

Economic Opportunities for Municipalities in Biomass Waste Utilization in Asia - Role of Knowledge Management and Technological Intervention

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Definition of Biomass

- Bio-waste that is generated from agricultural residual and industrial activities
- Has high moisture content and low heating value
- Increasingly utilized for energy production through various techniques

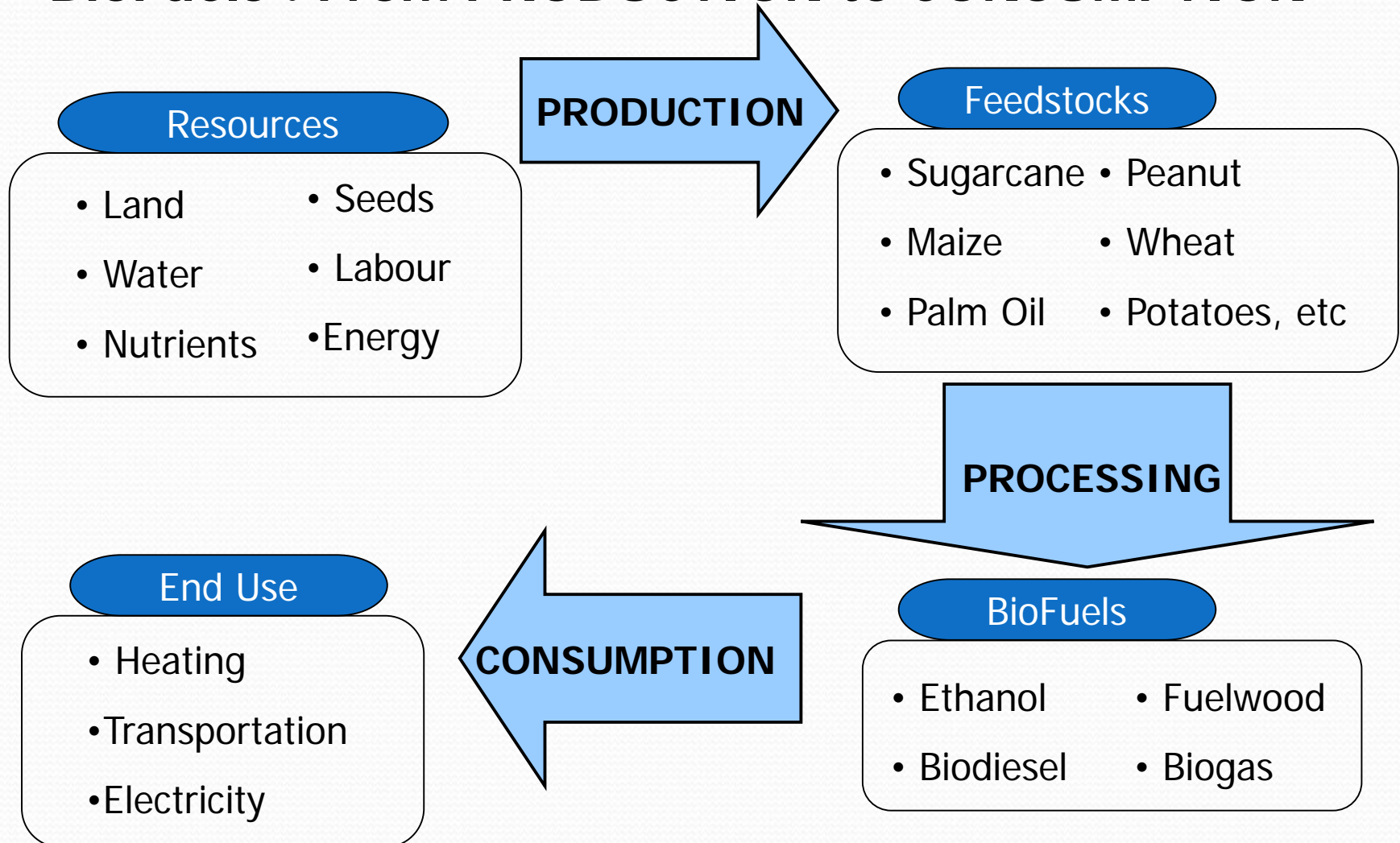
Biomass as an Alternative

- Shifting of paradigm towards BIOMASS
 - Renewable energy
 - Sustainable
 - Environmentally friendly
 - Abundant
 - Untapped energy
- Uncertainties of BIOMASS
 - Technological proven ?
 - Economically feasible ?
 - Constant supply ? (quality and quantity)
 - Availability & distribution ? (worldwide)

Biomass utilization

- Thermal conversion - power/electricity generation
- Biological conversion – CH₄ generation
- Biological Conversion - Organic acids generation
 - acetic, propionic and butyric acids
- Biological Conversion – Bioplastics
 - organic acids into poly-hydroxyalkanoates
- Biological Conversion - Bio-compost
 - Good properties such as pH 6-8, C/N 20 and comply to USEPA standards

BioFuels : From PRODUCTION to CONSUMPTION



What is AgroWaste?

Animal Waste

- Forest Slash
- Manure
- Animal Carcasses
- Pesticides, Insecticides, Herbicides, etc

Food Processing Waste

- Increased production of processed food
- Maize: only 20% canned
80% is waste

AgroWaste

Crop Waste

- Cornstalks
- Sugarcane Bagasse
- Drops and culls from Fruit & Vegetables
- Prunings

Hazardous & Toxic Waste

- Pesticides
- Insecticides
- Herbicides, etc

Agricultural Waste Generation



- Globally, 1.2 billion tonnes of Agricultural Waste is produced in a year.
- In Malaysia, 1.44 million tonnes of agricultural waste is disposed into landfills annually. (World Bank, 2012)

AgroWaste Generation in Asia

Country	Agricultural Waste Generation (kg/cap/day)	Projected Agricultural Waste Generation in 2025(kg/cap/day)
Brunei	0.131	0.143
Cambodia		0.165
Indonesia	0.079	0.150
Laos	0.105	0.165
Malaysia	0.228	0.285
Myanmar	0.068	0.128
Philippines	0.078	0.135
Singapore	0.223	0.270
Thailand	0.264	0.293
Vietnam	0.219	0.27

- An estimated 15% of total waste generation consists of Agro Waste.

AgroWaste Generation in Asia (cont'd)

Country	Agricultural Waste Generation Rate (kg/cap/day)	Projected Agricultural Waste Generation in 2025 (kg/cap/day)
Nepal	0.018	0.105
Bangladesh	0.064	0.113
Mongolia	0.099	0.143
China	0.153	0.255
Sri Lanka	0.03-0.14	0.150
Republic of Korea	0.187	0.210
Japan	0.255	0.257

- An estimated 15% of total waste generation consists of AgroWaste

AgroWaste Utilization

AgroWaste	Utilization
Rice Husk Ash & Charcoal	<ul style="list-style-type: none"> • Additive in cement mixes • Water glass manufacture • Active carbon
Rice Husk	<ul style="list-style-type: none"> • Electricity production
Banana Peel & Sugarcane fibers	<ul style="list-style-type: none"> • Paper making pulp
Oil Palm Empty Fruit Bunch (EFB)	<ul style="list-style-type: none"> • Mulching, Organic Fertilizer
Oil Palm stems, Rubber wood	<ul style="list-style-type: none"> • Particleboards • Softwood furniture
Onion skin, Groundnut husk	<ul style="list-style-type: none"> • Heavy metal removal
Husk, Bagasse	<ul style="list-style-type: none"> • Mushroom cultivation
Bagasse, Banana Fruit Reject	<ul style="list-style-type: none"> • Ethanol production • Animal feed



AgroWaste Utilization (cont'd)

AgroWaste

Utilization

Husk, Straw, Cow Dung

- Biogas production
- Electricity generation

Sunflower stalk

- Reinforcement for thermoplastics

Corn Stalk

Bagasse Fibers

Animal waste (dung)

- Compost
- Fertilizer



Greenhouse Gas Emissions from Agricultural Sector

- Global mitigation potential is 5,500-6,000 megatons of CO₂e / year by 2030
- Carbon sequestration - nearly 90% of this potential
- Potential to reduce methane (CH₄) emission from rice fields in China and India by 26%
- Up to 50% of emissions (1,100-3,000mt CO₂-eq/yr) can be mitigated by 2030 through soil carbon sequestration
- Potential to reduce emissions by 277 Mt CO₂-eq/year at carbon price of \$20 per ton, equivalent to benefit of \$5.5 billion a year

3R's AgroWaste Opportunities

- **Heat Production** *agricultural residues burnt as fuel
 - 92% as thermal output (EIA 2008)
 - 12.9 and 14.6 million btu/tonne of agricultural residues
- Production of Cellulosic Ethanol as a **Biofuel**
- **Biogas production** as a substitute for cooking gas instead of fuel wood (in rural villages) and to meet urban demands for cooking biogas

3R's AgroWaste Opportunities (cont'd)

- **Compost** production in efforts of sustainable farming – organic fertilizers substituting chemical fertilizers
- **Electricity Generation**
- NCFR – Non Conventional Feed Resources
 - cattle/livestock is fed straw, spent grains, and other agricultural waste
- AIBP- Agro Industrial By Product

Conversion of agricultural feedstocks into liquid biofuels

SUGAR CROPS

- Sugar cane
- Sugar beet
- Sweet sorghum

Fermentation
and
distillation



STARCHY CROPS

- Maize
- Wheat
- Barley
- Rye
- Potatoes
- Cassava

Saccarification,
fermentation
and distillation



CELLULOSIC MATERIALS

- Switchgrass
- Miscanthus
- Willow
- Poplar
- Crop stover

OIL CROPS

- Rapeseed
- Oil palm
- Soybean
- Sunflower
- Peanut
- Jatropha

Extraction
and
esterification

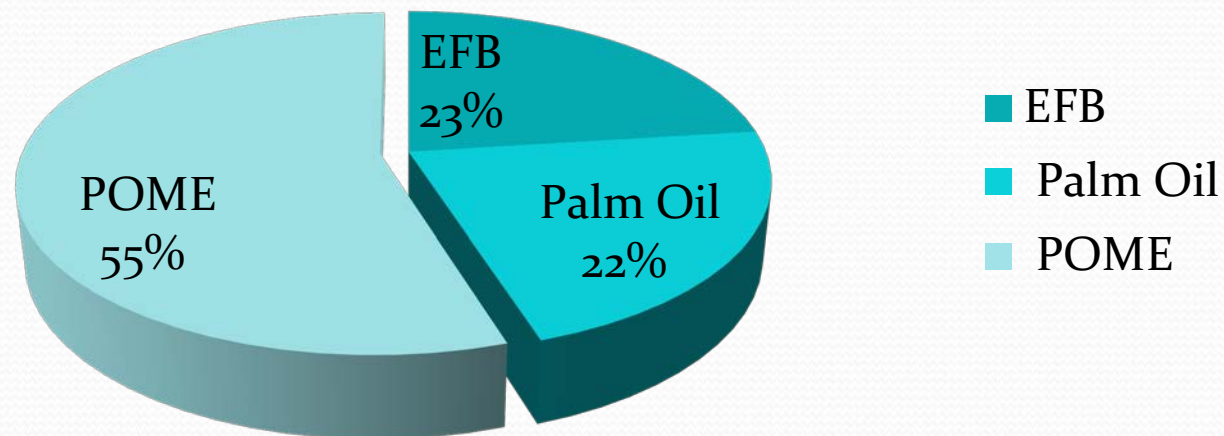


ETHANOL

BIODIESEL

Palm Oil Industry: A Case Study

- Malaysia is the largest producer of Palm Oil
- 17,734 million tonnes of CPO was produced annually
- 18-22% is Palm Oil
- 23 % is solid waste : Empty Fruit Bunches, EFB



Palm Oil Production and Waste Generation



Oil Palm

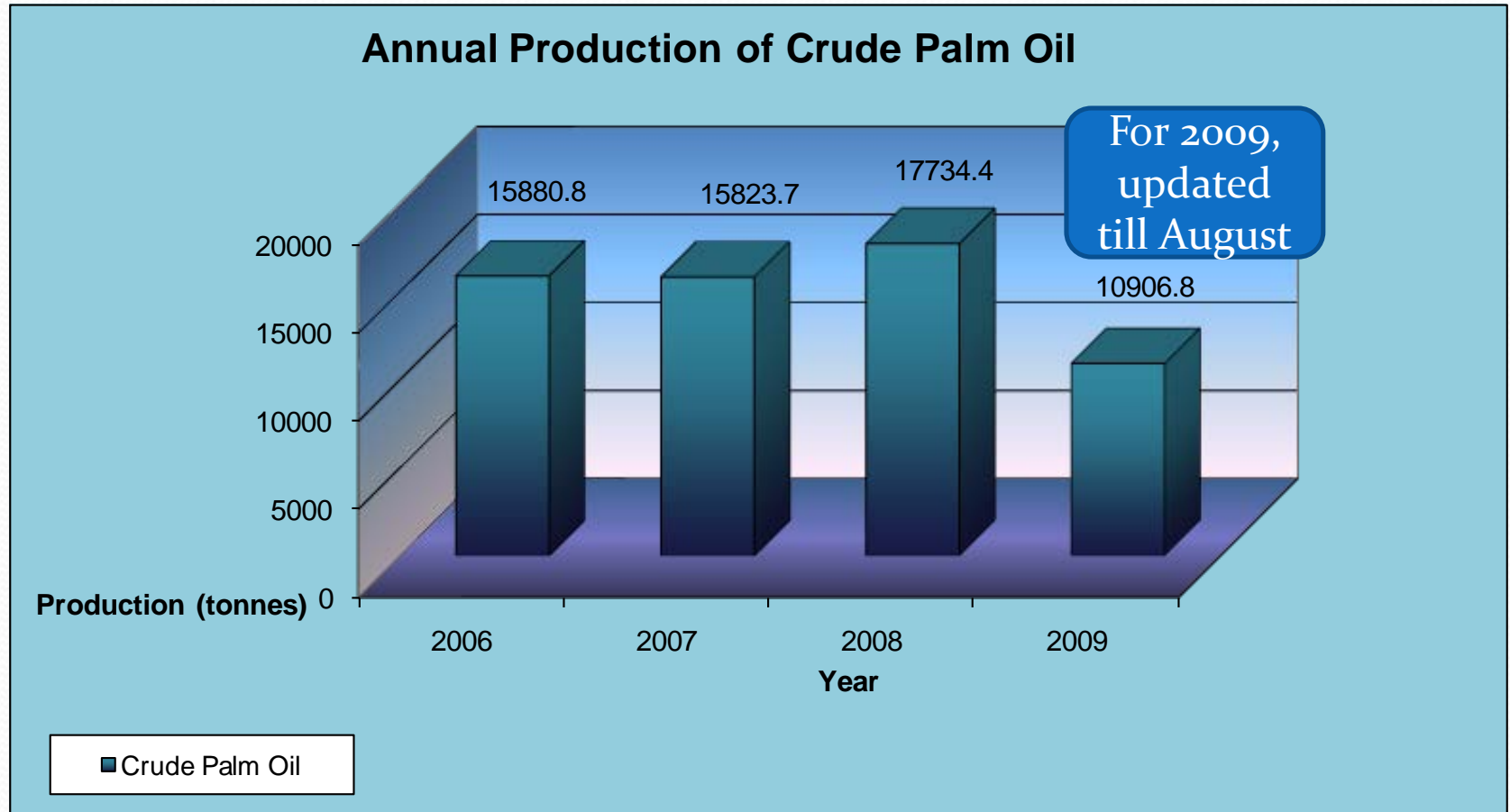


Palm Oil Fresh
Fruit Bunch
(FFB)



Application of empty fruit bunch (EFB) as covering material

Annual Production of Crude Oil





Where does all the waste go?

Two large 3D arrows are positioned on the left side of the slide. The top arrow is dark teal and points upwards and to the right. The bottom arrow is light blue and points downwards and to the right.

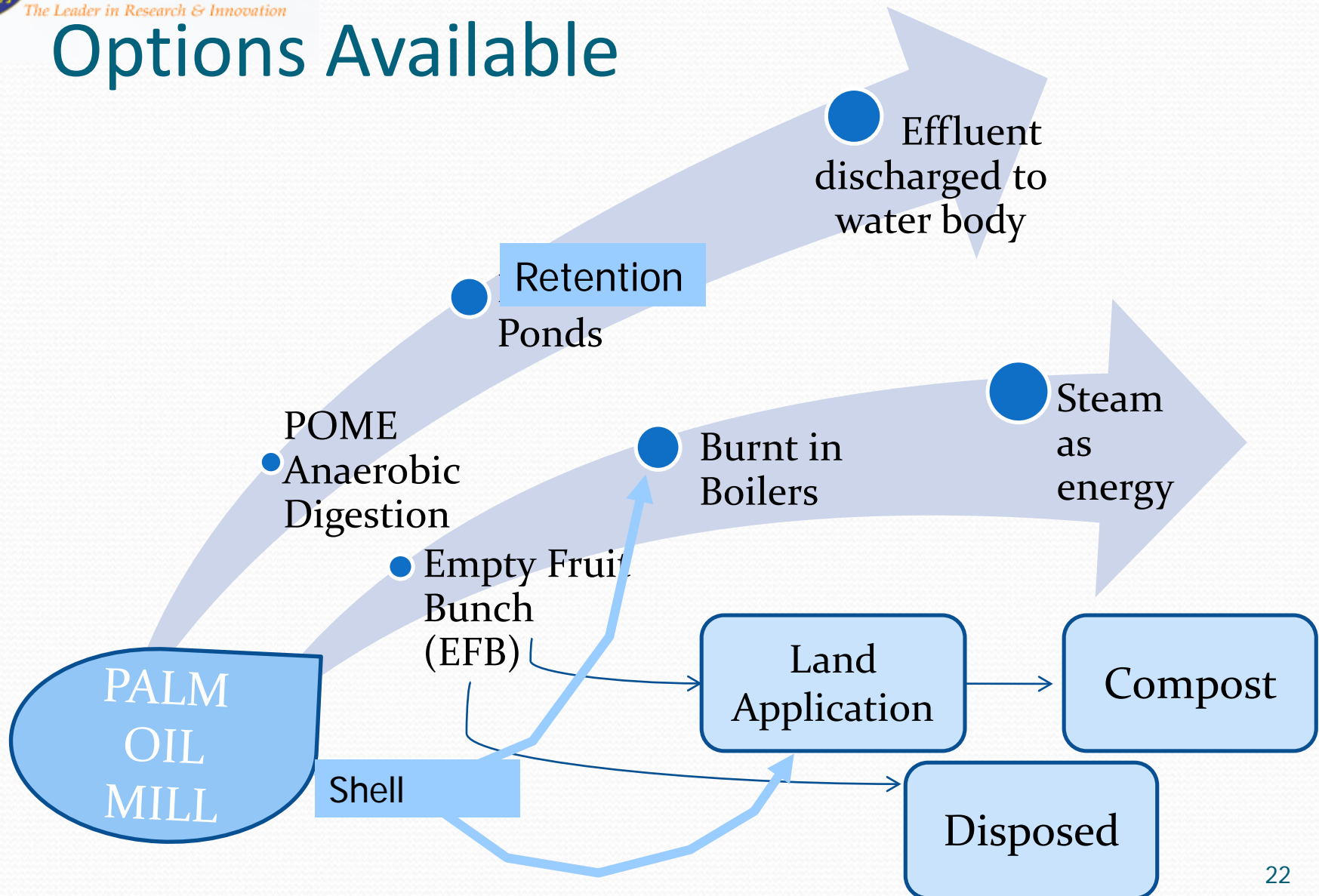
18,000 tonnes of
Crude Palm Oil
produced

2008

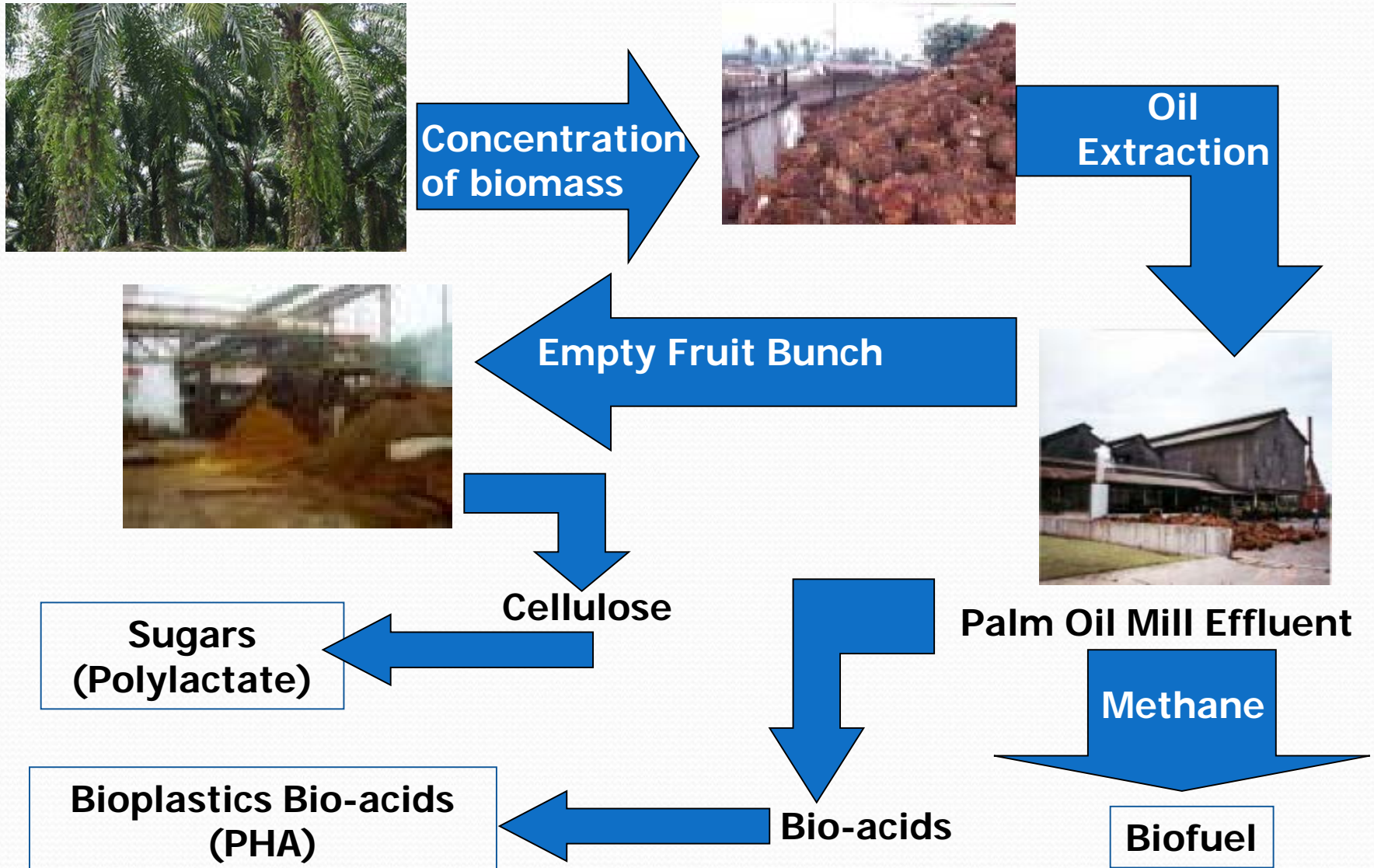
63,000 tonnes of
EFB & POME
(waste) produced



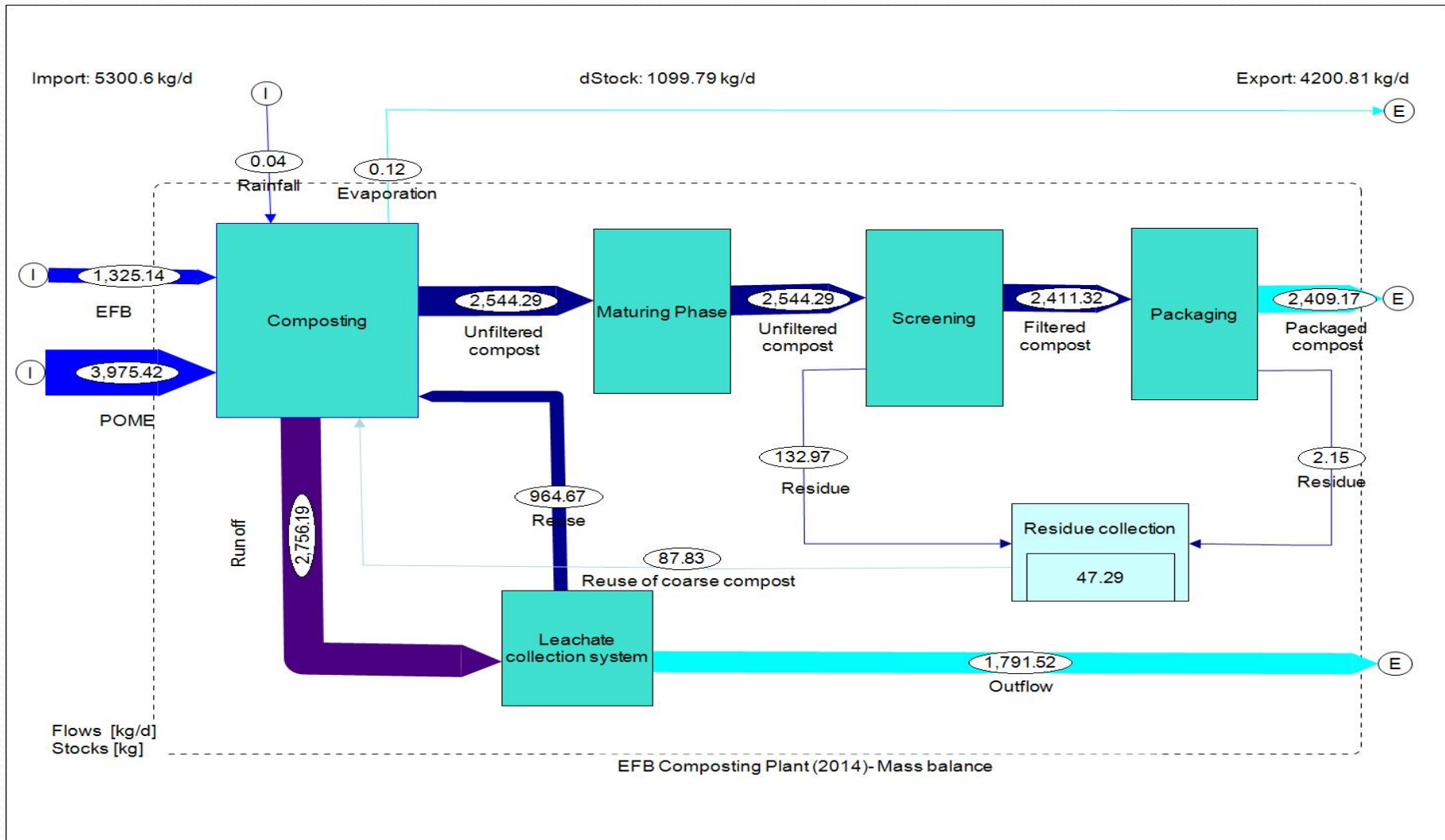
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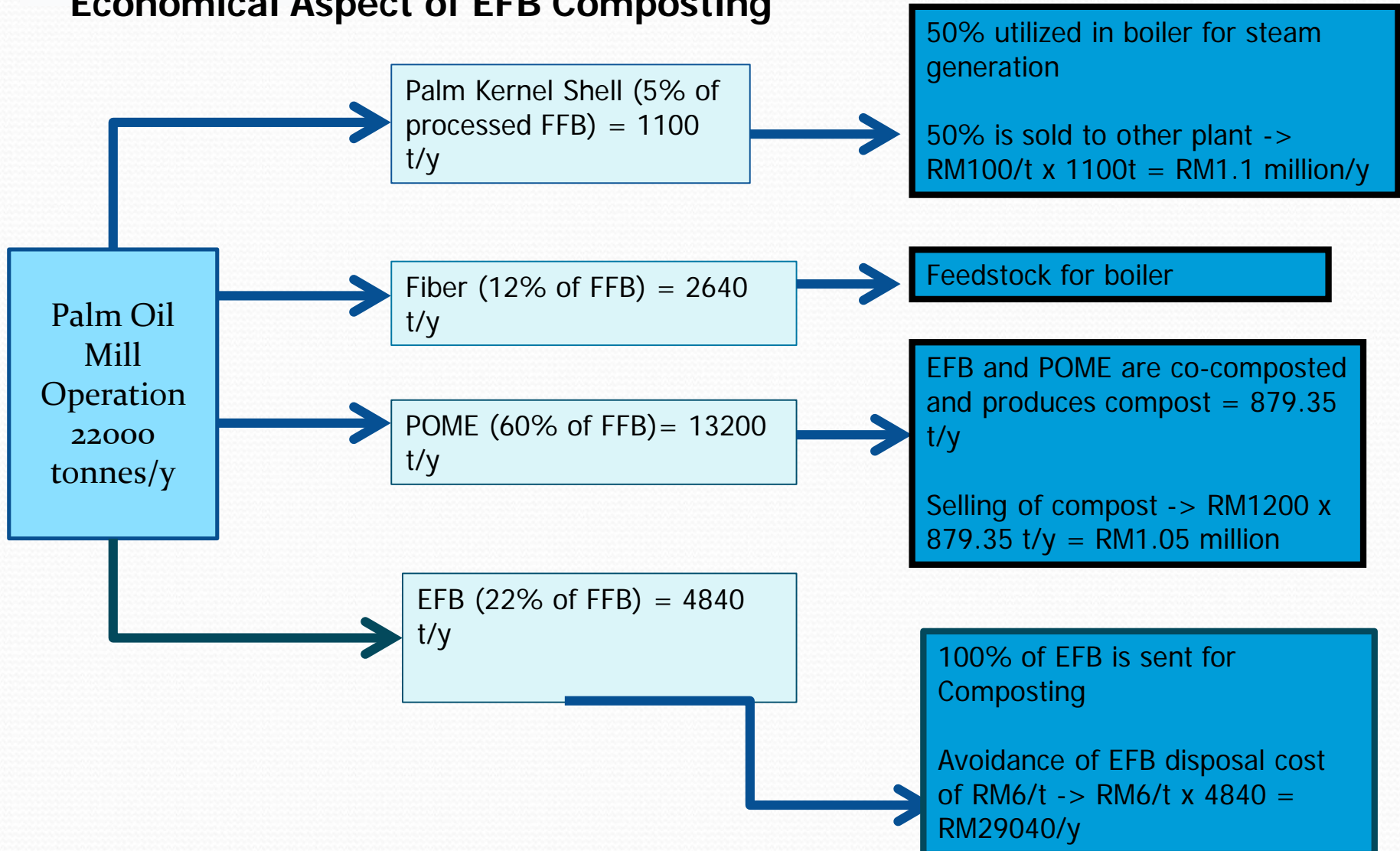
Palm oil Industry: Towards Zero Emission



Mass Balance of Palm Oil EFB Composting



Economical Aspect of EFB Composting



Case study 2: Agrowaste Utilization in India

- India:
- the world's largest producer of paddy, produces 98 million tonnes of paddy with roughly 130 million tonnes of straw
- India also produces about 350,000 tonnes of cane that will yield about 50 million tonnes of cane trash
- A power generation project using these waste is estimated to potentially generate over 50,000 MW of power while giving extra income to farmers
- Example →
- a 12 MW plant needs 120,000 tonnes of paddy straw
- Supply from 15,000 farmers would enable them to earn an incremental income of about USD8 /acre
- So each project can give the local farmers extra income of roughly USD600,000

Summary

- With technology advancement and research findings, agricultural waste is no longer an environmental issue but a resource for energy production.
- ‘Waste-to-Wealth’ perception of Agricultural Waste
- A tremendous potential in improving the general state of sanitation, positive environmental actions to reduce GHG emissions.
- Significantly improves the crop yield, soil fertility
- Reduces the global dependence on chemical fertilizers, fossil fuel, etc.

THANK YOU