exFan is a European research project developing a novel way to manage and recover heat in fuel cell hydrogen-electric propulsion systems.
By integrating a **ducted heat exchanger** within an **electric geared turbofan engine**, exFan uses waste heat to generate additional thrust, improving overall propulsion efficiency.

OBJECTIVES

- Integrate a novel additively manufactured heat exchanger into the flow path of a geared electric fan engine.
- Develop a recuperation concept that converts fuel-cell waste heat into useful thrust.
- Implement system-level thermal management and performance simulations.
- Ensure active knowledge exchange with the Clean Aviation and Clean Hydrogen partnerships, and the Climate Friendly Aviation Technologies (ClimAvTech) cluster.

TEAM

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

CONNECT WITH EXFAN

GA: 101138184
Duration: 48 Months
Start Date: 01.12.2023
Project Month: 24

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Design by EASN-TIS

EXFAN

NOVEL RECUPERATION SYSTEM
TO MAXIMIZE EXERGY FROM ANERGY
FOR FUEL CELL POWERED
GEARED ELECTRIC AIRCRAFT
PROPULSION SYSTEM

M24

TURNING HEAT INTO THRUST

Funded by the European Union

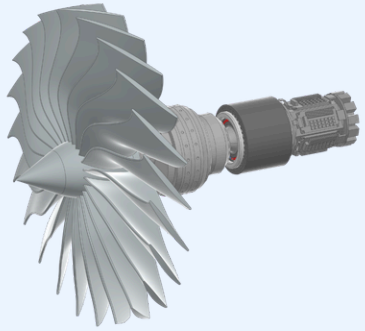
About the Project

exFan investigates how **heat dissipation and recovery** can be integrated into a **hydrogen-electric aircraft propulsion system**.

The project's key innovation lies in embedding a **heat exchanger (HX)** within the propulsor flowpath to recover waste heat and generate additional thrust through the **Meredith effect**.

This novel approach aims to:

- Improve propulsion efficiency,
- Support the transition to zero-emission aviation technologies, and
- Advance the concept to **Technology Readiness Level 3 (TRL 3)**.



EXPLORING THE POSSIBILITIES WHERE PROPULSION AND HEAT MANAGEMENT MEET

Mid-Term Achievements

At the 24-month stage, exFan has achieved major milestones across design, modelling, and materials.

Mechanical Powertrain

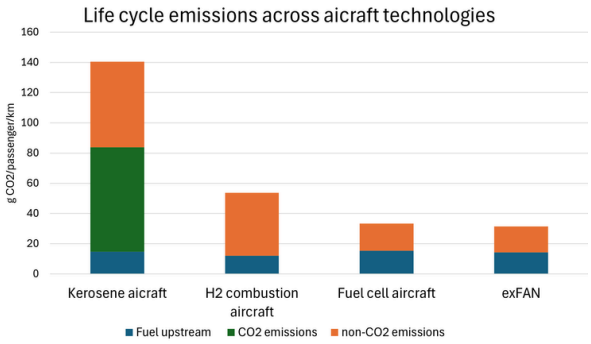
It provides the main performance values required: Shaft power, efficiency, mass, volume and power density.

Energy System

A fuel cell–battery concept that minimizes power losses using power-split, oxygen injection, and internal regeneration.

Life-Cycle Assessment

A best compromise between productivity and environmental performance is aimed. The exFan aircraft concept exhibits the lowest overall life-cycle climate impact among all evaluated aviation fuel and propulsion options. When direct CO_2 emissions, non-CO_2 climate effects, and fuel-production-related emissions are considered together, exFan emerges as the most promising pathway for reducing aviation's climate footprint.

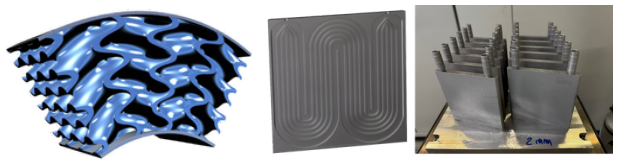


Heat Propulsor

Concepts for intake, fan stage, diffuser, heat exchanger, and nozzle investigated in 1-D simulations.
Fan, diffuser, and heat exchanger identified as critical components for detailed design.

Material & Surface Work

CIDETEC has initiated coating tests for the HX, applying chemical polishing and electroless NiP coatings on additively manufactured samples. These coatings aim to enhance corrosion resistance, reduce fouling, and improve heat rejection.



- **Surface polishing**: Roughness reduced by nearly 50% (Ra 11 µm → 4-5 µm).
- **NiP coatings**: Thicknesses 9–30 µm, improved adhesion, corrosion, and erosion resistance.
- **Innovative designs**: TPMS-inspired geometries with novel tunnel shapes for better airflow.