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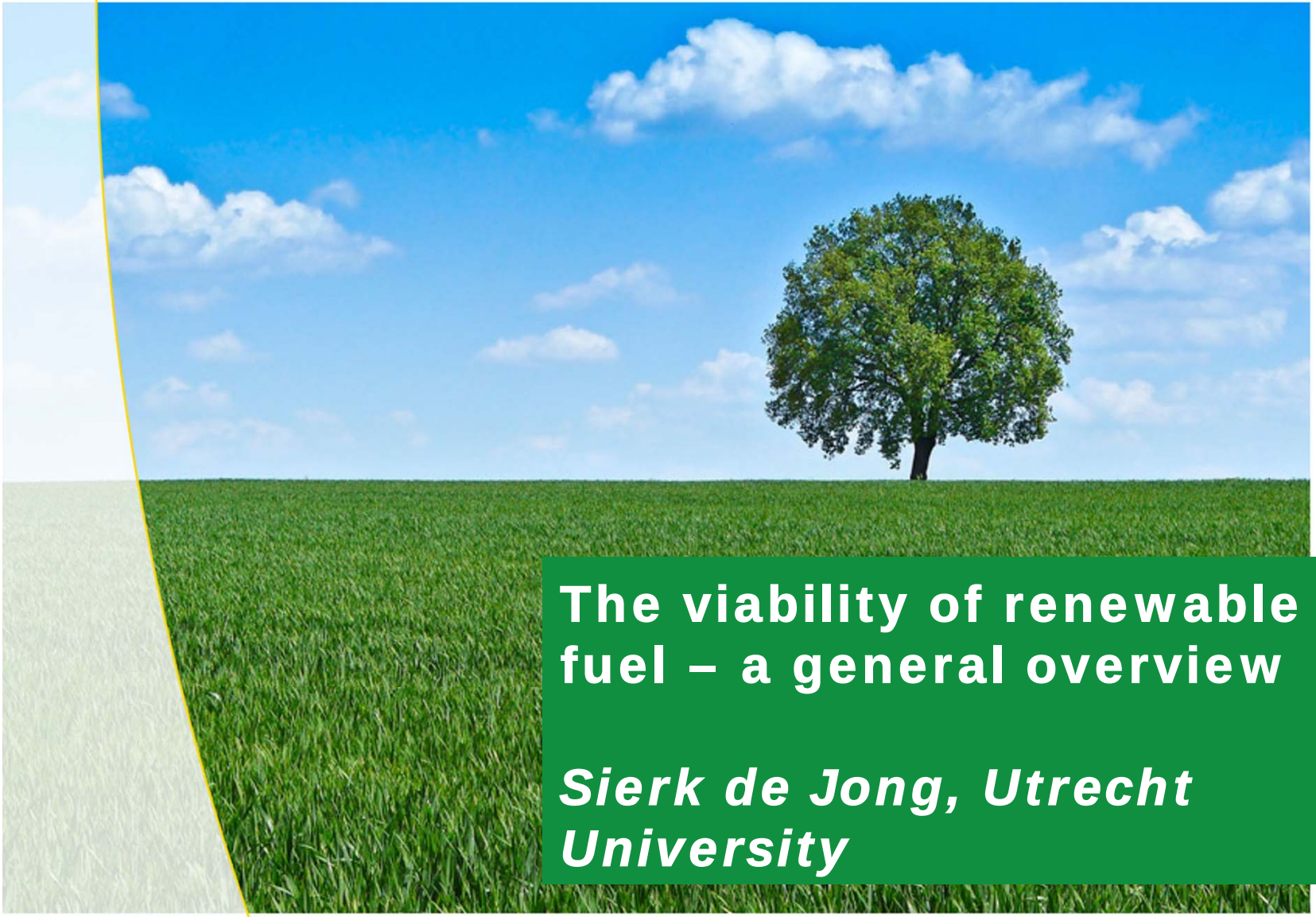

The viability of renewable jet fuel – a general overview

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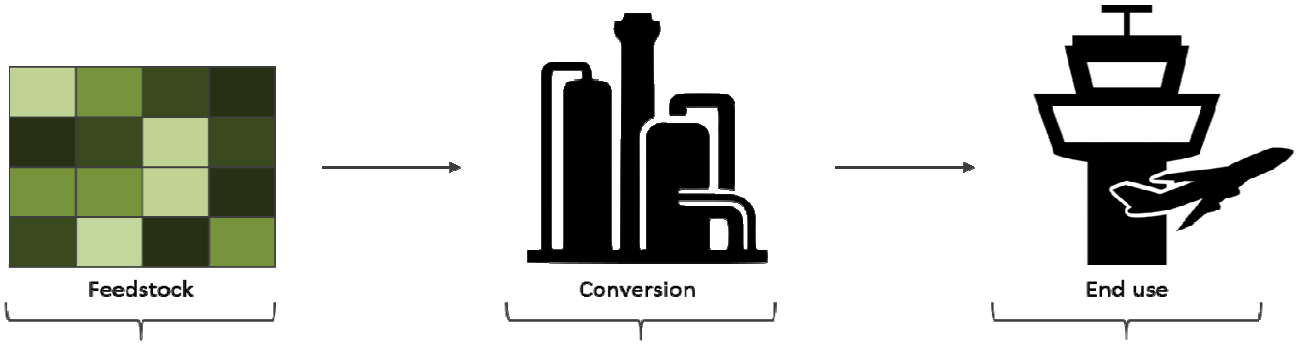
Are renewable jet fuels (RJF) viable?

This depends on its

The RENJET project assesses the viability of RJF and showcases promising concepts

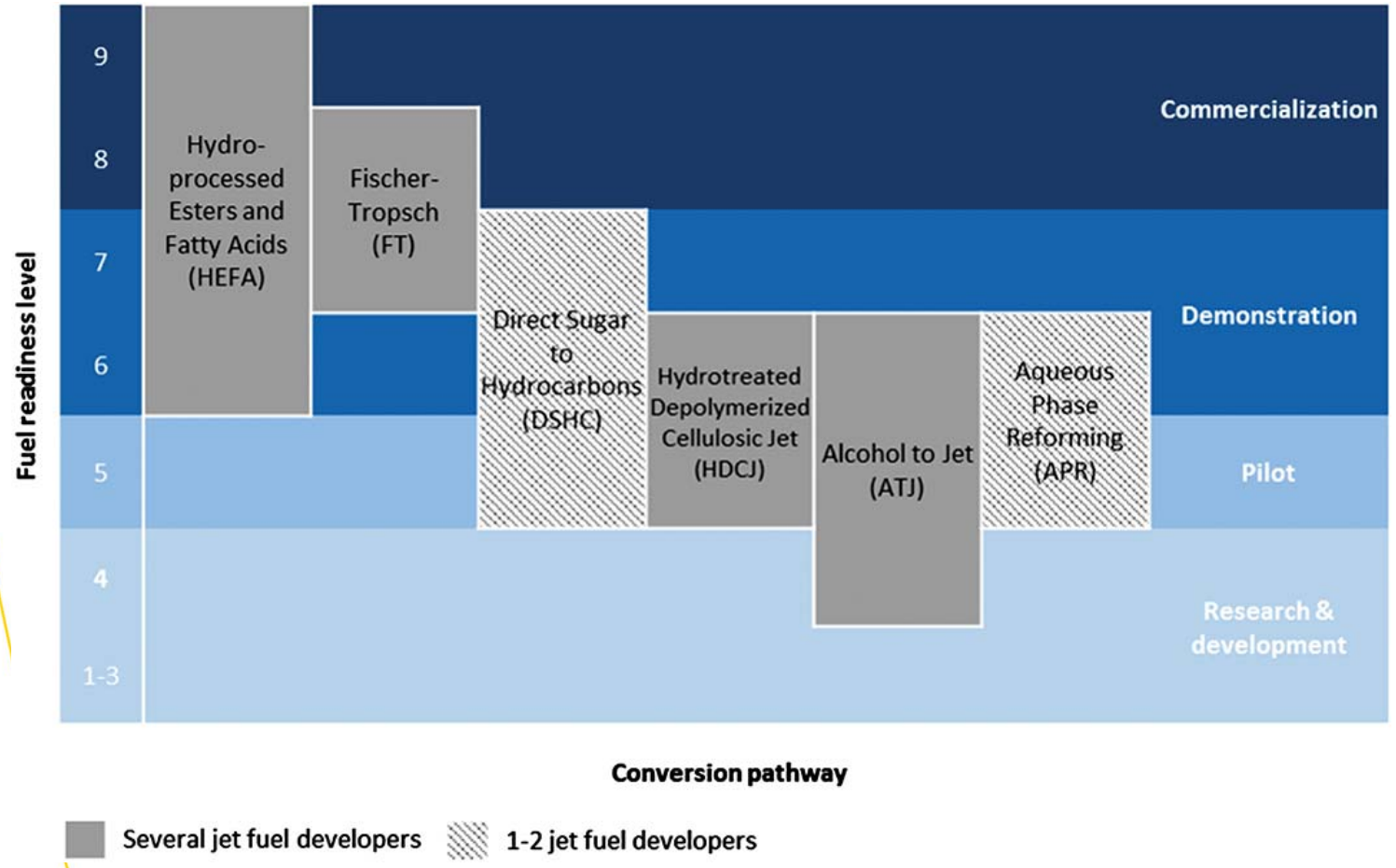
Identifying promising concepts



Showcases with additional partners

It is technically viable to produce renewable jet fuel (RJF), but further technology development is required

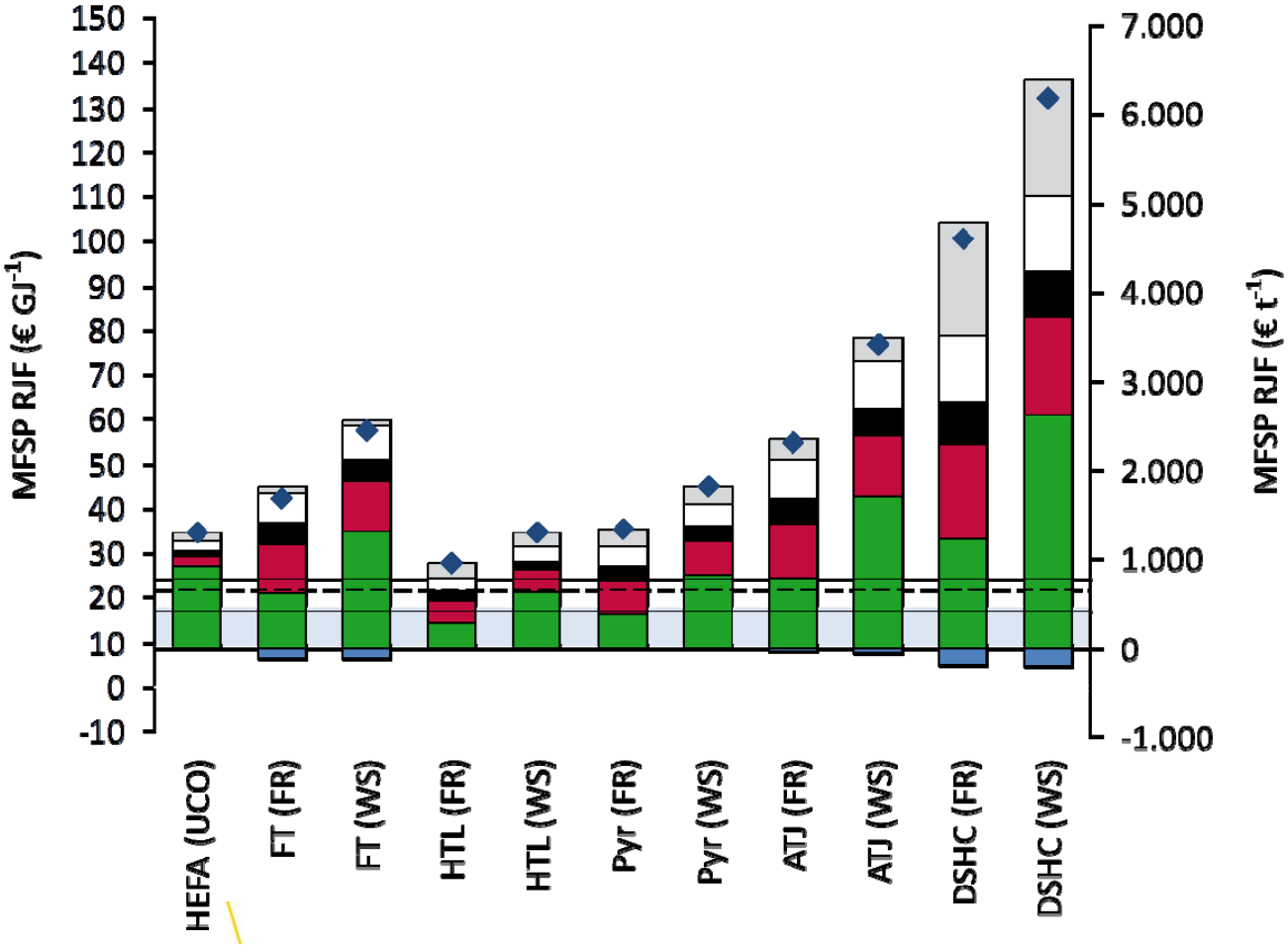
Fuel readiness level assessment of RJF conversion pathways



Mawhood et al. "Production pathways for renewable jet fuel: a review of commercialization status and future prospects". Biofuel, Bioprod. Bioref. (in press) DOI: 10.1002/bbb.1644

None of the assessed conversion pathways can reach fossil jet fuel prices

Production cost of RJF conversion pathways



Legend

- MFSP
- Utilities & other raw materials
- Other OPEX (incl. corporate taxes)
- Maintenance and repairs
- CAPEX
- Feedstock
- Non-hydrocarbon co-products

Top tenth percentile of the fossil jet fuel in the period 2005-2014

Average fossil jet fuel price 2014

Bottom tenth percentile of the fossil jet fuel in the period 2005-2014

Abbreviations

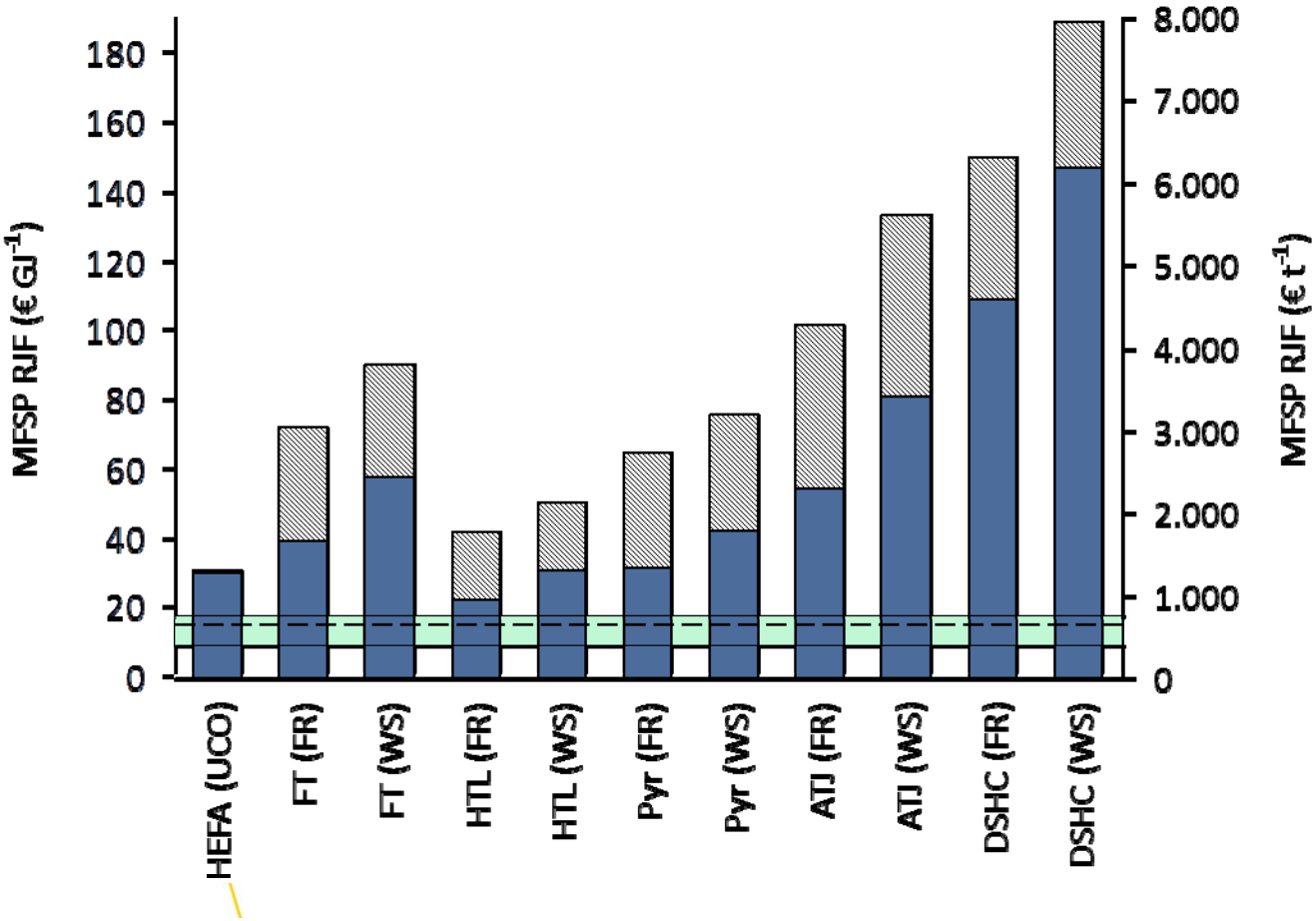
HEFA = Hydroprocessed Esters and Fatty Acids
FT = Fischer-Tropsch
HTL = Hydrothermal Liquefaction
Pyr = Pyrolysis
ATJ = Alcohol-to-Jet
DSHC = Direct Sugars to Hydrocarbons

UCO = Used cooking oil
FR = Forestry residues
WS = Wheat straw

De Jong et al. "The feasibility of short-term production strategies for renewable jet fuels – A comprehensive techno-economic comparison". Biofuel, Bioprod. Bioref. 9:778–800 (2015), DOI: 10.1002/bbb.1613

HEFA shows the best economic results on the short term; liquefaction routes are promising alternatives

Production cost of RJF conversion pathways (pioneer plant analysis)



Legend

- Pioneer plant
- Nth plant
- Top tenth percentile of the fossil jet fuel in the period 2005-2014
- Average fossil jet fuel price 2014
- Bottom tenth percentile of the fossil jet fuel in the period 2005-2014

Abbreviations

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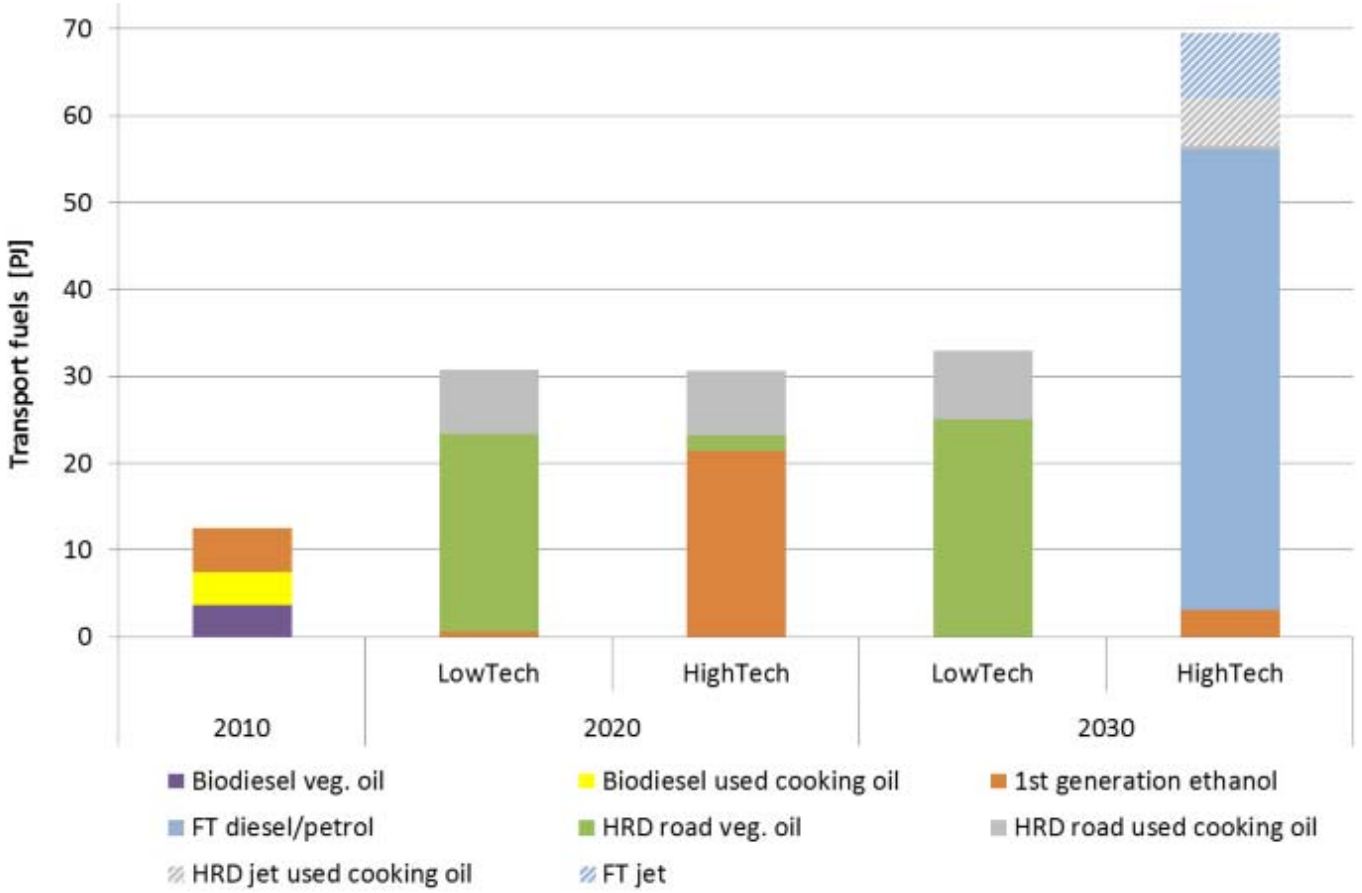
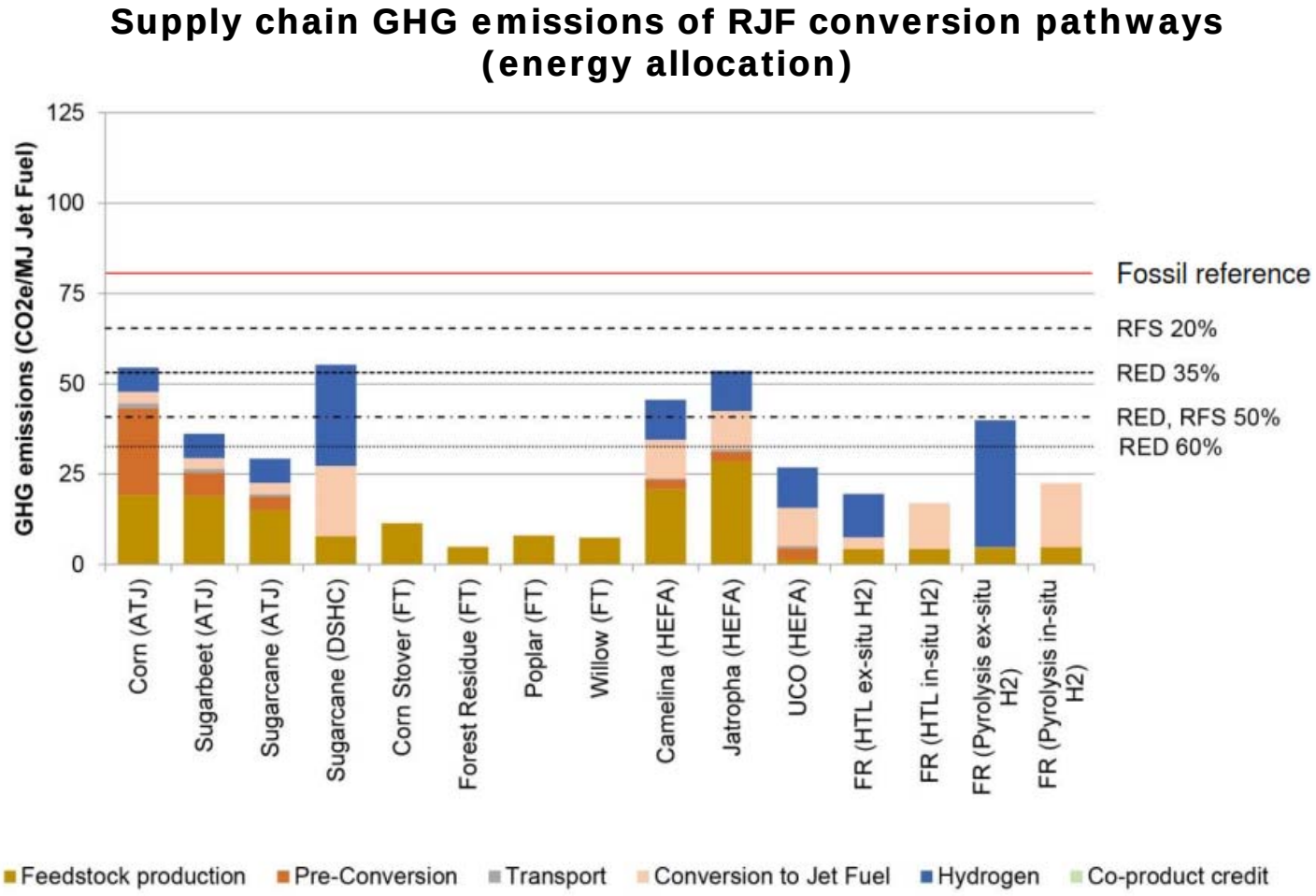
A mixed technology portfolio and high technology development is essential to get RJF to scale

Projections of bio-based transport fuels in the Netherlands in 2010-2030 by technology type



Tsiropoulos et al. “Emerging bioeconomy sectors in energy system modeling – integrated systems analysis of electricity, heat, road transport, aviation and chemicals: a case study for the Netherlands”. Preliminary results

Whereas FT can reduce GHG emissions by 90%, other pathways struggle to meet RED or RFS thresholds

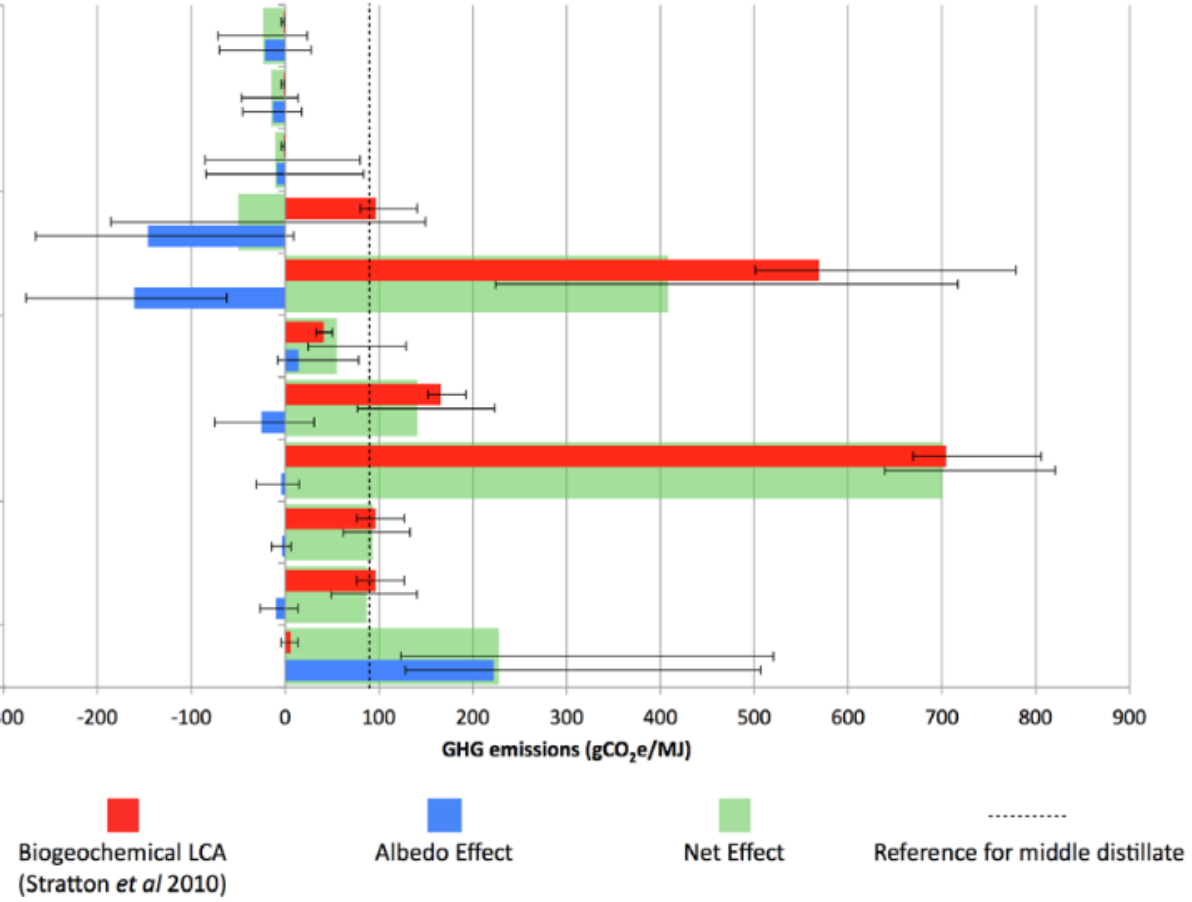


Antonissen et al. “Greenhouse gas performance of renewable jet fuel: a comparison of conversion pathways”. Preliminary results

Besides supply chain GHG emissions, other (local) sustainability criteria should be taken into account

GHG emissions of different conversion pathways under different land use change scenarios

Biomass	Original land	LUC Code	Fuel
Switchgrass	Corn	B1	F-T MD
Switchgrass	Soy	B2	F-T MD
Switchgrass	Barren	B3	F-T MD
Soy	Cerrado	S1	HEFA-MD
Soy	Rainforest	S2	HEFA-MD
Palm	Logged forest	P1	HEFA-MD
Palm	Rainforest	P2	HEFA-MD
Palm	Peat land	P3	HEFA-MD
Rapeseed	Corn	R1	HEFA-MD
Rapeseed	Uncultivated	R2	HEFA-MD
Salicornia	Desert	H1	F-T MD/ HEFA-MD



Caiazzo et al. "Quantifying the climate impacts of albedo changes due to biofuel production: a comparison with biogeochemical effects". Environ. Res. Lett. 9 (2014) DOI:10.1088/1748-9326/9/2/024015

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Are renewable jet fuels viable?

Technological viability

✓

There is no silver bullet; technology development remains essential

Sustainable viability

✓

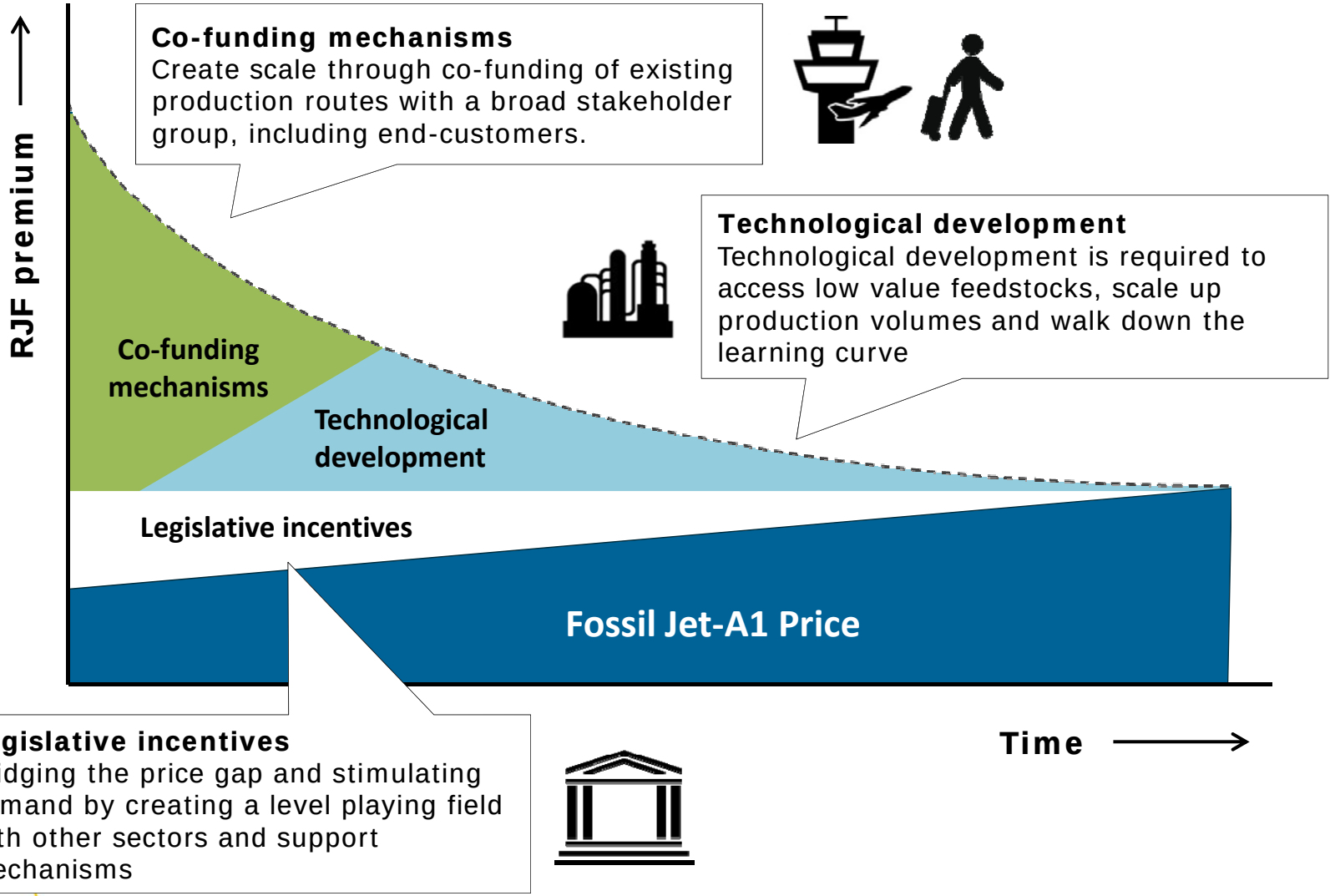
Yes, depending on local circumstances

Economic viability

✓

Mechanisms to bridge the premium are necessary on the short term

Getting this industry to scale requires cooperation of multiple stakeholders



Co-funding mechanisms
Create scale through co-funding of existing production routes with a broad stakeholder group, including end-customers.

Technological development
Technological development is required to access low value feedstocks, scale up production volumes and walk down the learning curve

Legislative incentives
Bridging the price gap and stimulating demand by creating a level playing field with other sectors and support mechanisms

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Thank you for your attention!

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Publicly available RENJET outputs

- De Jong et al. "*The feasibility of short-term production strategies for renewable jet fuels – A comprehensive techno-economic comparison". Biofuel, Bioprod. Bioref. 9:778–800 (2015)*, DOI: 10.1002/bbb.1613
- Mawhood et al. *"Establishing a European renewable jet fuel supply chain: the technoeconomic potential of biomass conversion technologies"*. Report (2014)
- Mawhood et al. "Production pathways for renewable jet fuel: a review of commercialization status and future prospects". Biofuel, Bioprod. Bioref. (in press) DOI: 10.1002/bbb.1644
- Antonissen et al. "Greenhouse gas performance of renewable jet fuel: a comparison of conversion pathways". (forthcoming)

Supply chain GHG emissions of RJF conversion pathways (energy allocation)