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FROM WASTE TO WEALTH:

The Rise of Biomass Energy in Malaysia

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INTRODUCTION

The demand for energy is currently witnessing a significant growth globally, and the Malaysian market is no exception to this. Since the discovery of fossil fuels such as coal, petroleum, and gas, these fuels have continued to play a vital role in the provision of global energy demand. As of 2020, four energy sources in the national total primary energy supply ("TPES") mix are natural gas (42.4%), crude oil and petroleum products (27.3%) and coal (26.4%), renewables, comprising hydropower, solar and bioenergy (3.9%).

The Malaysian Government under the National Energy Transition Roadmap ("**NETR**") outlines a comprehensive strategic plan to steer the energy systems away from conventional, fossil-fuel-based sources and towards cleaner, more sustainable alternatives, aiming to achieve net-zero emissions by 2050 with a gradual increase in renewable energy shares, targeting 31% by this year, 40% by 2035, and 70% by 2050. There is a diverse range of renewable energy sources including solar, hydropower, biomass, biogas and biofuels [1] and these renewable energy sources are crucial in reducing overreliance on fossil fuels and supporting the transition to cleaner energy.

In this article, we would explore the biomass industry in Malaysia, where biomass energy (bioenergy) utilization is a formidable underlying potential that can be leveraged to further develop the local renewable energy scene in Malaysia and as an option to reduce greenhouse gas ("**GHG**") emission by 45% of the nation's GDP by 2030. [2]

THE BIOMASS INDUSTRY IN MALAYSIA

Biomass refers to organic matter derived from plants, agricultural residues, forestry by-products, and organic waste. [3] Biomass energy, in turn, is a renewable energy solution that is obtained via direct combustion or burning biomass to produce a sustainable, cleaner energy while the heat generated is then used for cooking, heating buildings, and powering steam turbines to generate electricity. [4]

To stimulate the biomass industry in Malaysia, the Ministry of Plantation and Commodities had introduced a guideline known as "*The National Biomass Action Plan (NBAP) 2023-2030*" ("**Plan**") [5] which is intended to generate significant sustainable development benefits in terms of green wealth creation, socioeconomic development and addressing the net-zero emission target through circular economy practices.

It is expected that various institutional enablers will be further strengthened and by the year 2030, it is envisioned that the Plan will contribute to an incremental RM 17 billion economic value and generate around 33,000 jobs. [6]

According to the Plan, there are five (5) types of biomass industries identified by the Ministry of Plantation and Commodities as the core biomass industries with potential areas of growth in Malaysia as follows: [7]

No.	Biomass Industry	Details
1.	Plantation Biomass	The plantation sector offers abundant biomass resources, particularly oil palm and rubber, and biomass generated from these plantations can be harnessed for bioenergy generation and bio-materials production. [8] The plantation biomass sector provides significant circular economy opportunities, of which almost 90% is obtained from the plantation biomass industry alone. [9]
2.	Forestry Biomass	The forestry sector offers significant potential for biomass utilisation as industry residues can be utilised for bioenergy production including heat and electricity generation. The primary sources of forestry biomass are residues from logging activities, wood-based processing industries such as sawn timber mills, plywood mills, veneer processing centres and moulding factories as well as the biomass obtained from felled rubber trees during replanting activities.[10]
3.	Agricultural Biomass	Agricultural residues can be converted into biofuels, carbonised products or used for heat and power generation. The utilisation of agricultural by-products for biomass industries can help reduce waste, promote resource efficiency and create additional revenue streams for farmers. [11]
4.	Livestock Industry Waste	Livestock wastes, such as poultry manure, swine slurry and biogas from anaerobic digestion can be utilised as sources of renewable energy. The utilisation of livestock wastes for energy generation not only reduces GHG emissions but also offers an opportunity for waste management in livestock farming. [12]
5.	Fisheries Industry Waste	Fisheries by-products can be processed into fishmeal, fish oil or hydrolysed to produce bioactive compounds and liquid biofertiliser. Utilising fisheries by-products can reduce waste in the fishing industry and create additional economic opportunities. [13]

In modern times, bioenergy is obtained via thermochemical conversion methods, which include:

i. pyrolysis (biomass heated in the absence of oxygen, resulting in the production of bio-oil, biochar, and syngas),

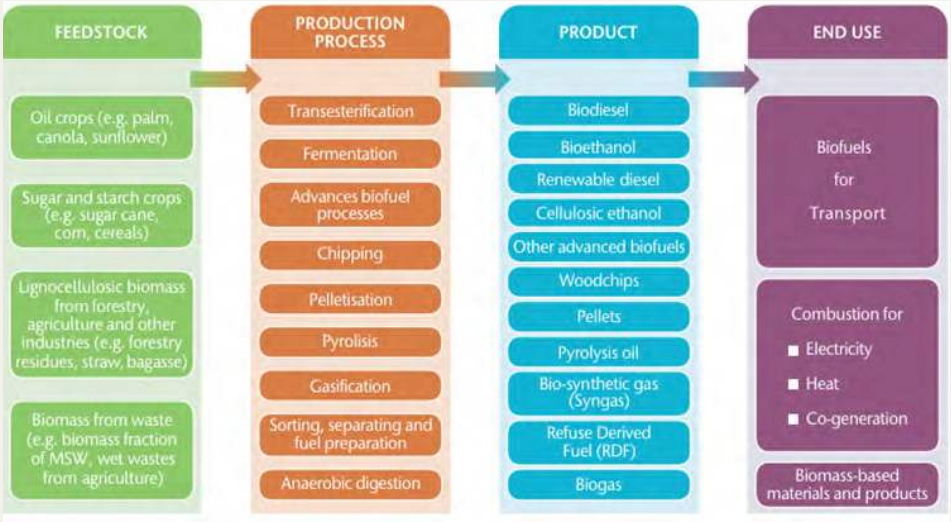
ii. gasification (biomass is converted into syngas containing hydrogen, carbon monoxide, and other components), and

iii. torrefaction (biomass is heated to remove moisture and create a stable, energy-dense material that can be used as fuel), as well as through biological conversion, which involves using microorganisms to break down biomass and produce liquid or gaseous biofuels. [14]

and this efficiently provides for energy needs and replaces the need for fossil fuels.

Figure 1 illustrates a number of the main pathways available for these conversion methods.

Figure 1: Bioenergy pathways: From biomass to final energy use [15]



Source: Technology Roadmap Delivering Sustainable Bioenergy OECD/IEA, 2017, pg 11 https://www.ieabioenergy.com/wp-content/uploads/2017/11/Technology_Roadmap_Delivering_Sustainable_Bioenergy.pdf

From the above, it can be seen that biomass feedstock has attractive potential for bioenergy-based electricity generation in view of its generation costs, which are low compared with other sources. It is pertinent to note that the above modern and proven technologies are also available locally and manufacturers who require financial assistance in relation to the funding for these technologies can access financing facilities under machinery loan, conventional SME loan as well as Green Technology Financing Scheme ("**GTFS**"),[16] which is a scheme that was introduced by the Ministry of Natural Resources and Environmental Sustainability to support companies that are in the business of green technology (which includes both producers and users of green technology).[17] In order to qualify as a company in the business of green technology, the company must ensure that it is in the business of development and application of products, equipment, and systems used to conserve the natural environment and resources, and minimise the negative impact of human activities.[18]

Grid connected Biomass Power Plant

Conventional power plants, which have traditionally been powered by coal or natural gas, are slowly transitioning to biomass-based feedstock. Currently, a grid-connected biomass power plant is one of the most popular biomass business models due to the global agenda to promote the use of bioenergy from overseas, such as Japan and South Korea. [19] In Malaysia, this business model is supported by the Renewable Energy Act 2011 ("**REA 2011**") to promote the Feed-in-Tariff (FiT) mechanism for grid-connected biomass power plants utilizing various biomass feedstocks, including wood pellets and empty fruit bunches ("**EFB**"). The successful biomass power plant bidder is eligible to sign a twenty-one (21) year renewable energy power purchase agreement ("**REPPA**") with Tenaga Nasional Berha ("**TNB**"). [20]

Thanks to the Malaysian government's initiatives to stimulate growth of biomass energy, there are several successful ventures by companies in relation to grid connected biomass power plants in Malaysia as follows:

(a) TSH Resources Berhad power plant in Kunak, Sabah [21]

A fully integrated complex in Kunak, Sabah was built by TSH Resources Berhad in 2005, designed to maximize the potential of bio-waste products within the palm oil industry. This facility includes both biomass and biogas power plants, enabling the entire complex to operate on renewable green energy generated by a 14MW biomass co-generation plant. Notably, the Kunak complex is the first biomass power plant in Malaysia to be connected to the national grid, supplying green electricity under a REPPA with Sabah Electricity Sdn Bhd.

(b) FTJ Bio Power Sdn Bhd's biomass power plant in Jengka, Pahang [22]

FTJ Bio Power Sdn. Bhd. ("**FTJ**"), a joint venture project between FGV Palm Industries Sdn Bhd ("**FGVPISB**") and TNB Energy Services Sdn Bhd ("**TNBES**") (a wholly owned subsidiary of TNB had constructed a biomass power plant, which started its operations in September 2016, and supplies electricity to TNB's Grid Feed-In Tariff Project with a total capacity of 12.5 MW. The plant will use a feedstock of 100% oil palm EFB to generate electricity, which is then supplied to the TNB substation at Bandar Jengka, Pahang.

Certifications

In order to export the biomass feedstock such as wood pellets and EFB to different jurisdictions, producers can apply for various certifications which gives comfort to the importing country that the wood pellets are sourced and delivered legally and sustainably. Some examples of these certifications are as follows:

No.	Certification	Details
1.	Sustainable Biomass Programme ("**SBP**") certification scheme [23]	Facilitates compliance with key regulatory requirements across jurisdictions, including the **EU Renewable Energy Directive (RED) and EU Deforestation Regulations**, ensuring a strong foundation for market access and facilitating cross-border trade. As of 1 October 2025, three (3) Malaysian companies hold active certification from SBP. [24]
2.	Green Gold Label ("**GGL**")	GGL is an international certification programme which is in line with the **SDE++ of the Netherlands and the FIT/FIP schemes of Japan** [25] for sustainable biomass. GGL certification covers the complete supply chain from production, processing, transport to final use for bioenergy and biobased applications. [26] Green Gold Label primarily focuses on two market segments: (a) Biomass for the production of biobased chemicals and other products; and (b) Biomass for electricity and heat production. As of 1 October 2025, there are eighty-five (85) Malaysian companies that hold active certification from GGL. [27]
3.	Forest Stewardship Council Chain of Custody certification ("**FSC-COC**")	The FSC standards are among the most rigorous certification standards in the world, as they are the only forest certification system that is **ISEAL code-compliant. ISEAL (International Social & Environmental Accreditation & Labelling) is the global associate for social and environmental standards with members from over a hundred countries worldwide.** [28] As of 1 October 2025, there are forty-seven (47) Malaysian companies that hold active FSC-COC certification. [29]

4.	Programme for the Endorsement of Forest Certification (“**PEFC**”)	Forests and countries are highly diverse, and there are different legislation and law enforcement, and support structures in each country. This diversity means there is more than one way to manage a forest sustainably. PEFC works through local national forest management standards, developed by local stakeholders. **This enables countries to tailor their sustainable forest management requirements to their specific forest ecosystems, legal and administrative framework, socio-cultural context and other relevant factors.** As of 1 October 2025, nineteen (19) Malaysian companies hold active PEFC certification.[30]

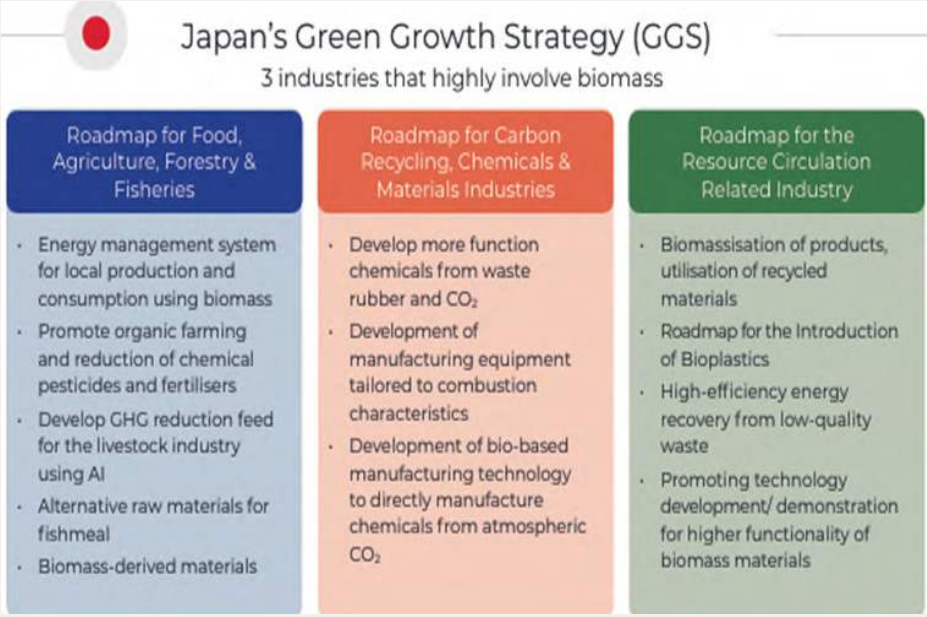
From the above, it is apparent that the GGL and FSC-COC certifications are extremely popular among biomass producers in Malaysia who are seeking for certifications to export their biomass products internationally. Based on our analysis of the certifications above, it seems that the FSC-COC certification is the preferred certification as it is ISEAL code compliant and this code is compliant with the certification standards from over one hundred countries in the world. By simply obtaining a FSC-COC certification, companies shall automatically gain access to the exports of biomass resources to the member countries of ISEAL.

INTERNATIONAL BEST PRACTICES ON BIOMASS POLICIES AND INITIATIVES

(a) JAPAN

In 2020, Japan had developed a Green Growth Strategy towards realisation of Carbon Neutrality by 2050. The Green Growth Strategy involving biomass is provided in Figure 2 as follows:

Figure 2: Japan's Green Growth Strategy [31]

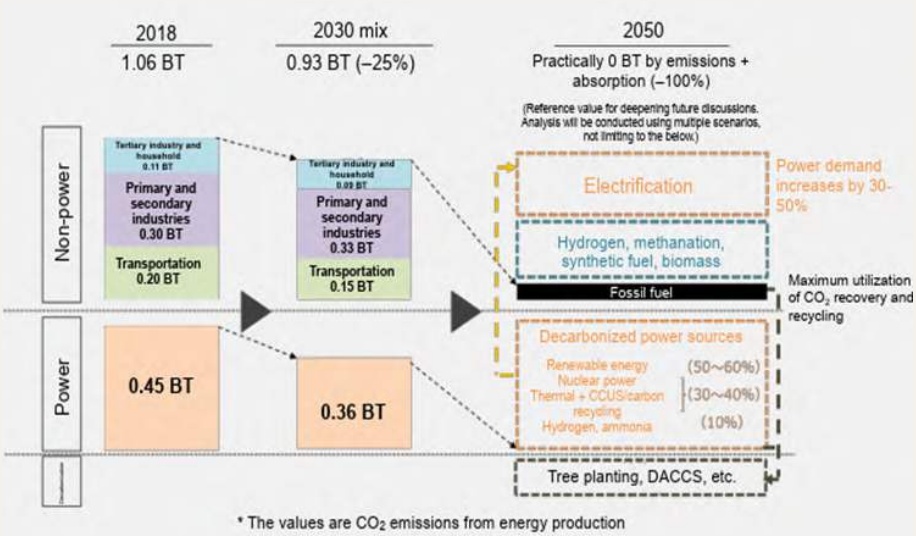


Source: National Biomass Action Plan, pg 122
https://www.kpk.gov.my/kpk/images/mpi_biomass/27122023-National_Biomass_Action_Plan.pdf

As a result of the introduction of the above policy involving biomass by the Japanese government, coupled with the feed-in-tariff ("**FiT**") initiative, which was introduced in 2012, it has resulted in the mushrooming development of biomass power plants in Japan, with 4.4 million tonnes of imported wood pellets with Malaysia being one of the major exporters of wood pellets to Japan. [32]

Figure 3 then illustrates the Japanese government's proposed process of transition to carbon neutrality by 2050 via the Green Growth Strategy.

Figure 3: Proposed process of transition of carbon neutrality [33]



Source: Green Growth Strategy Through Achieving Carbon Neutrality in 2050, pg 3
https://faolex.fao.org/docs/pdf/jap207779En.pdf

The figure shows the pathway to achieving net-zero CO_2 emissions from energy production by 2050. From 2018 to 2030, emissions are projected to drop by 25% through improved efficiency and renewable adoption. By 2050, near-zero emissions will be achieved through electrification, widespread use of hydrogen, biomass, and synthetic fuels, and a shift to decarbonized power sources such as renewables, nuclear, and CCUS technologies. Additional measures like tree planting and direct air carbon capture will further balance remaining emissions.

In relation to financing initiatives to achieve the carbon neutrality goals by 2050, the Japanese government has decided to establish a Green Innovation Fund at the level of 2 trillion yen as part of the New Energy and Industrial Technology Development Organization ("**NEDO**"). The plan, based on the specific goals shared by public and private sectors, is to continuously support companies and other organizations, which show their commitment to challenge such ambitious goals as their business issues, ranging from research and development (R&D) to demonstrations to social implementation of the outcomes. [34]

(b) CHINA

The Chinese Government has implemented a range of policies and regulations to promote the development of the biomass and bioenergy industry as follows:

(i) Renewable Energy Law of the People's Republic of China [35]

Article 16 of the Renewable Energy Law of China emphasizes the state's encouragement of the clean and highly efficient development and utilization of biomass fuels. In relation to financing initiatives by the Chinese government under the Renewable Energy Law, Article 25 then provides that a financial institution may offer a favorable loan with a financial discount for a renewable energy development and utilization project that is listed in the renewable energy industry development guidance catalog and that meets the credit requirements. [36]

(ii) Biomass Energy Price Policy [37]

The Chinese government sets upper and lower limits for the price of biomass feedstock based on market conditions and transportation costs to control the prices, supply, and demand for biomass feedstock.

(iii) Qingdao Institute of Bioenergy and Bioprocess Technology [38]

The Chinese government has made biomass energy a priority by setting up a special institute for the research of bioenergy and bioprocess technology innovations in new energy and accelerating the transformation of its energy generation and consumption framework into a clean and efficient one.

(iv) Biomass Power Generation Project Construction Work Plan

In August 2021, the National Development and Reform Commission, the Ministry of Finance, and the National Energy Administration of the People's Republic of China jointly issued the "2021 Biomass Power Generation Project Construction Work Plan", which clarified that 2.5 billion RMB of financial subsidies from the central and local governments will be provided for biomass power generation in 2021. [39]In this work plan, the central and local governments will be allocated subsidies through competition, and this program is developed to further strengthen the construction and operation management of the biomass power generation projects throughout China and promote the sustainable and healthy development of the industry.

Global Market Trends and Projections

The use of biomass to generate biofuel and biogas is attracting considerable attention worldwide as an innovative strategy to tackle climate change and limit GHG emissions. In light of the increased support in the use of biomass, there are some noteworthy global market trends and projections impacting the future of energy sourced from biomass feedstocks as follows:

(a) Diverse Feedstock Availability [40] – The global biomass industry is driven by the wide availability of diverse feedstocks, which ensures a reliable raw material supply and promotes sustainability. Regions with strong agricultural output and waste management issues are especially well-positioned for market growth.

(b) Government Support and Policy Frameworks [41] – Government support is vital to the global biomass industry, with many countries introducing regulations and incentives—such as tax credits, grants, and feed-in tariffs—to boost investment. In Malaysia, the Green Technology Financing Scheme (GTFS) exemplifies this effort by providing financial incentives for green technology development.

(c) Technological Advancements in Biomass Conversion – Advancements in biomass conversion[42] technologies like gasification and anaerobic digestion are improving efficiency, lowering costs, and enhancing the viability of biomass power generation. These innovations are driving increased investment and global market growth.

(d) Rising Demand for Renewable Energy[43] **–**Following the Paris Climate Change Agreement, global demand for renewable energy has risen as countries aim for net-zero emissions.

Consequently, many governments are adopting policies and incentives to promote biomass as a sustainable energy source.

CHALLENGES OF BIOMASS ENERGY IMPLEMENTATION IN MALAYSIA

Pursuant to the above, it is apparent that there are numerous advantages in the utilisation of biomass energy, as there is an abundance of biomass sources in the country, along with the multiple initiatives by the government and its respective agencies. However, there are several challenges for the smooth implementation of biomass initiatives as follows:

(a) Sustainable Biomass Sourcing [44] – Unsustainable biomass sourcing may cause deforestation, biodiversity loss, and harmful land use changes, undermining environmental balance and carbon storage. To prevent this, governments and stakeholders shall promote sustainable practices such as selective logging, reforestation, and soil conservation to ensure environmentally responsible biomass production.

(b) Biomas Supply Chain Infrastructure [45] – The biomass supply chain, which involves harvesting, transport, and processing, can be complex and expensive, especially with limited infrastructure and skilled labour. To address these challenges, collaboration between the government, stakeholders, and educational institutions is vital to capacity building, for the bioenergy sector. [46]

(c) Environmental and Social Impacts [47] – If not properly managed, traditional biomass combustion may generate harmful emissions and raise land use risks for nearby communities. Weak or inconsistent environmental regulations may worsen these issues and discourage any investment. Implementing advanced emission control technologies such as scrubbers, filters, and electrostatic precipitators can help reduce air pollution and improve regulatory compliance. [48]

CONCLUSION

All in all, the development of biomass energy in Malaysia represents both a challenge and an opportunity, as Malaysia is an extremely biodiverse country with abundant resources from the plantation, forestry, agricultural, livestock, and fisheries industries. In view of its biodiversity, Malaysia is uniquely positioned to leverage biomass as a sustainable energy source to reduce reliance on fossil fuels, stimulate socioeconomic growth, and contribute toward its net-zero targets in 2050.

However, the sustainability and credibility of biomass energy depend heavily on responsible sourcing, robust regulation, and transparent certification. Without careful safeguards, regulatory framework, and legislation in place, biomass initiatives may be subject to risks such as deforestation, biodiversity loss, and negative climate impacts, thereby undermining the very sustainable goals they seek to achieve.

Looking ahead, Malaysia's biomass industry shall prioritize sustainable practices, technological innovation, and strong governance to ensure long-term viability. By adopting global best practices, enhancing infrastructure, and fostering international market competitiveness, biomass energy can become not only a cornerstone of Malaysia's renewable energy mix but also a model for circular economy development in the region. If effectively implemented, biomass energy has the potential to transform Malaysia's waste into a resource, turning environmental challenges into engines of sustainable growth and resilience in the foreseeable future.

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