The Palm Oil Industry can be Net-Zero Carbon by 2040

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

The pledges

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

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

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

Palm oil has the lowest CO2 emissions

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

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

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

*Preliminary Data

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

<u>The palm oil industry is approaching net-zero carbon emissions</u>

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

Table 2. Reduction in KLK's GHG emission intensity

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

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

It is important to measure as you cannot improve if you do not measure. We are waiting for the MSPO (Malaysian Sustainable Palm Oil) GHG calculator, which we are told will be available at the

beginning of 2022. Then we can see where we stand with 96% of plantations certified and 89% of mills certified to MSPO. Bear in mind only 20% are certified to RSPO.

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

Getting to Net-Zero Carbon

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

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

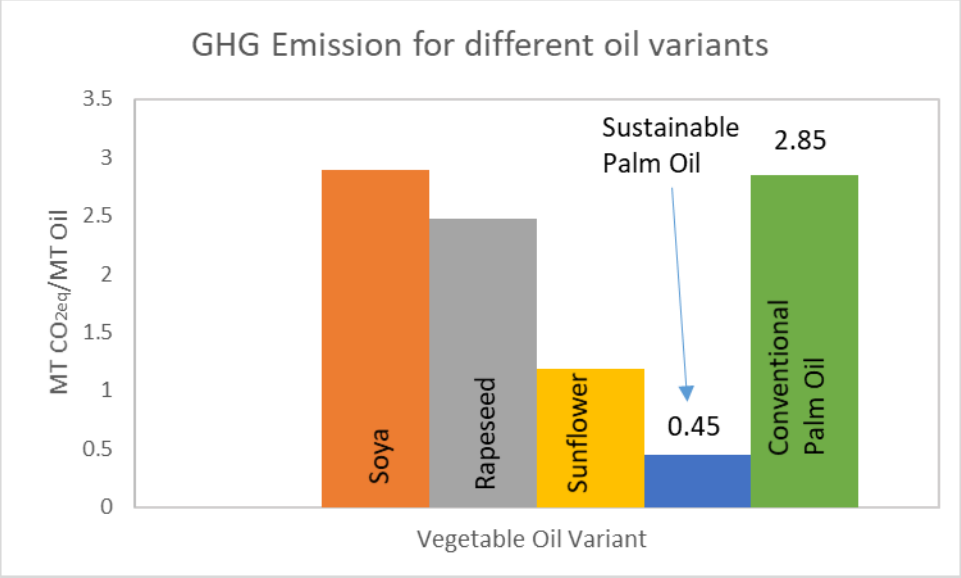

Figure 1 – GHG emissions predicted by different vegetable oil crops, with sustainable oil palm being the lowest emitter of GHG (data source: IAFES – Maria Vincenza Chiriacò).

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

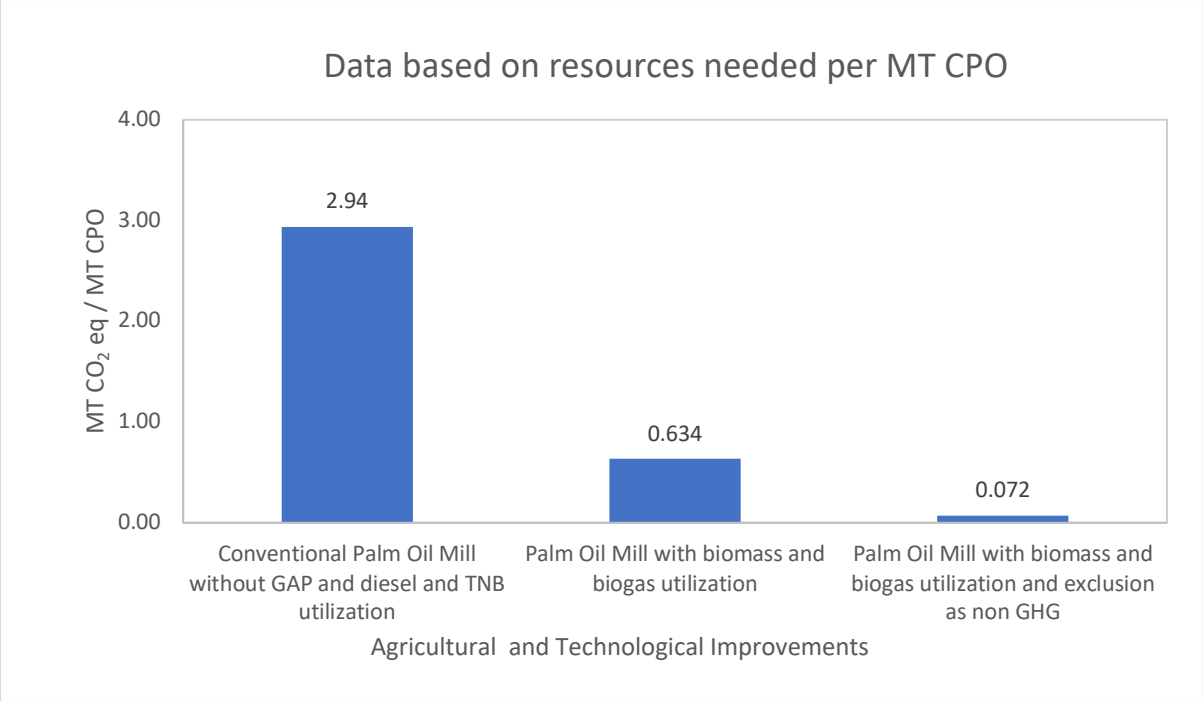

Figure 2 – Our calculations on reductions of GHG emissions for the plantation and the mill as a single unit.

The first bar of 2.94 Mt CO2eq/MT CPO is for a plantation without GAP (Good Agricultural Practices) and a mill powered by diesel and electricity supplied by an external source, such as Tenaga Nasional Berhad (TNB). The second bar of 0.634 Mt CO_2eq/MT CPO is for with GAP and the mill using all its biomass and biogas for energy generation. Bear in mind that for every tonne of crude palm oil 4 tonnes of biomass (empty fruit bunches, mesocarp fibre, palm kernel shells) is available. In the last bar of 0.072 Mt CO2eq/MT CPO we have discounted the GHG from biomass. This argument is valid as the biomass that is renewable is a by-product of the milling process. We have not got to zero because there is insufficient biomass. But we are almost at net-zero carbon, which can be met with actions that we will cover downstream.

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

<u>Use of biomass has challenges</u>

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

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

The mill would need to make investments and in line with Malaysia's net-zero carbon target, the government should assist by providing matching grants to mills. Perhaps some the RM12 billion

windfall tax could be channelled here. Such a programme could be as fast as 10 years or as long as 20 years but may be accelerated well before 2050.

What can be done downstream

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

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

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

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

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

The benefits of achieving net-zero carbon emissions

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

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

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

Conclusion

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

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