Technical University of Munich
Chair of Helicopter Technology
Chair of Carbon Composites

Hydrogen Demonstrator and Development Environment (HyDDEn)

Holistic Air Mobility Initiative Bavaria (HAMI)

Motivation

For future eVTOL aircraft with a long range, powertrain concepts with high energy densities are crucial. TUM, DLR and Elektra Solar will therefore research such drives in the HyDDEn project.

Project Plan

Models, methods and knowledge will be acquired in the following research fields:

- Development of a **demonstrator drone** by converting the AREA research drone from battery-electric to hydrogen-hybrid energy supply.
- Development of a **conformable tank** for integration into the demonstrator
- Modelling of hydrogen architectures and development of a **design environment** for their dimensioning under consideration of performance, mass and **safety**

Abb.: AREA-Forschungsdrohne, entwickelt von HT und DLR

Development Environment (HT)

Hydrogen energy supplies for aircraft require considerably more complex system architectures than batteries. Relevant components include:

- Fuel cell
- Hybrid batteries for peak loads
- Pressure tanks with pipes
- Power electronics
- Air supply and cooling

To address this complexity, a design environment for arbitrary hydrogen power supply architectures for eVTOLs will be developed.

Safety (HT)

Safety and certification of such systems is considered from the beginning through the following aspects:

- Analysis of current and future standards (e.g. SAE ARP4761)
- Generic functional and safety analyses
- Research into the failure behaviour of components
- Combined consideration of the correlation between safety and system mass

Conformable Hydrogen Pressure Tank (LCC)

A tank optimised for the AREA is being developed and built. This is to demonstrate the advantages over cylindrical tanks:

- Improved use of installation space leads to higher volume and greater range
- Optimised tank design can improve aerodynamics and thus reduce power consumption

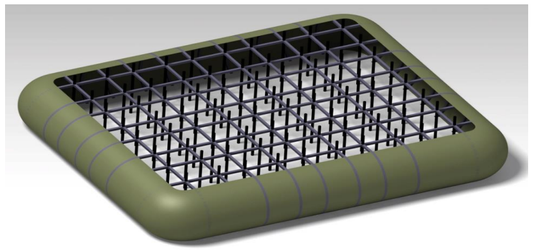

Abb.: Prototypenkonzept für bauraumkonforme Tanks [TUM-LCC, Polymers4Hydrogen]

Challenges are:

- Absorption of additional bending loads
- Simultaneous weight minimisation for aerospace application

The following development steps are planned :

- Concept development & evaluation
- Design & preliminary layout
- Detailed design and analysis
- Prototype production
- Validation with burst test, integration & ground test

Demonstratordrohne (HT, DLR, Elektra Solar)

The AREA research drone, developed jointly by HT and DLR, is being converted in HyDDEn from the previously installed battery power supply to a hydrogen-hybrid system. This consists of:

- Fuel cell with 4.8 kW power
- Hybrid batteries for load peaks
- Pressure tanks

The targeted flight duration is > 1h with a payload of 5 kg. The aircraft will have an estimated take-off weight < 60 kg.

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Funded by:

Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie

Supported by:

AIRBUS DIEHL Aviation CRYOMOTIVE BMW GROUP

Technical University of Munich
TUM School of Engineering and Design
Chair of Helicopter Technology
Chair of Carbon Composites

Deutsches Zentrum für Luft- und Raumfahrt
Institut für Robotik und Mechatronik
Oberpfaffenhofen

Elektra Solar GmbH
Landsberg am Lech

Holistische Air Mobility Initiative Bayern (HAMI)
Bayerische Staatsministerium für Wirtschaft,
Landesentwicklung und Energie (StMWi)

Projektträgerschaft:
Industrieanlagen-Betriebsgesellschaft mbH
Ottobrunn