



Sustainable Fuels for Aviation



Aviation Initiative for
Renewable Energy in Germany e.V.

Our Goals for 2030



Research & Development

Constructing and operating of a **PtL research, technology and demonstration platform** in Germany



Beginning Industrialization

Operation of at least one **commercial SAF production plant** in Germany



SAF-Rates

Rates for sustainable, regenerative aviation fuels

2026: 2 %



2028: 5 %



2030: 10 %

64 Members and Strong Partners



Aviation Initiative for
Renewable Energy in Germany e.V.

AIRBUS	ARNECKE SIBETH DABELSTEIN	Austro Engine	AVIALLIANCE	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	CAC CAC ENGINEERING GMBH	CONTINENTAL AEROSPACE TECHNOLOGIES	DEKRA	DEUTSCHE AIRCRAFT		DHL Group
DLR	EDL PÖRNER GRUPPE	Emirates	ENERTRAG Eine Energie voraus	ETERNAL POWER	BER BERLIN BRANDENBURG AIRPORT	Fraunhofer IBP	Greenlyte
GRIESEMANN	H2FLY	Hamburg Behörde für Wirtschaft und Innovation	H-C-S GROUP	HESSEN Hessisches Ministerium für Wirtschaft, Energie, Verkehr, Wohnen und ländlichen Raum	HH-2E	HIF	THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大学 DEPARTMENT OF LOGISTICS AND MARITIME STUDIES
HORVÁTH	hynamics EDF GROUP	ISCC International Sustainability & Carbon Certification	Institute of Environmental Technology and Energy Economics IVE	JATRO GREEN Sustainable Energy, Madagascar	JÜLICH Forschungszentrum	KIT Karlsruher Institut für Technologie	Catalysis Leibniz-Institut für Katalyse LIKAT
MABANAFT	McKinsey & Company	MTU Aero Engines	M / Flughafen München	Niedersächsisches Ministerium für Umwelt, Energie und Klimaschutz	NESTE	norsk e-fuel	OCEANERGY
OMV	PCK	PtXLab LAUSITZ	pwc	ROLLS ROYCE	RWE	sasol ecoFT	SH Schleswig-Holstein Ministerium für Wirtschaft, Arbeit, Verkehr und Technologie
SIEMENS energy	spark e-fuels	SYNTHECFUELS	PROFESSUR FÜR REAKTIONSTECHNIK	Thorsten Luft Beratung für Treibstoffmanagement und Sustainable Aviation Fuels	TotalEnergies	uni per	WIWeB

Cooperation Agreements

CAAFI FUELING SOLUTIONS FOR SECURE & SUSTAINABLE AVIATION	en2x
IATA	impact ON SUSTAINABLE AVIATION

Memberships

European Climate Foundation	RLCF Alliance
ICAO • OACI • HKAO 国际民航组织 • 国际民航组织	

Organizational Structure

General Assembly

Executive Board

Six members of the Board

Advisory Council

Advisory Council members from science, industry and politics

Coordinating Committee

Consisting of the Executive Board and the chairs of the WGs

Auditors and Head Office

Working Groups and Task Force

Resources and Technologies



Sustainability



Quality, Certification and Use



Task-Force Economy and Production



Our Executive Board



Siegfried Knecht
Chairman of the Board



Uwe Gaudig
Deputy Chairman of the Board



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



Melanie Form
Member of the Board
Managing Director

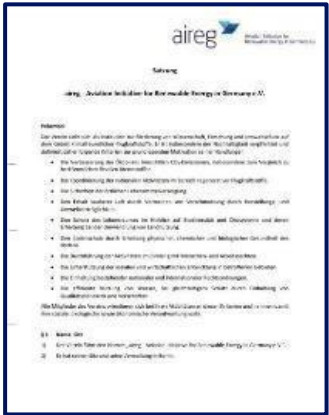


Prof. Dr.-Ing. Manfred Aigner
President Science and Research



Prof. Dr. Jürgen Ringbeck
President 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

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

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

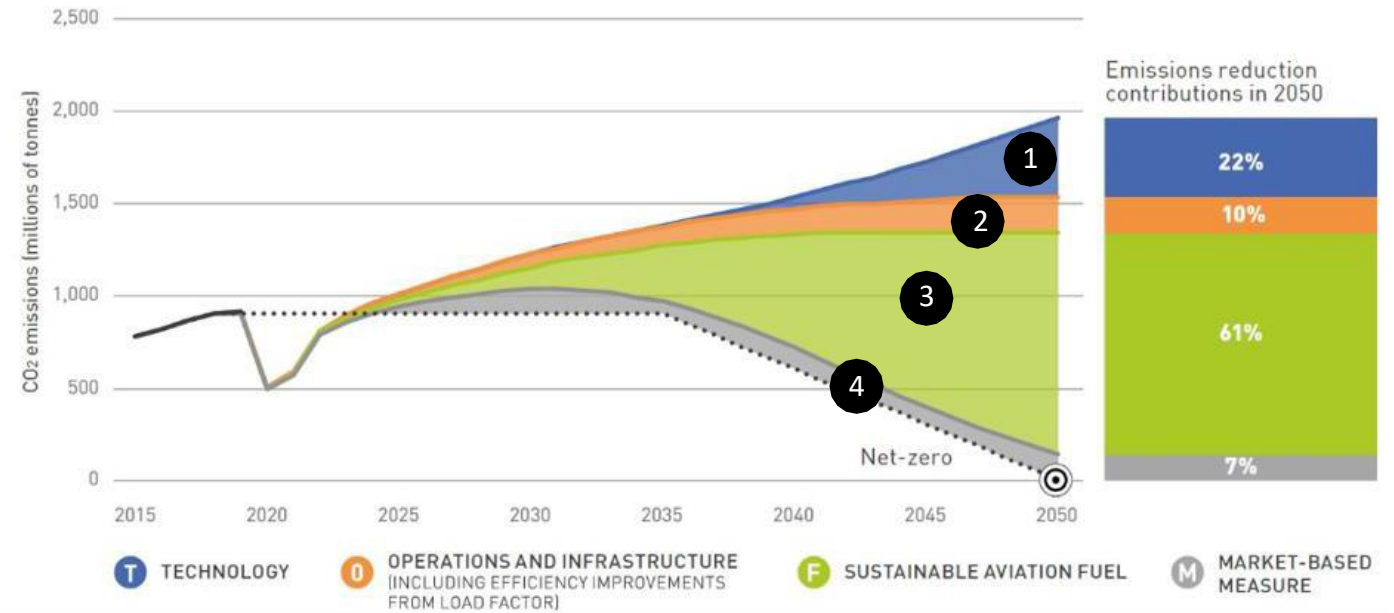
→ At least doubling of the climate impact if no measures are taken. !

1. Technology: Technological improvements and the use of aircraft with hybrid and electric propulsion primarily on short-haul routes from 2035 to 2040.

2. Operations and Infrastructure: Significant investments in the efficiency of operations and infrastructure.

3. SAF: The largest contribution is to be made by sustainable aviation fuels. In 2050, 90% of fuel is to be replaced by SAF, which saves 100% emissions respectively.

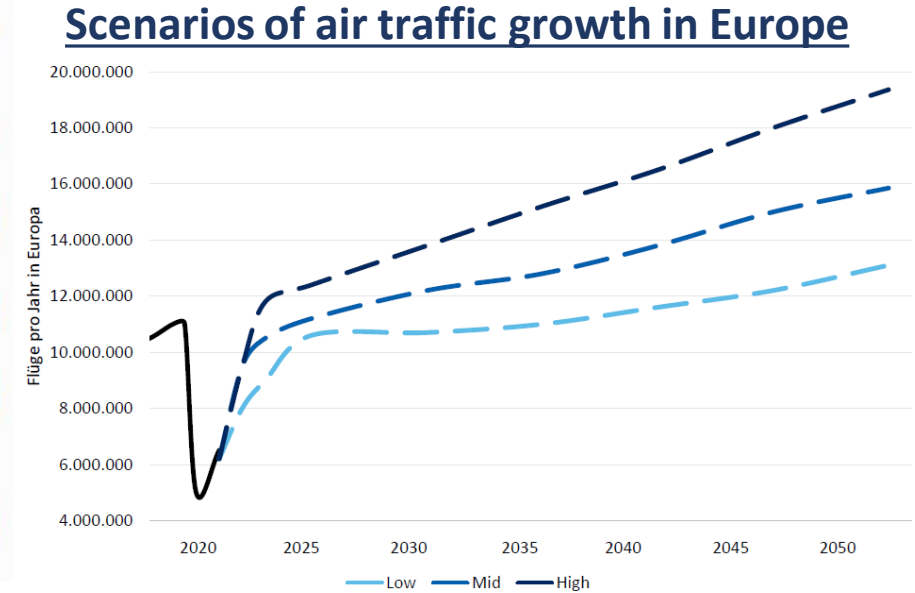
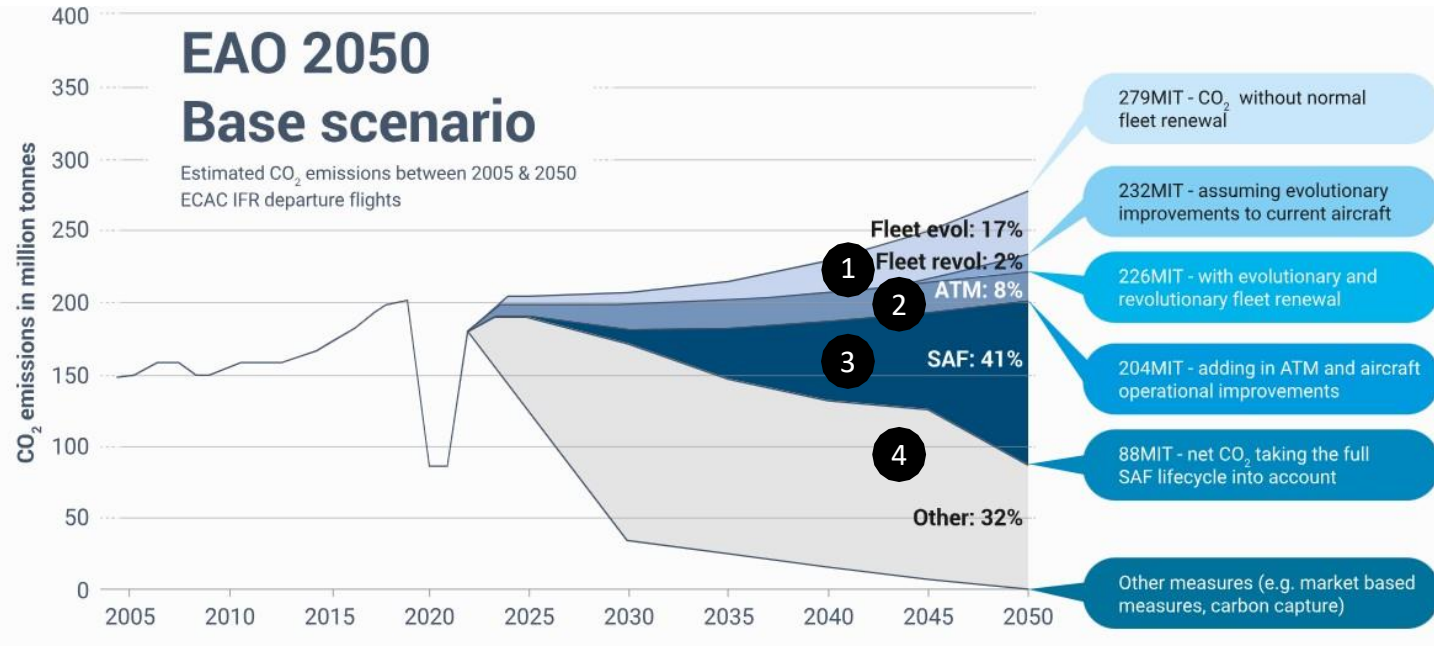
Possible route to climate neutrality by 2050 from the perspective of the aviation industry:



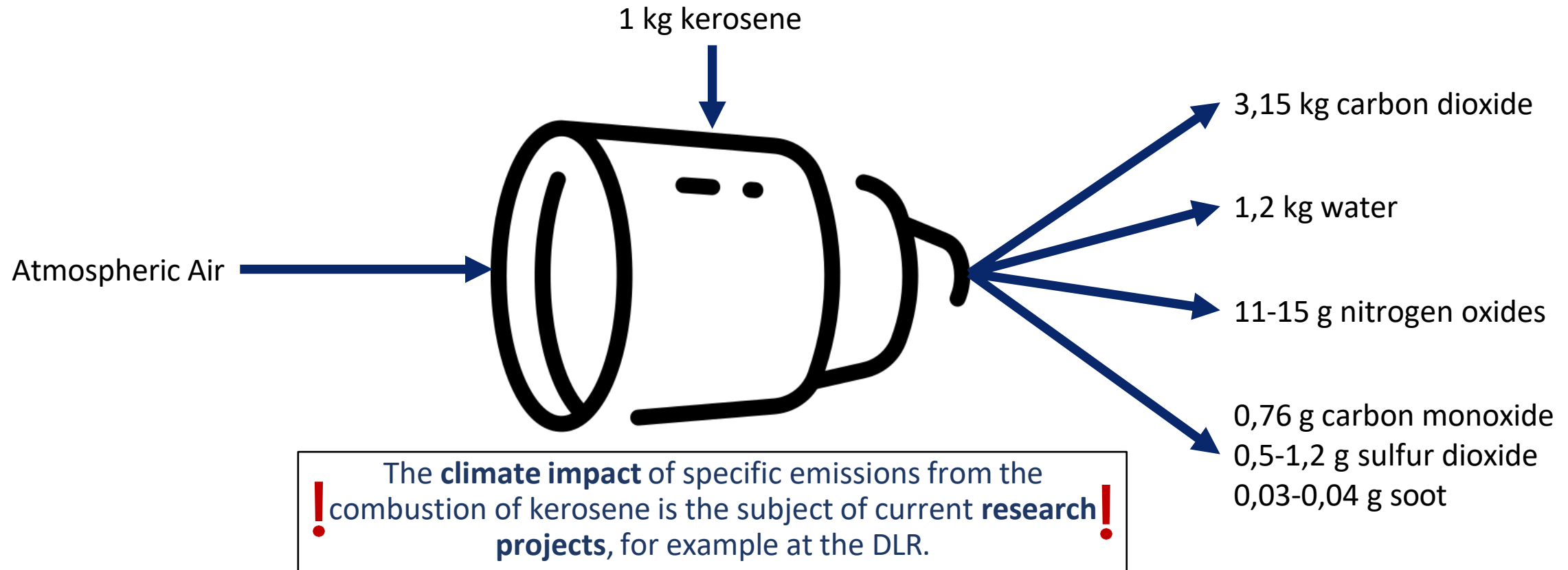
Proportions of different measures on the way to climate neutrality in aviation

4. Market-based measures: Emissions not prevented by the previous three areas are offset through compensatory measures.

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

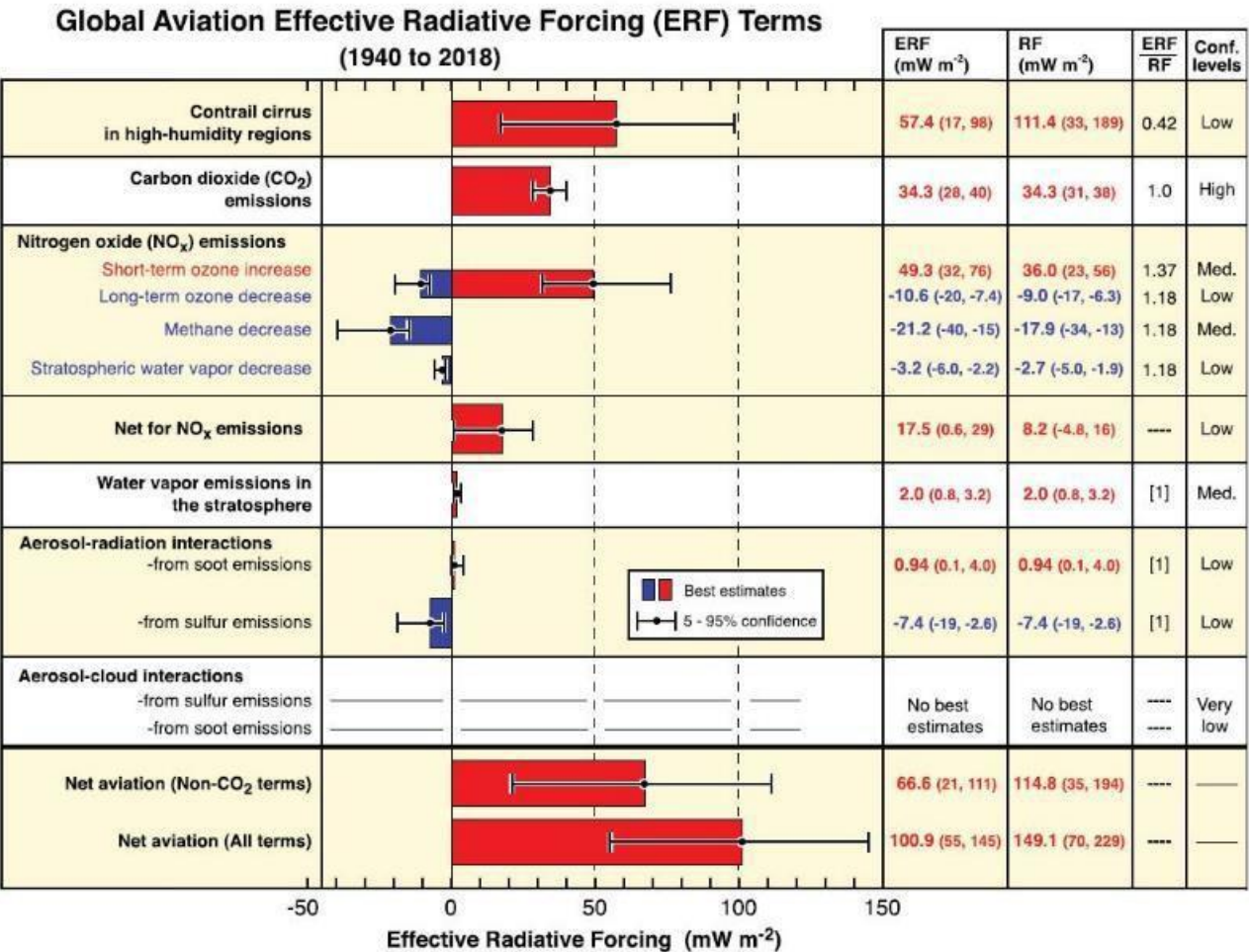


1. Savings measures by renewing aircraft fleets with modern aircraft types and improving efficiency compared with current technology, savings potential: 53 million metric tons of CO₂
2. Savings measures through efficiency improvements in operations and infrastructure, savings potential: 24 million metric tons of CO₂
3. Savings measures through the use of SAF, savings potential: 116 million tons of CO₂
4. Further savings through market-based measures or CO₂ capture and storage, Savings potential: 88 million metric tons of CO₂



- In addition to CO₂, **other climate-impacting** substances are emitted
- These include water vapor, soot particles, sulfate particles and nitrogen oxides emitted at high altitudes
- Their complex interaction and the resulting climate impact are the subject of current research
- Non-CO₂ effects account for about **2/3 of the total climate impact** of aviation
- Click [here](#) for more information o non-CO₂ effects

SAF burn cleaner than fossil kerosene and thus also reduce non-CO₂ effects. Further information in this regard can be found in the [aireg roadmap](#).



¹EASA Final Report: Updated analysis of the non-CO₂ climate impacts of aviation and potential policy measures pursuant to the EU Emissions Trading System Directive Article, p. 28, fig. 2, November 2020

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 2030 at the earliest
- Duration of market ramp-up very high due to long service life of aircraft

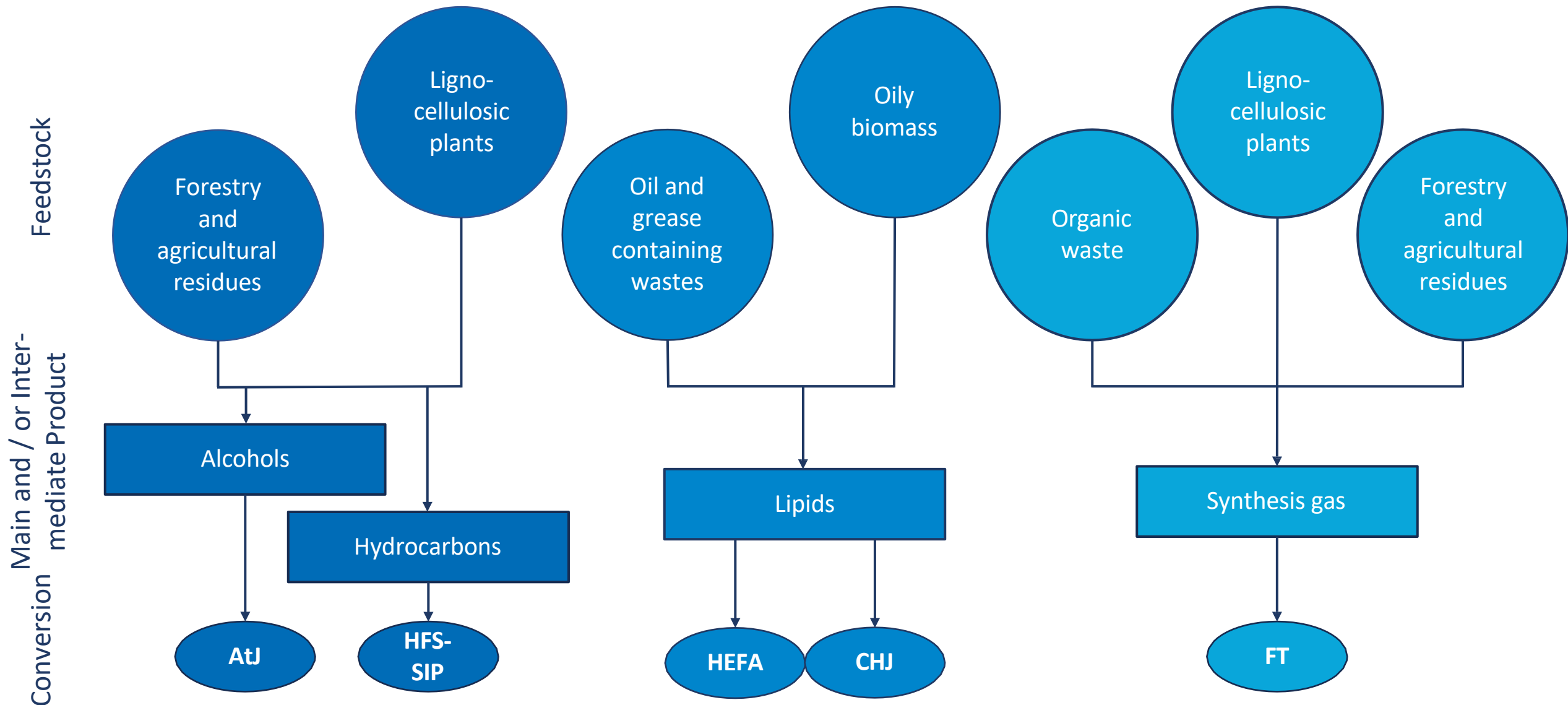


Drop-in solution

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



Biogenic SAF Production Pathways



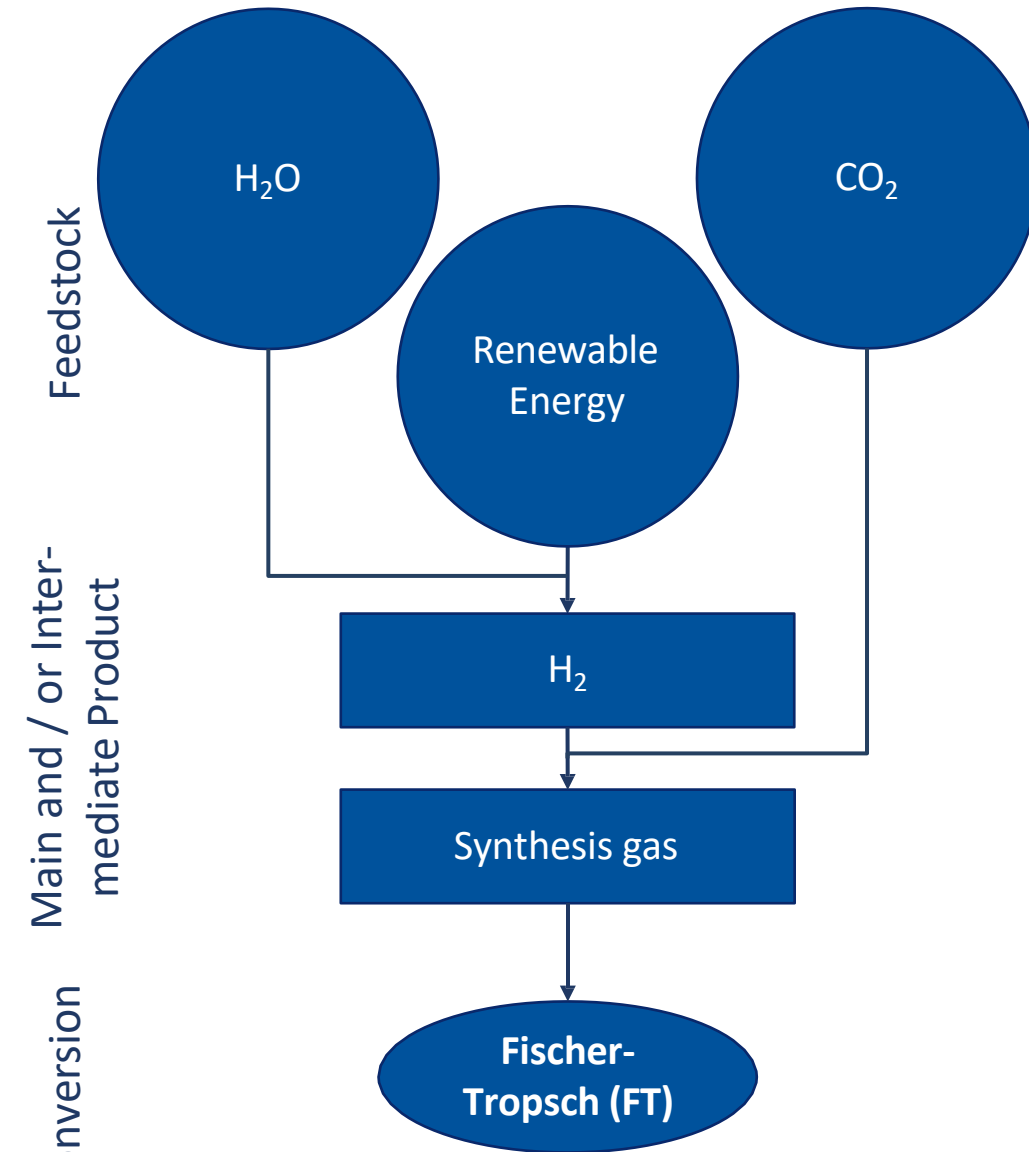
Overview of Approved SAF Options

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

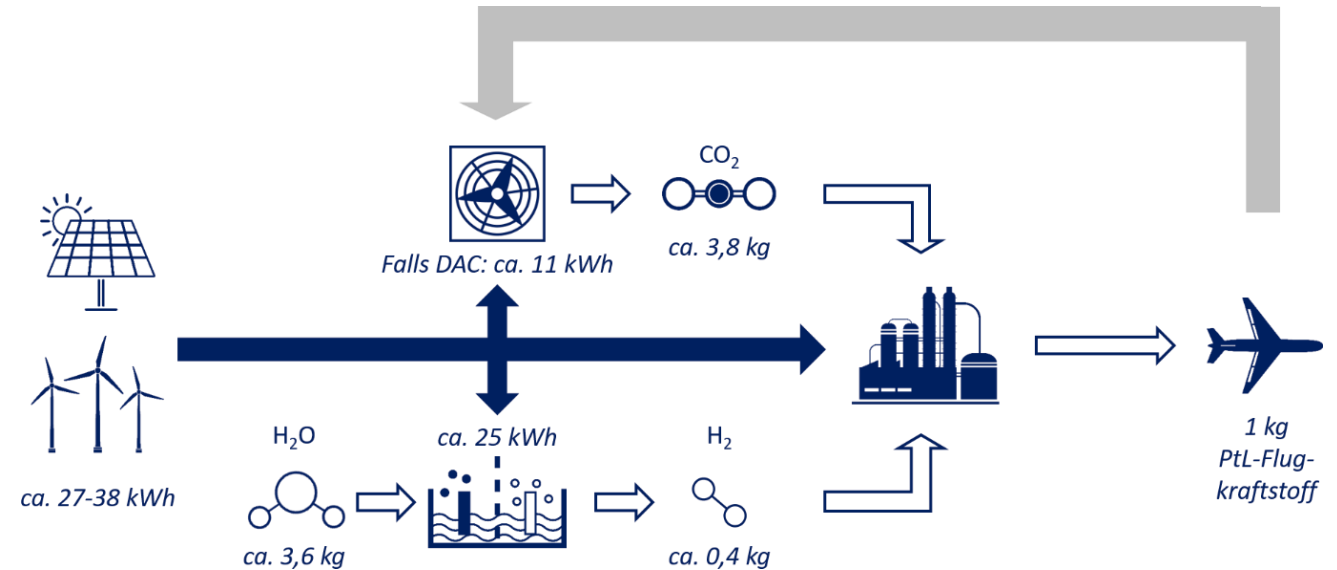
ATJ-SPK (Alcohol to Jet Synthetic Paraffinic Kerosene), **ATJ-SKA** (Alcohol to Jet Synthetic Paraffinic Kerosene with Aromatics), **CH-SK** (Catalytic Hydrothermolysis Synthesized Kerosene), **FT** (Fischer-Tropsch), **HC** (Hydrocarbons), **HEFA** (Hydroprocessed Esters and Fatty Acids), **HFS-SIP** (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**.

Electricity-based SAF – Power to Liquid (PtL)

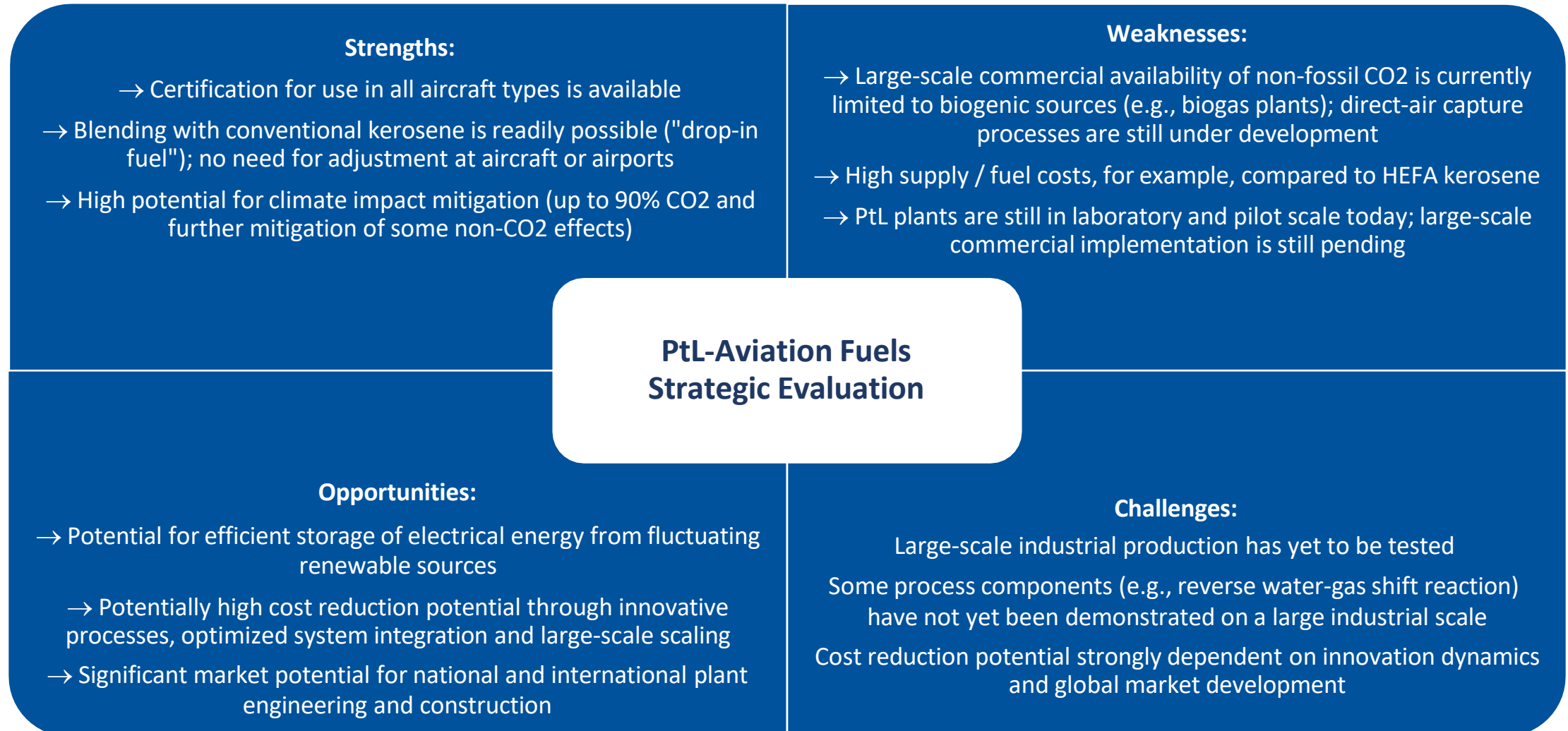


Quantitative overview of required feedstocks in the PtL production pathway:

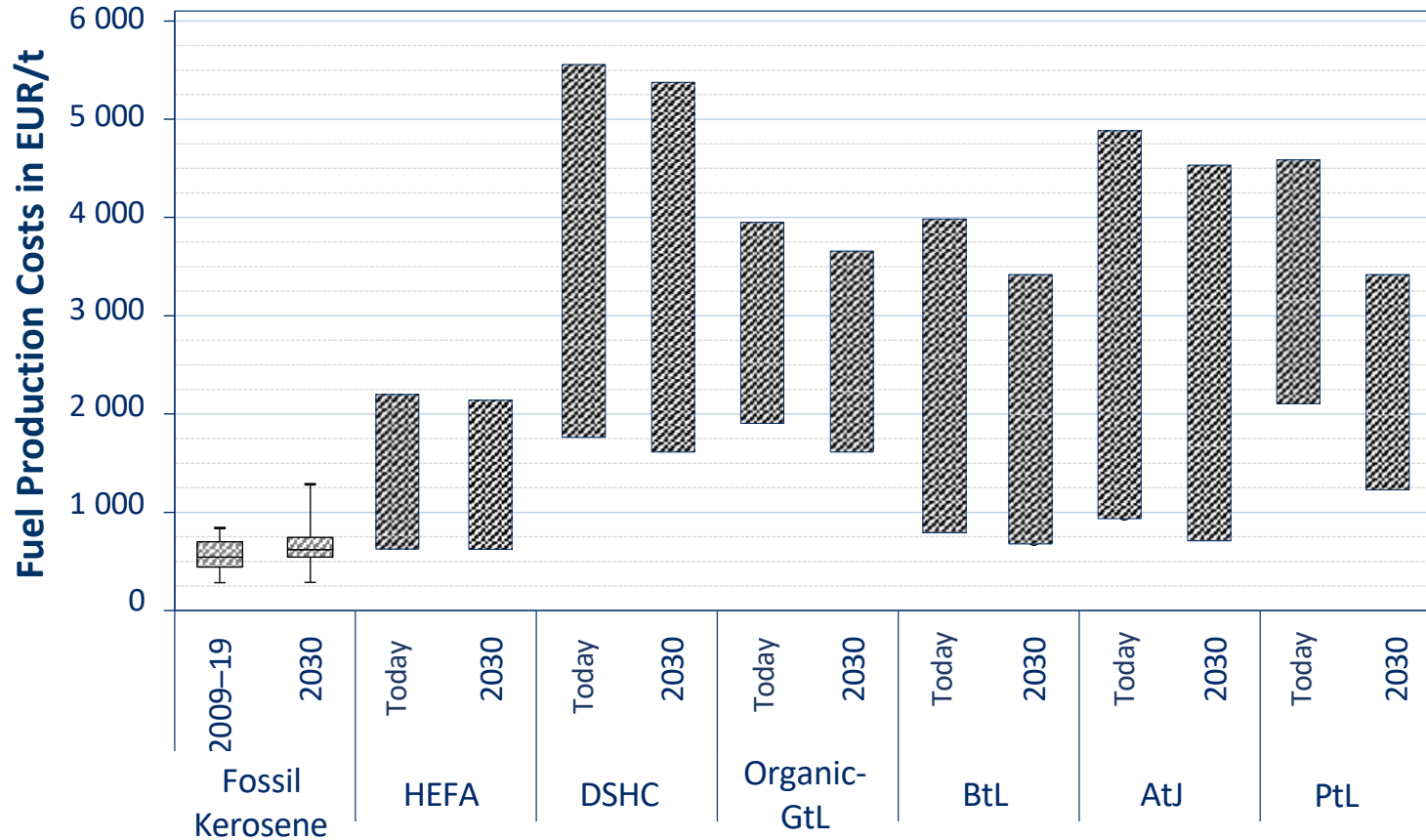


Feedstock required to operate all domestic German flights with PtL:

- 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



SAF price remains high in the medium term due to high production costs

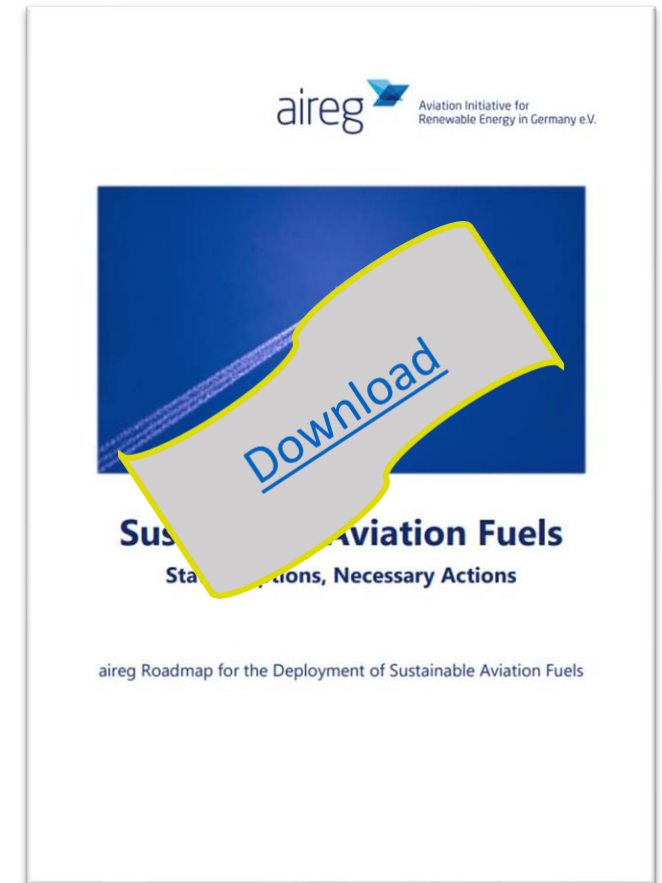


Source: aireg e.V. – TU HH / Institut für Umwelttechnik und Energiewirtschaft

- Sustainable aviation fuels have been and will continue to be very expensive compared to fossil kerosene, **severely hampering their market entry**
- Cost reduction through innovation and scaling of the entire value chain.
- Price parity is more likely to be achieved through government incentive programs

Roadmap for the Development and Introduction of Sustainable Aviation Fuels

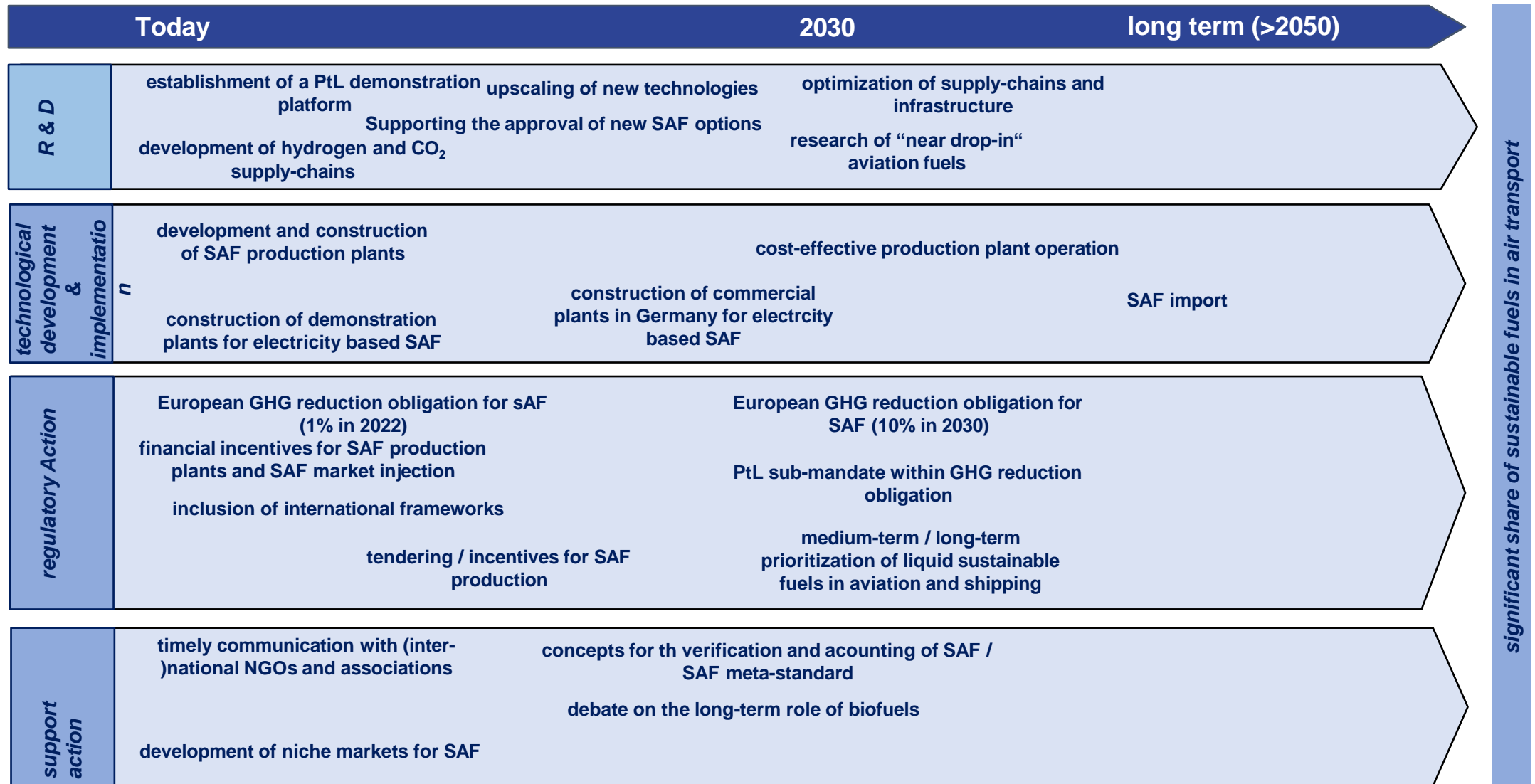
- The aireg **Roadmap** presents measures and incentives to achieve **a significant share of sustainable fuels** in aviation.
- This includes measures in the field of research and development (R&D) of corresponding manufacturing technologies, milestones for technological development and implementation as well as regulatory and other supporting measures.
- The Roadmap contains
 - establishment of a PtL Demonstration and Research Centre in Germany
 - Research and development (R&D) of corresponding manufacturing technologies
 - Milestones for technical development
 - regulatory and other supporting measures
- The aireg members offer cooperation to politicians at the federal and state level as well as other stakeholders from industry, business and science in order to accelerate the urgently needed market launch and production ramp-up of SAF.



Roadmap for the Development and Introduction of Sustainable Aviation Fuels

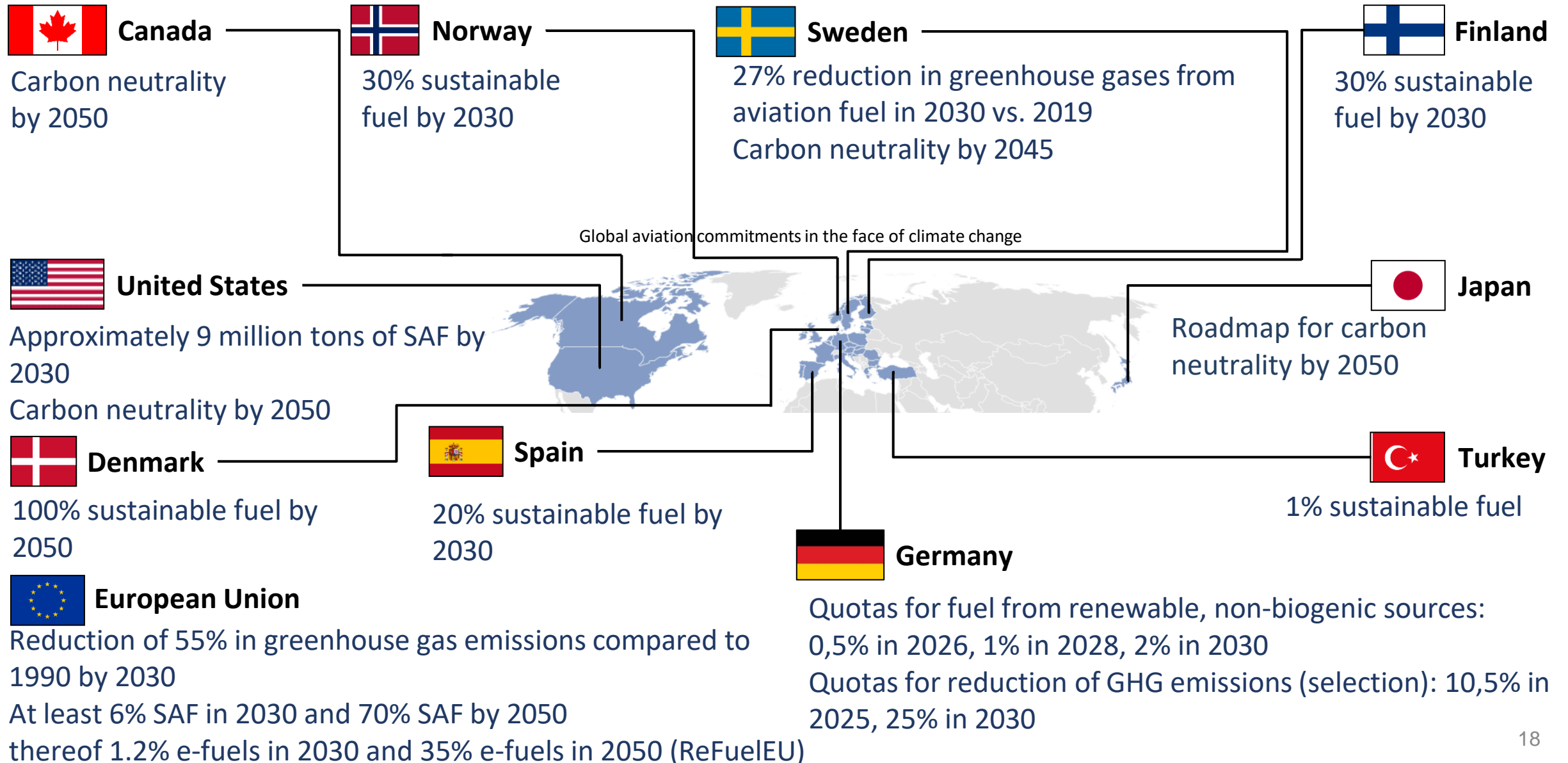


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significant share of sustainable fuels in air transport

Selection of commitments: Climate protection in aviation of different countries



UNITED 

 **Lufthansa**

AIRFRANCE  **KLM**

virgin atlantic 

BRITISH AIRWAYS 

 **DHL**
Group

American Airlines 

 **RYANAIR**

SAS

5% SAF by 2030, ca. 22,000 tons of SAF since 2016, 50% reduction in GHG emissions from 2019 levels by 2035, USD 100 million fund for the promotion of SAF SBTi-validated

5% - 10% SAF by 2030, reduction of CO₂ intensity (CO₂ emissions per transported ton kilometer) by 30% compared with 2019 by 2030, SBTi-validated

10% SAF by 2030, at least 1% SAF on each flight from France and the Netherlands, CO₂ emissions reduction by 30% per RPK until 2030 compared to 2019, SBTi-validated

10% SAF by 2030, first transatlantic flight with 100% SAF, 40% net reduction in CO₂ emissions by 2040

10% SAF by 2030, 70% SAF by 2050 at IAG

30% SAF by 2030 in the area of air freight, SBTi-validated

10% SAF by 2030, SBTi-validated

12.5% SAF by 2030, 70% of which is already contractually secured, 26% lower CO₂ impact compared with 2019 in 2031, SBTi-validation is in progress

17% SAF by 2030, reduction of CO₂ intensity by 40% compared with 2019 by 2035 (SBTi-compliant), separate booking classes with 50% SAF for each flight

Thank you for your Interest!

Contact:

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