

Passenger Aircraft towards Zero Emission with Hydrogen and Fuel Cells

Task for a *Project*

Background

According to the EU's "Green Deal", no more net greenhouse gas emissions should be released in 2050. All modes of transportation will have to contribute to this reduction. This includes also aviation. To keep things relatively simple here, the aircraft is considered the system boundary. This is called "tank-to-wake". The options to achieve "zero emission" flight (in these boundaries) are limited. Electric flight with batteries will be limited to short range for years to come. Burning hydrogen in jet engines would be a major step forward, but is clearly no solution to achieve "zero emissions", it emits NO_x and water vapor. Electric flight with hydrogen and fuel cells could be an option. It has neither CO₂ nor NO_x emissions. Furthermore, it releases water in liquid form. Discussed is a new short-medium range aircraft to the Top Level Aircraft Requirements (TLAR) of the Airbus A320. Liquid hydrogen (LH₂) is considered as fuel. Tools for preliminary sizing of jet and propeller passenger aircraft (PreSTo-Classic) are available, but need to be modified for a fuel cell aircraft.

Task

Task of this project is to determine the feasibility of a fuel cell passenger aircraft powered by LH₂. The subtasks are:

- Review current aircraft projects with hydrogen and fuel cells.
- Describe and discuss the components of the hydrogen-electric powertrain.
- Summarize fundamentals of preliminary aircraft sizing.
- Show the necessary additions to a tool for preliminary aircraft sizing of propeller aircraft (CS-25) to allow sizing of a fuel cell aircraft.
- Show options how to deal with the emitted water. Can the water be collected in a tank and transported down? Can the water be transformed into ice cubes that are discarded over board? What would (most likely) be the consequences of emitting water depending on cruise altitude?
- Evaluate your designs: Compare the A320 jet with a related propeller aircraft, a hydrogen fuel cell aircraft sized with current technology parameters, and one sized with future technology parameters.

- Summarize the results, draw conclusions, and make recommendations for further research.

The report has to be written in English based on German or international standards on report writing.