IChemE ADVANCING CHEMICAL ENGINEERING WORLDWIDE

IChemE presentation

Introduction to Palm Oil Industry

Presenter name

Qua Kiat Seng CEng FIChemE

POPSIG

http://www.icheme.org/communities/countries/malaysia.aspx

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.

It is not limited to traditional areas of milling, refining or oleochemicals. It includes new areas such as nutraceuticals, biogas and energy, biomass, biofuels and bio-based chemicals.

Processing in the palm oil industry encompasses all the four key challenges in *Chemical Engineering Matters* viz energy, food & drink, health & well being and water. The approach to improving the quality of life through the use palm oil has to be done safely and sustainably

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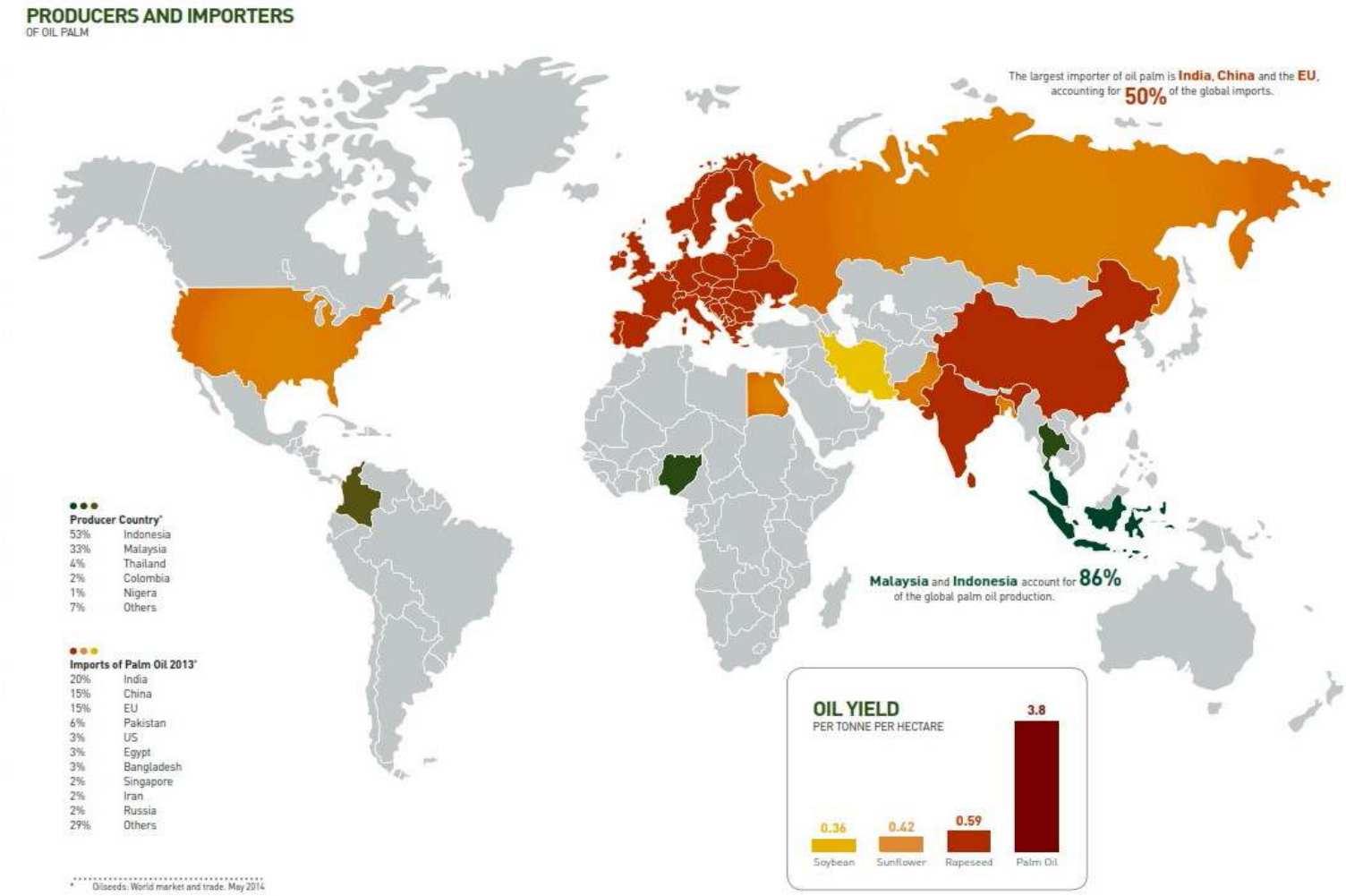
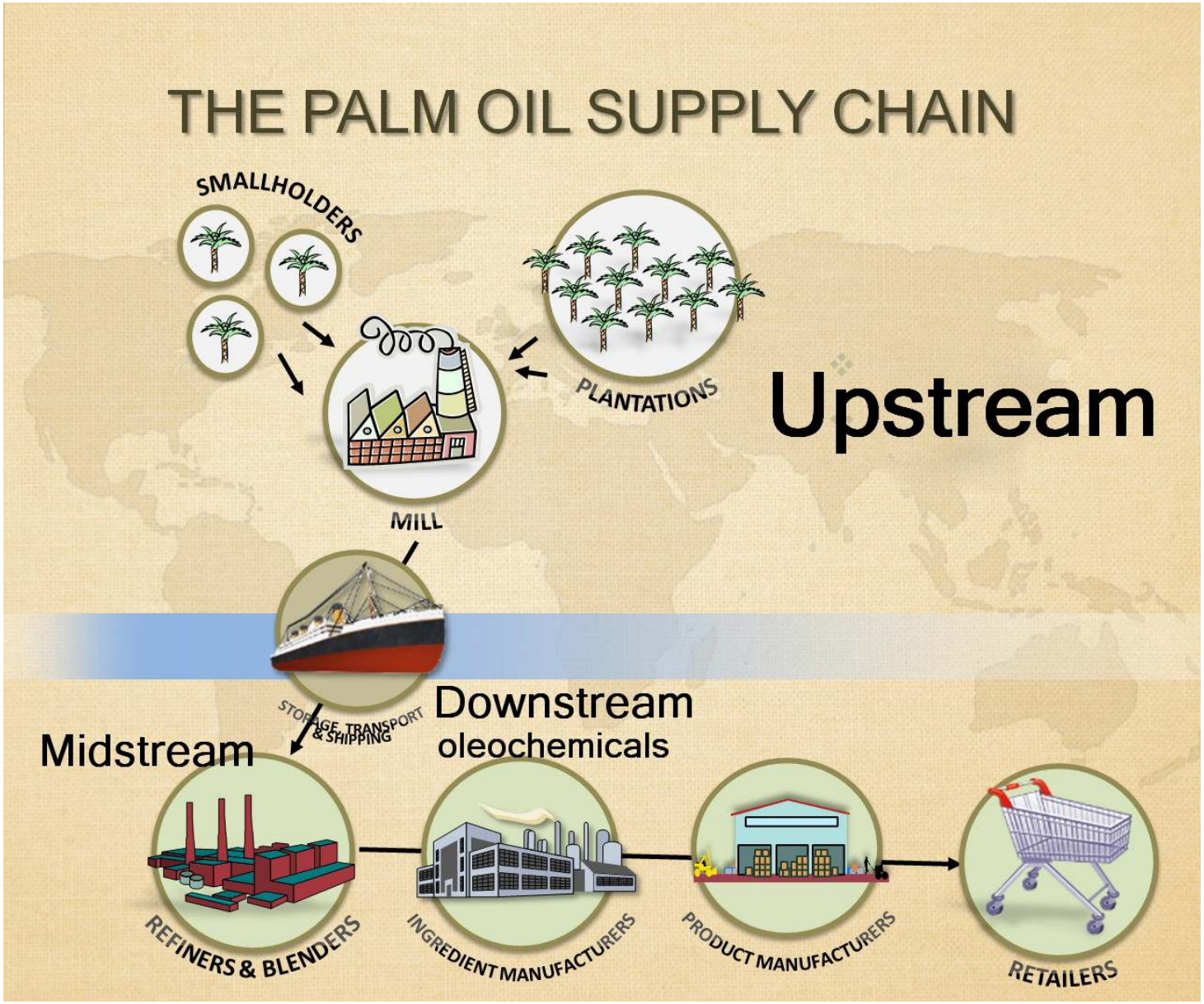
An Introduction to the Palm Oil Industry

By
Qua Kiat Seng CEng FIChemE
Committee Member
Palm Oil Processing Special Interest Group
IChemE in Malaysia

Palm Oil at a Glance





What will be covered

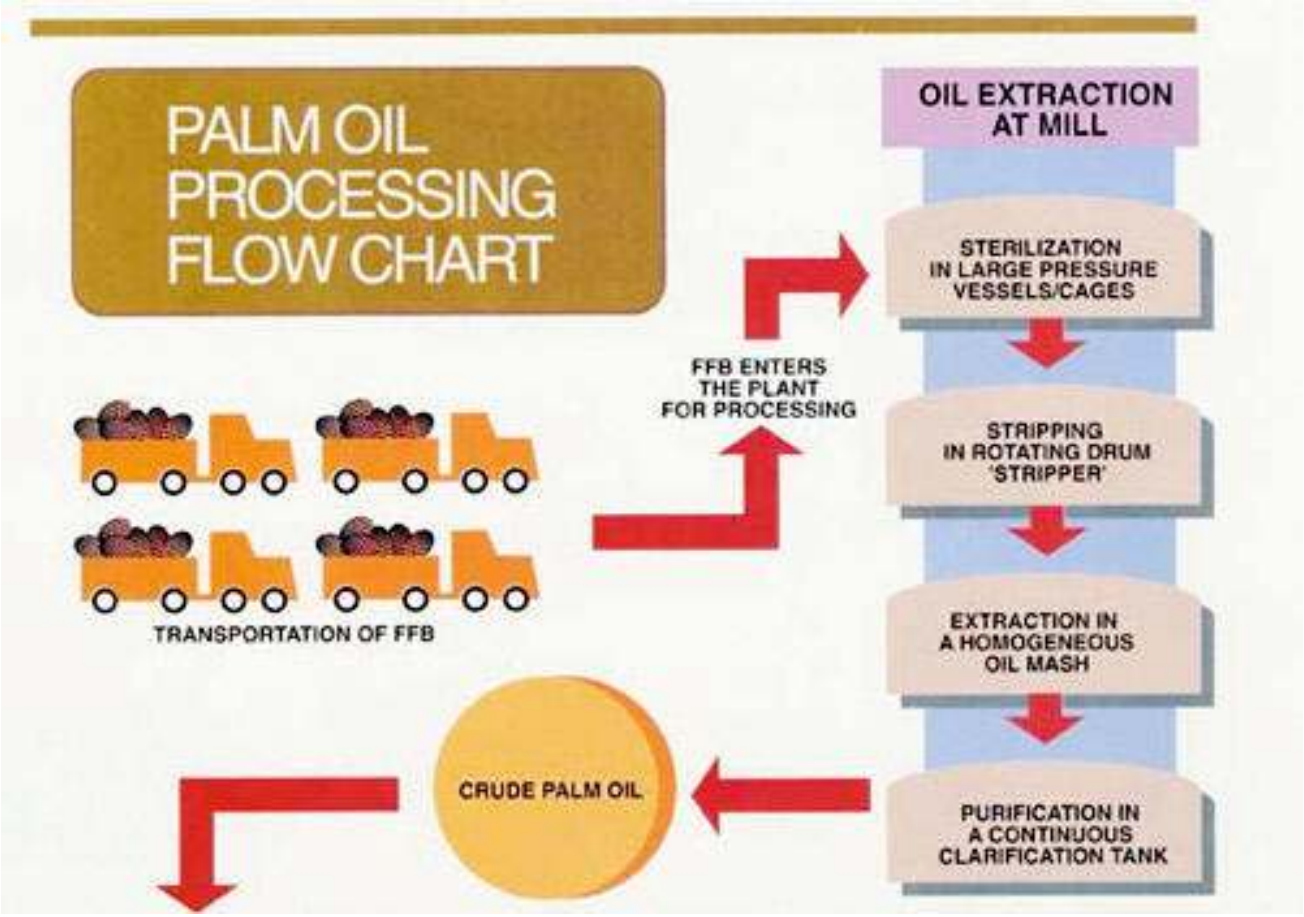
- The importance of palm oil
- Milling
- Refining
- Oleochemicals
- Bulking Installations
- Sources of information
- NKEA and the 8 EPPs in Malaysia
- The role of a chemical engineer
- The players

Some Key Numbers 2015 for Malaysia

- 5 million hectares of land (13% of land mass)
- 20 million tonnes of palm oil & 2 million tonnes of palm kernel oil
- 11% of world's oil & fat production
- 32% of world's export trade of oils & fats
- Export revenue RM 40 billion (5%, #5)
- 600,000 people employed directly

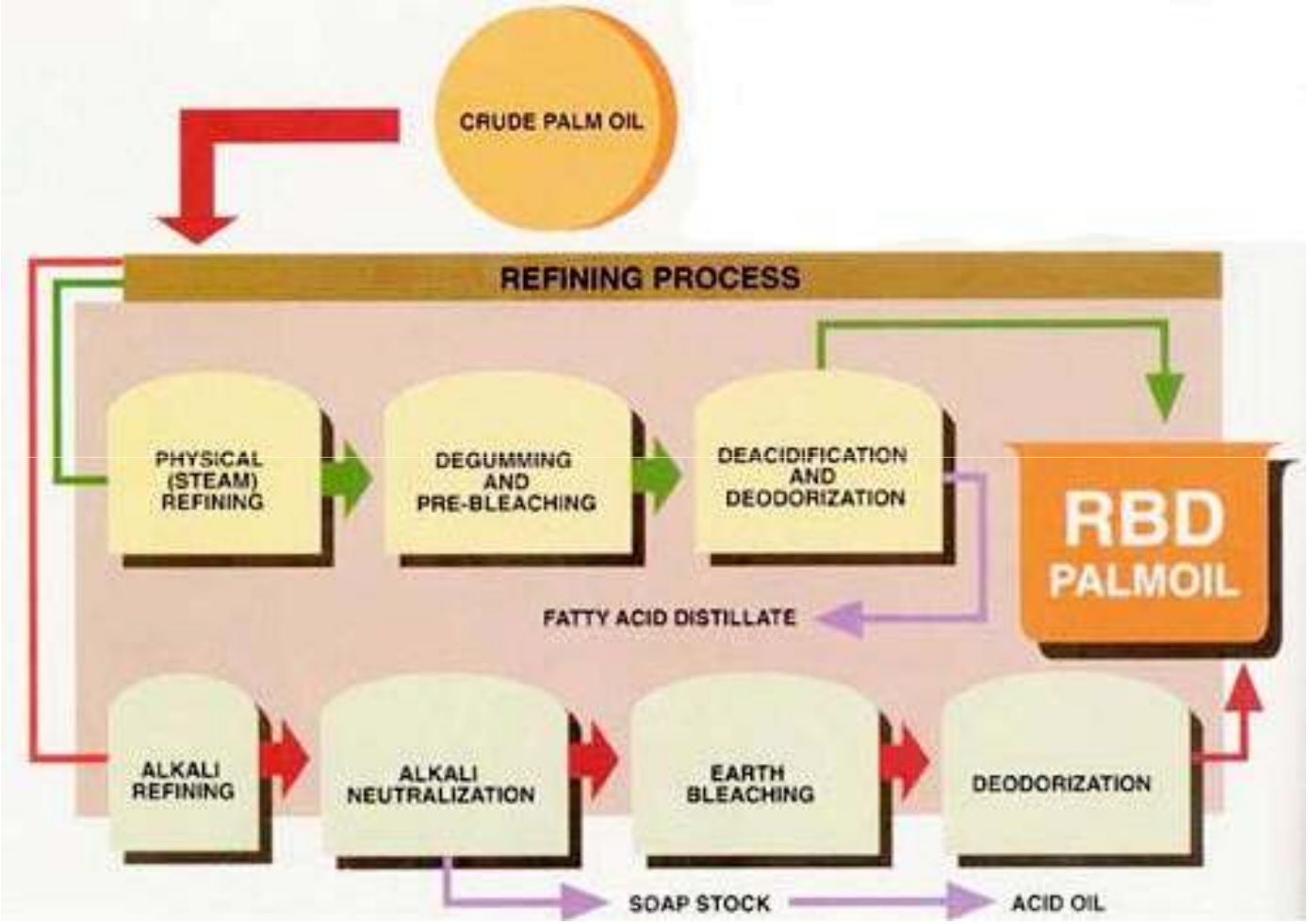
Palm Oil Plantation

Flow Chart – Oil Extraction



Palm Oil Mill

Flowchart - Refining



Palm Oil Refinery

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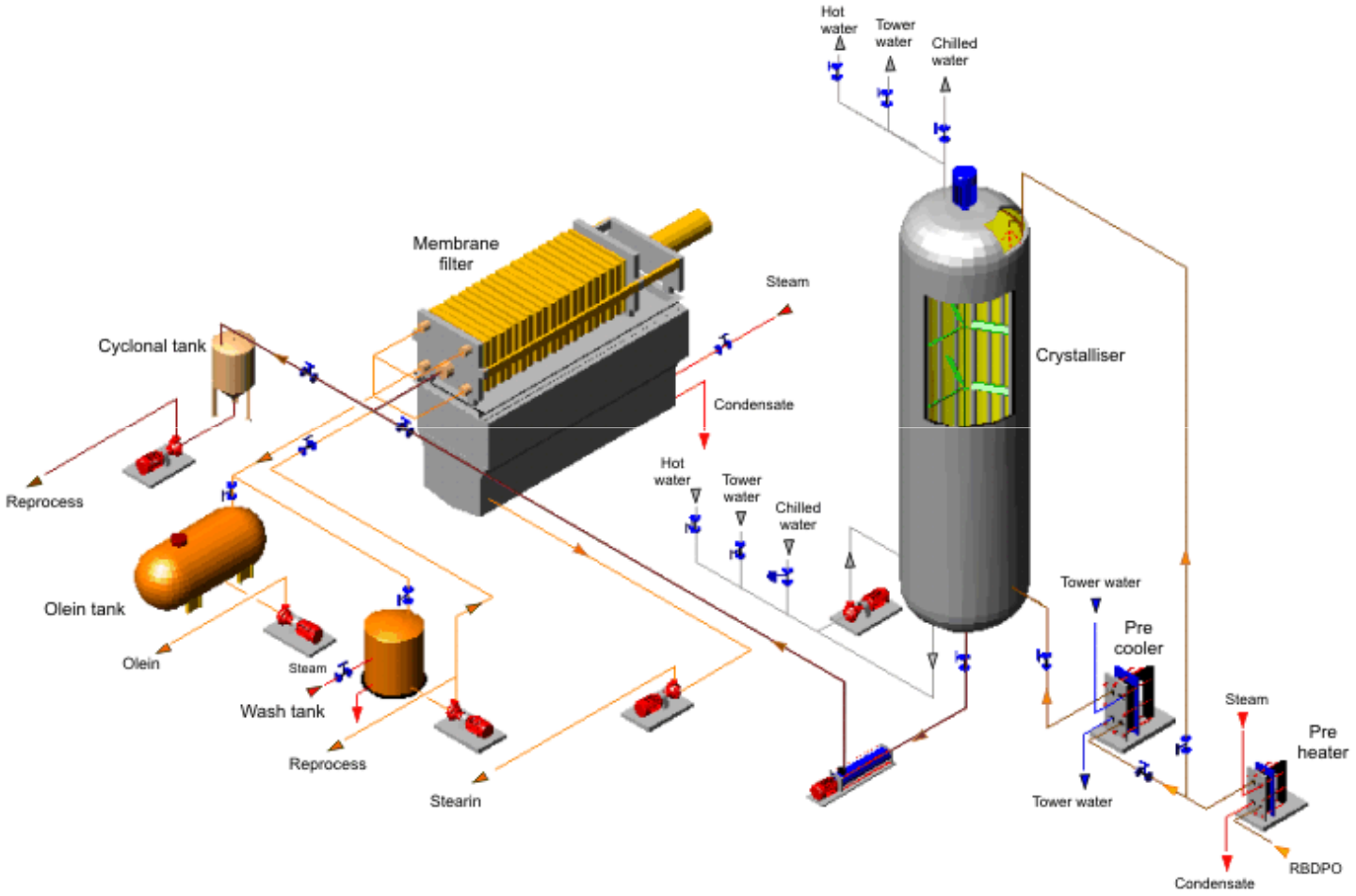
Palm Oil Fractionation



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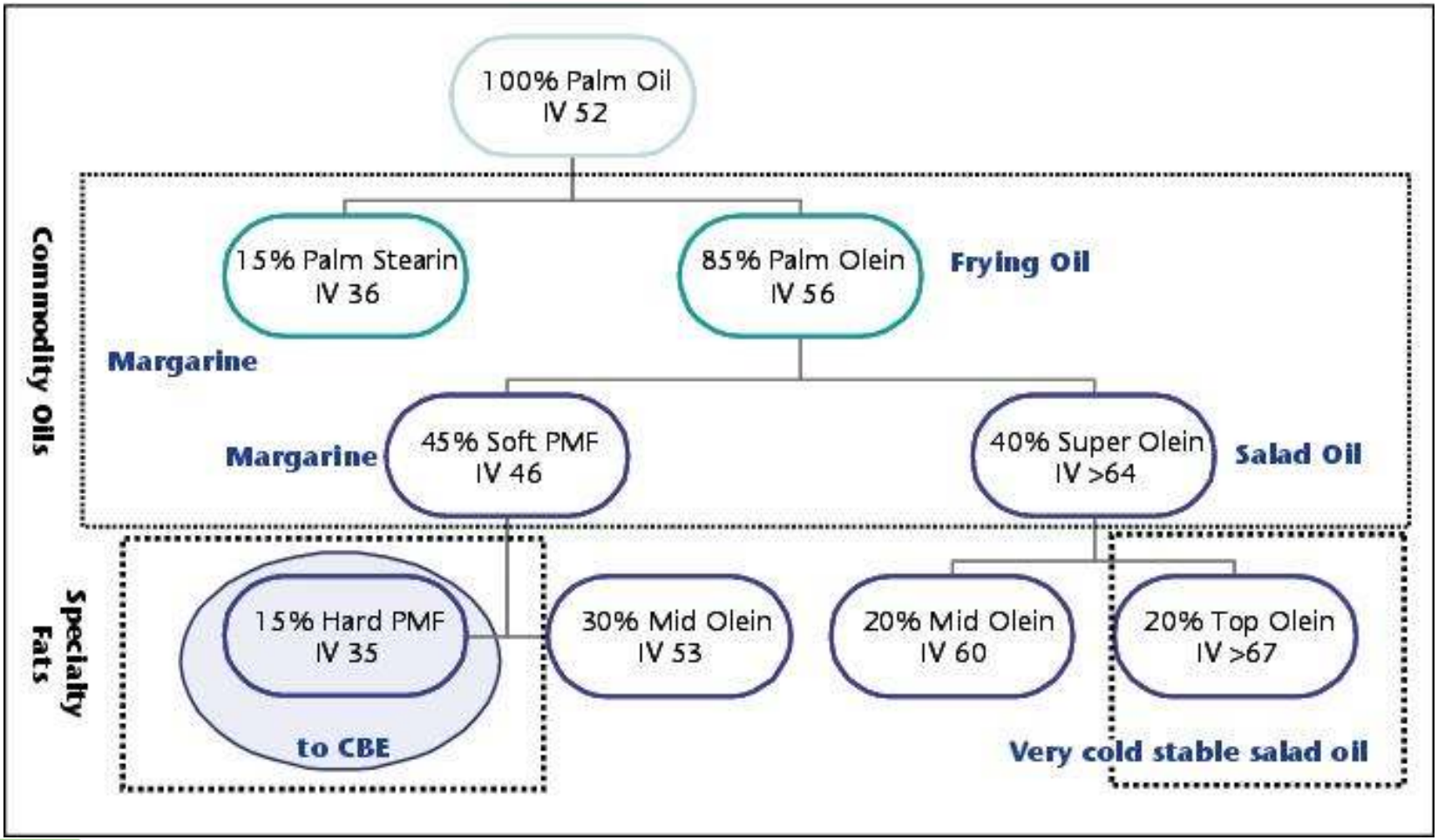
Fractionated Palm Oil Products

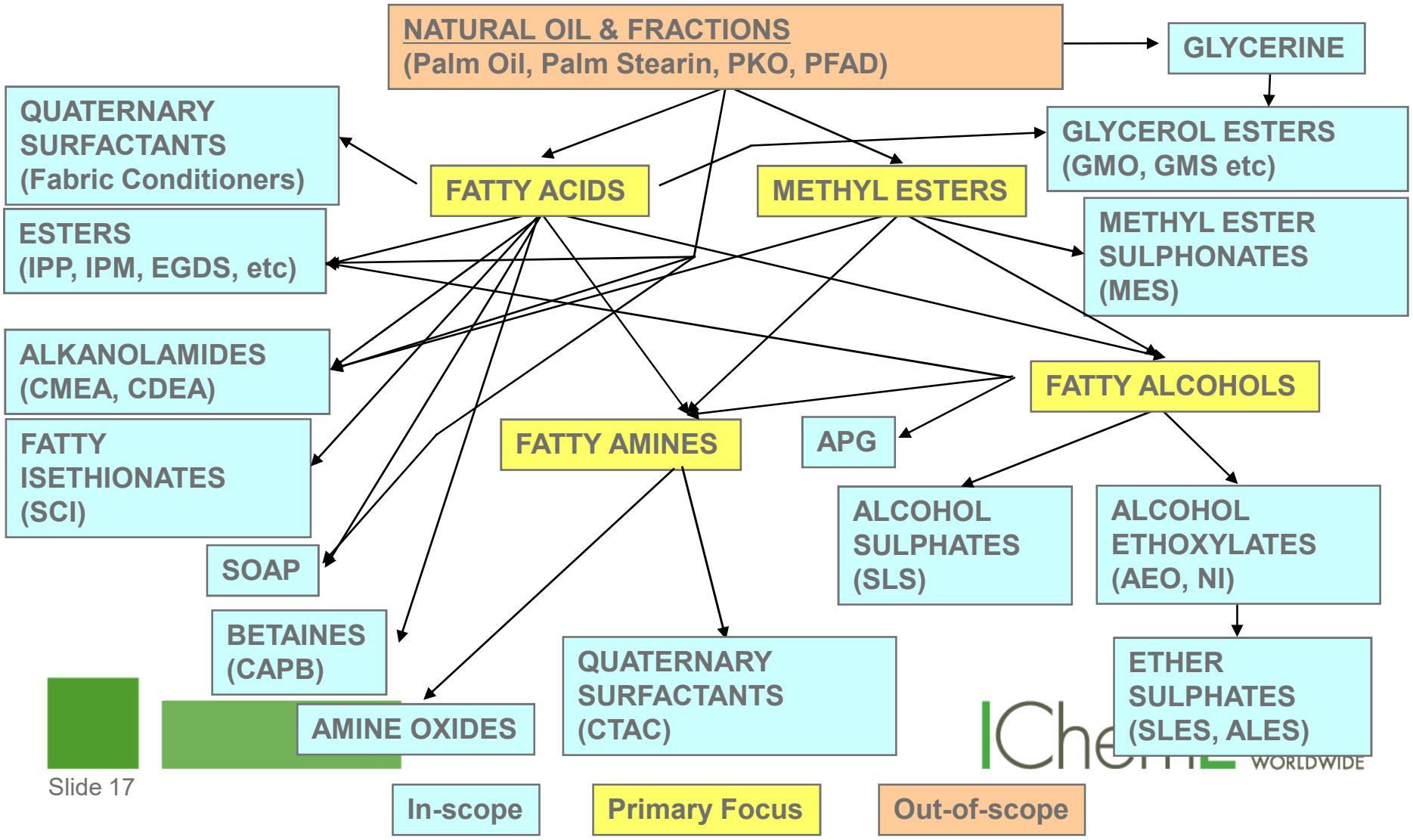


Activity 1 – 2 minutes

Enter into the question section
some edible products
made from palm oil.

Edible Palm Oil Products

Palm Oil Derivatives Flowchart



Fatty Acids & Fatty Alcohol Plants

Activity 2 – 2 minutes

Enter into the question section

some end consumer products containing oleochemicals and their derivatives

Derivatives Consumer Products

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

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Bulking Installations – Key for Exports

Important Organisations

Name	Full name
MPOA	Malaysian Palm Oil Association (Growers)
MPOB	Malaysian Palm Oil Board (Licensing/R&D)
MPOC	Malaysian Palm Oil Council (Promotion)
PORAM	Palm Oil Refiners Association of Malaysia
AOMG	ASEAN Oleochemical Manufacturers Group
MEOMA	Malaysian Edible Oil Manufacturers Association
MBA	Malaysian Biodiesel Association
RSPO	Roundtable on Sustainable Palm Oil

Read

The Chemical Engineer

IChemE

A Bunch of Challenges

What can chemical engineers do to boost the efficiency of palm oil milling?

HONG WAI ONN
CHAIR, ICHEME PALM OIL PROCESSING SPECIAL INTEREST GROUP

THE use of palm oil is expected to double by 2020, as the world's population increases, and efforts to deploy renewable alternative energy sources escalate.

While palm oil is produced via a pretty straightforward route (*see Figure 1*), there are many areas within the milling stage that could be further improved, especially by chemical engineers. In this article we'll take a look at some of the important process control challenges for palm oil milling.

Palm oil is an edible vegetable oil, derived from the fruit of the oil palm tree. It is a common ingredient in a wide variety of products, ranging from biscuits, bread, chocolates, ice creams and noodles to shampoo, lipsticks, candles, and detergents. In 2015, there was about 60m t of palm oil produced globally. It has been estimated that around half of all packaged items found in supermarkets contain it. On top of that, palm oil is also used as biofuel and biogas that can offer great potential as an alternative source of energy.

Chemical engineers are integral in palm oil milling, although not in huge numbers in comparison to other disciplines. The objective of milling is to extract the maximum amount of palm oil and kernel from the fruit at minimum cost. Like chemical engineers in other industries, we rely on our knowledge of mathematics and science, particularly chemistry and physics to maximise extraction or recovery rates as well as overcome technical problems safely and economically.

STERILISATION

Sterilisation is one of the key processes in palm oil milling. It involves detaching fruits from the bunch, deactivating the enzyme responsible for quality deterioration, and pre-conditioning the fruit for further processing. The most commonly-used process involves heating the fruits in a steriliser (an enclosed vessel) to a temperature of about 143°C. This temperature will be obtained when the pressure gauge shows 3 barg – but only if the steriliser contains just saturated steam, with no air present. Inadequate or incorrect sterilisation will undoubtedly adversely affect the efficiency of the down-stream process. From my experience of seeing mills operating, a common problem is engineers paying attention to pressure

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NKEA in Malaysia

National Key Economic Areas (NKEA)

2) Palm oil and related products

EPP in Malaysia

Entry Point Project (EPP)
Upstream productivity

- EPP 4: Increasing the oil extraction rate; and
- EPP 5: Developing biogas at palm oil mills.

Downstream expansion and sustainability

- EPP 6: Developing oleo derivatives;
- EPP 7: Commercialising second generation biofuels; and
- EPP 8: Expediting growth in food- and health-based downstream segments.

List of companies under EPP 6 Q1 2014

List of companies/projects under EPP 6 (Commercialisation)

EPP 6 Product commercialisation projects

Companies/Projects – Products	Total investment	Total grant committed*
ICM Specialty – Surfactant & Glycerol Derivatives	134.40	19.01
IOI Esterchem – Glycerol Derivatives and Bio-lubricants	130.00	43.60
KLK – Palm Oleo Klang – Specialty Esters	16.40	5.25
KLK – Oleomas – Fatty Alcohols/Acids & MES Integrated Complex	480.10	107.90
Ancom – MSMA Herbicides Manufacturing Plant Expansion	9.77	0.09
Emery P1 – Plastic Additives and Bio-Lubricants	136.50	7.72
Emery P2 – Surfactant (Specialty Esters)	86.7	11.20
Emery P3 – Surfactant (Sulphates)	187.52	12.80
Emery P4 – Expansion of ME Fractionation & Tank Farms	69.89	3.89
Carotino – Expansion of MCT Plant	10.00	0.80
Unioleon – Oleo Derivatives for Food Application	91.85	11.21
Company A – Production of Methyl Ester, Glycerine, and crude Carotene	100.00	1.10
Company B – Short Path Distillation Extension for Glycerol Derivatives	17.00	5.59

Source: PEMANDU

Chemical Engineering Matters

The role of chemical engineers

in the palm oil industry

and society

Chemical Engineering Matters

Chemical Engineering Matters

A review of IChemE's technical strategy

IChemE

http://www.icheme.org/media_centre/technical_strategy/chemical%20engineering%20matters.aspx

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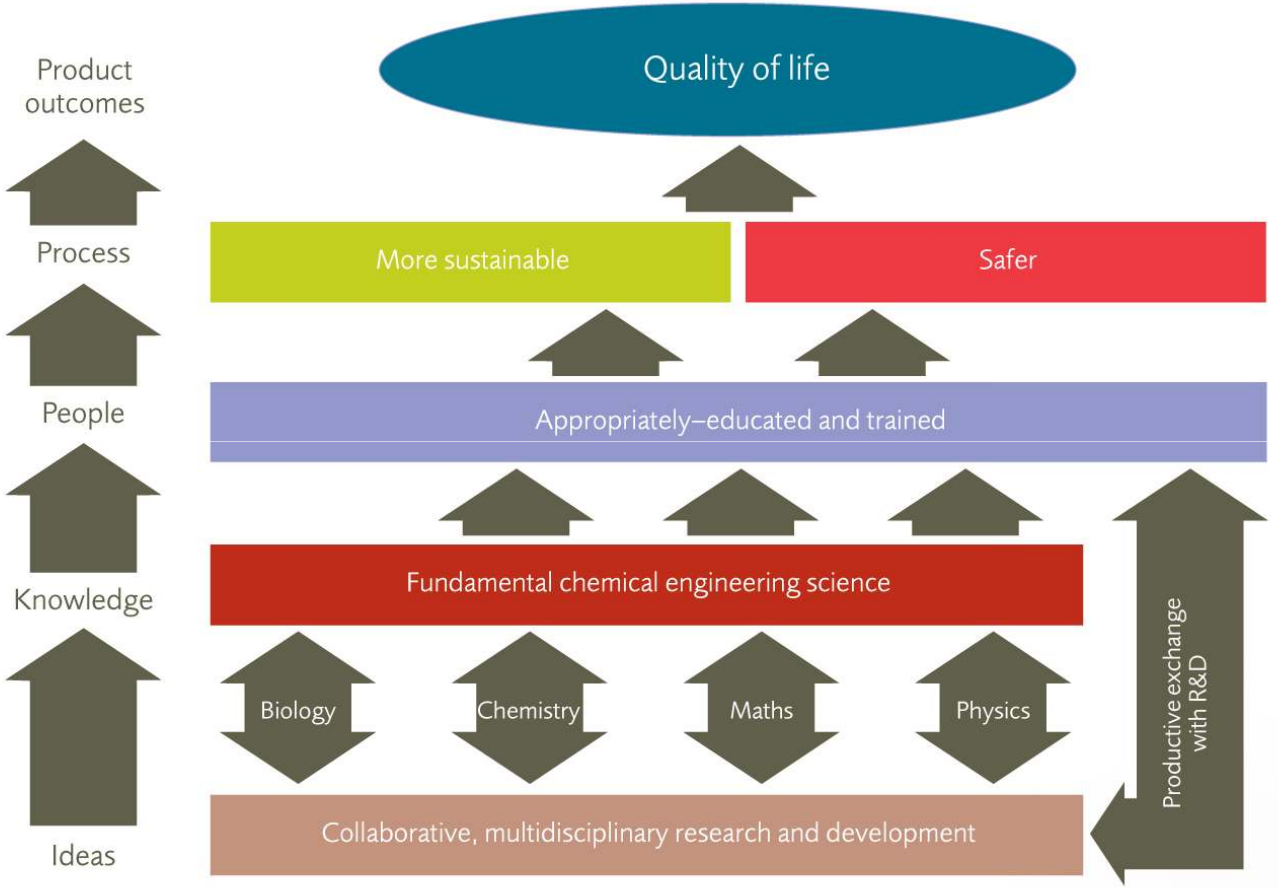
The Role of a Chemical Engineer



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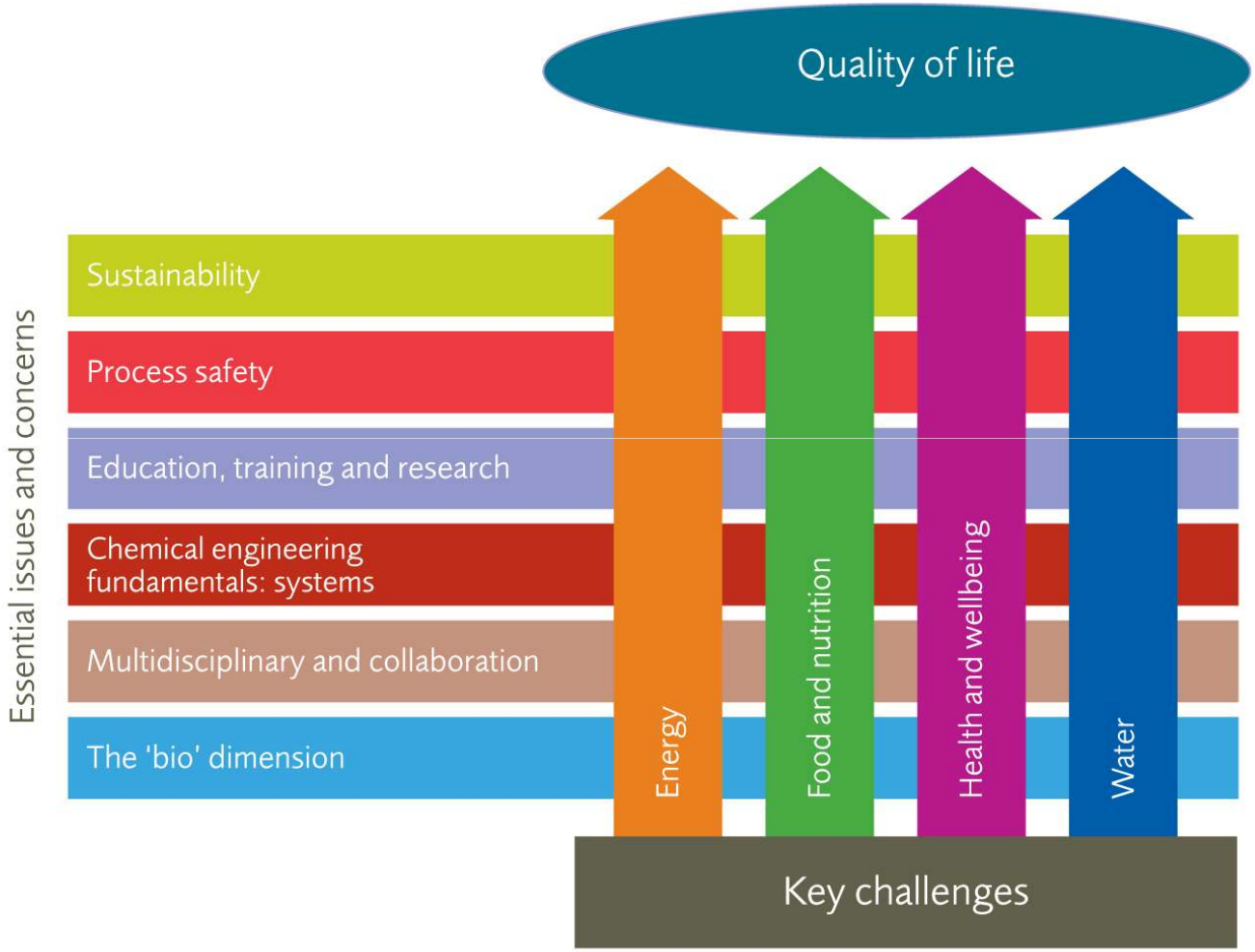
The Role of a Chemical Engineer



The Role of a Chemical Engineer

Competence

- Application of knowledge
- Wider implications
- Transferable skills

A. Application of Knowledge

Item	Examples
Process technologies	Distillation, crystallisation, filtration
Safety systems	Management of change, Hazop
Laws of conservation	Multiple effect evaporation
Mathematical modeling	Spray crystallisation, catalysed reactions
Underlying chemistry	Hydrolysis, esterification, hydrogenation
Systems analysis	Trouble shooting, control of processes
Chemical thermodynamics	Increasing splitting degree in a hydrolyzer
Economic evaluation	Plant debottlenecking, cost savings

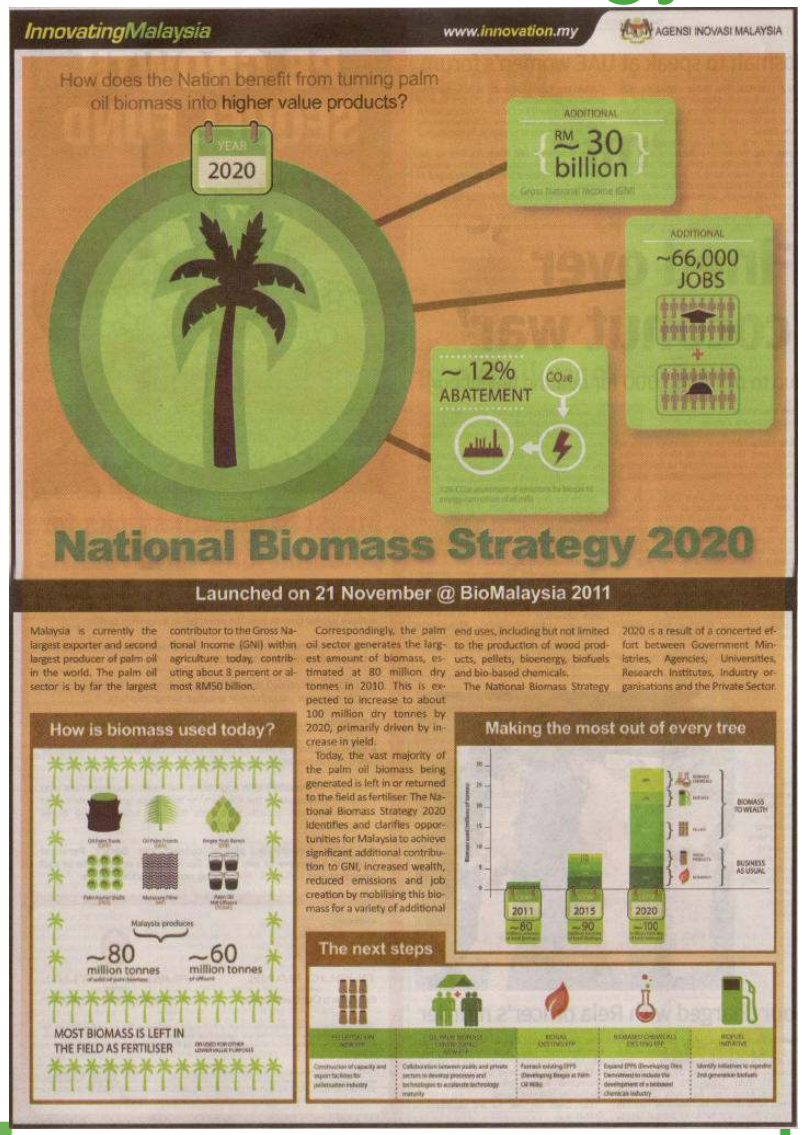
A. Technical Areas

Process plant operation	Legislation, regulation
Computer application	Development of products, services
Project management, administration	Teaching, managing, training
Instrumentation & control	Quality & assurance
Technical / economic evaluation	R&D
Economic accountancy, cost estimation	Technical sales, marketing, contracts
Health, safety, risk aspects	Design of process, plant & equipment
Sustainability & environmental aspects	

B. Wider Implications

Item	Examples
Health, hazard and safety aspects	Opportunity to improve process safety
	Registration, **E**valuation, **A**uthorisation and Restriction of **Ch**emical substances (EU)
Sustainability aspects	Clean Development Mechanism (POME) & National Biomass Strategy 2020
	Roundtable on Sustainable Palm Oil (**RSPO**)
Commercial and economic aspects	Fluctuating palm oil & palm kernel prices
	NKEA : Palm Oil as a Growth Engine in the Tenth Malaysia Plan (2011-2021)

National Biomass Strategy



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Palm oil can power the world

14 INSIGHT Star2, TUESDAY 1 MAY 2012

The palm oil sector can produce more energy than what most countries need.

Powering the world

By LIZ LEE
star2@thestar.com.my

WHEN we talk about sustainable energy, we think about fire, wind, water and sunlight which usually translate into biomass combustion, wind turbines, dams and solar farms.

The idea of having oil palm biomass joining the race for sustainable energy is almost unheard of. But it truly harbours potential to supply energy to the world.

As pointed out in consultant Dr Ian Halsall's paper published in the Malaysian Palm Oil Council (MPOC) *Journal of Oil Palm and the Environment*, if all the world's oil palm byproducts were used as fuel, the annual energy supply would exceed most countries' requirements.

As an estimate of the potential oil palm has in the sustainable energy arena, the whole industry can produce up to 7.31 exajoules of energy per year, which is more than what most countries require.

Currently, only countries like the United States, China, Russia, Japan and India use more than 7.31 exajoules. For 101 other countries, this figure exceeds the national requirement on a individual country basis, potentially covering the needs of several smaller countries at one go.

In Halsall's paper, he explains how oil palm biomass can supply more than the world's need for energy.

"If all the palm oil produced were combusted as fuel, then that would produce 1.64 exajoules of energy per year. On top of that, there is the palm oil industry's biomass byproducts which, if combusted, would give an extra 5.67 exajoules, bringing the total to 7.31 exajoules annually," he writes.

Halsall says there is no fixed figure to illustrate how much energy a country consumes as the need is relative to what society wants.

"This is a big and complex issue. Here we're looking at basic questions such as how big do we need our cars to be, how many cars do we need or how big do we need our house to be? It all depends on how much of a high-consumption lifestyle people want," he says.

"Presently, energy consumption in the West is very high, and developing countries such as Malaysia want the same."

The annual production of the worldwide palm oil industry is sizable, some 42 million tonnes as of 2009 with most of that going into the retail market as consumables, soaps and cosmetics.

However, the sheer size of the industry is not the only resounding reason for oil palm to be a contender in the energy arena.

In the realm of fuels, palm (oil) is renewable – unlike coal, oil and natural gas – and will continue as long as crops are planted and harvested.

From biomass to biofuel

The quantities of non-oil palm biomass such as palm lumber, fronds and fruit bunches after processing, equal around 3.5 times the energy value of palm oil alone.

At the moment, palm biomass is an inevitable by-product from plantations which have only a limited use in animal feed. This by-product make up 85% non-oil biomass and could be salvaged to create fuel, commonly referred to as biodiesel.

Palm biodiesel holds great potential as an alternative fuel source. On the local front, there are already initiatives to develop the palm biodiesel industry.

MPOC chief executive officer Tan Sri Dr Yusof Basiron says: "It has been tested through many years of research carried out by the Malaysian Palm Oil Board and is currently used in Malaysia's B5 programme.

"Here (in the programme), instead of using 100% fossil fuel, the fuel mix consists of 5% palm oil biodiesel and 95% fossil fuel and the biodiesel is also sold to the United States and European Union (EU) as biofuel," he says.

Yusof adds that palm biodiesel can be used in all climates in temperate countries as the oil has a low pour point.

It has also been tested and used successfully as an aviation fuel on a Jumbo Jet in 2008.

Halsall notes in his paper that diesel engine cars worldwide run on biodiesel and MPOB has shown that running them on palm oil works just fine. He adds that palm biodiesel can be used in lorries, buses, trains, ships, power stations and domestic heating in homes.

Palm as a biofuel is still at its infancy and makes up a small part of palm's use currently. Most of its potential applications in the world are limited not by science and technology but by political and social will.

"Demand for palm oil can be increased if markets such as the EU and US do not implement trade barriers or protectionist measures to keep out palm biodiesel which is a more viable and cheaper option for consumers," Yusof says.

"Scientific studies carried out by independent scientists, consultants and MPOB reveal that the greenhouse gas savings of palm biodiesel exceed the threshold values set by these countries by a marked degree, although the EU and US has ruled otherwise."

He adds that low numbers have been accorded to palm biodiesel without scientific basis and that Malaysia and Indonesia are keen on addressing this issue which distorts free trade among nations and contravenes the principles of the World Trade Organisation.

"The demand for palm biodiesel can certainly be increased in the EU and US where renewable energy programmes are already in place. It's a question of whether palm biodiesel can be allowed into these markets thereby providing cheaper and more viable options to manufacturers and end-users," he says.

Part of the cycle

Another plus point palm has compared to fossil fuels is that it is part of the carbon cycle, capable of achieving carbon neutrality where all the carbon dioxide (CO2) produced by the combustion of palm oil or its biomass is absorbed by productive palm trees.

Halsall writes that although it is debatable how close palm is to carbon neutrality, the amount of carbon dioxide produced and absorbed in the industry are comparable.

He says oil palm's carbon neutrality remains a big debate but if the right efforts are taken, the industry can well be near carbon neutral.

"With the amount of methane coming from palm oil mill effluent, the carbon footprint of fertilisers and pesticides, the fossil fuel used in the processing and distribution of palm oil, the industry is far from carbon neutral just now in my estimate.

major supplier: oil palm biomass can supply more than the world's need for energy, while oil palm by-products can be converted into biodiesel, as an alternative fuel source for vehicles.

If all the world's oil palm byproducts were used as fuel, the annual energy supply would exceed most countries requirements, says Halsall.

Palm biodiesel can be used in all climates in temperate countries as the oil has a low pour point, says MPOC's Yusof.

"But the good news is that the palm industry is well placed to be much closer to carbon neutral – if the will is there," he says.

Yusof says the official data has been published and submitted by the Natural Resource and Environment Minister on this matter, showing that oil palm is a carbon sink, locking up or removing more carbon from the atmosphere than it produces.

"Every five years, countries do a carbon accounting and submit a report to the United Nations Framework Convention on Climate Change (UNFCC). Malaysia's submission to UNFCC in January 2011 clearly shows that in 2000, Malaysian oil palm had a net removal of more than 80 million tonnes CO2 equivalent," he says.

Yusof explains that in 2000, Malaysia had 3.576 million hectares of oil palm plantations and the carbon removal capacity of this plantation crop was 82 million tonnes, while total emissions from the land use and land use change, and forestry and agricultural sector was 35.5 million tonnes CO2 equivalent.

"This implies that oil palm plantations can remove not only their own emissions generated from deforestation and methane emission from processing of effluent ponds at the palm oil mills, but also the emissions from all land use change and agricultural activities of the country," he says.

While there is much to be researched on, developed, and lobbied to put palm oil further on the main stage of fuels, it has undeniably the opportunity given its plus factors.

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Waste is profit

8 SPECIAL FOCUS

Profits from oil palm waste

All Cosmos uses bio-technology to improve fertiliser quality

By WONG WEI-SHEN

THE recycled biomass industry is one that is growing at an ever-increasing pace throughout the world. In Malaysia, awareness of using recycled biomass products to be more eco-friendly is on the rise.

All Cosmos Industries Sdn Bhd, a pioneer in bio-organic fertilisers, is a 100% subsidiary of All Cosmos Bio-Tech. All Cosmos is a Malaysian manufacturer and marketer of high-grade bio-organic and bio-chemical fertilisers. They strive to be the innovative driving force in the bio-technology industry whilst helping to improve the country's ecological status.

"This industry will continue to grow as environmental awareness increases," says All Cosmos Industries senior regional and marketing manager Alex Tan. The need for recycled biomass in the oil palm industry is also great, he adds, due to the Ganoderma Basil Stem Rot disease which affects mature palms and causes the internal tissues surrounding the base of the oil palm trees to rot. By using fertilisers produced with recycled biomass with the addition of good bacteria, the disease can be prevented.

The company believes that using a mixture of organic material, inorganic material and effective micro-organisms can increase the quality of fertiliser. The organic materials used are the biomass waste from cocoa, coffee, oil palm and paddy plantations. The inorganic materials used are chemicals such as urea, ammonia sulphate, rock phosphate, muriate of potassium amongst others. Examples of effective micro-organisms that are used are Rhizobium trifolii, Azotobacter vinelandii, Herdersonia, and Trichoderma.

Most chemicals are water-soluble. When inorganic fertilisers are used on oil palm plantations, especially during monsoon season, the trees will be less likely to absorb the nutrients as the rain will wash them away. This causes a major problem for the ecosystem, as the chemicals leak into the water supply through the soil.

Tan says the effective micro-organisms assist by helping the soil polymers and soften it. It also prevents diseases and contributes to the environment by making the chemical portion of the fertiliser and the soil's heavy metal content harmless. Also, by including microorganisms in the fertiliser, it will reduce the amount of chemicals needed.

The ideology of the company actually started when group chairman and chief executive officer Datuk Tony Peng Shih Hao came to Malaysia from Taiwan. He was impressed with Malaysian cuisine and also with fruits such as jambu air. The fruit in Taiwan was a lot larger than the ones he found here.

He found that Malaysian plantations were more geared towards using genetically modified seedlings and he felt that they failed to look at the bigger picture. Peng foresaw the potential of the agricultural industry in Malaysia due to the shortage of technology and investors to sustain the industry.

The idea of adding effective micro-organisms to fertiliser came from Taiwan. Combining this factor with the agriculture opportunities in this country, Peng believed that plantations here could see a much better growth and quality of their produce.

To produce the fertiliser, first, the plant-based organic raw materials are put through a fermentation process with the addition of effective microorganisms. The fermentation process usually takes one to two years. However, with the use of effective micro-organisms, the process is complete in only a month.

Next, the fermented product and chemical raw materials (urea ammonia sulphate, rock phosphate, potassium, magnesium, boron and other trace elements) are put through a machine. The first level of the machine is an infrared ray separation machine that separates nitrogen, phosphorus, potassium, magnesium and other chemicals based on the ratio required with a computer prescription.

Then, it is put through another progress that grinds the product and fries it. Then, it is pelletised and put through a few temperature-controlled procedures. First, the pellets are exposed to temperatures up to 100°C to eliminate all unwanted bacteria. Good bacteria are then sprayed onto the pellets.

Then, the pellets are immediately frozen to keep the bacteria in a dormant state. After that, the pellets are packaged with a manufacturing by-date of 24 months. Finally, the pellets are put through strict quality control "measures" before being released for distribution.

The challenge that recycled biomass companies face is that more and more plantations are recycling their own organic waste to produce their own fertilisers. However, Tan says that the fertilisers that these plantations produce are incomplete as they do not contain the effective micro-organisms.

He says that without help from the effective micro-organisms, the oil palm trees are still susceptible to the Ganoderma disease.

All Cosmos procures the biomass waste from several suppliers such as Yayasan Pelajaran Johor for palm oil wilme, Delfi Cocoa (M) Sdn Bhd for cocoa waste and Super Coffeemix Manufacturing Ltd for coffee waste. It acquires paddy waste from Kelantan, Kedah and also Thailand. It has contracts with each of its suppliers to supply the biomass waste in bulk at a fixed price.

Over the past 10 years, prices of biomass waste have increased at least two-fold due to demand. Even so, All Cosmos stays competitive by buying in supply in contracts.

This means that it procures the biomass waste in bulk at a fixed price and for a fixed number of years. Its suppliers are chosen based on their capabilities to provide the supplies that are high in quality, and are able to provide the necessary quantity in good time. It does not risk procuring products that are inconsistent and inadequate.

The fertilisers it produces cater for oil palm, vegetables, fruits, flowers and rice plantations.

Besides catering for the Malaysian market, All Cosmos distributes their fertilisers to countries across the greater Asia-Pacific region such as Indonesia, Vietnam, China, Singapore, Taiwan, Myanmar, and the Philippines. It is currently in the midst of entering the Cambodia market.

Plantations it is currently working with include ICI Corp Bhd's plantation division Kuala Lumpur Kepong Bhd, Rimbunan Hijau Group, Sahaf Sutwoods Bhd, Felda, and Felcra on oil palm. All Cosmos also works with rubber plantations such as Lembaga Getah Malaysia and Risda.

The application of fertiliser is dependent on the type of crop, plant age, soil nutrient status, weather conditions and management practice.

The company is striving to create awareness of bio-organic fertilisers by promoting their products at events hosted by the Malaysian Palm Oil Board, International Society of Planters, Malaysian Agricultural Research and Development Institute and other plantation organisations. They also send consultants to plantations to educate planters on the effectiveness of the fertiliser and also how their produce can be improved.

In long-term objectives are to create a bigger impact economically by increasing the productivity of the work force, improving the efficiency in the use of farmland, and transforming the industrial structure into a knowledge-based economy.

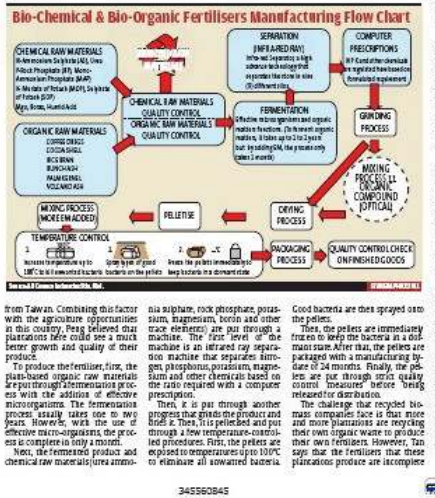
It hopes to reach ecological growth and to also be internationally competitive.

All Cosmos has high faith in narrowing the gap in living standards between urban and countryside folk.

The company was the first to combine chemical, and organic material and microbes into fertiliser. It was incorporated in 1999 and currently

SEE NEXT PAGE

Palm protection: The use of fertilisers made with recycled biomass with the addition of good bacteria can prevent ganoderma basil stem rot disease which attacks oil palm, says Tan.



FROM PREVIOUS PAGE

All Cosmos sets up second plant in Sabah

produces 20 different types of fertilisers that are distributed locally as well as for the larger Asia Pacific region.

A modern plant was built in Pasir Gudang, Johor, and completed in 2001 to meet increasing demands for its products. Construction for a second plant in Sabah has just started and completion is expected to be in September this year.

All Cosmos currently largely focuses on the oil palm sector as the volume and potential are higher. Between 2000 and 2011, the areas planted with oil palm trees in Malaysia increased from 3.38 million hectares to 5 million hectares.

Meanwhile, research on paddy, rubber and vegetables is currently in progress.

The company is currently working with Universiti Teknologi Malaysia to cultivate effective micro-organisms, as research has shown that home-grown microbes are more effective and efficient.

It is also currently working on producing a 4-in-1 formula that includes more added values in the fertiliser, depending on current and future needs.

Bags of fertiliser stored at the All Cosmos warehouse.

At the packaging department of All Cosmos' factory in Pasir Gudang, Johor, (pic left) the end product: fertiliser pellets.

Biomass products gain demand

They promote efficiency and are environmentally friendly

PREVIOUSLY, biomass was not a product that was sought after. In fact, companies used to pay third parties to assist in disposing it. However, in recent years as people and companies are getting more environmentally friendly, biomass products began to be high in demand.

All Cosmos Industries (ACI) group chairman and chief executive officer Datuk Tony Peng Shih Hao says: "Use of biomass helps to prolong the soil life for planting, and facilitates plants to grow stronger, resulting in them being more fruitful."

This is strategic for ACI as it fits into the country's policy of boosting biomass, lowering the risk of pollution and reducing costly dependence on chemical imports in the agriculture sector.

The use of biomass promotes the efficiency of effective microorganisms (EMs). EMs are used to positively influence decomposing organic matter to maintain sustainable practices such as farming.

"Biomass is used" by ACI by integrating it with chemicals to increase the pH levels of the soil and thus increase the efficiency of the nutrient intake by the crop," Peng says.

He adds that "biomass" also enhances the retention of chemical nutrients in the soil to improve soil quality.

On average, ACI consumes about 50,000 tonnes of biomass products, which ranges in price from hundreds of ringgit to the thousands per tonne. Sourcing of biomass products is carried out through sustained relationships, which usually have mutual benefits.

"By collaborating with one another, we reap the benefits of sustainable profits and livelihood for everyone," Peng says.

The agriculture sector has the potential to grow exponentially as the demand for food grows.

In terms of the company's expansion plans, Peng says: "We are confident of the role that we play in enhancing food production. Plantation-related activities are natural business areas for ACI to explore. Our vast experience and in-depth knowledge of the various aspects of plant growth, nutrition and diseases give us the advantage."

He adds that exposure to small, medium and large-scale plantations as well as varying crop types also provide ACI with the relevant expertise to further tap the agriculture sector.

Currently, the demand for ACI's fertiliser is largely in Indonesia and Vietnam. Both countries have excess land that can be used for planting. Peng says that as most countries in Asia are developing, the demand for food is also increasing.

Due to the insufficiency in food production, price and demand for many food staples have rapidly increased for reasons beyond just pop-

ulation growth.

The demand for fertiliser in Asia has grown especially since the global area planted for oil palm has grown eight-fold.

"Oil palm is 10 times more productive than soy beans. Over the past three decades, the price of palm oil in real terms have fallen by around 1% per annum, which represents a major improvement in food security for consuming countries," Peng says.

"Research and development are lifeline activities of a growing company. It is considered a top priority here at ACI. In fact, we are the first company to have applied EM technology in Malaysia," Peng says on the company's operational success.

He adds that the company believes that EMs play an important role in the promotion of green and environmentally friendly technologies that are being used in many advanced countries.

"We will endeavour to work with corporations locally and overseas to provide specialised technologies and formulas that meet their individual needs," he says.

The increasing rally by governments around the world to promote new and safe technologies supports the use of EMs.

Another attribute of the company's success is the ongoing marketing effort to secure the company's future. Despite hard times, when most companies move to cut spending, ACI continues to advertise both its existing and new products aggressively.

"Visionary and opportunity grabbing is part of the operational success of the company," Peng says.

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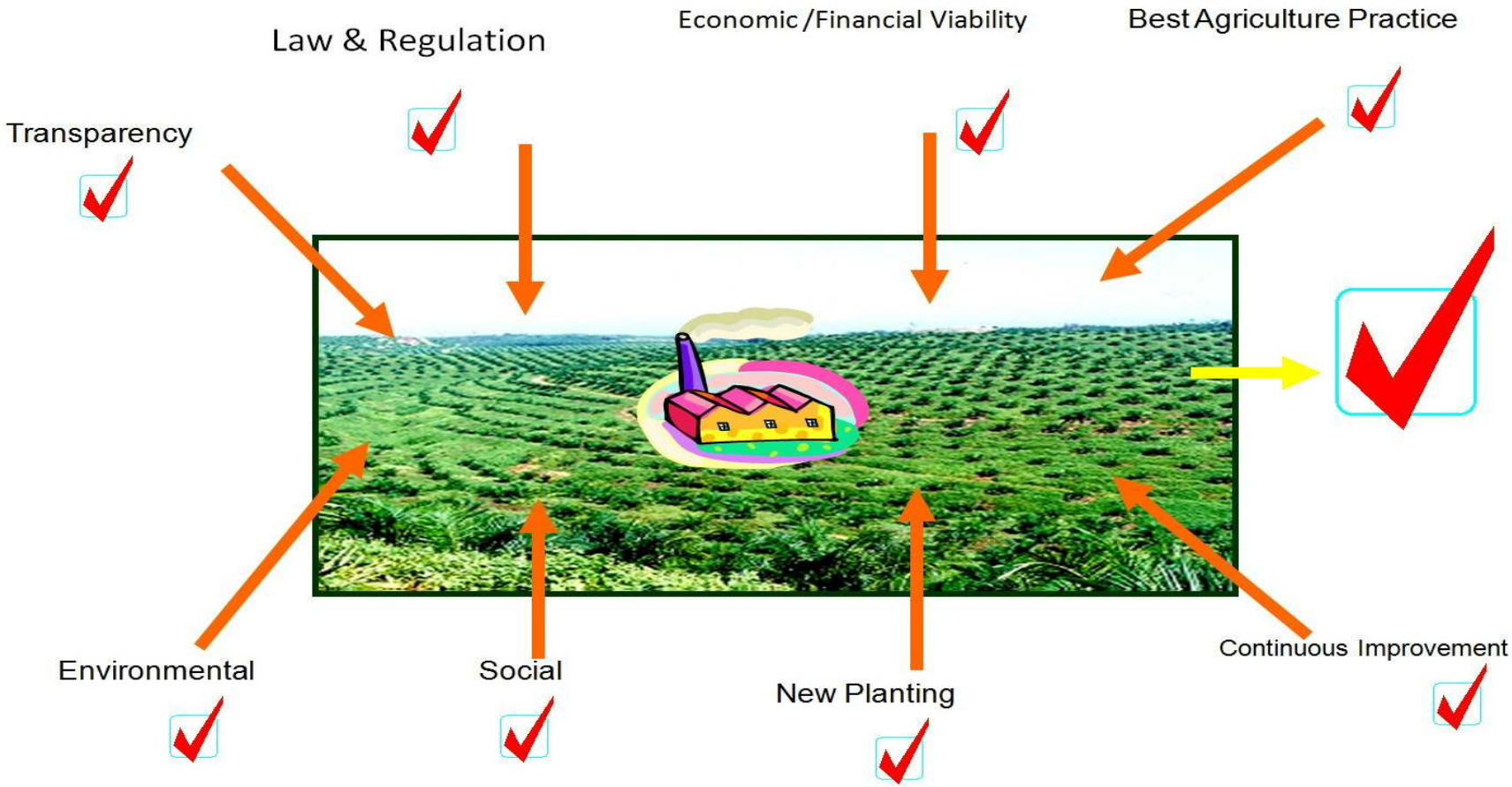
B. Wider Implications

Item	Examples
Health, hazard and safety aspects	Opportunity to improve process safety
	Registration, **E**valuation, **A**uthorisation and Restriction of **Ch**emical substances (EU)
Sustainability aspects	Clean Development Mechanism (POME) & National Biomass Strategy 2020
	Roundtable on Sustainable Palm Oil (**RSPO**)
Commercial and economic aspects	Fluctuating palm oil & palm kernel prices
	NKEA : Palm Oil as a Growth Engine in the Tenth Malaysia Plan (2011-2021)

RSPO

Roundtable on Sustainable Palm Oil

RSPO P & C
8 principles, 39 criteria, 125 indicators



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Palm oil for well being (tocotrienols)

Tocotrienols, the lesser-known siblings of the vitamin E family, are fast emerging as a superior addition to the prevalent and more popularly used tocopherols. Together, they provide a full range of antioxidant properties that are vital for good health.

A rising star

Not all equal

Looking to the future

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C. Transferable Skills

Item	Examples
Managing relationships	Developing supporting staff with low level of formal education
Leadership in a professional role	Lead peers from different backgrounds in project
Communicating ideas formally	Applying to be a Chartered Chemical Engineer

The Role of a Chemical Engineer

Commitment D & E

Item	Example
D. Commitment to profession	Be active in IChemE & your trade/technical association
E. Continuing professional development.	Do regular gap analysis

Typical Numbers 2015

Item	Mill	Refinery	Oleochemical Plant
Investment RM million	55	85	125
Capacity t/day	500	1000	400
No of employees	50	100	180
No of chemical engineers	0.5	2	10

Activity 3 – 2 minutes

Enter into the question section
some key players in the palm oil industry

- Suppliers
- Manufacturers
- Customers

The Players

Suppliers		Manufacturers		Customers	
Item	Company	Item	Company	Item	Company
Caustic Soda	CCM	Mill	Sime Darby	Soap noodles	J & J
Plant	Desmet Ballestra	Refinery	Cargill	Edible Oils	Unilever
Methanol	Petronas	Fatty Acids	IOI Oleo	Edible Oils	Kraft Heinz
Boiler	MechMar	Fatty Alcohol	Emery Oleo	Fatty Acids	P & G
Mill	CB Ind Prod	Esters	Nat Oleo	Fatty Alcohol	BASF
Hydrogen	Linde	Biodiesel	Carotino	Esters	L'Oreal
Biogas plant	Kubota	Biorefinery	Genting	Biodiesel	Shell

Conclusion

- You will have the education and the skills
- Go and apply them in the workplace
- Join the palm oil industry and be a leader
- Set your sights now on being a Chartered Chemical Engineer

Good Luck!