How sustainable are SAF?

Sustainability criteria

Table 4.2 (/eco/eaer/popup/figure-table/30740/nojs) provides an overview of the sustainability criteria used within both the RED II [**1**] and the ICAO Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) [**9**] .

GHG emissions reductions

As the emissions from the combustion of drop-in SAF are comparable to fossil-based jet fuels, except for marginal efficiency gains, the majority of the reductions in GHG emissions originate from the production process. In order to assess the overall climate benefit from using SAF, a Lifecycle Analysis (LCA) is performed to account for all the stages in the lifecycle of aviation fuels. It includes feedstock recovery and transportation, fuel production and transportation, and fuel consumption by aircraft.

The GHG emissions of fuels are provided in terms of gCO_2e/MJ, which can be compared to the relevant baseline emissions used for fossil-based jet fuel in order to calculate the overall GHG emissions reduction[37]. Figure 4.2. (/eco/eaer/popup/figure-table/30739/nojs) illustrates the components of typical well-to-wing lifecycle analysis steps for fossil- based jet fuel and SAF.

[37]Greenhouse gas emissions are expressed as grams of carbon dioxide equivalent (gCO_2e) emissions of CH_4, N_2O and non-biogenic CO_2 calculated on the basis of a 100-year global warming potential (GWP), consistent with the Intergovernmental Panel on Climate Change (IPCC). CO_2e are calculated per energy unit expressed as megajoule of fuel produced and combusted in an aircraft engine (gCO_2e/MJ).

The LCA of a fuel is a complex process and many variables (e.g., origin and type of feedstock, electricity mix, production method) can have a considerable impact on the total GHG emissions. Figure 4.3. (/eco/eaer/popup/figure-table/30741/nojs) provides an overview of modelled direct emissions reductions under CORSIA for approved SAF production pathways as of January 2022. Work is ongoing to approve GHG emissions reductions for Power-to-Liquid fuels, but with a fully decarbonised supply chain, emission reductions of up to 100% can be achieved compared to a fossil fuel reference.

Additional effects from use of SAF

The SAF feedstock and production process typically results in very low levels of sulphur and aromatic content, which form part of volatile and non-volatile particulate matter (PM) emissions. Studies on the use of SAF blended into fossil-based jet fuel have shown that PM emissions behind the aircraft at cruising altitudes are reduced by 50-97% compared to fossil-based jet fuel. The highest reductions can be observed at low engine power, typically applied when the aircraft is taxiing, and hence SAF can also improve local air quality and reduce health impacts [**10**] . As such, due to their different physio-chemical composition, SAF drop- in fuels can have a positive impact on both air quality around airports as well as climate change through the reduction in the formation of contrail-cirrus clouds. This is assuming that there are no increases in the aromatic and sulphur content of the fossil-based part of the blended fuel that negates the SAF benefits.

Land use impacts are a common concern surrounding some aviation biofuels. Direct land use changes (DLUC) occur when existing farmland is converted for the growth of feedstock for biofuel production, while indirect land use change (ILUC) occur when the increasing demand for biofuel lead to land expansion elsewhere, including the conversion of land with high carbon stock such as forests (e.g., deforestation and the release of CO_2 stored in trees and soil) [**11**] [**12**] . The impact of ILUC is estimated through complex modelling and the range of values can be wide. Studies have shown that the conversion of land with very high biodiversity, such as rainforest or peatlands, can release up to several hundred times more CO_2-equivalent emissions than what the biomass subsequently grown on that land is able to reduce annually [**12**] . For the above reasons, under RED II, the contribution of biofuels produced from food and feed crops towards EU Member States' renewable energy targets for transport are capped. The contribution of biofuels from food and feed crops for which a "significant expansion of the production area into land with high carbon stock" is observed is also capped at 2019 level and phased- out by 2030. For the same reasons, biofuels produced from food and feed crops are not eligible under the proposed ReFuelEU Aviation.

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