

Sustainable Aviation Fuels (SAF)

Options and Challenges

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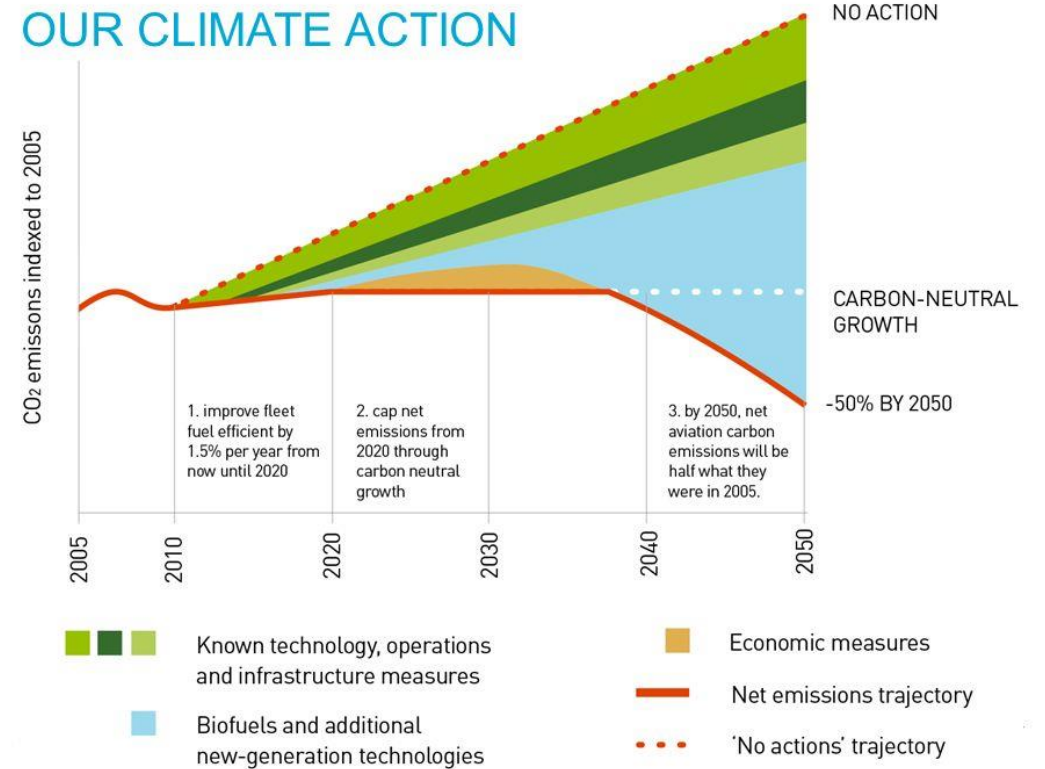
Wissen für Morgen



Challenge

Maintaining Social & Economic Benefits while Reaching Climate Targets

- 915 million tons of CO₂ produced by flights worldwide in 2019
 - 2.4% of anthropogenic CO₂ emissions
 - 12% from all transport sources
 - 80% of aviation CO₂ from flights of over 1500 km,
- 4.5 billion passengers with 82% average occupancy per aircraft,
- 87.7 million jobs supported worldwide in aviation & tourism.



Very ambitious target for 2050

Sources: Air Transport Action Group (ATAG) www.atag.org 2019
Beginner's Guide to Aviation Efficiency, IATA Economics.



Planned SAF-Quotas in Europe

Norway

binding quota:
2020: 0.5%, 2030: 30%

Sweden

Quota planned:
2021: 1%, 2025: 5%, 2030: 30%

Finland and Denmark

Quota planned:
2030: 30%

Netherlands

Quota planned from 2023:
2030: 14%

Germany

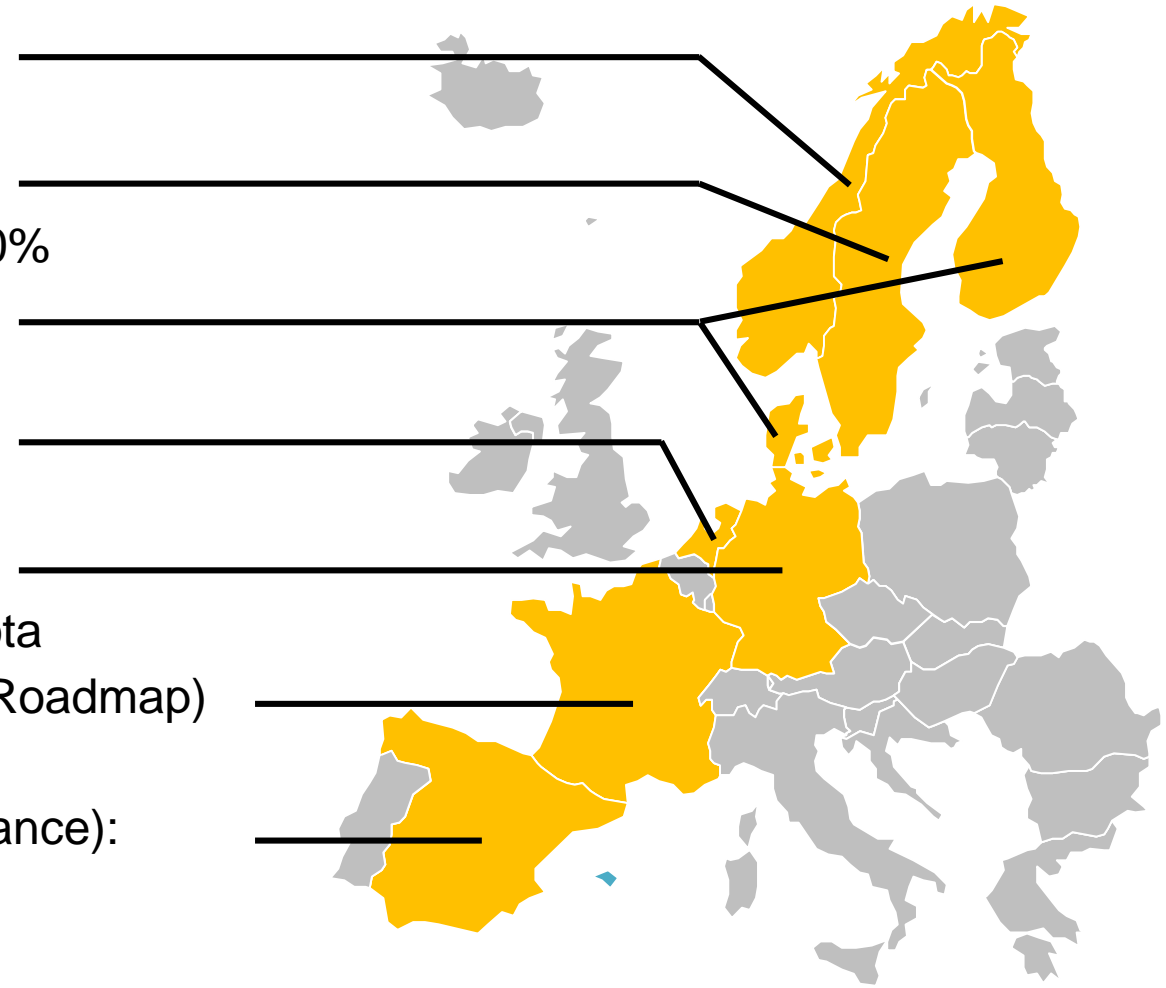
National Hydrogen Strategy:
2026: 0.5%, 2030: 2%-PtL-Quota

France

Quota planned (formulated in a Roadmap)
2025: 2%, 2030: 5%

Spain

Quota planned (together with France):
2025: 2%



Source: BDL / National Platform Future of Mobility

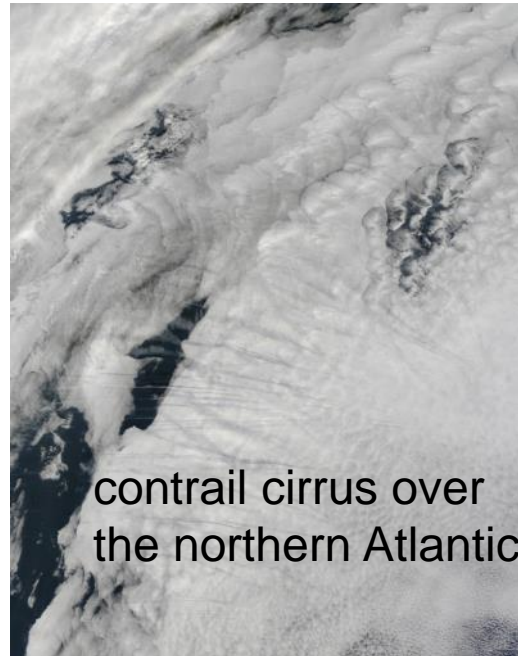


Aviation

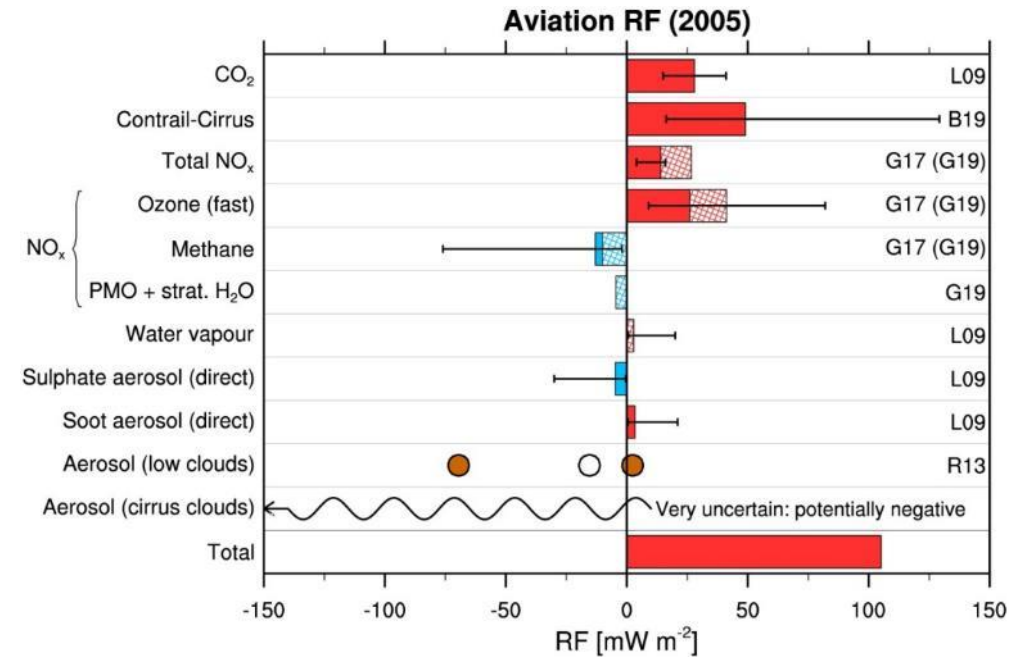
More than CO₂ Effects

The contribution of global aviation in 2011 was calculated to be 3.5 % of the net anthropogenic effective radiative forcing ERF^[1]. Two-thirds are non-CO₂ terms

- CO₂
- NO_x → CH₄ & O₃
- H₂O
- Soot particle emission
- SO_x
- Unburnt Hydrocarbons (UHC)
- Formation of persistent linear contrails
- Aviation induced cloudiness (AIC)



[2]



[3]

Sources

[1] Lee et al, Atm. Env. 2021.

[2] NASA, MODIS, Terra Satellite February 9, 2015.

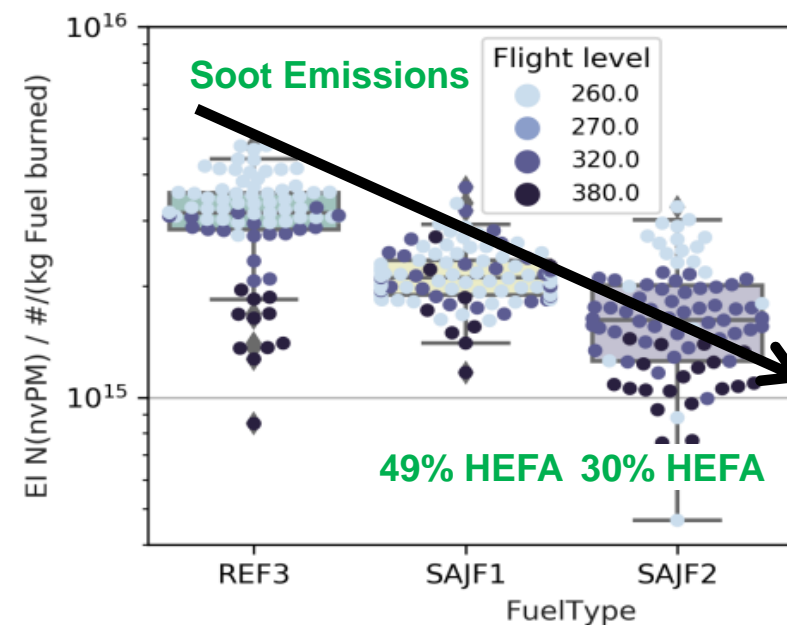
[3] DLR Institute of Atmospheric Physics



ECLIF – II / ND-MAX Measurement Campaign Results



- Using sustainable aviation fuel (SAF) to reduce CO₂ emissions from a LCA perspective: Roundtable on Sustainable Biomaterials (RSB) report shows HEFA biofuel used in ECLIF-II yields > 60% reduction in CO₂ emissions w/r fossil Jet A-1.
- Designing the composition to reduce non-CO₂ effects: Designer fuel based on 30% HEFA (SAF2), which is currently more realistic from a production capacity and economic perspective leads to greater reductions in soot emissions and ice crystal concentrations than the 49%-51% blend (SAF1).



Source: D. Sauer, DLR, 2018.



Sustainable Aviation Fuels

Drop-In vs. Near Drop-In vs. Non Drop-In Fuels



Drop-In

Fully compatible to transport-, storage- and technology systems

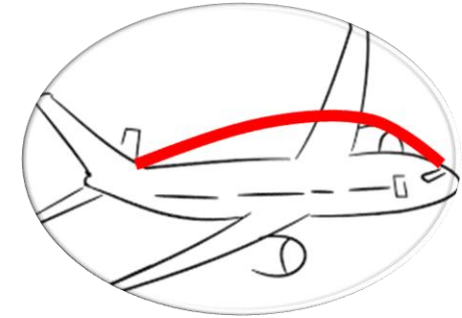
- Max. 50% SAF blend
- Max. 40% CO₂ reduction



Near Drop-In

Up to 100% SAF
(e.g. FT-SAF according to D7566 fully compatible)

- 80-100% CO₂ reduction
- No sulfur
- No aromatics
- Increased local air quality



Non Drop-In

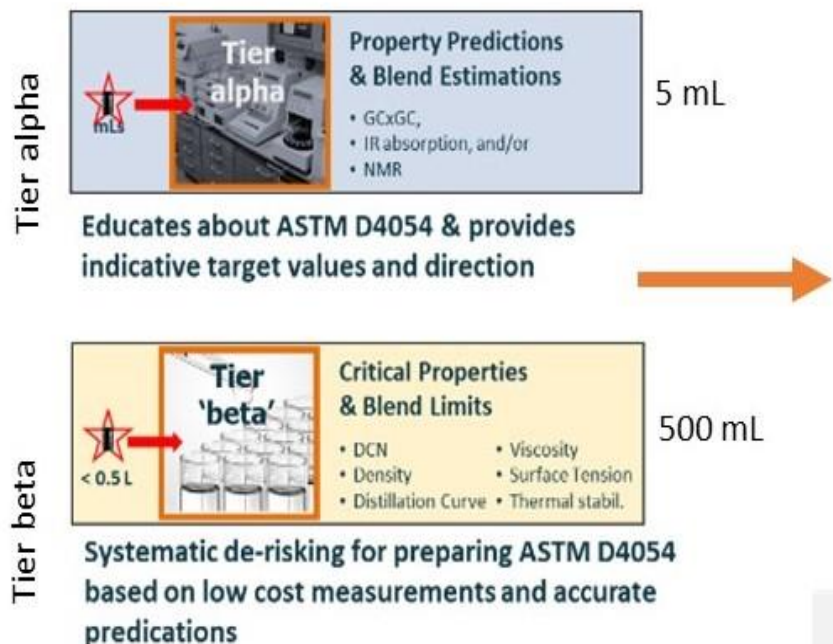
LH₂

- Zero emissions of carbon and soot
- Significant water emissions
- Open question: tank volume

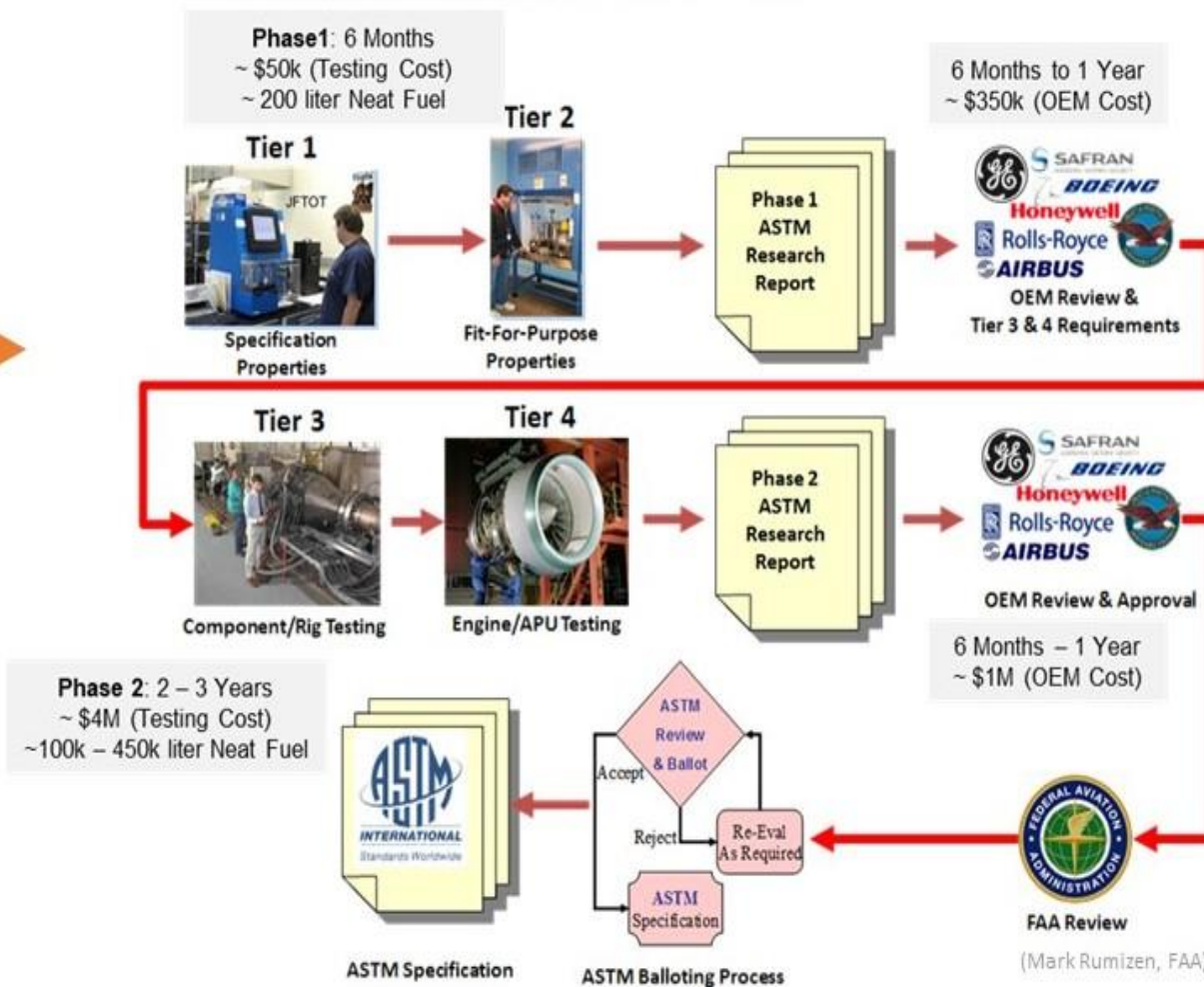


Don't forget the certification process for Jet Fuels!

Fuel prescreening process (JETSCREEN & NJFCOP joint development)



ASTM D4054 Fuel Evaluation Process



Final Remarks

Sustainable Aviation Fuels: Options and Challenges

Sustainable Aviation Fuels (Bio- and e-Fuels!) essential for climate targets while increasing local air quality



Advanced Bio-Fuels

- Development and demonstration of process technologies for waste material and advanced biomass
- Support investment by supporting regulations and business cases
- Decentralized concepts feasible



PtL technologies

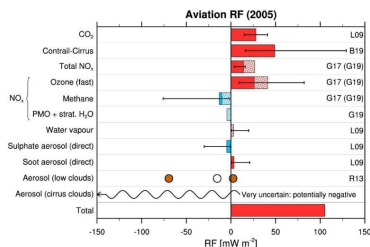
- Processes steps are known, lack of experience for commercially sized plants and entire process chain
- Development and demonstration large-scale plants
- Initiative of BMVI for a development platform for PtL fuels
- Research for specific technical components (as CO₂-source, MtJ, ...)

Challenges and Chances

- Reduction of costs!
- Important non-CO₂ component of the aviation climate impact (>50%) e.g. aircraft induced cloudiness (AIC)

SAF will reduce climate impact: Mitigation of CO₂ emissions and reduction of AIC

→ A premium jet fuel worth the premium price



Thank you for your attention!

