April—June 2022

# 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

# Table of Contents

# Table of Contents

# Table of Contents

IChemE ADVANCING CHEMICAL ENGINEERING WORLDWIDE

Palm Oil Processing Special Interest Group

## Leadership Team

**Chair**

Professor Ir. Dr. Chong Mei Fong AMIChemE

**Deputy Chair**

Assoc. Prof. Ir. Dr. Viknesh Andiappan MIChemE

**Secretary**

Ir. Dr. How Bing Shen MIChemE

**Treasurer**

Ir. Dr. Chew Jiuan Jing

**Vice Secretary**

Wong Wei Han

**Event Director**

Ir. Prasath Ramani

Ir. Dr. Wendy Ng Pei Qin

**Chief Manager of ICT & UK Coordinator**

Oscar Ting Teo Wei AMIChemE

**Roadshow Director**

Vincent Tiang Soon Thai

**Event Coordinator**

Thillai Kali

Dr. Tan Yie Hua MIChemE

**Statistics and IKPO Programme Lead**

Melvin Wee Xin Jie

**Graphic Design and Production Lead**

Cheah He Ming

**Continuous Improvement & Future Dev. Lead**

Kek Ming Xuan

**Roadshow Coordinator**

Nur Basyirah Binti Roslan

Assoc. Prof. Dr. Jobrun Nandong MIChemE

**Chief Editor**

Assoc. Prof. Dr. Bridgid Chin Lai Fui AMIChemE

**Editorial Board Committee**

Ho Jia Lynn

Nor Nazeelah Saleem AMIChemE

Bay Paey-Shya

**Exco**

Assoc Prof. Dr. Wu Ta Yeong MIChemE

Ir. Hong Wai Onn FIChemE

Dr. Jeff Kor Yann Kae AMIChemE

# Editor's Message

We live in an ever changing world from the unusual two years of pandemic lockdown and moving towards to a resilient lifestyle. After the Great Lockdown, we are now facing inflations caused by regional tensions and trade barriers. Supply chain disruption has caused food crisis. Nonetheless, palm oil (PO) emerges strong as solutions to global challenges. Numerous speakers have shared their technical knowledge during POPSIG webinars.

Ir Razmahwata bin Mohamad Razalli showed how process safety management can be incorporated into Malaysian PO industry; Ir Qua Kiat Seng described how the sustainability of science and engineering can be achieved to advance the industry; and, Ir Dr Lim Chun Hsion shared the potential and challenges of Industry 4.0 in Malaysian PO industry. These webinars were held in light of IChemE's 100th Anniversary that fell on 2nd May 2022 since the institution was established in 1922.

MOSTA Climate Change Webinar suggested strategies and plans needed to tackle global warming. CPOPC webinar about SDGs revealed how sustainability moderates socio-economy, education to smallholders and MSPO achievements. Dr Ruslan Abdullah (MPOC) discussed how land matters, smallholders and international acceptance of MSPO challenge Malaysian PO industry during SPOC-CPOPC webinar.

Mr Mohammad Hafezh bin Abdul Rahman (MPOCC) unfolded the way forward of MPOCC on improving certification processes during Competere webinar. Mr Hafezh also delivered his talk on transforming the PO industry in post-COVID-19 era during WTI forum, which was also contributed by MPOB, MPOC, MPOCC and CPOPC.

Director General DG of MPOB Datuk Dr Ahmad Parveez Haji Ghulam Kadir had contributed three webinars at UPM. They are about sustaining quality and environmental conservation, management and leadership, mechanisation and automation. Labour-focused webinar chaired by Deputy Chief Executive Officer of MPOC Ms Belvinder Sron discussed the future of labour rights movement in Malaysian palm oil industry.

POPSIG has had the pleasure to contribute to IChemE Student Chapter Festival 2022, which was organised by IChemE-UM SC and co-organised by UNM IChemE SC. Mr Michael Ng (MPOC) presented MSPO certification scheme to the students at USM, while Ms Yung Yen Li (IOI Edible Oils) delivered a virtual site tour to their refinery site. POPSIG would like to congratulate Mr Ahmad Shahdan Kasim on his new role as Conservation Manager at MPOGCF.

In this issue, the recipients of 2021 POPSIG Student Research Project Bursary have contributed their articles that summarised their funded research about electro-catalyst, photocatalytic degradation, green solvent, and co-pyrolysis, respectively. POPSIG is also proud to be an official Institution Partner of MPIC-organised MIACES in July 2022. POPSIG looks forward to the wonderful events in the second half of 2022.

Thanks to all our valued POPSIG members and POPSIG sponsors for their continuous support and dedication.

# Webinar: Process Safety Management—An Introduction

On 10th May 2022, IChemE POPSIG had organized a webinar on the introduction of webinar on the process safety management. The aim of this webinar is to conduct a Process Safety Management (PSM) program to enable asset teams to demonstrate that their assets are safe in an auditable manner, with reference to appropriate criteria. In this session, elements of PSM, and examples of roles and tasks of various functions in an organization had been presented. The webinar recorded 40 participants.

Ir Razmahwata bin Mohamad Razalli, the Director IGL Services Sdn Bhd was invited to give a sharing session for this talk. Her current technical roles involve leading technical safety assessments and workshops, measurement and allocation reviews, and providing training on Hazard Operability (HAZOP) study, Safety Integrity Level (SIL), and Safety Integrity Level Layer of Protections Analaysis (SIL LOPA) methods.

Process Safety Management is an analytical tool focused on preventing releases of any substance defined as a “highly hazardous chemical. There is no definition in Malaysian Regulations, but element ofi it are used in CIMAH. The purpose of PSM for preventing and minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals.

He had also explained each pillars involved in the PSM. The pillars of PSM consists of process safety information, process hazard analysis, operating procedures, employee participation, training, contractors, pre-startup safety review, mechanical integrity, hot work permit, management of change, incident investigation, emergency planning and response, compliance audit, and trade secrets.

In addition, he also provided information on how process safety management can be conducted in a palm oil industries. The few suggestions were to use process safety tools such as HAZOP, SIL, and SIL LOPA methods. He also explained the strengths and weaknesses of using these various process safety tools.


Figure 1: Ir Razmahwata bin Mohamad Razalli presenting a talk on the Process Safety Management

# Webinar: The Sustainability of Science and Engineering in the Malaysian Palm Oil Industry

On 16 May 2022, Ir Qua Kiat Seng, Senior Lecturer at Monash University Malaysia delivered a webinar to discuss about the sustainability in Malaysian palm oil (PO) industry. The webinar recorded 52 online participants.

## Deterioration of Bleachability Index (DOBI)

Ir Qua presented that the index-graded CPO has the following categories: sludge palm oil, poor, fair, good and excellent. A higher DOBI indicates that the fruit is more fresh, ripe and free of contaminants. He reported that the CPO DOBI specifications were not updated for years.

## Biodiesel

The MPOB-research biodiesel technology is well established and continues to improve. In Malaysia, 31 plants were established but only 18 are in operation today. At B20+B7 (for transport and industry), the contribution to our total primary energy supply will be 1.5% as renewable energy (RE).

## Nutrition

A recent article in 2020 stated that there were no significant association between saturated fat intake and coronary artery disease or mortality. Palm oil is considered a saturated fat.

## Silos

Ir Qua highlighted that the palm oil industry and the government ministries work largely in silos. The approach in the sector is vastly reactive rather than proactive. Industry and government need to work hand in hand for the benefit of the entire industry and the nation, be forward looking, have strategic thinking and quick collective decision making.

## Stakeholders

As Figure 1 shows, the upstream has the largest number of organisations whereas downstream there is almost always a single sub-sector organisation. This can give difficulties to MPIC agencies like MPOB or the Malaysian Palm Oil Certification Council (MPOCC) to get a balanced consensus.

## An umbrella body

Ir Qua then proposed an umbrella body with the name Malaysian Palm Oil Industry Group (MPOIG) that recognises both the tonnage and sub-sector, as shown in Figure 2. This will create a level playing field for the industry players.

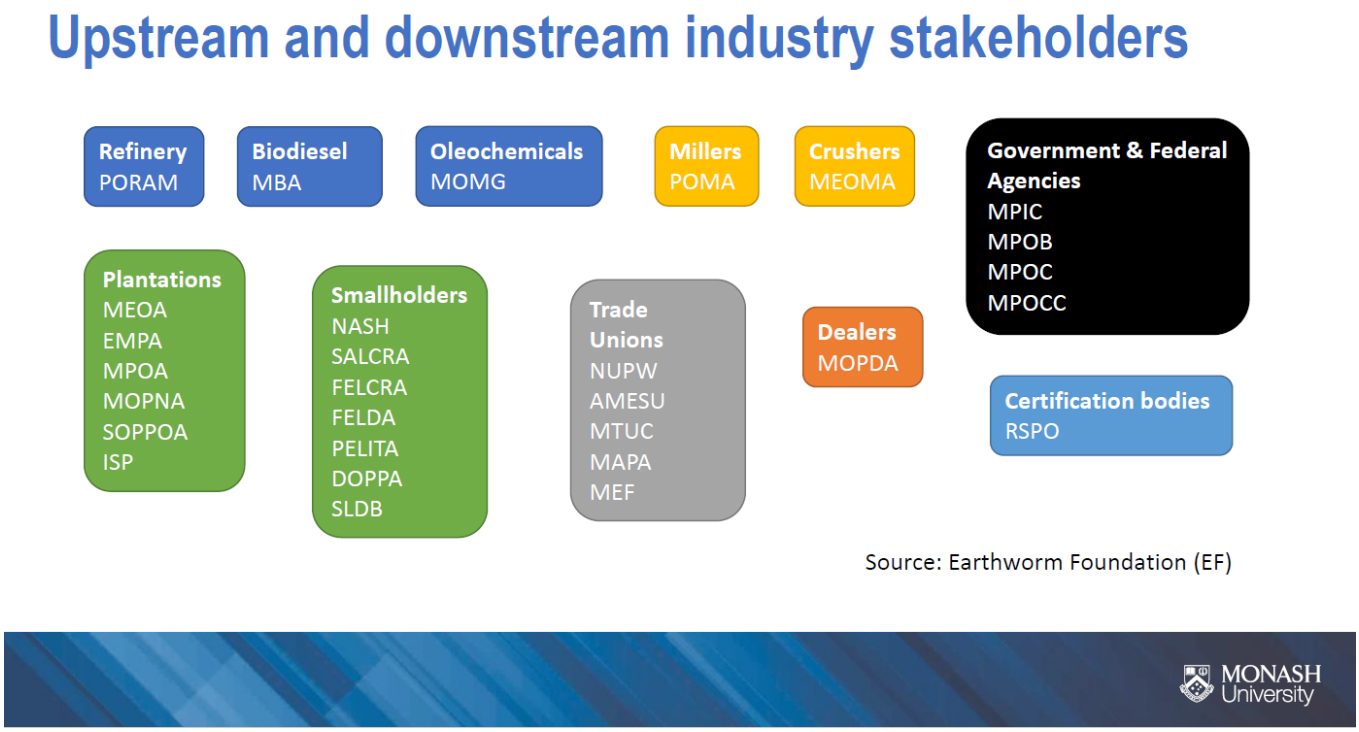



Figure 1: Upstream and downstream industry stakeholders. Image adapted from Qua Kiat Seng (2022).

### An umbrella body

Ir Qua then proposed an umbrella body with the name Malaysian Palm Oil Industry Group (MPOIG) that recognises both the tonnage and sub-sector, as shown in Figure 2. This will create a level playing field for the industry players.

In the chemical sector, the Chemical Industries Council of Malaysia (CICM) is the umbrella body that represents the various sub-sector chemical groups (ranging from oleochemicals, paints, fertilisers, petrochemicals, agriculture chemicals, industrial gases, coating resins and biodiesel sectors) following a restructuring exercise in 2001.

The Malaysian Oleochemical Manufacturers Group (MOMG) is an honorary member of CICM's executive committee as oleochemicals come under MITI and not MPIC.

### Ministries

On the government side, it would be good if some ministries could be merged as there are always overlaps, some more than others. A good example was the Ministry of Energy, Science, Technology, Environment & Climate Change (MESTECC), where the related portfolios were better streamlined.

It is vital to have the policies in each ministry aligned with the national strategy so that all are moving in the same direction. An area which will become critical will be in dealing with climate change as almost all ministries will be involved.

There are also a number of Acts and regulations that need be updated. An example is the Environmental Quality Act 1974 (Act 127), which is almost 50 years old.

Within MPIC, apart from the agencies MPOB, MPOC and MPOCC, there is the Palm Oil and Sago Industries Division (BISS) and Biofuel Division (BBA). Given the importance of palm oil and its by-products to Malaysia, there should be a head of palm oil industry in MPIC, who would be the first point of contact for the chair of MPOIG. He would also provide continuity for the palm oil industry as we have to accept that the minister is a political appointee. A long-term policy aligned with the national strategy would ensure that the palm oil industry stays on course.

There should also be some continuity in MPIC agencies. Heads and chairs of their boards/council since GE14 have changed, with only the director-general of MPOB, Datuk Dr Ahmad Parveez Haji Ghulam Kadir remaining. This has been disruptive for the industry.

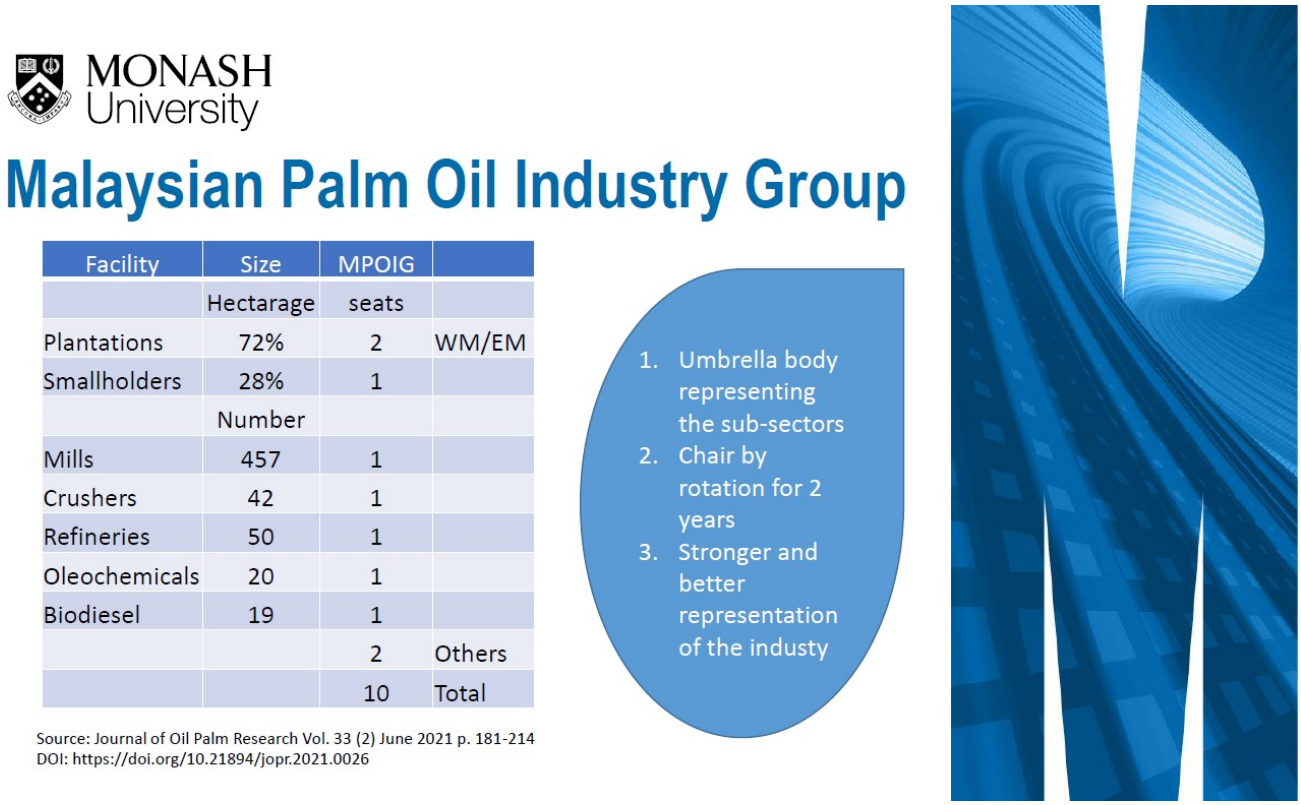



Figure 2: Malaysian Palm Oil Industry Group. Image adapted from Qua Kiat Seng (2022)

## A national aspiration

Reorganising will help in some ways to break down the silos but it remains for the people in them to feel passionate about the future and the greatness of palm oil to totally bring down the silos.

In December last year, Zuraida declared, “Malaysia has steadfastly worked towards promoting the important message that palm oil is a nutritious and affordable food for all. Our scientists — who also collaborate with renowned research institutions worldwide — continue to explore new technologies to ensure that the industry remains dynamic, spawns high-income jobs and entrepreneurial opportunities, and raises export earnings. At the same time, the government is striving to establish a zero-waste industry that is sustainable, well-regulated and mindful of the needs of end-users.”

This is a national aspiration that can be quickly achieved when all the actors work together, free from thinking and working in silos.

## Acknowledgement

The summarised content is adapted from Ir Qua Kiat Seng’s article in The Edge Market (May 2022).

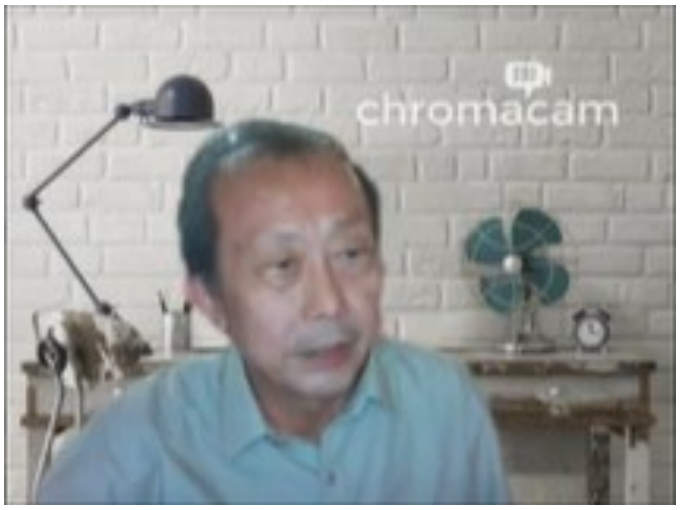




Figure 3: The Dawn of the New Oil & Gas Industry—Palm Oil. Image adapted from Qua Kiat Seng (2022).

# Webinar: The Potential and Challenges of Industry 4.0 in the Palm Oil Industry

On 13 June 2022, Ir Dr Lim Chun Hsion, Assistant Professor, Heriot-Watt University Malaysia delivered a webinar to discuss about the Industry 4.0 development in Malaysia. The webinar recorded 36 online participants.

## Current state of palm oil industry

Chun Hsion first shared the current state of palm oil industry in oil palm plantation (Industry 1.0), palm oil mill (Industry 2.0) and refineries and oleochemicals (Industry 3.0).

## HAZOP methodology

He incorporated HAZOP methodology to understand the potential of Industry 4.0 in the palm oil production.

## Smart computational technologies

Chun Hsion presented how to optimise oil palm harvesting and evacuation path using mathematical modelling approach, as shown in Figure 1. The challenges are the data input and the availability of computational facilities.

## Feasibility study

He demonstrated the techno-economic analysis of drone application at oil palm plantation. He adopted graphical financial pinch analysis to compare profit/cost saving ves CAPEX.

Nonetheless, the challenges included the unique adaptation of IR4 based on application, rapid development of technology, unknown cost estimation model and difficulty to quantify the impact and justify the investment.

## Circular economy

As shown in Figure 2, he showed the involvement of multiple IR4 enablers would have different applications, investment in stages and the minimisation of the investment "waste". The complex "upgrading" process in circular IR4 possessed software/ hardware compatibility challenges and unknown "upgrading" cost.

## Moving towards palm oil Industry 4.0

Through digitalisation, smart sensor can incorporate smart system (AI, ML etc) to overcome analytical and optimisation problems. Adaption of robotics and drones can promote simple and repetitive motion problems.

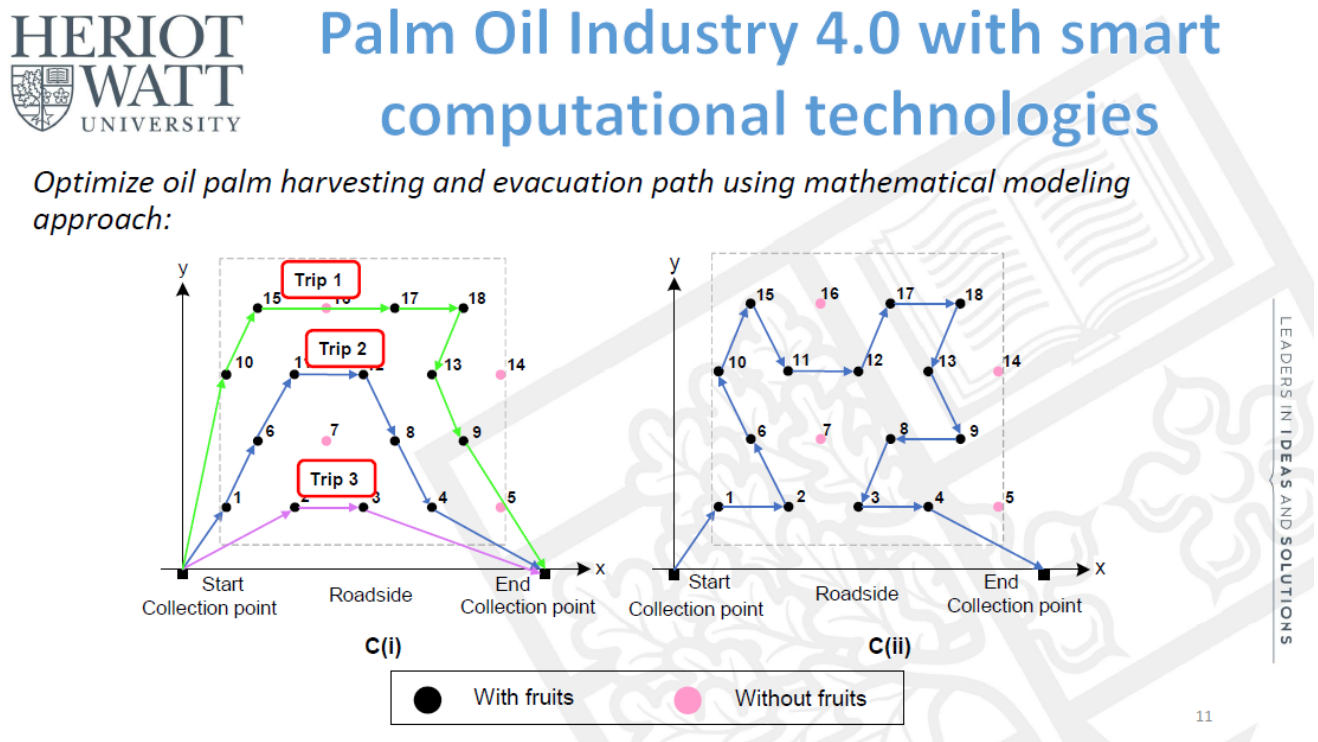



Figure 1: Optimisation using mathematical modelling. Image adapted from Lim Chun Hsion (2022).

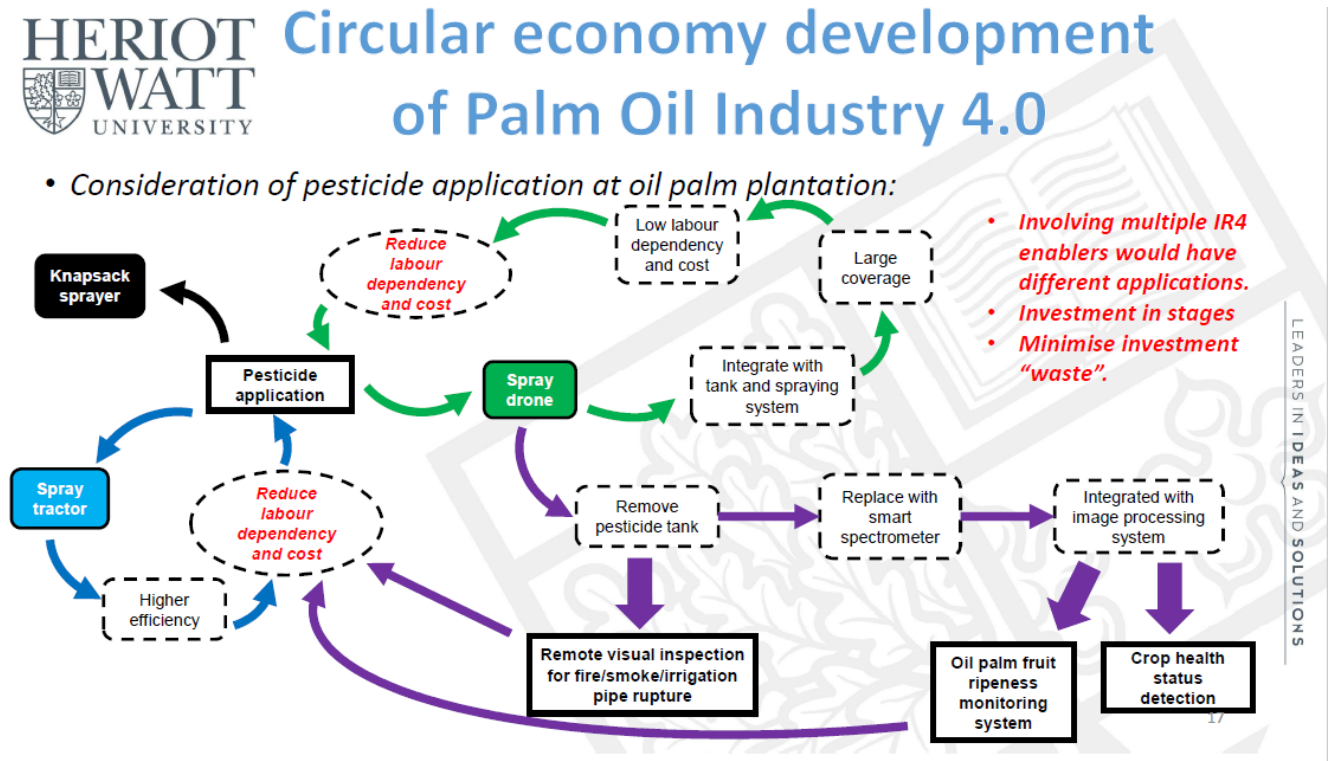



Figure 2: Circular IR4.0. Image adapted from Lim Chun Hsion (2022).

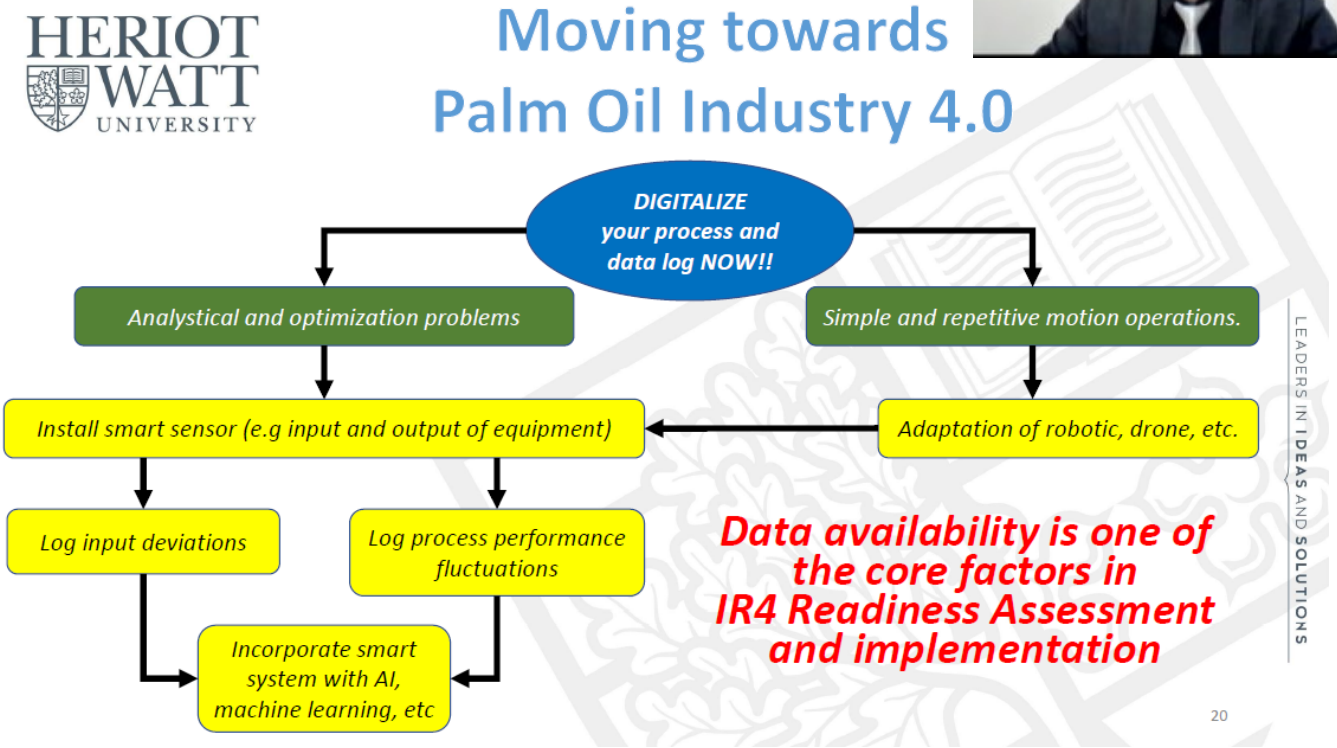



Figure 3: Way forward towards IR4.0. Image adapted from Lim Chun Hsion (2022).

# Event: IChemE100: The potential future trajectories of society and how the work of the chemical engineering profession may be tasked to add value

On 13 April 2022, ChemEng Evolution organised the third IChemE100 webinar with the theme of Social Experience. At POPSIG, webinars about gender equity have been organised to encourage the participation of women in palm oil industry. POPSIG also provides an equal learning opportunity through POPSIG-MPOC educational roadshow.

The panel consisted of:

- Dr Marlene Kanga - Non Executive Director, Sydney Water Corporation
- Professor Genevieve Bell - Vice President & Senior Fellow, Intel
- Tom Burke - Co-founding Director and Chairman, E3G
- Dr Adeeba Kamarulzaman - Dean of the Faculty of Medicine and Professor of Medicine and Infectious Diseases at the University of Malaya in Kuala Lumpur, Malaysia
- Liveris Academy Scholars, The University of Queensland, Australia
- Lilly Van Gilst - Liveris Scholar
- Victoria Barnes - Liveris Scholar
- Kyel Steensma - Liveris Scholar

Lilly Van Gilst presented that the big issues with today's world is about nutritious food, accessible healthcare, appropriate housing, sustainable power, land and resources and ethical supply chains. In chemical engineering, several elements need to be considered during the design, including research, public perception, government, business, economics, ethics. Constant learning in a transparent way is important, and it is important to be unafraid to change our own opinion through learning process. By communicating ideas and findings, suitable solutions can be discovered through diverse teams.

Victoria Barnes discussed about sustainable cities and smart infrastructures. Control urban sprawl aims to minimise our impact on nature while maintaining housing affordability, co-existing with nature instead of pushing nature out of the way, transforming under-utilised land areas (oceans, previously developed land, middle of Australia). Zero emission materials are widely innovated, such as: carbon negative materials vs carbon absorption materials. For a more circular economy, technology is developed to turn waste into valuable products.

Sustainable construction breaks the feedback loop of CO2 emissions using thermal mass. Hence, it is important to understand the environmental details of the region, to incorporate nature into infrastructure, for example, utilise natural building materials like mycelium (naturally fire retardant, fast-growing) and close water cycle. To prepare for repercussions, there are 2-pronged approach: change to reduce impacts and introduce protective measures. Proper policy can be exercised through understanding the facts and translate to law. Chemical engineers are in positions of decision making to create a harmonious biodiversity, clean air and pure water.

Kyel Steensma stated that chemical engineers should get involve in public discourse. It is encouraged to communicate tricky topics, such as the real magnitude of challenge, uncertainty, rates of progress, risk and complex systems. Academics should escape the research echo chamber and go into the public eyes, while industry needs to embrace open source and build in public. Kyel also emphasised to promote a society dedicated to public understanding, to foster a generation of engineering-communications graduates dedicated to making topics approachable, understandable, and engaging. Education campaigns, regular debate, and discussion grounded in facts and quantities are important to bring solutions into public communities.

Figure 1: Panel discussed the issues about sustainability and environment .

# Event: IChemE100: Redefining the Energy Mix. What does the Future of Energy Look Like in the Transition to Net Zero?

On 11 May 2022, ChemEng Evolution organised the fourth IChemE100 webinar with the theme of Energy.

At POPSIG, webinars about circular economy and novel extraction technology had been organised to promote energy saving in palm oil processing. During POPSIG-MPOC educational roadshow, webinars were organised to encourage the reuse of palm biomass to generate energy for milling.

The panel of the ChemEng Revolution webinar consisted of:

- Yasmin Ali - Chair - Project Development Manager (Hydrogen), RWE
- Neil Loader - VP Carbon Ambition, Strategy and Sustainability
- Professor Peter Taylor - Chair in Sustainable Energy Systems, University of Leeds
- Alexandra Meldrum - Vice President IChemE Learned Society

The panel described that the rich society's dependence on energy has been a major contributor to climate challenge. Chemical engineers need to transform energy economy – from fossil fuels to alternatives. It was suggested that the government and policy-makers could: (1) Support specific technologies. (2) Use price-based instruments such as taxes, subsidies and emissions trading schemes. (3) Use command and control approaches. (4) Use information and voluntary approaches.

Figure 1: The panel discussed about the energy crisis.

# Event: IChemE100: Safer processes for a sustainable world

On 8 June 2022, ChemEng Evolution organised the fifth IChemE100 webinar with the theme of Processes & Safety.

At POPSIG, webinars about process safety management had been organised to promote safety practices. During POPSIG-MPOC educational roadshow, webinars about food safety (3-MCPD level in products) were organised to encourage innovation to reduce the contaminants to its minimal potential.

The panel of the ChemEng Revolution webinar consisted of:

- Dr Thomas Lakey - Chemical Engineer, BP International
- Dame Judith Hackitt - Past President, IChemE
- David Edwards - Honorary Treasurer (elect)
- Trish Kerin - Director, IChemE Safety Centre
- Ian Shott - Executive Chairman, Shott Trinova

Hazard identification is one of the major contributors in chemical engineering. It manages risks and reduces incidents, loss of life and pollutions. As technologies evolve, the risk management practices are improving. Chemical engineers need to recognise that the phenomena are formed of interrelated parts.


Figure 1: The panel discussed the potential of chemical engineers in improving process safety management.

# Webinar: CPOPC: Blockchain Technology: Innovating the Palm Oil Ecosystem

On 11 April 2022, CPOPC organised a blockchain technology webinar to describe about the technology that can offer great value to Malaysia's palm oil production. The application of blockchain technology in the Malaysian palm oil industry can provide an unprecedented level of trust in the supply chain.

## Blockchain promotes traceability

CEO of DIBIZ Group U.R. Unnithan presented about sustainability authentication that is powered by blockchain. He introduced 'SaaS' modules that could improve productivity, easily maintain digital documentation of supply chain, increase OER/yield through data analytics, communicate with partners, blockchain based immutable data to avail benefits and end-to-end traceability. In plantation, it is easy to use mobile apps for all plantation workers even without cellular network; in mills, it increases profits by improving productivity through collaboration with planters and smallholders; in refineries, it provides instant implementation of digital traceability system at low cost and real-time traceability to the plantations.

## Blockchain challenges in palm oil sector

Prashanth Nayar shared that blockchain means a chain of blocks, which is referred to digitally distributed public ledger that exists across a network. Distributed ledger technology enables real-time data exchange, in addition, it also promotes transparency.

Although 10 industries were identified to have implemented blockchain technology, Prashanth shared three primary pain points in the palm oil industry. One, trust to the sector. Proper land use has been exercised in palm oil industry, such as cultivation of plantation land is not through thorough deforestation. Two, credibility to the system. The industrial players have committed to safeguard welfare of workers, protect biodiversity and carefully treat fauna and flora. Three, recognition to the industry. Palm oil sector has to adhere to expectations of stakeholders worldwide.

Prashanth stated that blockchain can assist upstream (plantation, cultivation and harvesting), midstream (refinery and processing), and downstream (end products and brands) processes. He identified six elements of blockchain: programmable, secure, immutable, time stamped, distributed and unanimous. Overall, palm oil industry will be more prosper with the involvement of blockchain technology.

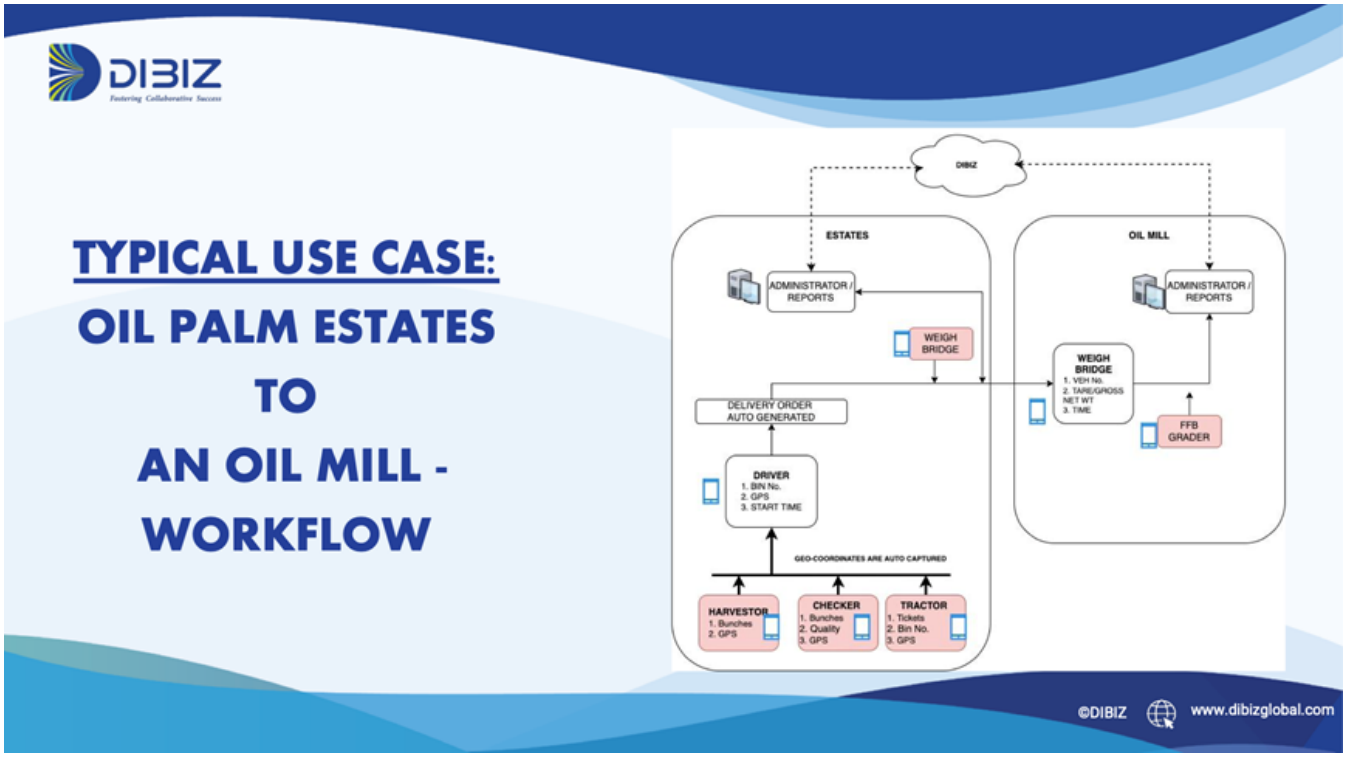



Figure 1: Mr Unnithan showed the use of DIBIZ application in the oil palm field. (Image adapted from: DIBIZ, 2022)

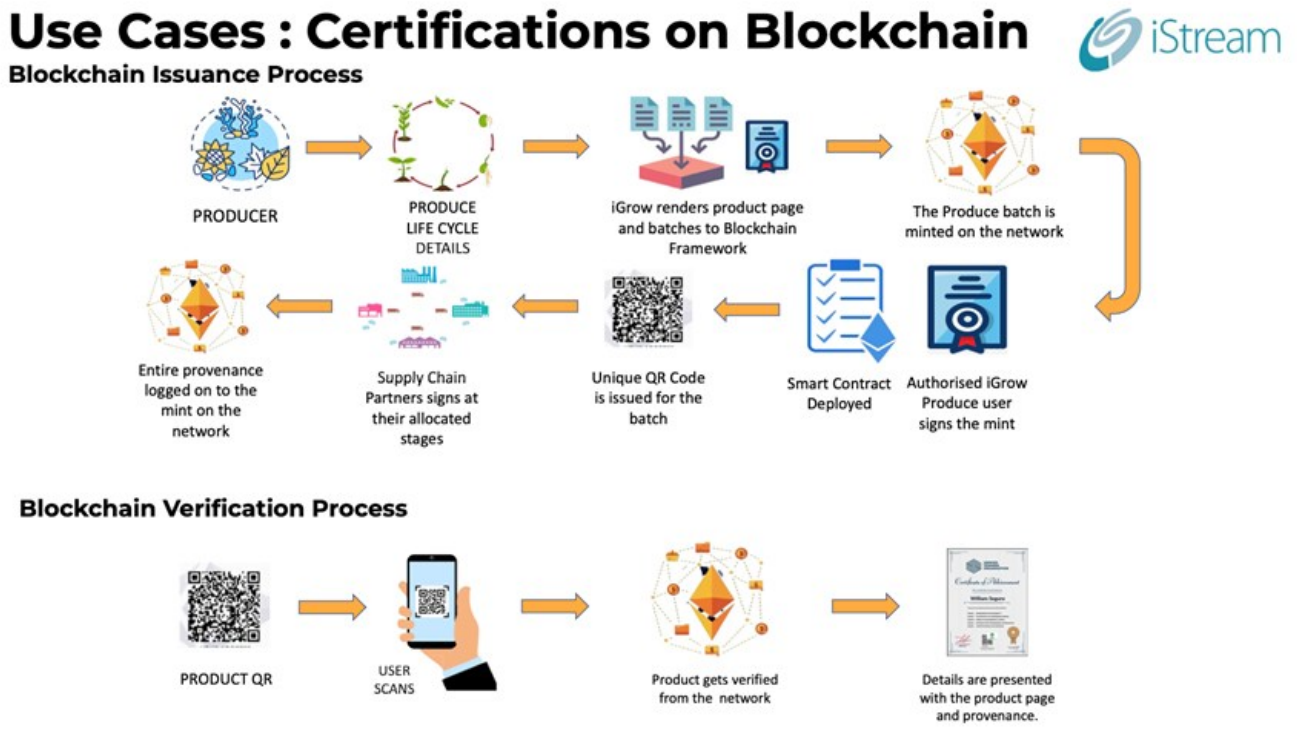



Figure 3: Russel presented the certification process on blockchain. (Image adapted from: Rahim, 2022)

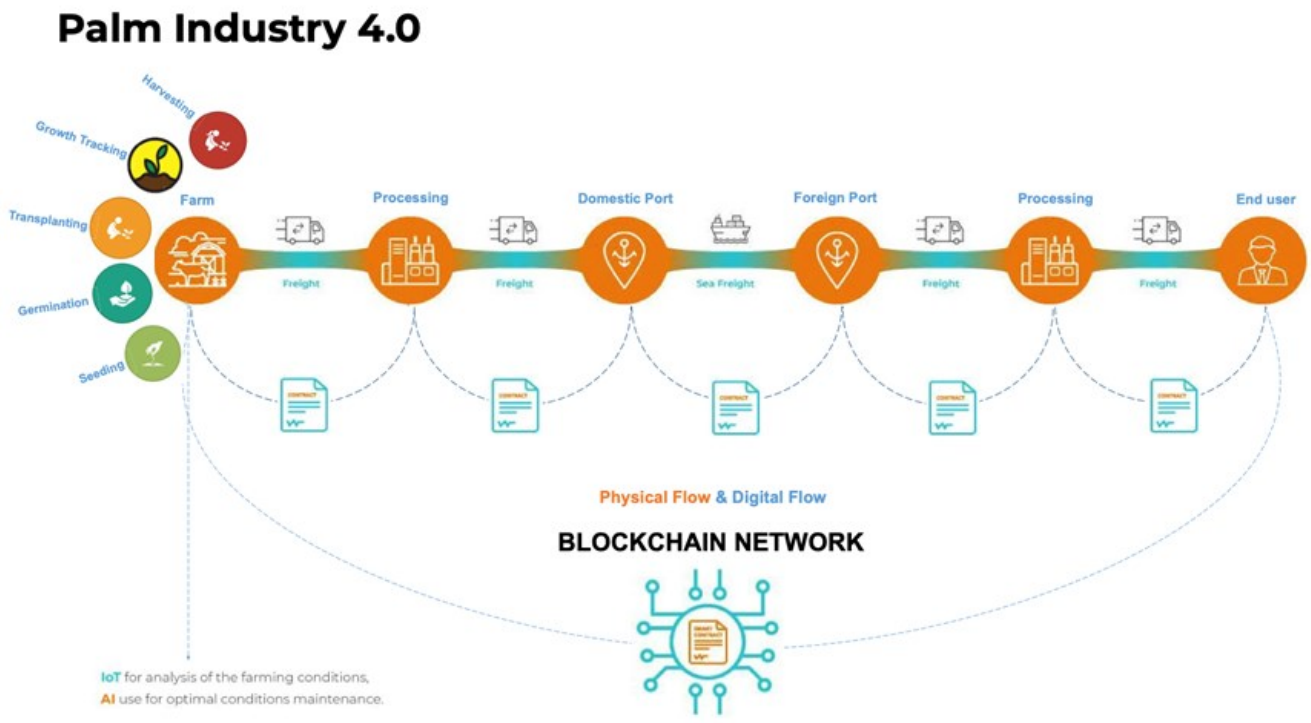



Figure 4: Russel presented the palm industry 4.0. (Image adapted from: Rahim, 2022)

### Farming democratisation to decentralise cyclic economy

Russel Rahim identified that the bottlenecks in palm oil industry include variability of change, cost of change, multiple standards and organisations, lack of champion, multiple technology providers and lack of integration. In smart agriculture, IoT is used to collect a seamless way to extract, analyse and report real-time plant information, with alerts on the growth and yield results. For farming democratisation, blockchain enables all participants to be a part of the farming economy; truly rewarding owners and operators for their contribution to maintain and operate the distributed farm. Blockchain helps in establishing direct link between farms and consumers. It helps the operators to reach to the market without depending on the middlemen.

### Blockchain in plantation

Kamal Milatu presented the need for blockchain technology in plantation management. The issues facing fertiliser supply are quality discrepancies and delays in delivery. It affects field application schedule, immediate yield and long-term performance. Machinery also plays important role in product evacuation and transport, daily production, field input application schedule. He underlined that plantation issues include financial capabilities, timeliness of payments and credit worthiness.

### Technology levels up trust

To conclude, blockchain technology can improve Malaysia's palm oil production towards sustainability and credibility. It will provide real-time traceability of palm oil from plantation to plate, reduce tracking costs, and protect workers. Advanced technologies can accelerate efficiency in plantation management and improve consistency.

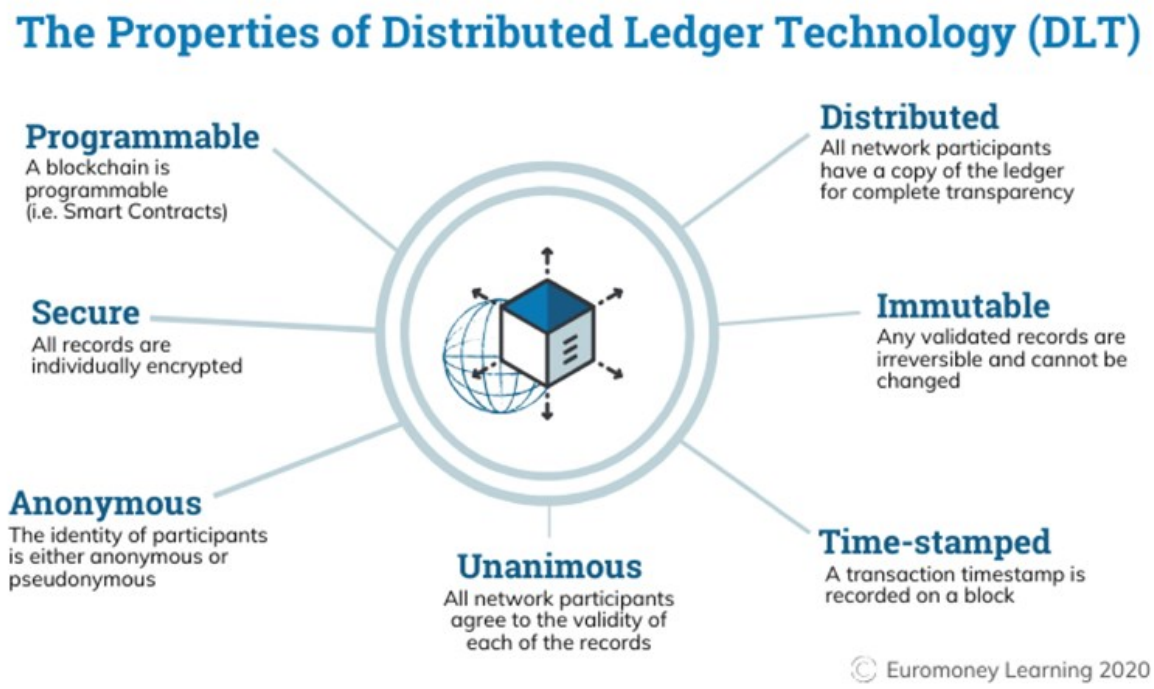



Figure 2: Prashanth presented seven properties of distributed ledger technology. (Image adapted from: Nayar, 2022)

# Webinar: MOSTA Cimate Change Webinar

On 13 April 2022, MOSTA organised Climate Change Webinar on Zoom. It was moderated by Dr Jaybalan A/L Tamahrajah, Senior Technologist at KLK Oleomas Sdn Bhd. President of MOSTA Yang Berbahagia Academician Tan Sri Emeritus Professor Datuk Dr Augustine S H Ong delivered his opening remark.

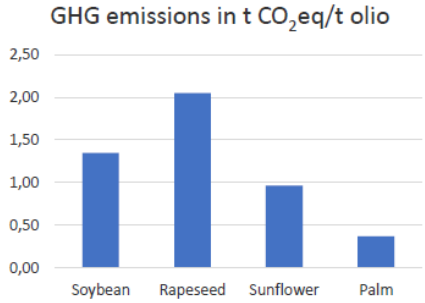
Dr Maria Vincenza Chiriacò, Researcher at CMCC Foundation (Italy) presented three indicators of life cycle assessment (LCA): (1) carbon footprint per unit of land; (2) carbon footprint per unit of product; and, (3) land needed to produce 1 ton of oil – directly dependent on the crop yield. She showed that GHG emissions (in t CO2 eq/t olio) of palm oil is the lowest (less than 0.5) as compared to rapeseed at just over 2.0.

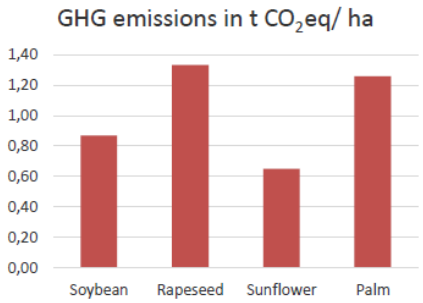
Ir Dr Mohd Shiraz Aris, Head of Processing Technology at Sime Darby Plantation Berhad presented three components of circular economy. One, reducing resource use. Two, reuse. Three, extending the utilisation period of goods. Circular bioeconomy is all about the integration of circular economy principles into the bioeconomy. However, circular bioeconomy development is challenged by cost of technology and heavy investments. Dr Shiraz shared several solutions, including: CO2 sequestration via algae farming, zero discharge of mill and refinery effluent, virtual mills and refineries.

Amir Afham Abdullah, Head of Climate Change Roundtable on Sustainable Palm Oil, introduced PalmGHG Calculator, which is used to estimate net GHG emissions from palm oil production. On new development, he suggested to avoid HCV/HCS areas and avoid development/ drainage of peatlands. He recommended to first identify the significant emission sources/ sinks and set targets. It is then followed by planning and monitor.

## GHG emissions through LCA

| Oil | Leading producer countries | Emissions per unit of product (t $CO_2$eq/t oil) | | Emissions per unit of cultivated area (t $CO_2$eq/ha/year) | | Area (ha) required to produce 1 tonne of oil | |
|---|---|---|---|---|---|---|---|
| | | | *Avg* | | *Avg* | | *Avg* |
| Soybean | Brazil | 1.30 | | 0.86 | | 1.51 | |
| | USA | 1.37 | **1.35** | 0.90 | **0.87** | 1.51 | **1.6** |
| | Argentina | 1.39 | | 0.82 | | 1.70 | |
| Rapeseed | Canada | 1.10 | | 0.87 | | 1.27 | |
| | China | 3.04 | **2.05** | 2.15 | **1.33** | 1.41 | **1.5** |
| | India | 2.27 | | 1.12 | | 2.03 | |
| Sunflower | Russia | 0.96 | | 0.54 | | 1.76 | |
| | Ukraine | 0.94 | **0.96** | 0.75 | **0.65** | 1.25 | **1.4** |
| | Argentina | 1.07 | | 0.76 | | 1.41 | |
| Palm | Malaysia | 0.40 | **0.37** | 1.71 | **1.26** | 0.23 | **0.3** |
| | Indonesia | 0.35 | | 1.10 | | 0.32 | |

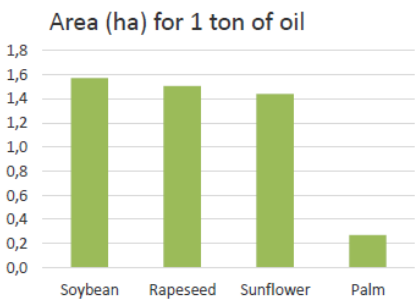




Figure 1: Dr Chiriacò presented GHG emissions through LCA. (Image adapted from: Chiriaco, 2022)

Rashyid Redza Anwarudin, Head, Group Sustainability at Sime Darby Plantation Berhad introduced five actions in response to climate change. One, reducing operational emissions. Two, implementing Nature Based Solutions (NBS). Three, responsible sourcing. Four, adapting and mitigating to material climate risks. Five, climate change-related governance and disclosure.

Dr Vijaya Subramaniam, Research Officer Special Grade C, VK7 Biorefinery & Environment Group Leader at MPOB, presented bio-circular economy. She showed that biogas capture achieved 14.84 kg CO2 eq/kg GHG savings from these practices.

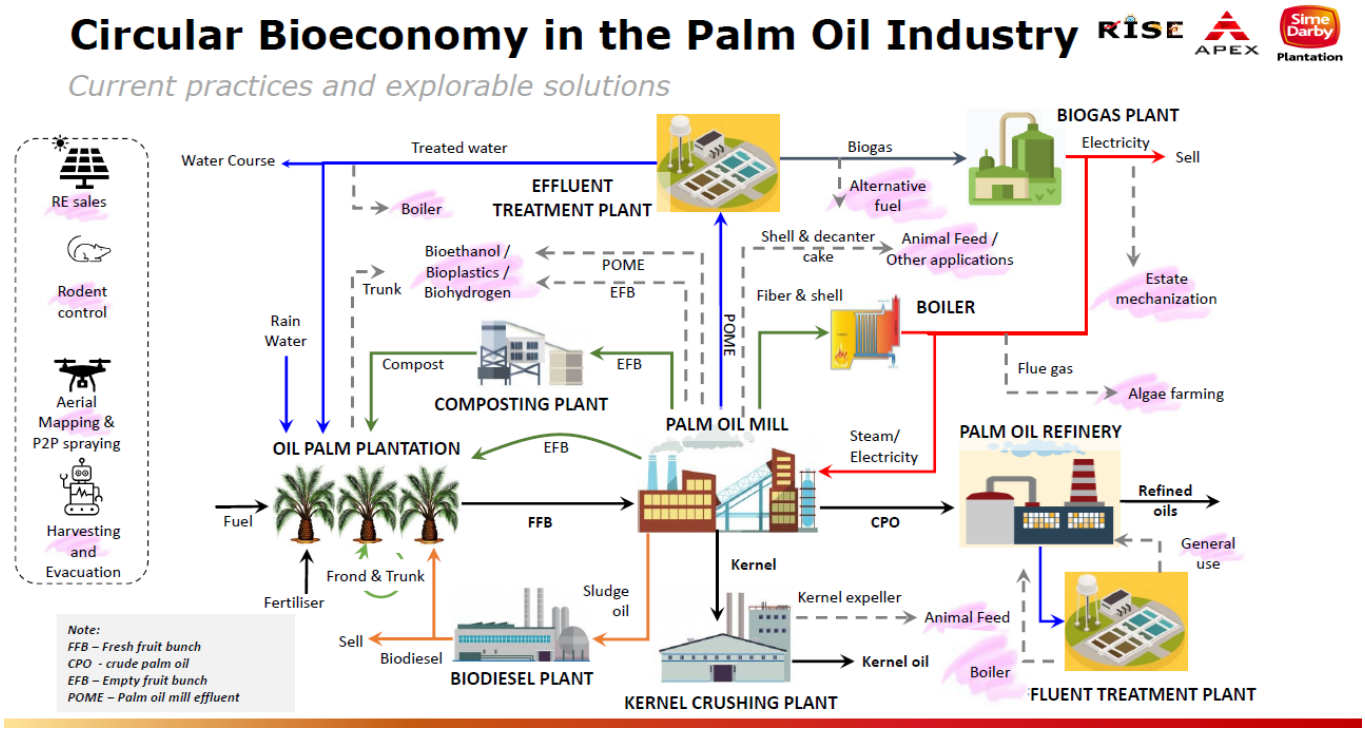



Figure 2: Ir Dr Mohd Shiraz Aris presented circular bioeconomy at SDP. (Image adapted from:: Aris, 2022)

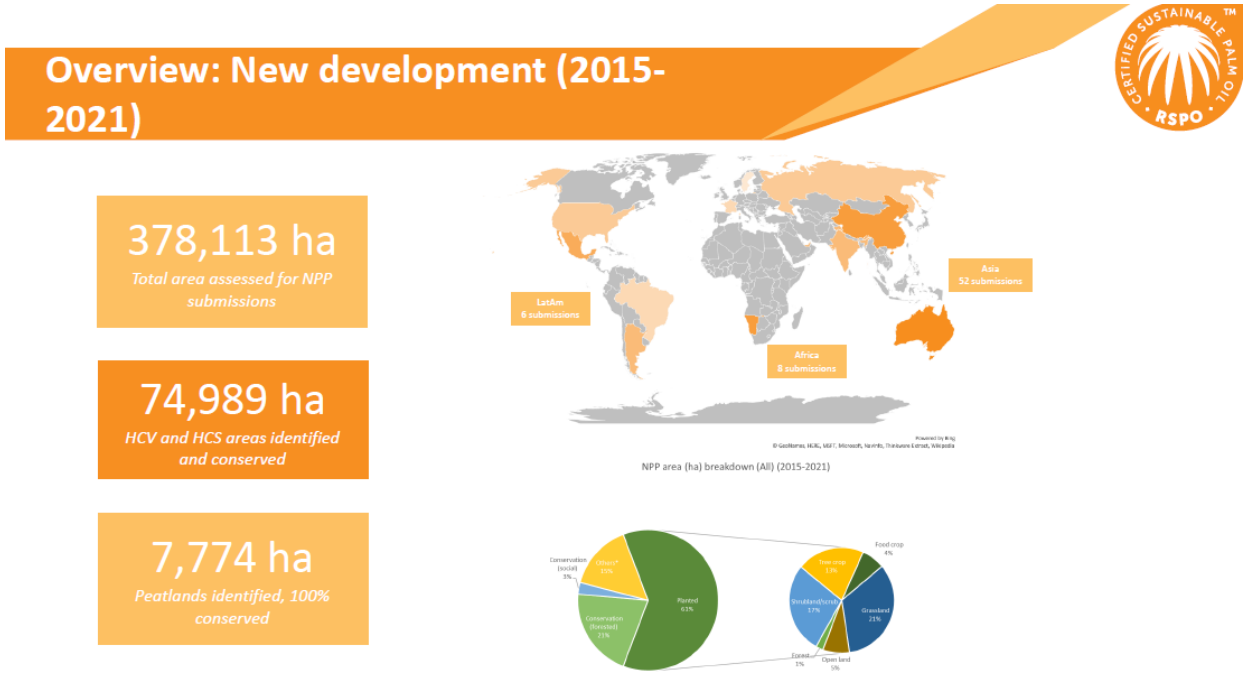



Figure 3: Amir Afham Abdullah presented new development of RSPO (2015-2021). (Image adapted from: Abdullah, 2022)


Figure 4: Rashyid Redza Anwarudin introduced renewables business to drive decarbonization at SDP. (Image adapted from: Anwarudin, 2022)

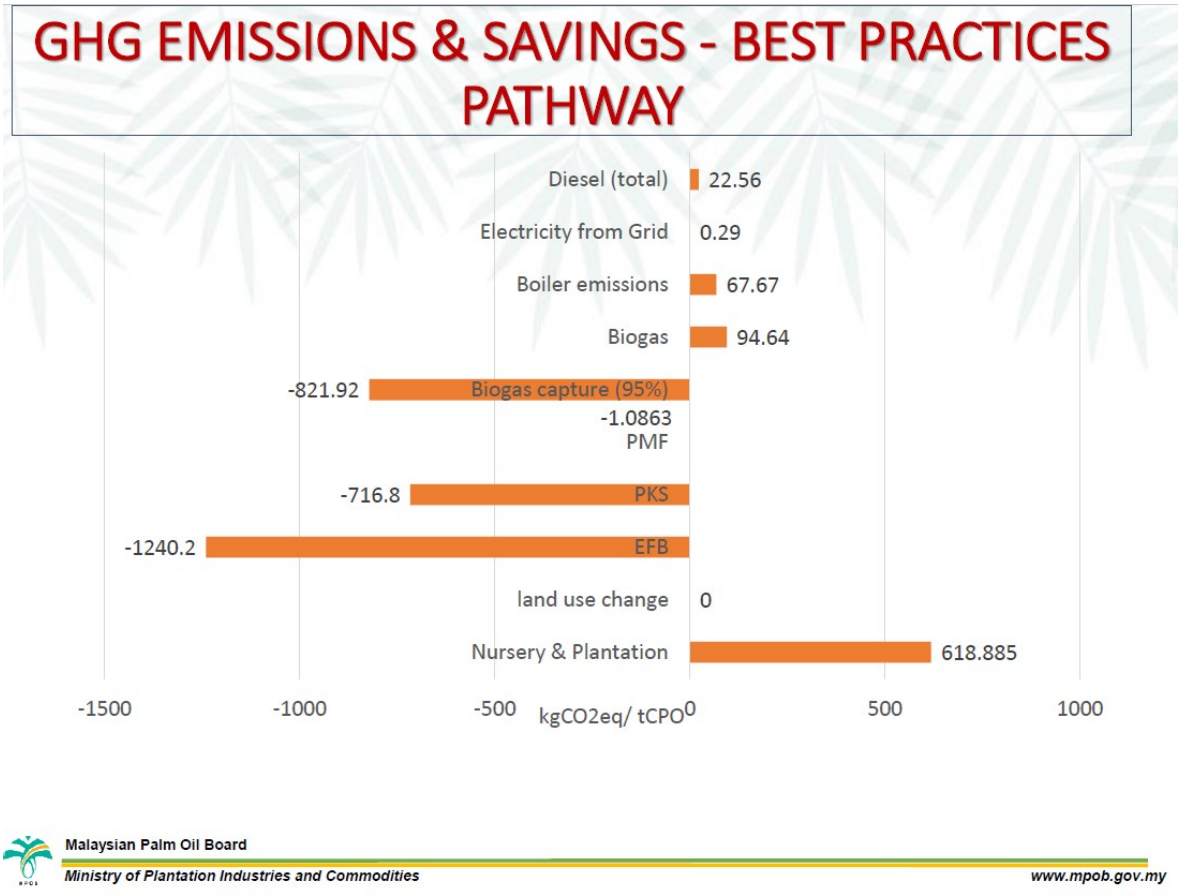



Figure 5: Dr Vijaya Subramaniam presented GHG emissions & savings. (Image adapted from: Subramaniam, 2022)

# Webinar: CPOPC: How Sustainable Vegetable Oil Production Contributes to UN Sustainable Development Goals

In partnership with Europtimum Conseil, CPOPC had organised an SDGs-themed webinar on 20 April 2022. Europtimum Conseil is a public affairs consultancy founded in 2009 that specialises in European Affairs and working with the EU Institutions and main stakeholders. The EU established a joint working group with the ASEAN on SDGs in the vegetable oils sector following the EU-ASEAN Summit on 01 December 2020.

## Substantially contributes to achieving SDGs

Lecturer at the Agribusiness Study Programme, University of Jambi, and Researcher at the Consortium Studies on Smallholder Palm Oil Zulkifli Alamsyah shared that increasing population drives the world consumption of vegetable oil to increase. Thailand observed the greatest growth rate (15.8%) in palm oil harvested area from 2000 to 2021, as compared to Indonesia (13.9%) and Malaysia (5.8%). World demand for vegetable oils is projected to increase from 2021 to 2030. CPO is expected to increase to over 140,000 ton. CPO will grow by 6.02%, while sunflower oil will increase by 4.96%. Fertiliser consumption for oil palm (Indonesia, 30 kg N/ton oil) was the lowest as compared to soybean (Brazil, 34 kg N/ton oil), sunflower (Ukraine, 75 kg N/ton oil) and rapeseed (EU, 100 kg N/ton oil). Pesticide consumption for oil palm (Indonesia, 0.13 kg AI/ton oil) was the lowest as compared to sunflower (Ukraine, 3.44 kg AI/ton oil), rapeseed (EU, 3.87 kg AI/ton oil) and soybean (Brazil, 10.27 kg AI/ton oil).

## Sustainability moderates socio-economy

Matteo Bellotta, the Researcher of the Division on Impacts on Agriculture, Forests and Ecosystem Services at Euro-Mediterranean Center on Climate Change (CMCC), shared the findings on the socio-economic impacts of palm oil production. It aimed to analyse the effects and contributions of palm oil production. Certification schemes slow down the growth of poverty rate. Sustainable palm oil crops improve access to food and mitigate potential threats to food security. Well-being in rural communities that depend on the basic socio-economic conditions can be improved through palm oil development. Oil palm plantation allows the development of infrastructures and educations. The programme also provides opportunities for improving the condition of women. Sustainable production incorporates integrated management and the use of technologies for water collection and storage and waste treatment. It can improve working conditions and fair wages and reduce inequalities.

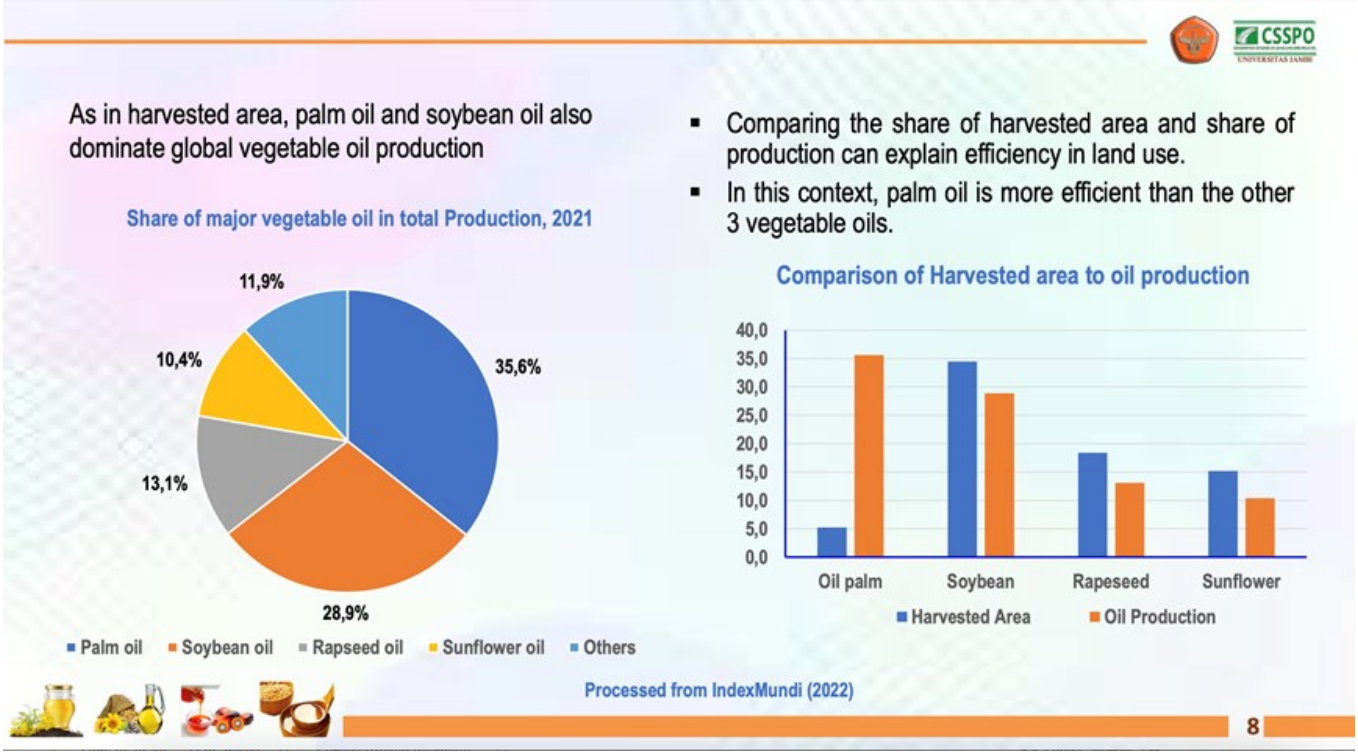



Figure 1: Oil palm is the most efficient crop as compared to soybean, rapeseed and sunflower. (Image adapted from: Alamsyah, 2022)

### Educate smallholders on sustainability

Rukaiyah Rafik from Indonesian Sustainable Palm Oil Smallholders Forum (FORTASBI) shared that the organisation's vision is to promote sustainable palm oil's norm and culture among independent smallholders in Indonesia. Sustainability certification is important for smallholders as it promotes best practices in farm, legality obedience and good management in organisation. It also educates the smallholders on HCV protection, land management and worker right.

### MSPO supports SDG achievement

Deputy President of National Organization of Smallholders (NASH), Malaysia, Haji Adzmi Hassan presented that palm oil contributed RM45 billion (53.4%) of the total agricommodity contribution that accounted for RM84.3 billion in 2021. He emphasised three principles in MSPO, they are people, prosperity, and planet. All sectors in Malaysian palm oil industry are 100% certified except independent smallholders. There are 459,232 (83.3%) smallholders, in which 50.4% of them are dependent smallholders, whereas the remaining are independent groups. 5.87 mil Ha of oil palm area are certified with MSPO as of 2021. Palm oil export value was at RM108.5 billion in 2021. MSPO programme provides a continuous improvement to the achievement of SDG.

### SDGs for better future

In summary, increasing global populations will see higher demand on food and edible oils. The operators need to follow the sustainability framework to maintain a harmonious relationship between human and the planet.

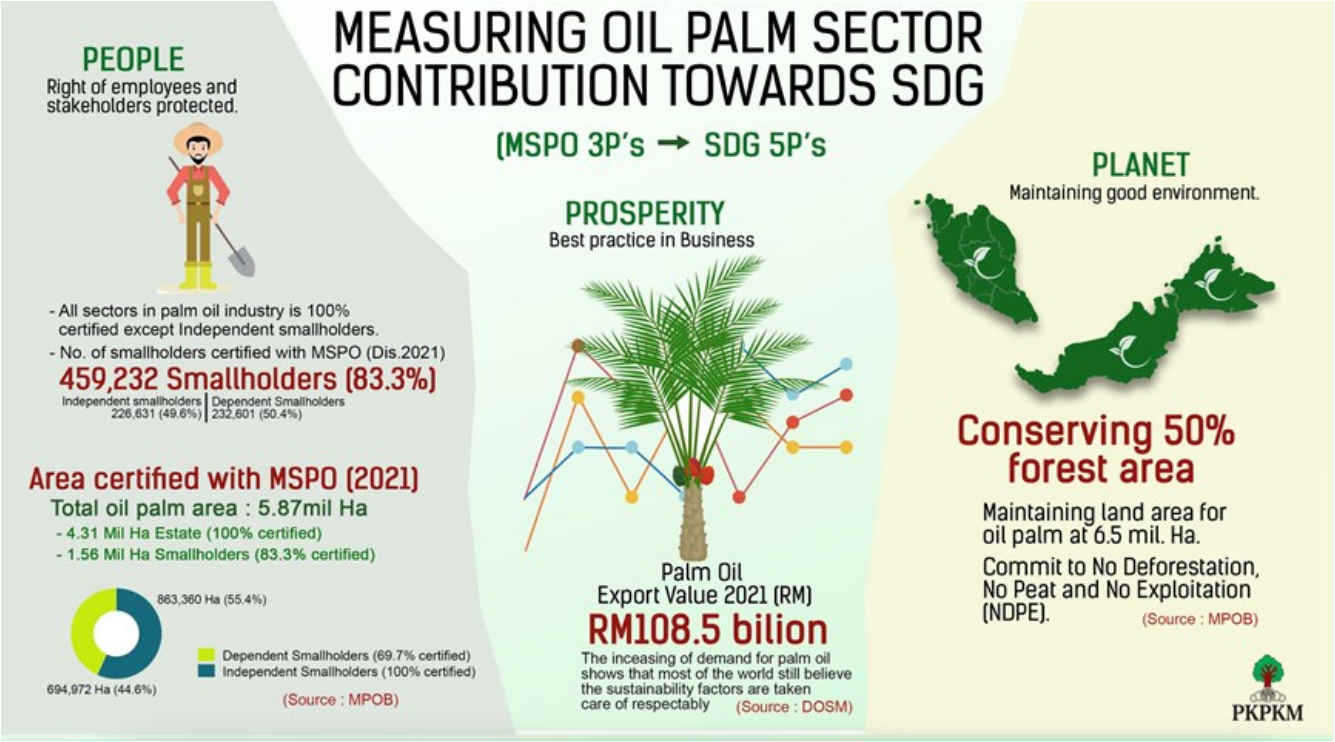



Figure 2: Adzmi presented that how to translate MSPO's principles into SDG's principles. (Image adapted from: Hassan, 2022)

# Webinar: CPOPC &SPOC: Deforestation-Free Commodities, The Case of Palm Oil & the Latest State of Play in Indonesia and Malaysia

On 21 April 2022, CPOPC and SPOC co-organised a webinar to analyse the current trends and the role of palm oil. The webinar was hosted by Marieke Leegwater of Solidaridad and SPOC lead.

## Malaysia maintains forest cover

Niels Wielaard of Satelligence reported that palm oil production is increasing, while EU demand is not decreasing. Although there is a decline in deforestation in Malaysia and Indonesia, some ongoing deforestations were caused by some companies operating outside No Deforestation, No Peat, and No Exploitation (NDPE) commitment supply chains. Niels reported that Satelligence shows commitment on analysis palm-driven deforestation in Africa and Latin America.

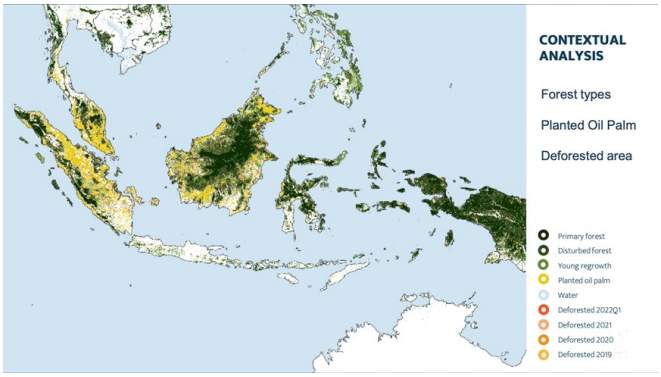



Figure 1: Niels presented the contextual analysis. (Image adapted from: Wielaard, 2022)

## Indonesia commits to forest conservation

Former Country Director Tropenbos International Dr Petrus Gunarso stated that Indonesia decided to improve Nationally Determined Contribution (NDC) in national and international interests. The commitment will be submitted to UNFCCC prior to COP-22. A moratorium has been signed by the authority to prohibit the conversion of Indonesian primary natural forests and peatlands to reduce greenhouse gas emissions from deforestation.

## Malaysia caps planted area

MPOC's Director of Science, Environment and Sustainability Division Dr Ruslan presented that Malaysia's Green Deal comprises a ban on new planting of oil palm in peatland areas and on land converted from forest reserves. He also stated that all oil palm plantation maps will be made available for public access. He underlined the challenges in Malaysian palm oil industry, including land matters, smallholders and international acceptance of MSPO.

## Analyse ISPO, MSPO, RSPO

The Auditor and Founder of Kayon Bart W van Assen differentiates the three certifications: ISPO, MSPO and RSPO. He stated that ISPO indicators allow forest conversion (except primary and peatland forests) and require due diligence on HCV areas; MSPO indicators do not explicitly prohibit forest conversion and require due diligence on High Biodiversity Values; and, RSPO benefits from HCV, high carbon stock assessments and new planting procedure.

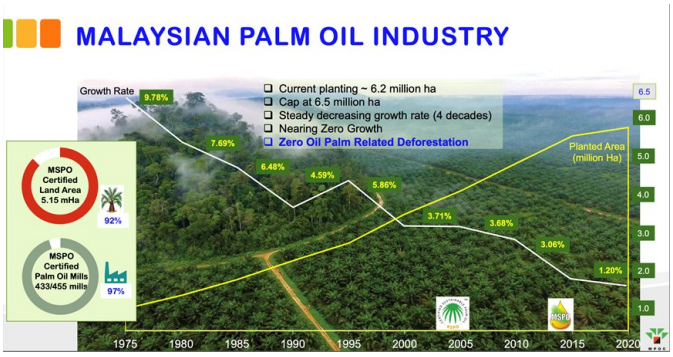



Figure 2: Dr Ruslan presented the trend of Malaysian oil palm planted area and decreasing growth rate since 1975. Total oil palm planted area is capped at 6.5 mHa. (Image adapted from: Abdullah, 2022)

# Competere Webinar: A Sustainable Friend in Troubling Times. Can We Trust the Palm Oil Supply Chain?

On 12 May 2022, Competere hosted a webinar titled A Sustainable Friend in Troubling Times. Can We Trust the Palm Oil Supply Chain? The webinar was moderated by the President of Competere.eu Pietro Paganini.

Ximena Mahecha is the Executive Director of APSColombia Corporation. She presented that Colombian Palm Oil assures smallholders inclusivity, is committed to sustainability and the well-being of communities. Fadhil Hasan, the Head of Foreign Affairs at GAPKI, also contributed to this event.

José Roberto Montenegro is the President of Tropical Oil Division at AgroAmerica. He presented that three tropical oil mills in Guatemala are 100% RSPO Identity Preserved Certified. One tropical oil mill in Panama will soon be certified. He added that one refinery in Mexico is at RSPO supply chain certification standard.

Mohammad Hafezh bin Abdul Rahman is the CEO of MPOCC. Hafezh introduced that MPOCC was incorporated in December 2014 under Companies Act 1965. It is governed by a 13-member board of trustees. MSPO is a sensible tool for sustainable palm oil.

Moving forward, he presented that MPOCC will improve certification processes, wisely use the technologies, set out impact frameworks and analysis, and make continuous improvements.

On collaborations, the government has established national policy on sustainability – Dasar Agrikomoditi and NCD. The government also promotes industry engagement to get buy-ins on relevant policies set. The scheme owner acts as intermediaries in ensuring government's aspiration is achieved; industry's expectations are met; standards are relevant and good scheme documents produced. MPOCC also works with CPOPC, Bursa Malaysia and other NGOs.


Figure 1: A national strategy that promotes adoption of best practices to ensure sustainability (Image adapted from Ximena Mahecha, 2022)



Figure 2: CEO of MPOCC Mohd Hafezh Abdul Rahman's Presentation (Image adapted from: MPOCC, 2022)

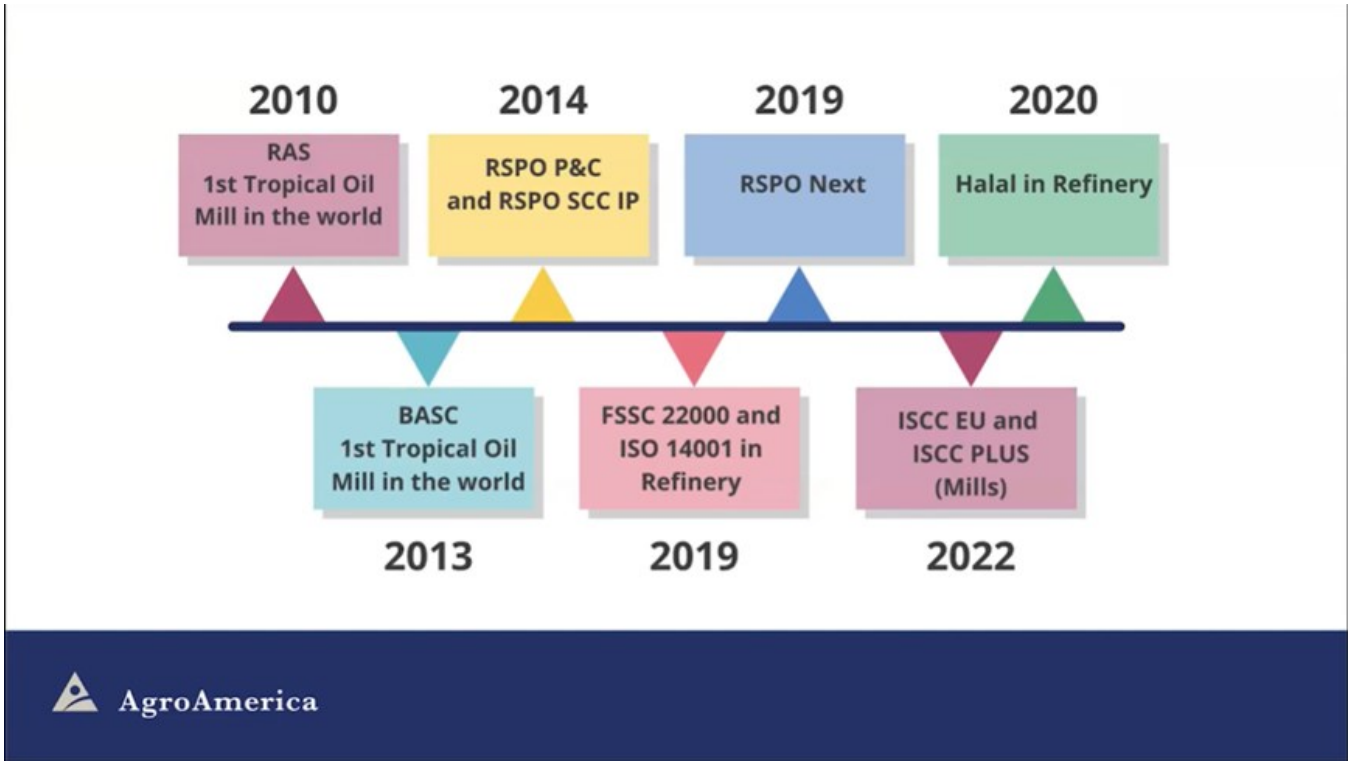



Figure 3: AgroAmerica Presentation (Image adapted from: José Roberto Montenegro , 2022).

# World Trade Institute Webinar: Sustainability and Responsibility: Transforming the Palm Oil Industry in Post-COVID-19 Era

On 16 May 2022, a forum titled Sustainability and Responsibility: Transforming the Palm Oil Industry in Post-COVID-19 Era was organised in Silva Casa Auditorium, World Trade Institute (WTI), Hallerstrasse 6, Bern, Switzerland. The forum was jointly organised by the WTI and the Institute of Malaysian & International Studies (IKMAS, UKM) and the MPOB-UKM Endowment Chair.

The event was gathered by regulatory body, industry, civil society and the scientific group to discuss the challenges and opportunities. They provided critical review and exchanged aspirations towards a sustainable future for palm oil. The forum was participated by Dr Yusof Basiron (CPOPC), Wan Kasim Wan Hadir (FGV Holdings Bhd), Romain Deveze (Senior Program Manager, Markets & Forest Risk Commodities, WWF Switzerland), Monica Rubiolo (Head of Trade Promotion, the State Secretariat for Economic Affairs, SECO), Mohammad Hafezh Abdul Rahman (CEO of MPOCC), Datuk Dr Ahmad Parveez Hj Ghulam Kadir (DG of MPOB) and Wan Aishah Wan Hamid (CEO of MPOC).


Figure 1: Mohammad Hafezh, CEO of MPOCC, delivered his address during Forum at WTI.

# MPOB Webinar: Role of MPOB in Sustaining Quality and Environmental Conservation of Oil Palm Industry in Malaysia

On 1 June 2022, Department of Biological and Agricultural Engineering (DBAE), Faculty of Engineering at UPM organised a webinar titled “Role of MPOB in Sustaining Quality and Environmental Conservation of Oil Palm Industry in Malaysia”. The webinar was delivered by MPOB’s Director General YBhg Datuk Dr Ahmad Parveez Hj Ghulam Kadir, who is also the Adjunct Professor at DBAE UPM. The session was chaired by Professor Ir Dr Hasfalina Che Man.

In general, MPOB plays its role in four major areas: R&D, national agenda, industry engagement and collaboration with agencies. R&D has focused on improving productivity of palm oil, and promote sustainability, conservation and certification. They also push on the development of B20 biodiesel in automotive and B7 for industry. MPOB also actively engage with all industry’s association (MPOA, POMA, MEOA, SOPPOA and EMPA). They also collaborate with MPOCC on the development of MSPO standards.

To address food safety issue, a few strategies were proposed. One, dissemination of technology to reduce chloride content in CPO and 3-MCPDE and GE in PPO. Two, novel process for chloride removal in CPO. Three, improvement of Malaysian standards for CPO. Four, strengthening code of practice at the mills (COPM). Five, implementation of maximum level for 3-MCPDE and GE. The by-products of palm oil processing can be recycled into circular economy. Datuk Parveez underlined that POME can be used as energy source and other organic products.

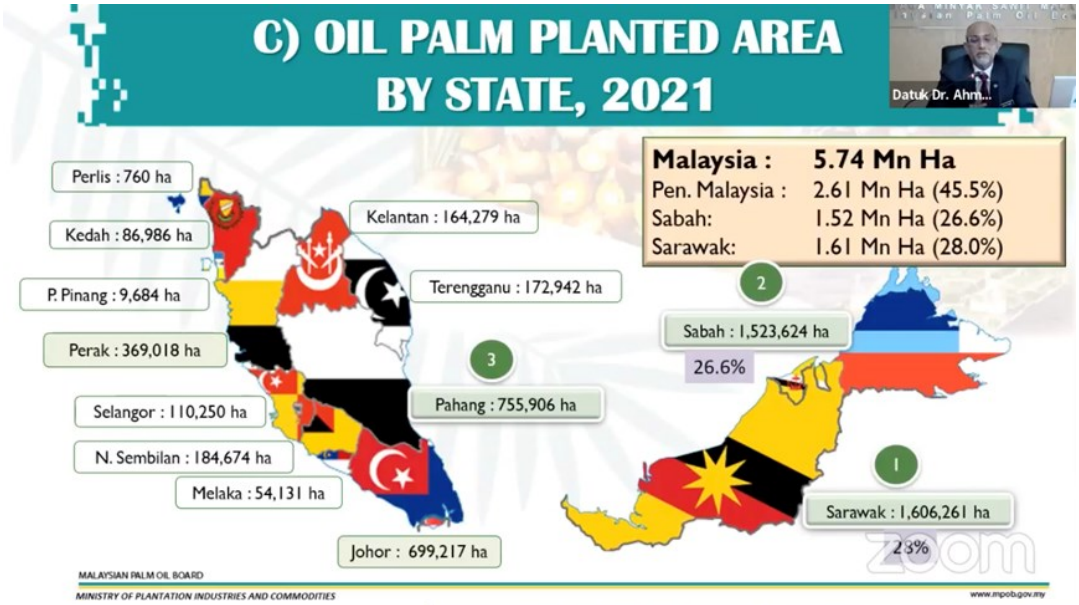



Figure 1 (left): Oil palm planted area by state. (Image adapted from: MPOB, 2022)

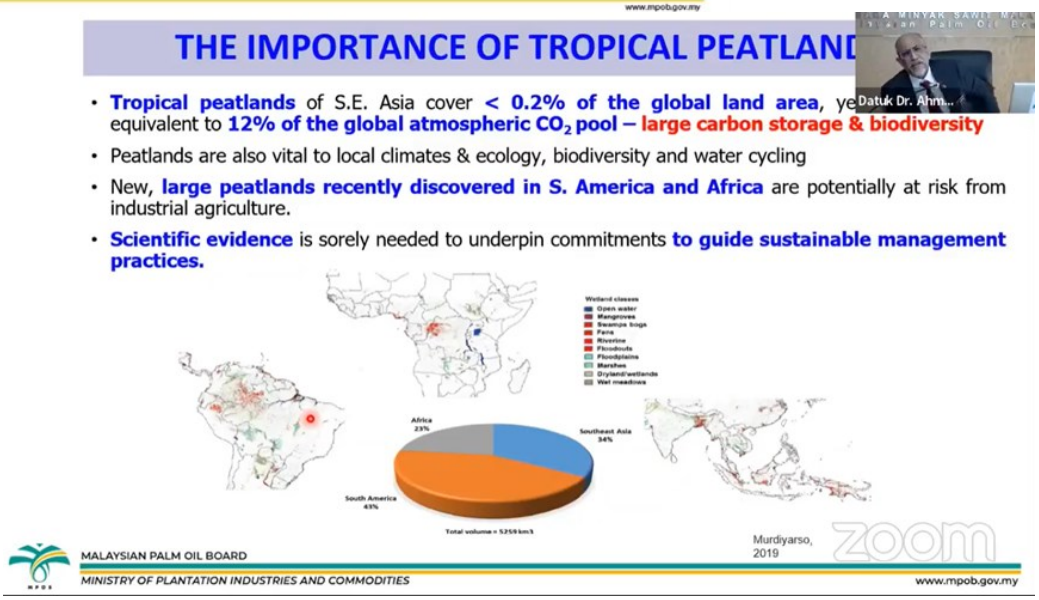



Figure 2 (right): Datuk Parveez presented the importance of tropical peatland. (Image adapted from: MPOB, 2022)

# MPOB Webinar: Management and Leadership

On 13 June 2022, Department of Biological and Agricultural Engineering (DBAE), Faculty of Engineering at UPM organised a webinar titled “Management and Leadership”. The webinar was delivered by MPOB’s Director General YBhg Datuk Dr Ahmad Parveez Hj Ghulam Kadir, who is also the Adjunct Professor at DBAE UPM. The session was chaired by Dr Noorellimia Binti Mat Toridi.

Datuk Parveez presented MPOB’s Experience in Managing and Leading the Oil Palm Industry. There are four basic management functions. He shared that MPOB organisational goals are guided by vision & mission statements for planning. As a leading organisation, MPOB not only just inspires and encourages employees but also its stakeholders to fulfil national objectives. MPOB organises R&D and other important tasks to progress. Control is important to monitor the progress towards goals and taking corrective action.

The root causes of change are mainly change in business environment and outlook of world population. This causes consumers demand a high standard from the oil palm industry. Hence, Malaysian oil palm industry has to constantly adjust practices to protect and grow market share. MPOB leadership would have to embrace the continual change effectively.

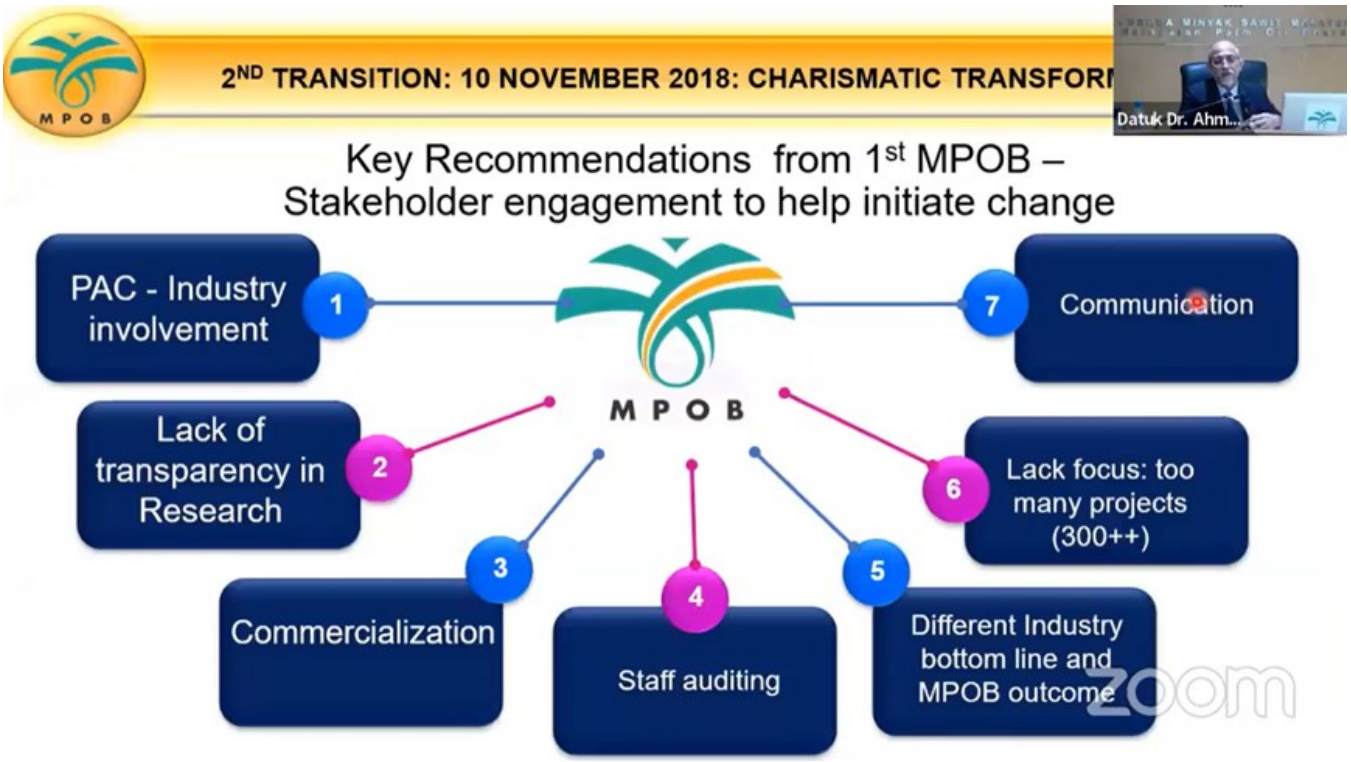



Figure 1: Datuk Parveez presented the charismatic transformation at MPOB. (Image adapted from: MPOB, 2022)

# MPOB Webinar: Mechanisation and Automation in Oil Palm Plantation: Challenges and the Way Forwards

On 21 June 2022, Department of Biological and Agricultural Engineering (DBAE), Faculty of Engineering at UPM organised a webinar titled “Mechanisation and Automation in Oil Palm Plantation: Challenges and the Way Forwards”. The virtual event was co-organised by Smart Farming Technology Research Center. The webinar was delivered by MPOB’s Director General YBhg Datuk Dr Ahmad Parveez Hj Ghulam Kadir, who is also the Adjunct Professor at DBAE UPM.

## 2021 data

Datuk Dr Parveez introduced that palm oil industry is an important driver contributing to the Malaysian economic growth. In 2021, it contributed 3.2% to Malaysia’s GDP. On global ranking in 2021, Malaysia was the 2nd largest palm oil producer, which was equivalent to 25.9% of the total world palm oil production.

In 2021, total planted area was 5.74 Mn Ha (18% area of Malaysia) while mapping continues to determine more plantation. Big plantation accounted for 73%; organised smallholders (example: FELDA, FELCRA, SALCRA, KESEDAR) comprised 12%; and, independent smallholders made up of 15% of the total planted areas.

## Labour shortage crisis

Datuk Dr Parveez highlighted that the first five months of 2022 (January-May) was 0.5% lower as compared to 2021. This reflected that the production was not significantly improved although the world has walked out from the global travel restrictions. On labour shortage, fresh fruit bunch (FFB) harvesters and collectors accounted for 53.0% of the total labour shortage, field workers comprised 34.4%, general workers comprised 9.5%, mandores comprised 2.0% and officer workers comprised 1.1%.

## Short-term solutions

Short-term solution is to attract local participation in oil palm sector. Palm oil training centre (PLASMA) demonstrates the government’s commitment in encouraging local participation in oil palm industry. Local participation has increased by 2.7% in 2021 as compared to 2020.

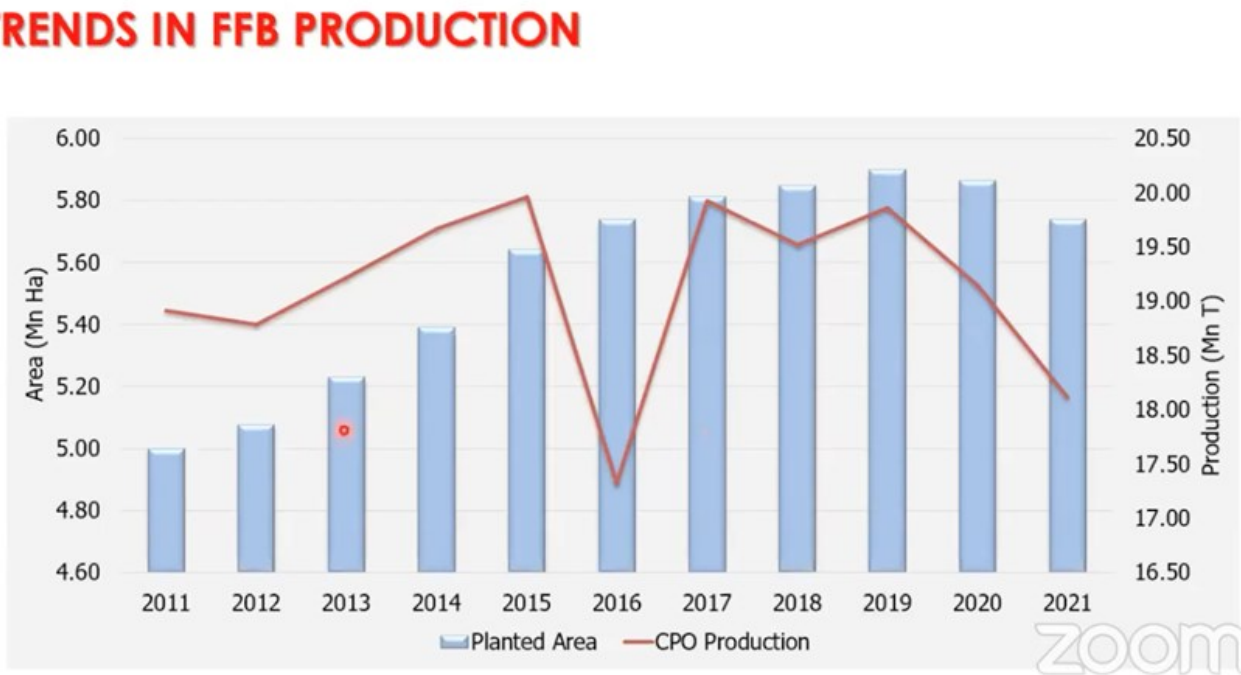



Figure 1: Blue column represents licenced planted areas. As shown on red line graph, production was hit hard by El-Nino in 2016 and the Great Lockdown in 2020-2021. Image adapted from: DBAE (2022).

## Long-term solutions

Mechanisation and automation are developed to provide a sustainable solution to the labour shortage. Datuk Dr Parveez presented the general concept of oil palm mechanisation. It is all about to use technologies to complete tasks. It helps reduce manpower requirement, improve labour productivity, minimise operational costs, enhance sustainability and boost profits.

Motorised cutter has been developed into battery powered Cantas Electro in 2020. It is widely used for the oil palm trees below 8m height. Cantas Electro achieves 30% higher productivity with more than 5 Ha area covered per day, as compared to Cantas Petrol. The harvesting machine is used for harvesting fruits on the trees above 8m height. The drawbacks of utilising harvesting machine are terrain, soil type, efficiency, capital and operational cost. This machine also could not attract the industry to adopt. Hence, laser cutter and robotic arm were suggested as alternatives.

## We need efficient adoptation

Datuk Dr Parveez underlined that MPOB has produced over 50 technologies on mechanisation and automation. Nonetheless, MPOB R&D outcomes are limited to the Technology readiness Level 5: Technology validated in relevant environment. As the implementation and utilisation of advanced technologies currently are not widely adopted and efficiently practised in the industry, it is a national effort on our journey towards a more sustainable development.

## Latest development on MARCOP

The DG presented the strategic target of MARCOP. Within 1 to 3 years, it aims to establish a collaborating unit, consisting of experts to improve the existing mechanical cutter. In the coming 3 and 5 years, the objectives are to combine a wide variety of advanced technologies (image databases, sensor technology and geolocation integration) to improve the harvesting process of FFB. On long term (more than 5 years), the harvesting system should include three processes – covering distance, searching or locating, and harvesting.

## Agriculture Revolution 4.0

In conclusion, Datuk Dr Parveez highlighted that a significant reduction in foreign labour requirement can only achieved by embracing Agriculture Revolution 4.0. Mechanisation development could attract talent to contribute to the oil palm sector, and create more new businesses.

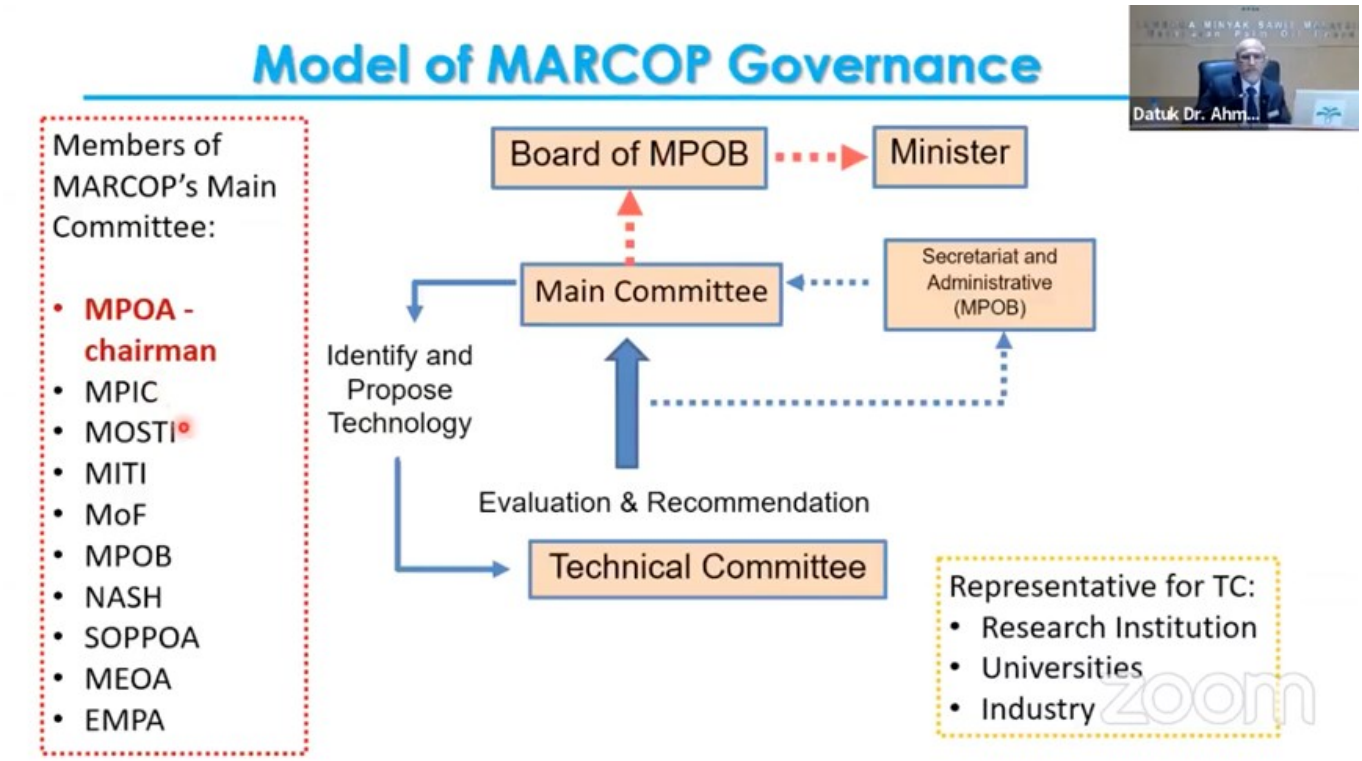



Figure 2: Model of MARCOP governance presented by Datuk Dr Parveez. Image adapted from: DBAE (2022).

# MPOC Webinar: Meeting The Challenge Of Improving Labor Rights In The Malaysian Palm Oil Supply Chain

On 30 June 2022, MPOC organised a webinar titled “Meeting The Challenge Of Improving Labor Rights In The Malaysian Palm Oil Supply Chain”. Deputy CEO of MPOC Belvinder Sron was the moderator of the webinar.

## US on labour issues

Professor Marc Busch is the Professor of International Business Diplomacy at Georgetown University in Washington. Professor Busch shared that US has made the “trade and labour” connection more central in policy. He presented that the implementation of “withhold release orders” (WROs) was rare until recent days. US might rather answer call to block goods made by poorly-treated labour. In his presentation, he underlined that Malaysia, which is ranked by State Department as Tier 3 country, like Afghanistan and North Korea, will therefore be relatively easy to target.

## Proposed EU laws might affect Malaysian palm oil

Hosuk Lee-Makiyama is the Director at European Center for International Political Economy (ECIPE) in Brussels. He presented that the proposed EU Deforestation Regulation would require the importer to submit due diligence documentation including place of production with GPS coordinates annually. The proposed EU Corporate Sustainable Due Diligence would require EU importers and Malaysian exporters in scope to undertake the identification, prevention and mitigation ‘in a dynamic way and at regular intervals’. Malaysian palm oil could be indirectly affected by the proposed EU laws. Hosuk said that better promotion should be done for MSPO and continue positive labour rights reforms and enforcement. He shared that MPOC’s strategy on environmental issues was very successful for the past 10 years, and he suggested to use the same approach for labour issues.

## SUHAKAM suggested to eradicate force labour

Dato’ Mah Weng Kwai is a former Commissioner at Human Rights Commission of Malaysia (SUHAKAM). He shared six key issues on labour: (1) recruitment of migrant workers; (2) abusive working conditions and substandard living conditions; (3) forced labour risks in supply chains; (4) immigration policies, work permits & enforcement practices; (5) access to justice & grievance mechanisms; and (6) right to work for refugees. To eradicate force labour in businesses, one can (1) respect human rights, (2) adopt a responsible business conduct, (3) identify and access the adverse impacts of forced labour risks in supply chains, (4) map out operations and supply chains, and, (5) manage human rights risks by monitoring and auditing.

## MSPO 2022 addressed gaps

Muhammad Haris Abdullah is the Manager in Certification Scheme Unit at Malaysian Palm Oil Certification Council (MPOCC). Haris presented that MS2530:2022 addressed the gaps and strengthens the requirements. On human rights, the standard created a policy on respecting human rights in line with the Federal Constitution, the UN Declaration on Human Rights and the ILO Decent Work Agenda. Child rights has also been included in MS2530:2022 as one of the aspects to be assessed under Social Impact Assessment (SIA).


Figure 1: Belvinder Sron (Deputy CEO of MPOC) chaired the discussion session. (Image adapted from: MPOC, 2022)

# Roadshow: Sustainability-Oriented Symposium (SOS)

*Written by Lee Shuet Yee from Monash University Malaysia*

The Sustainability-Oriented Symposium (SOS) was an event organized by Monash IChemE Student Chapter in collaboration with IEM Monash Student Section (IEMMSS). The hallmark event included talks involving different speakers who will discuss sustainability in the industry, particularly in chemical engineering, besides the role of chemical engineers in ensuring sustainable production. The event aims to provide participants with an insightful perspective on sustainability and sustainable practices in the chemical engineering industry.

The first day of the event held on the 18th of April 2022 started with a talk from Mr. Ahmad Shahdan, Executive at Malaysian Palm Oil Council on sustainable initiatives in industries. He started with a short introduction of Malaysia's palm oil industry, followed by the statistics of oil palm plantations in Malaysia. He has emphasized on the need for the oil palm industry to be optimized while maintaining and preserving the environment. In that effort, scientific evidence-based Good Agricultural Practices (GAPs) in oil palm plantations are implemented. He has also highlighted the biodiversity conservation efforts undertaken by Malaysian Palm Oil Industry (MPOI) which are currently led by the Malaysian Palm Oil Industry Green Conservation Foundation (MPOIGCF). MPOIGCF has executed various initiatives in conserving the environment. He ended his session on the note of introducing the virtual tour developed by MPOI. During the Q&A session, he emphasized that the current challenge in the industry is to increase yield and production especially among smallholders, instead of increasing hectares of plantation. He has also stated that MPOI's conservation efforts will continue to represent and transform the industry to be environmentally aware while generating the economy.

The following speaker was Ir. Dr. Wendy Ng Pei Qin who spoke on biorefinery and palm biomass. She first briefly introduced IChemE and IChemE POPSIG, including their background, past and upcoming events, and the opportunities available for students and researchers such as bursaries. Thereafter, she briefly introduced the basics of the palm oil extraction process, covering the source of palm oil and the palm oil milling process. She has explained that biomass produced from the palm oil mills come in various types and that the palm oil processing industry has evolved to not only produce crude palm oil (CPO), but also produce value-added products, besides contributing to power generation from biogas, generating clear water and producing organic-based fertilizers. One of the highlights of her talk was regarding the use of a biorefinery in palm oil processing as an application of integrating technologies to execute different processes and recover or produce different products. Considering that a huge amount of palm-based biomass is produced, it poses a potential source of energy and value-added products with untapped energy sources. Nonetheless, it requires efficient, economic, and sustainable technology to realize this as a single technology will not be feasible, hence a biorefinery would be a solution to this issue. Moreover, Ir. Wendy has emphasized on the issue of waste reduction, resources sustainability, optimal processing, and energy conservation.

During the second day of the event (19th of April 2022), Ir. Shyam Lakshmanan, the General Manager at IOI Edible Oils, and a chartered chemical engineer, chartered scientist and fellow of IChemE was invited to deliver an industrial talk. Ir. Shyam started off his presentation by a brief introduction to sustainability and global warming, followed by an overview of the IOI Edible Oils and IOI Bio-Energy plants. He has highlighted the sustainable measures implemented in their Sandakan Complex which are managed by the energy management committee (EMC) to reduce carbon footprint through saving diesel, gas, steam, and energy, for which the aforementioned measures included implementation of various sustainable practices and unit processes. The complex has been recognized for its efforts through several awards. Ir. Shyam has also emphasized on the effects of global warming on the bee population which is the world's major pollinator and the impact of a colony collapse disorder. Ir. Shyam concluded his presentation by stating that the increase in population comes with an increase in demand which will bring changes to the environmental landscape, hence young engineers and researchers are encouraged to be involved in the efforts to implement and spread awareness on green processes and sustainability, as it is also a quality which employers seek.

Thereafter, Ir. Qua Kiat Seng, a senior lecturer at Monash University Malaysia and fellow of Monash Industry Palm Oil Education and Research Platform (MIPO) gave a talk on sustainable technologies in palm oil processing. He briefly introduced the Monash-Industry Palm Oil Education and Research Platform (MIPO), followed by giving a brief introduction to technology and systems. He has highlighted the greenhouse gasses (GHG) emissions for major oils and that with the best practices pathway, GHG savings will outweigh GHG emissions, hence producing potential net negative emissions. Nonetheless, there are challenges in the sustainable practices

pathway, GHG savings will outweigh GHG emissions, hence producing potential net negative emissions. Nonetheless, there are challenges in the sustainable practices in palm oil processing mills. Ir. Qua has emphasized that biomass is more valuable due to the minimal carbon tax. He has touched on the fact that oil palm biomass is a significant contributor of renewable energy, however bioenergy projects, particularly biomass, have a history of unfavorable project economics and poor operational and reliability track record in Malaysia. He has also listed examples of the current sustainable downstream applications of green energy in the industry and stated that the palm oil industry is truly a circular bioeconomy. The palm oil mill processing was briefly explained, particularly in oil extraction where it was mentioned that in efforts through several feasible technologies to increase the oil extraction rate, resulting in more revenue, use less land and reduce emissions. Lastly, Ir. Qua spoke on the role of data analytics in implementing such technologies in the industry.

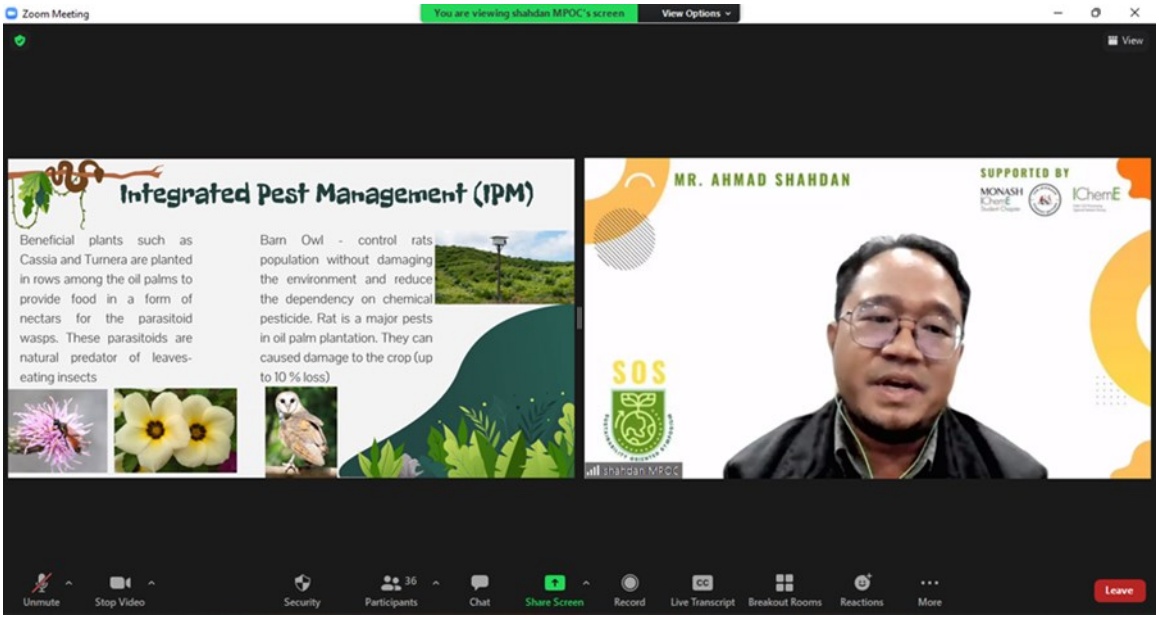



Figure 1: Mr. Ahmad Shahdan's talk on sustainable initiatives in industries

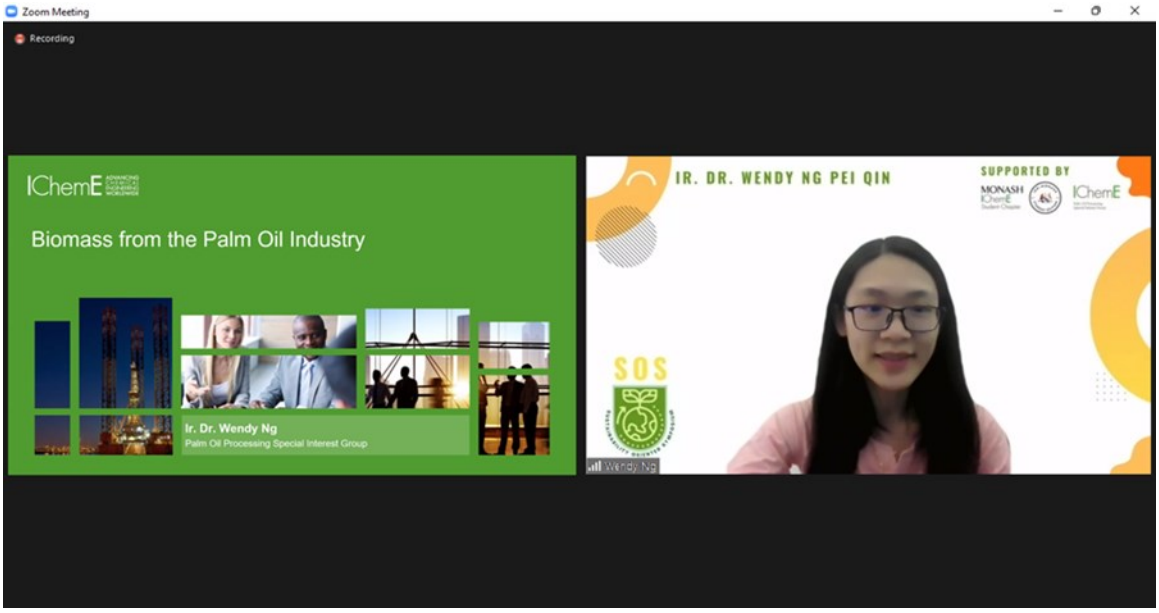



Figure 2: Ir. Wendy's talk on biorefinery and palm biomass

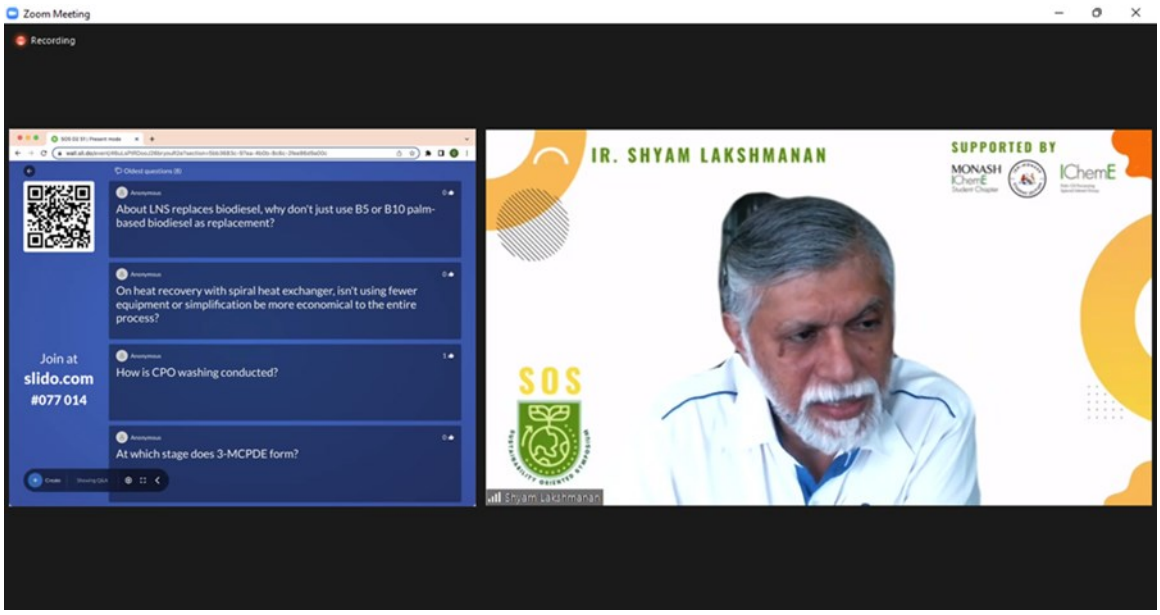



Figure 3: Q&A session with Ir. Shyam after concluding his industrial talk.

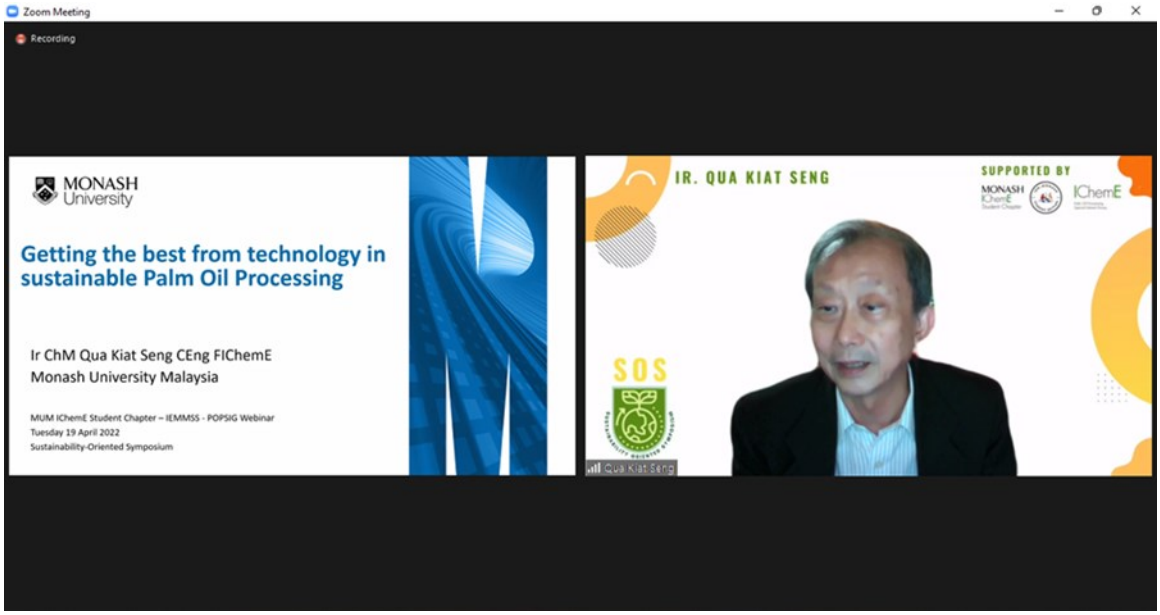



Figure 4: Ir. Qua's talk on sustainable technologies in palm oil processing.

# Roadshow: Virtual Industry Visit to Desmet Ballestra (Malaysia)

*Written by Yumna Humaira binti Hamdi, Tai Sin Ru, and Shekinah Petin*

Virtual Industry Visit is an event in which we had invited three engineering-based companies to give virtual industrial tours to expose students to the real-world working environment and develop knowledge about industrial practices and new technology. Following the discussion, the date of the event was set from April 20th until April 22nd, 2022. With the help of IChemE's Palm Oil Processing Special Interest Group (POPSIG), we were able to invite Desmet Ballestra Sdn Bhd to join our event on 22nd April 2022. During the live event, the event was kicked off at 2.05 pm after waiting for the arrival of participants. Dr Dario Altera, the Manager of the Oleo and Biodiesel center of excellence, was the speaker of the third day of the industrial tour. At 2.10 pm, Dr Dario started his sharing session by explaining about Desmet Ballestra Sdn Bhd, where he mentioned that The Desmet Ballestra group involved in developing, engineering and supplying technologies, processing plants and proprietary equipment, where it can be divided to two type of business areas which are (i) Food & Feed, and (ii) Chemicals For Life. In the sharing session, Dr Dario focused more on chemical properties and physical properties of oils and fats and oleochemicals. He also shared about the palm oil processing which had 3 stages including a palm oil mill, palm oil refinery, where there are physical and chemical refining and oleochemical plant. Next, Dr Dario explained to the participants about the oleochemical processes, the oleochemical market and the advantages of oleochemical. Before the sharing session ends, Dr Dario took the participants to a tour around the 3D process plant where he shared about unit operation involved in the plant and its function.

The Virtual Industry Visit with Desmet Ballestra Sdn Bhd was attended by most participants from UTP as well as from other universities (59 participants in total), and the event was an enormous success thanks to the collaboration of all the organising committees. However, participants were passive during the two-way interaction that took place at the speaker's sharing session. At the Q&A session, the number of questions from attendees was lower than expected. During the feedback session, some of the participants had some thoughts and suggestions about the event. For this sharing session, participants thought it was a fantastic presentation. Nevertheless, they reflected in feedback form that they intended to have more time allocated for the details because the speaker explained the slides in brief due to time constraints. To conclude, the event went off without a hitch, and the objectives of the Virtual Industry Visit with Desmet Ballestra Sdn Bhd were met. Throughout the sharing session, all participants were able to learn and gain insight into industrial processes from Desmet Ballestra Sdn Bhd. Most participants appreciated and enjoyed the Virtual Industry Visit with Desmet Ballestra Sdn Bhd.

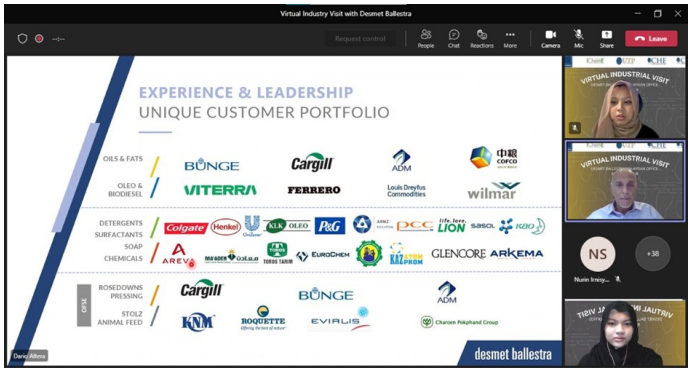



Figure 1: Sharing session with speaker

To summarise, the event was a success because the objectives were met. All of the participants were exposed to a real-world working environment and learned about industrial processes and new technology. Participants had the opportunity to virtually tour the company's facilities and observe the entire product manufacturing process. Most of the participants gave great feedback about this event.

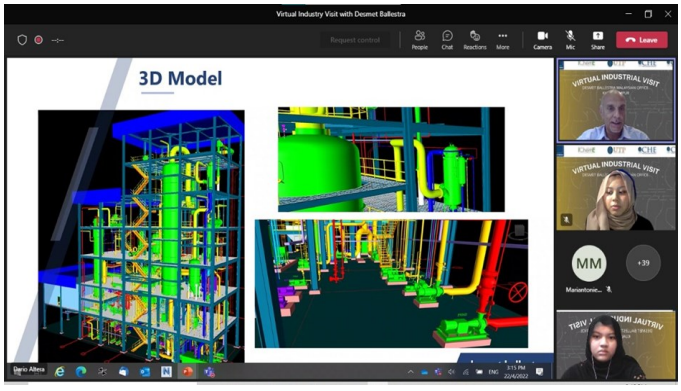



Figure 2: 3D Plant Tour

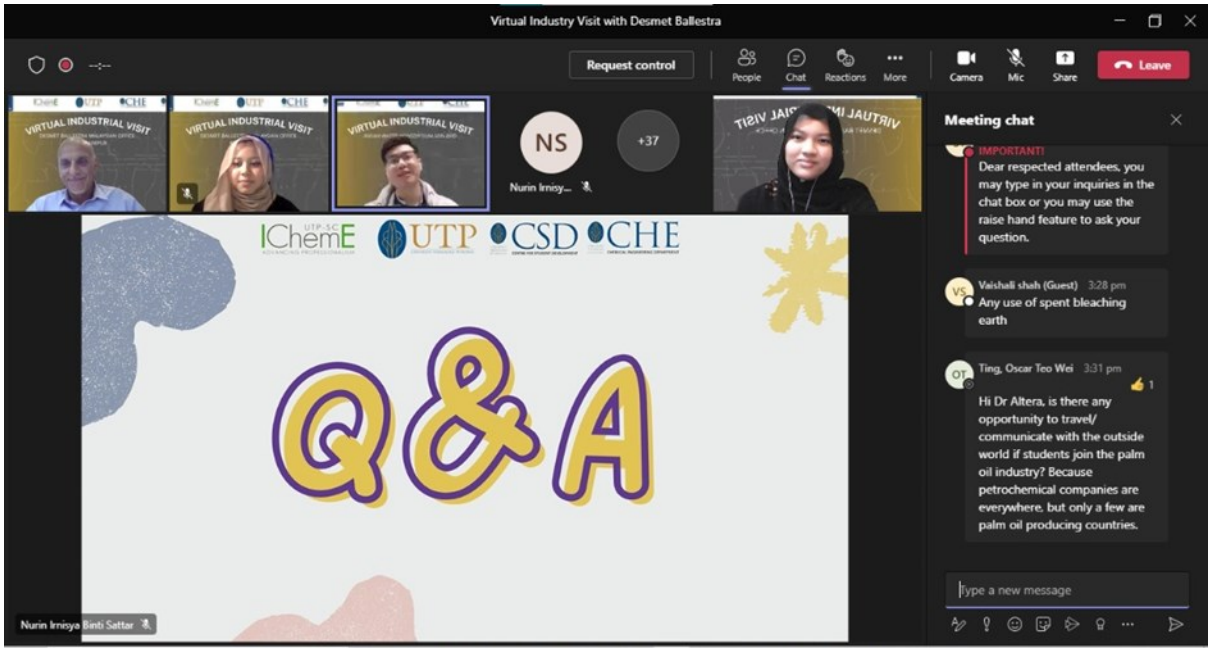



Figure 3: Question and Answer Session with Participants and Speakers

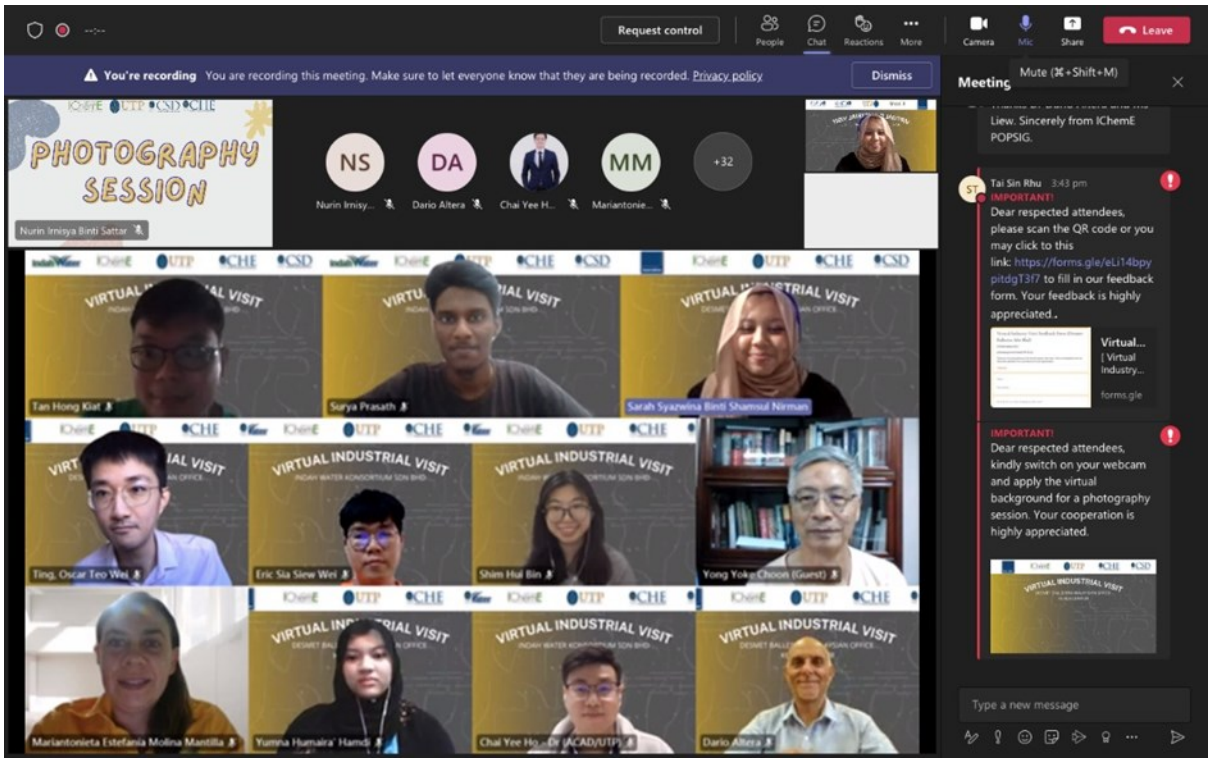



Figure 4: Group photo session.

# Roadshow: A New Perspective on Palm Oil Industries (Universiti Sains Malaysia)

*Written by Tan Kah Huat*

On 20th April 2022, the Chemical Engineering Student Society (ChESS) from Universiti Sains Malaysia (USM) organised a virtual University Roadshow in collaboration with Institution of Chemical Engineers Palm Oil Processing Special Interest Group (IChemE POPSIG) and Malaysian Palm Oil Council (MPOC) using online Webex platform. This event intends to expose students and public to the real world of palm oil industries. Besides, it aims to enhance the perceptions of palm oil industries and create better acceptance on the utilisation in terms of technical and economical awareness, and environmental sustainability. Mr. Michael Ng Foo Yuen from MPOC and ChM. Yung Yen Li from IOI Edible Oils Sdn. Bhd. Sandakan were invited to be the speakers for this university roadshow. A total of 344 participants took part in this roadshow.

Firstly, Mr. Michael started his talk with certification systems and agriculture related to sustainable Malaysian palm oil. Currently, he is the assistant manager for Science, Environment and Sustainability Division in MPOC. It was informed that the global population is expected to increase to 9 billion by year 2050, leading to the increased demand for land usage. Palm oil production, as the world's most consumed vegetable oil, had a total of $20.8bn Global Trade Flow in year 2019. It was found to have adverse impacts on 193 endangered and vulnerable species. Hence, palm oil and sustainability certification emerged in the agricultural sector for the purpose of monitoring and controlling. The main scheme is Roundtable on Sustainable Palm Oil (RSPO), followed by national schemes such as Indonesian Sustainable Palm Oil (ISPO) and Malaysian Sustainable Palm Oil (MSPO).

Mr. Michael continued his talk by introducing MSPO. It was launched in 2015 and mandatory from 2020 onwards. This is to ensure the sustainable production of Malaysian palm oil, offering a market alternative to RSPO. Meanwhile, he also introduced Strengths, Witnesses, Opportunities, and Threats (SWOT) analysis of MS2530:2013. Improvements such as social impacts assessment, and transparency and traceability of full supply chain were done later in 2022 by introducing MSPO version 2 (MS2530:2022). To further enhance sustainable palm oil production in the future, he proposed that government should incentivise the global market landscape with concerted efforts and engagements between stakeholders. This is to understand customers' needs and markets. Before he ended his talk, he showed a virtual reality oil palm plantation tour which give an deep insight to the audiences on real palm oil production.

Next, it was the talk by ChM. Yung Yen Li, a Professional Chemist, and also the Quality Assurance and Quality Control Manager of IOI Edible Oils Sdn. Bhd., Sandakan. She showed to students the overall layout and structure of plants of IOI Edible Oils. Also, she introduced the processes in palm oil refinery to produce new products. In IOI Edible Oils Sdn. Bhd., physical refinery of palm oil consisting of degumming of crude palm oil, bleaching, filtration and deodorization is applied. Operating conditions such as contact time and temperature are vital to maintain the process efficiency. Physical refinery took over chemical refinery as chemical refinery involves acid-base neutralization that is not sustainable.

Dry fractionation, a crucial process in processing palm fruits, was briefed in details to the audiences. It mainly includes membrane press filter and crystallizer with four steps which are Refine, Bleached & Deodorized Palm Oil (RBDPO) from refinery plant, pre-heat RBDPO, crystallization, and filtration. Ash coming out from reactor will be converted into fertilisers for sustainability purpose. Then, there was a video explaining the equipment and processes of palm oil processing through interesting facts and graphics. This was indeed an advantageous industrial exposure to all the audiences, especially for those who have never been in the palm oil industries before. Furthermore, she mentioned that engineers from abundant disciplines are needed in IOI Edible Oils Sdn. Bhd. such as chemical engineers and mechanical engineers.

Before ending the roadshow, a photo session was held to take a group photo of all participants. A short quiz session was also conducted through Kahoot! to reward the attendees that paid full attention during the talks. A total of 13 questions were asked during the quiz while top 5 winners were chosen. Each of the winners was awarded RM50 sponsored by MPOC. Lastly, feedbacks from the audiences were asked and collected for further improvements. Undeniably, participants gained a new perspective on palm oil industries that are beneficial for them.

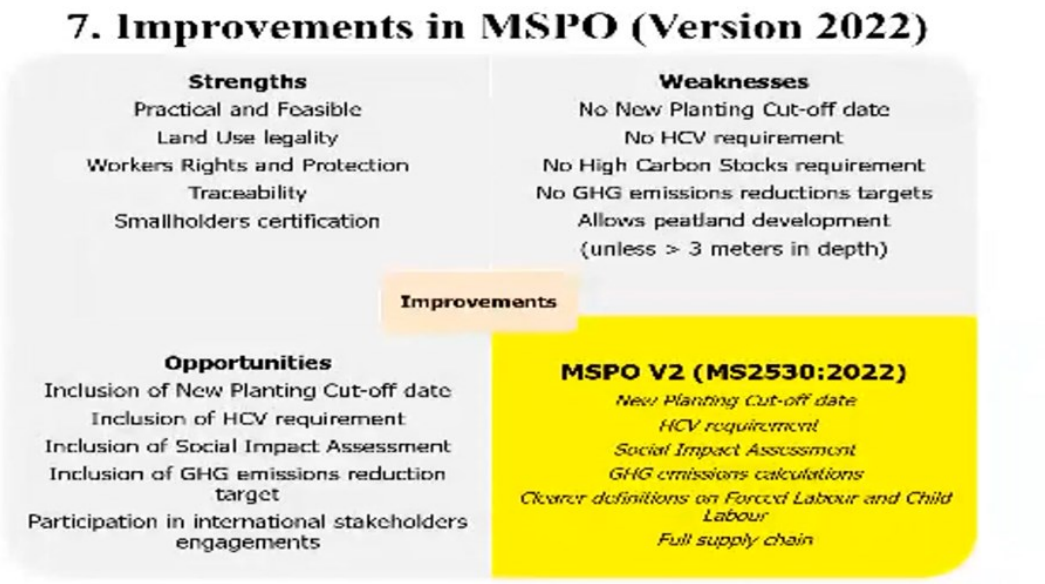



Figure 1: Improvements in Malaysian Sustainable Palm Oil (MSPO) for Version 2022


Figure 2: Overall Layout and Structure of Plants of IOI Edible Oils Sdn. Bhd.

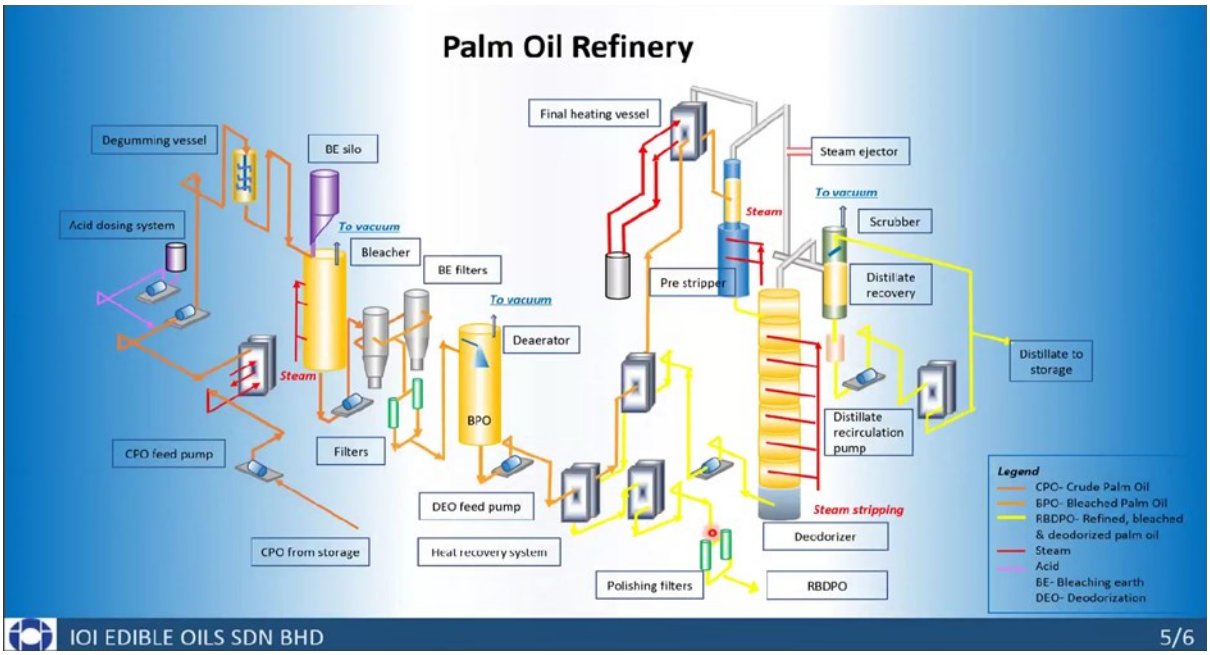



Figure 3: Palm Oil Refinery Process


Figure 4: Group Photo University Roadshow Attendees

# Roadshow: POPSIG Technical University Roadshow 2022 on the Theme 'Responsible Consumption in Palm Oil Industry'

*Written by Kelvin Ong Jee Hui and Lee Sing Yin*

On the 29th June 2022, Swinburne University of Technology Sarawak Campus (SUTS) IChemE Student Chapter hosted the POPSIG Technical University Roadshow in collaboration with Palm Oil Processing Interest Group (POPSIG), IChemE Student Chapter of Curtin University Malaysia (CM), Universiti Malaysia Pahang (UMP), Universiti Teknologi MARA (UiTM) and Taylor's University Lakeside Campus. The theme of this roadshow was entitled, "Responsible Consumption and Production in the Palm Oil Industry". A total of 56 participants from the above universities joined this event via Microsoft Team platform.

The main objective of this event was to expose students to the palm oil industry and palm oil as a whole. The invited speakers which consists of Ms Anna Zulkifli (Executive for Science Environment & Sustainability Division of the Malaysian Palm Oil Council (MPOC)), Dr Peer Mohamed Abdul (Senior Lecturer, Universiti Kebangsaan Malaysia), and Dr Nuruljannah Khairudddin (Industrial Panel, Universiti Putra Malaysia (UPM)) shared their thoughts on the latest palm oil news and their own experiences in the palm oil industry which helped to widen the knowledge of participants in this particular field.

The first speaker was Ms Anna Zulkifli who was an ecologist and currently an Executive attached to Science, Environment and Sustainability Division of Malaysian Palm Oil Council (MPOC). She raised the issue of whether palm oil will be revered by Mother Nature and should the public boycott palm oil to protect the ecosystem. Later, she further clarified that livestock was the biggest contributor to deforestation instead of palm oil and palm oil merely has a small carbon footprint compared to other agricultural products for instance soy products and grains. She then further strengthened her points by showing graphs, statistics and related news. Besides, her talk covered an overview of oil palm plantations in supporting biodiversity protection. Some notable organizations related to the palm oil industry such as MPOC, Malaysian Palm Oil Board (MPOB) and Malaysian Palm Oil Certification Council (MPOCC) as well as their respective principles were also introduced to the participants.

The second speaker, Dr. Peer Mohamed who is a senior lecturer at the department of chemical and process engineering in University Kebangsaan Malaysia (UKM) and also a manager of UKM- Yayasan Sime Darby Chair of sustainability had brought up an interesting talk that relates to the sustainability of the palm oil industry. He further clarified how the network introduced by Academic Research on Palm Oil Sustainability (ARPOS), a non-governmental organisation (NGO), has a significant impact on the improvement of the sustainability of the palm oil industry in Malaysia. He then strengthened his talk by explaining the United Nation - Sustainable Development Goals (UN-SDG) 12 which represents the theme of Responsible, Consumption and Production that can help to improve the sustainability of palm oil industry by minimizing the negative impact. "Doing more and better with less" was the conclusion of his subtopic, and he also explained some ways to achieve the UN-SDG 12. Furthermore, he provides an overview of the Green Technology for Sustainable Development Goals (SDG) by recommending some improvements to palm oil-related products, equipment, or systems. Some industrial treatments to treat the Palm Oil Mill Effluent (POME) were explained by Dr Peer Mohamed as well before he concluded his talk.

The last speaker, Dr. Nuruljannah Khairuddin who is an industrial panel from UPM and has worked in the Green Lagoon Technology Sdn Bhd for 2.5 years as an R&D engineer. She had shared her thoughts on the waste minimization, waste to profit, pollution control and treatment technology based on her experience. Brief explanations were conducted by Dr. Nuruljannah Khairuddin on the treatment technology. Also, pros and cons of the system were discussed as well to promote the sustainability of the palm oil industry.

After the sharing session, the event proceeds with the group photo session as shown below in Figure 1. Towards the end of the event, the challenging Kahoot competition was held. About 30 participants have actively participated in this competition and the top 10 students who make the cut will be awarded cash prizes sponsored by MPOC

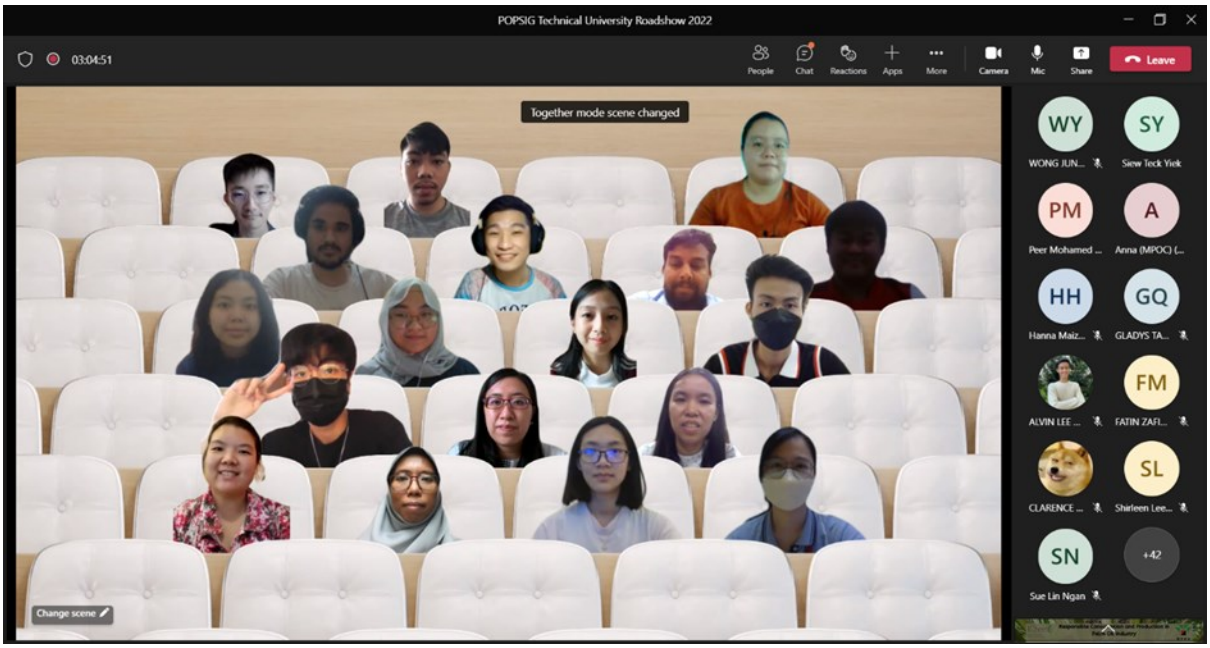



Figure 1 : Group photo of all the participants with the invited speakers and organisers.

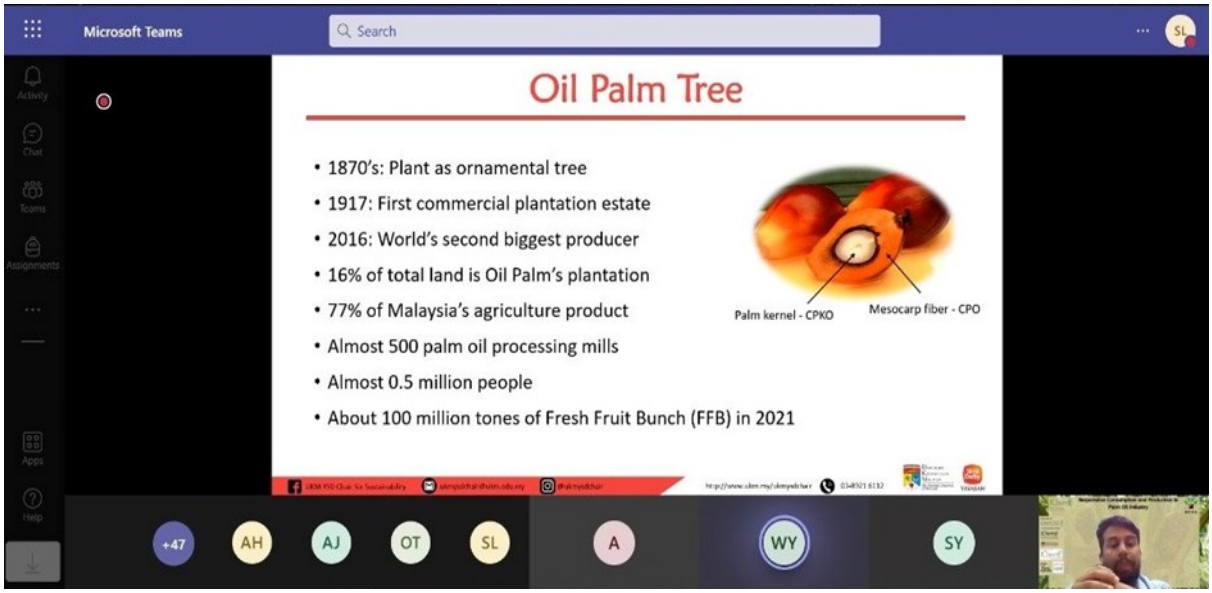



Figure 2: : : Dr Peer Mohamed Abdul delivered a sharing session on the oil palm tree history.

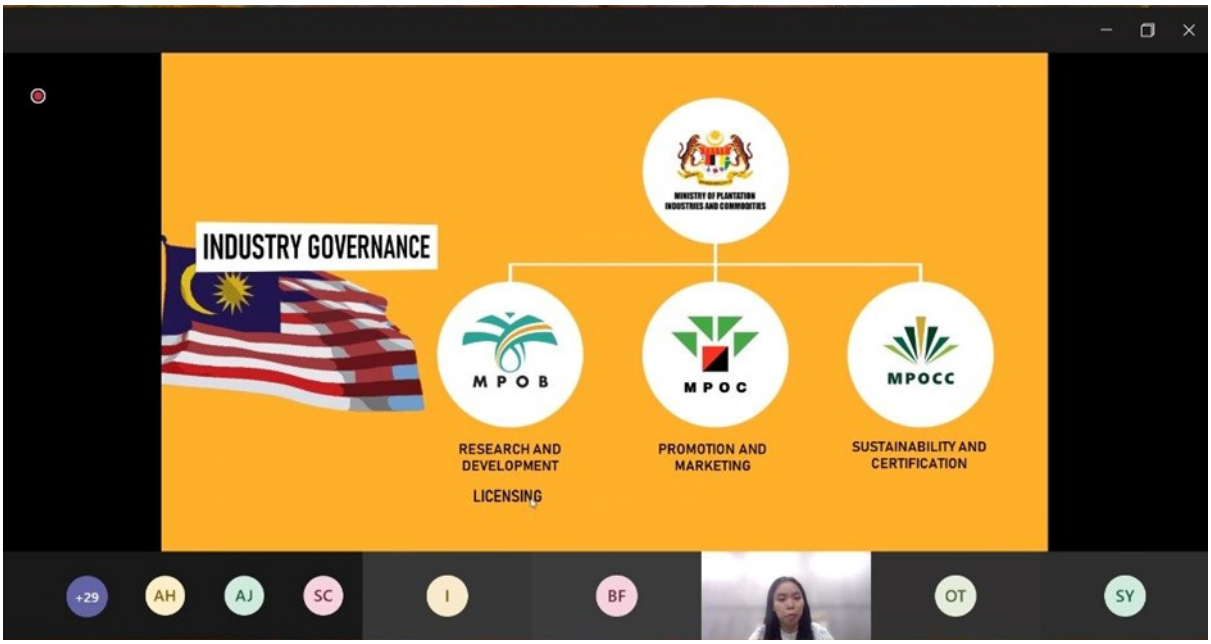



Figure 3: Ms Anna Zulklifi presented on the industry governance involved in the palm oil industry to the audiences.

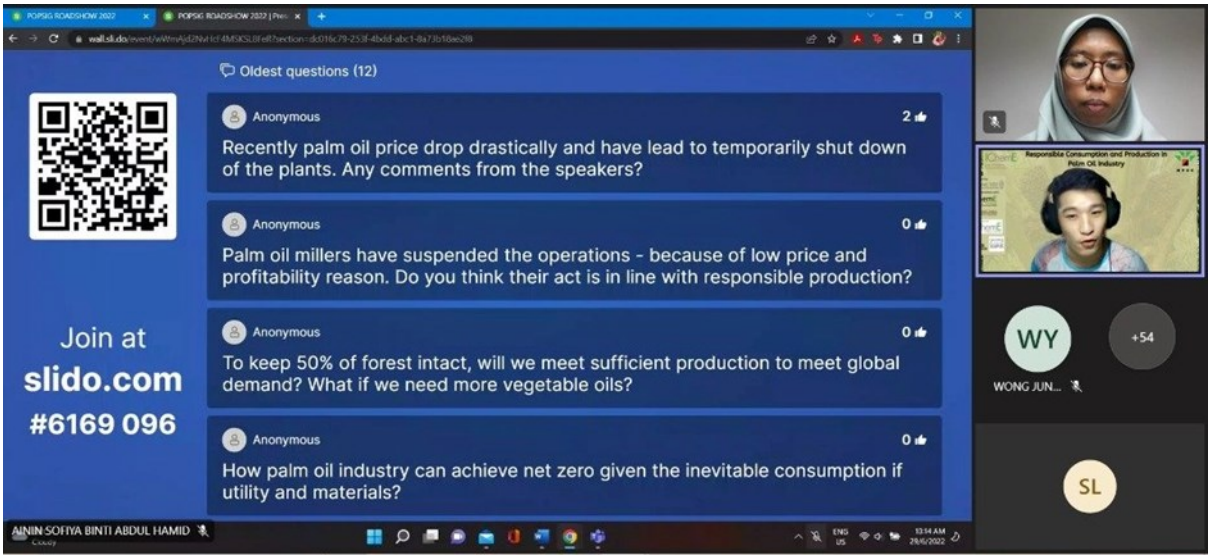



Figure 4::Question and Answer session between the speakers and participants using Slido application.

# Article: Upgrading Hydrogen Production from Waste Palm Cooking Oil (WPCO) - Preparing Malaysia Towards Hydrogen Economy

*Written by Amanda Yap Yi Tong and Gladys Calvina Timothy*

Among other things, cooking oils are one of the essential ingredients used in food preparation in our country. Since Malaysia is one of the largest producers of palm oil, it is not a surprise that most of the cooking oils used across the country are made up of palm oil due to their affordability and ease of accessibility. However, over the past decades, it has been observed that over hundreds of thousands of tons of waste cooking oils (WCO) that were generated in households and various industries, were discarded into the environment without proper treatment beforehand. This raises questions about the degradation that it caused to the environment over the years and whether efforts had been taken or planned to tackle this issue.

Every year, approximately 29 million tons of WCO are produced worldwide from various sources [1]. This has caused tremendous effects on the environment as WCO discharge into waterways alters the oxygenation process and kills aquatic life by producing a layer that covers the water surface and hinders oxygen dissolution. As a result, aquatic life absorbed harmful substances from contaminated water and eventually returned to humans via the food chain. Furthermore, WCO will create sewer backups and overflows into the surrounding environment, which may result in possible environmental health problems and additional expenditures for clean-up activities. In 2016, Malaysia's Klang Municipal Council spent about RM6 million to clear clogged drains caused by solidified cooking oil [2]. Instead of being dumped into the environment, waste palm cooking oils (WPCO) in particular, possess a great potential to be utilized to generate renewable energy such as hydrogen (H2). If done correctly, we can significantly reduce pollution by producing H2 from WPCO, which is in accordance with SDG 12 (Responsible Consumption & Production) and SDG 7 (Affordable & Clean Energy). Increasing energy demand, along with the depletion of fossil fuel supplies has rekindled the interest in utilizing H2 as a clean fuel [1]. Moreover, H2 has been offered as a viable energy source due to its availability, purity, and high energy output. By taking their commercial potential and economic factors into consideration, renewable H2 generation systems could contribute to the sustainability of the environment in a long run, apart from securing the energy demand for future generations.

Chemical looping reforming (CLR) appears to be a feasible and ecologically process for producing H2 from WPCO. Based on multiple research, the CLR system to be used is proposed to consist of two main reactors, namely an air reactor (AR) and a fuel reactor (FR) [1]. In general, WPCO will be converted to H2, H2O and CO2 with the help of an Oxygen Carrier (OC), which essentially is a catalyst in the form of metal oxide. Meanwhile, air will be supplied into the AR to oxidize the 'spent' OC (in the form of metal) to be reused in the fuel reactor. One of the major advantages of this technique is contributed by the use of OC and air as opposed to using pure O2 as it produces a more adaptable fuel, which is H2 with high purity at a lower cost [1]. To ensure that the CLR system is operating at its maximum potential, the selection of OC to be used is a crucial step as it is one of the main drivers of the overall process. For instance, a potential OC must be cost and environmentally friendly with high reduction and oxidation rates (contributes to a higher yield of H2 per kg WPCO) as well as to have a low tendency of agglomeration for it to be used in a longer period of time [3]. With the help of carbon capture technology, the CO2 produced from the process can be captured efficiently and consequently reduces the net CO2 emission unlike other techniques of producing H2 such as steam reforming and partial oxidation.

Despite the attractive alternative to utilize WPCO for hydrogen production via CLR, it is undeniable that the development of hydrogen initiatives is rather snail-paced in Malaysia due to the heavy reliance on fossil fuels as our energy source. Furthermore, since WPCO is typically used to produce biogas, the research and technologies developed in Malaysia with regards to hydrogen production from WPCO are also limited. Most of the technologies developed to make use of hydrogen gas as a fuel source mainly focus on hydrogen production via electrolysis as what had been done in Sarawak recently. Through the initiatives done by Sarawak Energy Berhad (SEB) in collaboration with Linde in 2019, an integrated hydrogen production plant and refueling station have been commissioned in Kuching to produce green hydrogen through electrolysis [4]. Nevertheless, it could take a while for this technology to be fully integrated across the country due to the limited renewable hydropower potential in some places in Malaysia. By utilizing the abundant WPCO as the fuel to produce H2, we could slowly introduce this technology as a familiarization stage for H2 economy in our country.

Moving forward, upscaling the H2 production from WPCO will be a challenging task as it requires joint efforts from national authorities along with players from different business sectors such as multinational oil and gas companies, service providers, educational institutions, etc. Apart from providing more funds for research and development works, more attention and efforts are also required to devise commercialization strategies to promote the use of clean H2 in the industries. Since the technology discussed in this article is fairly unusual in our country, proper planning needs to be done for its integration across various industries in Malaysia to be efficacious in combatting the global warming issue in a long run.

**References**

[1] N. Faleh, N. Hajjaji, and M.-N. Pons, “Thermodynamic investigation of waste cooking oil based hydrogen generation system with chemical looping process,” South African Journal of Chemical Engineering, vol. 21, pp. 18–27, Jul. 2016, doi: 10.1016/j.sajce.2016.04.001.

[2] P. N. Z. Megat, “How to dispose of used cooking oil: The Sustainable Way,” Malaysian Palm Oil Council (MPOC). https://mpoc.org.my/how-to-dispose-of-used-cooking-oil-the-sustainable-way/

[3] M. A. Pans, P. Gayán, A. Abad, F. García-Labiano, L. F. de Diego, and J. Adánez, “Use of chemically and physically mixed iron and nickel oxides as oxygen carriers for gas combustion in a CLC process,” Fuel Processing Technology, vol. 115, pp. 152–163, Nov. 2013, doi: 10.1016/j.fuproc.2013.05.013.

[4] “Sarawak Energy - Power To Grow,” Sarawak Energy, Oct. 27, 2020. https://www.sarawakenergy.com/media-info/media-releases/2020/progressing-towards-a-green-hydrogen-economy-sharing-sarawak-energys-hydrogen-development-at-igem-2020

# Upscaling Hydrogen Production from Waste Palm Cooking Oil (WPCO) – Preparing Malaysia Towards Hydrogen Economy

Prepared by Amanda Yap Yi Tong & Gladys Calvina Timothy

## Moving towards Hydrogen Economy

Hydrogen energy is expected to become the choice of the future energy systems as it has the potential to sustainably meet the growing global energy requirements.

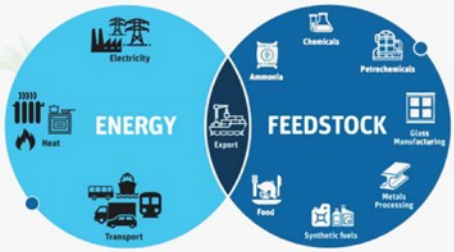



Figure 1: Potential Use of Hydrogen

## Commercial Potential

The market value of hydrogen is expected to be 300 billion U.S Dollar in 2027.

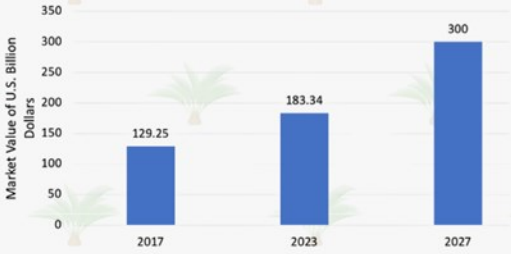



Figure 2: Market Value of Hydrogen Worldwide

## Proposed Mechanism of Hydrogen Production from WPCO via Chemical Looping Reforming (CLR)

| | Typical Range | Optimum |
|---|---|---|
| Temperature | 400 – 1000 °C | 600 °C |
| Pressure | - | 1 atm |
| Steam to Carbon ratio, S/C | 1 - 14 | 5 |
| Nickel Oxide to Carbon ratio, NiO/C | 0 - 2 | 0.493 |

Table 1: Proposed Operating Conditions

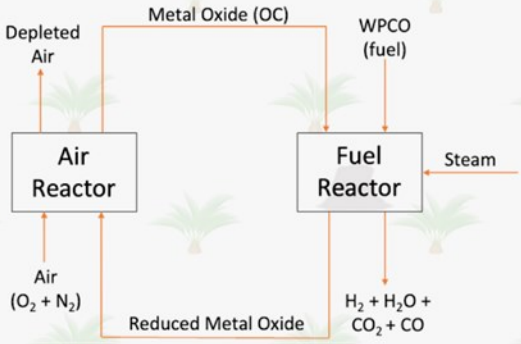



Figure 3: Proposed Process Flow for CLR System

## Economical factors

By using chemical looping reforming to produce hydrogen, it will result in the least environmental impact and relatively low total capital costs with and without the carbon capture, which makes it an attractive option to upscale the hydrogen production from waste palm cooking oil (WPCO).

| Chemical Looping Reforming (CLR) | Steam reforming | Partial oxidation |
|---|---|---|
| Higher purity with lower production cost | Complex operational system with higher cost | Higher cost is needed for $O_2$ plant |
| 100% $CO_2$ can be captured during the process | Requires external igniter to start up | Lower energy efficiency |
| Air may be used instead of pure $O_2$ | Higher potential of carbonaceous material formation | Limitation in the synthesis gas yield from the direct oxidation |

Table 2: Comparison of CLR vs. other Hydrogen Production Techniques


| Technology | Total capital costs (with carbon capture) in U.S million dollars | Total capital costs (without carbon capture) in U.S million dollars | Environmental Impact |
|---|---|---|---|
| Steam Methane Reforming | 831 | 241 | 10 kg $CO_2$ /kg $H_2$ |
| Autothermal Reforming | 628 | 326 | 9 kg $CO_2$ /kg $H_2$ |
| Syngas Chemical Looping | 885 | 813 | 13 kg $CO_2$ /kg $H_2$ |
| Chemical Looping Reforming | 638 | 570 | 8.6 kg $CO_2$ /kg $H_2$ |

Table 3: Total Capital Costs & Environmental Impact of Various Hydrogen Production Technologies

**References:**
1.Bruce, S. (2018). How hydrogen power can help us cut emissions, boost exports, and even drive further between refills.
2.N. Sönnichsen. (2021). Global market value of hydrogen 2023. Statista. Retrieved 19 May 2021.
3. Global Market Insights, I. (2021). Hydrogen Market value to hit $300 billion by 2027, Says Global Market Insights Inc.
4. Ayodele, F., Mustapa, S., Ayodele, B., & Mohammad, N. (2020). An Overview of Economic Analysis and Environmental Impacts of Natural Gas Conversion Technologies. Sustainability, 12(23), 10148.

# Article: Achieving Circular Economy through Sustainable Production of Palm Oil

*Written by Tan Kah Huat*

Palm oil is an edible vegetable oil originating from the fruit of oil palm trees with the scientific name - Elaeis guineensis. As an exceptionally versatile oil that owns various chemical properties, palm oil is widely used everywhere [1]. According to data found from Statista, from term 2015/2016 to 2021/2022, palm oil usage has been increased gradually from around 59 million to over 73 million metric tons [2]. From economy aspect, palm oil has pulled millions of people out of poverty in Indonesia and Malaysia which account for around 85% of global production. In year 2016, palm oil provided 32% of production by using only 7% of lands worldwide [3]. Malaysia, the world's leading producer and exporter of palm oil, despite producing 15 million tonnes of palm oil in 2005, oil palm plantations covered only 4 million hectares (10%) of the country's total geographical area [4As According to Matin Qaim, an agricultural economist, oil palm yields three times the amount of oil per acre as soybean, or sunflower. Alternative vegetable oils would necessitate significantly more spaces for production, resulting in further loss of forests and other natural habitats [5].

Nevertheless, there is a misperception saying that palm oil cannot achieve circular economy. Circular economy is a regenerative system in which resource consumption and waste creation, as well as emissions and energy waste, are reduced by slowing, reducing, and closing the material and energy cycles. During production of palm oil, secondary products such as palm oil mill effluent (POME), decanter cake, empty fruit brunches (EFB), and oil palm fibres and shells are generated massively [6]. For every ton of crude palm oil produced, 9 tons of biomass are created [7]. As from the study, 8.3 tonnes of biomass are accumulated by oil palm plantation per year, which is higher than rainforest that produces 2.5 tonnes per year [4]. Numerous advanced technologies have been created, applied, and commercialized to convert these wastes into useful products. Further treatment, recycling, and reuse of wastes are carried out to generate power for the factory's continuous operation and lower down materials usage. As a fertiliser, it could also amplify yield and lessen production costs [7].

Palm Oil Mill Effluent (POME), being the most significant source of pollution from palm oil mills, possesses an oxygen depletion potential which is 100 times that of home sewage. During the palm oil production, 0.77- 0.84 m3 of POME per ton of fresh fruit brunches (FFB) are produced. If it remains unprocessed, it will have Chemical Oxyen Demand (COD) values ranging from 43,375 to 60,400 mg/l which is harmful to environment[8]. For complete utilization of POME, it can be treated to produce fertilisers. It consists of great amount of plant nutrient which raises it potentials for the conversion. The data appears to suggest that it reduces the fertiliser costs utterly and increases the productivity of plantation simultaneously by producing valuable products. Additionally, to promote the conversion efficiency, native microorganisms or microbial consortia could be used as they are vital in biogeochemical cycles of carbon and nitrogen, allowing the ecosystem to recycle these substances into a usable form for living organisms [9]. Meanwhile, EFB and POME could be composited to ease nutrients loss by concentrating all of the nutrients. In the co-composting of POME and EFB, POME keeps the moisture of EFB at around 60% to maintain its efficiency. It is also found to boost the land productivity for FFB production of oil palm [8].

Meanwhile, POME and EFB could be used to produce biohydrogen for biogas generation in fuel cells. According to reports, the energy released by H2 is 2.75 times that of traditional fossil fuels. It does have substantial potential in sustainable renewable energy and biorefinery fields as it could meet the demands of increasing world population without releasing hazardous substances and wastes. However, purification of biohydrogen needs to be done because impurities such as carbon monoxide (CO) and hydrogen sulphide (H2S) may affect the catalyst functionality by blocking its active sites in polymer electrolyte membrane fuel cell (PEMFC). By using adsorption-desorption technology with activated carbon, more than 90% purity of H2 can be achieved. For further treatment, EFB also needs to be lowered in size, undergone physical-chemical destruction, and hydrolysed enzymatically beforehand. Two-stage anaerobic sequencing batch reactors (ASBR) is applied and it is capable to reach 1.67±0.02 L-H2/L-POME of biohydrogen production which is a quite attractive technology [9].

To further adapt circular economy, by applying integrated membrane filtration system, wastewater could be treated to be used as boiler feed water, enabling recycling and reusing of water for sustainability. The system primarily consists of a sand filter, a crossflow membrane module, and an activated carbon pre-treatment unit to process the partly-treated POME. For continuous delivery to the manufacturing line, a palm oil

requires an enormous volume of steam from high-quality water. From the experiments done, the treated water is proved to be functional in sustaining operation efficiency. Thus, amount of wastewater discharged and total water consumption could be diminished concomitantly to align with the principles of Roundtable on Sustainable Palm Oil (RSPO) [9].

During calcination of oil palm fibres and shells in heating zone of a steam boiler, palm oil clinker (POC) is generated as a waste by-product. Due to the presence of alumina-siliceous compounds in POC, it is a pozzolanic aggregate that can adhere properly to a geopolymer matrix in the right way. It is usually disposed in landfills as it is only apt to generate little economic benefits. Other than causing soil pollution and degradation, it can also contaminate ground water. In addition, continuous disposing may cause wastes accumulation, bringing adverse effects to the environment such as using of fertile land for wastes collection. As POC can create strong bond in geopolymer matrix, by combining with Fly-ash based geopolymer binder, a concrete with significant workability and strength could be assembled. It will also possess distinguished resistance to water absorption and compressive strength of larger than 30MPa with density of 1821 kg/m3. If ordinary Portland cement (OPC) is used, 32% reduction in strength is experienced. Moreover, splitting tensile strength is also elevated with satisfied Ultrasonic Pulse Velocity (UPV) values [10].

In conclusion, palm oil biomass possess notable potential to contribute to circular economy. By utilising POME, EFB, wastewater, and POC appropriately, sustainability aim could be achieved for environment and community's wellbeing. Therefore, government should implement proper regulations with assistances from all other bodies to develop a successful and sustainable circular economy.

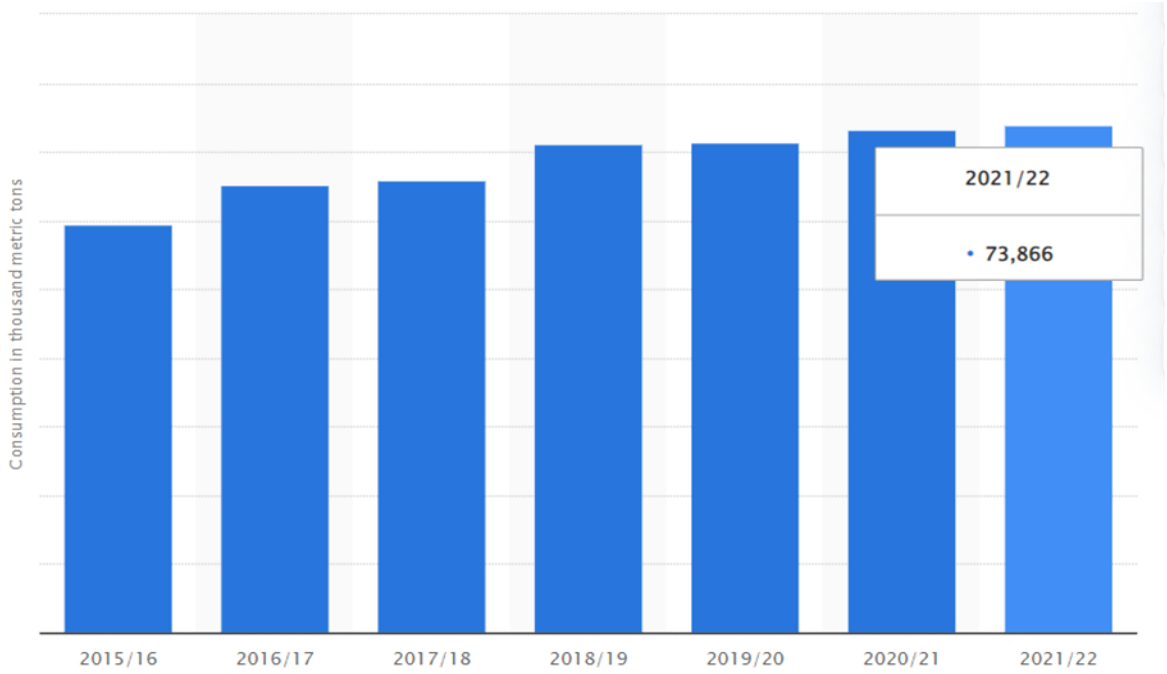



Figure 1: : Palm Oil Consumption Worldwide from Term 2015/2016 to 2021/2022 [2]

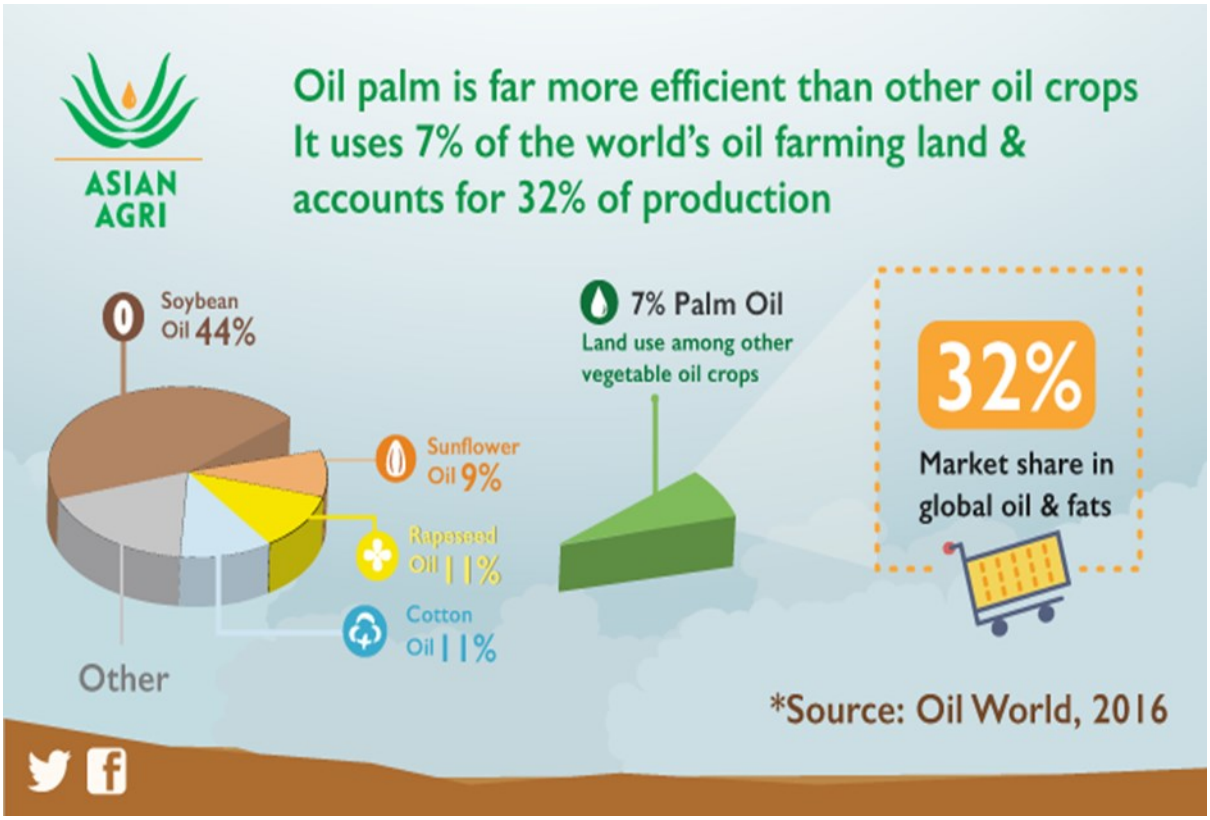



Figure 2 : Efficiency of Palm Oil Plantation [3]

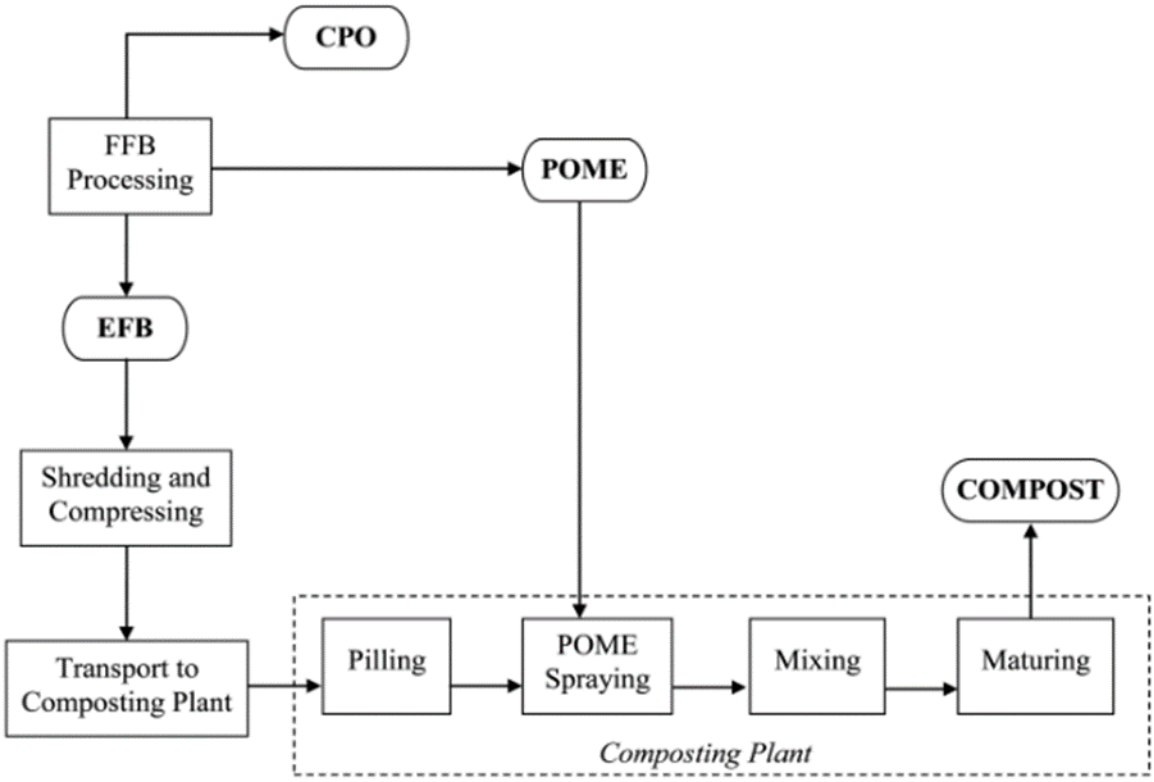



Figure 3: Co-composting of EFB and POME [8]

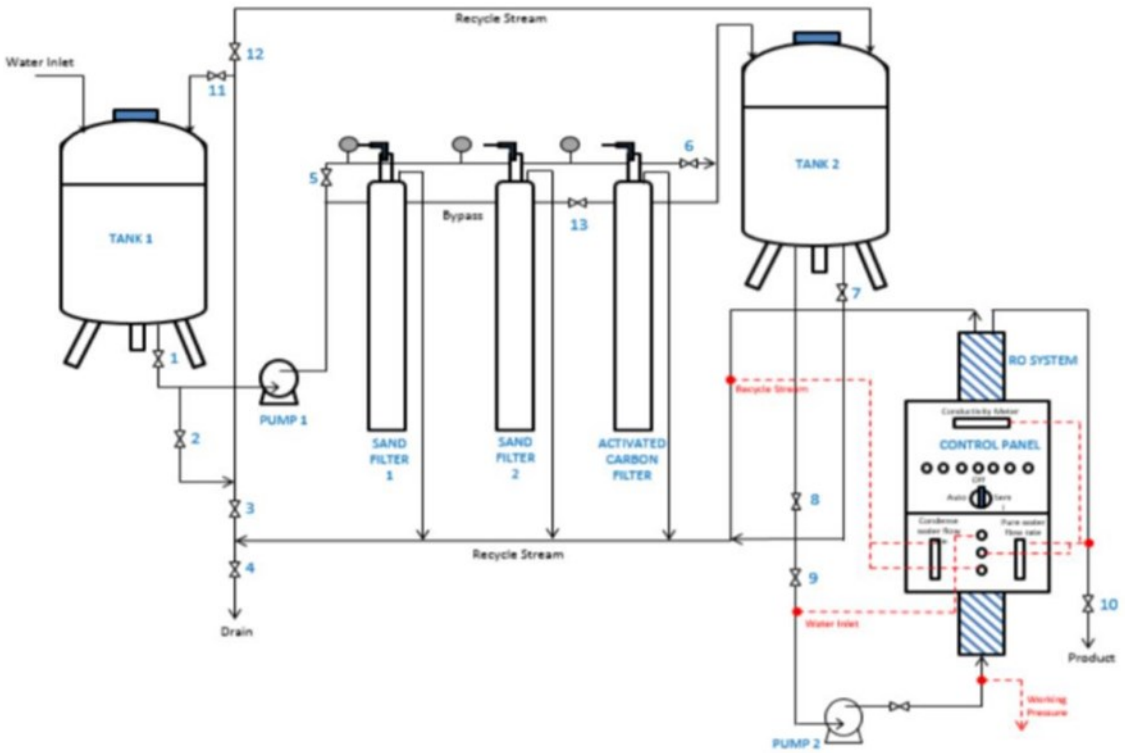



Figure 4: Integrated Membrane Filtration System for Recycling and Reuse of Water [9]

**References**

WWF. (n.d.). 8 Things to Know About Palm Oil. Available at: https://www.wwf.org.uk/updates/8-things-know-about-palm-oil (Accessed 23 May 2022)

Statista. (2022). Palm oil consumption worldwide from 2015/2016 to 2021/2022. Available at: https://www.statista.com/statistics/274127/world-palm-oil-usage-distribution/ (Accessed 23 May 2022)

Asian Agri. (n.d.). The Benefits of Palm Oil. Available at: https://www.asianagri.com/page/media-publications/articles/the-benefits-of-palm-oil/ (Accessed 23 May 2022)

K.T. Tan, K.T. Lee, A.R. Mohamed, S. Bhatia. Palm oil: Addressing issues and towards sustainable development. Renewable and Sustainable Energy Reviews, Volume 13, Issue 2, Pages 420-427, ISSN 1364-0321, Available at: https://doi.org/10.1016/j.rser.2007.10.001 (Accessed 23 May 2022)

Institute of Food Technologists (IFT). (2020). Economic, environmental impact of palm oil. Available at: https://www.ift.org/news-and-publications/news/2020/may/20/economic-and-environmental-impact-of-palm-oil (Accessed 24 May 2022)

Global Oil & Fats Business Online – Gofbonline.Com. (2019). Palm Oil and the Circular Economy. Issue 1 - 2019, Technology. Available at: https://gofbonline.com/4378-2/ (Accessed 24 May 2022)

Darkwah, D. O. & Ong-Abdullah, M. (2021). Sustainability of the Oil Palm Industry. In (Ed.), Elaeis guineensis. IntechOpen. Available at: https://doi.org/10.5772/intechopen.100156 (Accessed 24 May 2022)

Hasanudin, U., Sugiharto, R., Haryanto, A., Setiadi, T., & Fujie, K. (2015). Palm oil mill effluent treatment and utilization to ensure the sustainability of palm oil industries. Water Science and Technology, 72(7), 1089–1095. Available at: https://doi.org/10.2166/wst.2015.311 (Accessed 28 May 2022)

Teow Yeit Haan, Mohd Sobri Takriff. (2021). Zero Waste Technologies for Sustainable Development in Palm Oil Mills. Journal of Oil Palm, Environment & Health 2021, 12:55-68. Available at: https://doi.org/10.5366/jope.2021.04 (Accessed 28 May 2022)

Hasanudin, U., Sugiharto, R., Haryanto, A., Setiadi, T., & Fujie, K. (2015). Palm oil mill effluent treatment and utilization to ensure the sustainability of palm oil industries. Water Science and Technology, 72(7), 1089–1095. Available at: https://doi.org/10.2166/wst.2015.311 (Accessed 28 May 2022)

Teow Yeit Haan, Mohd Sobri Takriff. (2021). Zero Waste Technologies for Sustainable Development in Palm Oil Mills. Journal of Oil Palm, Environment & Health 2021, 12:55-68. Available at: https://doi.org/10.5366/jope.2021.04 (Accessed 28 May 2022)

Hussaini Jagaba, A., Rahman Mohamed Kutty, S., Hayder Ahmed Salih, G., Noor, A., Fakhuma Ubaidillah Bin Md Hafiz, M., Shehu Aliyu Yaro, N., Ameen Hezam Saeed, A., Mohammed Lawal, I., Haruna Birniwa, A., & Usman Kilaco, A. (2022). Palm Oil Clinker as a Waste by-Product: Utilization and Circular Economy Potential. Elaeis Guineensis. Available at: https://doi.org/10.5772/intechopen.97312 (Accessed 29 May 2022)

# Article: A Sustainable Renewable Energy Source: Biodiesel

*Written by Yat Yu Dong, Alicia Tan Xin, and Thian Sei Gee*

The primitive way of extracting the vegetable oil using the blending technique is unable to resolve the issues such as viscosity value, free fatty acids (FFA) composition, acid content and gum formation of the oil (Ma and Hanna 1999). In recent progress, the fourth-generation biodiesel has implied the transformation of solar energy into fuel with the use of photosynthetic microorganisms that have been modified under biotechnology. The metabolically or genetically modified microorganisms will be cultured in a bioreactor to improve the energy conversion of solar photon emission (Siddiki et al. 2022; Vignesh et al. 2021). This will improve the simplicity, speed up the reaction rate and improve the production yield of the process. Hence, the fourth-generation biodiesel is a prominent fuel product that is effective and sustainable in terms of economic and environmental aspects.

One factor that results in global warming is the increased sea surface temperature due to the growing carbon dioxide concentration. The usage of renewable energy can lessen the toxic emissions of greenhouse gases. Although there is a variety of available green energy such as hydroelectric and geothermal, biofuel positioned itself as a prominent source as it has good integration with the current fossil-fuel distribution infrastructure with minor cost repercussions (Khan et al. 2021). In addition, to avoid the dependency on one single energy source, local biomass is used to enhance the variety of green energy sources. However, biodiesel's manufacturing and its applications possess limitations in cost, cold performance, storage stability, wastewater issue, and life cycle analysis (LCA).

Currently, expensive edible oils are employed on a large industrial scale. This circumstance presents a significant challenge in maintaining a reasonable margin of manufacturing cost. In the coming years, continuous growth in waste feedstock usage is projected to retain the biodiesel business while widening the gap between biodiesel breakeven and selling price (Joshi et al. 2017). Besides, the gathering of the raw material also possesses logistic issues. One method to acquire tallow is through centralizing slaughterhouses to ease fat collection. Also, the savings gained from selecting the raw materials need to be higher than the pretreatment costs or can be a trade-off. The analysis to search for cheaper sources of biodiesel is continuing to be carried out. This effort can ensure the ease of supplementing the cheaper feedstocks whenever shortages in oil supply for biodiesel happen.

Cold flow properties are important as they allow biodiesel to be used in a broader geographic and season range (Maximo et al. 2018). In biodiesel, high saturation levels cause crumbling at low temperatures, leading to poor cold characteristics as depicted in Figure 1. Ethyl esters can improve cold qualities to suit the needs of cold climatic zones. Alternatively, cold performance issues may be resolved by mixing biodiesel with petroleum diesel and kerosene, transesterification using branched-chain alcohol, and modifying the oil's fatty acid composition (Verma, Sharma, and Dwivedi 2016). As biodiesel is a blend of saturated and unsaturated fatty acid esters, it is prone to auto-oxidation. Auto-oxidation causes poor fuel quality by degrading the biodiesel and developing undesirable by-products. Hence, oxidation stability is an essential parameter in determining biodiesel quality.

Besides, microbial contamination can affect biodiesel storage by the growth of bacteria and fungus as listed in Table 1. This phenomenon occurs between the interface of water and fuel at the bottom of the tank (Komariah et al. 2022). Some manufacturers utilize warm water during the biodiesel purification process to purify the product by washing. Therefore, it creates plenty of wastewater that needs to be handled effectively to comply with the regulations and requirements. Consequently, the companies need to endure the cost of treating the wastewater produced, and this expenditure cannot be neglected in the production cost. Bear in mind that cost is the primary challenge in biodiesel production. In consequence, substantial efforts have been dedicated to conserving water consumption and creating less-contaminated wastewater.

The main focuses of a specific operation in life cycle analysis (LCA) are the overall cost, energy, and waste. However, the critical part of LCA is to define the boundaries for each aspect. For instance, non-renewable fossil fuel is used to produce biofuel. In that case, it is unclear whether to consider the effect of fossil fuels on the ecosystem. Thus, it is raising doubt about the credibility of the LCA studies (Rajaeifar et al. 2019). Also, the influence of indirect land use is often overlooked, although the carbon and energy balances are considered throughout the research.

In conclusion, it is very challenging to synergize the benefits of different generations of biodiesel into a single conversion strategy. Apart from that, as feedstock availability is the key challenge, a strategy of incentivizing biomass owners and farmers could be developed to encourage biomass-related activities such as aggregation, storage, and handling.

of feedstock supplies. Besides, interstate taxes can be abolished to encourage the smooth flow of feedstock and biofuel throughout the country. The government should also foster public-private partnerships in the biofuel industry to guarantee fuel security. Hence, the production of biodiesel can be commercialized.

**References**

Joshi, Girdhar, Jitendra K. Pandey, Sravendra Rana, and Devendra S. Rawat. 2017. "Challenges and opportunities for the application of biofuel." Renewable and Sustainable Energy Reviews 79: 850-866. https://doi.org/https://doi.org/10.1016/j.rser.2017.05.185.

Komariah, Leily Nurul, Susila Arita, Muhammad Rendana, Cindi Ramayanti, Ni Luh Suriani, and Desi Erisna. 2022. "Microbial contamination of diesel-biodiesel blends in storage tank; an analysis of colony morphology." Heliyon 8 (4): e09264. https://doi.org/https://doi.org/10.1016/j.heliyon.2022.e09264.

Ma, Fangrui, and Milford A Hanna. 1999. “Biodiesel Production: A Review.” Bioresource Technology 70 (1): 1–15. https://doi.org/10.1016/s0960-8524(99)00025-5.

Maximo, Guilherme J., Ana M. S. Magalhães, Mariana M. Gonçalves, Eduardo S. Esperança, Mariana C. Costa, Antonio J. A. Meirelles, and João A. P. Coutinho. 2018. "Improving the cold flow behavior of methyl biodiesel by blending it with ethyl esters." Fuel 226: 87-92. https://doi.org/https://doi.org/10.1016/j.fuel.2018.03.154.

Rajaeifar, Mohammad Ali, Meisam Tabatabaei, Mortaza Aghbashlo, Saeed Sadeghzadeh Hemayati, and Reinout Heijungs. 2019. "Biodiesel Production and Consumption: Life Cycle Assessment (LCA) Approach." In Biodiesel: From Production to Combustion, edited by Meisam Tabatabaei and Mortaza Aghbashlo, 161-192. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-00985-4_8.

Rajagopal, Deepak, and David Zilberman. 2008. "Environmental, economic and policy aspects of biofuels." Foundations and Trends® in Microeconomics 4 (5): 353-468. https://doi.org/10.1561/0700000029.

Siddiki, Sk Yasir Arafat, M. Mofijur, P. Senthil Kumar, Shams Forruque Ahmed, Abrar Inayat, F. Kusumo, Irfan Anjum Badruddin, et al. 2022. “Microalgae Biomass as a Sustainable Source for Biofuel, Biochemical and Biobased Value-Added Products: An Integrated Biorefinery Concept.” Fuel 307 (September 2021): 121782. https://doi.org/10.1016/j.fuel.2021.121782.

Verma, Puneet, M. P. Sharma, and Gaurav Dwivedi. 2016. "Evaluation and enhancement of cold flow properties of palm

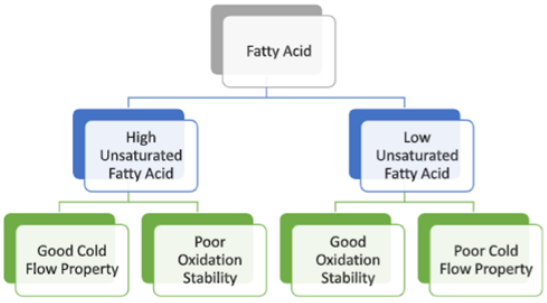



Figure 1: Factor affects the cold flow behaviour and oxidative stability

Source: Figure reproduced from Verma, Sharma, and Dwivedi (2016, 11).

| Common Diesel fuels | | Biodiesel-Diesel Blends |
|---|---|---|
| Bacteria | Sulfate reducing bacteria (SRB), *Flavobacterium, Acinetobacter*, and *Micrococcus* | *Actinetobacter, Bacillus sp., Clostridium sporogenes, Flavofacterium diffusum, Micrococcus sp., Pseudomonas sp., Pseudomonas aeruginosa, Serratia marcescens, Sarcina sp., Hydrogenomonas sp., Clostiridum sp., Gordonia sp.*, etc. |
| Yeasts | *Candida, Saccharomyces, Torula, Hansenula* | *Candida sp., Candida famata, Candida lypolytica, Candida silvícola, Candida tropicalis, Rhodotorula sp., Saccharomyces sp.*, etc. |
| Moulds/ Fungus | *Hormoconis resinae, Cladosporium resinae, Aspergillus, Penicillium, Fusarium and Botrytis* | *Acremonium sp., Aspergillus sp., Aspergillus fumigatus, Cladosporium sp., Fusarium oxysporum, Penicillium sp., Penicillium citrinum, Penicillium funiculosm, Trichiderma sp., Paecilomyces sp,. Moniliella and Byssochlamys, Phyla sp., Pseudallescheria boydii., Hormoconis resinae, Fusarium sp., Aureobasidium pullulans, Moniliella wahieum, Byssochlamys nivea*, etc. |

Table 1: Common microorganisms found in the storage tanks

Source: Table reproduced from Komariah et al. (2022, 2).

# Article: The recovery methods for various palm-based wastes

*Written by Ng Sheng Tat (UCSI University, Malaysia)*

## Waste management for palm-based products

Despite the undeniable usefulness of palm oil in various industries, the extensive use of palm-based products requires proper waste management approaches to its by-products or waste generated upon its usage to be implemented. According to reliable statistics, approximately 10% of the total biomass obtained from palm oil farms is converted into useful products, while the others will be disposed of without being utilized (Zahan & Kano, 2018). Hence, this paper will present several potential applications or management approaches for different palm-oil wastes such as transforming them into construction material, turning them into fuel with the application of suitable technologies.

## Palm oil fuel ash (POFA) as a construction material

In Malaysia's palm oil industry, the palm oil fuel ash (POFA) waste was close to 5 million tons and wasted in 2010 (Alyousef et al., 2019). It is produced from the burning of palm oil shells and husk to generate electricity for the extraction process of palm oil. The researches on POFA as pozzolanic ash suggest that it could be recycled and used in the construction industry due to its ability to enhance the properties of the construction material. POFA is proven to be able to serve as supplementary material in the manufacturing of WMP fibers-reinforced concrete. Compared to an Ordinary Portland Cement, OPC, POFA, both with WMP fiber content, is much stiffer with low workability (Alyousef et al., 2019). POFA concrete mixture has higher compressive strength, meaning that more compressive strength the concrete can sustain upon gradual application of load. This is attributed to the development of uniformly spaced C-S-H gels when the pozzolanic action of POFA consumes more calcium hydroxide compared to OPC (Alyousef et al., 2019). Nevertheless, there are several processing steps required to substitute OPC with POFA, including large particles removal, carbon content minimization, heating, sieving, etc.

## Empty Fruit Bunch (EFB) processing with Microwave Co-Torrefaction (MCT)

Since empty fruit bunch is one of the most abundant wastes, its management could be of utmost importance. In the current research, it is proposed that this material together with waste oil, including used cooking and engine oil, can be treated using Microwave Co-Torrefaction (MCT) technique to produce solid fuel products (Lam et al., 2019). The solid fuel is suitable for power plant energy generation and boiler application in the chemical industry. In reality, EFB in pellet form (EFBP) is ready to be co-fired with another fuel by itself without any advanced processing methods. However, the fuel product is less efficient because of the inferior composition of the EFBP such as high moisture and ash content. Hence, the torrefaction process, which is characterized by heating using microwave heat and followed by colling in a desiccator, is proposed. In this technology, a self-purging method is applied, hence the introduction of purging gas such as nitrogen gas is not required. Depending on the dielectric properties of the feedstocks, microwave technology is able to rapidly heat the feedstock even in its bulk form. However, this promising technology needs much research because the mechanisms of the transformation are not known to date. According to the findings, it is found that the addition of waste oil to EFBP in microwave co-torrefaction will increase the ratio of fixed carbon to volatile matter, enhancing the fuel properties of the torrefied product in terms of energy yield. Together with the low moisture absorption of co-torrefied oil, it implies that it can be stored for a longer duration compared to torrefied oil produced from a unique oil source.

## Hydrogen gas production from Empty Fruit Bunch (EFB) and Palm Oil Mill Effluent (POME) via supercritical water gasification method

Since treating EFP and POME with high moisture content is impractical using the conventional thermal processes method, supercritical water gasification (SCWG) is suitable to be applied to EFP and POME (Ruya et al., 2020). It is capable of transforming carbonaceous materials into syngas, which are a mixture of hydrogen, carbon monoxide, and carbon dioxide gas. The hydrogen can be further isolated as clean energy using a hydrogen separation membrane or PSA. Before the separation phase, separation of  is needed as its presence impedes the separation process. During the process, the water will be superheated to act as a catalyst for the reaction. Although the efficiency of this technology is satisfied on a laboratory scale, there is no industrial-scale SCWG application due to the huge energy requirement, thus incurring a high operational cost. On the other hand, carbon dioxide greenhouse gas is produced as well during the gasification process. Hence, further research or processing units are required to minimize the emissions.

From the solutions to the palm-based wastes above, it is possible to minimize wastes from palm oil usage without causing damages to the environment and at the same time being able to fully utilize palm oil. Among the methods above, it is suggested that unleashing the full potential of MCT technology will be a great effort as it is a promising technology, solving two wastes at the same time without generating extra pollutants as the by-products. Nevertheless, collaboration from all industries and researchers is much needed to allow the issue to meet its end.

## References

Alyousef, R., Mohammadhosseini, H., Tahir, M. M., & Alabduljabbar, H. (2019). Green concrete composites production comprising metalized plastic waste fibers and palm oil fuel ash. Materials Today: Proceedings, 39(xxxx), 911–916. https://doi.org/10.1016/j.matpr.2020.04.023

Lam, S. S., Tsang, Y. F., Yek, P. N. Y., Liew, R. K., Osman, M. S., Peng, W., Lee, W. H., & Park, Y. K. (2019). Co-processing of oil palm waste and waste oil via microwave co-torrefaction: A waste reduction approach for producing solid fuel product with improved properties. Process Safety and Environmental Protection, 128, 30–35. https://doi.org/10.1016/j.psep.2019.05.034

Ruya, P. M., Lim, S. S., Purwadi, R., & Zunita, M. (2020). Sustainable hydrogen production from oil palm derived wastes through autothermal operation of supercritical water gasification system. Energy, 208, 118280. https://doi.org/10.1016/j.energy.2020.118280

Zahan, K. A., & Kano, M. (2018). Biodiesel production from palm oil, its by-products, and mill effluent: A review. Energies, 11(8), 1–25. https://doi.org/10.3390/en11082132

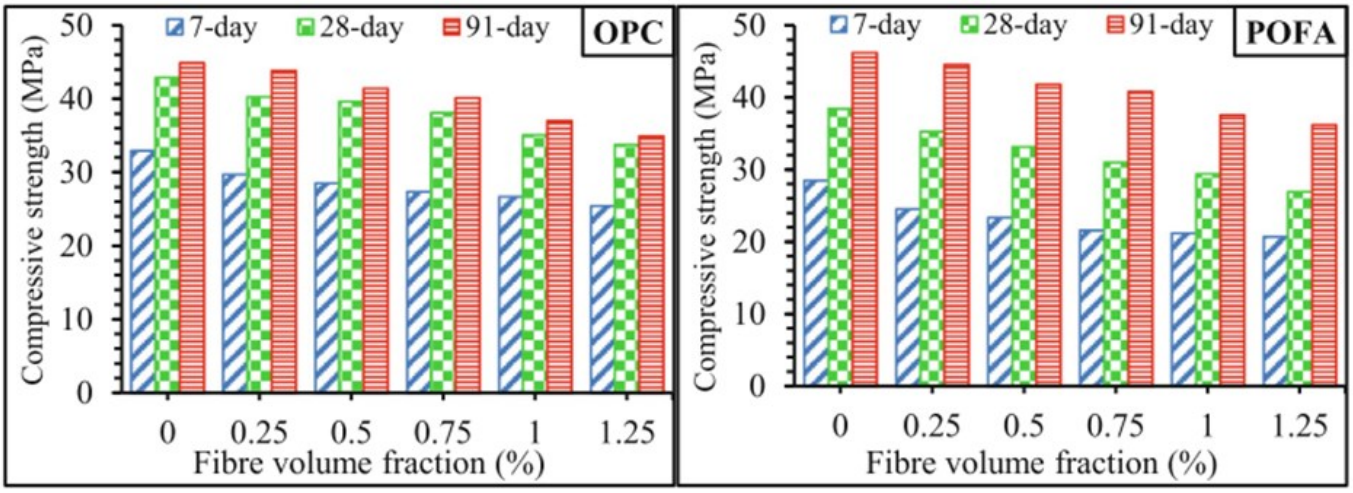



Figure 1: The variation in the compressive strength of OPC and POFA mixed with MPW fibers. (Alyousef et al., 2019)

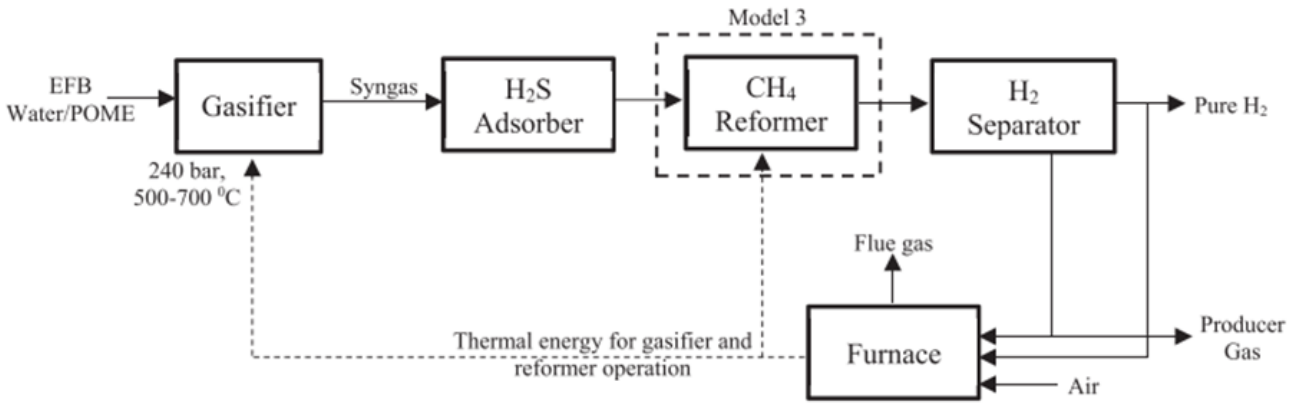



Figure 2: Simplified flow diagram of the supercritical water gasification system. (Ruya et al., 2020)

# Article: Palm Oil Industry: Growth and Sustainability

*Written by Afifah bin Sulaiman*

According to a comprehensive data with country-level facts and statistics illustrate in figure 1, Malaysia is currently the second largest producer of palm oil in the world with 19,800 million tonnes (Mt) behind Indonesia with 46,500 Mt. Since COVID-19 pandemic, Malaysia having a disruptions of palm oil supply chain due to the travel restriction of foreign labour. Statistic shows that in 2020 and 2021, the production of palm oil is 3.8% (19.14 Mt) and 9.55% (18.12 Mt) lower compared to 2019 which produce 19.85 Mt palm oil. It has been proven that palm oil industry is important from economical perspective since the production of palm oil valued approximately RM 72 billion and it provide jobs to more than half a million people in Malaysia. However, it is important to maintain its sustainability in order to create fair socio-economic conditions in the global palm oil supply chain.

There are a few ways to 'go sustainable' with palm oil production. First, fully utilize the palm oil plant or 'zero waste' instead of deforestation. Generally, tree is the biggest part which can be used as material for furniture, the leaflet can produce broomstick, empty fruit brunches can be utilized as organic fertilizer. By doing so, we could reduce the global warming since deforestation will contribute to greenhouse gases. Second, get certified in 'Roundtable of Sustainable Palm Oil' or RSPO. Basically, it is developed to create a space where palm oil agriculture and the environment can co-exist. According to data in 2012, Malaysia deserves world recognition due to the world's largest producer of Certified Sustainable Palm Oil (CSPO) for over 50% due to the active representation and contribution in RSPO. Lastly, implementing 'greener' approach in palm oil industry. In facts, in order to obtain the optimum palm oil production, it requires two strategies; weeding and fertilization. We know weeding balances the positive and potential negative effects of the undergrowth plant and fertilization increases the growth rate and productivity of oil palm. However, according to Hakim et al., (2020) weeding decreases the quality and quantity of fresh fruit brunches while fertilizer contribute to greenhouse effect and nutrient leaching losses (Darras et al., 2019). Recent study conducted by University of Göttingen, two years of large-scale palm oil production with less fertilizer and no herbicide give positive result to environment as well as profits. In facts, the profit is higher due to reduction in fertilizer cost.

All in all, in order to have a balanced between profit and sustainability, the government should raise awareness in adopting voluntary industry commitments as national standard and implementing 3Ps concept inspired from 80's; people, planet and profit which define provide job to local population, planet will not be harm if implementing appropriate agricultural practice and palm oil company will certainly gain profit.

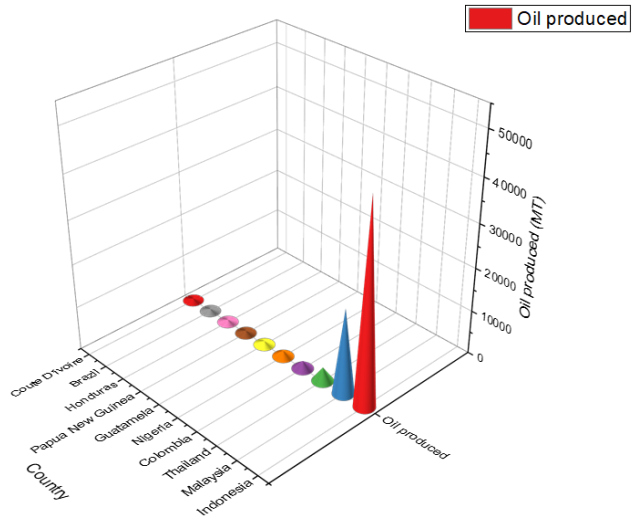



Figure 1: World's palm oil production in million tonnes (MT).

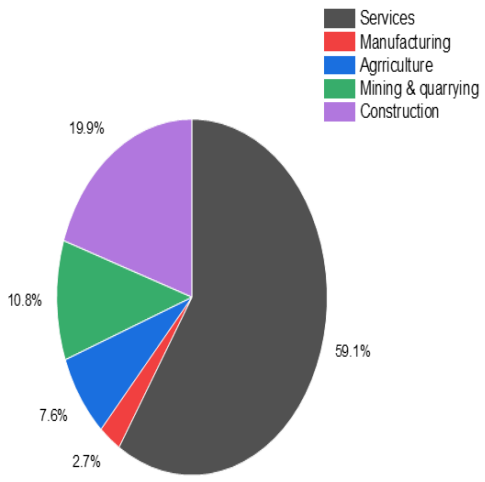



Figure 2: Sectors that contribute to Malaysia's economy in 2020.

# Research: Palm oil mill effluent (POME) waste treatment using $TiO_2/Ti_3C_2T_x$ MXene composite aerogel via photocatalytic degradation process

**Jocelyn Lim Jean Yi[a], Andrew Ng Kay Lup[a,b,*]**

Palm oil mill effluent (POME) is one of the major wastes produced by palm oil industry during crude palm oil production (Fig. 1). POME is rich in palm oil based organic compounds such as carotene, carboxylic acids, pectin, lignin and phenolics which are unfavourable to the ecological environment [1-4]. Generally, conventional open-pond system has been widely used in the industry for POME wastewater treatment. Nevertheless, this method can be time and space consuming and inefficient for low concentration of POME. Hence, novel treatment that provides higher degradation efficiency is essential. Herein this work, a hybrid of {001}-$TiO_2$ with $Ti_3C_2$ MXene aerogel was synthesised to form a $TiO_2/Ti_3C_2$ MXene aerogel composite. The composite was studied in this work on its suitability for the photocatalytic degradation of POME as compared with other conventional photocatalysts such as pristine $TiO_2$.


Figure 1: POME Sample.

POME sample was obtained from the final discharge point of Gomali Palm Oil Mill, IOI Group. Layered $Ti_3C_2$ MXene was obtained from $Ti_3AlC_2$ MAX precursor via the in-situ HF etching technique [5]. The MXene was freeze dried at -50°C for 48 h and dispersed in deionised water to form MXene colloidal solution. The colloidal solution was heated for 6 h at 95 °C in a sealed Teflon container to form MXene hydrogel which is then further freeze dried at -50°C for 48 h to form MXene aerogel (Fig. 2a). A 100 mL $TiO_2$ suspension containing 100 mg of anatase $TiO_2$ powder was mixed with 30 mg of $Ti_3C_2$ MXene aerogel and hydrothermal treated at 120°C for 5 h to form $TiO_2/Ti_3C_2$ hydrogel which is then freeze dried to form $TiO_2/Ti_3C_2$ composite aerogel (Fig. 2b).

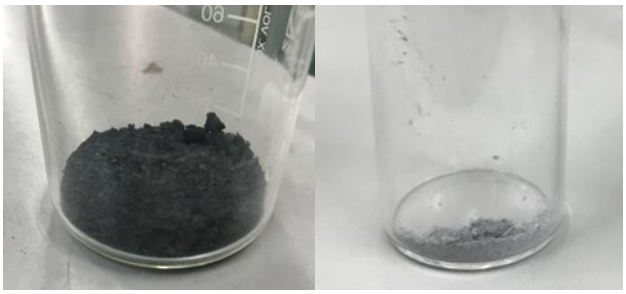


Figure 2: Layered $Ti_3C_2$ MXene (left) and $TiO_2/Ti_3C_2$ photocatalyst composite (right).

Photodegradation of POME was done using 34 mg of $TiO_2$, $Ti_3C_2$ aerogel and $TiO_2/Ti_3C_2$ composite aerogel samples with 20 mL of filtered POME solution. The photocatalytic setup was done under black light irradiation (100 W) and without external oxygen bubbling to simulate the photocatalytic process under natural ponding condition. POME photodegradation was able to be achieved using $TiO_2$, $Ti_3C_2$ and $TiO_2/Ti_3C_2$ samples with the respective photodegradation efficiencies of 58.9%, 73.7% and 98.3% after 24 h of reaction. The huge increase in POME photodegradation efficiency after the incorporation of $Ti_3C_2$ is highly desirable. This is attributed to the promotion of efficient charge separation and reduction of electron-hole recombination by $Ti_3C_2$ as cocatalyst [6].

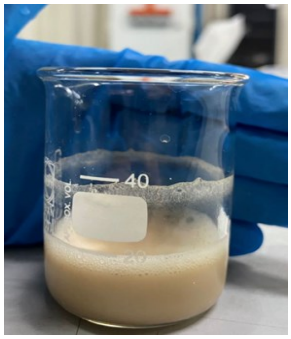


Figure 3:. Release of $CO_2$ during POME photodegradation.

## References


[1] S. Sani, A.F. Dashti, R. Adnan, 2020. Applications of Fenton oxidation processes for decontamination of palm oil mill effluent: A review. Arabian Journal of Chemistry. 13, 7302-7323.

[2] N.F.M. Hussein, C.Z.A. Abidin, F.M. Ridwan, S.N. Sabri, N.A. Razali, 2019. Comparative study on palm oil mill effluent (POME) treatment by electro-oxidation using catalyst and electrode. AIP Conference Proceedings. 2157, 020018.

[3] N.Z. Zainuri, N.H.H. Hairom, D.A.B. Sidik, A.L. Desa, N. Misdan, N. Yusof, A.W. Mohammad, 2018. Palm oil mill secondary effluent (POMSE) treatment via photocatalysis process in presence of ZnO-PEG nanoparticles. Journal of Water Process Engineering. 26, 10-16.

[4] K.H. Ng, 2021. Adoption of $TiO_2$-photocatalysis for palm oil mill effluent (POME) treatment: Strengths, weaknesses, opportunities, threats (SWOT) and its practicality against traditional treatment in Malaysia. Chemosphere. 270, 129378.

[5] M. Alhabeb, K. Maleski, B. Anasori, P. Lelyukh, L. Clark, S. Sin, Y. Gogotsi, 2017. Guidelines for synthesis and processing of two-dimensional titanium carbide ($Ti_3C_2T_x$ MXene). Chemistry of Materials. 29, 7633-7644.

[6] O. Arutanti, A.A. Sari, A. Berkah, M. Nurdin, M.A. Fitriady, Y. Parmawati, N. Rinaldi, A. Yuniarto, T. Hadibarata, 2020. Advanced degradation of lignin from palm oil mill effluent (POME) by a combination of photocatalytic-fenton treatment and $TiO_2$ nanoparticle as the catalyst. Water, Air, & Soil Pollution. 231, 266.

[7] Z. Zhao, Z. Li, Z. Zou, 2010. Surface properties and electronic structure of low-index stoichiometric anatase $TiO_2$ surfaces. Journal of Physics: Condensed Matter. 22, 175008.

[8] M. Khazaei, M. Arai, T. Sasaki, A. Ranjbar, Y. Liang, S. Yunoki, 2015. OH-terminated two-dimensional transition metal carbides and nitrides as ultralow work function materials. Physical Review B. 92, 075411.

# Research: Kinetic and Thermodynamic Analyses for the Conversion of Co-Pyrolysis of Palm Oil Wastes and COVID-19 Surgical Waste to Biofuel Production

*Written by Melvin Wee Xin Jie*

Palm oil, is a versatile product from the oil palm industry which can be processed for food or oleochemical purposes (Yeo et al. 2020). The demand of the palm oil has contributed to the rapid growth of the oil palm industry, especiallty in the Southeast Asia countries. In fact, the top producers of palm oil are from Indonesia, and Malaysia, as shown in Figure 1, where the palm oil industry is projected to increase its production volume as the countries are recovering from the stagnant period caused by the global pandemic (Chu 2022; Hirschmann 2020; Indonesia exports over 36 million tonnes of palm oil In 2019 2020; Indonesia raises 2022 palm oil output 2022; Nordin, Hassan & Razali 2021; Palm oil industry 2020 reflection and 2021 prospect 2021; Ritche & Roser 2020). However, accoding to Yeo et al. (2020), the products from the oil palm industry (i.e. kernel, crude palm oil), only represents roughly 12.5 % of the total harvest, the remainders are the biomass from the oil palm plantation (41.4 %), and palm oil mill (53.94 %). In other words, the generation of these wastes are 8 times the production of palm oil. Examples of oil palm biomass includes, the empty fruit bunches (EFB), palm kernel shell (PKS), palm oil mill effluent (POME), oil palm trunk (OPT), and oil palm frond (OPF). Current utilisation of these wastes in order to reduce these wastes such as direct combustion, fertilisers, and landfills, are not sustainable (Sidek, Saleh & Abdul Samad 2021).

However, there are waste to wealth conversion technologies that can better utilise these biomass to produce renewable fuels. For example, the thermochemical route, pyrolysis. Pyrolysis is defined as the thermal degradation of solid waste materials in an inert condition, to generate bio-fuels in the form of bio-oil, biochar, and biogas. Moreover, in recent studies, researchers are directing their focus on the co-pyrolysis of biomass and plastic wastes (Lin et al. 2021; Navarro et al. 2018; Ng et al. 2018; Park et al. 2021; Suriapparao et al. 2020). The benefits of co-pyrolysis are, the plastic sample material acting as a hydrogen donor, and the biomass derived radicals initiate the -sciscion, or tail end cutting of the plastic polymer chain to form simpler hydrocarbons (Lin et al. 2020).

In light of the current pandemic, has led to the surge of single-use plastic wastes, i.e., disposable face mask (DFM). According to the World Health Organisation (WHO), in USA, approximately 89 million medical masks per month are required for the COVID-19 response (Shortage of personal protective equipment endangering health workers worldwide 2020). In UK, it is 24.37 billion per year (Selvaranjan et al. 2021). Furthermore, China has also increased its daily production of face maks to 14.8 million per day as of February 2020 (Selvaranjan et al. 2021). In Japan, it is also recorded to require more than 600 million face masks per month back in April 2020 (Selvaranjan et al. 2021). However, as new variants are emerging and with no end in sight as of March 2022, the accumulation of these disposable face mask waste would lead to major environmental complications. For example, the random disposal of these wastes could also lead to microplastic pollution in the food chain, especially in aquatic life (Patrício Silva et al. 2021).

Furthermore, to determine the viability of the co-pyrolysis process, the study and determination of the kinetics of the pyrolysis process is fundamental for the design, scale-up, optimization, and potential industrial application (Luo et al. 2021). Hence, this project utilises the distributed activation energy model (DAEM) as the kinetic modelling tool to determine the kinetic parameters of the process, i.e. activation energy and pre-exponential factor. According to ref, DAEM is a suitable kinetic model to analyse heterogenous samples, which in this case is the oil palm biomass and DFM wastes. The model assumes a series of first order reaction steps occurring simultaneously in the pyrolysis of these solid waste materials to the pyrolytic products (Navarro et al. 2018).

Hence, the aim of this project is to study and evaluate the co-pyrolysis of EFB along with DFM wastes in terms of the thermo-kinetic parameters, to provide insight on the potentials of this waste management alternative. The project can be represented as Figure 2. The objectives of this research includes:

1) To study the thermal degradation properties of EFB and/ with disposable face masks.

2) To determine the effects of different co-pyrolysis parameters, (i.e., feedstock ratio, presence of different catalysts, catalyst amount, and heating rates) on the thermo-kinetic parameters, such as, activation energy, pre-exponential factor, change in enthalpy, change in Gibbs free energy, and change in entropy.

3) To comment on any synergistic effect between the feedstock in the co-pyrolysis process.

process.

The project will serve as a guideline as a potential waste management outlook of the oil palm industry. To address the sustainability issue regarding environment impacts of landfills of oil palm biomass, by providing a waste to wealth alternative, i.e. thermochemical conversion to bio-fuels. Besides that, to play a part in contributing to the circular economy of the palm oil industry. Lastly, alignment to the Sustainable Development Goals (SDGs), affordable and clean energy, responsible consumption and production, and life below water. In conclusions, this could improve the resilience to climate change and natural disasters in moving towards building a socio-economic development that aligned with the SDG led by the United Nations that redefines sustainable development goals 9, 12, and 13; and to achieve the goals in the 12th Malaysia Plan.

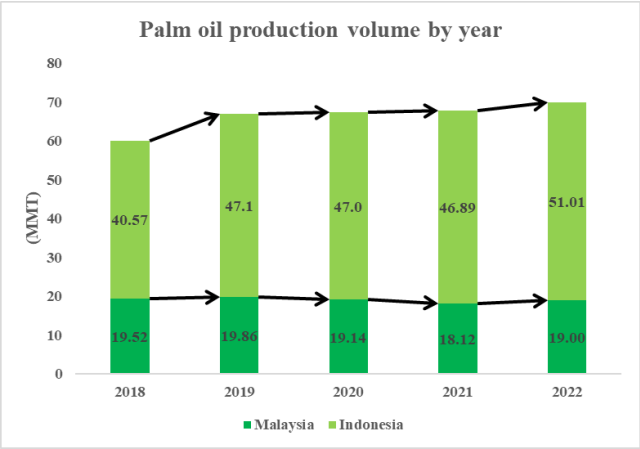



Figure 1. The palm oil production volume by year by country (Chu 2022; Hirschmann 2020; Indonesia exports over 36 million tonnes of palm oil In 2019 2020; Indonesia raises 2022 palm oil output 2022; Nordin, Hassan & Razali 2021;

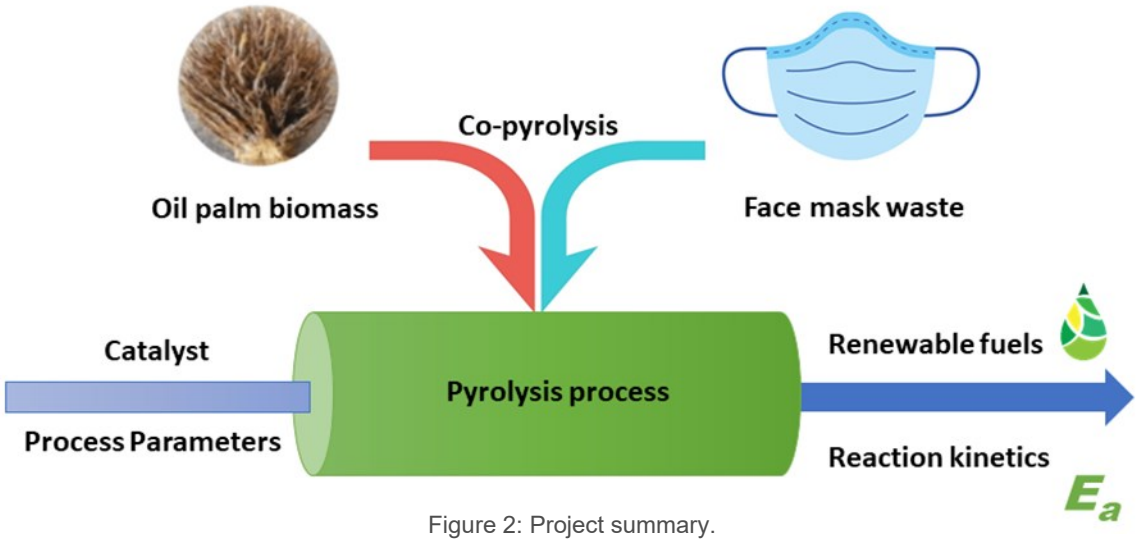



Figure 2: Project summary.

# Research: Thermogravimetric Analysis and Combined Kinetic Study on the Pyrolysis of Empty Fruit Bunches Lignin Extracted using Sucrose-Malic-Acid Water Low Transition Temperature Mixture

*Written by Jonathan Cheng Lin Yang*

## Background

Global consumption of fossil fuels has skyrocketed in the last century, causing a global energy crisis and negative environmental impacts such as air pollution and climate change. Malaysia is the second-largest palm oil producer, with an estimated 85-110 million metric tons of biomass produced annually in 2020 (Tan 2020). The majority comes from the palm oil sector. Given the energy potential of oil palm biomass, it would be strategic to utilise oil palm biomass for green energy production. Cellulose and hemicellulose are macromolecular polysaccharides crucial to producing fermentable sugars and bioethanol. In these cases, the biomass usually is pre-treated to remove the lignin and improve the quality of the bio-oil feedstock. Isolated lignin, typically treated as a waste, is a potential feedstock for thermochemical processes such as pyrolysis. Thermochemical processing such as pyrolysis enables the conversion of lignin into convenient energy carriers such as bio-oil that produces less harmful gas emissions when combusted.

The green solvent extraction method using a low transition temperature mixture (LTTM) of malic acid (HBD), sucrose (HBA) and water proposed by Yiin (2018) is adopted in this research project to harvest the targeted lignin component. Empty fruit bunches (EFB) with its high content of lignin (31.68 wt%) is a good precursor for the extraction process. There is still a lack of insight into the operating conditions governing lignin extraction efficiency and lignin purity using malic acid-sucrose-water LTTM. Therefore, this work investigates the parametric effect of operating temperature and the biomass to LTTM ratio on lignin extraction efficiency and lignin purity. The inclusion of thermal degradation behaviour, kinetic parameters, and reaction mechanisms outcome from the study will support the potential process optimisation and design in the later stage of the work.

## 2. Results

Effect of different operating temperatures (70 to 110 °C) on lignin extraction efficiency and lignin purity of EFB and rice husk was shown in Figure 1.. The lignin extraction efficiency of EFB shows an increasing trend as the operating temperature rises. Higher operating temperature weakens the bonding between HBA and HBD, which reduces the viscosity of the LTTM. The lower viscosity of the malic acid-sucrose-water LTTM allows more movement and interaction between the solvent and the biomass during the extraction process in the oil bath. This enhanced the solvent's ability to penetrate the biomass's lignocellulosic matrix, which allowed more lignin to be extracted. The highest lignin extraction efficiency obtained for EFB and rice husk were recorded at 110 °C. Although the extraction efficiency continues to increase when the operating temperature rises, the extraction feature of the malic acid-sucrose-water LTTM relies on its thermal properties, which regulate within a specific temperature range where the solvent can maintain its liquid state (Loow 2017). Excessive extraction temperatures would lead to the thermal degradation of the solvent.

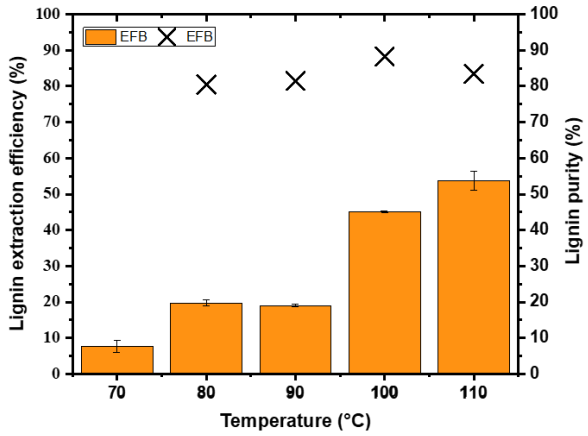



Figure 1:. Lignin extraction efficiency and lignin purity

Figure 2. shows the lignin extraction efficiency of EFB increases as the biomass to LTTM ratio decreased. A biomass to LTTM ratio of 1:10 yields the lowest lignin extraction efficiency of EFB of 1.68%. The high biomass to LTTM ratio caused the malic acid-sucrose-water LTTM could not thoroughly saturate the EFB samples. This leads to the lignin samples could not be dissolved and removed effectively. However, the biomass to LTTM ratio required to submerge the biomass fully also depends on the raw material used as different types of biomass has different physical structures (Sai 2019). Low biomass to LTTM ratio will increase biomass degradation, which affects the resulting product. Also, low biomass to LTTM ratio will result in other negative impacts like oversizing of extraction equipment and waste of solvent, leading to an overall higher extraction cost.

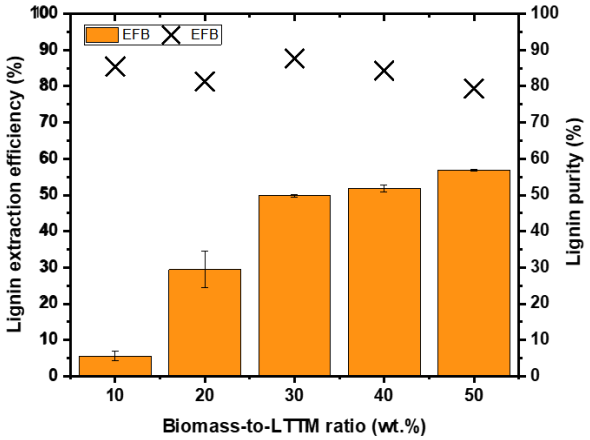



Figure 2. Lignin extraction efficiency and lignin purity

Figure 3. depicts the thermogravimetric (TG) profile of lignin at different heating rates (i.e., 5, 10, 15, 20 °C/min). The mass loss profiles are skewed towards higher temperatures at higher heating rates. This trend is likely caused by decreasing heat transfer efficiency as the heating rate increases. It can be observed that there is a massive mass loss from 175 to 500 ° C. This stage attributes to the devolatilisation of the EFB derived lignin.

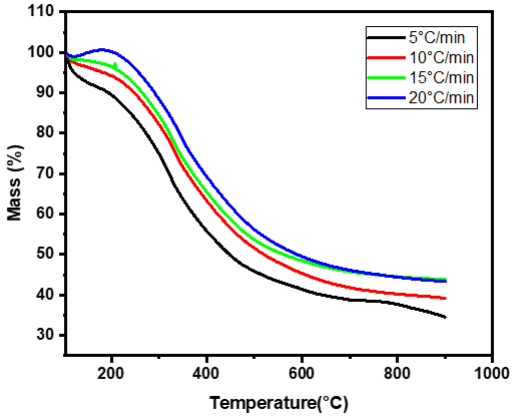



Figure 3: TG curve of lignin

The activation energy (Ea) is the minimum energy needed for a chemical reaction, which refers to pyrolysis to initiate. The Ea of lignin was determined from linear plots of Kissinger-Akahira-Sunose (KAS) models shown in Figure 4. The KAS model's average activation energy (Ea) was 66.68 kJ. Table 1. shows the resultant kinetic parameters after the Ea was substituted into the Sestak-Berggren (SB) model. The adjusted R2 of lignin under different heating rates is above 98%, which is considered very high and fits well with the TGA data gathered for lignin pyrolysis. Adjusted R2 was chosen because R2 assumes every independent variable in the model explains the variation in the dependant variable, whereby this one-to-one relationship rarely exists. Adjusted R2 provides the percentage of variation explained by only those specific independent variables that truly affect the dependent variable

**KAS model:**

$$\ln\left(\frac{\beta}{T^2}\right) = \ln\left(\frac{AR}{Eg(x)}\right) - \frac{E}{RT}$$

**SB model:**

$$\ln\left(\frac{d\alpha}{dt}\left[\frac{1}{\exp\left(-\frac{E_a}{RT}\right)}\right]\right) = \ln A + m\ln(\alpha) + n\ln(1-\alpha) + p\ln(\ln[1-\alpha])$$

| Heating Rate(°C/min) | ln(A) | m | n | p | $E_a$ (kJ) | Adjusted $R^2$ |
|---|---|---|---|---|---|---|
| 5 | 8.9830 | -39.9770 | 15.5046 | 36.8646 | 66.68 | 0.9980 |
| 10 | 9.9043 | -32.7640 | 13.6208 | 30.8323 | 66.68 | 0.9965 |
| 15 | 11.6134 | -11.6196 | 5.5606 | 10.6691 | 66.68 | 0.9968 |
| 20 | 14.4607 | 33.2693 | -11.6185 | -32.6880 | 66.68 | 0.9807 |

3.

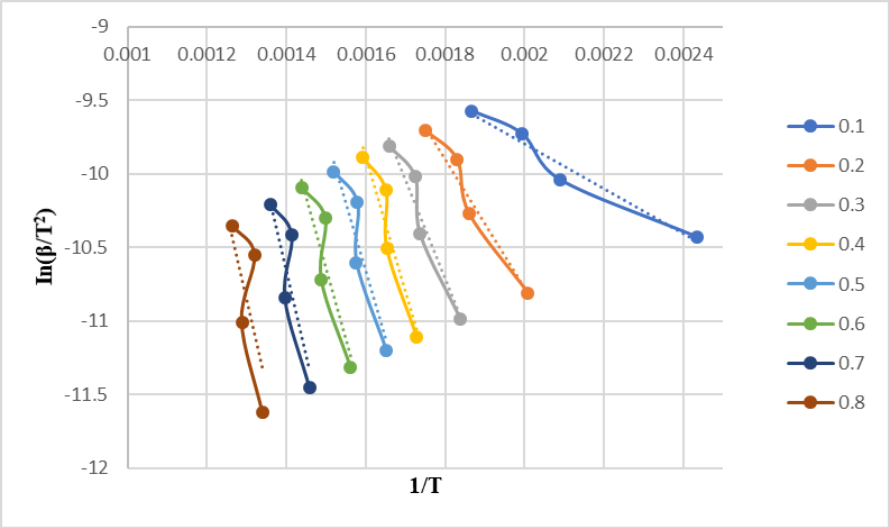



Figure 4: Kinetic plots by the KAS model for lignin thermal

## Conclusion

The lignin extraction efficiency increased from 7.67 to 53.70 % when operating temperature increased from 70 to 110 °C. When the biomass to LTTM ratio decreased, the lignin extraction efficiency increases from 5.57 to 56.82 %. The study of the influence of heating rate on lignin pyrolysis concluded that the higher the heating rate, the lower the effectiveness of the thermal degradation. The estimated average Ea for lignin pyrolysis was found to be 66.68 kJ. SB model was utilized for the exploration of the kinetic mechanisms of lignin pyrolysis and the simulation results fit very well with the data attained from TGA analysis.

## 4. Acknowledgement

The authors would like to acknowledge the financial assistance support in this research from IChemE Palm Oil Special Interest Group (POPSIG) through POPSIG Student Research Project Bursary.

## 5. References

C. L. Yiin, A. T. Quitain, S. Yusup, Y. Uemura, M. Sasaki, and T. Kida 2018, "Sustainable green pretreatment approach to biomass-to-energy conversion using natural hydro-low-transition-temperature mixtures," Bioresource Technology, vol. 261, pp. 361-369

Sai, Y.W., Lee, K.M., 2019. Enhanced cellulase accessibility using acid-based deep eutectic solvent in pre-treatment of empty fruit bunches. Cellulose 26, 9517-9528.

Tan, Z 2020, 'Green Technology: Time to tap biomass', The Edge Malaysia, 21 February, viewed 1 May 2020, <https://www.theedgemarkets.com/article/green-technology-time-tap-biomass>.

Y.-L. Loow, T. Y. Wu, J. Md. Jahim, A. W. Mohammad, and W. H. Teoh, "Typical conversion of lignocellulosic biomass into reducing sugars using dilute acid hydrolysis and alkaline pretreatment," Cellulose, vol. 23, no. 3, pp. 1491-1520

# Research: Synthesis of Carbon Nanoparticles from Oil Palm Empty Fruit Bunch as Electro-catalyst for Energy Storage

*Written by Brenda Lim Ai-Lian*

*(Universiti Tunku Abdul Rahman)*

The depletion of non-renewable energy had shifted the attention as well as usage to renewable energy sources. Energy storage technologies such as batteries and fuel cells play an important role in storing energy generated from renewable energy sources and enabling the usage of portable electronic devices in our daily lives. The metal-air battery (MAB) is a technology that operates through electrochemical reactions between the metal anode and oxygen from the ambient air through the air cathode. However, the commercialization of MAB was hindered due the high cost of electro-catalyst in the air cathode. Hence, it is crucial to find a cheaper and robust alternative electro-catalyst material.

Carbon materials were discovered to perform well as electro-catalyst due to its porous structure and high catalytic activity during the discharge and charge process at the air cathode. Biomass waste is a promising low-cost precursor to synthesize carbon materials due to its high carbon content and huge availability. Oil palm empty fruit bunch (OPEFB) is widely generated and available especially in palm oil producing countries such as Malaysia and Indonesia. Consequently, it could be a promising precursor as the electro-catalyst. This study was carried out to synthesize low-cost carbon nanoparticles from OPEFB to be applied as an electro-catalyst material in MAB.

The synthesis process included the pre-treatment of OPEFB followed by the carbonization of the precursor. The carbonized precursor was then activated with KOH through wet impregnation before it underwent heat treatment followed by washing with HCl and water to remove impurities. The activated carbon was dried and stored in sealed containers prior to subsequent usage. A preliminary study was conducted for the comparison between 2 carbonization methods including carbonization with limited air in a chamber furnace and carbonization with inert condition in a tube furnace purged with nitrogen gas.

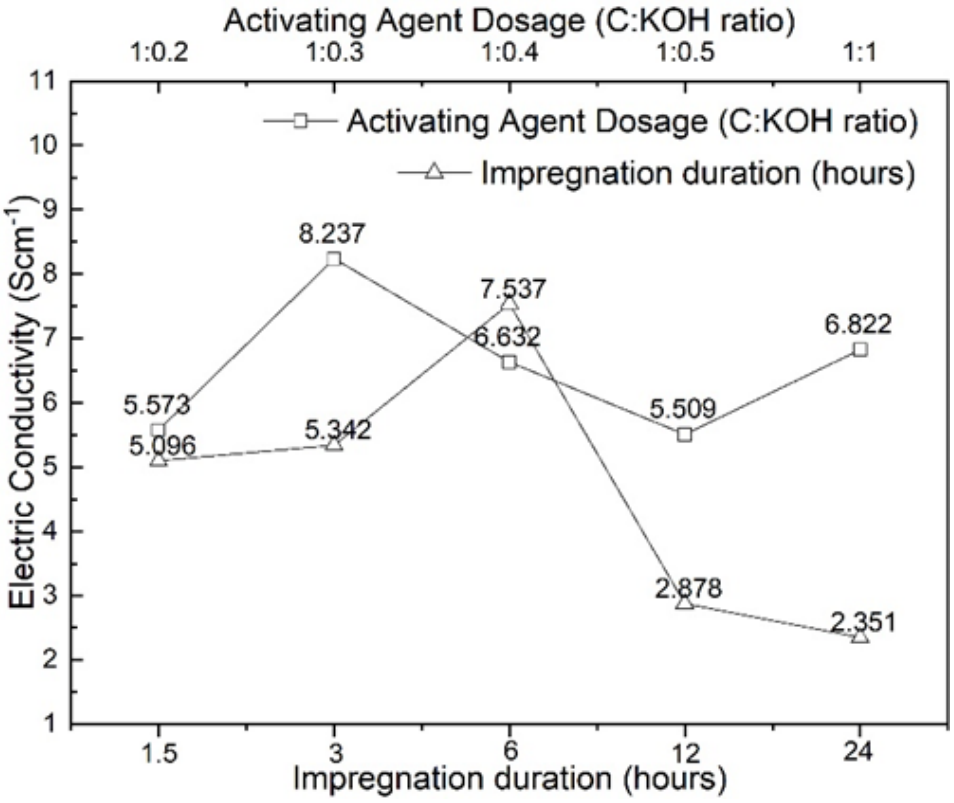



Figure 1:. Change in EC with activation parameters

The experimental study included several parameter studies such as the activation impregnation duration, activating agent ratio, carbonization time and carbonization temperature. The electrical conductivity (EC) of the synthesized carbon samples was carried out via the current sweep method using a potentiostate (ZIVE, SP1). The carbon samples were mixed with carbon black, polytetrafluoroethylene dispersed in water and a few drops of 1,3-propanediol until a homogeneous paste was formed. The paste was moulded onto a carbon cloth and shaped into a rectangular form before being left to dry in an oven. The dried carbon electrode was then clipped on the ends with crocodile clips and the current sweep was performed.

Based on the preliminary results obtained, carbonization of OPEFB using the tube furnace was preferred compared to the chamber furnace. A layer of ash was found in the carbonized sample using chamber furnace which was absent when the tube furnace was used instead. Ash content is less desirable as it increased the material's resistance which affects the EC performance negatively. The samples synthesized using the tube furnace achieved higher EC than that with chamber furnace at 5.59 and 4.83 S cm-1, respectively. Hence, the subsequent experimental study was carried out with the tube furnace.

Based on the experimental study, it was deduced that the optimum parameters to synthesize carbon material were KOH impregnation of 6 hours with 1:0.3 carbon to KOH weight ratio. KOH activation was carried out to induce the generation of porous structure. KOH can generate more pores in the carbon material when it reacts with carbon and alters its lattice structure. More pores were formed when the products or K compounds were removed through heat treatment and washing [1]. Porous structure is a desirable characteristic in a carbon material. It is able to provide higher surface area which gives higher number of active sites as well as better channelling to improve the mass transfer and subsequently enhances the EC of the material.

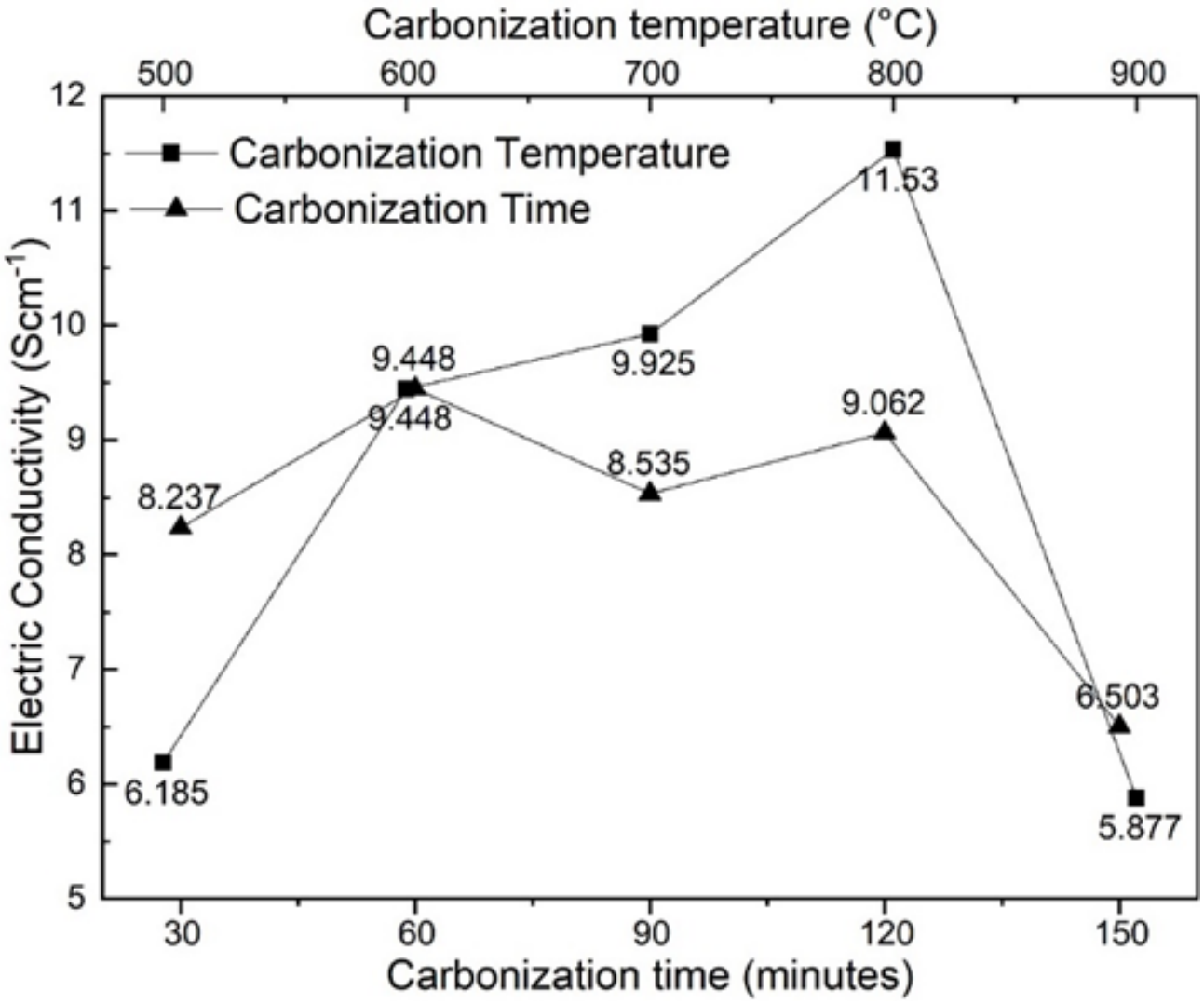



Figure 2. Change in EC with carbonization parameters

Figure 1 illustrates the change in EC with impregnation duration and activating agent dosage. The impregnation duration had affected the SSA of the carbon samples by providing adequate time for the activating agent KOH to react with the carbon structure and thus increasing the rate of reaction [2]. Similarly, higher activating agent dosage also increased the rate of reaction which enhanced the formation of pores. However, extended impregnation reaction and excessive activating agent added would be redundant as there would be less available carbon or active sites to react with the activating agent. In addition to that, high rate of activation would lead to excessive reactions between the carbon and KOH that resulted in the widening and sintering of pores. This explained the drop in SSA and EC of the carbon samples.

The carbonization of precursor at 800 °C for 60 minutes was found to yield carbon nano-particle with the highest SSA and EC at 807.85 m2g-1 and 11.53 S cm-1, respectively. Figure 2 illustrates the change in EC with carbonization time and temperature. Low carbonization temperature and short carbonization time resulted in incomplete decomposition of the lignocellulosic content as well as removal of volatile content in the OPEFB [3]. The decomposition of the lignocellulosic content in OPEFB is crucial as it can concentrate higher carbon content to promote the electrical conductivity. On the other hand, the removal of volatile content is also important in the generation of porous structure by leaving indentation or defects in the carbon structure [1]. However, prolonged carbonization time and excessively elevated temperature were detrimental to the thermal stability of the carbon framework which caused the pores to widen and fuse and subsequently resulting in the collapse of the carbon structure [4]. Hence, it is important to find the optimum parameters to enhance the EC without jeopardising the stability of the carbon framework.

In conclusion, OPEFB was found to be a promising precursor to synthesize an alternative low-cost electro-catalytic material for energy storage. Killing two birds with one stone, this approach could also aid in the reduction of biomass waste in the agricultural sector. As such, this project fulfils the circular economy concept and enhances the sustainability of energy storage in the future.

## Reference

1. Wang, J.; Kaskel, S. KOH Activation of Carbon-Based Materials for Energy Storage. Journal of Materials Chemistry 2012, 22, 23710–23725.

2. Charola, S.; Patel, H.; Chandna, S.; Maiti, S. Optimization to Prepare Porous Carbon from Mustard Husk Using Response Surface Methodology Adopted with Central Composite Design. Journal of Cleaner Production 2019, 223, 969–979, doi:10.1016/j.jclepro.2019.03.169.

3. Leng, L.; Xiong, Q.; Yang, L.; Li, H.; Zhou, Y.; Zhang, W.; Jiang, S.; Li, H.; Huang, H. An Overview on Engineering the Surface Area and Porosity of Biochar. Science of the Total Environment 2021, 763.

4. Sekhon, S.S.; Kaur, P.; Park, J.S. From Coconut Shell Biomass to Oxygen Reduction Reaction Catalyst: Tuning Porosity and Nitrogen Doping. Renewable and Sustainable Energy Reviews 2021, 147.

# News: 2022 POPSIG Award Winners

**(January-March)**

## Best Post-event Report Award — sponsored by MPOC: IChemE Student Chapter Festival 2022

### Ng Wai Hoong

Wai Hoong is a second-year Bachelor of Engineering in Chemical Engineering student in 2021/2022 at Universiti Malaya. He was the Director of IChemE Student Chapter Festival 2022, which was a nationwide event connecting Student Chapters. He was the Head of Multimedia and Technical Department in Engineering Development, Motivation and Awareness Training-43 (EDMAT-43) in 2022. Wai Hoong was also a member of delegation department in Regional Chemical Engineering Conference (RCEUC) 2021.

## Best Post-event Report Award — sponsored by MPOC: University Roadshow @ Universiti Sains Malaysia

### Tan Kah Huat

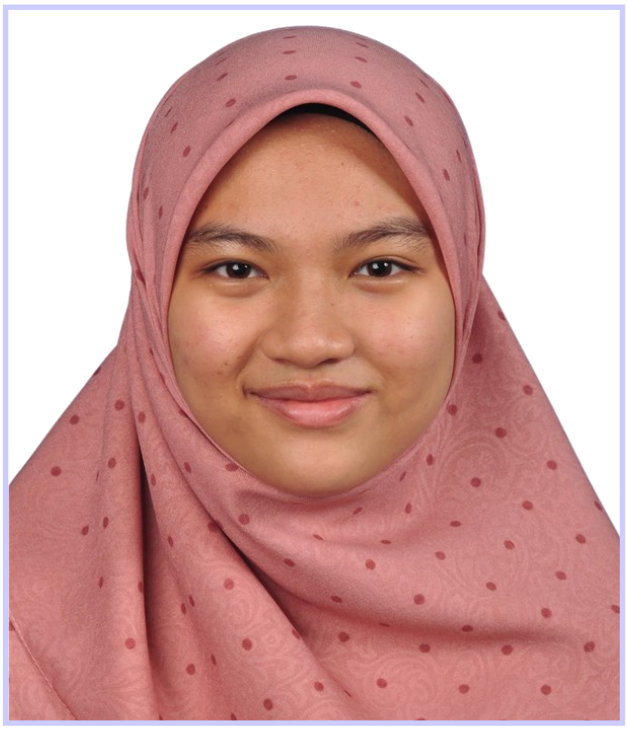
Kah Huat is a third-year Bachelor of Engineering in Chemical Engineering student in 2021/2022 at Universiti Sains Malaysia. He has consecutively been awarded Dean's List from Year 1 Semester 1 to Year 3 Semester 1. He was also selected as the Top 6 Winner for Southeast Asia Global Innovation Challenge (SEA-GIC) 2021. In 2021, Kah Huat joined TF-AMD Microelectronics Penang as a Voluntary Intern. He is the Vice President of USM Chemical Engineering Student Society (ChESS) in 2021/2022. He was the President for ChESS Virtual Charity Run 2020, which was awarded Golden Activity of The Year. Kah Huat is awarded TORAY Group (Malaysia) Scholarship from 2019 to 2023. He was also presented Gold Medal & Best Malaysian Young Inventor for 29th International Invention, Innovation & Technology Exhibition (ITEX) 2018.

## Best Post-event Report Award — sponsored by MPOC: Sustainability-oriented Symposium

### Lee Shuet Yee

Shuet Yee is a second-year Bachelor of Chemical Engineering (Honours) student in 2022 at Monash University Malaysia. She was awarded Faculty of Engineering Dean's Honour List 2021, and since 2021 Monash High Achiever Award. He has consecutively been awarded Dean's List from Year 1 Semester 1 to Year 3 Semester 1. Shuet Yee is the Secretary of Monash IChemE Student Chapter (2022) and, since 2021, has been Monash University Student Ambassador. She worked as a high school substitute teacher at SMK Cochrane from November 2021 to January 2022 and had taught Mathematics, Science and Chemistry to lower and upper form students.

## Best Post-event Report Award — sponsored by MPOC: Virtual Industry Visit to Desmet Ballestra (Malaysia) Sdn Bhd



### Yumna Humaira' binti Hamdi

Yumna Humaira' is a first-year Bachelor of Engineering (Honours) in Chemical Engineering in 2021/2022 at Universiti Teknologi PETRONAS. She was the Project Director for Virtual Industry Visit, Head of Department of Public Relations for Virtual Competition: Low-Carbon Pathway for Growth & Sustainability, Head of Department of Public Relations for E-Culture Race, Assistant Head of Department of Administration for Ready For Take-Off: Our Return, and Committee of Media Department for Life Is In Blood (Blood Donation) at UTP. Yumna Humaira' is also an active member of IChemE-UTP-SC, member of Rotaract Club at UTP and member of Virtual Technology, Education & Career 2022 (UTP).

## Best Post-event Report Award — sponsored by MPOC: Virtual Industry Visit to Desmet Ballestra (Malaysia) Sdn Bhd

### Tai Sin Rhu

Sin Rhu is a first-year Bachelor of Engineering (Honours) in Chemical Engineering student in 2021/2022 at Universiti Teknologi PETRONAS. She was presented Bronze Award for Kangaroo Math Malaysia Competition in 2020. She was the Head of Department of Creative Multimedia in Journalism Club, Head of Department of Multimedia for Journalism in Gen Z workshop session, and Assistant Project Director for Virtual Industry Visit at UTP.

### Shekinah Petin

Shekinah is a second-year Bachelor of Engineering (Honours) in Chemical Engineering in 2021/2022 at Universiti Teknologi PETRONAS. She was awarded Foundation Dean's List 2020. Shekinah is the Exco of Academic Cluster SRCUTP and an active member of IChemE-UTP-SC. She was the Treasurer of Virtual Industry Visit and Head of Facilitator for O'Week May 2022 at UTP.

## Best Post-event Report Award — sponsored by MPOC: POPSIG Technical University Roadshow 2022

### Kelvin Ong Jee Hui

Kelvin is a third-year Bachelor of Engineering in Chemical Engineering student at Curtin University Malaysia in 2022. He received the best presentation award in 2020 for presenting physics project, and Commendation Letter for Year 1 and Year 2. Kelvin joined Curtin Malaysia IChemE Student Chapter in 2021 as a Designer and became Vice President in 2022. He was also the organising chairperson for a virtual site visit to a glove manufacturing company in 2022.

### Lee Sing Ying

Sing Ying is a third-year Bachelor of Chemical Engineering student at Curtin University Malaysia in 2022. She received the Dean's list awards in 2021. She is the President of Curtin IChemE Student Chapter for 2022 term. She was the External Committee of Rotaract Club 2019 term, Secretary of VAD 57 (Voluntary Act Detachment) aka Malaysia Red Crescent for 2019-2020 term, and External Committee in ICMCC for 2021-2022 term. Sing Ying was a 24 Season Drum performer in One Beat One Soul Concert organised by the Curtin Chinese Culture Club. She also participated in community service, such as environment cleaning and tree planting projects by VAD 57. She has volunteered in numerous events, such as internship and placement fair organised by Curtin University Malaysia, OPM Cancer Challenge, Speed Eater Challenge by IChemE and KHitz Dance Competition. Sing Ying received Consolation Prize for Cassini Scientist organised by Planetarium Negara Kementerian Sains, Teknologi dan Inovasi (MOSTI).

## POPSIG Article Honorarium — sponsored by MPOC:

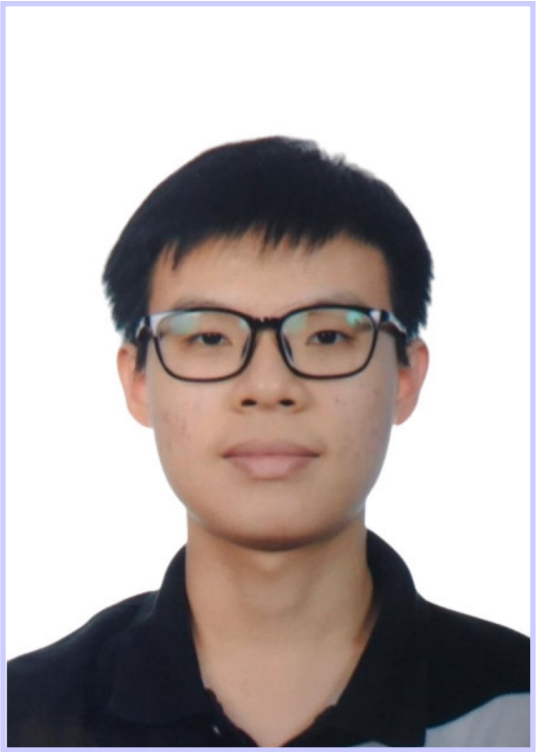
### Amanda Yap Yi Tong

Amanda is a third-year Bachelor of Chemical Engineering student at Universiti Teknologi PETRONAS, Malaysia in 2021/2022 session. She has received the Dean List Award for 8 consecutive semesters. Currently, she is undertaking six-month research internship in France under the National Superior Engineering of Industrial Technologies. Amanda was presented Silver award during ICMCC Innovation and Invention Competition 2021 with top 3 best presentation award; and, Winner of American Institute of Chemical Engineers (AIChE) Refinery Design Internal Competition 2021. She was chosen as Top 100 Monstar Asia Young Talent Award 2021 and awarded the Recipient of PETRONAS Education Sponsorship Programme (PESP). She was the Project Director of UTP IChemE Internship Sharing Session 2020, Vice President of IChemE-UTP-SC 2020/2021 session, and Head of Ceremony and Protocol Department for 'Impacts of Climate Change on Coastal Sustainability' International Forum 2021.

### Gladys Calvina Timothy

Gladys is a third-year Bachelor of Chemical Engineering student at Universiti Teknologi PETRONAS, Malaysia in 2021/2022 session. Currently, she is undertaking an internship in the Integrated Facilities Department at PETRONAS Carigali Sdn Bhd (Sarawak Asset). During her internship, she initiated a Facilities Improvement Proposal (FIP) project on MCOT Cooling Tower System Modifications with the assistance from Field Operation Executive (FOE) prior to FIP registration. She also conducted a research to explore the possibility of integrating Electrocoagulation (EC) technology in MCOT Industrial Effluent Treatment System (IETS) to enhance the effluent discharge quality (EDQ) performance. Gladys won 2nd Runner Up and Silver Award in Innovation & Invention Competition organised by ICMCC 2021. She also won Silver Award in 47th Science & Engineering Design Exhibition (SEDEX47) under Engineering Team Project category.

## POPSIG Article Honorarium — sponsored by MPOC:



### Ng Sheng Tat

Sheng Tat is a second-year Bachelor of Engineering in Chemical Engineering student at UCSI University, Malaysia in 2022. He received the Dean's List Award from the faculty across all the academic years. In 2021, he won a Bronze Award in a Poster Competition organised by UTP. Sheng Tat has joined numerous professional organisations, including IChemE, IET and IEEE students club, where he holds several positions such as Treasurer and Assistant Liaison Department Head.

### Tan Kah Huat

Kah Huat is a third-year Bachelor of Engineering in Chemical Engineering student in 2021/2022 at Universiti Sains Malaysia. He has consecutively been awarded Dean's List from Year 1 Semester 1 to Year 3 Semester 1. He was also selected as the Top 6 Winner for Southeast Asia Global Innovation Challenge (SEA-GIC) 2021. In 2021, Kah Huat joined TF-AMD Microelectronics Penang as a Voluntary Intern. He is the Vice President of USM Chemical Engineering Student Society (ChESS) in 2021/2022. He was the President for ChESS Virtual Charity Run 2020, which was awarded Golden Activity of The Year. Kah Huat is awarded TORAY Group (Malaysia) Scholarship from 2019 to 2023. He was also presented Gold Medal & Best Malaysian Young Inventor for 29th International Invention, Innovation & Technology Exhibition (ITEX) 2018.

## POPSIG Article Honorarium — sponsored by MPOC:

### Yat Yu Dong

Yu Dong is a final-year Bachelor of Engineering in Chemical Engineering student at Curtin University Malaysia in 2022. He received Curtin Malaysia Merit Scholarship and Curtin Malaysia Scholarship in 2018 and 2019. Previously, he joined Top Glove Medical Sdn. Bhd. as a trainee in the production department, where he studied the automated cleaning system, effectiveness of unit operations operability and materials quality. He was the winner of POPSIG Article Honorarium 2021. Yu Dong held the position as communication director and media director at Curtin Malaysia IChemE Student Chapter in 2020 and 2021, respectively.

### Alicia Tan Xin

Alicia is a final-year Bachelor of Engineering in Chemical Engineering student at Curtin University Malaysia in 2022. She received Dean's List Award in 2019, 2020 and 2021; Vice-Chancellor's List in 2019 and 2020 as Top 1% of the undergraduate students across all disciplines, campuses, years and modes of study. In 2021, Alicia joined a medical technology manufacturing company as a manufacturing intern. She received Quarterly Problem-Solving Process Improvement (PSPI) Award during an internship at Boston Scientific Medical Device (Malaysia) Sdn Bhd. She joined Curtin Malaysia IChemE Student Chapter as Assistant Event Coordinator and Treasurer in 2019/2020 and 2020/2021 respectively.

## POPSIG Article Honorarium — sponsored by MPOC:

### Thian Sei Gee

Sei Gee is a final-year Bachelor of Engineering in Chemical Engineering student at Curtin University Malaysia in 2022. She is the holder of Sarawak Timber Association Scholarship, Curtin Malaysia Merit Scholarship and Curtin Malaysia Scholarship. Sei Gee previously joined Top Glove Chemical Sdn. Bhd. as a trainee in the production department, where she studied the overall equipment effectiveness (OEE), black particle in sulphur dispersion, sulphur caking issue, control of chemical specification and corrective actions on quality issues. She received Award of Excellence in 4th International Festival of 24 Festive Drums and was the first runner-up in 2nd Borneo 24 Festive Drums Competition. Sei Gee was the designer at Curtin Malaysia IChemE Student Chapter in 2021 and 2021, and also involved in Young Innovate National Competition.

### Nor Afifah binti Sulaiman

Afifah is a Master of Science in Chemistry student at Universiti Malaya and currently a Research Assistant at Sunway University. In 2019, she joined Malaysian Agricultural Research and Development Institute (MARDI), a research and development institute, as a QC intern. She became a Graduate Research Assistant at UM-UTP (collaborated) from 2020 to 2022. Afifah received Dean List award from UiTM in 2019; Gold Award in video documentary competition in 2020; and Silver Award in Low Carbon Pathways competition in 2021. Afifah completed a Diploma of Science at Universiti Teknologi MARA (UiTM) in 2017 and graduated with a Bachelor of Science (Honours) in Chemistry, also, from UiTM in 2019.

# News: Congratulations to Ahmad Shahdan Bin Kasim on His New Role as Conservation Manager at MPOGCF

*Sincerely from*
*IChemE Palm Oil Processing Special Interest Group*

POPSIG would like to send out our warmest congratulations to Mr Ahmad Shahdan Bin Kassim, Conservation Manager at Malaysian Palm Oil Green Conservation Foundation (MPOGCF) on his new role. Shahdan had been contributing to POPSIG University Roadshow in 2021 and 2022 when he was at MPOC.

Shahdan graduated from UPM in 2007 with Bachelor of Forestry Science. Ever since he left college, he has been involved in biodiversity conservation activities when he started his career as Naturalist at one of the world-renowned resorts, the Pangkor Laut Resort. Besides taking care of the biodiversity that exist on Pangkor Laut Island, he also took the tourist for interpretive jungle trekking. After that he joined 2 prominent environmental NGOs in Malaysia namely MNS (Malaysian Nature Society) and GEC (Global Environment Centre). In these 2 NGOs, he was involved with mangrove forest restoration programmes and creating alternative livelihood opportunities for coastal fishermen who were affected by land use changed in their area.

Later, Shahdan join the Department of Wildlife and National Parks (PERHILITAN) and his main task at the Department was on Malayan Tiger conservation program through the National Tiger Conservation Action Plan (NTCAP). Although his journey with PERHILITAN were cut short, his passion in biodiversity especially tiger conservation lives on. His endeavour to save the Malayan Tiger continue when he joined Malaysian Palm Oil Council (MPOC). He has been tasked to look after projects initiated by MPOC under the Malaysian Palm Oil Wildlife Conservation Funds (MPOWCF). Conservation programmes undertaken by MPOWCF includes iconic species such as Asian Elephant, Borneo Pigmy Elephant, Bornean Orangutan and Malayan Tiger. Besides the conservation of wildlife species, conservation projects also include preservation of degraded forest area through projects like 1 Million Forest Tree Planting and restoration of Central Forest Spine (CFS) area.


Figure 1: Mr Shahdan met Mr. Lim from MPOC in MITEC during MIACES.

In 2021, when MPOWCF was upgraded into Malaysian Palm Oil Green Conservation Foundation (MPOGCF), all conservation programmes under MPOWCF were handed over to MPOGCF and in June 2022, Shahdan has joined MPOGCF as its Conservation Manager.

Overall, with his 15 years of experiences in biodiversity conservation, he hopes to transform the Malaysian palm oil industry to be the most sustainable industry and the most wildlife friendly industry in the world.

Figure 2 (above): Mr. Shahdan and MPOGCF's team visiting the family of the victim of elephant attack in Mentakab, Pahang to hand over MPOGCF's contribution of RM5000 to help ease the burden of the deceased's family.


Figure 3 (left): Announcement of the appointment of Ahmad Shahdan Bin Kasim as the Conservation Manager of MPOGCF.

# POPSIG is the Official Institution Partner of Malaysia International Agricommodity Expo & Summit 2022

***Organised by Ministry of Plantation Industries and Commodities***

## Organiser

Malaysia International Agricommodity Expo & Summit (MIACES) is organised by the Ministry of Plantation Industries and Commodities (MPIC) Malaysia, and co-organised by Malaysian Rubber Council (MRC), Malaysian Palm Oil Council (MPOC) and Malaysian Timber Council (MTC). POPSIG is the official Institution Partner of MIACES 2022. The theme of MIACES 2022 is Advancing Agricommodity in Sustainable Ecosystem.

## About event

MIACES aims to provide a platform to uplift the agricommodity sector. The event comprises of conference, exhibition, roundtable discussions, B2B meetings and awards night. It also focuses in bringing all the industry players, producers, investors and other stakeholders all together to showcase their products, latest equipment and technology under one roof.

## POPSIG as Institution Partner

POPSIG is delighted to be an official Institution Partner of MIACES 2022.


Figure 1: POPSIG was the Official Institution Partner of MIACES 2022




Figure 2 & 3: Posters credit to MIACES 2022

1ST ANNOUNCEMENT

JOINTLY ORGANISED BY

IChemE

Palm Oil Processing
Special Interest Group

ACADEMIC RESEARCH ON PALM OIL SUSTAINABILITY
ARPOS

# POPSIG-ARPOS SEMINAR 2022

## Roles of Palm Oil Industry in Achieving UN SDGs

THE GLOBAL GOALS

DATE: Monday 04 July 2022
TIME: 16:00-18:30 MYT(UTC+8)
PLATFORM: ZOOM (Fully Virtual)

PROUDLY SUPPORTED BY

MPOC

MONASH University MALAYSIA

MONASH INDUSTRY PALM OIL PLATFORM

Universiti Kebangsaan Malaysia
The National University of Malaysia

Sime Darby YAYASAN

WWW.ICHEME.ORG/SDG-SEMINAR-2022

RCEUC 2022 - KEYNOTE SPEECH

# REIMAGINING PLANTATIONS

AUGUST 2022

**18**

THURSDAY

## Harikrishna Kulaveerasingam

**CHIEF RESEARCH AND DEVELOPMENT OFFICER, SIME DARBY PLANTATION BERHAD**

Event is supported by IChemE Palm Oil Processing Special Interest Group and Malaysian Palm Oil Council

# Apply for 2022 Final Year Design Award

# Apply for 2022 Student Bursary

# Apply for 2022 Student Research Project Bursary

IChemE
Palm Oil Processing
Special Interest Group

Sponsored by:
MPOC

2022 POPSIG Student Research Project Bursary

**Award** : RM3000 per project

**Eligible** : Undergraduate & Postgraduate students

**Deadline** : 15 August 2022

**More info** : IChemE.org/palm-research-bursary

**Email** : popsigmalaysia@gmail.com

SCAN ME

IChemEPOPSIG
IChemEPOPSIG
ichemepopsig

# Apply for 2022 POPSIG Palm Oil-Themed Article

## POPSIG PALM OIL-THEMED ARTICLE

## 2022

**Call for article**

**Theme: Correcting the misperception on palm oil**

### Introduction

- Palm oil industry contributes to economy, society and environment
- The objective is to encourage the public participation in promoting palm oil sector

### Scope of article

- Discuss any **myths, misinformation, misperception** or **incorrect information** about **palm oil**

### Topics

- Employment, sustainability, digitalisation, circular economy, health, environment

### Deadline: (Open all year round)

- Selected article will be published in **POPSIG Newsletter**
- Submission deadlines are shown at www.icheme.org/palm-article-honorarium

**RM200** for selected article

**For more info:**
popsigmalaysia@gmail.com

IChemE
Palm Oil Processing Special Interest Group

ichemepopsig | IChemEPOPSIG | IChemEPOPSIG

MORE INFO

# Apply for IPOSC 2022 Infographic Competition

MSPO

MALAYSIAN PALM OIL FULL OF GOODNESS
www.fullofgoodness.com.my

**FINAL ANNOUNCEMENT**

ORGANISER
MPOC

EVENT PARTNER
MPOGCF
Sime Darby Plantation

GOLD SPONSOR
MPOCC

BRONZE SPONSOR
FGV

# IPOSC 2022

## INTERNATIONAL PALM OIL SUSTAINABILITY CONFERENCE

## SHIFTING SUSTAINABILITY COMPLIANCE INTO SUSTAINABILITY STEWARDSHIP

**Tuesday, 13 September 2022 | 9:00 am - 5:30 pm**

**InterContinental Hotel, Kuala Lumpur, Malaysia**

**2 WEEKS LEFT!**

**Highlights**

- **Plenary Paper : YBhg. Tan Sri Dr. Zakri Abdul Hamid**
  Joint Chairman, Malaysian Industry-Government Group for High Technology (MIGHT)
- **8 Paper Presentations by Experts**
- **Forum : Moving Towards Net Zero and Decarbonisation – The Future of Certification and Sustainability**

**For more information on IPOSC 2022:**
**https://bit.ly/IPOSC2022**

REGISTRATION FEE
**RM500/pax**

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

# UPCOMING EVENTS

| DATES | EVENTS |
|---|---|
| 4 July 2022 | POPSIG-ARPOS Seminar: Roles of Palm Oil Industry in Achieving United Nations Sustainable Development Goals |
| 26-28 July 2022 | Expo: Malaysia International Agricommodity Expo & Summit 2022—Advancing Agricommodity in Sustainable Ecosystem |
| 8-9 August 2022 | Event: 33rd Symposium of Malaysian Chemical Engineers |
| 17-18 August 2022 | Event: Regional Chemical Engineering Undergraduate Conference 2022 |
| 13 September 2022 | MPOC Conference: 7th International Palm Oil Sustainability Conference (IPOSC) 2022—Shifting Sustainability Compliance into Sustainability Stewardship |
| 26 September 2022 | Event: POPSIG Research and Design Showcase 2022 |
| 18-19 October 2022 | MOSTA Congress: Oils and Fats International Congress (OFIC) 2022—Boosting the Potential of Oil Palm and Its Products |
| 7 November 2022 | Webinar: Conversion of refinery byproduct PFAD to biodiesel by catalytic and photocatalytic processes |
| 22 November 2022 | Forum: Circular Economy - Exploring The Industry Symbiosis Within and Outside the Palm Oil Industry |
| 22-24 November 2022 | Event: National Chemical Engineering Symposium 2022 |

# IChemE offices

## Global headquarters

### UK

Tel: +44(0) 1788 578214
Email: membersupport@icheme.org

### Australia

Tel: +61(0) 3 9642 4494
Email: austmembers@icheme.org

### Malaysia

Tel: +603 2283 1381
Email: malaysianmembers@icheme.org

### New Zealand

Tel: +64 (4) 473 4398
Email: nzmembers@icheme.org

### Singapore

Tel: +65 6250 0385
Email: singaporemembers@icheme.org