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21st International Oil Palm Conference

POMEVap Technology – A sustainable way of treating Palm Oil Mill Effluent (POME)

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Overview

01 Challenges faced by palm oil mills

02 POMEVap solution

03 Resource recovery & GHG reduction

04 Towards ZLD in Palm Oil Mills

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Palm Oil Industry

Palm oil has **higher oil yield per hector** as compared to other oils and it **accounts for almost 40% of the world's vegetable oil demand**.

Industry Trend

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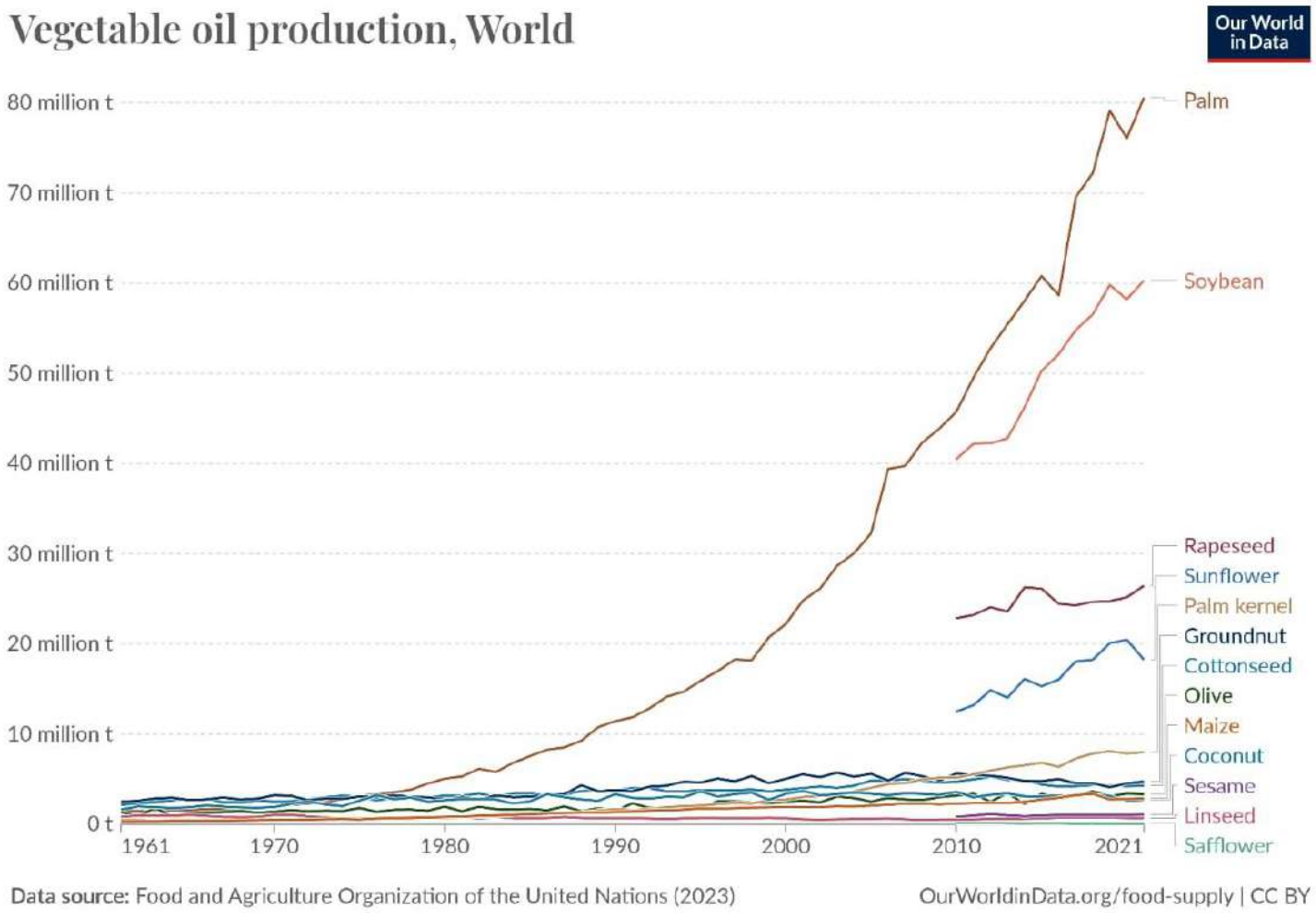

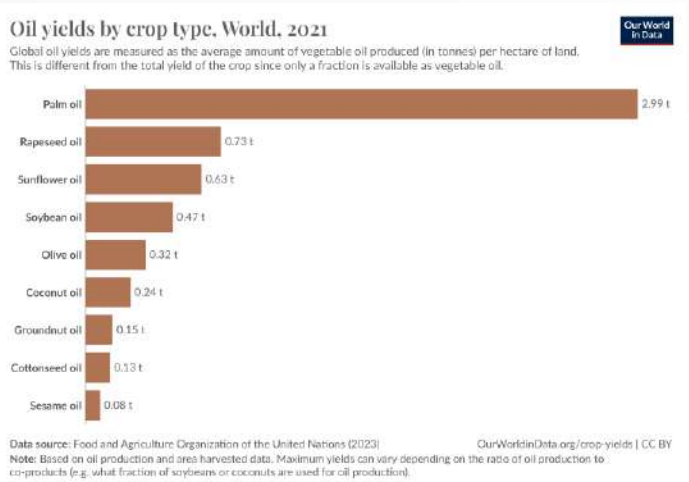

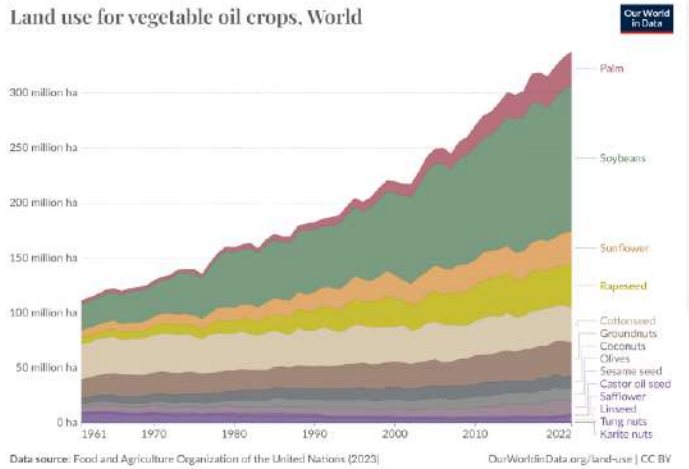

Palm oil industry pain points

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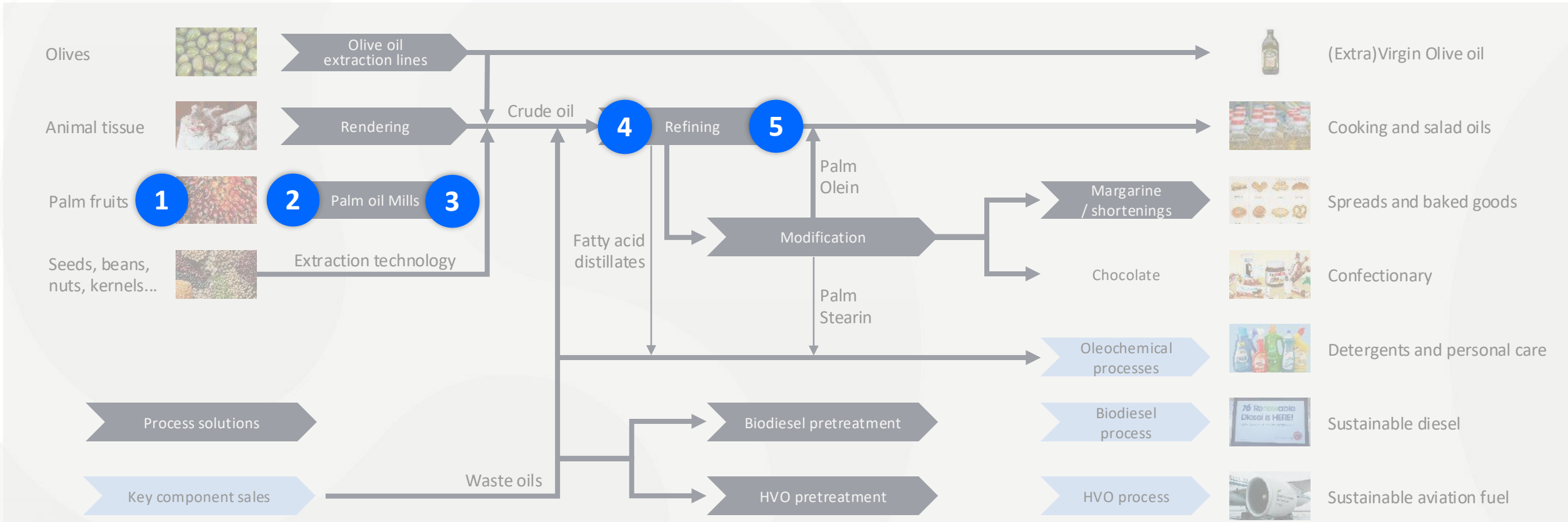
1- Oil yield | 2- Waste water & GHG | 3 – Fresh water | 4 - Refined oil trace impurities | 5 – Energy usage



Typical palm oil mill

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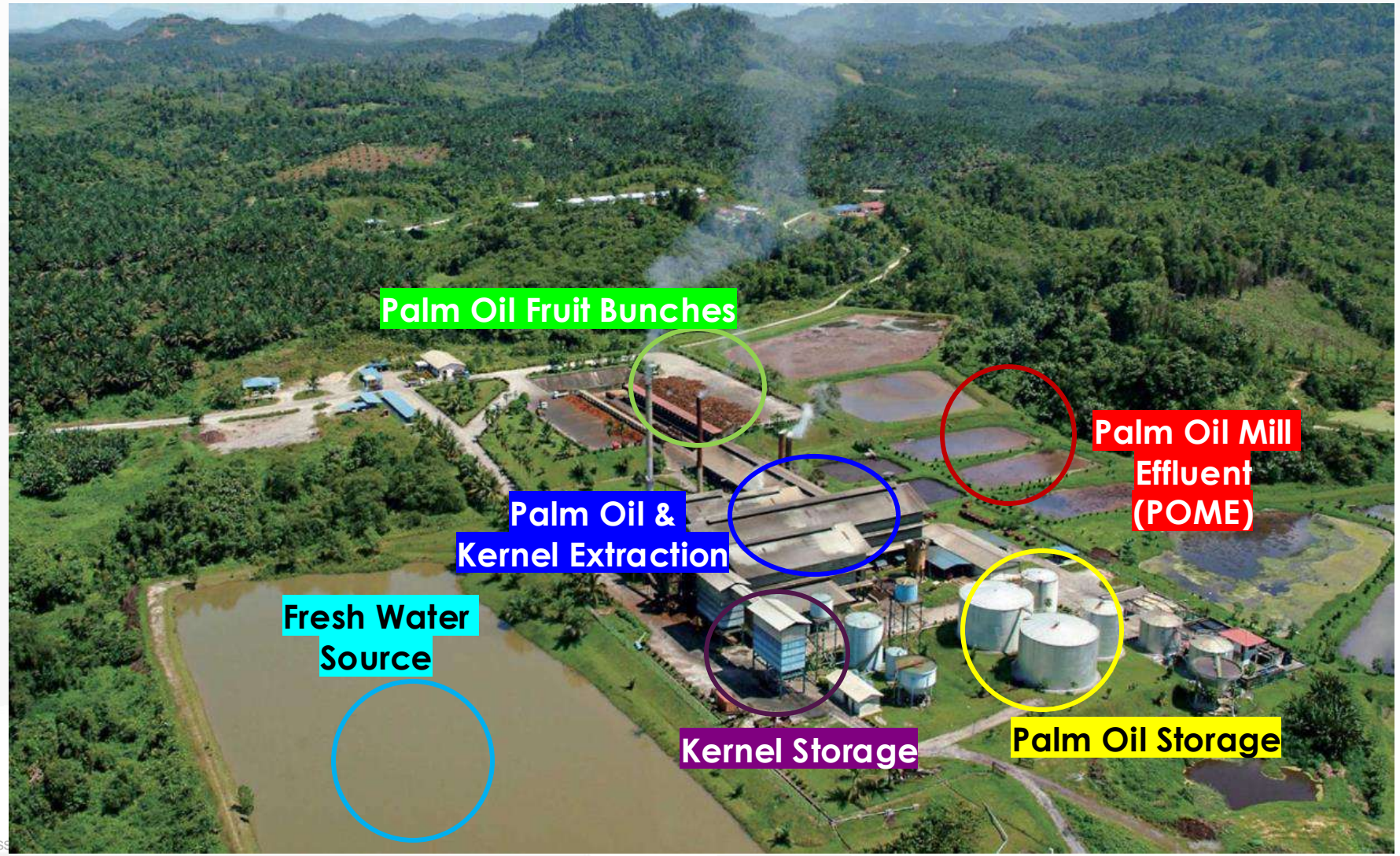

Conventional palm oil mill process

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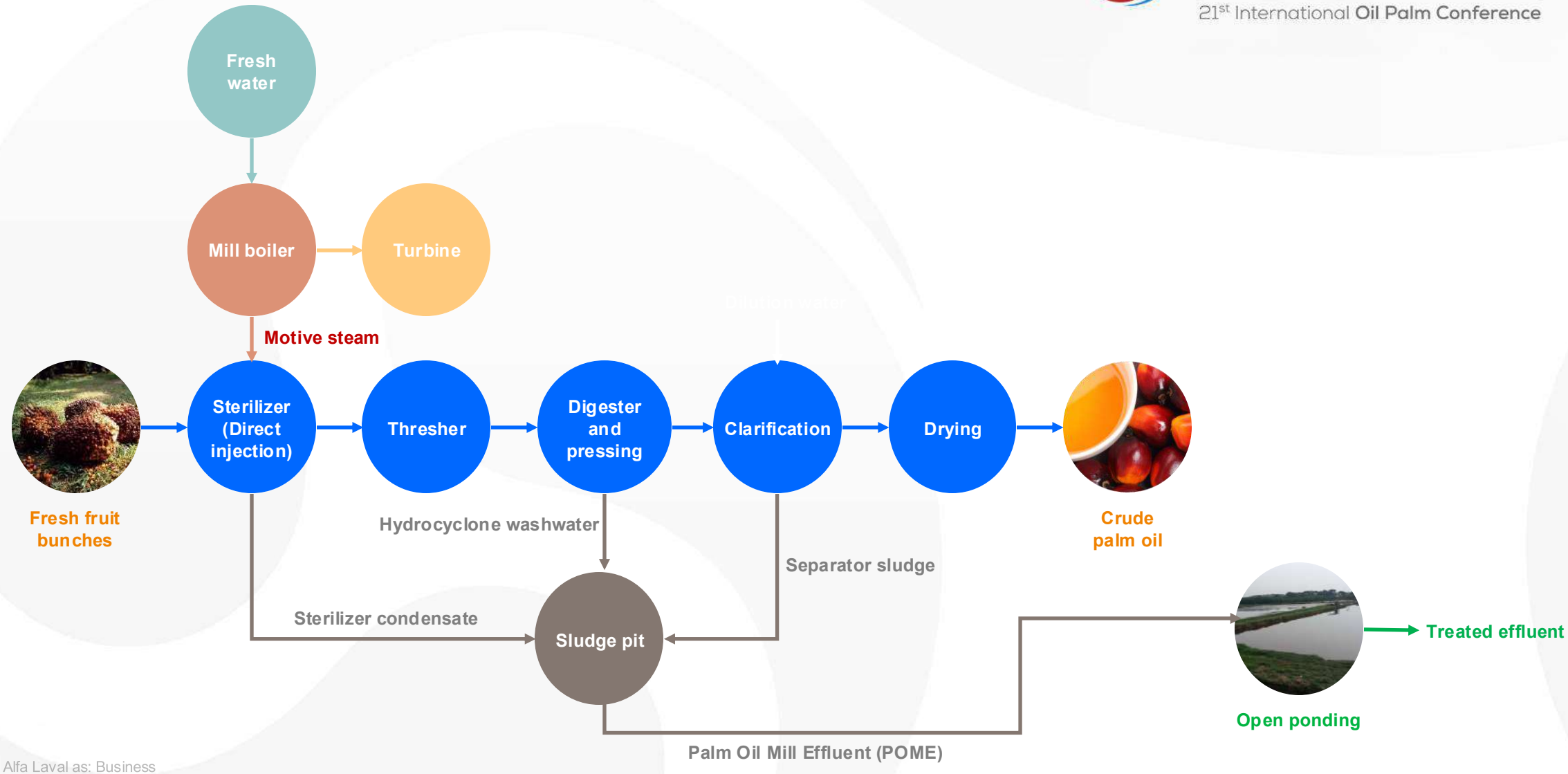

Typical POME loads

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POME generation = 0.5–0.7 times FFB rate

Mill capacity tons/hr (FFB)	**POME** tons/hr	**Oil in POME** tons/hr
30	15–21	0.15–0.21
45	22.5–31.5	0.22–0.31
60	30–42	0.3–0.42
75	37.5–52.5	0.37–0.52
90	45–63	0.45–0.63

Palm Oil Mill Effluent (POME)

Colour: Dark brown

Temp: ≈ 80°C

Water: 94–95 %

Non-oil solids: 4–5 %

Oil: 0.8–1.0 %

pH: 3.4–5.2

BOD: 10,000–45,000 ppm

COD: 15,000–100,000 ppm

Sludge pit:
POME collection

BOD – Biological Oxygen Demand indicates the degree of pollution in the water, or the amount of oxygen required by aerobic bacteria to remove organic matter from wastewater via decomposition

COD – Chemical Oxygen Demand is the oxygen required by chemical to destroy all organic matter in the wastewater

Palm Oil Mill Effluent (POME)

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Acceptable effluent discharge standards in Colombia

	Parameter	Unit	Extraccion De Aceites De Origen Vegetal
(a)	pH value	–	6.0–9.0
(b)	BOD (5 days)	mg/L	600
(c)	COD	mg/L	1500
(d)	Total Suspended solids	mg/L	400
(e)	Oil and grease	mg/L	20

Source: Resolucion No. 0631, Ministerio De Ambiente Y Desarrollo Sostenible

Drinking water
BOD: 1–2 ppm

River water
BOD: < 5 ppm

GHG emission from CPO extraction

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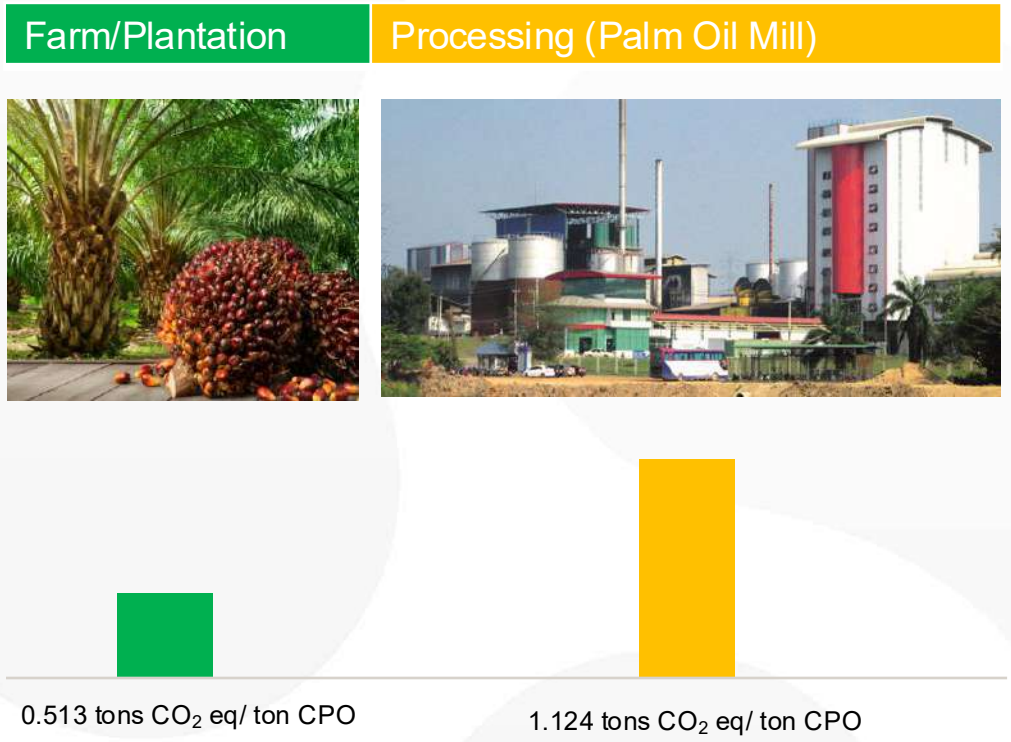
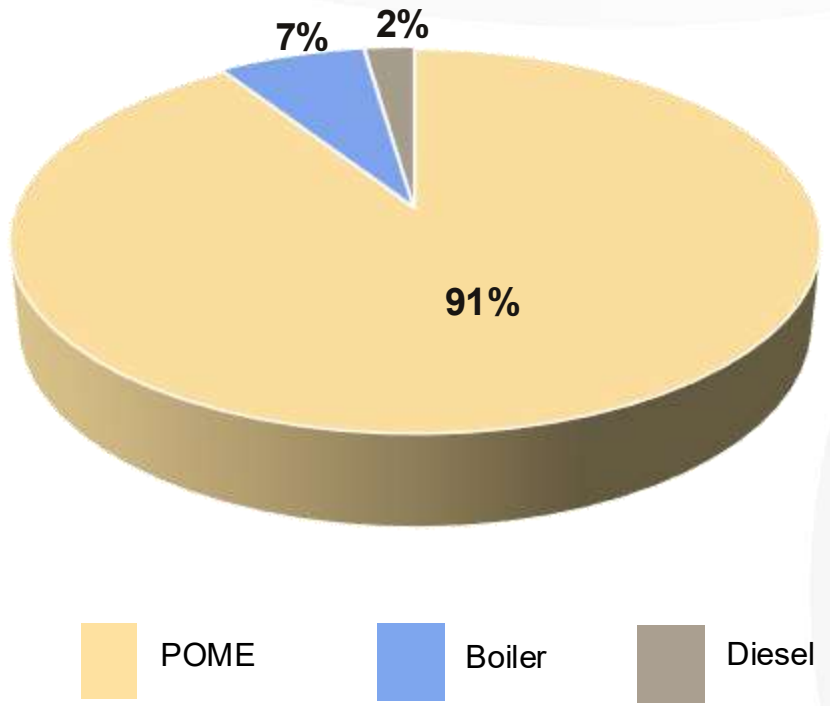
Typical GHG Emissions from Plantation and Mill



Ref: Dr. Norbert Schmitz (22-24 Aug 2016), Sustainability as a Success Factor for the Palm Oil Industry, II CONGRESO PALMERO C//PAL

Typical GHG emissions by source in Mill



Source: Vijaya et al., 2010

Challenges faced by palm oil mills

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- Open ponding requires huge space
- Methane (GHG) emissions to the atmosphere
- Methane capture and reuse systems still requires further treatment
- No resource recovery from POME

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POMEVap solution

- Recovers **valuable by-products**
- Creates clear **water for re-use**

POMEVap

Forced circulation plate evaporator for treatment of palm oil mill effluent

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Based on AlfaFlash technology, POMEVap efficiently separates effluent into:

✚

(1) Water in the form of process condensate

(2) Solids in the form of concentrate (sludge with up to 40% solids)

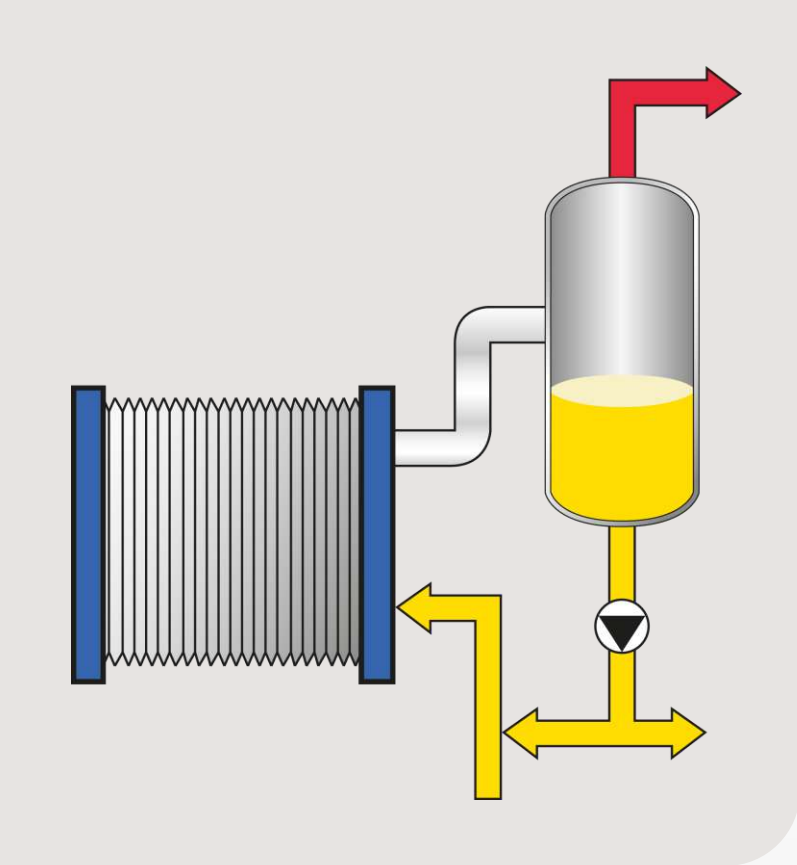
Single-effect AlfaFlash plate evaporator

POMEVap – Operating principle

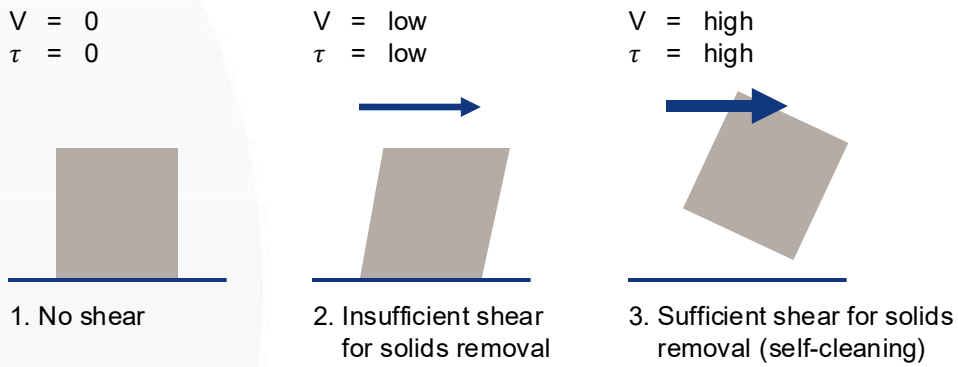
- POMEVap test unit

POMEVap

Forced circulation plate evaporator for treatment of palm oil mill effluent



- High liquid circulation rates → high turbulence and high shear rate
- Self-cleaning effect → cleaning/preventing fouling
- Significantly improved CIP efficiency and maximum uptime



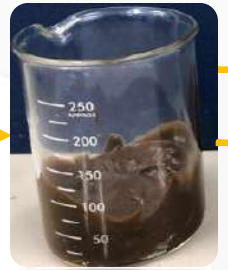
POMEVap

Forced circulation plate evaporator for treatment of palm oil mill effluent

Heavy phase
(4-5% NOS + 1% oil)

AlfaFlash

Process condensate



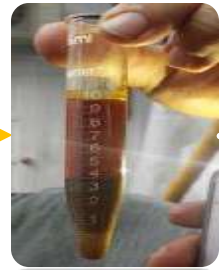
Concentrate

Remove from System

Decanter

Cake

Heavy phase



Light phase recovered oil
(40–50% recovery)

POMEVap – Installed & Running

In a Palm Oil Mill in India

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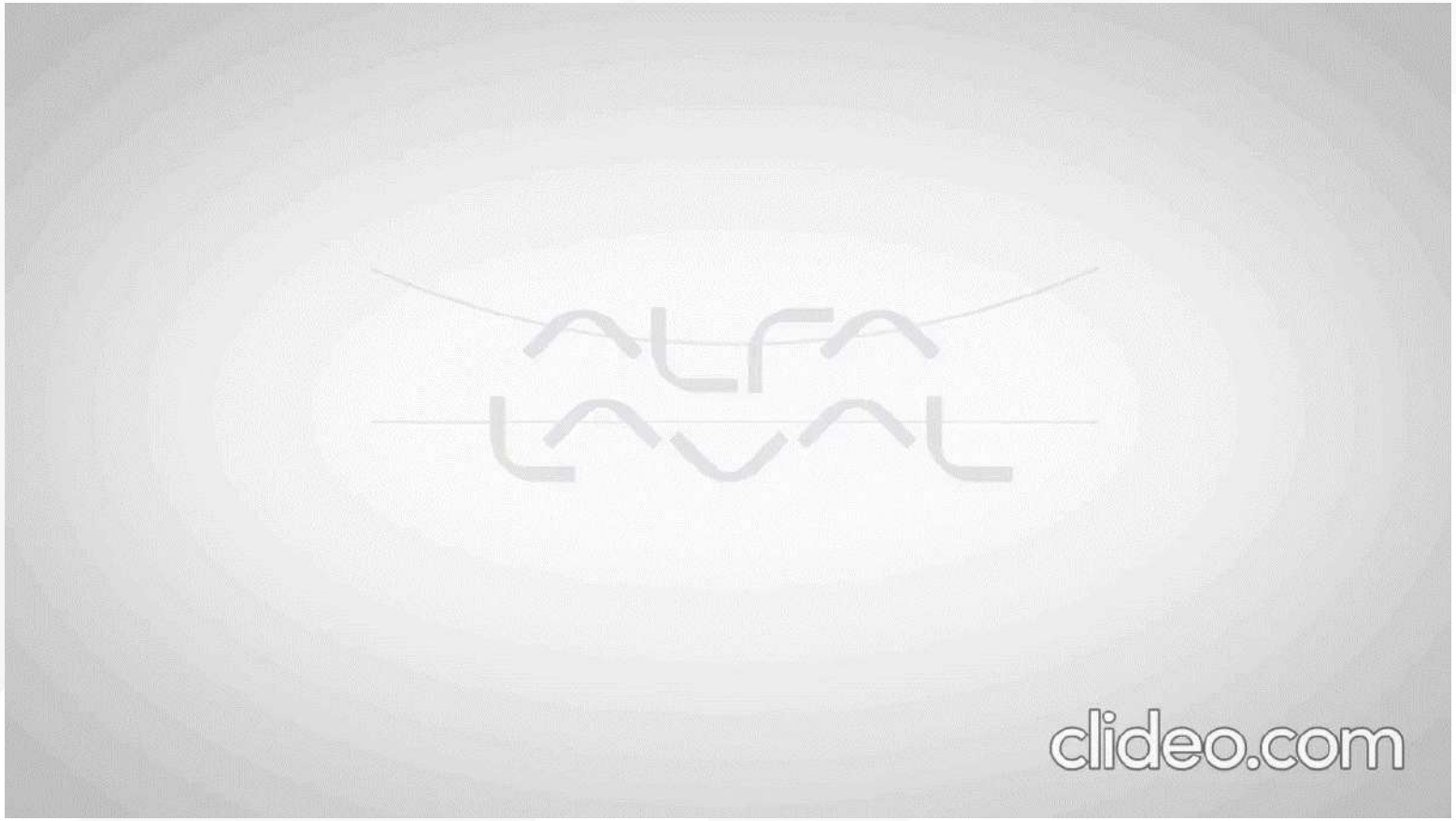

POMEVap - Results

From a System Installed and running

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Visual impression of Concentrated POME

Decanter Cake from POMEVap System

Condensate from POMEVap System

POMEVap - Results

Quality of recovered POME-oil, process condensate and solids

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Recovered oil quality

Parameters	Value	Unit
Total fats	97	%
Moisture	2.6	%
Ash	0.11	%
FFA	4.05	%
Iodine value	49	
DOBI	2.92	
Mineral Oil	Negative	

Process condensate quality

Parameters	Value	Unit
pH	4.1	
Turbidity	1	NTU
COD	2253	ppm
Total Nitr.	9	ppm
TSS	4	ppm
Chlorides	2	ppm
TDS	102	ppm

Recovered cake (solids) quality

Parameters	Value	Unit
Protein	4.57	%
Carboh.	15.31	%
FAT	2.59	%
Ash	4.49	%
Water	73.0	%

POMEVap - Results

Additional income from recovered POME-Oil

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	Value	Unit
Mill capacity (FFB/hr) Mill running hour Mill capacity (FFB/year)	45 6000 270,000	FFB tons/hr hour/year FFB tons/year
POME factor Total POME generated	0.60 162,000	– tons/year
Oil Recovery (40% of oil in POME)	**648**	**tons/year**
Oil price (current average, will vary)	~1000	USD/ton
Added income from oil recovery	**648**	**kUSD/year**

Recovered oil from decanter

GHG emission reduction

From a System Installed and running

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Mill capacity tons/hr (FFB)	**CPO**(3) tons/hr	**POME**(3) tons/hr	**GHG from POME**(1) tons CO_2eq/hr	**GHG Reduction**(1) tons CO_2eq/year
30	5.9	18	5.6	33328
45	8.8	27	8.3	49992
60	11.8	36	11.1	66657
75	14.7	44.9	13.9	83321
90	17.7	53.9	16.7	99985

Example: For 60 tons/hr FFB mill, the CPO production is approx. 11.8 tons/hr (based on ratio of 5.09 tons FFB per ton of CPO from Ref. 3)

The POME generation is approx. 36 tons/hr (based on ratio of 3.05 tons POME per ton of CPO from Ref. 3)

As per Ref. 1, about 12.36 kg of Methane is emitted per ton of POME. Based on Global Warming Potential (Ref.2) of Methane:CO_2 (25:1), the equivalent CO_2 emission is = 12.36*25 = 309 kg CO_2 eq per ton of POME. This results in GHG emission of 36*309 = 11124 kg CO_2 eq per hour = 11.1 tons CO_2 eq per hour). The POMEVap helps to avoid emission of these GHG's. Therefore, using POMEVap the GHG emission reduction potential is 11.1 / 11.8 = 0.94 ton CO_2 eq per ton of CPO.

Assuming 6000 operational hours/year, the potential GHG reduction is approx. 66657 tons CO_2 eq per year.

Ref: (1) Yacob et al., 2005; (2) US EPA; (3) Vijaya et al., 2008.

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ZLD using POMEVap

By **re-using POMEVap process condensate** in mill process using patented process

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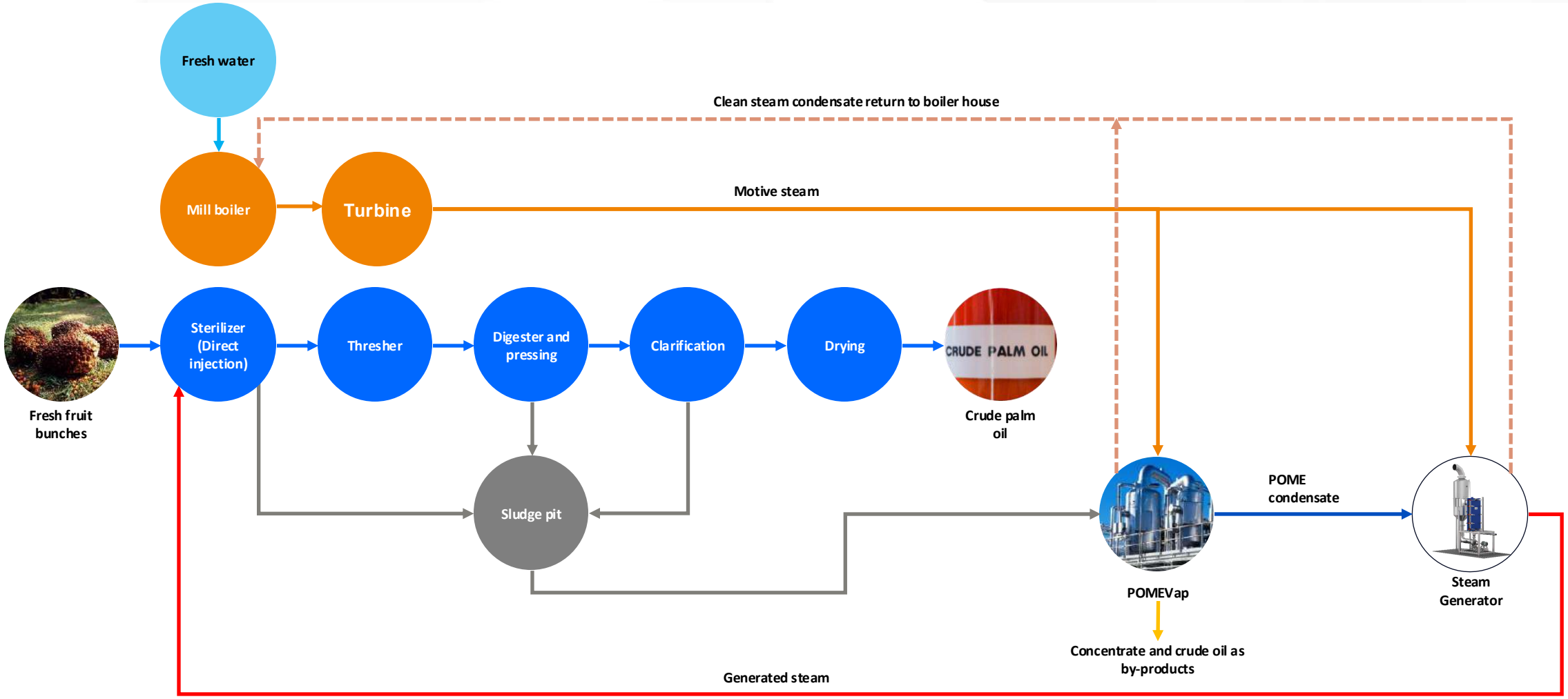
Towards ZLD in Palm Oil Mills

By re-using POMEVap process condensate in mill process



POMEVap solution

Sustainable way of Palm Oil Production

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Higher yield

Improved oil recovery, concentrate as a fertilizer or as an animal feed

Minimizes fresh-water consumption

Condensate can be re-used

Less space for installation

POMEVap requires only ≈ 300 m^2

Methane (GHG) avoidance

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Thank you

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