Understanding Palm Oil

A presentation from POPSIG by Ir Qua Kiat Seng CEng FIChemE

January 2019

POPSIG was set up with the view that the palm oil industry can benefit from more chemical engineers working in the industry. This is evident in the downstream oleochemical sector where the majority of chemical engineers in the palm oil industry work. Chemical engineers here apply their knowledge and skills to make the processes safer, more sustainable and energy efficient as well as upscale and design from R&D breakthroughs. Our challenge is to kindle the interest of chemical engineering graduates and at the same time encourage the industry to employ more chemical engineers especially upstream.

Palm oil is a contentious subject and we need to know that it is not unhealthy and that it can be grown sustainably. To help members understand palm oil we have prepared a presentation deck of 50 slides.

The global population is increasing rapidly and will reach 8.5 bn by 2020 and needs more and more edible oils and fats to feed it. We will not solve the issues around palm oil by ignoring or rejecting it. Rather we need to engage with the players. Palm oil represents a fraction of land used for agriculture so focusing on palm oil will not combat climate change and its impact. Palm oil is one of four major seed oils but it is the only one subjected to such intense scrutiny and sustainability standards. About half of the palm oil is produced not by large plantations but by smallholders. Smallholders generally lack access to expertise, capacity building and infrastructure for sustainable practices.

The new Malaysian government has reiterated that Malaysia will keep to its promise of 50% forest cover and in the presentation you will see that in Malaysia the production of palm oil has stagnated over the last five years. The challenge is now to extract as much oil as possible out from the fruit, and this, chemical engineers are addressing by designing unit operations that understand the characteristic features and biology of the fruit. At this very moment such an upscaled plant is being built.

We ask you study the presentation deck and direct your questions to our secretary
Assoc. Prof. Dr Wu Ta Yeong wu.ta.yeong@monash.edu from which we hope to build up a FAQ section.

Qua Kiat Seng CEng FIChemE
Founder and Exco Member of POPSIG

Contents

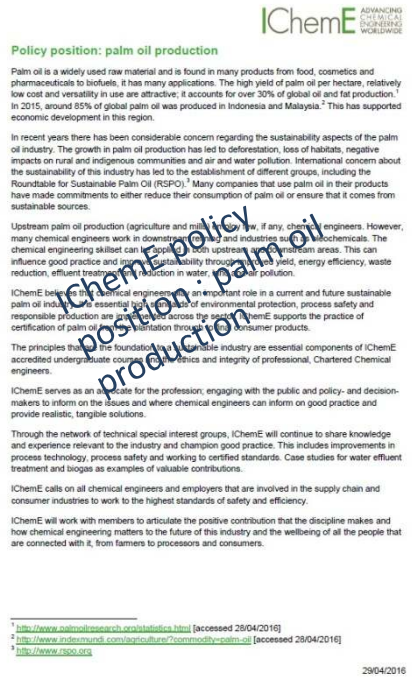
- Introduction to POPSIG
- The seed oils market
- Processing and Products
- Oleochemistry and well being
- Sustainability
- What POPSIG did

POPSIG

POPSIG was formed on 3rd August 2015 in Kuala Lumpur, Malaysia to provide a forum for the exchange of ideas, the sharing of experiences and encouraging innovation in the palm oil processing industry.

Volunteers passionate about the palm oil industry & process engineering

Not limited to chemical engineers



IChemE

Policy position: palm oil production

Palm oil is a widely used raw material and is found in many products from food, cosmetics and pharmaceuticals to biofuels, it has many applications. The high yield of palm oil per hectare, relatively low cost and versatility in use are attractive; it accounts for over 30% of global oil and fat production.[1] In 2015, around 85% of global palm oil was produced in Indonesia and Malaysia.[2] This has supported economic development in this region.

In recent years there has been considerable concern regarding the sustainability aspects of the palm oil industry. The growth in palm oil production has led to deforestation, loss of habitats, negative impacts on rural and indigenous communities and air and water pollution. International concern about the sustainability of this industry has led to the establishment of different groups, including the Roundtable for Sustainable Palm Oil (RSPO).[3] Many companies that use palm oil in their products have made commitments to either reduce their consumption of palm oil or ensure that it comes from sustainable sources.

Upstream palm oil production (agriculture and milling) is not, by law, if any, chemical engineers. However, many chemical engineers work in downstream industries and industries such as biochemicals. The chemical engineering skillset can be applied to both upstream and downstream areas. This can influence good practice and improve sustainability through increased yield, energy efficiency, waste reduction, effluent treatment and reduction in water, soil and air pollution.

IChemE believes that chemical engineers play an important part in a current and future sustainable palm oil industry. The essential building blocks of environmental protection, process safety and responsible production are grounded across the sector. IChemE supports the practice of certification of palm oil [illegible] through to consumer products.

The principles that are the foundation for a sustainable industry are essential components of IChemE accredited undergraduate courses. The ethics and integrity of professional, Chartered Chemical engineers.

IChemE serves as an advocate for the profession; engaging with the public and policy- and decision-makers to inform on the issues and where chemical engineers can inform on good practice and provide realistic, tangible solutions.

Through the network of technical special interest groups, IChemE will continue to share knowledge and experience relevant to the industry and champion good practice. This includes improvements in process technology, process safety and working to certified standards. Case studies for water effluent treatment and biogas as examples of valuable contributions.

IChemE calls on all chemical engineers and employers that are involved in the supply chain and consumer industries to work to the highest standards of safety and efficiency.

IChemE will work with members to articulate the positive contribution that the discipline makes and how chemical engineering matters to the future of this industry and the wellbeing of all the people that are connected with it, from farmers to processors and consumers.

[1] http://www.palmoilresearch.org/statistics.html [accessed 28/04/2016]
[2] http://www.indexmundi.com/agriculture/?commodity=palm-oil [accessed 28/04/2016]
[3] http://www.rspo.org

29/04/2016

IChemE policy position: palm oil production

https://www.icheme.org/membership/groups/special-interest-groups/palm-oil-processing/

POPSIG objectives & activities

Objectives

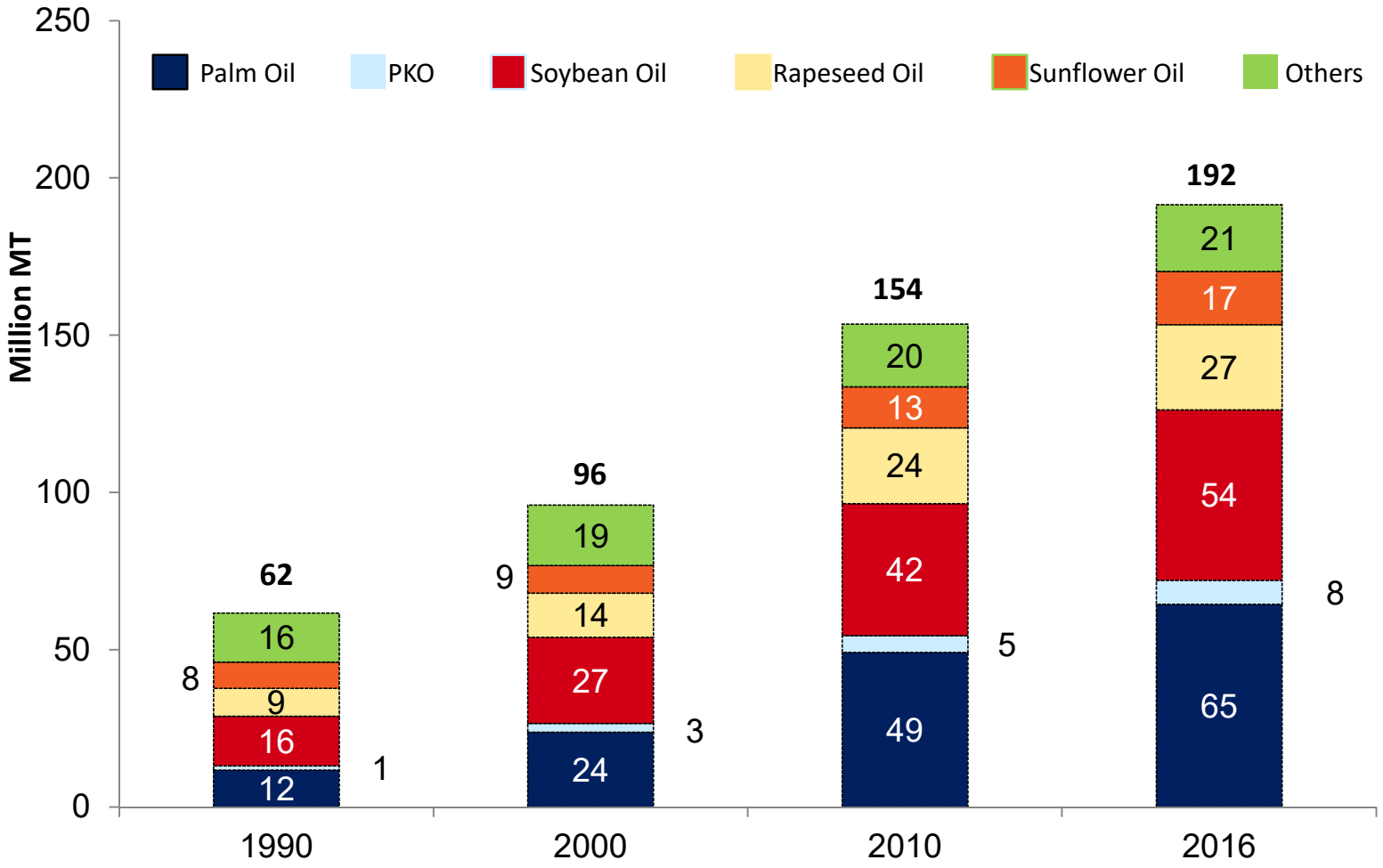
- share and promote best practices
- encourage innovation in processing oil palm products
- promote professional aspects of the palm oil industry
- act as a focal point for all those interested in the process aspects of oil palm processing.

Activities

- technical seminars, workshops, site visits, webinars and physical evening talks
- quarterly newsletter
- yearly forum
- support for the annual IChemE Malaysia Palm Oil Industry Award

The seed oils market

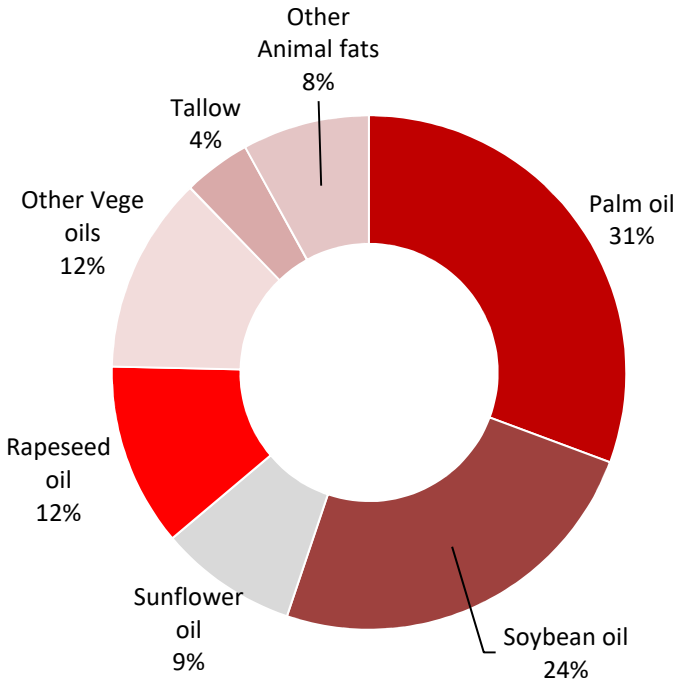
Global Vegetable Oil Production



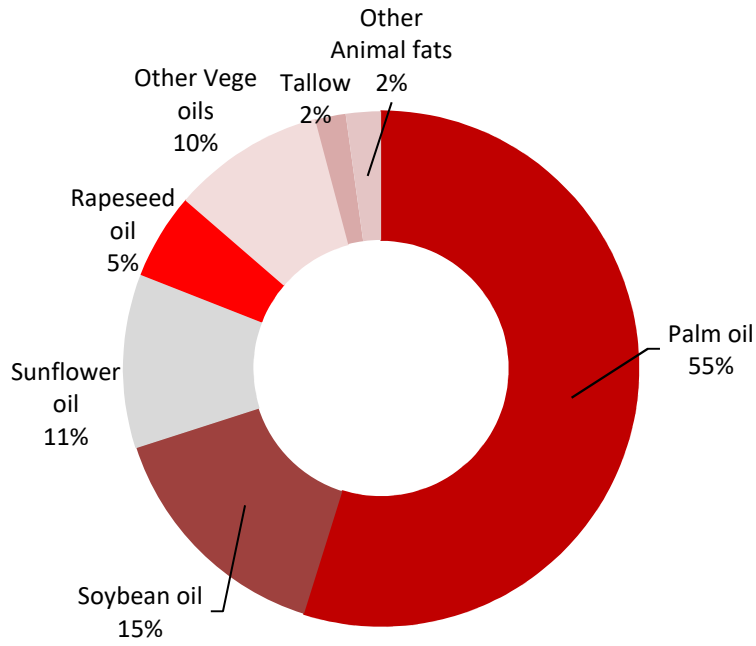
Source : Oil World

Palm oil is the most widely used edible oils

Breakdown of production of edible oils – 2017



Breakdown of export of edible oils – 2017



Total = 210 m tonnes

SOURCE: OIL WORLD, CIMB RESEARCH

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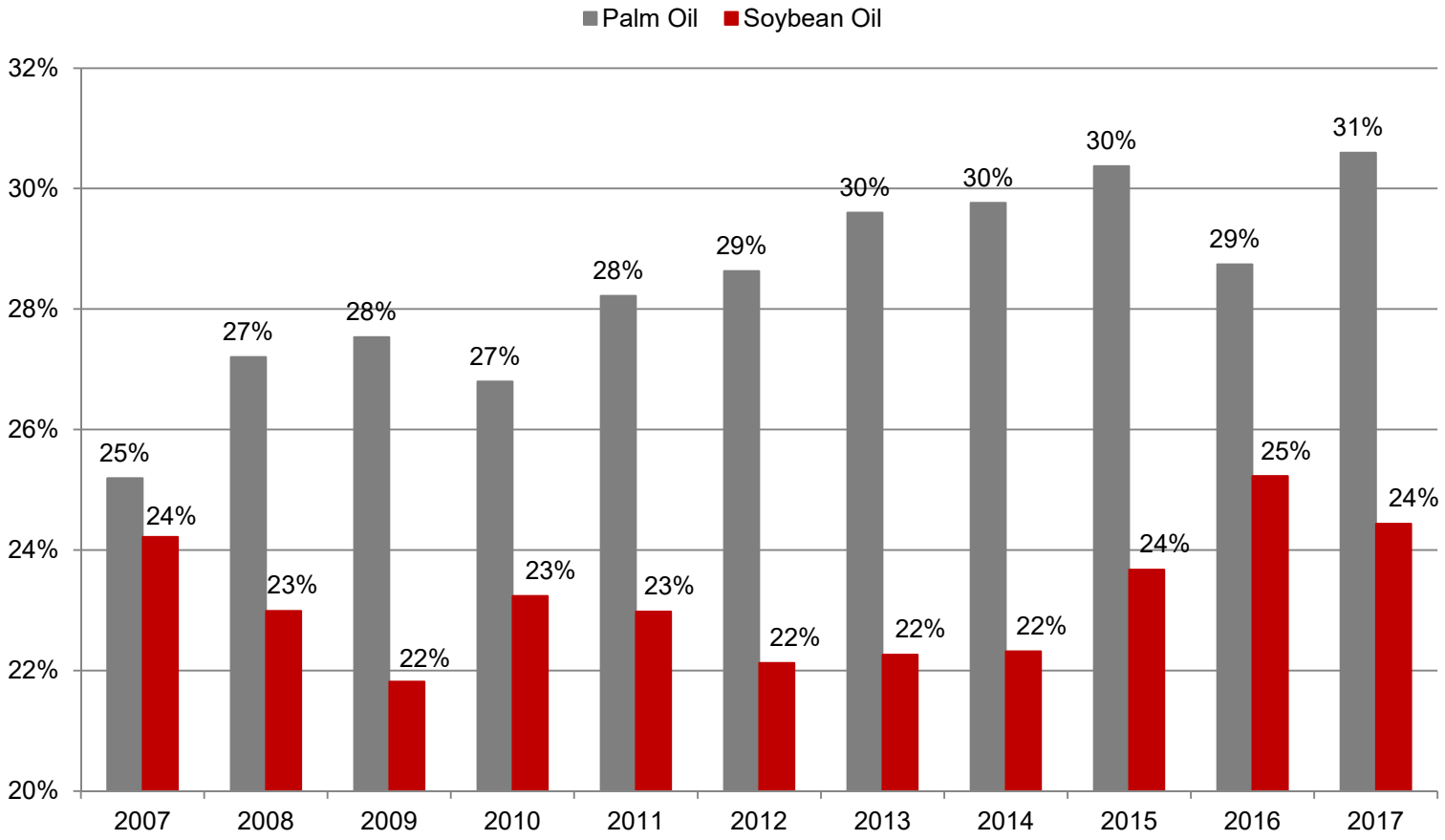
Palm oil's rising share in the edible oils supply

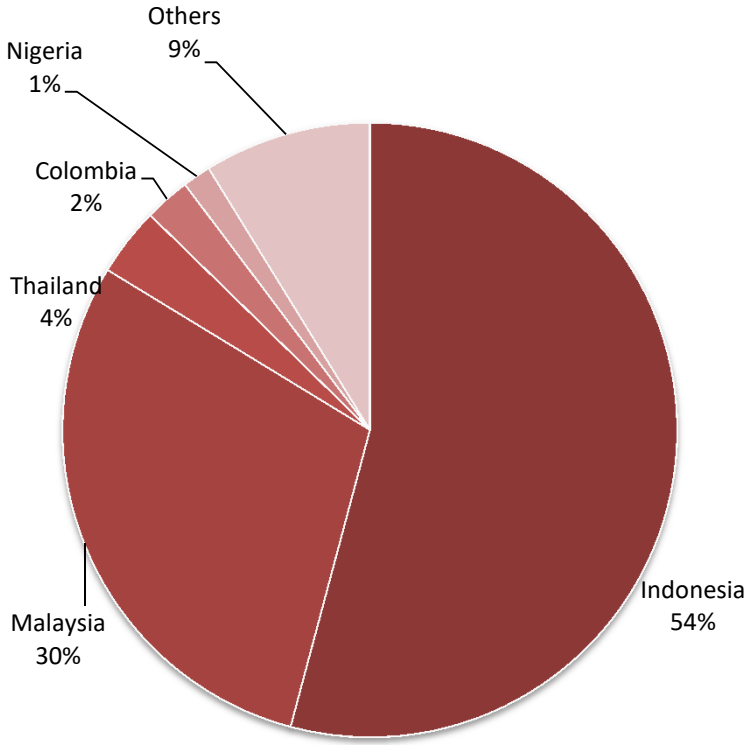
Palm oil and soybean oil share of global oils and fats supply



SOURCE: OIL WORLD, CIMB RESEARCH

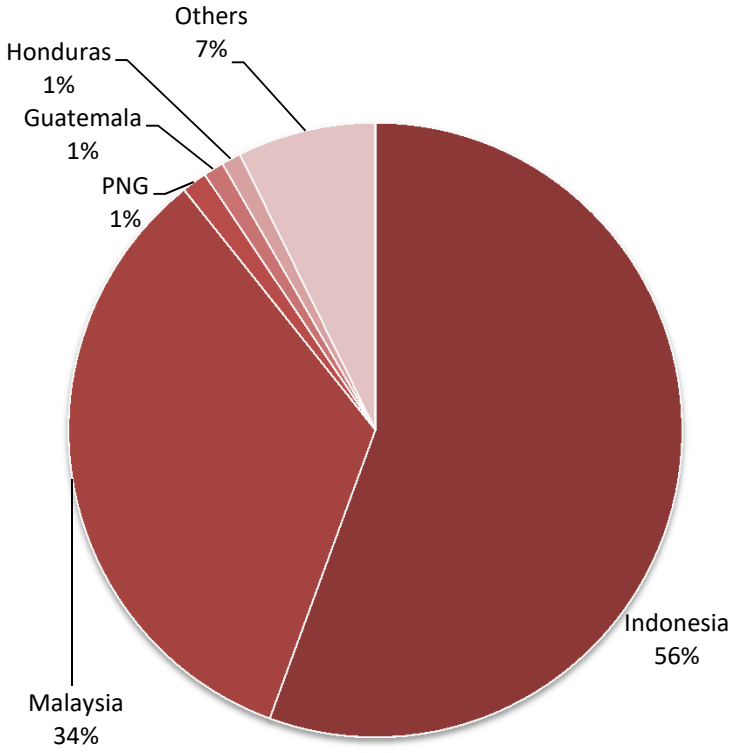
Major producers and exporters of palm oil

World major producers of palm oil in 2017



SOURCE: MPOB, CIMB RESEARCH

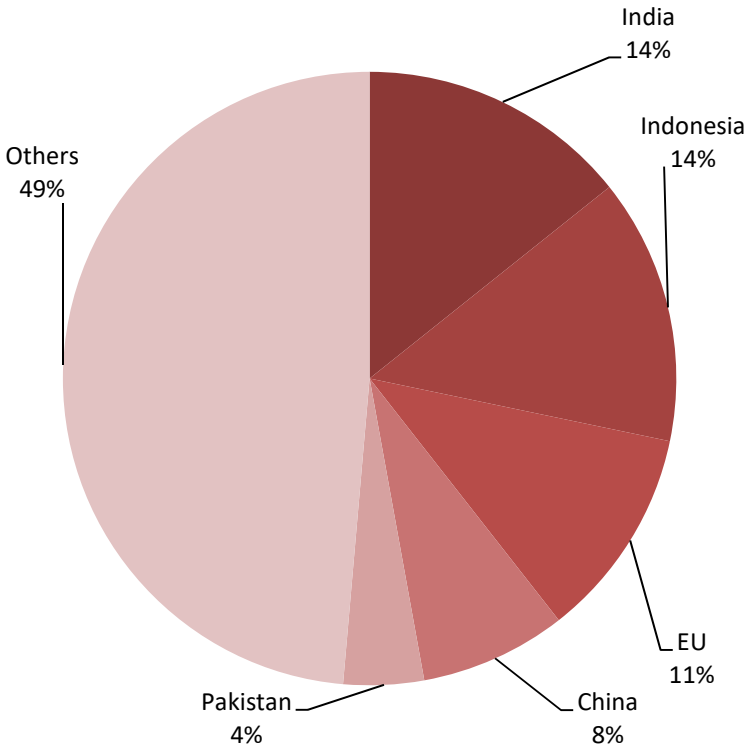
World major exporters of palm oil 2017



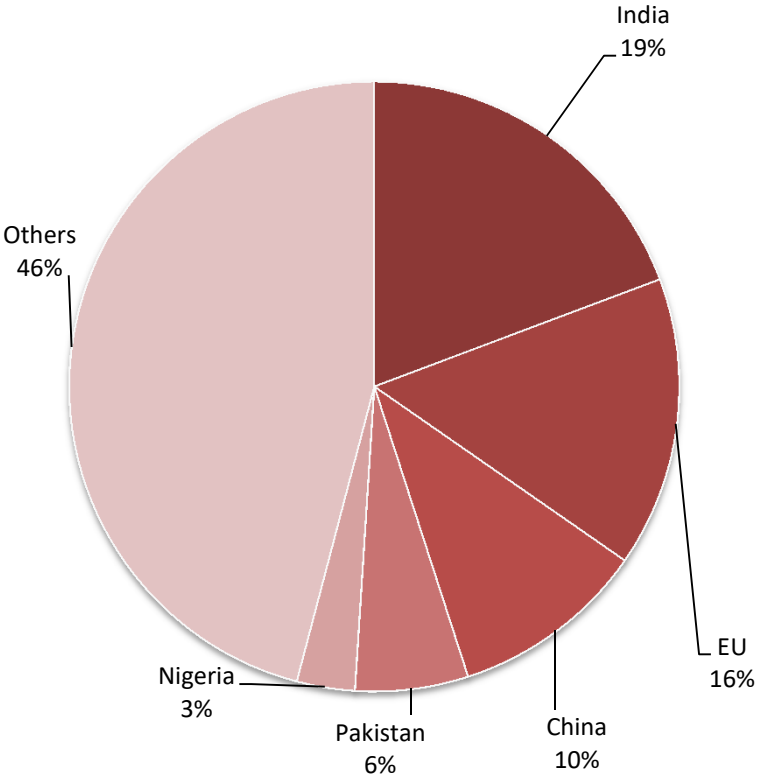
SOURCE: MPOB, CIMB RESEARCH

Major consumers and importers of palm oil in 2017

World major consumers of palm oil in 2017

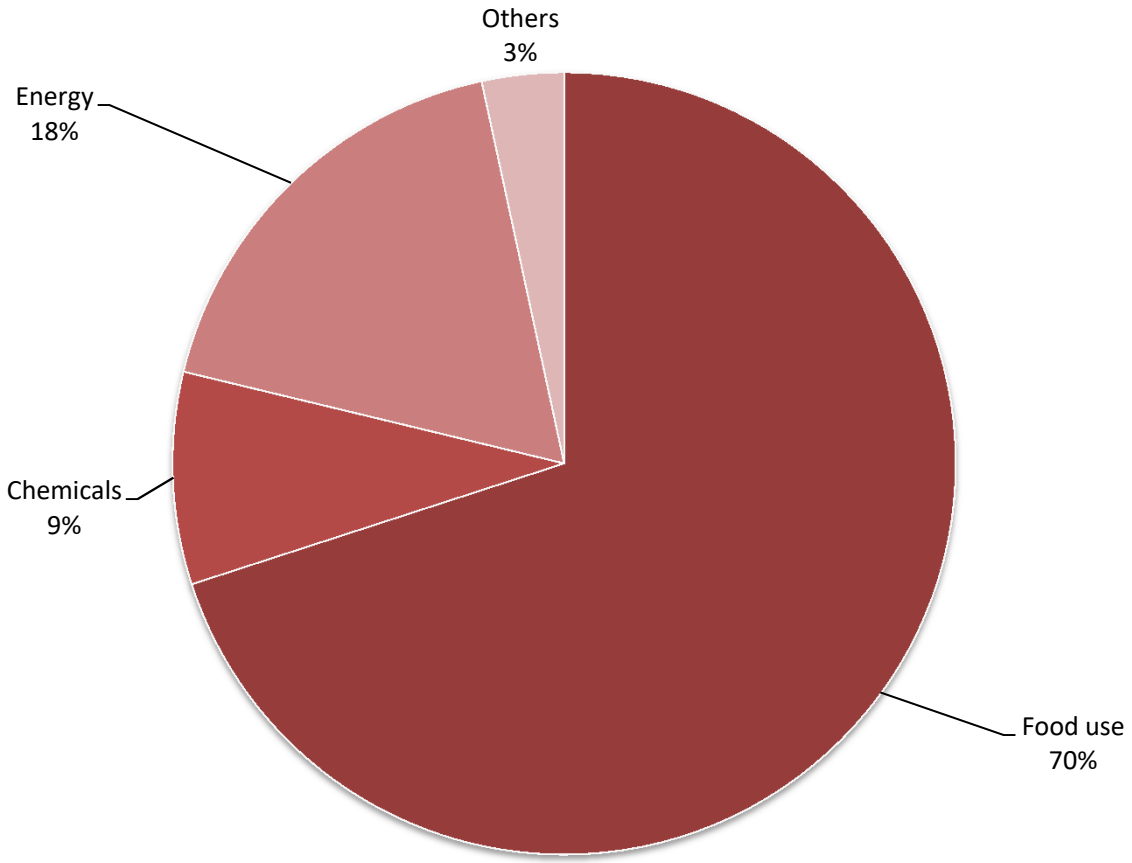


World major importers of palm oil 2017



SOURCE: MPOB, CIMB RESEARCH

Usage of palm oil in 2017 (65m tonnes)



SOURCE: OIL WORLD, CIMB RESEARCH

Global Biodiesel Market

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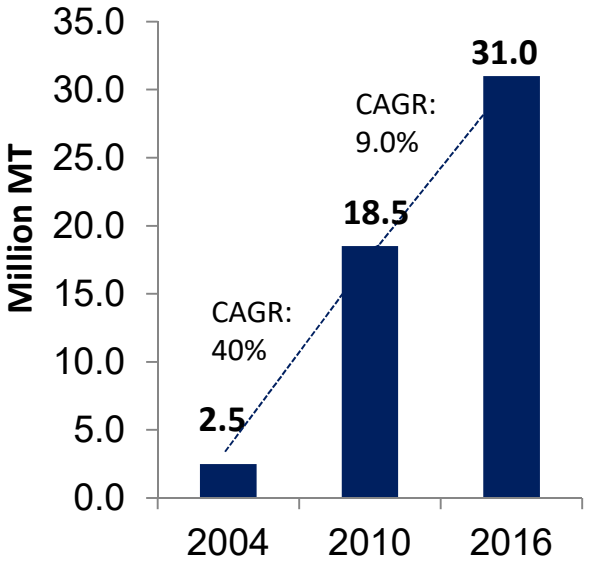
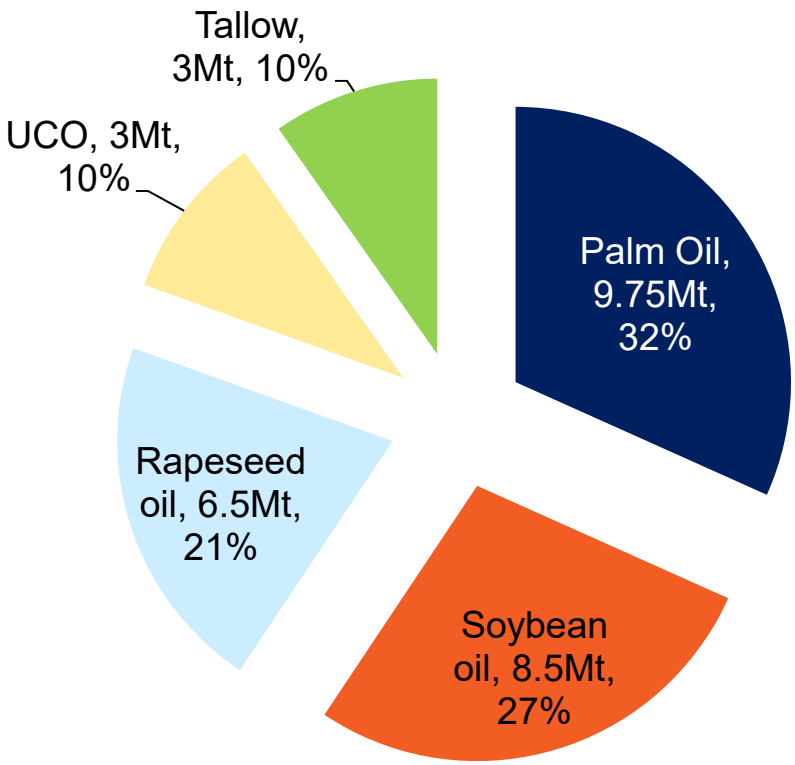


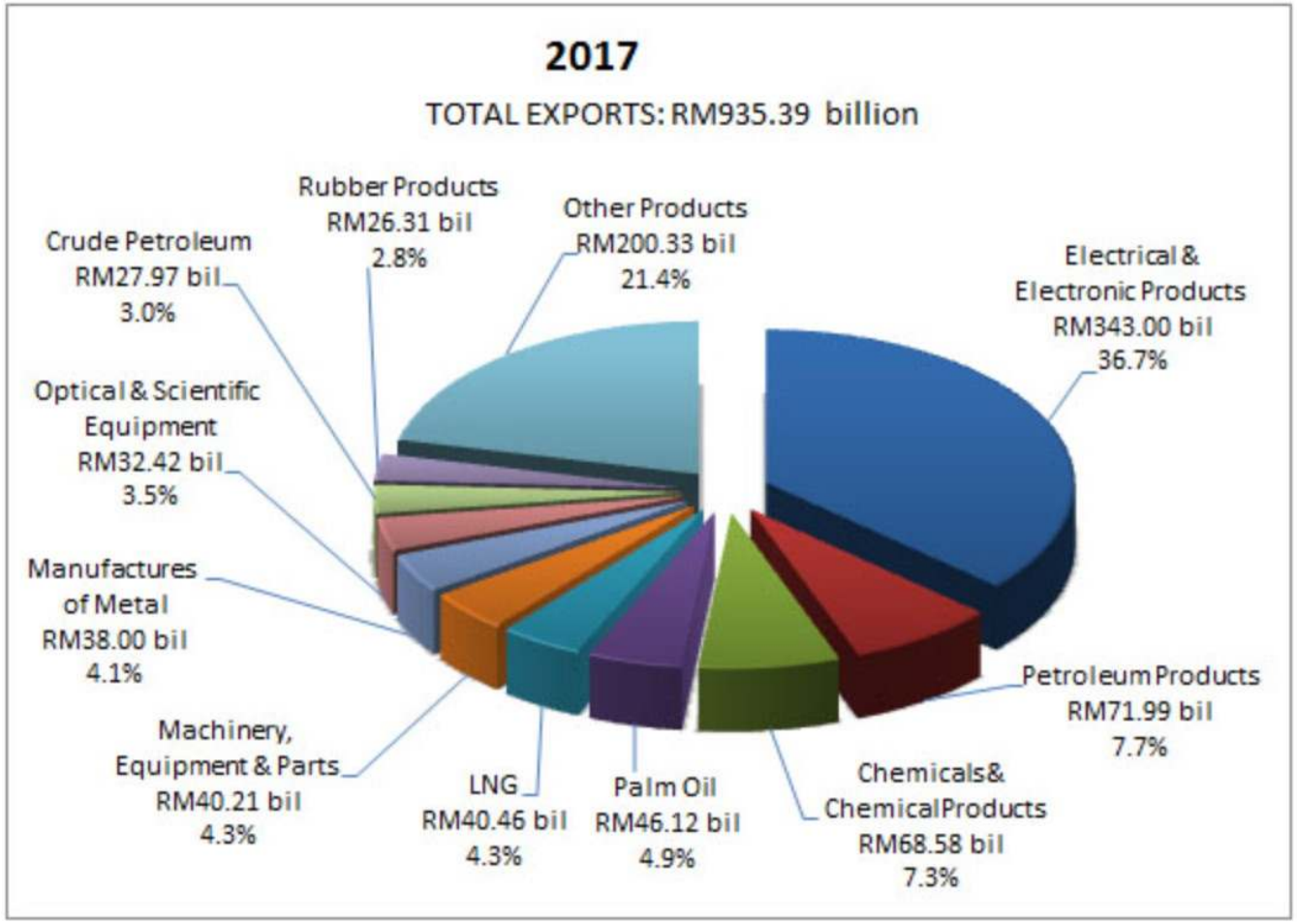
- **Market Size: 31 million mt, $ 25 billion.**

Global Biodiesel Market by type of oil, 2016



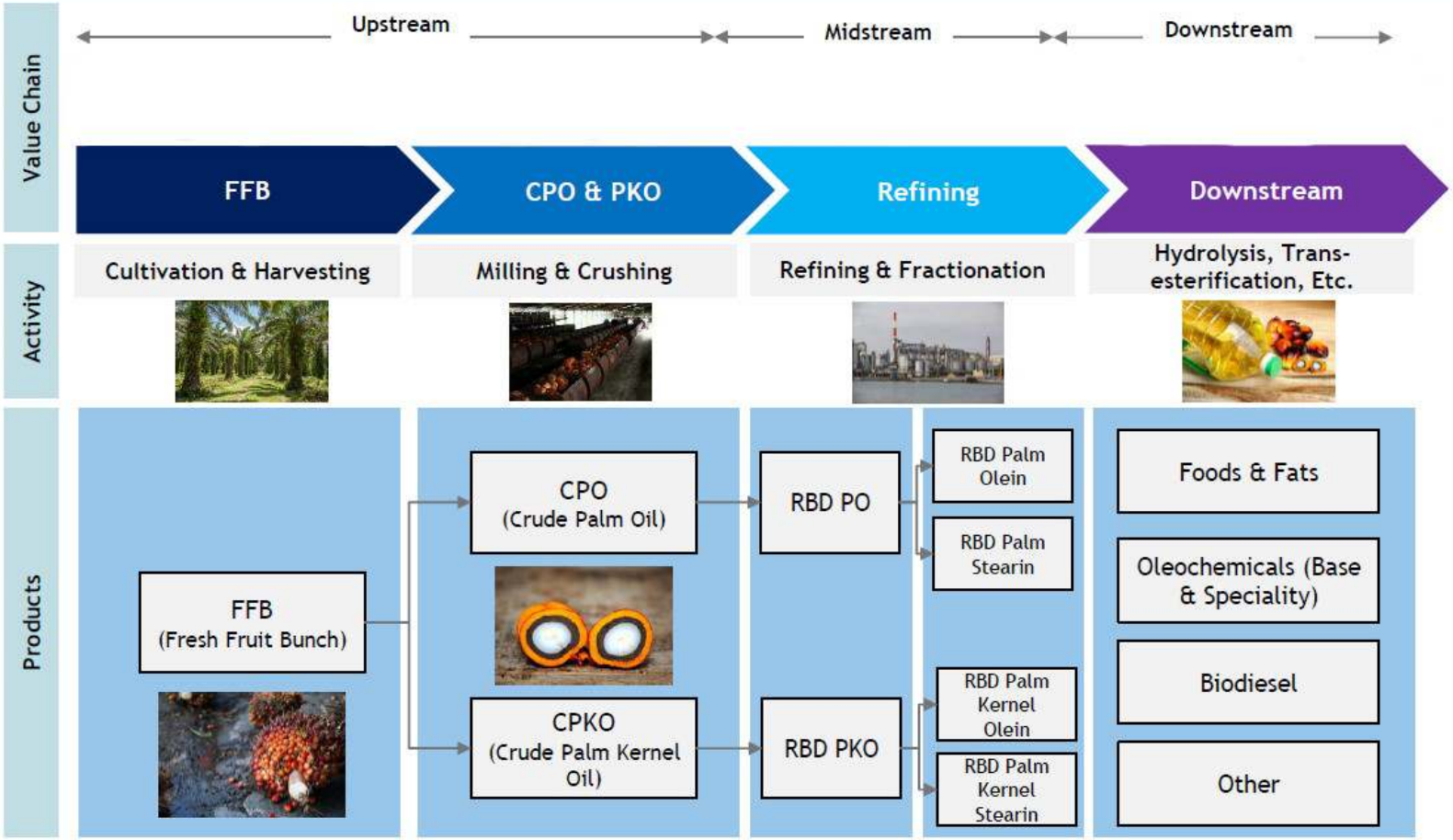
Source : Oil World

Top 10 Major Export Products (Malaysia)

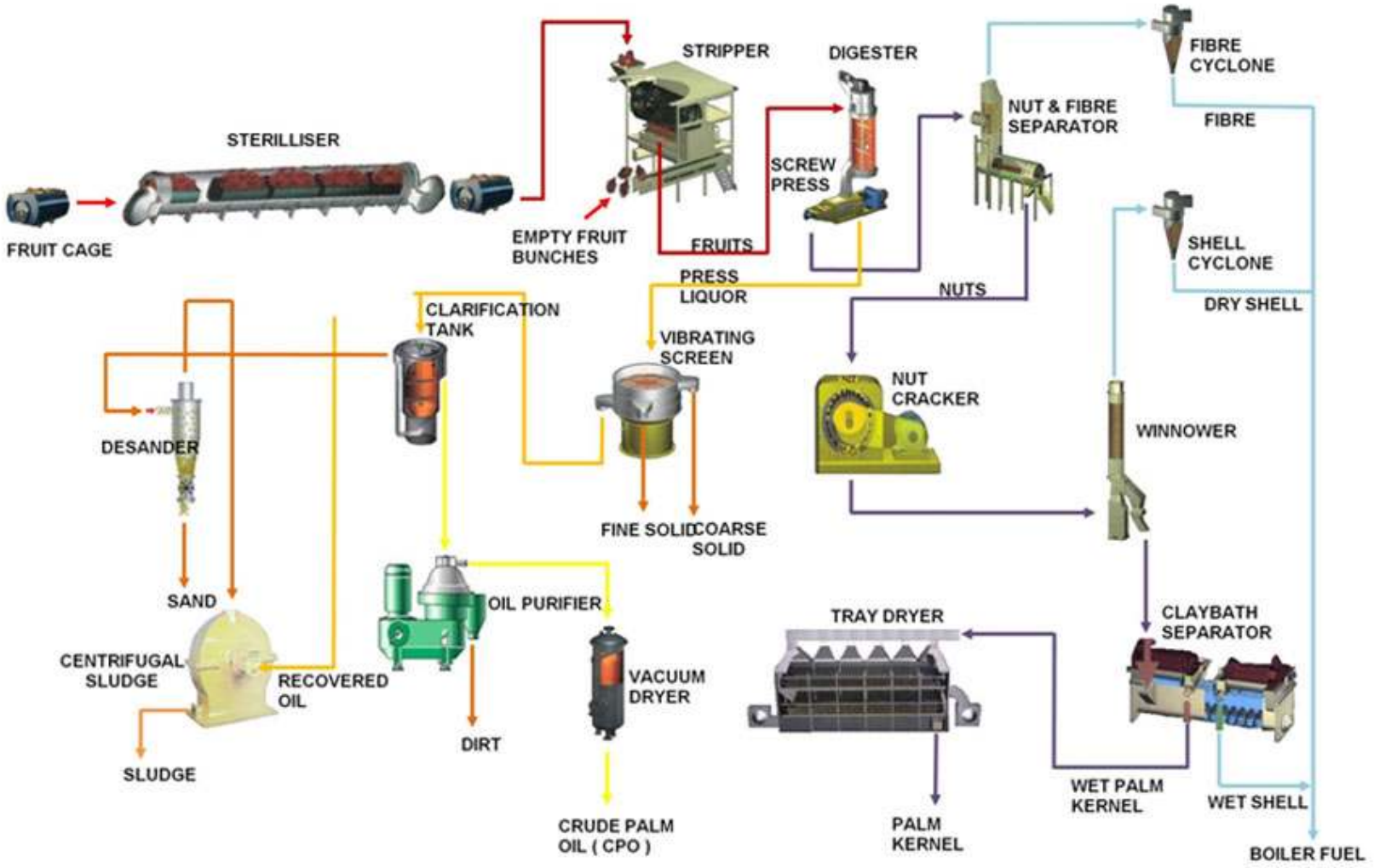


Processing and Products

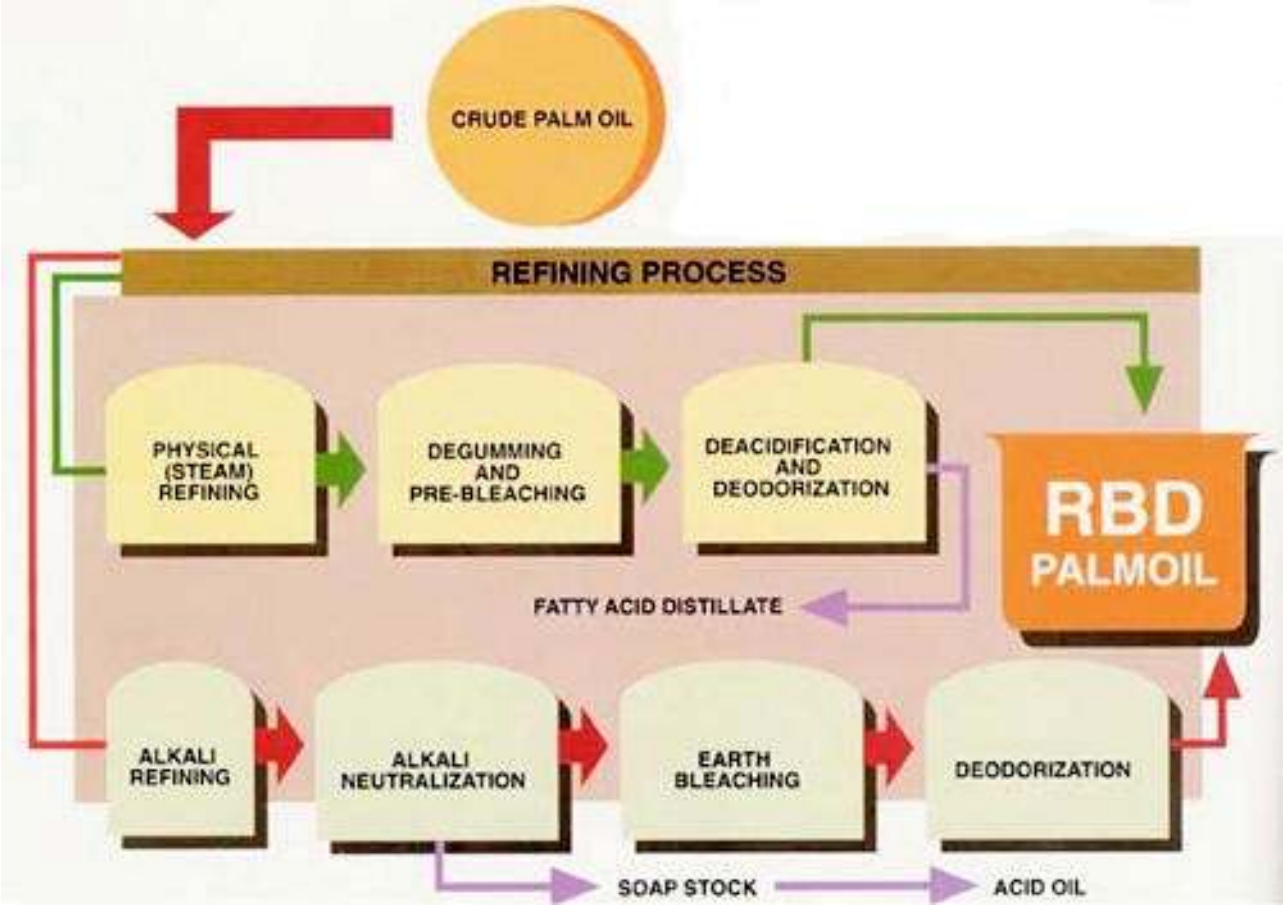
PO & PKO supply chain



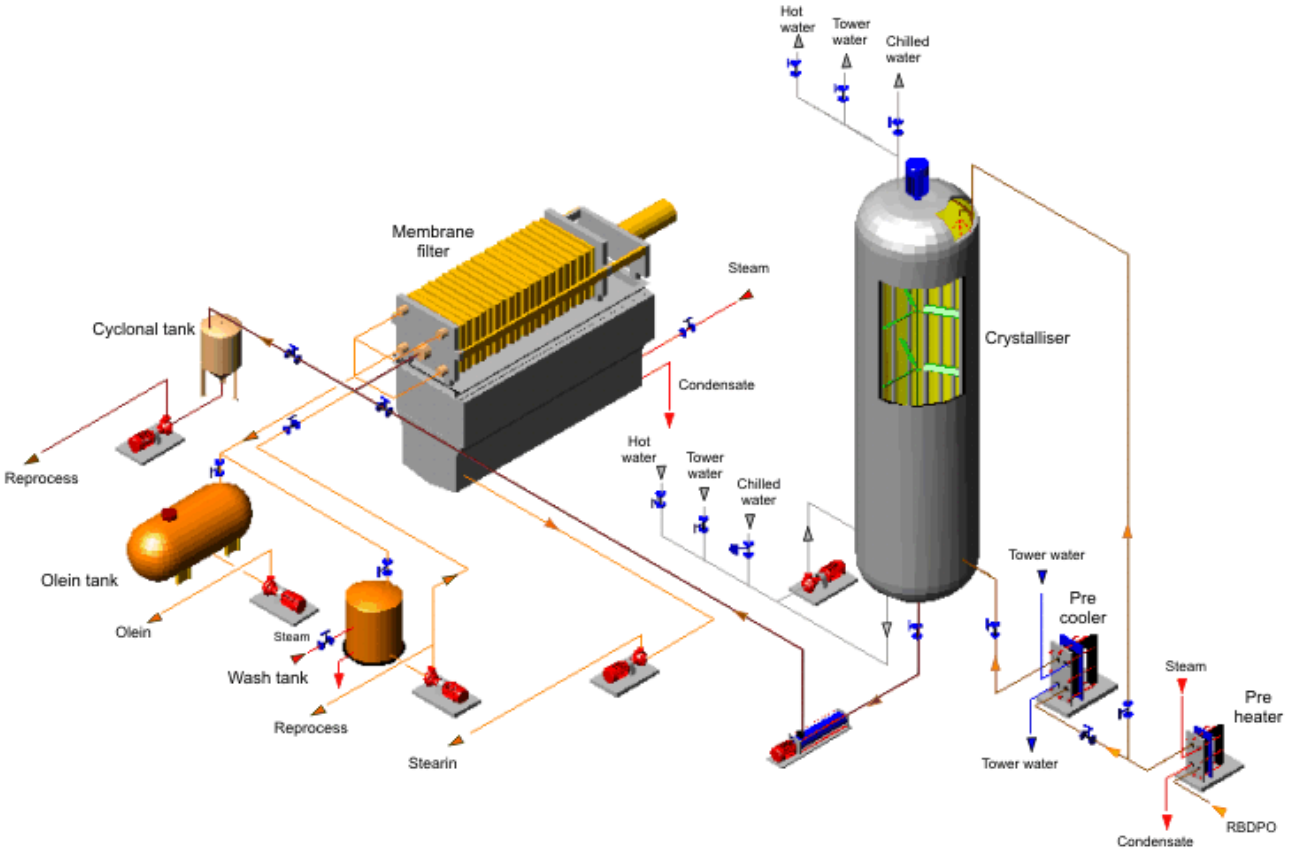
PALM OIL MILL PROCESS FLOW DIAGRAM



PO Refining Process



Palm Oil Fractionation



Palm oil : palm olein as cooking oil

Palm kernel oil : cocoa butter substitute

Edible Palm Oil Products

Palm oil is used in a wide range of foods

stability at high cooking temperatures

crispiness and crunch

neutral taste and smell

solid or semi-solid at room temperature

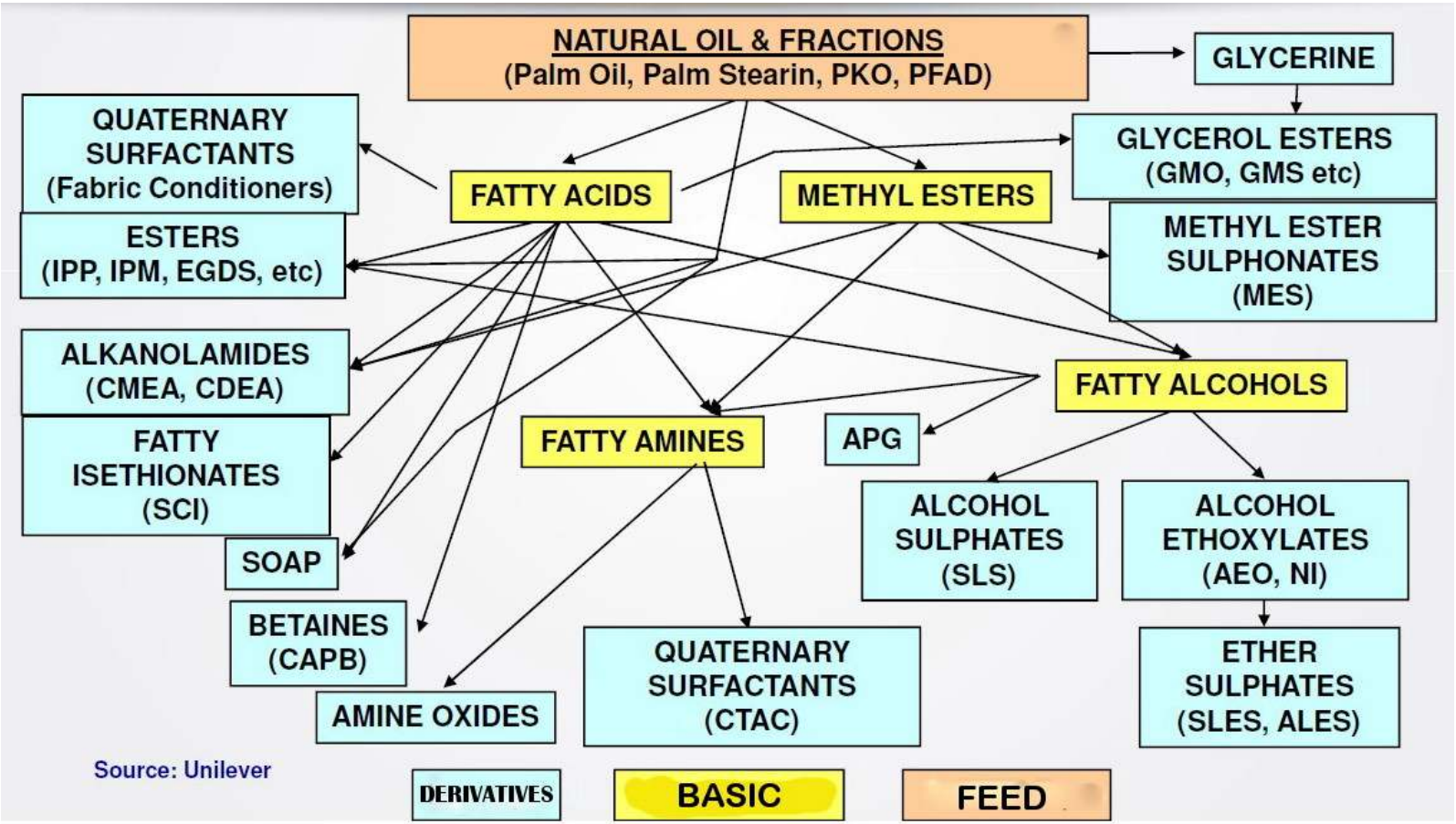
smooth and creamy texture

excellent mouth feel

alternative to trans fat

Source : European Palm Oil Alliance (EPOA)

Oleochemical Processes



End Consumer products …

 Soap noodles		 Sodium lauryl sulfate	 Stearic Acid	 Esters
 Glycerin, Isopropyl Myristate	 Methyl Ester Sulfonate	 Cetyl palmitate, isopropyl myristate, sorbitan monostearate, stearyl alcohol	 Amide as slip agent	 Tocotrienols

Oleochemistry and well being

The fatty acids in palm and palm kernel oil

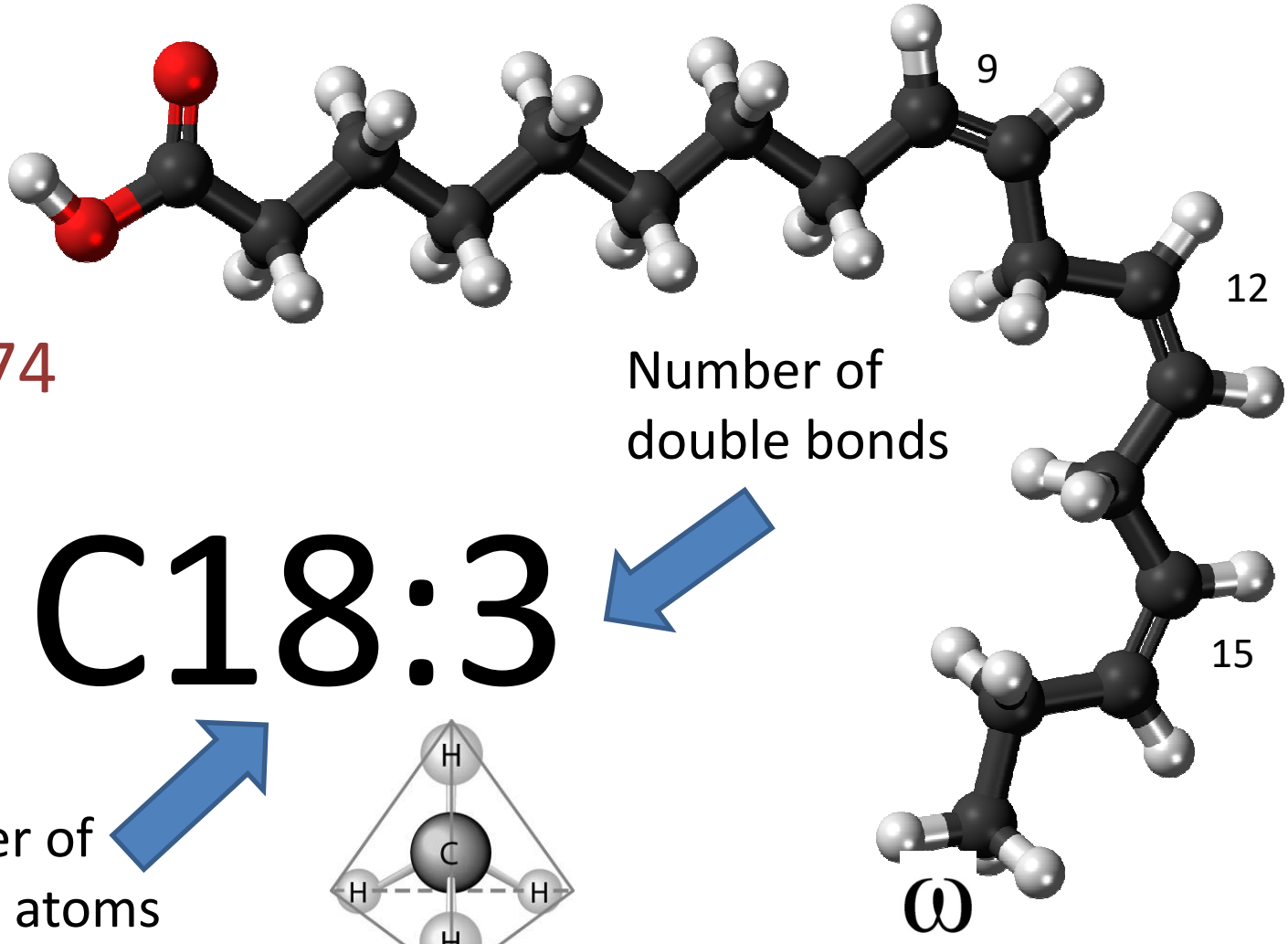
C8 to C16

- C8:0
- C10:0
- C12:0
- C14:0
- C16:0

C18

- C18:0
- C18:1
- C18:2
- C18:3

Understanding a fatty acid molecule

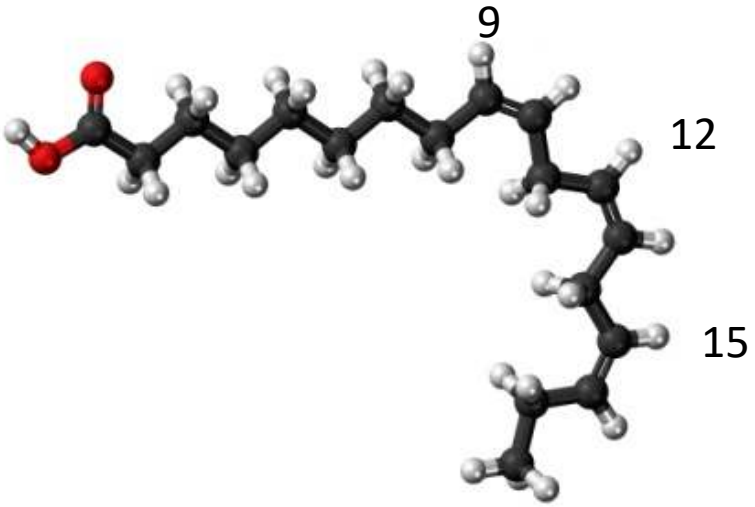


Molecular structure fatty acids

PUFA

Polyunsaturated Fatty Acid

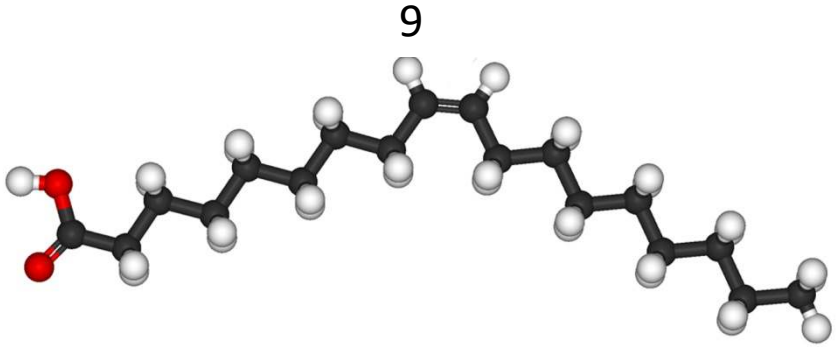
9,12,15-octadecatrienoic
or α-linolenic 18:3(n-3)



MUFA

Monounsaturated Fatty Acid

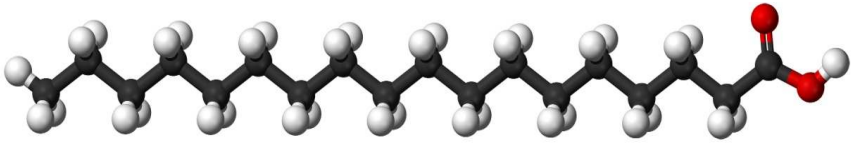
oleic acid 18:1 (n9)



SAFA

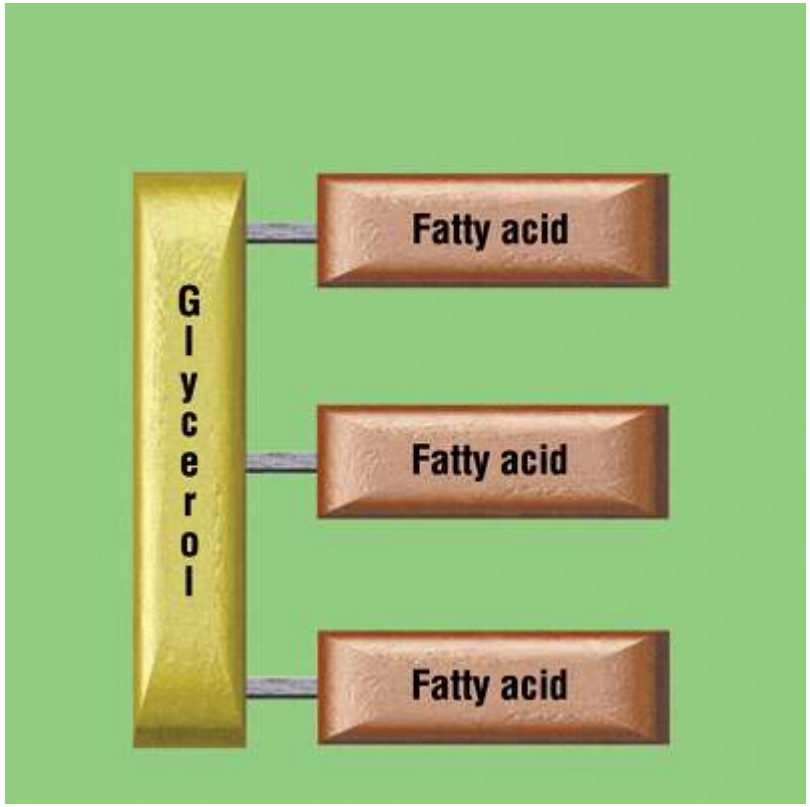
Saturated Fatty Acid

stearic acid 18:0



Placement of fatty acids in PO

(40 possible combinations)



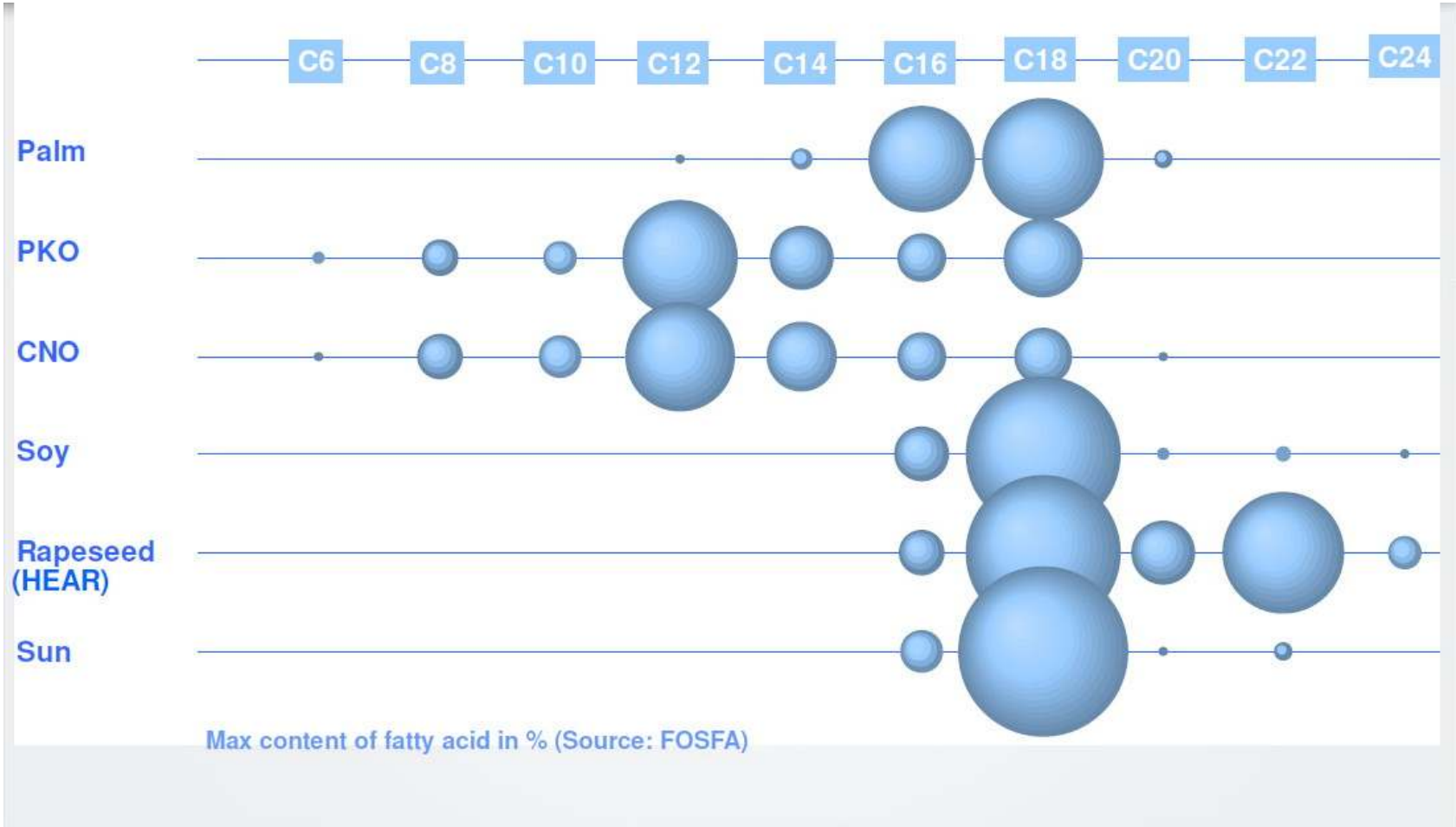
eg. POP at 23.7%

sn-1 Palmitic 16:0

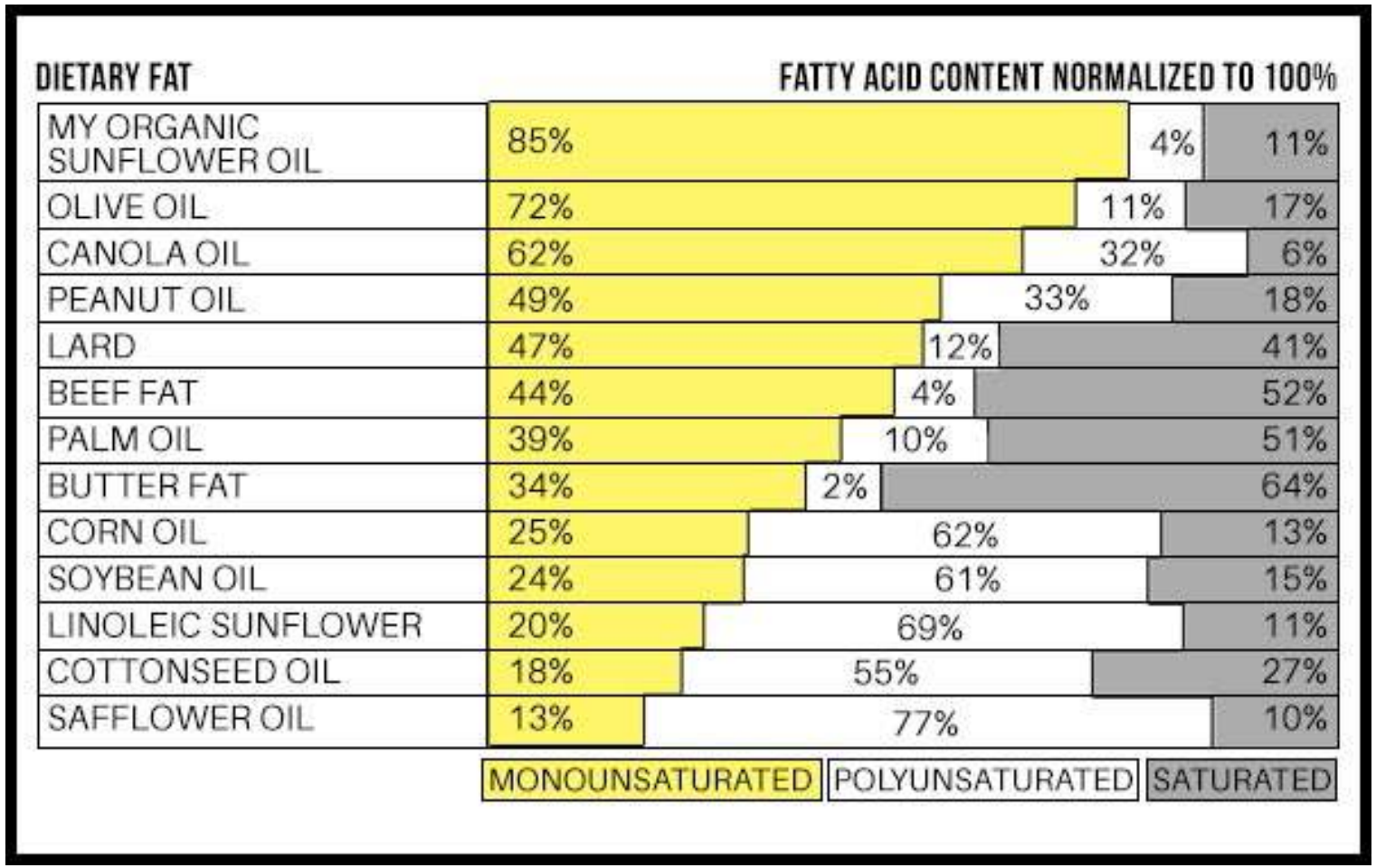
sn-2 Oleic 18:1 (n-9)

sn-3 Palmitic 16:0

Composition of selected oils



Monounsaturated
[Oleic acid 18:1 (n-9c)]



Source : Dr Mercola organic sunflower oil

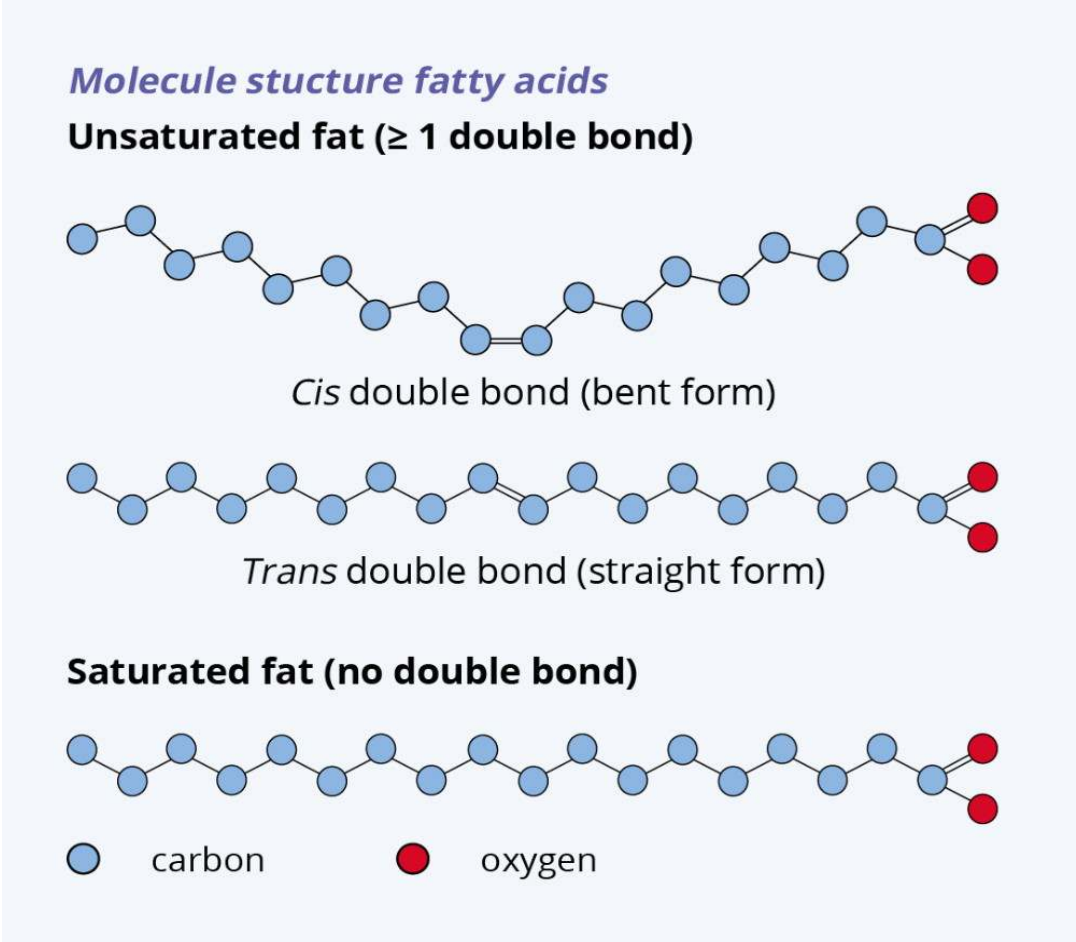
TFA

(Trans Fatty Acids)

Oleic acid 18:1 (n-9c)

Elaidic acid 18:1 (n-9t)

Stearic acid 18:0



Trans (unsaturated) fatty acid is a result of the hydrogenation process. It increases the risk of developing heart disease and stroke

New information on heart disease

- For the past 60 years, saturated fat and cholesterol have been wrongfully vilified as the culprits of heart disease
- Refined carbs, sugar, trans fats found in processed foods are the real enemy—not the saturated fats found in foods such as butter, palm oil or eggs
- Inflammation of arteries causes blockage. Refined carbs, sugar, trans fats and oxidised polyunsaturated oils cause inflammation.

Sustainability

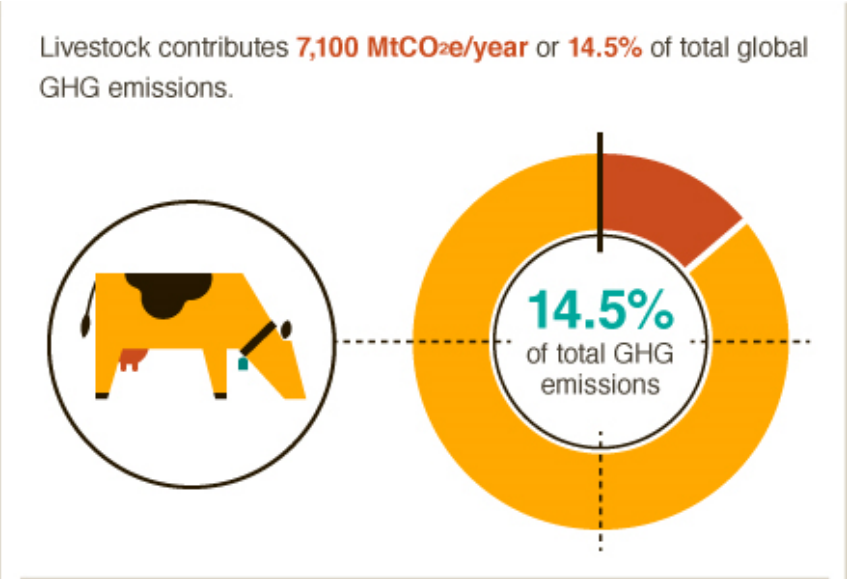
The key sustainability issues

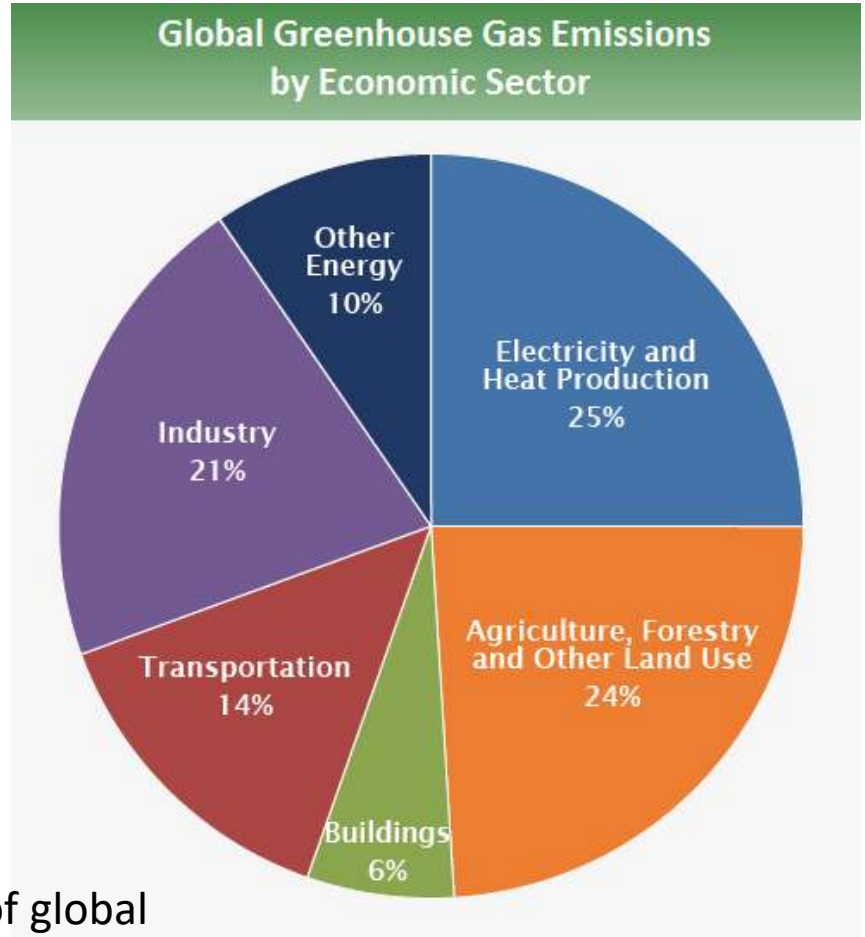
- Deforestation of rain forests and use of fire
- Destruction of habitat of flora and fauna
- Climate change : prevent GHG emissions due to deforestation and expansion on peat.
- Exploitation : land rights of indigenous people labour and fairness to small holders

Some sustainability standards

Standard	Year	CSPO	Hectares	Remarks
Roundtable on Sustainable Palm Oil (RSPO)	2004	13.6 m tonnes 19% (52% sold)	2.8 m production	Voluntary
International Sustainability and Carbon Certification (ISCC)	2006	22 m tonnes of FFB (2016)		Voluntary
Rainforest Alliance	1987			Voluntary
Indonesian Sustainable Palm Oil (ISPO)	2011		50%?	Mandatory
Malaysian Sustainable Palm Oil (MSPO)	2015		All RSPO, ISCC etc by 31 Dec 2018. All 31 Dec 2019.	Mandatory

Global GHG Emissions





EPOA : Palm Oil contributes to 2.3 % of global deforestation and 5% of tropical deforestation

Cows fart & burp methane

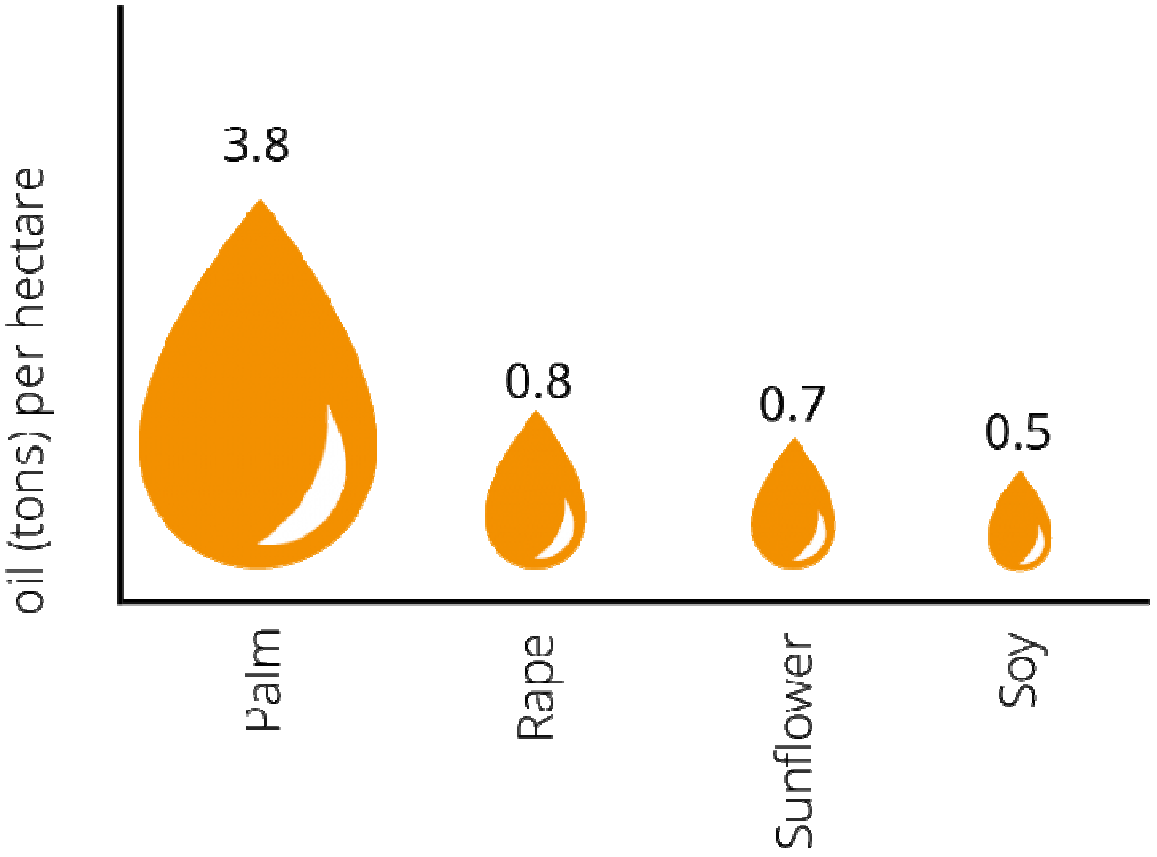
- Microbes in their stomach break down their food into methane as a byproduct
- One cow = one car. 1.5 billion cows and bulls
- Forest cover is cut for grazing pastures

We trap our methane!

- Biomethane from anaerobic digestion of POME is used for heating and power generation

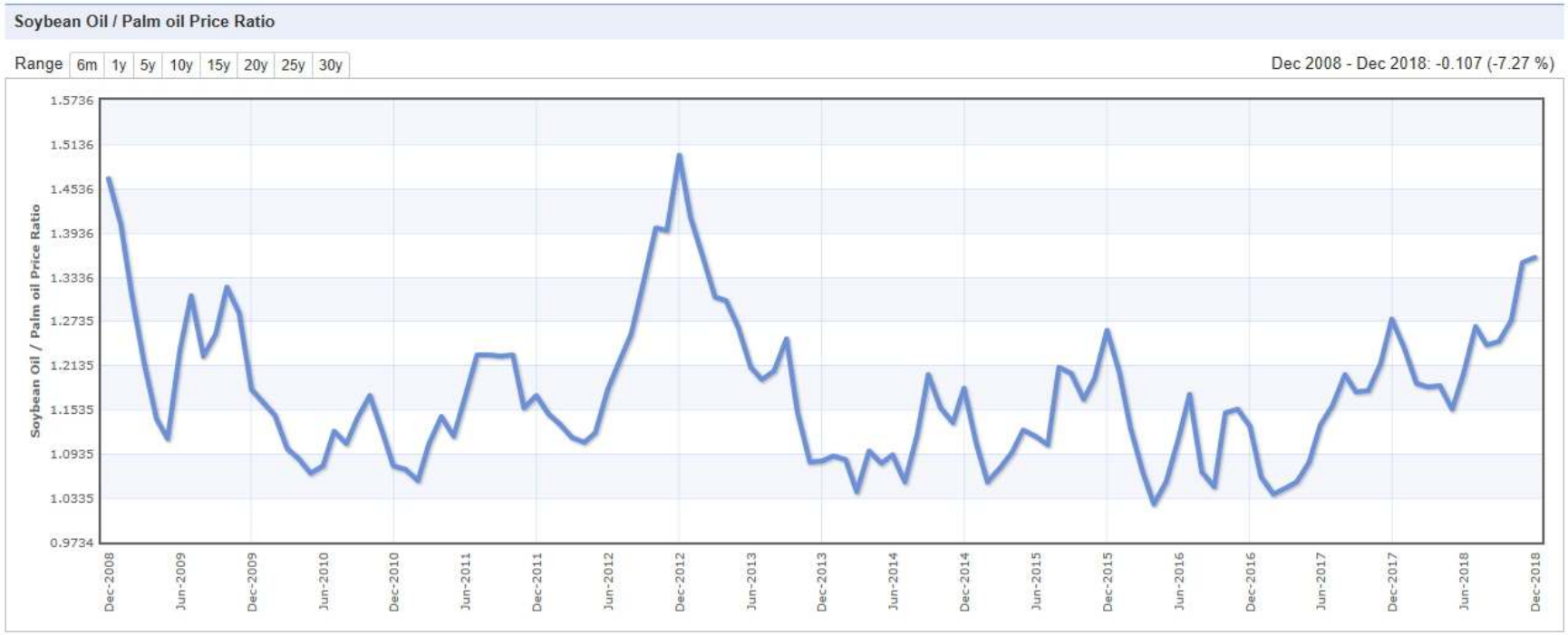
A highly efficient crop (Oil World 2016)

Highest Yield



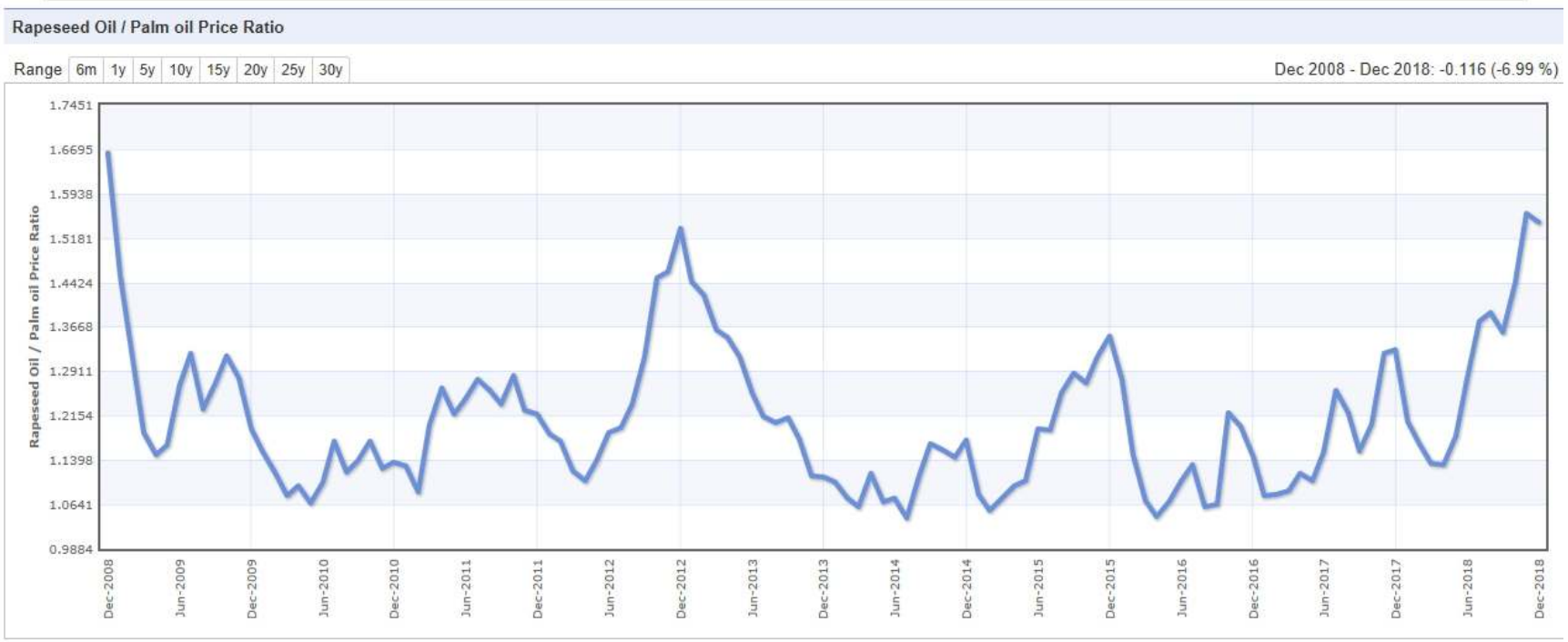
Source : The European Palm Oil Alliance (EPOA)

PO is cheaper than SBO



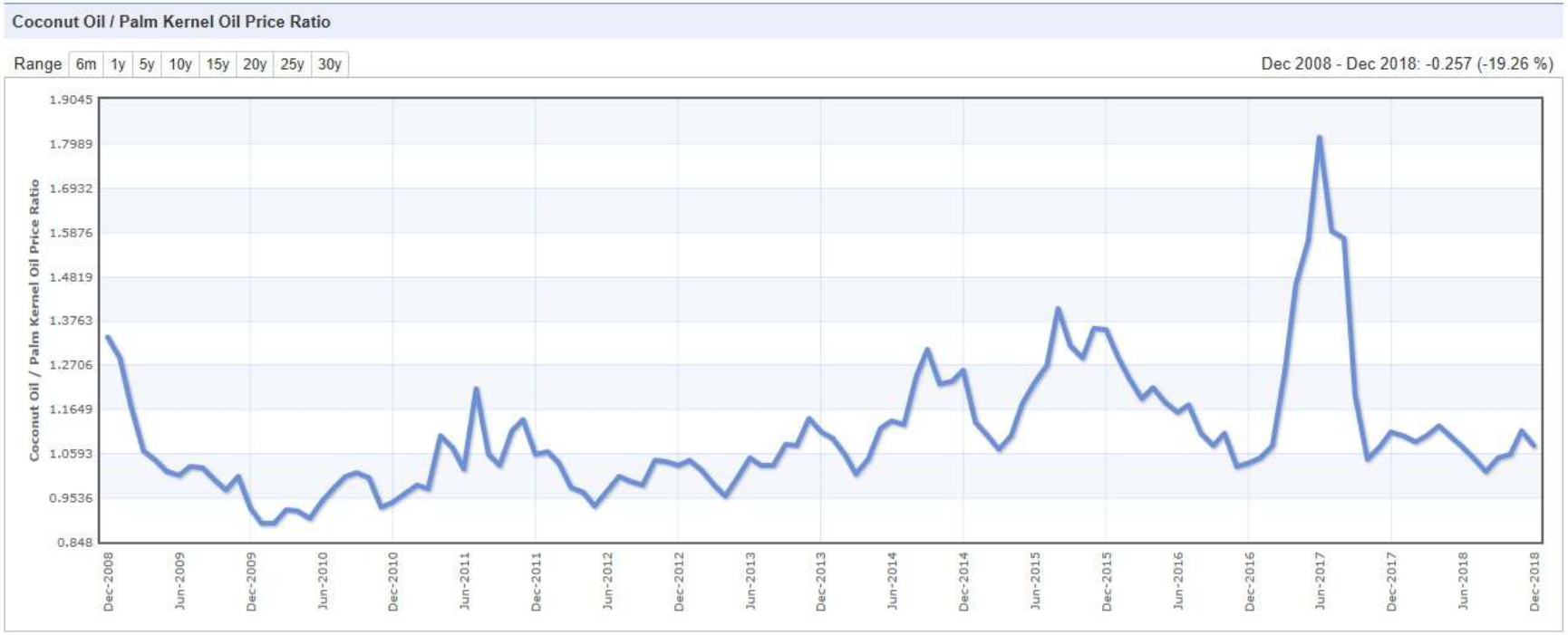
Source : Index Mundi

PO is cheaper than rapeseed oil



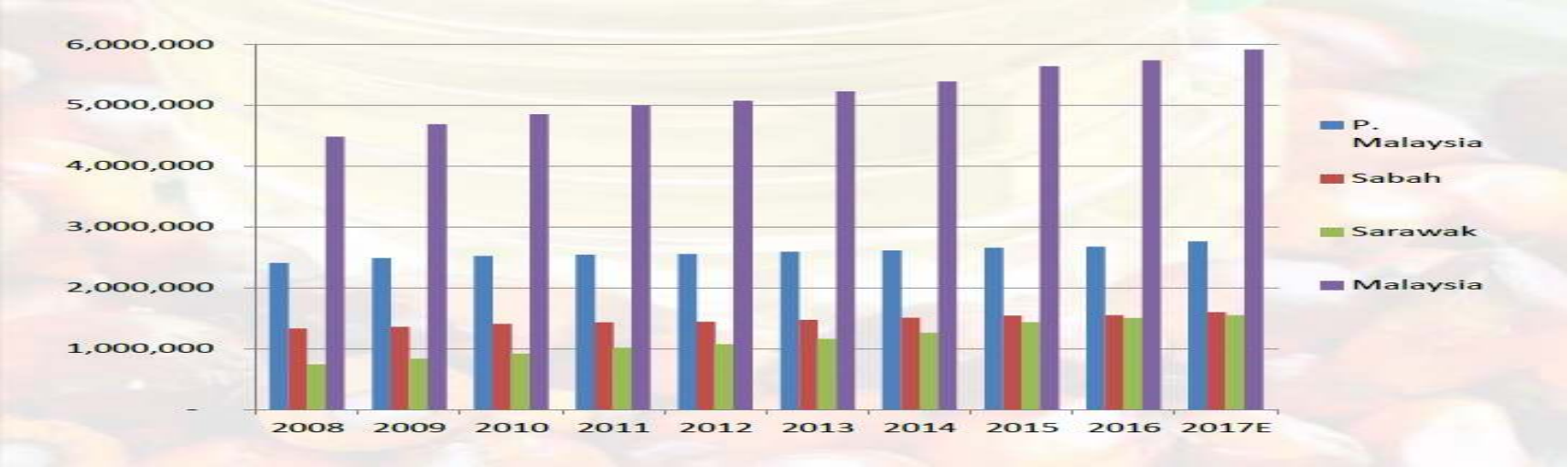
Source : Index Mundi

PKO can be cheaper than CNO



Source : Index Mundi

Malaysian PO production plateaus



	(in 1,000 MT)	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018
Production	Indonesia	20,500	22,000	23,600	26,200	28,500	30,500	33,000	32,000	36,000	38,500
	Malaysia	17,259	17,763	18,211	18,202	19,321	20,161	19,879	17,700	18,860	20,500
	World	44,474	46,374	49,192	52,529	56,378	59,306	61,810	58,833	64,801	69,332
	Indonesia Share (%)	46%	47%	48%	50%	51%	51%	53%	54%	56%	56%
	Malaysia Share (%)	39%	38%	37%	35%	34%	34%	32%	30%	29%	30%
	Others Share (%)	15%	14%	15%	15%	15%	15%	14%	16%	15%	15%

What POPSIG did

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IChemE believes that chemical engineers play an important role in a current and future sustainable palm oil industry. It is essential high standards of environmental protection, process safety and responsible production are implemented across the sector. IChemE supports the practice of certification of palm oil from the plantation through to final consumer products.

The principles that are the foundation to a sustainable industry are essential components of IChemE accredited undergraduate courses and the ethics and integrity of professional, Chartered Chemical engineers.

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Through the network of technical special interest groups, IChemE will continue to share knowledge and experience relevant to the industry and champion good practice. This includes improvements in process technology, process safety and working to certified standards. Case studies for water effluent treatment and biogas as examples of valuable contributions.

IChemE calls on all chemical engineers and employers that are involved in the supply chain and consumer industries to work to the highest standards of safety and efficiency.

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[1] http://www.palmoilresearch.org/statistics.html
[2] http://www.indexmundi.com/agriculture/?commodity=palm-oil
[3] http://www.rspo.org

29/04/2016

IChemE Palm Oil Industry Award 2018

Year 2015 (Sponsored by KLK Oleo):

'Palm oil olein yield improvement project'
Mr. Toh Seong Hin - Asst VP, Plantation Advisory – Refinery from **Sime Darby Plantation Sdn Bhd.** receiving the 1st Palm Oil Industry Award from Mr. Siew Fook Ming, Project Director of KLK Oleo.

Year 2016 (Sponsored by POPSIG):

'Re-engineering current palm oil degumming process'
Muhammad Saiful Nidzam Ismail of Sime Darby Research Sdn Bhd - Senior chemical engineer in Oils & Fats Refinery Technical Advisory Services Units receiving the Palm Oil Industry Award from Hong Wai Onn, Chair of POPSIG.

Year 2017 (Sponsored by Sime Darby):

'Novel integrated process for the extraction of phytonutrients and production of biodiesel from crude palm oil'
Chin Hui Ling and **Lim Ching Yee** from **Excel-Vite Sdn. Bhd.** receiving the Palm Oil Industry Award from Tuan Syed Said Syed Saggaf - Head of Sime Darby Biodiesel Sdn Bhd, Head of Sime Darby Kernel Crushing Plant, Head of Health & Wellness Business.

'The Young Industrialist Award' Her Royal Highness Queen of Perak Darul Ridzuan, Tuanku Zara Salim, Royal Patron of IChemE in Malaysia presenting the award to Chew Chien Lye of Sime Darby Plantations. Looking on is Ir Dr Christina Phang.

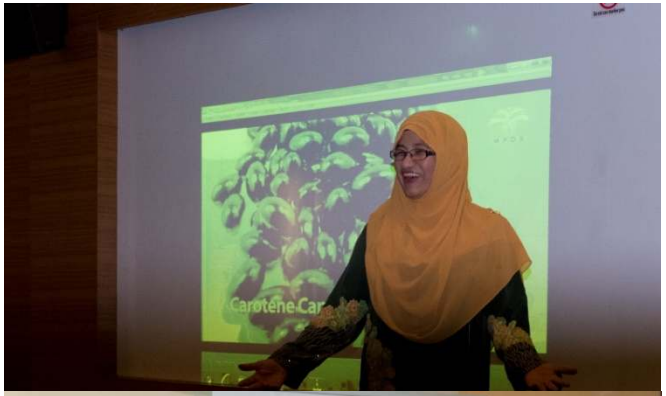
The IChemE Palm Oil Industry Award 2018 sponsored for the second time by KLK Oleo.
'Heat Recovery Using Vent Economisers'
Mr Siew Fook Ming, Project Director at KLK Oleo presented the certificate and trophy to Chong Tze Haw & Hassan Abas, IOI Edible Oils.

Evening talks cum webinars

'MICRONES : a more efficient palm extraction method' by Prof Dr Robiah Yunus, UPM

'Introduction to oleochemicals' by Ir K S Qua of AOMG. Participants included 30 auditors from Certifying Bodies of RSPO from 14 countries

'Revolution X.0 in the Palm Oil Industry' by Ir K S Qua of POPSIG at UMS in Kota Kinabalu, Sabah.



'Integrated Anaerobic-Aerobic Bioreactor (IAAB) for Palm Oil Mill Effluent (POME)' by Prof Ir. Dr Denny K.S. Ng and Ir Prof Ir. Dr Chong Mei Fong of University of Nottingham Malaysia. The project was Highly Commended in the Biotechnology Award at the IChemE Global Awards 2018.

Regional Palm Oil Processing Seminar

2017 : 100 Years Palm Oil Industry Seminar – “Can Malaysia continue to be the global technology leader in processing its Golden Crop?”

Forum members discussing the theme.

2018 : 2nd RPOPS – “Value addition in the Downstream Palm Oil sector.”

Speakers and committee members

Field visits

1. Jomalina Refinery
2. Emery Oleochemicals
3. Ulu Kanchong Palm Oil Mill

Quarterly Newsletters

Bursaries & Award

- Financial assistance in a form of student bursaries to undergraduate and postgraduate students to attend scientific conferences, workshops or forums which are related to palm oil processing
- The main objectives of such assistance are to spur the students' motivation and support their research in palm oil processing
- The student bursaries contribute towards the registration, travel and accommodation costs to help make the palm oil processing conferences or events more accessible to the students.
- Each bursary is worth RM1000

- Each year, POPSIG awards Best Final Year Design Award to a group of final year students, whose final year project design revolves around palm oil processing
- The main objective of this award is to encourage the universities to introduce palm oil processing design for their final year students.
- The selection of Best Final Year Design Award is based upon a palm oil processing design which reflects on efficiency, values inherent safety and mitigates environmental impacts, and demonstrates project viability to the palm oil industry.
- The annual award is RM2000