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Decarbonising Singapore's Aviation and Maritime Sectors: Policies for Sustainable Aviation Fuel and Ammonia

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SYNOPSIS

Singapore relies extensively on aviation and maritime transport to sustain its role as a global hub, making decarbonisation of these sectors both economically critical and structurally complex. This policy brief examines Singapore's policies to reduce emissions from these two sectors, focusing on the two key policies mentioned in Budget 2026: the introduction of a distance-based sustainable aviation fuel (SAF) levy for aviation and the development of ammonia bunkering infrastructure on Jurong Island. It evaluates global market developments, discusses the opportunities and challenges associated with scaling these fuels, and introduces Singapore's approach to address them.

KEY POINTS

- Singapore's SAF levy shifts cost management from volatile market pass-through to centralised procurement, reducing uncertainty across the aviation value chain.
- Primary barrier for developing ammonia as a shipping fuel is coordination failure, rather than cost. Singapore's front-end engineering and design investment aims to anchor infrastructure development ahead of demand consolidation.
- Singapore's diversified fuel strategy hedges against technological uncertainty, prioritising compliance readiness over single-fuel commitment.

INTRODUCTION

Aviation and maritime shipping, accounting for approximately 2.7% and 2.2% of global energy-related carbon dioxide (CO_2) emissions in 2024 respectively, are widely regarded as "hard-to-abate" sectors. These sectors rely heavily on energy-dense liquid fuels and operate long-lived capital assets such as aircraft and ocean-going vessels, which limits the scope for rapid technological substitution. Given that direct electrification remains technically constrained for long-distance aviation and deep-sea shipping, shifting to low-carbon fuels is considered the primary pathway for reducing emissions in these sectors. However, both sectors face substantial infrastructure investment requirements, while many low-carbon fuel pathways are still in the early stages of commercialisation. This creates a dual challenge of scaling up supply in a cost-effective manner while avoiding premature technological lock-in. Policy design therefore plays a critical role in shaping both the pace and direction of decarbonisation in these capital-intensive sectors.

These two sectors constitute the core pillars of Singapore's trade-dependent economy. The air hub contributes roughly 5% of GDP and supports more than 60,000 jobs, whilst the maritime sector accounts for over 7% of GDP and employs around 170,000 people. To sustain economic gains from these sectors, Singapore must balance decarbonisation goals with the need to maintain connectivity, competitiveness and logistical efficiency when designing policies affecting aviation fuel or maritime energy systems. Recent policy developments reflect Singapore's attempt to navigate these competing priorities. Singapore introduced a Sustainable Aviation Fuel (SAF) target of 1% beginning in 2027, supported by a distance-based SAF levy applied to departing flights, designed to bridge the green premium between SAF and conventional jet fuel. Alongside this, Singapore is advancing ammonia bunkering infrastructure and ammonia-based power generation on Jurong Island, reflecting a broader strategy of developing next-generation maritime fuel supply ahead of global demand consolidation. Against this backdrop, this policy brief evaluates global market trends in SAF and ammonia, discusses the opportunities and challenges associated with scaling these fuels, and introduces Singapore's approach to address them.

ANALYSIS

Global Trends in SAF Deployment and Related Challenges

The deployment of SAF is widely regarded as the most viable near- to medium-term solution for reducing lifecycle emissions in the aviation sector. According to the International Air Transport Association (IATA), SAF could deliver over 60% of the carbon abatement needed to achieve the aviation sector's target of net-zero emissions by 2050. SAF can be blended with conventional jet fuel and utilised across existing aircraft fleets without requiring significant engine modifications. As a drop-in substitute for fossil-based jet fuel, it can be produced from a diversity of feedstocks and conversion processes. Such flexibility is expected to support long-term scalability as technologies mature and supply chains expand.

A defining characteristic of the global SAF market is a persistent mismatch between policy-driven demand and the pace of supply expansion. Several jurisdictions have introduced binding blending mandates to accelerate SAF adoption. Under the European Union (EU)'s ReFuelEU Aviation Regulation, SAF is required to account for 2% of aviation fuel in 2025, rising progressively to 70% by 2050. Similarly, the United Kingdom has established a mandate beginning at 2% in 2025, increasing to 10% by 2030 and 22% by 2040. Such policy approaches have also been adopted in Asian jurisdictions: Singapore has introduced a 1% SAF target for 2027 with the goal of increasing it to 3-5% by 2030; South Korea (1% in 2027 and 3-5% in 2030); and Japan (10% by 2030). The expansion of SAF mandates is expected to increase overall demand and stimulate investment in SAF production by providing greater certainty in long-term demand.

However, the increase in such mandates does not fully address the underlying supply constraints. Although SAF output increased from 0.08 million tonnes (Mt) in 2021 to 1.9 Mt in 2025, it accounted for only 0.6% of global jet fuel consumption in 2025, rising marginally to 0.8% in 2026. Moreover, while 500 Mt of SAF is required to achieve net zero by 2050, actual production is projected to be around 400 Mt due to constraints in feedstock availability, technological maturity, and high capital costs. These trends suggest that policy-induced demand growth may outpace supply expansion, reinforcing concerns over future shortages and price volatility.

A further challenge concerns the high cost of SAF and its distribution across the aviation value chain. While some governments, such as Japan, the Netherlands, and the United States, support SAF production with subsidies and tax credits, airlines usually bear the incremental cost of SAF in many jurisdictions. For example, airlines are projected to face a SAF-related cost burden of approximately 3.6 billion USD in 2025, since SAF currently trades at two to five times the price of conventional jet fuel in several mandated markets. Facing difficulties managing fuel cost risks under volatile SAF prices, airlines implicitly pass these costs to passengers by increasing ticket prices. Uncertain cost recovery and volatile price signals may also deter capital investment in SAF production capacity, such that even with strong policy-driven demand signals, supply expansion may remain constrained.

Singapore's New SAF Policy: SAF Levy

Building on the 1% SAF blending target, Singapore introduces a distinctive policy approach that fundamentally reshapes how transition costs are distributed. Rather than adopting a percentage-based mandate tied to volatile SAF price premiums, the Civil Aviation Authority of Singapore announced in October 2025 the adoption of a fixed, distance-based SAF levy. To the best of current knowledge, it is one of the first dedicated SAF levy mechanisms introduced in the aviation sector globally. The levy was initially planned to apply to flights departing Singapore from

October 2026, but due to heightened fuel price volatility arising from conflicts in the Middle East, the government postponed its implementation to tickets purchased from October 2026 for flights departing Singapore from January 2027. Passenger charges will range from 1 SGD to 41.60 SGD depending on distance and cabin class. For example, economy-class passengers will pay 1 SGD for Bangkok, 2.80 SGD for Tokyo, and 10.40 SGD for New York. Cargo shipments will face a distance- and weight-based levy of 0.01-0.15 SGD per kilogramme. The levy is calibrated to reflect projected SAF price differentials as well as associated certification, blending, and delivery costs. Revenue collected from the levy will be pooled into a central procurement fund designed to meet the 1% blending target.

This policy design represents a shift from implicit cost pass-through to a structured, predictable cost allocation mechanism. From an economic perspective, it can be interpreted as a form of risk pooling and price smoothing. Based on centralised procurement and aggregate demand, Singapore may effectively absorb short-term price volatility at the system level. Hence, rather than exposing individual airlines and passengers to fluctuating SAF price premiums, the levy fixes compliance costs ex ante, reducing uncertainty across the aviation value chain and introducing greater price transparency for consumers. Furthermore, by providing a more stable and predictable demand signal, Singapore's levy-based system may lower perceived risks for SAF producers, facilitating long-term contracting and supporting capacity expansion. In this sense, Singapore's policy framework not only addresses the cost distribution but also improves the overall functioning of the SAF market.

Utilisation of Ammonia as a Marine Fuel and Related Challenges

The use of ammonia as a marine fuel presents a fundamentally different challenge from that of SAF. The primary barrier is not cost, but coordination failure across multiple interdependent components of the value chain. Unlike SAF, which can be deployed within existing infrastructure, ammonia requires the simultaneous development of fuel supply, compatible vessels, and bunkering infrastructure. However, the strong interdependence across these components creates a coordination barrier that cannot be resolved by individual market participants. Fuel producers face demand uncertainty in the absence of shipowner commitments; shipowners are unwilling to invest in low-carbon vessels without reliable bunkering infrastructure; and port operators face substantial capital risks without assured fuel throughput.

This coordination problem becomes more evident when viewed against the broader landscape of maritime fuel transition. The maritime sector is undergoing a gradual transition towards low-carbon fuels, yet progress remains highly uneven across technological pathways. While more mature alternatives such as LNG continue to dominate, given their established vessel technologies, fuel supply chains, and bunkering infrastructure, fuels with lower greenhouse gas (GHG) intensity, such as ammonia and hydrogen, remain at a nascent stage across the entire value chain. The number of vessels currently capable of operating on ammonia remains extremely limited, with only a handful in operation and a relatively small order book. Ammonia fuel supply to the shipping sector remains negligible, and dedicated bunkering infrastructure is almost absent globally, although several ports have pilot or demonstration projects. These patterns suggest that ammonia remains underdeveloped across all key components of the value chain. Further, the divergence in system readiness among fuel options suggests that the transition is not constrained uniformly but reflects varying degrees of readiness for market formation. In brief, the limited uptake of ammonia and hydrogen indicates that the key barrier lies not only in technological maturity, but also in the absence of coordinated development across supply, infrastructure, and demand.

Singapore's Policies for Ammonia Utilisation

Singapore has adopted a proactive strategy aimed at addressing these coordination constraints through targeted infrastructure investment and institutional support. Singapore is developing low-carbon ammonia bunkering on Jurong Island, potentially positioning Singapore among the first jurisdictions to supply ammonia commercially for international shipping. The Energy Market Authority and the Maritime and Port Authority of Singapore have appointed industry partners to undertake front-end engineering and design (FEED) studies across the value chain, associated terminal infrastructure, and planned bunkering capacity of at least 0.1 Mt per annum. While this figure is modest relative to DNV's projected global ammonia demand as a marine fuel of approximately 2.3 Mt per annum by 2030, it is consistent with the preparatory phase of market formation, including establishing operational protocols, safety standards, and supply chain linkages that are prerequisites for subsequent scaling. Critically, 2025 to 2030 is widely regarded as a period of infrastructure groundwork rather than volume deployment, making early-mover positioning in bunkering standards and operational experience, which is potentially a durable competitive advantage for Singapore.

Beyond infrastructure provision, Singapore's approach also reflects a strategy of risk diversification across multiple fuel pathways. Rather than committing to a single technological trajectory, Singapore continues to develop capabilities in both methanol and ammonia bunkering. In July 2023, Singapore established the world's first ship-to-containership methanol bunkering operation and completed its first trial in December 2025. This diversified approach helps manage uncertainty regarding future fuel adoption and mitigates the risk of premature lock-in.

In addition, Singapore seeks to enhance the economic viability of ammonia through cross-sectoral integration of demand. The FEED studies also cover a 55-65 megawatt (MW) ammonia-fired power plant, allowing infrastructure investments to be utilised across multiple applications. This cross-sectoral demand aggregation improves asset utilisation rates and strengthens the commercial case for early-stage investment, though the scale of power generation demand relative to bunkering volumes remains a key variable in determining whether the integrated model delivers sufficient throughput to justify the infrastructure costs.

CONCLUSION

Singapore's Budget 2026, announced in February 2026, reflects recognition that low-carbon fuels are no longer peripheral environmental options, but competitive variables requiring institutional management. For both SAF and ammonia, market forces alone are insufficient to coordinate the scale of investment, risk-sharing, and infrastructure development required for a credible fuel transition. Singapore's demand-side levy for SAF and coordinated FEED investment for ammonia bunkering reflect attempts to internalise these coordination problems through institutional design. However, significant challenges remain. SAF supply constraints will persist well beyond 2030, and the commercial viability of ammonia hinges on final investment decisions that are not yet to be made. Whether Singapore can sustain this institutional momentum as blending targets rise and bunkering markets mature will determine whether its early-mover positioning translates into durable competitive advantage.

WHAT TO LOOK OUT FOR

- Effectiveness of Singapore's distance-based SAF levy in stabilising transition costs following its implementation
- Outcomes of the ammonia FEED studies and progression into final investment decisions
- Development of IMO's GHG regulatory framework and its implications for the commercial viability of ammonia as a marine fuel

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