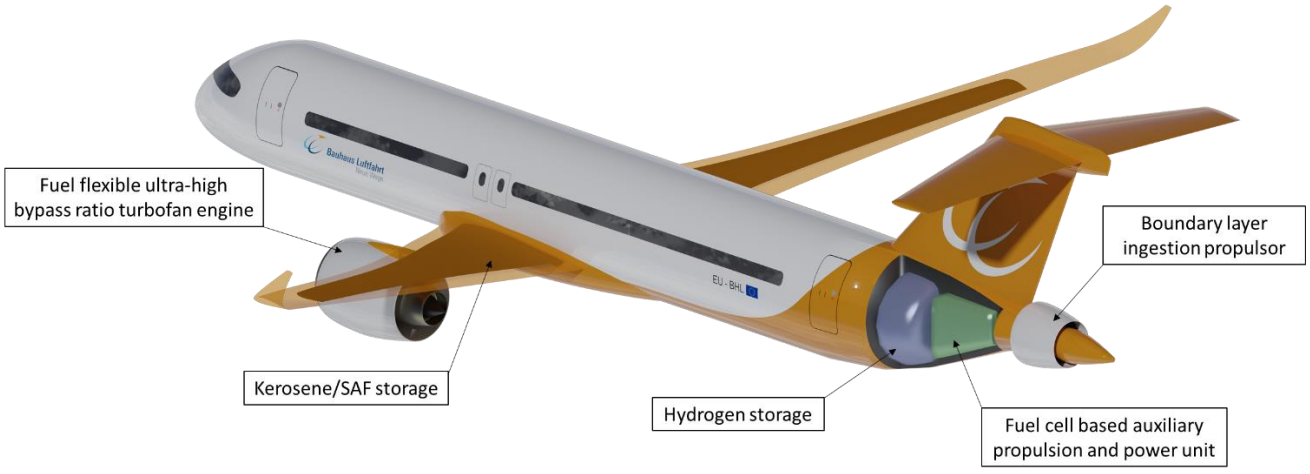
Horizon Europe HOPE project to advance hydrogen-powered propulsion

Although the contribution of aviation to global climate change is relatively small, it also keeps increasing. Meanwhile, air quality and noise impact in areas around large airports is still pressing issue. Currently, a lot of research is directed at aircraft which use hydrogen produced with excess wind or solar power ("green hydrogen"), instead of kerosene. However, using hydrogen as the main fuel requires a lot of changes to today's aircraft designs, which need a long development phase and extensive testing before large passenger aircraft can fly on hydrogen. On top of this, the need for an infrastructure to create and distribute the hydrogen leads to a chicken-and-egg problem: Why build the hydrogen facilities before there are aircraft to use it, and why buy a hydrogen aircraft when there are only a few places to fill up the tank?

A consortium of TU Delft, Chalmers University of Technology, Bauhaus Luftfahrt, Ergon Research, Hit09 and Manchester Metropolitan University has been awarded by Horizon Europe with an overall budget of nearly 3.4 million euros to develop the technologies required for the transitional period. The project HOPE (Hydrogen Optimized multi-fuel Propulsion system for clean and silEnt aircraft) has a duration of 48 months (from 1st Feb 2023 to 31st Jan 2027) and will focus on improving local air quality and the abatement of noise emissions in the proximity of airports, by developing two concepts for an aircraft which can partially fly on hydrogen, as and when available. HOPE will research an integrated propulsion system for conventional tube/wing aircraft, consisting of two multi-fuel (kerosene/sustainable aviation fuel + hydrogen) ultra-high bypass ratio turbofan engines, a hydrogen fuel cell and a novel boundary-layer-ingesting (BLI) electric propulsor at the tail end of the fuselage, and aims to:

1) Minimize the combustion and noise emissions during landing and takeoff (LTO) and on the ground, by switching to hydrogen-only operations and using only the electric propulsor in situations where emissions and noise matter most, without compromising efficiency in cruise;
2) Modify an existing aircraft configuration, allowing substantially shortened development time;
3) De-risk the use of hydrogen in aircraft configurations by introducing hydrogen technology as an "add-on";
4) Smooth aviation's energy transition through the assessment and exploitation of several greener propulsion technologies at different maturity levels.

The new aircraft concept is expected to have a much-reduced impact on the airport environment: NOx: -50%, CO: -50%, soot: -80%, perceived noise: -20% (~3 dB per operation); and a considerably lower climate impact (-30%), than a state-of-the-art technology in 2020 (A320neo).



To make sure that the outcomes of the project find their way into actual aircraft, HOPE plans to demonstrate multi-fuel combustion technology for hydrogen and kerosene/SAF for future turbofan engines. Another work package is

devoted to assessing societal impact, environmental burden, and a cost/benefit analysis of the reduced noise and emissions by HOPE technology. Finally, the project will generate policy recommendations to remove potential political and regulatory obstacles to the speedy adoption of the kind of technology developed within HOPE, which helps aviation to transition away from fossil fuels and generally reduce its impact on the environment.

Link to the website of the project on the CORDIS portal: https://cordis.europa.eu/project/id/101096275

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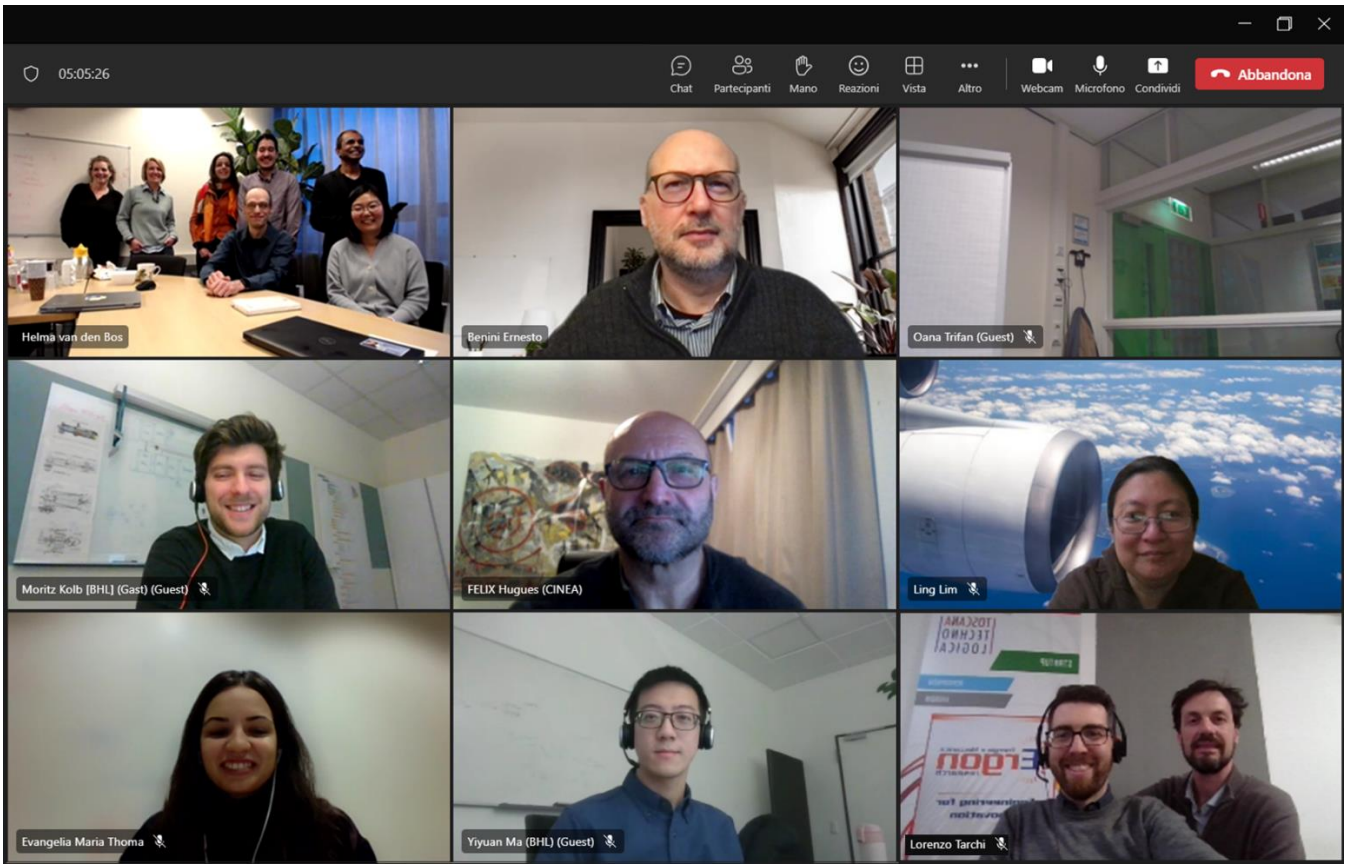

Let's find out more about the consortium that met for the first time on 9th February for the pre-kickoff meeting:

Delft University of Technology, also known as TU Delft, is the oldest and largest Dutch public technical university, located in Delft, Netherlands. With more than 25,000 students and 6,000 employees, it is the leading Dutch university in the field of aerospace engineering, with research experience in conceptual aircraft design, aircraft propulsion, combustion technology for aircraft engines and environmental impact of aircraft emissions.

Chalmers University of Technology is a highly progressive university founded in 1829 and situated in Gothenburg, Sweden. The research group Turbomachinery and Aeroacoustics, as a part of the Fluid Dynamics division at the Mechanics and Maritime Sciences department of Chalmers, has an extensive experience in conceptual design and evaluation of new aircraft propulsion concepts in collaboration with industry, universities and research institutes within different EU and Swedish research projects.

Bauhaus Luftfahrt is *the* aviation think tank from Germany and an interdisciplinary research institute. As a think tank, Bauhaus Luftfahrt's mission is the identification of long-term options for sustainable and climate-neutral air transport while also being a bridge builder between research, industry, politics and the public. Bauhaus Luftfahrt incorporates a holistic approach, combining engineering, natural sciences, social sciences and economics in order to develop new approaches for the future of aviation with a high level of technical creativity and an unparalleled overall system understanding.

Ergon Research was founded in 2008 and nominated spin-off of the University of Florence in 2012. It is specialized in technology transfer from the research world to the industry, working in the fields of combustion, energy, fluid

dynamics, turbomachinery and thermal management. Ergon Research counts about 25 people, many of them with a PhD. The mission is to innovate products by exploiting CFD simulations, 1D tools and experimental tests. The company and its members have large experience in regional, national and European funded R&D programmes (FP7, Clean Sky 2, FF4EuroHPC and Clean Aviation).

HIT09 is an Italian SME created in 2010 as a spin-off company from the University of Padova, active in the field of design optimisation, simulations and code development for aeronautic and aerospace engineering. In addition, HIT09 is dedicated to the design and analysis of small propulsors for UAVs and ultra-light aircraft. Since it was established, HIT09 has participated in a number of both public (EU) and private projects in aeronautics mainly devoted to aircraft and propulsion design optimisation and complex fluid-dynamic numerical simulations including testing in wind tunnels.

Manchester Metropolitan University is amongst the largest campus-based universities in the UK, and the recent UK Research Excellence Framework (REF) assessment ranked 90% of MMU's research impact as being of world-leading or internationally excellent quality. Its Ecology and Environment Research Centre (EERC) has a strong track record in modelling, measurement and fundamental research investigating many aspects of aviation including emissions calculations and modelling, alternative fuels, air quality and climate impacts.

In addition, HOPE has established a strong advisory (AB) board with stakeholders of OEMs (**Airbus**, **Safran**), airports (**Rotterdam The Hague airport**), regulators (**EUROCONTROL**), and public bodies (**Dutch National Institute for Public Health and the Environment - RIVM**). By closely engaging its AB members, the HOPE consortium will build on partners' knowledge and expertise to deliver clean and silent aircraft propulsion systems in close cooperation with the Clean Aviation program to facilitate sustainable aviation.

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