Technology Platform Power-to-Liquid-Fuels (TPP)

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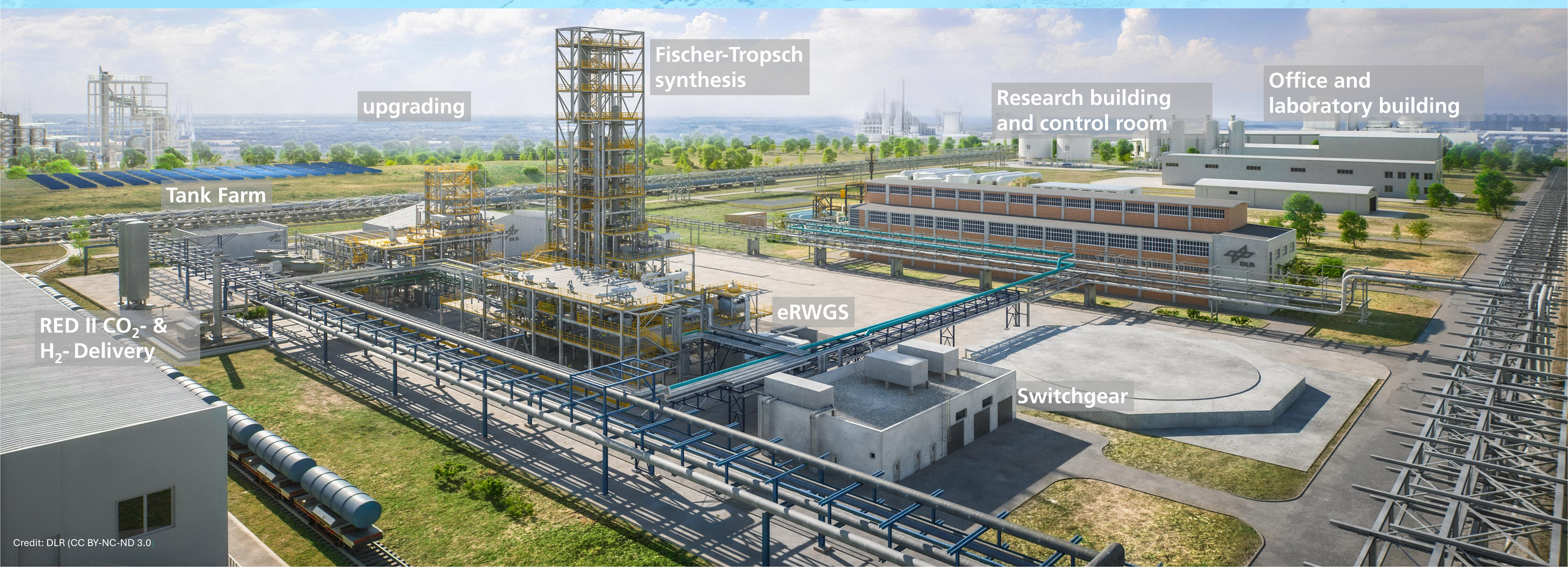

Motivation

- To reduce the climate impact of aviation, the use of liquid Sustainable Aviation Fuels (SAF) is necessary and unavoidable [1].
- Due to the limitation of available low GHG biomass within the EU, Power-to-Liquid fuels are needed for defossilisation of the aviation sector[1].
- A strongly rising demand of aviation fuels over the coming years (about 1.5 - 2 % per year) is expected [1].

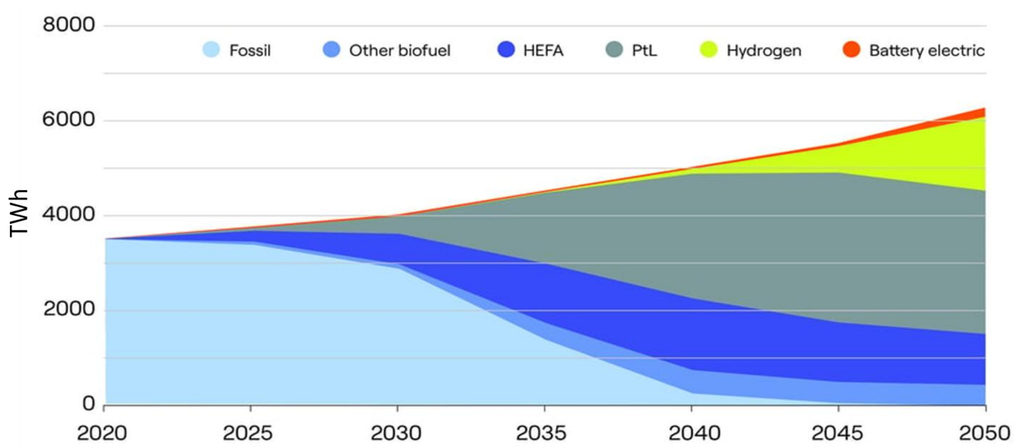

Figure 1 IATA Climate Ambition Pathway. Aviation fuel energy (in TWh) from each technology as a % of total consumption (2020-2050) [2]

- By the use of PtL-SAF,
  - the GHG-emissions can be reduced by more than 80 % [3].
  - non-CO_2-effects, e. g. by the formation of contrail cirrus, can be significantly reduced by Fuel Design [4].
- EU is supporting the introduction of SAF and especially of PtL with the “Fit For 55” package, setting quotas starting in 2025 from 2 % SAF raising up to 70 % SAF with a sub quota of 35 % PtL in 2050 [5].

Technology Platform for PtL Fuels (TPP)

- The Technology Platform Power-to-Liquid Fuels (TPP) is building by the German Aerospace Center (DLR)
  - Location: Leuna Chemical Site (Germany),
  - Capacity: 2,500 t/a PtL
  - Start of research operation: 2028
- At the TPP the whole process chain is build from renewable CO_2 and green hydrogen to the standard conform fuels
- Focus is set on scalable technologies
- renewable CO_2 and green hydrogen will be supplied to the TPP
- Synthesis gas is generated by an electrically heated Water Gas Shift reaction (eRWGS) of Topsoe (eReact™)
- Synthesis gas is converted to a PtL-Crude by Sasols Fischer-Tropsch Synthesis (FTS)
- FT-crude is upgraded to norm-conform and/or optimized fuels by Topsoe Upgrading

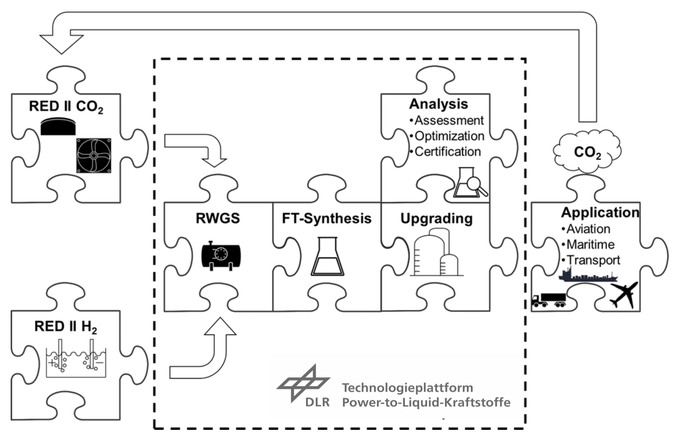

Figure 2 Components of the power-to-liquid fuels technology platform

Challenges

- Challenges for First-of-a-Kind plants
  - Demonstration larger than lab/technicum scale is missing
  - Low experience on off-takers side in handling PtL
- To overcome this problem, the gap between lab/technicum and industrial scale has to be filled by a semi-industrial plant.
- Such research and demonstration platform allows:
  - De-risking of the technology, integration, and upscaling
  - Producing relevant amounts of PtL for off-taker experience generation

Targets

- Demonstration of the successful operation of a power-to-liquid (PtL) plant
- Optimisation of PtL fuel production, e.g. in terms of energy efficiency and costs
- Risk minimisation during the planning, construction and operation of PtL plants
- Development of strategies for scaling up, integrating and optimising the technology
- Fuel design strategies to minimise the climate and environmental impact of fuels
- Fuel certification to support the market launch of PtL fuels

References

[1] Aigner, M. et al.: Roadmap für strombasierte Kraftstoffe, Zenodo 2023.
[2] Apollo Engineering Consultants Ltd. Alternative diesel study - ETF project, Net Zero Technology Center 2024.
[3] Pavlenko N. et al.: The cost of supporting alternative jet fuels in the European Union, International Council on Clean Transportation (ICCT) 2019.
[4] Voigt, C. et al.: Cleaner burning aviation fuels can reduce contrail cloudiness. Commun Earth Environ 2 2021.
[5] Artz, J. et al.: Normkonformität und Materialverträglichkeit alternativer Kraftstoffe 2025.

FUNDING PROGRAMME RENEWABLE FUELS
With funding from the Federal Ministry of Transport by decision of the German Bundestag
Coordinated by NOW
Project management agency VDI VDE IT

DLR