SMBC AVIATION CAPITAL

Clearing the Path for SAF

Removing barriers and creating incentives: Scaling up Sustainable Aviation Fuel in the EU.

Ger Komori, Shane Wilson
The Nest

David Griffin, Shane Matthews
Strategic and Market Analysis

Introduction

In our prior publication, *'Fuelling the Future of Flight'* we discussed how the aviation industry can reduce carbon emissions in the journey to net zero by 2050. We examined the four key components: aircraft technology, fuel, market-based measures and operations.

Sustainable Aviation Fuel (SAF) represents aviation's most immediate lever for decarbonisation. The challenge does not centre on SAF as an available solution, it is a solution, and it is available. The challenge lies in its limited accessibility and high cost, which make it insufficient to meet the industry's needs or deliver on mandated targets. This paper outlines two key pillars that we believe can help overcome these barriers and unlock SAF at scale.

SMBC Aviation Capital has partnered with Trinity College Dublin (TCD) to host a SAF Research Facility providing a dedicated facility for the research and development of SAF.

Emerging mandates are designed to stimulate production, but the reality on the ground tells a more complex story: production is limited, the investment climate remains challenging, and the cost gap between SAF and traditional jet fuel is formidable.

The current SAF ecosystem is shaped by agile, technology-first companies — but most lack the financial resilience needed to deliver large-scale projects on time and on budget. The capital-intensive nature of SAF projects, feedstock constraints, infrastructure shortfalls, and a protracted certification process all combine to stall progress. Existing policy frameworks fail to address the commercialisation challenges faced by emerging, technology-driven SAF companies, making it difficult to attract sufficient private capital. At the same time, traditional fuel suppliers remain hesitant to commit to the rapid, large-scale infrastructure buildout needed to meet global SAF demand.

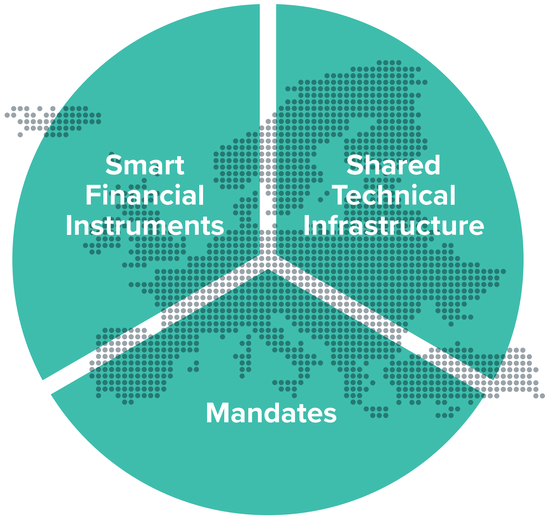
This paper takes a focused look at two interlinked EU-level strategies that we believe can help clear these roadblocks:

Smart financial instruments — from concessional loans and price guarantees to tax incentives, can de-risk investment and accelerate the commercialisation of SAF.

Shared technical infrastructure — such as the EU SAF Clearing House, now supported through our partnership with Trinity College Dublin. Trinity College Dublin lead the Prescreening Service of the Clearing House from their SAF Research Facility which is co-located at our headquarters. Trinity's Professor Stephen Dooley is the Clearing House director, and it has the mission to fast-track the approval of new SAF pathways and support early-stage producers.

Together, these interventions reflect a more holistic EU response — not just mandates, but the ecosystem supports to meet them. We also look forward to the publication of the EUs Sustainable Transport Investment Plan and the ideas and solutions it will outline to address the investment challenge. At SMBC Aviation Capital, we recognise our role in this transition — financing next-generation aircraft and championing the tools that will scale sustainable fuel.

To achieve critical mass in the availability and affordability of SAF, there needs to be a critical mass of investment in the production of SAF. We believe that is best facilitated by deploying smart financial instruments and providing robust support for shared technical infrastructure.



SAF production

It is worth reminding ourselves of the scale of the challenge and the urgent need for action. Production in 2024 was equivalent to just 0.3% of global jet fuel production in the same year, in 2025 this is forecast to reach 0.7%.

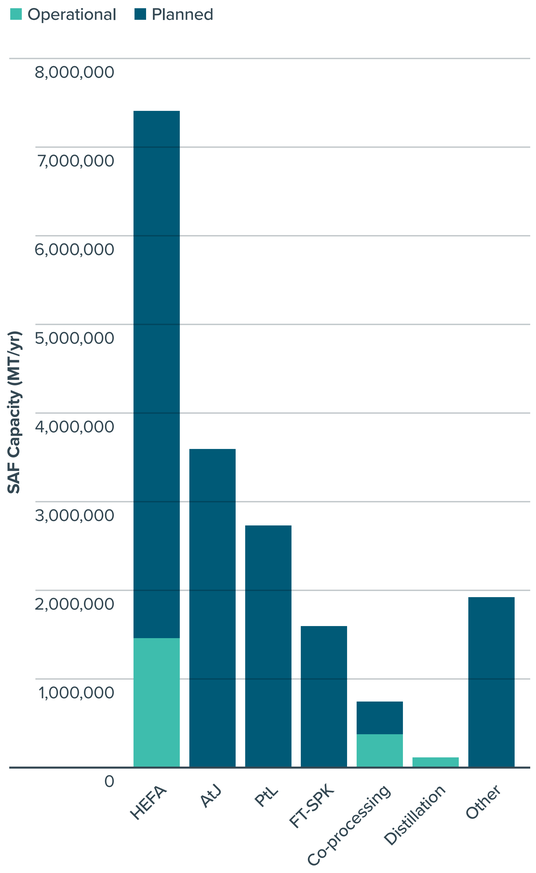
While this constitutes a doubling of output, it is from a very low base and production needs to ramp up significantly. Airlines for Europe (A4E), a lobby group, recently stated that airlines will not likely be able to meet the EU's 6% sustainable aviation fuel mandate by 2030 because of a lack of SAF production capacity and recent shift by oil producers away from renewable energy activities.

Total SAF capacity as of February 2025 stands at 2 million MT/yr for the operational facilities, with another 16 million MT/yr for planned facilities. On the production side, according to IATA, total production in 2024 reached 1 million MT, up from 0.5 million MT produced in 2023, but significantly below the previous estimate of 1.5 million MT. Looking forward, global demand is projected to reach 17 million MT per annum by the end of this decade, representing 4-5% of jet fuel production, but production will struggle to keep pace. The World Economic Forum estimates that there is an investment gap of up to $45 billion to scale up production.

There are just over 250 SAF projects announced, and around 160 of these should be generating or progressing towards SAF production by the end of the decade. While there are 37 countries involved, more than half of capacity will be from the US.

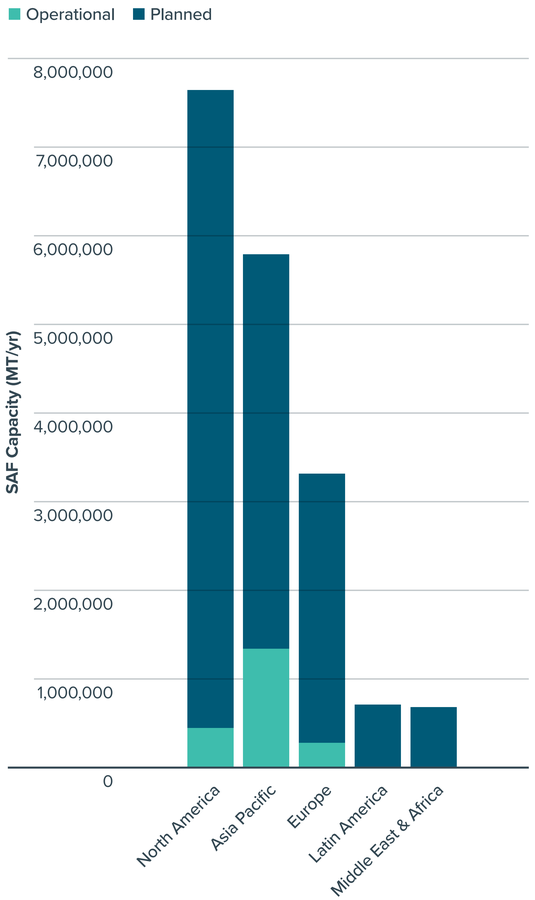
Of this planned capacity, 80% will come from HEFA, however, the feedstocks required, mainly consisting of used cooking oils, animal fats and oilseed crops are limited, and may be subject to competition. Impending mandates drive Power-to-Liquid (PtL) plans, but this method suffers from higher capital and operating costs so will need further support to come to fruition.

SAF Capacity by Technology



Source: Argus & IATA

SAF Capacity by Region



Source: Argus & IATA

Barriers to SAF production

There are a number of barriers we need to overcome in order to narrow the price gap between SAF and traditional jet fuel and to get technology-driven SAF producers to cross over Final Investment Decision (FID).

High Cost (CAPEX)

Worldwide shortage of Labour/Material/EPC (Engineering, Procurement and Construction) contractors has led to soaring initial investment costs for SAF producers.

High Cost (OPEX)

Different sectors are chasing the same feedstock, such as UCO (Used Cooking Oil), which results in higher operating costs. There is a lack of appetite from the private sector to address the risks of advanced technology/feedstock developments.

Limited Infrastructure

Inadequate SAF production, supply chain, and distribution networks hinder new technology-driven SME's (Small and Medium-sized Enterprises) entering into the market.

Lengthy Certification Process

ASTM (American Society for Testing and Materials) certification is largely controlled by the OEMs and takes min. 2-3 years for the entire approval processes. This is prohibitive for new entrants developing advanced technologies/feedstocks.

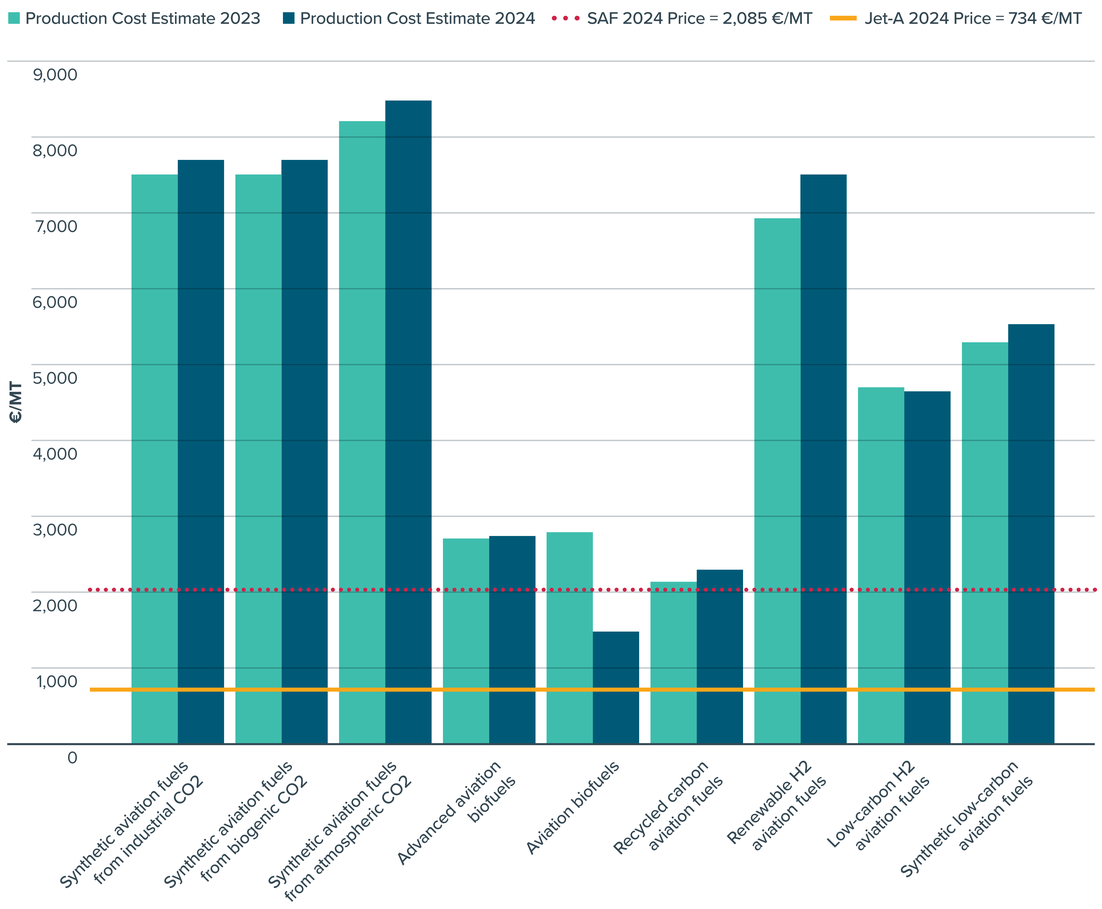
Untested Regulatory Frameworks

Uncertainty associated with possible regulatory changes means the industry is cautious about scaling up.

Policy Gaps

Insufficient government incentives and regulatory frameworks weaken investor appetite and airline appetite for long-term offtake.

SAF Production Costs



Source: EASA 2025 Briefing Note - 2024 Aviation Fuels Reference Prices for ReFuel EU Aviation

Proposals to reduce the cost of SAF

In order for the EU to remain competitive, ensure long term energy security, and meet existing mandates, the conditions must be created where investment in the Sustainable Aviation Fuel value chain is viable and attractive. Ultimately the price gap between jet fuel and SAF must be narrowed.

Jet fuel represents a significant share of an airline's operating costs, typically in the range of 20-30%. Therefore, it is imperative that the price of SAF continues to decline, to mitigate the pass-through of higher costs to consumers.

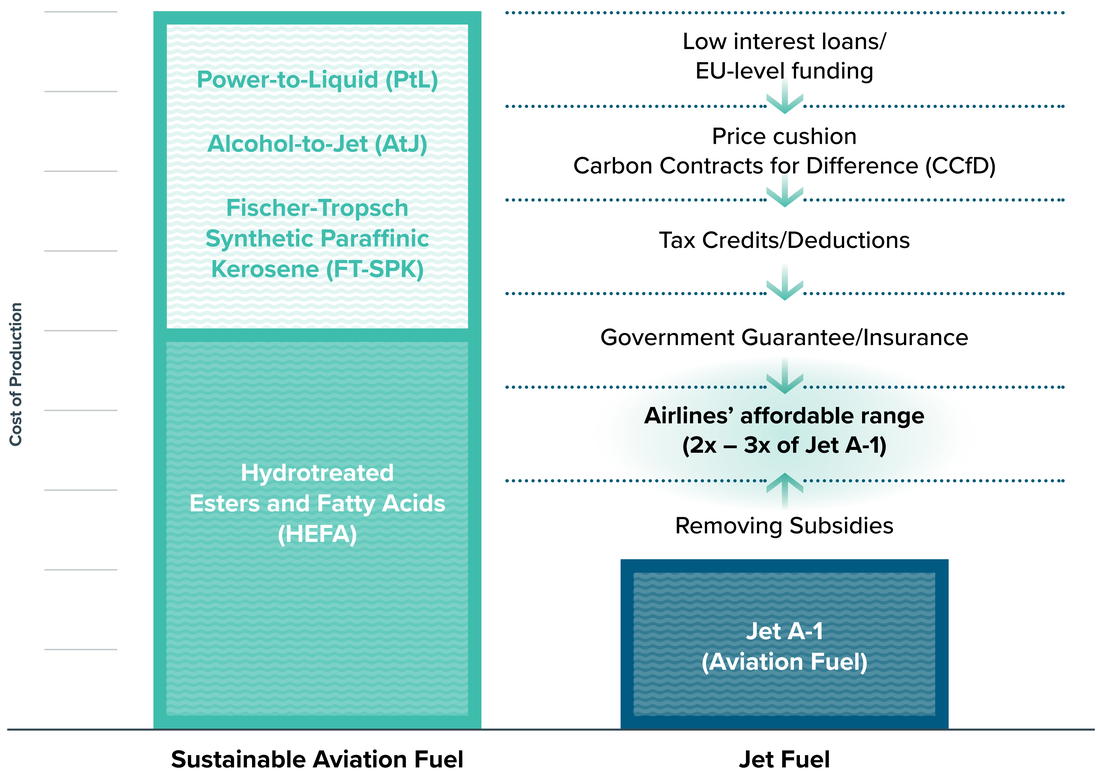
Depending on the type of SAF used, it can be between two and five times more expensive than fossil-based jet fuel. According to IATA, in 2023 the cost was 2.8x jet fuel, adding c.$750 million to the industry fuel bill. Brent oil averaged $80 per barrel in 2024 and continues to decline. As of mid-May, it sat at $64 p/b, further increasing the spread between SAF and jet fuel.

The Environmental and Energy Study Institute (EESI) puts the value of US fossil fuel explicit producer subsidies at $3 billion per year. Globally, these subsidies represent just over one trillion USD. If redirected, these subsidies could significantly reduce the gap between SAF and jet fuel.

We propose the following financial tools, of which details are further described in the following pages:

1. **Expansion of EU-level funding programs**
2. **New Scheme for Concessional Financing/Low-interest Loans to be led by EBRD**
3. **Price Cushion/CCfD**
4. **Tax Credits/Deductions for SAF Production**
5. **Governmental Guarantee/ Insurance covering airline credit risks**

Closing the Price Gap



1. Expansion of EU-level funding programs

EU-level funding programs, for example the Connecting Europe Facility and Horizon Europe, should be extended to cover SAF production facilities, airport infrastructure and other SAF supply chain logistics, along with research and development of advanced technologies and feedstocks (including biomass).

Connecting Europe Facility (CEF)

CEF is designed to promote growth, jobs and competitiveness, through infrastructure investment in the EU region.

Under CEF, there are three pillars: “CEF Energy”, “CEF Transport” and “CEF Digital”. However, CEF Energy focuses on sectors such as Electricity, Gas, and Hydrogen, while SAF/biofuels are not targeted.

Also, CEF Transport focuses mainly on the surface transportation sector and associated fuels infrastructure, while again aviation/SAF is not targeted.

CEF is designed to promote growth, jobs and competitiveness, through infrastructure investment in the EU region.

Horizon Europe

Horizon Europe is the European Union’s main funding program for research and innovation. It’s designed to support scientific research, technological development, and innovation across Europe and beyond.

Horizon Europe is a €95.5 billion program (2021–2027) that helps fund projects that aim to solve big challenges - like climate change, health crises and digital transformation.

Its Pillar II/Cluster 5, “Clean Aviation”, covers “disruptive new aircraft technologies”, however, it is not clear whether it will be extended to support SAF and alternative aviation fuels.

It is correct to state that Horizon Europe currently lacks measures specifically dedicated to SAF. While Clean Aviation serves as the public-private partnership (PPP) focused on technology development—including hydrogen—SAF is notably excluded. This omission needs to be addressed.

EU aviation projects implemented via CINEA* (2014-2025)

SHAPING THE FUTURE OF AVIATION

€1 billion

for 200 projects

in research and innovation involving 1250 partners in 47 countries

MODERNISING AIR TRAFFIC MANAGEMENT

€1.8 billion

for 85 projects

involving +200 partners in all 27 EU countries

IMPROVING INFRASTRUCTURE

€1.3 billion

for 49 projects

across 32 airports in 18 EU countries

* The European Climate, Infrastructure and Environment Executive Agency (CINEA), manages several EU programmes in the fields of energy, environment, climate action, and transport.

2. Concessional financing/Low-interest loans to be led by EBRD

Mandates have stimulated, and will stimulate, demand in Europe for deployment of SAF and e-SAF, however, there is an absence of sufficient supply side stimuli required to unlock investor appetite.

Unless the supply of SAF is properly incentivised, mandates may not be sufficient policy tools to increase production.

Hence, new financial schemes could be established, where the European Bank for Reconstruction and Development (EBRD) would lead concessional financing or low-interest loans through public-private partnerships.

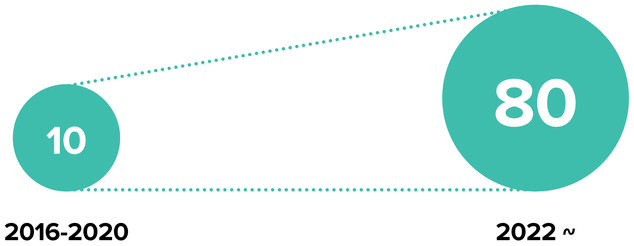
The financing should be utilised for supporting not only SAF production facilities, but also development of advanced technologies and feedstocks (including biomass) and, moreover, long-term offtake contracts by airlines.

Unless the supply of SAF is properly incentivised, mandates may not be sufficient policy tools to increase production.

A good live example is the US DoE (Department of Energy) loan guarantee scheme for SAF producers, under the DoE Title 17 Clean Energy Financing Program. The DoE provides a guarantee for loan repayments by the loan applicants and, based on such guarantee, private lenders will provide more cost effective (i.e. lower-interest) loans for such loan applicants.

There is no breakdown on a sectorial basis (specific to SAF development) reported. However, the average number of applications under the Title 17 Program rose from about 10 per year (2016-2020) to over 80 per year in recent years, since the Inflation Reduction Act came into effect and significantly expanded/ enhanced the Title 17 Program in 2022.

Number of Applications under the DoE Title 17 Program



Examples of SAF applications under the Title 17 Program

Company (Pathway)	Loan Amount	Status
Calumet/Montana Renewables (HEFA)	$1.44bn	Approved
Gevo (AtJ)	$1.46bn	Approved
World Energy (HEFA)	$2.0bn	-
USA Bioenergy (FT)	$1.63bn	-
DG Fuels (FT)	$2.15bn	-

3. Price cushion/Carbon Contracts for Difference (CCfD)

A system is needed to bridge the price difference between the market price and the production cost of SAF, such as Carbon Contracts for Difference (CCfD) and/or an auction process, similar to the European Hydrogen Bank Auction.

Carbon Contracts for Difference (CCfD)

Carbon Contracts for Difference (CCfD) are a financial tool used by governments to help companies invest in low-carbon technologies - especially in industries that are hard to decarbonise, such as steel or cement.

A CCfD is a financial agreement between a government and a company, which guarantees a certain carbon price for reducing emissions, where:

– The government and the company agree on a strike price.

– If the market price is lower than the strike price, the government pays the difference to the company.

– If the market price is higher than the strike price, the company pays the difference to the government.

European Hydrogen Bank Auction

The European Hydrogen Bank auction system is a funding mechanism created by the European Commission to support the production of renewable hydrogen in Europe.

The system works as follows:

– Producers of renewable hydrogen submit bids.

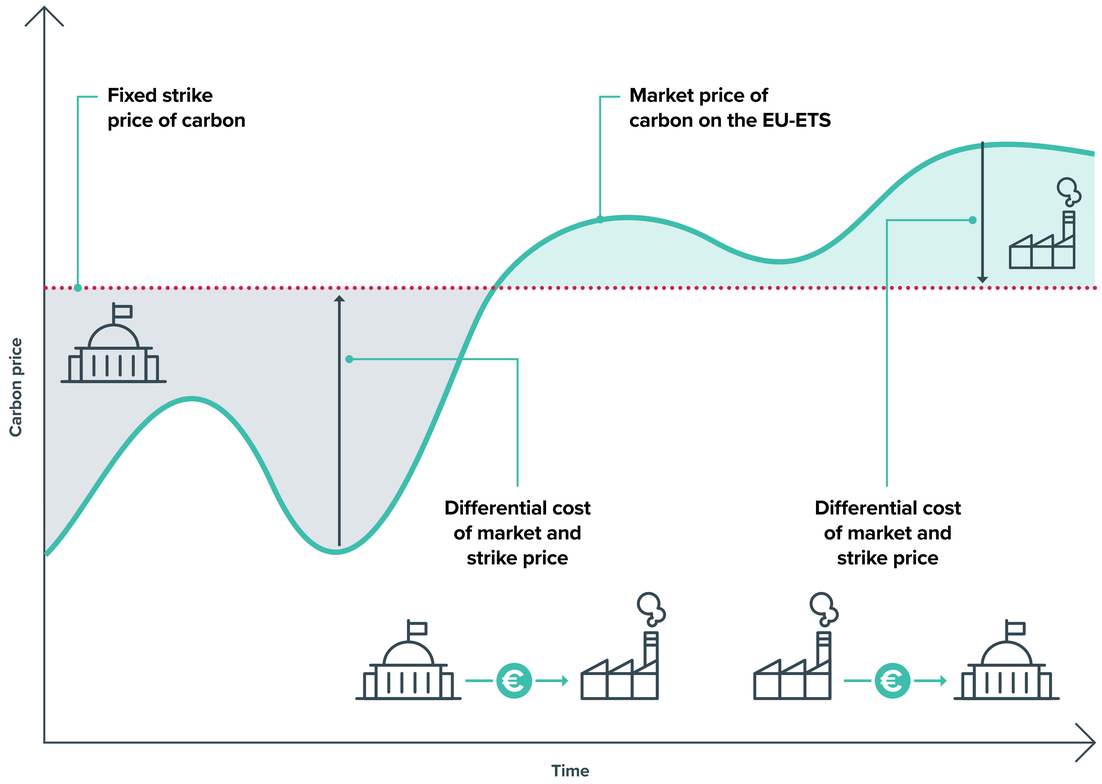
– Each bid proposes a fixed premium that the producer wants to receive on top of the market price.

– The European Commission ranks the bids from lowest to highest premium.

– Projects with the lowest bids are selected until the budget cap is reached.

– Winners receive a 10-year fixed premium for each kilogram of renewable hydrogen they produce.

Carbon Contracts for Difference (CCfD)



Source: Deloitte

4. Tax credits and tax deductions for SAF production

Another financial instrument to incentivise investment is tax credits/ deductions for investments in SAF production facilities and supply chains, similar to the Sustainable Aviation Fuel Tax Credit in the US. In the US, they have both federal-level and state-level incentives.

US Federal SAF Tax Credits

SAF Blenders Tax Credits (Section 40B)

– Created by the Inflation Reduction Act of 2022.

– The credit goes to the blender, the entity that physically mixes SAF with conventional jet fuel and sells or uses the blended fuel.

– Offers a base credit of $1.25 per gallon, with minimum 50% GHG reduction.

– Bonus of $0.01 per each percentage point that the SAF's lifecycle GHG emissions reduction exceeds 50%. So, total maximum is $1.75 per gallon.

SAF Producers Tax Credits (Section 45Z)

– Replaces Section 40B credits starting from 1st January, 2025.

– The credit goes to the fuel producer, not the blender.

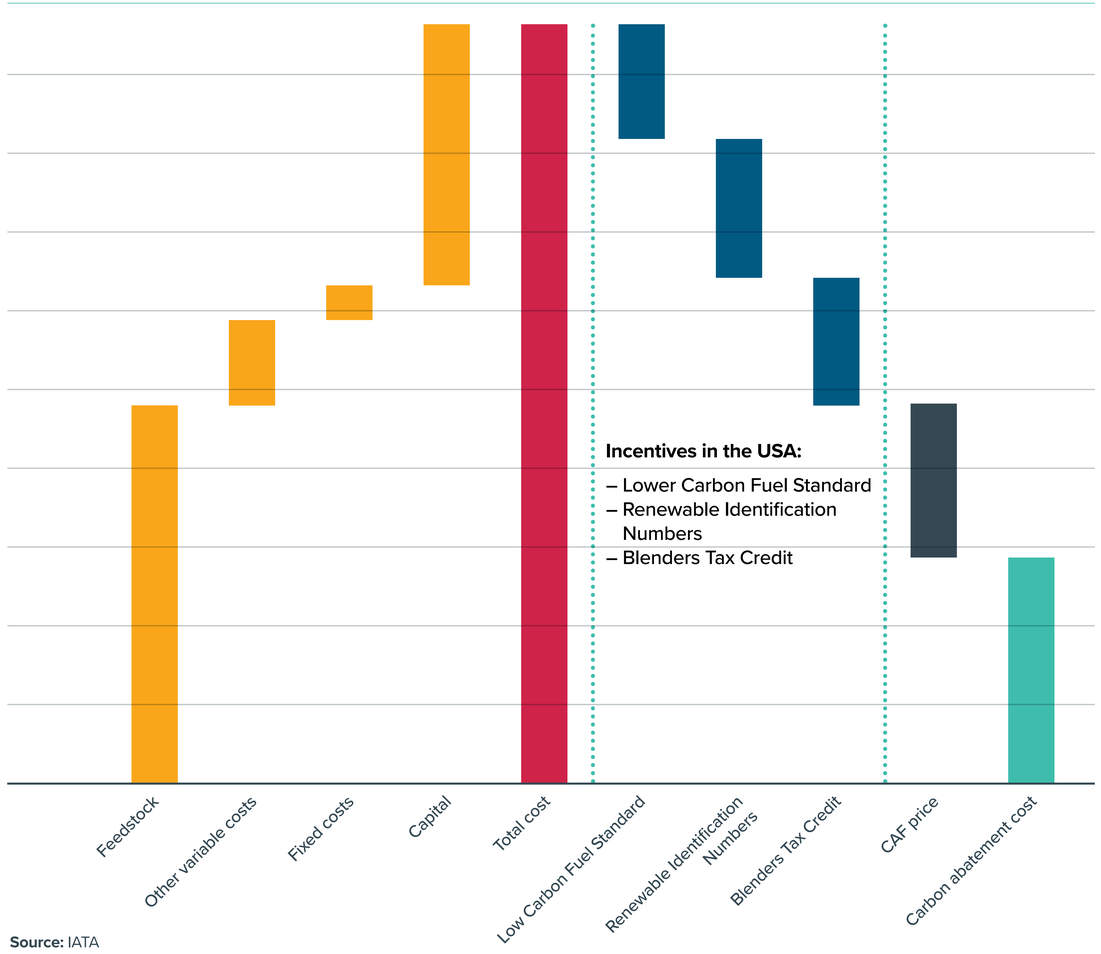
– The credit amount will vary based on CI (Carbon Intensity) scores of produced SAF.

US State-level SAF Incentives

– Several U.S. states offer additional SAF tax credits to complement federal incentives:
- California
- Illinois
- Minnesota
- Washington

While the U.S. model demonstrates how layered federal and state tax credits can catalyse SAF investment, similar mechanisms are largely absent in Europe. The EU could explore a harmonised SAF tax credit regime to reduce the cost gap and attract private capital. Aligning such incentives with lifecycle GHG reductions, as done in the U.S., would provide both financial clarity and environmental credibility for producers across Member States.

Cost-plus Pricing Model (reflecting incentives)



Source: IATA

5. Governmental guarantee or insurance coverage for airline credit risks

The airline business is characterised by low margins and relatively constrained balance sheets. As such, the value of long-term contracts entered into by an airline may not provide sufficient comfort to investors in SAF projects which require long-term certainty with strong counterparties.

Hence, a guarantee or an insurance scheme could be offered by the European Commission to provide certainty for investors from an airline credit risk perspective.

The European Investment Fund (EIF) provides certain guarantee schemes, which could be extended to cover credit risk of airline companies.

InvestEU Sustainability Guarantee

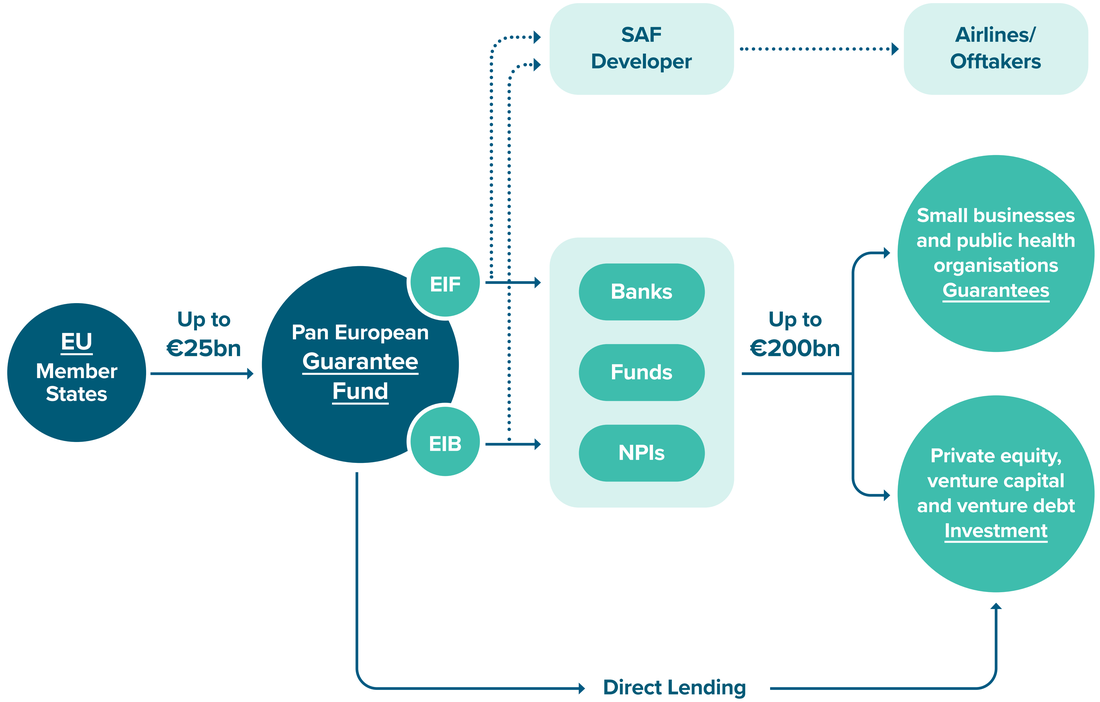
Provides credit risk protection to financial intermediaries (like banks and leasing companies).

Supports investments aligned with EU sustainability goals, such as energy efficiency, renewable energy, clean transport, and circular economy initiatives.

InvestEU Portfolio Guarantee

Provides portfolio guarantees to contribute to policy objectives, such as, (i) the competitiveness of the EU, (ii) growth and employment in the EU economy, the sustainability of the EU economy and its environmental and climate dimension, and (iii) the promotion of scientific and technological advances, of culture, education and training.

European Guarantee Fund Structure



Source: European Commission

Technical supports by the EU SAF Clearing House

Before any new SAF can be used in commercial aircraft, it must first meet strict fuel specification requirements. A qualification process ensures the safe integration of new fuels with existing aircraft, engines and associated infrastructure, to be qualified as a ‘drop-in’ fuel, i.e. a fuel equivalent to conventional petroleum-derived aviation fuel.

The high cost and complexity of this qualification process presents a significant but necessary barrier to entry for new SAF types in the market.

SMBC Aviation Capital has partnered with Trinity College Dublin (TCD) to host the SAF Research Facility located at its headquarters in Fitzwilliam 28, Dublin, which provides a dedicated facility for the research, development and deployment of sustainable aviation fuels.

The Research Facility plays a crucial role in identifying and validating potential new fuels and in ensuring their sustainability. Its infrastructure and the experts it trains underpin the EU SAF Clearing House. The EU SAF Clearing House aims to remove as many barriers as possible to support the EU & international deployment of SAF.

The EU SAF Clearing House gives priority support to accelerating the regulatory evaluation and approval of new SAF pathways by working with the aviation OEMs to facilitate and improve the ASTM D4054 standard practice.

Serving as an impartial one-stop-shop for SAF producers, SAF technology developers and OEMs, the EU SAF Clearing House facilitates the ASTM D4054 synthetic aviation fuel evaluation process in the EU, ensures data quality & efficiency of service, providing fuel testing capabilities and report writing functions.

The ultimate goal here is to shorten the entire approval process for new SAFs and lower the barriers for SAF developers creating new technologies and utilising new feedstocks.

The high cost and complexity of this qualification process presents a significant but necessary barrier to entry for new SAF types in the market.

Conclusions

While Sustainable Aviation Fuel is not the sole solution to aviation's decarbonisation, it will play the most pivotal role in achieving net zero emissions by 2050. The journey to net zero is neither straightforward nor obstacle-free — we must actively identify and remove the roadblocks ahead. To do so, immediate, coordinated, and harmonised action is required from all stakeholders across the aviation sector.

Financial Instruments

We would urge the European Commission to enact in its Sustainable Transport Investment Plan to be published later this year, the following financial instruments:

(i) Expansion of EU-level Funding Programs,
(ii) New Scheme for Concessional Financing/Low-interest Loans led by EBRD,
(iii) Price Cushion/CCfD,
(iv) Tax Credits/ Deductions for SAF Production, and
(v) Governmental Guarantee/Insurance covering Airline Credit Risks.

We would emphasize the societal and economic importance of Aviation to Europe. Aviation is essential to Europe's cohesion – connecting islands and remote regions with mainland Europe while fostering cultural and economic opportunities. It plays a fundamental societal role, creating high-quality, skilled jobs across the ecosystem and driving research and innovation.

Moreover, aviation drives job creation, cross-sector prosperity, and positions Europe as one of the most connected regions globally. In 2019, air transport supported 14 million jobs and contributed €851 billion to GDP in Europe – equivalent to 1 in every 17 jobs (6% of total employment) and 5% of the continent's GDP.

Aviation supports essential, reliable transport routes and contributes to Europe's defence capabilities, upholding both sovereignty and economic security. A strong aviation sector is a foundation for prosperity, enabling the investments needed for decarbonisation.

Cross-Sector Collaboration

In order to make a strong impact on policy/regulations, we need all of our colleagues in the relevant sectors to send out unified and harmonised messages to the policy makers and the regulators.

We co-hosted with Trinity College Dublin/EU SAF Clearing House an event called "Clearing the Path for SAF" during the SAF Congress held in Amsterdam earlier this year.

At that event representatives from a wide range of stakeholders, including SAF producers/developers, airlines, OEMs, financiers and regulators, assembled to identify common barriers and discussed how to tackle these together.

We will look to build up industry-wide consensus through initiatives of this kind, in collaboration with Trinity College Dublin and other SAF Clearing Houses in the coming months.

We are confident that the actions proposed in this paper can help to accelerate the deployment of SAF. It's time to match ambition with action to clear the path for SAF.

Glossary

AtJ (Alcohol-to-Jet): A process that converts alcohols, such as ethanol or butanol, into jet fuel. AtJ fuels are a type of sustainable aviation fuel that can be produced from a variety of biomass sources and offer a renewable alternative to conventional jet fuel.

ASTM (American Society for Testing and Materials): An international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

CAPEX (Capital Expenditure): Funds used by a company to acquire, upgrade, and maintain physical assets such as property, industrial buildings, or equipment.

Carbon Cycle: The natural process by which carbon is exchanged between the atmosphere, oceans, soil, and living organisms. SAFs fit within the short-term carbon cycle, recycling existing carbon rather than adding new carbon from fossil fuels.

CCfD (Carbon Contracts for Difference): A financial agreement between a government and a company that guarantees a certain carbon price for reducing emissions, helping companies invest in low-carbon technologies.

CEF (Connecting Europe Facility): An EU funding program designed to promote growth, jobs, and competitiveness through targeted infrastructure investment.

ESG: Environmental Social and Governance is a framework that is used to determine how sustainable an organisation or company is.

FT-SPK (Fischer-Tropsch Synthetic Paraffinic Kerosene): A type of synthetic fuel produced through the Fischer-Tropsch process, which converts carbon monoxide and hydrogen into liquid hydrocarbons.

GHG (Greenhouse Gas): Gases that trap heat in the atmosphere, contributing to global warming. Common GHGs include carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O).

HEFA (Hydrotreated Esters and Fatty Acids): HEFA refines vegetable oils, waste oils, or fats into SAF through a process that uses hydrogen.

Lifecycle Carbon Reduction: The total reduction in carbon emissions achieved over the entire lifecycle of a product, from production to disposal.

Net Zero Carbon Emissions: Achieving a balance between emitting carbon and absorbing carbon from the atmosphere in carbon sinks, aiming for no net increase in atmospheric carbon levels.

NOx (Nitrogen Oxides): NOx are any of several oxides of nitrogen most of which are produced in combustion and are considered to be atmospheric pollutant.

OPEX (Operating Expenditure): The ongoing cost for running a product, business, or system, including expenses such as rent, utilities, and salaries.

PtL (Power-to-Liquid): A technology that converts renewable electricity into liquid fuels, such as synthetic aviation fuel, through processes like electrolysis and Fischer-Tropsch synthesis.

SAF (Sustainable Aviation Fuel): Aviation fuel derived from sustainable sources that can reduce carbon emissions compared to conventional jet fuel.

UCO (Used Cooking Oil): Waste oil collected from cooking processes, which can be used as a feedstock for producing biodiesel and SAF.

About the authors

Ger Komori

Ger joined The Nest as SVP Innovation in January 2025, on a secondment from Sumitomo Corporation, one of the shareholders of SMBC Aviation Capital. He has over 30 years' experience in aircraft leasing and financing, and before joining The Nest, he worked as Head of Sustainability Solutions at Commercial Aviation SBU (Strategic Business Unit) of Sumitomo. Ger holds a Bachelor of Engineering Degree in the field of Information Science from Kyoto University.

Shane Wilson

Shane joined The Nest, SMBC Aviation Capital's innovation hub, upon its inception in 2018. The Nest's mission is to identify and develop opportunities that add value, as well as to nurture an innovative mind-set in the business. Shane combines over 12 years' experience in the Transaction Management and Transaction Execution (now Commercial Negotiation & Execution) teams with a passion for innovation and creative problem solving. Shane holds a first class honours Degree in Industrial Design from the National College of Art & Design in Dublin.

David Griffin

David is SVP Strategic and Market Analysis. He initially joined SMBC Aviation Capital in 2021 as a member of the Commercial Analysis team, with responsibility for assessment and evaluation of company transactions. In 2023 he joined the SMA team where he covers market and asset analysis along with broader industry research. Prior to joining SMBC Aviation Capital, David was a Valuation Consultant with Cirium Ascend. David holds a Bachelor's Degree in Aeronautical Engineering and a Master's in Business Management, both from the University of Limerick. He is also an ISTAT Certified Appraiser.

Shane Matthews

Shane is Head of the Strategic and Market Analysis Team leading a team of six analysts who have responsibility for SMBC Aviation Capital's proprietary models, databases and market analysis. He joined the company in 2005 as a credit risk analyst covering customers in Asia Pacific. Shane spent 10 years as an equity analyst covering airlines with NCB Stockbrokers and HSBC Securities in Singapore. He holds a Bachelor of Commerce Degree and a Masters in Business Studies in Banking and Finance from University College Dublin.

Acknowledgements

The authors gratefully acknowledge Stephen Dooley *(Trinity College Dublin and the EU SAF Clearing House)* for his valuable insights and guidance. The Trinity College Dublin Sustainable Aviation Fuel Research Facility at SMBC Aviation Capital is supported by Ryanair, Research Ireland, and SMBC Aviation Capital.

Queries

Investor

Shane Matthews
Head of Strategic & Market Analysis

E: shane.matthews@smbc.aero

Media

Conor Irwin
SVP Communications

E: conor.irwin@smbc.aero