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Hydrogen lightweight & innovative tank

H2ELIOS

for zero-emission aircraft

NEWSLETTER ISSUE 2

December 2024

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ACITURRI

Dear readers,

We're excited to share the latest progress from the H2ELIOS project. This issue highlights key advancements across our Work Packages as we work toward sustainable hydrogen-powered aviation.

Work Package 1 has established crucial specifications for the LH2 tank, setting the foundation for certification, thanks to insights from our collaboration with EASA. **Work Package 5** has successfully screened and tested materials for the Inner and Outer Tanks, ensuring they meet demanding conditions, while early functional testing is well underway. Finally, **Work Package 6** has implemented a robust communication strategy to enhance visibility and held two critical IPR and Exploitation workshops, aligning our innovations with market needs.

This issue provides a snapshot of our achievements and what's next as we continue our mission to make hydrogen-powered aviation a reality. We hope you enjoy these updates, and thank you for your continued support!

Warm regards,
The H2ELIOS Project Coordinator

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WP1 : Specifications and certification, by Aciturri / Piaggio Aerospace

Highlights Summary: Work Package 1 (WP1) is dedicated to defining the high-level requirements and specifications for a novel liquid hydrogen (LH2) tank concept. This effort has been driven through the combined expertise of Piaggio Aerospace, Pipistrel, and Aciturri, with Aciturri leading the design phase. The collaborative work with the European Union Aviation Safety Agency (EASA) has been crucial in shaping a preliminary roadmap for certification standards applicable to hydrogen-based systems in aviation, addressing key regulatory and safety considerations essential for the future of hydrogen in aeronautics.

Main Results / Significant Achievements:

WP1 has successfully issued high level requirements and updated demonstrator and future product specifications for the LH2 tank, marking a pivotal milestone in the H2ELIOS project. This outcome is the result of coordinated input from the consortium's OEM partners and ongoing dialogue with EASA, which informed critical aspects of the airworthiness and certification process. Deliverables D1.3, D1.4 & D1.5 regarding specifications for the tank were developed. D1.3 and D1.4 were finalised and important progress was made in the D1.5 with expected finalization by 2024 year end.

- **Deliverable D1.6** analyzed the regulatory landscape, highlighting certification risks and gaps associated with hydrogen storage solutions.
- **Deliverable D1.2** defined the system requirements for hydrogen cryogenic fuel storage, ensuring the necessary performance standards are met.
- **Deliverable D1.5** final configurations to establish the specifications for the tank demonstrator, clearly identifying any differences between the demonstrator and the final product.

These achievements demonstrate the consortium's dedication to addressing certification challenges early on, laying the foundation for a safe and viable LH2 storage solution for future aircraft.

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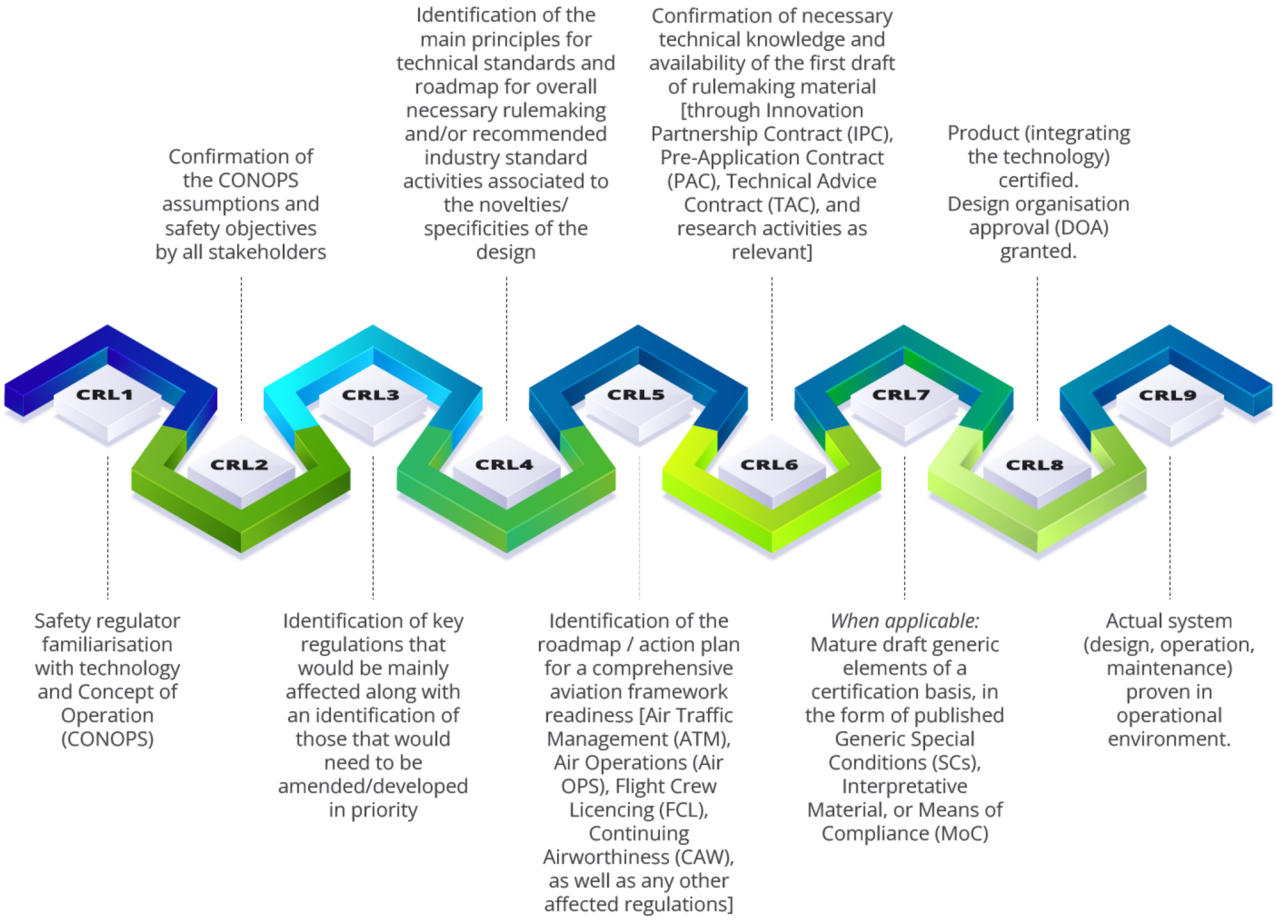
WP1 : Specifications and certification, by Aciturri / Piaggio Aerospace

What's Next:

The next steps for WP1 involve drafting a comprehensive roadmap for qualification and certification in Deliverable D1.8 (“Qualification and Certification Planning”). This document will propose strategies to bridge regulatory gaps, with a focus on achieving Certification Readiness Levels (CRL) 3 and 4, supporting the pathway toward full certification compliance.



The CRL Scale | Developed by Clean Aviation Project: Concerto for EASA

Contribution to the Overall H2ELIOS Scope:

WP1 is fundamental to the entire H2ELIOS project, setting essential “stepping stones” not only for the demonstrator’s design but also for the certification pathway of the final product. This work enables all subsequent WPs to align their efforts with the defined technical and regulatory requirements, guiding project development and reinforcing the H2ELIOS mission to advance hydrogen-powered aviation.

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WP5 : Material Screening and Functional Testing, by PVS / APPLUS

Highlights Summary:

Material Screening: Activities led by PVS, focused on screening materials for the Inner and Outer Tanks in collaboration with consortium partners ACIENG, APPLUS, FHG, NTNU, AIMEN, and ALESTIS. Deliverable D5.1 outlined the initial selection of Inner Tank materials and reported early permeability testing results for the Outer Tank. During this task, materials were immersed in Liquid Hydrogen (LH2) at the coupon level to test thermal shock performance and investigate microcrack formation. Deliverable D5.10 later documented comprehensive material properties for both tanks, marking a significant step toward ensuring material reliability under operational conditions.

Functional Testing: APPLUS is leading this action, which centers on the definition and design of a test bench for functional testing of the LH2 tank. Safety analysis, including a HAZID study related to LH2 supply and test location, has been completed, with instrumentation definition ongoing. The initial filling strategy for the functional test is in development, with the Preliminary Design Review (PDR) passed and preliminary quotations assessed.

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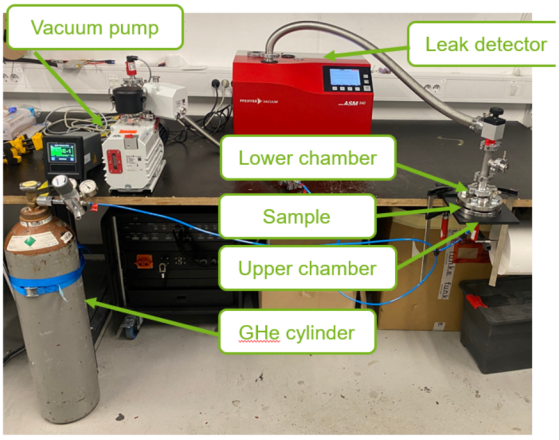
WP5 : Material Screening and Functional Testing, by PVS / APPLUS

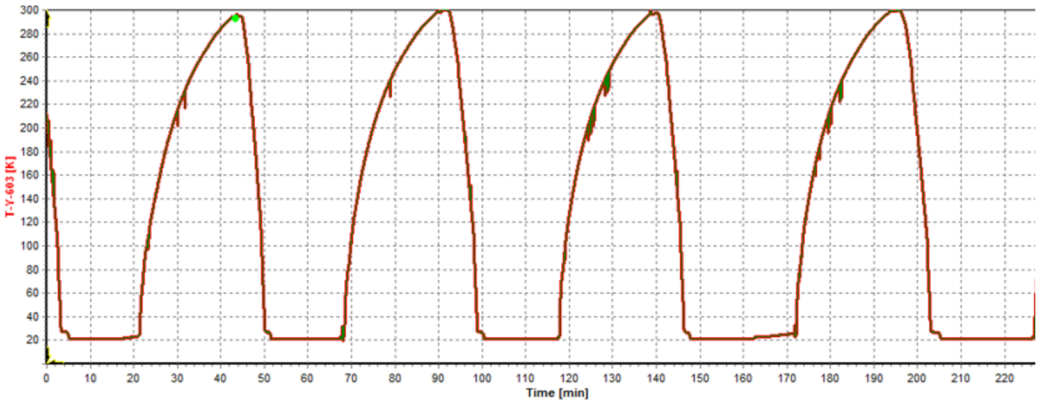
Main Results / Significant Achievements:

Material Screening:

- Outer Tank material was rigorously tested for permeability across various preconditioning scenarios, including LH2 immersion, pristine conditions, and strain application at 77K. Results yielded estimates for hydrogen leak rates under maximum envisioned conditions.



Test assembly located in PVS' premises to permeability testing at room temperature



Temperature recording of thermal shock preconditioning of coupons when immersed in Liquid Hydrogen and heated up to Room temperature

- Extensive literature comparison between Hydrogen and Helium permeation was performed for precise result validation.
- Fatigue behavior and interlaminar shear strength of the Outer Tank material were validated at both room temperature and under Liquid Nitrogen immersion, assessing sensitivity to thermal shocking.
- The best Inner Tank material was selected based on fracture properties and crack inspection results, with comprehensive testing of mechanical properties (tensile and compressive strength, ductility, welding strength) at 293K and 77K following thermal shock preconditioning.
- Further testing spanned the coefficient of thermal expansion and viscoelastic properties to ensure the material's reliability in cryogenic conditions

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WP5 : Material Screening and Functional Testing, by PVS / APPLUS

Main Results / Significant Achievements:

Functional Testing

- PDR for the test bench Process and Instrumentation Diagram (PID) was successfully completed.
- Location and LH2 supply for testing have been secured, with ongoing instrumentation definition.
- Preliminary safety analysis (HAZID: Hazard Identification) was completed, and the initial filling strategy is under development. The final design and HAZOP(Hazard and Operability Study) - await the Critical Design Review (CDR) of the tank.

What's Next:

- **Material Screening:** Task is now complete, with all essential material data provided to partners, supporting continued design work and key project decisions.
- **Functional Testing:** The HAZOP and final design of the test bench await the tank's CDR to finalize the design. Detailed test definitions, including instrumentation and execution steps for the first filling procedure, are the next milestones.

Contribution to the Overall H2ELIOS Scope:

Material Screening has been instrumental in selecting optimal materials for the Inner and Outer Tanks, providing critical property data to other related Work Packages. This task maximized the consortium's testing resources, enabling the advancement of demonstrator design and supporting executive decisions.

Functional Testing will conduct essential functional tests to correlate with simulation models, using these results to evaluate the key performance indicators (KPIs) of the designed tank.

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WP6 : Dissemination, Exploitation, and Communication, by EASN / PVS

Highlights Summary:

The **Dissemination and Communication (D&C) strategy** of H2ELIOS aims to raise awareness and generate interest in hydrogen-based innovations for aviation through both conventional and innovative outreach methods. This approach is documented in the "Intermediate Plan for Dissemination & Communication Activities," outlining the project's primary methods for engaging stakeholders and the public. Emphasizing the importance of effective D&C for Clean Aviation initiatives, the strategy maximizes H2ELIOS's impact and promotes European research and innovation.

The consortium is dedicated to a continuous D&C plan over the project's 36-month lifecycle to consistently engage target audiences with H2ELIOS's progress and achievements. Key D&C objectives include:

- **Dissemination for Awareness:** Ensuring broad recognition of H2ELIOS's activities to build community identity and profile.
- **Dissemination for Understanding:** Targeting groups that would benefit from a deeper comprehension of the project's work.
- **Dissemination for Action:** Equipping key influencers with the knowledge and tools to adopt H2ELIOS's outputs, aiming for transformative change within their organizations.

A variety of D&C tools are deployed to reach diverse audiences, including the scientific community, industry stakeholders, policymakers, other Clean Aviation projects, and the general public. Tools include digital and printed materials, project websites, newsletters, videos, media coverage, scientific articles, and participation in workshops and conferences.

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WP6 : Dissemination, Exploitation, and Communication, by EASN / PVS

Highlights Summary:

PVS, handling the Exploitation activities, led two IPR and Exploitation workshops to establish strategies for managing intellectual property and enhancing the project's exploitable results:

- **First Workshop (May 12, 2023):** This online session included all consortium partners and focused on the importance of IP management and monitoring. Partners aligned on how to maximize environmental and business impacts by identifying and refining key exploitable results.
- **Second Workshop (January 24, 2024):** Held with additional input from advisory board members, including representatives from Ineco and Lufthansa Technik, this workshop reviewed the external market landscape to benchmark H2ELIOS's solutions. The consortium discussed risks, barriers, and potential mitigation strategies, providing insight into the competitive position of H2ELIOS storage solutions.

What's Next:

- **Communication & Dissemination:** Continue engaging all target groups through diverse channels, tracking the impact of D&C activities, and adjusting strategies to sustain engagement and visibility.
- **Exploitation:** Further market analysis and refinement of exploitation strategies based on insights from workshops, focusing on maximizing the impact and applicability of project outcomes.

Contribution to the Overall H2ELIOS Scope:

WP6 plays a vital role in amplifying H2ELIOS's visibility and facilitating broader impact by informing and engaging stakeholders through effective communication. The exploitation workshops have set the groundwork for strategically positioning H2ELIOS's innovations in the market, ensuring that key findings and outputs can be readily adopted and translated into actionable insights, fostering meaningful change in the aviation sector.

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Events / Conferences / Exhibitions

H2ELIOS @ EASN Conference 2024

The H2ELIOS team at the 27th International Conference on Composite Structures (ICCS27)

H2ELIOS @ ECCM21 2024

H2ELIOS at Eurotherm 2024

H2ELIOS at the NETZEROTECH Forum

H2ELIOS the JEC 2024 Exhibition

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PIPISTREL

CIRA
Italian Aerospace Research Centre

Applus laboratories

aimen
TECHNOLOGY CENTRE

Fraunhofer

UPC

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ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ

TESTFUCHS
AEROSPACE SYSTEMS

NTNU
Norwegian University of Science and Technology

EASN TIS

Designed by **EASN-TIS**

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