# How hybrid-electric technology can facilitate better adoption of sustainable aviation fuel

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## Introduction

The global climate situation remains critical in 2025, despite significant advancements in clean energy technologies and various environmental commitments from countries worldwide. According to the Copernicus Climate Change Service, 2024 was the warmest year on record globally[1] - partly due to global carbon emissions from fossil fuels hitting a record high in 2024 - with "no sign" that the world has reached a peak[2].

Despite the relatively low contribution to global carbon emissions - accounting for 2.5% of global energy-related $CO_2$ emissions in 2023 - aviation-related emissions are on the rise, increasing by 19.5% between 2022-2023[3]. The industry has a target to reach net-zero emissions by 2050, but already in 2025 the International Air Transport Association (IATA) has sounded the alarm that this target is sliding off course. IATA places part of that blame on fuel companies, saying they have ignored their own sustainable aviation fuel (SAF) supply promises.

Regardless of where the blame lies, relying so heavily on SAF at the expense of other solutions will not lead us anywhere near the drop in emissions that we, as a collective industry, need by 2050.

## The role of SAF in reducing aviation's carbon footprint

Much has been lauded about the benefits of SAF: its production being from renewable resources like waste oils and agricultural residues, its low carbon emissions lifecycle and its ability to be used in existing aircraft. It's also, crucially, been proven by a number of parties to lower greenhouse gas emissions by up to 80% compared to traditional aviation fuel. But its high production costs, reliance on feedstocks (which are in limited supply), production using hydrogen (which therefore still faces significant energy hurdles) and requirements for specific (expensive) infrastructure are proving to be obstacles too high to overcome at the scale needed.

If SAF is to be a viable decarbonisation route, coordinated global policies are essential to facilitate its widespread adoption. To date, countries have adopted various policies and initiatives to encourage SAF production and adoption, including:

- **European Union:** The ReFuelEU Aviation Regulation has set a minimum supply mandate for SAF in Europe, starting with 2% in 2025 and increasing to 70% in 2050[4]. It obligates fuel suppliers to meet the specified SAF blending percentages, with compliance mechanisms to monitor and enforce adherence.

1 https://climate.copernicus.eu/copernicus-2024-first-year-exceed-15degc-above-pre-industrial-level
2 https://wmo.int/media/news/record-carbon-emissions-highlight-urgency-of-global-greenhouse-gas-watch
3 https://www.statista.com/statistics/1491003/international-aviation-emission-change-worldwide/
4 https://www.easa.europa.eu/en/domains/environment/eaer/sustainable-aviation-fuels

- **United States**: The U.S. aims to produce three billion gallons of SAF by 2030 and 35 billion gallons by 2050, supported by incentives and policy frameworks to encourage production and adoption[5].
- **United Kingdom:** The UK's SAF mandate started in 2025 at 2% of total UK jet fuel demand, increasing on a linear basis to 10% in 2030 and then to 22% in 2040. It comes along with incentives for fuel suppliers to supply SAF into the market and a revenue certainty mechanism for SAF producers who are looking to invest in new plants in the UK[6].

But not enough progress is being made. SAF now urgently needs to be backed up by technological innovations that can facilitate an increase in its adoption and embed it in the broader aerospace ecosystem. The industry needs to reconsider the heavy extent of its reliance on SAF and explore - and invest - in ways to reduce carbon emissions whilst utilising lower levels of SAF.

Alongside other modifications to operations and modernisation of infrastructures, technology has a critical role to play here: combining decarbonised fuels with fuel optimisation technologies will be what unlocks a real net-zero aviation. Here's where hybrid-electric innovations come in.

## Hybrid-electric technologies are the key to unlocking the potential of SAF

As with the automotive industry, the aviation industry first began exploring all-electric forms of transportation - before quickly encountering range and infrastructure limitations, including heavy batteries and long recharge times. Whilst a number of great innovations are still happening in the all-electric space - from the likes of the first certified electric airplane Pipistrel Velis Electro, flying taxis from companies such as Joby Aviation or Archer, and Eviation with its business aviation aircraft in particular - the result of these innovations on the overall environmental impact of aviation will be minimal due to poor performance not matching the operational requirements from operators and won't lead to any drastic reductions in carbon emissions. All-electric aircraft will certainly have a place in the future aviation industry, but won't play a leading role in getting us there.

In contrast, hybrid-electric solutions - based on a propulsion architecture combining electricity and combustion power - integrate alternative energy sources, such as SAF now and hydrogen in the future, while reducing fossil fuel consumption by up to 50%. This means that twice as many aircraft can be powered from the same volume of SAF. At the same time, hybrid-electric fuel optimisation technologies also reduce the amount of traditional aviation fuel used in-flight, bringing down overall carbon emissions.

## Ascendance: for the skies of tomorrow

Since its founding in 2018, Ascendance has been on a mission to create hybrid-electric solutions to decarbonise both current and future aviation. Founded by four ex-Airbus engineers who had first-hand experience of the limitations of all-electric aircraft, hybrid-electric was a deliberate and strategic choice from day one.

## Sterna

In 2021, it unveiled its patented hybrid-electric propulsion architecture: Sterna. Designed for airframers and operators seeking rapid decarbonisation, Sterna enables the replacement of a plane's conventional nose- or wing-mounted engines with a combination of batteries, electric motors and an engine running on SAF or hydrogen. Thanks to this hybrid-electric architecture, the engine and batteries are interconnected and deliver power in tandem. This innovative modular architecture is controlled by algorithms in a highly sophisticated energy management system developed and patented by Ascendance.

Sterna uses its batteries to provide the high levels of power needed for the takeoff and climb phases of flight,

5 https://aviationacrossamerica.org/news/2024/01/05/global-sustainable-aviation-fuel-saf-production-set-to-double-in-2024-future-growth-policy-dependent/

6 https://www.gov.uk/government/speeches/sustainable-aviation-fuel-initiatives

**FIGURE 1:** Cessna Caravan with conventional propulsion system (left hand side) vs. Cessna Caravan equipped with STERNA hybrid-electric technology (right hand side).

then switches to the engine for the cruise phase when less power is needed. This means not only that the engine can be smaller and used at maximum efficiency, Sterna is also an enabler of a whole new generation of engines which reduce carbon emissions but need hybridization to boost their performance for high thrust. Thanks to this combination of optimally sized systems, a conventional aircraft retrofitted with a Sterna powertrain can achieve overall fuel savings and reduce pollutant emissions by up to 50%.

Ascendance's Sterna technology can be readily adapted to existing aircraft. Today, we estimate that there are at least 25,000 turboprop aircraft flying that could benefit from a hybrid-electric retrofit: no modifications to flight operations are needed, offering simplicity and enabling continuity of use. The opportunity for this hybrid technology will only increase when it is integrated in future new developments from aircraft Original Equipment Manufacturers (OEMs).

And it's not just traditional aircraft: Sterna is designed to be integrated into aircraft of all sizes, from regional aircraft up to 70 passengers to unmanned aerial vehicles (UAVs), with real-life applications full-steam ahead. In 2023, Ascendance and Daher, the aircraft manufacturer, announced a collaboration with Ascendance researching new ways of hybridising the propulsion systems of Daher aircraft and testing its hybrid-electric propulsion systems on Daher aircraft.

## Making sustainable aviation a reality

Growing climate urgency is coming at the same time as increasing global uncertainty and an increasingly fragmented world - when what's needed to reach net-zero emissions and to slow global warming is collaboration and an agreed approach.

Whilst country-specific targets and initiatives will continue to shift, those at the coalface of aviation decarbonisation must stay committed to the collective goal of net-zero emissions by 2050. This will require radical innovations - many of which are already in existence - supported by extremely substantial financing and tight global and industry collaboration.

Innovations like that of Ascendance's prove that decarbonising aviation can be done in many different - but complementary - ways - from modifications to existing aircraft, to new purpose-built aircraft with sustainability at their core. But too much attention and expectations are being placed on SAF alone right now. Whilst ramping up SAF production and adoption is undoubtedly critical to the future sustainability of the aviation industry, so too is modernising fleets and creating aircrafts for the future. The two will go hand-in-hand in developing long-lasting change.