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Technology Collaboration Programme on
Advanced Motor Fuels

National SAF Developments and Strategies

Findings from AMF Task 63

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AMF Task 63

Project overview

- November 2021 – April 2023
- Task member countries: Austria (lead), Brazil, China, Denmark, Germany, Switzerland, USA
- Activities of the Task include:
  - Identify major challenges for SAF market uptake
  - Showcase examples of successful deployment
  - Organization of workshops and online seminars

- Further information and publications are available here: https://iea-amf.org/content/projects/map_projects/63

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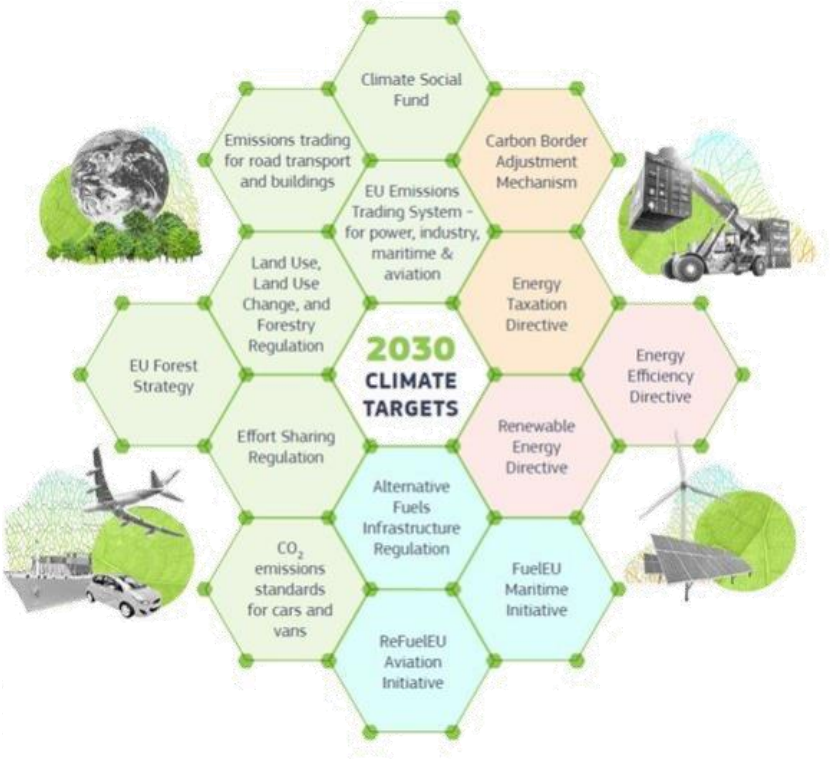
National SAF Developments and Strategies Europe

Legal Framework

European Union

- Green Deal (Fit-for-55 Package)
  - Reducing GHG emissions by at least 55% by 2030 compared with 1990 levels
- RED II (RED III under negotiation)
  - 1.2 multiplier for SAF (non-food/feed)
- EU-ETS
  - Incentives for biobased SAF in compliance with RED II sustainability criteria „zero emission“
- CORSIA (ICAO international)
  - Use SAF that comply with dedicated sustainability criteria instead of purchasing emission offsets



https://ses.jrc.ec.europa.eu/eirie/en/news-and-events/news/fit-55-major-step-towards-decarbonized-eu-2050

ReFuelEU Aviation Initiative

Proposal by the Commission

- EU proposed regulation 2021/0205 (COD) on ensuring a level playing field for sustainable air transport
  - SAF are defined as drop-in fuels, either synthetic aviation fuels or advanced biofuels - Feed and food crop-based fuels are excluded due to limited scalability potential and sustainability concerns
  - Fuelling obligation for aircraft operators who have to ensure that 90% of the annually required aviation fuel is uplifted at a given EU airport
  - Reporting obligation for aircraft operators and fuel suppliers with financial penalties for non-compliance

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0561

ReFuelEU Aviation Initiative
(under negotiation)

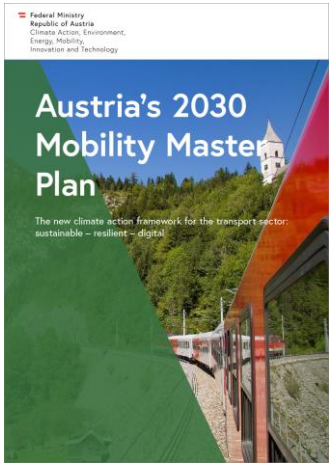
- EU proposed regulation 2021/0205 (COD) on ensuring a level playing field for sustainable air transport
  - On all commercial flights carrying passengers (including business travel), cargo or mail traveling within the EU and departing from the EU
  - Gradual increase of the volumetric share of SAF in the fuel supplied to operators at EU airports with a sub-target on synthetic aviation fuels

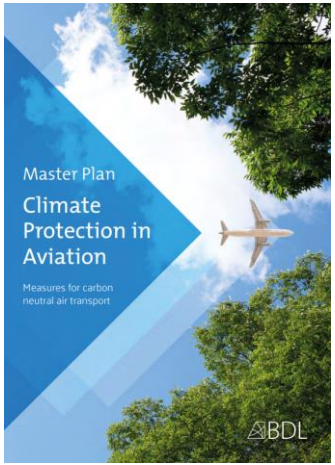
[%]	2025	2030	2035	2040	2045	2050
SAF	2	6	20	34	42	70
Synt. SAF	0	0.7	5	8	11	28

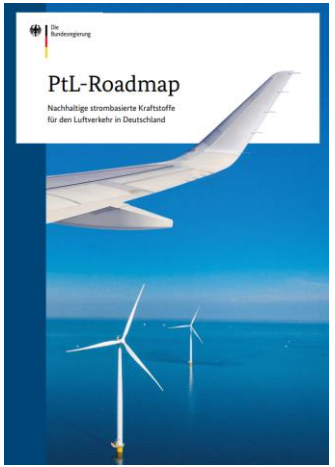
https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/698900/EPRS_BRI(2022)698900_EN.pdf

National strategies

- Several countries already commissioned or published strategies or roadmaps on SAF market uptake







Austria

Targets	Climate neutrality by 2040 • For industries, energy systems and transport (except aviation)
Strategies	Hydrogen strategy & Renewable gas strategy • H_2 for industries which are hard to decarbonize (incl. aviation) • Green gas only for sectors with no substitution option (excl. aviation) Mobility master plan • Promotion of e-fuels, hydrogen and battery for aviation • Advanced biofuels for aviation if there is no other more efficient application SAF roadmap (under development)
Projects/ Initiatives	SAF action plan • Joint position of leading companies in the mobility & energy sector TAKE OFF program (Austrian Research Promotion Agency) • Implementation of the research strategy for the Austrian aviation sector
Strengths	Agreement on the importance of SAF of politics and industry Know-how, there are several related research institutes and technology providers

Denmark

Targets	One green domestic flight route in 2025 All domestic aviation must be green by 2030
Strategies	Aviation plan announced • Transition will be financed by imposing a flat passenger fee of €1.70 (domestic and international flights – excl. transit)
Projects/ Initiatives	Bornholm Energy Island • Huge investment in off-shore production of electricity in the north sea together with Germany, The Netherlands and Belgium • Electricity from the energy island shall be converted into e-fuels for the marine and aviation sectors ALIGHT project • Copenhagen Airport as example for a sustainable airport of the future GreenLab project • First and largest commercial PtX facility
Strengths	A strong political willingness to foster investments and research

Germany

Targets	PtL SAF capacity of at least 200,000 t/a by 2030
Strategies	PtL SAF roadmap (linked with National hydrogen strategy) & BDL master plan • Clear focus on PtL SAF by industry and government • Aimed market ramp up in Germany of at least 200,000 t/a by 2030 GHG quota with the compliance option PtL in aviation: 0.5% by 2026 (about 50,000 t/a), 1% by 2028 (about 100,000 t/a), 2% by 2030 (about 200,000 t/a); amounts can be double-counted
Projects/ Initiatives	Several projects and demonstration plants for SAF production are ongoing, e.g.: • BP is co-processing UCO in an existing refinery • A first PtL plant in Germany with a capacity of 360 t/a • Project Amelia for a ATJ plant with a capacitiy of 60,000 t/a • Different SAF related projects on DE/EU level (e.g. KEROSyN100, HyKero, TULIPS, HyFlexFuel and ALIGHT)
Strengths	Well developed fuel infrastructure (especially important for importing SAF) There are leading technology providers and users as well as R&D institutions Accompanying funding for PtL SAF projects

Switzerland

Targets	Reduction of fossil CO_2 emissions from aviation with SAF by at least 60% by 2050 • Compared to a development without measures
Strategies	Following the ReFuelEU Aviation proposal by the EC • Without any notable differences in quota or sustainability criteria Swiss Emission Trading System (linked to EU-ETS) • Allows crediting of SAF use on flights starting in Switzerland Biogenic fuels are tax exempted when complying with sustainability criteria • Dedicated cultivation of biogenic resources for the purpose of SAF production is not supported (residues only) Swiss Roadmap for Sustainable Aviation (RMSA) was elaborated • SAF (biogenic and synthetic) seen as central and most important measure
Projects/ Initiatives	Funding of pilot and demonstration plants • Helvoil – production of biofuels (incl. SAF) from UCO and waste animal fats Multiple projects (biogenic and synthetic SAF production) are currently in the concept phase, but have not yet been publicly announced
Strengths	Excellent network of universities and notable technology providers Highly motivated actors to contribute to a quick upscaling of SAF

Summary of European Strategies

- European strategy is mainly driven by the ReFuelEU Aviation proposal
  - Main focus is ensuring a level playing field for sustainable air transport
- Although legal framework is set on European level, strategies of Member States vary
  - Several Member States already published SAF roadmaps
  - Denmark and Germany have a strong focus on PtL
- In all four countries SAF is considered as important measure to decarbonize aviation by politics and industry
- There are notable technology providers and university networks

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National SAF Developments and Strategies
Brazil

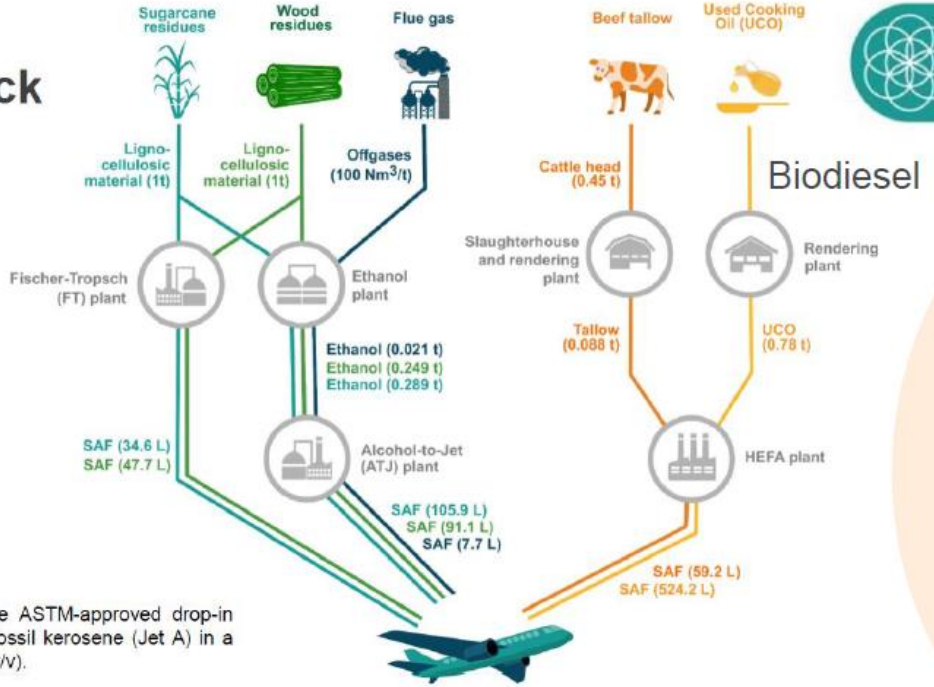
What is the SAF future in Brazil we foresee...

- Brazil is a **continental power** in **oil, sugar, ethanol, soy and bioenergy**. It is also full of **airports and aerodromes** in its entire territory. Despite its **18 refineries**, only **one is producing Jet**.
- The country is committed to reduce **carbon intensity**, adjusting to the energy transition journey, particularly in the **aviation sector**, with different technological alternatives.
- **Brazil has abundance and diversity of energy sources** to comply with the iNDCs, it has many and diverse actors through the **aviation value chain** with **several technological routes and alternatives**, some of them already approved by **ASTM and ANP**.
- In terms of the **regulatory framework**, the country has already approved a program to incentivize SAF routes and market development.
- Considering the importance of Brazil in biofuels' market, its energy sources, its actors, the technological routes already available, and its commitment to iNDCs, **Brazil, given all its potential**, is set to unfold **great opportunities with SAF** economy in a global scale.

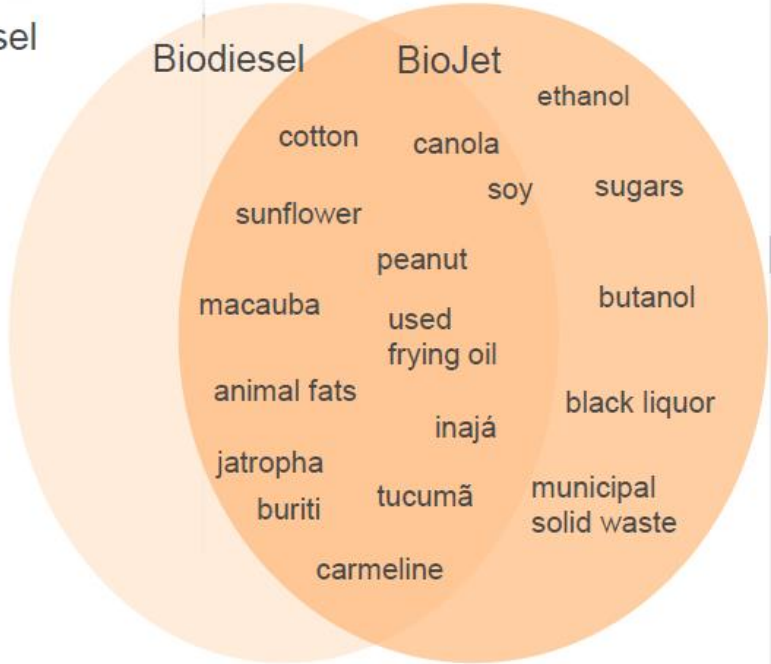
SAF, Biodiesel and BioQAV Feedstock

SAF Feedstock

Waste and residues



*All pathways comprise ASTM-approved drop-in fuels to be used with fossil kerosene (Jet A) in a maximum 50% blend (v/v).



SAF Strategies for some key selected Brazilian actors

Company name	Type / sector	SAF Strategy
Petrobras	**1st fuels producer / distributer** in Brazil.	Petrobras is a major fuel producer in the Brazilian market, and plan to be the highest SAF producer. Just announced a construction of SAF/HVO plant for the next years.
Raízen	**Biofuels producer /distributer**	In July 2022, signed a **letter of intent** with Embraer to develop the **Brazilian SAF ecosystem** for production. Its commitment to both innovation and bioenergy enables it to become a **key SAF trailblazer in Brazil.**
LATAM	The leading **airline group** in Latin America.	In its Sustainability Strategy, LATAM plans the following 3 steps: • Be carbon neutral by 2050. • Offset 50% of domestic emissions by 2030. • **Use SAF until 2030**.
Azul - Linhas Aéreas Brasileiras	The **3rd largest airline** in Brazil (2016).	In 2012, ahead of its group, Azul attempted to use BioQAV with Amyris and it was unsuccessful, due to: (1) there is no tax classification code for the product; (2) there were no laboratories able to certify the blend in Brazil, and (3) costs abroad were prohibitive to them.
Embraer	**1st Aircraft manufacturer in Brazil**.	It seeks carbon neutrality by 2040. It also focuses on the development of products, services, and technologies for aviation net-zero carbon **2050** and on **100% SAF compliant aircraft.**
Airbus	**Aircraft manufacturer in Brazil.**	They aim to offer **100% SAF capacity on commercial aircraft up to 2030**, as well as becoming the largest manufacturer to offer a neutral aircraft by 2035.

Principles for the application of the SAF Policy in Brazil

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- Quality certification
- Sustainability

International Alignment (ICAO)
CORSIA Elegibility

- Prioritize the most relevant airports for the national aviation sector.

- Incentives for the buyer through credits tax-deducted.
- Without market distortions and no compromising financial sustainability of airline companies.

- Support R&D SAF projects.
- Open to all routes and technologies (not necessarily biomass and residuals) and regional production vocations.

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National SAF Developments and Strategies
USA

SAF policies at the federal and state level

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- Section 13203: Sustainable Aviation Fuel Credit
  - Incentive for SAF (40B tax credit)
  - Incentive amount is based on LCA GHG results
  - LCA is based on CORSIA or RFS
  - Applies to SAF sold or used after December 31, 2022
- Section 13704: Clean Fuel Production Credit
  - Incentive for clean transportation fuels, including SAF (45Z tax credit)
  - Incentive amount is based on LCA GHG results
  - LCA is based on GREET (or as above for SAF)
  - Applies to fuels sold or used after December 31, 2024
- Section 13204: Clean Hydrogen
  - Incentive for clean hydrogen (45V tax credit)
  - Incentive amount is based on LCA GHG results
  - LCA is based on GREET
  - Need regulation/guidance by Aug. 16, 2023 (one year from enactment)
  - State of Illinois
  - $1.5/gallon tax incentive, based on GREET LCA results
- State of California
  - Will consider jet fuels in CA as regulated fuel under its LCFS regulation

SAF Provisions of the 2022 Inflation Reduction Act (IRA)

The Inflation Reduction Act of 2022, signed into law by President Biden on August 16, includes a two-year Tax Credit for those who blend SAF; a subsequent three-year Tax Credit for those who produce SAF; and a grant program of $290 million over four years to carry out projects that produce, transport, blend or store SAF or develop, demonstrate, or apply low-emission aviation technologies. To be eligible, the SAF must achieve, in general, at least a 50% improvement in greenhouse gas (GHG) emissions performance on a life-cycle basis as compared with conventional jet fuel.* The tax credit – which starts at $1.25/gallon of neat SAF – increases with every percentage point of improvement in lifecycle emissions performance up to $1.75/gallon.

SAF R&D investment

USA

- FAA FAST-SAF and FAST-Tech program
  - To advance SAF and low emissions aviation technologies to reduce emissions from aviation and aid in addressing climate change
  - $297 million will be available
- US Department of Energy
  - SAF production technologies
  - Optimized combustion of new jet fuels
- USDA, NASA, and other agencies
- Private sector investment fund
  - United Airlines, Boeing, JP Morgan
  - $100 million will be available

Conclusions

Key differences EU/USA/Brazil

- Carrot or stick:
  - EU volume-based blending obligation
  - USA carbon intensity-based tax credits
  - Brazil tax credits
- Eligible feedstocks
  - EU SAF only based on residues and wastes or synthetic (PtL), some countries PtL only
  - USA all feedstocks
  - Brazil all feedstocks, incentives for Family Farming

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Thank you