LH_2CRAFT

SAFE AND EFFICIENT MARINE TRANSPORTATION OF LIQUID HYDROGEN

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Clean H_2 JU Max. Contribution	5 627 595.94
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Coordinator Beneficiary	HYDRUS ANOTATI SYNEKTIKI MICHANIKI ETAIREIA SYMVOULON ANONYMI ETAIREIA, EL
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https://lh2craft.eu/

PROJECT AND GENERAL OBJECTIVES

The LH_2CRAFT project aims to develop next-generation, sustainable, commercially attractive, and safe solutions for the long-term storage and long-distance maritime transportation of liquid hydrogen (LH_2), with potential applications as fuel in selected use cases. It focuses on an innovative membrane-type cargo containment system designed for large-scale storage (up to 200 000 m³ at −253 °C), which will be demonstrated and validated through a 10-ton (180 m³) prototype.

The project investigates alternative conceptual designs while embedding safety and risk assessments from the earliest design stages, targeting cargo containment systems that go beyond the current state of the art and are comparable in scale to LNG carriers. Key subsystems, including storage, handling, distribution, safety, and monitoring, are defined to ensure the modularity and scalability of the overall concept.

LH_2CRAFT aims to achieve Approval in Principle (AiP) from major classification societies, with support from three IACS members. The validation strategy includes detailed design, construction, and testing of the reduced-scale prototype. In parallel, the project develops a preliminary integrated ship design and performs cost assessments, targeting boil-off rates as low as 0.5% per day.

A lifecycle modelling framework and life cycle assessment (LCA) are developed to evaluate environmental impacts, compare design and retrofit strategies, and support sustainability and recyclability considerations across the full value chain. Overall, the project contributes to strengthening European leadership in maritime innovation, supporting the development of international regulatory standards, fostering highly skilled jobs, and enabling the transition toward a hydrogen-based energy system.

NON-QUANTITATIVE OBJECTIVES

- Advance LH_2 maritime storage and transport through safe, sustainable, and commercially viable next-generation solutions.
- Develop an innovative membrane-type cargo containment system with integrated storage, handling, safety, and monitoring functions.
- Embed safety and risk assessment early in the design to ensure robustness and regulatory compliance.
- Enable modular and scalable solutions compatible with existing industrial and ship design practices.
- Integrate system-level ship design and lifecycle modelling, including environmental impact assessment.
- Support the development of future regulatory frameworks and classification standards for large-scale LH_2 transport.
- Contribute to Europe's leadership in maritime innovation and the hydrogen economy transition.



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PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

The project has completed the conceptual design of the Cargo Containment System (CCS), providing a solid basis for further engineering development and system integration. In parallel, the basic design of the Handling, Distribution, Safety, and Monitoring Subsystems (HDMSS) has been finalised, ensuring coherent integration of operational and safety functions within the vessel architecture.

A major milestone was the successful issuance of Approval in Principle (AiP) for both the CCS and HDMSS for the 200 000 m³ LH_2 carrier concept, confirming compliance with relevant classification and safety expectations at the concept level.

Testing and assessment requirements for the LH_2 cargo containment system have been defined, establishing the verification framework for subsequent development phases. Detailed engineering of the prototype LH_2 tank has been completed, alongside the design of a reduced-scale experimental test model for performance validation under representative conditions.

Alternative conceptual design solutions have been developed and assessed through desktop studies, with emphasis on modularity and scalability. In addition, qualitative and quantitative evaluations have been performed through technical workshops covering both CCS and HDMSS, supporting iterative refinement of the 200 000 m³ LH_2 carrier concept.

FUTURE STEPS AND PLANS

- Completion of remaining testing activities for Cargo Containment System (CCS) materials to validate performance under cryogenic and operational conditions.
- Finalisation of the preliminary LH_2 carrier ship design to consolidate system-level integration and demonstrate vessel feasibility at an industrial scale.
- Completion of alternative conceptual design solutions (desktop studies), enabling comparative evaluation and down-selection of optimal design pathways.
- Finalisation of the detailed design phase of the Handling, Distribution, Safety, and Monitoring Subsystems (HDMSS), ensuring readiness for integration.
- Manufacturing and testing of both the small-scale experimental model and the prototype LH_2 tank to validate design assumptions and structural integrity.
- Execution of qualitative and quantitative assessment activities through technical workshops on desktop study cases, supporting expert validation and design refinement.
- Upgrading of the Approval in Principle (AiP) status for the LH_2 containment system, reflecting increased design maturity and compliance with classification requirements.
- Completion of Life Cycle Assessment (LCA) and Life Cycle Cost (LCC) analyses to assess environmental and economic performance across the system lifecycle.
- Definition and implementation of a KPI-based evaluation framework for CCS solutions to enable structured benchmarking and comparison of design alternatives.

PROJECT TARGETS

Target source	Parameter	Target achieved?
Project's own objectives	Safe, cost-effective, and energy-efficient storage and transportation of large LH_2 quantities over longer distances	
	Design modular and scalable LH_2 storage to large dimensions, similar to those of existing LNG carriers	
	Achieve AiP for CCS concept and general approval by major IACS classification societies	
	Develop an LH_2 cargo containment system (CCS) for shipping that exceeds the sizes currently demonstrated	
	Develop a preliminary integrated ship design and conduct the corresponding cost estimate.	

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