July-December 2021

COP26

Net Zero • Mechanisation

POPSIG

A palm oil newsletter brought to you by:

IChemE Palm Oil Processing Special Interest Group

IChemE

Palm Oil Processing
Special Interest Group

Correcting the misperception on palm oil

WHAT'S IN THIS ISSUE

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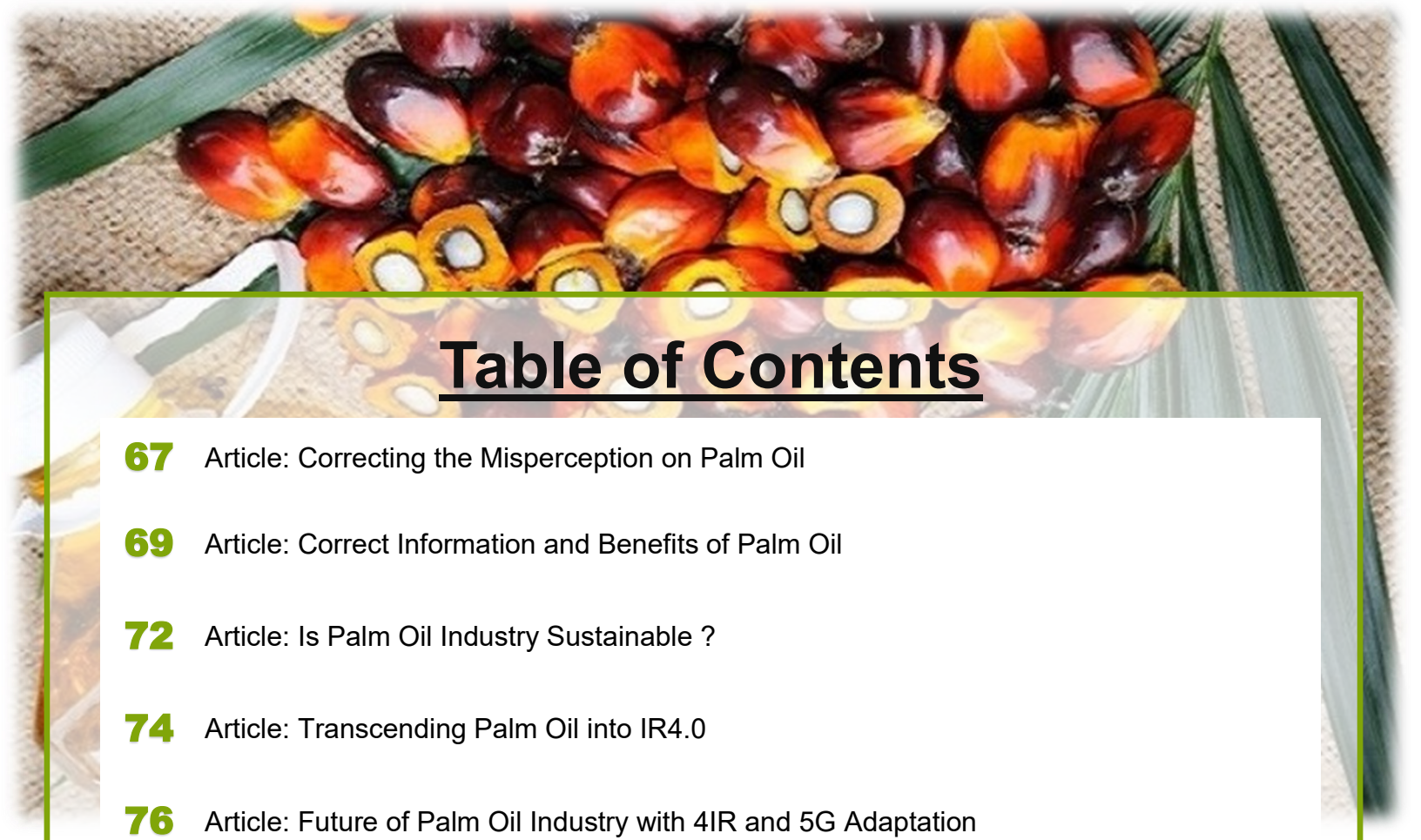

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Editor's Message

Although 2021 was another year of uncertainty with the pandemic, POPSIG continues to organise our activities using the advanced technologies that bring people together in many ways. We are delighted to share that many have turned the challenges into opportunities, in innovative ways, during this difficult time. We take a moment to reflect on what can be done to build a more sustainable palm oil industry.

The world eyed on COP26 summit in Glasgow, which marked a significant milestone for a new chapter in safeguarding our planet. POPSIG commits to the stewardship of net zero and takes stock of the transformative changes in industrial sustainability development over years. Confexhub-hosted Future-proofed Palm Oil (FPPO) 2021 summit focused on palm oil economy, MSPO, net zero, satellite imaging, circular economy, mechanisation and digitalisation in the industry.

This year, POPSIG had launched Seminar Series to address pressing palm oil-related issues. In light of COP26, the first series emphasised on net zero in palm oil industry. Transformation requires support from the major industry players, policy makers, society and financial institutions. It was suggested all stakeholders should corporate in creating the needs for net zero.

As MSPO is a national commitment, CEO of MPOCC YBrs. Mr. Mohammad Hafezh Abdul Rahman presented that the scheme monitors and reduces GHG throughout the supply chain; restricts open burning; and prohibits forced and trafficked labour. Several POPSIG webinars were organised to address pressing issues: current technological development, circular economy, environmental sustainability, and the role of women in palm oil industry.

MPOC's Science and Sustainability Engagement Webinar Series presented the roles of palm oil in cancer management, its carotenoids in immunology and digitalisation within the sector. In addition, numerous webinars organised by other organisations, including MPOGCF, CPOPC, MIPO and Competere, presented the biodiversity conversion, opportunities in the industry, climate change issues, palm olein and the role of smallholders.

POPSIG had organised three roadshows to introduce the industry as an alternative career choice. Our delegates also participated in IChemE Student Summit and NACES to discuss the application of chemical engineering knowledges in sustainable development and 4IR. We also appreciated MPOC for their efforts in hosting university-based events: Palm Oil Educational Outreach Webinar and CEO Day @ UTP.

This year, we had the pleasure to award more than 21,000 MYR to over 50 individuals at both industrial and academic levels for their contributions to promoting the industry and addressing accurate perceptions. The 2021 POPSIG Best Final Year Design Award was presented to the team from UCSI University, Malaysia on their project on using palm biomass to produce hydrogen; the 2021 POPSIG Student Research Project Bursary was awarded for palm oil-themed researches on pyrolysis, carbon nanoparticles, photocatalytic degradation and biofuel.

POPSIG appreciated all the sponsors for our 2021 activities, awards and bursaries. As IChemE is stepping into its 100th year, POPSIG will organise a series of activities to commemorate this significant milestone. We look forward to 2022 – a year of centenary celebration.

POPSIG gratefully acknowledges our sponsors

Webinar: Current Technological Development and Future Prospects of Palm Oil Industry in Malaysia

On 23 August 2021, Dr. Steven Lim, an Assistant Professor at UTAR Malaysia, delivered a webinar to discuss about the status of palm oil industry development, the pressing challenges, and its prospects in Malaysia. The webinar recorded 80 online participants.

Status in Malaysia

Dr. Lim presented that life cycle analysis (LCA) was a useful scientific tool to evaluate the sustainability development in palm oil sector. From cradle to grave, the industry involved numerous stages starting from plantation to producing palm oil-based products. Its supply chain included plantation, transportation, refinery and manufacturing. Product diversification strategy had been implemented to stabilise CPO price and to ensure a more consistent demand for palm oil-based products.

Key challenges

The assistant professor outlined six key challenges facing the industry today: land availability, expensive labour, climate change, cost, product safety and consumer sentiments. He introduced that peat land was wet organic soil formed over thousands of years from plant remains. Carbon from atmosphere would be consumed by plants and stocked into the peat soils. It represented a very valuable global carbon storage and would reduce carbon emissions into the atmosphere.

MSPO is the Malaysian certification standard and outlines the management on palm oil plantation with many regulations to fulfil the sustainability criteria. During oil refinery, some toxic by-products, such as 2-MCPD, 3-MCPD and glycidol, might be generated through breaching and deodorisation.

Future outlook

On prospects, Dr. Lim suggested the importance of five important areas: genetic engineering, robotics and mechanisation, IoT and digitalisation, optimisation, and marketing. Through genome editing and sequencing, a new generation of oil palm could be created with higher resistance to diseases and more constant productivity.

Mechanisation could help to reduce labour requirements and cut costs in the plantation site while improving work efficiency. Drone technology with real-time monitor could improve harvesting and monitoring the oil palm trees. Data could be performed more in-depth analysis for further improvements, including data sharing between stakeholders for R&D and accreditation purposes.

Centralised biorefinery processing could be implemented for ease of access to the tools and for a more economic scale due to significant production. Biorefinery integrated processing could also be established to incorporate the processing of other oil palm biomass such as EFB and oil palm frond. Dr. Lim stressed that the accurate information about palm oil and its industry should be channelled on social media as they gained high popularity among the younger generations.

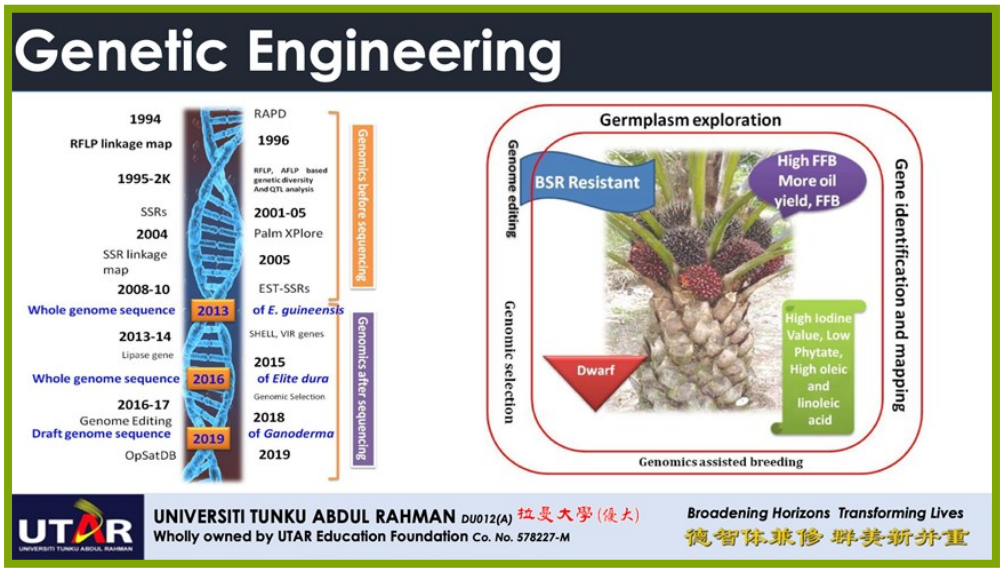


Figure 1: Genetic engineering helps to create novel traits

Palm biomass conversion technologies

Dr. Lim presented his research about the conversion technologies such as converting biomass into biofuels and bioproducts. He has notably been working on using EFB as main feedstocks for scientific investigation. His study developed crops with cell walls optimised for deconstruction and conversion to biofuels and bioproducts. The research also engineered metabolic pathways in microbes to synthesise biofuels and bioproducts through biomass breakdown.

The academician shared that the technology could be used to synthesise solid catalyst, which could be made from various biomass waste, for examples, easily accessible EFB, POF and monk fruits. Hence, the high performing catalyst was easily separable (in solid form), green, renewable and biodegradable (made of biomass). It had different benign and facile sulphonation methods and was cheaper than metal catalyst.

Organosolv pretreatment with organic solvent and water is a biothermochemical pathway to isolate ligocellulosic components. Its advantages include high purity of products, recoverable solvent, and lower operating cost.

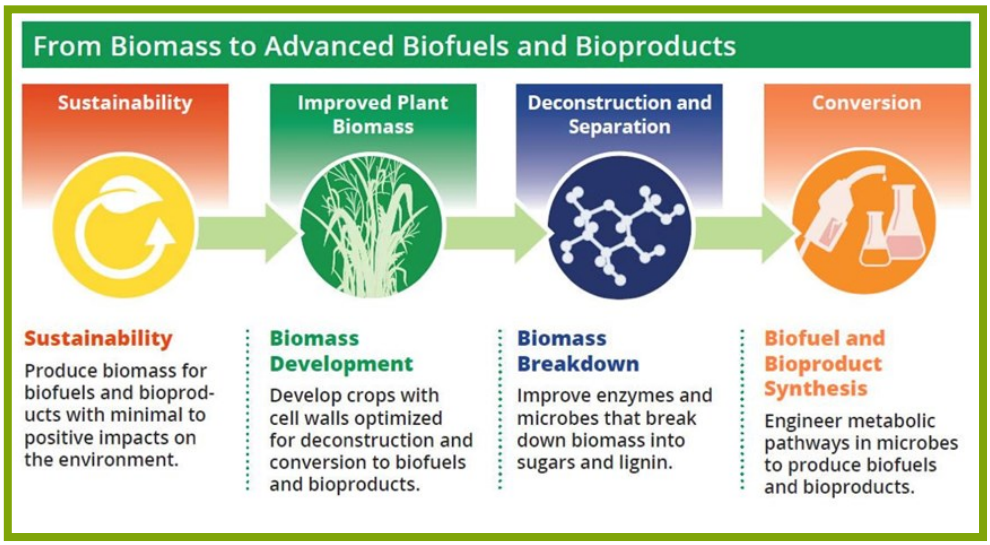


Figure 2: Dr. Lim's research to convert biomass into valuable products

Studies needed to respond to allegations

Dr. Lim concluded that the readiness and paces to address the challenges and allegations were slow. He suggested to implement correct strategies, improvements and traceability of products to ensure transparency. It was urged to counter allegations with solid facts and proven scientific findings, and the efforts require the cooperation from all relevant stakeholders.

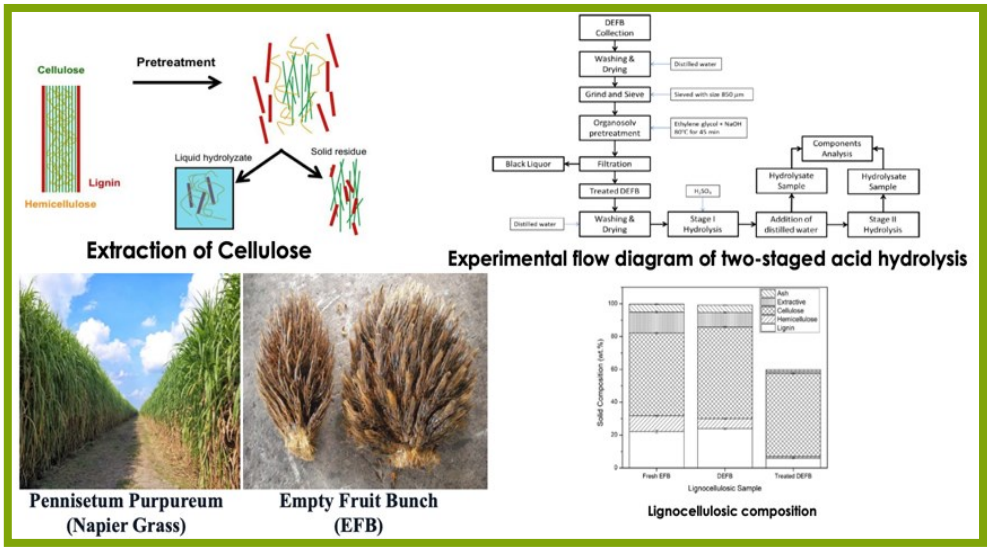


Figure 3: Schematics of organosolv pretreatment method with low operating cost

Webinar: Circular Economy for Oil Palm Biomass Industry: Concept to Modelling

On 20 September 2021, Dr. How Bing Shen, a Lecturer at Swinburne University of Technology, Sarawak Campus, Malaysia, delivered a webinar about circular economy. The webinar recorded 67 online participants.

Linear economy

Linear economy is a traditional business model which compasses of three stages: take, make and dispose. “Take” involves the extraction of resources; “make” converts resources into production; and, “dispose” refers to waste disposal after use.

Circular economy as attraction option

To transform into circular mode, one should emphasise on “make, use, recycle” to channel the process back to the product line. This attractive option is beneficial to the environment and economy.

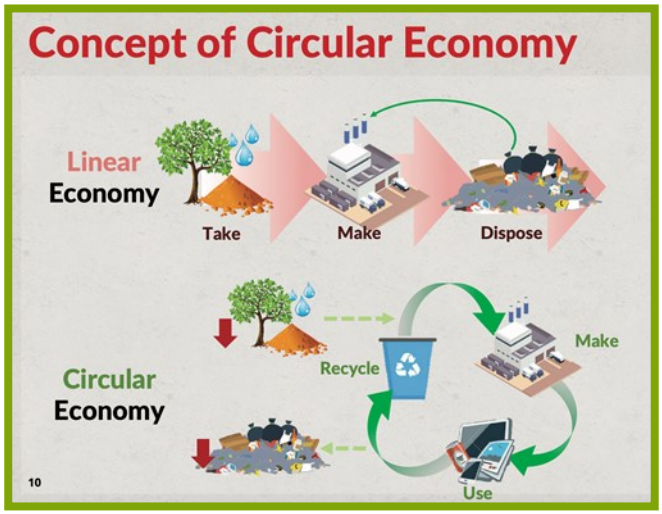


Figure 1: Concept of circular economy

Thermochemical process for conversion

Dr. How outlined two categories for conversion: thermochemical process and biological pathway. In the former method, combustion can be performed to generate heat and power energy. Through thermal cracking process, pyrolysis focuses on bio-oil production while upgrading the products to higher graded fuels such as: gasoline, biodiesel, and jet fuels. Biochar can be used as boiler feed and absorbent for water treatment.

Gasification aims to generate synthetic gas that consists of hydrogen and carbon monoxide. Hydrogen acts as alternative energy carrier for automobile fuel. The gas can preserve as important raw materials for ammonia production and can be used in hydrogenation in oil refinery.

Biological pathway for conversion

On biological processes, anaerobic digestion method converts biomass into biogas through four sequential processes – hydrolysis, acidogenesis, acetogenesis, methanogenesis. The alternative technique is two-step sequential dark-photo fermentation that converts biomass into hydrogen. Dark fermentation first converts organic metals into acidic acids, and later, the generated acetates are hydrolysed into hydrogen via photo to fermentation. Microbes activities involves in the sequential dark-photo fermentation.

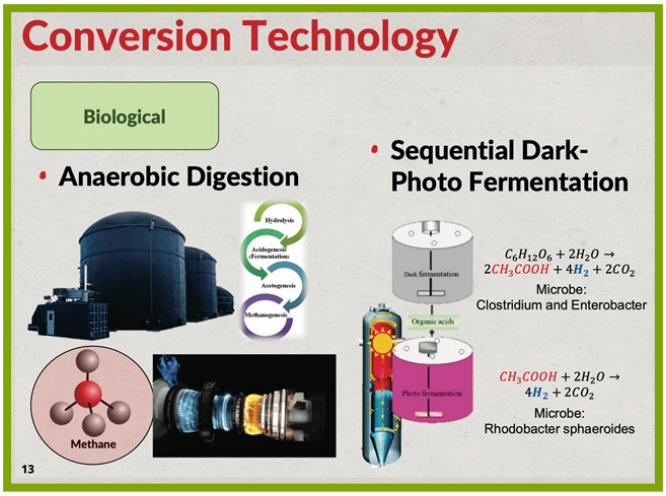


Figure 2: Conversion technology

P-graph gives multiple solutions

P-graph is a powerful tool to determine all combinatorically feasible solutions and rank these solutions based on the objective function. Its unique selling point is to generate multi-solution simultaneously and provide hidden insights of each result. The tool is also user friendly as it does not require in-depth programming background; it offers visual interface that is beneficial for presentation purpose. Another feature is efficient search as P-graph is an accelerated branch-and-bound method. P-graph has been used to solve problems in energy planning, hydrogen economy and hydrogen supply network.

Optimisation

A series of parametric studies was conducted to find the threshold price of the fresh resources which make this circular path become favourable. Combustion pathway would be more favourable than fertiliser one if unique cost of electricity tariff was increased by 20%. The former pathway was more realistic as the refurbishment of energy policy is more viable to change the tariff rate of conventional coal-free energy in Malaysia to make biomass-to-power pathway become favourable.

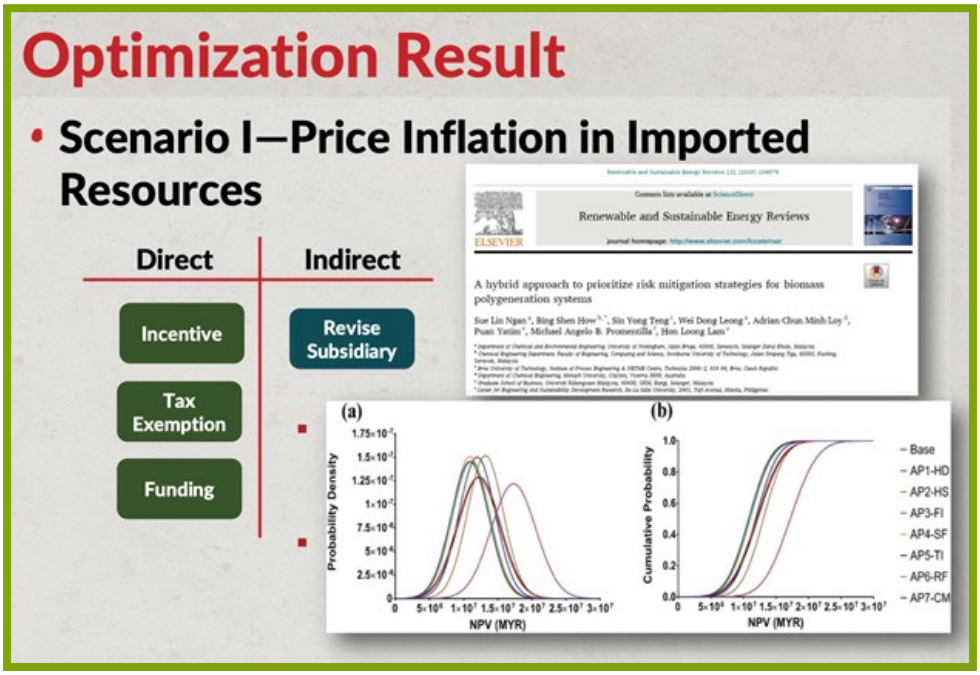


Figure 4: Optimised result provided risk mitigation strategies

Government effort is required

Dr. How suggested a few methods to promote bioenergy deployment in Malaysia. One is via direct method where the government can set up some policies, for examples, financial incentives and tax exemptions for industrial players who invest in biomass energy.

The academician said that Malaysia was one of the top 25 countries that still provided high subsidiaries for the fossil fuel-based energy. It accounted for 0.5% of Malaysia's GDP. He suggested to reduce or to remove the subsidiaries, so to enhance competitiveness of biomass-derived electricity. His research group had benchmarked the impacts of several policies on business risks for biomass polygeneration systems.

Figure 5: Dr. How responded to the queries from the online participants

Webinar: Malaysian Palm Oil Sustainability Certification Effort through MSPO - Getting the Right Fact on Palm Oil

Overview

Yang Berusaha Mr. Mohammad Hafezh Abdul Rahman is the Chief Executive Officer of Malaysian Palm Oil Certification Council (MPOCC) in Malaysia. With his expertise and experiences, he shared the strategies about the development of sustainable palm oil in Malaysia through MSPO. The webinar was held on 4 October 2021 and recorded 72 participants from five continents.

Introduction to MPOCC

Mr. Hafezh introduced that MPOCC, the scheme owner of MSPO certification, is a council under the Ministry of Plantation Industries and Commodities, Malaysia. MPOCC was incorporated in December 2014 and starts operation on January 2016. The council is governed by 13 Board of Trustees represented by the government, NGOs, supply chain actors and academicians.

Global demand for palm oil

Global palm oil production did not meet the global consumption since 2019, as the worldwide food market was expected to reach over USD 8,000 billion in 2020. Mr. Hafezh described that the demand for palm oil will continue to grow as the global population is expected to reach 9.5 billion in 2050. Oil palm is integral in the global supply chain dynamics, so the way forward is to promote the use of certified sustainable palm oil.

Less land for producing palm oil

The CEO presented that the global planted area for palm oil production was at 23.45 million ha (or equivalent to 0.46% global agriculture area), which was the lowest as compared to soybean, rapeseed and sunflower oil productions. Nonetheless, the global palm oil production accounted for 74.05 mil MT, representing the highest amongst the four edible oils.

MSPO reflects UNSDGs

It was highlighted that MSPO principles match the United Nations Sustainable Development Goals, which aim to create jobs eliminating poverty and hunger, provide decent work and economic growth, promote responsible production, actively address climate change, and many more. MSPO certification is developed based on domestic laws and regulations, and in addition, international sustainability requirements including ISO17021.

MSPO's value

As the catalyst for transforming the industry for its sustainability, MSPO certification scheme addresses key issues revolving around people, planet and profit. Sharing similarities with RSPO and ISCC, MSPO monitors and reduces GHG throughout the supply chain; restricts open burning; and, prohibits forced and trafficked labour including children.

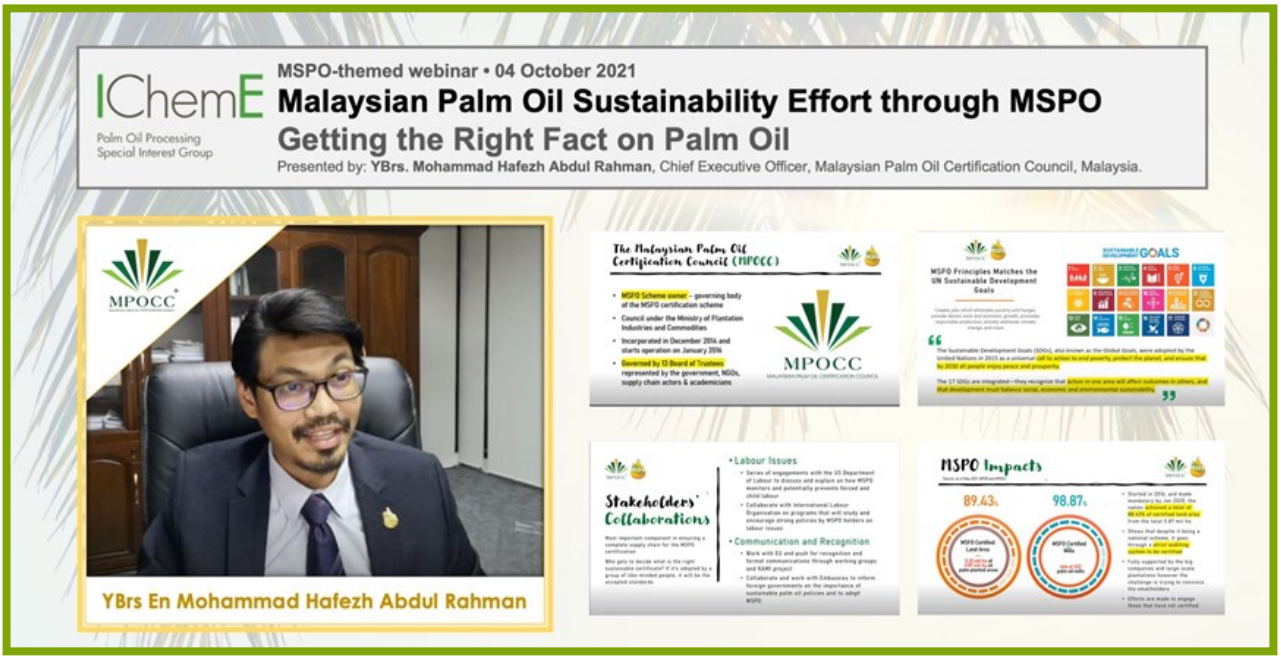


Figure 1: Mr. Mohammad Hafezh Abdul Rahman delivered a fruitful and information-rich webinar about MSPO.

Scheme certifies quality

In his conclusion, Mr. Hafezh pressed that transparency and traceability in MSPO allow all stakeholders to see the complete supply chain of the certified material right to its source, and also to build trust for increasing company value. Quality of certified materials are ensured as it goes through a 3rd party audit that is impartial which requires the suppliers to adhere to strict set of requirements that ensure best practices and protects all those involved in the supply chain.

Acknowledgement

POPSIG expressed our sincere appreciation to Yang Berusaha Mr. Mohammad Hafezh Abdul Rahman for his contribution to delivering MSPO-themed webinar.

Figure 2: Mr. Hafezh was presenting MSPO principles that match UN SDGs.

Figure 3: POPSIG expressed sincere appreciation to Mr. Hafezh's contribution.

Webinar: POPSIG Seminar Series 1 - Towards Net Zero Carbon in Palm Oil Processing

Overview

POPSIG Seminar Series 1: Net Zero concluded on 26th October 2021. Five professionals exchanged their views about the net-zero technologies to tackle climate change. The professionals discussed the feasible strategies to succeed 1.5°C pledge and drive the nation towards net zero.

Welcoming address

Ir. Dr. Wendy Ng Pei Qin, Event Director at POPSIG, welcomed all the speakers and audiences to the first POPSIG seminar series that was launched to share the latest academic and industrial advancements about the improvement in palm oil processing to all stakeholders and the public.

Emission reduction and net zero

In her welcoming address, she gave an overview about the greenhouse gas (GHG) emission reduction and net-zero emission targets. The former one is established to ensure reduction at a rate that is consistent to the company's goal, while the latter describes that the companies take responsibility on the emissions that have yet to be reduced, or remain unfeasible to be eliminated.

Figure 1: Ir. Dr. Wendy Ng Pei Qin justified the concept of emission reduction and net zero

Ir. Dr. Ng stated that the palm oil industry is improving to tackle GHG emission, while the recent research has actively promoted sustainable palm oil production to transition the industry towards net-zero emission era. These technologies convert the emissions during palm oil processing into useful applications and this moves to industry closer to achieve the net-zero carbon emission target.

She highlighted that the seminar would share the latest academic and industrial advancements in achieving net-zero carbon emission in palm oil processing. She welcomed the six professionals for contributing to the seminar.

Opening speech

Chair of POPSIG, Professor Ir. Dr. Chong Mei Fong introduced the theme of POPSIG for the year of 2021: Correcting the misperception on palm oil. She outlined that the core activities supporting the theme are webinars, university roadshows, newsletters, and awards and bursaries.

In 2021, POPSIG has hosted and co-organised 20 webinars, which contributed to the increase of net followers by 84 users, the engagement improved by 4,000, and the promotional materials reached 14,000 people. To support the education, over 18,000 MYR have been utilised to benefit 50 individuals and 11 institutions in both Peninsular and East Malaysia. POPSIG is actively engaging with the Ministry of Plantation Industries and Commodities (MPIC) and other agencies.

Palm oil mill effluent (POME) waste treatment

Professor Ir. Dr. Chong Mei Fong presented the POME waste treatment - a journey in biogas development and its challenges. POME is a major source of biogas. Professor Chong illustrated that from fresh fruit bunch to clarified crude palm oil (CPO), POME is generated as the wastewater of the processing.

Figure 2: Professor Ir. Dr. Chong Mei Fong justified POPSIG's effort in correcting misperceptions on palm oil

Initiatives converting POME treatment into value-added processes improve the palm oil processing. Clean Development Mechanism (CDM), which is a carbon trading mechanism for reducing GHGs, has begun in 2007 and was overseen and supported by Malaysia Energy Centre. The Malaysian Federal Cabinet approved the National Renewable Energy Policy and Action Plan (NREPAP) in April 2011, and has started the feed-in-tariff (FiT) mechanism since 1st December 2011.

Sustainable Energy Development Authority (SEDA) in Malaysia functions to administer and manage the implementation of the FiT mechanism which is mandated under the Renewable Energy Act 2011 [Act 725]. Under National Key Economic Areas (NKEA), EPP5 aims to develop biogas at palm oil mills. MPOB had rolled out that starting from 1 Jan 2014, all new palm oil mills and existing ones applying for throughput expansion in the country should install full biogas capture or methane avoidance facilities.

Challenges to the current initiatives include the limited market or demand because FiT is quota-based, selection of biogas versus effluent treatment, and imbalance between supply and demand. The policy is supportive (motivation and regulation approach) but too restricted (micro approach).

Professor Chong suggested that the initiatives should have an overarching policy (macro approach) allowing an active balancing of demand and supply to make impact. Biogas versus effluent treatment also requires integration and simultaneous solution.

Process integration using pinch analysis

The Prime Minister of Malaysia, Yang Amat Berhormat Dato' Sri Ismail Sabri Yaakob has tabled the 12th Malaysia Plan (12MP) or Rancangan Malaysia ke-12 (RMK12), which pledges the nation to become a "carbon neutral country by 2050 at the earliest", as announced on 27th September 2021.

Ir. Dr. Lim Jeng Shiun discussed that the user should refer to the carbon management hierarchy for oil palm supply chain. He described that the improvement on the complex core process side, in addition to that on the utility system, should be done to enhance the overall energy efficiency. He also shared the impact of efficiency improvement of different process layers on the utility requirements.

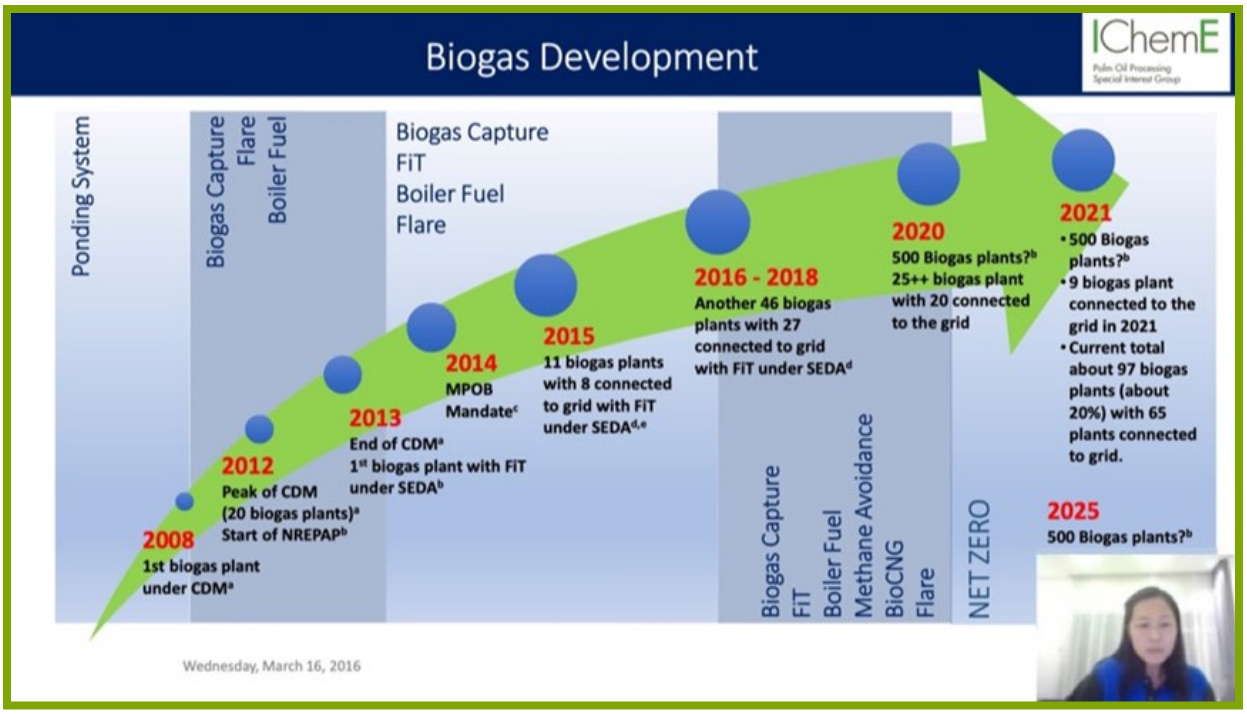


Figure 3: Professor Ir. Dr. Chong presented the biogas development from 2008 to 2021

Pinch analysis for optimal design can be done using graphical or algorithm approaches. While maximising the impact of renewable energy integration, he addressed that solar thermal itself may not be economically attractive, but proper process integration is required. Both in-process and end-of-pipe analysis needs to be performed to maximise thermal energy saving. Pinch analysis can provide multiple deep insights into the utility and process improvements for thermal, electricity, water and emissions, while the technique can also be applied for other resource minimisation analysis.

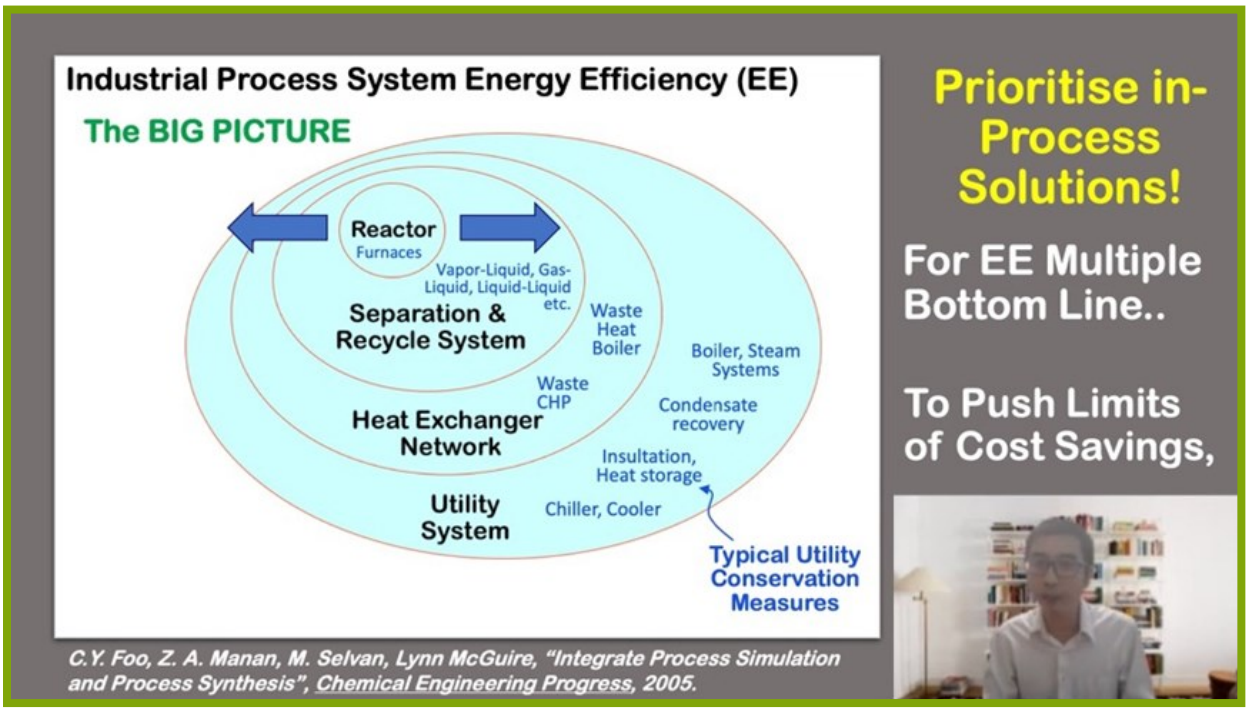


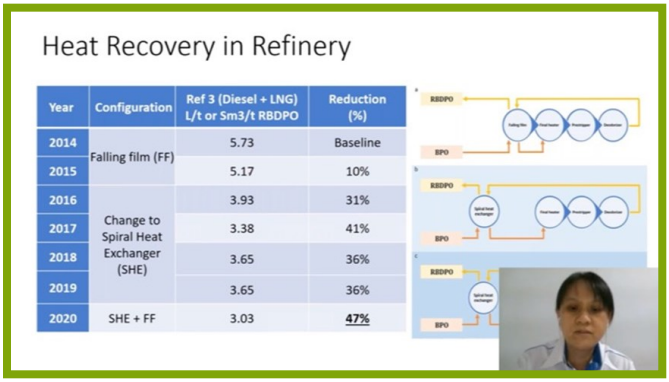
Figure 4: Ir. Dr. Lim Jeng Shiun informed the significance of energy efficiency improvements

Sustainability in industry

ChM. Yung Yen Li, QA/QC and R&D Manager at IOI Edible Oils Sdn Bhd, Malaysia presented the approach to systematically minimize energy wastage at the mills. On utilities saving, vent economizer is used to recover heat from flash steam from condensate tank.

To practise green energy initiatives, GHG emission is monitored at the by-product stream. Shorter cycle time reduces electricity consumption by 40%. Saving in chemical usage contributes to the reduction of GHG emissions. Sludge is streamed to reactor for the bacterial digestions. About 85% of the treated water is used as industrial water.

The more environmentally friendly LNG replaced diesel for Geka boilers to reduce carbon footprints. The steam generated by biomass boiler has increased to 2.61 tonne steam per tonne EFB from 2017 to 2020. The firm also uses biolubricants that is biodegradable and non-toxic to human beings and aquatic habitats. Wet scrubber was used to improve the air quality and half the emission, as restricted in the Clean Air Act.



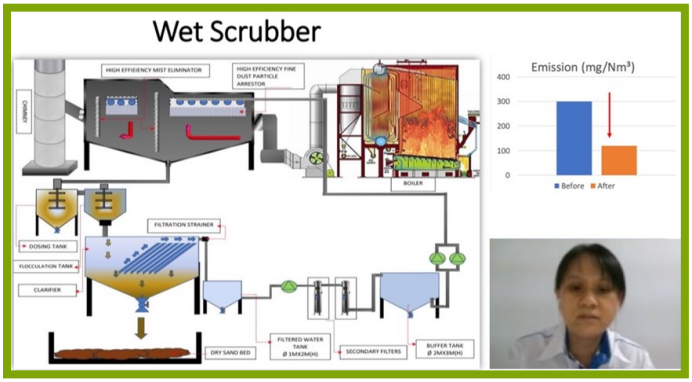


Figure 5: ChM. Yung shared the sustainable practices and success stories at IOI Edible Oils Sdn Bhd

Zero emission

Professor Dato' Dr. Mohd Ali Hassan, Professor at UPM lectured about the concept of zero emission, waste-to-wealth and biomass-to-business strategies. He emphasized the 3Ps principles: profit, people and planet, in addition to the sustainable development goals (SDGs).

Adding values to biomass is vital because they are not waste, but renewable sources. Biogas capture during POME waste treatment is important to generate bioenergy and bioproducts. POME can also be converted into biogas and biohydrogen for producing biomass energy besides manufacturing bioplastic (PHA). Through bioreactor, empty fruit bunch can be used to make bioplastic (PLA) and bioethanol.

In his JICA-JST SATREPS project, the air and water pollutions could be eliminated to safeguard the biodiversity conservation. The installation of a modern biogas capture system and the replacement of the extensive lagoon area into a biomass business area are critical for developing bioeconomy in the rural area. Biogas provides electricity for new business and contributes to zero-emission plans.

By sealing the lagoons, it will reduce GHG emissions, prevent pollutions, promote water recycling and create job opportunity for biobusiness. Professor Ali also stated that the development of new oil palm plantations in the tropical rainforest will no longer be sustainable.

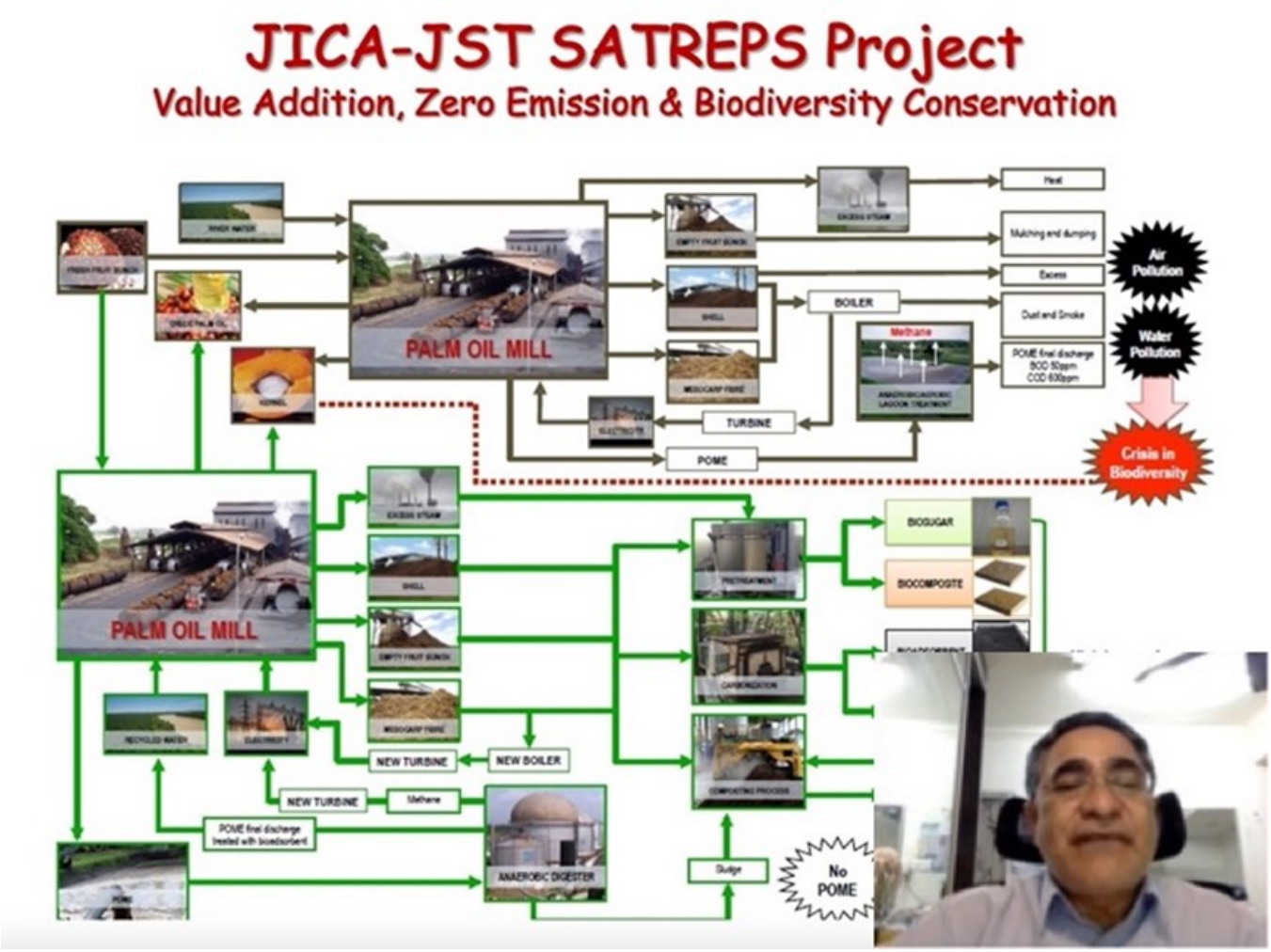


Figure 6: Professor Dato' Dr Mohd Ali Hassan presented his projects with an institution at Japan about zero emission in palm oil sector

Net zero

Founder of CSPO Watch, Robert Hii shared that the agricultural sectors are being enrolled in the fight against climate change. He shared that Global Warming Commission in the US revealed a plan that will be dependent on farms and forests to absorb emissions; Danish authorities introduced legally binding legislations to reduce GHG emission by half in 9 years time starting from 2021.

Robert also discussed that palm oil can be the first net-zero vegetable oil because of its industrial advantages including the contributions by NGOs to identify the emission sources. He outlined that company-specific emissions must be calculated to set firm targets, and the emission savings must be quantified.

Robert also shared that it is important to reduce CO_2 emission stepwise from 2.85 Mg CO_2/ton to 0.45 Mg CO_2/ton to Net Zero. The first step is emission reduction through certification demands, and followed by mill actions towards net zero. These include to adhere to the qualified certifications, including ISCC, MSPO, RSPO to achieve 0.38 Mg CO_2/ton and to protect high biodiversity value areas. Other key actions include to convert known mill wastes into green energy to power the mill operations, increase OERs at mill to decrease carbon footprint, and quantify emissions.

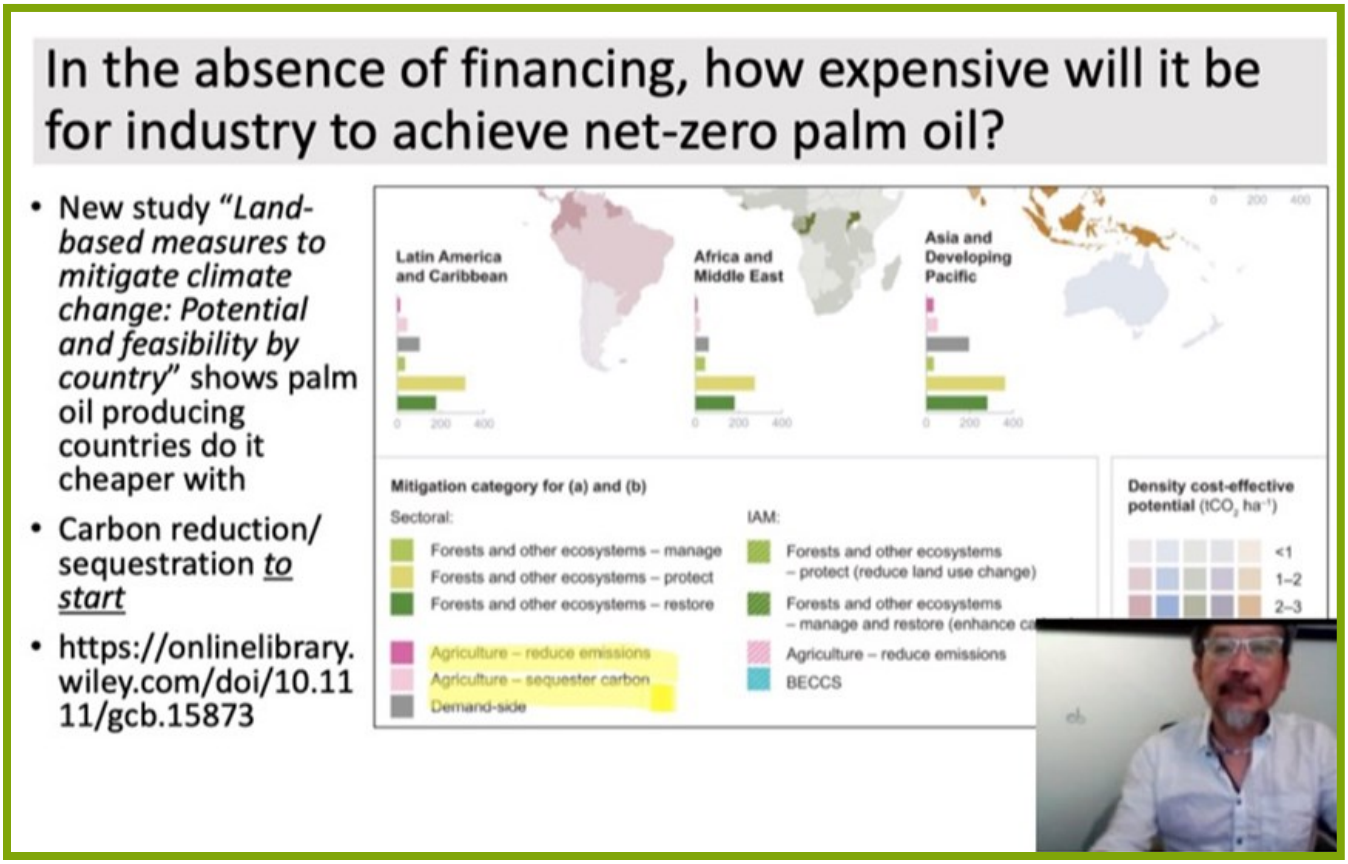


Figure 7: Robert Hii pressed the funding and cooperation needed to manufacture net-zero palm oil

Forum discussed plans to move forward

Professor Ir. Dr. Denny K. S. Ng, Associate Head of the School of Engineering and Physical Sciences at Heriot-Watt University Malaysia, chaired the forum session during POPSIG Seminar Series 1. The forum concluded that chemical engineers able to provide viable solutions in palm oil processing for net zero carbon emissions. Support from the major industry players, policy makers, society and financial institutions are needed for such transformation to happen.

All stakeholders involved should look into:

(1) creating the needs for net zero

(2) integrate net zero into business risk and opportunity

(3) ensure net zero is a part of palm oil business and not a component of social responsibility

(4) create a sustainable market demand for net zero

(5) provide a strong financial cum marketing platform for net zero based technologies

(6) identify the implementation, feasibility, financial and business gap

Figure 8: Professor Ir. Dr. Denny K. S. Ng chaired the forum session

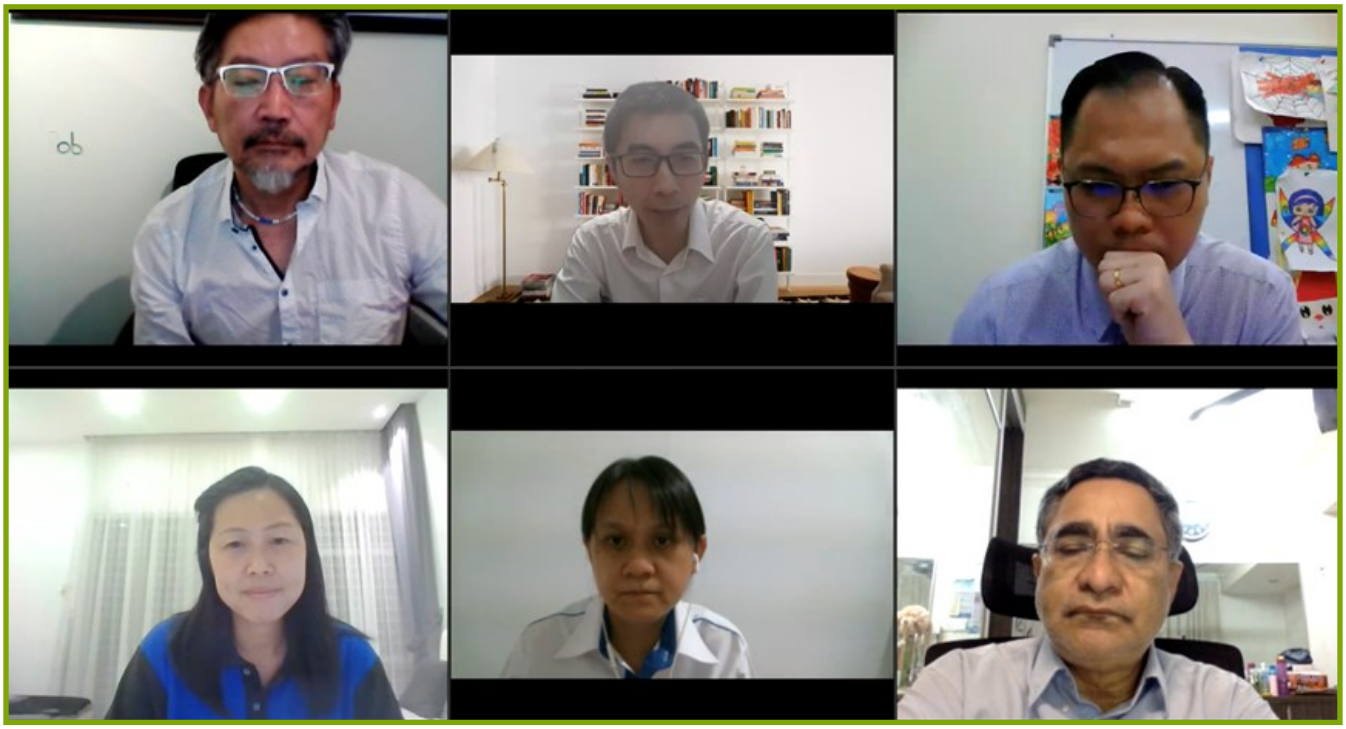


Figure 9: Speakers discussed about net zero in palm oil industry during the forum discussion

Figure 10: Group photo session

Webinar: Environmental Sustainability in the Palm Oil Sector in Malaysia: Impacts, Challenges and Way Forward

On 20 September 2021, Mr. Randolph S. Jeremiah, Senior Environmental Consultant, Director, ERE Consulting Group, Malaysia delivered a webinar about environmental sustainability.

Palm oil's economic value

Randolph highlighted that the agriculture sector employed about 1.87 million people in Malaysia while oil palm was the major contributor to the GDP at 37.7% within agriculture.

Environmental challenges

Forest fires and transboundary haze cause damage and loss of property to the palm oil sector. The hazardous gas also has negative health impacts on all living creatures.

Randolph commented that methane emission from the POME treatment contributes to the environmental issues.

Site clearing for the establishment of oil palm plantation causes soil erosion, which results in temporary surge of sediment loads in the receiving waterways.

Palm biomass waste comprises oil palm trunk (OPT), oil palm frond (OPF), empty fruit bunches (EFB), mesocarp fibres (MF) and palm kernel shell (PKS). OPT and OPF are shredded in the oil palm field; PKS and MF act as fuel stock for steam generation; and, EFB can be incinerated for ash or used directly as a mulch.

Plan for future

Restrictions are required on the conservation of peatland for agriculture. De-gazettement of Permanent Reserved Forest should be strictly prohibited. The industries should adopt the MSPO certification scheme for sustainable palm oil.

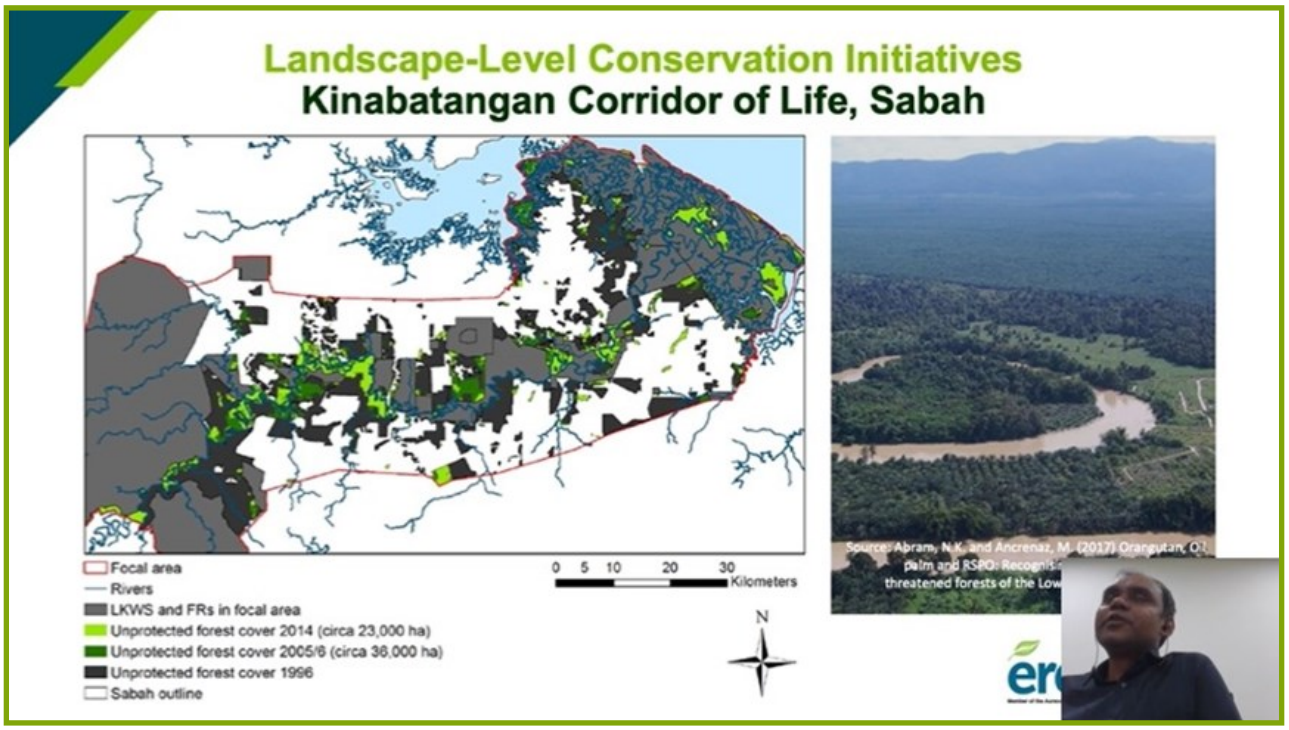


Figure 1: Conservation initiatives will reduce human-wildlife conflict in Malaysia

On RSPO, companies and smallholders should adhere to the seven principles outlined. RSPO New Planting Procedure (2021) is a framework that aims to mitigate negative impacts on high conservation value (HCV) areas, high carbon stock (HCS) forests, peatland, fragile and marginal soils, as well as to uphold the rights of local peoples.

Advanced POME treatment incorporates aerobic/anaerobic treatment and tertiary treatment, for example, clarification, membrane filtration, coagulation and flocculation.

Figure 2: Seven principles outlined in RSPO for sustainable production

Action required by professionals

Randolph suggested that the government should implement holistic land use planning strategies that integrate biodiversity consideration across the national landscape.

Palm oil companies should invest in sustainable operations of oil palm plantations and palm oil mills, including adoption of sustainability certification.

Academicians and researchers were suggested to explore cost-effective options for integrated waste management of POME, biomass and other residues that reduces and eliminates pollution impacts.

Webinar: Experience Sharing Session - Women Working in Palm Oil Industry

On 14 December 2021, Husna Hamizah binti Nor Haslan, Logistic Executive at KLK Palm Oleo Sdn Bhd, Malaysia presented the webinar titled “Experience Sharing Session – Women Working in Palm Oil Industry”. She is also a PhD candidate in Mechanical Engineering at Universiti Teknologi MARA, Shah Alam, Malaysia.

Oleochemical palm oil plant

Husna introduced that oleochemical products are generally derived directly from naturally occurring fats and oils. Oleochemicals are used in the production of the Food and Drug Administration (FDA), approved food packaging as well as sanitisers for food contact surfaces.

Women involvement in operation

Asian Development Bank (ADB) Strategy 2020 recognises gender equity to ensure that the policy and decision-making processes involve the interests and needs of both sides. Diversity in leadership is helpful to the business management. Husna shared that women account for the majority in health and social work sectors, followed by education and accommodation and food sectors.

Requirement in palm oil operation

From personal experience, Husna shared that women have several outstanding characteristics, such as: high determination, positive self-behaviour, dedicated to learn and leadership. She presented that approximately 40 – 160 million women may progress towards advanced roles by 2030.

Expectation and challenges

Husna outlined four challenges that could potentially be faced by the female workers in the industry. For examples, lack of support to do independent work, sexual harassment at work, work-life balance, and tight competition with men in mainstream industry. Husna suggested that a fixed quota could be introduced to ensure a gender balance at work to improve organisational performance and enhance ability of companies to attract talent and retain employees.

Husna suggested to the students that female could join operation team to explore themselves. She encouraged the female employees to be brave to ask and learn new skills in the industry, as well as offer suggestions to contribute to the company.

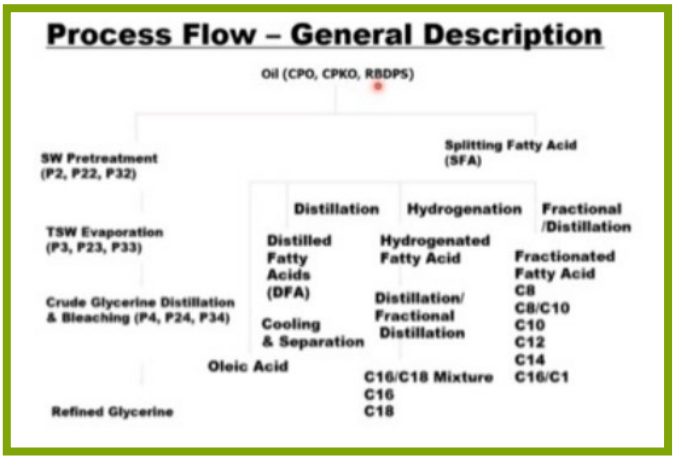


Figure 1: Process flow in the oils and fats industry

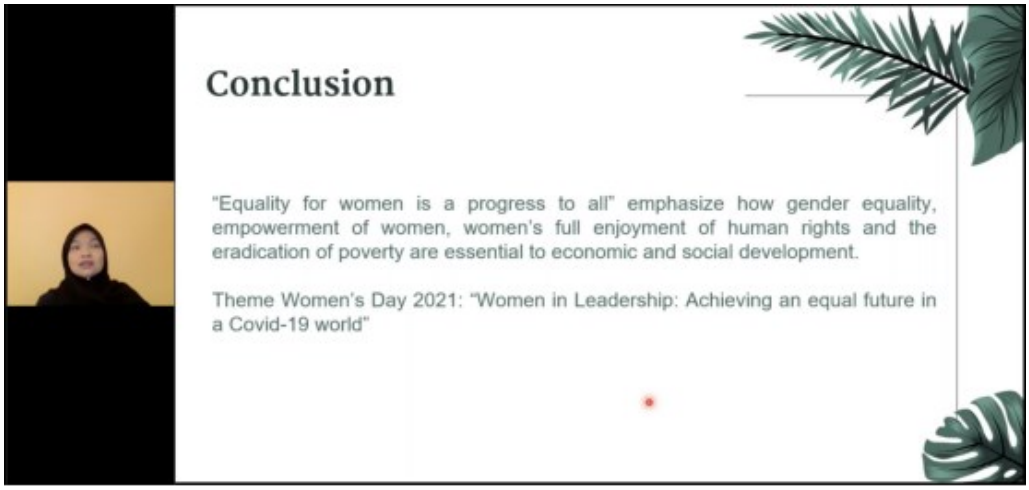


Figure 2: Husna Hamizah gave her concluding remark that women can give significant contributions to the industries.

Webinar: MPOC Science and Sustainability 3, 4, and 5 — Negative Perception, Palm Carotenoids and Digitalisation

Malaysian Palm Oil Council (MPOC), through the Science, Environment and Sustainability Division had organised science-based webinar series with the first webinar on 27 May 2021. Series 3, 4 and 5 aimed to provide an update to the palm oil industry stakeholders on the latest developments in sustainability, digitalisation, health, and nutrition.

Series 3: Contaminant mitigations and palm oil's role in disease management

Series 3 was held on 24 August 2021 and moderated by Dr Ruslan Abdullah, Director of Science, Environment and Sustainability Division at MPOC; it recorded 285 online participants. Dr Prakash Adhikari, Mewah R&D Solution presented that palm oil is versatile because it has high stability to oxidation and is an alternative to replace animal fat. Palm oil tends to display beta form, which is useful for shortenings and margarines production for polymorphic stability.

Dr Azmil Haizam Ahmad Tarmizi, MPOB demonstrated that 3-MCPDE is difficult to remove upon formation while glycidyl ester (GE) is developed from diacylglycerols (DAG) during refining. The Malaysian government has allocated research grants on the mitigation of 3-MCPDE and GE, such as: chloride removal in CPO at mills and refineries, and investigating the processes to reduce their level at refineries. Mineral oil saturated hydrocarbons were identified to cause inflammation to human livers, while mineral oil aromatic hydrocarbons were found to be possible genotoxic and carcinogens.

Professor Dr Smiti Gupta, Department of Nutrition and Food Sciences, Wayne State University, USA presented that tocotrienols could behave as preventative and therapeutic micronutrients in non-small cell lung cancer (NSCLC). Tocotrienols modulates NOTCH signalling in NSCLC cells via upregulation of the tumour suppressor, miRNA34a, while delta-tocotrienols attenuates NSCLC cell proliferation by downregulation of mTOR via inhibition of glutamine receptors and decrease in glutamine uptake. Dietary oil palm phenolics arrested the growth of pancreatic cancer in KPC transgenic mice.

Dr Jonny Bowden, Board Certified Nutritionist, USA presented that saturated fat raises cholesterol that causes heart diseases. He emphasised that virgin red palm oil is rich in vitamins and anti-oxidants including tocotrienols. Previous study supported natural vitamin E tocotrienol protects brain against stroke and brain white matter. He added that palm oil is also rich in vitamin K, improves hair growths, reduces risk of macular degeneration and boosts hormonal balance.

Series 4: Palm carotenoids and red palm oil offer health benefits

On 15 September 2021, the webinar recorded 450 online participants. The question-and-answer session was moderated by Mr Anthony K Veerayan, Environment Manager in Science, Environment and Sustainability Division at MPOC.

Associate Professor Dr. Norhaizan Mohd Esa (UPM) introduced that carotenoids are abundantly found in deeply pigmented fruits and vegetables. Palm phytonutrients found in red palm oil include vitamin E, carotenoids, phytosterols, squalene and ubiquinone. Previous study identified that β-carotene acted as a chemotherapeutic agent regulating the invasion and metastasis of neuroblastoma via hypoxia inducible factor-1α (HIF-1 α); carotenoids can downregulate IGF-1 activity and inhibit androgen receptors for anti-tumour effects.

Associate Professor Dr. Tony Ng Kock Wai explained that red palm oil (RPO) has antioxidant properties. RPO can biologically inhibit HMG-CoA reductase in cholesterol biosynthesis, block cholesterol absorption, suppress chronic inflammation, reduce LDL-oxidation and atherosclerosis.

Associate Professor Dr. Nyam Kar Lin (UCSI) emphasised that RPO is rich in omega 3 and 6, while their combination can diminish inflammatory skin diseases. RPO can protect skins from oxidative stress and perform cellular antioxidant level to improve skin health. She added that RPO may be applied in cosmetic or pharmaceutical industries due to its natural characteristics..

Dr. Radhika Loganathan (MPOB) underlined that vitamin A deficiency is a pressing health problem among the rural community in Malaysia. MPOB's RPO study aimed to study the effect of the supplementation of red palm shortening-forfeited

biscuit on the nutritional status, ocular status, intestinal parasitic infections and gut microbiota of vitamin A deficient children. She elaborated that the individuals from the low household income have higher risks of vitamin A deficiency, underweight and stunting. She concluded that RPO provides a natural solution to these health problems, while provitamin A carotenes in RPO are also identified to be highly bioavailable.

Series 5: Emerging technologies drive palm oil industry towards digitalisation

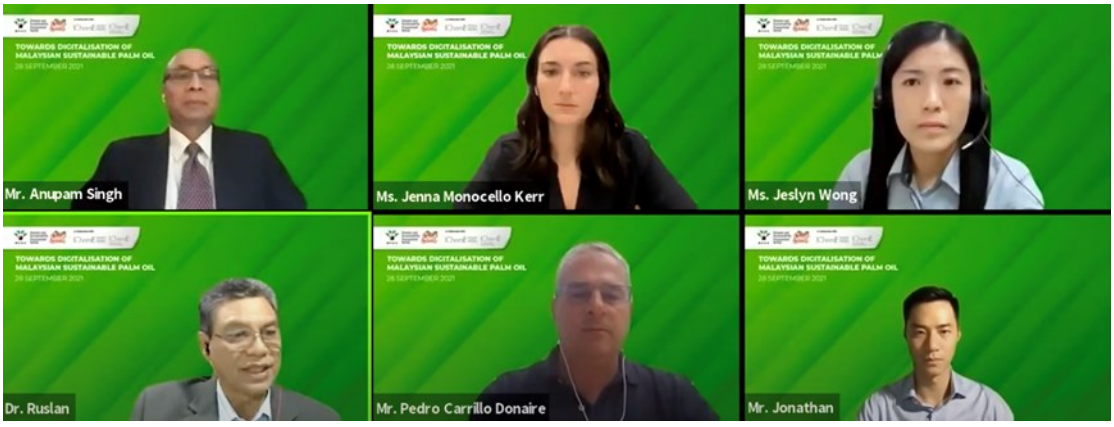
Science and Sustainability Engagement Series 5 was co-organised with POPSIG and was held on 28 September 2021. The webinar was moderated by Dr Ruslan Abdullah (MPOC) and it recorded 476 online participants.

Brittany Zajic, Business Development Manager, Planet justified that sustainable sourcing plays important role in managing risks, achieving sustainability, and enhancing brand value. She added that many firms lost traceability and transparency and resulted in loss of market share, loss of major talent pool, and increasing risk of investment. Planet data complements GLAD and RADD alerts with validation through high resolution imagery.

Pedro Carrillo, CEO, ec2ce presented the application of AI in agriculture. The objective was to improve yield by optimising fertilisation based on historical records. On planning and planting, the technology could forecast season weather, seed productivity and quality. AI solutions will help predict the demand and labour need to reduce manpower problems.

Anupam Singh, Co-founder and President of 113 Industries Inc. jointed Jeanna Monocello Kerr, Director of Insights and Strategy, 113 Industries Inc. to analyse consumer perception towards palm oil using AI. Using the social intelligence, the analysis will present the behavioural patterns, compensating behaviours, unarticulated needs, and surprising connections. One suggested deep learning-based method as a subset of machine learning based on neural networks that permit a machine to train itself to perform a task.

Jeslyn Wong, F&B Industry Manager, Endress + Hauser, outlined four values towards digitalisation: reduced downtime, preventing waste and rejects, increased process safety, and cost-effective use of resources. Digitalised management consists of three layers: business, information and physical. Business layer comprises of demand forecast and supply chain management; information layer considers thresholds, costs and consumptions; physical layer includes CPO and RBDPO productions.



MPOC

IChemE POPSIG gratefully appreciate MPOC's effort in organising webinars to provide complementary online educations on accurate information about palm oil to the public.

Event: IChemE Student Summit 2021

Introductory remark

The 2021 summit was held on 3 August 2021. The moderator Mr. Oscar Ting Teo Wei from Biochemistry and Cell Biology Research expressed sincere gratitude to the organisers – IChemE and UM IChemE Student Chapter. The event was also supported by Monash IChemE Student Chapter.

Mr. Ting, also the Chief Manager of Information, Communications and Technology and UK Affairs Coordinator at POPSIG, stated that the summit was very remarkable to POPSIG as the palm oil-themed forum coincided with its 6th anniversary. He then welcomed the three speakers, Professor Dr. Chan Eng Seng (Monash University Malaysia), Dr. Viknesh Andiappan (Heriot-Watt University Malaysia) and Ir. Hong Wai Onn (Novozymes Malaysia).

Roles of chemical engineers in palm oil industry

The forum began with understanding the scope of responsibilities of chemical engineers in the industry. Ir. Hong stated that the graduates would participate in daily operational activities and to perform basic investigation on site. Professor Chan and Dr. Andiappan added that graduates would formulate how to apply knowledges at site.

On skills, Ir. Hong stressed that communications and soft skills were the key elements that graduates need to pick up. It was vital so the messages to solve problems and to propose solutions could be articulated and understood by the operational team. The academicians stressed that many applications including Aspen Tech learnt at tertiary educations could be applied in the industry.

Ir. Hong emphasised that upstream and downstream activities were different, as the upstream involved harvesting and processing, while the downstream comprised purifications, formulation, packaging, and waste management. Dr. Andiappan added that researchers played important roles to improve operational activities.

Challenges in the industry

Dr. Andiappan stated that media played very important role to disseminate accurate and positive information about palm oil. Negative information about palm oil were often exaggerated when media reported the news. Ir. Hong justified that the trading with the western worlds would affect the overall production and performance. Nonetheless, the consumption of palm oil-based products did not fall and remained strong at global market.

Professor Chan pressed that sustainability was vital to build the image of palm oil. Ir. Hong told that many companies in Malaysia were adhering to the MSPO certification scheme, so to build trusts in their productions and products. He added that operational activities continued on site while adhering to the restriction rules. Dr. Andiappan shared that the institutions put in efforts to maintain the quality of learning and students were acquiring engineering skills through online platform amidst the pandemic situation.

Webinar: MPOC-Swinburne Palm Oil Educational Outreach Webinar

MPOC, through the Science, Environment and Sustainability Division had organised its eighth science-based webinar series "MPOC-Swinburne Palm Oil Educational Outreach Webinar" on 13 October 2021. Five speakers shared their experiences and their opinions on the future of research in the palm oil industry for young scientists and engineers. The event recorded 402 participants.

Dr Sen Nathan from Sabah Wildlife Department (SWD), Malaysia urged to address pertinent human-wildlife conflicts and conservation issues that Sabah has been facing for some time. He also appreciated the funding support from MPOC, MPOGCF and other bodies. The three major type of operation attended by Wildlife Rescue Unit (WRU) in 2020 were rescue, control and translocation. Macaque, estuarine crocodile and Bornean elephant are the main species recorded by WRU in 2020.

Dr Lee Chin Mei from Universiti Malaysia Pahang (UMP) presented that POME undergoes hydrolysis, acidification, acetic acid formation and methane formation to produce biogas including methane, carbon dioxide and hydrogen sulphite. Nonetheless, producing biogas from POME requires high initial investment cost, while this route has limited models of successful biogas project and has not been the primary business of the mills.

Professor Dr Lam Hon Loong from University of Nottingham, Malaysia Campus stated that green supply chain can be applied for biomass utilisation and consideration of underutilised biomass, debottlenecking biomass supply chain deficiency and optimisation and debottlenecking biomass/bio-oil sustainability.

Dr Sitti Rahma Haji Abdul Hafid from MPOB justified that palm tocotrienol are superior antioxidants. It was scientifically shown to suppress cancer cell growth, attenuate cholesterol biosynthesis, provide protection against stroke and prevent UV-induced cancer on skin.

Dr Ruslan Abdullah from MPOC outlined three key aspects of the challenges in oil palm industry's R&D: economic, social and governance. The obstacles include misconception about the sector, assumptions in which agriculture is not the trending choice, funding issues, lack of awareness and attractiveness.

Figure: Five speakers addressed the accurate perceptions of palm oil to the participants.

Event: MPOC: CEO Day @ Universiti Teknologi PETRONAS

CEO DAY@UTP 2021 hosted by the Malaysian Palm Oil Council (MPOC) and in collaboration with Universiti Teknologi Petronas (UTP) provided a platform for students to engage in a knowledge and experience sharing session with industry leaders on career opportunities and entering the working world. This event also aimed to cultivate a greater sense of pride for palm oil and its contributions to the economy and sustainability agenda. Highlights of the 2-day event included CEO Forum, virtual oil palm plantation tour, virtual career fair, quizzes and many more.

Palm Oil TikTok Challenge was also organised to increase the knowledge related to palm oil industry in Malaysia among the students through informative and creative video presentation and enhance their creativity in carrying out literature review. The competition also aimed to spread awareness on the benefits and positive stories on Malaysian palm oil provides opportunities to cultivate academic, presentation and research communication skills.

YB Datuk Hajah Zuraida Kamaruddin, Minister of Plantation Industries and Commodities, Malaysia was invited to deliver her opening address. Ir Ts Kuhan Pathy, Dr Nurzhafarina Othman, Lim Chia Wei (Cempaka) and YBrs. Mr Mohammad Hafezh Abdul Rahman were the speakers for the CEO forum, and they shared the critical skills that are helpful to their future career.

Figure 1: YB Datuk Hajah Zuraida Kamaruddin, Minister of Plantation Industries and Commodities, Malaysia delivered her opening address during CEO DAY @ UTP 2021.

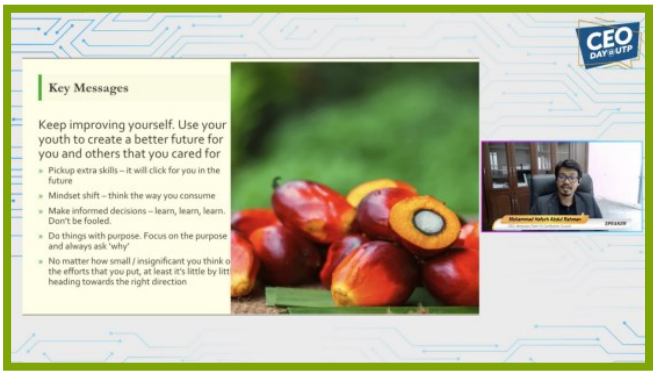


Figure 2: CEO of MPOCC Mr Mohammad Hafezh Abdul Rahman summarised his messages and advised the audiences to keep improving for a better future.

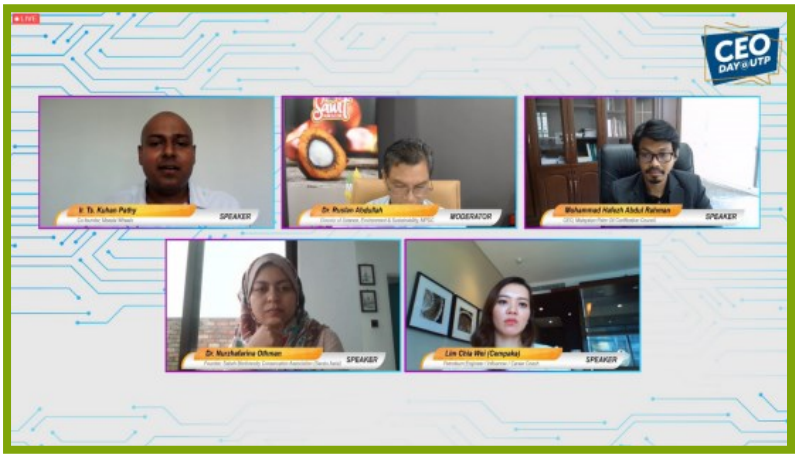


Figure 3: Presentations were made by Ir Ts Kuhan Pathy, Dr Nurzhafarina Othman, Lim Chia Wei (Cempaka) and Mr Mohammad Hafezh Abdul Rahman. The session is moderated by Dr Ruslan Abdullah, MPOC.

Webinar: MIPO Webinar Series S2/2021

On 8 November 2021, Tan Sri Emeritus Professor Datuk Dr. Augustine Ong (President of MOSTA) and Ir. ChM. Qua Kiat Seng (Senior Lecturer at Monash University Malaysia) presented at MIPO Webinar Series S2/2021. The webinar recorded 80 online participants.

Studies on saturated fat

Ir. Qua shared that coronary heart disease (CHD) is associated with saturated fat and sugar. According to epidemiologic, experimental and clinical evidence, a lowering of the proportion of dietary saturated fatty acids is among the dietary changes that benefits human health.

Figure 1: Dietary goals for the USA

The senior lecturer stated that fat is a concentrated source of energy and a structural components of cell membrane and hormones. He presented that vegetable fat is the best as compared to animal fat and trans-fat (such as: partially hydrogenated oils, PHO). He commented that tropical oils demonstrate no cardiovascular disease (CVD) risk.

Previous Prospective Urban Rural Epidemiology (PURE) study concluded that total mortality and CVD events were associated with consumption of carbohydrates and total fat. Total fat and its type were not linked to CVD, myocardial infarction or CVD mortality, whereas saturated fat had an inverse connection with stroke. Nonetheless, high carbohydrate intake associated with higher risk of total mortality as compared with fat consumption.

Palm olein

Tan Sri Augustine Ong stated that saturated fatty acid (SAFA) is stable and present in medium chain triglycerides (MCT) and human milk fat; monosaturated fatty acid (MUFA) presents in olive oil; polyunsaturated fatty acid (PUFA) is an essential fatty acid and unstable to oxidation. Hydrogenation converts PUFA to TFA.

He shared a previous study showing that palm olein and virgin olive oil possessed similar effects on CVD risks. Another study in Italy concluded that palm oil (40% saturated) is a tropical equivalent of virgin olive oil (15% saturated). It is because both oils have similar unsaturation at the sn-2 position of the molecules.

Tan Sri Augustine Ong concluded that palm olein is the tropical equivalent of olive oil, while health is determined by balanced diet and healthy lifestyle.

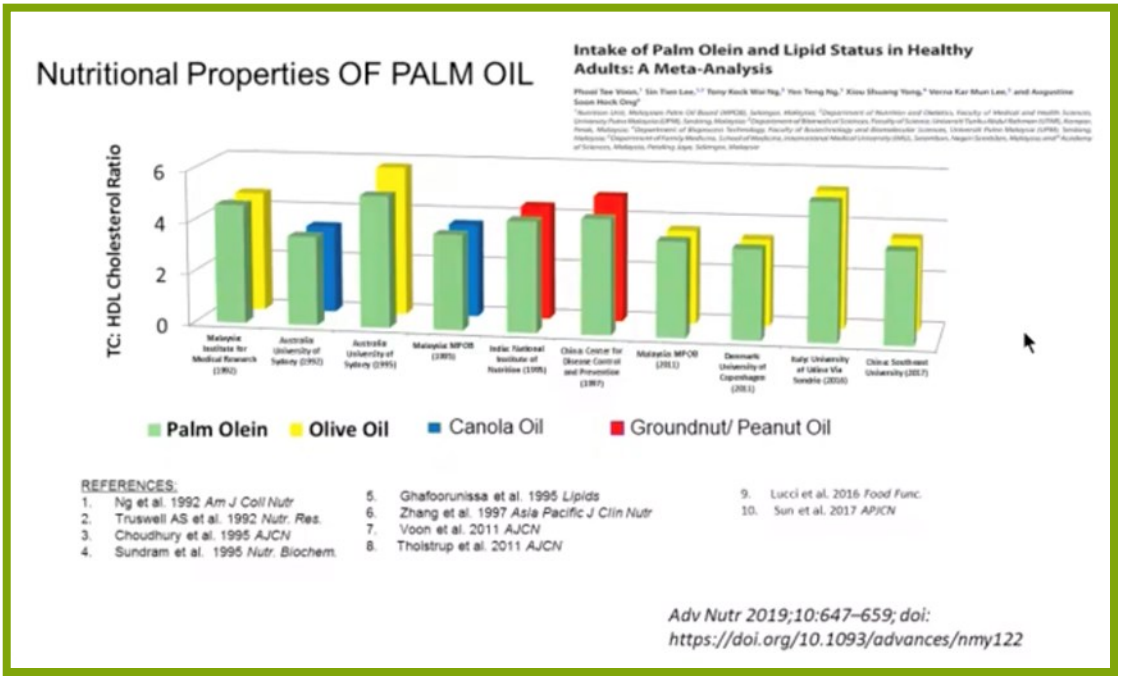


Figure 2: Tan Sri Augustine Ong presented the nutritional characteristics of palm oil as compared to other vegetable oils

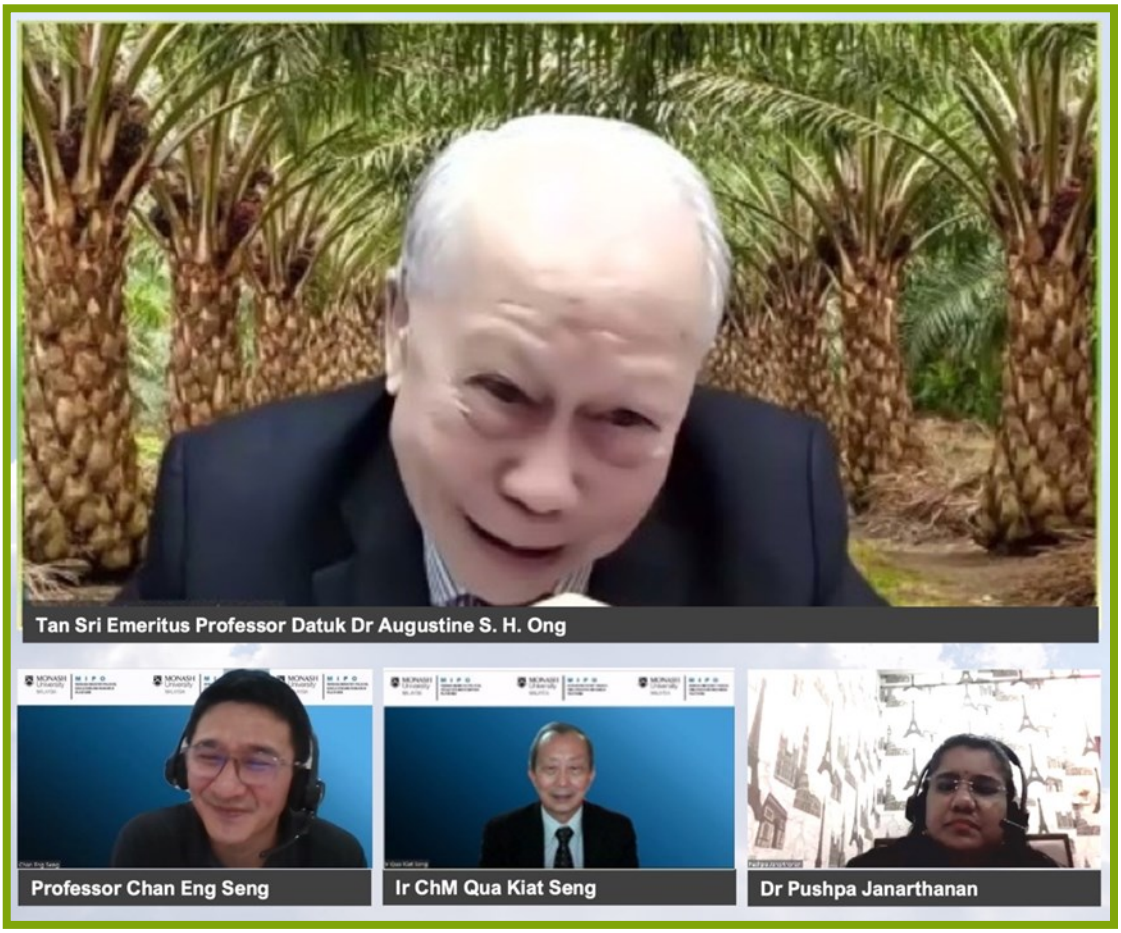


Figure 3: Group photo session with Tan Sri Ong and Ir. Qua

Event: POPSIG Staged at Future-Proofed Palm Oil - FPPO 2021

Future-Proofed Palm Oil (FPPO) 2021 International Summit and Exhibition was held virtually from 23 to 24 November 2021. The theme of the year was “Dismantling Barriers. Revitalising Preference.”

Introductory remark was delivered by Datuk Dr Abdul Aziz S.A. Kadir, Chairman, Confexhub Group. Palm oil has grown into a major industry over decades due to its many advantages and benefits. It is the most land efficient and versatile oil crops. The industry is also a significant contributor to the livelihood of the producing economies, offering trade and employments to millions of smallholder farmers globally. Today, the sector targets for net zero in oil and fats industry as discussed in COP26 conference. Way-forward strategies will be deliberated for the palm oil industry.

YB Zuraida officiated FPPO 2021

Datuk Hajah Zuraida Kamaruddin, Minister of Plantation Industries and Commodities (MPIC), Malaysia expressed her greatest appreciation to the organisers for inviting her to the event. She said MPIC is working closely with the stakeholders, including Indonesia, in making improvements on practices and sustainability while dismantling barriers to build a healthy competition in the international market. Zuraida highlighted that MPIC and numerous agencies have made efforts to promote the Malaysian palm oil industry, which is a responsible and environmentally friendly industry adhering to the international standards.

The minister elaborated that the government is dedicated to formulate policies to help qualified smallholders to obtain MSPO certification. The minister is keen to adopt circular economy in the palm oil industry to boost revenue. She encouraged mechanisation and automation to improve manpower efficiency, practise carbon neutrality and develop energy-efficient technologies. The conference began as Zuraida declared open FPPO 2021.

Figure 1: Opening address

Special address focused on sustainability

Datuk Dr Ahmad Parveez Hj Ghulam Kadir, Director General, Malaysian Palm Oil Board delivered his special address titled “Environmental sustainability practices”. The Palm Oil Mechanisation and Automation Research Consortium (MARCOP) was introduced, so to encourage more industrial players to apply mechanisation and to reduce labour issues. In today’s industry, drones and sensors are used to monitor diseases and planted areas. Software are also developed to monitor greenhouse gases GHGs) and to check parameters, such as temperature and rainfall. He summarised that MPOB will work collaboratively to develop high technology, including artificial intelligence and IR4.0, so the industry is more future ready and obtains higher return of investment.

Mohd Nazrul Izam Mansor, GCEO of FGV Holdings Berhad delivered his special address titled “Changing The Narrative: FGV’s Holistic Sustainability Strategy”. His speech focused on improving the mechanisation and digitalisation to support the achievement of net-zero carbon emission targets by 2050. The R&D centre at FGV utilises advanced genomics, cloning, and big data analysis tools for crop improvement through molecular breeding and oil palm DNA fingerprinting. Other modern techniques include the application of precision farming, drought-tolerant materials and drone-spraying methodology.

Experts shared views on reimagining the palm and kernel oils economy

The plenary addresses were delivered by the following presenters:

- **Mohammad Hafezh Abdul Rahman**, Chief Executive Officer, Malaysian Palm Oil Certification Council, strengthened that MSPO complies to most of the international requirements and in line with the Malaysia’s NDC commitments to the UN.
- **Dr Rosediana Suharto**, Executive Director, Responsible Palm Oil Initiative, highlighted that the implementation of carbon neutrality and circular economy which related to emission reduction may reduce the market access of palm oil to enter EU market.
- **Willem Klaassens**, Director Markets & SourceUp | BU Landscapes, IDH – The Sustainable Trade Initiative, stated that National Initiatives for Sustainable & Climate Smart Oil Palm Smallholders (NI-SCOPS) is important to build trust at all levels of supply chain.

- **Supun Nigamuni**, General Manager, Control Union Malaysia, stated that standardisation is vital to build confidences in products, services and systems.
- **Dr Belinda Howell**, Managing Director, Decarbonize Limited, presented that transparency has several importance, such as: to meet global and government expectations, to allow market access and is workforce attractive.

Rashyid Redza Anwarudin, Head, Group Sustainability, Sime Darby Plantation Berhad, was the Chair of Forum 1 "Future-proofing the palm oil industry with ESG enablers", which was joined by Chua Choon Hwa, Undersecretary for Palm Oil and Sago Industries Development Division, Ministry of Plantation Industries and Commodities (MPIC), Malaysia.

Figure 2: Speakers discussed about the future of palm oil economy.
From top left to bottom right:

- Dr Belinda Howell
- Dr Rosediana Suharto
- Mr Chua Choon Hwa
- Mr Willem Klaassens
- Mr Rashyid Redza Anwarudin
- Mr Supun Nigamuni
- Datuk Dr Ahmad Parveez Hj Ghulam Kadir
- Mr Mohammad Hafezh Abdul Rahman

POPSIG staged at FPPO 2021

Ir Dr Viknesh Andiappan, Deputy Chair of POPSIG, presented "Low Carbon Technologies and Energy Efficiency in Palm Oil Milling Processes" during FPPO 2021. In his presentation, he outlined that the introduction of negative emission technology and the utilisation of biochar for plantation are valuable suggestions. Enzymatic processes are also useful to improve oil yield and reduce emissions, while microwave sterilisation technology (FFB) can eliminate POME and reduce moisture in EFB. The quantification of the emissions is needed to provide clear proof of achievements, identify areas for improvements, set reasonable targets and policies.

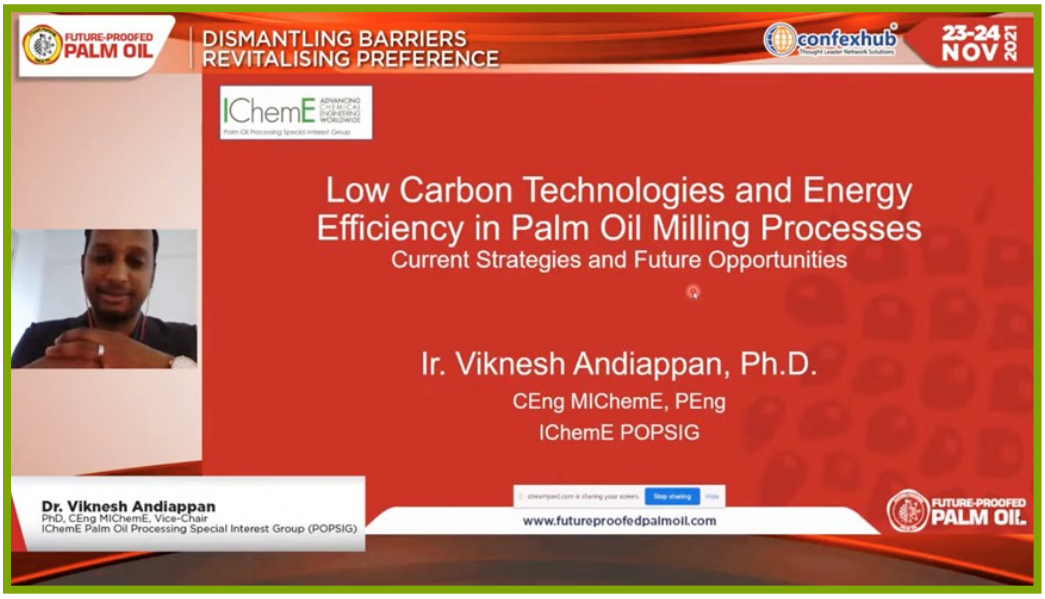


Figure 3: Ir Dr Viknesh Andiappan presented suggestions about low carbon technologies.

Professionals expressed their views about innovating to net-zero

Several papers were presented by other presenters:

- **Pedro Carrillo Donaire**, Chief Executive Officer, ec2ce, presented that data prediction improves predictive capability, labour organisation and forecasting.
- **Dr Leonardo Bonanni**, Founder/CEO, Sourcemap, presented that mapping the end-to-end supply chain adds value to every aspect of the business, including procurement, responsible sourcing, legal and IT areas.
- **Dr Preetam Singh**, Founder, Biezel Green Energy Pvt., introduced thermally accelerated anaerobic digestion (TAD) technology for unlocking the fuel potentially presented in biomass and providing higher energy value than gasification technology.
- **Dr Shariman Alwani Mohamed Nordin**, Chief Strategy & Innovation Officer, Sime Darby Plantation Berhad, outlined strategic approaches with external parties, including: open innovation platform, co-development with start-up, collaboration with academic, technology deployment with service provider, and partnership with corporate and agency.
- **Professor Ir Dr Denny K. S. Ng**, Associate Head, School of Engineering and Physical Sciences, Heriot-Watt University, Malaysia, summarised that circular economy is the foundation of net zero while regional planning beyond palm oil industry is important.
- **Jonathan Ong**, Country Manager, APAC, Planet, presented that satellite data can be used to monitor remote areas where the deforestation risk is high, and the planting progress can be determined in Peninsular Malaysia.

Professor Dato' Dr. Ahmad B. Ibrahim, Head of Research at Confexhub Group, Advisor at Fraunhofer was the Chair of Forum 2 "Technological strategies in meeting net-zero, mechanisation and digitalisation targets".

Figure 4: Ir Dr Viknesh Andiappan and other speakers joined the forum to discuss about net zero, mechanisation and digitalisation.

Event: MPOGCF: Issues and Challenges of Biodiversity Conservation in the Palm Oil Industry in Malaysia

On 23 November 2021, Malaysian Palm Oil Green Conservation Foundation (MPOGCF) hosted a webinar themed "We are the solution". The objectives of the two-day webinar are outlined as follow:

- To identify the issues and policies related to biodiversity conservation
- To share the role of industry and NGOs in biodiversity conservation
- To mobilize research and development ideas from research institutions
- To build a structured networking for green conservation activities

Opening speeches described the ambitions of palm oil story

Mr Zamakhshari Muhamad, General Manager of MPOGCF delivered the opening remark. He introduced that the palm oil industry significantly contributes to Malaysian socio-economy in achieving sustainable development goals, driving rapid economic growth, and contributing to the elimination of rural poverty. Actions need to be taken against the anti-palm oil activities to retain Malaysia's position among the top 12 mega-biodiversity countries in the world. This also required the government commitment in sustainable management on natural resources and environmental conservation.

YB Datuk Hajah Zuraida Kamaruddin, Minister of Plantation Industries and Commodities (MPIC), Malaysia said in her keynote address that the palm oil industry creates integrated changes in the economy, jobs and workforce. In 2020, Malaysia produced 25.8% of the world's palm oil production and 34.3% of the world's export, while the industry is facing competitions with other vegetable oils. More researches and technologies are needed to increase exports, improve quantity and quality of palm oil, and produce competitive products. MPOGCF will continuously fund R&D on all issues addressed in anti-palm oil campaigns. While Malaysia has declared to maintain at least 50% of her forestland, the stakeholders, GLCs and professional bodies can contribute to the government policies on biodiversity conservation. Datuk Zuraida said that the chairs from MPOGCF and the universities that are identified by the relevant secretariats can advise the gov on the biodiversity management.

Figure 1: Mr Zamakhshari Muhamad, General Manager of MPOGCF delivered his opening address.

Figure 2: YB Datuk Hajah Zuraida Kamaruddin, Minister of MPIC, Malaysia delivered her keynote address.

Policies and actions

Datuk Dr Ahmad Parveez Hj Ghulam Kadir (Director General of MPOB) presented that oil palms are immobile and exposed to various environmental stresses, such as: temperature fluctuation, soil-water status and light intensity. He suggested that it is important to have pragmatic approach and inclusiveness in developing sustainability, and give assurance on conservation activities.

Dr Khairul Naim bin Adham (Division Secretary, Biodiversity Management Division, Ministry of Energy and Natural Resources - KeTSA, Malaysia) suggested to strengthen MSPO implementation, develop a conservation plan, encourage industrial contributions, enhance HCV approach and intensify awareness campaigns.

Dato' Abdul Kadir bin Abu Hashim (Director General, Department of Wildlife and Natural Parks Peninsular Malaysia - PERHILITAN) urged that all NGOs, academia and media should play their role to support the wildlife protection programmes. The public support to the government effort on *Selamatkan Harimau Malaya* (SHM) campaign is essential to protect Malayan tigers from extinction.

Dato' Dr Hj Mohd Puat bin Dahalan (Senior Director of Forest Management Division, Forestry Department of Peninsular Malaysia) outlined numerous programmes and initiatives to reduce human-wildlife conflict, drive ecotourism, contribute to carbon absorption, and create coincident solution for the long term.

Mr Mohammad Hafezh Abdul Rahman (CEO of MPOCC) highlighted that MSPO is a national commitment to produce sustainable palm oil. On economics, he recommended that the communication on responsible sourcing to trading partners, incentives for efforts and continuous improvements are essential to power sustainability in Malaysian palm oil sector.

Dr Ruslan Abdullah (Director of Science, Environment and Sustainability Division, MPOC) presented that the industry is challenged with the compliance with internationally acceptable sustainability standard, sustainability, regulation, food and contaminant. He addressed that MPOC will continue to provide correct information and seek equal opportunity for all vegetable oils.

Tan Sri Dr Salleh Mohd Nor (Senior Advisor, Malaysian Nature Society – MNS) was the moderator of the Day 1 discussion forum.

Figure 1: Professionals exchanged their opinions during the Day 1 discussion.

Action of research agencies, NGOs, and industry in the palm oil industry

Tan Sri Datuk Dr Yusof Basiron (Executive Director at CPOPC) identified three key research challenges on sustainability and highlighted that comparative fact-based research would be the new challenges for sustainability debate.

Dr Hajah Yatela Zainal Abidin (CEO of Yayasan Sime Darby) described that Sime Darby's Plantation and Yayasan Sime Darby focused on biodiversity, reforestation and rehabilitation, and human and wildlife coexistence for environmental conservation.

Professor Dr Shukor Md Nor (Head of Department, Biological Sciences & Biotechnology, Faculty of Science & Technology, Universiti Kebangsaan Malaysia - UKM) concluded that the implementation of strategies to accommodate the maximum amount of wildlife species was crucial for conservation, while the importance of research was underlined to uncover and redesign the approaches for conservation.

Professor Emeritus Dato' Dr Abdul Latiff Mohamad (Research Fellow, UKM) suggested to conduct biodiversity assessment to understand the ecological dynamics. He proposed the enrichment with biodiversity and replanting, particularly in buffer zone that should be redesigned to be enlarged.

Mr Vincent Chow (Vice President, MNS) highlighted that the government is an important stakeholder in environmental issues, while NGOs should collaborate with relevant departments such as: Ministry of Energy and Natural Resources (KeTSA).

Dr Henry Chan (Conservation Director, World Wide Fund For Nature - WWF) suggested that it is required to frame a credible narrative of sustainable palm oil in Malaysia, while Malaysia's large forest blocks provide healthy carbon sink and natural habitat for wildlife.

Professor Dr Ahmad Ismail (President of MNS) was the moderator of the Day 2 discussion forum.

Figure 2: Professionals exchanged their opinions during the Day 2 discussion.

Webinar: CPOPC: Outlook for Challenges and Opportunities for Palm Oil Producers

On 23 November 2021, Council of Palm Oil Producing Countries (CPOPC) hosted a webinar to discuss the challenges and opportunities faced by the palm oil producers. The forum discussion was moderated by Tan Sri Datuk Dr Yusof Basiron, Executive Director of CPOPC.

Opening addresses about formulating strategies

The opening addresses were delivered by Mr Moch Edy Yusuf and Datuk Ravi Muthayah. Mr Moch Edy Yusuf, Assistant to Deputy Minister for Estate Crops' Agribusiness Development Coordinating Ministry for Economic Affairs, Indonesia said that OCOPOP was organised to meet objectives of CPOPC to strengthen collaborations between palm oil producing countries. It also aimed to inform and update the palm oil supply demands and price situations and make forecast for the upcoming years. As Indonesia is one of the main producing countries of palm oil, Moch Edy stated that Indonesia has designed a downstream palm oil industry development roadmap to improve productivity and support downstream activities, create ecosystems, implement good governance, improve capacity building, and develop technology to boost palm oil businesses.

Figure 1: Mr Moch Edy Yusuf, Assistant to Deputy Minister for Estate Crops' Agribusiness Development Coordinating Ministry for Economic Affairs, Indonesia delivered his opening address

Datuk Ravi Muthayah, Secretary General at the Ministry of Plantation Industries and Commodities (MPIC), Malaysia focused on three aspects: supply, demand and prices at global market. He said the development of balanced supply and demand strategy will provide sustainability in the livelihood of the smallholders. The authority will formulate strategies for sustainable supply and demand, mitigate trade challenges and develop opportunities for palm oil producers. To increase export, he suggested that corporate measure needs to be taken to obtain a fair price and be prepared to face market challenges.

Figure 2: Datuk Ravi Muthayah, Secretary General of MPIC, Malaysia delivered his opening address

OCOPOP presentations outline

Mr Thomas Mielke, Editor and CEO, Oil World ISTA Mielke GmbH

It was shown that the oils and fats market is dominated by palm oil and soya oil. Although the estimation for the global palm oil production was estimated at 79.4 million in 2021/22, it was justified that palm oil has lost its growth dynamics while the annual average growth will slow down in the next 5 to 10 years. In his view, the current high prices of vegetable oil are not sustainable. With the increasing production and stocks, it was predicted that the prices of palm, sunflower and soya oils will fall in Jan/Jun 2022.

Mr UR Unnithan, President of the Malaysian Biodiesel Diesel Assocation

UR presented that over 90% of Malaysian biodiesel exports are destined to the EU with most consumption in Spain, Italy, Germany and France. Tightening EU regulations will result in lower exports from Southeast Asia. It was projected that in 2022, Malaysian biodiesel exports will fall to the lowest in five years. As the B20 biodiesel for transport was announced in February 2020, its implementation started on 1 January 2020 and will soon cover the entire nation at the end of 2022. In the 12th Malaysia Plan (RMK-12), it aims for B30 for transport by 2025, while the requirements for the industry will gradually progress towards B30. In the RMK-12, carbon tax will also be rolled out to justify the economics of higher local mandates.

Ms Leow Huey Chuen, Director ASEAN Plantation Research, UOB Kay Hian Securities (M) Sdn Bhd

Huey Chuen stated that policy change in the palm oil importing countries is impactful to the palm oil production. EU introduced non-trade barriers, such as: RED II and proposal for a regulation on deforestation-free products. India launched "Mission on Edible Oil – Oil Palm" to encourage more oil palm planting in the nation. On positive side, China rolled out a technical blueprint to reduce dependency on imported soybean and corn. Overall, the production of Indonesia and Malaysia in 2021 fell below expectation, due to dry weather in 2019 and La Nina in 2020. COVID-19 pandemic and labour shortage were also the contributing factors to the operational disruptions. She concluded that the supply outlook remains supportive to the current elevated price.

Mr Togar Sitanggang, Deputy Chairman of IPOA

Togar highlighted that Indonesian production growth will be affected due to lack of new planting area. In short term, levy revision was not required. While the current price of world vegetable oils is high, Indonesian domestic cooking oil price should embrace this high price. World commodities prices are on the high side, and this will make inflation rate high, including in Indonesia.

Dr Julian McGill, Head of South East Asia, LMC International Ltd

As the pandemic situation eases, foreign workers start their employments in Malaysia and it resolved the labour shortage on the plantation. The demand for palm oil will still reduce despite substitution towards sunflower oil and locally produced rapeseed oil.

Dr Mohamad Fadhil Hasan, Director of Corporate Affairs at Asian Agri Group

Dr Fadhill Hassan's study showed a positive impact of an increase of domestic biofuel consumption on the prices of CPO. Previous study identified that the volume of domestic biofuel program has a positive correlation with the domestic prices of FFB and CPO. Hence, the overall impact of biofuel program is dependent on the variable that has a stronger effect on the CPO prices.

Engage and identify feasibility are critical to uplift the industry

Mr Mohd Haris Mohd Arshad, Managing Director at Sime Darby Oils, Malaysia suggested that the mill owners could reconfigure the structure of their mills and the industry should investigate on feasibility beyond specification. Mr Bernad Lim, General Manager at First Resources Trading, Singapore commented that the consumption of palm oil in renewable energy will be discontinued in the EU as the situation develops in Brussel while RED II will phase out palm oil products until 2030 in EU. He added that the decrease in the palm oil import was in the food sector. He suggested CPOPC to directly engage with EU while palm oil producers should investigate the approaches to sustain the volume of imports into EU.

Figure 3: Panel discussion was chaired by Tan Sri Datuk Dr Yusof Basiron, Executive Director of CPOPC.

Event: Vincent Tiang Discussed IR4.0 Development at NACES 2021

Introduction

National Chemical Engineering Symposium (NACES) has been organised for over one decade since 2009. Each year, the symposium focuses on different areas in chemical engineering, from clean technologies to environmental management, which contribute to the sustainability of many industries, such as: oil and gas, energy, and palm oil sectors. UTM had hosted the NACES in 2011 with the theme of "Sustainable Development", and 10 years later, UTM hosts the 12th annual symposium again in 2021. The theme of NACES 2021 was "Industrial Revolution 4.0: Transcending Process Industry Boundaries".

Vincent declared open NACES 2021

Vincent Tiang Soon Thai, Roadshow Director at POPSIG, was honoured to officiate NACES 2021 via Cisco Webex on 10 December 2021. In his opening address, he congratulated UTM for hosting the symposium for the second time. Vincent was delighted to be invited as a panellist for the forum, and hoped it could serve as a platform for in-depth discussion and promote better understanding about chemical engineer's role in digitalisation.

He addressed that IR4.0 is all about cyber physical system, which includes internet of thing, machine learning and cloud computing. The COVID-19 pandemic, which has changed the norm of our daily life, has significantly boosted digitalisation in almost every sector. Since last year, many activities are shifted to online system, such as: e-commerce, e-learning, e-banking and e-meeting.

He advised that young engineers have a significant role in transforming palm oil into cooking oil, margarine, cosmetic and food products through the use of advanced automation and digitalisation. The companies in palm oil industry apply IT systems to incorporate blockchains to improve data integrity, transparency, and traceability. It helps minimise human errors and track manhours to resolve labour issues, while satellite imaging promotes sustainable sourcing and monitors planting progress.

Figure 1: Vincent Tiang declared open NACES 2021.

Industrial revolution in palm oil sector

On 12 December 2021, Vincent presented his views about industrial revolution in the forum titled “Mastering IR 4.0: Transforming The Engineering Process Towards Digitalization”. Availability of the data, connectivity and data analysis are the vital elements of IR4.0. The information needs to be measured and stored to allow the data to be analysed for making important business decisions. As the industries are globalising, connectivity helps improve supply chain and evolve the business operation towards modern industry.

Vincent shared that the function of the department of production and engineering is to transform raw materials into desirable products in a safe and clean manner. The workers will analyse the data collected, such as: temperature, pressure, and flowrates. Through the interpretation, suggestions are made to optimise the process, improve energy efficiency and reduce waste.

As COP26 conference in Glasgow settled down, numerous initiatives are proposed to tackle the alarming climate change. Many countries made the pledge as outlined in Glasgow Climate Pact to monitor carbon emission and improve net-zero strategies. It also gives a clearer picture on the modern oil palm plantation, natural conservation and wildlife protection.

Vincent highlighted that the younger generations should equip themselves with critical thinking and openness to learning new skills. As the world evolves, automation technologies will safeguard the employment opportunities while more high-value tasks will be offered to the graduates. Low-skilled labour will be trained to equip themselves with advanced techniques in the current industry. Engineers play important roles in improving the automation, techniques and data management, so the health and safety of the employees are improved.

In summary, business is improving to adapt to changes in this rapidly changing world. Skilled workforces will help drive the revenue of a firm and introduce novel methodologies to improve the quality of life and raise living standards. As the virtual symposium concluded, Vincent expressed his gratitude to the organising committee for inviting him to open NACES 2021 and to join the forum for discussion.

Figure 2: Vincent Tiang presented his view about IR4.0 and digitalisation in palm oil industry.

Webinar: Competere: Small-Holders: Drivers of Prosperity and Sustainability

On 14 December 2021, Competere hosted a roundtable with smallholders operating in the oil palm supply chain, the pumping heart of global production. The mixed of English and Spanish conference were contributed by Gert van der Bijl (Senior EU Policy Advisor, Solidaridad, The Netherlands), Djono Albar Burhan (Indonesian Palm Oil Smallholder Association, APKASINDO), Adzmi Hassan (National Association of Smallholders Malaysia, NASH), Juan Alberto Lemus Silva (Agroindustria Palmera San Román, Guatemala), Maria Goldameir Mektania (smallholder, Indonesia), Daniel Mauricio Rico Valencia (Founder and Director, C-Análisis, Columbia), Teresa Peña (smallholder, Columbia) and Nelsy Vega (smallholder, Columbia). Pietro Paganini, President of Competere was the moderator of the webinar.

It was summarised that:

- Smallholders play important role to improve a holistic sustainable development and to achieve zero deforestation.
- The new EU policies should not ignore the role of smallholders in food production. The isolation would lead to higher poverty, lower living standards and individual rights for billions of people, and suffer a reversal of action to tackle climate change.
- It is vital to involve smallholders by taking actions on proactive policies, intensive investments in palm oil producing countries and active engagement with EU institutions.
- Oil palm plantations provide opportunities for smallholders in developing countries, including increasing job opportunities, enhancing living quality, improving the labour rights and regulations.
- Green colonialism must be avoided.

Figure 1: The panel expressed their views about the roles of smallholders in modern palm oil industry.

Figure 2: The speaker presented about the effect of oil palm on social and economics

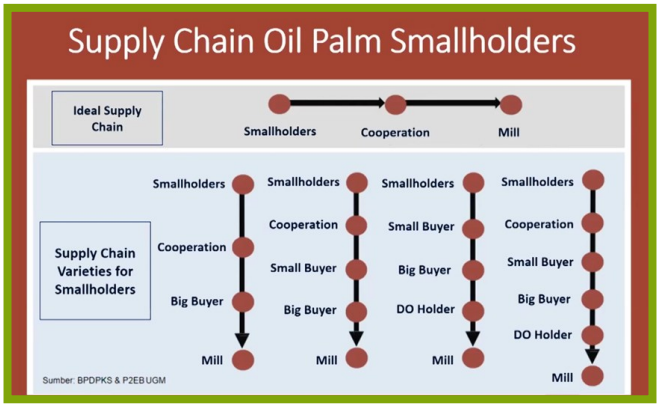


Figure 3: Djono presented his talk on the supply chain involving oil palm smallholders.

Roadshow: UCSI Student Chapter

Written by Nur Haliza binti Jamal Mohamed Nazar (UCSI University)

The palm oil industry is one of the industries that have been on the sensitive side of the spectrum of industries. Some are completely against the palm oil production, and some are for the palm oil production. The main factor of the opposition is due to the extensive deforestation of tropical forests by the palm oil industry, which consequently destroys the wildlife habitat of endangered species such as the Malayan tigers in Malaysia. These forests are cleared to make room for the palm oil plantations. Contrastingly, some people support the palm oil production forasmuch that the palm oil industry has aided in lifting millions of people out of poverty in Indonesia and Malaysia by providing well-paid jobs. Nevertheless, the common ground is that palm oil is one of the most applicable vegetable oil in the world. Palm oil industry is one of the largest industries in Malaysia. According to World Wildlife Fund (WWF), the palm oil industry supports about 4 million jobs in Indonesia and Malaysia alone.

The role of chemical engineers in the palm oil industry was exquisitely explained by Mr. Prasath Ramani, an Industry Technology Specialist from Novozymes during the IChemE POPSIG Webinar organised by UCSI IChemE Student Chapter on 31st July 2021. He highlighted the importance of the chemical engineer's roles in the palm oil industry since palm oil is one of the main components found in most everyday use items such as soaps, margarine, chocolate and cooking oil. Despite all of this, the palm oil industry has been under scrutiny due to the effect of deforestation. Based on BBC, about 8% of the world's deforestation occurred between the years 1990 and 2008 is caused by the production of palm oil alone. Besides that, the palm oil industry causes deliberate burning of forests to clear areas to grow oil palms which consequently causes greenhouse gases to be released to the environment that attributes to climate change.

As chemical engineers, our responsibilities are dominant in almost every step of the palm oil processing. Palm oil milling process, crude oil refining, fractionation process, modification of oil and lastly the oleochemical production are just some of the processes that chemical engineers work on. The common household palm oil products are often overlooked. Products such as cosmetics has an astonishing number of processes required to produce the final product from the raw product. Knowing all this, you must be wondering what are the impacts on the country's economy from the palm oil industry and also the job prospects for future chemical engineers. If the use of palm oil were to be banned all over the world, millions of chemical engineers who are currently working in the palm oil industry will lose their jobs. As one of the biggest industries in Malaysia slows down, the employee density of companies from other sectors will increase to a point where it's completely saturated. Ergo, at such point, there are going to be some chemical engineers who will no longer have an engineering profession. It can be predicted that the future for current chemical engineering students is going to be more competitive and it's going to be difficult to get a job.

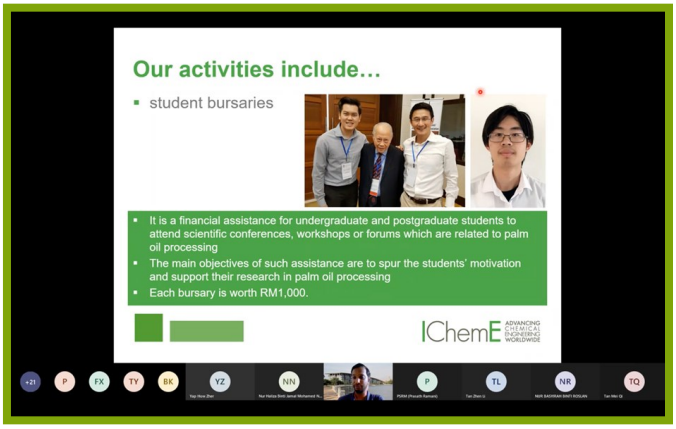


Figure 1: Presentation by Ir Dr Viknesh Andiappan

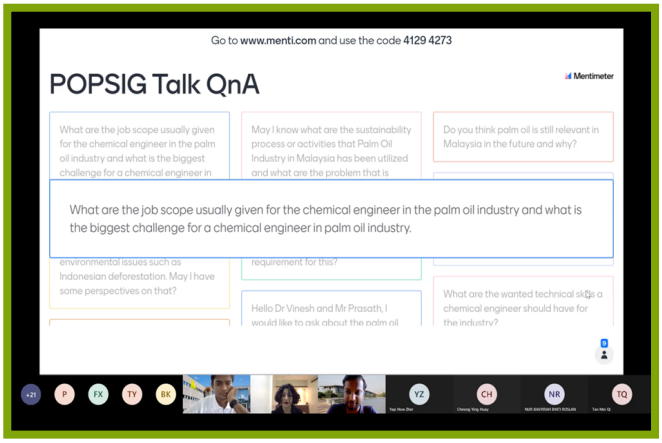


Figure 2: Question and Answer (Q and A) session

On the other hand, it is illogical to think that every country in the world will ban the use of palm oil considering palm oil is widely used as a raw material for certain products. As engineers, we should emphasize the importance of the public's health, safety and welfare and the environment around us. Of course, some activities such as deforestation and clearing the lands by forest fires are not in any way environmental-friendly. Would the use of sunflower oil, rapeseed oil or soybean oil be any better than palm oil? Relatively speaking, the palm oil uses the least amount of land compared to any other vegetable oil. Ergo if we do eliminate the palm oil production, we will just end up using more land to produce other vegetable oil. This discussion was brought up during the Question and Answer (Q & A) session of this event and Ir Dr. Viknesh Andiappan, the vice-chair for IChemE POPSIG gave a good insight into the portrayal of the palm oil industry in the media. Indubitably, it is detrimental for us listen to both sides of the story as it is a salient aspect for us to make a proper conclusion.

Roadshow: IChemE POPSIG East Malaysia University Roadshow

Written by Evane Serrah June Gani (Curtin University Malaysia)

On the 14th September 2021, Curtin Malaysia IChemE Student Chapter and Swinburne University of Technology Sarawak campus Student Chapter had organised IChemE Palm Oil Processing Interest Group (POPSIG) East Malaysia University Roadshow in collaboration with Palm Oil Processing Special Interest Group. The participating universities include Curtin University Malaysia (CM), Swinburne University of Technology Sarawak campus (SUTS), Universiti Malaysia Sabah (UMS), Universiti Malaysia Sarawak (UNIMAS), University College of Technology Sarawak (UCTS), Universiti Teknologi Brunei (UTB), and Institut Teknologi and Sains Bandung (ITBS), Indonesia. A total of 157 participants had participated in this event.

The invited industrial and academia speakers comprised of Dr Viknesh Andiappan (Deputy Chair for IChemE POPSIG & Assistant Professor at Herriot Watt University Malaysia), Mr Galau Melayong (Head of Sustainability, Sarawak Oil Palm Berhad (SOPB)), Mr Prasath Ramani (Industry Technology Specialist at Novozymes), and Ms Vicky Chia (Senior Executive from Science, Environmental and Sustainability Division at Malaysia Palm Oil Council (MPOC)) meanwhile industrial panellists consisting of Ir Tian Foon Howe (Senior Mill Manager at MJM (Palm Oil Mill) Sdn Bhd), and Ir Shyam Lakshmanan (General Manager, IOI Edible Oils Sabah)

CM's Faculty of Engineering and Science, Professor Tuong-Thuy Vu, in his opening speech, said though hosting an online event had its inherent technical challenge, it also had its advantages to the audience. In addition, he also thanked the organiser, invited speakers, and panellists, and participants for making this event a successful one. He also hope the participants would benefit from this educational event and this could provide university-industry collaboration to advance in the palm oil industries.

Dr Viknesh Andiappan had provided an introduction to POPSIG. In his speech, he had highlighted the POPSIG objectives. One of the activities from POPSIG include providing student bursaries to attend scientific conferences, workshops, or forums which are related to palm oil processing. This is to support and motivate the students to undertake research in palm oil processing. The second activity is the webinars and online seminars organised by POPSIG and MPOC. In addition, he also announced the call for the Best Post Event submission for East Malaysia Universities and introduced the Hong Wai Onn Individual Project Award and POPSIG Honorarium (Student) for Best Palm Oil-themed Article with the theme of 'Correcting the Misconception of Palm Oil'.

Figure 1: Mr Prasath Ramani from Novozymes

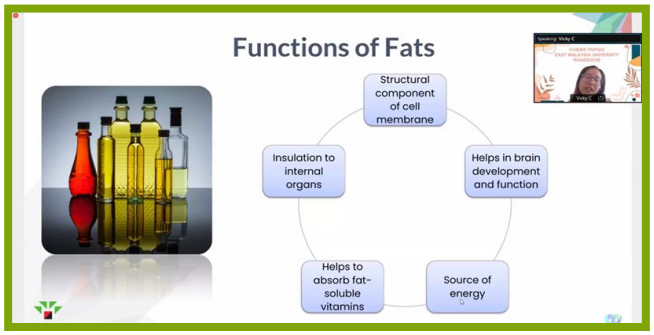


Figure 2: Ms Vicky Chia from MPOC

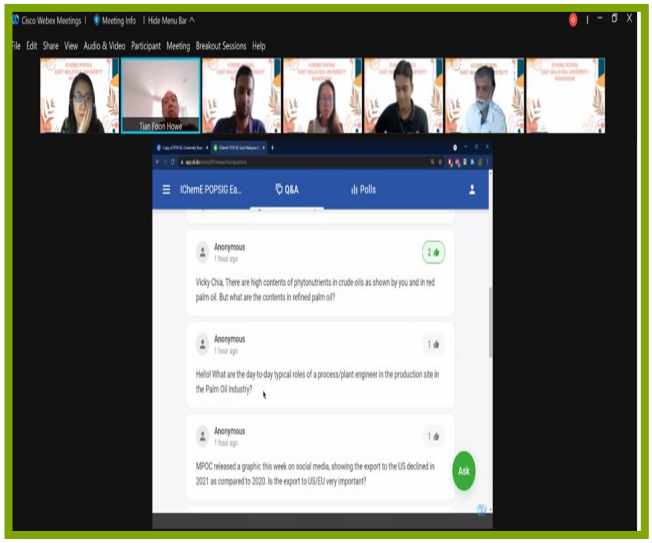


Figure 3: Forum discussion with panelists and speakers.

In Mr Prasath's talk, he had presented a talk entitled on, 'The Role of Chemical Engineers in the Palm Oil Industry'. His presentation consists of palm oil processing industry, integration and application of chemical engineering knowledge, and challenges lying ahead in the palm oil industry. He also shared the employment outlook for chemical engineers in palm oil industries. Lastly, he also mentioned that forefront on new emerging technology will sustain employment growth. Ms Vicky's talk include the overview of palm oil, and nutrients available (fats, phytonutrients, vitamin E, and pro-vitamin A) in oil palm, and food application and advantages derived from palm oil. Mr Galau's show us the Sarawak Oil Palm Berhad corporate video and also presented a virtual site visit of palm oil processing mill. He also presented the oil palm industry value chain which consists of upstream (planting, cultivation, and harvestation), midstream (refining, and processing), and downstream (End-product, brands, and industrial derivatives processes. In addition, he also shared the challenges in the image of the palm products in the marketing level.

The topics discussed during the panellist forum discussion are palm oil industry recovery plan during the COVID-19 pandemic situation, palm oil industries and POPSIG green initiatives, initiatives undertaken by palm oil industries to address the challenges faced by them today, day-to-day typical roles of process engineers or plant engineers in the production site in the plant oil industry, and the industrial panels view on the European Union countries plan to apply a ban on palm oil, and sustainable approaches implemented in the oil palm industries.

During the event, an online quiz with 19 multiple choice questions was conducted for the participants to answer. The online quiz questions were derived from the invited speakers talk. Each winners will be awarded a cash prize of RM 50. There are 4 winners from each university. From CM, the winners consist of Priyankavini Maga Nadan, Melvin Wee Xin Jie, Elvira Evita Erich, and Rachel Yee Fung Mei. From SUTS, the winners are Stephanie Wong Ying Lin, Precious Keza Bisangwa, James Seo Chai Fah, and Audrey Stefanie anak Julip. For UCTS, the winners are Wong Jing Xiong, Elvis Tang Swee Bin, Ling Xia Yun, and Alex Sim Kiat Lung. For UMS, the winners are Ornell Tamin, Syahidatul Shafiqah binti Ramlee, Nurul Amni Samuel, and Nurin Nadia bini Hariffin. Lastly, the winners from UNIMAS are Chan Yong Soon, Vanecey Jakelei, Eva Natasya Chloreg, and Danny Lee Wei Lun.

Figure 1: Group photo session during the IChemE POPSIG East Malaysia University Roadshow.

Roadshow: University of Nottingham Malaysia

Written by Chan Yuan Hui and Chai Yi Ni (University of Nottingham Malaysia)

On the 6th November 2021, IChemE POPSIG X UNM IChemE Roadshow started with a warm welcome speech by Professor Ir Dr Law Chung Lim, the Dean of Faculty of Science and Engineering at UNM. After a round of appreciation for the guests, the roadshow officially started with 89 online participants. Firstly, Mr Vincent, a representative from IChemE POPSIG started his introduction talk on IChemE POPSIG. Through Mr. Vincent we learned a bit more about the history of IChemE and initiatives taken by them. IChemE aims to advance the Chemical Engineering industry worldwide by being the leading accrediting body for university courses and company training alongside being the publisher of The Chemical Engineer which seeks to keep all their members up to date with new updates within the industry.

Palm Oil Processing Special Interest Group, or POPSIG for short was formed on the 3rd of August 2015 to provide a forum for exchange of ideas regarding the palm oil related matters in order to promote the innovation within the palm oil industry. The main objectives of POPSIG are to share and promote best practices throughout the entire production and processing stream within the Palm Oil Industry, encouraging innovation in processing of oil palm products, promote professional aspects of the palm oil industry and to become the focal point for all that is interested in the process aspects of oil palm processing.

With that Mr. Vincent's brief introduction into IChemE and IChemE POPSIG. Following that, Ms. Liew Sin Lu's talk with the title of "The Role of Chemical Engineers in the Palm Oil Industry" started. The talk started with a short briefing on the session outline of the talk. According to Ms. Liew, oil palm tree requires a tropical climate to grow healthily which is why Indonesia and Malaysia are responsible for most of the world's production and export of palm oil. Later, Ms. Liew briefly explained the processing flow of oil palm crops to us. Palm oil refinery and fractionation plants are needed to process the crude palm oil into a product that suits our needs. Modification of the oil is carried out so that palm oil can be further separated into different types of oils exhibiting different properties resulting in a wide selection of products such as margarine, frying oil, cocoa butter substitute and salad oil.

To close out her talk, Ms. Liew discussed about the challenges lying ahead the palm oil industry. According to her, the role of chemical engineers is to get idea and knowledge through research and studies and then collaborate with other to incorporate them into a process to improve its sustainability and safety. Ms. Liew also reiterates that chemical engineers can be found in many areas and it is mostly up to our own interests and strengths.

After the informative talk by Ms. Liew, a short break was given. Following that, the event continued with the second talk entitled "What Do You Know About Palm Oil?" presented by Ms. Noraisyah Zulkawi from the MPOC. Her focus of the talk is about the palm oil in global context, palm oil nutritional benefits, the application of palm oil as well as the challenges and effort in the oil palm industry. It was introduced that the palm oil is the most productive vegetable oil in terms of yield per hectare compared to other vegetable oils such as soybean oil, rapeseed oil and sunflower oil. Moreover, she also talked about the nutritional benefits of the palm oil.

After the talk session by Ms. Aisyah, it was followed by the virtual site visit to the MPOC certified palm oil mill in Malaysia led by Ir. Hor Kok Luen in which a site tour video shot using drone was shown. During his presentation, he mentioned that the palm oil mills are generally located in the heart of the oil palm plantation area, thus easing the transportation of the fresh fruit bunch (FFB) and the products. Also, energy and power are normally generated on site which makes the palm oil mill self-sustainable.

Finally, the event ended with a 10-minute quiz session using an online platform, Quizizz to increase the engagement and interactions between the participants and the speakers. Questions related to the information mentioned in the previous sessions were asked during the quiz.

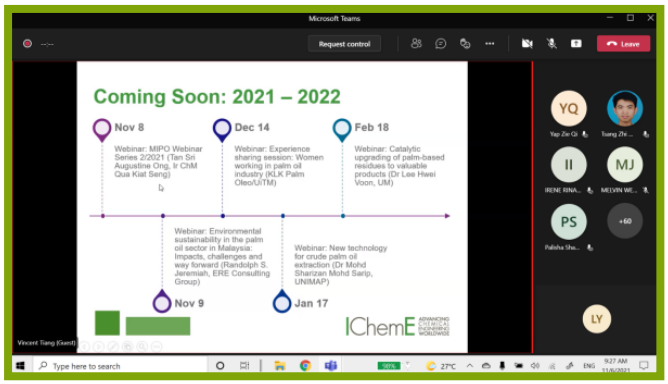


Figure 1: Presentation by Vincent Tiang from POPSIG

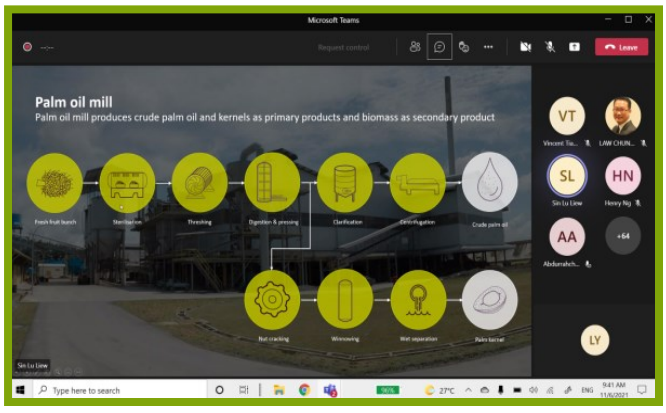


Figure 2: Presentation by Liew Sin Lu from Desmet Ballestra

Figure 1: Presentation by Noraisyah Zulkawi from MPOC

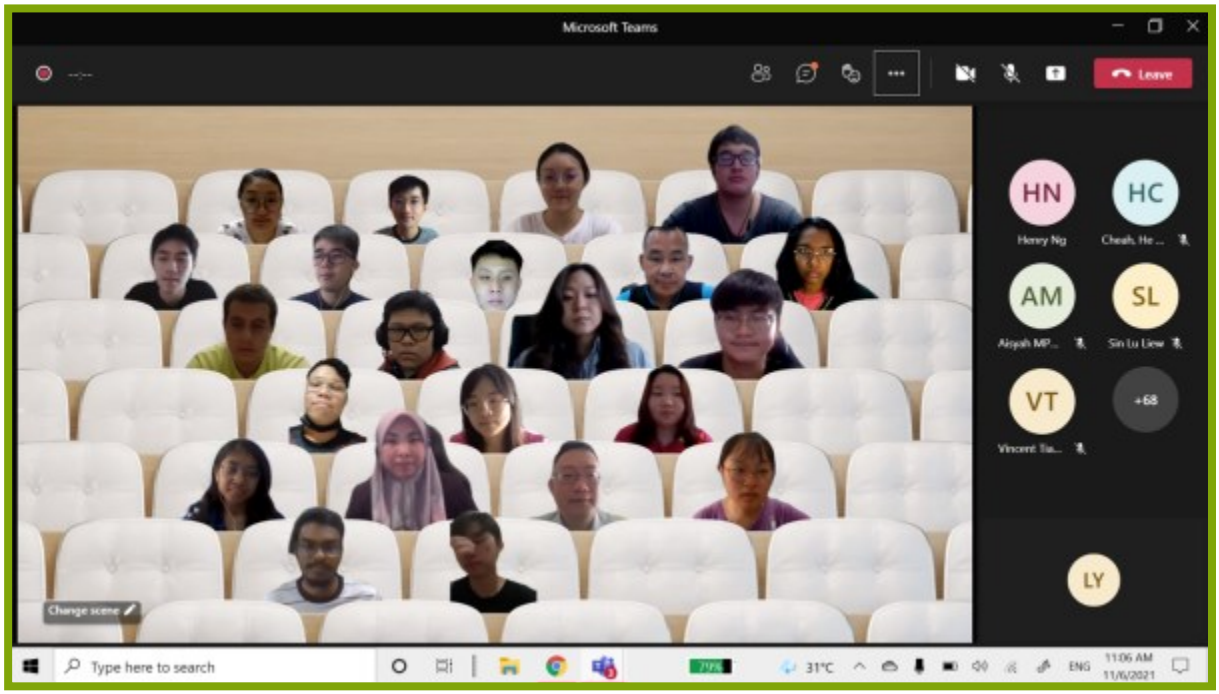


Figure 2: Group photo session with speakers

Roadshow: Xiamen University Malaysia

Written by Silvanir and Leiu Yu Xuan (Xiamen University Malaysia)

On 27th November 2021, a one-hour session of POPSIG talk was organized by Xiamen University Malaysia (XMUM) IChemE Student Chapter. The event featured talk by Mr. Thillai Kali, PMP on the topic of "Future Potential Valorization of Palm-Oil or Its Waste into Other Value-Added Products". The invited speaker, Mr. Thillai Kali, MP is a representative of POPSIG who graduated from University Putra Malaysia. He had over 8 years of working experience in the oil and fat industry. To date, he is working as a Project Manager at Alfa Laval Group that focuses on edible oil processes.

The objectives of the event are to expose students to the prominent palm-oil industry and to uncover the future potential of palm oil by providing a free platform for the students to have direct interaction with a well-versed POPSIG representative.

A total of 55 participants from Xiamen University Malaysia attended this event.

In the introduction, Mr. Thillai emphasizes the topic of the new concept of palm oil wastewater management that revolves around the Alfa Laval Company. Alfa Laval Company is a Swedish-based company that provides an engineering solution for the palm oil industry for the last 15 years. His presentation covers the operation chain industry, current global palm oil issue and adopted solutions, effluent generation from adopted solutions, and value-enhancing steps towards effluents.

Before going deeper, Mr. Thillai explained the general palm oil processing as well as the major challenges in various sectors, especially in the health department. Recent findings had highlighted the carcinogens in a well-known biscuit brand. This burdened the refinery process of the palm oil industry due to the discovery of 3-MCPD as one of the carcinogens. The culprit originated from the chloride ions presence that was passed down from the fertilizer, soil, and water in the upstream processes. Chloride ions reacted with the primary product, TAG, forming 3-MCPD.

Alfa Laval Group conducted a series of experiments to mitigate this obstacle. It was found that washing the crude palm oil (CPO) with alkaline water was a promising method that reduced the chloride composition by 84%. This process was then designed at an industrial scale using a centrifuge to separate the water and clean oil.

However, it has some drawbacks regarding the heavy volume wastewater effluent produced. With the current costly wastewater treatment technologies, Alfa Laval Group utilizes the basic concept of oil recovery using evaporation and separation and come up with a backwards feed multiple-effect evaporator that successfully reduced the volume of wastewater effluent by 80% through methods of evaporating the palm oil effluent into two factions, distillate for recycle water and recovered oil. Additionally, oil losses from the plant can be reduced by introducing oil recovery procedures using decanter and evaporation to the highly concentrated oil.

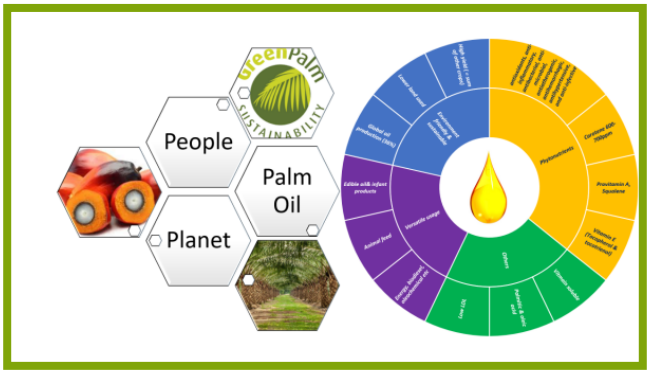
Before ending the POPSIG Talk session, Mr. Thillai informed the students about the upcoming event from POPSIG and proceed with the QnA session, which concludes the end of the POPSIG Talk event in XMUM.

Figure 1: Group photo session during the Xiamen University Malaysia IChemE Registration X POPSIG Talk

Article: Let Us Not Allow to Recur with Palm Oil

Written by Yung Yen Li, Shyam Lakshmanan, Kong Sing Lim & Joanne Sonia (IOI Edible Oils Sdn Bhd)

Graphical Abstract



Oil palm (Elaeis guineensis.) originates from Africa and it grows well close to equator regions with sufficient rainfall throughout the year (Berger, 2003). The palm fruit develops in bunches in trees of 3 to 4 years of age, with 1000 to 3000 fruitlets in each bunch. The fruits are harvested throughout the year. The fruits consist of a fleshy mesocarp with a kernel enclosed within a hard shell. Crude palm oil (CPO) refers to the oil that is obtained from the mesocarp while crude palm kernel oils are obtained from the palm kernel (Shyam Lakshmanan; Yen Li Yung; Boon San Chan; Tze Haw Chong, 2020).

Palm oil is known to be a versatile vegetable oil. Palm and palm kernel oils are used in a wide variety of food, feed and non-food applications including oleochemicals, energy, biofuel and other usage (Rosidah Radzian, 2009). Its finished products include cooking oils, margarine, non-dairy creamer, infant formula and as animal feed. Its non-food applications includes as surfactants, cosmetics, detergents, skin lotions, soaps, toothpaste, palm based biodegradable- polyurethane, polyols and agrochemical products. (Sue, 2017).

The natural content of vitamins and anti-oxidants in palm oil makes it a valuable raw material for extracting tocopherols, tocotrienols, squalene etc. Its fatty acid composition also provides natural anti-bacterial and anti-viral properties which is an added bonus. Hence, it is a source of raw material for the pharmaceutical and nutraceutical sector. However, we often read of palm oil being categorised as a less environmentally friendly crop.

Palm oil uses significantly less land per volume of oil produced, compared to other crops. In fact, palm oil stands out from various vegetable oils as it achieves a much higher yield. In 2017, a study conducted by using data from the Food and Agriculture Organization (FAO) of United Nations, showed that only 8.6% land was used by oil palm to produce 36% of global vegetable oil (Hannah Ritchie & Max Roser, 2020). To obtain similar oil production volumes, soybean and sunflower oil (which give a combined 34.5 % of global vegetable oil production), utilizes as much as 48.5% which is 5.5 times the land used for oil palm. The other vegetable oils such as rapeseed and mustard, groundnut, cottonseed, olive, coconut and sesame seed oil are far worse in terms of land use compared to palm oil. Palm oil has been acknowledged as the highest yielding of 2.84 tons/ha among these crops. In comparison, sunflower yields 0.71 tons/ha, rapeseed and mustard yields 0.65 tons/ha and soybean yields 0.45 tons/ha

Statistical data have pointed out land stress as a future global issue which directly impacts the whole ecosystem. Land stress may result in adverse human health and malnutrition issue, congestion of population, and won't help achieve zero hunger target, which is also part of sustainable principles. The concept of land sparing innovated by plant scientist, Norman Borlaug, founder of Green Revolution (Phalan BT, 2018), may be even more difficult to achieve if we do not use our land effectively. In view of the fact that land has become scarce as a vital resource, more efficient land use and management is crucial. So, why say no to palm oil as oil palm has been evidenced as an outstanding vegetable oil produced over a smaller land area (See Figure 1), and with diverse application.

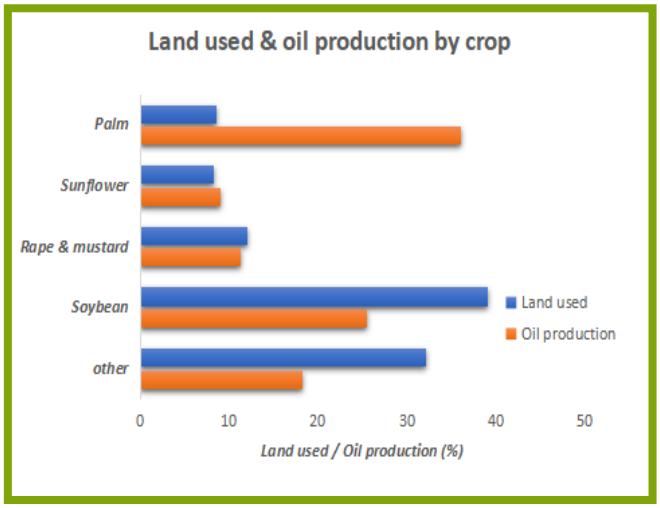


Figure 1: Land used and vegetable oil production by crop (Hannah Ritchie & Max Roser, 2020)

Some users may comment on the reddish colour of palm oil and wonder if it has any negative impact to users. The crude palm oil (CPO) is extracted from the mesocarp of the sterilized palm fruit of the oil palms. The mesocarp is a reddish pulp and its extraction results in a reddish liquid (CPO). The reddish colour of CPO is due to the presence of carotenoids and anthocyanins (A Ruswanto, A H Ramelan, D Praseptiangga, I B B Partha, 2021).

For several decades now, carotenoids have been identified as important pigments found in living organisms. These micronutrients are present in various vegetable oils at low concentrations, typically below 100ppm (including soy-bean oil, rapeseed oil, corn oil, groundnut oil, linseed oil, olive oil, barley oil, sunflower seed oil and cotton-seed oil). In comparison with these other oils, CPO has the highest carotenoid content on this planet. Altogether CPO contains 13 types of carotenes, giving a concentration of 600-700 ppm (Mei Han Ng & Yuen May Choo, 2016). The major contents are β-carotene at 56% of total and α-carotene (35%) with the rest coming from γ-carotene, δ-carotene and others. The high composition of β-carotene is an equivalent source of retinol or provitamin A. The advantage of Vitamin A in vision improvement is a known fact, it also reduces the risk of developing cataract and macular degeneration. Anthocyanins have been classified as flavonoids which are natural pigments commonly found in fruits, vegetables and grains and they exhibit antioxidant properties (Augustine S.H. Ong, E.S. Tee, 1992). Vitamin E (tocopherols & tocotrienols) is another valuable ingredient found in CPO. These naturally occurring Vitamins and anti-oxidants provide wider opportunities for palm oil to be used not only in food, but to also be utilized as raw material in the nutraceutical industry (Cynthia Ofori-Boateng & Keat Teong Lee, 2013).

Palm oil which is rich in Vitamin A and E, helps to boost the vitamin deficiency issue in young children and also adults (Olaf Sommerburg, 2015) (Savita Khanna, 2005) (Yogheswaran Gopalan, 2014). Besides the high amounts of carotenoids, especially beta carotene, palm oil has been identified as the only one vegetable oil containing both tocopherols and tocotrienols.

Palm oil is known for its antioxidants, anti-inflammatory, antibacterial, anti-microbial, antiatherogenic, antihemorrhagic, antihypertensive, and anti-infective properties (Radhika Loganathan, Kanthimathi M. Subramaniam, Ammu K. Radhakrishnan, Yuen-May Choo, Kim-Tiu Teng, 2017). Studies show that the additional advantages of palm oil include prevention and management of skin aging, wound healing, and as permeability enhancers for oil soluble vitamin to tackle cystic fibrosis problems and it also supports brain health. Further health benefits include improved metabolism and weight loss, as well as reduced risk of cardiovascular disease and cancer ; it is said to be able to slow the progress of degenerative neurological diseases (Choo Yuen May, Goh Swee Hock & A.S.H. Ong, 2020). Some other valuable contents of palm oil that would benefit from further development include its content of phytosterols, squalene and coenzyme.

Some researchers had explored palmitic acid's antioxidative properties and its good stability and applied it in protecting the lung and boosting immune system against pathogenic viruses.. Further studies should be considered, especially considering the current Covid-19 pandemic (Choo Yuen May, Goh Swee Hock & A.S.H. Ong, 2020), and the potential benefits that can be attained from palm oil where palmitic acid is one of the major constituents. .

Palm oil is a high cholesterol oil? Some query the high saturated fats content of palm oil indicating that the oil is not healthy at all, implying it is a high cholesterol risk. Cholesterol is an oil-based substance and it is commonly referred to as low density lipoprotein (LDL) and high-density lipoprotein (HDL). Humans require cholesterol for various applications which include hormone production in biogenesis, Vitamin D production, making up digestive bile sacs in the intestine as well as being an essential part of cell wall structures and is also vital for brain health (Sen, C. K., Rink, C., & Khanna, S., 2010). Therefore, cholesterol is vital for the body and the concern of negative impact of cholesterol to human health is limited to LDL since HDL is considered as good cholesterol. The degraded palm oil from repeated heating has been identified to cause cardiovascular diseases in in vivo studies (Tan Kai Xian, 2012). Adverse effects have also been reported from repeated heating of other vegetable oils which have been reported to be genotoxic, mutagenic and carcinogenic, contributing to lung, colorectal, breast, and prostate cancers. Studies have demonstrated that cooking fumes emitted may enhance the breaks, fragments, exchange and multiple chromosomal damage (Kumar Ganesan, 2019).

Palm oil consist of 50% saturated fatty acid (SFA), 40% monounsaturated fatty acid (MUFA) and 10% polyunsaturated fatty acid (PUFA). The main fatty acids in Palm Oil are palmitic acid (SFA) and oleic acid (MUFA) with smaller portion of stearic (SFA) and linoleic acids (PUFA). Several studies had evidenced the nutritional value of palm oil due to its composition of monosaturated fats at the crucial 2-position of the oil's triacylglycerols (Ong AS, 2002). Studies also show that there are no negative impacts of palm oil diet or saturated fatty acids on total cholesterol (TC) and LDL cholesterol level in in vivo studies (Zhang J, 1997) (Gupta SV, 2001). It is just another misperception that palm oil causes high cholesterol. In fact, saturated fats are also widely present in meats, dairy products besides baked goods, deep-fried, and processed foods.

Although the opinions may differ, palm oil has been credited with lower stroke risk and giving protection against heart diseases (Ana Marice Ladeia, 2007) (Elena Fattore, 2014). In their research, P Lucc et al. (2016) state that the hybrid Elaeis oleifera × E. guineensis palm oil can be seen as a "tropical equivalent of olive oil" after having found no significant differences in their comparison studies which showed a reduction of overall TC and LDL in the palm oil consuming group (P. Lucci, 2016).

An interesting fact to ponder is that both breast milk and palm oil consists of 48- 52% saturated fats (Eva Gesteiro, 2018) (Rosidah Radzian, 2009). The benefits of breast milk and its effect on growth and immune system of babies are well acknowledged today. If breast milk provides optimum nutrition to babies, then palm oil with similar saturated fatty acids composition should also provide essential fatty acids, and should not be harmful. It is agreed that just comparing the fatty acid composition is not sufficient to support the above statement. However, research studies have been conducted to show it may be used, not to replace but as an alternative in the event that breastfeeding is not possible (Eva Gesteiro, 2018) (Guenard, 2020) (Margot Bertelsmann, 2021).

For many years, coconut oil was branded as an unhealthy oil due to its high content of saturated fatty acids and allegations of contributing to high cholesterol etc. It took more than 20 years to rid people of the misperception surrounding coconut

oil, and today it is classified as one of the healthiest oils. We had learnt a lesson there, so let us not allow that misconception to recur with palm oil, another versatile tropical oil. Let's correct the misperception surrounding palm oil taking into consideration the points mentioned above, and in many other research articles.

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Article: Uncovering Misconception on Sustainability of Palm Oil

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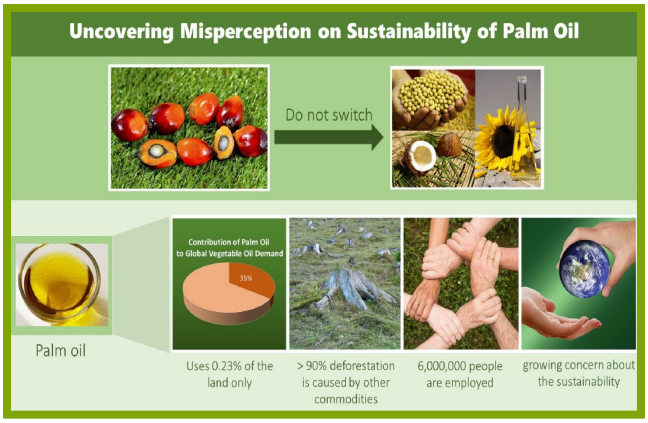
Graphical Abstract



Palm oil is an edible vegetable oil derived from the fruits of oil palm trees (Elaeis Guineensis) that grow well in regions surrounding the equator (European Palm Oil Alliance 2021). When the trees are three to four years old, fruits bunches are produced, and the individual bunch can have hundreds of fruits (European Palm Oil Alliance 2021). The flesh of the fruits can be squeezed to extract crude palm oil, whereas their kernel and seed can be crushed to extract palm kernel oil (Chin 2019). Globally, palm oil is a significant contributor to economic development and food security (European Palm Oil Alliance 2021). Although palm oil is originated in West Africa, the cultivation of oil palm trees is common across Latin America, Africa and Asia today. Specifically, 85% to 90% of the palm oil usage worldwide is supplied by Indonesia and Malaysia. Palm oil production is also increasing in Thailand, Colombia, and Nigeria (European Palm Oil Alliance 2021).

As palm oil is highly versatile and available, it is commonly used in food and non-food manufacturing. Approximately 50% of the products found in supermarkets use palm oil as one of the ingredients (World Wildlife Fund 2020). These include chocolate, shampoo, lipsticks, toothpaste and many other products. Palm oil is also used as biofuels and animal feed in agriculture (World Wildlife Fund 2020). Although palm oil is widely used, the sustainability issues related to palm oil have long been debated. Palm oil is perceived to be unsustainable as it drives deforestation extensively. In tropical regions, 5% of tropical deforestation is caused by palm oil production (European Palm Oil Alliance 2021). Palm oil has also led to 2.3% of deforestation globally (European Palm Oil Alliance 2021). The destruction of the forests with high biodiversity has caused the habitat of the endangered species to be destroyed (World Wildlife Fund 2020). For instance, the endangered species threatened by palm oil production include Orangutans, Sumatran rhino, pygmy elephants and other animals. Climate change is also one of the consequences as the loss of forests increases the greenhouse gases in the atmosphere (World Wildlife Fund 2020). Other than that, palm oil production has contributed to social effects, particularly conflicts between the palm oil companies and local communities over issues related to worker rights and land ownership (Qaim et al. 2020).

Today, sustainable palm oil remains controversial. Some palm oil critics think that switching to other oils is the best alternative to help combat the sustainability issues of palm oil. The initiatives include avoiding products with palm oil and making laws that require the companies to include palm oil in the ingredient label (Shah 2017). Nonetheless, this is seemingly a misconception as much research revealed that palm oil is more sustainable than other vegetable oils. The main reason is that the crop efficiency of palm oil is very high. With only 0.23% of the agricultural land, palm oil fulfils 35% of the vegetable oil demand worldwide (Palm Oil Health 2021). However, other alternative oil crops with less significant contributions in the market use larger lands. For example, sunflower requires 0.51%, rapeseed requires 0.67%, and soybean requires 2.14% of agricultural land (Palm Oil Health 2021). Also, palm oil produced per land area is greater than other vegetable oil crops. For instance, the land area required to obtain the equivalent quantity of alternative oils such as soybean, coconut, sunflower and rapeseed oils is four to ten times more than the area needed to produce palm oil. Hence, it seems pertinent to say that the larger land area required would cause more issues to other species and their habitat (World Wildlife Fund 2020). Other than that, some studies concluded that palm oil production in Southeast Asia may harm the environment, but the impact is relatively minor (Wijnbergen 2019). For example, the deforestation caused by soybean farming is twice the deforestation caused by palm oil production (Wijnbergen 2019).

The perception that other oils are more sustainable than palm oil may not be true. Bek-Nielsen (2020) argued that the deforestation issues due to other commodities are not explored. Some studies focused only on palm oil but failed to discuss the impact of soybean, maize and other commodities that lead to more than 90% deforestation. In the past 25 years, only 5%

of deforestation was caused by oil palm (Bek-Nielsen 2020). Notably, World Wildlife Fund continues to report a declining trend in deforestation contributed by palm oil in Malaysia and Indonesia (European Palm Oil Alliance 2021). On the contrary, by avoiding palm oil, biodiversity loss would likely be displaced but not halted. Besides requiring larger land, the energy, fertiliser and pesticides needed for oil palm production are less than other vegetable oils. For example, 2.9 GJ of energy, 315 kg of fertiliser and 29 kg of pesticides are required for the production of one tonne of soybean oil (Asia Agri 2019). The energy required to produce the same quantity of palm oil is approximately 83% lower, the fertiliser is 85% lower, and the pesticides are 93% lower (Asia Agri 2019). Therefore, if people switch to alternative oils, the demand for other vegetable oils would likely be higher. This may increase the lands, energy, fertilisers and pesticides needed. Consequently, more forests, natural habitats and species would likely disappear (Qaim 2020).

Sustainability is not just concerning the environment. The balance between environmental, social and economic aspects are essential (UCLA 2021). Similar to other food and agriculture industries, the palm oil industry faces social challenges such as worker exploitation and labour abuse (UCLA 2021). The encroachment and land acquisition also lead to conflicts with indigenous people (Asia Agri 2019). In this case, switching to other oils may be deemed an effective way to solve the social sustainability issues related to palm oil. Nonetheless, the majority of environmentalists view that boycotting palm oil is not a good solution. In the global economy, palm oil is a crop that contributes significantly to the Gross Domestic Product (GDP) (Bek-Nielsen 2020). Specifically, 6,000,000 people worldwide are employed in the palm oil industry, and 36.67% are smallholder farmers (Shah 2017). In Borneo and Papua, some indigenous people were stripped of their traditional land rights due to palm oil production (Qaim 2020). However, this may not necessarily represent the overall impact of palm oil on the local communities. For instance, small farms are given the opportunities to manage more than 40% of palm oil land in Malaysia and Indonesia (Qaim 2020). Their landholdings are averagely smaller than five hectares. Apart from that, oil palm brings greater profit than vegetables, rice, rubber and other crops (Qaim 2020). As a result, people may earn a source of income to improve the health, nutrition and education of their children. Also, oil palm benefits non-farm families as the job opportunities and wage rates increase. Research has shown that the rates of poverty in some regions in Malaysia, Indonesia and Sumatra are halved due to the involvement of communities in the palm oil industry (Qaim 2020). Therefore, switching to other vegetable oils may not be effective to attain sustainability as socioeconomic growth would likely be thwarted.

Sustainable palm oil is not unachievable as there is a growing concern about the importance of sustainability. The Malaysian Palm Oil Board introduced the Malaysian Sustainable Palm Oil (MSPO) certification scheme that focuses on smallholder farmers and deforestation (Hii 2021). The MSPO is also a standard for conservation, sustainable palm oil production, human rights, women's and workers' rights. In Malaysia, the MSPO standard has been mandated, and 87% of palm oil producers have received the MSPO certification (Hii 2021). The MSPO standard has also successfully become a global sustainability model as it helps conserve the landscape and endemic species (Hii 2021). In addition, people in different countries are constantly working towards achieving sustainable palm oil production. In the United Kingdom (UK), the government has strived to ensure that palm oil used in their countries are totally from sources that are harmless to the environment and people (World Wildlife Fund 2020). As a result, 75% of the palm oils imported in the UK in year 2016 were sustainable (World Wildlife Fund 2020). In European countries, 86% of palm oil used in food has received the Roundtable on Sustainable Palm Oil (RSPO) or other equivalent sustainable certification (European Palm Oil Alliance 2021). This is vital for the protection of rainforests and biodiversity. Also, the socioeconomic equality of their supply chain can be achieved. In Indonesia, efforts include partnering larger companies with smallholders. This allows the smallholder farmers to obtain certification of sustainability, reduce the impact on the environment and improve livelihoods (Asia Agri 2019). Thus, switching to other vegetable oils may be unnecessary as different groups strive to achieve sustainable palm oil production.

In conclusion, there seems to be a misperception that switching to other vegetable oils is an ideal alternative to solve the sustainability issues of palm oil. Various studies have shown that other vegetable oils may not be able to replace palm oil. Switching to other vegetable oils may potentially cause more sustainability issues. Hence, the main problem to be addressed is the ways used to manage the oil crops and not the types of crops. In this context, taking more actions to incorporate sustainability in the palm oil industry would be a better solution to foster sustainability. Therefore, voluntary and mandatory standards that focus on environmental, economic and social sustainability in the palm oil industry are significant. With the cooperation among groups and individuals, the journey towards a sustainable palm oil industry can be accelerated.

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Article: Misperception on Palm Oil and Its Truth

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According to Ritchie and Roser (2021), the world production trend of the oil palm had been increasing tremendously with around threefould starting from year 2000 to year 2018 as illustrated in Figure 1. As in 2005, around 80% of 35 million tonnes of total world production palm oil was produced in Malaysia and Indonesia (Tan et al., 2009). Due to the high demand for biodiesel and depletion of petroleum, palm oil has gained much attention from the public to act as an alternative source of biofuel to replace non-renewable energy. Apar from biofuel, palm oil can also be used for various functions ranging from food manufactured goods to engine lubricants and even some cosmetics. However, despite the endless applications of palm oil, palm oil issues are hotly debated worldwide, especially those related to sustainability, safety and social economy.

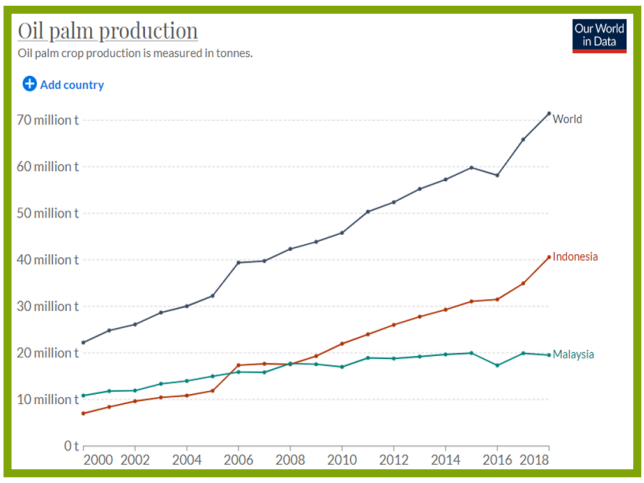

Figure 1: World, Indonesia and Malaysia oil palm production

Recently, there are claims that palm oil industry is not sustainable as burning is usually used to clear vegetation in natural forests and oil palm plantations. The burning of oil palm releases smokes, carbon dioxide and fine particles into the atmosphere, resulting in air pollution. Based on Searle (2018), the burning of oil palm in Indonesia and Malaysia every year has released almost 500 million tonnes of carbon dioxide and this has contributed to 1.4% of global net carbon dioxide emissions. Furthermore, it will affect the health of human beings once there is severe air pollution. Other than that, the plantation of palm oil will cause peatland destruction. Peatland, as shown in Figure 2, is one kind of wetlands where the soil consists of high percentage of partial decayed organic material, and it acts as a carbon sink to preserve the global total carbon cycle of the earth (Tan et al., 2009). However, due to the increasing demand for palm oil, among 27 million hectares of peatland in South-East Asia, 45% of the peatland are currently logged and mostly drained (Hooijer et al., 2006).

Despite so much disputes related to palm oil, palm oil plantation expansion is unavoidable due to the high demand for palm oil as the supply of vegetable oil and fats. With the growing population worldwide, palm oil is one of the critical sources of oil and fats to be utilised in our daily lives. To achieve sustainable palm oil development, the roundtable on sustainable palm oil (RSPO) was founded in year 2004 to stimulate the growth and use of sustainable palm oil with the collaboration within the supply group and stakeholders (Tan et al., 2009). The members of RSPO includes plantation firms, palm oil products manufacturers, and environmental NGOs. RSPO sets eight rules and regulations to ensure the lifecycles of palm oil are environmentally friendly and economically viable. Once the palm oil companies comply with the rules, they will be certified as sustainable palm oil manufacturers. The principles of RSPO were shown in Figure 3.

The top ten RSPO members include United States, Germany, United Kingdom, Japan, Italy, Netherlands, China, France, Australia and Malaysia (RSPO 2021).

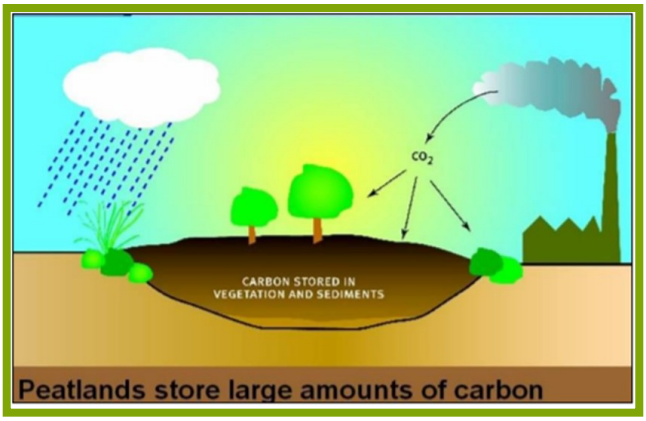

Figure 2: Peatland as the largest natural carbon store (Davies et al. 2010).

Figure 3: RSPO's principles and criteria for certifying sustainable palm oil.

In a case study by Tey et al. (2015), with the implementation of RSPO in East Malaysia, the number of herbicides and chemicals used by certified smallholders are lesser than non-certified smallholders. This is because the certified smallholders are better trained and well-educated. Apart from that, these certified smallholders prevent the use of forest burning in their plantation and have proper handling of chemicals inputs, promoting the environmentally friendly method to manage oil palm plantation. With the help of RSPO, the certified smallholders also become very optimistic about the environmental benefits. They have better waste management, lower harm to the environment and are well-conserved of natural resources.

Besides RSPO, Wilmar International Limited first announced a new policy, 'No Deforestation, No Peat, No Exploitation (NPDE)', in 2013 (Wilmar, 2019). The NPDE policy is focused specifically on the best practice management for the environment and sustainable management of natural resources. Based on Chain Reaction Research (2020), NPDE policies covered 83% of palm oil processing capacity in Indonesia and Malaysia as of April 2020. The companies involved in the policy are committed to the Free, Prior and Informed Consent (FPIC) for ethnic and other local populations, including zero burnings, prevent weak working circumstances, and guarding High Conservation Value (HCV) areas, High Carbon Stock (HCS) areas and peatlands. With the implementation of NPDE, Chain Reaction Research (2020) reported that the deforestation rates in Indonesia have declined in recent years, proving the policy's effectiveness. Moreover, Wilmar will assist the inclusion of smallholders into the supply chain and offer practical assistance to them so that they are well-informed about the details of the policy.

To sum up, the misperceptions on the unsustainability of the palm oil industry could be a truth in the past, but not in the future. Palm oil plantation plays an essential role in providing biofuels, oil, and fats used in our lives. With proper rules and regulations such as NDPE and RSPO, the lifecycles of palm oil are becoming more sustainable, and the negative impacts such as air pollution or damaging of peatland can be minimised and avoided. Therefore, the professionals, academia, industrial employees and students should not be hesitated to be involved in the palm oil industries.

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Article: Correcting the Role in the Personal Care Industry

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The usage of palm oil is not only limited to food but to personal care products. Statistics of palm oil usage in categories involving personal care from Europe, India and China are shown in Table 1 whereas Lim (2019) states that 70% of personal care ingredients are being derived from palm oil. According to the United States Food and Drug Administration United States Food and Drug Administration (2016), personal care products are defined as items which are available in health and beauty sections of either drug or departmental stores. Nevertheless, the usage of palm oil in the industry has often been negatively perceived by consumers despite the availability of consumer brands found in supermarkets as shown in Figure 1.

Table 1: The data of the main countries utilising palm oil in the personal care

No.	Country	Category	%	Description	Ref.
1.	China	Personal Care, Detergents and Cosmetics	69	Shares of palm oil utilisation.	UNDP China 2020
2.	Europe	Home and Personal Care (HPC)	51	Rate of certification by selected RSPO members.	Barthel et al. 2018
3.	India	Personal Care and Cosmetics	5-10	Based on the country's market structure.	Mishra and Tapsall 2017

Figure 1: Consumer brands which utilises palm oil derivative in their products

Gesteiro et al. (2019) observed that the information regarding palm oil in personal care products has often been incomplete or prejudiced. This was also justified in an article by Lim (2019) where most consumers criticized the personal care industry for causing palm oil related issues but in contrary, personal care products only utilises around 5% of the world's palm oil supply in 2019, (Grand View Research 2020). These findings are significantly supported by Marangoni et al. (2017) who stated that the misconception emerges from the lack of assertion from the scientific community to the public, which sparks a thought-provoking question on the benefits of palm oil derivatives in the personal care industry and its sustainability in the long run.

Some palm oil derivatives such as carotenoids, squalene, and glycerol have their dermatological benefits. Carotenoids are one of the most beneficial ingredients in the personal care industry as it provide nutritional benefits of Vitamin A into the body and towards skin. As a dietary supplement, carotenoids are essential to promote growth and maintain visual function (Ghosh et al. 2019) but from a dermatological perspective, carotenoids can prevent premature aging of the skin in addition to providing ultraviolet radiation (UVR) protection (Balic and Mokos 2019). Refined, bleached, and deodorised (RBD) palm oil plays a significant role in providing the most carotenoid content for its maximum extraction. This is proven through an experiment conducted by Nainggolan and Sinaga (2021), where refined palm oil produces higher levels of carotenoids which is ideally used as antioxidants for inhibiting UVR rays compared to palm kernel oil.

With the improvement of current technologies, sustainable methods such as hydrophobic nanofiltration, Deep Eutectic Solvent (DES) extraction and solvolytic micellization can be implemented to reduce carbon-footprints produced from refineries. Nabu, Sulaswatty and Kartohardjono's (2021) research establishes that the implementation of a hydrophobic nanofiltration membrane technology can utilise the usage of green solvents such as cyclopentyl methyl ether which helps reduce waste generated by carotene extraction. Similar to hydrophobic nanofiltration, DES method is a type of solvent extraction process as it separates carotenes using biodegradable and non-toxic solvents through hydrogen bonding (Manurung and Siregar 2020). Meanwhile, the solvolytic micellization of carotenes from fatty acid methyl esthers (FAME) is a new alternative of the conventional molecular distillation carotene extraction as it consumes less energy and is simple to operate (Hoe et al. 2020). ingredient of personal care products for youth longevity and growth supplements.

Table 2: A list of squalene properties and pharmaceutical applications.

Bioactive Property	Application
Cardioprotector	Intravenous injection, oral consumption to consumption to cholesterol control
Antioxidant	Tropical emulsions, oral adminstration
Squalene—Antibacterial and antifungal	Cream topical, oral medication
Anticancer	Preventive and chemotherapeutic substances; drugs and vaccines (emulsions, conjugates)
Detoxifying	Nutritional supplements

Source: Table reproduced from Lozano-Grande et al. (2018, 5).

Furthermore, a recent research by Firsta et al. (2020) has indicate a global shift in producing squalene from vegetable sources, for example, palm oil instead of extracting from fish or shark liver oil. This is due to the criticism received by the personal care industry on the potential extinction of certain fish species and the endangerment of sharks in the ocean (Firsta et al. 2020). Despite the controversy, squalene is a natural emollient that imitates the natural oils secreted by the skin (Higuera and Patel 2020) and proven to have antioxidant properties which inhibits the development of acne, comedogenics and wrinkles (Lozano-Grande et al. 2018). Other usages and pharmaceutical applications of squalene can be referred in Table 2.

Palm olein is proven to be a good source to obtain squalene because it has a larger squalene concentration of 213 mg/ml compared to palm kernel oil which contains 42 mg/ml of squalene (Nainggolan and Sinaga 2021). Additionally, palm fatty acid distillate (PFAD) residue produced from physical refining of palm oil can be reused to extract squalene since PFAD contains 0.76% squalene (Nurfatimah et al. 2021). Extracting squalene from PFAD residue can contribute to the reduction of greenhouse gases (GHG) emissions by 84% to 85% in respect to the GHG emissions by the petroleum industry (Xu, Lee and Wang 2020). Herewith, squalene produced from palm oil can be construed as a better and sustainable alternative that provides the same natural emollient and anti-cancer benefits as traditional methods.

Likewise, glycerol is another common valuable palm oil derivative as it is present as glycerin in 54.59% of personal care products such as hair conditioners, sunscreens, and face creams (INCI Beauty 2017). It is widely used would be due to its humectant properties as supported by Azelee et al. (2019) where the topical usage of glycerol can significantly improve the elasticity and barrier function of skin. An experiment conducted by Danby et al. (2020) shows the ability of L'Oréal branded creams and lotions with glycerol as one of the main ingredients managed to deliver 24-hours moisture onto eczema-prone skin compared to other lotions and creams where glycerol is not a prominent ingredient. On the other hand, L'Oréal released a palm oil policy where 100% of the palm oil purchased has been approved by the Roundtable of Sustainable Palm Oil (RSPO) via the segregated model (L'Oréal 2018). Hovorkova, Lalouckova and Skrivanova's (2018) research also determines that the glycerol extracted from palm kernel oil exhibits better moisturizing properties and promising antibacterial effects as it has the highest lauric acid content compared to other vegetable oils.

In the refining process of crude palm oil (CPO), waste bleaching clay mixed with PFAD can processed to produce soap as Punvichai and Pioch (2019) states that the used bleaching clay provides more glycerol content during the saponification reaction. Waste bleaching clay contains around 30 wt% of waste palm oil (Punvichai and Pioch 201) whereas PFAD contains 96.1% of fatty acids and glycerides (Nurfatimah et al. 2021). With this study, it is estimated that reproducing soap from waste by-products from CPO refinery can reduce around 6% of waste produced by palm oil per year worldwide (Punvichai and Pioch 2019). Besides its popularity inside the personal care industry, the role of glycerol extends to become a natural sweetener for diabetic communities with the aid of further chemical conversions (Azelee et al. 2019). Consequently, the presence of palm oil-based glycerol present in most personal care products is indeed beneficial for skin and food whereas its production can serve as a carbon-sink towards creating a circular economy.

Overall, it is important for society to fully comprehend and be aware of the information provided by reputable oil palm organisations such as the Malaysian Palm Oil Board (MPOB). With open-access to MPOB's Journal of Oil Palm Research and PALMOILIS database available online, consumers can deduce the benefits of palm oil derivatives in the personal care industry, thus refuting the negative perception of the public towards the palm oil sector in general. Nonetheless, the government should introduce incentives such as providing a Malaysian Sustainable Palm Oil (MSPO) certification (Bernama 2019) for personal care industries and small and medium-sized enterprises (SMEs) to foster the usage of sustainable palm oil in personal care product formulations.

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Article: Valorisation of Wastes from the Oil Palm Industry

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Malaysia is one of the largest palm oil exporters in the world. In 2020, Malaysia exported 12.95 million metric tonnes of processed palm oil (PPO) and 4.42 million metric tonnes of crude palm oil (CPO) (Kondalamahanty 2021). Approximately a quarter of the palm oil production in the world is contributed by Malaysia. In addition, 34.3 % of palm oil export is sourced from Malaysia ("Malaysian Palm Oil Industry" n.d.).

Although there are various benefits of the oil palm industry in Malaysia, one of the main problems is the substantial amount of waste that is produced from oil palm tree cultivation and palm oil extraction. The increasing scale of the palm oil industry has led to an increase in the amount of biomass waste, which creates the problem of disposal. In the industry, 90% of the biomass are discarded, where about 77.24 million tonnes of waste were produced in 2009 (Ng et al. 2012). The biomass wastes include mesocarp fibre (MF), palm kernel shell (PKS), oil palm fronds (OPF), oil palm trunks (OPT), and empty fruit bunch (EFB). The approximate weight of oil palm biomass is illustrated below in Figure 1. Traditionally, before oil palm replantation, old oil palm trees are knocked down, stacked and burned openly. However, this traditional practice has been replaced with zero burning technique due to the severe environmental pollution caused by the substantial amount of smoke released to the environment during open burning (Noor 2003). Many large oil palm companies carry out open burning to clear land for oil palm cultivation. This contributed to the haze problem, which peaked in 1997 in Southeast Asia region, especially Indonesia, Singapore, Brunei and Malaysia (Noor 2003; Sastry 2002). Figure 2 portrays forest fires in Indonesia, which caused the widespread haze across Southeast Asia. Consequently, open burning of oil palm biomass has been banned by the Malaysian government since 1998.

One of the common misperceptions in the oil palm industry is these wastes are simply disposed in landfills or incinerated, which causes serious environmental pollution. Contrary to the misperception, these wastes can be repurposed and turned into useful products hence contributing to the zero-waste approach in the oil palm industry. The difference in the compositions as determined by proximate and ultimate analysis, which is specified in Table 1, contributes to the wide range of applications of these oil palm wastes. Oil palm wastes are repurposed through mechanical or thermal and thermochemical processes. Mechanical processes include shredding and size reduction for mechanical pulping or production of boards. Another mechanical process is densification and drying for the production of pellets and briquettes. On the other hand, thermal and thermochemical processes consist of extraction, combustion, gasification, pyrolysis and liquefaction. Some of the resultant products include bio-oil, fuel gases and charcoal. Additionally, this method can also be used for heat and steam generation (Awalludin et al. 2015).

MF is the fibrous waste produced from oil extraction when oil is pressed out of the fruit mesocarp. One of the applications of MF is as boiler feed or fuel for heat generation in palm oil processing mills (Umar et al. 2021). In these processing mills, heat is used to convert water into steam. The generated steam is then used to run turbines for electricity production (Vijaya et al. 2008). By doing so, the dependence on fossil fuels to generate electricity can be reduced. Additionally, the amount of oil palm waste can also be decreased. The excess MF, which are unused are then sold as fuel. The high potential of MF to be used as fuel without any pre-treatment is due its ideal properties as shown in Table 1. An ideal boiler fuel should have a high calorific value and low moisture content (Hamzah, Tokimatsu, and Yoshikawa 2019). A high calorific value indicates higher energy content in a fuel (Oliveira and Da Silva 2013). On the other hand, low moisture content is essential to reduce cost incurred for drying of biomass as well as to minimise the amount of smoke produced during combustion, thus reducing environmental pollution (Hamzah, Tokimatsu, and Yoshikawa 2019; Umar et al. 2021). MF exhibit the second highest gross calorific value (19.06 MJ kg^{-1}) and the second lowest moisture content (37.09 wt. %) when compared to other oil palm wastes. In addition, when compared to bituminous and lignite coal, MF possess comparable calorific value and moisture content, making it an ideal boiler fuel (Loh 2017).

PKS is the leftover shell fraction after the nut is removed during fruit crushing. Similar to MF, PKS has also been used as boiler fuel in processing mills to generate heat as it has the highest gross calorific value (20.09 MJ kg^{-1}) and lowest moisture content (12.00 wt. %) in comparison to other oil palm wastes, as specified in Table 1 (Loh 2017; Umar et al. 2021).Other than the oil palm industry, industries namely rubber glove, clay brick and cement production are also using PKS as feed for combustion (Dit 2007). As an example, clay brick manufacturers utilise PKS as feedstock for heat generation instead of diesel. Alternatively, PKS has also been used for road paving in the estates (Yusoff 2006). This can reduce the cost incurred for road pavements while also reducing the amount of PKS waste from the oil palm industry. Currently,

there are a few companies in Malaysia that operate on a commercial scale to produce charcoal from PKS. Some of the companies include IOP Specialists, Zahan Resources and Global Green Synergy (Umar et al. 2021). Global Green Synergy, a company based in Kuala Lumpur, uses PKS as an alternative to coconut shells for the production of charcoal. Compared to coconut shells, PKS derived charcoal has a large surface area, which is ideal for adsorption. Some of the potential applications of the charcoal include filtration systems and wastewater treatment ("PKS Charcoal" n.d.).

The most substantial amount of oil palm industry waste is the OPF, which contributes to about 70 % of the total waste (Zahari et al. 2012). OPF is the branch of the oil palm trees that is the side product from pruning and cultivating the plant (Umar et al. 2021). This biomass, which is available throughout the year, used to be burned as a way to lessen the amount of waste. However, due to the environmental pollution associated with open burning, OPF are left on the ground and allowed to decompose. Aside from fertiliser for soil, the rotting OPF can also inhibit soil erosion (Wan Zahari et al. 2003). In addition, OPF has also been used as a replacement for hay or rice straw as feedstock for ruminants (Ooi et al. 2017). This can lower the feeding cost of ruminants, thus increasing income from farming activities.

OPT is obtained during the knocking down of oil palm trees. Similar to OPF, OPT is also obtained during the replanting process, where 70 % of the produced waste will consist of OPT (Khalil et al. 2012; Umar et al. 2021). Typically, the OPT will be left to rot in plantation areas for mulching process (Awalludin et al. 2015). Mulching process is where mulch, which usually consists of organic materials, are placed on the soil to help improve the quality of the soil. Besides that, this process can also help increase crop yield and reduce water consumption (Stauffer and Spuhler 2020). However, this biomass also has a high potential for other types of applications. One of them is in the manufacturing of boards. The OPT is converted into veneer and combined with wood veneer to produce plywood (Sulaiman et al. 2011). Other products, which utilise OPT include compressed wood, particleboard, and medium density fibreboard (Rosli et al. 2016).

EFB is the leftover bunch, obtained from oil palm mills after oil is extracted from the fresh fruit. Similar to OPT and OFB, it is also used as mulch in oil palm plantations due to the high contents of nutrients, which is ideal as fertiliser (Chang 2014). Nowadays, there are a few companies that utilise EFB in the paper making industry. One of them is 1Green Enviro which converts raw EFB into pulp to produce industrial brown paper ("'Green gold' – a billion dollar industry" 2011). Besides that, EFB has also been used in fibre processing for the production of cushion and rubberised mattresses (Kong et al. 2014).

In conclusion, the oil palm industry produces a significant amount of biomass waste, namely MF, PKS, OPF, OPT and EFB, from cultivating and milling activities. The large production of these wastes causes serious environmental problems. Hence, numerous research have been conducted for repurposing these wastes. Some of the commercial applications of these biomasses include fuel for energy generation, fertiliser for oil palm plantations and feedstock for ruminants. These applications can help to reduce the amount of biomass waste, which can help contribute to the zero-waste approach in the oil palm industry. Additionally, it can also increase the supply of renewable energy sources to meet the increasing energy demand in a more sustainable way.

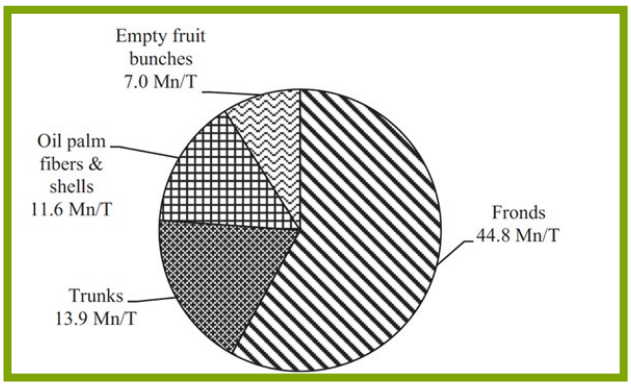

Figure 1: Dry weight of oil palm biomass in Malaysia in 2009 (Ng et al. 2012).

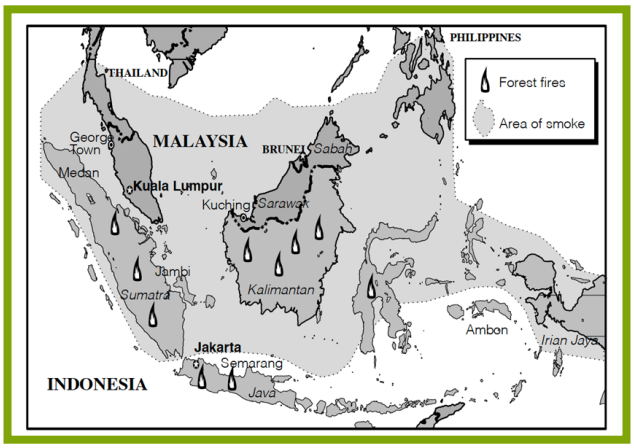

Figure 2: Map showing forest fires and area of smoke in Southeast Asia region in 1997 (Sastry 2002).

Table 1: Table 1. Proximate and ultimate analyses of different oil palm wastes and coal (Loh 2017).

Sample	Gross Calorific Value (MJ kg^{-1})	Proximate Analysis			Ultimate Analysis				
		Moisture Content (wt. %)	Ash Content (wt. %)	Volatile Matter Content (wt. %)	Nitrogen	Carbon	Hydrogen	Oxygen	Sulphur
Mesocarp fibre (MF)	19.06	37.09	6.10	84.91	0.391	46.396	9.283	50.212	ND*
Palm kernel shell (PKS)	20.09	12.00	3.00	83.45	0.043	57.909	12.600	49.994	ND
Oil palm fronds (OPF)	15.72	70.60	3.37	85.10	12.402	48.431	10.476	46.750	ND
Oil palm trunks (OPT)	17.47	75.60	3.35	86.70	0.169	51.408	11.816	51.160	ND
Empty fruit bunch (EFB)	18.88	67.00	4.60	87.04	0.249	48.715	7.858	48.179	ND
Bituminous Coal	28.30	11.00	8.70	46.00	1.4	73.1	5.5	~10	2.4
Lignite Coal	2.80	39.00	10.70	29.00	1.6	56.4	4.2	26.0	0.4

***ND = Non-detectable**

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Article: Dispelling the Myth of Oil Palm Plantations as a Major Source of Transboundary Haze and Developing a Strategy for Valorising Oil Palm Biomass into Value-Added Commodities

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Throughout the decade, oil palm industry in Southeast Asia, particularly in Indonesia and Malaysia, has seen fast expansion and development. The first oil palm tree was reportedly introduced by Americans in the 17th and 18th centuries and planted in Java in 1848, while the first plantation was developed in Malaysia in 1917 (D. et al. 2009) . Palm oil production in Malaysia has increased dramatically over the years, from 4 million tonnes in 1985 to 18.8 million tonnes in 2012 (Chang 2014). In contrast, Indonesia is the world's largest and fastest-growing producer of palm oil, thanks to its optimal conditions for cultivating oil palm trees, which include abundant land and low-cost labour (D. et al. 2009). According to reports, Indonesia's palm oil production reached 47.5 million tonnes in 2019 (BPS-Statistics Indonesia 2010). Small vendors, government estate plantations, and private estate plantations make up these oil palm plantations, with government estate plantings accounting for 10% of palm oil production, small vendors for 40%, and private estate plantations for 50% (D. et al. 2009). On a worldwide scale, both of these countries account for 85% of palm oil production. (Varkkey, Tyson, and Choiruzzad 2018). The areas in Malaysia and Indonesia planted with oil palm trees are depicted in Figure 1. Despite the fact that palm oil is a major driver of economic growth and plays a critical role in improving the prospects of impoverished communities, non-governmental organisations (NGOs) have been vocal in their opposition to the expansion of the oil palm agroindustry, claiming that it contributes to deforestation, peat degradation, ecosystem destruction, and forest fires (D. et al. 2009). The purpose of this article is to discuss the areas that contributes to the formation of transboundary haze, as well as the current approach of oil palm company in sustaining oil palm biomass by valorising it into value-added products such as nanocellulose extraction, which has numerous applications in various industry fields. Existing pre-treatment technologies, such as alkaline and dilute acidic, will be discussed for the purpose of modifying the structure of oil palm biomass (lignin-hemicellulose matrix) to facilitate the production of nanocellulose (Chaturvedi and Verma 2013).

Figure 1: Oil Palm Area in Malaysia and Indonesia

Empty fruit bunches account for the most biomass generated in Indonesia, with an estimated value of 40 million tonnes, followed by oil palm trunks and midribs, which account for 30 million tonnes. By 2017, the potential for solid waste biomass generated by plants might be as high as 120 million tonnes of biomass material (Rahayu et al. 2018). Based on Table 1 below shows the annual oil palm biomass that is being generated from year 2014 to 2017 (Rahayu et al. 2018). Meanwhile, it was estimated that by 2020, oil palm biomass generation is predicted to be in the range of 85 - 110 million tonnes for dry solid wastes and 70 – 110 million tonnes for liquid wastes, respectively (Onoja et al. 2019). Forest fires are caused by small and medium-scale operations burning oil palm biomass in the open, and local farmers clearing areas for company expansion and agricultural purposes because transportation and disposal costs are prohibitively expensive (Tan et al. 2018). The territories that forest fires tend to occur are in the Sumatra and Kalimantan regions of Indonesia, whereas in Malaysia are Sarawak and Sabah regions (Tan et al. 2018).

Table 1: Generation of Oil Palm Biomass in Indonesia (Reproduced from Rahayu et al. 2018)

Description	Unit	2014	2015	2016	2017
Plantation Area	Ha	10,754,801	11,260,277	11,914,499	12,307,677
Production	Ton	182,724,069	191,312,106	202,427,338	209,107,432
Productivity	kg/Ha	3,645	3,625	3,763	3,817
Solid Biomass					
Max. PKS Biomass	Ton	12,790,685	13,391,847	14,169,914	14,637,520
Min. PKS Biomass	Ton	9,136,203	9,565,605	10,121,367	10,455,372
Average PKS Biomass	Ton	10,963,444	11,478,726	12,145,640	12,546,446
Max. EFB Biomass	Ton	42,026,536	44,001,784	46,558,288	48,094,709
Min. EFB Biomass	Ton	36,544,814	38,262,421	40,485,468	41,821,486
Average EFB Biomass	Ton	39,285,675	41,132,103	43,521,878	44,958,098
Max. Mesocarp Biomass	Ton	24,667,749	25,827,134	27,327,691	28,229,503
Min. Mesocarp Biomass	Ton	20,099,648	21,044,332	22,267,007	23,001,818
Average Mesocarp Biomass	Ton	22,383,698	23,435,733	24,797,349	25,615,660
Max. OPT Biomass	Ton	40,330,504	42,226,039	44,679,371	46,153,789
Min. OPT Biomass	Ton	34,953,103	36,595,900	38,722,122	39,999,950
Average OPT Biomass	Ton	37,641,803.50	39,410,969.50	41,700,746.50	43,076,869.50
Max. OPF Biomass	Ton	37,458,434	39,218,982	41,497,604	42,967,024
Min. OPF Biomass	Ton	26,494,990	27,740,255	29,351,964	30,320,578
Average OPF Biomass	Ton	31,976,712	33,479,619	35,424,784	36,593,801
Total Biomass Solid (Max)	Ton	151,896,507	159,035,648	168,295,618	173,828,707
Total Biomass Solid (Min)	Ton	132,606,159	96,612,614	102,225,806	105,599,253
Total Average Biomass Solid	Ton	142,251,333	109,526,181	115,889,651	119,714,005

Table 2: Cellulose composition of untreated and treated oil palm biomass (Reproduced from Megashah et al. 2018)

Oil Palm Biomass	Cellulose (%)	Hemicellulose (%)	Lignin (%)	Extractives (%)
OPMF				
Untreated OPMF	28.2 ± 0.8	32.7 ± 4.8	32.4 ± 4.0	6.5 ± 0.1
OPMF cellulose extract	88.8 ± 1.7	11.2 ± 1.7	ND	ND
OPEFB				
Untreated OPEFB	37.1 ± 4.4	39.9 ± 0.75	18.6 ± 1.3	3.1 ± 3.4
OPEFB cellulose extract	93.0 ± 0.5	7.0 ± 0.5	ND	ND
OPF				
Untreated OPF	45.0 ± 0.6	32.0 ± 1.4	16.9 ± 0.4	2.3 ± 1.0
OPF cellulose extract	94.6 ± 3.2	5.4 ± 3.2	ND	ND

Nanocellulose has gained popularity among researchers and industry because of its advantageous properties, which include a large surface area, a high concentration of hydroxyl groups for modification, excellent mechanical properties, and natural properties that are guaranteed to be environmentally friendly (Phanthong et al. 2018). Nanocellulose is divided into three types namely crystalline nanocellulose (NCC), nano-fibrillated cellulose (NFC), and bacterial cellulose (BC), with different extraction methods used to obtain the appropriate nanocellulose (Yu et al. 2021). Mechanical methods can be used to extract nano-fibrillated cellulose (NFC), in which the microfibrils are individually exfoliated (Phanthong et al. 2018). Nanocellulose crystalline (NCC) is normally extracted via chemical treatment, with acid hydrolysis being the most common method, in which the amorphous region of the cellulose is hydrolysed while the crystalline region remains intact, and bacterial nanocellulose is produced as pure cellulose using microorganisms [13, 14]. Because lignocellulosic biopolymers, such as cellulose, hemicellulose, and lignin, are structured in a complex manner, thus contribute to biomass recalcitrance, which impedes biomass digestibility, accessibility to cellulose, and subsequent hydrolysis solubilisation [14, 15]. Based on Figure 2 below shows the complex arrangement of lignocellulosic biomass (Lee, Hamid, and Zain 2014). Thereby, prior to hydrolyzing the oil palm biomass, a pre-treatment step is required to remove the lignin-hemicellulose matrix.

Several pre-existing methods have been commercialised and applied within the industry, including physical, chemical, physicochemical and biological pre-treatments (Arora et al. 2020). Alkaline reagents, for example, have been explored to improve biomass digestibility, and numerous alkaline reagents, such as sodium hydroxide, ammonia, and calcium hydroxide, are routinely used in the alkaline pretreatment process (Arora et al. 2020). Sodium hydroxide, a reagent used to improve biomass digestibility since the early 1900s, is known to effectively solubilise hemicellulose and lignin under ideal conditions (Kim, Lee, and Kim 2016). The delignification mechanism via sodium hydroxide pre-treatment involves the cleavage of lignin-carbohydrate complex (LCC) links due to the saponification of the intermolecular ester bonds that link the lignin-hemicellulose matrix (Hu and Ragauskas 2012). Based on Table 4 below depicts the comparison of various alkaline reagents pretreatments (Kim, Lee, and Kim 2016).

Furthermore, evidence exists for dilute acid pretreatment (DAP), which has been successfully tested on a variety of feedstocks and agricultural corps in reducing lignocellulosic recalcitrance (Hu and Ragauskas 2012). Similar to alkaline pretreatment, DAP hydrolyses the majority of the hemicellulose and lignin structure is disrupted while cellulose may potentially be degraded into glucose under severe conditions (Hu and Ragauskas 2012). DAP is made with a variety of acids, including hydrochloric acid, nitric acid, and peracetic acid, as well as sulphuric acid, which is the most widely used due to its potency and low cost (Hu and Ragauskas 2012).

To summarise, as the nanocellulose market has grown significantly over the years, oil palm biomass is considered to be utilised as a feedstock for nanocellulose manufacturing on a large scale. This strategy has the potential to alleviate much more of the transboundary haze problem caused by the open burning of oil palm fields. Apart from that, the use of either alkaline or dilute acid pretreatment is notable. It decreases the lignin-hemicellulose matrix by a large amount while increasing cellulose accessibility, resulting in a higher output of nanocellulose. Meanwhile, the reagents used are generally inexpensive and may be carried out in milder settings, speeding up the commercialisation of nanocellulose. As a result, the approach for reducing haze from the oil palm sector is considered viable.

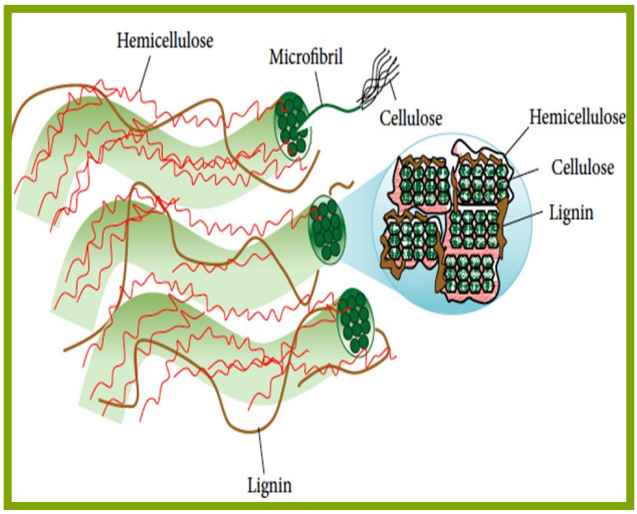

Figure 2: Complex arrangement of lignocellulosic biopolymers (Reproduced from Lee, Hamid, and Zain 2014) (Reproduced from D. et al. 2009)

Table 3: : Potential Applications and Opportunities of Nanocellulose (Reproduced from Sinquefield et al. 2020)

Application Areas	Opportunities
Aerospace	Ligtweight NC-enabled materials for aerospace, aircraft, and satellites
Automotive	Composites and coatings for automobile bodies and interiors
Construction	Additives for construction wallboard to improve strength, water resistance, and insulation; additives to cement
Cosmetics	Additives for emulsifiers, hydrating agents, and rheology modifiers in cosmetics
Coatings / Paint	Viscosity modifiers for paints
Composites / Polymer reinforcement	Improves strength, reduces density, adds shape-memory, and adds water adsorbency; adds biodegradable components and reinforcement to plastics
Electronics	Substrates for flexible and recyclable electronics
Food packaging	Sensors in food packaging that indicate freshness
Health care	Reinfored injured tissue while the tissue heals and serves as a delivery mechanism for medications
Oil Drilling	Tailors the viscosity of drilling mud and improves spill cleanup absorbents
Paperboard / packaging	Coatings and fillers in paper and board manufacturing
Specialty paper	NC in surface applications and fillers

Table 4: Comparison of different reagents of alkaline pre-treatment (Reproduced from Kim et al., 2016)

Description	NH_3	NaOH	Na_2CO_3	$Ca(OH)_2$
Pretreatment process				
Pressure	High	Low	Low	Low
Temperature	High	Low	High	Low
Concentration or Chemical loading	~15 – 30% aq. or gas	1 – 5%	5 – 15%	0.1g $Ca(OH)_2$/g solid
Recovery process	Simple evaporation, high pressure equipment required	Kraft process, expensive	Partial Kraft process, less expensive	CO_2 carbonating, less expensive
Corrosiveness	Low	High	Medium	Low
Advantages	High selectivity (delignification) & retention of carbohydrates Elimination of liquid stream detoxification High fermentation efficiency because of absence of toxins and inhibitors			

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Article: Correcting Misperception on Palm Oil

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Palm oil has been a major staple in Malaysia's economy, accounting for around 4.67% of the country's gross domestic product (GDP) in 2019 [1]. Malaysia is currently responsible for 39% of the world's palm oil production and 44% of the world's exports[1]. Palm oil is being used in a wide range of products such as food, cosmetics, and biofuels. However, this industry is being increasingly subjected to negative sentiments regarding its effects on the environment, society, and human health that stem from misinformation on the topic of palm oil, leading to a significant degradation in the demand for palm-oil-based products. Therefore, this article aims to rectify some of these misperceptions with the correct factual and scientific information.

1. There is no such thing as a sustainable palm oil

Historically, the unsustainable nature of farming practices of palm trees has caused widespread clearances of the rainforests, especially in South-East Asia[2]. These rainforests are home to some of the world's most biodiverse areas and clearing them for palm plantations means destroying the habitat of animals including endangered species such as the orangutan, pygmy elephant, and Sumatran tiger. Also, the subsequent loss of carbon-rich peat soil has caused millions of tonnes of carbon dioxide and other greenhouse gases to be released into the atmosphere, contributing to global warming. These impacts have led to widespread accusations that palm oil plantations will never be sustainable and would only lead to environmental devastations.

Over the last 15 years, as concerns and awareness begin to grow on the impact of unsustainable palm oil, there has been a joint global effort to find ways to transform production methods and to produce sustainability credentials. Ultimately in 2008, the Roundtable on Sustainable Palm Oil (RSPO) has developed a set of criteria across several key areas in which companies must adhere to in order to be certified as being sustainable. One of the most important criteria states that no primary forests or areas which contain significant concentrations of biodiversity (e.g. endangered species) or fragile ecosystems, or areas that are fundamental to meeting basic or traditional cultural needs of local communities can be cleared[3]. The RSPO has strengthened its standards most recently which can be seen from few companies which adopt the 'No-deforestation, No-peat and No-exploitation' (NDPE) policy[2]. Malaysia has also its own national scheme referred to as the Malaysian Sustainable Palm Oil (MSPO) certification scheme to help small and mid-range cultivators who could not afford RSPO certification to operate sustainably. The principles enforced to obtain these sustainability certifications have helped reduce the negative impact of palm oil cultivation on the environment. Currently in Malaysia, 75.1% of 5.9 million hectares of plantations are RSPO-certified, while 88.1% are MSPO-certified[1]. For mills, 431 of 452 are MSPO-certified[1]. This has truly proven that nowadays palm oil can be a truly sustainable option. Globally, more than 14% of palm oil is certified by RSPO[3]. It is hopeful that greater percentages of cultivators would practice sustainable palm oil farming in the future. Consumers, suppliers, outlets, and manufacturers can play a huge role in reducing palm oil produced by unsustainable practices by purchasing products only from producers that have received certifications by RSPO and MSPO.

2. Replacing palm oil can stop the negative impacts on society and the environment

There has been a big misconception that replacing palm oil with other types of vegetable oils such as soybean and rapeseed can reduce the environmental and social impacts of palm oil. This is not as simple as it seems for several reasons.

Palm oil is the most efficient in terms of oil production with 4-10 times more oil yield when compared with other crops per unit of cultivated land[3]. On the other hand, vegetable oils such as soybean, rapeseed, and sunflower yield significantly lower oil as compared to palm oil. Replacing palm oil with other vegetable oils would mean that as much as 4-10 times more land would need to be used for cultivation, destroying more forests areas and subsequently more biodiversity[4].

Furthermore, the palm oil industry has become the source of income for a total of 4.5 million people living in Malaysia and Indonesia[3]. This industry plays an integral role in reducing poverty in these areas. Stopping the production of palm oil and replacing it with other types of vegetable oils would seriously affect the source of living for millions of people who support their families by working in this industry.

Therefore, not only do the cultivation of other vegetable oils would cause issues to society and the environment; they would even exacerbate the problems we currently are facing. As consumers, the best solution to this problem is to buy palm -oil products produced from sustainable practices.

3. Consumption of palm oil increases the risk of breast cancer

There is currently no scientific evidence that proves palm oil increases the risks of breast cancer. This misconception stems from false information regarding the presence of trans-fatty acid in palm oil. Trans-fatty acid can be found in significant amounts in other vegetable oil such as partially hydrogenated soy and canola oil[5]. Various scientific literature has provided evidence that the regular consumption of trans-fatty acid induces breast cancer, especially in post-menopausal women[6,7]. However, palm oil is completely free of any trans-fatty acid content5. In fact, palm oil is the only vegetable oil that contains an abundant amount of tocotrienols, which offers strong protection against breast cancer[5]. This is in stark contrast to the alleged misinformation being made against palm oil.

Conclusion

The increasing negative campaigns being made against palm oil that stem from false information has caused bad publicity surrounding the palm oil industry. According to the Malaysian Palm Oil Council (MPOC), some of the false information is being spread by Non-Government Organizations (NGOs) that are motivated by political means as opposed to genuine concern for the environment[8]. The ease with which this information is being spread is facilitated even further by the means of social media. With the country relying heavily on palm oil exports, these campaigns that are based on false information against palm oil have negatively impacted the producers, export earnings, and the economic income of over 650,000 smallholders as well as over 2 million people working in the palm-oil industry[8]. Therefore, it is of utmost importance for people nowadays to carefully examine the information being fed to them on the topic of palm oil, as not only do the information can be false but the consequent negative perceptions and decision-making can significantly reduce the demand for palm-oil based products, impacting the livelihood of millions of people.

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Article: Correct Information and Benefits of Palm Oil

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Abstract - The aim of this paper to disseminate correct information about the palm oil and also to encourage the involvement of future generations in the palm oil industry. Palm oil is the most widely traded vegetable oil globally, with demand projected to increase substantially in the future. Almost all oil palm grows in areas that were once tropical moist forests, some of them quite recently. The conversion to date, and future expansion, threatens biodiversity and increases greenhouse gas emissions. Today, consumer pressure is pushing companies toward deforestation-free sources of palm oil. [1]

Introduction - The oil palm tree is an ancient tropical plant that originated from West Africa. Palm oil has centuries' long use as food and medicine. This review covers the recent significant materials found in the literature on palm oil processing, refining, and use in frying especially in blends with other vegetable oils. Crude palm oil (CPO) is obtained from the fruit of the oil palm tree (Elaeis guineensis). The oil is rich in palmitic acid, β-carotene and vitamin E. CPO has been fractionated mainly into liquid palm olein and solid palm stearin in order to diversify its food applications. Palm oil is highly stable during frying especially due to the synergistic activity of β-carotene and tocotrienol. In recent years there has been a shift from the use of animal fats and hydrogenated vegetable oils in frying and other food applications. The use of naturally stable oils such as palm oil and composite oils like blends of palm oil and other fats and oils is practice to ensure that maximum benefits are derived from the oils. Blending offers functional, nutritional and technical advantages, such as tailoring the oil to suit frying applications. [2]

Objectives - The aim of the researchers is to disseminate the correct information about the palm oil. The following section presents the correct information about the palm oil which is useful and helpful to solve the misconception of people thought about all the issue related to palm oil.

Sustainable palm oil

This misconception is voiced by a featured article in the newspaper The Independent, which stated that "there is no such thing as sustainable palm oil," which only talks about palm growing in Southeast Asia. Latin America, a growing palm-producing frontier with a very different growth mindset, was not included in the research. The research pinpoints some shortcomings around certification standards, like consensus over what counts as deforestation, the use of sufficiently strict guidelines for forest protection, and lax enforcement. It does not dig into some of the great solutions that are happening in Latin America, like in Colombia, where producers signed the first national zero-deforestation agreement for palm oil. Or in Ecuador, where the Ministry of Agriculture reactivated its jurisdictional Round Table on Sustainable Palm Oil (RSPO) Certification plan, which means entire provinces will be certified sustainable, instead of individual companies and plantations. When companies (and countries) do not compromise, sustainable palm oil is a reality. This means taking the challenges facing palm oil seriously: eradicating the use of chemicals by using 100 % organic practices, refraining from deforestation, taking a wildlife friendly approach to oil palm growing, and taking a fair and social approach to farmers and workers.[3]

GreenPalm defines certified sustainable palm oil (CSPO) and palm kernel oil (CSPKO) as produced by palm oil plantations which have been independently audited and certified against the Roundtable on Sustainable Palm Oil (RSPO). The Roundtable on Sustainable Palm Oil (RSPO) was established in 2004 to promote the production and use of sustainable palm oil for people, the planet and prosperity. A total of 40% of the world's palm oil producers are members of the RSPO, as well as many product manufacturers, retailers, environmental and social non-governmental organisations (NGOs). The RSPO has become the globally recognised standard for sustainable palm oil. Sustainable palm oil is defined by the eight principles and criteria against which oil palm plantations are certified. [4]

Figure 1: The 8 RSPO principles and criteria [4]

In a nutshell, sustainable palm oil does make businesses profitable while not harming people or the environment. To achieve this, palm oil majors have in the past few years adopted policies that promise no deforestation, no peat development, and no exploitation (NDPE). Companies with NDPE policies in effect include Singapore-based Musim Mas, Golden Agri-Resources (GAR), Wilmar International; American agribusiness firm Cargill, and Indonesian grower Asian Agri. These policies are usually applicable across the company's supply chains, including third party suppliers and smallholders. They require farmers to stop burning land to clear it, assess land for high carbon stock and high conservation value before developing new plantations, and obtain land use permission from communities using a process known as 'Free, Prior and Informed Consent'. Many of these requirements are reflected in what is widely considered to be the industry's most comprehensive way to identify sustainable

palm oil: the RSPO certification system. The RSPO is founded in 2004 which brings various players in the palm oil sector to a common discussion table to develop and implement standards for sustainable palm oil. Its stakeholders include plantation companies, processors and traders, consumer goods manufacturers, retailers, financiers, and civil society groups from countries that produce, as well as use, palm oil. The standards, which are finalised through consensus among these stakeholders, are called the RSPO Principles and Criteria (P&C). They consist of eight principles and more than 40 criteria that growers need to fulfil to prove adherence to the criteria.[5]

Palm oil is a primary cause of deforestation

People will testify that global deforestation is linked to palm oil if you ask someone in a grocery store, on the street, or in a café. They would even argue that boycotting palm oil would be an effective way to stop deforestation. This is also incorrect. While it is the true fact that palm oil production, particularly in Southeast Asia, has caused significant environmental damage, numerous reports show that livestock, beef production, and soy farming have caused far greater deforestation. In fact, soy farming is responsible for more than double the amount of deforestation than palm oil production. In the context of other food sources, livestock and beef production has led to more than five times the amount of deforestation, compared to palm oil. [3]

Economic benefits

The palm oil industry has helped lift millions of people out of poverty in Indonesia and Malaysia, which together account for around 85% of the global production. Oil palm plantations have created millions of well-paying jobs, and enabled tens of thousands of smallholder farmers to own their own land.

In Indonesia the palm oil industry accounts for 1.6 per cent of GDP and employs 4.5 million people. As the majority of the harvest is exported the industry brings in more than $18 billion a year in foreign exchange, the single biggest contributor in the country. [6]

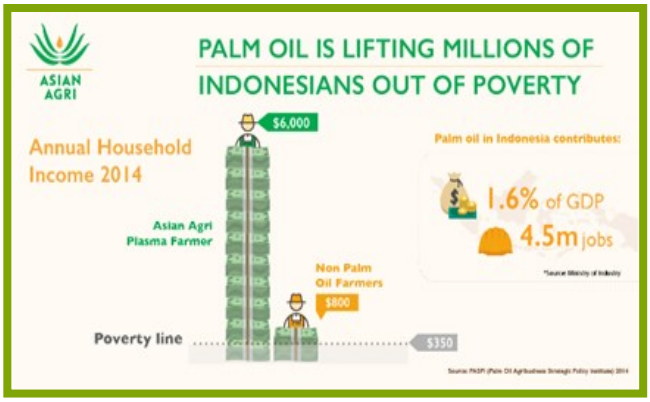

Figure 2: Palm oil lifting millions of Indonesians out of poverty [6]

Asian Agri partners with 30,000 smallholder farmers as part of our (One to One Commitment), which the main target is to match each hectare of their own land with land owned by smallholders by the end of 2018. Smallholders represent 42% of palm oil plantations in Indonesia but account for just 37% of production, in order for their partnership to provide an important way to increase their productivity and therefore their living standards.[6]

Versatility

Palm oil has a long shelf life and is solid at room temperature, making it an ideal ingredient in a wide variety of foods. It gained significant popularity since the 1990s as manufacturers looked for alternatives to unhealthy hydrogenated and partially-hydrogenated fats. Like most natural seed oils, palm oil contains less than 1% trans fats that plays an important role in a healthier diet.

It is stable at high temperature hence it makes an ideal ingredient to be used in cooking and frying, while its high melting point makes it a cost-effective replacement for animal fats in products such as spreads and baked goods.

Palm oil is used to manufacture sodium lauryl sulfate, which is used as a foaming agent in many body care products such as soap and toothpaste, and is also often added to household cleaning products.

Its fat content also makes it an ideal emulsifier for moisturisers, makeup and even candles. [6]

Efficiency

Oil palms are significantly more efficient than other oil-producing crops. A single hectare of land can produce 4.17 metric tons of palm oil in a year, compared to just 0.56 tons of sunflower oil, 0.39 tons of soybean oil and 0.16 tons of groundnut oil. In fact in 2016, it is reported that only 7% of oil palm used the world's oil farming land while accounting for 32% of production. [6]

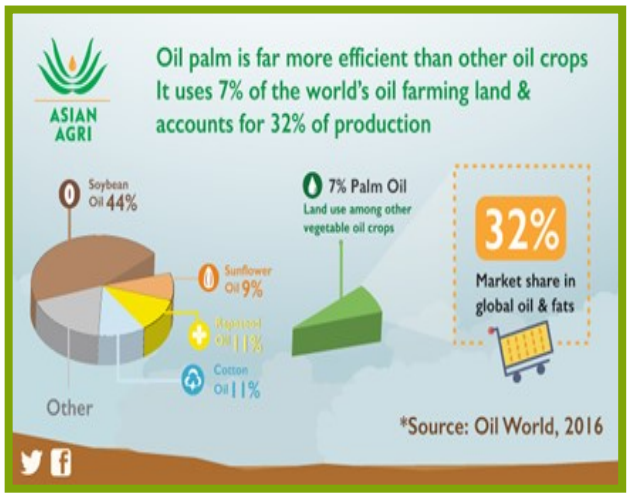

Figure 3: Palm oil efficiency [6]

That means that significantly less land needs to be cleared to meet demand for vegetable oil, as other crops require at least five times more land to produce the same volume as oil palms.

Oil palms also require significantly lower quantities of fertilizer, pesticides and energy. According to The Guardian, the production of a ton of soybean oil requires 315kg of fertilizer, 29kg of pesticides and 2.9 GJ of energy, compared to just 47kg of fertilizer, 2kg of pesticides and 0.5GJ to produce the equivalent amount of palm.[6]

Asian Agri combines these benefits with a commitment to ensuring that our entire supply chain adopts best practices in the production of sustainable palm oil. [6]

Health Benefits

- **Brain health**

Palm oil is an excellent source of tocotrienols, a form of vitamin E that may support brain health.

Animal and human studies suggest that the tocotrienols in palm oil may help protect the delicate polyunsaturated fats in the brain, slow dementia progression, reduce the risk of stroke and prevent the growth of brain lesions.[7]

In a two-year study of 121 people with brain lesions, the group who took palm oil-derived tocotrienols twice a day remained stable, whereas the group who received a placebo experienced lesion growth.[7]

- **Heart health**

Palm oil has been credited with providing protection against heart disease. Although some study results have been mixed, this oil generally appears to have beneficial effects on heart disease risk factors, including lowering “bad” LDL cholesterol and increasing “good” HDL cholesterol.

A large analysis of 51 studies found that total and LDL cholesterol levels were lower in people who followed palm oil-rich diets than those who consumed diets high in trans fats or myristic and lauric acid.[7]

- **Improved Vitamin A Status**

Palm oil can help improve vitamin A status in people who are deficient or at risk of deficiency.

Studies in pregnant women in developing countries have shown that consuming red palm oil increases vitamin A levels in their blood, as well as in their breastfed infants.[7]

One study found that people with cystic fibrosis, who have difficulty absorbing fat-soluble vitamins, experienced an increase in blood levels of vitamin A after taking two to three tablespoons of red palm oil daily for eight weeks.[7]

Red palm oil has also been shown to help boost vitamin A levels in adults and young children. In fact, a study from India reported that preschool-aged children who took 5 ml (1 teaspoon) per day had greater increases in vitamin A levels than children who received vitamin A supplements. [7]

Conclusion

I hope this study enable every people will know the benefit of palm oil that not only bring benefit to our country economy but also benefit to human health. More and more people getting know better about palm oil through this article and enjoying the wonderful benefit that palm oil brings.

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Article: Is Palm Oil Industry Sustainable?

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People are always judging and doubting the sustainability of palm oil, but many of the products nowadays are derived from palm oil especially food products. People might not have realized it, but they have used so many palm oil derived products. In fact, there are many misperceptions of the sustainability of palm oil that must be clarified to prove that palm oil industry is sustainable.

In terms of environmental aspect, land requirement of palm oil is less than half compared to other oil-producing crops. In this era of globalization, oil is defined as global demand as most food production requires oil. Land usage to produce oil is taken as one of the ways to support the high demand of oil People do think that the development of palm oil plantation nowadays causes more land consumption to meet the market demand. Consequently, people judge that palm oil is the main cause of pollution compared to other crops. As shown in Figure 1, palm oil stands the largest oil yield with lesser land usage compared to other crops. Other crops such as soybean and rapeseeds produce lesser oil yield, indicates that more land is required to produce the same amount of oil as palm oil (Zimmer 2016). Nowadays, palm oil industry is trying to reduce the dependent on the usage of rainforest and make use of degraded land for crop plantation (Wicke et al. 2008). This is not only implying the concept of 3Rs (Reduce, Reuse and Recycle), but also generating and increasing new capacity of carbon sink to reduce the amount of carbon dioxide in atmosphere The reduction of carbon dioxide would help to alleviate the greenhouse effect that attributes to global warming. Wicke et al. (2011) also did a study to identify the projected growth of palm oil industry and the effect towards the land use. The result indicated that the expansion of industry would require additional land use, but this could be resolved by assimilating the degraded land without causing further loss of rainforest. Biofuel technologies that make use of the palm oil would also enhance the sustainability in terms of environmental aspect, by providing an alternative of petroleum and natural gas as energy producing medium (Mukherjee and Benjamin 2014). The efficiency of biofuel could be improved by integrating the palm oil with other renewable sources via improvement of biodiesel technologies, etc. Some governmental assistances such as feed-in-tariff encourage the industry to invent the technologies, by providing remuneration the fund that has invested in the form of Clean Energy Cashback.

Next, environmental pollution by destroying biodiversity holds a position among the misperceptions. Alloway (1996) claimed that usage of any land would pollute the water and soil. Water pollution happens as the industry used fertilizers on the crops and leaching of fertilizer could occur, causing phenomenon such as eutrophication that affects the ecosystem of the aquatic life. Also, excessive usage of fertilizer could cause barren land. Hence, it was undeniable that growing crops using land might pollute water and soil. In comparison with other crops such as sunflower, rapeseeds and soybean plant, the land usage of palm oil is the least. Carbon emission is a concern as the usage of peat land for palm oil plantation might reduce the capacity of carbon sink. The palm oil mill effluent (POME) that creates the largest source of pollution in the industry has high chemical and biological oxygen demand. Improper treatment of POME could cause the emission of methane that is 25 times more impactful than carbon dioxide as greenhouse gas. Therefore, policies such as Kyoto Protocol had proposed international emission trading, joint implementation and clean development mechanism that not only awarding the reduction of carbon dioxide, but also encouraging the initiatives of renewable energies invention. Wastes are produced in palm oil plantation such as POME, fiber, shell, empty fruit bunch (EFB), trunk, fond, etc. Regeneration (REGEN) system that integrates technologies to transform the

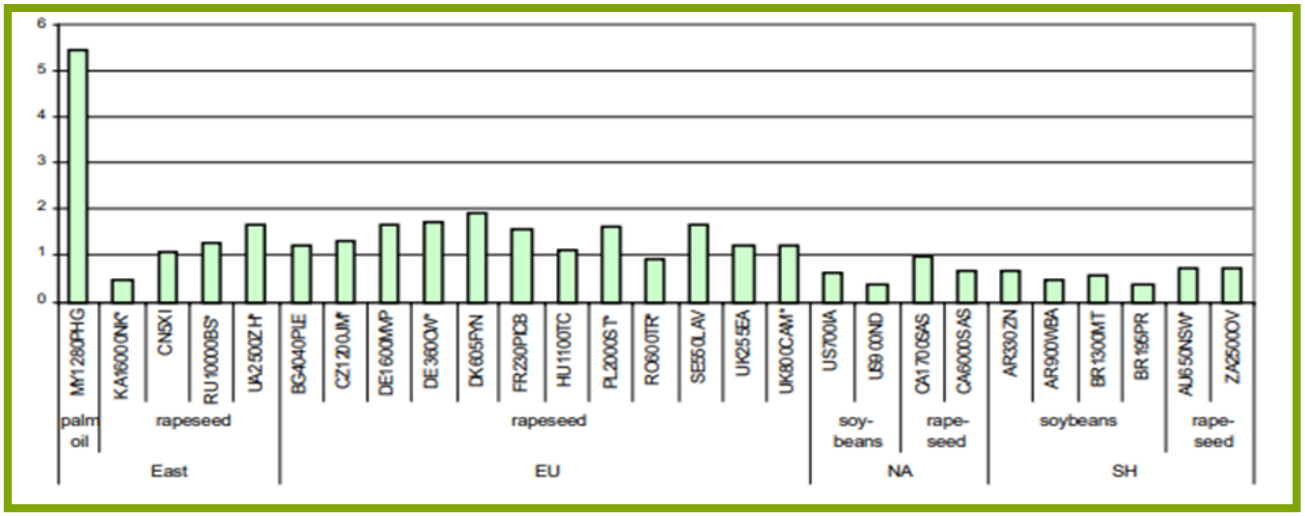

Figure 1: Yield of vegetable oil (tonnes/ hectare)

Source: Figure reproduced from Zimmer (2016, 86).

wastes into reusable consumables or valuable products can achieve zero waste management and self-sustainability. For example, POME can be used for electricity generation; shell, fiber and EFB can be transformed as fuel for boiler or heater, trunk and fond can be processed as furniture or composite materials. Also, in Malaysia, the main source of water pollution is POME and effective solution of using electrocoagulation process that helps to dissolve the contaminants in the wastewater using electrical current and this has reduced the risk of affecting the environment to the lowest compared to other growing crops (Sayuti and Abdul 2015).

There is another controversy in terms of social aspect. It is related to the environmental issues raised by the palm oil plantation. People doubt that the development of palm oil plantation affects the life quality of the residents living in rural areas. River is the main water supply in rural areas. Water pollution due to POME could deteriorate the water quality and causes infectious diseases. Deforestation and land ownership are the common conflicts too. In fact, palm oil requires the least land. Some countries such as Malaysia have taken the rural areas into consideration when making polices regarding palm oil crop plantation to boost the economy in rural areas, by improving palm oil plantation using more modern techniques, knowledge-based planting techniques, competitive force of palm oil derived products, and etc. The development and expansion of palm oil industry creates and sustain more than millions of working opportunities. This can improve the accessibility towards the rural areas as the residents are involving in the palm oil industry by developing their land. The involvement of smallholders will generate interests of the investment and improve the development of rural areas. Also, Roundtable Sustainable Palm Oil Certification (CSPO) and Malaysian Sustainable Palm Oil Certification (MSPO) have devised the rules and regulations to ensure the palm oil industry to achieve sustainability according to the three pillars, i.e., social, environmental and economical.

Lastly, there is a contradiction to claim that palm oil is inefficient in economic aspect. As mentioned above, land usage is the main source of all the controversy come from. The expenditure of resolving the environmental issues is always being questioned. In fact, palm oil is generally cheap. People do think that the oil is inefficient. The unique characteristic of palm oil omits the need of hydrogenation that can produce harmful trans-fatty acid. This has allowed the processing procedures to be simpler and reduce the processing cost. Also, it should be noted that palm oil has accounted more than 30% of the world's vegetable oil market and 60% of the global exports (Carter et al. 2007). This proved that the trading of palm oil is a neediness. Besides, there are feed-in-tariff, fiscal incentives, rules, regulations, fines and penalties that are implemented as governmental initiatives to protect and enhance the development of palm oil industry. For instance, Table 1 shows that there are various types of fiscal incentives introduced to improve the economy rate of palm oil industry in Indonesia. The reason is because of the potential of palm oil industry in making revenue. By taking Malaysia and Indonesia as reference, both lead the global production of palm oil, approximately account for a total of 85% (Carter et al. 2007). It is fourth largest contributor to the national economy in Malaysia. Other than that, waste generated in palm oil industry can be treated to seize the new business opportunity. For example, Malaysia devised National Biomass Strategy (NBS) to effectively make use of the abundant wastes produce from the agricultural sector to create new business opportunities other than resolving environmental and social issues.

In conclusion, palm oil is sustainable in terms of environmental, social and economic aspect. Many initiatives have been implemented and continued in palm oil industry to reduce the possible negative impacts towards the three pillars of sustainability to reduce or mitigate the bad consequences and creating new business opportunities. The presence of RSPO has also encouraged the industry to be self-sustainable by implementing green technologies. As a consumer, people should also support the use of sustainable palm oil by purchasing the products that are accredited with RSPO trademark. For millers, assurance of using the certified palm oil sources is crucial to ensure the quality of the palm oil derived products.

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Article: Transcending Palm Oil Sector into IR4.0

Young minds of chemical engineering students

Written by Muhammad Hazman Bin Hasnan, Muhammad Farhan Bin Abdul Halim, Muhammad Ezwan Bin Saifuddi, Muhammad Danial Bin Abd Jalil, Fariza Binti Hamidon

(Universiti Teknologi MARA, Shah Alam, Malaysia)

As the world is shifting toward the fourth industrial revolution (IR 4.0), it is expected that most of the industry operation will be digitalised and automized. This consists of machine learning, real time data and even interconnectivity. Thus, without a doubt that in the nearest future the industrial world has to adapt with the change specifically the palm oil industry in Malaysia. The palm oil sector has been lacking with fewer breakthrough in the recent years. In fact, most of the process is still manually conducted in term of plucking and grading process of the palm fruits. Due to the current state of the palm oil sector, a study is conducted in order to transcend the palm oil sector into IR 4.0.

In order to achieve IR 4.0 in the palm oil industry, we need to implement automation to increase the efficiency of plucking palm fruits. Smart robotic claw is implemented to help pick and carry heavy fruits which is hard for human to carry and can be a hazard to them in the long run. Plus, a Hue Saturation Sensor (HSI) is attached to the machine to differentiate between a ripe and unripe fruit. This will significantly improve the time for the overall process as the manual grading process is removed. Furthermore, the smart robotic claw is attached at the back of 6WD truck in order to manoeuvre in between tight spots.

Next, the system of the palm oil sector will be integrated with the Earth Observing System (EOS). EOS is a tool for farmer to control the overall plantation via computerized data. This included the field activity log which keep all records of the cultivation activities as well as sowing and harvesting dates. With the utilization of the internet of things, the palm oil producers can keep an eye on their plantation field and schedule all necessary events.

In any type of operation, safety is the number one priority. Several safety features have been installed on our Smart Robotic Claw. The first one is watertight enclosures to ensure that the electronics will not be damaged by water and can be operated during heavy rain. Next, an emergency shut-down button and a lockout or tagout system are installed to ensure safety during maintenance work. Lastly, cameras are installed to help in manoeuvring in between tight spots and avoid collision during the operation.

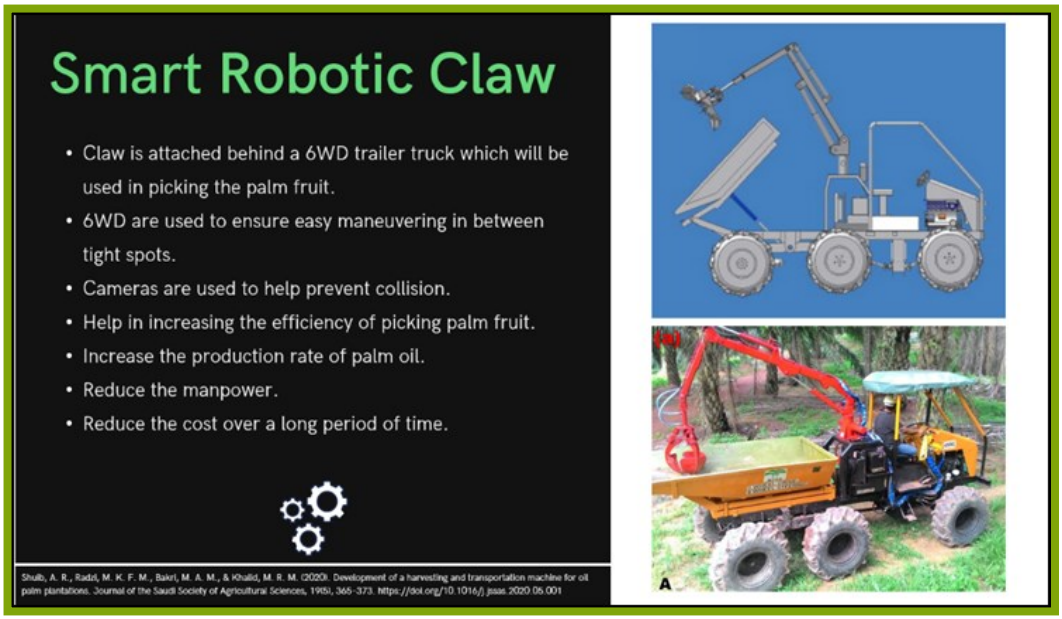

Figure 1: Smart robotic claw improves risk management in the field.

In term of profit harvesting machines are more productive and less labour-consuming than manual picking. Complete machine harvester is attributed to nearly double productivity as compared to conventional process. Therefore, by utilizing this technology, the industry will definitely gain higher profit through time. This is due to the fact that it can reduce the time taken for each process and reduce the amount of manpower needed. Plus, a higher quality and yield of product can be achieved with the implementation of the HSI and EOS.

In conjunction with IR 4.0, the product can develop 21st-century skills among plantation workers by improving their knowledge regarding the technology.

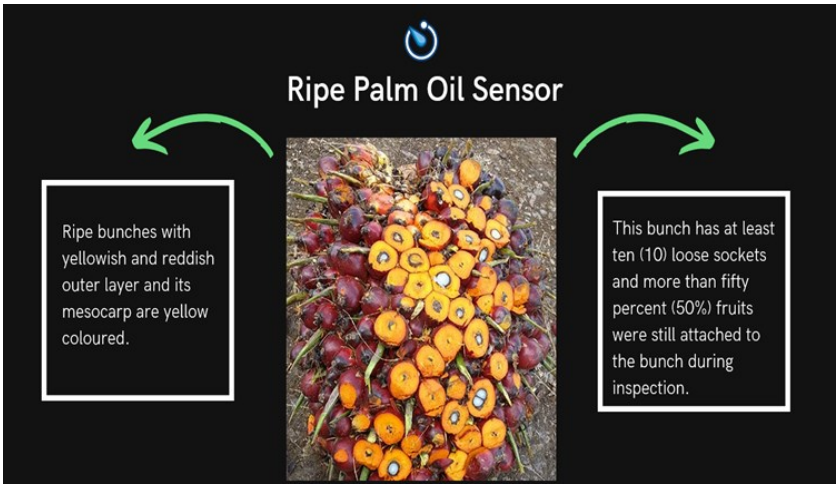

Figure 2: Ripe palm oil sensor improves time efficiency at work.

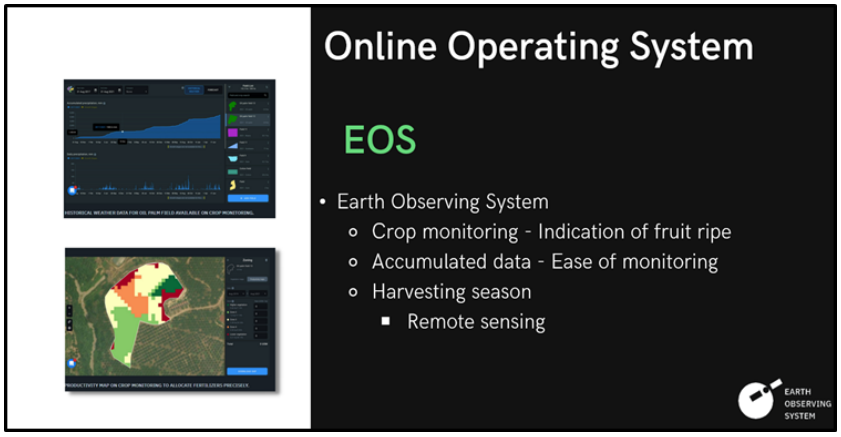

Figure 3: EOS uses IoT to monitor cultivation activities.

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Article: Future of Palm Oil Industry with 4IR and 5G Adoption

Young mind of chemical engineering student

Written by Nur Ashazzianna binti Lajakaya
(Universiti Malaysia Sabah)

The fusion of cloud computing, AI, IOT, and big data could define the 4.0 IR in the palm oil industry. 5G is the future that will outperform current oil palm technologies.

Utilizing 4.0 IR in the palm oil industry improves operational efficiencies, productivity, and profit. Prior to the era of 4.0 IR, workers manually entered data, diverting time and energy away from other duties. Employees may remotely monitor the palm oil mill, improving process safety and quality. This reduces the risk of workplace accidents.

5G internet speed is 400 times faster with 100 times the capacity compared to 4G (50 ms). 5G can transfer 1000 MB/s and provides real-time controller-sensor networking (TSN). IoT platform interfaces and app experiences will improve as internet speeds and reliability increase. Additionally, it eliminates the requirement for large-scale investments in IT infrastructure.

For instance, the pressed-crew extraction method of mesocarp fibre might employ sensors and AI to maintain hexane at 68° C. Using cloud computing, 5G, and big data, palm oil operations and plants may be compared significantly easier while palm oil soil monitoring via IoT and 5G, will accelerate the transfer of WSN sensor data for the pH and moisture content of palm oil soil.

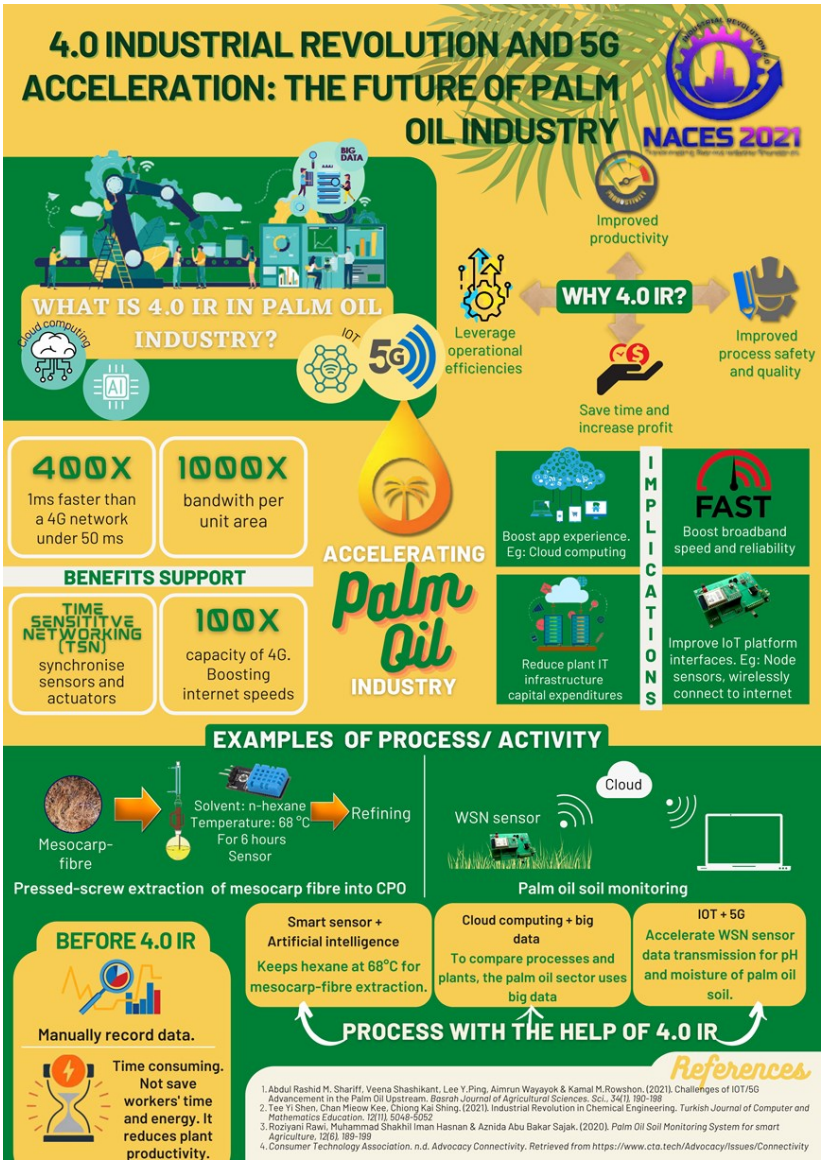


Figure: Nur Ashazzianna binti Lajakaya designed the infographic associated with palm oil, 4IR and 5G technologies.

News: POPSIG Best Final Year Design Award 2021

The IChemE POPSIG's 3rd Annual Best Final Year Design Project Award 2021, sponsored by Desmett Ballestra (M) Sdn Bhd, was awarded to the student group from UCSI University, Malaysia

UCSI Student Team

The student group comprised 6 members under the supervision of Ms Wan Adeebah binti Wan Mahmood, the lecturer at UCSI University, Malaysia. The members of the selected group were Koh Jun Da (Team Leader), Khee Yue LiAN, Pravin Ganesar Gunasegaran, Raj Vaman A/L Selvanthan, Win New Pyone, and Tiang Min Tun..

Hydrogen production project won the award

The selected project was titled, '*Production of 20,000 MT/year hydrogen gas using palm kernel shell through pyrolysis process'*. The accomplishment was awarded *"for the production of hydrogen from palm kernel shell that accelerates the renewable energy"*.

Chair of POPSIG had confident about future projects

The 2021 Award ceremony was held on 30 October 2021 on Zoom. Chair of POPSIG, Professor Ir. Dr. Chong Mei Fong shared that she was confident to see many more creative projects designed by the students to contribute to net zero, circular economy, POME waste treatment and so on. Professor Chong believed that the creative projects can promote palm oil processing among chemical engineers. She could foresee many records on high-quality projects about palm oil processing every year throughout POPSIG's annual award.

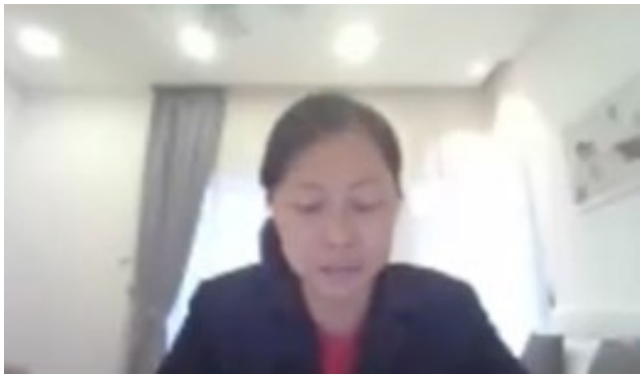


Figure 1: Chair of POPSIG, Professor Ir. Dr. Chong Mei Fong delivered her opening address.

Wan Adeebah called for sustainable fuels

Supervisor of the awarded team, Ms Wan Adeebah binti Wan Mahmood expressed her sincere appreciation to the judging panel that selected their team as the recipient for 2021 award. Although it was challenging as the country underwent nationwide lockdown period, she was delighted to see all the efforts of the team on their group project. She stated that the project was about to convert oil palm waste into biofuel for sustainable energy. Adeebah stressed that greener and sustainable fuels should replace the non-renewable ones, while she was confident that the demand for green hydrogen will surge in the upcoming decades.

Innovative engineers needed, said Mr. Khoo Kiak Kern

Managing Director at Desmet Ballestra (Malaysia) Sdn Bhd, Mr. Khoo Kiak Kern addressed that more innovative engineers are needed to create more value-added chains, incorporating main products, waste materials and by-products. He praised that POPSIG has been encouraging younger generation to play a role in palm oil sector. POPSIG's initiative to present this award had certainly instigated the innovation and creativity skills of the participants. Mr. Khoo congratulated the team from UCSI University, Malaysia for their hydrogen production project. Although the project was still at design stage, he shared that all inventions always start with innovative ideas.

Hydrogen technology for decarbonisation effort

Oscar Ting presented the science behind the prize. This year's design was about using PKS to produce hydrogen — the fuel of the future. The process design comprises syngas modification and separation for hydrogen production. Hydrogen produces only water during oxidation. The use of hydrogen as clean fuel marks a significant milestone in heavy industries. In Malaysia, hydrogen-powered bus began its service in Kuching, Sarawak, and was the first vehicle with zero emission in Southeast Asia. The process design created by the team from UCSI University, Malaysia was believed to potentially contribute to the innovations in the palm oil industry and sustainable living environment.

Figure 2: Oscar Ting (POPSIG) presented the science behind the prize.

Figure 3: Managing Director of Desmet Ballestra (Malaysia) Sdn Bhd delivered his speech to the audiences.

Quotes by UCSI Team

Koh Jun Da (Team Leader) - “First of all I would like to thank IChemE POPSIG and Desmet Ballaestra, providing a great platform for us to apply engineering knowledge and ideas in improving energy sustainability. In recent shifts by countries around the world to reduce dependency on non-renewable fuel source has sped up initiatives to replace with hydrogen fuel. We belief hydrogen gas will become one of the competitive fuels in the future that can be compared with conventional fossil fuels, benefiting the transportation sector. Hence, it is high time for all of us to explore new possibilities by utilising palm oil-based waste. For my fellow teammates, all the commitments and sacrifices you made has huge impact towards this project. United we stand, divided we fall, great job guys!”.

Pravin Ganesar Gunasegaran (Team Member) - “Thank you for this award. I would also like to thank our supervisor and my teammates, especially the team leader, Koh Jun Da, for all the effort in making this achievement possible although we couldn't meet one another during this pandemic. The team and I are truly honored to receive this award. It is an even greater honor to be placed among the award recipients as those of the past honorees, all of whom have made important contributions to the field of chemical engineering in palm oil industry. Special thanks go to the IChemE POPSIG committee for having the generosity to award us and to the Desmet Ballestra (M) Sdn. Bhd., for making this event possible.”

Khee Yue Lian (Team Member) - “Thank you for providing us with such a wonderful platform to showcase the plant design project we did. I would like to express my deepest appreciation to our supervisor and team members for their dedication and cooperation throughout the project. One of the most important things that I have learnt from this project was that sustainable and environmental-friendly solutions are important in designing a plant. By converting the leftover palm oil mill waste into hydrogen gas, we can bring a positive impact to the environment in line with Sustainable Development Goal.”

Win Nwe Pyone (Team Member) - “I am much thankful to those responsible organizations and companies such as IChemE, Desmet Ballaestra and POPSIG for allowing us to showcase our project involving the use of palm oil mill waste (palm kernel shell) to generate sustainable energy such as green hydrogen that will benefits the respective country economically. It is very fortunate of me to have such dynamic team who individually possess amazing work ethic and personality. I am very appreciative of their patience and commitment to this endeavour. It provided me with a chance to hone my understanding of chemical plant design from both a technical and economic standpoint and trained me to applied all the fundamental of Chemical Engineering coursework that had been observed during academic years in to this project.”

Tiang Min Tun (Team Member) - “I am very grateful to be a part of this team and having the experience to participate in this project that provide practical solution on generating new type of energy source from palm oil wastes. It sharpens my understanding towards engineering and provide insight on how to design a plant. Once again, I would like to thank IChemE, POPSIG for providing the platform and my team leader Koh Jun Da along with my supervisor Ms.Adeebah and my fellow teammate.”

Raj Varman A/L Selvanathan (Team Member) - “I am extremely proud and honoured to be part of this team’s success. First and foremost, I would like to thank our supervisor and team members for their contribution and commitment. I also would like to highlight the main objective of this project which is to create an environmental-friendly design project. The use of palm oil mill waste in this project can produce a sustainable alternative fuel which can be a great help to many developing countries in improving their economy growth. I hope the ideas used in this design project will be very useful for my future career. Last but not least, my heartiest gratitude to POPSIG, IChemE and Desmet Ballaestra for giving us this opportunity to showcase our design project.”

Wan Adeebah binti Wan Mahmood (Supervisor) - “The competition has given a great opportunity to students, to show their design project. By empowering the production of biofuel from palm oil based waste, it serves as an great alternative to conventional fuel. Furthermore, the students get to apply all fundamentals related to chemical engineering which they have learned throughout the course in UCSI University. I acknowledge this award to the excellent teamwork, effort and dedication from the students. Good job guys! Thanks to organizer: POPSIG, IChemE and Desmet Ballaestra for this opportunity.”

Technical Summary

GE Solutions were dedicated on transforming the spectrum on hydrogen gas as competitive fuels with a greener approach. With the utilisation of renewable biomass from palm oil plantations, the final product produced from pyrolysis process were deemed to be more cleaner and sustainable. During pyrolysis process, the pyrolyzed product will be separated, with the oil itself being further treated to yield more hydrogen gas and bio-char to be sold off readily.

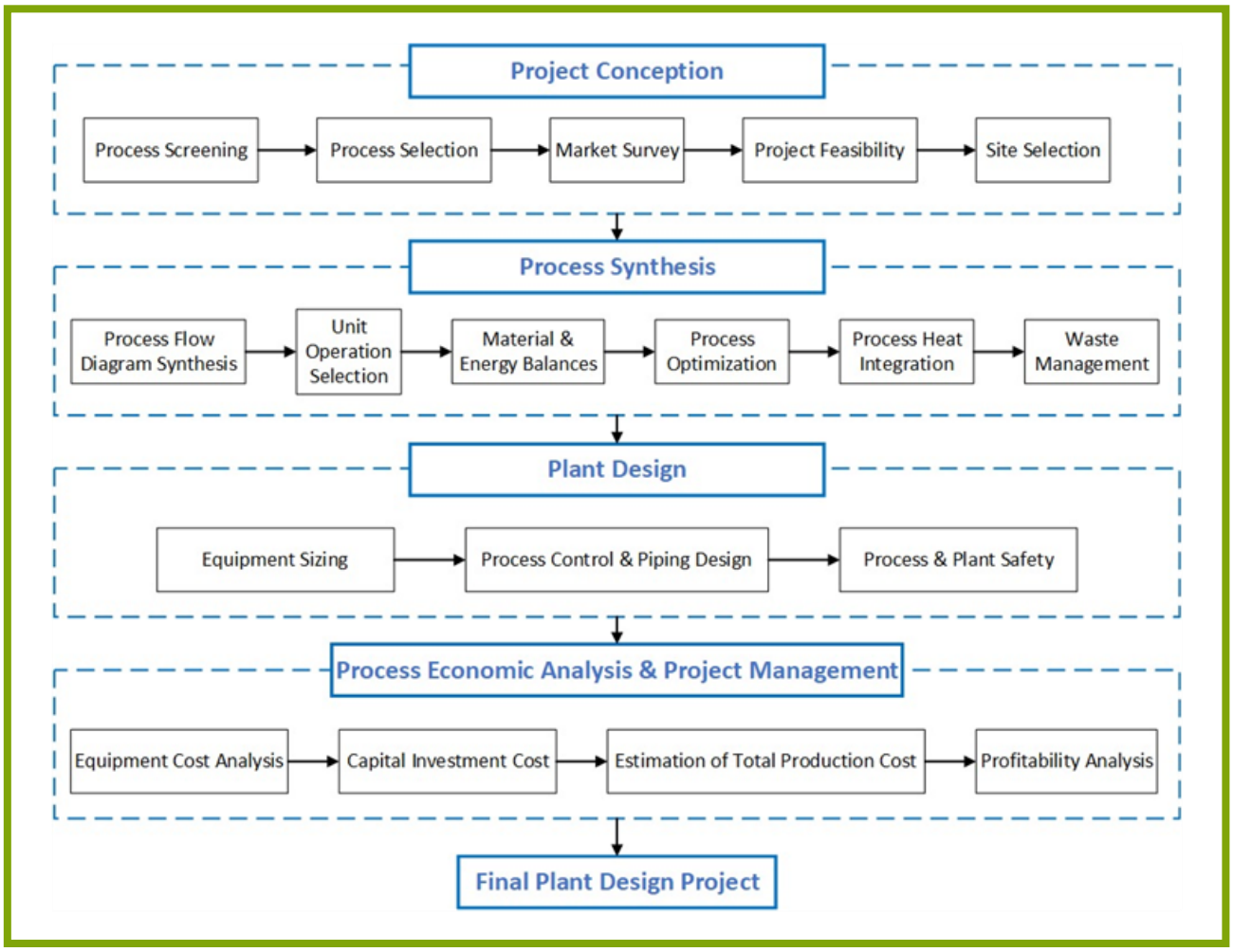


Figure 4: Overall project flow to design hydrogen production plant

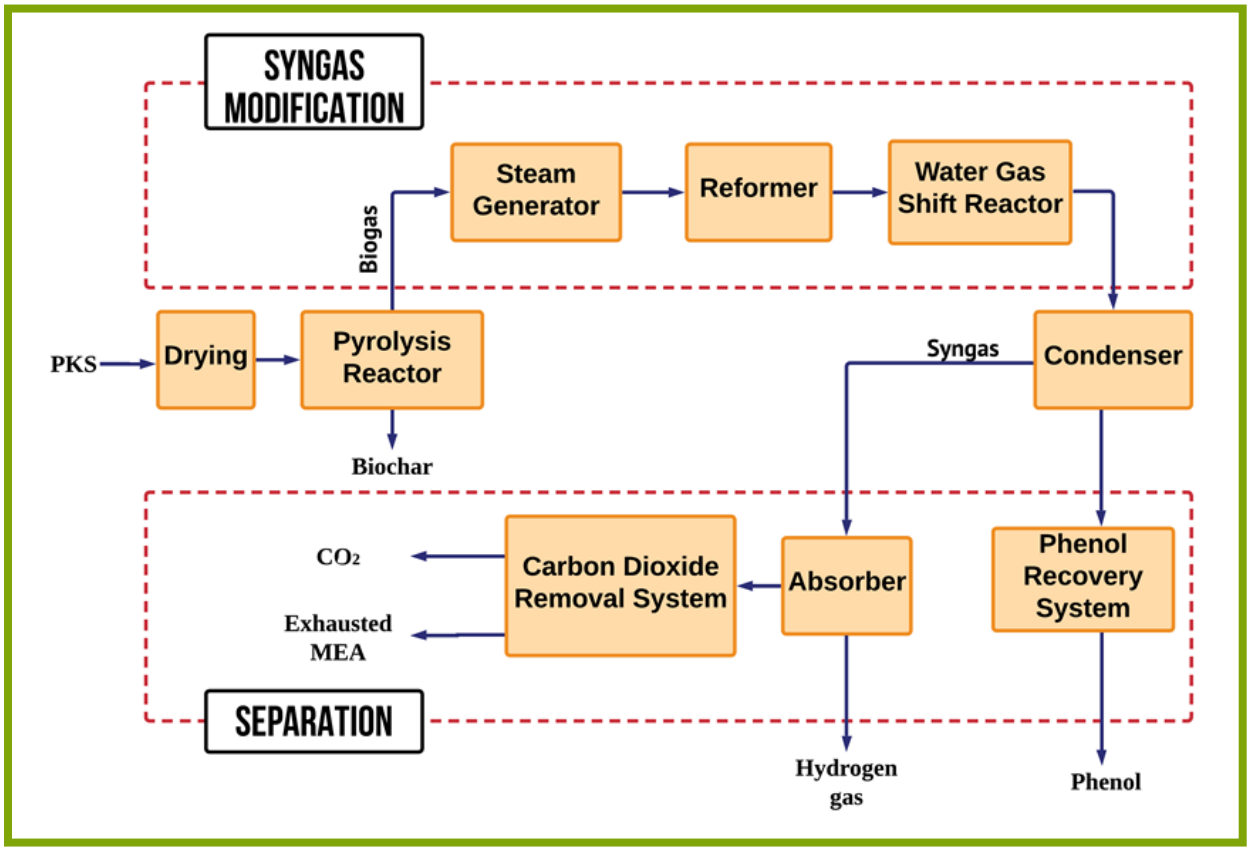


Figure 5: Block flow diagram of the hydrogen production process

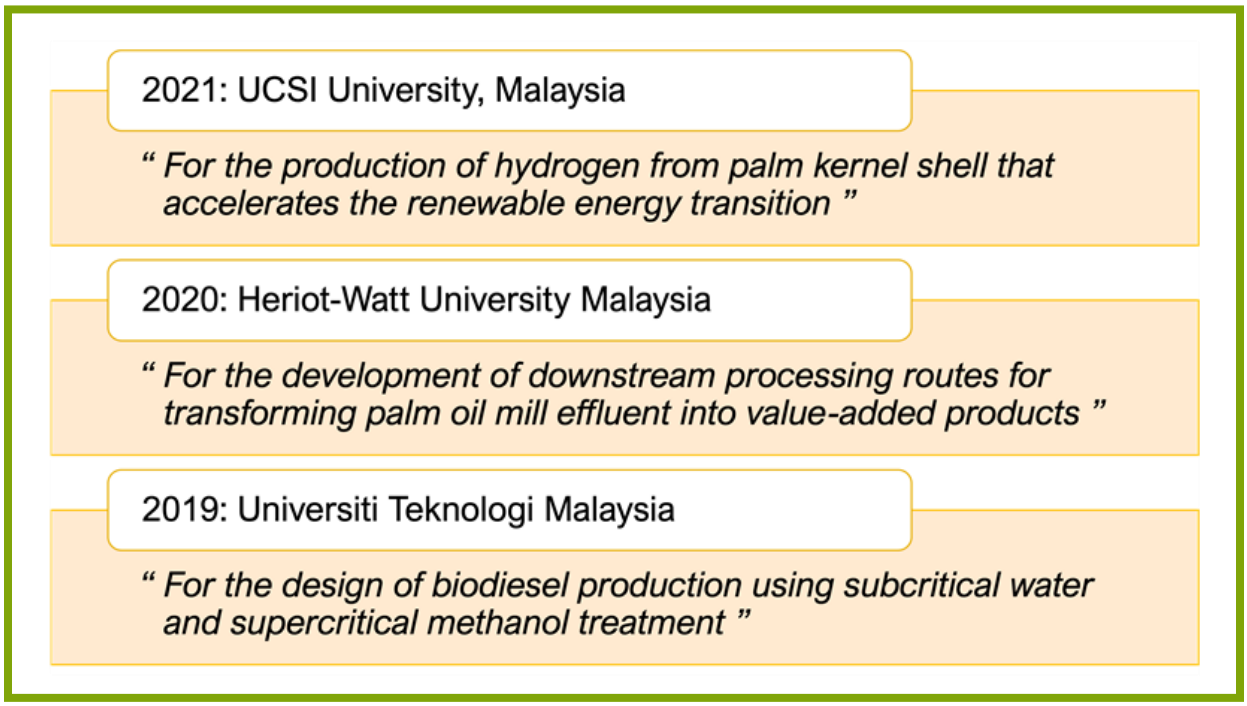


Figure 6: Overview of 2019 – 2021 POPSIG Best Final Year Design Award

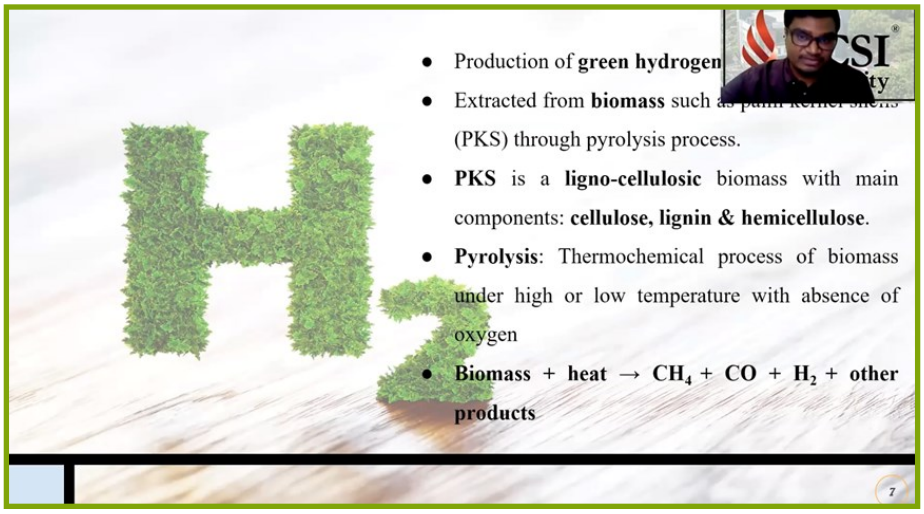


Figure 7: Pravin Ganesar Gunasegaran presented the introduction of their design.

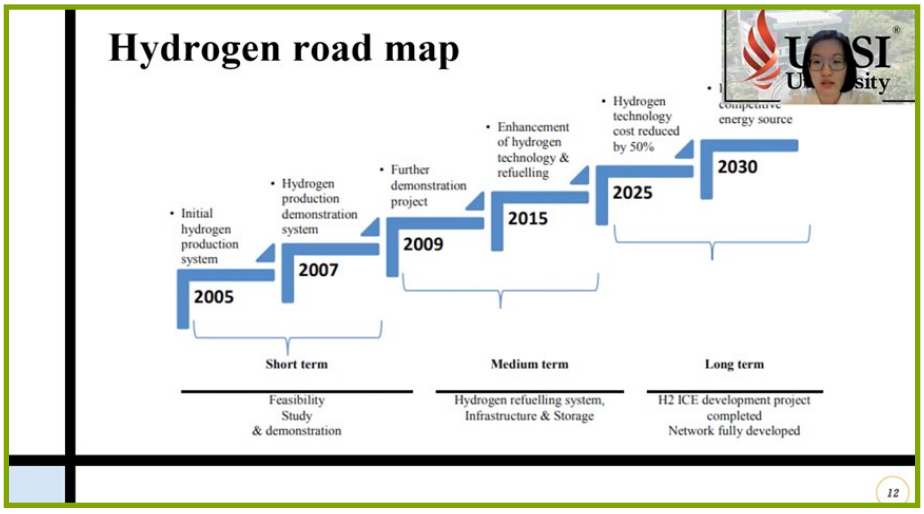


Figure 8: Khee Yue Lian presented hydrogen road map.

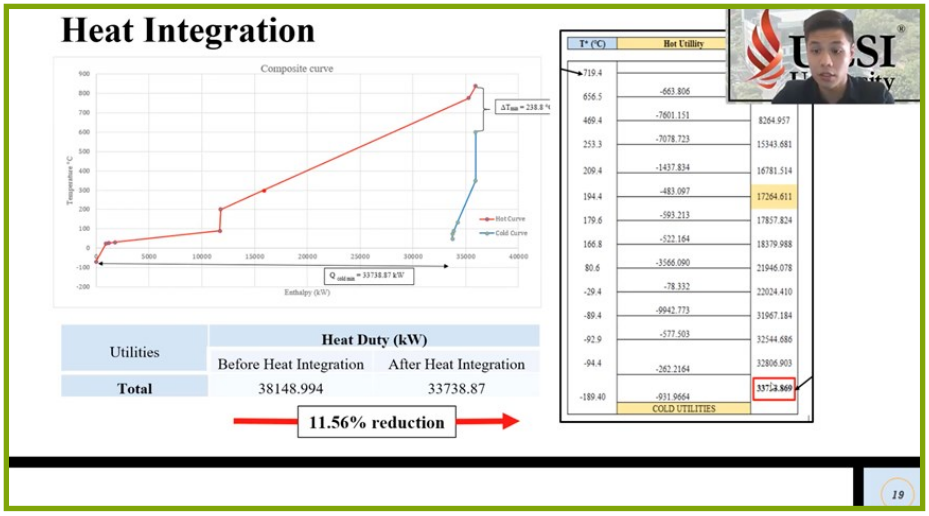


Figure 9: Koh Jun Da presented heat integration result

News: POPSIG Student Bursary 2021 (Travel Bursary)

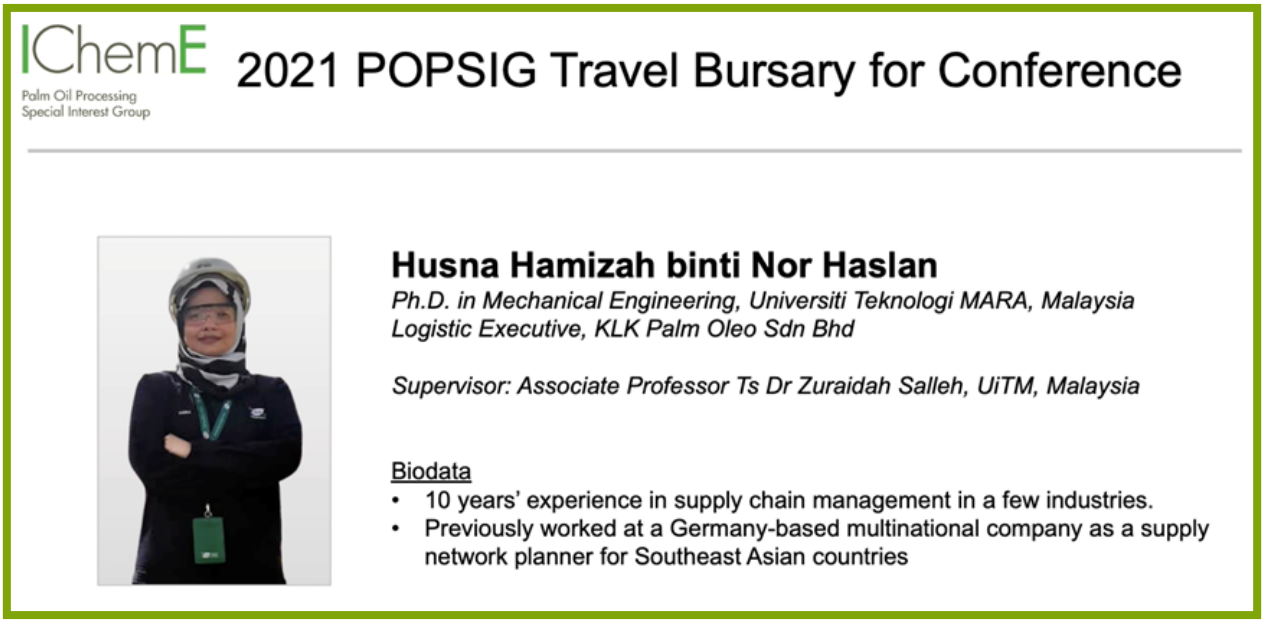
Husna Hamizah won 2021 POPSIG Student Bursary

On 15 September 2021, POPSIG announced that the 2021 POPSIG Student Bursary was awarded to Husna Hamizah binti Nor Haslan. Since 2021, Husna has been undertaking PhD study in Mechanical Engineering at Universiti Teknologi MARA (UiTM), Shah Alam, Malaysia. She is also a Logistic Executive at KLK Palm Oleo Sdn Bhd, Malaysia.

Husna completed Diploma in Automated System and Maintenance Technology (2005–2008) and Bachelor (Honours) in Industrial Automation and Robotics Technology at UniKL (2008–2011). She then joined the post-graduate program, Master in Engineering Management at UiTM (2019–2021).

Husna has about 10 years' experience in supply chain management in a few industries. She previously worked at a Germany-based multinational company as a supply network planner for Southeast Asian countries.

Her bursary application to present a paper at ByPalms Conference in September 2021 was successful. POPSIG wished her every success in her PhD study. POPSIG gratefully acknowledged the 2021 sponsorship provided by Desmet Ballestra (Malaysia) Sdn Bhd.



News: POPSIG Student Research Project Bursary 2021

The 2021 POPSIG Student Research Project Bursary was awarded to four successful candidates whose research projects cover a wide variety of topics. POPSIG gratefully acknowledged the sponsors to the prize: Desmet Ballestra (Malaysia) Sdn Bhd and Malaysia Oleochemical Manufacturers Group (MOMG).

Electro-catalyst as sustainable alternative for metal-air batteries

Brenda Lim Ai-Lian is undertaking Master of Engineering Science in the Department of Chemical Engineering, Lee Kong Chian Faculty of Engineering and Science at Universiti Tunku Abdul Rahman (UTAR), Malaysia. Her research is titled "Synthesis of carbon nanoparticles from oil palm empty fruit bunch as electro-catalyst for energy storage". The project is supervised by Dr Steven Lim (UTAR), who is the Chairperson of the Centre for Photonics and Research; It is co-supervised by Dr Pang Yean Ling (UTAR) and Ts Dr Shuit Siew Hoong (UTAR).

Titanium-based MXene efficient for wastewater treatment

Jocelyn Lim Jean Yi is undertaking Bachelor of Science in Chemical Engineering with Honors in the School of Energy and Chemical Engineering at Xiamen University (XMUM), Malaysia. Her research is titled "Palm oil mill effluent (POME) waste treatment using TiO2/Ti3C2Tx MXene composite aerogel via photocatalytic degradation process". The project is supervised by Dr Andrew Ng Kay Lup (XMUM), together with a research collaborator, Professor Ir Dr Mohd Azlan bin Hussain (UM).

Low transition temperature mixture is economical to isolate lignin from EFB

Jonathan Cheng Lin Yang is undertaking Master of Engineering (by Research) in the Faculty of Engineering, Computing and Science at Swinburne University of Technology, Sarawak Campus (SUTS), Malaysia. His research is titled "Thermogravimetric analysis and combined kinetic study on the pyrolysis of empty fruit bunches lignin extracted using sucrose -malic acid-water low transition temperature mixture". The project is supervised by Associate Professor Jaka Sunarso (SUTS), and co-supervised by Dr Chew Jiuan Jing (SUTS), Dr Elaine Yeu Yee Lee (SUTS), Dr Nishar Hameed (Swinburne University of Technology, Australia) and Dr Joseph Ho Yong Kuen (MUM).

Investigate co-pyrolysis to address responsible production

Melvin Wee Xin Jie is a Doctor of Philosophy (by Research) candidate in the Department of Chemical Engineering, Faculty of Engineering and Science at Curtin University (CUM), Malaysia. His research is titled "Kinetic and thermodynamic analyses for the conversion of co-pyrolysis of palm oil wastes and COVID-19 surgical waste to biofuel production". The project is supervised by Associate Professor Dr Agus Saptoro (CUM), and co-supervised by Dr Bridgid Chin Lai Fui (CUM); The associate supervisors to the project are Associate Professor Dr Jaka Sunarso (SUTS), Professor Ir Dr Suzana Yusup (UTP), Dr Chew Jiuan Jing (SUTS).

Research findings useful to the industries

Their research findings will be presented in mid-September 2022 during POPSIG Research Seminar 2022. Full information about the awarded researches can be found at www.icheme.org/palm-research-bursary.

Figure: The 2021 research bursary recipients were awarded for palm oil-themed researches.

News: POPSIG Award for Reports 2021

POPSIG Best Post-event Report Award

The award was delivered to the candidates whose report was selected. From May to December 2021, four students received this award that came along with cash prize and certificates.

Nur Shafiqa Atiqah Binti Adnan (Universiti Teknologi MARA), Kuganagiesry D/O Subramaniam (Universiti Malaysia Perlis), Nur Haliza binti Jamal Mohamed Nazer (UCSI University) and Evane Serrah June Gani (Curtin University Malaysia) were the recipients for the 2021 award.

Figure 1: Nur Haliza binti Jamal Mohamed Nazar from UCSI University, Malaysia won Best Post-Event Report Award Image adapted from: UCSI University, Malaysia

Figure 2: (L to R) Evane Serrah June Gani, Tessy Bernadine Koh, Kelvin Ong Jee Hui and Yat Yu Dong from Curtin University Malaysia. Image adapted from: Curtin University, Malaysia

News: POPSIG Award for Articles 2021

POPSIG Article Honorarium

2021 POPSIG's theme was "Correcting the Misperception on Palm Oil". Through the honorarium, POPSIG aimed to encourage the public to contribute their articles to address the accurate information about palm oil.

Following candidates were awarded the prize. Their articles were presented in the previous section.

Industry Level

Yung Yen Li, Shyam Lakshmanan, Kong Sing Lim and Joanne Sonia (Team), IOI Edible Oils Sdn Bhd, Malaysia

Undergraduate/Postgraduate Level

- Chan Liang Wen, Swinburne University of Technology Sarawak, Malaysia
- Fitra Dhiafallah Akbar, Swinburne University of Technology Sarawak, Malaysia
- Hanna Maizura bt Mohd Noor Hazrin, Swinburne University of Technology Sarawak, Malaysia
- Muhammad Aizuddin bin Mohd Ali, University of Nottingham, Malaysia
- Tessy Bernadine Koh, Curtin University, Malaysia.
- Tiffany Ang Jia Ning, Swinburne University of Technology Sarawak, Malaysia
- Kelvin Ong Jee Hui, Yat Yu Dong, Curtin University, Malaysia
- Jacky Ling Tai Yew, University College of Technology Sarawak

Figure 1: (L to R) Student at Swinburne University of Technology, Sarawak Campus, Malaysia
Hanna Maizura Binti Mohd Noor Hazrin, Tiffany Ang Jia Ning, Fitra Dhiafallah Akbar, Chan Liang Wen.
Image adapted from: Swinburne University of Technology, Sarawak Campus, Malaysia

News: Dr How Bing Shen won 2021 IChemE Young Researcher Award (Global & Malaysia)

Dr How Bing Shen

Dr How Bing Shen, the secretary of POPSIG and also a lecturer at Swinburne University of Technology Sarawak had recently won the Global Young Research Award. The IChemE Young Researcher Award recognises the chemical engineer who best demonstrates the impact of their chemical engineering research to address important technical, economic, environmental or social issues.

Dr How is a chartered engineer (Engineering Council UK). He has over 60 publications with an H-index of 16 in Scopus. He is the author of two books and has been promoted as the associate editor of Frontiers in Sustainability in early 2021. He was named the Top Peer Reviewer for Global Peer Review Award presented by Publons. In research, he has secured research grants that account for MYR374,400, or equivalent to GBP65,000.

In the first four years of his research journey, Dr How had been heavily focused on biomass supply chain, in which it includes transportation design, SVS diagram analysis, circular economy and stochastic modelling. After he completed his Ph.D. study, he has applied his skills into a wide variety of areas, such as green hydrogen economy, lean and green management and resource conservation network using P-graph.

On grant application, he secured fundings from national grant, state fund and through industrial collaboration. He led a team for discovering the economic feasibility of building a green hydrogen plant in Kuching, Malaysia. The research acts as an important guide for SEDC Energy in identifying the potential gap prior to the actual deployment of the plant.

In 2020, Dr How and his team secured a state fund that aimed to foster the research that support green economy and sustainable development in Sarawak. The project aimed to convert the carbon dioxide, cement waste and unwanted fly ash into useful green building materials through adsorption and AWL technology. On national grant, one of his projects aimed to explore the feasibility on the transition of oil and gas industry into circular business model.

Dr How has organised P-graph workshop to researchers in numerous institutions and coordinated a SPC workshop at Institute of Health Systems Research. He also gave a keynote presentation in IAGPS and shared his knowledge through the POPSIG-hosted webinar on 20 September 2021. He is also keen on providing mentorship for the younger generation to become a talented researcher.

Dr How believed that young is never a constraint, but it is a fuel to explore further without fear. After the announcement for the winner, Dr How expressed his gratefulness for the decision made by IChemE. He also expressed sincere congratulations to Dr Zhihao Chen (National University of Singapore) and Dr Neil Robinson (The University of Western Australia) for their achievements, and warmest wishes to Dr Kenny Koh Kok Yuen (National University of Singapore), Dr Amani Othman Alghamdi (Saudi Aramco, Saudi Arabia) and Dr Thomas David Machin (Stream Sensing, UK).

News: Top-3 Winner of Transformative Research Challenge by World Food Forum of UN FAO

TEAM: Prebio-Tech/Pan-Gaea

We started with Prebio-Tech in pitch events, but are gradually changing the team name to Pan-Gaea as we want to extend knowledge services across the supply and value chain of proteins beyond prebiotics.

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Co-founder of Datanam (Precision Vertical Farming)
Climate Leader for Climate Reality Project
Outgoing Curator of Global Shapers Kuala Lumpur

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TITLE

Malaysian team, Top 3 Winner of an UN FAO competition in the food system of tomorrow!

INTRODUCTION

On the 2nd of October 2021, a Malaysian team became the first national team to be one of the top 3 winners of Transformative Research Challenge (TRC) by the World Food Forum of UN FAO. The team is an amalgamation of the best minds of STEM from academia and industry, to innovate and scale Malaysia's own biotechnology and agri-technology. This collaborative endeavour will ensure a more sustainable production in protein supply chain, to feed a growing and more prosperous population locally, regionally, and globally.

WHAT WAS THEIR CRITERIA FOR THE MALAYSIA TEAM?

Insect farming is growing at a CAGR of close to 30% and it is expected to stay that way for the next 5 years, predominantly for the development of animal feed. Yet Malaysia has not really capitalised on capturing this fast-growing market, nor has Malaysia significantly attracted investment into the development of the insect market locally, to become regional and global supply chain powerhouse the way palm oil and glove industries are.

This global milestone enables palm oil to become a major supply player in the development of insect farming and the holistic supply chain of alternative protein. When the next generation of biotechnology and agri-technology are both used with by-products of palm oil, Malaysia can reduce production cost of inputs by 50%, from USD1200-1300 (current commercial practice to produce one tonne of dried insect), to about USD700. This makes Malaysia a competitive place to draw in investment for the development and commercialisation of insect farming, supported by a formidable supply chain in palm oil.

The value added-manufacturing of the by-products of palm oil is currently estimated to create USD$2.5 billion per annum of wealth, and will only increase as the value of protein will only increase due to growth in livestock farming and aquaculture. The trifactor of cost, quality, and quantity of protein that palm oil promises, there are no existing homogenous and scalable supply chains that can currently best palm oil. As biotechnology, agri-technology, and insect farming are value-added activities, the upskilling opportunities it can provide is estimated to be about 45,000 jobs.

Palm oil is the case study used and the benchmark point of reference in best practices for which other by-products from other agricultural and food-production supply chains can adopt, to initiate and expand on their value-added manufacturing capabilities. The wealth creation for other non-palm-oil by-products is USD$250 billion per annum, with 4.5 million upskilling opportunities for less-skilled workers on farms and plantations. Thus, the knowledge, services, and technologies that can be sold and exported by palm oil industry to other sectors are significantly beyond just USD$2.5 billion per annum of wealth creation.

WHAT WAS THE TEAM'S STORY?

As COVID-19 became and still is the ubiquitous disruptive problem to micro and macro-economic of livelihoods, so does "nature positive" become the disruptive idea of 2021 in UN and World Economic Forum. The ***"nature positive"*** zeitgeist brought the team together with a ***"Malaysia Boleh"*** ambition in becoming the globally recognised food system leader that has already started and shifting into higher gears. The team is well-prepared with combined experience of a decade of academic and a decade of commercial experience in alternative protein.

The PhD-qualified team of associate professor, chartered engineer, chartered scientist, UNESCO affiliate, and WEF affiliate, being advised by entomology engineer and technologist, came together at the start of 2021. It dawned to the team that Malaysia's food supply chain needs to be more resilient, and that there needs to be a post-pandemic economic recovery plan that is highly scalable, vertically and horizontally, with predictable end-user demand that will continue to grow past 2030. The latter is an important factor as long-term demand makes return on investments and return on capital employed, both significantly more attractive to venture capitals, pension funds, and sovereign wealth fund. Secure yet sustainable growth in food production, by extension protein security, is inevitable in the face of population growth, yet with fixed arable land/water for food production.

Prior to the global milestone at the FAO arena, the milestones that team has already achieved include external commercial partnership in the development of aquafeed from palm oil, and

Growth Asia Foundation & UNINET's Rising Star Innovation Challenge powered by Thought For Food.

MOVING FORWARD

Palm oil industry has been getting bias bad press, and playing defensive is a reactive fire-fighting measure. Proactive charmed offensive is necessary. Palm oil industry should be further integrated into the sustainable fabric of food production and the sine qua non of food security, and by extension, protein security. The oil side of palm oil alone would be insufficient argument against critics who argue against the necessity of excessive fat consumption in a balanced diet of a growing and more prosperous population. The protein approach will provide the additional economic and sustainability moats that the palm oil industry very much needs against continuous barrage of bias bad press. Insect farming is the opportunity that palm oil industry must not forsake or play laggard to. Insect farming is the pathway towards “nature positive” circular economy, where charting a course in alternative protein is not only a positive brand image, but one that is also a commercially viable route. Creating market and brand leadership is not about fellowship but leadership, so can Malaysia and the palm oil industry work together to seize this leadership opportunity, then export ideas and know-hows, or playing second fiddle to our neighbours?

(For the pitch, click on the link here, and for the Q&A by UN FAO judges, click here).

News: Malaysia Agreed COP26 Pledges

Written by Oscar Ting Teo Wei

Glasgow hosted COP26

Six years ago, countries were asked to make changes to keep global warming well below 2°C as outlined in the 2015 Paris Agreement. This year, countries gathered at Glasgow, UK for the United Nations Framework Convention on Climate Change (UNFCCC) COP26 summit to revisit the 2015 agreement on climate actions.

2015 Paris Agreement aims at 1.5C target

The 2015 Paris Agreement aimed for limiting global warming at 1.5°C, as the scientists concluded that the 1.5°C limitation will avoid the most dangerous consequences of climate change.

Projection showed 2.4C of warming

It was calculated that the world is heading for 2.4°C of warming based on what countries have tabled for 2030. This year, Climate Action Tracker (CAT) suggests that the world's projected warming is 2.7°C by 2100, while the prediction is far more than the committed goal.

Consequences of global warming

As the effect of global warming, billions of people could be affected by fatal heat and humidity if the average temperature rises by 2°C above pre-industrial levels as predicted by CAT.

UK's PM called for immediate actions

The Prime Minister of the UK, Boris Johnson said that he was cautiously optimistic on climate action and urged countries to do everything they can to limit keep 1.5°C target. He also urged for immediate actions to halve emissions by 2030 as the globe has been hit by more severe heatwaves, droughts, wildfires, and hurricanes.

Emission cut of methane

After the two-week conference, the COP26 agreement has set the global agenda on climate change for the next decade. Countries agreed a scheme to cut 30% of methane emissions by 2030 as methane molecules have a more powerful warming effect on the atmosphere than single carbon dioxide molecule.

Figure 1: Prime Minister of the United Kingdom Boris Johnson said that the nation prepares to form coalitions to help countries to transition from fossil fuels to avoid both economic and environmental catastrophes. (The Guardian, 2021)

Malaysia pledged to reduce methane emission

Malaysia agreed to participate in the Methane Global Pledge, which require collaboration of palm oil industry. Despite the fact POME is the second biggest methane emission source in Malaysia, the government could face challenges to capture 100% methane emission from POME ponds. It challenged the innovations as it has been difficult for the smallholders to obtain the certified palm oil status due to the lack of accountability to capture emissions and to do on-ground monitoring.

Palm oil as highly efficient crop

Malaysia also signed up for the Glasgow Leaders' Declaration on Forests and Land Use. It is also a challenging commitment as some states are dependent on the forestry as a major source of income. Oil palm is a highly efficient crop as it produces 3.8 tons palm oil per hectares, while palm oil accounts for 6% of cultivated land for vegetable oils globally.

Malaysia to reach net zero as early as 2050

YB Tuan Ibrahim Tuan Man, Minister of Environment and Water (KASA), Malaysia led the national delegation to attend the conference in Glasgow on 9 and 10 November 2021. He stated that Malaysia released Nationally Determined Contribution (NDC) that targets to reduce seven types of GHG emission while commits to achieve net zero as early as 2050.

Reduction on coal and fossil fuel subsidies

Countries adopted the Glasgow Climate Pact to explicitly plan to reduce coal, the worst fossil fuel for GHG. The deal called for more urgent emission cuts and phase-out fossil fuel subsidies. It also made promises to scale up support to help developing countries adapt to climate impacts.

Countries to revisit CO2 emission cuts

The pledge to maintain 1.5°C target will be revisited in 2022 to discuss on further emission cuts of carbon dioxide and to ensure the goal is achievable, as the current pledges will only be feasible for 2.4°C of warming. The goal is to keep cutting emissions until they reach net zero by mid-century.

impact our jobs and our lifestyles. World leaders will meet in the Egyptian city of Sharm El Sheikh for COP27 meeting in 2022 to further discuss pledges on suppressing global warming.

High commitments needed to save planet

All our lives will change through the dedicated commitment to COP26 pledges. Decisions made at the conference could impact our jobs and our lifestyles. World leaders will meet in the Egyptian city of Sharm El Sheikh for COP27 meeting in 2022 to further discuss pledges on suppressing global warming.

Figure 2: Minister of Environment and Water, Malaysia, YB Tuan Ibrahim Tuan Man pledged to achieve 31% capacity of renewable energy by 2025 and to maintain at least 50% forest cover as outlined in the 1992 Rio Declaration. (KASA Malaysia, 2021)

Figure 3: COP26 president Alok Sharma announced that the Glasgow Climate Pact was agreed by delegates at the conference. (UNEP, 2021)

News: Oil Palm Can Meet Malaysia's Commitment to the Paris Agreement of 2015

Written by Ir Qua Kiat Seng Ir. Qua Kiat Seng,

Senior Lecturer & Fellow, Monash-Industry Palm Oil Education and Research (MIPO) Platform

It can not only meet but exceed Malaysia's commitment on climate change at the Paris Agreement of 2015. So says Ir. Qua Kiat Seng at the CAN (CEO Action Network Malaysia)/ CGM (Climate Governance Malaysia) round table for the plantation sector on 4th August 2021.

The round table is a private sector initiative to provide inputs to the Malaysian government for COP26 in November 2021. It covers the energy, property and construction, plantation, telecommunications etc. The engagements are to assess the viability of a Net Zero Emissions target by 2050 and what climate action is required to achieve this.

Datin Seri Sunita Rajakumar, is the founder of Climate Governance Malaysia which is the country chapter of the World Economic Forum's Climate Governance Initiative.

Picture 1: Datin Seri Sunita Rajakumar

Session 2 of the round table with the theme Optimising Resource Use for the plantation sector was opened by Dato Henry Barlow of Sime Darby Plantation and moderated by Dr Gary Theseira of Malaysia Green Technology Corporation (MGTC).

Picture 2 Moderator Dr Gary Theseira and Dato Henry Barlow
Ir. Qua started by presenting the work of MIPO (Monash-Industry Palm Oil Education and Research Platform). This is the yet-to-be published paper "Potential of palm bioenergy in achieving Malaysia's renewable energy target and climate ambition in line with the Paris Agreement." He observed that the palm oil industry is quite well placed to meet the challenges of net-zero carbon emissions. The palm oil mill is an excellent example of a self-sufficient production unit in terms of energy when it uses its own biomass and biogas. This circular economy is net-zero carbon and any excess biomass or energy delivered outside the mill makes it carbon negative.
Theoretically, palm bioenergy could make up 64% of the total primary energy supply. A model energy mix was suggested where solid biomass products play a key role. This suggested mix could contribute to a 35% renewable energy share in the primary energy supply and a 54% greenhouse gas intensity reduction based on 2005 levels. However, it is to be noted that energy is not the only potential use of biomass. Energy is selected as it is the largest contribution to GHG emissions.

Picture 2: Moderator Dr Gary Theseira and Dato Henry Barlow

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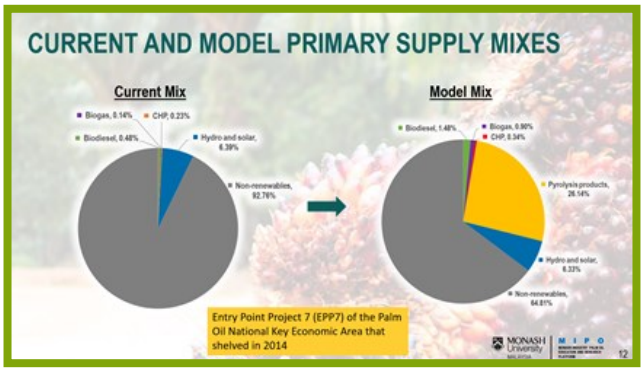


Figure 1: Pyrolysis products can be the largest contributor of renewable energy as compared to biofuel, biogas and biomass CHP.

MIPO followed up a policy recommendation outline after the round table.

Picture 3 The panelists. Clockwise Dr Gary Theseira, MR Chandran (IRGA/RSPO), Ir. Qua Kiat Seng (MIPO) and Dr Harikrishna Kulaveerasingan (Sime Darby Plantation)

Next Dr Harikrishna Kulaveerasingam spoke on “How can the Oil Palm Industry reduce its carbon foot print to facilitate a 50% reduction in carbon intensity by 2030?” A significant impact on reducing carbon intensity can be achieved by addressing methane evolution from Palm Oil Mill Effluent (POME) ponds.

An overall reduction of about 40%-50% of the plantation industries carbon foot print can be achieved by addressing this issue. In larger mills of 60t/hr or greater, methane captured from POME treatment ponds can be utilised after suitable treatment to run generators to produce renewable electricity for the grid. Currently Green incentives to support funding of these initiatives via banks exist, however, the process of application has to be improved.

However, the mills that are further away from power line infrastructure, the economics are no longer favourable and therefore there is a need to incentivize Tenaga to extend the grid to these areas to connect to this renewable energy resource.

Another alternative would be to compress the gas into cylinders and transport it for utilisation at other sites and in this case, Gas Malaysia would need to be incentivised to do so.

The last speaker was M R Chandran who spoke on “Potential Value Proposition From The Downstream Segment As An Economic Driver For The Palm Oil Industry” He gave a very comprehensive coverage across the entire value chain with focus on downstream activities.

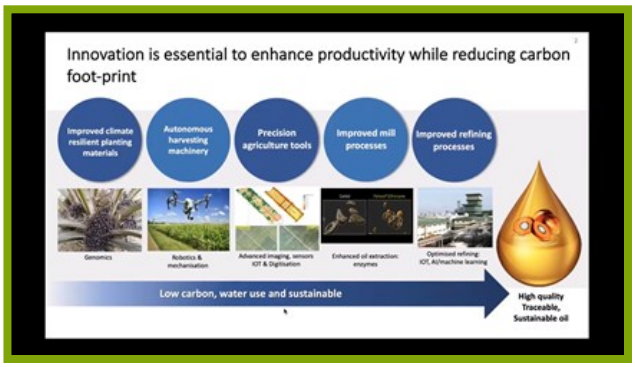


Figure 2 At Sime Darby innovation is essential to reduce its carbon foot print

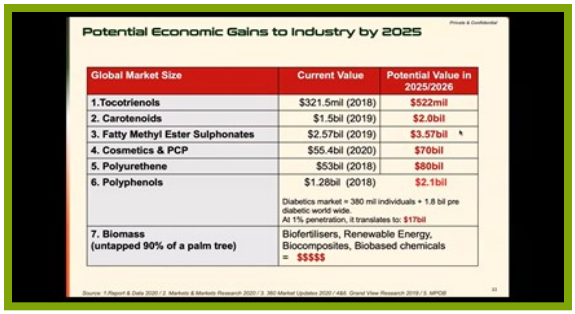
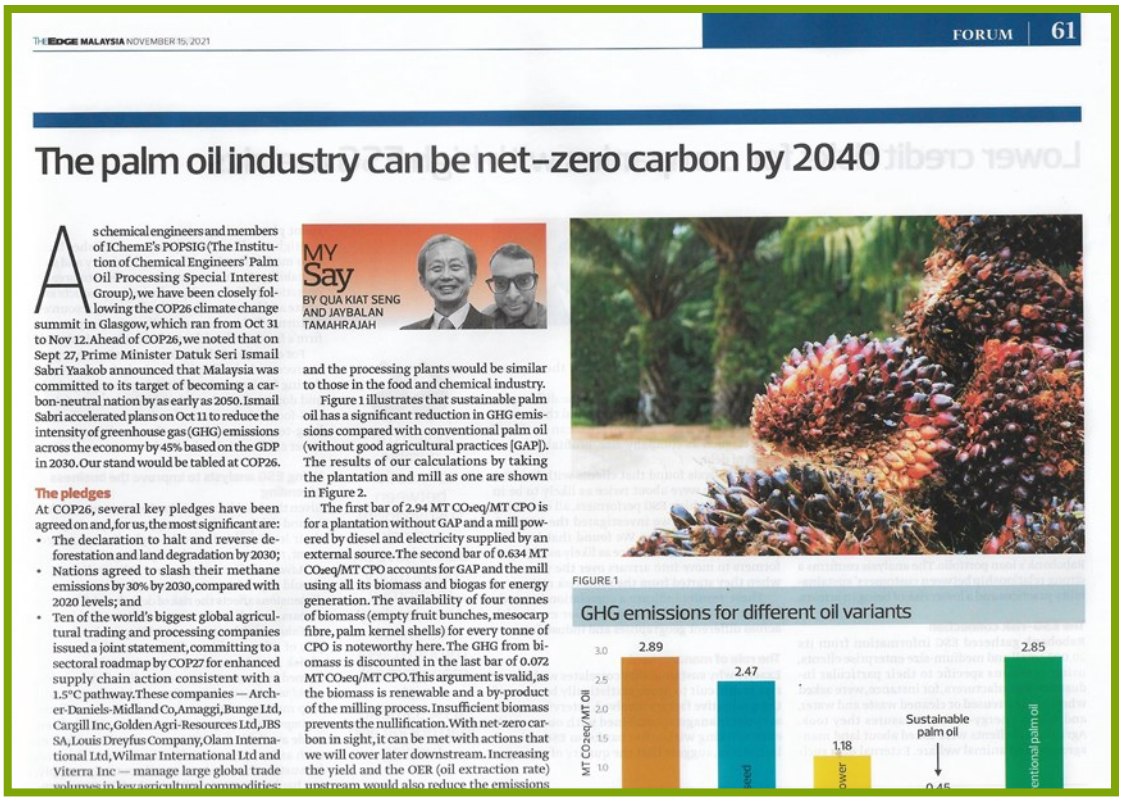


Figure 3 Tremendous potential value addition to palm oil

Chandran lamented the absence of buy-in of cutting edge technologies by players in the Malaysian oil palm industry. It is risk averse to new home-grown technologies. While it may not be practical for the government to intervene in all cases, it may be necessary for the government to sponsor and work with the industry in the commercialization of high impact strategic projects which have large investment cost.

News: The Palm Oil Industry Can Be Net Zero by 2040

Written by Ir. Qua Kiat Seng (Senior Lecturer & Fellow, Monash-Industry Palm Oil Education and Research (MIPO) Platform) and Dr. Jaybalan Tamahrajah (Senior Technologist, KL-Kepong Oleomas Sdn. Bhd.)



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The palm oil industry can be net-zero carbon by 2040

MY Say

BY QUA KIAT SENG AND JAYBALAN TAMAHRAJAH

As chemical engineers and members of IChemE's POPSIG (The Institution of Chemical Engineers' Palm Oil Processing Special Interest Group), we have been closely following the COP26 climate change summit in Glasgow, which ran from Oct 31 to Nov 12. Ahead of COP26, we noted that on Sept 27, Prime Minister Datuk Seri Ismail Sabri Yaakob announced that Malaysia was committed to its target of becoming a carbon-neutral nation by as early as 2050. Ismail Sabri accelerated plans on Oct 11 to reduce the intensity of greenhouse gas (GHG) emissions across the economy by 45% based on the GDP in 2030. Our stand would be tabled at COP26.

The pledges

At COP26, several key pledges have been agreed on and, for us, the most significant are:

- The declaration to halt and reverse deforestation and land degradation by 2030;
- Nations agreed to slash their methane emissions by 30% by 2030, compared with 2020 levels; and
- Ten of the world's biggest global agricultural trading and processing companies issued a joint statement, committing to a sectoral roadmap by COP27 for enhanced supply chain action consistent with a 1.5°C pathway. These companies — Archer-Daniels-Midland Co, Amaggi, Bunge Ltd, Cargill Inc, Golden Agri-Resources Ltd, JBS SA, Louis Dreyfus Company, Olam International Ltd, Wilmar International Ltd and Viterra Inc — manage large global trade volumes in key agricultural commodities;

and the processing plants would be similar to those in the food and chemical industry.

Figure 1 illustrates that sustainable palm oil has a significant reduction in GHG emissions compared with conventional palm oil (without good agricultural practices [GAP]). The results of our calculations by taking the plantation and mill as one are shown in Figure 2.

The first bar of 2.94 MT CO_2eq/MT CPO is for a plantation without GAP and a mill powered by diesel and electricity supplied by an external source. The second bar of 0.634 MT CO_2eq/MT CPO accounts for GAP and the mill using all its biomass and biogas for energy generation. The availability of four tonnes of biomass (empty fruit bunches, mesocarp fibre, palm kernel shells) for every tonne of CPO is noteworthy here. The GHG from biomass is discounted in the last bar of 0.072 MT CO_2eq/MT CPO. This argument is valid, as the biomass is renewable and a by-product of the milling process. Insufficient biomass prevents the nullification. With net-zero carbon in sight, it can be met with actions that we will cover later downstream. Increasing the yield and the OER (oil extraction rate) upstream would also reduce the emissions

FIGURE 1

GHG emissions for different oil variants

A shorter version was published in The Edge Malaysia November 15, 2021. This longer version is exclusively for POPSIG members.

Chemical Engineers Palm Oil Processing Special Interest Group) we have been closely following the COP26 summit in Glasgow that ran from October 31st to November 12th of this year. One of us is a virtual delegate. Ahead of COP26, we noted that on the 27th of September 2021 Prime Minister Datuk Seri Ismail Sabri Yaakob announced that Malaysia is committed to its target of becoming a carbon-neutral nation by as early as 2050. Ismail Sabri said economic instruments such as carbon pricing and the carbon tax will be introduced to support this effort. Then on October 11th of this year, Ismail Sabri added that Malaysia plans to reduce the intensity of greenhouse gas (GHG) emissions across the economy by 45% based on the Gross Domestic Product (GDP) in 2030. This is 10% more than the earlier target. Our stand will be tabled at COP26.

The pledges

At COP26 a number of key pledges have been agreed and for us the most significant are

- The declaration to halt and reverse deforestation and land degradation by 2030. This got off to a good start with 110 nations signing up and the number continues to increase
- Nations agreed to slash their methane emissions by 30% by 2030, compared with 2020 levels. Initially nearly 90 signed up with more coming
- Ten of the world's biggest global agricultural trading and processing companies issued a joint statement, committing to a sectoral roadmap by COP27 for enhanced supply chain action consistent with a 1.5°C pathway. These companies – ADM, Amaggi, Bunge, Cargill, Golden Agri-Resources, JBS, Louis Dreyfus Company, Olam, Wilmar and Viterra – manage large global trade volumes in key agricultural commodities viz soy and palm oil.

As a delegate albeit virtually, one can go beneath the glitzy event with its star-studded cast and get a feel of what is really happening by joining side events. The main takeaway from the developing nations like Africa, South America and South & East Asia as well as the island nations is that pledges for finance and technology have not been kept and that nations that pollute the least suffer the most.

Palm oil has the lowest CO2 emissions

So, what action can the palm oil industry take? Fortunately, it has started its sustainability journey early and has a 15-year head start, as you will soon learn, to its advantage. On September 30th in Milan, Maria Vincenza (Cinzia) Chiriacò, CMCC (Euro-Mediterranean Centre on Climate Change) Division on Climate Change Impacts on Agriculture, Forests and Ecosystem Services (IAFES) presented a paper "The environmental impacts of palm oil and main alternative oils." Palm oil has an average emission of 0.45t CO_2eq/t oil compared to 2.89 for soya, 2.47 for rapeseed and 1.18 for sunflower. This is the results she presented.

The palm oil industry is approaching net-zero carbon emissions

Kuala Lumpur Kepong Berhad has published its Sustainability Rating Report on October 21st 2021 and its 7% YOY reduction in GHG (Green House Gas) emissions is shown in Table 2. RAM Sustainability has reaffirmed KLK's Sustainability Rating at Gold (G2)..

As a member of RSPO (Roundtable on Sustainable Palm Oil) KLK has committed to No Deforestation, No Peat and No Exploitation (NDPE) and used the RSPO GHG calculator to measure their GHG emissions. KLK figures are in line with Maria Vincenza Chiriacò's data.

It is important to measure as you cannot improve if you do not measure. We are waiting for the MSPO (Malaysian Sustainable Palm Oil) GHG calculator, which we are told will be available at the beginning of 2022. Then we can see where we stand with 96% of plantations certified and 89% of mills certified to MSPO. Bear in mind only 20% are certified to RSPO.

So, we are on the way to net-zero carbon emissions but how do we get there?

Table 1: GHG emissions by country and average emissions. (data source: data source: IAFES – Maria Vincenza Chiriacò).

Crop based oil	Top producing countries	Emissions (t CO_2 eq / t Oil)	Average emissions t(CO_2 eq / t Oil)
Soya	Brazil	3.45	2.89*
	USA	2.91	
	Argentina	2.3	
Rapeseed	Canada	1.59	2.47*
	China	3.03	
	India	2.79	
Sunflower	Russia	1.12	1.18*
	Ukraine	1.05	
	Argentina	1.37	
Palm	Malaysia	0.38	0.45*
	Indonesia	0.51	

*Preliminary Data

The figures apply to sustainable palm oil and it is clear that sustainable palm oil has the lowest CO_2 emission of the major vegetable oils.

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Getting to Net-Zero Carbon

We would like to suggest a solution by considering the palm oil industry as upstream and downstream. Upstream would consist of the plantation and the mill whilst downstream would be the refineries and oleochemical plants. Downstream, the approach would be very different as there is just not one product viz crude palm oil (CPO) and the processing plants would be similar to processing plants in the food and chemical industry.

If we look at Figure 1 you can see that sustainable palm oil has a significant reduction in GHG emissions compared to conventional palm oil (without Good Agricultural Practice)..

We made our own calculations taking the plantation and mill as one unit and the results is shown in Figure 2.

Table 2: Reduction in KLK's GHG emission intensity

Year	2018	2019	2020
GHG emissions intensity (kg CO_2eq/dry mt CPO)	779.32	637.54	592.09

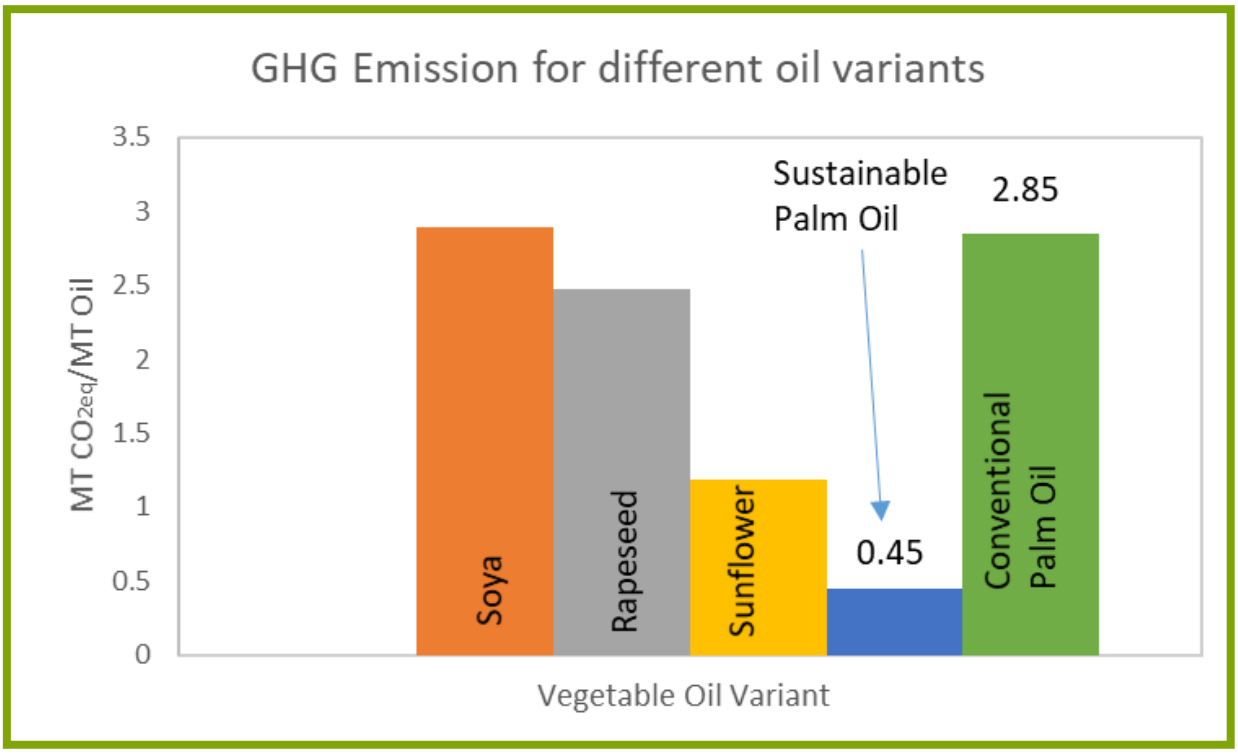

Figure 1: GHG emissions predicted by different vegetable oil crops, with sustainable oil palm being the lowest emitter of GHG (data source: IAFES – Maria Vincenza Chiriacò).

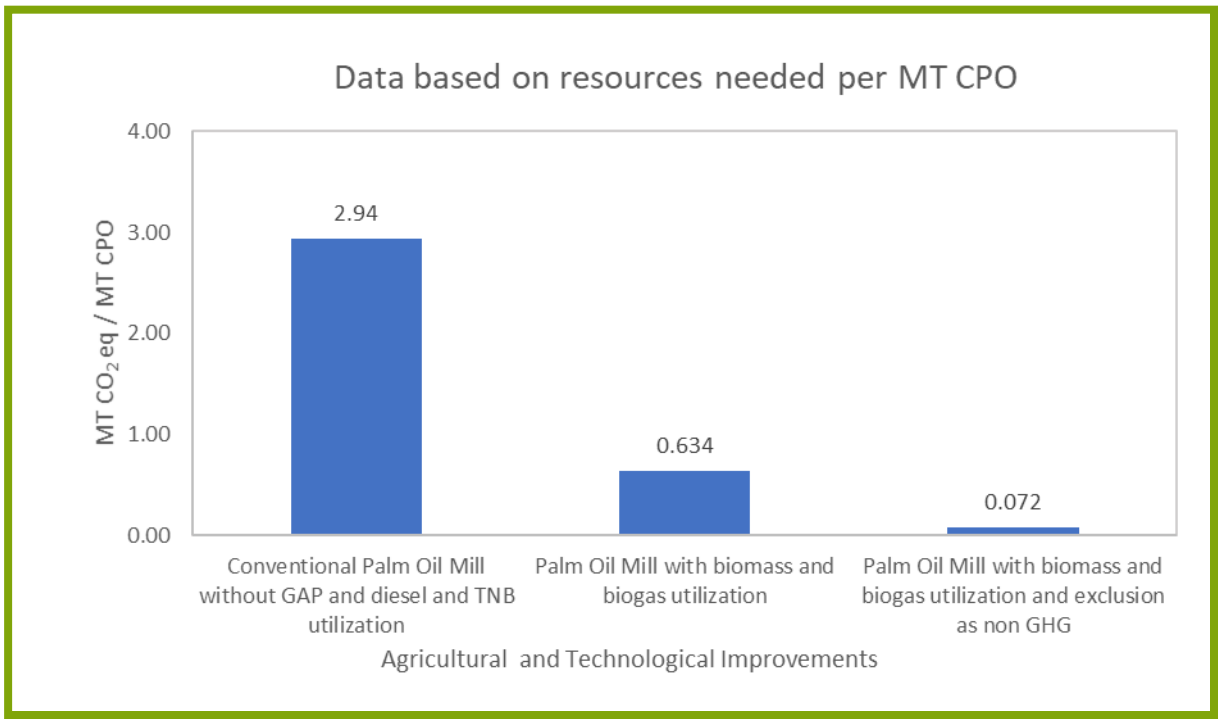

Figure 2 : Our calculations on reductions of GHG emissions for the plantation and the mill as a single unit.

The first bar of 2.94 Mt CO2eq/MT CPO is for a plantation without GAP (Good Agricultural Practices) and a mill powered by diesel and electricity supplied by an external source, such as Tenaga Nasional Berhad (TNB). The second bar of 0.634 Mt CO2eq/MT CPO is for with GAP and the mill using all its biomass and biogas for energy generation. Bear in mind that for every tonne of crude palm oil 4 tonnes of biomass (empty fruit bunches, mesocarp fibre, palm kernel shells) is available. In the last bar of 0.072 Mt CO2eq/MT CPO we have discounted the GHG from biomass. This argument is valid as the biomass that is renewable is a by-product of the milling process. We have not got to zero because there is insufficient biomass. But we are almost at net-zero carbon, which can be met with actions that we will cover downstream.

Increasing the yield and the OER (oil extraction rate) upstream would also reduce the emissions per tonne.

Use of biomass has challenges

If the use of biomass was convenient and easy, it would have been used a long time ago for energy (thermal and electrical) in the mill. Most biomass cannot be used as such and needs to be prepared by various methods such as shredding, drying, grinding and pelletizing. Biomass possesses a low calorific density. Boilers need to be designed for its use and has to be cleaned of ash every 45 to 60 days.

We come from the refining and oleochemical industry where we have seen technology improve because of the demand by customers. With the increase of demand in plants, technology suppliers have invested in research and development. As an example, an oleochemical plant production output in the 1980s was 30,000 t/a but today is 250,000 t/a. The splitting plant had a splitting degree (yield) of 95% then, but today 99% is easily achieved. We believe the same can apply to boiler technology.

The mill would need to make investments and in line with Malaysia's net-zero carbon target, the government should assist by providing matching grants to mills. Perhaps some the RM12 billion windfall tax could be channelled here. Such a programme could be as fast as 10 years or as long as 20 years but may be accelerated well before 2050.

What can be done downstream

75% of our GHG emissions come from energy and transport. We have the Efficient Management of Electrical Management of Electrical Energy Regulations (EMEER) 2008 for any installation that consumes equal or exceeding 3,000,000 kWh in 6 consecutive months. A registered electrical energy manager is appointed to report electrical energy savings every 6 months. There are registered Energy Service Companies (ESCO) that provide very attractive consultancy services in saving electrical energy. We should have a similar set up for thermal energy. These will help factories reduce their Scope 1 and Scope 2 emissions.

At Monash University Malaysia and other universities our undergraduate students are taught climate change and they apply Global Warming Potential, Resource Depletion and Heat Integration in their final year design project. Our young engineers like those youths we see at COP26 are passionate about climate change as it is them who will live to see the consequences of our actions today. Heat integration is crucial for improving energy efficiency and reducing operational costs in the energy related applications as it eventually reduces GHG emissions. The most widely used heat integration technique is the Pinch Analysis Method. We have in POPSIG at least one renowned expert in Pinch Analysis.

The above can be applied to the mill to save energy in their last mile towards net-zero carbon emissions.

A downstream example is IOI Corporation Berhad who is a leader in energy management. IOI Pan-Century Oleochemicals received the Prime Minister's Hibiscus Award 2016/17 for protecting the environment and sustainable development. IOI Acidchem received a similar award for 2014/15. IOI Edible Oils has also won many energy awards including the IChemE Palm Oil Industry Award in 2018. In September of 2021, it received the National Energy Award for Winner in Renewable Energy in the Cogeneration category. The award-winning steam boiler was designed, constructed, installed and commissioned by IOI Bio-Energy Sdn Bhd in-house steam engineers in October 2019. It utilises empty fruit bunches fibres and palm kernel shells as fuel to generate power.

Companies can join the Science Based Targets initiative (SBTi). Science-based targets provide a clearly-defined pathway for companies to reduce greenhouse gas (GHG) emissions, helping prevent the worst impacts of climate change and future-proof business growth. Science-based targets for companies is analogous to nationally-determined contributions for countries, showing how much and how quickly they must reduce emissions to be in line with keeping warming to 1.5°C.

The benefits of achieving net-zero carbon emissions

The palm oil industry has been continuously plagued by accusations of deforestation and exploitation of labour despite its efforts in sustainability. Net-zero is a step further as it nullifies the claim of deforestation whilst enhancing the palm oil industry's sustainability credentials.

In aspiring to be green importing countries are becoming wary of importing goods that carry high carbon emissions. In EU's Green Deal to prevent 'carbon leakage', it has introduced the Carbon Border Adjustment Mechanism (CBAM) in July 2021.

Although organisations do not need to report their Scope 3 emissions which will include their supply chain, when the supply chain is a significant contributor of their GHG emissions, they will want to manage and report on this. So, in selecting their vegetable oil and derivatives net-zero carbon palm oil will be the choice.

Conclusion

The Malaysian government has made significant and stretching commitments to climate change mitigation at COP 26. It will now be looking hard to find ways to meet these commitments and the palm oil industry, as we have shown, can play its part as it knows what needs to be done. The achievements will not only benefit the nation but improve the image of Malaysian palm oil globally. And this can come before 2050 as the palm oil industry could be net-zero by 2040.

News: Public Comments Reviewed for the MSPO Standards Revision

Written by Ir Qua Kiat Seng Ir. Qua Kiat Seng, Senior Lecturer & Fellow, Monash-Industry Palm Oil Education and Research (MIPO) Platform

The MSPO Standards, MS2530:2013 series and the Supply Chain Certification Standard used under the MSPO Certification Scheme is a set of national standards that addresses sustainability and traceability requirements of the oil palm industry in Malaysia.

Following the Working Groups meetings in April 2021 the draft MSPO Standards (MSPO Part 1 to Part 4-3) were made available for public comment from 5 May to 4 July 2021 through the Standards Malaysia and MPOCC websites as well as physical roadshows throughout Peninsular and East Malaysia to gather comments from the public and stakeholders. As a very large number of comments were received many days were devoted to the review of the public comments by the working groups.

For Working Group MSPO Part 4 (Part 4-1, Part 4-2, and Part 4-3) Zoom meetings were held from 1st to 3rd & 6th to 10th September 2021 over a period of 8 gruelling days.

Prof. Denny is the chair of this WG but due to the many days Ir. Hong was elected as protem chair to cover the days Prof. Denny was not available. The chairs had a very challenging task of keeping the meeting proceeding at a good pace and we were quite fortunate to have the invaluable expert inputs from members. Members kept upper most in their minds that this standard should be accepted internationally.

The output will now go through due processes and hopefully will be launched at the beginning of 2022. In the meantime members look forward to the details of MSPO Trace which MPOCC has decided to mandate from 1st October 2021 with a three months grace period. Members also look forward to the MSPO GHG calculator referenced in the standards.

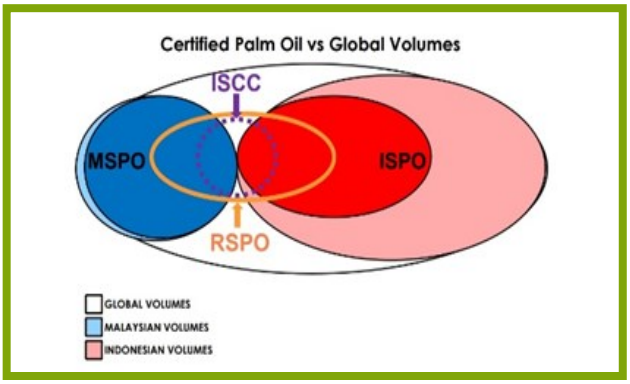

Figure 2: Standing of MSPO vis-à-vis the other standards (Source: Wilmar)

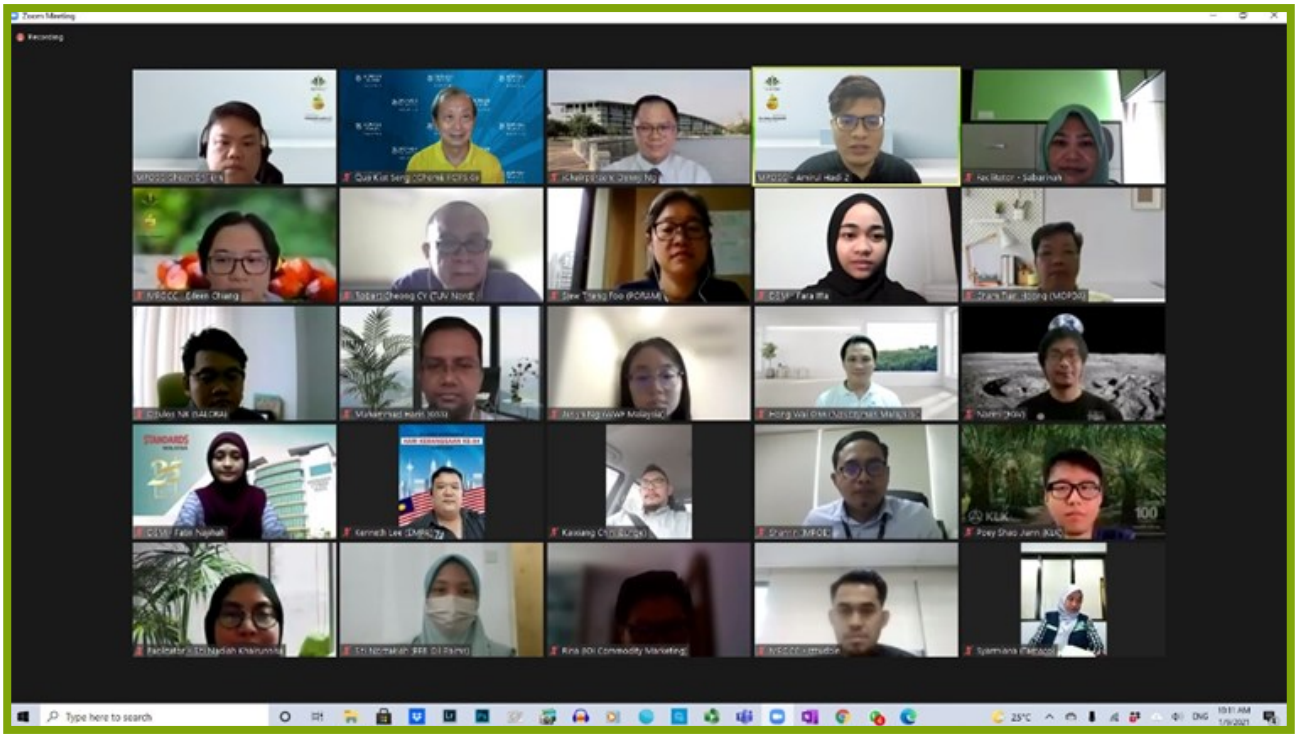

Figure 1: Some members of the Working Group MSPO Part 4. Clockwise nr. 2 Ir. Qua Kiat Seng IChemE POPSIG, nr.3 Professor Ir. Dr. Denny K. S. Ng APROS and nr.14 Ir. Hong Wai Onn Novozymes.

News: Best Paper Award from SOMChE2021 Conference

On 16th July 2021, the 32nd Symposium of Malaysian Chemical Engineers 2021 (SOMChE2021) had announced the best paper award to the participants. One of the papers that had been awarded is entitled, 'Development of optimization model for black solider fly-based aqualculture feed supply chains in Malaysia'. This research work had been conducted by a group of researchers which consist of Mr Chin -Ang Isaac Ng (pictured on the left), Dr Chian Wei Chan, Dr Viknesh Andiappan Murugappan, Dr Lik Yin Ng, and Professor Denny Kok Sum Ng.

Below is the abstract details:

Abstract Details:

Development of optimisation model for black soldier fly-based aquaculture feed supply chains in Malaysia.

Chin-Ang Isaac Ng[1], Chian Wei Chan[2], Viknesh Andiappan Murugappan[1], Lik Yin Ng[1] and Denny Kok Sum Ng[1]

[1] School of Engineering and Physical Sciences, Heriot-Watt University Malaysia, 62200, Putrajaya, Wilayah Persekutuan Putrajaya, Malaysia

[2] Agridon Technologies, Lot 2745-D, Jalan Industri 12, 47000 Kampung Baru Sungai Buloh

Abstract: Aquaculture is identified as one of the critical food supplies in Malaysia. Due to the increasing demand for aquaculture products, the demand for protein sources for fish feed is also increased accordingly. Black soldier fly larvae is identified as one of the main protein sources that can be used in fish feed. Such larvae can be grown using different types of organic materials, such as food waste, agriculture waste, etc. As Malaysia is the second-largest palm oil producer in the world, therefore, a large number of agricultural wastes, also known as palm-based biomass (e.g., empty fruit bunches, mesocarp fibre, decanter cake, etc.) are generated annually. Based on the current industry practice, palm-based biomass can be converted into value-added products. However, using palm-based biomass as feedback to grow black soldier fly larvae is a relatively recent discovery. Thus, a viable supply chain model has yet to be established. In this work, a mathematical optimisation model is developed via commercial optimisation software (Lingo v.16) to synthesise an optimum black soldier fly-based aquaculture feed supply chain that utilized palm–based biomass as the feedstock. Based on the optimised result, the annual operating cost of the aquaculture feed supply chain is estimated as RM 5.2 million.

News: Congratulations to Datuk Dr Ahmad Parveez Haji Ghulam Kadir

In conjunction with the official birthday of the King of Malaysia, Yang di-Pertuan Agong (YDPA), Al-Sultan Abdullah Ri'ayatuddin Al-Mustafa Billah Shah, 1,207 individuals were conferred the 2021 Federal orders, decorations, and medals.

The investiture ceremony was held at Balairong Seri in Istana Negara on 13 November 2021. YDPA was accompanied by Raja Permaisuri Agong Tunku Hajah Azizah Aminah Maimunah Iskandariah.

YDPA has conferred the Darjah Panglima Jasa Negara (P.J.N.) award, which carries the title “Datuk”, on Dr Ahmad Parveez Haji Ghulam Kadir, Director General of Malaysian Palm Oil Board (MPOB).

Datuk Dr Parveez was a speaker for a POPSIG-hosted webinar. Presented on 13 August 2018, his talk was titled "Research on oil palm biotechnology and breeding - an introduction for chemical engineers".

Congratulations to Yang Berbahagia Datuk Dr Ahmad Parveez Haji Ghulam Kadir.

Image: Yang Berbahagia Datuk Dr. Ahmad Parveez Haji Ghulam Kadir was conferred P. J. N. award by the YDPA.

Image adapted from: RTM TV1 Malaysia

News: Appreciations to Outgoing POPSIG Committee

POPSIG would like to express our sincere appreciations to Liew Sin Lu, Chia Ing Chuk and Ausiera Rosland for their services and contributions to POPSIG.

Liew Sin Lu is the Head of Department of Process at Desmet Ballestra (Malaysia) Sdn. Bhd. From 2016 to 2021, she first served POPSIG as Event Coordinator, and later as the Event Director. In her term, she had organised over 40 webinars for POPSIG and delivered nearly 10 experience-sharing sessions at the university roadshow from 2019 to 2021.

Chia Ing Chuk is a Technical Manager at Desmet Ballestra (Malaysia) Sdn Bhd. He joined POPSIG in 2020 as the Event Coordinator to assist the event organisation. He also contributed to numerous talks at the university to share his experiences with the students.

Ausiera Rosland is a Project Engineer at Sime Darby Oils, Malaysia. She first joined POPSIG in 2020 as an editorial member to document all POPSIG activities. In her two-year term, she led the editorial team and made two publications of POPSIG newsletters (Issues 16 and 17).

Sin Lu, Ing Chuk and Ausiera had played their roles in building success stories for POPSIG. Their contributions transformed many conceptions into completion. POPSIG wishes them all the best in their future professions.

Apply for 2022 Student Research Project Bursary

Apply for 2022 POPSIG Palm Oil-Themed Article

Apply for COPO 2022 Cook with Palm Oil (3-Min Video)

UPCOMING EVENTS

DATES	EVENTS
17 January 2022	Webinar: New extraction technology for crude palm oil extraction
18 February 2022	Webinar: Catalytic upgrading of palm-based residues to valuable products
5-6 March 2022	Event: National Chemical Engineering Exposure Camp 2022
15 March 2022	Webinar: Industrial automation to industrial autonomy
28 March 2022	Webinar
10 May 2022	Webinar: Process safety management — An introduction
13 June 2022	Webinar: The potential and challenges of Industry 4.0 in the palm oil industry
8-9 August 2022	Event: 33rd Symposium of Malaysian Chemical Engineers (SOMChE)
September 2022	Seminar: POPSIG Research Seminar 2022

DEADLINE FOR APPLICATIONS

DATE	EVENTS
15 August 2022	2022 POPSIG Student Research Project Bursary

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