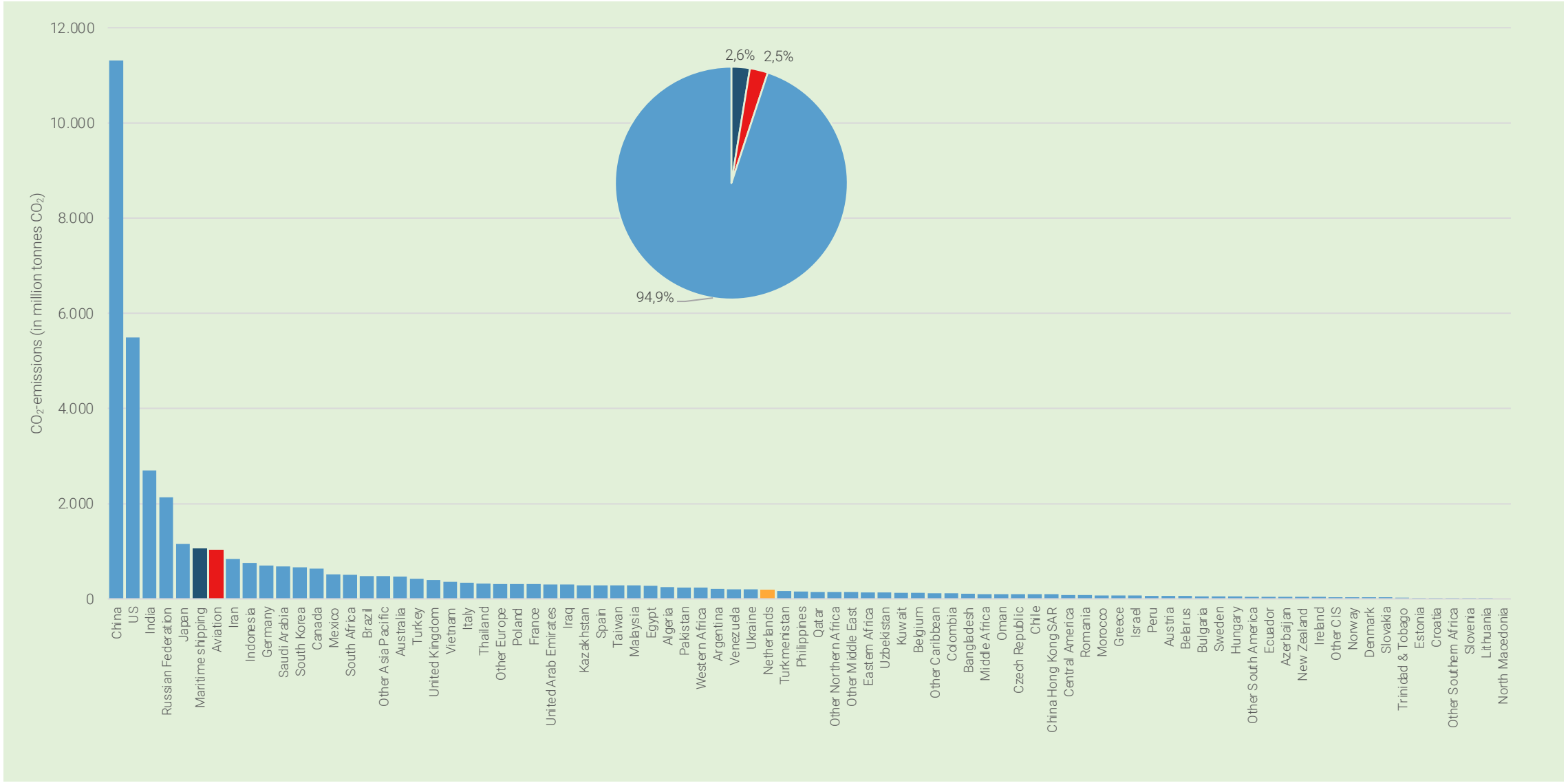
Setting the scene on Sustainable Aviation Fuels SAF

Eric van den Heuvel

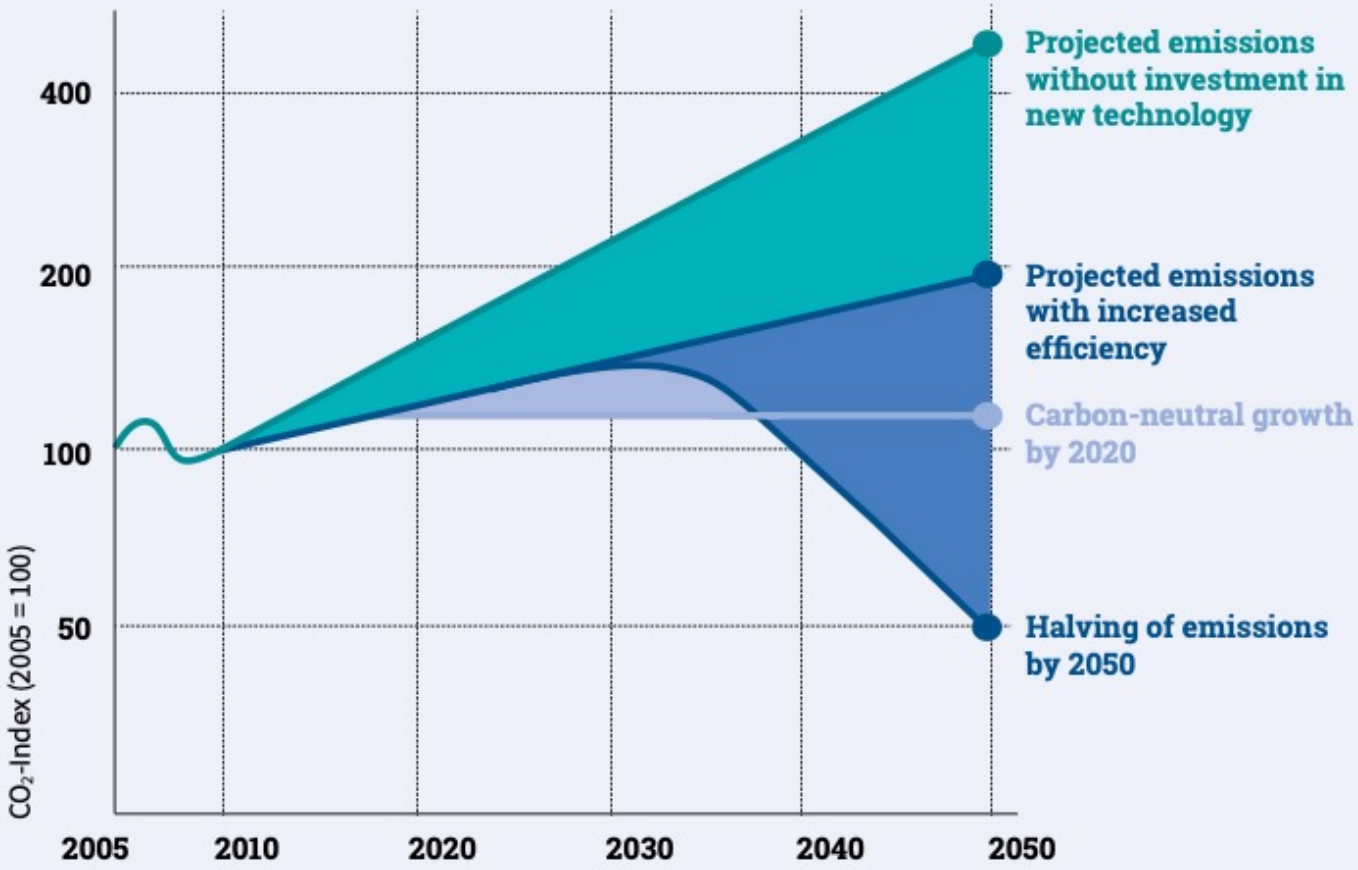
EUBCE Tripartite meeting SAF
23 June 2024
Marseille

On CO_2-emissions: how large is the aviation sector?



Graph by studio Gear Up, on basis of data from:: IEA, IMO, BP Statistical Renew of world energy. data refer to year 2018

Already in 2005 strong policy focus to reduce the climate impact…



Savings through technology, infrastructure and operations

Savings made in other sectors through carbon trading

Savings from additional technologies and substainable fuels

Source: based on IATA [44]

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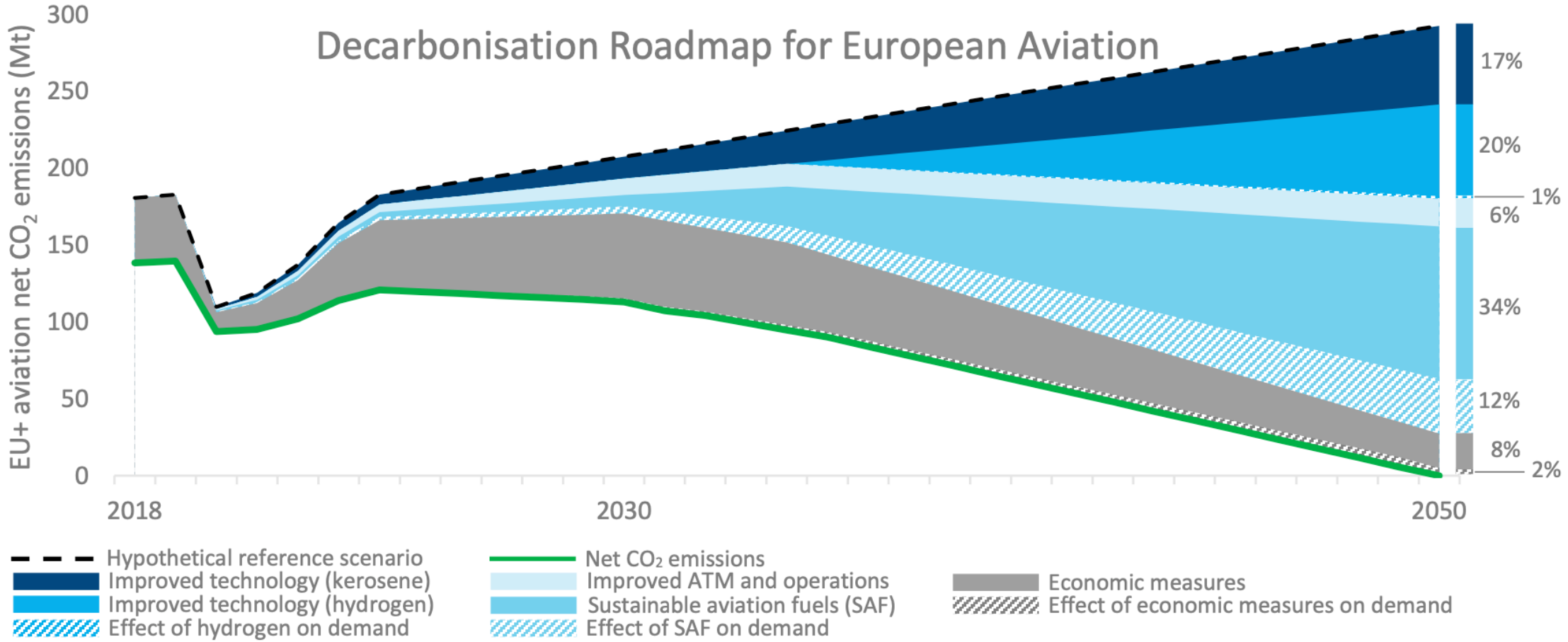
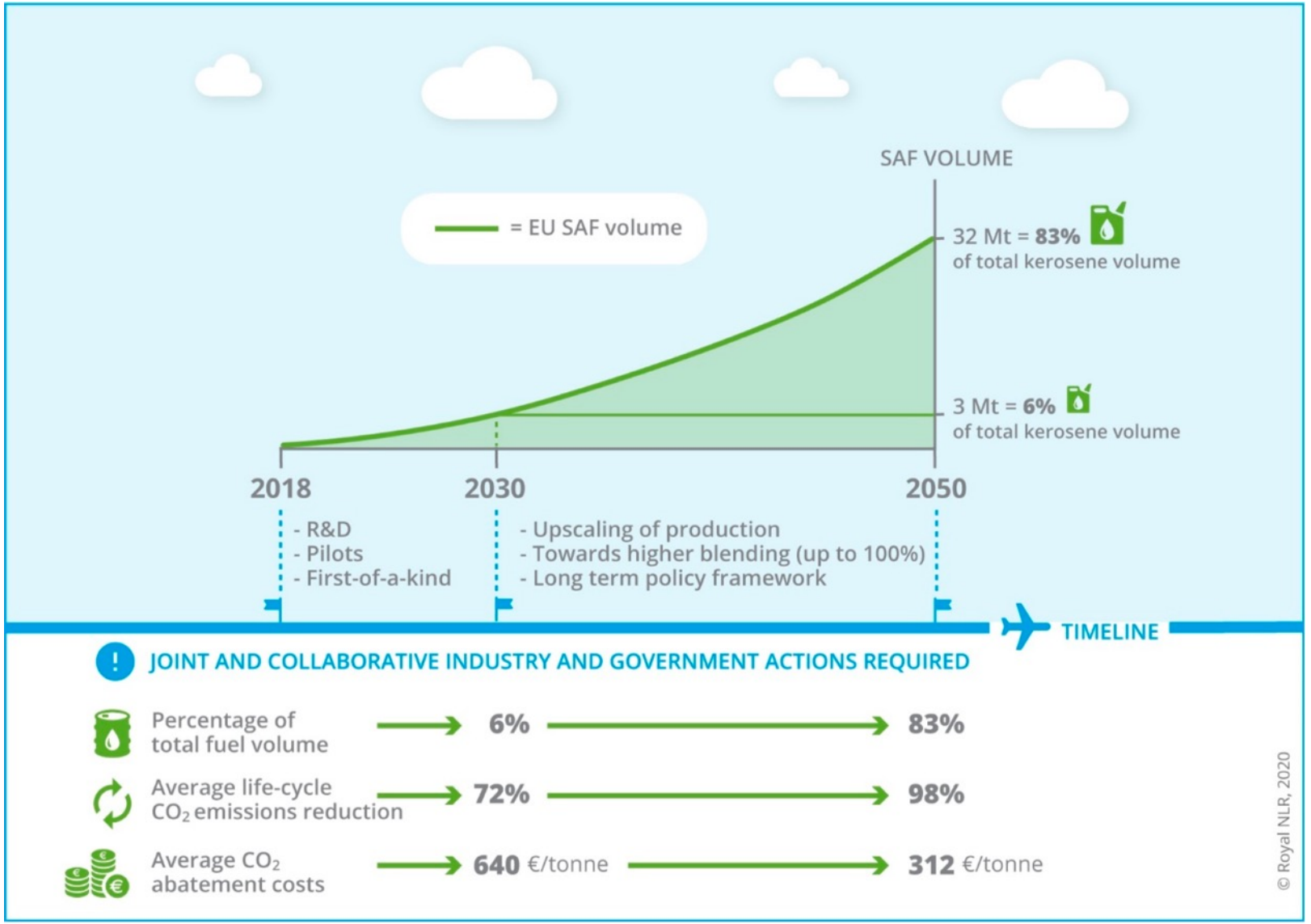
And targets have been further sharpened to net zero…



Source: NLR, SEO, 2021, Destination 2050, A Route To Net Zero European Aviation

… and strong growth required for Sustainable Aviation Fuels



Source: NLR, SEO, 2021, Destination 2050, A Route To Net Zero European Aviation

But what are sustainable aviation fuels?

	HEFA	Alcohol-to-jet[i]	Gasification/FT	Power-to-liquid
Opportunity description	Safe, proven, and scalable technology		Potential in the mid-term, however significant techno-economical uncertainty	Proof of concept 2025+, primarily where cheap high-volume electricity is available
Technology maturity	Mature		Commercial pilot	In development
Feedstock	Waste and residue lipids, purposely grown oil energy plants[ii] Transportable and with existing supply chains Potential to cover 5%-10% of total jet fuel demand		Agricultural and forestry residues, municipal solid waste[iv], purposely grown cellulosic energy crops[v] High availability of cheap feedstock, but fragmented collection	CO_2 and green electricity Unlimited potential via direct air capture Point source capture as bridging technology
% LCA GHG reduction vs. fossil jet	73%–84%[iii]		85%-94%[vi]	99%[vii]

i. Ethanol route; **ii**. Oilseed bearing trees on low-ILUC degraded land or as rotational oil cover crops; **iii**. Excluding all edible oil crops; **iv**. Mainly used for gas./FT; **v**. As rotational cover crops; **vi**. Excluding all edible sugars; **vii**. Up to 100% with a fully decarbonized supply chain

Source: CORSIA; RED II; De Jong et al. 2017; GLOBIUM 2015; ICCT 2017; ICCT 2019; E4tech 2020; Hayward et al. 2014; ENERGINET renewables catalogue; Van Dyk et al., 2019; NRL 2010; Umweltbundesamt 2016

Source: McKinsey, 2020, Clean Skies Tomorrow

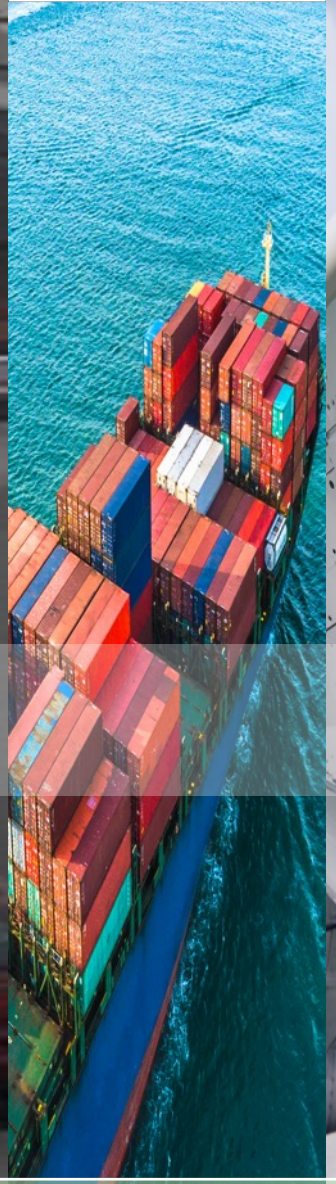
2030 renewable enery targets in EU:

RED: 14,5% lower GHG intensity / 29% Renewable energy

FuelEU Mar.: 6% lower GHG int.

ReFuelEU Aviation: 6% SAF

Visual by studio Gear Up, data from EC regualtion and directive



2030 targets:

RED: **14,5% lower GHG intensity /**
29% Renewable energy

-6% GHG

6% SAF

Visual by studio Gear Up, data from EC regualtion and directive

Policy ambitions and mandates:

- **European Union**:
  - Increasing mandated shares of SAF up to 2050:
    - Starting from 2% in 2025
    - Ending up at total of 70% SAF, of which 35% should be e-SAF
    - Expected volume for 6% target in 2030: 1.3 Bgal (3.8 Mt)
  - Only waste based, recycled carbon fuels and RFNBO allowed

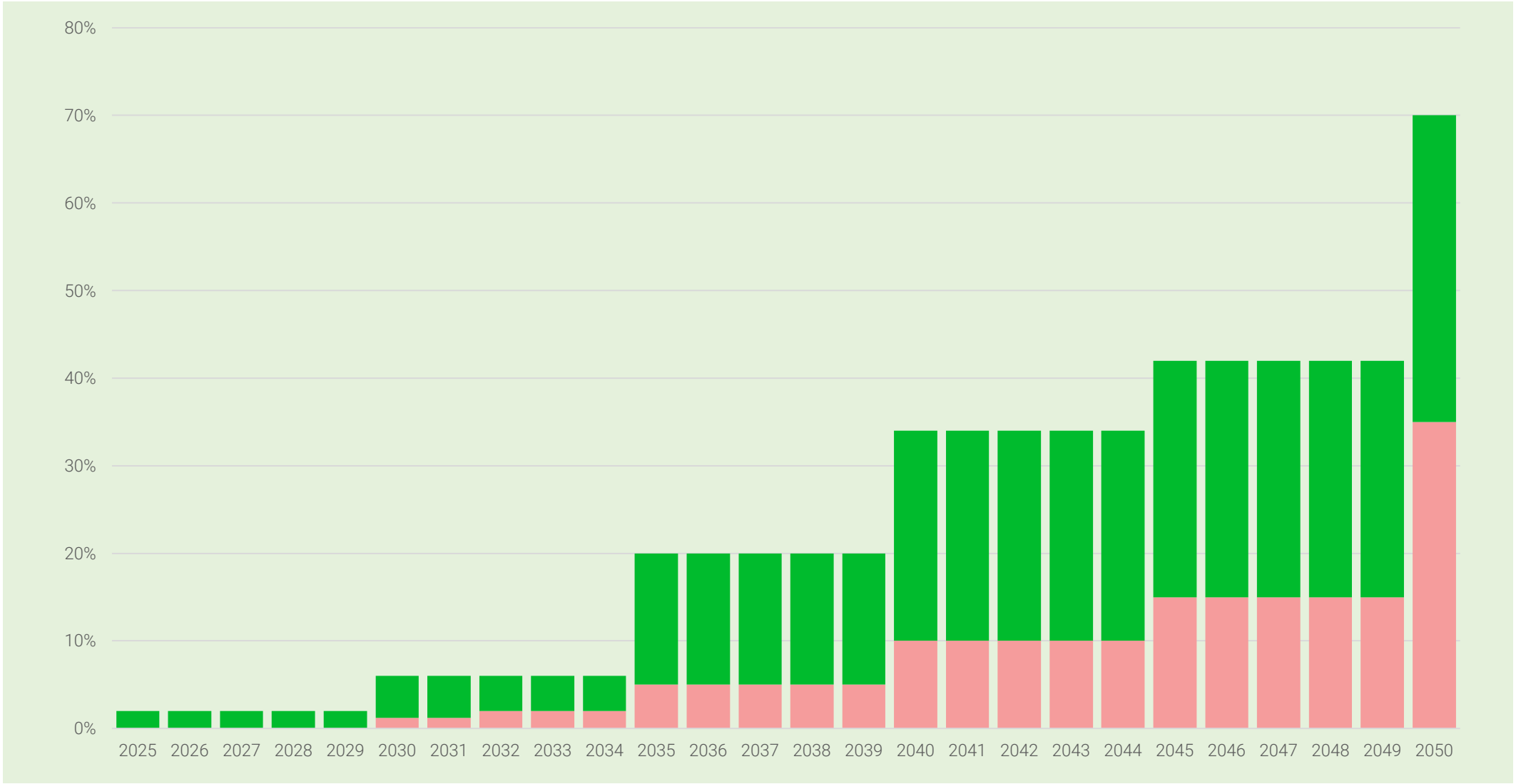
- United Kingdom:
  - 10% mandate in 2030, with a limit to lipid based HEFA, supporting AtJ, FT-SAF and e-SAF

- **United States:**
  - Aspirational target for 3 Bgal in 2030 (9,1Mt)
  - Also crop based biofuels are allowed

- **Rest of the World**:
  - In Asia, Japan announced a 10% blending mandate, other Asian countries start up production,
  - South America aims to develop as a significant production hub

Source: skyNRG, 2024, Sustainable Aviation fuel market outlook

EU mandates blending volumes for SAF, in pink the sub-mandates for e-SAF



Visual by studio Gear Up, based on mandate information from 2023, EC, ReFuelEU Aviation (EU) 2023/2405

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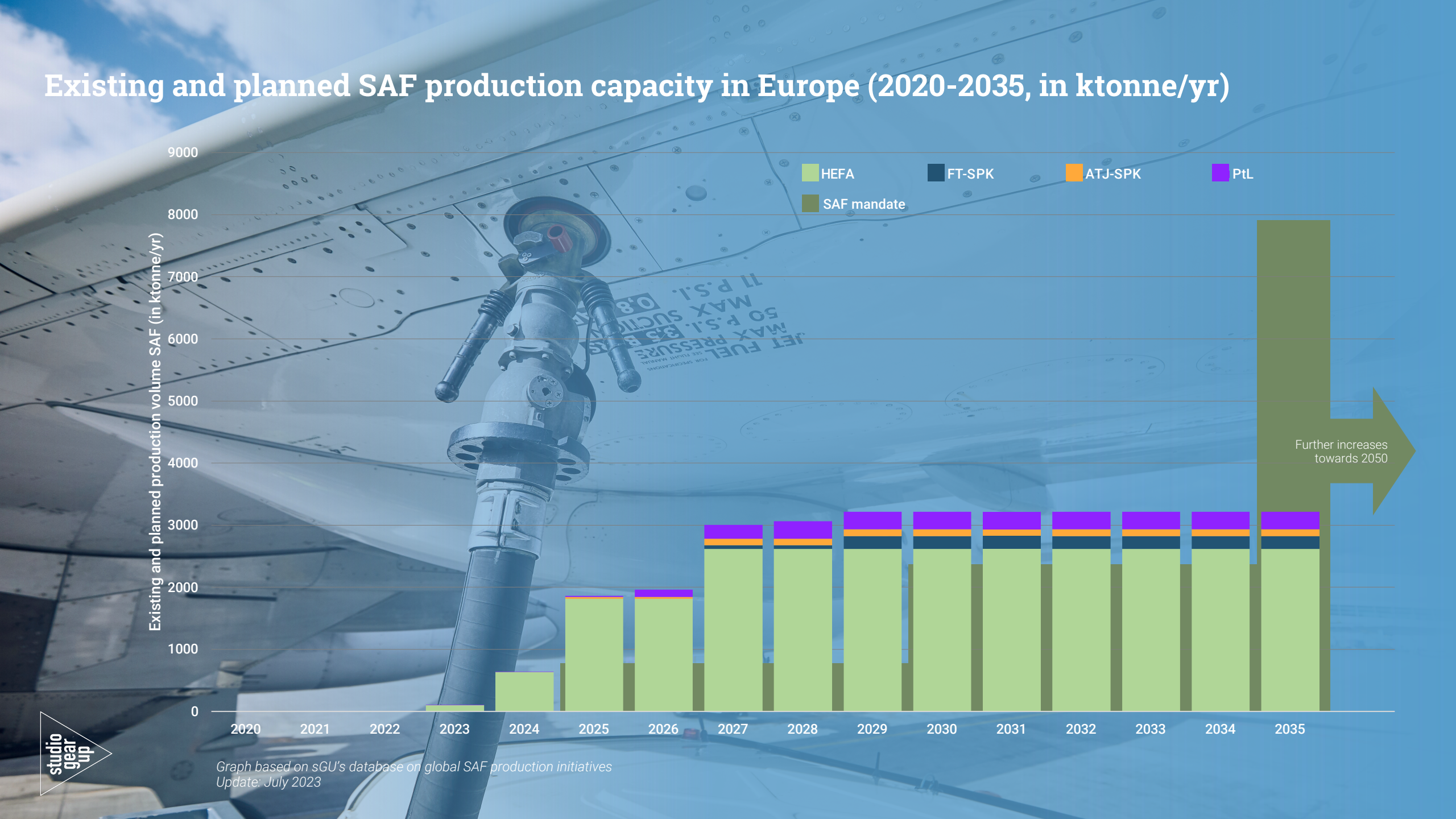
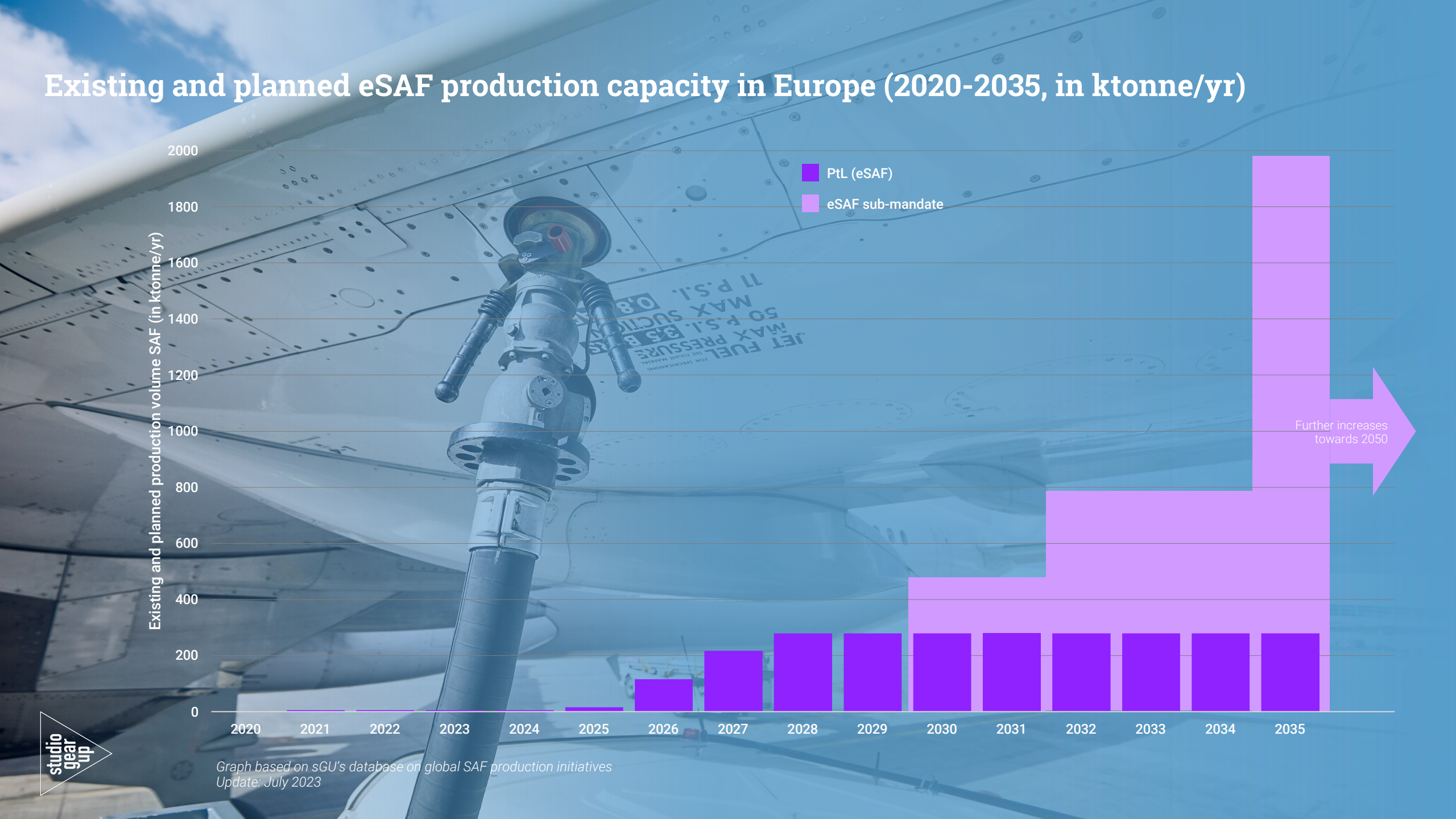
Existing and planned SAF production capacity in Europe (2020-2035, in ktonne/yr)



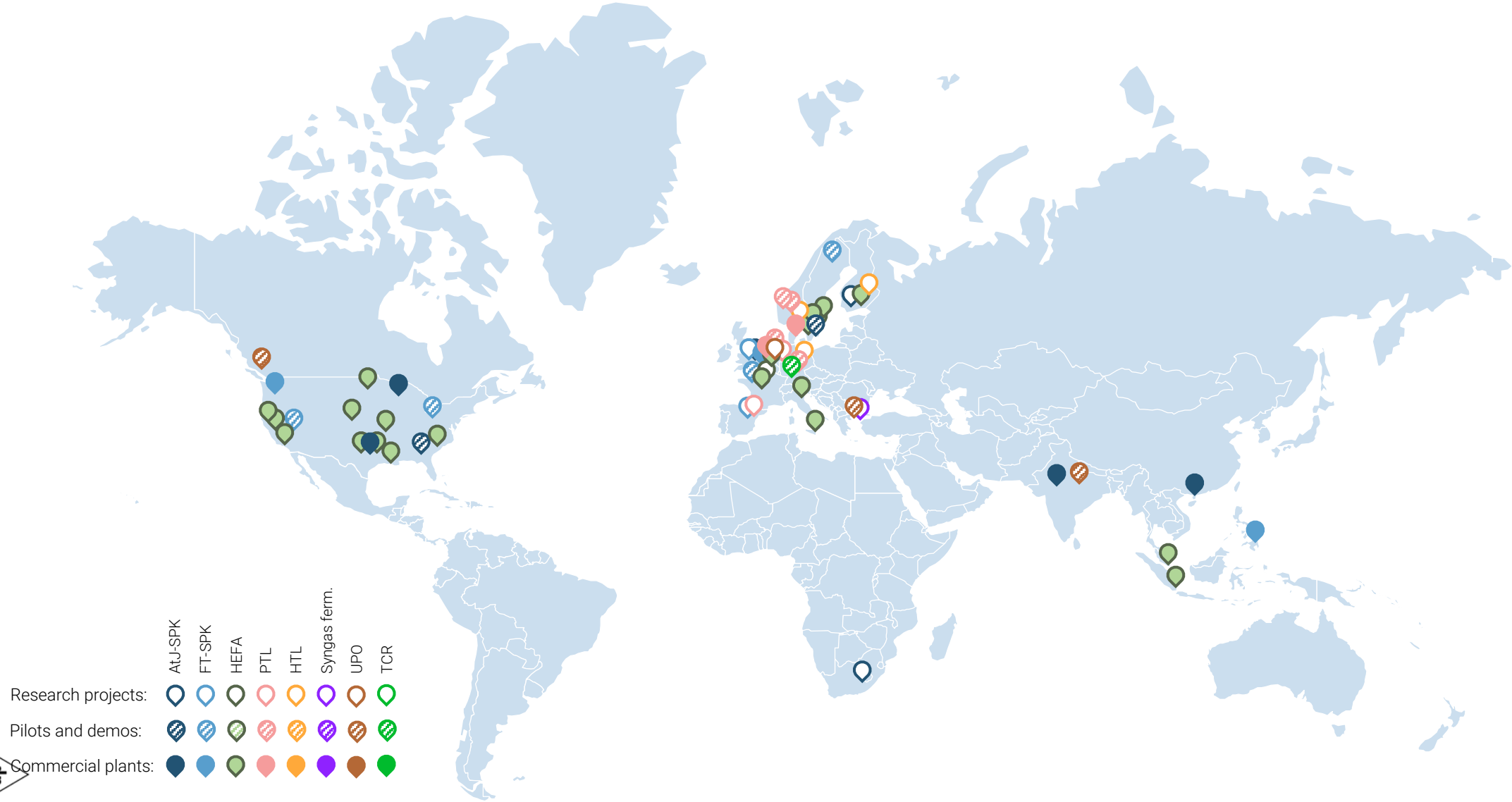
Graph based on sGU's database on global SAF production initiatives
Update: July 2023

Existing and planned eSAF production capacity in Europe (2020-2035, in ktonne/yr)



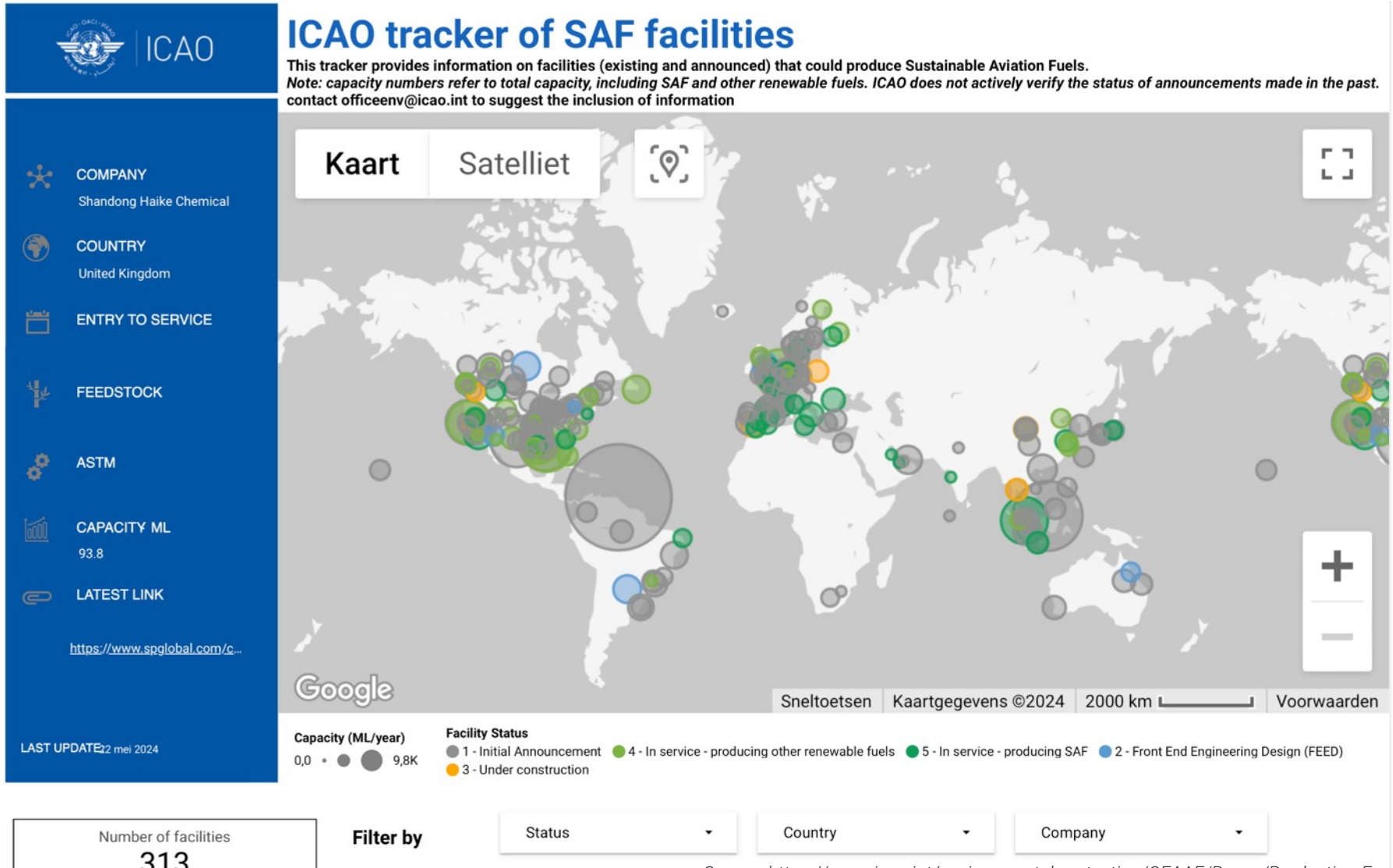
Graph based on sGU's database on global SAF production initiatives
Update: July 2023

Location of SAF projects worldwide (known to sGU, status 2021)
Research, pilot/demo and commercial (realised and announced)



Map created by studio Gear Up, based on public announcements on SAF projects, status april 2021

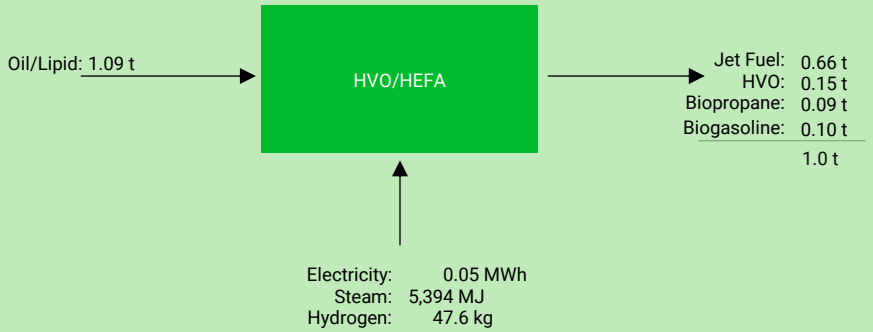
Overview of SAF plants – online map by ICAO
Commercial (realised and announced)



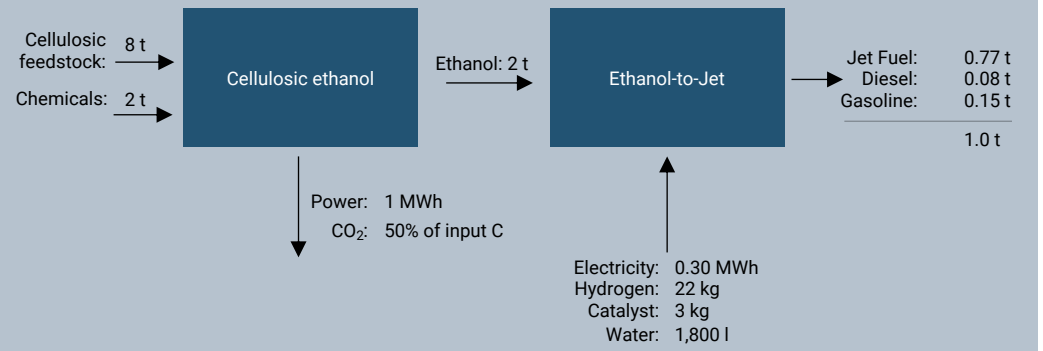
Source: https://www.icao.int/environmental-protection/GFAAF/Pages/Production-Facilities.aspx

Expected corresponding volume: 82 Mton

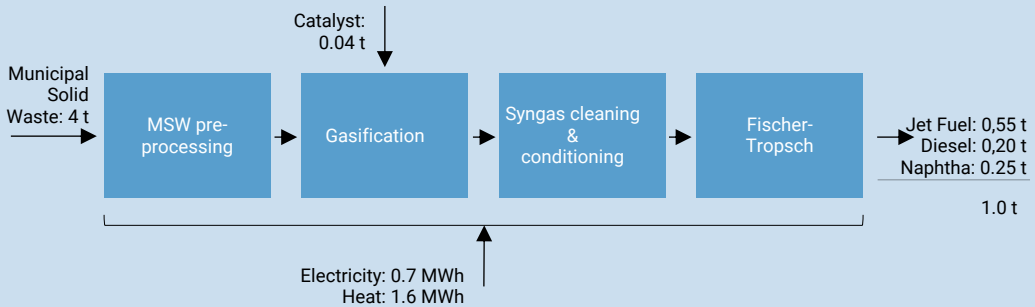
HEFA pathway



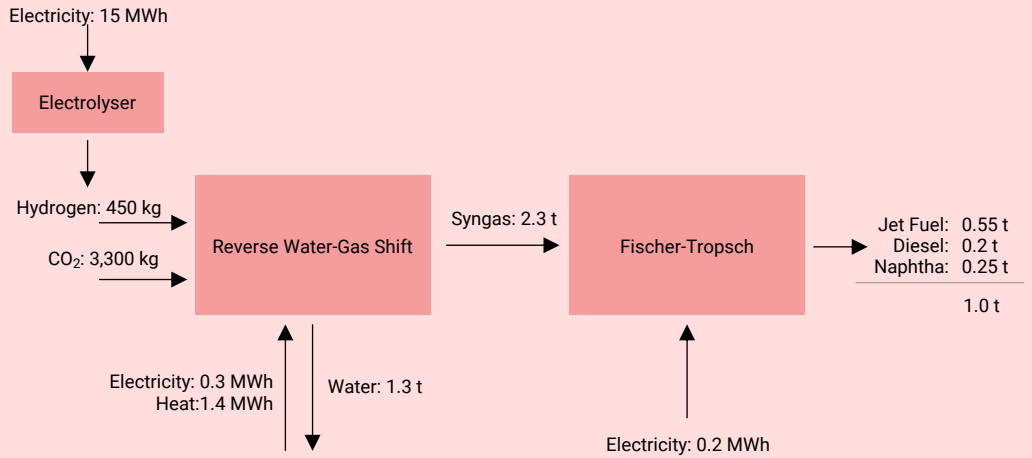
Alcohol to Jet pathway



Syngas-FT pathway

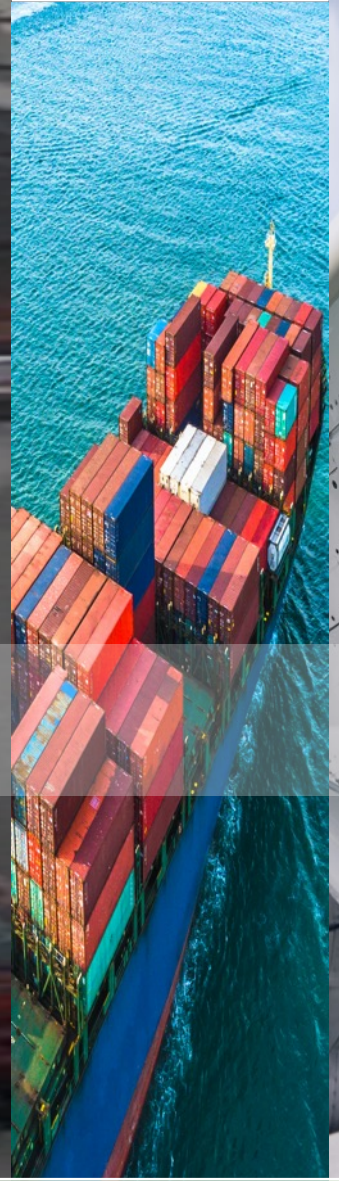


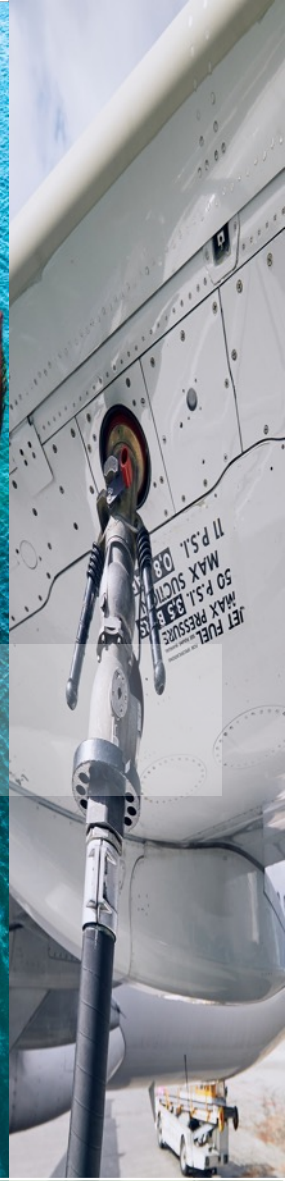
Power to Jet pathway



The information is based on a validation from studio Gear Up from project team experts, available industry information and public sources (a.o. McKinsey, 2020, ICCT, 2019). Graph produced for project for Innovation Quarter, 2020

Back to the 2030 targets in EU:





RED3 targets represent ~ 2700 PJ / ~65 Mtoe renewable energy

-6% GHG

6% SAF

Visual by studio Gear Up, data from EC regualtion and directive

2030 RED3 volume would be sufficient to supply the 2050 demands of RefuelEU Aviation and Fuel EU Maritime (~60 Mtoe)

RED3 targets represent ~ 2700 PJ / ~65 Mtoe renewable energy

Visual by studio Gear Up, data from EC regualtion and directive

Contact details

Eric van den Heuvel
eric.vandenheuvel@studiogearup.com
+31-6-83223098

studio Gear Up B.V.
Cruquiusweg 111A,
1019 AG Amsterdam
The Netherlands