WORLD BIOGAS ASSOCIATION

Market Report

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Overview

The Malaysian biogas industry has picked up since 2016 driven primarily by the palm oil industry. The government's proposed requirement of digesting all palm oil mill effluent by 2020 as a part of the National Transformation Programme, Key Economic Area, and introduction of feed in tariffs for electricity generated has resulted in the deployment of AD at palm oil mills; however, there is much still to be done for utilisation of agricultural, municipal and industrial organic waste. Demand for the feed in tariff (FIT) quota exceeded the 25MW allocated for biogas operations in 2017. While the limited support is capping the growth of the industry, there are signs of growing interest and investment both from the industry and the government.

Current Status

Malaysia currently has ~68MW installed biogas capacity under the feed in tariff scheme with an additional 73MW approved and waiting commencement. 226 GWh of renewable energy was generated from biogas in 2018 resulting in 464 ktonnes of avoided CO_2 emissions[1]. Figure 1 shows the electricity generated by projects operating under the FIT scheme in Malaysia since 2012. It shows how the biogas industry has grown by 400% since 2014.

[1]SEDA (2018) Renewable installed Capacities https://bit.ly/2tvroeD Accessed on 24/01/2019

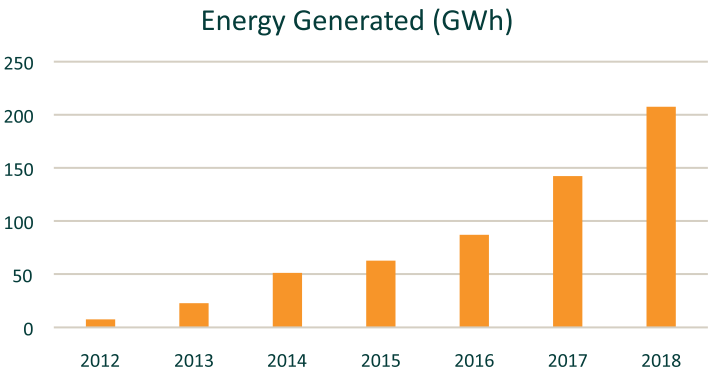

Figure 1

The year 2017 recorded the highest increase in activity in the biogas sector. A cumulative total of 30 biogas FIT projects with installed capacity of 55.83 MW had achieved commercial operations by 2017, as compared to 2016, when 18 biogas plants with 30.89 MW capacity were operating[2]. 2018 saw the addition of 11.71 MW of installed capacity[3].

Currently, there are 2 biomethane upgrading plants operating in Malaysia: one is a government owned plant located in Sabah built by SIRIM, the other is a plant owned by Felda built by Sime Darby Engineering with Gas Malaysia. Both these plants use palm oil mill effluents as feedstock and utilise the upgraded biogas as vehicular fuel[4,5].

The biogas industry in Malaysia is currently being driven primarily by palm oil mills and biogas capture from landfills[6]. In addition to those under FIT, there are biogas plants built in Malaysia which flare their biogas. These take advantage of the carbon savings from the capture of biogas and flaring it but not that of the energy content of biogas. The exact number of such plants is not known[7].

Key Drivers

- **GHG abatement targets:** Malaysia ratified the Paris Agreement and under its Intended Nationally Determined Contribution (INDC) committed to reduce its greenhouse gas emissions intensity of Gross Domestic Product by 45% by 2030 as compared to intensity in 2005[8].

- **Environmental strategy:** The 11th Malaysia Plan guided by the Malaysian National Development Strategy, sets a target of 2,080MW of installed renewable energy (RE) capacity by 2020, raising the RE portfolio to 7.8% — from less than 1% today — of the national electricity generation. It is targeted that 12% of 2080MW capacity (~250MW) should come from biogas supported by FIT and Net Energy Metering schemes[9].

- **National Key Economic Area:** Malaysia aims to become a high-income nation by 2020 and development of biogas facilities at palm oil mills across the country is one of the identified steps towards achieving that goal. Malaysia proposes to have biogas plants on all operating palm oil mills by 2020. Currently, only mills with a biogas plant or with plans of biogas plants are able to extend their licenses[10].

- **Feed in tariff:** Introduced in 2011, the feed in tariff is available for generators of renewable energy, including biogas produced from agricultural wastes and landfills. Biogas based electricity feed into the grid gets a guaranteed price from the government with bonus benefits for higher energy efficiency, use of locally manufactured or assembled technology and use of landfill, sewage or agricultural waste including animal waste. The feed in tariffs are valid for 16 years from commencement date, funded via a 1.6% levy on electricity bills[11,12]. In 2018, Malaysia started transition to an e-bidding mechanism within the current FIT system by which projects under 5MW are able to bid for basic feed in tariff for a share of biogas application quota[13].

- **Tax benefits:** A number of tax benefits: exemption from income tax, investment tax allowance, import and sales tax exemptions are available for generators of renewable energy.

- **Financial support:** Green Technology Financing Scheme, Domestic Investment Strategic Fund and other technology acquisition grants provide partial financing amount to qualifying projects.

- **Local stakeholders for deal facilitation:** Organisations like the Malaysian Biomass Industries Confederation, Agensi Inovasi Malaysia, BioTechCorp and Malaysian Industry-Government Group for High Technology are open to receiving applications for projects.

The opportunity

- **Palm Oil Mill Effluent (POME)** – Malaysia is the second largest producer and exporter of palm oil in the world. The extraction process of palm oil requires vast amounts of energy and water and generates large quantities of solid (empty fruit bunches, palm press fibre, palm kernel cake, palm kernel shells, decanter cake), liquid (Palm Oil Mill Effluent) and gaseous waste[14].

  The Palm Oil Mill Effluent (POME) is high in organic carbon loading and also releases methane into the atmosphere during decomposition. With the palm oil industry growing year on year, capturing methane from these waste materials presents a very unique opportunity in high production countries like Malaysia, Indonesia and Thailand.

  As of the end of 2018, Malaysia had 451 palm oil mills operating. These process 97.8 million tonnes of fruit bunches every year[15].

[2] SEDA Annual Report 2017

[3] SEDA (2019) Operational plants https://bit.ly/1jxFArz Accessed on 24/01/2019

[4] Sime Darby (not dated) 1st Bio-compressed natural gas (Bio-CNG) commercial plant: a case study on converting biogas from POME into BioCNG for industry use https://bit.ly/2EkhylX Accessed on 24/01/2019

[5] Azhar Abdul Raof (2014) Bio natural gas from palm oil mill effluent (POME) https://bit.ly/2GSpywc Accessed on 24/01/2019

[6] SEDA (2018) Renewable energy capacity map https://bit.ly/2Nh8lO6 accessed on 24/01/2019

[7] Harmen Dekker, DMT (2019) Personal Communication

[8] MESTECC (2018) Malaysia: Third national communication and second biennial update report to the UNFCCC https://bit.ly/2U04k3g Accessed on 04/01/2019

[9] 11th Malaysia Plan https://bit.ly/2BLbroT Accessed on 04/01/2019

[10] EU-Malaysia Chamber of Commerce and Industry (2017) Oil palm biomass and biogas in Malaysia, 2017 https://bit.ly/2GP6UFv Accessed on 04/01/2019

[11] Sustainable Energy Development Authority Malaysia http://seda.gov.my/

[12] The Edge (not dates) Untapped potential of biomass and biogas energy in Malaysia https://bit.ly/2Nh1DYp Accessed on 04/01/2019

[13] SEDA (2018) Quota release for biogas https://bit.ly/2SeklAX

[14] Chaikitkaew S, Kongjan P and O-Thong S (2015) Biogas production from biomass residues of palm oil mill by solid state anaerobic digestion, Energy Procedia, 79, pages 838-844 https://bit.ly/2GBvnP3

[15] Malaysian Palm Oil Board (2018) Sectoral status 2018 https://bit.ly/2Vd9ZmN Accessed on 10/01/2019

The mills generate 68 million m^3 of POME as a result. If all of this effluent were digested anaerobically, it can generate over 500MW of electricity for the mills (calculated). In 2016, 92 biogas plants were operating on palm oil mills, with additional 9 under construction and 145 in various planning stages[16]. There is still potential for this sector to nearly double.

- **Digestate Utilisation:** Currently digestate from POME digestion is not recycled into fertiliser and this is an opportunity for the industry both to raise its environmental performance by recovering this resource, and to reduce use of artificial fertilisers in palm oil cultivation.

- **Dry digestion of solid palm oil mill waste:** 60% of the waste generated in palm oil mills is solid - empty fruit bunches, palm press fibre, palm kernel cake, palm kernel shell, decanter cake. These are currently mulched or shredded and baled and shipped to China or used as biomass in the boilers. There is an opportunity to dry digest these substrates to produce biogas which can substitute the biomass in the boilers while the digestate can substitute the mulch.

- **Sharing cost of grid connection:** For mills that are not currently connected to the grid, economies of scale can be developed through the development of clusters and centralised sites. Another option is to have a mechanism to connect to the grid or upgrade existing grid on a fair cost-sharing basis between the mill operators and grid owners. This could lead to improvement of financials for AD and hence growth in the sector.

- **Biomethane:** Even in the absence of direct financial incentives, there is increasing interest amongst industries and palm oil mills to capture of biogas for use as biomethane to offset the use of diesel in boilers and truck fleets. With an existing gas grid, there is also growing interest in injection of biomethane to grid. Supporting biomethane production and utilisation can have substantial benefits in regions which are not yet connected to the electricity grid[17].

- **Livestock manure:** Malaysia has 0.7 million cattle, 1.6 million pigs and 308 million chickens[18]. It has been estimated that there is potential for the generation of 1043 MW of energy recovery from animal manures. This will also address the issues faced by farms related to odours and flies.

- **Food waste and sewage:** Malaysia has a population of over 31 million people generating sewage as well as food waste. These two sources of organic matter have the potential of generation 285 MW of energy and nutrients (calculated).

- **Agricultural residues:** Residues from the production of major crops of Malaysia aside from palm oil: rubber, cocoa, rice, coconut, cassava, corn, and sugarcane are also available for the production of biogas[19].

[16] Loh S. K, Nasrin A. B., Mohamad Azri S., Nurula Adela B., Muzzammil N., Daryl Jay T., and Stasha Eleanor R A (2017) Biogas capture – A means of reducing greenhouse gas emissions from palm oil mill effluent, Oil Palm Bulletin, 75, November 2017, p 27-36 http://palmoilis.mpob.gov.my/publications/OPB/opb75-loh.pdf

[17] Harmen Dekker, DMT (2019) Personal Communication

[18] FAO STAT (2018) Live animals – Malaysia http://www.fao.org/faostat/en/#data/QA

[19] N. Abdullah and F. Sulaiman (2013). The Oil Palm Wastes in Malaysia, Biomass Now - Sustainable Growth and Use, Dr. Miodrag Darko Matovic (Ed.), InTech, DOI: 10.5772/55302. Available from: https://bit.ly/28QXqel

DMT – Example Case Study

Scenario: The palm oil mill has a renewed licence but is too far (>10 km) from an electricity grid connection so the question arises, how to utilise the biogas? The mill can supply itself with electricity via ample supply of biomass in boilers. Small extra capacity is needed on electricity and Bio-CNG will save on diesel.

Input: The palm oil mill treats 60 t fresh fruit bunch per hour.

Output: The digestion of POME produces +/-1200 Nm^3/h biogas, of which the mill uses 300 Nm3/h onsite. 900 Nm^3/h of biogas is upgraded to approximate 13.500 Kg CNG per day. This has potential diesel savings during season of 250 days (factor 1.5): 5,062,500 litre. With a diesel price 2.2 RM per litre it gives a total saving of RM 11 Million per year.

Investment: Gas cleaning, small CHP engine, CNG compressor & set up: RM 10,5 million.
Investment on gas capture (digester): RM 14,5 million (obligatory)
Total: RM 25 million

Current Barriers

- **Grid connectivity:** Most palm oil mills are located in remote areas. This means that they are not always connected to the grid or are not connected to the high-voltage transmission grid. This leads to either inability to make use of the FIT or higher upfront expenditure to build infrastructure. This is being addressed by the government but infrastructure upgrades are long term projects. In the short and medium term, businesses are also looking into utilising biogas onsite, selling it as domestic fuel for cooking and investing in microgrids and clusters.

- **High opportunity cost:** The income generated from the FIT is quite low as compared to the core palm oil business. The same investment in the plantation development is likely to produce much higher returns. Mills harness biomass as a cheaper alternative for bioenergy or bail it for export[20].

- **Insufficient funds for feed in tariff:** The total FIT quota offered to the prospective biogas applicants in 2017 was insufficient to meet the existing demand due to the constraints in the Renewable Energy fund. The Renewable Energy fund is financed by a 1.6% levy added to the electricity bills of all consumers (except Sarawak) meeting a minimum use criterion. The government is now transitioning to an e-bidding system for FIT biogas quota which will make the market more competitive[21]. Financial investment from the government would be able to attract more projects to be implemented.

[20] The Edge (not dated) Untapped potential of biomass and biogas energy in Malaysia https://bit.ly/2Nh1DYp Accessed 04/01/2019

[21] SEDA Annual report 2017

- **Lack of regulatory support and incentives for non-electricity uses of biogas:** Malaysia does not provide any regulatory or financial incentives for capture of heat, injecting biomethane into the gas grid or utilising it as vehicle fuel. Wider support for production of different forms of renewable energy from biogas and utilisation of more diverse feedstocks such as food waste, sewage, and livestock manures are required for the development of the sector.

- **Fossil fuel reserves and subsidy:** Malaysia is world's third largest exporter of liquefied natural gas. In addition, it has large crude oil reserves that are tapped extensively and exported. This coupled with the historical subsidy on fossil fuels, which come at a great cost to the economy, society and the environment has hampered the growth of renewable energy in the country. There is indication of intent to end this subsidy in the near future. While only 2% of energy consumed in Malaysia in 2017 came from renewable sources[22], the government target is to reach 20% by 2030 and is working on a number of programmes and reforms to achieve it[23].

Special thanks to

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[22] US Energy Information Administration (2017) Malaysia https://bit.ly/2EjK6Mq

[23] The Edge Markets (2018) Malaysia sets new goal of 20% clean energy generation by 2030 https://bit.ly/2Sg2jy2 Accessed on 10/01/2019

[24] Veolia Case Study (not dated) https://bit.ly/28RXGbr Accessed on 04/01/2019

[25] Ernest Navaratnam, Cenergi (2019) Personal Communication

Case Studies

Serting Hilir Palm Oil Mill (FELDA)[24]

Inputs: Designed to treat 770 m^3/day of palm oil mill effluent (POME).

Output: 1.2 MW of electricity per hour which is used in the operation of the mill. The excess is exported to the grid of the local energy provider (Tenaga Nasional Berhad).

Unique feature: The operation achieves 85% removal of Chemical Oxygen Demand (COD) reduction, which has significant environmental benefits.

Cenergi - Tanah Makmur Biogas Power Plant at Sri Jelutung Palm Oil Mill[25]

Inputs: Effluent from palm oil mill processing 45 tonnes of fresh fruit bunches per hour.

Output: Electricity from 1.5 MW capacity power plant is exported to the national grid via high-voltage cables that connect the biogas plant to the nearest electrical substation.

Unique feature: Since the start of operations in October 2017, Sri Jelutung Biogas Plant has generated over 13.4 million kilowatt-hours of electricity. The Biogas Plant has generated enough power to supply 3,400 homes with electricity (as of January 2019). Cumulatively, the volume of methane that has been prevented from release is equivalent to over 9,600 tonnes of carbon dioxide. Over the long 40-day retention time of anaerobic digestion, the COD level of the POME is reduced by 85 – 90%. The wastewater is then directed back to the mill's own treatment system.

> *Malaysia possesses a huge potential on renewable energy resources. If utilised in a proper way, Malaysia can fulfill its total energy need in a sustainable way! Biogas is an important factor in the sustainability equation which also enables new jobs in this sector. Further it can contribute in solving food waste problems and improve air quality in cities by using bio-CNG as transport fuel.*
>
> **Harmen Dekker,**
> **DMT Environmental Technology**

> *With the support from the Sustainable Energy Development Authority (SEDA)'s feed in tariff Program, Cenergi and other Malaysian companies have proven that biogas provides the Government of Malaysia a solution for renewable energy. From the experienced built to-date from generating electricity, the biogas industry is looking forward to expanding the opportunities to other forms of green energy."*
>
> **Ernest Navaratnam, Cenergi**

We're only a phone call or e-mail away

Have a question about membership?
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