OVERLEAF PROJECT

NOVEL LOW-PRESSURE CRYOGENIC LIQUID HYDROGEN STORAGE FOR AVIATION

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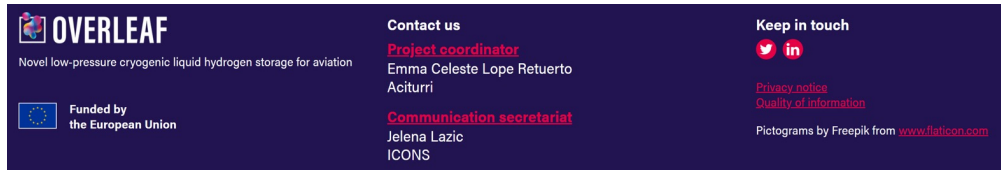
Project presentation

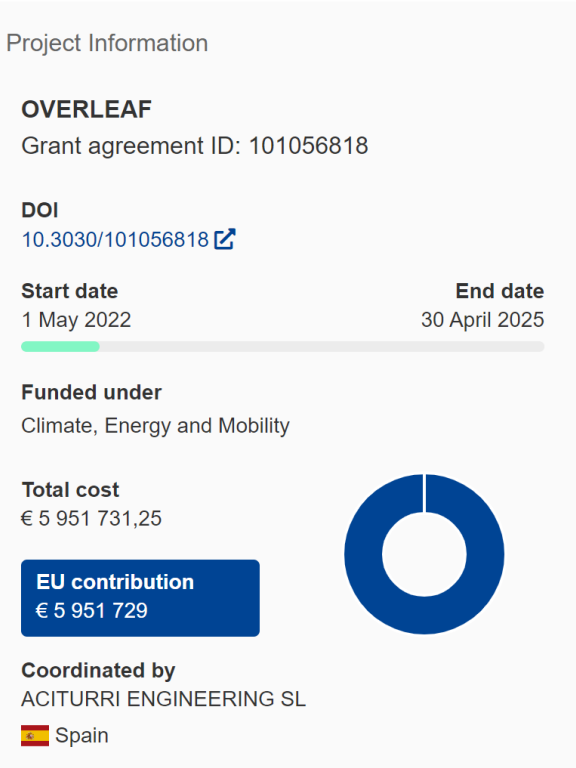
OVERLEAF in a nutshell

OVERLEAF

Facts

- Call: HORIZON-CL5-2021-D5-01-05 - Greenhouse gas aviation emissions reduction technologies towards climate neutrality by 2050
- Project Coordinator: Emma Celeste Lope Retuerto, Aciturri, Spain





Challenges

The rising demand for air travel has led to a **34% increase in direct CO2 emissions worldwide over the past five years.** This is expected to further increase by 3-5 % per year as the population grows. Aviation is forecast to be responsible for 24% of global emissions by 2050. As a result, the aviation industry must shift to new, **low-carbon propulsion technologies and/or new fuels, such as hydrogen (H2).**

The EU has identified H2 as a clean fuel. As such, H2 can help tackle climate change and reduce GHG emissions in a sector as important as aviation. Today's industry, however, can't move toward hydrogen-powered aircraft. The main challenge is the absence of **viable H2 storage systems in aircraft**, considering the strict limitations in weight, volume and cost-efficiency.

Hydrogen's gravimetric energy density (GED) is three times greater than that of kerosene. This means aircraft would have to be redesigned to allow for larger tanks on board. **The size and weight of H2 tanks pose major limitations** for high energy demand on flights, thus reducing cost-effectiveness significantly for medium to long-range aircraft.

Objective

In order to meet the objectives of the European Green Deal by 2050 in the aviation sector, the **transition towards H2-powered aviation** is the solution with the most potential. Although hydrogen-powered aircrafts exist, the current cost of storing and using H2 as a fuel in prolonged flights make their democratization impossible.

The main blocking point is the absence of viable storage systems of H2 in aircrafts considering the strict **limitations in terms of weight**, volume, and cost-efficiency. A sensitivity analysis shows how the economics depend on the tank's gravimetric index (GI). **Today's** technology can barely achieve **20% GI for 500kg of H2**, while industry actors need at the very least **35% GI for 500kg of H2** to transition towards H2-powered aviation.

OVERLEAF intends to develop a game changer Liquid Hydrogen (LH2) storage tank to enable the transition towards H2-powered aviation. Based on a disruptive design (under patent process) and leveraging innovative materials and technologies, the OVERLEAF solution is expected to boast a **GI higher than 60% for 500kg of LH2, with no venting over 24h**. Furthermore, the concept is an enabler for using the **aircraft's fuselage as the outer tank**, allowing to seamlessly integrate the tank in the aircrafts structure.

OVERLEAF will have an interdisciplinary R&D approach focusing on advance materials engineering, testing and combination at lab and at pilot scale, together with appropriate simulation of different design architectures of the hydrogen storage system. The project will be based on **three distinctive phases** and implemented in **7 Work Packages**. The consortium includes multidisciplinary partners from 6 different EU countries and contains all the necessary expertise and know-how to carry-out all tasks needed to achieve OVERLEAF's ambitious objective.

OVERLEAF

Our innovation

Low-pressure, **liquid hydrogen storage** system architecture (LPH) with new **materials solutions**, advanced and flexible **manufacturing technologies**, and **sensors** into an optimum configuration design.

OVERLEAF

We fly beyond the current innovation landscape

Reduction of CO_2 and non-CO_2 emissions

Gravimetric index >60%

Lighter fuel storage tank

LPH integration in the aircraft structure

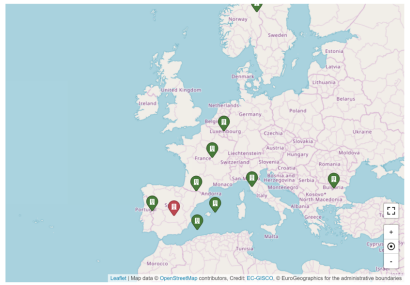
Economically viable solution in aviation

Safe H_2 storage

Tank materials with >75% circularity

60% H2 cost reduction

OVERLEAF



The OVERLEAF team

ACITURRI ENGINEERING
Coordinator; specifications and design of the prototype low-pressure H2 storage tank

AIMEN TECHNOLOGY CENTRE
Materials engineering and manufacturing

CANOE PLATFORME
Research & technology development; testing/validation of approaches and ideas

UNIVERSITAT DE GIRONA
Simulation; Mechanical tests on coupons

TU DELFT
Development & integration and testing of leak detection and SHM sensors

ARKEMA
Insulator formula; wall composites formula

AIMPLAS- TECHNOLOGICAL INSTITUTE OF PLASTICS
Foaming process

FONDAZIONE ICONS
D&C and engagement; co-definition of research and market needs

ICSI
CFD for thermal progress; Testing and validation of approaches and ideas

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY
Sustainability, circularity, and recyclability (LCA/LCCA) aspects

OVERLEAF PROJECT

Thank you!

Visit our website:
overleaf-project.eu

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NTNU | Norwegian University of Science and Technology

ASEM lab

Advanced & Sustainable Engineering Materials Laboratory

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