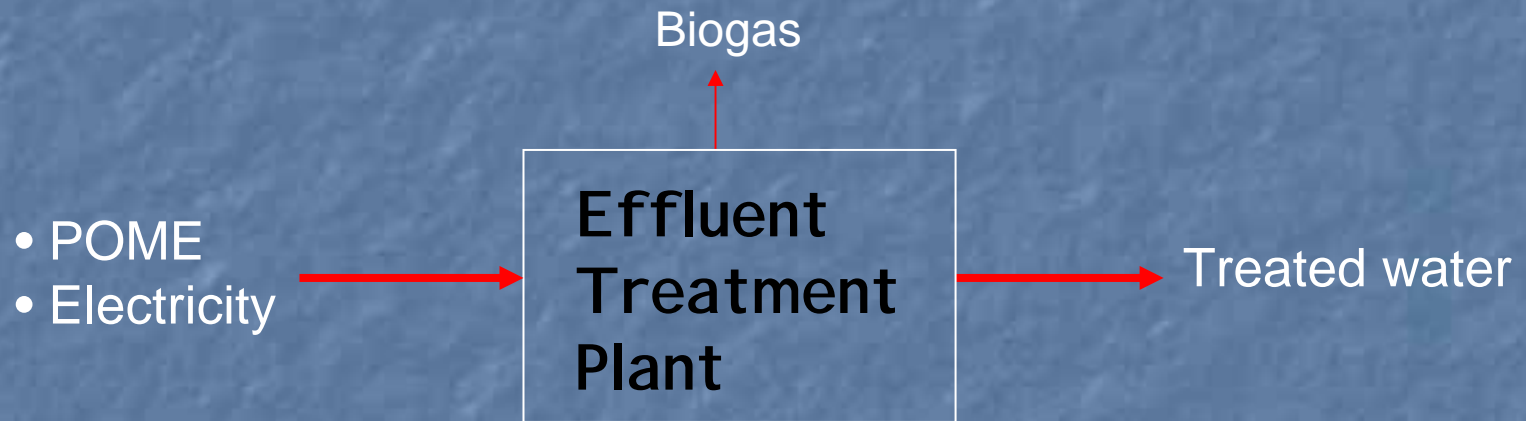
# Sub-unit: Palm Oil Mill



Functional unit: per kg CPO



# Sub-unit: Effluent Treatment Plant



Functional unit: per seedling



# GOAL OF STUDY

- ◆ To establish the material and energy balance for the production of crude palm oil (CPO) starting from the seedling stage to milling.
- ◆ To quantify the CO<sub>2</sub> emission at various stages and identify the stage that emits highest amount of the GHG.



# NURSERY STAGE – Material Flow to Quantify CO<sub>2</sub> Emission

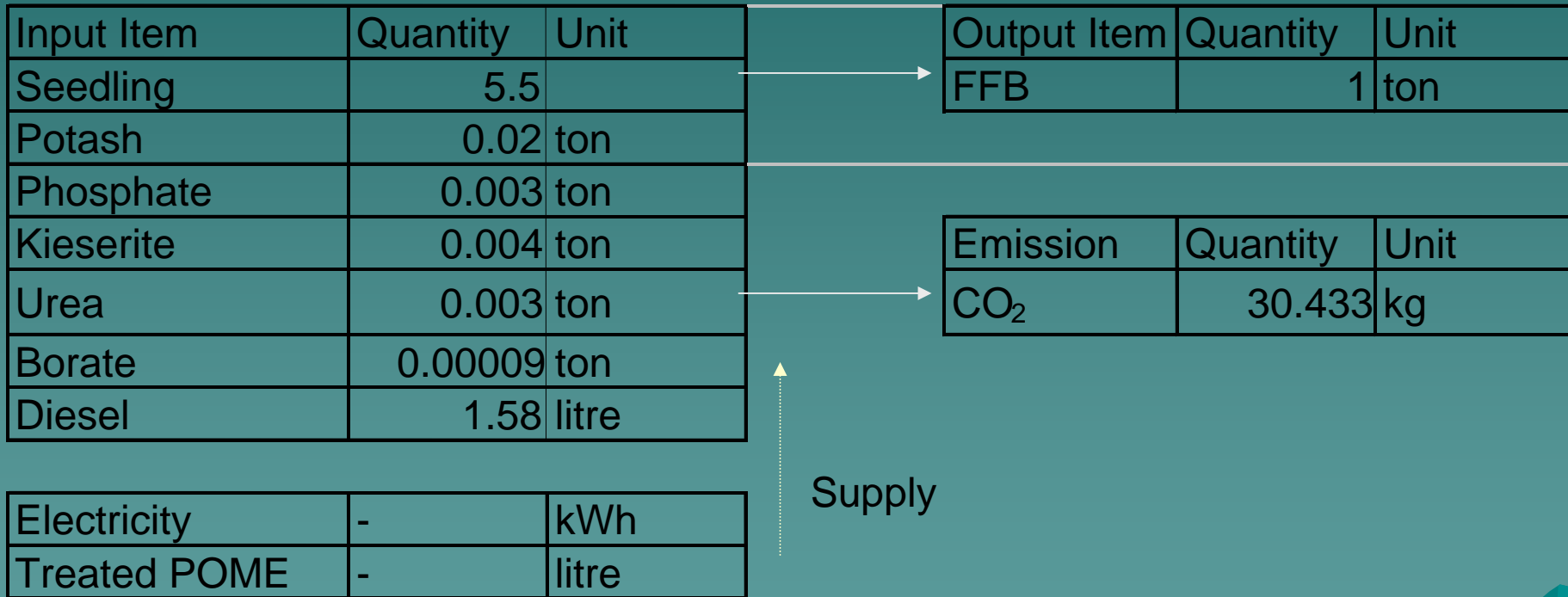
Input Item	Quantity	Unit	Output Item	Quantity	Unit
Seed	1		Seedling	1	
Polybags	1				
Orthene 755	91	litre	Emission		
Roger-40	45.5	litre	CO <sub>2</sub>	43.710	kg
Furadan 3G					
Siputox					
Warfarin					
Water	456	litre			
Electricity	79.473	kWh			

Supply



# PLANTATION STAGE

## Material Flow to Quantify CO<sub>2</sub> Emission



Input Item	Quantity	Unit
FFB	5.1	ton
Electricity	103	kWh
Diesel	3.17	litre
Fibre (fuel)	0.5	ton
Shell (fuel)	0.18	ton
Water (for steam)	3.21	ton

Output Item	Quantity	Unit
CPO	1	ton

Emission	Quantity	Unit
Shell	0.12	ton
Mesocarp	0.11	ton
EFB	1.19	ton
POME	3.1	m <sup>3</sup>
Boiler ash	0.015	ton
Flue gas		
-particulate	0.05	kg
- CO	0.16	kg
- CO <sub>2</sub>	<b>86.4</b>	kg
-SO <sub>2</sub>	0.0017	kg
-NO <sub>x</sub>	0.12	kg
Wastewater	3.54	m <sup>3</sup>
CH <sub>4</sub>	56.18	m <sup>3</sup>

Emission	Quantity	Unit
Total CO <sub>2</sub>	273.183	kg
CH <sub>4</sub>	40.264	kg

**186.78**

# PALM OIL MILL STAGE



Input Item	Quantity	Unit
FFB	5.1	ton
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Diesel	3.17	litre
Fibre (fuel)	0.5	ton
Shell (fuel)	0.18	ton
Water (for steam)	3.21	ton

Output Item	Quantity	Unit
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# PALM OIL MILL STAGE



# POME TREATMENT

## ASSUMPTIONS

1. Optimal performance of system and gas is not trapped.
2. 1 m<sup>3</sup> POME = 1 ton POME
3. Rate of production of biogas = 28 m<sup>3</sup> biogas/ton POME
4. Biogas contain 65% CH<sub>4</sub> (average) and 35% CO<sub>2</sub> (average)

Input Item	Quantity	Unit		Emission	Quantity	Unit
POME	0.036	m <sup>3</sup>	→	Biogas	1	m <sup>3</sup>
Electricity	-			CO <sub>2</sub>	0.23	kg
			↑	CH <sub>4</sub>	0.43	kg

Supply



Current LCI from nursery to mill for production of CPO is preliminary because:

1. Only 6 out of ~360 mills
2. Only 1 nursery out of ~345 nurseries
3. Only 3 plantations out of ~3736 plantations
4. Big plantations versus small holdings
5. Need to consider other environmental impacts namely impact on waterways and landuse.
6. Allocation of impact between CPO and Palm Kernels as PKO is transformed to oleochemicals with wide applications.



# Study Summary / Conclusion

Factors affecting assessment:

- ✓ Lack of local background data to support assessment
- ✓ Lack of participation/co-operation from the industries



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**THANK YOU FOR  
THE KIND ATTENTION**

**SIRIM-JETRO PROJECT  
ESTABLISHMENT OF LCA METHODOLOGY  
& APPLICATIONS IN MALAYSIA  
April 2005 – March 2008**

