Synthetic fuels in aviation – Current barriers and potential political measures

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1. Background

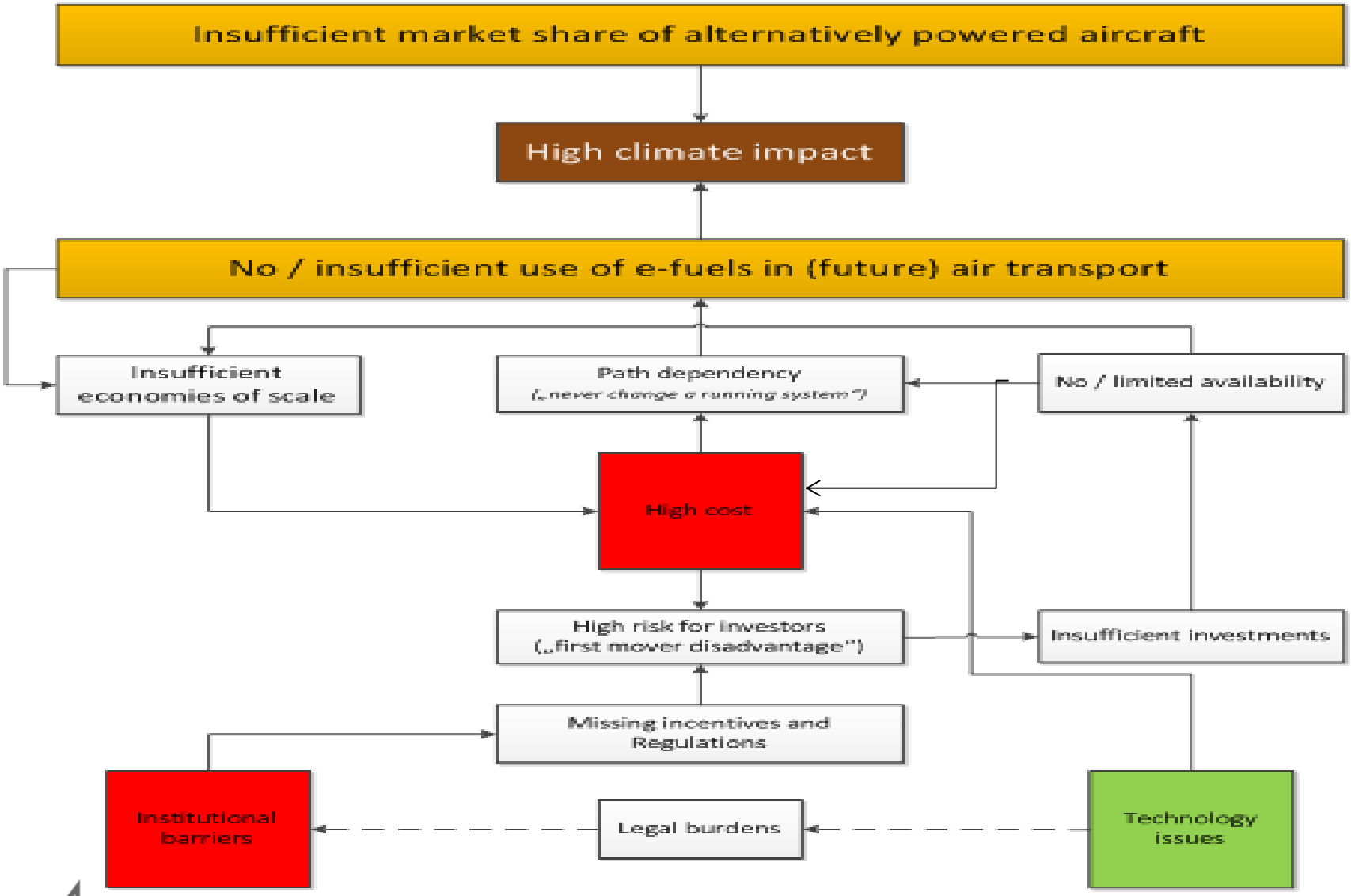
Alternative fuels can reduce aviation's climate-relevant emissions. Most promising options from today's point of view are: **biofuels** and **synthetic fuels** (power-to-liquid, short: PtL or e-fuels). Results from a supply perspective show that biofuels are advantageous in the short term while synthetic fuels could be favorable in the long run.

As it would certainly be too costly to finance a transitional biofuel system, it might be better **to prioritize** the use of **synthetic fuels** from the start.

Due to the **international character** of aviation, the future production and use of synthetic fuels in aviation is a global issue.

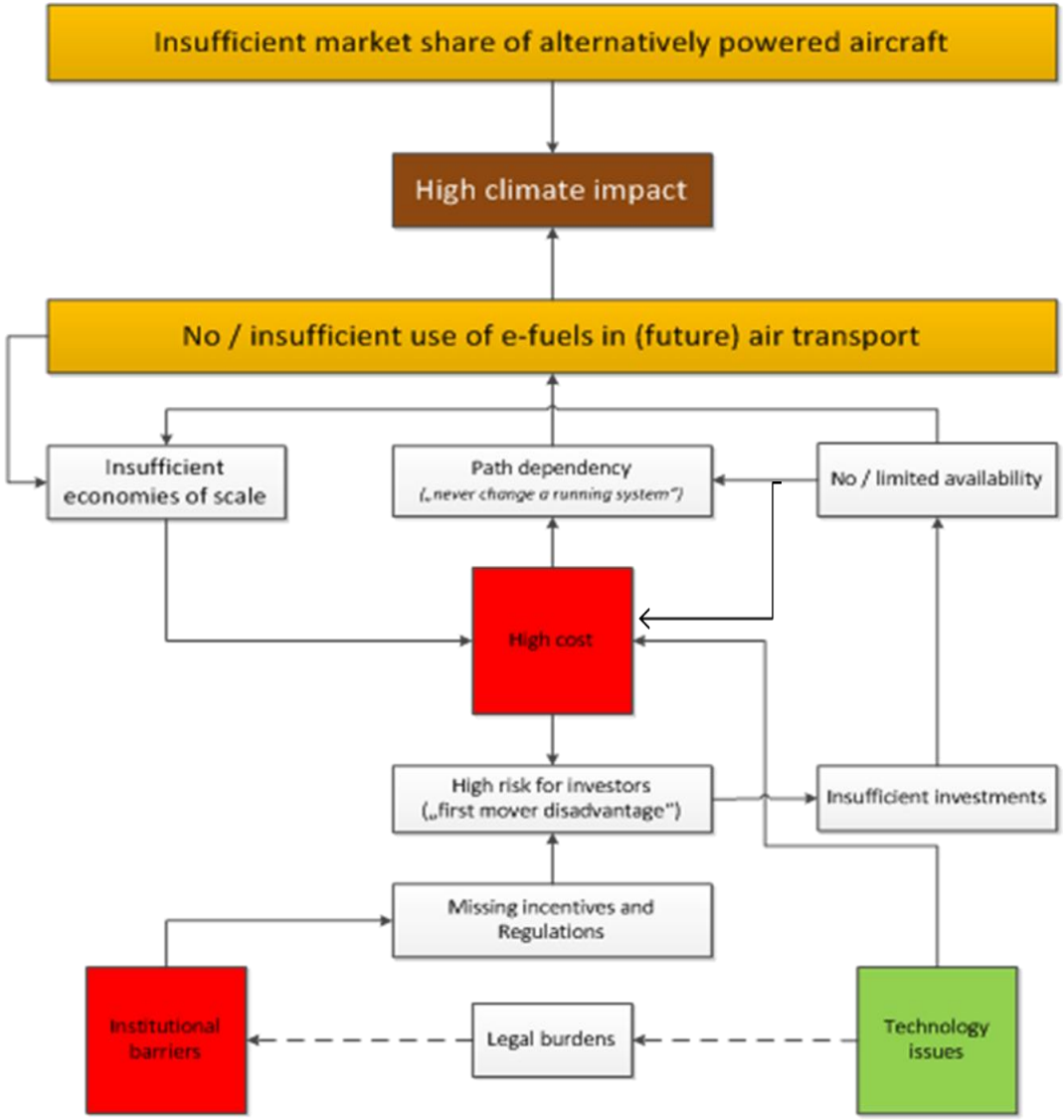
Which are the current **barriers** to the use of e-fuels in air transport? Which **political measures** could facilitate the use of e-fuels?

2. Barriers to the use of e-fuels in aviation - overview



2.1 Technological issues

- Fuel supply in aviation = well-attuned, running system
- ASTM D7566 and other standards allow for blending of Fischer-Tropsch and HEFA Synthesized Paraffinic Kerosene of up to 50% with conventional jet fuel
- Technologically, enough scope for massive PtL fuel in aviation



2.2 Cost of e-fuels

- Fuel costs make about one third of airline operating costs; low margins and high competition in aviation.

- Today, cost of e-fuels are about **3 – 4 times higher** than traditional jet fuel (DLR: 2.26 €/l for 2016 compared to about 0.5 €/l for conventional jet fuel (Albrecht, 2017)).

- For 2050, significant production costs reductions are expected by LBST (Ludwig-Bölkow-Systemtechnik GmbH). This could lead to a price of circa 1.352 €/t, still almost **twice as high** as for conventional fuel today. If the use of e-fuels increases, the price for conventional fuels could drop which would lead to an even larger delta between the prices for both kind of fuels.

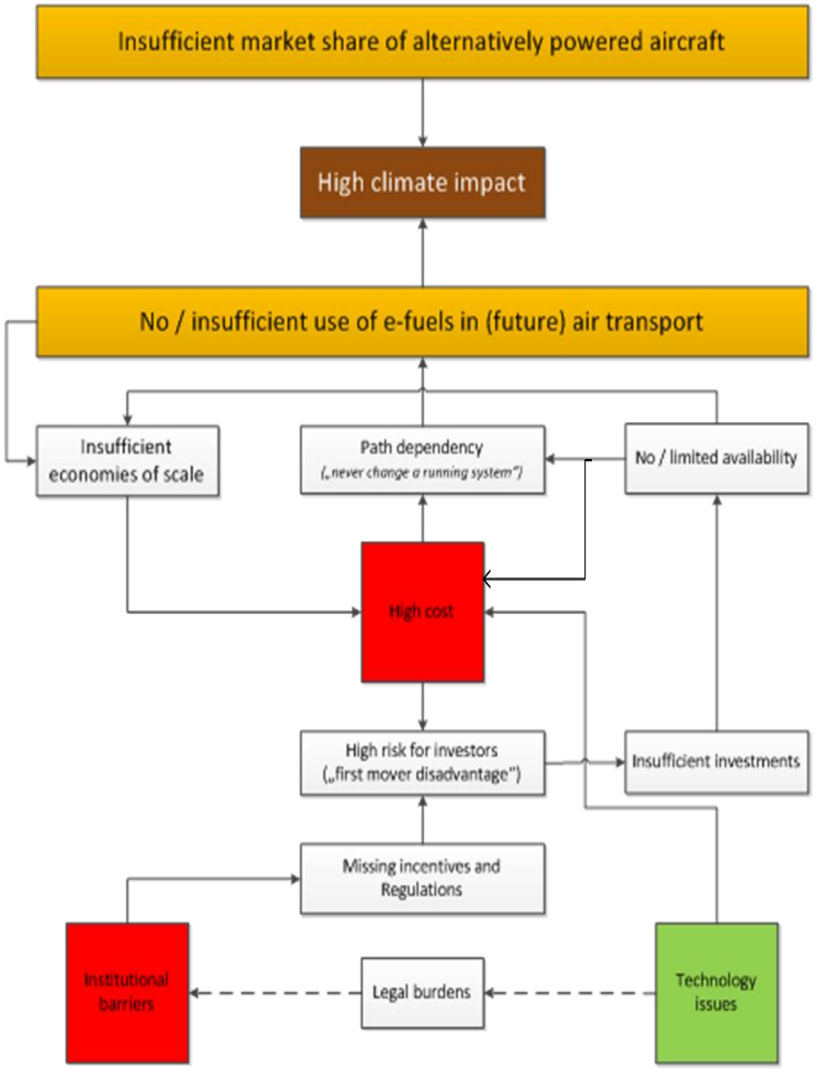
- No incentive to change fuel type as long as cost of e-fuels are higher than cost of conventional fuel.

2.3 Institutional and legal barriers

Missing incentives or regulations:
- Today, no incentives or regulatory measure to raise PtL share in aviation

Lack of global, cross-sectoral strategies

Legal barriers:
- Not yet assessed
- Stakeholders argue that blending quotas could well be introduced at national levels (technical specifications)



3. Potential political measures to facilitate the use of e-fuels - 3.1 Incentives for the development

- E-fuels production still has **high potentials for cost savings** – 3000-4000 € / t to 1000-1500 €/t in 2050 (Schmidt et al. 2018)

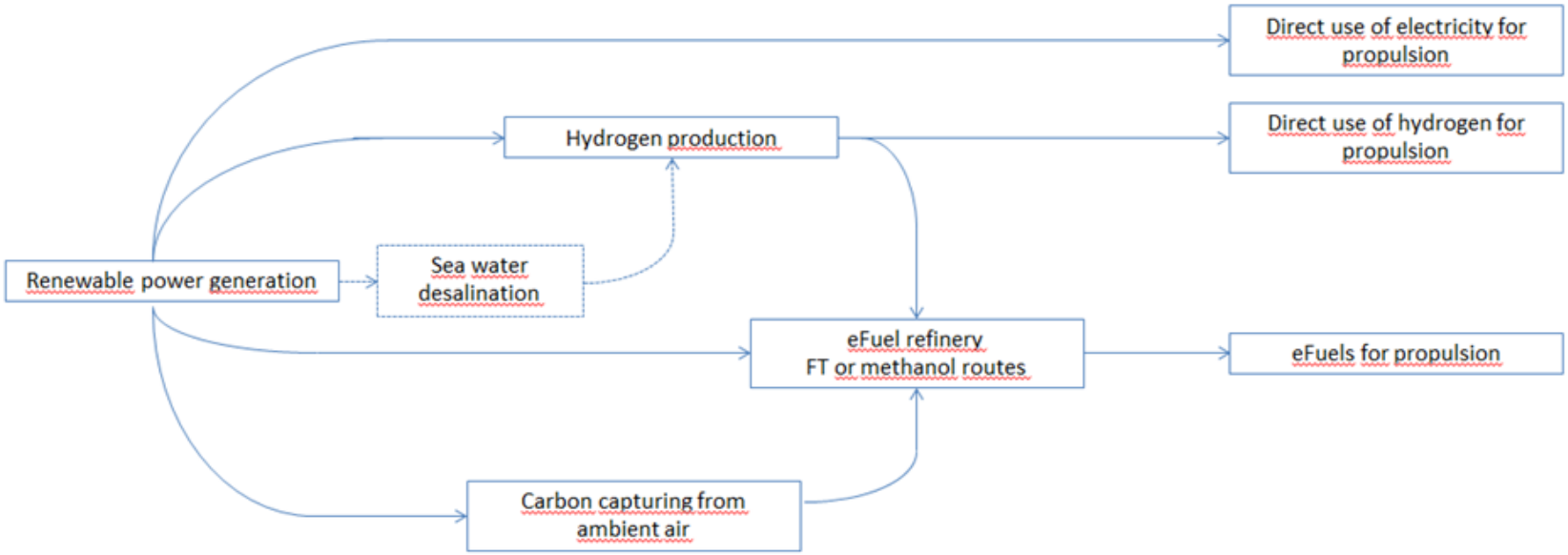
- **Market failure** for private investment due to uncertainty. This provides a reason for state intervention.

- State support in research and development will be important: **Subsidies** into the R&D of processes and/or **funding of pilot e-fuels refineries**. This could convince private investors to co-fund the development of e-fuels.

- However, **R & D needs a long time**. Therefore it is important to start soon.

3.2 Incentives for the production of e-fuels (1)

Flow chart of PtL production with Fischer-Tropsch or Methanol routes



Source: DLR.

E-fuels production cost are ultimately driven by **energy costs** and **capital costs** to build hydrogen production and carbon capture facilities, desalination plants, E-fuels refineries and initially also renewable power generation plants.

3.2 Incentives for the production of e-fuels (2)

Potential political measures include:

- **Subsidies** for the construction of technical elements of the PtL production chain (electrolyzeurs, carbon capturing, desalination, PtL refineries)

- „**German EEG-like**“ surcharge for cross-subsidising PtL production
  - Guaranteed price for producers
  - Who shall pay? Mineral oil producers/distributors or airlines? This implies legal questions
  - Experience with German EEG: Relatively high effectiveness (40% share in electricity consumption 2018), but at a price (30 billion € re-distribution annually to renewable energy lobby)
  - Legal issues in aviation (energy tax exemption, bilateral ASAs)

3.3 Incentives for the use of e-fuels

Possible political measures include:

- **Increasing the cost** of petroleum-based jet fuel by fuel/carbon tax or tightening of EU-ETS / CORSIA. This could reduce the cost differential between petroleum-based jet fuel and PtL.

- Introduction of a **compulsory blending quota** (in analogy to the blending quota applied in Germany for road transport fuels on the basis of the EU Directive 2009/28/EC and German Federal Emissions Law (BImSchG) §37a.)

- Introduction of so-called **green certificates**. This way, a split between the physical use and the financial flows is possible with advantages in logistic costs. However, kerosene is produced at far less than 100 locations in Europe, so logistics should be manageable.

4. Conclusion

A future use of more sustainable fuels would have significant impacts on the environmental footprint of the aviation sector. However, a system transition to alternative fuels would require **large investments** and needs a **long time**.

Our assessment of **possible political measures** for the promotion of e-fuels has shown that on the one hand a **variety** of measures would be useful.

However, on the other hand the **international character** of aviation makes improvements difficult to realize. Against this background it is recommendable to **start with national and European approaches** first while at the same time begin negotiating on the **ICAO level**. An alternative would be to directly address the **mineral oil industry** instead of ICAO.

Thank you very much for your attention!

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