Sustainable Aviation Fuel (SAF)

A Path Toward Lower Emissions and a More Sustainable Aviation Industry



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Topic 1: **Introduction to Sustainable Aviation Fuel**

SAF is a non-fossil fuel for use in aircraft. It can be produced from many different sustainably sourced materials called feedstocks, such as used cooking oil, biomass waste and residues, and renewable energy and carbon. These materials can be converted using multiple technology pathways, and lifecycle carbon emission reductions vary by fuel type.

To qualify under international sustainability frameworks, SAF must meet stringent sustainability and lifecycle emissions-reduction criteria, such as those set by the International Civil Aviation Organization (ICAO) under its Carbon Offsetting & Reduction Scheme for International Aviation (CORSIA) framework.

IATA estimates that Sustainable Aviation Fuel (SAF) could contribute up to 65% of the reduction in emissions needed by aviation to reach net zero CO2 emissions by 2050.

Today, most SAF production uses waste- and residue-based feedstocks through the Hydroprocessed Esters and Fatty Acids (HEFA) pathway, typically delivering lifecycle emissions reductions of around 80% compared to conventional aviation fuel. Emerging technologies and new feedstocks have the potential to increase lifecycle emissions reductions above 90%, even achieving negative emissions on a lifecycle basis.

In addition to reducing emissions, SAF can strengthen a country's energy security by diversifying the energy supply and building domestic fuel production from locally available resources. SAF can also support economic growth by driving investment in agriculture, waste management, renewable energy, and advanced fuel technologies, and create new jobs across all these new industries.

Topic 2: **Corporate Travel and Emissions Accounting**

How do corporate travel buyers account for SAF purchases within their Scope 3 greenhouse gas inventories, and what structural controls prevent greenwashing and double counting?

Under the Greenhouse Gas (GHG) Protocol Scope 3 Standard, emissions from commercial business travel fall under Category 6 (Business Travel). Because commercial airlines maintain direct operational control over aircraft and jet fuel combustion, the fuel burned during a flight is reported as **Scope1 (Direct Emissions)** by the airline.

Because corporate buyers are passengers rather than aircraft operators, they cannot claim direct Scope 1 reductions. Instead, corporate travel programs utilize market-based accounting mechanisms to purchase certified environmental attributes associated with Sustainable Aviation Fuel (SAF). This allows corporations to account for SAF purchases within their **Scope 3 (Indirect Supply Chain)** inventories, lowering their reported business travel carbon footprint without physically fueling the aircraft themselves.

To ensure these market-based mechanisms align with global environmental goals, international oversight is coordinated through the **International Civil Aviation Organization (ICAO)** framework. Through initiatives like ACT-SAF (Assistance, Capacity-building and Training for Sustainable Aviation Fuels), ICAO provides developing member states with the technical training and infrastructure support necessary to scale production and maintain transparent accounting standards globally.

Topic 3: **SAF Purchasing and the Book-and-Claim System**
Sustainable Aviation Fuel (SAF) is a non-fossil fuel for use in aircraft. It can be made from many different sustainable materials called feedstock. Some airlines use it to reduce the emmisions and to be recognized by experts or meet international standars.

According to IATA, SAF must be accounted for through a reliable system because it becomes mixed with conventional aviation fuel throughout the supply chain. Although SAF and conventional fuel produce approximately similar amounts of CO_2 during combustion, SAF can provide environmental benefits throughout its lifecycle because of its non-fossil origin. Its lifecycle emissions are evaluated by considering feedstock production, fuel processing, and transportation (IATA, 2024).

Unlike the response for CAF (“to fly our aircraft”), there are several possible reasons for buying SAF, including regulatory compliance, corporate strategy, shareholder requirements, and customer demands.

Corporate customers can create additional demand for certified SAF emissions reductions through voluntary purchases. The World Economic Forum explains that corporate travelers can participate in SAF certificate programs to address emissions associated with their air travel. These programs also provide a standardized approach for accounting and reporting environmental benefits across the aviation value chain (World Economic Forum, 2022).

Book-and-Claim is a chain of custody model that allows the transfer of SAF environmental benefits, such as greenhouse gas (GHG) emission reductions, from the producer to the end-user without requiring physical connection between them. The producer registers the fuel and its characteristics in a dedicated registry and issues certificates representing its environmental benefits. The buyer purchases these certificates and claims the emission reductions, even if they do not physically use the fuel. The certificates are then retired to prevent double counting.

The Roundtable on Sustainable Biomaterials explains that Book-and-Claim separates the environmental attributes of a product from its physical movement through the supply chain. These attributes can be documented, verified, and transferred through a dedicated registry. The system is particularly useful for aviation because sustainable fuels are not available in every geographical location (RSB, n.d.).

A company in Puerto Rico that buys the environmental certificate linked to SAF used in Europe gains the right to claim the emissions-reduction benefit of that SAF, even though the fuel was physically consumed elsewhere.

According to RSB's 2026 guidance, corporate end-users purchasing business travel services can disclose SAF-related emissions reductions when they acquire the appropriate retirement statements. The guidance also explains that corporate customers often depend on information provided by airlines and intermediaries to support their environmental claims. Traceability and consistency are therefore important for demonstrating the credibility of these claims (RSB, 2026).

Sustainability certification serves as a comprehensive tool for demonstrating environmental, social, and economic sustainability across various aspects of operations, products, and supply chains. It enhances credibility and trust and is an important process to assure that products or services offered by an organization meet recognized sustainability standards or comply with environmental regulations and standards set by governments and regulatory bodies.

IATA explains that sustainability attributes must be appropriately accounted for, traced, transferred, and communicated throughout the SAF supply chain. Certification bodies and auditors can examine documentation and accounting records to verify that certified fuel batches are properly tracked and that duplicate registrations do not occur (IATA, 2024).

Where multiple actors in a chain, from the airline through to the corporate end-user, might each have a legitimate claim on the same underlying SAF volume, the guidance sets out how disclosures should be structured so that the same emissions reduction is not reported as achieved by more than one party in a way that would misrepresent the total reduction delivered across the chain.

IATA identifies double issuance, double counting, and double claiming as important risks for the SAF certificate market. Its September 2026 publication explains that interoperability between different SAF registries is necessary to maintain the integrity of environmental claims. These systems help track certificates and ensure that environmental attributes are not issued or claimed improperly (IATA, 2026).

However, although SAF has several environmental values, the procurement of SAF on a large-scale encounter various challenge. Such challenges are high production costs, scarce feeder stock, technical matters, supply chain issues, and regulatory aspects.

RSB explains that sustainable aviation fuels remain geographically limited and significantly more expensive than conventional fossil fuels. These limitations affect the ability of airlines and corporate customers to participate in sustainable fuel purchasing programs. Increasing

production capacity, developing supply chains, and improving access to sustainable feedstocks are important factors in expanding the market (RSB, n.d.).

Topic 4: **Greenwashing and Transparency Concerns (E)**

The CPC Network established that phrases like “green flying,” “eco-friendly airline,” “climate neutral,” or “zero emissions flight”, in the absence of any robust or scientific evidence, are misleading. Furthermore, framing optional carbon offset payments as a way to “cancel” or “neutralise” a flight’s emissions misleads passengers, as these payments do not prevent the actual emissions from the flight itself.

The agreement marks a transition from “green” as a marketing aspiration to “green” as a strictly regulated legal requirement.

- Clarification in offsetting: make clear that the CO_2 emissions of a specific flight cannot be neutralised, offset, or directly reduced by contributions to climate protection projects or alternative aviation fuels;
- Substantiate SAF: use the term “sustainable aviation fuels” (“SAF”), only with clear supporting evidence; Avoid using vague “green” language: refrain from using phrases like “green”, “sustainable”, “responsible”, “environmentally friendly” or “climate neutral” without specific substantiation (i.e. scientific evidence and information to support the claim);
- Clear timelines: provide clear, achievable steps and timelines for future targets, such as achieving net-zero greenhouse gas emissions; and
- Transparent data: ensure that any CO2 emissions calculations and scientific evidence are displayed in a clear and transparent way.

Nonetheless, it is now widely agreed that airlines can no longer present themselves as sustainable in general terms without tying the relevant claim to something specific, such as a quantified reduction in emissions per passenger-kilometre against a clear baseline year, or a documented increase in the proportion of SAF in total fuel use. In summary, evidence is key.

The key for the ASA is the overall impression created by an advert: an airline that highlights a small SAF trial, for example, must ensure that consumers are not left with the impression that a large portion of its flights are run on SAF.

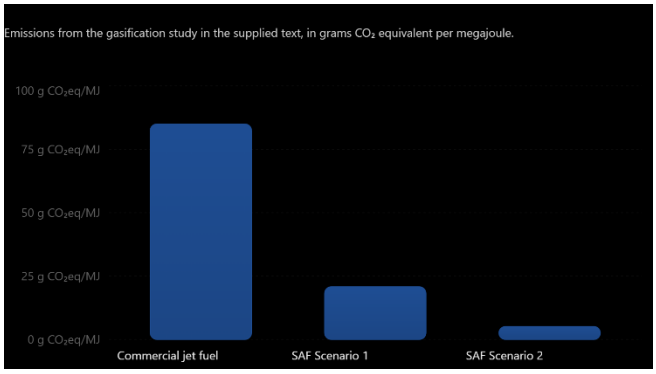
Where the evidential basis of an environmental claim is weak, the airline’s safest option is to avoid the claim in its entirety.

While factual, data-heavy transparency might make marketing less eye-catching, it is the only way to ensure an airline’s brand remains both credible and legally protected in an increasingly unforgiving regulatory climate.

Topic 5: **Scientific Analysis, Future Developments, and Conclusion**

a. Scientific Analysis

Techno-Economic Analysis (TEA) is used to analyse industrial processes' technical performance and economic viability [116,137]. It helps predict the processes' expenditures and profits [138]. In TEA, the processes are usually modelled using simulation software to estimate the mass and energy balances.



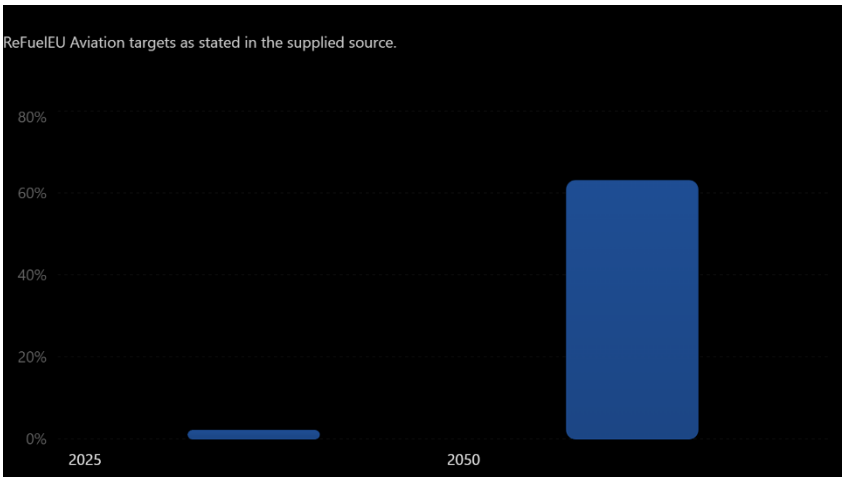
Alternatively, Life Cycle Analysis (LCA) is a technique for assessing the potential environmental impacts associated with the life cycle of a process or product [138]. The cradle-to-grave LCA, defined by the International Organization for Standardization (ISO 14040 and ISO 14044), consists of four stages: defining goal and scope, inventory analysis, impact assessment and interpretation of results [137].

Today, the new processes developed to produce jet fuels may emit more carbon than at the combustion stage. Hence, the LCA has to consider the total carbon footprint of various stages.

LCA revealed that the environmental footprint of Scenario 2 was lower than Scenario 1. By adopting the SAF production process with hydrogen generation through hydrothermal gasification, the GHG emission of Scenario 2 (5.1 g CO2eq MJ−1) was 94 % lower than the commercial jet fuel production process (85 g CO2eq MJ−1).

b. Future Developments

Large-scale SAF production faces several challenges that must be addressed for widespread adoption. The primary challenge is securing a sufficient, sustainable feedstock supply for SAF production. Common feedstocks include waste oil, agricultural residues and non-food energy crops.



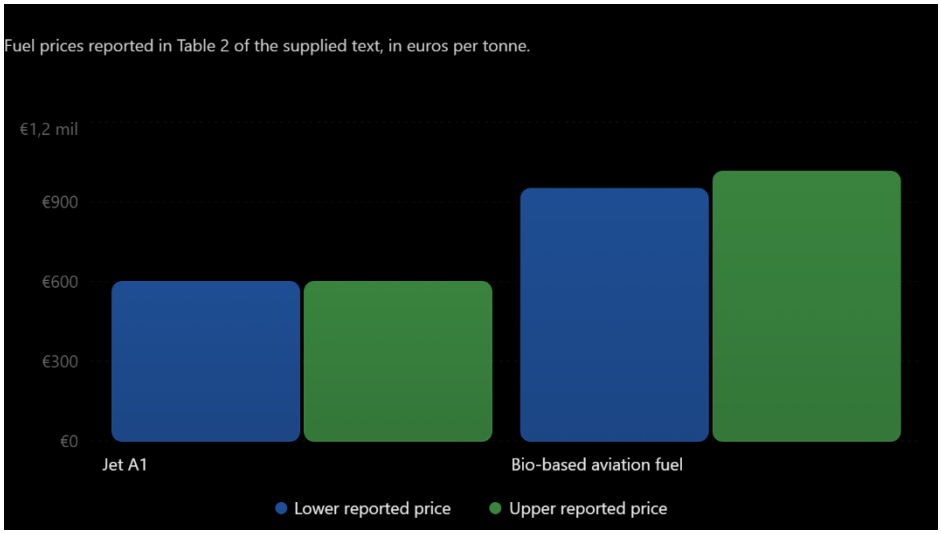
Reducing production costs through technological advancements, process optimisation and economies of scale is crucial to make SAF economically viable. Moreover, developing and commercialising efficient and scalable conversion technologies for converting feedstocks into SAF is a significant hurdle.

Researchers are investigating alternative sources such as algae, municipal solid waste, and carbon dioxide (CO2) capture and utilization. Diversifying feedstocks can help reduce competition with food production, minimize environmental impact, and ensure a sustainable supply.

Furthermore, advancements in conversion technologies are being researched and developed to improve efficiency and reduce costs; this includes catalyst development, process optimization, and innovative techniques like pyrolysis, gasification, and bioconversion [41,142].

Increasing investments in research and development (R&D) is crucial for advancing SAF technologies. Governments, industry players, and research institutions are allocating funding and resources towards R&D initiatives focused on feedstock development, conversion processes, and efficiency improvement.

International collaboration and establishing common standards are fundamental for the global adoption of SAF. Organisations like the ICAO and the Roundtable on Sustainable Biomaterials (RSB) are working towards setting globally recognised sustainability criteria, certification standards, and best practices for SAF production [37]. These efforts promote consistency, transparency, and trust in the SAF market.



Airlines and other stakeholders can provide certainty to SAF producers by entering into long-term contracts and offtake agreements. Such agreements guarantee a market for SAF, reduce financial risks and provide a stable foundation for upscaling production [143].

By combining these proposed solutions and approaches, the challenges associated with large-scale SAF production can be overcome and accelerate the transition towards a more sustainable aviation industry.

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