SABA EDUCATION SERIES

Module SAF Basics   Topic SAF 101

Introduction

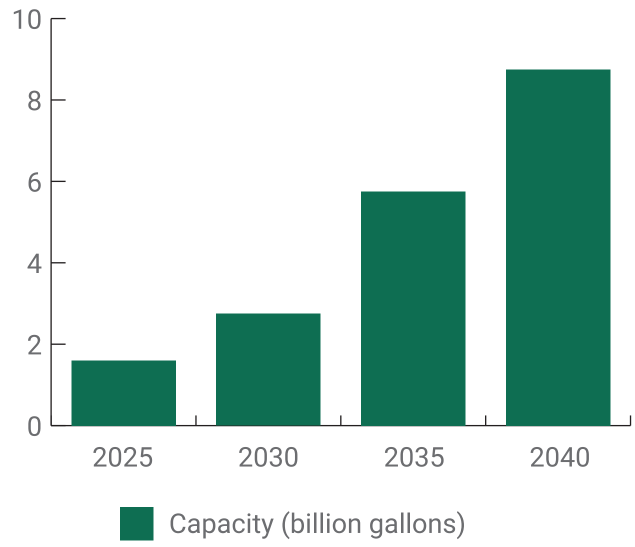
Sustainable aviation fuel ("SAF") is the most viable near-term solution to mitigate the environmental impact of air travel and transport. SAF can reduce CO_2 emissions from air travel and transport to over 85% on a "lifecycle basis" (see Section II for more) when used in place of conventional jet fuel, yet it comprises less than 0.1% of jet fuel today[1].

SAF is a "drop-in" fuel, approved for use in existing aircraft engines and fueling infrastructure up to a blend ratio of 50% and certified to the same technical and safety standards as fossil jet fuel. After further testing and potentially small updates to the fuel or aircraft, SAF is likely to be approved for use without blending.

The SAF market is nascent and on the cusp of exponential growth, driven by regulatory incentives, compliance requirements, and sustainability commitments made by airlines as well as major corporations seeking to reduce their scope 3 emissions from business travel or freight transport.

Global SAF supply has grown nearly twelve-fold from less than 7 million gallons in 2019 to ~80 million gallons in 2022[2]. Based on data from nearly 120 production facilities planned or in operation, SAF capacity is expected to ramp to ~8.75 billion gallons by 2050[3].

Exhibit 1. Projected SAF Capacity



Source: S&P Global[3]

1 WEF 'Fueling sustainable aviation for the long haul'

2 IATA Update on Sustainable Aviation Fuels (SAF), 2023

3 S&P Global: 'Long-term demand for SAF could run into supply constraints'

Public policies are expected to meaningfully increase the amount of SAF produced. Examples of programs regulating or incentivizing the uptake of SAF today include:

1. The International Civil Aviation Organization (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) set a cap for international aviation emissions at 85% of 2019 levels (600 million tCO_2). CORISA phases in over several years, starting in 2021
2. The European Commission approved a blending mandate requiring that SAF make up 2% of all aviation fuel supplied to EU airports beginning in 2025 with a progressive increase to 75% by 2050[4]
3. The Inflation Reduction Act (IRA) passed by the U.S. Congress in 2022 includes a SAF tax credit for fuel producers for up to $1.75 per gallon of SAF produced

I. Production Pathways & Feedstocks

SAF is derived from renewable sources, such as non-food crops, waste oils, and agricultural residues, all of which are referred to as **feedstocks** in the production process.

SAF can be produced through several "production pathways," each involving specific feedstocks and conversion processes (i.e., technologies used to convert a feedstock into aviation fuel, primarily through chemical reactions to produce hydrocarbons[5]).

There are four main SAF production pathways with potential for commercial scale: (1) Hydrogenation of esters and fatty acids (HEFA); (2) Gasification and Fischer-Tropsch; (3) Alcohol-to-Jet (AtJ); (4) Power-to-liquid (PtL).

HEFA-based fuels dominate the current SAF market, but fuels made through the other conversion pathways, using more easily scalable feedstocks, are expected to gain market share in the coming years.

Please visit 'Production Pathways and Feedstocks' for more detail.

II. SAF Life Cycle Assessment

The emissions savings associated with any given batch of SAF is determined through a life cycle assessment that measures emissions across the full well-to-wake lifecycle of the fuel.

1. Well-to-wake (WTW): Full lifecycle emissions from the production of the feedstock to the combustion of fuel; inclusive of emissions from (2) and (3) below
2. Well-to-tank (WTT): Emissions from the upstream production and processing of the feedstock, and transportation of the finished fuel to the aircraft
3. Tank-to-wake (TTW): Emissions from combustion of the fuel during aircraft operation

4 European Commission press release: 'European Green Deal'

5 ICAO Environment: Conversion processes

Only well-to-wake (WTW) LCA assessments are considered comprehensive and appropriate for determining the carbon intensity of SAF; WTT and TTW (defined above) represent only a portion of the total emissions related to SAF. The carbon intensity of the SAF is compared to the carbon intensity of conventional jet fuel to calculate total carbon savings from SAF use.

III. Sustainability Certification

All jet fuel including SAF must meet global safety standards, but SAF should also be certified in accordance with a credible sustainability standard to ensure the calculation of LCA values has been done correctly and that producing the fuel does not lead to other unintended negative impacts on the environment. ICAO has approved for use in its main climate program two sustainability certification systems (SCSs): the Roundtable on Sustainable Biomaterials (RSB) and International Sustainability and Carbon Certification (ISCC). They each have several high-quality standards designed to meet different regulatory and market needs. They all require certification at each step of the SAF value chain, including - and most importantly - when the feedstock is sourced.

Please visit 'Sustainability Certification' for more detail.

IV. Book-and-claim

A so-called "book-and-claim" chain of custody model allows the decoupling of physical SAF from its environmental attributes, similar to the renewable energy certificate (REC) and Guarantee of Origin (GO) systems used in several countries. Book-and-claim for SAF is different than with RECs, however, in that both the scope 1 (air transport providers) and the scope 3 (aviation customers) environmental attributes can be booked and claimed. Separately booking scope 3 attributes allows aviation customers who do not purchase physical fuel to purchase the environmental attributes from SAF for use toward their voluntary climate targets. These attributes are codified in SAF certificates (SAFc), whose value typically corresponds to the SAF "green premium," i.e. the incremental price of SAF compared to conventional jet fuel. As a result, companies who are aviation customers can support the uptake of SAF through SAFc purchases.

Please visit 'Book-and-Claim Fundamentals' for more detail.

V. Procurement

Airlines and other aircraft operators (e.g., freight transporters, companies with private aircraft) can procure physical SAF by working directly with a SAF producer or SAF broker. Given the competitive nature of the aviation sector, however, most aircraft operators would not voluntarily procure SAF unless aviation customers supported them in doing so by purchasing the scope 3 SAFc enabled by the book-and-claim system described in the previous section. Such customers are typically companies with voluntary scope 3 climate targets and significant emissions from air travel and transport. Scope 3 SAFc can be purchased either directly from an air transport operator or, in some cases, from the SAF producer.

Given the nascent SAF market, collective procurement efforts and strong demand signals are critical to incentivize SAF supply and empower scope 3 aviation customers to invest in SAFc with confidence.