Authors:

MIDF Team
research@midf.com.my

BIOMASS ENERGY

The Pioneer of the Circular Economy Revolution

KEY HIGHLIGHTS

- Biomass energy (Bioenergy) is a renewable energy solution that conserves agricultural wastes and residues, as well as municipal and cattle waste, to produce a sustainable, cleaner energy while adhering to the circular economy model.
- Bioenergy is used significantly within the plantation, agriculture and industrial sectors to reduce GHG emissions, enhances energy security by diversifying fuel sources, and stimulates economic growth through involvement with rural workforce.
- Challenges remain on policy uncertainty and slow advancement in technology, while sentiments on bioenergy's impact to the environment (deforestation, extensive land use) hampered its utilization and improvement.
- Under the National Biomass Action Plan 2023-2030 (NBAP), Malaysia has the potential to develop and deploy bioenergy on the strength of abundant feedstock and its potential to integrate to other energy transition solutions, including CCS and Hydrogen, in accordance with the National Energy Transition Roadmap (NETR).

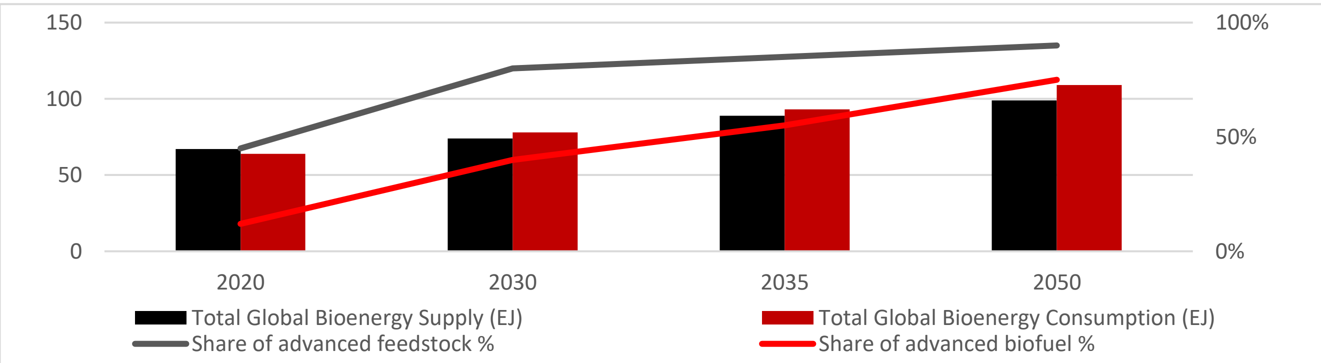
INTRODUCTION

Biomass refers to organic matter derived from plants, agricultural residues, forestry by-products, and even organic waste. It has been used for centuries as a source of heat, cooking, and transportation. In recent years, the exploration of alternative and renewable energy sources has gained prominence due to concerns about climate change, energy security, and environmental sustainability. Biomass stands out as a promising solution because it offers a renewable and carbon-neutral energy source. Biomass energy has a global market value of USD128b (approx. RM604b) with a 10-Y CAGR of 6%.

Biomass energy (Bioenergy) plays a crucial role in achieving the 1.5°C climate target, as it has the potential to substitute fossil fuels for power generation. Subsequently, Bioenergy is one of the most effective ways to recycle and reuse wastes from crop residues and animal manure, making it pivotal in transitioning towards a renewable-based energy mix. As of 2020, Bioenergy contributed 9.5% to the global primary energy supply, of which came from: (i) solid biomass which includes agricultural waste and municipal solid waste (43%), (ii) traditional biomass which includes crop residue, firewood and manure (39%), and (iii) biogas and biofuel feedstocks which includes biodiesel, bioethanol and methane (18%). Overall biomass supply is projected to increase by +55% to 86 exajoule (EJ) by 2030, and up to 135EJ by 2050, indicating the increased need to utilise the waste as part of the sustainability goals.

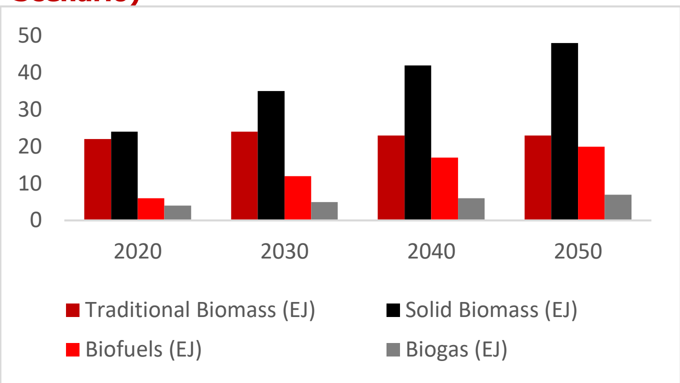
By 2030, Bioenergy players aim to drastically reduce inefficient biomass use for cooking and heating in buildings, necessitating the widespread adoption of clean cooking and heating technologies. As of 2020, traditional Bioenergy consisted of nearly half of Bioenergy produced globally. As such, measures to increase the use of other Bioenergy consumption was necessary. The modern use of bioenergy in buildings is projected to grow +55% to 11.3EJ by 2030. For heating on the industrial level as well as for chemical feedstock, Bioenergy demand for the sectors is estimated to reach 21EJ by 2030. In efforts to decarbonize transport, Bioenergy consumption is projected to rise nearly 2-fold to 9.1EJ by 2030. This growth will complement improvements in fuel efficiency for on-the-road vehicles and aviation, as well as the increasing adoption of EVs.

CHART 1: Global Bioenergy Supply and Consumption (Forecast)(EJ)



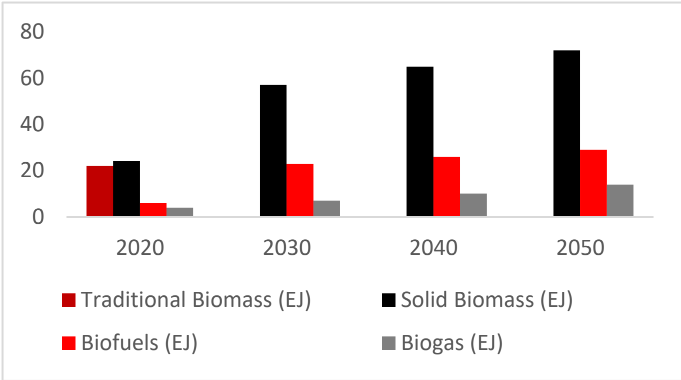
Source: IRENA, IEA, MIDFR

CHART 2: Bioenergy Supply (Planned Energy Scenario)



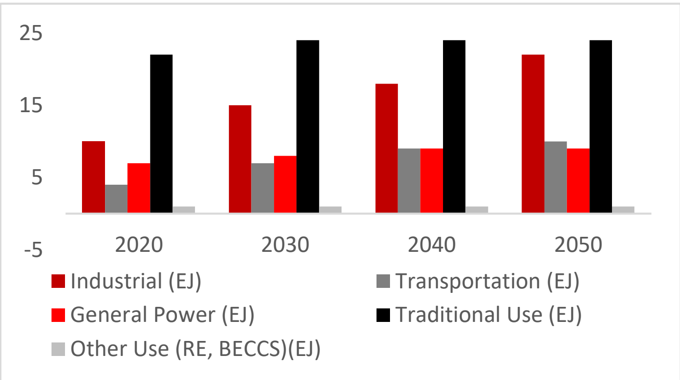
Source: IRENA, MIDFR

CHART 3: Bioenergy Supply (1.5°C Scenario)



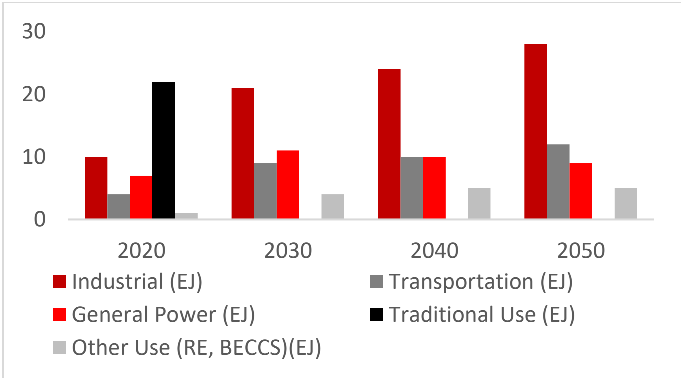
Source: IRENA, MIDFR

CHART 4: Bioenergy Demand (Planned Energy Scenario)



Source: IRENA, MIDFR

CHART 5: Bioenergy Demand (1.5°C Scenario)



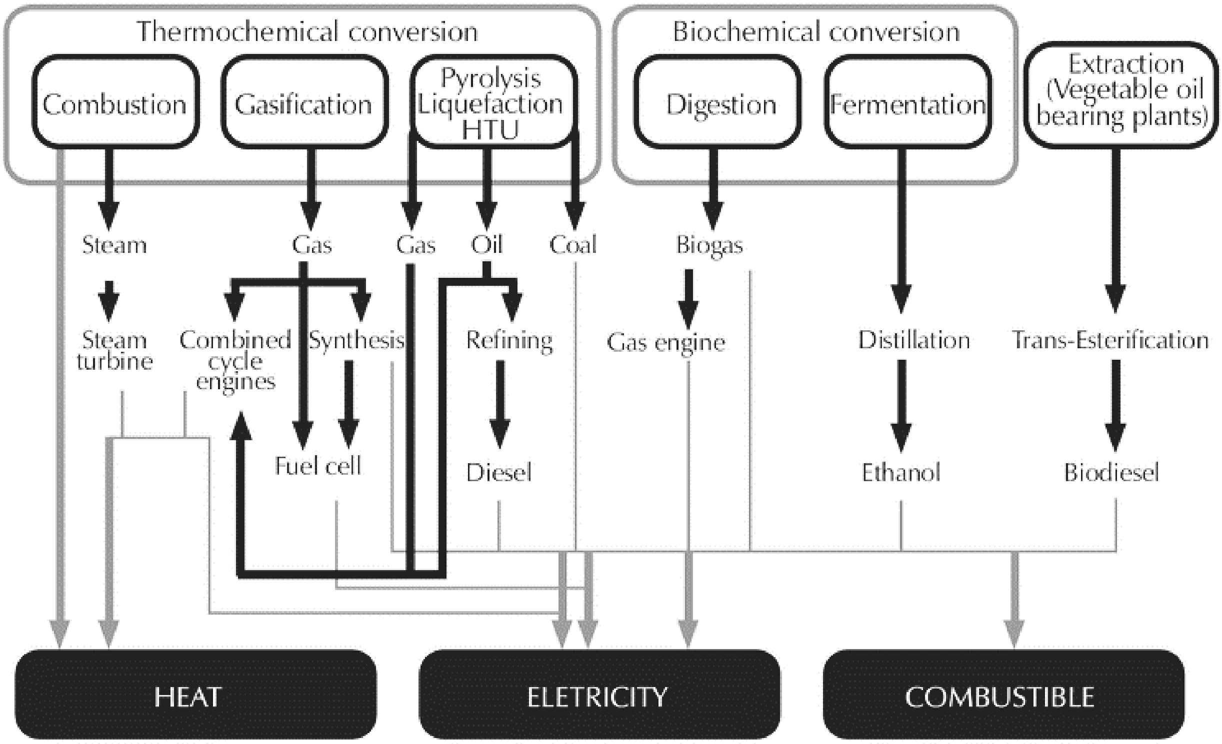
Source: IRENA, MIDFR

Bioenergy – the old-school power generation solution. Bioenergy conversion is not a new process. Since before hydrocarbons were used as an energy source, Bioenergy was obtained via direct combustion or burning. This was used to produce heat and it involves using feedstocks like wood, plants, or waste materials as fuel. The heat generated was used for cooking, heating buildings, and over time, powering steam turbines to generate electricity. In modern times, Bioenergy were obtained via thermochemical conversion methods, which includes: (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.

Complementary to CCS, hydrogen and biofuel. Bioenergy can be deployed and combined with carbon capture and storage (CCS) in the power and industrial sectors is crucial for achieving net-zero emissions. It's estimated that such processes could potentially capture around 10GtCO2 equivalent annually by 2050 with bioenergy with CCS (BECCS) expected to sequester 3.4GtCO2 in 2050, primarily from power and heat (84%) and industrials (16%). Additionally, Bioenergy can be utilised in the processing of hydrogen fuel via clean energy combustion in the electrolysis process for green hydrogen as well as the separation from natural gas for blue hydrogen. Bioenergy also produces biofuel and biogas, which can be blended into conventional fossil fuels to make hybrid fuels like SAF to assist in reducing carbon emissions in the transportation industry. This collaboration among various sectors – notably other hard-to-abate sectors like Oil and Gas and Plantation – is essential for realizing sustainable bioenergy's potential while mitigating climate change impacts and enhancing energy security globally.

But challenges impeded Bioenergy potential. The deployment of bioenergy falls short of the levels required to meet medium- and long-term targets, primarily due to: (i) policy uncertainty and weak institutional structures, (ii) financial and economic obstacles like fossil fuel subsidies, (iii) high costs of EPCC and MRM, (iv) low technology readiness, (v) reliability concerns, and (vi) inadequate infrastructure. While feedstock is relatively available from various resources, the unstable feedstock supply and shortages of qualified standards alongside sustainability risks, further impede Bioenergy deployment. Nevertheless, it should be noted that the sustainability of bioenergy is a multifaceted issue. While bioenergy offers potential benefits, including GHG emissions mitigation through replacing fossil fuels in power generation, heating, transport, and industry, it also presents environmental and socio-economic advantages. However, if not managed effectively, Bioenergy development can lead to adverse impacts on agriculture, forestry, rural development, and waste management. These impacts are closely intertwined with bioenergy activities and could exacerbate environmental, social, or economic challenges. Moreover, achieving decarbonization goals through Bioenergy necessitates phasing out the traditional use of biomass and careful mitigation of impacts throughout the supply chain.

CHART 6: Bioenergy Production Flow



Source: Nogueira et.al (2008)

ADVANTAGES

Renewable and Sustainable. Biomass is derived from organic materials such as plants and animal waste, which are renewable resources that can be replenished over time. Bioenergy is one of the few established energy conversion methods that ensures a cyclical operation, utilising recycling as its basis. While burning biomass releases carbon dioxide, the carbon emitted is part of a carbon cycle and does not add new carbon to the atmosphere, making it nearly carbon neutral. Bioenergy often utilizes organic waste materials that would otherwise be disposed of in landfills or left to decompose, which are often associated with other environmental problems including land pollution, water table pollution, extensive land use and methane emissions. Bioenergy thus helps reduce GHG emissions, making Bioenergy a sustainable ESG solution in the long term.

Local Resource Utilization. Many regions, including the ASEAN region, have access to biomass resources, including: (i) agricultural residues, (ii) forest residues, and (iii) dedicated energy crops. Using these local resources for energy production can enhance energy security and reduce dependence on imported fuels. On the social side, developing Bioenergy projects can create jobs in rural areas, notably in farming, forestry, processing industries, and energy production. Bioenergy can provide additional income opportunities for farmers and forest owners by utilizing their residues or growing dedicated energy crops, providing the agricultural players a new revenue stream and an opportunity to improve their ESG scores as well. This can help improve the economic viability of these sectors.

Flexibility and Versatility. Biomass can be used for various forms of energy production, including electricity generation, heating, and transportation fuels (biofuels). This versatility allows Bioenergy to contribute to different sectors of the economy. When biomass is produced sustainably and managed properly, it has the potential to be carbon neutral or even carbon negative, subsequently minimising and potentially reversing the overall impact on atmospheric carbon levels across the value chain. Biomass diversifies energy sources and reduces dependence on fossil fuels, giving innovators multiple opportunities to advance Bioenergy technology in accordance to the feedstock, the conversion method and the products.

Additionally, Bioenergy can be harmonised with other renewable energy and energy transition projects. Below are the examples of how Bioenergy could present alternative solutions to various sectors in accelerating the transition to a cleaner future:

Projects	Sectors/Agencies Involved	Opportunities	Actions/Risk Mitigation
Biomass Energy with Carbon Capture and Storage (BECCS)	Oil and Gas, Plantation, Industrials, Consumers	• Achieving negative emissions by capturing CO2 from biomass combustion and storing it underground, helping to mitigate climate change • Enhancing energy security by utilizing renewable biomass resources for energy production • Utilizing agricultural residues, forestry waste, and dedicated energy crops, turning them into valuable energy resources • Job creation in rural areas • Presenting potential scaling to meet global carbon reduction targets	• Ensure biomass is sourced sustainably to avoid deforestation and negative impacts on biodiversity • Implement robust monitoring and verification systems to ensure carbon capture and storage efficiency • Invest in research and development to improve capture efficiency and reduce costs • Advocate for supportive policies and incentives to make BECCS financially viable • Engage local communities to ensure social acceptance and address concerns related to land use and resource allocation
Gasification and Pyrolysis	Oil and Gas, Utilities, Industrial, Agriculture, Consumer, Transportation	• Producing syngas, bio-oil, and biochar for energy production, chemical synthesis, and soil enhancement • Converting agricultural and forestry waste into valuable products, reducing landfill use • Providing a renewable source of energy that can replace fossil fuels • Biochar produced during pyrolysis can be used for soil enhancement and carbon sequestration • Enabling decentralized and localized energy production, benefiting rural and remote areas	• Ensure a consistent and sustainable supply of biomass feedstock to avoid supply chain disruptions • Implement technologies to control emissions and minimize environmental impact • Develop business models and financial incentives to make gasification and pyrolysis economically viable • Invest in R&D to improve the efficiency and reliability of gasification and pyrolysis technologies • Ensure compliance with environmental regulations and standards
Hydrogen From Biomass	Oil and Gas, Utilities, Agriculture, Transportation	• Producing hydrogen, a clean fuel with applications in transportation, industry, and energy storage. • Present potential for carbon-negative hydrogen production if combined with carbon capture technologies • Converting biomass waste into a valuable energy source, reducing waste and emissions • Reducing dependence on fossil fuels and enhances energy security	• Ensure sustainable sourcing of biomass to avoid negative environmental impacts • Invest in R&D to improve the efficiency and reduce the cost of hydrogen production from biomass • Develop infrastructure for hydrogen production, storage, and distribution • Advocate for policies and incentives to support the development of biomass-based hydrogen

Projects	Sectors/Agencies Involved	Opportunities	Actions/Risk Mitigation
		• Stimulating job creation in biomass supply chains and hydrogen production facilities	• Monitor environmental impacts to ensure the sustainability of hydrogen production processes
Wood Pellet Expansion	Agriculture, Forestry, Utilities	• Providing renewable and carbon-neutral source of energy for heating and power generation • Growing demand for wood pellets in domestic and international markets • Generating economic benefits for rural and forestry communities • Utilising forestry residues and low-value timber, reducing waste and improving forest management • Enhancing energy security by providing a stable and local source of energy	• Ensure sustainable forestry practices to avoid deforestation and protect biodiversity • Implement certification systems to verify the sustainability of wood pellet production • Implement technologies to control emissions from wood pellet production and combustion • Develop resilient supply chains to ensure a consistent supply of raw materials • Engage local communities and stakeholders to address concerns and ensure social acceptance

KEY CHALLENGES

Sustainable Biomass Sourcing. Unsustainable biomass sourcing can lead to deforestation, biodiversity loss, and adverse land use changes. For example, large-scale deforestation for bioenergy crops can degrade ecosystems and reduce carbon sequestration capacity. Biomass resources are also needed for food, feed, and other industrial uses. Increasing demand for biomass for energy can lead to competition with these other uses, potentially driving up prices and causing shortages. Additionally, Bioenergy competes with other renewable energy sources and fossil fuels; further affecting the pricing of feedstock and competitiveness of Bioenergy.

We opine that implementing sustainable forestry and agricultural practices is the key to ensure that biomass is sourced without harming the environment. This includes selective logging, replanting trees, and maintaining soil health. In a larger picture, balancing the production of biomass with other land uses, such as food production and conservation provides a better land management. Diversification of biomass feedstock could keep a lid on price volatility, which includes energy mixing and dedicated energy crops utilisation. On the investment side, we believe certification schemes as well as carbon pricing could provide standards and auditing processes to verify Bioenergy sustainability, thus increasing interests in the industry.

Infrastructure and Logistics. The biomass supply chain involves harvesting, collecting, transporting, and processing, which can be logistically challenging and costly. Furthermore, inadequate infrastructure for transporting and processing biomass can hinder the development of bioenergy projects. We believe that a collaboration with transportation and logistics sector could provide efficient network to manage the collection, transportation, and processing of biomass. This can also provide an opportunity to invest in infrastructure development, including transportation networks (roads, railways), storage facilities, and processing plants.

Environmental and Social Impacts. Traditional biomass combustion can produce emissions, including particulate matter, NOx, and other pollutants, which can affect air quality if not properly managed. The land use for Bioenergy projects may also be a potential concern to local communities. These impacts could be worsened with unclear or inconsistent regulatory policies and environmental compliances, which would further deter investment in biomass energy. Although we expect traditional bioenergy to phase out by 2030, we believe in the meantime that the implementation of advanced emission control technologies, such as electrostatic precipitators, scrubbers, and filters, can assist in minimising air pollution from biomass combustion. Engagement with local communities to address concerns and ensure social acceptance would subsequently provide substantial regulations and transparent policies to ensure best practices within the Bioenergy industry.

CASE STUDIES

Three case studies from other regions are examined to illustrate successful Bioenergy production and implementation initiatives, offering insights into best practices, lessons learned, and potential strategies:

Case Study 1: IKEA Group's Bioenergy practices

IKEA Group (IKEA) has integrated Bioenergy into its operations to reduce carbon emissions and achieve energy independence. The group uses biomass boilers and combined heat and power (CHP) plants fueled by wood pellets derived from the leftover residue from its furniture and other biomass sources. While IKEA has the means to provide the feedstock for the conversion process, challenges persisted including: (i) securing a sustainable biomass supply, (ii) managing costs, and (iii) ensuring compliance with environmental regulations. To overcome these challenges, IKEA had been investing in biomass procurement strategies that prioritize sustainability and traceability, establishing long-term contracts with reliable biomass suppliers. As recent as 2021, IKEA had collaborated with Meva Energy – one of the world's leading providers of gasification technology for RE production based on small fraction fuels – to produce long-term renewable power from wood residue using a patented energy technology. Per the agreement, Meva Energy owns and operates a thermochemical conversion plant, including a 2.4 MW power station within IKEA Industry's manufacturing unit in Zbaszynek, Poland. The plant will be a reference point and constitute future best practice for all wood-based manufacturing industries in how to better value by-streams and achieve maximum impact in terms of CO2-reduction. IKEA also expanded its program to help suppliers access renewable energy in ten additional markets, including the Czech Republic, Germany, Italy, Lithuania, Portugal, Romania, Slovakia, Sweden, Türkiye, and Vietnam. Through bundled framework agreements and Power Purchase Agreements (PPAs), IKEA enables its direct suppliers to consume 100% renewable electricity in their production. The group also optimized their Bioenergy systems for efficiency and environmental performance, collaborating with local authorities and communities to ensure compliance and support for its biomass projects.

Case Study 2: Ørsted integrating bioenergy with CCS

Ørsted (XCSE: ORSTED) has successfully transitioned from fossil fuels to renewable energy sources, including biomass, in its power generation portfolio. Continuing from its predecessor, DONG Energy, the group operates biomass-fired power plants alongside offshore wind farms. Ørsted had faced the challenge of integrating biomass into their energy mix while maintaining grid stability, managing biomass feedstock logistics, and navigating regulatory frameworks. To increase efficiency and cost optimisation, Ørsted diversified its RE portfolio by investing in biomass supply chain infrastructure, including biomass storage and transportation, and leveraged their expertise in energy management and technology integration to optimize biomass utilization. Recently, Ørsted had announced its initiative to capture and store 400,000T of carbon a year for its newest straw- and wood chip-fired combined heat and power (CHP) plants in Denmark. The two plants boast the best possible infrastructure, as they are linked to the grid and the district heating system and have their own harbours. Thus, they can act as hubs for the handling and shipping of both carbon and green fuels. Ørsted's CHP plants will not only serve as hubs for the capture and shipping of its own carbon, but also for shipping carbon produced by other players. The first volumes are expected to be shipped and stored from 2025. This determined that bioenergy solutions can be integrated with other energy transition initiatives, and in consideration that CCS can be upscaled, the biological conversion processes has the potential to follow suit.

Case Study 3: Novonesis pioneering bioconversion

Novonesis (NSIS-B.CO) is a biotechnology company that utilizes biomass-derived enzymes and microorganisms for industrial applications, including biofuel production. Novonesis was formed in 2024 through the merger of Novozymes and Chr. Hansen. Following the merger, the company became the world leader in industrial enzymes and microbial solutions, with a nearly 50% market share in both. The group supplies a wide range of industry groups: household care, food and beverages, bioenergy, agriculture and feed, technical and pharmaceuticals. Its biological solutions create value for its customers by improving yield efficiency and performance, while saving energy and generating less waste. Nevertheless, Novonesis faced challenges in scaling up the production and maintaining cost competitiveness, as Bioenergy conversion from enzymatic processes is not as highly utilised as thermochemical conversion. However, the group addressed these challenges through continuous R&D to improve enzyme efficiency and reduce production costs. The group also collaborated with biofuel producers to customize enzyme solutions for different biomass feedstocks, enhancing process efficiency and yield. Regulatory support and market incentives for biofuels also played a role in their success. In their latest financial results (1QFY24), Novonesis saw an increase by +3%yoy in sales growth for its energy biosolutions with its highest sales originating from the Asia-Pacific region (+13%yoy), indicating a higher demand for bioenergy conversions in a bid to accelerate energy transition in the long-run.

OUR VIEW

Malaysia is well-positioned to leverage its abundant biomass resources and existing agricultural industry to develop a robust Bioenergy sector. Malaysia produces many agricultural residues, particularly from palm oil plantations, rubber plantations, and rice paddies. The palm oil industry alone generates vast quantities of biomass waste, including empty fruit bunches, palm kernel shells, and palm oil mill effluent, which can be used for energy production. An estimated 176mT of biomass production was contributed by palm oil industry annually. Malaysia has shown commitment to renewable energy and energy transition through various policies and incentives, including Bioenergy. To utilise Bioenergy by 2050, it is expected that a total of USD34b (approx. RM160b) investment is needed. As of 2020, Malaysia achieved a total installed capacity of 441MW powered by biomass, equivalent to 1.2% of the country's total electricity generation. This effort resulted in a reduction of approximately 395Gg of CO_2.

The National Biomass Action Plan 2023-2030. In Dec 2023, Malaysia launched the National Biomass Action Plan 2023-2030 (NBAP) by the Ministry of Plantation and Commodities. The paper was developed based on the Twelfth Malaysia Plan (12MP), the National Agri Commodity Policy 2021-2030 and related policies to empower the local biomass industry. The action plan supports three of the six pillars of Malaysia MADANI's policies, namely Sustainability, Well-being and Kindness. NBAP involves the entire dynamic ecosystem, including regulation activities and observation of supply and market demand. The following are the industries earmarked as the focal point for Bioenergy under NBAP:

Plantation Biomass. Malaysia is renowned for its extensive plantations, especially those for oil palm and rubber. Biomass from these plantations can be utilized to create various value-added products. The plantation sector offers abundant biomass resources suitable for bioenergy generation and biomaterials production. This sector presents significant opportunities for a circular economy.

Forestry Biomass. Malaysia's rich forest resources offer significant potential for biomass utilization. Residues from the timber industry can be used for bioenergy production, including heat and electricity generation. Wood waste can also be transformed into value-added products like wood pellets and medium-density fiberboard (MDF). Sustainable management of forestry resources ensures responsible biomass extraction while preserving forest ecosystems and biodiversity.

Agricultural Biomass. Malaysia's diverse agricultural sectors produce substantial amounts of by-products and waste materials. Agricultural residues can be converted into biofuels, carbonized products, or used for heat and power generation. They can also be processed into organic fertilizers or animal feed. Utilizing agricultural by-products for biomass industries can help reduce waste, promote resource efficiency, and create additional revenue streams for farmers.

Livestock Industry Waste. Malaysia has a thriving livestock industry, generating wastes such as poultry manure, swine slurry, and biogas from anaerobic digestion. These wastes can be used as sources of renewable energy. Utilizing livestock wastes for energy generation reduces greenhouse gas emissions and provides an effective waste management solution for livestock farming.

Fisheries Industry Waste. Malaysia's coastal and marine resources support a vibrant fisheries industry. Fisheries by-products can be processed into fishmeal, fish oil, or hydrolysed for producing bioactive compounds and liquid biofertilizers. Utilizing fisheries by-products can reduce waste in the fishing industry and create additional economic opportunities.

The biomass potential of these sectors is estimated at 182mMT per annum, of which almost 90% is obtained from the plantation biomass industry alone. NBAP is also in line with the National Energy Transition Roadmap (NETR) in targeting the implementation of co-firing projects at electric power stations through the burning of coal-fired blended fuels with biomass pellets. This also coincides with the sustainable energy target towards 70% power generation energy mix by 2050. We believe this plan would assist in increasing investments and provide incentives within the biomass industry to an estimated RM3b by 2030. Oil palm biomass remains a primary resource, and we believe this would continue to be the main contributor towards an active transition to a low-carbon renewable energy.

Apart from the abundant biomass resources and strong governmental support, we also highlight the following key factors that we believe could place Malaysia in a pivotal role within the Bioenergy industry.

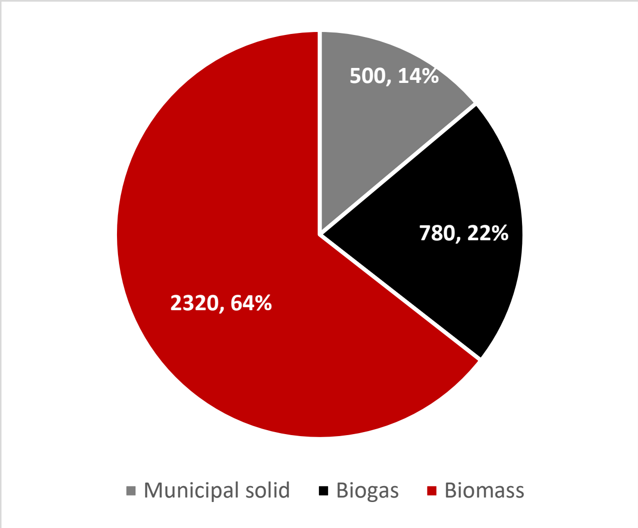
Strategic Location and Infrastructure. Malaysia's strategic location in Southeast Asia provides access to growing regional markets and facilitates export opportunities. Considering that the palm oil industry was established in the early 20th Century, existing infrastructure in the palm oil industry and ports can be leveraged to support the collection, processing, and transportation of biomass resources. The strategic location also contributed to its developed R&D capabilities. Malaysia has several research institutions and universities actively engaged in bioenergy research and development, driving innovation and technological advancements. Consequently, this advantage could bring in expertise through international collaborations to develop better Bioenergy technologies.

Public-Private Partnerships. Collaborations between the government agencies such as the Malaysian Palm Oil Board (MPOB) and the private sector can enhance resource mobilization and project implementation. A strong participation from private companies, including major palm oil producers and energy companies, can drive large-scale bioenergy projects and investments, furthering the Bioenergy solutions to include other energy transition projects including CCS and Hydrogen fuel. Bioenergy can help diversify Malaysia's energy mix, reducing dependence on fossil fuels and enhancing energy security. The industry also aligns with Malaysia's commitments to reduce GHG emissions and transition to a low-carbon economy via NETR and NIMP2030.

Economic and Social Benefits. The bioenergy industry can create employment opportunities, particularly in rural areas, contributing to social and economic development. Bioenergy projects can provide additional income streams for farmers and promote rural industrialization. The growing global demand for renewable energy sources presents export opportunities for Malaysian bioenergy products, such as wood pellets and biofuels. Given Malaysia's trading routes within the region, Malaysia can position itself as a pioneer in bioenergy trading within the ASEAN region, influencing regional energy policies and markets.

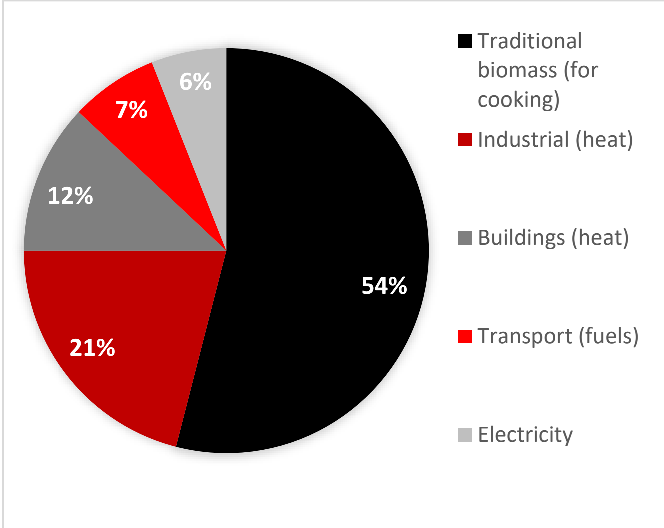
Common challenges from feedstock sources persisted. As is with most energy solutions, the sustainability of the energy resources takes centre stage. The challenge to this is to ensure a sustainable biomass resource inflow without deforestation and other activities that have an adverse impact to the environment and biodiversity. In addition to adhering to the regulatory framework set by the government and other renewable energy agencies, ensuring that biomass is sourced sustainably is crucial to avoid deforestation and negative impacts on biodiversity. Advanced conversion technology and a comprehensive network from upstream to downstream are crucial to improve efficiency and cost-effectiveness of Bioenergy projects. With agriculture contributing about 9% to Malaysia's GDP, the government is expected to provide regulatory frameworks and financial incentives, such as feed-in tariffs and grants, to support the initial investment and operational costs of biomass energy projects, while ensuring that the sustainability of the agriculture sector is maintained, and the energy transition commitment is adhered to.

CHART 7: Overview of Bioenergy resources in Malaysia (MW)



Source: NBAP, IEA, MIDFR

CHART 8: Bioenergy consumption by end-use



Source: IRENA, MIDFR

RECOMMENDATIONS

While Bioenergy is a well-established energy source in Malaysia, common challenges shared within the industry persisted. Ensuring a strong foundation and policy for bioenergy conversion and the utilisation of bioenergy products is crucial to maintain long-term sustainability of Bioenergy projects, while mitigating the common challenges and getting in line with the trajectory of the Net Zero 2050 aspirations. We believe the following policy recommendations can be implemented to improve the Bioenergy industry in Malaysia:

Recommendations	Remark	Challenges	Risk Mitigation
Diversification of Biomass Sources	Government bodies, environmental agencies and energy corporations can encourage the utilization of diverse biomass sources including agricultural residues (e.g., palm oil residues, rice husks), forestry residues, municipal solid waste, and energy crops.	• Ensuring sustainable sourcing practices • Managing feedstock quality and availability • Addressing logistics for varied biomass types	• Implement policies that promote sustainable biomass harvesting and processing practices • Invest in infrastructure for efficient biomass collection, storage, and transportation networks • Develop partnerships with farmers, forestry sectors, and waste management authorities to secure diverse biomass sources
Technology Development and Adoption	Corporations that utilise energy and produce wastes are encouraged to invest in research and development (R&D) for biomass energy technologies such as combustion, gasification, pyrolysis, and biogas production	• Technological capability and knowledge barriers • High initial and startup costs • Lack of skilled labor for operating and maintaining the specialized equipment	• Provide incentives for technology adoption through grants, subsidies, and tax incentives • Facilitate knowledge transfer and capacity building through partnerships between research institutions, industry, and educational bodies • Pilot and demonstrate innovative biomass technologies to showcase feasibility and benefits
Policy and Regulatory Framework	Establish clear and stable policies and regulations that support biomass energy development	• Regulatory uncertainty • Complex permitting processes • Higher demand for harmonization across different	• Develop comprehensive biomass energy policies that include feed-in tariffs, renewable energy targets,

Recommendations	Remark	Challenges	Risk Mitigation
		sectors (energy, agriculture, environment)	environmental standards for biomass sourcing and emissions, and streamlined permitting processes • Conduct regular reviews and updates of policies to adapt to technological advancements and changing market conditions
Infrastructure Development	Invest in infrastructure for biomass collection, storage, processing, and distribution	Limited infrastructure, particularly in rural areas where biomass resources are abundant, but transportation networks are lacking	• Implement public-private partnerships to develop biomass infrastructure • Expand storage facilities and biomass handling capabilities at ports and industrial zones • Improve rural road networks and establish biomass collection centers to facilitate efficient biomass supply chains
Capacity Building and Public Awareness	Enhance skills and knowledge among stakeholders involved in biomass energy, including farmers, biomass producers, technology developers, and policymakers	• Limited awareness of biomass energy potential • Skills gaps in biomass management and technology adoption	• Provide training programs, workshops, and educational campaigns on sustainable biomass practices, technological advancements, and the benefits of biomass energy • Foster collaboration between academia, industry, and government agencies to build a skilled workforce and promote knowledge sharing
Environmental and Social Sustainability	Ensure that biomass energy projects adhere to environmental sustainability criteria and contribute positively to local communities	Potential impacts on land use, biodiversity, air quality, and community acceptance	• Conduct thorough environmental impact assessments (EIAs) and social impact assessments (SIAs) for biomass projects • Implement best practices for sustainable land management and biomass harvesting • Engage with local communities through participatory approaches and benefit-sharing mechanisms • Monitor and mitigate potential environmental and social impacts throughout the project lifecycle
Market Development and Financial Support	Stimulate market demand for biomass energy through financial incentives and market mechanisms	Cost competitiveness with conventional energy sources, fluctuating biomass prices, and limited access to financing	• Provide financial incentives such as feed-in tariffs, tax exemptions, and grants for biomass energy projects • Establish biomass energy funds and venture capital support for technology startups and small-scale biomass producers • Facilitate access to financing through partnerships with financial institutions and development banks

CONCLUSION

The energy demand in Malaysia has seen a significant rise in recent years, with an estimated annual rate of +1.7% projected by 2035. Energy in Malaysia is largely obtained from natural gas and coal; however, due to the adverse environmental impact and concerns on the depletion of hydrocarbon reserves in the long run, Malaysia had advocated for the transition towards sustainable renewable energy sources to meet future demand. Given Malaysia's abundant natural resources, Bioenergy emerges as a promising alternative. The Bioenergy sector has been replaced by the 12th Malaysia Plan (12MP) as one of the eight strategic and high impact industries to regenerate economic growth. Malaysia is developing the potential of bioenergy in various sectors, including plantation, forestry, agriculture, livestock and fisheries industries. These sectors have been outlined as the focal areas of the National Biomass Action Plan 2023 – 2030, which had shown potential to contribute to sustainable consumption and production, while supporting Malaysia's transition towards a low-carbon and circular economy with the creation of new jobs.

Although the global bioenergy consumption is expected to be on a single digit yearly growth, in comparison to other renewable energy, the total annual primary biomass production is estimated to be about 1250EJ per year, promising an abundant and sustainable bioenergy feedstock in the long run. However, environmental constraints, lack of awareness and somewhat immature technology brought the yearly potential of utilisation to approximately 500EJ per year. Despite this, Malaysia is poised to benefit from this renewable energy project as oil palm biomass remains Malaysia's primary resource. The country has approximately 5.67 million hectares of oil palm plantations, producing over 90mT of dried palm biomass.

Bioenergy fits into the circular economy model, due to several factors: (i) easily available and replenished organic materials are used as primary feedstocks, (ii) bioenergy systems can reduce GHG emissions, subsequently be carbon-neutral or even carbon-negative, (iii) locally produced which reduces dependence on imported fossil fuels, (iv) waste utilisation and (v) increase energy access in rural and remote areas. Bioenergy also has diverse applications, including heat and electricity, biofuels, biochemicals and biogas.

However, challenges remain in financial barriers as bioenergy is often considered a costly operation, due to the lack of subsidies for bioenergy products and market perception on the profitability of the industry. Many existing bioenergy technologies face low readiness levels, while the supply chain is hampered by lower skilled workers and unstable feedstock pricing. Additionally, if not run efficiently, bioenergy could lead to biodiversity loss, food insecurity and deforestation. Nevertheless, measures like phasing out subsidies, introducing carbon pricing, and facilitating affordable financing can enhance bioenergy competitiveness in the RE market. Moreover, policy support and action plans by government agencies and corporations can accelerate commercialization and minimise adverse impacts to the environment, and in turn, promising a successful deployment and additional investments in the industry.

In Malaysia, bioenergy feedstocks are primarily derived from agricultural residue and waste, with high potentiality in municipal waste, animal manure and microalgae. This diversification of feedstocks could increase future availability and drive demand for better technology. By embracing bioenergy as part of Malaysia's initiative in energy transition, in tandem with NBAP2030 and NETR plans, we believe the local agriculture, forestry and industrial sectors can move forward to a more sustainable future and cleaner trading without jeopardising existing environmental and socio-economic goals within the renewable energy sector.

APPENDIX – Summaries from National Biomass Action Plan 2023-2030

Types of Biomass Feedstock in Malaysia

PLANTATION BIOMASS

89.8%

164 MILLION TONNES

Palm Oil Mills Fresh Fruit Bunch Production: 94,814,456 tonnes	Empty Fruit Bunch (EFB) Mesocarp Fibres (MF) Palm Kernel Shells (PKS) Palm Kernel Cake (PKC) Palm Oil Mill Effluent (POME)	7,300,713 tonnes 7,679,023 tonnes 4,427,835 tonnes 2,465,176 tonnes 63,525,686 tonnes
	Oil Palm Fronds (OPF) Oil Palm Trunks (OPT)	59,593,762 tonnes 10,548,826 tonnes
Cocoa Processing Factories: 537 tonnes	Cocoa Bean Shell Cocoa Hob & Pulp	49 tonnes 364 tonnes
Kenaf Planted Area: 1,500 hectares	Kenaf Shoot	3,000 tonnes
Sago Planted Areas: 33,928 hectares	Sago Palm Frond	53,564 tonnes
Palm Sagu Mill Production: 133,911 tonnes	Sago Bark Sago Hampas Sago Waste Water	147,302 tonnes 147,302 tonnes 8,034,660 tonnes

AGRICULTURAL BIOMASS

2.3%

4.2 MILLION TONNES

Paddy Production: 2,364,453 tonnes	Rice Straw Rice Husk	1,307,315 tonnes 534,356 tonnes
Banana Production: 329,573 tonnes	Banana Stalk	790,975 tonnes
Coconut Production: 604,428 tonnes	Coconut Husk Coconut Shell	271,993 tonnes 72,531 tonnes
Pineapple Production: 377,300 tonnes	Pineapple Peel Waste Pineapple Leaf	154,693 tonnes 565,950 tonnes
Durian Production: 455,458 tonnes	Durian Husk	296,048 tonnes
Sweet Corn Production: 63,155 tonnes	Sweet Corn Stalk Cob / Husk / Silk	113,679 tonnes 47,366 tonnes
Sugarcane Production: 25,032 tonnes	Sugarcane Top Sugarcane Bagasse Sugarcane Press Mud Sugarcane Molasses	5,006 tonnes 7,510 tonnes 876 tonnes 125 tonnes

WOODY BIOMASS

2.0%

3.6 MILLION TONNES

Logging Production: 7 million m3	Logging Activity Residue	1,492,341 tonnes
Wood-based Industry Production: 4 million m3	Wood-based Industry Wood Residue	1,943,165 tonnes
Rubber Tree Replanting: 469,669 tonnes	Rubber tree biomass (Branches, twigs, leaves, roots)	212,120 tonnes

LIVESTOCK INDUSTRY WASTE

5.6%

10 MILLION TONNES

Number of Poultry is approximately 295 million	Poultry Manure Poultry Waste from Slaughter House	4,000,531 tonnes 176,103 tonnes
Number of Cattle Livestock is approximately 721 thousands	Cattle Manure Cattle Waste from Slaughter House	4,418,016 tonnes 15,156 tonnes
Number of Goat Livestock is approximately 312 thousands	Goat Manure Goat Waste from Slaughter House	219,785 tonnes 237 tonnes
Number of Sheep Livestock is approximately 125 thousands	Sheep Manure Sheep Waste from Slaughter House	91,034 tonnes 158 tonnes
Number of Swine Livestock is approximately 1.7 million	Swine Manure Swine Waste from Slaughter House	1,161,551 tonnes 75,634 tonnes

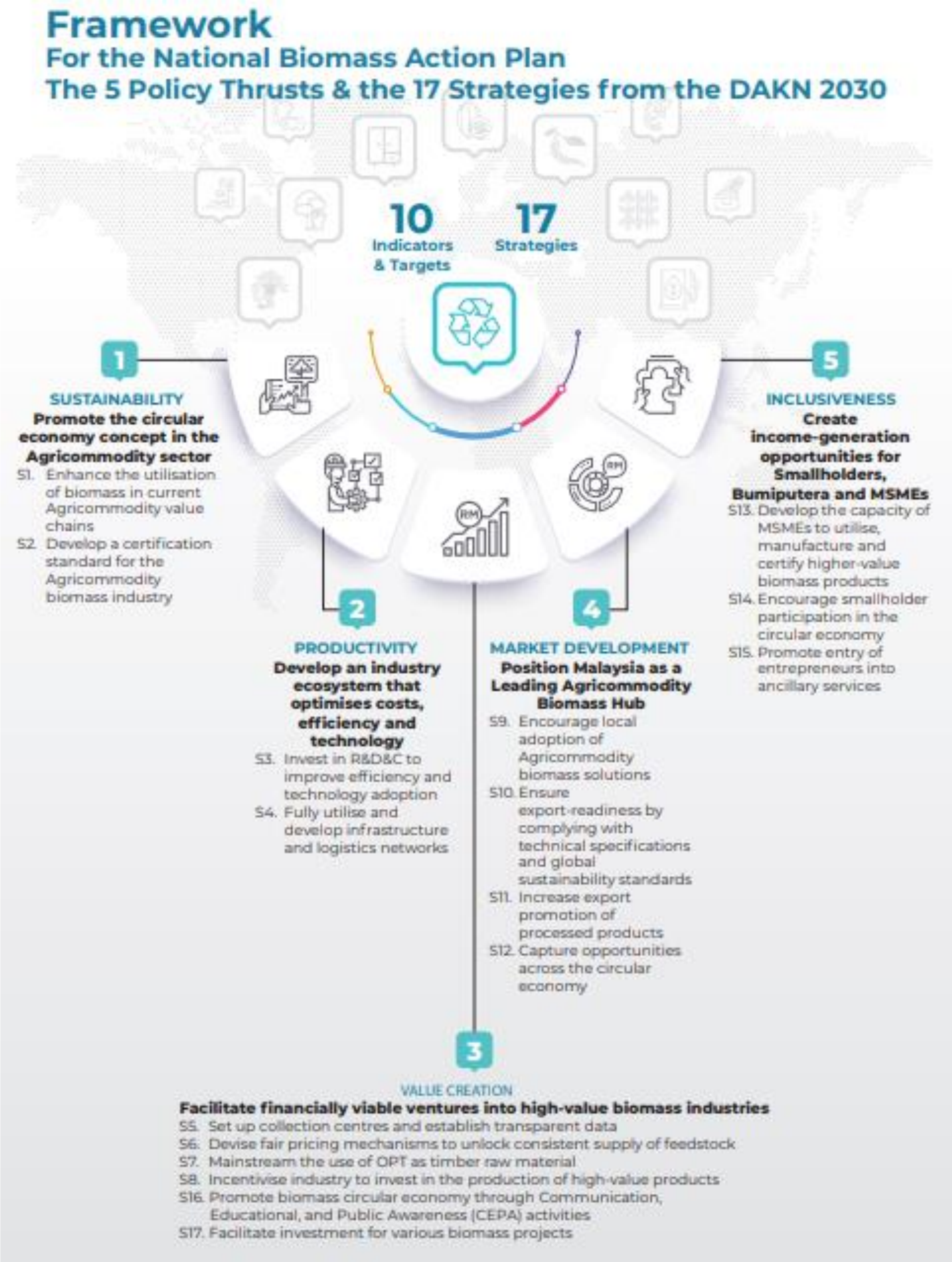
FISHERIES INDUSTRY WASTE

0.4%

0.7 MILLION TONNES

Production of the Fisheries Industry: 1,890,288 tonnes	Fish Waste	695,133 tonnes

NBAP Framework



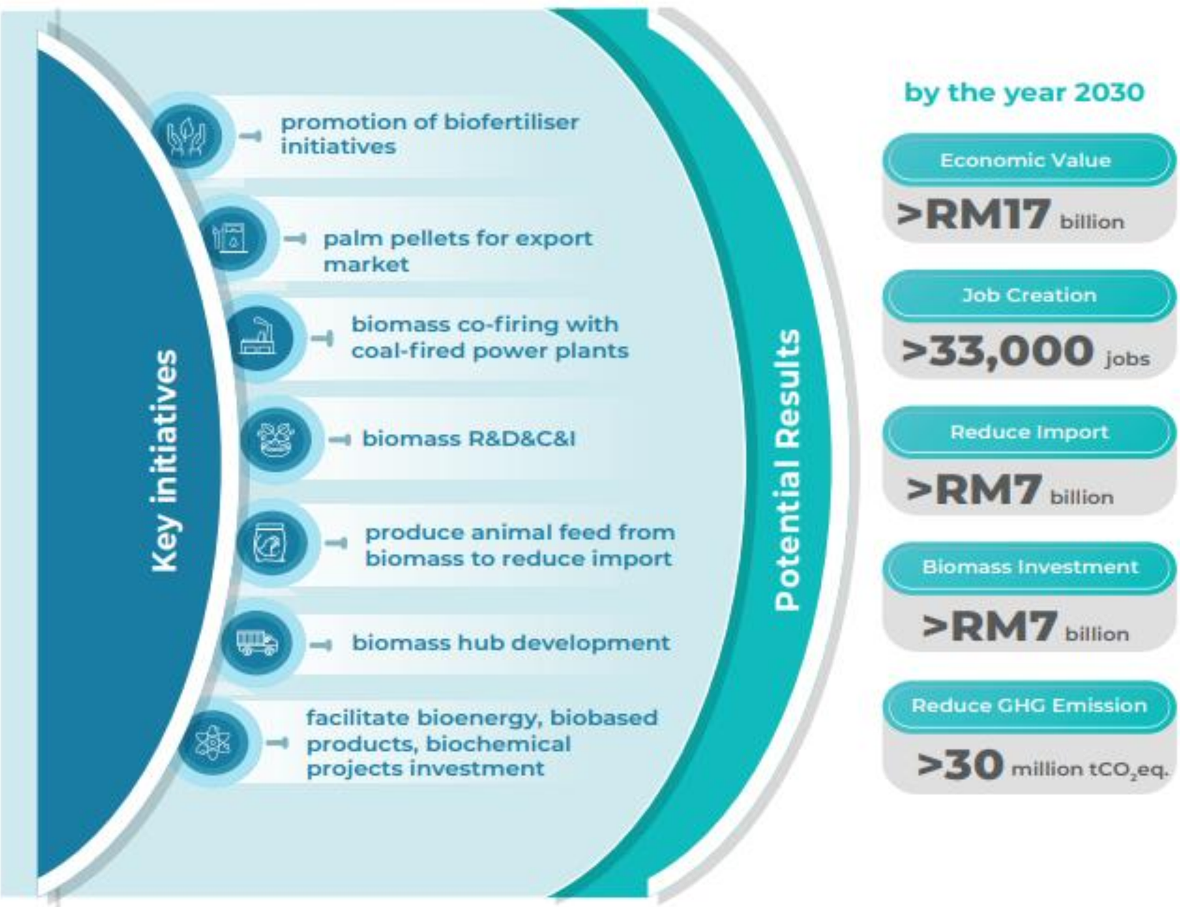
5 Policy Thrusts & 17 Strategies

Policy Thrusts	T1 SUSTAINABILITY	T2 PRODUCTIVITY	T3 VALUE CREATION	T4 MARKET DEVELOPMENT	T5 INCLUSIVENESS	Total
Strategies	2 Strategies	2 Strategies	6 Strategies	4 Strategies	3 Strategies	17
Actions	7 Actions	10 Actions	17 Actions	8 Actions	9 Actions	51
Quick Win	1	-	4	1	-	6
High Impact	6	7	9	7	2	31
Entry Point	-	3	4	-	7	14

Cross-cutting Enablers

Enablers				
Feedstock Availability	Policy & Regulations	Financing and Investment Incentives	Research & Development & Commercialisation & Innovation	Technology & Business Models

Key Initiatives and Potential Results



MIDF RESEARCH is part of MIDF Amanah Investment Bank Berhad (197501002077(23878 – X)).
(Bank Pelaburan)
(A Participating Organisation of Bursa Malaysia Securities Berhad)

DISCLOSURES AND DISCLAIMER

This report has been prepared by MIDF AMANAH INVESTMENT BANK BERHAD (197501002077 (23878 – X)) for distribution to and use by its clients to the extent permitted by applicable law or regulation.

Readers should be fully aware that this report is for information purposes only. The opinions contained in this report are based on information obtained or derived from sources that MIDF Investment believes are reliable at the time of publication. All information, opinions and estimates contained in this report are subject to change at any time without notice. Any update to this report will be solely at the discretion of MIDF Investment.

MIDF Investment makes no representation or warranty, expressed or implied, as to the accuracy, completeness or reliability of the information contained therein and it should not be relied upon as such. MIDF Investment and its affiliates and related companies and each of their respective directors, officers, employees, connected parties, associates and agents (collectively, "Representatives") shall not be liable for any direct, indirect or consequential loess, loss of profits and/or damages arising from the use or reliance by anyone upon this report and/or further communications given in relation to this report.

This report is not, and should not at any time be construed as, an offer, invitation or solicitation to buy or sell any securities, investments or financial instruments. The price or value of such securities, investments or financial instruments may rise or fall. Further, the analyses contained herein are based on numerous assumptions. This report does not take into account the specific investment objectives, the financial situation, risk profile and the particular needs of any person who may receive or read this report. You should therefore independently evaluate the information contained in this report and seek financial, legal and other advice regarding the appropriateness of any transaction in securities, investments or financial instruments mentioned or the strategies discussed or recommended in this report.

The Representatives may have interest in any of the securities, investments or financial instruments and may provide services or products to any company and affiliates of such companies mentioned herein and may benefit from the information herein.

This document may not be reproduced, copied, distributed or republished in whole or in part in any form or for any purpose without MIDF Investment's prior written consent. This report is not directed or intended for distribution to or use by any person or entity where such distribution or use would be contrary to any applicable law or regulation in any jurisdiction concerning the person or entity.

MIDF AMANAH INVESTMENT BANK : GUIDE TO RECOMMENDATIONS	
STOCK RECOMMENDATIONS	
BUY	Total return is expected to be >10% over the next 12 months.
TRADING BUY	Stock price is expected to *rise* by >10% within 3-months after a Trading Buy rating has been assigned due to positive newsflow.
NEUTRAL	Total return is expected to be between -10% and +10% over the next 12 months.
SELL	Total return is expected to be <-10% over the next 12 months.
TRADING SELL	Stock price is expected to *fall* by >10% within 3-months after a Trading Sell rating has been assigned due to negative newsflow.
SECTOR RECOMMENDATIONS	
POSITIVE	The sector is expected to outperform the overall market over the next 12 months.
NEUTRAL	The sector is to perform in line with the overall market over the next 12 months.
NEGATIVE	The sector is expected to underperform the overall market over the next 12 months.
ESG RECOMMENDATIONS* - source Bursa Malaysia and FTSE Russell	
☆☆☆☆	Top 25% by ESG Ratings amongst PLCs in FBM EMAS that have been assessed by FTSE Russell
☆☆☆	Top 26-50% by ESG Ratings amongst PLCs in FBM EMAS that have been assessed by FTSE Russell
☆☆	Top 51%- 75% by ESG Ratings amongst PLCs in FBM EMAS that have been assessed by FTSE Russell
☆	Bottom 25% by ESG Ratings amongst PLCs in FBM EMAS that have been assessed by FTSE Russell

* ESG Ratings of PLCs in FBM EMAS that have been assessed by FTSE Russell in accordance with FTSE Russell ESG Ratings Methodology