SUSTAINABLE AVIATION FUEL

Implications on Malaysia's Pursuit for Cleaner Energy

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KEY HIGHLIGHTS

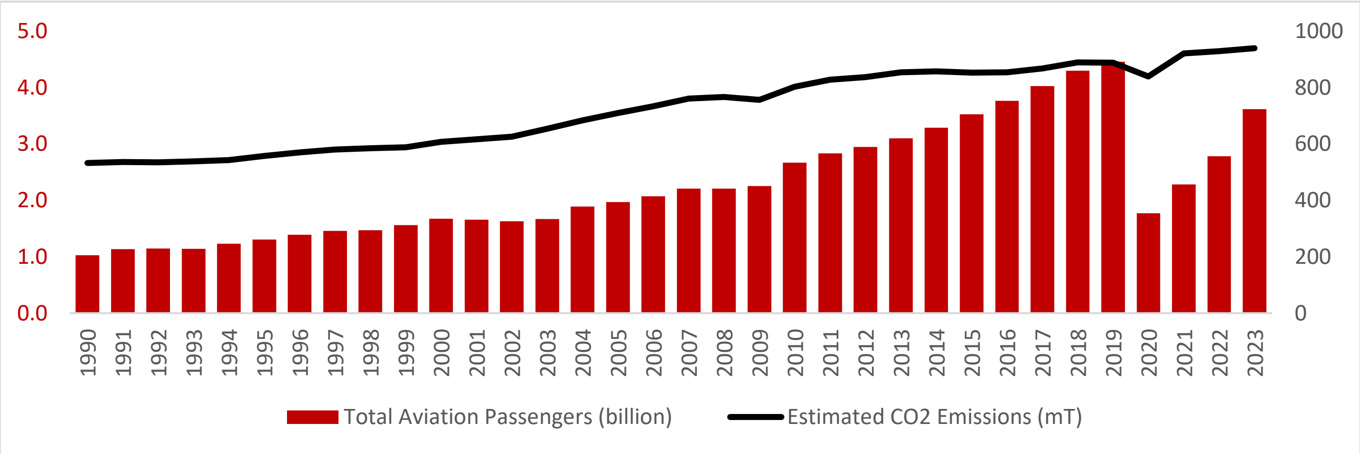
- Sustainable Aviation Fuel (SAF) – produced from waste fats, oil and greases, as well as by synthetically capturing carbon directly from the air is capable to reduce CO2 emissions by up to 80% compared to conventional Jet A1.
- SAF is used to significantly reduce GHG emissions, enhances energy security by diversifying fuel sources, and stimulates economic growth through the development of a new industry.
- Challenges remain on low availability due to limited investment and technology maturity, disparate policies and government support across regions, and higher production costs compared to traditional fossil jet fuel.
- Malaysia has the potential to become a leading supplier of feedstock for SAF production in the Asia Pacific region via collaboration with international partners to enhance capabilities and optimize the supply chain for SAF. Investment in R&D is also need to scale up the feedstock options and subsequently reduce production costs.

INTRODUCTION

Since 1990, flying has been more energy-efficient from improved design and technology and higher passenger load factor. However, little progress has been made to move to cleaner fuels. In the pursuit of a sustainable future, the aviation industry stands at a critical crossroads, grappling with the imperative to reconcile its soaring demand with the pressing need to mitigate its environmental footprint. Globally, aviation emits 2-3% of CO2 emissions. Additionally, aviation emissions are attributed to countries, wherein CO2 emissions from domestic flights are counted but international flights are categorised as bunker fuels. This brings lower incentives by many governments to reduce carbon footprint. Nevertheless, aviation is considered one of the Top 10 hard-to-abate industries when it comes to GHG emissions, mainly due to its use of Jet A1 fuel – a conventional petroleum products that omit about 3.2kg of CO2 per 1 Kg of combustion; approximately higher by +33% from petrol and Diesel.

As such, the International Air Transport Association laid out a net zero emission plan for the aviation industry that mandated 65% of medium and long-haul flights are to be powered by Sustainable Aviation Fuel (SAF) and 13% of short-haul flights are powered by electric planes or hydrogen by 2050. While electric and hydrogen-powered planes are yet to be commercialised worldwide, SAF had been making the rounds within the aviation players as well as oil and gas refineries as an achievable initiative and adaptation by 2025.

CHART 1: World passenger for aviation (billion) vs Estimated CO2 emission from aviation (mT)



Source: AITA, WEF, MIDFR

SAF – a promising future for cleaner jet fuel. Sustainable Aviation Fuels (SAFs) are liquid fuels for commercial aviation, capable of reducing CO2 emissions by up to 80%. At its core, SAF represents a departure from conventional fossil-derived aviation fuels, notably Jet A1, by harnessing renewable and sustainable feedstocks for its production, as well as via synthetically production through a process that directly captures carbon from the atmosphere. SAF is derived from a diverse array of sources with lower lifecycle carbon emissions. SAFs are also deemed 'sustainable' due to its feedstocks not competing with food crops or output, nor requiring additional resource consumption such as water or land clearance. Additionally, SAF could seamlessly integrate with airlines jets without compromising operational efficiency, equipment compatibility and user safety. Furthermore, SAF boasts a higher energy density and superior combustion characteristics compared to its conventional counterparts, translating into enhanced performance and range for aircraft, thereby bolstering its appeal to airlines and manufacturers alike.

Regional regulations set to include SAF in global aviation. Airlines are increasingly seeking multi-year supplies of SAF, with demand expected to solidify further as national SAF mandates come into effect, particularly from 2025 onwards. European Union (EU) regulators are leading this charge, with mandates requiring a certain percentage of SAF in jet fuel supplied to EU airports by specific dates, reaching up to 63% SAF by 2050, including a significant portion from e-fuel. Other countries such as Sweden, Norway, France, and the UK are also implementing or planning its own SAF mandates. The US aims a production target of at least 11.4b litres of SAF per year by 2030, supported by tax credits and funding for SAF research and development. California, a leader in low carbon fuel standards, has legislated that 20% of aviation fuel consumed in the state should be SAF by 2030.

Feedstock readily available, but competition is high. Currently, the dominant SAF feedstock is vegetable oil, either virgin or waste oil from cooking, converted into synthesized paraffinic kerosene through hydroprocessed esters and fatty acids (HEFA) technology. Despite its simplicity and cost-effectiveness, HEFA's availability is limited by feedstock supply and competition with other sectors like road and maritime fuel. Additionally, the price of feedstocks is heavily influenced by factors such as geopolitical events, leading to volatility and potential supply issues for producers, once SAF is fully commercialized. Numerous feedstocks used to make HEFA fuels are monocrops, heavily reliant on fertilizers, and susceptible to biodiversity loss and climatic/geopolitical price fluctuations. Nevertheless, in light of better technology in years to come, we anticipate that SAF can be derived from alternative biogenic and non-biogenic waste sources, including agricultural residues, discarded tires, and municipal solid waste (MSW). Despite these challenges, there exists substantial upside potential for investors, who stand to benefit from inflated prices as long as demand continues to outpace supply, a scenario likely to persist.

CHART 2: SAF Production Cycle

Source: MAG

ADVANTAGES

Reduction of GHG emissions. SAF offers a significant reduction in greenhouse gas (GHG) emissions compared to traditional fossil fuels like Jet A1. By utilizing renewable feedstocks such as agricultural residues, municipal waste, or biomass, SAF production processes emit lower levels of carbon dioxide and other pollutants. These feedstocks capture and store CO2 during their growth, effectively offsetting the emissions generated when SAF is burned. As a result, the aviation sector can substantially reduce its carbon footprint, contributing to global efforts to combat climate change and meet emission reduction targets set by international agreements such as the Paris Agreement.

Enhance energy security. Diversifying the aviation fuel supply with SAF enhances energy security by reducing dependency on finite and geopolitically sensitive fossil fuel resources. SAF production can utilize a wide range of renewable feedstocks, including those sourced domestically, thereby reducing reliance on imported petroleum products and mitigating the risks associated with supply disruptions or price volatility in global oil markets. This diversification strengthens national and regional energy resilience, ensuring a more stable and sustainable energy supply for aviation operations.

Stimulate economic growth. The development and adoption of SAF stimulate economic growth through various channels. Firstly, investment in SAF production facilities and associated infrastructure create jobs and stimulate economic activity in local communities. Additionally, SAF production can provide new revenue streams for farmers, foresters, and other feedstock suppliers, contributing to rural development and agricultural diversification. Moreover, the growth of the SAF industry fosters innovation and technological advancements, spurring research and development in bioenergy, biorefining, and renewable energy sectors. Lastly, as the demand for SAF grows globally, countries that establish themselves as SAF producers and exporters stand to benefit economically from trade opportunities and increased competitiveness in the aviation fuel market.

Below are examples of how SAF could present opportunities to various sectors that are economically viable:

Role	Sectors/Agencies Involved	Opportunities	Actions/Risk Mitigations
Airlines	Transportation	Mitigating the environmental impact of air travel	• Secure early supplies by employing floating market-indexed pricing mechanisms and exploring potential strategic investments in SAF production • Advocate for stronger SAF sustainability credentials and ensure transparency when promoting the technology to passengers to gain their support. • Push for government support and strategic clarity on advanced fuels technologies.
Fuel Producers	Oil and Gas, Plantation, Consumers	• Leveraging on existing expertise and infrastructure while driving the decarbonization agenda • Diversifying away from traditional oil investments • Promoting a positive narrative	• Secure offtake agreements with airlines and seek new sources of funding • Ensure project development plans are credible propositions for commercialization, instilling confidence in investors • Collaborate with competitors to share insights at various stages of plant development, reducing technology risks and instilling market confidence in SAF delivery
Fuel Distributors	Oil and Gas, Consumers	• Ensuring the availability of SAF in close proximity to airports, particularly those serving carbon-intensive routes • Establishing more widespread distribution networks can alleviate logistical hurdles and facilitate greater uptake among airlines	• Prepare supply chains to accommodate both fossil jet and SAF, ensuring timely and safe delivery to airports or aircraft upon request. • Expand delivery and storage infrastructure to ensure SAF availability where demand requires. • Facilitate SAF traceability and reporting initiatives. • Introduce innovative refueling schemes to absorb some of the cost premium airlines incur for SAF.

Role	Sectors/Agencies Involved	Opportunities	Actions/Risk Mitigations
Energy Generators	Oil and Gas, Utilities, Renewables Energy	Capitalising on efficient energy-and-fuel integration	• Partner with SAF producers to de-risk investment, and acquire expertise and technology
Financial Support	Government, Banking	Investing in Power-to-Liquid (PtL) fuel offers an avenue for the aviation finance community to diversify risk within a sector they are familiar with	• Explore low carbon fuel opportunities through commercial due diligence and screening of suitable technical partners
Regulations and Policies	Government	• Ensuring contribution to both national and international carbon emissions reduction targets • Enhancing country's fuel security • Foster domestic supply chains • Retain valuable fuel expertise and infrastructure • Creating new employment opportunities • Driving industrial development • Attracting additional investment	• Set ambitious SAF uptake targets to guide the market direction, attract investment, and facilitate scale-up. • Implement supply-side incentives, demand mandates, and certification schemes • Ensure regulatory clarity and support policies that penalize non-compliant actors • Align national policies internationally, including traceability, reporting, verification, point of sale, and credit generation structures • Allocate funds for research, appropriately rewarding non-CO2 savings, and supporting operational efficiencies and airspace modernizations

CHALLENGES

Low availability amid low investment and technology immaturity. One of the primary challenges facing the widespread adoption of SAF is its low availability, which stems from inadequate investment/capex and relatively immature production technologies. Compared to conventional fossil fuels, SAF production facilities are limited in number and capacity, resulting in constrained supply. It is estimated that for 1 ton of SAF, the price-at-wing is USD2,400 (approximately RM11,000) with capex at approximately 50%. Additionally, the technology required for large-scale SAF production is still evolving, leading to production inefficiencies and higher costs. This limited availability poses a significant barrier to scaling up SAF production to meet the growing demand from the aviation sector.

However, with the inevitable demand for cleaner fuel, we believe this challenge could be negated by increasing the investment in SAF production facilities via grants, subsidies, tax incentives, or partnerships with private investors. Additionally, continued research and development (R&D) is essential to advance SAF production technologies, improve efficiency, and reduce costs. Public-private collaborations and government-funded research programs can accelerate technology maturity.

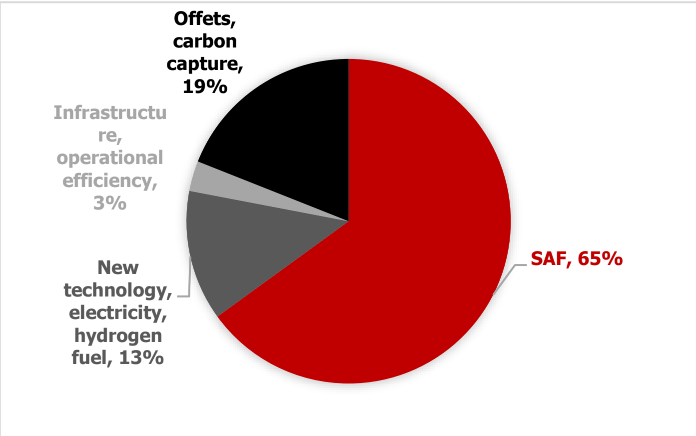
Dissimilar policies and governmental support. Another obstacle hindering the development of SAF is the lack of uniform policies and governmental support across different regions. While some countries have implemented supportive regulations and incentives to promote SAF production and adoption, others have yet to develop comprehensive frameworks or provide sufficient financial incentives. This disparity in policy approaches creates uncertainty for investors and producers, inhibiting investment in SAF projects and impeding market growth.

Harmonizing policies and aligning governmental support mechanisms on a global scale is crucial to creating a conducive environment for SAF development and deployment by creating consistent policies and adoption globally. International organizations such as the International Civil Aviation Organization (ICAO) can facilitate dialogue and collaboration among nations. Incentive programs such as renewable fuel mandates, tax credits, carbon pricing mechanisms, and grants could also encourage SAF production and uptakes.

Costly production deters demand in market. The production of SAF is currently more expensive compared to traditional fossil jet fuels like Jet A-1, most notably for nations that do not adopt any SAF incentives, by 3-8x higher. Factors contributing to the high production costs include the use of feedstocks with fluctuating prices, limited economies of scale in SAF production facilities, and the need for advanced conversion technologies. As a result, SAF is often priced at a premium, discouraging airlines from incorporating it into its fuel portfolios, especially amid cost-conscious operational environments which may have significant implications for the business models of low-cost carriers. Without addressing the cost challenges associated with SAF production, demand in the market is likely to remain subdued, impeding the transition to more sustainable aviation fuels.

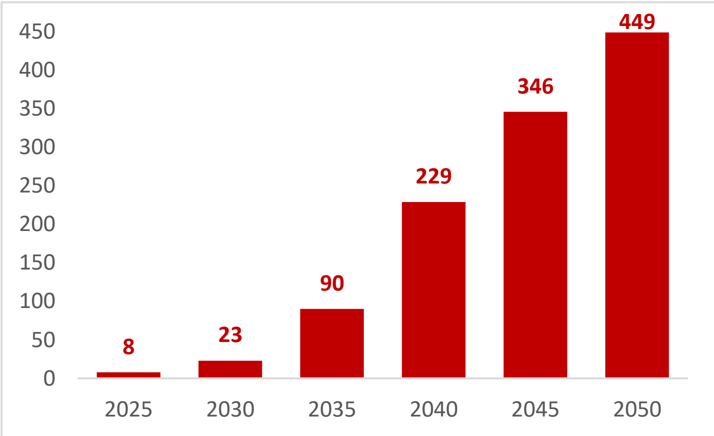
Nevertheless, a substantial evolution in the regulatory approach to aviation emissions over the next decade is anticipated, with a shift in focus from direct carbon emissions to total sector CO2 equivalent (CO2e) as the primary concern for regulators. This expanded attention is expected to emphasize on increasingly higher blends of SAF. Advances in biorefining technologies, feedstock diversification, and process optimization can help in reducing the concerns while also reducing production costs. Streamlining the supply chain for SAF production by optimizing logistics, reducing transportation costs, and improving feedstock procurement strategies via inter-sectorial collaboration can also enhance supply chain efficiency and reduce costs.

CHART 3: IATA's recommended strategy towards Net Zero 2050



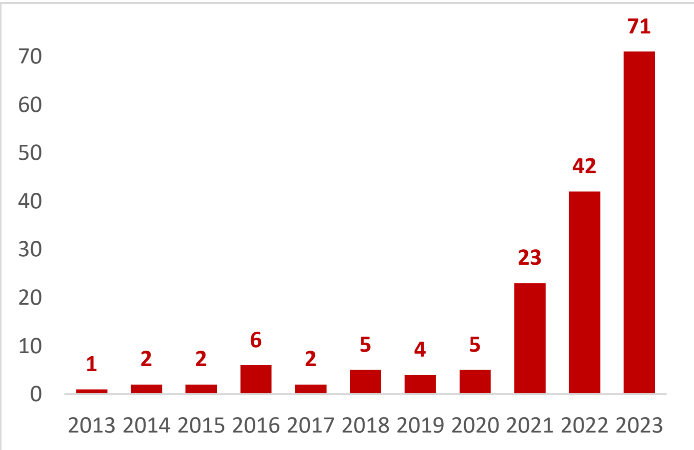
Source: IATA, MIDFR

CHART 4: Estimated SAF production to reach Net Zero 2050 (billion Litres)



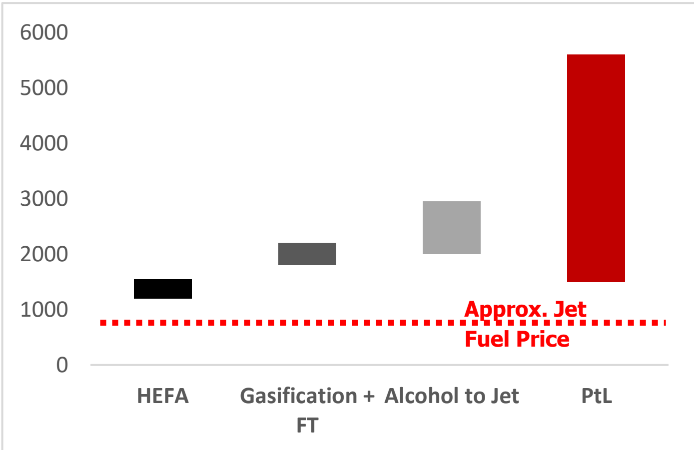
Source: IATA, MIDFR

CHART 5: SAF Offtakes (Global)



Source: ICAO, MIDFR

CHART 6: SAF production costs (USD/tonne)



Source: WEF, MAG, MIDFR

CASE STUDIES

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

Case Study 1: United Airlines' SAF Initiatives

United Airlines (UA) (NASDAQ:UAL) has been actively pursuing the use of SAF to reduce its carbon footprint and achieve its sustainability goals. UA was the first US airline to test SAF in 2009, and to invest in a SAF company (Fulcrum BioEnergy) in 2015. Since 2016, UA had been using SAF in its regular flights. Implementing SAF wasn't without its set of challenges. Similarly, UA faced the limited availability and high cost of SAF. SAF production facilities were few, and the production costs were often higher due to technological constraints and feedstock availability. Inconsistent policies and regulations across different regions also created barriers to investment and hindered the development of a robust SAF supply chain. To overcome these risks, UA had formed strategic partnerships with SAF producers and invested in SAF production facilities to increase availability and lower costs. UA also actively advocated for supportive policies and regulations to promote SAF adoption. The airline engaged with policymakers, industry stakeholders, and environmental organizations to push for incentives, mandates, and funding mechanisms to support SAF production and uptake. To ensure that the group reached its Net Zero goal by 2045, UA has invested in the future production of over 5b gallons (approximately 18.9b litres) of SAF – the most of any airline in the world.

Case Study 2: KLM's Biofuel Program

KLM Royal Dutch Airlines (KLM) has been at the forefront of sustainable aviation initiatives, including the use of biofuels. KLM had conducted the world's first commercial flight on blended biofuel in 2011. In 2021, a commercial flight with an admixture of sustainable synthetic fuel was launched. For SAF, KLM focuses on all technologies side by side: based on used cooking oil, forestry residues and sustainable synthetic fuel. Effective in 2022, a compulsory SAF admixture percentage was introduced to KLM in order to achieve a compulsory SAF proportion of 2% by 2025 for all flights within and from Europe and worldwide SAF proportion of 10% in 2030. Similarly to UA, KLM faced challenges related to feedstock availability and diversity for biofuel production. Biofuel is often sourced from used cooking oil and plantation residue, making it a challenge to public perception and persuade market demand for biofuels. Despite its environmental benefits, biofuels faced skepticism from consumers and investors, in part of the unconventional source of the feedstocks, leading to limited demand and investment in biofuel production. To abate these risks, KLM had invested in R&D initiatives to expand the availability and diversity of feedstocks. The airline collaborated with agricultural experts, biotechnology companies, and research institutions to explore new feedstock sources and improve cultivation techniques. KLM also actively engaged with stakeholders, including consumers, investors, and policymakers, to raise awareness about the benefits of biofuels and address misconceptions. The airline conducted public education campaigns, participated in industry forums, and collaborated with environmental organizations to build support for biofuel initiatives.

Case Study 3: Neste

Neste (HEL:NESTE) is a leading producer of renewable fuels, including SAF, derived from renewable feedstocks such as waste and residues. Neste has successfully commercialized its SAF production and distribution, supplying airlines worldwide. Its SAF is derived from various renewable feedstocks, including waste animal fats, vegetable oils, and used cooking oil. It has established themselves as a key player in the SAF market, securing partnerships with airlines like Finnair, Lufthansa, and American Airlines, demonstrating the commercial viability of its product with an estimated production capability of up to 1.5mTpa in early 2024. Initially, scaling up production to meet increasing demand posed a challenge. To address this, Neste invested in expanding their production capacity through the construction of new facilities and upgrading existing ones. Its expertise in renewable diesel production is leveraged to optimize its SAF production processes, enhancing efficiency and output. Meanwhile, the high cost of producing SAF is a risk to widespread adoption. Neste focused on continuous process optimization and technological innovation to drive down production costs. They also benefited from government incentives and subsidies for renewable fuel production, which helped improve cost competitiveness.

How will Malaysia fair in the SAF game? Malaysia has the potential to play a role in the global SAF market, leveraging on its: (i) abundant feedstock resources, (ii) established biofuel industry, (iii) government support, and (iv) solid collaboration with oil and gas players. However, addressing challenges such as competition with conventional fuel as well as other industries that sought similar feedstocks for its clean fuel endeavours, technological constraints, and environmental concerns will be crucial to realizing this potential and establishing Malaysia as a key player in SAF production and distribution. Within National Energy Transition Roadmap (NETR)'s initiatives, Malaysia adopted ICAO's net-zero carbon emissions goal for aviation by 2050 and targeted up to 47% SAF blending by 2050.

We highlight the following key factors that we believe could place Malaysia in a pivotal role within the SAF environment.

Recognition as major feedstock supplier. Malaysia possesses a diverse range of feedstock resources that can be utilized for SAF production, including palm oil, palm kernel oil, jatropha, algae, and agricultural residues. The country is one of the world's largest producers of palm oil, which can serve as a valuable feedstock for SAF production. In addition, oil and gas is one of Malaysia's major sectors and Jet A1 is one of the petroleum products produced. Currently, Malaysia produces 660,000 bl of liquids and approximately 7.0 bcft of gas per day. The country's remaining commercial reserves are estimated at over 17bboe from more than 400 fields, with gas making up 75% of the mix. With the combination of the feedstocks and the availability of Jet A1, Malaysia is poised to be one of the major SAF producers in the region. Recently, Air New Zealand (ANZ) has highlighted Malaysia's potential to emerge as a key provider of feedstock for SAF within the Asia Pacific region, citing Malaysia's abundant array of feedstock and biomass resources, in a bid to support the aviation industry's efforts towards decarbonization. The collaboration initiative represents a significant stride in ANZ's commitment to reducing its carbon footprint and is in line with Malaysia's NETR.

Well-established biofuel industry. Malaysia has a well-established biofuel industry, particularly in the production of biodiesel from palm oil. This existing infrastructure and expertise can be leveraged to transition towards SAF production. The country's experience in biofuel production provides a solid foundation for the development of SAF technologies and processes. While S&P Global sees limited growth in the road transportation fuel sector, given the current limited mandates for biodiesel in Malaysia and Indonesia, palm oil industry players are therefore exploring the use of palm oil in SAF which is currently allowed by ICAO under its global carbon offsetting programme CORSIA. Aside from palm oil, another potential biofuel feedstock is algae. Sarawak will begin commercial production of SAF from microalgae in 2024, with keen interest from Petroliam Nasional (PETRONAS), in line with its production target of 100,000 bpd of SAF by 2030. The state had identified 10,000 acres of land in Bintulu for the purpose of algae plantation.

Government's strong support in energy transition. The Malaysian government has shown commitment to promoting renewable energy and reducing carbon emissions. Policies and incentives aimed at supporting the biofuel industry could be extended to include SAF production. Government support, such as financial incentives, tax breaks, and research grants, can encourage investment in SAF projects and facilitate market development. Aligned with ICAO's directives via the Global Market-Based Measures, Malaysia is dedicated to confronting environmental issues and sustainability concerns. Malaysia has affirmed its full commitment to engage in the voluntary pilot phase of carbon offsetting scheme CORSIA, as well as to promote research on biojet fuel as a viable fuel source, with RM2b allocated for NETR and Net Zero Carbon Emission in the 2024 Budget. For that reason, Malaysia aims to advocate for crude palm oil to be included as an acceptable feedstock in CORSIA in the future.

Active collaboration with international SAF companies. Malaysia can benefit from international collaboration and partnerships in SAF research, development, and commercialization. Collaborating with other countries, industry stakeholders, and research institutions can facilitate knowledge exchange, technology transfer, and market access. In 2023, PETRONAS and Idemitsu Kosan Co., Ltd. (Idemitsu) collaborated to enhance capabilities and optimize the route to market for SAF. PETRONAS and Idemitsu will concentrate on a feasibility study to expand bio feedstock options, analyzing production costs, and ensuring security to maintain a steady and efficient supply chain for SAF. This includes exploring the supply potential of non-edible oil feedstock trees suited for SAF production, such as

Pongamia and Jatropha. PETRONAS is poised to have the capacity for large-scale production of SAF and other biofuels by 2026 through its biorefinery in Pengerang, Johor, and co-processing in Melaka.

Meanwhile, Idemitsu's expertise lies in its technologies for producing SAF from non-fossil renewables. Idemitsu is working towards establishing a domestic SAF production system of 500,000 Litres pa to achieve the target of replacing 10% of Jet fuel consumption in Japan, which aligned with PETRONAS's own sustainability aspiration for Malaysia.

But common SAF feedstock challenges persisted. HEFA is identified as the most matured feedstock for SAF, as it is safe with proven and scalable technology. HEFA consisted mainly of residue oil. Palm oil falls under a piloted maturity of GAS-FT, which gives a higher reduction in emission (approximately +12%) from HEPA. However, the palm oil industry, which is a major contributor to Malaysia's economy, may prioritize the production of traditional palm oil products over SAF feedstocks. Additionally, this would make feedstock and SAF products to be more susceptible to the price movement of the edible oils. However, recently, Malaysia had won against the European Union over the Renewable Energy Directive (RED II) – which was used to discriminate against oil palm crop-based biofuels on the basis of environmental and social concerns. These changes may provide some continued access to Malaysian palm oil as a feedstock for biofuel to the EU. All production of palm oil in Malaysia is considered sustainable, deforestation-fee and in full compliance to the Malaysian Sustainable Palm Oil (MSPO). Nevertheless, we expect palm oil will continue to be part of SAF Production Pathway as a biofuel, along with HEPA, Alcohol-to-jet and the latest opportunity of power-to-liquid (PtL).

RECOMMENDATIONS

Prior to facilitating the development of SAF through production plants and transportation, as well as the securing of SAF feedstocks, policies and regulations in regard to ensuring a sustainable and viable fuel must be reinforced. This is to safeguard the longevity of SAF utilization within the aviation industry, while mitigating the common challenges of SAF and getting in line with the trajectory of the Net Zero 2050 aspirations. We believe the following policy recommendations can be implemented to better foster the development and uptake of SAF in Malaysia:

Policy Recommendations	Remark	Challenge	Risk Mitigation
Grants and Subsidies	Government bodies and environmental agencies can offer grants and subsidies to SAF producers to help offset the initial capital investment required for infrastructure development and R&D.	• Ensuring efficient allocation of funds • Preventing misuse of subsidies	• Implement transparent and accountable grant allocation processes with clear eligibility criteria and performance metrics • Conduct regular audits to ensure funds are used effectively • Provide targeted grants to projects with proven potential for SAF development and deployment
Tax Credits and Incentives	• Tax incentives can be implemented to encourage investment in SAF initiatives. • Reduced corporate tax rates for SAF producers or tax breaks on equipment purchases and operational expenses related to SAF production can also incentivize companies to enter the market.	Balancing the need to incentivize SAF production with fiscal sustainability	• Gradually phase out tax credits and incentives as the SAF market matures and production costs decrease • Implement sunset clauses to ensure tax incentives are temporary and regularly evaluate their effectiveness • Provide tax credits for SAF blending or production based on carbon intensity to incentivize emission reductions
Low-Interest Loans and Financing	Financial institutions and government-backed lending programs can offer low-interest loans and favourable financing terms to SAF producers to facilitate capital investments	Ensuring the environmental integrity and additionality of carbon offset projects	• Establish dedicated financing mechanisms or loan programs with low-interest rates specifically for SAF projects • Collaborate with financial institutions to develop innovative financing solutions tailored to the needs of SAF producers • Provide guarantees or credit enhancements to reduce the risk for lenders and attract investment.

<table>
<tr><th>Policy Recommendations</th><th>Remark</th><th>Challenge</th><th>Risk Mitigation</th></tr>
<tr><td>Carbon Offsetting Schemes</td><td>Governments or regulatory bodies can establish carbon offsetting schemes that allow SAF producers to generate carbon credits for each unit of SAF produced, which can be sold on carbon markets.
This provides an additional revenue stream for SAF producers and incentivizes investment in low-carbon aviation solutions.
Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)
- CORSIA is the first global market-based measure
- CORSIA requires participating airlines to offset their emissions above a specified baseline by purchasing carbon credits from approved environmental projects</td><td>Additional costs, particularly due to the need to purchase carbon credits to offset their emissions
Stringent MRV requirements under CORSIA necessitate the implementation of sophisticated tracking systems
Ensuring the environmental integrity and additionality of carbon offset projects</td><td>Implement CORSIA in the mandatory phase (2027+) to all states
Working with a partner to develop an internal carbon trading framework and policy
Procuring strategy for purchase of EEUs (Eligible Emission Units).
Implement robust certification and verification mechanisms to ensure they meet recognized standards
Prioritize investments in projects that deliver co-benefits
Regularly monitor and evaluate the performance of offset projects to maintain integrity</td></tr>
<tr><td>Public-Private Partnerships (PPPs)</td><td>Governments can collaborate with private companies through PPPs to co-fund SAF production projects
By sharing the financial risk and leveraging public funds with private sector expertise, PPPs can accelerate the development and commercialization of SAF technologies</td><td>Aligning the interests and objectives of public and private sector partners can be complex.</td><td>Foster open communication and collaboration between public and private
Develop clear contractual agreements outlining roles, responsibilities, and risk-sharing mechanisms
Provide incentives for private sector involvement, such as revenue-sharing arrangements or performance-based payments</td></tr>
<tr><td>Research and Development Grants</td><td>Funding agencies and research institutions can provide grants for SAF-related research and development projects aimed at improving production efficiency, reducing costs, and enhancing the sustainability of feedstock sources.
These grants can support innovation and technological advancements in SAF production processes</td><td>Ensuring that R&D grants lead to tangible outcomes and commercialization of SAF technologies</td><td>Prioritize R&D funding for projects with clear commercialization potential and measurable milestones
Foster collaboration between research institutions, industry, and government agencies to leverage expertise and resources
Provide support for technology transfer and knowledge exchange to accelerate innovation and adoption</td></tr>
<tr><td>Market-Based Mechanisms</td><td>Governments can implement market-based mechanisms, to create demand for SAF and stimulate investment in production capacity.
Tradable certificates can incentivize companies to invest in SAF production by providing a tradable asset linked to the production of renewable aviation fuel.</td><td>Designing effective market-based mechanisms that incentivize SAF production and uptake without creating market distortions</td><td>Establish transparent and well-functioning markets for SAF through mechanisms
Set clear targets and benchmarks for SAF adoption to provide market certainty and drive investment
Regularly review and adjust market mechanisms based on market dynamics and policy objectives</td></tr>
<tr><td>Public Procurement Policies</td><td>Governments and airlines can adopt procurement policies that prioritize the purchase of SAF over conventional fossil fuels for aviation operations
This creates a guaranteed market for SAF producers and incentivizes investment in production facilities to meet demand from commercial airlines and government fleets</td><td>Ensuring that public procurement policies effectively stimulate demand for SAF and promote market development</td><td>Implement procurement policies that prioritize SAF use in government fleets and facilities, setting clear targets and timelines for adoption
Provide incentives or preferences for SAF suppliers in government procurement processes
Collaborate with industry stakeholders to develop standards and specifications for SAF procurement that meet environmental and performance criteria</td></tr>
</table>

CONCLUSION

In the anticipation that demand for commercial air travel is growing around 3.9%pa for the next 20 years, we believe that the development, production and implementation of SAF is timely. Aviation industry is responsible for around 2-3% of all man-made global carbon emissions and this industry could use up to 22% of the global carbon budget by 2050 if no drastic action is taken to adopt decarbonisation strategies. Therefore, the transition from using fossil fuel to SAF is essential for the future of the aviation industry, and to an extent, the oil and gas, and plantation sectors as well. As of 2023, SAF had been of service to 470,000 flights globally at 300m litres pa, under an approximately USD25b in purchase SAF offtake agreements. 63 airports had been distributing SAF and 38 countries had established SAF policies.

Overall, SAF is considered one of the easier, cleaner fuel to be manufactured and produced, and subsequently utilised, given: (i) the proven safety of SAF to be used on engines that run on Jet A1, (ii) the easy blending of SAF with Jet A1, (iii) the widely available low-carbon feedstock, and (iv) lesser susceptibility to fossil fuel price movement. Additionally, the blending technology of SAF may also attract other industrial sectors, primarily to heat boilers and generate electricity.

However, challenges remain on the production side, as the production cost of SAF is still higher than Jet A1, making adoption difficult, especially by low-cost carriers. SAF, like many clean fuel and renewable energy, faced low investment that subsequently hampered technology maturation required to make SAF better at reducing carbon emission. Additionally, the lack of policies to support SAF offtake is setting back Malaysia's attempt to cushion the cost impact and create a level playing field. While the US and EU had establish financial support and mandates for their commitment in SAF, Malaysia's economic framework for SAF remains in the roadmap stage. We believe, as with other cleaner fuels such as hydrogen and biofuel, a thorough and precise regulation is the first step to get SAF in momentum. Government grants and incentives, carbon levy, as well as financial support from the banking sector could mitigate on the high production cost and level the pricing of SAF to that of Jet A1. Additionally, the feedstocks available for SAF in Malaysia is mainly derived from waste, with intensive studies carried out for the viability of palm oil and palm waste, as well as microalgae. This could help in diversifying the feedstocks, thus increasing the availability and demand for better technology.

By embracing SAF as a viable alternative to conventional jet fuel, the aviation sector can transition towards a more sustainable and resilient future, while simultaneously contributing to broader environmental and socio-economic goals.

APPENDIX - SAF Production Pathway

Pathway	Blending Limitation	Feedstocks	Chemical Process
Fischer-Tropsch Synthetic Paraffinic Kerosene (FT-SPK)	50%	• municipal solid waste • agricultural and forest wastes • energy crops	• Wood biomass undergoes gasification to produce syngas, which is then converted to jet fuel through a Fischer-Tropsch synthesis reaction. • Utilizes various renewable biomass sources, predominantly woody biomass, including municipal solid waste, agricultural residues, forest waste, wood, and energy crops • ASTM approved in June 2009, with a blend limit of 50%
Hydroprocessed Esters and Fatty Acids (HEFA-SPK)	50%	Oil-based feedstocks (jatropha, algae, camelina, yellow grease)	• Triglyceride feedstocks are subjected to hydroprocessing to break down the long chains of fatty acids, followed by hydroisomerization and hydrocracking. • Yields a drop-in fuel • ASTM approved in July 2011, with a blend limit of 50%
Hydroprocessed Fermented Sugars to Synthetic Isoparaffins (HFS-SIP)	10%	Sugars	• Microbial conversion of sugars into hydrocarbons involves cellulosic biomass feedstocks (herbaceous biomass, corn stover), along with pretreated waste fats, oils, and greases • ASTM approved in June 2014, with a blend limit of 10%.
FT-SPK with Aromatics (FT-SPK/A)	50%	Same as Jet A1	• Biomass is converted to syngas, which is then transformed into synthetic paraffinic kerosene and aromatics through FT synthesis • Incorporates aromatic components and was ASTM approved in November 2015, with a blend limit of 50%
Alcohol-to-Jet Synthetic Paraffinic Kerosene (ATJ-SPK)	50%	Cellulosic biomass	• The conversion of cellulosic or starchy alcohols (isobutanol and ethanol) into drop-in fuel involves a series of chemical reactions, including dehydration, hydrogenation, oligomerization, and hydrotreatment • ASTM approved in April 2016 for isobutanol and in June 2018 for ethanol, with a blend limit of 30%
Catalytic Hydrothermolysis Synthesized Kerosene (CH-SK or CHJ)	50%	Fatty acids or fatty acid esters or lipids from fat oil greases	• Involves combining clean free fatty acid oil with preheated feed water in a catalytic hydrothermolysis reactor • Feedstocks include triglyceride-based oils such as soybean oil, jatropha oil, camelina oil, carinata oil, and tung oil • ASTM approved this process in February 2020, with a blend limit of 50%.
Hydrocarbon-Hydroprocessed Esters and Fatty Acids (HC-HEFA-SPK)	10%	Algal oil	• The conversion of triglyceride oil from Botryococcus braunii, a high-growth alga, into jet fuel and other fractionations • ASTM approved in May 2020, with a blend limit of 10%
Fats, Oils, and Greases (FOG) Co-Processing	5%	Fats, oils, and greases	• ASTM approved the coprocessing of 5% fats, oils, and greases with petroleum intermediates as a potential SAF pathway. • Used cooking oil and waste animal fats are popular sources for coprocessing.
FT Co-Processing	5%	FT biocrude	ASTM approved the coprocessing of 5% Fischer-Tropsch syncrude with petroleum crude oil to produce SAF.

Source: ICAO, MIDFR

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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