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Clearing the runway

How sustainable aviation fuels are poised to dominate the sector

Paul Ticehurst, Johnson Matthey

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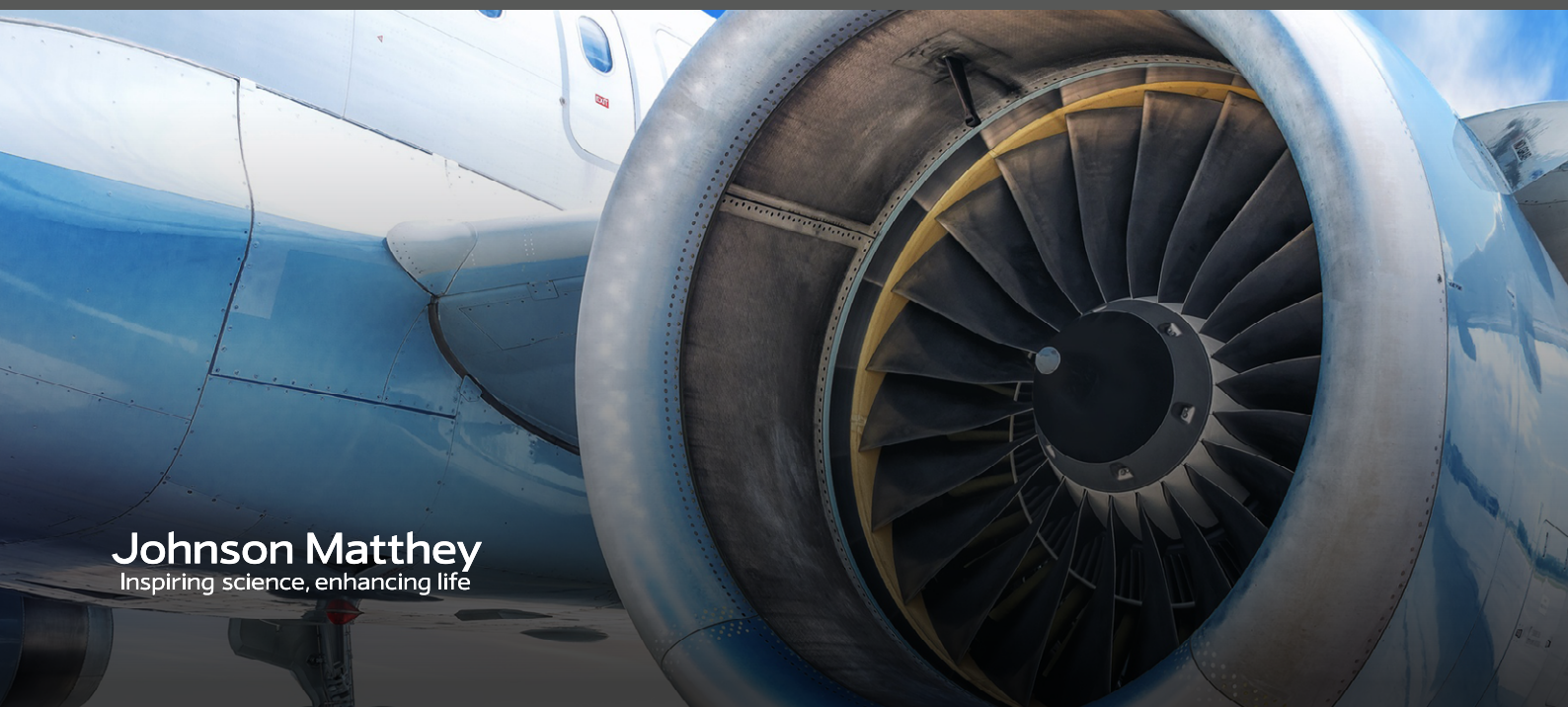

The need to decarbonise the aviation sector has never been clearer. In 2022, the International Air Transport Association (IATA) approved a resolution stating that the global air transport industry would achieve carbon-neutral status by 2050. However, for a sector fuelled by crude-oil derived kerosene, it's understandable that many are wondering how it can meet its targets.

The challenges of sustainable aviation

The pressure for a 'greener', more sustainable approach to air travel is no longer contained to internal discussions between industry leaders. Today, customers want to know that the brands they patronise align with their wider values. Climate awareness, for example, is generating pressure for airlines to adopt more sustainable practices and maintain flight volume. 'Flight shaming' captures these attitudes well, where climate activists played on the public's feelings of personal guilt and shame about flying, thereby encouraging people to examine the true impact of their journeys and seek alternative ways to travel. These views are not just limited to climate-conscious passengers alone either. For businesses that fly, sustainable aviation offers a simple way to decarbonise their processes.

Many of these businesses have pledged to go 'net-zero' and have an active interest in sustainable flying. From incremental technology improvements, such as upgrading aircraft fleets, to improved operational efficiencies, the aviation industry has already started its decarbonisation journey. However, real transformation will require a new approach to the fuels powering aircrafts and the wider aviation industry. Sustainable aviation fuel (SAF) is an overarching term that refers to aviation fuels that are derived from sustainable feedstock such as waste biomass, municipal solid waste or unavoidable carbon dioxide and renewable (green) hydrogen sourced from electrolysis.

These routes result in a significant overall reduction in carbon emissions relative to traditional jet fuel. An IATA report estimates that SAF could contribute roughly 65% of the reduction in emissions needed by aviation to reach net-zero in 2050. Comparing this to 'infrastructure and operational efficiencies', which the report believes could contribute 3%, showcases the importance of SAF in realising aviation's net-zero future.

In addition, SAF can also provide the industry with greater levels of fuel security by lessening reliance on (ofttimes tumultuous) oil and gas supply chains and potentially reduce the non-CO_2 based environmental impact of jet fuel.

The current approved SAF pathways provide airlines the ability to dilute the fossil-derived components of fuel via 'drop-ins', and due to their suitability for use in existing fuel infrastructure and engines, they are also a viable alternative to completely replace fossil-based fuels.

While other decarbonisation technologies within the aviation sector, such as hydrogen fuel or electric batteries, potentially offer long-term solutions, hydrocarbon-based fuels are still likely to dominate the sector for decades due to their superior energy density and technological maturity. Granted, SAF is still in its early stages as an industry (currently it represents about 0.1% of fuel consumption), but is demonstrably picking up momentum across the world.

Earlier this year saw a flurry of new sustainable aviation fuel deals, for example. SAF also encompasses a wide range of pathways and feedstocks, allowing fuel producers to tailor plant development to local feedstock availability and environment.

The future of the aviation sector relies on rapid decarbonisation and SAF is offering the fastest, most convenient route there. It is a rapidly changing industry and to stay on top of it requires a deep understanding of its current trends and dynamics, as well as the key drivers for it.

What's driving SAF adoption?

In addition to the rising number of climate-conscious passengers and airlines, target-driven governments are also contributing to the growing SAF need.

Major economies such as the US and EU, in an attempt to assert their authority on this rapidly growing industry, have set ambitious adoption targets for SAF. In the US, for example, recent targets are aiming for 10% SAF usage by 2030 and 100% SAF usage by 2050. Comparably, the UK is aiming for 10% by 2030 and 75% by 2050 and the EU is looking at 5% by 2030 and 63% usage by 2050. These targets are also liable to be accelerated as SAF picks up momentum. Adoption in major hubs for air travel such as Heathrow in the UK will have particularly significant effects on the aviation world.

To back up these targets, governments are providing clear incentives to adopt SAF for airlines. These vary dramatically by region. In the US, the Inflation Reduction Act (IRA) has introduced a new set of tax credits for SAF, rewarding companies for SAF production and use.

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Sustainable aviation fuels are poised to dominate the aviation sector's plans for decarbonisation

Europe, on the other hand, is enacting huge non-compliance penalties for failing to adopt SAF by a certain date. Either way, it is becoming increasingly prudent for airlines to source and use more SAF. Wherever you are, failure to comply will likely result in losing out on benefits or facing harsh penalties.

Reflecting the rapid growth of SAF, airlines themselves have also taken the unprecedented move to invest in SAF developers themselves. This alone demonstrates the huge future demand they are anticipating as they look to secure their futures. United Airlines, for example, has invested $100 million (€90.4 million) to launch an SAF-focused fund to invest in new technologies and grow the production of SAF.

With airlines, governments, and passengers all seeking more sustainable means to fly, the industry is facing phenomenal push and pull factors towards greater adoption of SAF. While current uptake rests at 0.1%, meeting these targets will be a huge technological challenge for producers and users, emphasising the importance of choosing the right technological pathway for their SAF future.

The technologies behind SAF

The current most widely used SAF technology, hydroprocessed esters and fatty acids (HEFA), uses cooking oils and agricultural waste as a feedstock, but there are several key pathways currently being deployed that convert biomass into SAF. These include Fischer-Tropsch (FT) which converts syngas – derived from biomass – to syncrude, alcohol-to-jet (AtJ), and Virent's BioForming® Sugar to Aromatics (S2A) technology. The key differentiator between these pathways is feedstock, something that is affected by regional deployment and local availabilities. HEFA for example, which uses vegetable and waste oils, naturally has a low ceiling on the maximum amount of feedstock available. FT in particular has recently been leveraged in several plants across the world to produce SAF.

The technology converts syngas derived from waste biomass to syncrude, ready for upgrading into jet fuel. The feedstock for the syngas can be from a wide range of sources, lending the technology a flexibility.

For example, Repsol and Aramco are due to commission a synthetic fuel plant in Bilbao, Spain, which uses green hydrogen and CO_2 as its only raw materials. Similarly, Fulcrum's Sierra Biofuels plant utilises waste, converting it into synthetic crude oil.

Current regulations surrounding what fuel is permitted for use in aviation are another key factor in its widespread adoption. Blending limits imposed by the American Society for Testing and Materials (ASTM) mean that 50% of Jet A (fuel for commercial aviation) must come from fossil-based sources. This is due to the requirement that a certain proportion of the fuel needs to be aromatic in nature.

Technologies such as BioForming® S2A can 'top this up' with 100% sustainable synthetic aromatic kerosene (SAK) which contains the invaluable cyclic compounds required to power an aircraft, enabling 100% sustainable fuel. Specially approved flights with Emirates in January and

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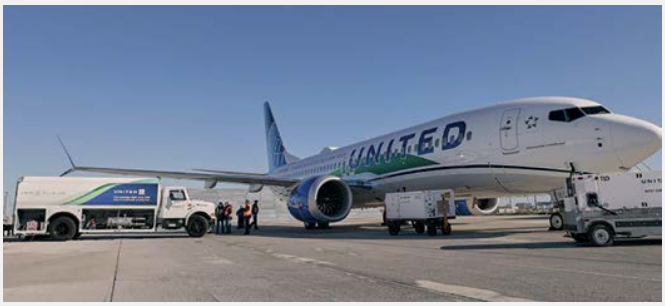
United in December 2021 proved this concept, flying with one engine using 100% sustainable fuel. For now, this is limited to these specially approved flights. In future, however, it is possible that flights running off 100% drop-in components will become increasingly common.

The future of SAF

The immediate future of SAF will be focused on closing the cost gap between SAF and fossil-based fuels. The fundamentals are a reason to be positive about this. The pressures, originating from businesses and passengers, government incentives and technological advancements mean that the SAF sector will only become more significant.

The biggest challenge will be persuading financiers that SAF is a worthy investment in order to streamline the project development process. Key to this will be reducing perceived risk as many of the technologies discussed here are yet to demonstrate significant operating capacity and longevity. Schemes designed to underwrite financial investments can help with this. The UK government, for example, has arranged a number of consultations examining ways of de-risking the sector, acknowledging that this could be a key driver of SAF development and deployment.

Another way to convince banks that the SAF development is a safe investment will be to simply prove the technology. The more the technology is used in plants and the wider the range of feedstocks applied to it, the easier it will be to build SAF business cases. Once banks become more confident in SAF production, it will spur on even further growth.



First commercial airline flight using 100% drop-in SAF enabled by Virent and Johnson Matthey

The technology itself will develop as well. Improvements around efficiency and operations are highly likely and will have further knock- on effects on reducing the overall cost of SAF, bridging the gap between it and fossil-based fuels. In short, this is a bustling and exciting industry that is poised to rapidly expand over the next decade.

A combination of factors is aligning to spur on adoption of SAF and little seems to contradict the consensus that SAF will become a mainstay of the aviation sector within the next 10 years.

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Billingham, UK
Tel +44 (0) 1642 553601
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