Carbon Emission Reduction Initiative through Methane Emission Capture and Renewable Energy in Sime Darby's Palm Oil Mill

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Sime Darby Plantation

Developing Sustainable Futures

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Sime Darby Plantation

Sime Darby: Centuries of Heritage

- **Kumpulan Guthrie** was founded in Singapore in 1821 by Alexander Guthrie as the first British trading company in South East Asia and one that introduced rubber and oil palm in Malaysia.

- **Golden Hope Plantations**, previously named Harrisons & Crosfield when founded in 1844, was a major oil palm plantation player in Malaysia.

- **Kumpulan Sime Darby**, founded in 1910 by British businessmen William Sime and Henry Darby, and grew into a diversified multinational.

- In **2007** all three companies merged to form the new **Sime Darby Berhad**.





Sime Darby focuses on 5 core businesses…

Sime Darby Berhad

Plantation	Property	Industrial	Motors	Energy & Utilities





Plantation: Vision and Strategic Thrusts

Sime Darby Plantation

Plantation Upstream: World's largest producer of certified sustainable palm oil

Plantation Downstream: Competitively active global downstream business

1 Realise Full Potential Of The Core Businesses

Key focus areas:

Cost ↓

FFB Yield ↑

OER ↑

2 Strive For Leadership Position

Certified Sustainable Palm Oil ™ RSPO

Leading

Global producer of green palm oil products

3 Pursue Strategic Portfolio Growth

Upstream Rubber

Land bank expansion

Sustainability Milestones of Sime Darby Plantation

Pioneering Best Agro-management Practices in the Industry	▪ Zero burning ▪ Integrated Pest Management (IPM)	**Since 1980's**
Compliance to Sustainability Management Programs encompassing Safety, Environment and Quality Standards	▪ Maintain HCV areas ▪ Stringent Safety Standards ▪ High Work & Crop Quality Standards ▪ Field, Soil/Water Conservation	**Since 1990's**
Compliance to New International Standards : RSPO, ISPO, ISCC, ISO	▪ Achieved 85% CSPO as of May 2012 ▪ Enhance FPIC- SOP ▪ Community Development Programs (CSR)	**Since 2005**
Commitment on Climate Change : ● Carbon Emission Reduction ● Water Conservation Policy	Carbon Reduction Target: 25% by 2016 40% by 2020	**2012-2020**

Carbon Footprint Overview

Sime Darby Plantation division's total carbon emissions for 2009 was **2,607,752 tCO_2-e** [(1)]

Effluent treatment was the highest emission source for the division **70%** of total division emissions

Malaysia Upstream Operations contributes 60% of the total emissions of plantation division

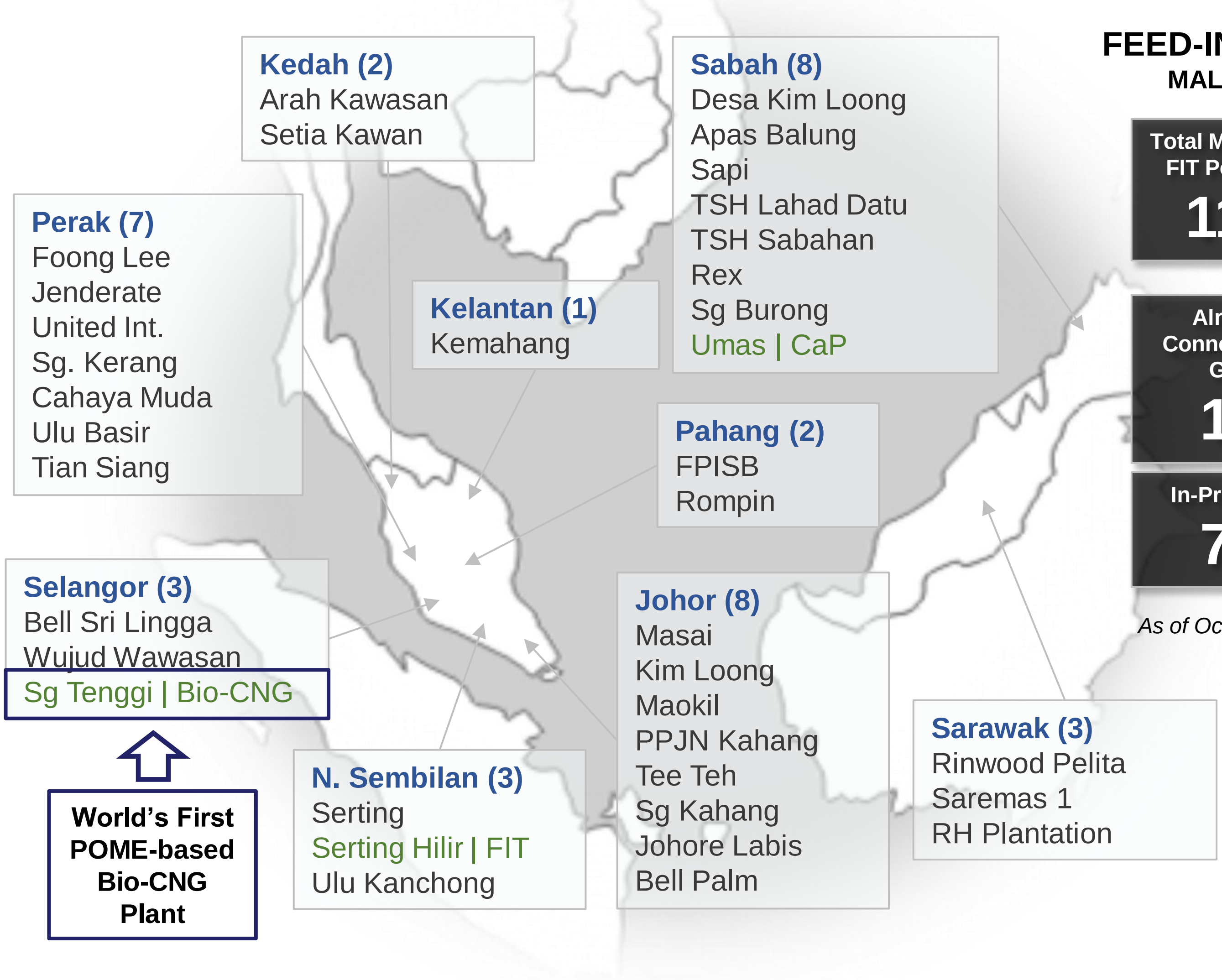
Emissions by Intensity tCO_2e/mt of products

Country[(2)]	FFB (Ton)	CPO (Ton)	Refined products (Ton)	Fresh Latex (Ton)	Dry Rubber (Ton)
Malaysia	0.22	1.07	0.07	0.29	0.26
Indonesia	0.25	1.03	-	-	-
Singapore	-	-	0.08	-	-
Thailand	-	-	0.10	-	-
Netherlands	-	-	0.13	-	-
Average	**0.23**	**1.06**	**0.09**	**0.29**	**0.26**

An average of 1.06 tons of carbon dioxide equivalent is emitted to produce a ton of CPO

Note :
(1) Validated by PwC - Plantation Division Global Rollout Report v2.0, dated June 2012
(2) 2009 Baseline data excludes emission from Vietnam, South Africa, China and Liberia. Complete list of data are made available in 2010 inventory .

Market Analysis – Industry Landscape



World's First POME-based Bio-CNG Plant

FEED-IN-TARIFF MALAYSIA

- Total Mills with FIT Potential: **113**
- Already Connected to Grid: **12**
- In-Progress: **79**

As of Oct. 2015

SIME DARBY

- Mills Completed: **1**
- In-Progress: **9**
- Planned: **15**

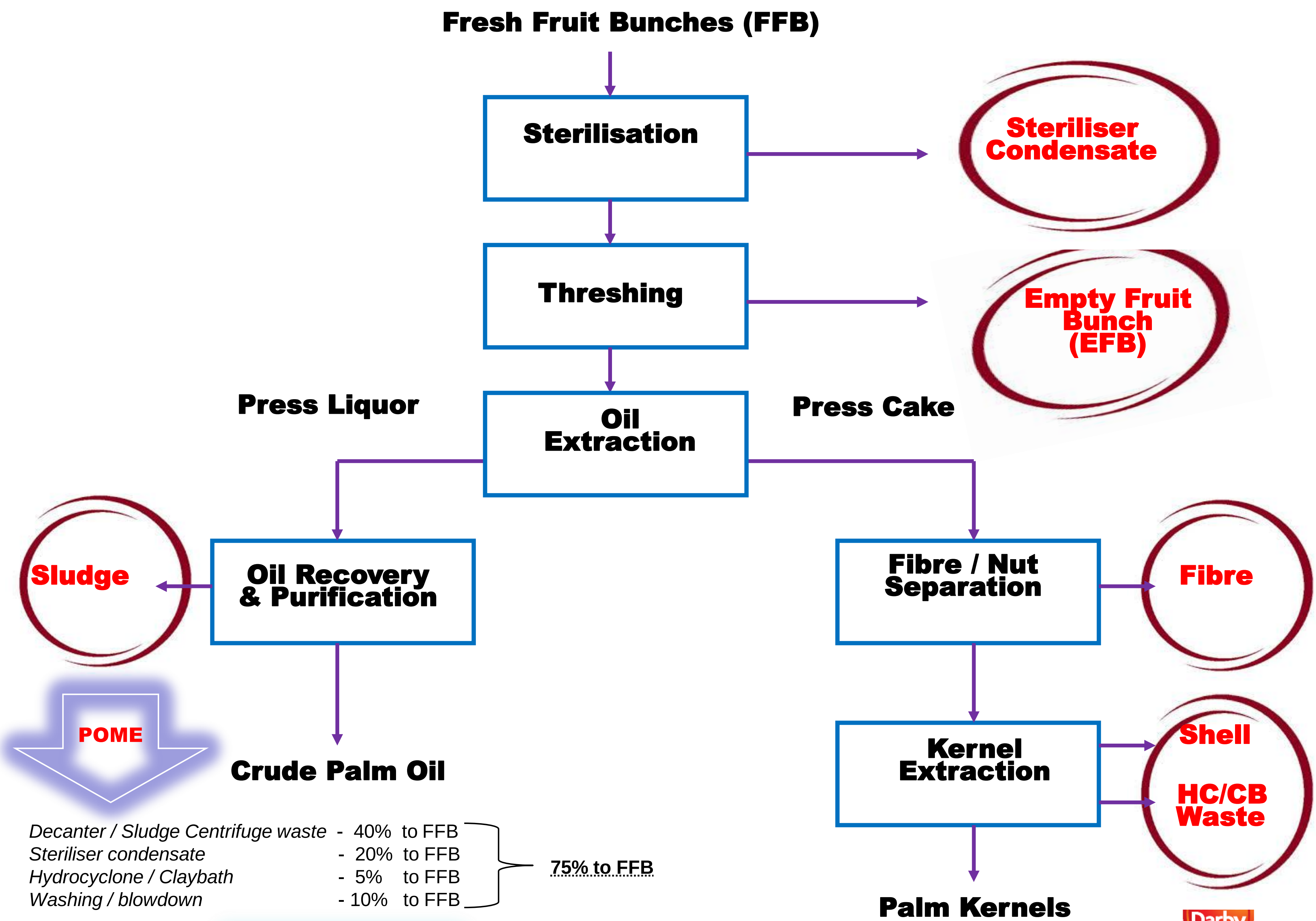
As of Feb. 2016

Mills with Biogas Capturing Facilities: 57

As of Oct. 2014

Note: Mapping only take into account mills that have responded; 36 out of 57 mills with completed biogas plant

Sime Darby Plantation


Fresh Fruit Bunches (FFB)
Sterilisation
Steriliser Condensate
Threshing
Empty Fruit Bunch (EFB)
Press Liquor
Oil Extraction
Press Cake
Sludge
Oil Recovery & Purification
Fibre / Nut Separation
Fibre
POME
Crude Palm Oil
Kernel Extraction
Shell
HC/CB Waste
Decanter / Sludge Centrifuge waste - 40% to FFB
Steriliser condensate - 20% to FFB
Hydrocyclone / Claybath - 5% to FFB
Washing / blowdown - 10% to FFB
75% to FFB
Palm Kernels

POME Characteristics

Parameter	Mean	Range
pH	4.2	3.4 – 5.2
BOD	25,000	10,250 – 43750
COD	50,000	16,000 – 100,000
TS	40,500	11,500 – 78,700
SS	18,000	5,000 – 54,000
TVS	34,000	9,000 – 72,000
Oil & Grease	6,000	150 – 18,000
AN	35	4 – 80
TKN	750	180 – 1,400

All units in mg/L except pH

- Brownish liquid
- Thick and viscous
- High organic strength
- Wide range

Regulations on POME

- Environment Quality Act 1974
  - Environment Quality (Prescribed Premises) (Crude Palm Oil) Regulations, 1977

No Discharge

Watercourse Discharge / Land Irrigation

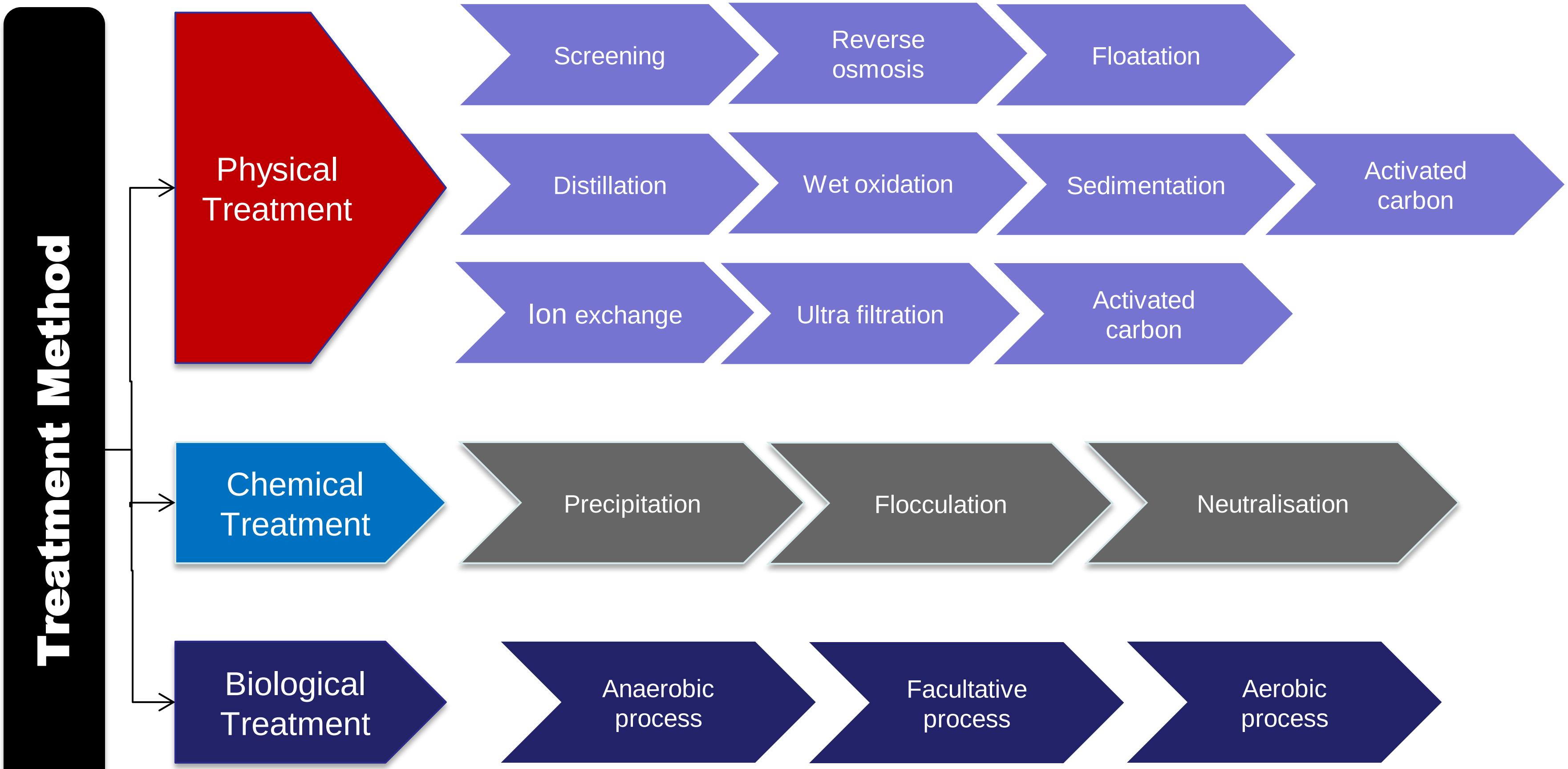
- **BOD < 100 mg/l**
  SS < 400 mg/l
  O&G < 50 mg/l
  AN < 150 mg/l
  TN < 200 mg/l
  pH 5.0 – 9.0
- **BOD < 50 mg/l**
  SS < 400 mg/l
  O&G < 50 mg/l
  AN < 150 mg/l
  TN < 200 mg/l
  pH 5.0 – 9.0
- **BOD < 20 mg/l**
  SS < 400 mg/l
  O&G < 50 mg/l
  AN < 150 mg/l
  TN < 200 mg/l
  pH 5.0 – 9.0

Land Application

- **BOD < 1,000 mg/l**
- **BOD < 3,500 mg/l**
- **BOD < 5,000 mg/l**

Wastewater Treatment Method

POME can be treated with one or either one or combination of the treatment methods below;



- Suitable for treatment of organic matters
- In biological treatment, the pollutants will be degraded into solids and gases

Concept of POME Treatment

- Combination of physical and biological processes
- To comply with discharge license stipulated by DOE:
  - Discharge to watercourse or land application
  - Combination of discharge to watercourse and land application

Primary
- Physical process is for preparation of POME to Secondary treatment

Secondary
- Biological process i.e. anaerobic, facultative and aerobic digestion

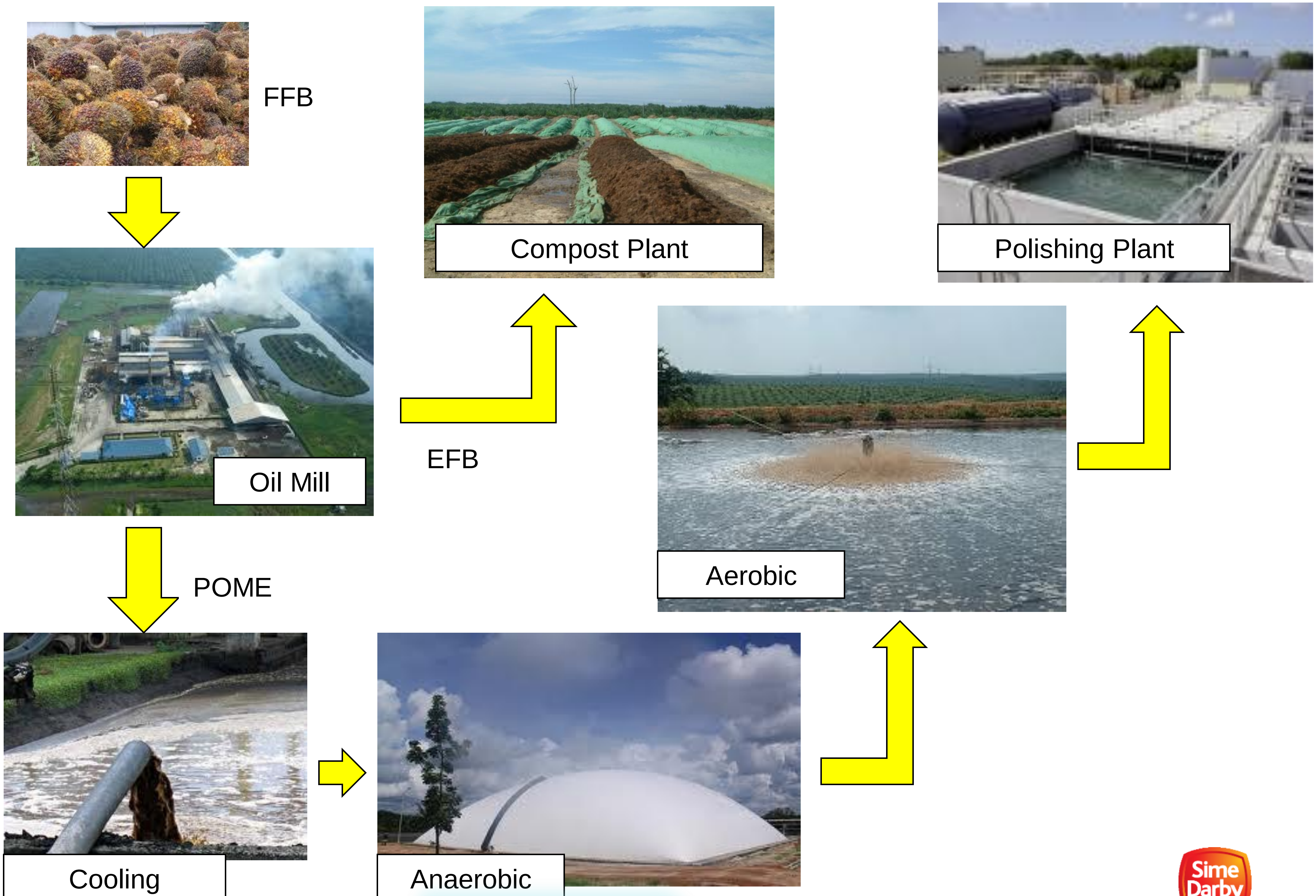
Tertiary
- Extended biological process to achieve BOD20

- Cooling process
- Separation process / collection of sludge oil in raw buffer pond

- Anaerobic, facultative and aerobic digestion processes

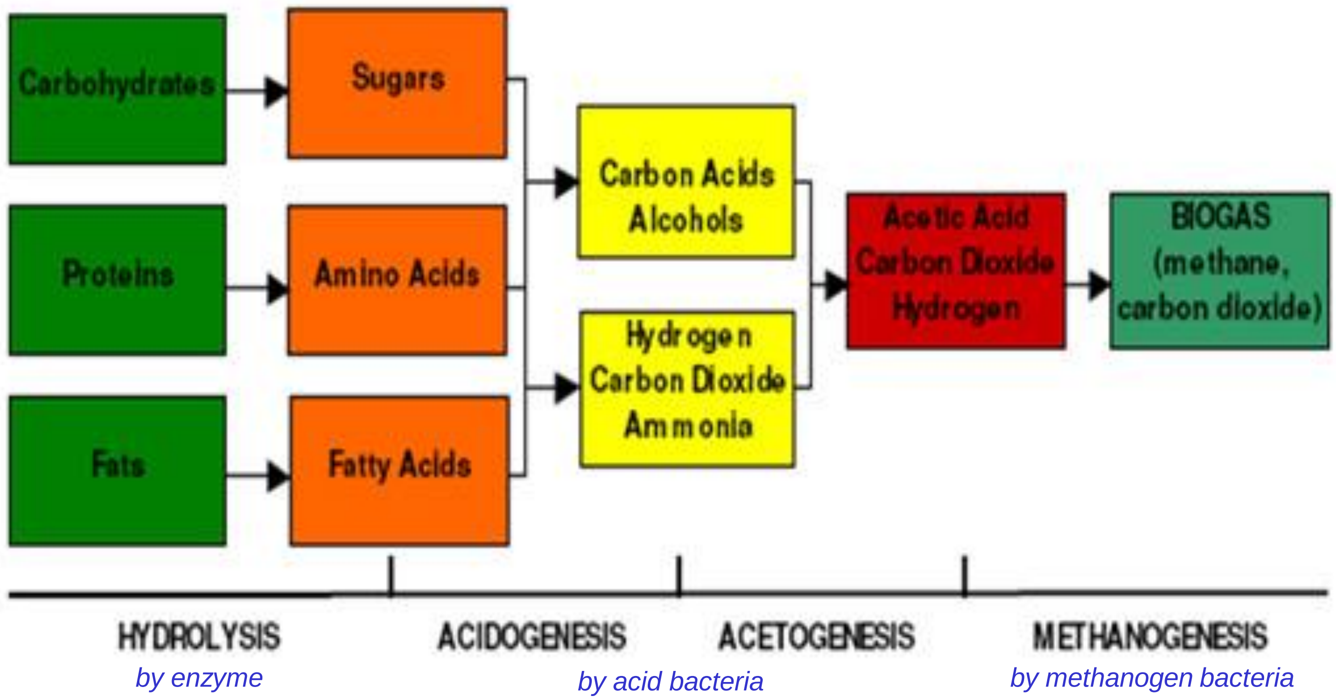
- For delicate and specific location

Effluent Treatment Plant



Anaerobic Digestion Process

- **Oxidation process of organic substance** without **presence of oxygen**.
- The process produces;
  - Gases such as carbon dioxide (CO_2) and methane (CH_4)
  - New bacteria cells
  - Stable organic matters
  - Inorganic residue
- Degradation stages of complex organic matters;



Anaerobic Digester Selection Criteria

Description	Remarks
Mesophilic @ 37ºC to 45ºC	Greater number of bacteria allows for wider range of environmental tolerance, affording operational stability
Anaerobic Suspended Growth	Covered lagoon, Continuous-Stirred Tank Reactor, Anaerobic Sequencing Batch Reactor based on suspended or contact process
Chemical Oxygen Demand (COD) Removal efficiency	✓ > 80% for CSTR ✓ > 90% for covered lagoon ✓ > 95 % for ASBR
Biogas / Methane Yield	✓ > 30 m^3 biogas/m^3 POME ✓ > 0.30 Nm^3 CH_4/kg $COD_{converted}$
Organic Loading	✓ From 1.5 kg COD/m^3-day up to 4 kg COD/m^3-day ✓ HRT = SRT = MRT

Notes :

Reason for above based on strong reference (similar configuration), POME characteristics (high TSS, O&G etc), stable, degree of process complexity etc.

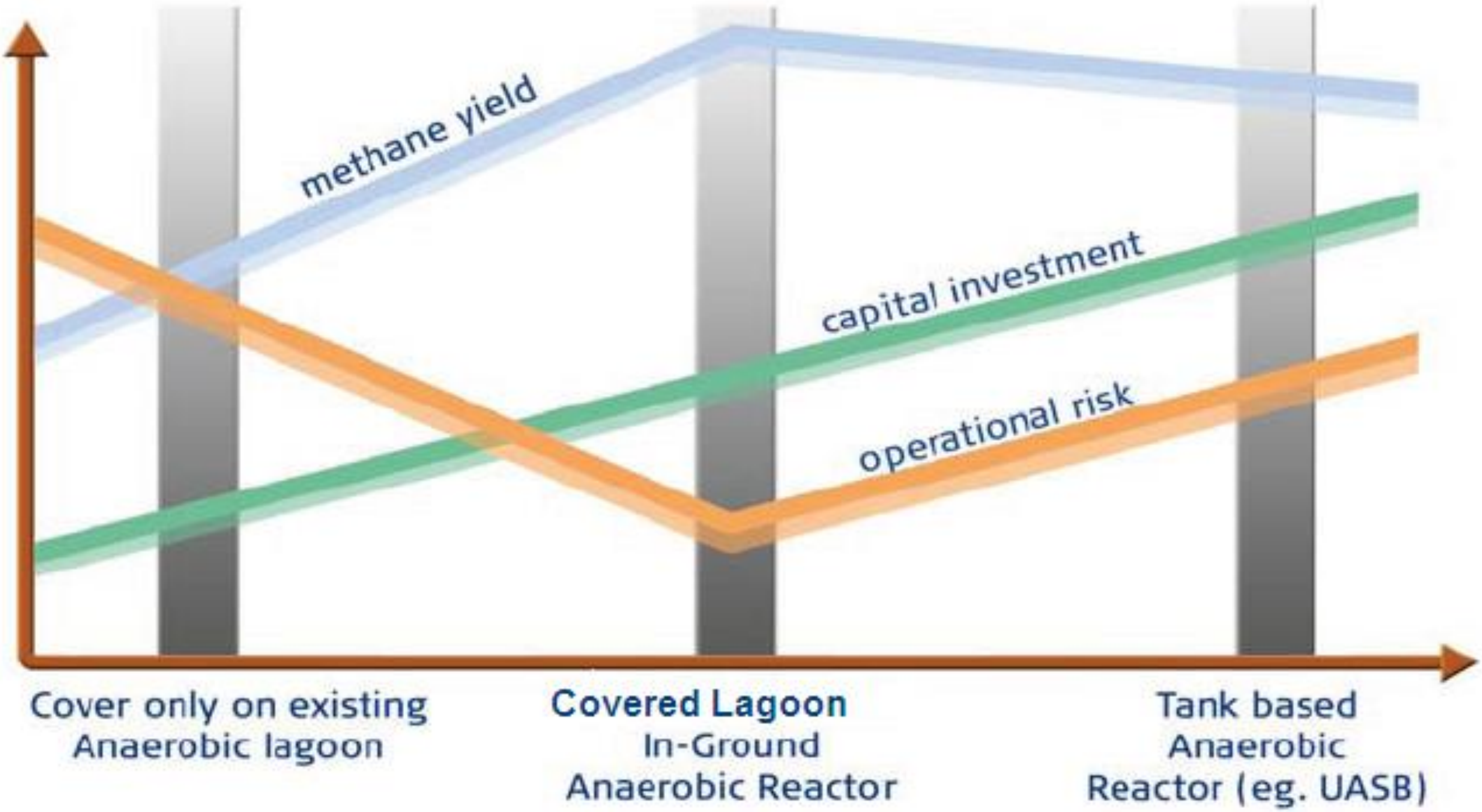
Other Types Anaerobic Digester

Description	Remarks
Thermophilic @ 50ºC to 55ºC	Operates at slightly elevated temperature, susceptible to temperature change, possibly increasing requirement for auxiliary load, narrow control of operational parameter
High Rate Anaerobic Process	*Anaerobic Sludge Blanket* Upflow Anaerobic Sludge Blanket, Anaerobic Baffled Reactor *Attached Growth Anaerobic Reactor* Upflow Packed-bed, Expanded Granular Sludge Blanket, Fluidized-Bed Reactor
Organic Loading	✓ > 6 kg COD/m^3-day ✓ Resulting in short HRT less than 10 days (HRT < SRT)
Issues	POME with high TSS easily clog digester, resulting in MO washout
Chemical Oxygen Demand (COD) Removal efficiency	Typically can achieved > 95 % for certain waste water , but may not be suitable for high TSS effluent ie. POME >5,000 mg/l

Notes :

Upflow Solids reactor are categorised as High Rate Anaerobic Digester, except process flow is sequenced to limiting failure in cells. UASB and EGSB can be adapted for secondary treatment for further biogas recovery.

Typical Anaerobic Digester Comparative Pointers



Summary of Key Criteria and Other Consideration

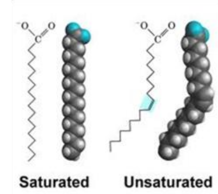
- Crop throughput and POME ratio
- Concentration of organic waste measured as COD
- Substrate composition is a major factor in determining the methane yield and methane production rates from the digestion of biomass
- Other composition i.e. TSS, pH, temperature etc

- ✓ Land availability, terrain, soil condition and flood possibilities
- ✓ Environmental constraint such as strong wind that may affect lagoon cover
- ✓ Flow variations
- ✓ Flexibility and compatibility for possible system expansion, shock loading or altered effluent characteristics
- ✓ Auxiliary load requirement to determine the net electricity output supply to the grid – for biogas power generation for export to the electricity grid
- ✓ Construction and Operation & Maintenance cost
- ✓ Spares and service personnel availability
- ✓ Technology track record

Steam generation (thermal energy generation)

Electricity generation

Use as a compressed Bio-Natural Gas which can be an alternative for natural gas vehicles

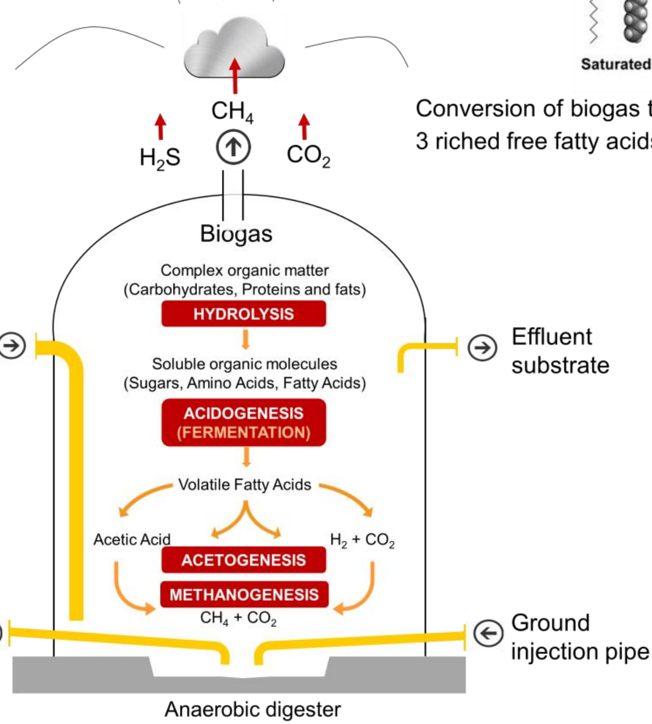


Conversion of biogas to chemicals (e.g. omega 3 riched free fatty acids).

Combined Heat and Power (CHP) for production of steam and electricity (direct thermal and electricity generation)

Fresh Fruit Bunch

Mill processing



Treated effluent substrate discharge

Biogas vs Bio-natural Gas

- Gas generated from organic material
  - Primarily consists of methane gas 50%-65%
- Potential source of biogas
  - Anaerobic digester
- Bio-natural Gas
  - Methane from renewable source - Upgraded biogas

Biogas		Bio-natural Gas
CH_4 : 50-65% CO_2 :30-45% O_2 :0-2% H_2S :0-4000ppm	Upgrade →	CH_4 > 96% CO_2 < 2% O_2 <0.5% H_2S < 20ppm

Bio-natural Gas Makes Sense

Electricity

60% Loss
40% Remaining

3% Loss
37 % Remaining

No Loss

37%
Energy
Remaining

Anaerobic
Digester

Raw Biogas → Generation → Transmission → End-use

Bio-natural gas

9% Loss
91% Remaining

3% Loss
88 % Remaining

8% Loss
81 % Remaining

81%
Energy
Remaining

Sime Darby Plantation

Existing Projects & Future Potential

Perak	Crop	
Flemington	236	FIT
Seri Intan	216	FIT | CNG | NEW
Elphil	129	CoF
Chersonese	186	TDC
Selaba	144	TDC

Kedah	Crop	
Sg. Dingin	320	CNG

Sarawak	Crop	
Rajawali	218	CNG
Lavang	200	CNG
Derawan	165	LP
Pekaka	190	TDC

Sabah	Crop	
Merotai	303	CNG
Sandakan Bay	198	CaP
Binuang	195	CaP
Giram	175	CaP
Melalap	82	LP

Selangor	Crop	
Tennamaram	253	FIT
West	211	CNG
East	128	CaP
Bkt Kerayong	139	TDC

Pahang	Crop	
Kerdau*	231	FIT | CNG
Jabor	74	LP
Bkt Puteri	55	LP

Indonesia	Crop	
Rantau	229	CaP
Pemantang	218	CaP

N. Sembilan	Crop	
Sua Betong	245	FIT
Tanah Merah	148	CoF
Kok Foh	172	CoF
Labu**	133	LP

Melaka	Crop	
Kempas	288	FIT
Diamond Jubilee	113	TDC

Johor	Crop	
Hadapan	231	FIT
Gunung Mas	263	FIT | CNG | NEW
Ulu Remis	247	FIT | CNG | NEW
Pagoh	167	CoF
Chaah	120	CoF
Bkt Benut	99	TDC

Project Summary	FIT	CNG	FIT OR CNG	FIT OR CNG OR NEW	CaP	CoF	Total	TDC OR LP
On-Going	3	2	-	-	5	-	10	11
Future Potential	2	3	1	3	1	5	15	
Total	5	5	1	3	6	5	25	11

Legend
On-Going Projects
Future Potential

Abbreviations
FIT *– Feed-in-Tariff*
CNG *– Compressed Natural Gas*
CaP *– Captive Power*
CoF *– Co-Firing*
NEW *– New Technology*
TDC – To be decommissioned
LP – Limited potential

Note
Crop – 5-year avg. (FY11-FY15), kMT p.a
*To reconsider – geographically isolated
** Earmarked for property development

Sime Darby Plantation

Existing Projects

No	Mill Name	Carbon Reduction (tCO_2e/year)	Projected year	Status
1	**Tennamaram**	40,036	Y2015/16	Completed
2	**West**	42,386	Y2016/17	86% Completion
3	**Merotai**	59,387	Y2016/17	Expected completion by July 2016
4	**Binuang**	20,810	Y2016/17	Tender - Evaluation in progress
5	**Sandakan Bay**	35,944	Y2017/18	Tender - Evaluation in progress
6	**Hadapan**	40,113	Y2017/18	Physical completion 46.7%
7	**Flemington**	40,063	Y2017/18	Physical completion 47.7%
8	**Giram**	21,501	Y2017/18	Tender - Evaluation in progress
9	**Rantau**	37,441	Y2017/18	Expected physical completion: 15th December 2016
10	**Pemantang**	53,227	Y2017/18	Expected physical completion: 15th November 2016

Conclusion

1. The Carbon 'Emission' Reduction Strategy is one of the key initiatives under Sime Darby Plantation's Sustainability Blueprint.

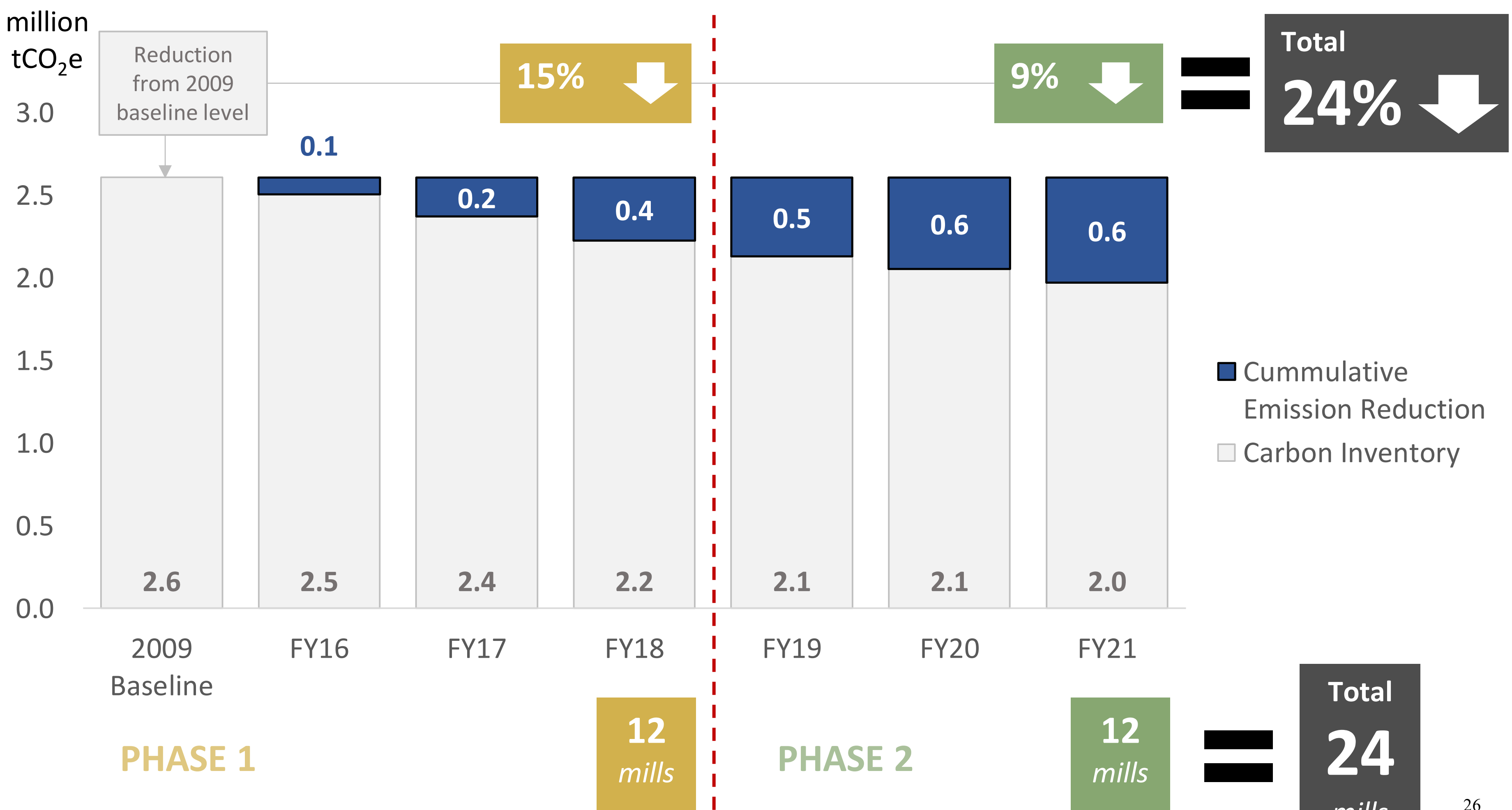
2. Among the various initiatives mentioned herein, the biogas initiative has huge bearing on enabling the Division to commit to a significant carbon reduction target immediately within the timeframe mentioned. As one of the major renewable resources, the biogas initiative meets the growing global Green aspirations of the plantation industry.

3. Besides reducing the GHG emissions, there are potentially other financial benefits that the Group can gain from carbon credit sales and receiving premium prices for our sustainable and traceable palm products.

Projected Outcomes

Sustainability Outlook

5-Year Carbon Emission Reduction



Source: Carbon Emission Reduction Strategy, 2012

Thank You

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