



Sustainable Fuels for Aviation



Aviation Initiative for
Renewable Energy in Germany e.V.

Introducing aireg: Vision and goals

- Founded in 2011 as an association of companies and organizations from industry, research, and science
- Availability and use of renewable energies in aviation in order to achieve the aviation industry's ambitious CO₂ reduction targets



What does aireg stand for?

Reliable regulatory framework

Consistent commitment to European regulation, in particular the SAF mandates of the ReFuelEU Aviation Regulation, as a key instrument for supporting the market ramp-up of sustainable aviation fuels (SAF).

Ambitious target achievement

Exceeding the specified SAF mandates for climate protection reasons and to actively support the ICAO's international climate targets in the area of sustainable aviation fuels.

Strengthening incentive systems

Further development and expansion of market-effective support and incentive mechanisms for the broader use of SAF in German and European aviation.

Reliable and sustainable value creation

Establishment of import structures for hydrogen derivatives to Germany in order to fulfill SAF mandates, while ensuring that a significant portion of industrial value creation remains in Germany—with the aim of securing technological leadership and strengthening national energy and supply sovereignty.

62 Members



Aviation Initiative for
Renewable Energy in Germany e.V.

AIRBUS	AVI ALLIANCE	Aviation Fuel Projects Consulting GmbH & Co. KG	Bauhaus Luftfahrt Neue Wege.	BOEING	bp	Die Senatorin für Wirtschaft, Häfen und Transformation Freie Hansestadt Bremen	CAPHENIA Turning CO ₂ into fuel	CONTINENTAL AEROSPACE TECHNOLOGIES	CORTEVA agriscience
CYLAD	DEKRA	DEUTSCHE AIRCRAFT	LUFTHANSA GROUP	DHL Group	DLR	EDL PÖRNER GRUPPE	eFUEL Commitment to CO ₂ Neutrality	Emirates	ENERTRAG Eine Energie voraus
EY	ETERNAL POWER	BER BERLIN BRANDENBURG AIRPORT	Fraunhofer IBP	Greenlyte	GRIESEMANN GRUPPE	Hamburg Behörde für Wirtschaft und Innovation	HALTERMANN CARLESS	UHASSETT	HESSEN Hessen Ministry of Economic Affairs, Energy, Transportation, Housing and Rural Areas
HIF	THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學 DEPARTMENT OF LOGISTICS AND MARITIME STUDIES	HORVÁTH	INERATEC	ISCC International Sustainability & Carbon Certification	IVE INSTITUT FÜR UMWELTECHNIK UND ENERGIEWIRTSCHAFT	JÜLICH Forschungszentrum	KIT Karlsruher Institut für Technologie	KITE DYNAMICS	MB Energy Our energy, your way.
McKinsey & Company	MTU Aero Engines	M MUNICH AIRPORT	Niedersächsisches Ministerium für Umwelt, Energie und Klimaschutz	NESTE	OMV	PCK	PtX Lab LAUSITZ	pwc	BRAATHENS RENAVIA
ROLLS ROYCE	RWE	spark e-fuels	Stricker Weiken Hartmann & Co. KG	Synhelion	SYNTHECFUELS	TU BERGAKADEMIE FREIBERG PROFESSUR FÜR REAKTIONSTECHNIK	Thorsten Luft Consulting on Fuel Management and Sustainable Aviation Fuels	TotalEnergies	uni per
				WIWeB	ZAFFRA				

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Cooperation Agreements



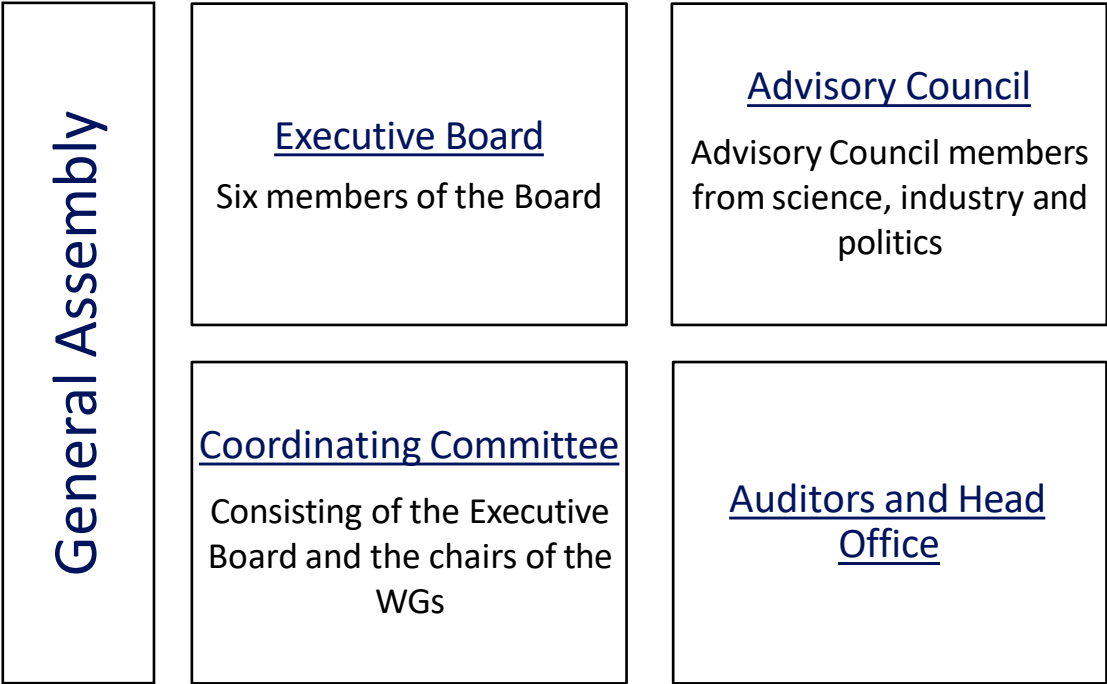
Memberships



- Strategy paper published for ILA 2024 – Germany as a leading market for sustainable aviation fuels (SAF)
- aireg sees itself as a competence network and open transformation platform whose members can be classified into four subject areas (Aviation; Fuel Producers; Research, Development & Consulting; Policy) and develop new approaches and innovative concepts for achieving the ambitious usage targets for SAF



Organizational Structure



Our Executive Board



Volker Ratzmann
Chairman of the Board



Prof. Dr.-Ing. Martin Kaltschmitt
Deputy Chairman of the Board



Uwe Gaudig
Deputy Chairman of the Board

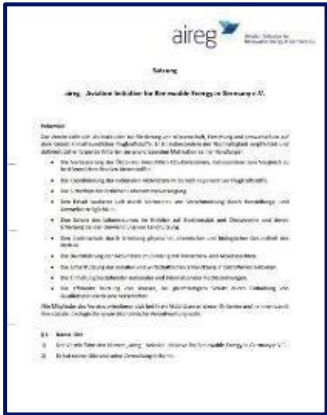


Prof. Dr.-Ing. Manfred Aigner
President for Science and Research



Prof. Dr. Jürgen Ringbeck
President for Industry and Aviation

Our Statutes



Working Groups and Task Force

Resources and Technology

Examine available feedstocks and production options for sustainable, renewable aviation fuels



Quality, Certification and Use

Practical use of sustainable, renewable aviation fuels and challenges of quality and certification

Sustainability

Considering all three pillars of sustainability – environment, social equity and economy – along the entire value chain



Task Force Economy and Production

Examination of economic aspects and potential production capacities of sustainable, regenerative aviation fuels

How does aireg work?

- **Network:** Our members cover the entire value chain for SAF. The office is happy to establish contacts for exchange purposes as needed.
- **airegNews:** Our weekly newsletter keeps our members up to date on everything related to SAF. Our SonderairegNews provides short-term information on current developments, such as draft legislation.
- **Events:** Biennial conference on SAF and participation in other high-profile industry gatherings (ILA, Aviation Evening, etc.)



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Climate Protection Plan of International Aviation in the face of major growth

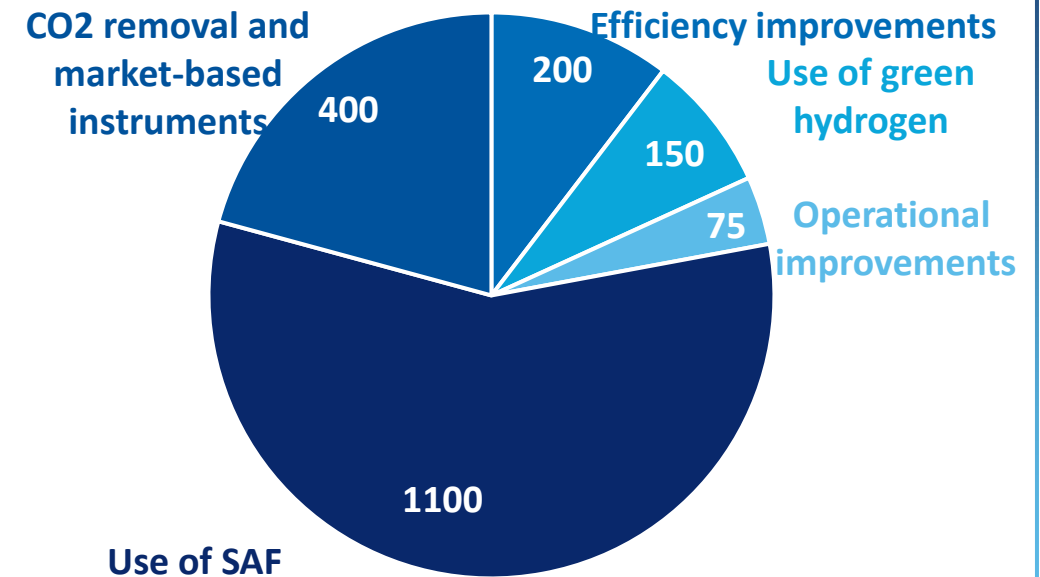
! Growth by 2050: ICAO expects revenue passenger kilometer (RPK) to double or even triple by 2050. !

→ At least doubling of the climate impact if no measures are taken.

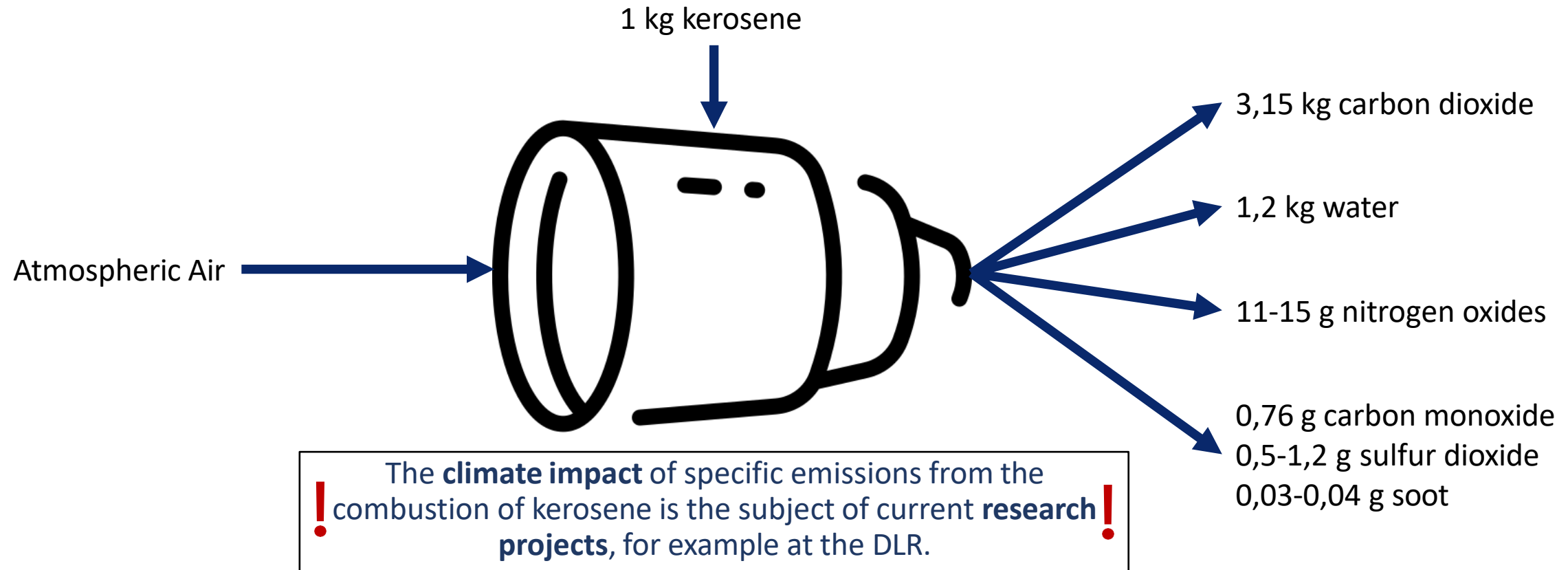
IATA has developed a net-zero scenario for global aviation in 2050. Renewable energies (SAF and green hydrogen) contribute 65% to the total reduction in emissions.

- **Use of SAF (57%):** IATA expects SAF to account for 80%–90% of fuel used by 2050.
- **CO2 removal and market-based instruments (21%):** DAC and offsetting create negative emissions.
- **Efficiency improvements (10%):** Modern aircraft and engines require less energy for their flights.
- **Use of green hydrogen (8%):** Green hydrogen is used on short- and medium-haul flights.
- **Operational improvements (4%):** Efficiency gains through investments in operations and infrastructure

IATA'S NET-ZERO SCENARIO FOR 2050



*Emissions reduction in megatons



Why SAF to reduce Climate Impact?



Lower GHG emissions

- Already up to 80% less GHG emissions with HEFA-SAF compared to fossil kerosene
- With electricity-based SAF potentially up to 100% CO₂ emission reduction



Reduction of non-CO₂ effects

- Result from the formation of soot particles and other climate-impacting substances
- SAF burns cleaner with reduced formation of particles



Lack of Alternatives

- Other climate-friendly propulsion systems (electric/hydrogen) will be available from 2040 at the earliest
- Duration of market ramp-up very high due to long service life of aircraft



Drop-in solution

- No adaption of engines and tank infrastructure necessary
- Commercially available and in use today
- Already approved in admixtures up to 50%

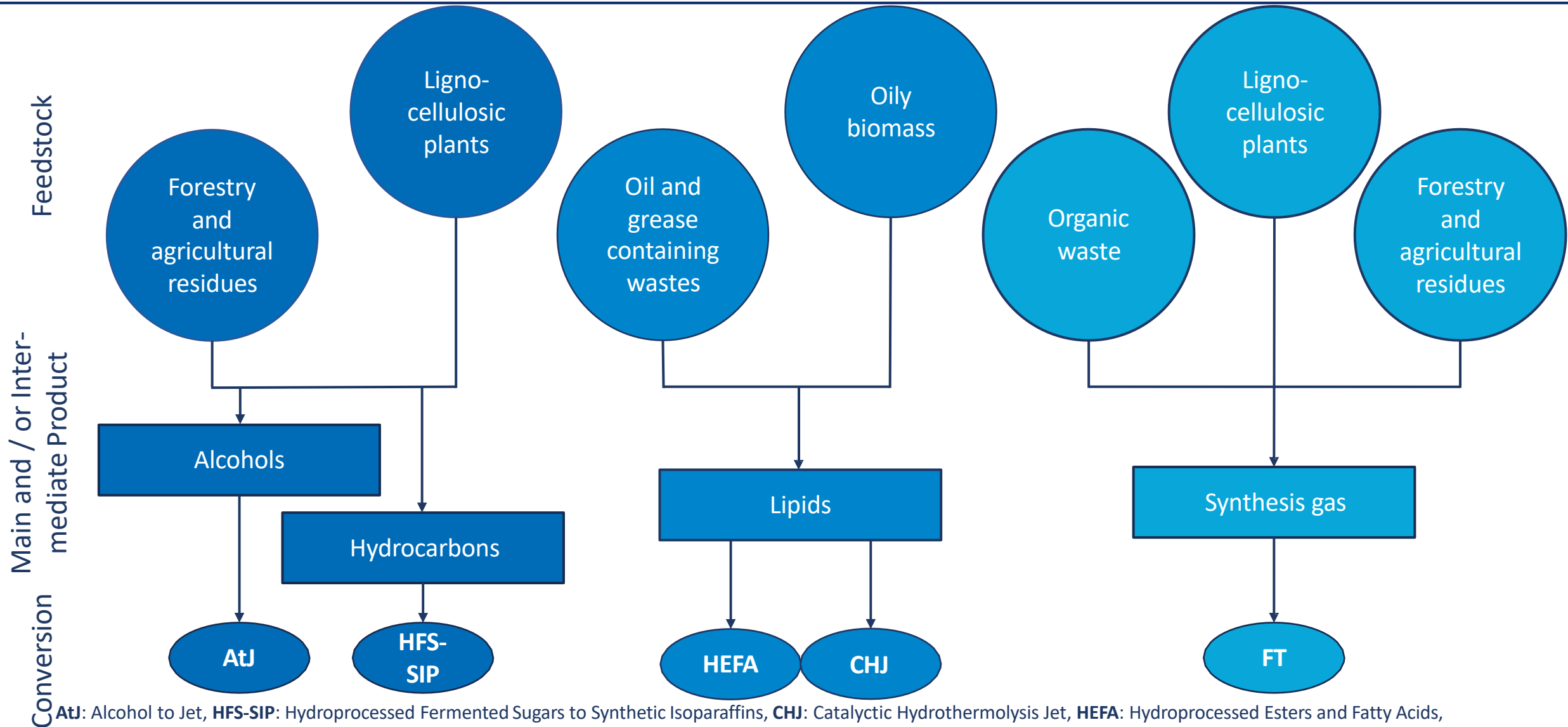
Overview of Approved SAF Options

ASTM	Annex	Year of Approval	Process	Blending Limit	Possible Feedstocks
D7566	1	2009	FT-SPK	50 Vol.-%	flexible (biogen, fossil, synthetic, e.g. PtL or BtL)
D7566	2	2011	HEFA-SPK	50 Vol.-%	fats/oils (e.g. plant-based oils, used cooking oils)
D7566	3	2014	HFS-SIP	10 Vol.-%	sugar, starch, lignocellulose
D7566	4	2015	FT-SPK/A	50 Vol.-%	flexible (biogen, fossil, synthetic, e.g. PtL or BtL)
D7566	5	2016	ATJ-SPK	50 Vol.-%	sugar, starch, lignocellulose
D7566	6	2020	CH-SK	50 Vol.-%	fats/oils (e.g. plant-based oils, used cooking oils)
D7566	7	2020	HC-HEFA-SPK	10 Vol.-%	fats/oils (algae oil)
D7566	8	2023	ATJ-SKA	50 Vol.-%	sugar, starch
D1655	1	2018	Co-Processing (HEFA-SPK)	30 Vol.-%	fats/oils (e.g. plant-based oils, used cooking oils)
D1655	1	2020	Co-Processing (FT-SPK, FT-SPK/A)	5 Vol.-%	FT-biocrude (primary feedstocks see FT-SPK, FT-SPK/A)
D1655	1	2023	Co-Processing (of HEFA)	24 Vol.-% (Feedstock) 10 Vol.-% (Product)	hydroprocessed biomass

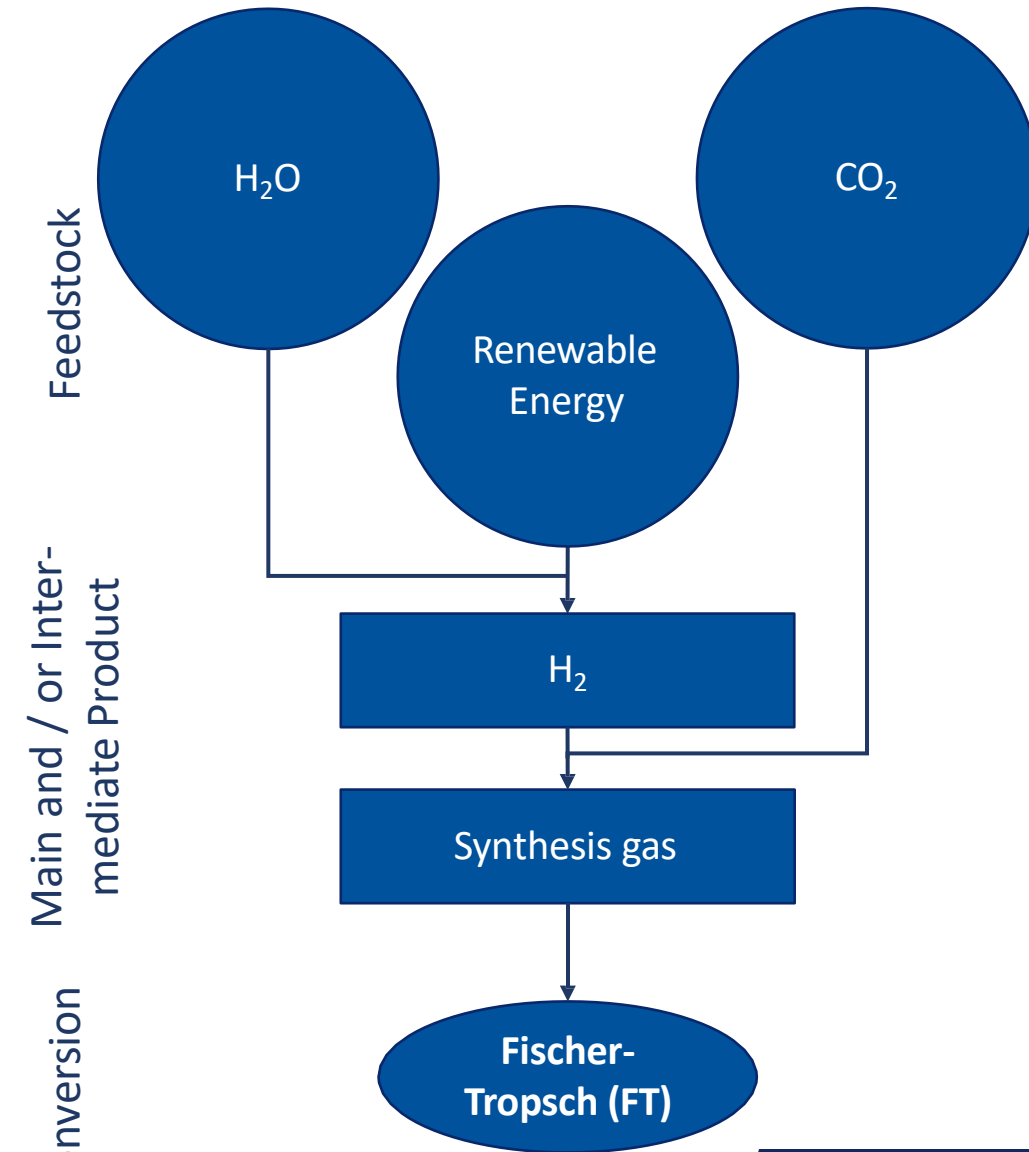
ATJ-SPK (Alcohol to Jet Synthetic Paraffinic Kerosene), **ATJ-SKA** (Alcohol to Jet Synthetic Paraffinic Kerosene with Aromatics), **CH-SK** (Catalytic Hydrothermolysis Synthesized Kerosene), **FT** (Fischer-Tropsch), **HC** (Hydrocarbons), **HEFA** (Hydroprocessed Esters and Fatty Acids), **HFS-SIP** (Hydroprocessed Fermented Sugars to Synthetic Isoparaffins), **PtL** (Power-to-Liquid), **SPK** (Synthetic Paraffinic Kerosene), **SPK/A** (Synthetic Paraffinic Kerosene with Aromatics)

In addition to **biogenic SAF** and **electricity-based SAF**, there is the option of combining these pathways. These SAF are called **hybrid SAF**.

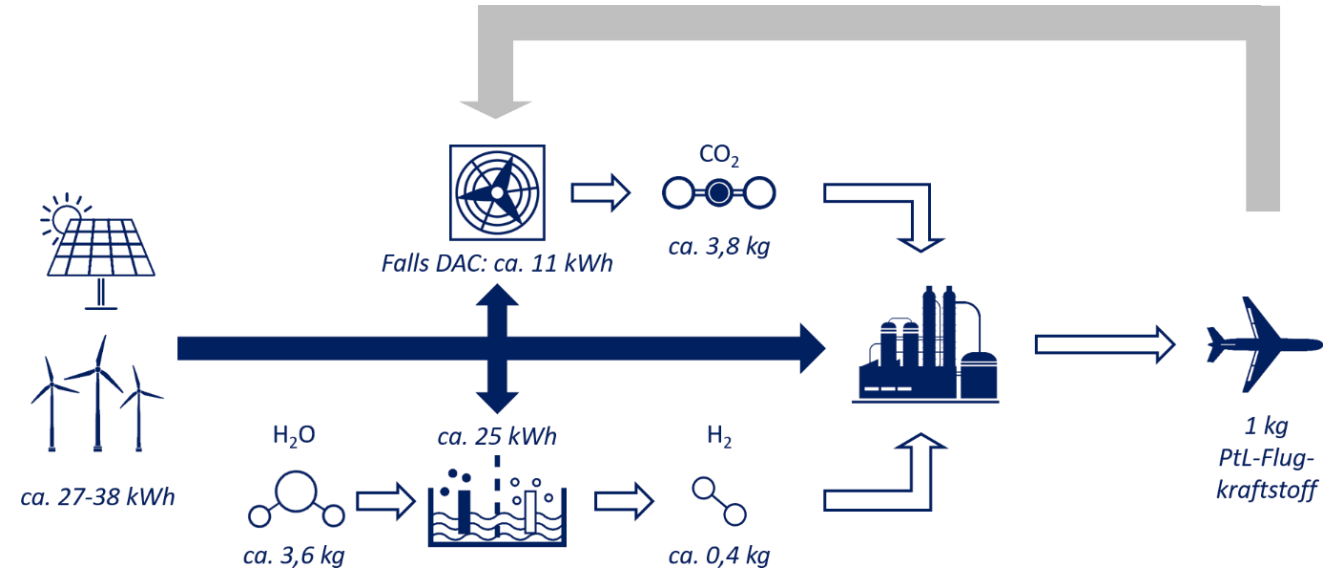
Biogenic SAF Production Pathways



Electricity-based SAF – Power to Liquid (PtL)



Quantitative overview of required feedstocks in the PtL production pathway:

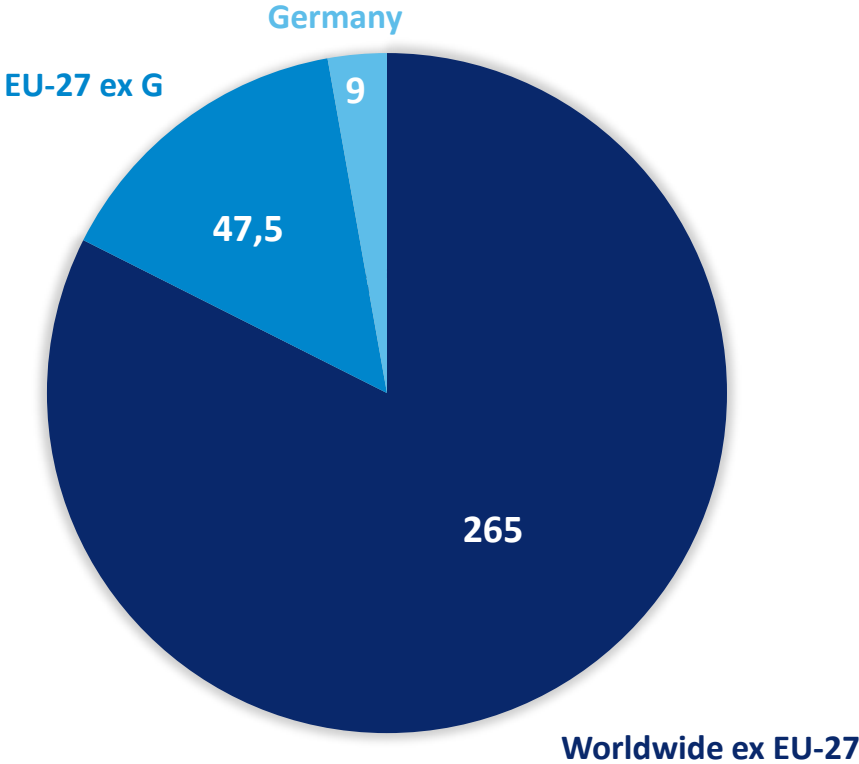


Feedstock required to operate all domestic German flights with PtL:

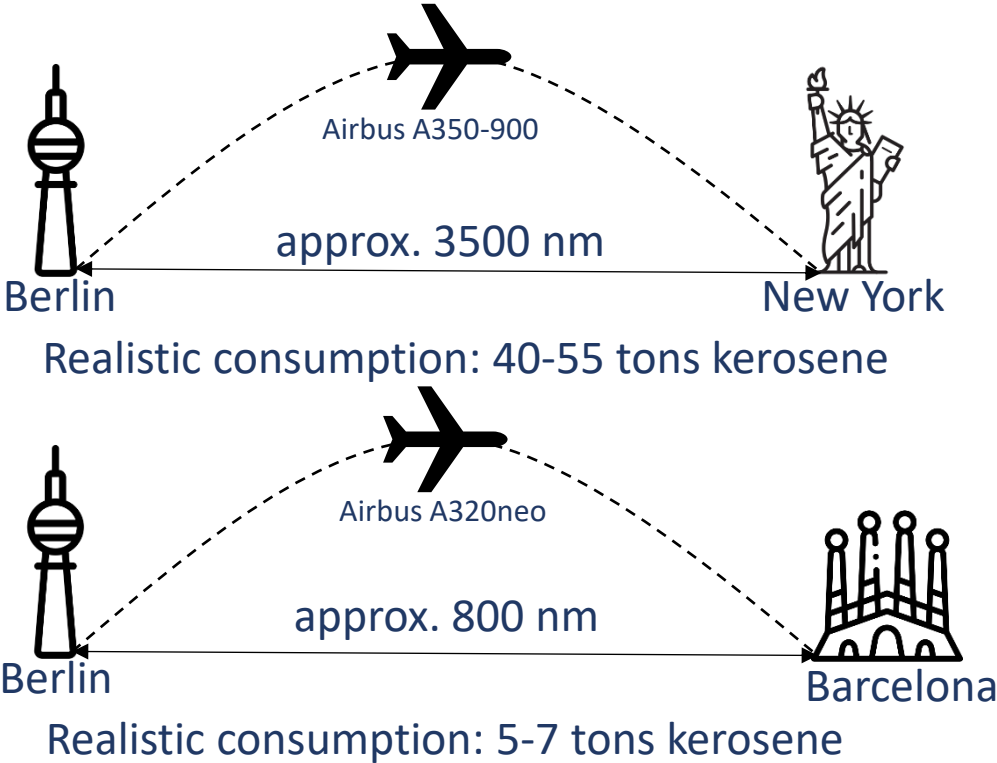
- Demand of about 700,000 tons of kerosene (comparison year 2019).
- At least 19,000 GWh of renewable energy -> 750 to 2,500 wind turbines
- 280,000 tons of hydrogen $\triangleq$ 9 TWh hydrogen -> 10% of Germany's hydrogen demand in 2030 according to hydrogen strategy of the Federal Government of Germany
- 2.7 million tons of biogenic CO₂ -> potential of CO₂ capture of approx. 13 million tons from biogas, biomethane and bioethanol production in Germany

Source: aireg e.V. / TUHH (2023): PtL Factsheet

GLOBAL KEROSENE CONSUMPTION IN
MILLIONS OF TONS IN 2024

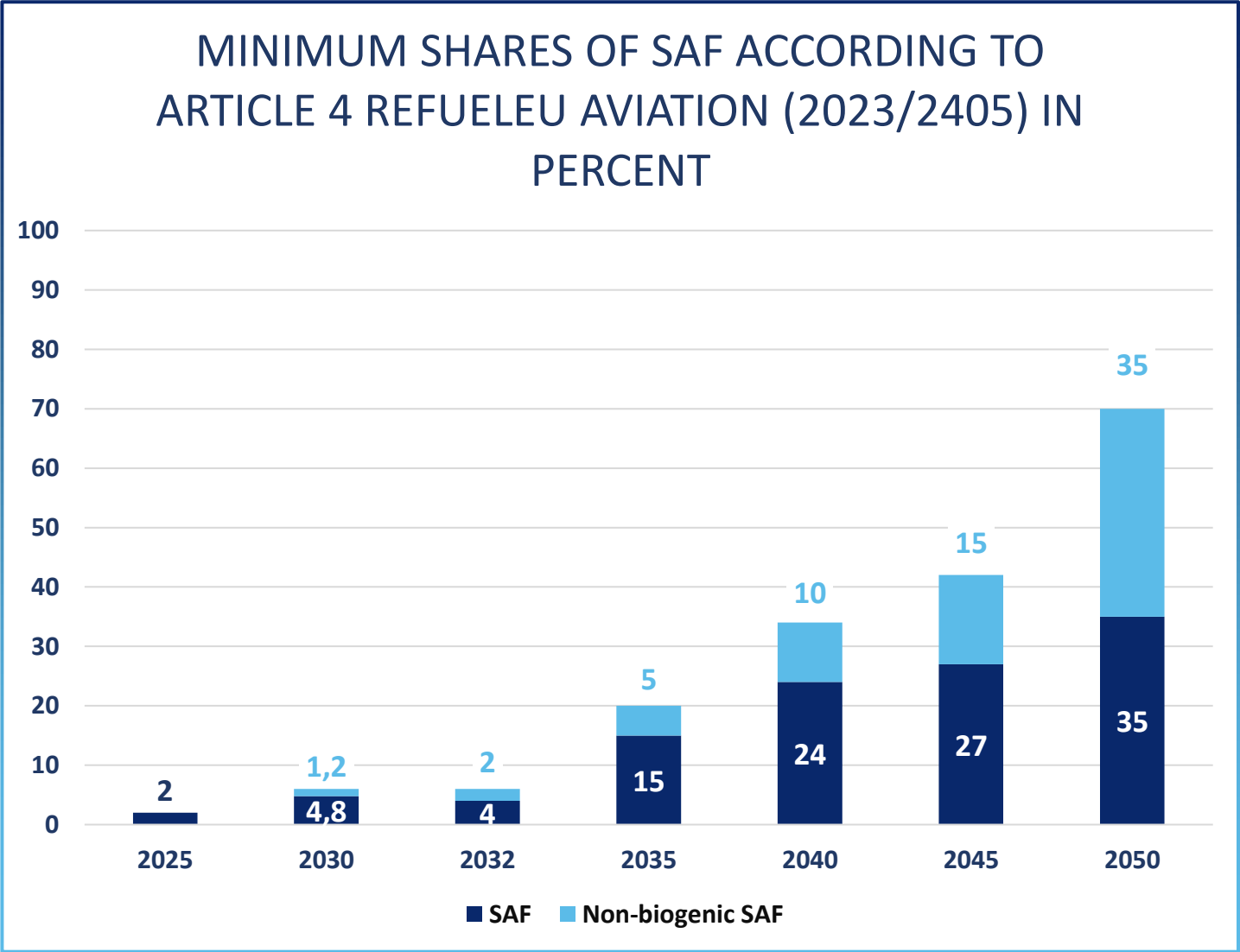


In 2024, German airlines achieved an average fuel consumption of 3.38 liters of kerosene per 100 passenger kilometers. To estimate the scale of individual flights, a number of realistic assumptions were made.

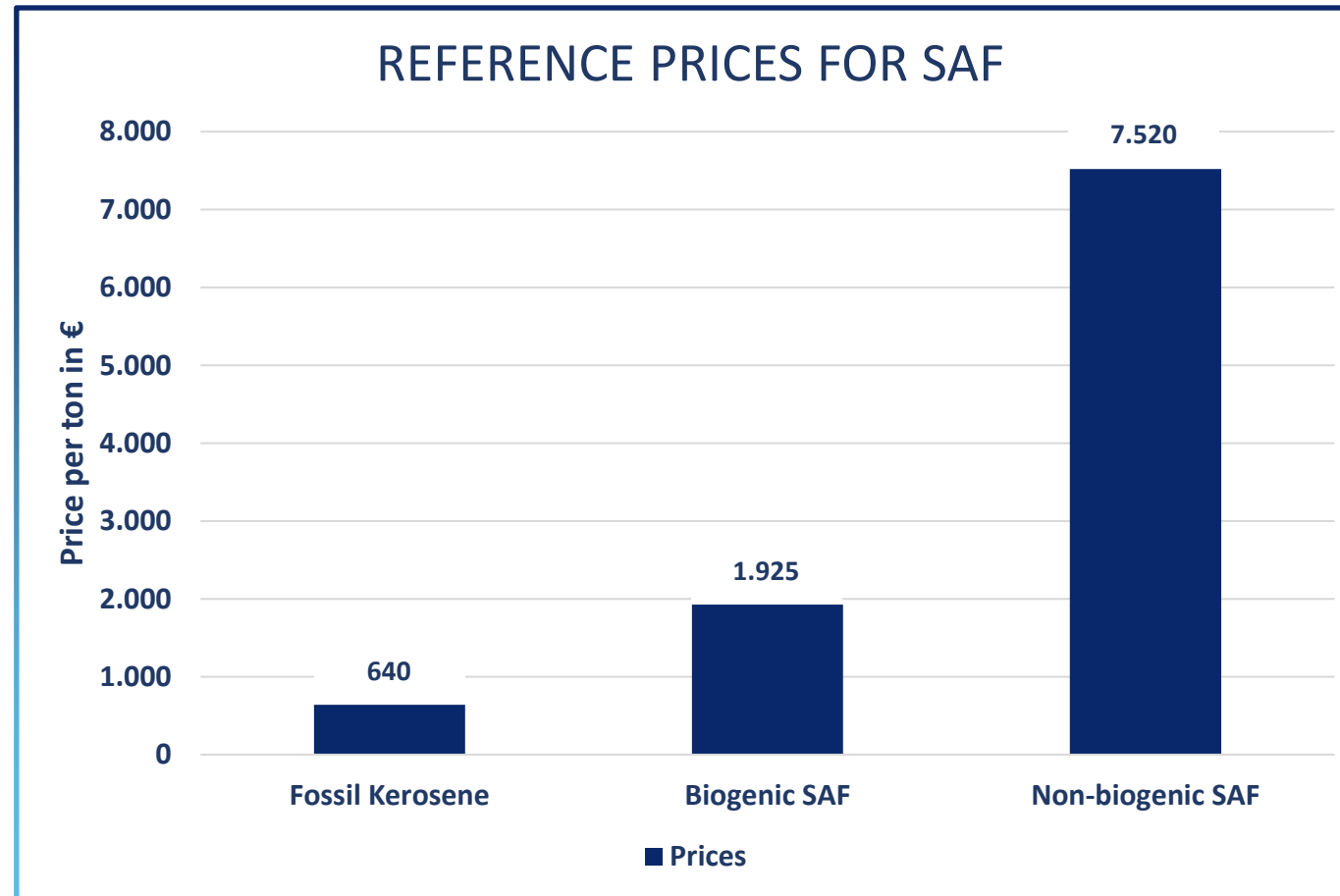


Sources: Statista - [Weltweiter Treibstoffverbrauch aller kommerziellen Fluggesellschaften von 2004 bis 2025](#)
EC – [Supply and transformation of oil and petroleum products](#)
BDL - [Kerosinverbrauch der deutschen Fluggesellschaften sinkt auf durchschnittlich 3,38 Liter pro Passagier und 100 Kilometer](#)

To stimulate the market ramp-up of SAF, the European Commission adopted the ReFuelEU Aviation regulation in 2023. Part of this initiative includes minimum quotas for distributors of aviation turbine fuel, which must be met from 2025 onwards. One percent corresponds to approximately 550,000 tons of aviation turbine fuel.

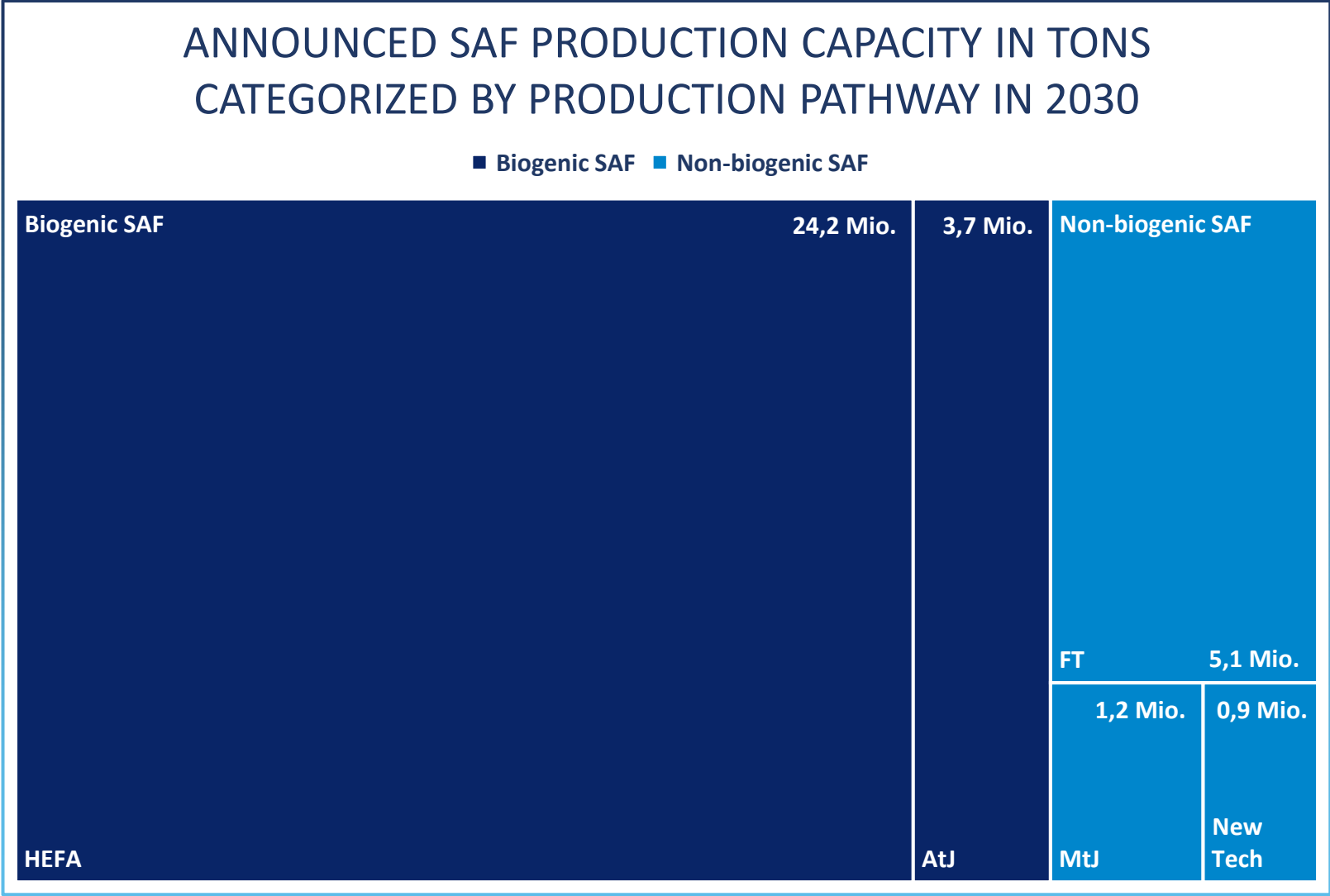


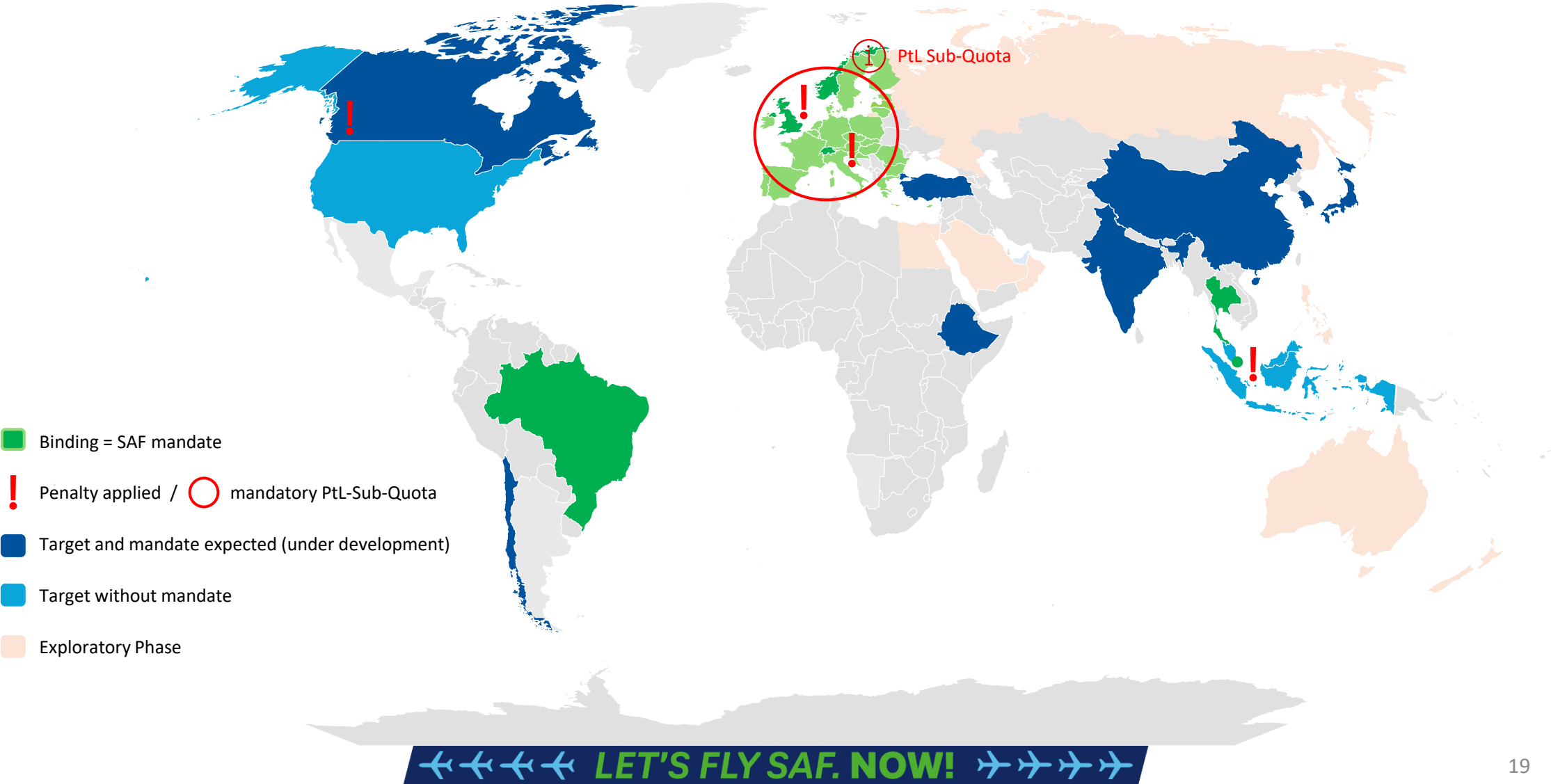
The reference prices (for SAF allowances/FEETS, among other things) are recorded annually in a report by EASA.



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In its annually updated
SAF Outlook, CENA
Hessen examines the SAF
production volumes
announced worldwide,
categorized here by
production pathway.







China | National SAF plan & mandate expected

- 50.000t SAF in 2025
- SAF blending mandate expected in 2026 with 15th 5-year plan: 2-5% in 2030
- China invests massively in production capacity
- Ambitious long-term targets expected



India | Target & Support

- 1% SAF target in 2027 on international flights; 5% in 2030
- Focus to attract SAF investments (especially ethanol feedstocks)



Thailand | SAF mandate & Support

- SAF mandate as a target from 2026
- 1% SAF in 2026; 1-2% in 2030; 8% in 2036
- Enforcement mechanisms



Singapore | SAF Levy

- SAF levy on tickets from 2026
- 1% in 2026; target 3-5% in 2030
-  Mandatory and penalties



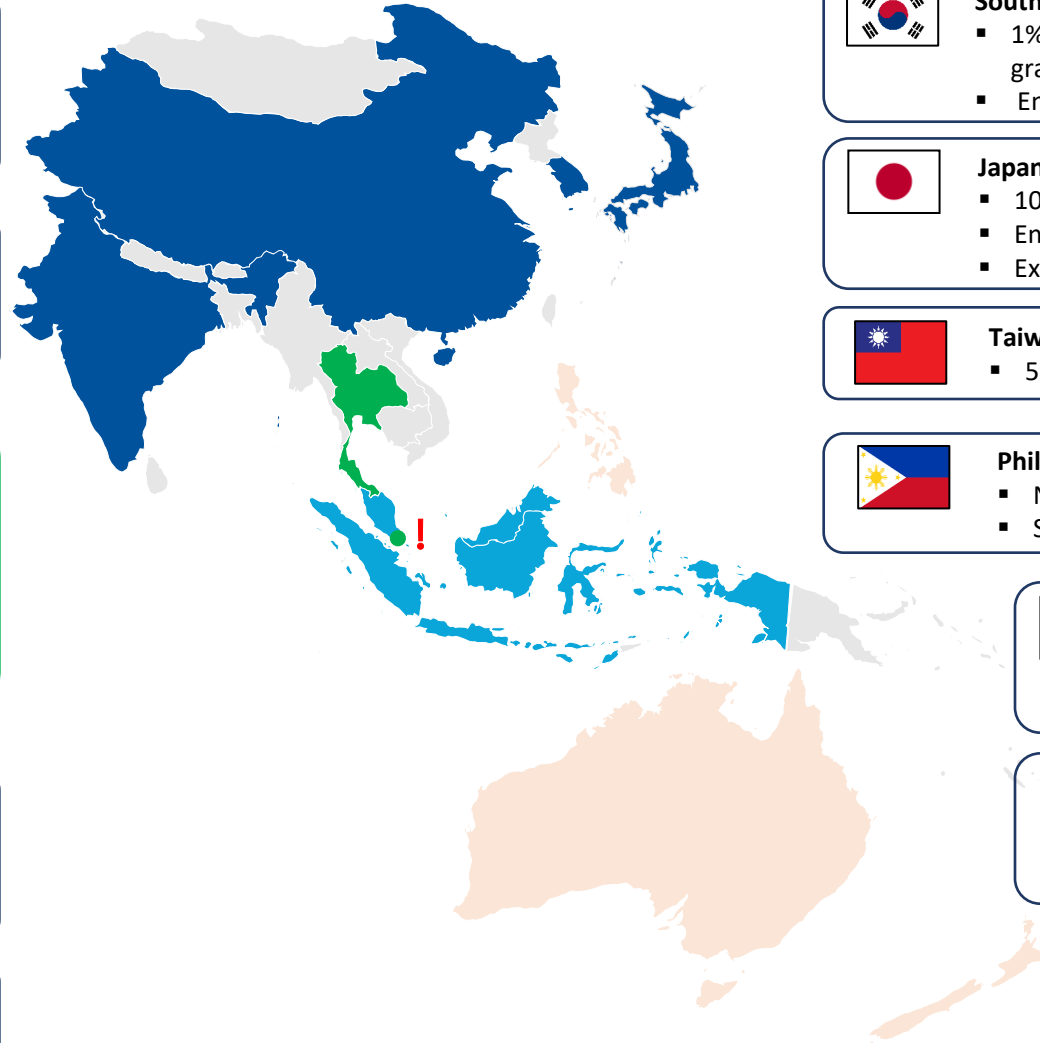
Australia | Exploratory Phase

- No binding SAF blending
- Focus on feasibility studies, domestic feedstocks, early offtakes and funding programs
- Government supports policy direction



New Zealand | Exploratory Phase

- No binding SAF blending
- Early policy discussions ongoing



South Korea | Target & mandate expected

- 1% SAF target in 2027 on international flights; gradual increase
- Enforcement and penalties under development



Japan | Target & mandate expected

- 10% SAF target by 2030
- Enforcement and reporting under development
- Expected scope domestic and international flights



Taiwan | Target

- 5% SAF target in 2030



Philippines | Exploratory Phase

- No binding SAF blending
- SAF policy framework and feedstock studies underway



Indonesia | Target & Roadmap

- 1% SAF target by 2027; 2.5% in 2030
- National SAF roadmap sets blending goals
- Implementation details pending



Malaysia | Target & Framework

- 1% SAF target by 2027; 47% in 2050
- Consultation stage
- Scaling tied to domestic biofuel roadmap



Turkiye | Target & mandate expected

- 1% SAF target in 2025; 5% by 2030 on international flights
- Target included In national decarbonisation roadmap and aviation GHG reduction plan
- Formal regulatory text pending



Israel | Exploratory Phase & Development

- No binding SAF blending
- Active development of a SAF-strategy targeting net-zero aviation in 2050
- Plans to implement a SAF blending mandate



Egypt | Exploratory Phase & Support

- No binding SAF blending
- Focus on developing SAF production capabilities and to align with international environmental standards



Russia | Exploratory Phase & Development

- No binding SAF blending
- Focus on SAF production development
- Russia has committed to a general national goal of net-zero GHG in 2060



UAE | Target & Support

- Voluntary 1% SAF blending target
- Production target of 700 mio. liters SAF annually by 2030
- Focus on SAF production support and PtL-pilot plants



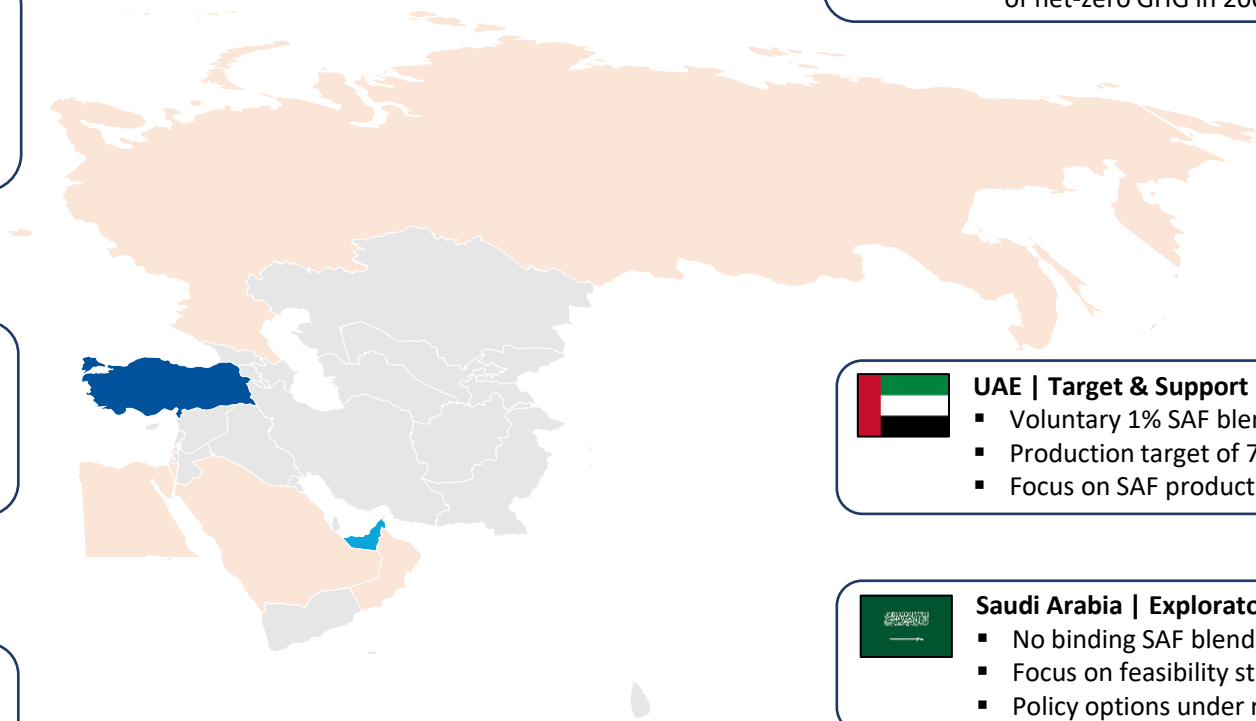
Saudi Arabia | Exploratory Phase

- No binding SAF blending
- Focus on feasibility studies and funding programs
- Policy options under review



Oman | Exploratory Phase

- No binding SAF blending
- Focus on R&D studies and renewable hydrogen projects





Canada | Target & Support

- No binding SAF blending
- Aspirational use goal of 10% in 2030
- SAF usage generates credits under the Clean Fuel Regulations



British Columbia | SAF Blending mandate

- Continents first provincial SAF mandate rule
- 1% by 2028; target 3% by 2030
-  Mandatory and penalties



Chile | Target & Roadmap

- No binding SAF blending
- National SAF roadmap sets blending targets
- 50% target by 2050
- Policy focus on PtL-production from domestic renewable hydrogen



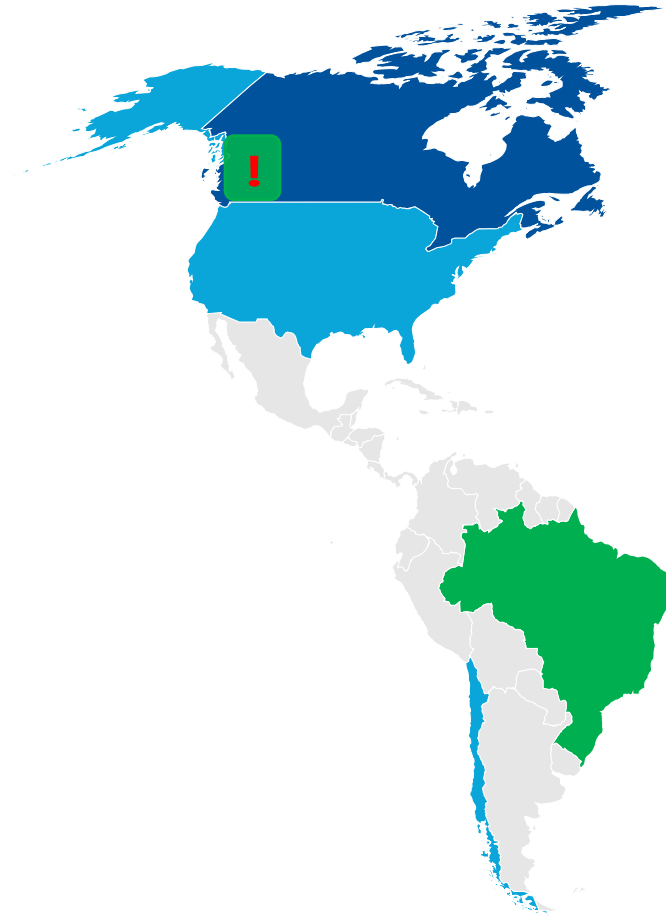
United States | Incentive lead growth

- No binding SAF blending
- 1.25-1.75 \$/gal. SAF tax credit under Inflation Reduction Act
- State Low Carbon Fuel Standards (e.g. California) reward SAF use
- Federal goal of 10% SAF by 2030 remains voluntary



Brazil | SAF Blending mandate

- GHG mandate / SAF mandate from 2027
- 1% in 2027; 10% in 2037
- Allowance for a book-and-claim system





UK | SAF Blending mandate

- SAF blending mandate
- 2% SAF in 2025, 10% in 2030 and 22% in 2040
- Additional PtL quota starting in 2028 with 0.2%; 4.5% in 2040
- Mandatory and penalties: buy-out-mechanisms



EU | SAF Blending mandate

- SAF blending mandate (ReFuelEU Aviation)
- 2% SAF in 2025, 6% in 2030 and 70% in 2050
- Additional PtL/eFuel subquota starting in 2030 with 1.2%; 35% in 2050
- Mandatory and penalties: no buy-out-mechanisms; shortfall must be compensated in the next year



Switzerland | SAF Blending mandate

- SAF blending mandate
- Adoption and Integration of ReFuelEU Aviation regulations into Swiss legislation from 2025
- 2% SAF in 2026
- Mandatory and penalties



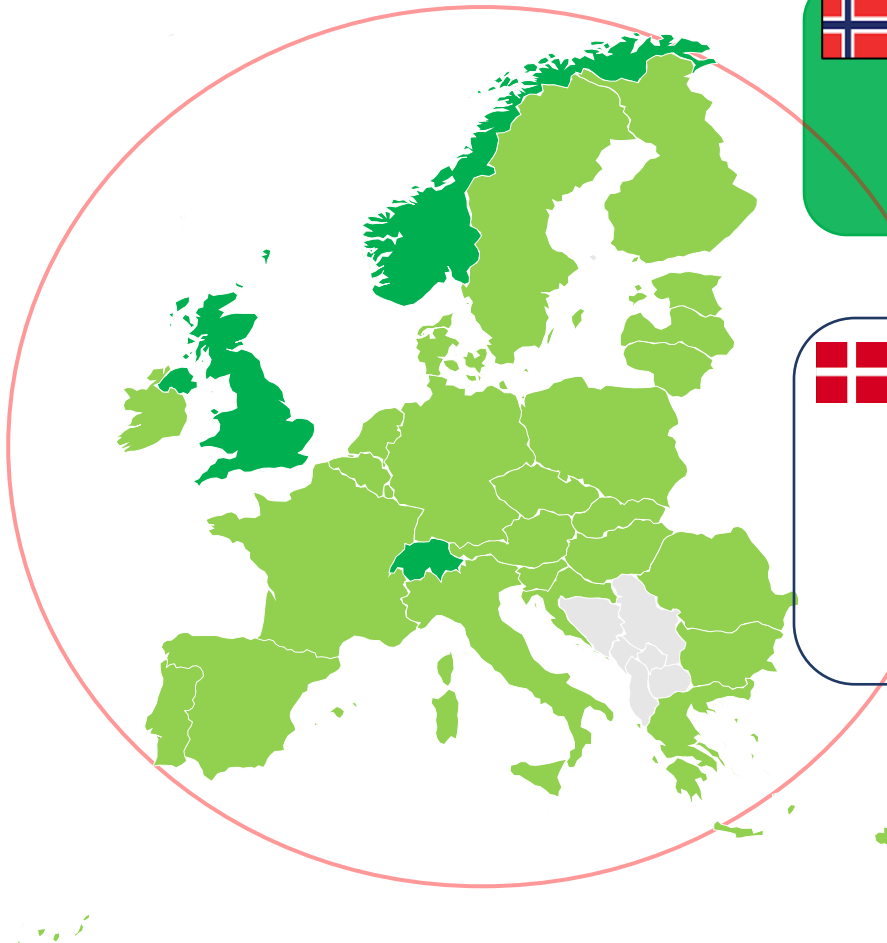
Norway | SAF Blending mandate

- SAF blending mandate
- Since 2020 national SAF quota of 0.5%
- Since 2025: Integration in ReFuelEU Aviation blending mandate and quotas; full integration planned in 2027 with 2% SAF quota
- Mandatory and penalties



Denmark | additional domestic SAF incentive scheme

- Additional domestic SAF incentive scheme
- 2025-2027 national SAF blend support of one domestic route with 40% SAF blend, targeting 20 weekly one way flights
- Funding by European Union (36 million Euros) to cover the cost difference between conventional kerosene and SAF
- Purpose to accelerate SAF usage beyond the EU SAF blending mandate



mandatory PtL-Sub-Quota

Thank you for your attention!



Aviation Initiative for
Renewable Energy in Germany e.V.

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