# SUSTAINABLE AVIATION FUEL (SAF) ADOPTION: GLOBAL TRENDS AND THAILAND'S READINESS- A SYSTEMATIC LITERATURE REVIEW

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**Abstract**

Driven by the need to cut CO2 emissions by up to 80%, this study employs a Systematic Literature Review (SLR) to assess global SAF trends and Thailand's readiness. While the U.S. and EU lead with aggressive mandates, global progress is hampered by high costs and infrastructure gaps. Thailand has integrated SAF into its national energy strategy, aiming for a 1% blend by 2026 supported by tax incentives. Despite these efforts, the study highlights a need for clearer long-term regulations to attract investment and remain competitive. To bridge the funding gap, future research should investigate "Green Surcharges" and passenger willingness to pay for sustainable travel.

**Keywords:** Sustainable Aviation Fuel (SAF), Global Trends, Thailand Readiness, Policy, Decarbonization

## Introduction

The aviation industry faces mounting pressure to address its environmental impact as global air travel expands. To combat high emissions from traditional Jet A-1 fuel, ICAO's Carbon Offsetting and reduction Scheme for International Aviation (CORSIA) framework aims to reduce aviation carbon emissions by 50% by 2050 (IATA, 2026). Consequently, Sustainable Aviation Fuel (SAF) has emerged as the primary viable alternative, drawing significant global investment from governments and airlines (Yoo at el, 2022).

Globally, airlines, governments, and international organization are investing in SAF devilment and deployment. Despite its potential, SAF adoption is hindered by high production costs, supply shortages, and infrastructure gaps. For instance, while the EU's upcoming blending mandates represent a major policy shifted, they also introduce heavy financial and logistical burdens. Research suggests that in regions like South America, adoption hinges heavily on carbon trading prices relative to the cost gap between SAF and conventional fuel (Cui, 2024).

In Thailand, the aviation sector is gradually integrating SAF into national environmental strategies. Currently, CAAT has set a voluntary initial goal of 0.5% to 1% SAF usage for specific international flights. However, a significant regulatory milestone arrives on January 1, 2026, when airlines will be legally permitted to use fuel blends containing up to 50% SAF (CAAT, 2025). Thus, the embedded research questions of this study are: firstly, what are the current trends, drivers, and barriers in the adoption of Sustainable Aviation Fuel (SAF) in global aviation? Secondly, how does SAF adoption in Thailand compare with global developments in terms of policy, implementation, and challenges? Finally, what are the key factors influencing successful SAF implementation, and what are the future prospects for SAF adoption in aviation? (CAAT, 2025).

**Objectives**

The primary objectives of this systematic literature review are:

1. To examine the current trends in SAF adoption in global aviation
2. To analyze the adoption of SAF in Thailand compared to global practices
3. To identify key drivers, challenges, and future prospects of SAF implementation

**Literature Review**

Sustainable Aviation Fuel: Progress, Policy, and Path to Net-Zero.

The Mechanism of SAF and Environmental Impact.

Sustainable Aviation Fuel (SAF) is a critical decarbonization technology capable of reducing lifecycle CO2 emissions by up to 80%. Unlike fossil fuels, SAF is synthesized from sustainable feedstocks, such as organic waste, agricultural residues, and atmospheric carbon—creating a closed carbon cycle where combustion emissions are offset by the carbon absorbed during feedstock growth. To maintain environmental integrity, these sources are strictly managed to prevent deforestation and biodiversity loss (IATA, 2026).

Regional Policy and Global Trends

Global adoption is currently driven by regional mandates and incentive programs:

The Americas: The United States leverages tax incentives, such as the 45Z credit (extended through 2029), to bolster domestic production, though eligibility is often restricted to North American feedstocks. While, Europe: The EU and UK have initiated mandatory blending requirements, starting at 2% for departing flights in 2025. In addition, Asia-Pacific: China is utilizing government subsidies to lower production costs and expand its export footprint. Meanwhile, Singapore and Thailand are both preparing for a 1% blending target by 2026 (ASUENE, 2026). Japan maintains one of the region's most ambitious goals, targeting 10% SAF usage by 2030

Barriers to Scalable Implementation

Despite its necessity, Sustainable Aviation Fuel (SAF) remains costly due to high production expenses and refining needs. Growth is further slowed by supply chain issues, raw material shortages, and regulatory uncertainty (Liang, 2025). Overcoming these barriers requires better technology and supportive government policy.

**Methodology**

Research Design

This study utilizes a Systematic Literature Review (SLR) to analyze current research. The SLR method is a structured approach used to organize and categorize literature within a specific timeframe (Rivera at el., 2022). It is recognized as an effective tool for evaluating research across diverse fields. To ensure high scientific standards, transparency, and replicability, this review strictly follows the PRISMA guidelines. A formal research protocol was established to manage search strategies, selection criteria, and data analysis.

Data Sources and Search Strategy

The research involved a systematic search of three primary databases for articles published between 2020 and 2025: (1) Science Direct: 29 articles (2) Springer Link: 11 articles (3) Google Scholar: 357 articles. The search string combined key terms related to fuel types, market trends, geography, and policy readiness, such as: *("Sustainable Aviation Fuel" OR "SAF" OR "Bio-jet fuel") AND ("Global Trends" OR "Market Adoption") AND ("Thailand" OR "Developing Countries") AND ("Readiness" OR "Policy framework").*

Inclusion and Exclusion Criteria

To maintain the quality of the primary data, specific criteria were applied to the gathered articles: Inclusion, only empirical articles published between 2020 and 2025 focusing on SAF adoption and global trends were included. Screening Process, articles were manually screened by title and abstract. One duplicate was removed, leaving 396 results. Exclusion, Studies were excluded if they lacked full-text access or were not relevant to the aviation industry. Final Selection, each remaining full-text article was screened against the inclusion criteria to eliminate bias.

Following the PRISMA2020 (Haddaway, 2022) guidelines, the final selection resulted in 15 core studies for the review. The complete selection process is documented in the study's flow diagram. Figure 1

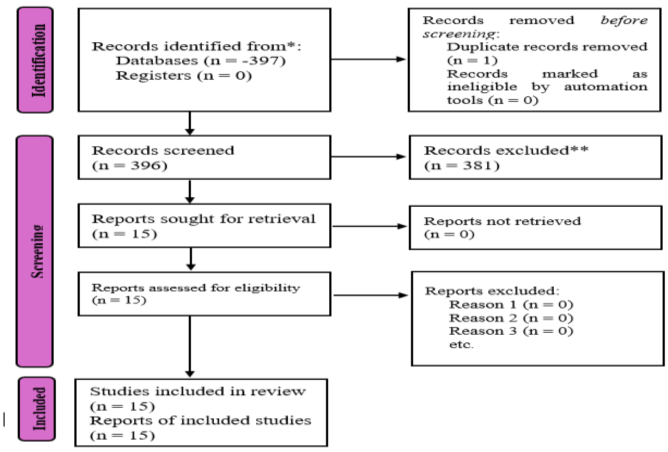


*Figure 1* PRISMA2020 flow diagram

**Results**

The findings from the systematic review are structured around the specific research questions that framed in this study:

- What are the current trends, drivers, and barriers in the adoption of Sustainable Aviation Fuel (SAF) in global aviation?

Global leaders like the U.S., Germany, the UK, and Japan are currently driving SAF development and policy. Major initiatives include the U.S. "Grand Challenge," targeting 3 billion gallons of annual production by 2030, and the EU’s "ReFuel EU" mandate, aiming for a 63% SAF blend by 2050 (Wandelt., 2025). However, the transition is hindered by high costs, raw material shortages, and infrastructure gaps. To succeed, the industry requires strong government support, stable funding, and global cooperation (Hanafi et al., 2024), (Nyemba, 2025).

- How does SAF adoption in Thailand compare with global developments in terms of policy, implementation, and challenges?

Thailand is advancing SAF integration through a collaborative roadmap between the Ministry of Energy, the Ministry of Transport, and CAAT. Supported by the AEDP and PDP, the government provides tax incentives and encourages public-private partnerships to enhance research and infrastructure. However, unlike the EU—which has set strict targets for emission reductions and Net-Zero by 2050 - Thailand still lacks clear mandates and a long-term strategy (Khongbamphen, 2025). To secure investment and a stable transition, it is essential for the government to establish transparent targets and a consistent regulatory framework (Thepchalerm & Pinsuwan, 2025), (Suriyasin el at, 2025).

- What are the key factors influencing successful SAF implementation, and what are the future prospects for SAF adoption in aviation?

The research emphasizes that successful SAF implementation is driven by a supportive policy environment and seamless coordination among all stakeholders, including government bodies and industry leaders (Wong et al., 2024). The primary motivation for these efforts remains the urgent need to mitigate the environmental impact of aviation and significantly reduce greenhouse gas emissions. Ultimately, the future of SAF adoption depends on the industry's ability to foster collaboration and create a well-coordinated ecosystem that supports sustainable growth (Raihan et al., 2025).

**Conclusion**

Thailand’s SAF success hinges on policy, technology, partnerships, and inclusivity, aiming to lower emissions and lead the regional green transition. While Thailand builds its framework, global leaders are setting aggressive benchmarks: the U.S. targets 3 billion gallons by 2030, and the EU mandates a 63% blend by 2050. Achieving these goals would secure Thailand's role in the future of sustainable global aviation.

**Discussion and Recommendations**

The SLR reveals that Thailand is building a strong foundation for SAF by combining industry skills, research, and government support. Even though it's just starting, this teamwork shows that Thailand is ready to produce and use green fuel on a large scale in the future (Laphet et al.,2025). The recommendation of the study was SAF currently 2 to 5 times more expensive than conventional jet fuel. The future study should focus on Eco- tax or Green Surcharge which study specifically for Thai or regional travelers. Do these travelers “Willingness to Pay" that their higher fares are actually funding real SAF?

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