Sustainable Aviation Fuels (SAF)
Options and Challenges

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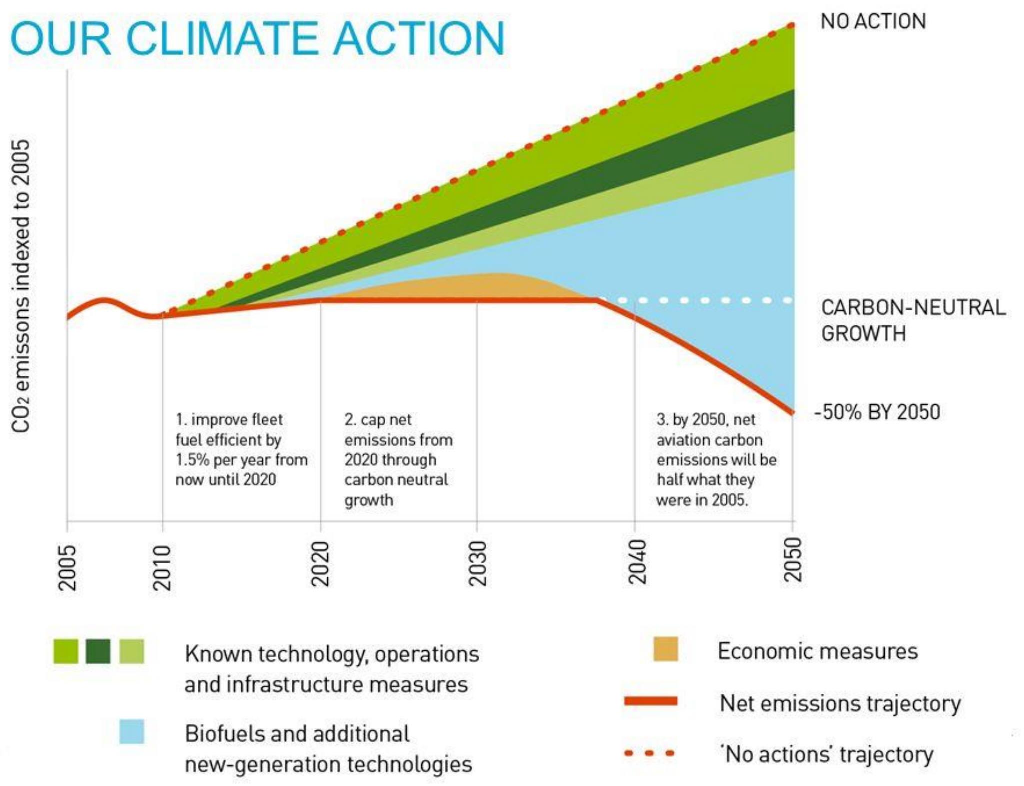
Challenge
Maintaining Social & Economic Benefits while Reaching Climate Targets

- 915 million tons of CO_2 produced by flights worldwide in 2019
  → 2.4% of anthropogenic CO_2 emissions
  → 12% from all transport sources
  → 80% of aviation CO_2 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.

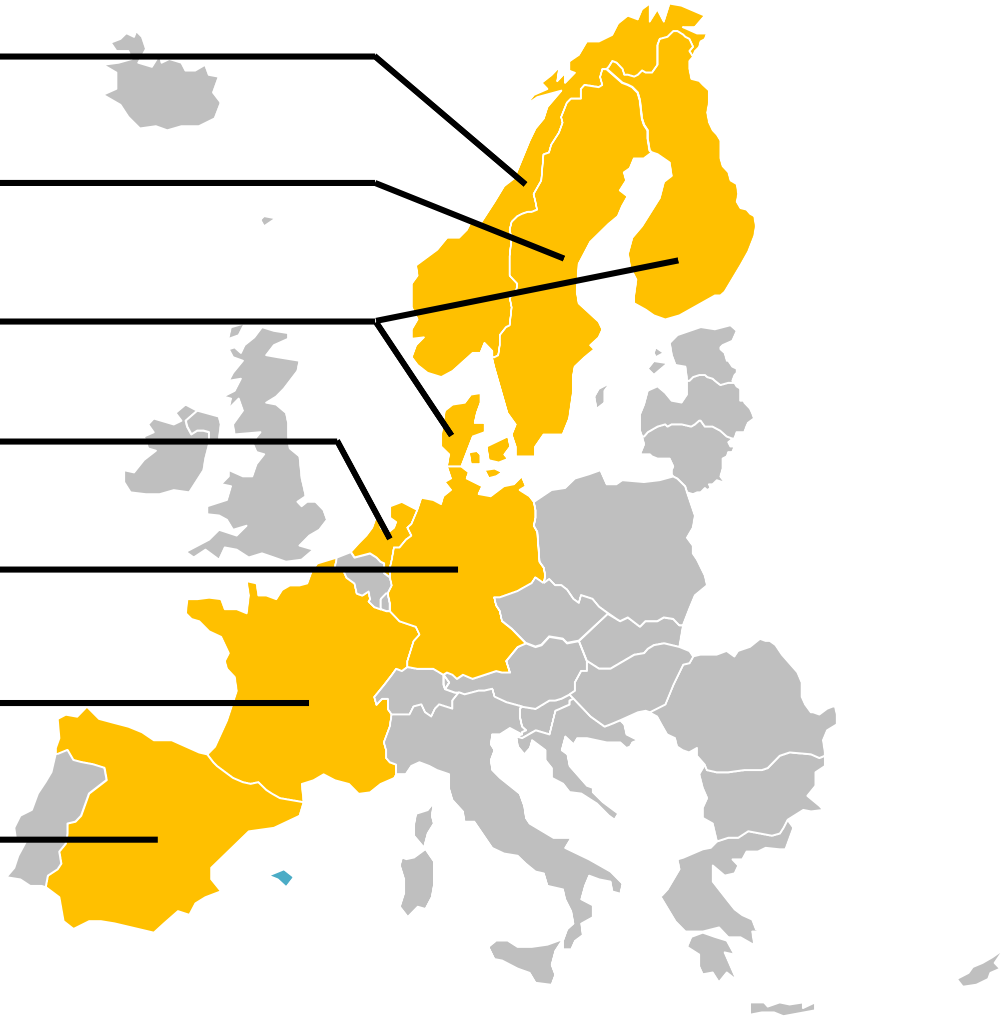


Very ambitious target for 2050

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%



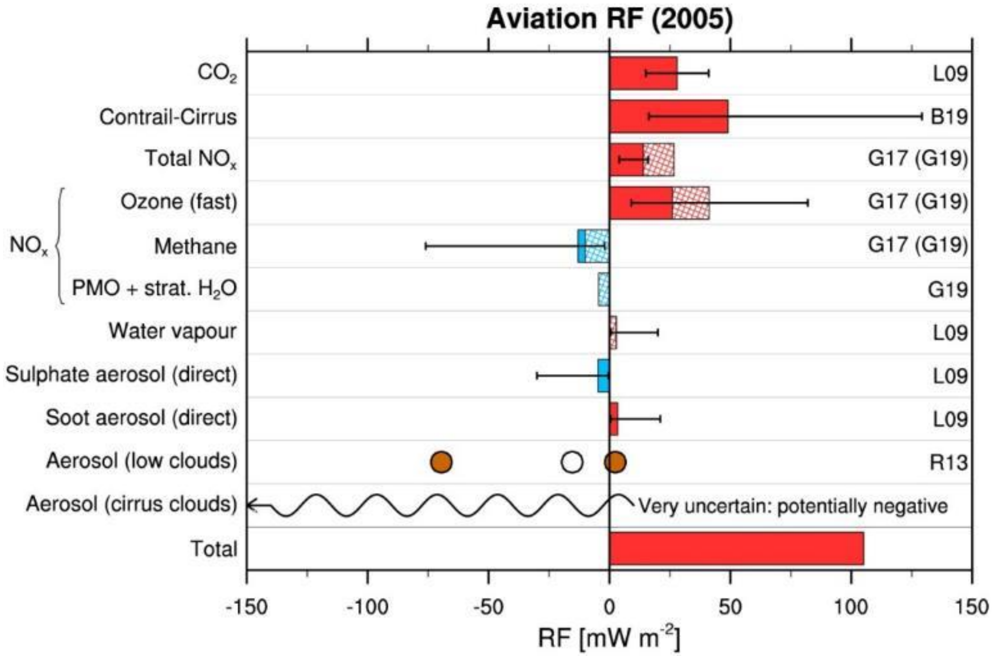
Source: BDL / National Platform Future of Mobility

Aviation
More than CO_2 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-CO_2 terms

- CO_2
- NO_x → CH_4 & O_3
- H_2O
- Soot particle emission
- SO_x
- Unburnt Hydrocarbons (UHC)
- Formation of persistent linear contrails
- Aviation induced cloudiness (AIC)

[2]



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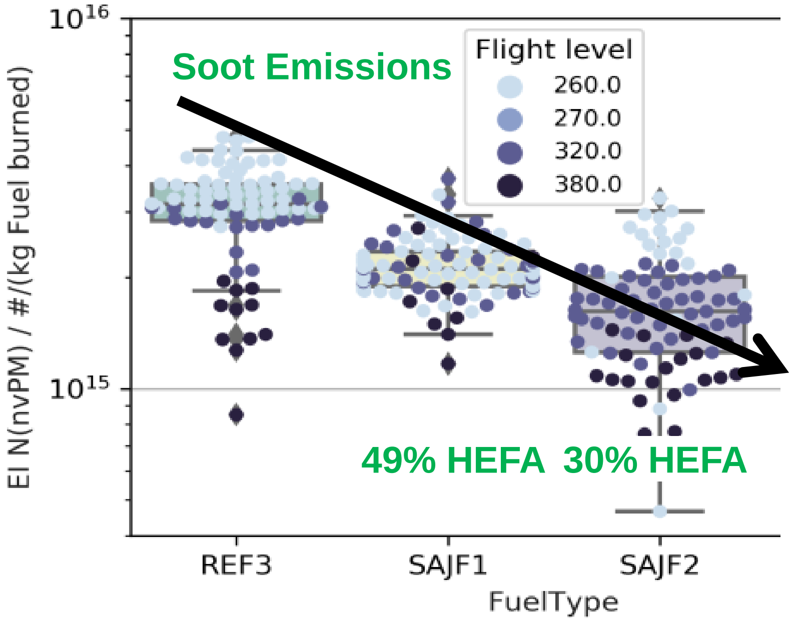
Sources
[1] Lee et al, Atm. Env. 2021.
[2] NASA, MODIS, Terra Satellite February 9, 2015.
[3] DLR Institute of Atmospheric Physics

ECLIF – II / ND-MAX Measurement Campaign

Results

- Using sustainable aviation fuel (SAF) to reduce CO_2 emissions from a LCA perspective: Roundtable on Sustainable Biomaterials (RSB) report shows HEFA biofuel used in ECLIF-II yields > 60% reduction in CO_2 emissions w/r fossil Jet A-1.
- Designing the composition to reduce non-CO_2 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

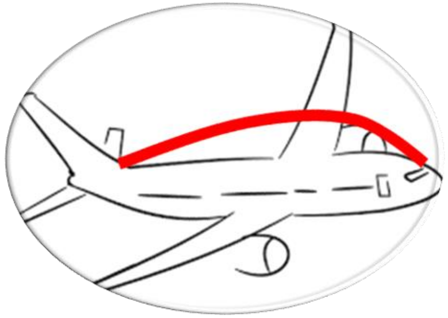
Drop-In vs. Near Drop-In vs. Non Drop-In Fuels

Drop-In
Fully compatible to transport-, storage- and technology systems

- Max. 50% SAF blend
- Max. 40% CO_2 reduction

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

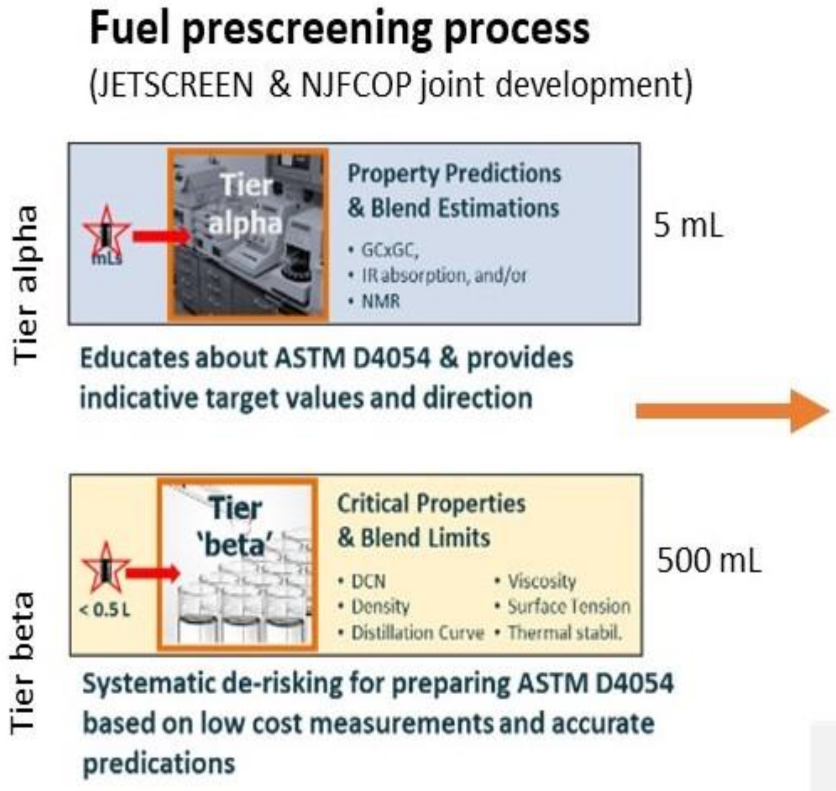
- 80-100% CO_2 reduction
- No sulfur
- No aromatics
- Increased local air quality

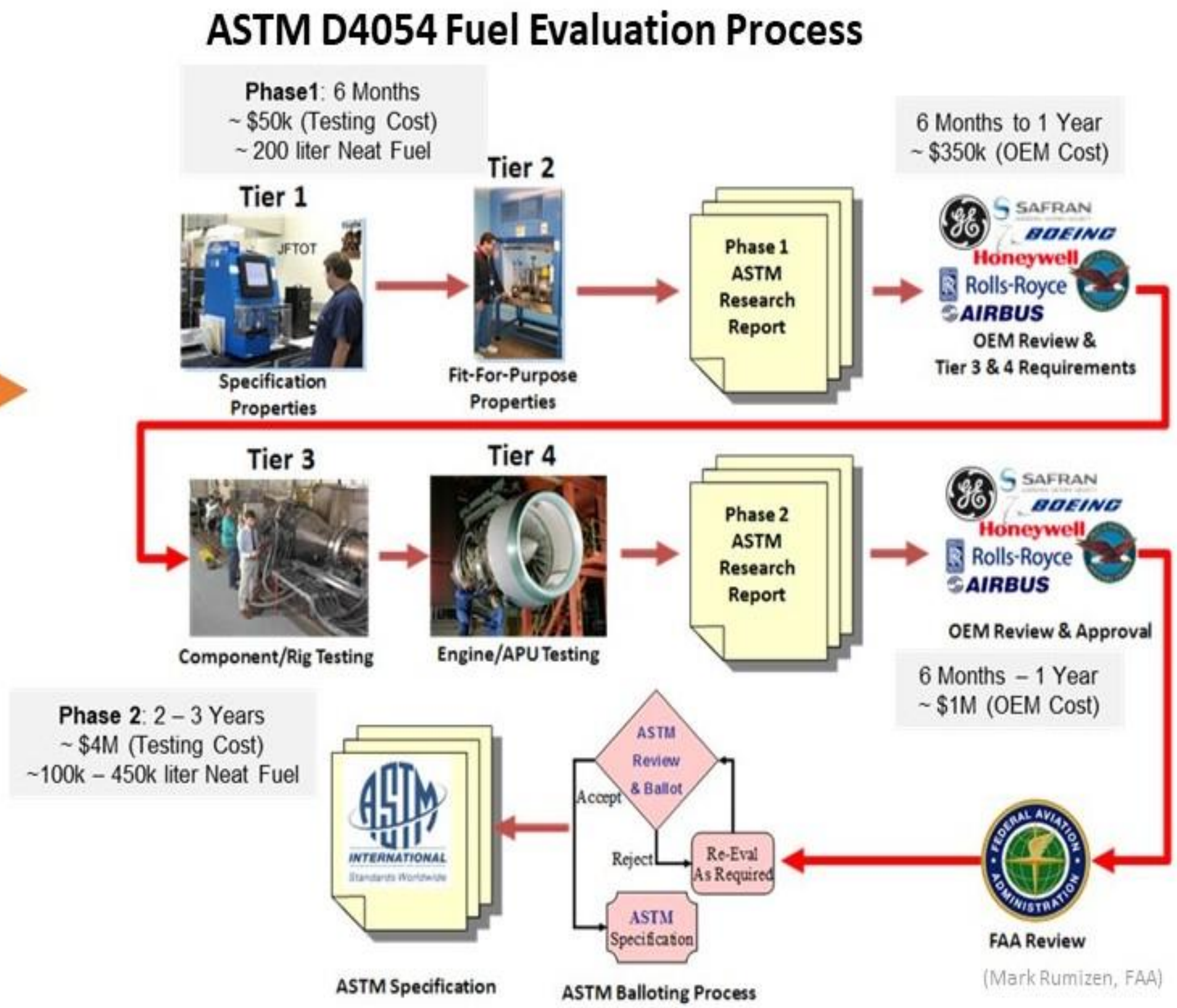


Non Drop-In
LH_2

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

Don‘t forget the certification process for Jet Fuels!





Final Remarks
Sustainable Aviation Fuels: Options and Challenges

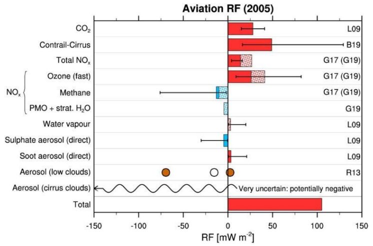
Sustainable Aviation Fuels (Bio- and e-Fuels!) essential for climate targets while increasing local air quality

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 CO_2-source, MtJ, …)



Challenges and Chances

- Reduction of costs!
- Important non-CO_2 component of the aviation climate impact (>50%) e.g. aircraft induced cloudiness (AIC)

SAF will reduce climate impact: Mitigation of CO_2 emissions and reduction of AIC
→ A premium jet fuel worth the premium price

Thank you for your attention!

Credits: DLR/NASA/Friz