JST/JICA SATREPS

4th JASTIP Symposium

PROMOTION OF GREEN ECONOMY WITH PALM OIL INDUSTRY FOR BIODIVERSITY CONSERVATION IN MALAYSIA

(Kyutech) ○Yoshihito Shirai*, (UPM)Mohd Ali Hassan

3rd July, 2017

NSTDA

Kyutech
Kyushu Institute of Technology

KYUSHU UNIVERSITY

National Institute of Advanced Industrial Science and Technology
AIST

UNIVERSITI MALAYSIA SABAH

UPM
UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

Background & Purposes

JICA Bornean Biodiversity Ecosystems Conservation Program Phase II（BBECII)

Our Goals

iversity conservation around the Kinabatangan, Sabah

f new green innovative industries. **Ramsar Wet land as litmus paper!**

Modernization of Palm Oil Industry！

Conservation of the Environment and Biodiversity！

Promotion of Green Industry with Palm Biomass & Biodiversity！

Sabah State

- **Nature**

Eco-tourism

Promising Income

- **Palm Oil**

Greatest Income

To Propose to Achieve the above Goals！

Palm Oil mil

⇒ **POME**

Anaerobic Pond

⇒ **Treated Water COD >1000ppm BOD<100ppm**

KINABATANGAN

Pollution STOP!

Zero Discharge

Bio-diversity

Brand & Green Industry

ADVANTAGES

of Palm Oil Industry as Green Industry!!

Business as Usual (key word: BaU)

No logistics issues as BaU

Constant collection of biomass through whole the year as BaU

Lagoons for POME treatment

Resources

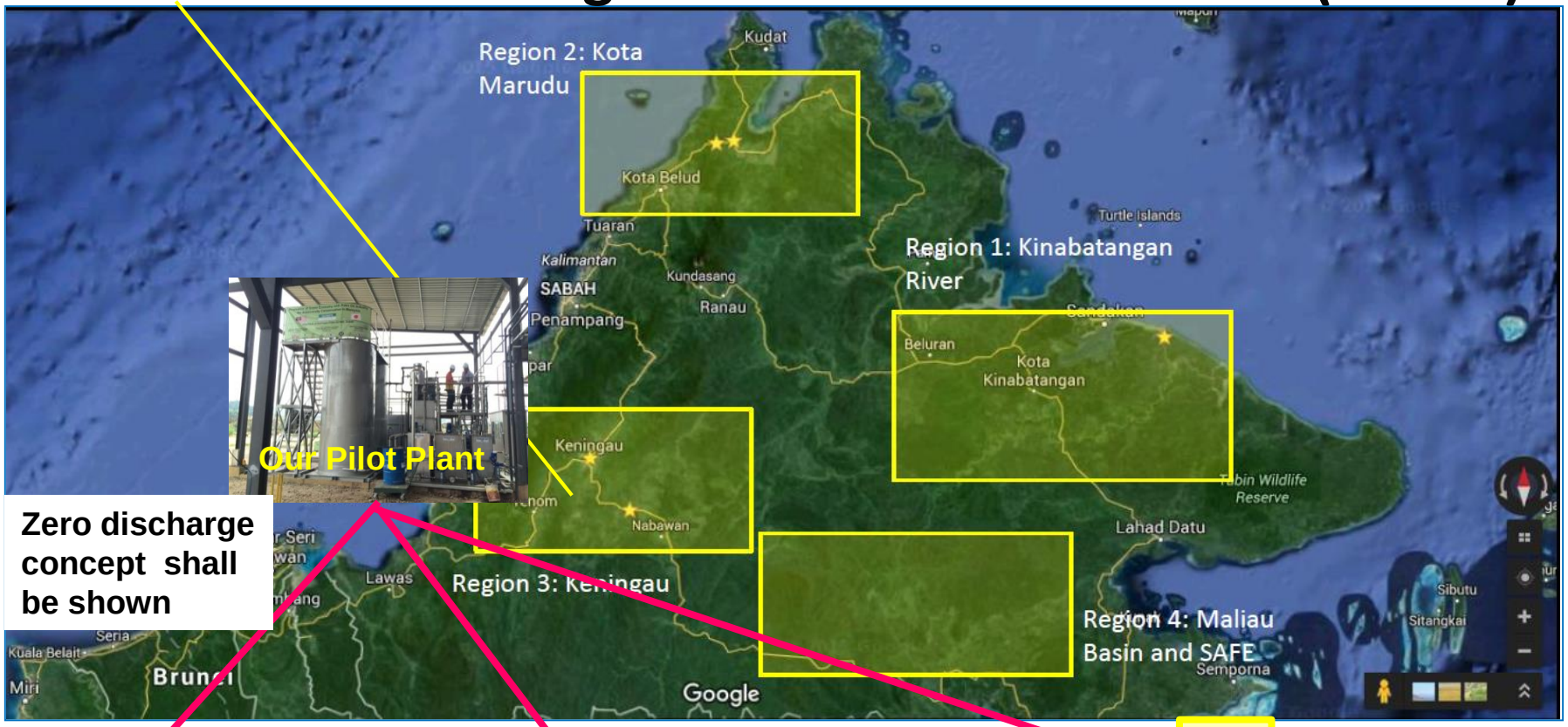
Energy

Even only one mill yields averagely no less than 40,000 tons of standardized biomass (they are not waste but resource!!) as BaU.

Our Showcase Mill

Our Research Strategy

Location of Keningau Palm Oil Mill Sdn. Bhd.(KPOM)



Zero discharge concept shall be shown

UMS Research site

Highest Value ⟷ **Low End**

Micro-composite

Nano-composite

Activated carbon ← Bio-char, bio-compost

Chemicals like 2,3 butanediol ← Sugars → Ethanol, Pellets, Briquets

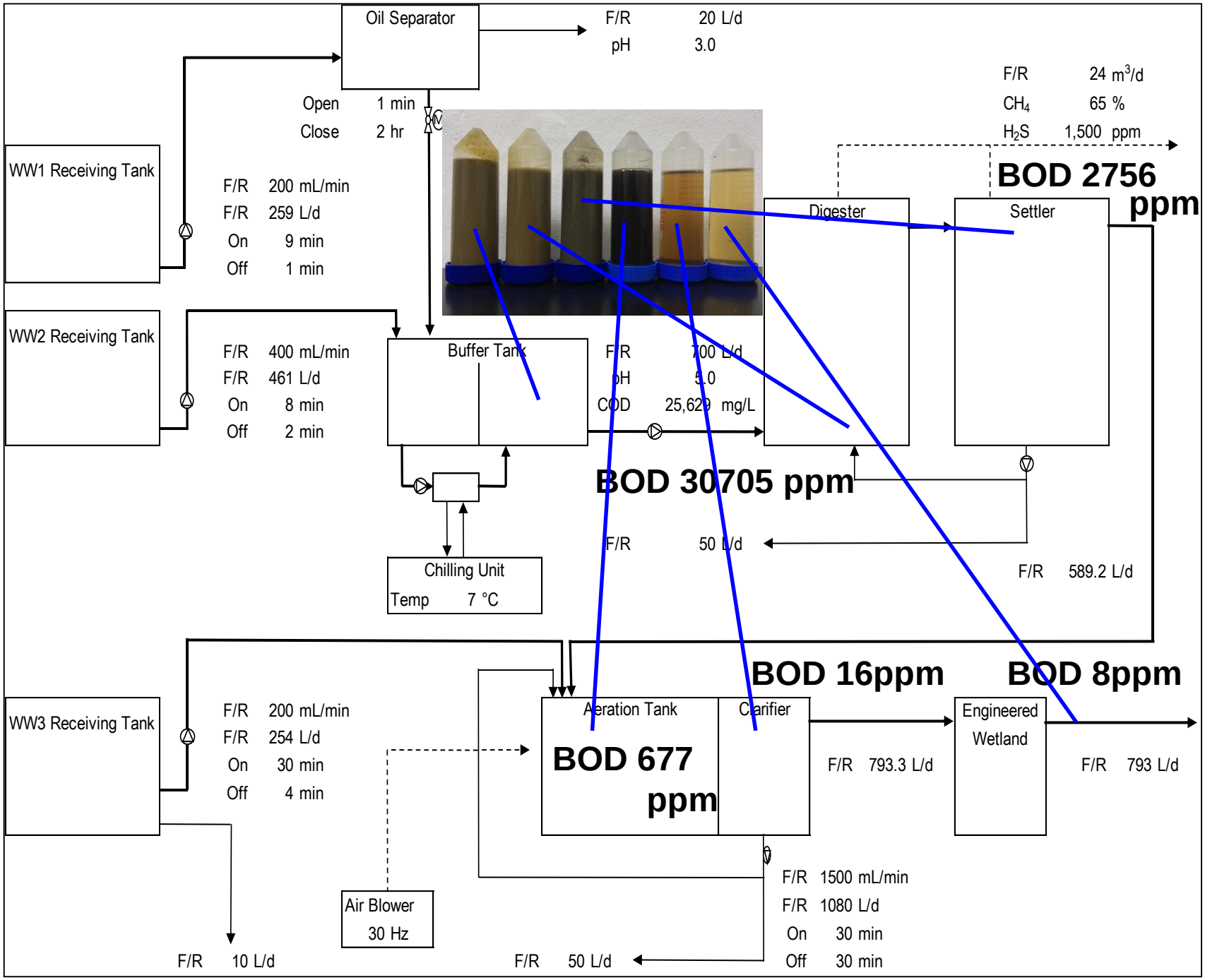
Zero Discharge Concept: Nothing Discharged from the mill except valued materials.

Our Pilot Plants in KPOM

POME Treatment System

Carbonization System

Compost System


Oil Separator
F/R 20 L/d
pH 3.0
Open 1 min
Close 2 hr
F/R 24 m3/d
CH4 65 %
H2S 1,500 ppm
BOD 2756 ppm
WW1 Receiving Tank
F/R 200 mL/min
F/R 259 L/d
On 9 min
Off 1 min
Digester
Settler
WW2 Receiving Tank
F/R 400 mL/min
F/R 461 L/d
On 8 min
Off 2 min
Buffer Tank
F/R 700 L/d
pH 5.0
COD 25,629 mg/L
BOD 30705 ppm
F/R 50 L/d
Chilling Unit
Temp 7 °C
F/R 589.2 L/d
BOD 16ppm
BOD 8ppm
WW3 Receiving Tank
F/R 200 mL/min
F/R 254 L/d
On 30 min
Off 4 min
Aeration Tank
Clarifier
BOD 677 ppm
F/R 793.3 L/d
Engineered Wetland
F/R 793 L/d
Air Blower
30 Hz
F/R 1500 mL/min
F/R 1080 L/d
On 30 min
Off 30 min
F/R 10 L/d
F/R 50 L/d

Mass and Energy flows and A Condition for the Creation of New Green Business

FFB 250,000 t/y

Water 280,000 t/y (Steam 160,000 t/y)

(Palm Biomass from FFB 58,000 t/y)

CPO 50,000 t/y

PK 12,500 t/y

Palm Biomass 127,500 t/y

Wasted Steam 140,000 t/y

POME 200,000 t/y

to yield 1MW (only a few % current P.G.E.)

How about the best mix?

Excess Palm Biomass 127,500 t/y

+ Available Steam 90,000 t/y

POME (water, sludge) 200,000 t/y

Anaerobic Treatment

Biogas Power Generation 1MW For Mill Operation

Zero!!

= High Values (Nano-composite, Chemicals for medicines etc.) + Middle Values (Bio-composite, Chemicals, Activated Carbon etc.) + Low Values (Compost, Char, Liquid Fuel, Solid Fuel :Energy!)


Promotion of Green Economy with Palm Oil Industry for Biodiversity Conservation in Malaysia

Evaporator

ADVANTAGES

of Palm Oil Industry as Green Industry!!

Business as Usual (key word: BaU)

No logistics issues as BaU

Constant collection of biomass through whole the year as BaU

Resources

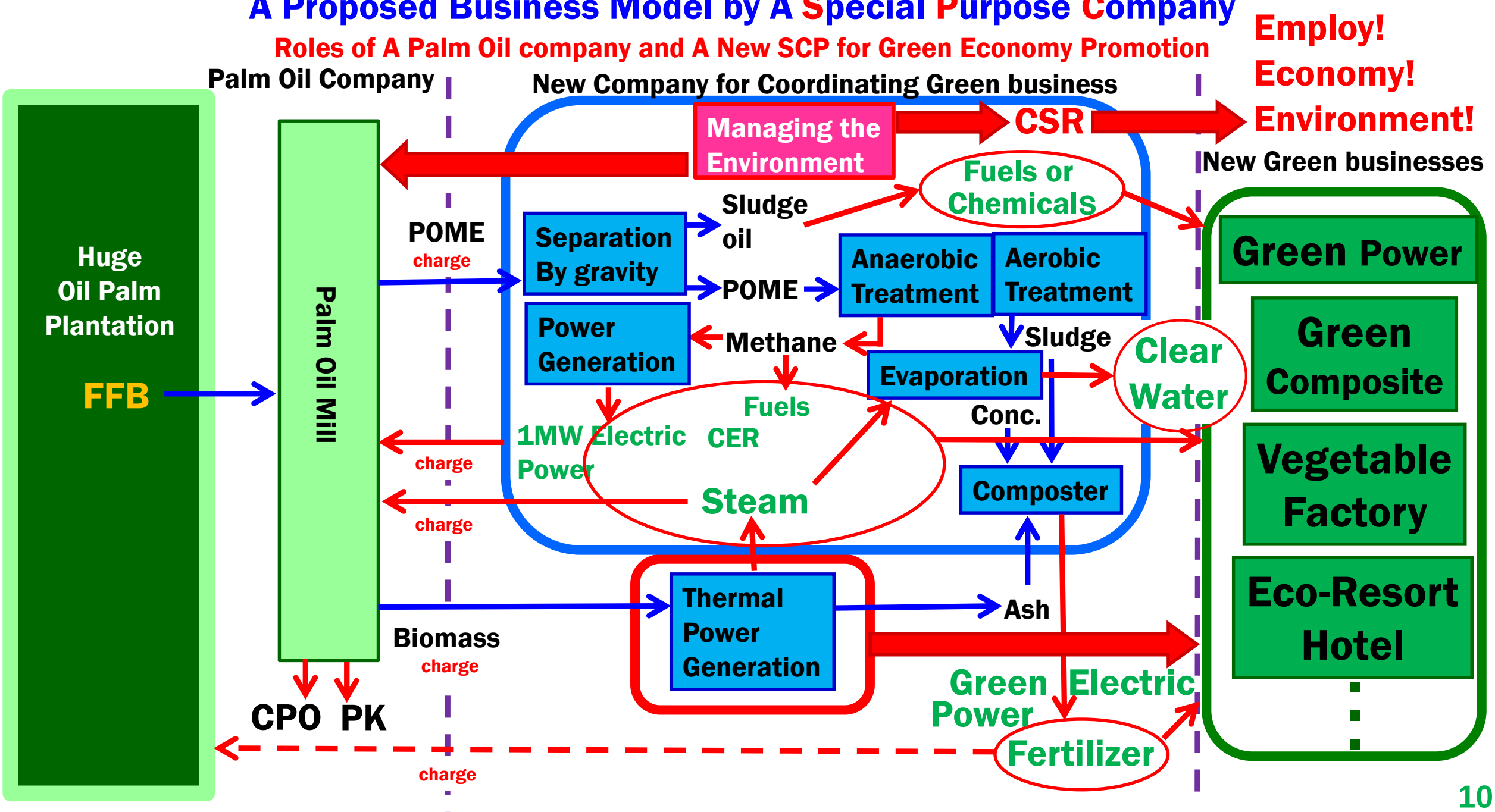
Energy

Lagoons for POME treatment

Even only one mill yields averagely no less than 40,000 tons of standardized biomass (they are not waste but resource!!) as BaU.

A Proposed Business Model by A Special Purpose Company

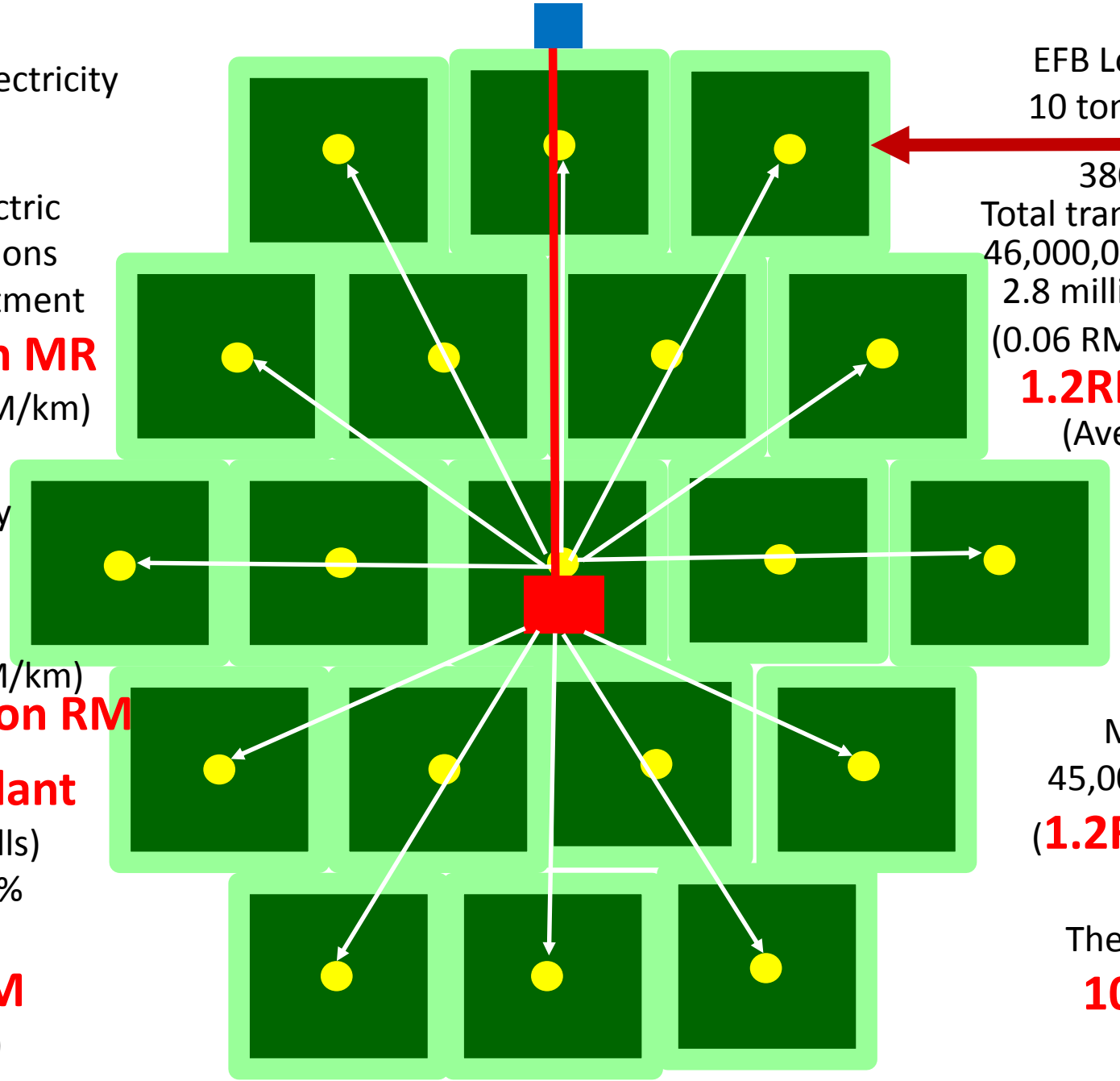
Roles of A Palm Oil company and A New SCP for Green Economy Promotion



Oil Palm Tree and Fresh Fruit Bunch

Oil Palm Plantation Area in Malaysia 5 million ha (Malaysia:35 million ha,14% of Malaysia)
Oil yield:3 – 5 tones/(ha•year)
Number of Palm Oil Mills: 500 (10,000 ha-plantation/mill)
40,000 tones CPO/ (mill•year)

Green Power Generation on A Large Scale Using Palm Biomass from 19 Palm Oil Mills



Power Grid by Sabah Electricity

Power electric Transmissions
Initial investment
25 km **25 million MR**
(1 million RM/km)

Power supply
260 km
Initial invet-ment
(100,000 RM/km)
26 million RM

190 MW Power Plant
(10MW/mill × 19 mills)
Power efficiency: 30%
Initial Investment
1520 million RM
(8 million RM/MW)

10 km
EFB Logistics
10 tons Lorry
380 km
Total transportation
46,000,000 ton・km
2.8 million RM/y
(0.06 RM/ton・km)
1.2RM/ton
(Average)
10 km
Oil Palm Plantation

Palm Oil Mill

EFB
60,000 t/y
(**10RM/t**)

CPO
50,000 t/y
PK
1,2500 t/y

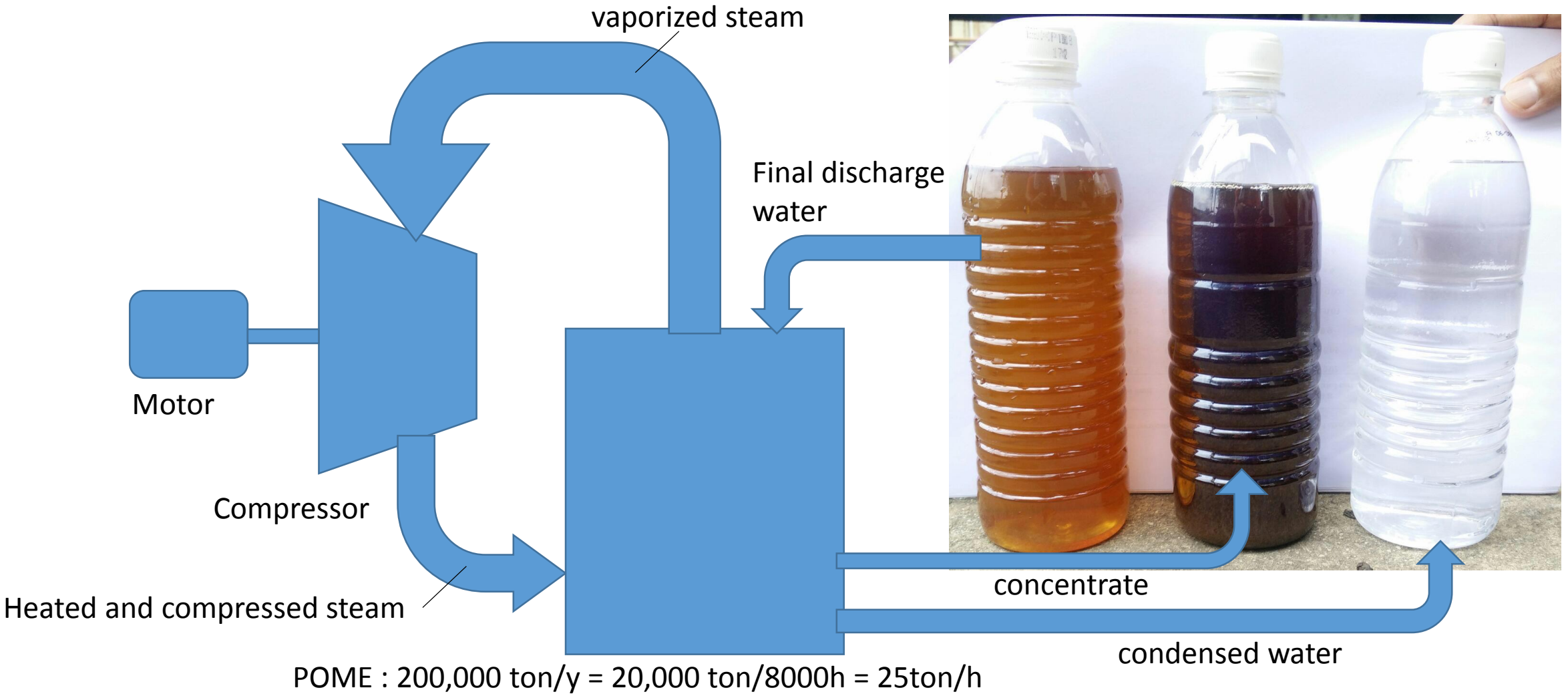
MF
45,000 t/y
(**1.2RM/t**)

PKS
16,000 t/y
(**100RM/t**)

Thermal Potential
10MW/mill

1RM=25JY
1RM=7.5Baht

Self-Heat Recuperation Technology



POME : 200,000 ton/y = 20,000 ton/8000h = 25ton/h

Latent heat for water evaporation : 25 ton × 0.65MWh/ton ≒ 16 MWh

Energy for compressor : 25 ton × 0.175 MWh/10 ton (cited from Kimura Chemical Plant Co. Ltd) ≒ 0.44 MWh

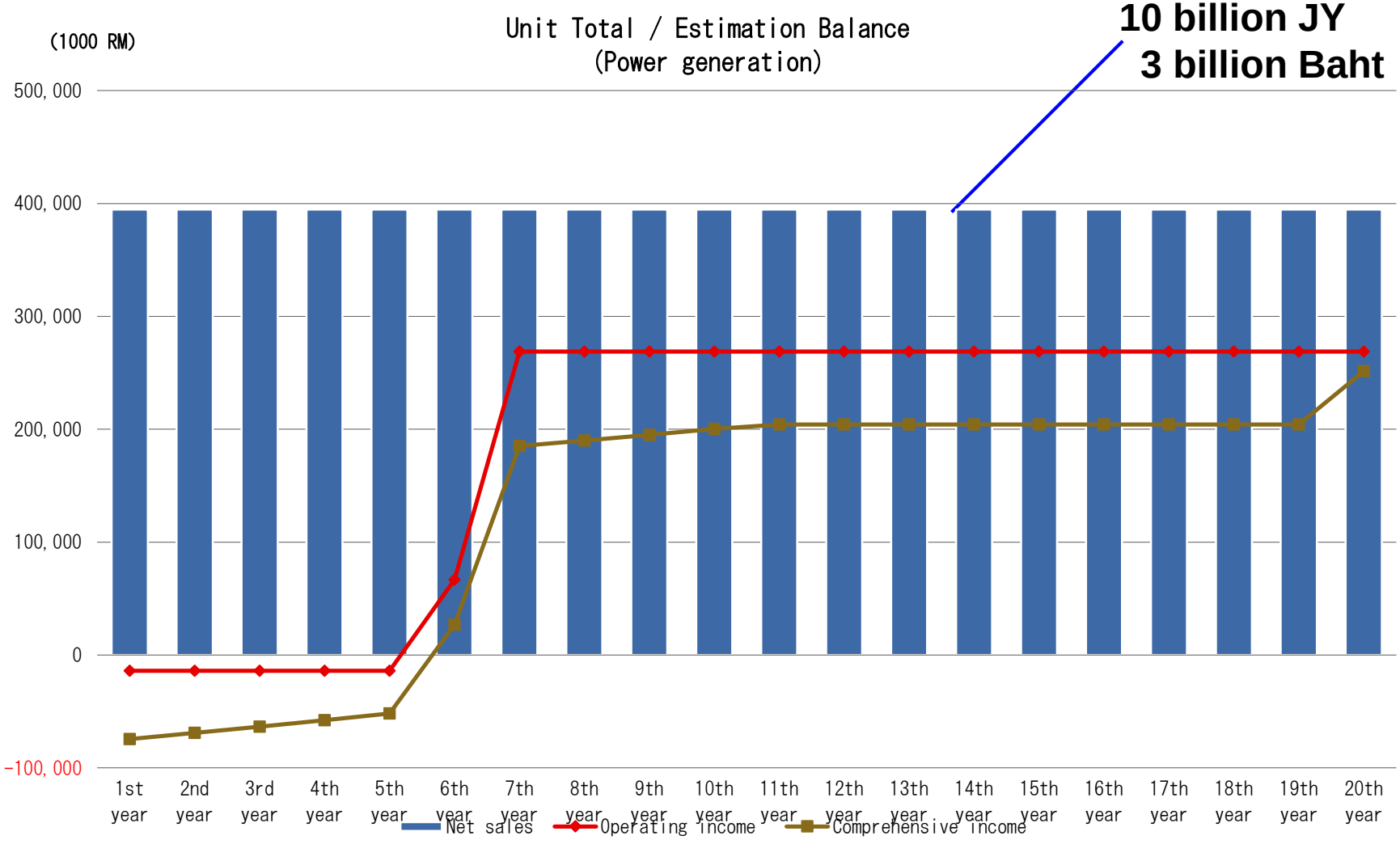
Key simulation conditions

(1) Power generation business		
Item	Setting condition	Contents
Amount of input biomass	2,280,000t / year 120,000t/year ×19	Estimated amount of excess biomass residue
Capacity of power generator	190,000 kW / year	
Power generation efficiency	15%	
Working days X Hours	330days X 24hours	
In-house electric power use	15% of generate	
Return power to Palm oil mill	For sale	
Initial investment amount	1571 million RM	Main body, incidental equipment including transmission and power supply
Power sale unit price	0.31 RM/kWh	Feed in tariff scheme in Malaysia
Steam sales unit price	For Sale	
Biomass residue purchase unit price	Mentioned previously	Free supply from Palm oil mill

Simulated by a cost benefit analysis

Revenue simulation result

400 million RM
10 billion JY
3 billion Baht



IRR : 5.96%

The Effect of change in Initial investment on the IRR

1,200 million RM (main body)
320 million RM (accessories)
25 million (Transmission: 25km)
+) **26 million (Power supply: total 260km)**
1,571 million RM

IRR = 5.96%

1,200 million RM (main body)
320 million RM (accessories)
100 million (Transmission: 100km)
+)**100 million (Power supply: total 1,000km)**
1,720 million RM

IRR = 4.40%

1,200 million RM (main body)
320 million RM (accessories)
250 million (Transmission: 250km)
+)**250 million (Power supply: total 2,500km)**
2,020 million RM

IRR = 1.63%