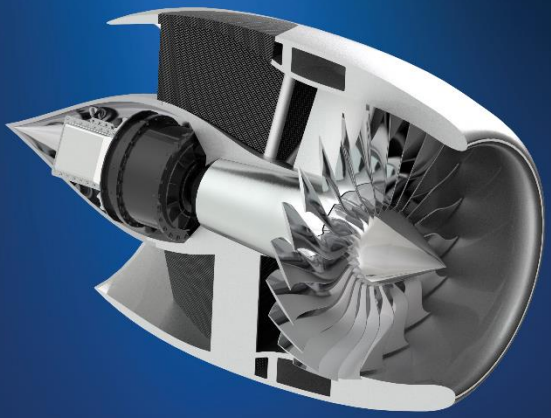
Organized by

EXFAN

# VIENNA AVIATION DAYS 2024

**08-09 JULY**

TU VIENNA | TUtheSky
Vienna, Austria



# PROGRAM

Hosted by TU WIEN

Powered by ADT engineering

Funded by the European Union

VIENNA AVIATION DAYS 2024

**VIENNA AVIATION DAYS**
**2024**

# *HYDROGEN HYBRID-ELECTRIC PROPULSION SYSTEMS AS KEY TO CLIMATE NEUTRAL AVIATION*

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EXFAN

# Hosted by TU Wien

The Vienna Aviation Days, initiated by exFan, is an event that brings together experts and enthusiasts in the field of hydrogen powered aviation. This platform enables the presentation and discussion of forward-thinking technologies from researchers and engineers with a dedication to complex and challenging ideas. TU Wien welcomes all participants to have an inspiring time together at TUtheSky!

Our research group is dedicated to developing systems for a sustainable aviation that warrant clean, efficient, and yet affordable air transport in the future. In exFan, TU Wien assumes the role of the research coordinator and we investigate the complex interaction between the heat exchanger and air side up- as well as downstream components in particular diffusers and nozzles.

We are excited to be part of the Vienna Aviation Days and invite all participants to actively engage in the discussions.

Martin Berens

**Prof. Dr.-Ing. Martin Berens**
**BMK Endowed Professorship for Innovative Aviation Technologies, TU Wien**
Lehargasse 6, Objekt 7
1060 Wien
Österreich

# Powered by ADT

I am glad to have the opportunity to welcome you to the first Vienna Aviation Days as the representative of ADT-Engineering.

This event is planned as a connection platform of different activities focused on sustainable aviation all over Europe. Information from research, industry and policy is shared with research and industry. It should help to find partners for further collaboration and a base to share knowledge.

Besides top-class presentations of innovations and the framework for it, there is also room for informal exchange during the evening event.

I wish you an interesting conference with good talks and a nice stay in Vienna. I hope to welcome you again to the Vienna Aviation Days 2025!

**Dr. Hanns Amri**
**General Director**
**Advanced Drivetrain Technologies GmbH**
Leonard-Bernstein-Straße 8/2/ EG 1
1220 Wien
Österreich

## Day 1

**Welcome Adress**
12:30-13:00 Registration
13:00-13:10 Opening Speech
13:10-13:30 Introduction Speech
- Jens Schneider TU Wien
- Michael Weigand TU Wien
- Martin Berens TU Wien

**13:30 - 15:00 Block 1 Policy, Strategies**
- M. Kyriakopoulos EC
- Janik Fernandez Clean Aviation
- Ingrid Kernstock BMK
- Kai Wagner BMWK
- Ron van Manen Luchtvaart in Transitie

**15:30 - 17:30 Block 2 Challenges & Opportunities**
- Johannes Hartmann Airbus
- Peter Rostek Airbus
- Michele De Gennaro AIT
- Feija Yin TU Delft
- Fabrice Giuliani TU Graz

**17:30 - 17:40 Closing Speech**
- Hanns Amri ADT

**18:30 Dinner at venue**

## Day 2

**09:00 - 09:10 Opening Speech**
- Hanns Amri ADT

**09:10 - 11:10 Block 3 Hydrogen combustion & hydrogen electric propulsion systems**
- Martin Berens TU Wien
- Yan Duranteau SAFRAN
- Stefanie De Graaf DLR
- Francesca Di Mare Uni Bochum
- Patrick Jagerhofer TU Graz

**11:40 - 13:30 Block 4 Architecture, On Board Storage, Modelling**
- Helmut Kühnelt AIT
- Michael Schilling Test-Fuchs
- Stephan Ucsnik HYCENTA
- Alexander trattner LKR
- Jan Haemisch DLR

**13:30 - 13:45 Event closure**
- Martin Berens TUW
- Hanns Amri ADT

## BLOCK 1: POLICY

Climate neutrality is a global challenge, in which all stakeholders need to participate to mitigate the impacts of climate change. For challenges at this scale, individual efforts may not be sufficient. European, German, Dutch and Austrian governments and partnerships focus their efforts in supporting the maturation of technologies and methods that help European aviation in becoming climate neutral, independent, sustainable and competitive.

M. Kyriakopoulos will represent the *European Commission*, Janik Fernandez *Clean Aviation*, Ingrid Kernstock the *Austrian BMK*, Kai Wagner the *German BMWK* and Ron van Manen the Dutch *Luchtvaart in Transitie* to discuss strategies and possible future synergies to accelerate climate neutral aviation.

*This block will present challenges and strategies of European policies to support the aviation industry.*

European Commission

CLEAN AVIATION

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie

Bundesministerium für Wirtschaft und Klimaschutz

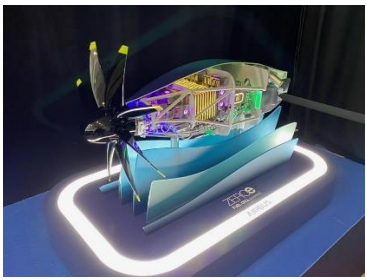
LUCHTVAART in transitie

## BLOCK 2: CHALLENGES & OPPORTUNITIES

The use of hydrogen as a sustainable aviation fuel offers substantial benefits regarding emissions and raw material availability. However, there are several challenges that need to be solved before hydrogen powered aviation may become commercially available: On the technological side, storage, fuelling and the development of a safe hydrogen infrastructure at airports is required. Additionally, there is a need for both the hydrogen propulsion technology and their qualification for a hydrogen aircraft to be permitted to fly.

While hydrogen is generally perceived as climate friendly, the real impact of hydrogen aviation on the environment is still unclear.

*This block presents solutions and roadmaps that aim to tackle the general challenges of using hydrogen as an aviation fuel and accurately predicting the climate impact due to non-CO2-emissions.*



*The ZeroE fuel cell propulsion system & facility for ground tests by Airbus*

## BLOCK 2: CHALLENGES & OPPORTUNITIES

**Johannes Hartmann** (Airbus) will open the session demonstrating a qualifiable fuel cell propulsion system for civil aircraft and presenting the strategic research and innovation agenda of the Clean Aviation JU.

**Peter Rostek** (Airbus) will show specific examples of ground test benches that are used to explore sustainable propulsion systems for future aircraft. Airbus ambitions and objectives will be presented.

**Feijia Yin** (TU Delft) will discuss how an aircraft propulsion concept can achieve fuel flexibility. Additionally, methods to better predict persistent contrails and significantly reduce global mean contral radiative forcing.

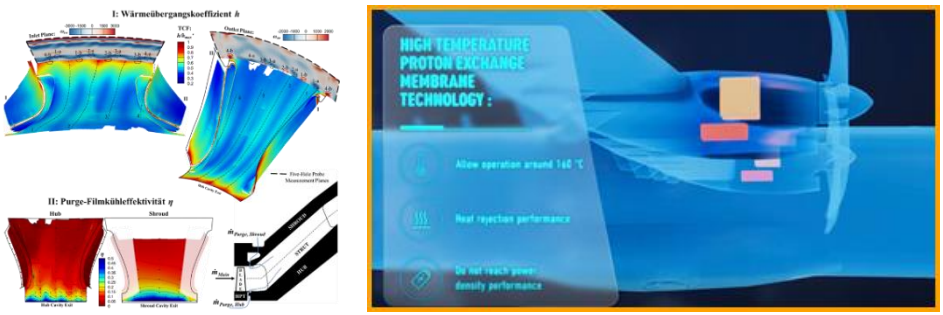
**Michele de Gennaro** (AIT) will present challenges regarding the ground operations of future green airports related to the H2-refuelling of aircraft. He will also discuss the next generation of reference models and methods to estimate present and future aircraft pollutants and noise and how many people it affects.

**Fabrice Giuliani** (Combustion Bay One) Thermal management of hydrogen is equally as important on the aircraft during operation as it is in storage infrastructure: The LH2 system of an airplane has to distribute LH2 in a liquid state and perform a last-minute gasification before consumption.

# BLOCK 3: HYDROGEN COMBUSTION & HYDROGEN-ELECTRIC PROPULSION SYSTEMS

The heart of the zero-emission aircraft is its propulsion system. When using hydrogen as fuel both combustion and fuel cells are possible methods to power the aircraft. For fuel cells in aviation, thermal management is a major challenge as nearly the same amount as electric power must be rejected as heat. Thus, large heat exchangers are necessary and there may be much potential to recuperate energy from the “waste” heat. Combusting hydrogen in an aviation turbine engine is a concept that comes closer to current propulsion technologies. However, hydrogen combustion comes with its own set of challenges: Hydrogen has different combustion properties than kerosene, material choice is critical and while no CO2 is produced, it may lead to NOx emissions.

*In this block, solutions to achieve the most efficient and lightweight hydrogen-propulsion systems for future aircraft are presented.*




*A simulation of heat transfer during hydrogen combustion (TU Graz) & the benefits of a high temperature PEM fuel cell (NIMPHEA)*

# BLOCK 3: HYDROGEN COMBUSTION & HYDROGEN-ELECTRIC PROPULSION SYSTEMS

**Martin Berens** (TU Wien) presents challenges for electric aircraft using low-temperature fuel cells and a possible solution for thermal management and recuperation of so-called “waste” heat.

**Yan Duranteau** (SAFRAN) shows how high-temperature PEM fuel cells have enormous potential for aircraft thermal management and presents activities related to a new membrane technology that may allow operation at around 160°C – about twice that of low-temperature PEM fuel cells

**Stefanie De Graaf** (DLR) discusses an even more high-temperature solution: A coupled solid-oxide fuel cell (SOFC) with a gas turbine. Usually SOFCs operate at around 500°C, which makes heat rejection much less of a problem but poses different challenges.

**Francesca Di Mare** (Uni Bochum) Beyond the fuel cell is also the option of hydrogen combustion. For this, new methods are necessary to design the core engine.

**Patrick Jagerhofer** (TU Graz) research starts in the combustion chamber, over heat transfer and film cooling and ends with thermal investigations on high-speed low-pressure turbines for future architectures.

# BLOCK 4: ARCHITECTURE, ON BOARD STORAGE & MODELLING

Liquid Hydrogen with its low temperature of around -250°C creates new challenges in the airplane. Those include tank, on board storage and fuel distribution systems as well as refuelling. Cryogenic technologies are required for long-term liquid storage and the choice of lightweight materials for aviation applications are challenging, especially when safety critical components such as valves are considered. Testing infrastructures for applications of liquid hydrogen are necessary to allow researchers to test technologies early. Battery electric storage often needs to be used in parallel to hydrogen but brings a major challenge due to its low energy density.

*This block will outline solutions for onboard energy storage (hydrogen & battery) as well as components necessary for cryogenic hydrogen storage and presents possibilities for testing facilities for researchers & industry.*

*Liquid hydrogen A320 ground demonstrator (DLR) and a load bearing battery cell (MATISSE) that may be used as a structural element in future more-electric aircraft*

# BLOCK 4: ARCHITECTURE, ON BOARD STORAGE & MODELLING

**Helmut Kühnelt** (AIT) gives an overview of electric energy storage and shows why it is relevant to have batteries on board of future aircraft. Including batteries within load bearing structures may be key for application of larger batteries in aircraft.

**Michael Schilling** (TEST-FUCHS) presents the practical challenges and solutions of cryo-technology for liquid hydrogen for aircraft such as valve technologies, testing solutions and ground support equipment.

**Stephan Ucsnik** (LKR) shows opportunities of using additive manufacturing to produce double layer aluminium tanks with vacuum. He will outline material characteristics for cryogenic applications, impermability testing and availability aspects for production.

**Alexander Trattner** (HYCENTA) discusses experiments and simulations related to liquid hydrogen tank & fuel cell technologies performed at the Austrian Hydrogen Center.

**Jan Hämisch** (DLR) presents the capabilities of the cryogenic testing infrastructure *Lampoldshausen*, their test rigs and the challenges associated with handling very low temperature media.

exFan is an EU funded collaborative research project set out to devise a novel heat dissipation and recovery system within a high-powered electric fan propulsion system driven by fuel cell technology. Central to this objective is the incorporation of a ducted heat exchanger (HX) within the propulsion system's nacelle. It will use the "Meredith effect" (ME) incorporating the ram jet effect to generate thrust from waste heat. The breakthrough innovations proposed in exFan will: allow aircraft manufacturers to offer savings in operation costs, enable European aeronautics industry to maintain global competitiveness and leadership, create significant contribution in the path towards CO and NOX emission free aircraft, investigate how heat propulsor can be integrated within a hydrogen-electric propulsion system, advancing it to Technology Readiness Level 3 (TRL 3)

Project Coordinator

cidetec surface engineering

Technical Coordinator

ADT engineering

Research Coordinator

TU WIEN TECHNISCHE UNIVERSITÄT WIEN

Project Partners

TUM FZG

IRES

Egile MECHANICS

EASN TIS

Fraunhofer IAPT

DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center

powerid

*THE VIENNA AVIATION DAYS WILL RETURN IN 2025*

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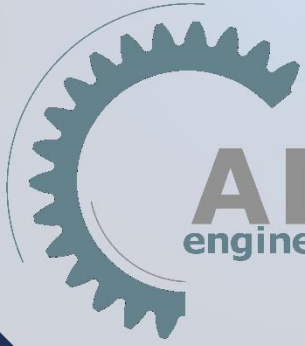


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