Sustainable Aviation Fuels - Status quo and national assessments

Participants

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Policy Relevance

Sustainable aviation fuels (SAF) are an important measure to reduce the carbon footprint of the aviation sector. Legally binding targets are about to be introduced by, for example, the EU. Incentives are provided in the U.S. Inflation Reduction Act. Consequently, first volumes of SAF are being produced, and production capacities are expected to ramp up quickly. As market demand for SAF grows, production technologies will need to diversify to allow a broader range of biomass and waste feedstocks, and also e-fuels are expected to contribute. However, currently there is a huge price difference between SAF and fossil jet fuel, leading to higher costs for the operation of flights. Policies should be aligned internationally as to avoid shifts in flight patterns to regions with less stringent SAF obligations and related sustainability criteria.

Major Conclusion

Although SAF production technologies other than hydrotreatment still have to be further developed and deployed, neither production technology nor technical issues when operating aircrafts on SAF are seen as the main challenges. Implementing SAF is primarily an economic challenge, rather than a technical one.

Background

The aviation industry is responsible for about 2% of global greenhouse gas (GHG) emissions, and with air travel expected to continue to grow in the coming years, it is crucial to find ways to reduce its climate impact. SAF are alternative jet fuels made from renewable biomass, waste-based feedstock or renewable electricity, which have lower life-cycle GHG emissions (carbon intensity) than conventional fossil jet fuels and which fulfill sustainability criteria beyond carbon intensity. SAF offer a promising solution as they can be used as a drop-in replacement for conventional jet fuel, meaning that they can be used in existing aircraft engines without the need for modifications (in blends within its technological route limits).

Global SAF production in 2022 was about 0.1% of global aviation fuel consumption. Current drivers for SAF demand are voluntary commitments and production is increasing rapidly (share has tripled since 2021). In order to achieve the ambitious decarbonization targets of the aviation sector, the market uptake of SAF must be promoted by identifying and overcoming various challenges and by improving the framework conditions. Identifying these barriers and showing successful examples of SAF market uptake is an important step to realize the potential of SAF in terms of reducing GHG emissions and achieving ICAO´s long-term aspirational goal (LTAG) of net-zero carbon dioxide emissions from aviation by 2050.

Research Protocol

Task 63 was structured in five work packages. For describing the international status quo on SAF, relevant information was gathered from publications of relevant organizations and personal contacts with stakeholders in respective task participant´s countries and other countries.

The national assessments, including a description of nationally specific situations and strategies, were carried out by each participating Task Member. The topics, as well as methods and data sources for these assessments were discussed in an internal scoping-workshop. A list of challenges was derived from comparing the national assessments.

To share best practices and facilitate learning among stakeholders in the field, three online seminars were conducted. The thematic focuses of these online seminars were:

- Feedstock & Conversion
- Supply & Operation
- Market & Policy.

During these online seminars, selected stakeholders described how they have implemented the production or application of SAF, the challenges they have faced and how they have overcome them. The findings and recordings from these seminars have been made available on the AMF website.

Key Messages from AMF Research

AMF Task 63

Key Findings

Task 63 identified major challenges in bringing SAF to market and showcased examples of successful deployment and application, facilitated exchanges among countries and stakeholders to learn from each other, and engaged with national and international stakeholders to increase the amount of SAF produced.

- Task Member countries agreed on the following main challenges for an accelerated market deployment of SAF:
  - High **production costs** and, due to limited market capacities, significant higher market prices of SAF compared to conventional jet fuel
  - **Feedstock limitations** as well as competition with other sectors for certain feedstocks and certain regions
  - Lack of clear international **regulations** and alignment between them (e.g. EU-ETS and CORSIA)
- Biogenic SAF is essential for decarbonizing the aviation sector, especially in the short to medium term.
  - Hydroprocessed Esters and Fatty Acids (HEFA) is currently the main pathway, by 2030 also Gasification-Fischer-Tropsch (FT) and Alcohol-to-Jet (ATJ) will contribute.
  - Power-to-Liquid (PtL) or e-fuels production technologies will take longer to be commercially available. However, all SAF technology pathways are needed to achieve the long-term targets of the sector.
  - Refineries that will produce SAF also coproduce other products like fuels for other transport sectors and the chemical industry.
- Even though the EU shares a common (proposed) framework, strategies among Member States vary (e.g. policies in Germany and Denmark focus on e-fuels alone).

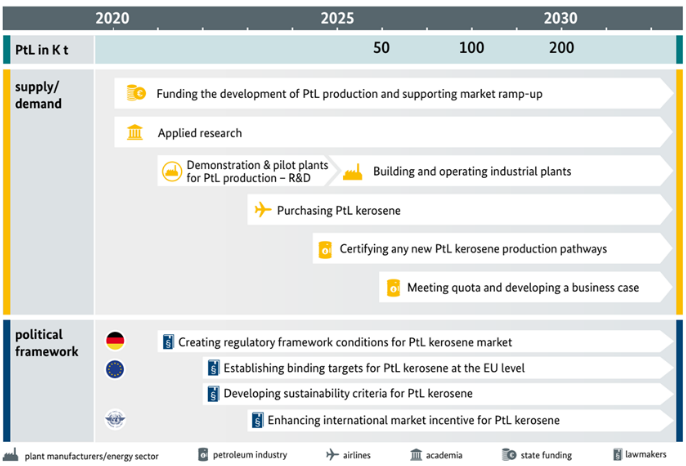

Figure 1: Implementation of PtL SAF roadmap for aviation (https://bmdv.bund.de/SharedDocs/DE/Anlage/LF/ptl-roadmap.pdf?__blob=publicationFile 2021)

- The deployment of SAF is mainly an economic and an administrative issue, not a technological one (even in case of multi-blending).
  - There are three ways for accounting for SAF delivery – segregated delivery, mass balance and book & claim.
- Scaling-up SAF capacities require huge investments and risk sharing among stakeholders.
  - Offtake agreements are one possibility for airlines to support SAF producers while securing their SAF supply.
- SAF availability is very limited at the moment, but the EU and the US have very ambitious plans to increase SAF capacity or set clear increasing targets on SAF demand (US SAF Grand Challenge, ReFuelEU Aviation).
  - Worldwide there are only a few production facilities in operation. In 2022, the production volume was about 0.24 – 0.36 million tons.
  - In the US the production forecast for 2027 is about 60 times higher compared to 2022.
  - According to McKinsey, SAF production in 2030 could reach about 19-23 million tons (based on modelled or stated SAF yields and 100% production site utilization rate, incl. speculative projects with high uncertainty).
  - According to Waypoint 2050, published by ATAG, global SAF demand will be about 380 million tons by 2050 (considering 100% emission reduction).
- Care needs to be taken to safeguard sustainable feedstock supply, efficient conversion, and reliable sustainability certification.
  - Sustainability criteria for SAF need to be harmonized globally, along with an internationally agreed method of calculating life-cycle GHG emissions (which allows carbon intensity measurement) of SAF
  - An international SAF registry or multiple regional registries will enable supply, trade and use of SAF globally.

The Advanced Motor Fuels TCP is eager to support this development through cooperative R&D and information exchange.

More information on Task 63 is available on the AMF website: https://iea-amf.org/content/projects/map_projects/63