Sime Darby Plantation's Journey in Mitigating Glycidyl Esters (GE) Formation in Refine Palm Oil

Sime Darby Plantation Berhad

7 April 2021

Presentation Outline

- Overview of Sime Darby Plantation
- Upstream Initiative
- Downstream Initiative
- The Future Direction

More Than 100 Years of Presence

Pioneering Plantation Growth

1890s
The group's first 500 acres of rubber in Malaya

1960s
Development of Oil Palm

1980s – 2000s
Strengthening Global Downstream Capacities

2007
Merger that Created the World's Largest Listed Oil Palm Plantation Company

BORNEO POST online
THE LARGEST ENGLISH NEWS SITE IN BORNEO

Business

Analysts laud Sime Darby demerger, plantations likely to be listed first

February 1, 2017, Wednesday

KUCHING: Analysts across [illegible] exercise plans last week, w[illegible]

REUTERS

UPDATE 1-Malaysia's Sime Darby to spin off plantation, property businesses

Jan 26 Sime Darby Bhd, the world's largest palm oil company by land size, will spin off its plantations and property businesses in separate listings on the local stock exchange, the Malaysian conglomerate said on Thursday.

The listing of the plantation business, which accounted for a major share of Sime Darby's 44 billion ringgit ($9.9 billion) revenue last year, could be the largest plantations listing since Felda Global Ventures in 2012.

THE STAR ONLINE

Saturday, 17 December 2016

Demerger exercise likely option for Sime Darby Plantations

BY HANIM ADHAN

THE plantation arm of Sime Darby Bhd – Sime Darby Pla[illegible]

THE EDGE PROPERTY Malaysia

Analytics Calculators New Launches News

Sime Darby rolls out demerger exercise plans

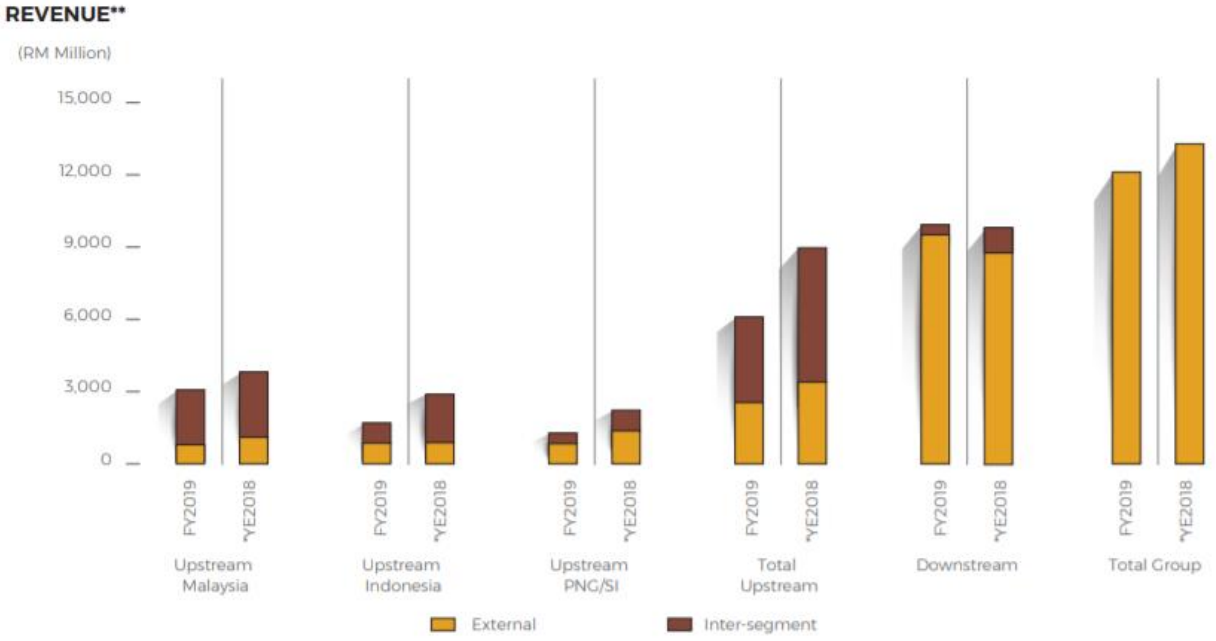
By Publishment Research | February 2, 2017 2:29 PM MYT

Maintain outperform call with an unchanged target price of RM9.30: Sime Darby Bhd has finally rolled out its long-awaited demerger exercise plans last Thursday, which will divide the group into three entities — Sime Darby Plantation Bhd, Sime Darby Property Bhd and Sime Darby Bhd.

Pure Play will be the next phase of growth for SDP

Sime Darby Plantation

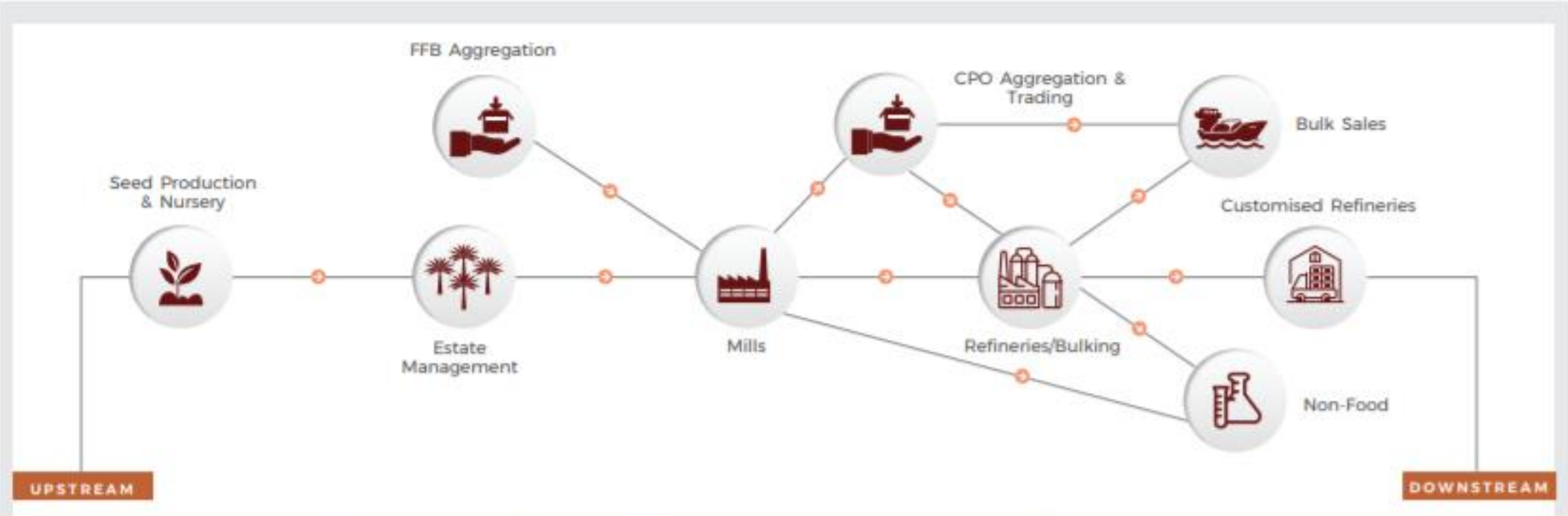
Company Background



R&D

Over 190 technocrats, scientists and technicians working together to improve every aspect of our business

Overview of Sime Darby Plantation



Drive efficiency to yield more CPO from our existing land bank

High quality & sustainable feedstock to fuel SDP's growth

'Integrated' model as differentiator & key offering

Leverage on sustainability, traceability & efficiency

Position SDP as a sustainable key downstream industry player

Emphasis on growth strategy to expand reach & capture value from palm oil

Sime Darby Plantation Global Footprint

16 Countries

776,812 Hectares Landbank

240 Estates
*including oil palm, rubber, sugar cane and grazing pasture

71 Mills
*including two (2) copra mills

5 R&D Centres

11 Refineries

3 Innovation Centres

Contaminates in CPO and RBDPO

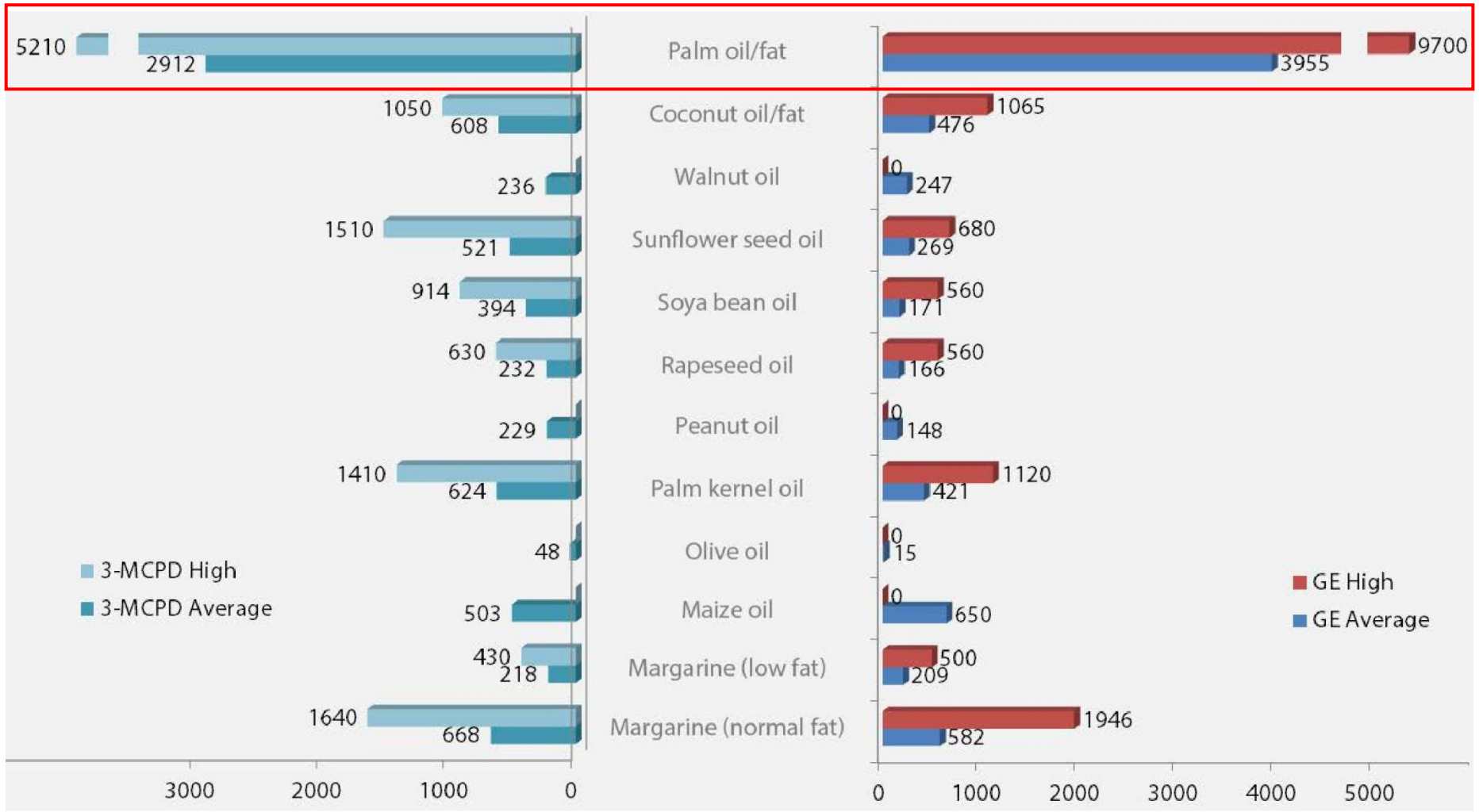
The Health Effects

Undesirable Minor Component	Origin	Health Effect
Heavy metals	Soil, milling storage & transport	Toxic
Pesticides	Crop protection chemicals	Toxic
Dioxins	Environmental pollution	Highly toxic
Mycotoxins	Mould or fungus	Toxic
Mineral oil	Process, storage, transport	Toxicity depends on chain length
Poly Aromatic Hydrocarbons	Drying of oil crop	Carcinogenic, Genotoxic
3-MCPD	High heat treatment	Carcinogenic
GE	High heat treatment	Genotoxic

The SPARK

Highly shared 3-MCPD and GE baseline data

Average/high levels of GE and 3-MCPD by type of oils/fats in µg/kg (collected 2012-2015, in most cases EU country of origin unknown)



How its formed

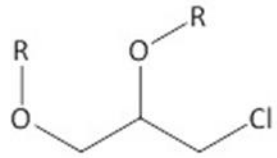
Oil Extraction

Crude Palm Oil

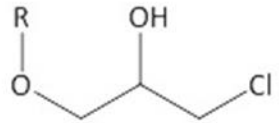
Deodorization

(>200 °C forms contaminants)

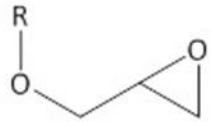
Processing contaminants



3-MCPD diester



3-MCPD monoester



glycidyl ester

Refined oil

Refined oil used to make infant formula

BIG QUESTION

Concentrations of processing contaminants in infant formula??

Overview of 3-MCPD and GE

EU Regulation

Name	Food Category	Maximum Level µg/kg
Glycidyl fatty acid esters, expressed as glycidol	Vegetable oils and fats, fish oils and oils from other marine organisms placed on the market for the final consumer or for use as an ingredient in food, with the exception of the foods referred to in 4.2.2 and of virgin olive oils	1000
	Vegetable oils and fats, fish oils and oils from other marine organisms destined for the production of baby food and processed cereal-based food for infants and young children	500
	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children and young-child formula (powder)[a]	50
Sum of 3-monochloropropanediol (3-MCPD) and 3-MCPD fatty acid esters, expressed as 3-MCPD	oils and fats from coconut, maize, rapeseed, sunflower, soybean, palm kernel and olive oils (composed of refined olive oil and virgin olive oil) and mixtures of oils and fats with oils and fats only from this category	1250
	other vegetable oils (including pomace olive oils), fish oils and oils from other marine organisms and mixtures of oils and fats with oils and fats only from this category	2500
	mixtures of oils and fats from the two abovementioned categories.	—[b]
	Vegetable oils and fats, fish oils and oils from other marine organisms destined for the production of baby food and processed cereal-based food for infants and young children	750
	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children and young-child formula (powder)[a]	125
	Infant formula, follow-on formula and foods for special medical purposes intended for infants and young children and young-child formula (liquid)[a]	15

a: "Young-child formula" refers to milk-based drinks and similar protein-based products intended for young children.

b: The oils and fats used as ingredient for the mixture shall comply with the maximum level established for the oil and fat. In case the quantitative composition is not known for the competent authority and the food business operator, not producing the mixture, the level of the sum of 3-MCPD and 3-MCPD fatty acid esters, expressed as 3-MCPD in the mixture shall in any case not exceed 2 500 µg/kg.

26 February 2018

Regulation (EU) No. 2018/290

In September 23,2020 the amended European Commission regulation

Maximum limits of

3-MCPD

&

GE

in refined vegetable oils entering Europe.

Regulation and Direction

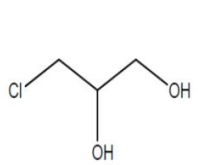
Total Chloride, 3-MCPD and GE

Contaminants	Regulation and Direction	Target and Goals

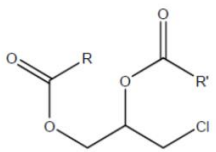
Contaminants

Cl^-

Total Chloride (TC)

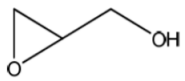


3-MCPD

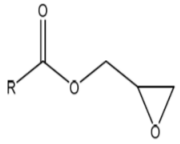


3-MCPD diester

3-MCPD



Glycidol



Glycidyl ester

GE

Regulation and Direction

MPOB

Nestlé, Unilever, efsa European Food Safety Authority, MPOB

Nestlé, Unilever, efsa European Food Safety Authority, MPOB

Target and Goals

Malaysian CPO TC **below 2 ppm**

* ONLY for Guideline.

Malaysian Refine Oil products 3-MCPD
Need to be below 2.5 ppm

EU Regulation
Soft Oils : < 1.25 ppm
Palm Oil + : < 2.5 ppm

Effective date:
EU : 1 Jan 2021
MPOB : 1 Jan 2023

EU Regulation**,** all Refine oils must **below 1 ppm**

Effective date:
EU : 1 Jan 2021
MPOB : 1 Jan 2023

MPOB Proposed New Regulation

The new Regulation for Malaysia

New Proposed Malaysia Standard for CPO and Refined PO with aggressive timeline for compliance

CPO New Specification

No.	Parameters	Standard CPO
1	FFA	5% max
2	M & I	0.25 % max
3	DOBI	2.31 min
4*	Chlorine (Cl)	**2.0 ppm max**

* Guideline

* Will be included in Malaysian Standard and will be included in the sales contract depending on willing buyer & willing seller for sales within Malaysia.

* All import and export consignment need to fulfil Malaysia Standard requirement.

Refined PO New Specification

No.	Parameters	Standard Refined PO
1	FFA	0.1% max
2	M & I	0.1 % max
3	Iodine Value (Wijs)	50 -55
4	Melting Point	33 -39 C
5	Colour	3 Red max
6^	3-MCPD	**2.5 ppm max**
7^	GE	**1 ppm max**

^New specification in refinery license.

Implementation Timeline

Source: MPOB

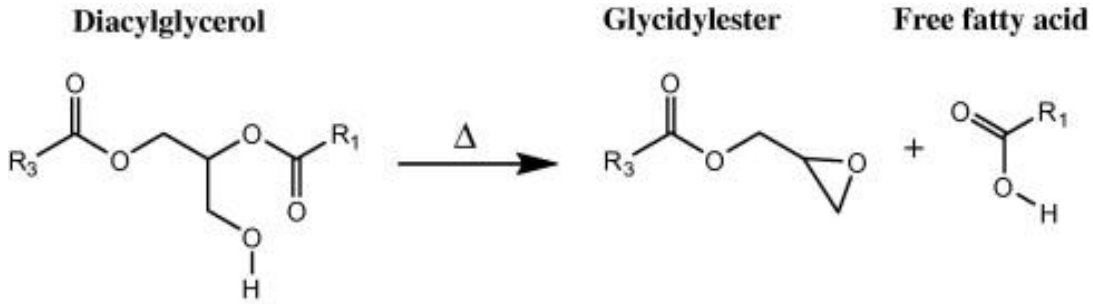
The Origin of GE

The Understanding through YEARS of Research since 2010

TAGs	ECNs	Composition (%) HFFA-CPO	Composition (%) CPO_{MS}[a]
OLL	42.0	0.1	0.2 – 0.9
PLL	42.6	1.5	1.3 – 3.4
MLP	43.3	0.2	0.2 – 1.0
OLO	44.1	0.9	1.3 – 2.3
PLO	44.7	9.6	9.0 – 11.2
PPL/PLP	45.3	8.2	6.5 – 11.0
OOO	46.2	2.5	3.3 – 6.6
POO/OPO	46.8	20.9	20.5 – 26.2
PPO/POP	47.4	25.0	27.1 – 31.0
PPP	48.0	2.3	0.7 – 7.2
SOO	48.8	0.7	1.0 – 3.6
POS	49.4	2.2	4.6 – 5.9
PPS	50.0	0.02	0.1 – 1.8
SOS	50.0	0.1	0.1 – 1.4
TAG %		74.2	≥ 90 %
DAG %		19.9	< 7.7 %
MAG %		5.9	≤ 0.5 %

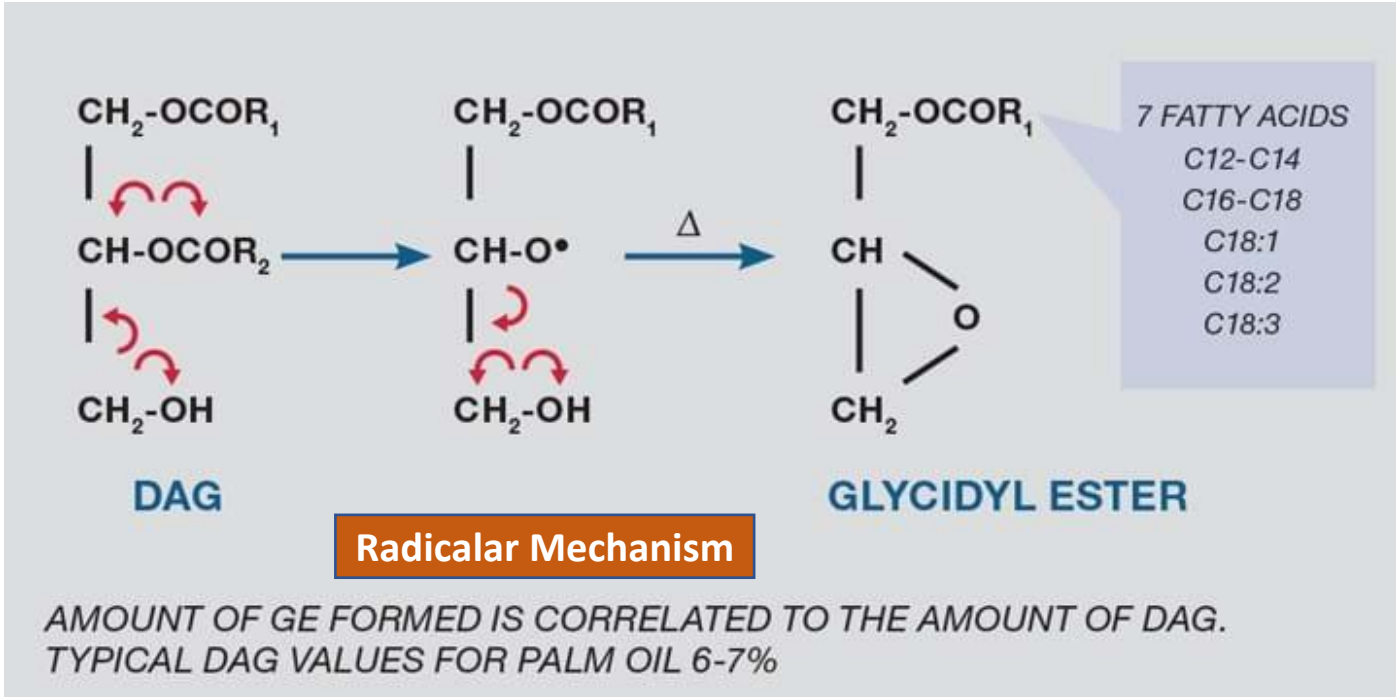
a: [28 – 30], ECNs: equivalent carbon number. HFFA-CPO: high free fatty acid crude palm oil. CPO_{AS}: crude palm oil after separation. CPO_{MS}: Malaysian crude palm oil standard M: myristic, P: palmitic, S: stearic, O: oleic, L: linoleic acid.

Source: Murad, 2016



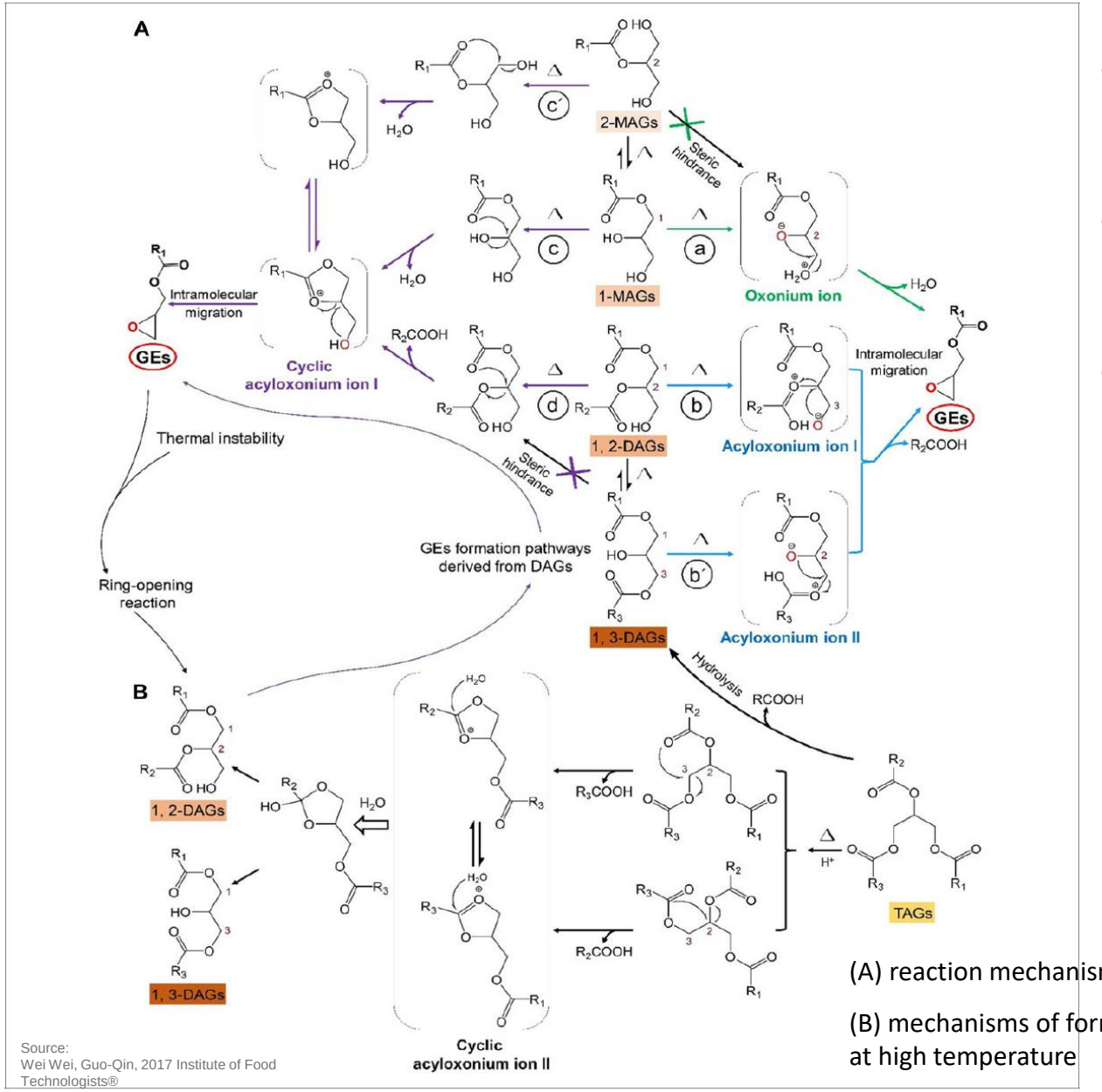
DAG

(6-8%)



The Origin of GE

The Understanding through YEARS of Research

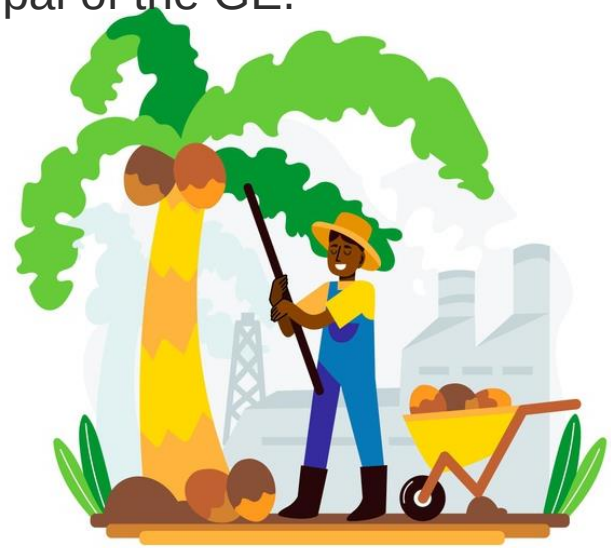


Source:
Wei Wei, Guo-Qin, 2017 Institute of Food Technologists®

(A) reaction mechanisms derived from DAGs and MAG

(B) mechanisms of formation of DAGs and MAGs derived from TAGs at high temperature

- Formation of GE from DAG is extensive at temperatures above 230–240 °C.
- Formation of GE accelerates in particular when the DAG levels in refined oils exceed 3% of total lipids.
- High levels (>100 ppm) of GE were also found in PFAD samples, which may indicate that the level of GE in fully refined palm oils also depends on the elimination rate of GE into the PFAD. This give us an idea on the removal principal of the GE.



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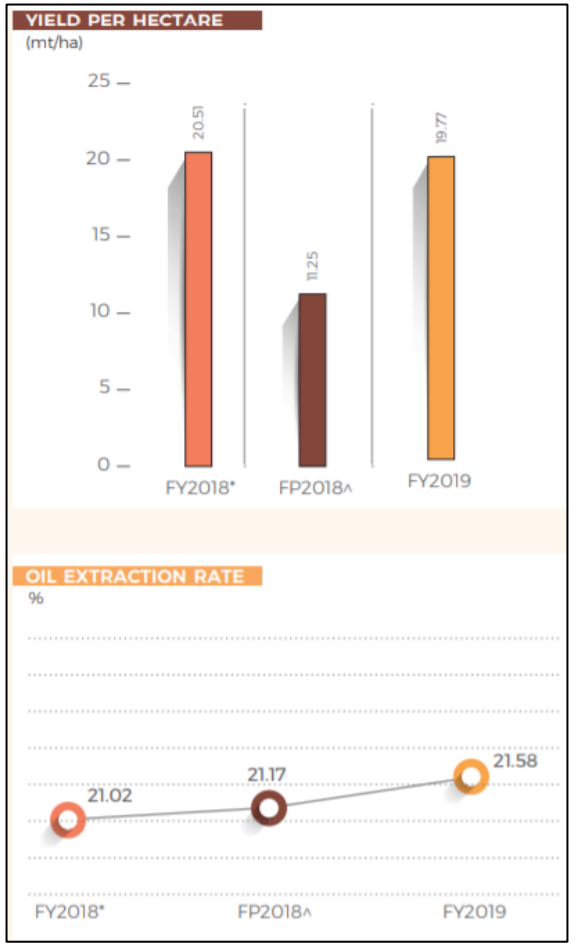
The Upstream

Current Mills

Sime Darby Mill
KKS Elphil, Perak



Sime Darby Plantation

Upstream Operation

MALAYSIA
SIME DARBY PLANTATION BERHAD

299,350 ha
Total Planted Area

INDONESIA
MINAMAS PLANTATION

195,729 ha
Total Planted Area

PAPUA NEW GUINEA & SOLOMON ISLANDS
NEW BRITAIN PALM OIL

96,224 ha
Total Planted Area

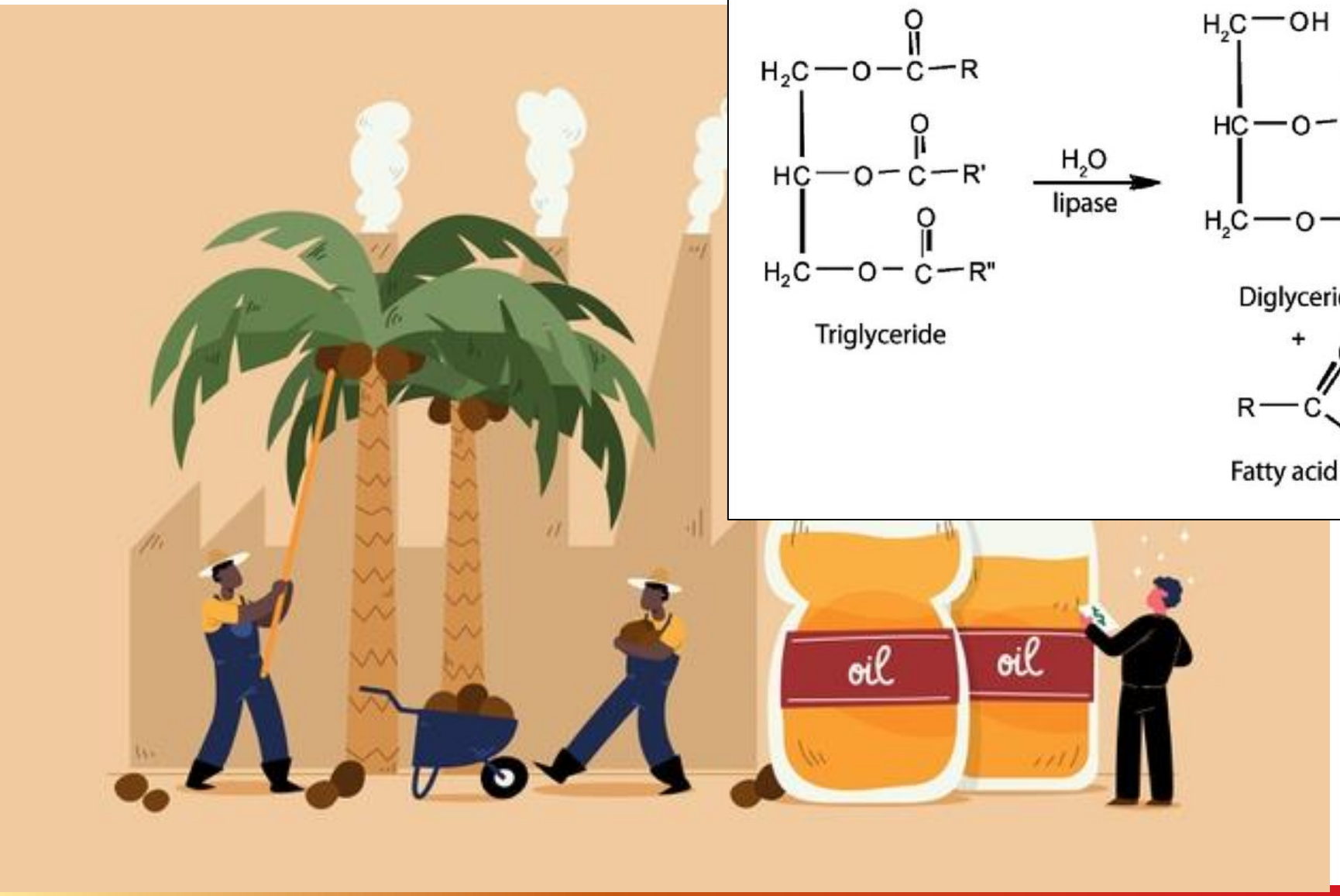
Palm Oil Milling

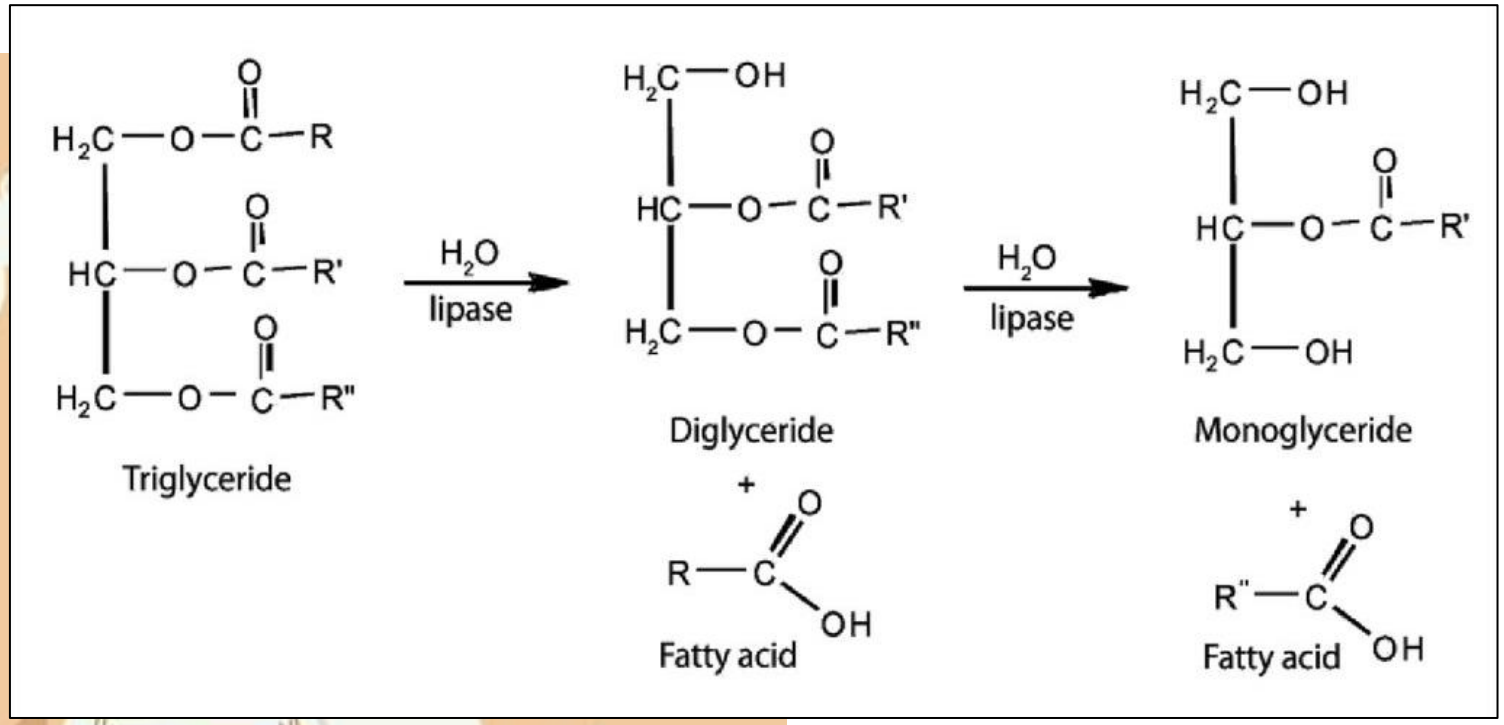
The Beginning

The first palm oil mill in Malaya at Tennamarain Estate, Batang Berjuntai, Selangor.
Oil palm was first planted commercially in Malaya in 1917 by Frenchman Henri Fauconnier.

Upstream Contribution

The principle – Breakdown of Fats



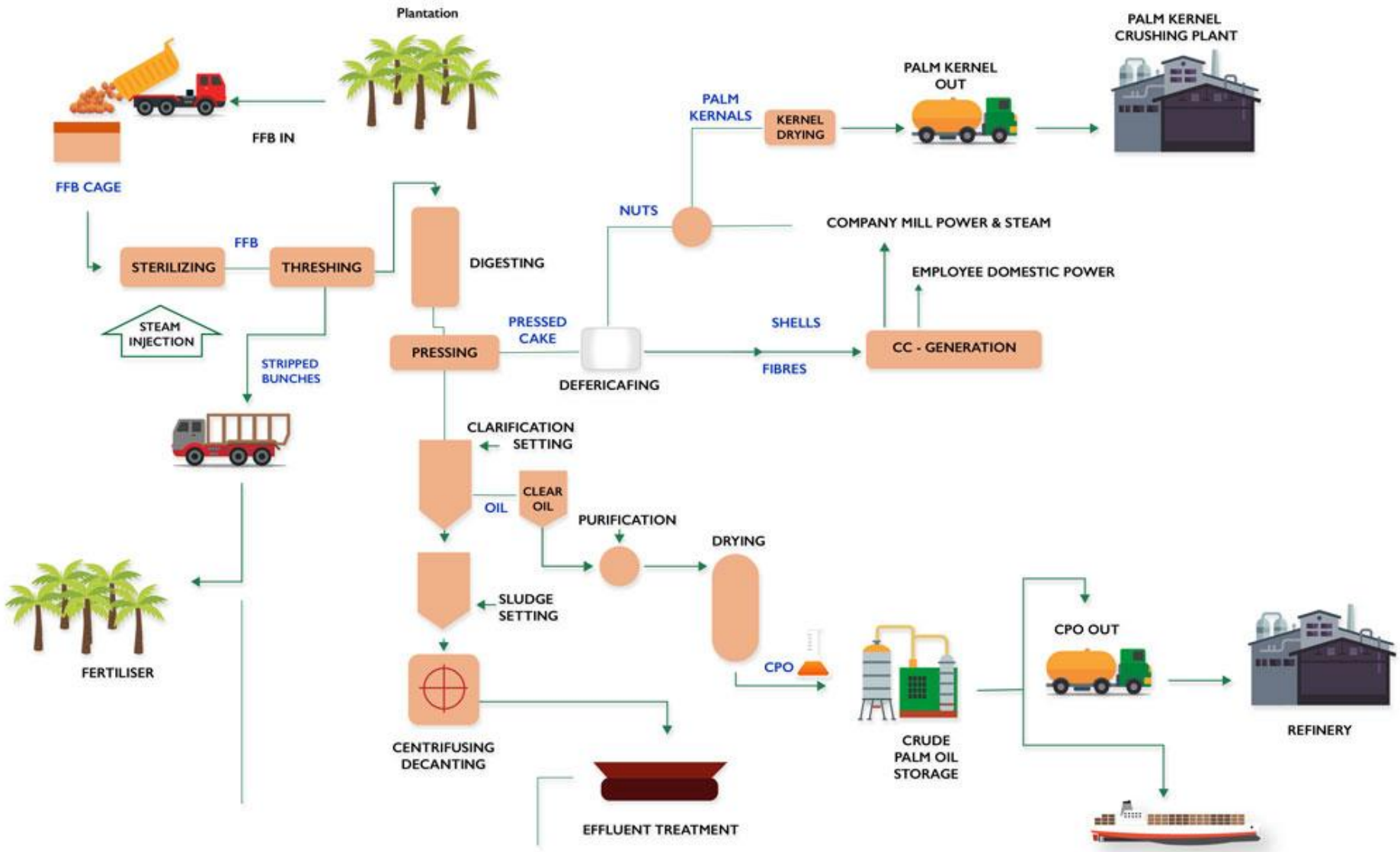


Sime Darby Plantation :Oil Palm Estate

- Improve FFB Quality
- Right Harvesting
- Evacuation Time
- FFB Bruising

Palm Oil Milling

Crude Palm Oil Milling Process



Improve CPO Quality

FFA

Processing Time

Secondary Oil

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Sime Darby Oils

Company Background

Sime Darby Oils Facilities Spread Across
7 Countries Worldwide

Sime Darby Plantation

Our global presence helps to secure customers effectively

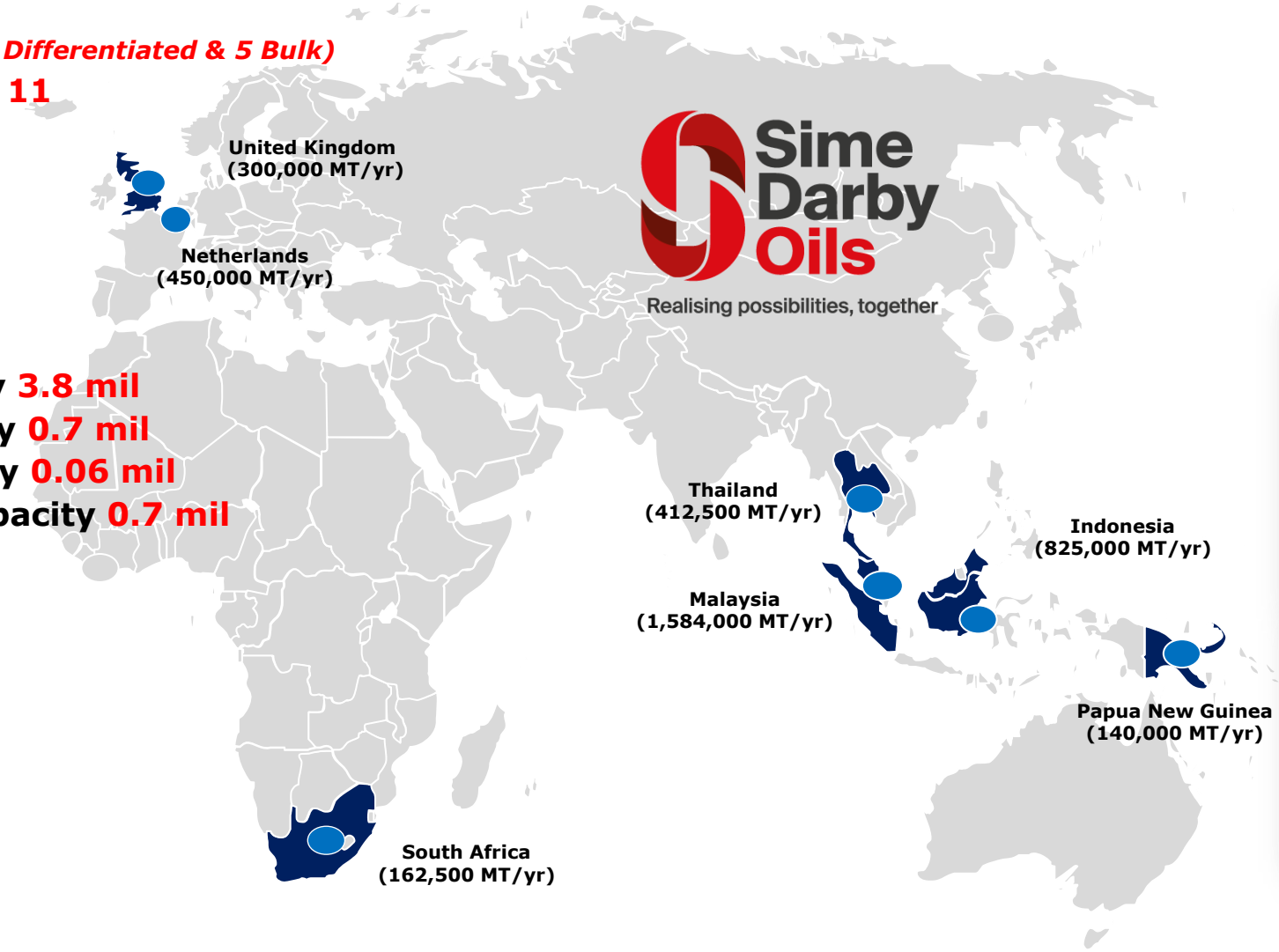
Number

- **Refineries 11** ***(6 Differentiated & 5 Bulk)***
- **Crushing Plants 11**

MT p.a.

- **Refining capacity 3.8 mil**
- **Crushing capacity 0.7 mil**
- **Biodiesel capacity 0.06 mil**
- **Oleochemical capacity 0.7 mil**

Note: Data is as at Dec 2018



Sime Darby Oils Capability

Where are we?

A Leading Sustainable Oils and Fats Company

SD Oils is a fully owned subsidiary of Sime Darby Plantation-World's Largest Producer Certified Sustainable Palm Oil (CSPO)

~20% of global supply
(4% of global CPO production)

Supplying essential ingredients to the World's famous brands in food & non-food products

Sime Darby Oils Capability

Product Segment

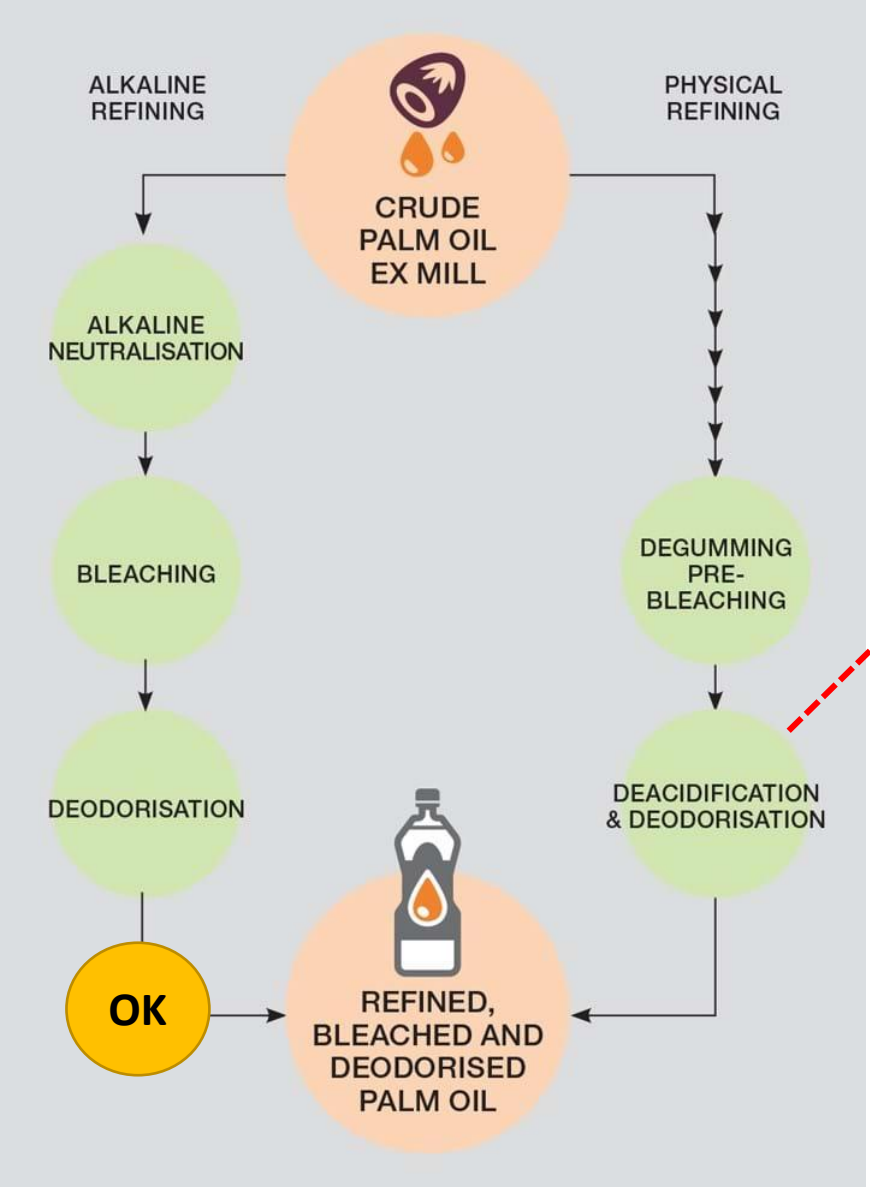
	Segment	Product Description	Products
1	**Frying**	Oil, or oil and fat blends for the purpose of food manufacturing and food preparation (quick serve) and the domestic use (retail oils)	**CERTIO® premium frying oil is produced from premium quality CPO, Blends of oils and fats, Blended liquid oil**
2	**Bakery**	Texturised blend of oils and fats such as shortening, margarine, vegetable ghee, pastry margarine and hard stocks used for the bakery/food manufacturing industry	**Shortenings, Margarine, Vegetable Ghee, Palm based hard stocks**
3	**Confectionery**	Confectionery fats are used for moulding, coating, cream filling, toffee/candy and as a substitute for cocoa butter	**Sugar Confectioneries, Chocolate Confectioneries** (CBS: Cocoa Butter Substitute, Filling Fats, Coatings)
4	**Health**	Nutritional purposes in food manufacturing and health/beauty products	**Tocotrienols**
5	**Specialty Ingredients**	Palm-derived ingredients and specialty oils & fats that fulfil specific functions	**Infant formula Ingredients, Red Palm Super Olein, Lecithins, Animal Nutrition** (PURAFEX)

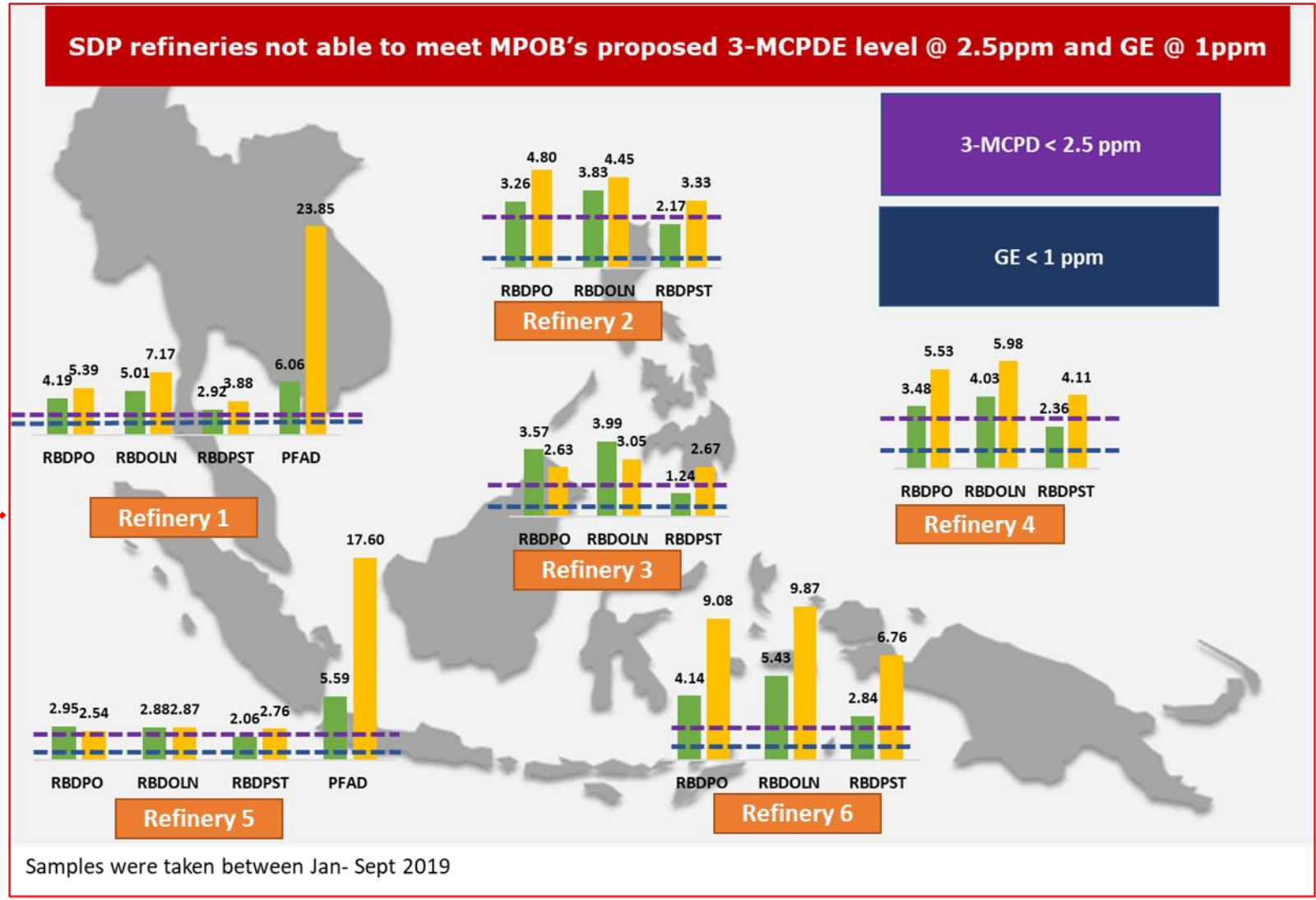
GE Level

As low as 0.1 ppm

The Baseline - SDO

Where we are – Physical Refining Plant?

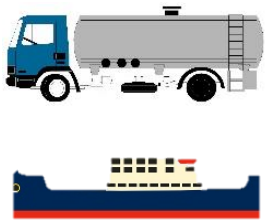




Samples were taken between Jan- Sept 2019

Downstream Operation

Palm Oil Refinery Process + THE CHALLANGE



Transportation
CPO being transfer to refinery from mill
via lorry and ship

Storage
CPO being pump into the storage tank

Quality check
Quality of the CPO being check

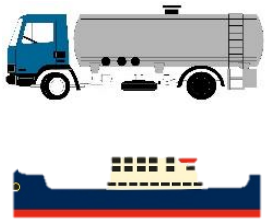
Degumming
The CPO is heated under vacuum and phosphoric acid were added to separate the gums

Bleaching
Bleaching earth being added to absorb impurities and color pigments in the oil

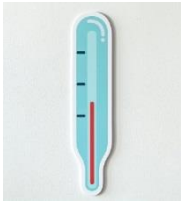
Filtration
The oil being send to filtration to remove the bleaching earth
At this point, the oil called Bleached Palm Oil (BPO)

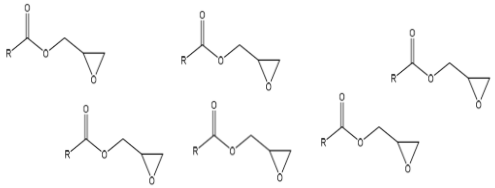
Deodorization
Odor and FFA being remove during this stage
Refined Bleached Deodorized Palm Oil (RBDPO) is the product
Palm Fatty Acid Distillate (PFAD) is the by - product where it gain from the vapor

Fractionation
The RBDPO going through this process to have product of stearin and olein where olein widely use as frying oil and stearin will use as margarine production



Transportation
The product being shipped to customer

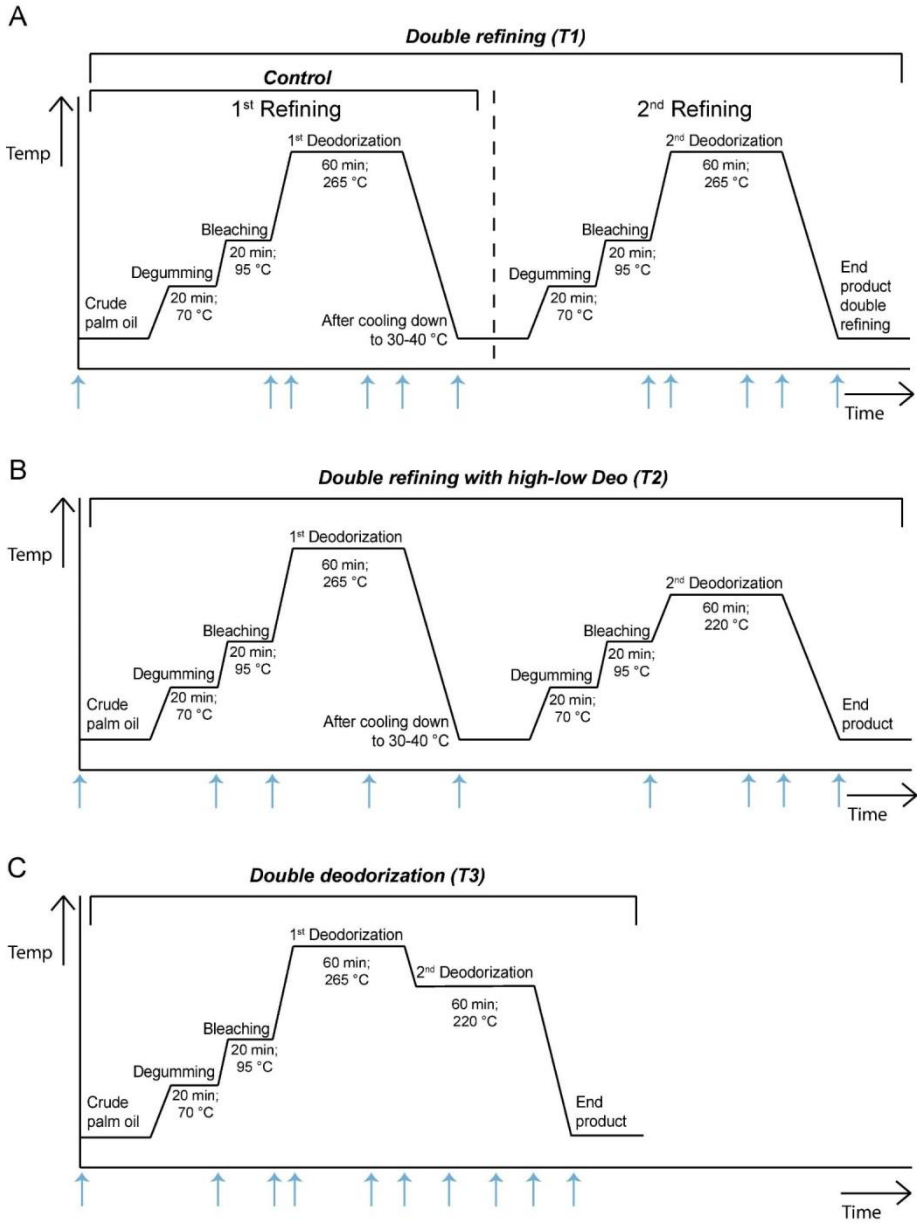


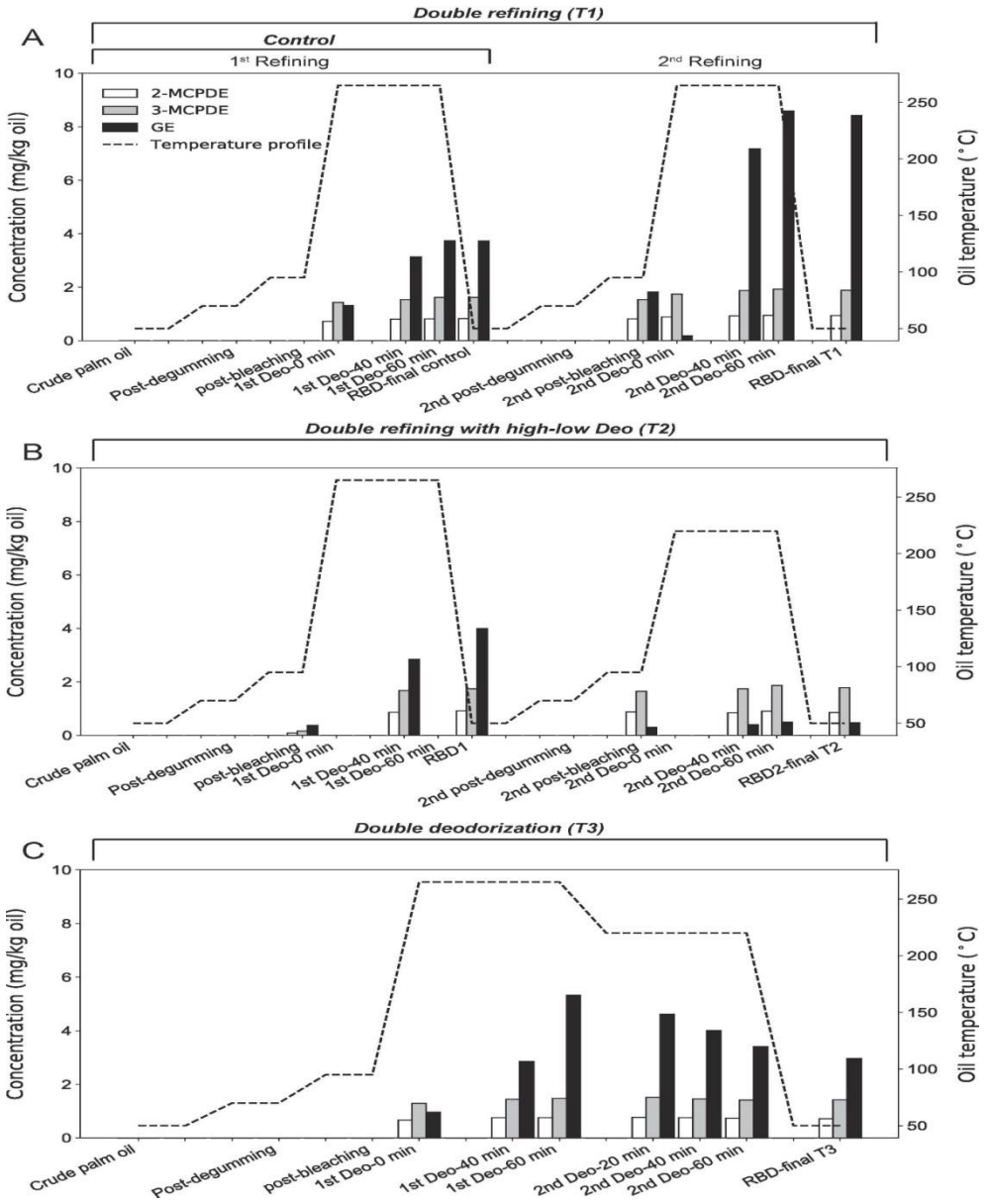


DAG

Double Physical Refining Route

Option with reduction of Plant capacity by > 50%.

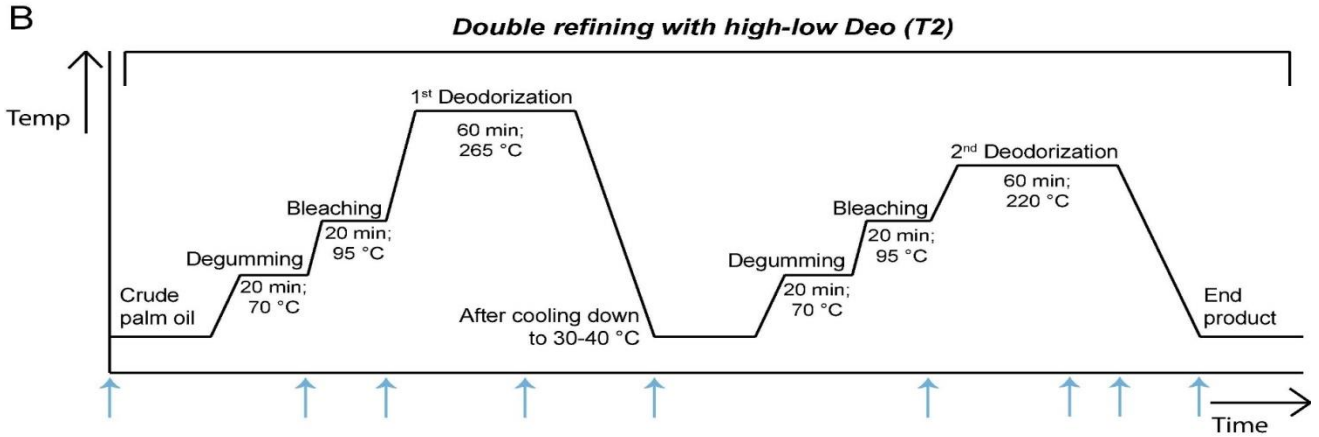




Source:
Wageningen Food Safety Research (WFSR),
Wageningen University & Research, Akkermaalsbos
6708 WB Wageningen, the Netherlands

Double Physical Refining Route

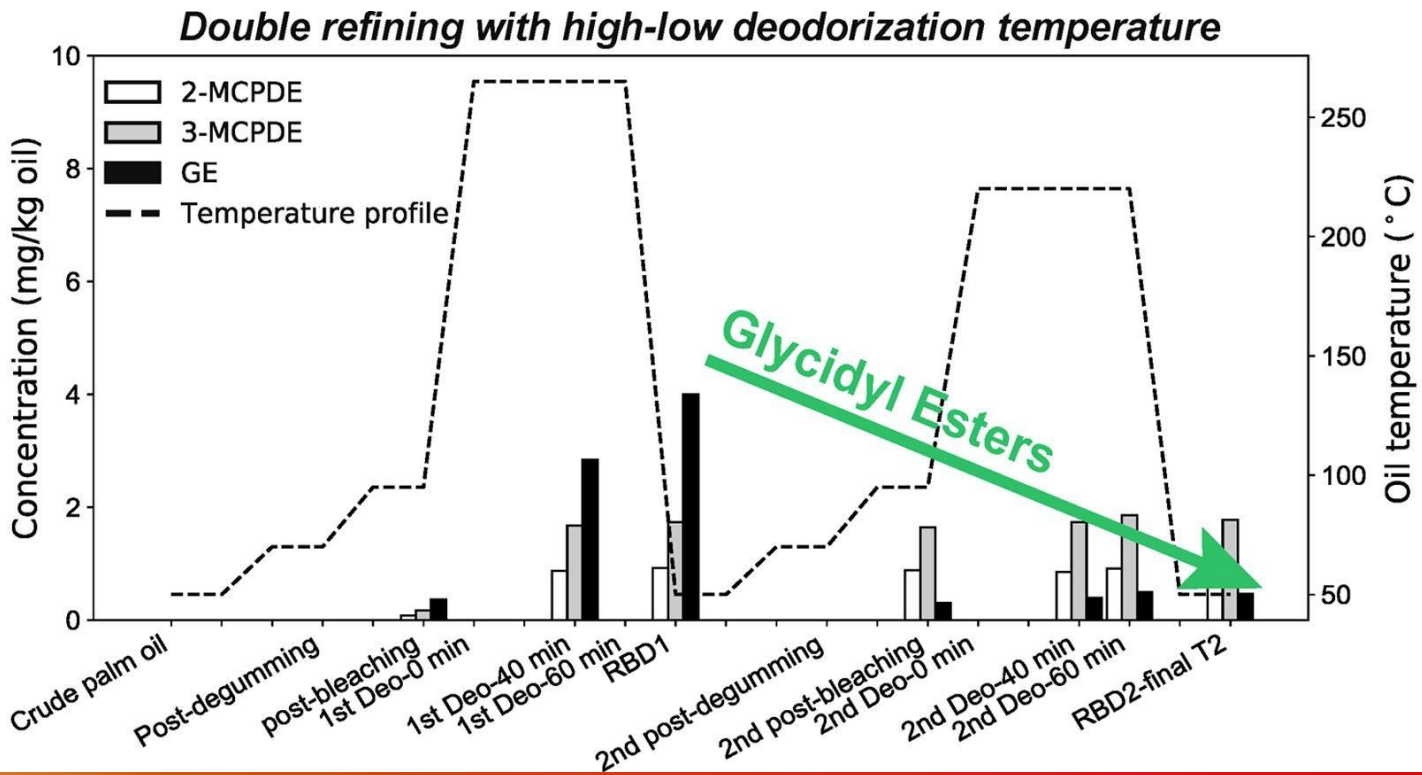
Option with reduction of Plant capacity by > 50%.

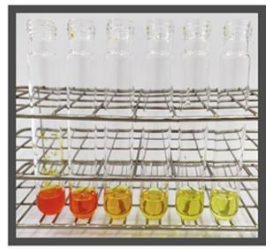


Pre-Treatment CRUCIAL

Post Deodorization < 230 °C

Palm fruit





Oil Refining

Source:
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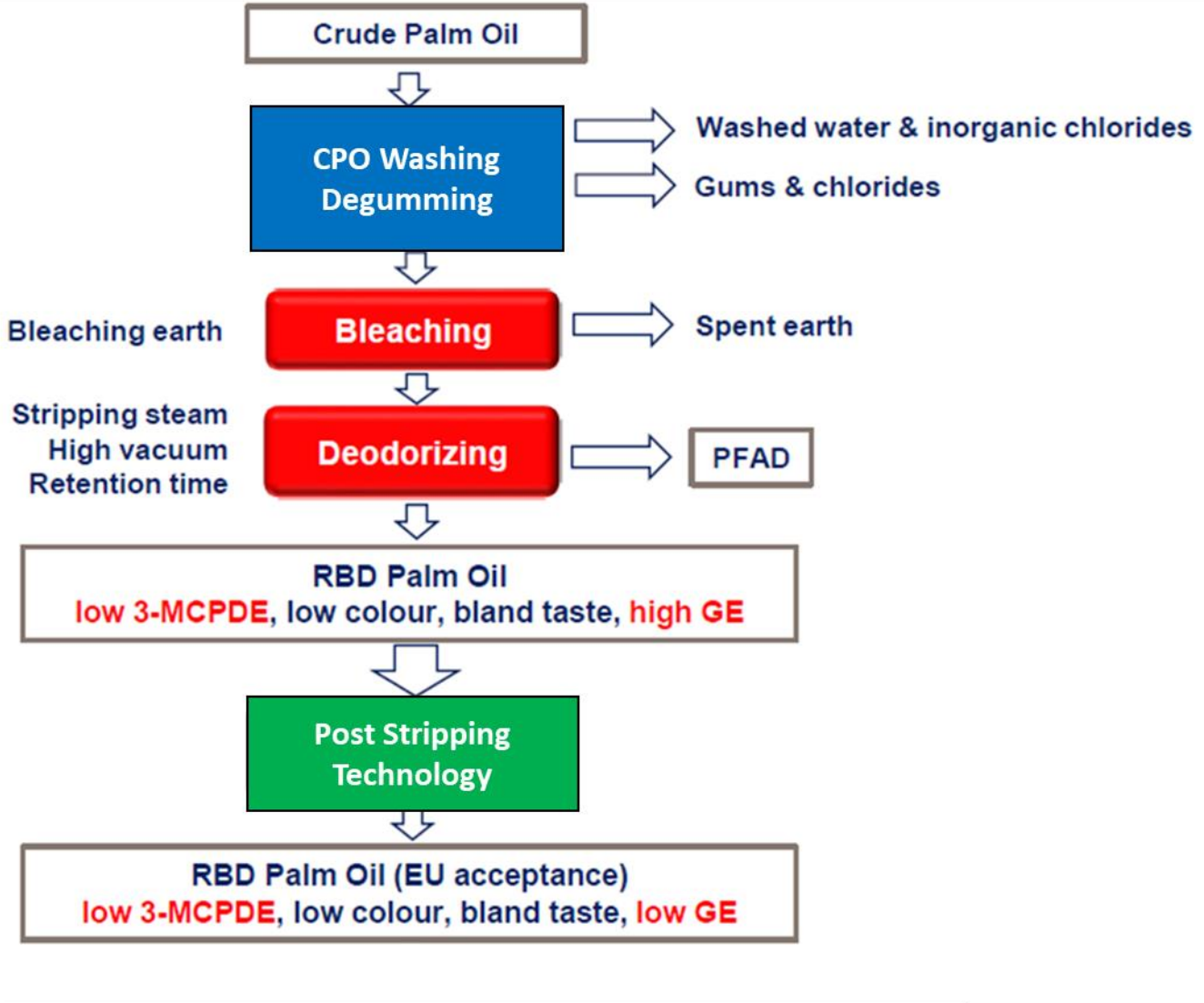
Wageningen University & Research, Akkermaalsbos
6708 WB Wageningen, the Netherlands

Post Stripping Technology - GE Removal System



Source:
From Alfa Laval

Technology Options

R&D has evaluated 9 technologies in mitigating TC, P, Fe, 3-MCPD and GE

No.	Technology	TC < 2 ppm	Phosphorus < 10 ppm	Iron < 5 ppm	3-MCPDE < 1.25 ppm	GE < 1 ppm
1	Clean CPO (SORS)	↓	↓	↓	↓	↓
2	Separate loose fruit processing	↓	n/a	n/a	↓	X
3	FFB washing	↓	X	X	↓	X
4	CPO washing at mill	√	↓	↓	√	X
5	CPO washing at refinery	√	↓	↓	√	X
6	Chemical refining	√	↓	↓	√	√
7	Refining at low temperatures	X	X	X	↓	↓ √
8	Double refining	X	X	X	X	√
9	Post-stripping at refinery	X	X	X	X	√

Legend:

can meet proposed levels	√
partial reduction	↓
no reduction	X
no data	n/a

- Based on preliminary assessment, a combination of technology options is necessary to meet MPOB directive.
- To guarantee meeting the new CPO and refined PO specifications, chemical refining and a combination of CPO washing and post-stripping or Double Refining was evaluated.

Source: SDP R&D

The Options for Downstream

The Overview

Parameters	Crude Palm Oil	Chemical Refining	Standard Physical Refining	CPO Washing Physical Refining	CPO Washing + Double Refining Physical Refining	CPO Washing + Post Stripping Physical Refining
FFA	5%	0.05%	0.05%	0.05%	0.03%	0.03%
Phosphatides as Phosphorus	15 - 25 ppm	nil	< 5 ppm	< 1 ppm	< 1 ppm	< 1 ppm
Colour (5-1/4 ") based on CPO DOBI 2.3		2.1R	2.2R	2.0R	2.0R	2.0R
GE		< 0.5 ppm	3.2 - 4.5 ppm	3.2 - 4.5 ppm	< 0.3 ppm	< 0.5 ppm
3-MCPD		< 0.5 ppm	3.5 - 4.4 ppm	< 1 ppm	< 1 ppm	< 1 ppm
Yield		91%	95%	94.8%	93.8%	94.5%
***OPEX (RM/MT)** *ONLY as Reference.		~ 120	~ 45	~ 55.00	~ 105.00	~ 70.00

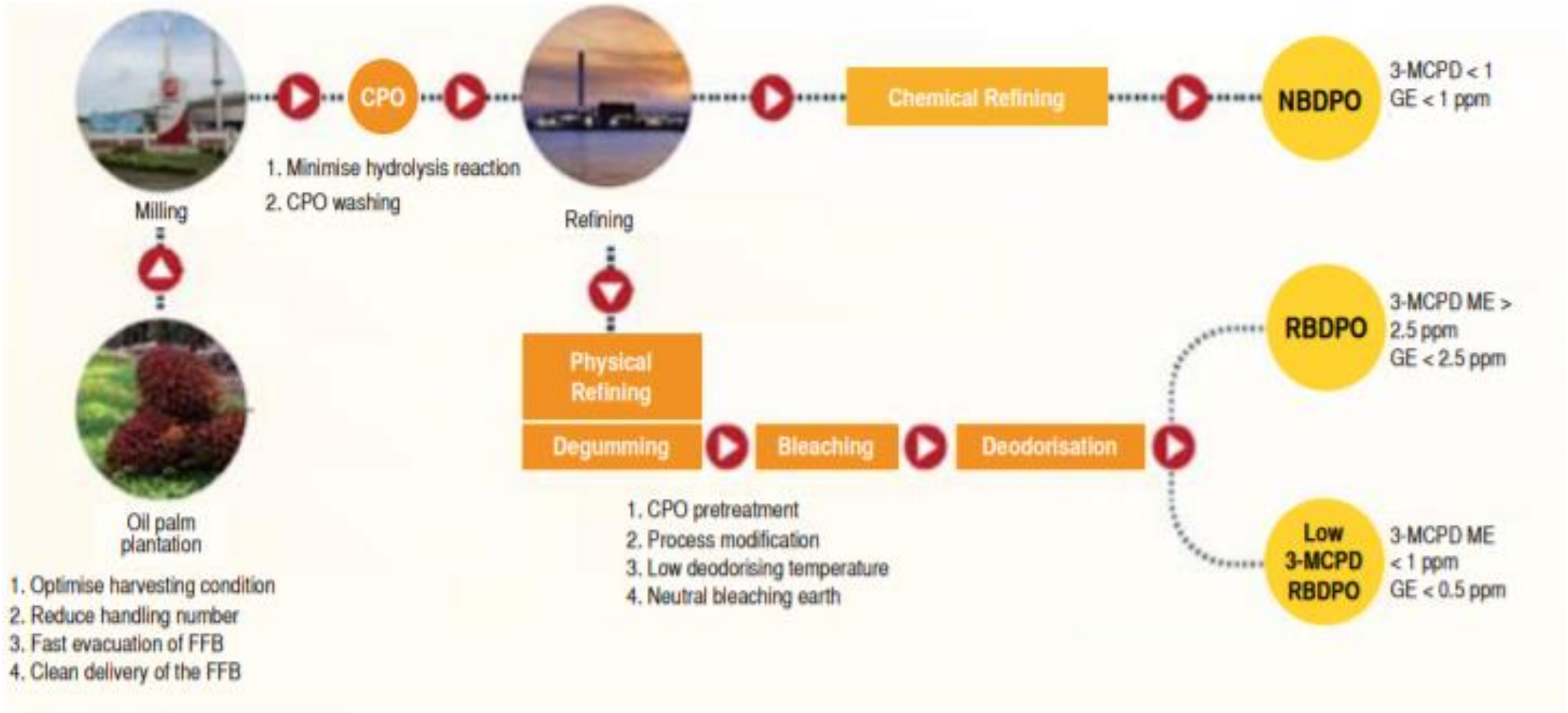
- Standard physical refining produces RBDPO with 3-MCPD and GE higher than the new MPOB Regulation specification of 2.5ppm, and 1ppm respectively.
- Both CPO Washing + Post-stripping and Chemical Refining technologies are able to produce RBDPO within the new MPOB specification.
- Although Chemical Refining produces lower 3-MCPD than CPO Washing, Chemical Refining has higher OPEX than CPO Washing + Post-stripping by RM61.32/MT, thus **CPO Washing + Post-Stripping is the economical recommendation**.

Presentation Outline

- Overview of Sime Darby Plantation
- Upstream Initiative
- Downstream Initiative
- **The Future Direction**

SDP Overall Strategies

Combating 3-MCPD and GE



The Company VISION???

The Target

Sime Darby Plantation

Sime Darby Oils

Realising possibilities, together

3-MCPD
< 2.5 ppm

GE
< 1 ppm

Sime Darby Plantation

Sime Darby Oils

Realising possibilities, together

THANK YOU

Sime Darby Oils

Realising possibilities, together

THANK YOU