



**WORKING PAPER**

**THIRD CONFERENCE ON AVIATION AND ALTERNATIVE FUELS  
(CAAF/3)**

**Dubai, United Arab Emirates, 20 to 24 November 2023**

**Agenda Item 2: Supporting policies to promote the development and deployment of cleaner energy for aviation**

**STATE OF THE SAF INDUSTRY: AN INDUSTRY VIEW**

(Presented by the Air Transport Action Group (ATAG), Airports Council International (ACI), Civil Air Navigation Services Organisation (CANSO), International Air Transport Association (IATA), International Business Aviation Council (IBAC) and International Coordinating Council of Aerospace Industries Associations (ICCAIA))

**EXECUTIVE SUMMARY**

This Working Paper outlines the transition to net-zero carbon emissions in international aviation by 2050, with sustainable aviation fuel (SAF) being a key component. Although SAF use has increased significantly, it still represents less than 1% of jet fuel uptake. The paper outlines the current state of the SAF industry, including supply and demand perspectives for the next few years, and alongside the other industry working papers for CAAF/3, emphasises the need for coordinated efforts from governments and industry to achieve the net zero carbon 2050 goal. In addition, policymakers must prioritise policies to ensure the channelling of feedstock and infrastructure towards sustainable aviation fuels.

Action by the Conference is in paragraph 4.

**1. INTRODUCTION**

1.1 At the 41st ICAO Assembly, ICAO adopted a sector-wide long-term global aspirational goal (LTAG) for international aviation of net-zero carbon emissions by 2050. In October 2021, the aviation industry, including the signatories to this paper agreed to strengthen the industry decarbonisation commitments first set in 2009, to a net zero carbon emissions goal by 2050.

1.2 Industry consensus suggests that sustainable aviation fuels (SAF) will contribute the majority of the industry's decarbonisation until 2050. Through the *Waypoint 2050*<sup>1</sup> analysis and other pathways such as the IATA Net Zero Roadmaps<sup>2</sup>, it has been identified that between 53% and 71% of the decarbonisation from air transport will come from SAF<sup>3</sup>, with the expectation that the global average carbon intensity of the fuel we use should be around 80% lower in 2050 compared with today's fossil fuel source.

<sup>1</sup> ATAG *Waypoint 2050*: [www.aviationbenefits.org/W2050](http://www.aviationbenefits.org/W2050)

<sup>2</sup> IATA Net Zero Roadmaps: [www.iata.org/en/programs/environment/roadmaps/](http://www.iata.org/en/programs/environment/roadmaps/)

<sup>3</sup> The rest of the emissions will be addressed by more efficient operations, efficiency improvements achieved through aircraft technology, hydrogen aircraft and market-based-measures.

1.3 All aviation decarbonisation roadmaps show the need for an unprecedented scale-up of existing and incumbent SAF pathways for the industry to meet its energy transition commitments. The SAF supply needs to go from the current 0.24 Mt of SAF to potentially around 490 Mt in 2050. New SAF pathways not currently available at scale, particularly for advanced feedstocks, will need to be further matured and scaled-up.

1.4 This paper outlines the state of the SAF industry today and highlights further commitments both from the supply and the demand side, which could help inform ongoing discussions on a level of SAF ambition in support of the LTAG.

## 2. STATE OF THE SAF INDUSTRY

### *State of the industry today:*

2.1 The estimated SAF uptake by airlines in 2021 was four times higher (0.08 Mt) than what it was in 2019 (< 0.02 Mt), and in 2022, this further tripled to 0.24 Mt. Despite this significant growth, SAF still represented less than 1% of the fuel uptake in 2022<sup>4</sup>. It is expected that in 2023, this number will continue to rise exponentially, with the commercialisation of new and expanded facilities.

2.2 The 2023 increase in SAF output has been driven by the commissioning of new renewable fuel refineries, along with the expansion of capacity at existing facilities, spanning North America, Europe and Asia Pacific. Today, SAF is being produced on a regular basis at around 10 facilities, including plants operated by BP, Calumet, ENI, Marathon, Neste, Philips 66, Repsol, Shell, Total and World Energy.

2.3 As of September 2023, ASTM certification has been provided for 8 pathways for SAF, with 3 co-processing pathways also having been made available for use in commercial flights at up to a 5% blend. An additional 7 SAF pathways are under active assessment, and the co-processing blend limit is being reviewed, which may see additional supply options in the next 2-5 years. This will ensure that there are diverse opportunities available for SAF supply, with almost 20 different feedstock or pathway approaches potentially certified by 2025-2027 and more to follow after that.

Additionally, lower carbon aviation fuels (LCAF) have been identified as an option to reduce the carbon intensity of aviation's fuel supply in the near-term, as there are demonstrable technologies and projects that today's conventional (fossil) jet fuel producers can implement to lower the lifecycle greenhouse gas emissions of the jet fuel they supply. LCAF can provide an adoptable lower-carbon solution in the coming years, as investment and construction in new SAF facilities accelerate and further SAF supply comes online.

### *Supply perspective:*

2.4 Looking at the wider renewable fuels market (including renewable diesel, SAF and other transport fuels), more than 150 global projects are being explored in 35 countries by over 100 different producers. Currently, this equates to 73.4 million tonnes (91.8 billion litres)<sup>5</sup> of advanced renewable fuel production capacity out to 2029, with a growth trajectory expected to continue out to 2030 and beyond. With the right policies and incentives, an increasing proportion of the renewable fuel production capacity could be channelled towards SAF production. However, in the absence of this, aviation could lag behind, and this capacity could go to meet other sectors' needs like road or marine transportation.

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<sup>4</sup> IATA, *Update on Sustainable Aviation Fuels*, [www.iata.org/en/iata-repository/pressroom/presentations/sustainable-aviation-fuel-agm-2023/](http://www.iata.org/en/iata-repository/pressroom/presentations/sustainable-aviation-fuel-agm-2023/)

<sup>5</sup> [Production facilities collated](#) on the ICAO website.

2.5 From the SAF projects tracked, 85% are currently derived from the hydrotreated esters and fatty acids (HEFA) pathway, however it has been identified that HEFA will have limits in meeting the full SAF demand for the industry in the long term (beyond 2035) due to constraints on feedstock availability. There is a need for quick and targeted diversification of feedstocks to increase the availability of SAF from advanced pathways such as alcohol-to-jet (AtJ), gasification Fischer-Tropsch (FT) and power-to-liquid (PtL) by the end of the 2030s.

2.6 ICAO, through the CAEP-FTG-TTP group, provided four SAF production projection scenarios to 2030. These scenarios estimate project maturity and resulting SAF quantities by 2030 ranging from 3.059 Mt (low scenario) to 16.973 Mt (high+ scenario), with most of the production currently concentrated in North America and Europe. These scenarios account for announcements made before January 2023, and include a rigorous feasibility assessment looking at variables such as: success rate of facilities; facilities which have reached final investment decisions; facilities which have announced specific plans to allocate production output to SAF; or facilities which could make SAF should they want to; amongst others. An update in November 2023<sup>6</sup> accounts for announcements made since January 2023, which potentially adds an additional 12 Mt to the previous estimate. These announcements have not been subject to the CAEP ‘project maturity and feasibility’ assessment. However, by way of example, should half of them succeed and provide their full expected output to SAF, a potential 23 Mt of SAF supply in 2030 is plausible. A positive outcome from CAAF/3 and additional government policy action in the coming 18-24 months, as well as genuine support and engagement from the finance and energy sectors, will be necessary to help boost the supply of SAF further.

### ***Demand perspective***

2.7 The industry has tracked proposed and committed global policies which could drive SAF uptake by 2030 to around 20 Mt, should they all be met. This includes the United States’ SAF Grand Challenge (9.08 Mt), the European Union ReFuel EU SAF mandate (3.58 Mt), the UK mandate (1.2 Mt) as well as other policies in Norway, Brazil, Turkey, the United Arab Emirates, Japan and India. Other countries are also exploring policy measures but are not included in this paper.

2.8 Airlines, operators and corporate partners currently have around \$45 billion in forward purchase agreements for SAF, an increase from \$6 billion pre-Covid.

2.9 More than 50 airlines have committed to 2030 SAF goals ranging from 5-30% of their total fuel usage, with most of them committing to 10% use. These airlines represented over 40% of global RTKs in 2019<sup>7</sup>. In addition, SAF is already being distributed at 69 airports on a regular basis<sup>8</sup>.

2.10 These efforts – demand (both voluntary and mandated), policy drivers and production estimates – will continue to evolve and should be included in any assessments of the SAF scale-up challenge. Regular reviews of the ‘state of play’ should be included in CAEP and ICAO work, including the annual Stocktake exercise. However, a formal approach should be taken as the development of SAF evolves: the cycle for convening a CAAF ideally should be considered in respect of the ICAO Assembly cycle.

<sup>6</sup> Contained in the CAAF/3 IP/6 Information Paper published on 9 November 2023.

<sup>7</sup> For example: OneWorld members Alaska Airlines, American Airlines, British Airways, Cathay Pacific, Finnair, Iberia, Japan Airlines, Malaysia Airlines, Qantas, Qatar Airways, Royal Air Maroc, Royal Jordanian, S7 Airlines, and SriLankan Airlines; additional IAG carriers Level, Vueling and Aer Lingus; ANA, Delta Air Lines, Air France, KLM, Transavia, SpiceJet, Virgin Atlantic, Air New Zealand, Jetstar, jetBlue, Southwest, Cebu Pacific, Hawaiian Airlines, AeroMexico, Fiji Airways, SpiceJet, IndiGo and LATAM (at 5% in 2030). Ryanair has committed to 12.5% SAF blend in its fleet by 2030, whilst SAS (25%), Norwegian (28%) and FedEx, DHL and UPS commit to 30%. Additionally, on 10 November 2023, the members of the Association of Asia Pacific Airlines committed to a goal of 5% SAF usage by 2030. This adds Air Astana, Air India, Bangkok Airways, China Airlines, EVA Air, Garuda Indonesia, Philippine Airlines, Royal Brunei Airlines, Singapore Airlines and Thai Airways.

<sup>8</sup> ICAO SAF airports map [www.icao.int/environmental-protection/GFAAF/Pages/Airports.aspx](http://www.icao.int/environmental-protection/GFAAF/Pages/Airports.aspx)

### 3. CONCLUSIONS

3.1 There has been unprecedented progress on the SAF industry ramp-up and a wider spread of its distribution into airports. Fossil-derived jet fuel still represents over 99% of aircraft energy input world-wide. This will need to be transitioned to an almost complete replacement with SAF by 2050 in order to meet the sector's net-zero goal.

3.2 There are well over 100 announcements for new renewable fuel plants. Some of them might not make it to final investment decision, others might emerge in the coming years as a result of new national policies and frameworks, and some of may opt to focus the production into supplying road transport unless the right policies and incentives from States prioritise the channelling of such feedstock and infrastructure towards sustainable aviation fuels.

3.3 To meet aviation SAF demand in the short term, public policy and private support will be needed. ICAO can provide, at the CAAF/3 meeting, an impetus for the development of what is needed to scale up production at the right levels. Ambition beyond current policies and incentives to reach net zero carbon by 2050 will necessitate even more coordinated efforts from government and industry alike.

### 4. ACTION BY CAAF/3

4.1 The Conference is invited to:

4.1.1 Note the progress being made by the industry already on voluntary SAF action.

4.1.2 Agree on a global framework which would further support development, investment and production of SAF globally, beyond currently forecast levels.

4.1.3 Agree to undertake regular reviews of the outcomes including the level of ICAO Vision ambition and implementation elements of the Global Framework, with expectation that CAAF/4 should be convened before the 43<sup>rd</sup> ICAO Assembly in 2028.