

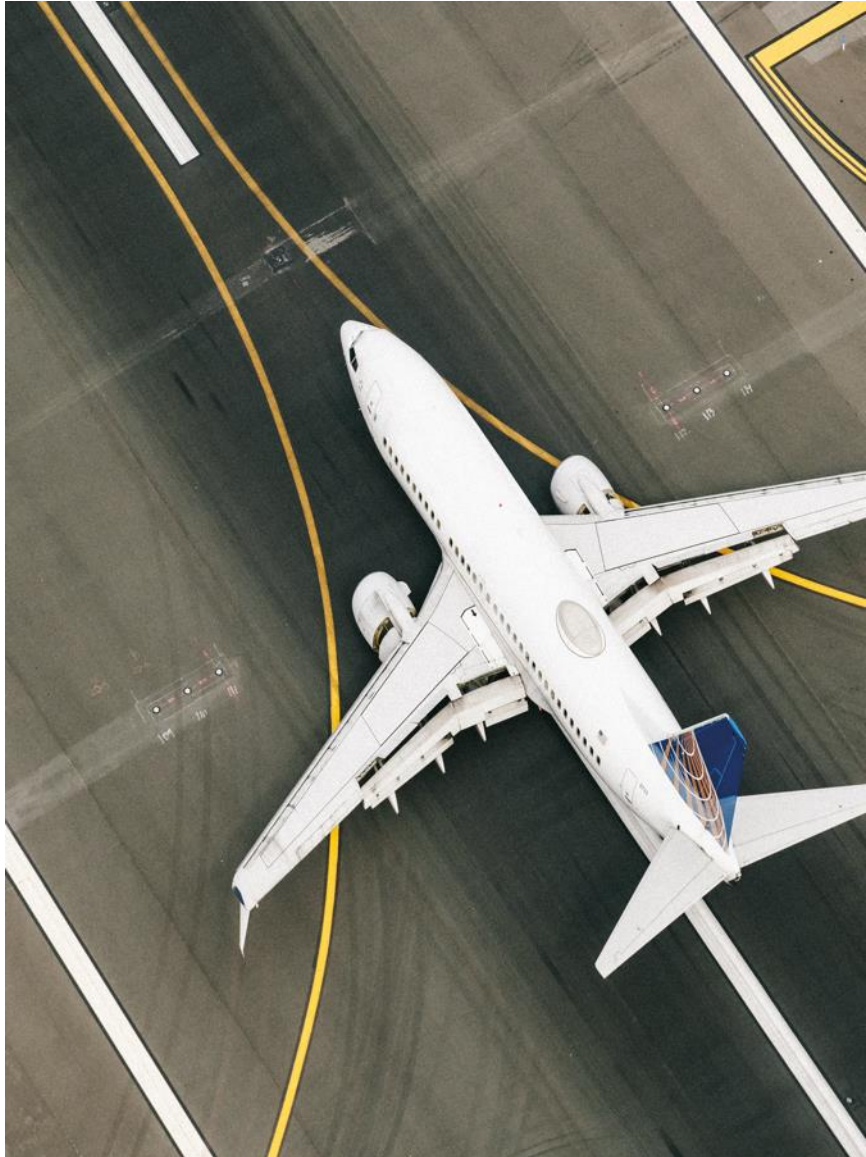
SUSTAINABLE AVIATION FUEL AND ITS MARKET OUTLOOK

Fueling event – Bio4a

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WE ARE SKYNRG



We are a SAF capacity developer



We supply SAF to airlines



We provide SAF solutions for corporate and individual travelers



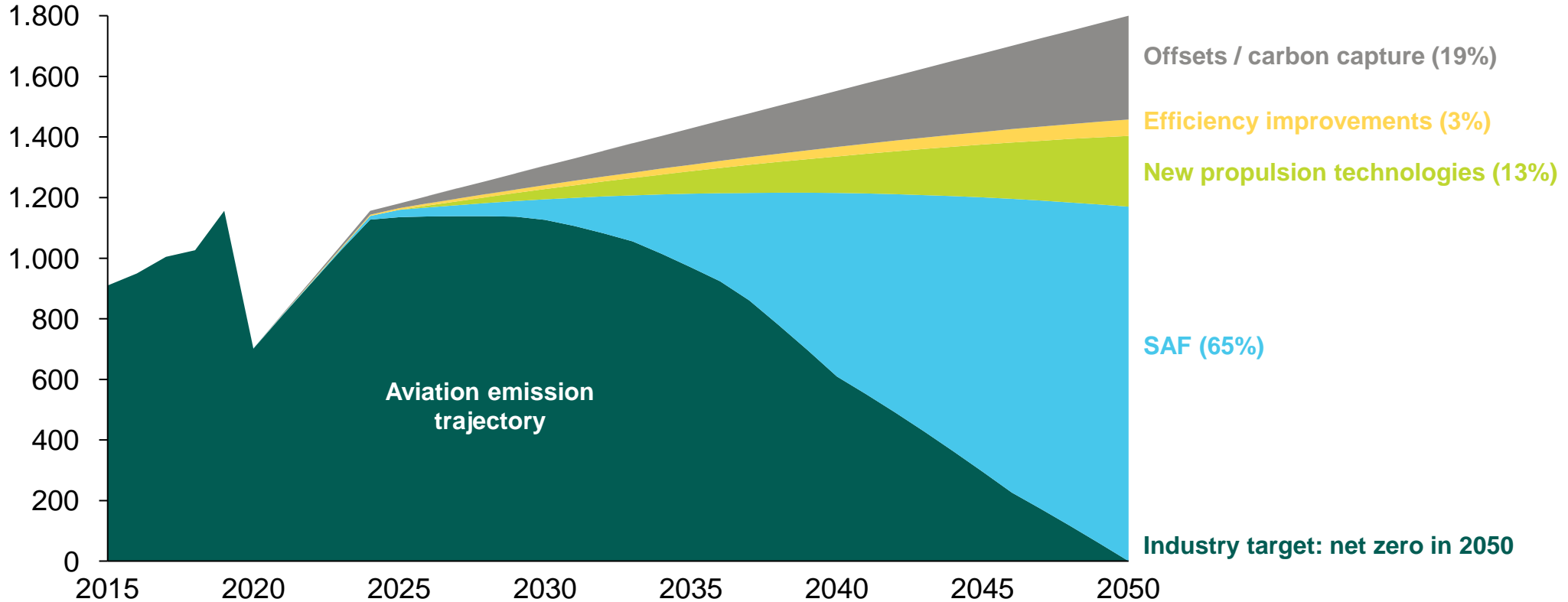
We do not compromise on sustainability



THE AVIATION INDUSTRY HAS COMMITTED TO NET ZERO IN 2050









Global aviation emissions (Mt CO₂)

Based on business-as-usual trajectory of IATA*



SAF market expected to grow from €0.2B today to €50B in 2030, to >€500B in 2050

SAF CAN BE MADE THROUGH A VARIETY OF PATHWAYS

Feedstock	Pathway	Process description	Commercial readiness
 Fats and oils	Hydro-processed Esters and Fatty Acids (HEFA)	Oils and fats react with hydrogen in the presence of a catalyst to produce SAF	Multiple commercial scale plants operational 
	Co-processing vegetable oil	Co-processing oils and fats in existing crude oil refineries	Common practice at multiple refineries, mainly to produce renewable diesel 
 Solid biomass (e.g., agricultural and woody residues, MSW)	Gasification and Fischer-Tropsch (FT)	The feedstock is decomposed (gasification) and then converted (FT synthesis) to SAF	Small commercial plants under construction (Red Rock & Fulcrum)  Expected: 2023
	Alcohol to Jet (AtJ)	The feedstock is fermented to produce ethanol which is then converted to SAF	Demo plant operational (Gevo), small commercial under development (LanzaTech)  Expected: 2023
 Point source or ambient CO₂	Power to Liquids (PtL)	CO ₂ and hydrogen are combined to produce syngas and converted to SAF	Pilot scale, but rapidly scaling up (Norsk e-fuel, Synkero)  Expected: 2027-2028

BESIDES INDUSTRY TARGETS - GOVERNMENT MANDATES AND INCENTIVES CREATE A CLEAR DEMAND SIGNAL FOR SAF

SAF demand will be driven by policies



The EU just announced a SAF blending mandate starting with 2% in 2025 and growing to 63% in 2050



In addition, various European countries announced more ambitious SAF targets



The United States already incentivize the use of SAF; The Biden administration targets 100% SAF use in 2050



The global CO₂ framework CORSIA is expected to cost airlines 3-12 B\$ by 2030¹

... and voluntary uptake

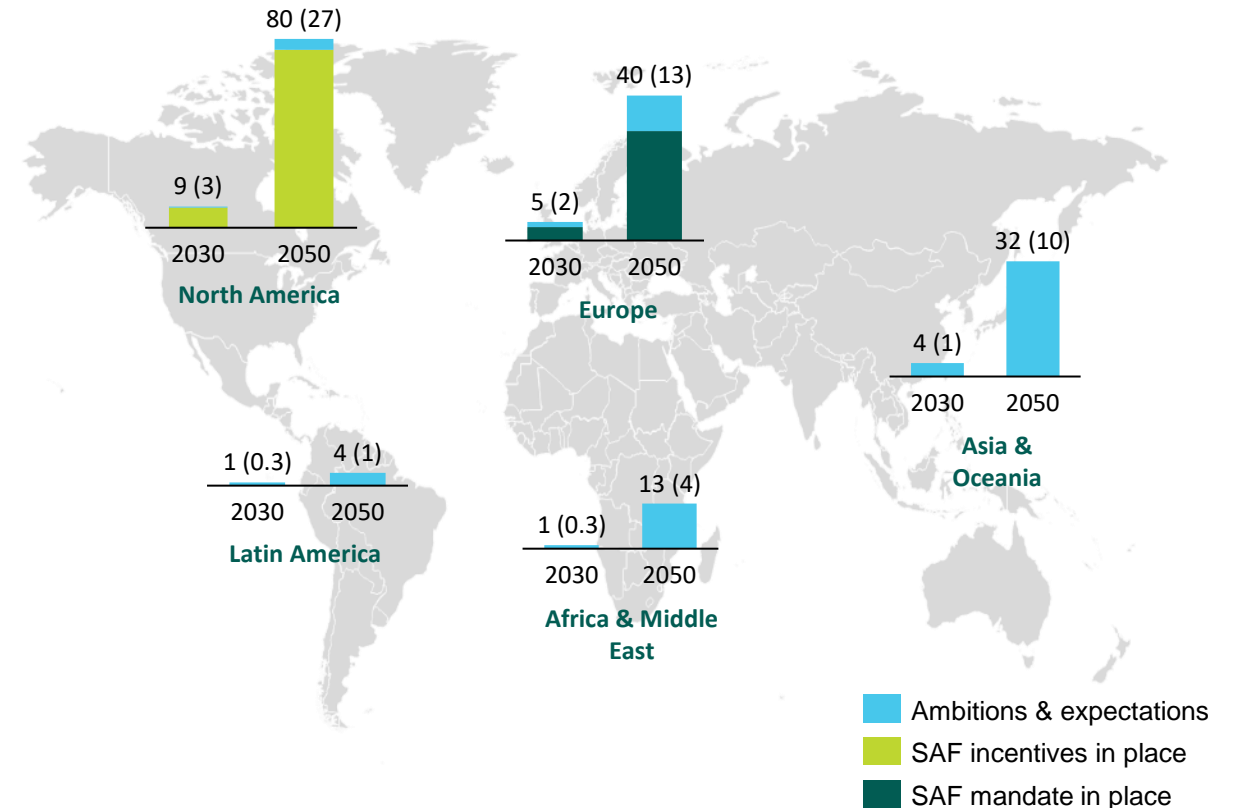


There are strong demand signals from corporates, airlines and cargo carriers which are starting to get backed by long-term offtakes, including, e.g.:

- DHL Express: 30% of fuel uptake by 2030
- Delta Airlines: 10% of fuel uptake by 2030
- IAG: 10% of fuel uptake by 2030

SAF demand to increase to 19 Mt (6 Bgal) in 2030 to ~170 Mt (60 Bgal) in 2050

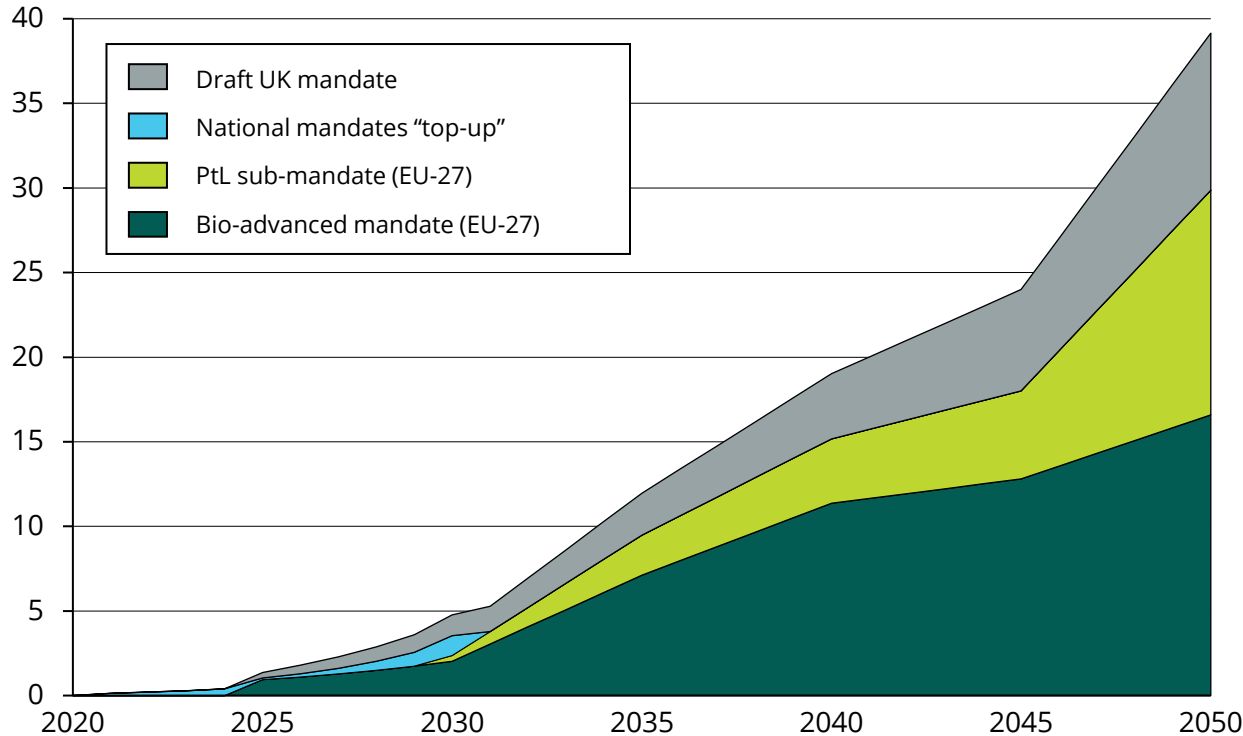
NB. Graphs denote SAF demand in million tonnes (Bgal in between brackets)



1. Under the CORSIA framework, airlines need to offset emissions to achieve carbon-neutral growth. Source: ATAG Waypoint 2050 (2020), EU ReFuel package (2021), US SAF Grand Challenge (2021), Argus (2020), McKinsey & Company (n.d.), CORSIA (2018), SkyNRG market outlook on SAF (2021), SkyNRG analysis

INSTALLED AND EXPECTED MANDATES IN THE EU AND THE UK COULD RESULT IN A SAF DEMAND IN EUROPE OF ~40 MT IN 2050

SAF mandates in Europe, incl. UK (Mt SAF)



Please note: Graph does not include voluntary SAF commitments from airlines and corporates

Key takeaways

- The ReFuelEU mandate for SAF increases steeply from 2.4 Mt in 2030 to 15.2 Mt in 2040.
- The mandate for PtL SAF accelerates after 2045 to 13.3 Mt in 2050.
- Total anticipated mandated volumes are 1 Mt in 2025, 3.5 Mt in 2030 and 30 Mt in 2050.
- The UK is currently considering installing a SAF mandate that would start at 10% in 2030,¹ increasing to net zero by 2050 resulting in 9.3 Mt SAF demand.

Note

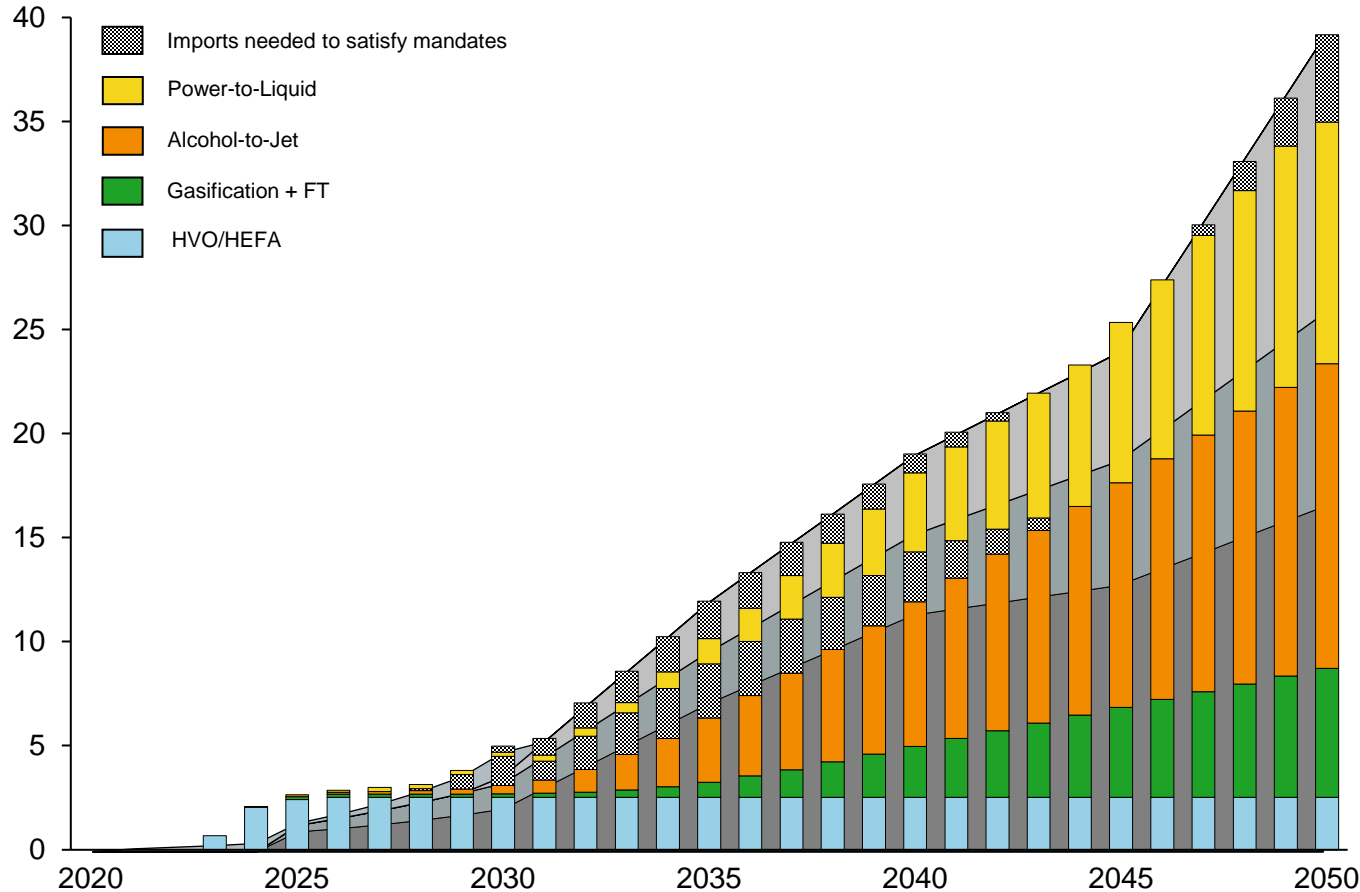
- As of September 2022, the negotiations (between EC, EP, and ministries) on ReFuelEU are ongoing which could still see the minimum percentages significantly changed.²
- The European Parliament has proposed increasing the target for the overall mandate to 85% by 2050, with the synthetic aviation fuel sub-mandate (PtL) responsible for the increase.

¹ Based on: Department for Transport, Sustainable Aviation Fuel Mandate - A consultation on reducing the greenhouse gas emissions of aviation fuels in the UK, Scenario E - Early SAF breakthrough ([link](#))

² Source: EURACTIV (2022)

WE NEED ALL FEEDSTOCK TECHNOLOGY COMBINATIONS POSSIBLE TO ACHIEVE THESE AMBITIOUS TARGETS

European SAF supply outlook up to 2050 (Mt)



Key takeaways

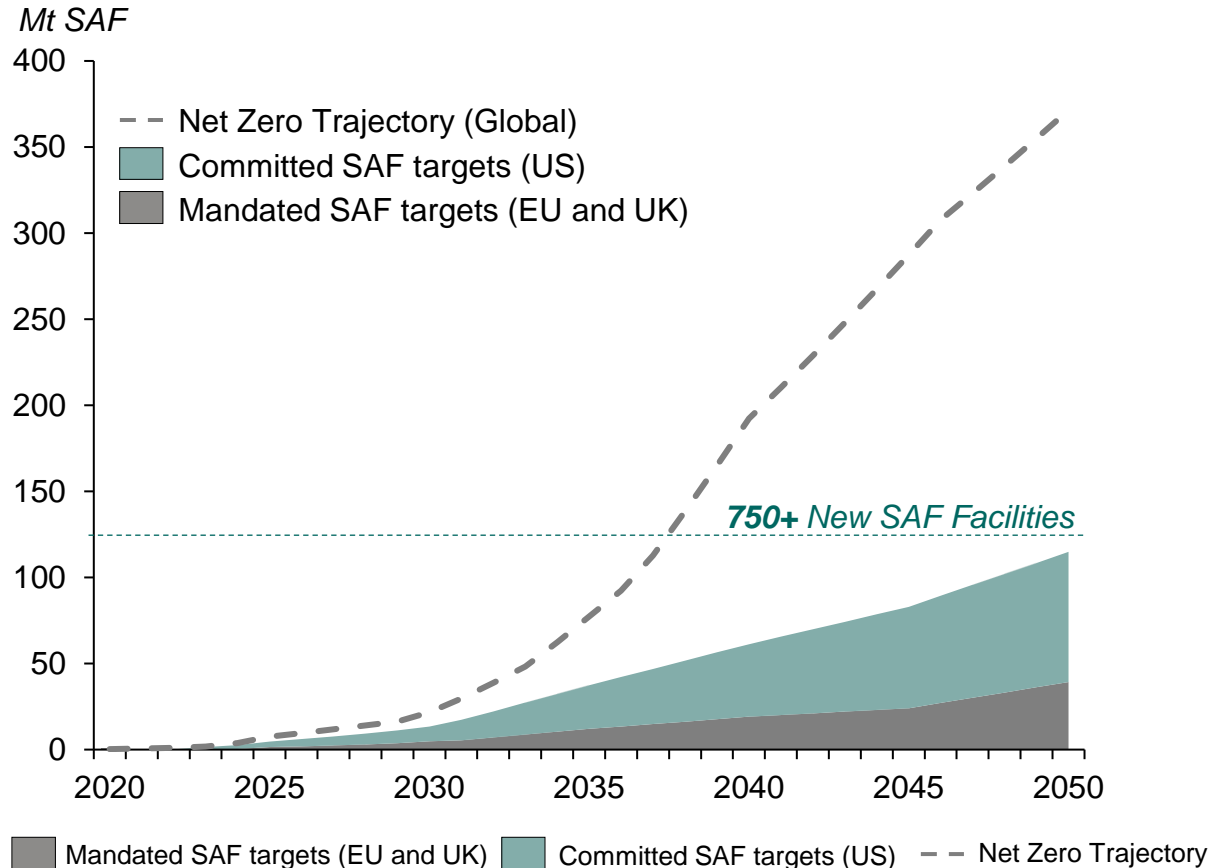
- About 400 SAF plants will be required to fulfil the expected European mandates by 2050 (vs. ~25 EU plants currently announced).
- Pathways depending on (ligno-)cellulosic wastes & residues will become essential to achieve mandated volumes.
- Rapid deployment of new technologies (AtJ, FT, PtL) and feedstock mobilization is required to supply mandated volumes post 2030.
- HEFA based SAF can be scaled further by unlocking new feedstock pools such as cover crops.

Key boundary conditions in this analysis




- Upscaling of plants is limited by global feedstock availability in case of HEFA, and EU feedstock availability for other pathways.
- A maximum of 10 bio-advanced SAF plants are realized per year, with a maximum of 10 for PtL.
- Imports amount to a maximum of 30% of the total SAF supply.
- Product slates of FT and HEFA technologies are not fully jet-optimized due to expected fuel demand from road sector.
- UK mandate assumed at same PtL/bio split as EU mandate.

LOOKING BEYOND EUROPE WE SEE SIGNIFICANT LARGER OPPORTUNITY FOR SAF TO REACH NET ZERO

Although policies are ambitious, net zero requires far more



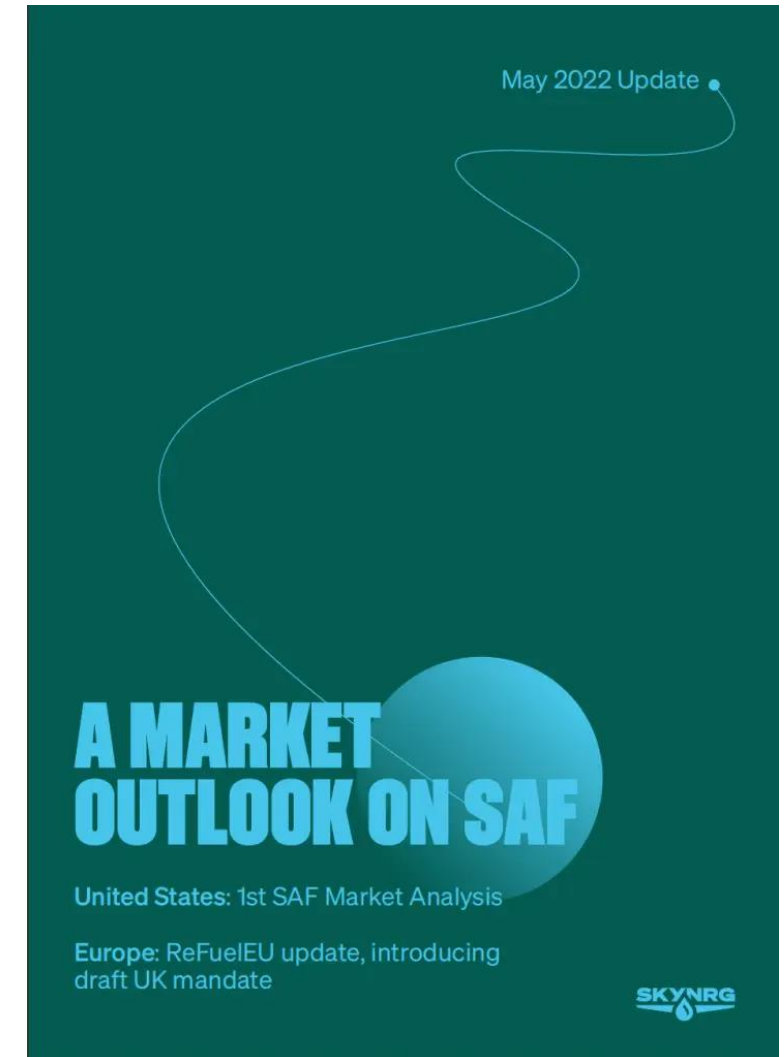
There are three main policies that underpin SAF demand

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 - **ReFuelEU Aviation** requires the use of a **2% SAF blend by 2025, 5% by 2030 and 63% by 2050** (under negotiation)
 - **Strong cost of non-compliance** for both supplier and user
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 - The White House is targeting 20% lower aviation emissions by 2030
 - **The US SAF Grand Challenge** – a government-wide commitment by US to scale up the production of SAF to **35 billion gallons per year by 2050, implying 100% SAF use in 2050**
 - US Congress introduced the **Sustainable Skies Act** and **US Inflation Reduction Act** accelerating the use of SAF
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 - **The UK government** has mandated the production of at least 10% SAF by **2030**
 - **UK** stated a net-zero target for aviation by **2050**

MAIN TAKEAWAYS

- ⦿ SAF is taking off rapidly, driven by major policy developments in Europe and the US
- ⦿ 2030 targets are seen as realistic: they can be achieved with currently available technologies
- ⦿ Post-2030, mandates need to be fulfilled with technologies and feedstocks that are not commercially ready today
- ⦿ We do not have the luxury to exclude feedstocks that can be used sustainably
- ⦿ E-Fuels / PtL based platforms will play an increasing role in fulfilling part of the mandated volumes
- ⦿ Failure to mobilize new and sustainable supply chains implies a need for demand reduction to get aviation 'Paris-aligned'

Want to learn more? Check out our SAF Market Outlook 2023 (coming in May)!





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