MAST3RBOOST CONCLUDES WITH MAJOR ADVANCES IN ADVANCED HYDROGEN STORAGE TECHNOLOGIES FOR A SUSTAINABLE ENERGY FUTURE

- MAST3RBoost concludes by delivering an innovative adsorption-based hydrogen storage demonstrator, showcasing the potential of AI-driven materials development, circular feedstocks and lightweight vessel technologies.
- From agricultural and industrial waste to high-performance hydrogen storage materials, MAST3RBoost has proven that circular economy principles and cutting-edge engineering can work hand in hand to accelerate the transition towards a climate-neutral energy future.

Madrid, Spain, 28 July 2026 - After four years of collaborative research and innovation, the European project MAST3RBoost has reached its conclusion, delivering significant advances in the development of next-generation hydrogen storage technologies. Bringing together leading research organisations, universities and industrial partners from across Europe and beyond, the project has demonstrated how advanced materials, digital tools and sustainable engineering can contribute to accelerating the transition towards a hydrogen-based economy.

Hydrogen is widely recognised as a key energy carrier for achieving climate neutrality. However, one of the major challenges for its widespread deployment remains the development of safe, efficient, and cost-effective storage systems. To address this challenge, MAST3RBoost focused on the creation of innovative adsorption-based hydrogen storage solutions using machine learning-enhanced ultraporous materials and lightweight vessel technologies.

Throughout the project, researchers developed advanced activated carbons and Metal-Organic Frameworks (MOFs) capable of storing significant amounts of hydrogen. These materials were produced using sustainable approaches, including the valorisation of agricultural residues, agri-food by-products, urban waste streams and industrial waste sources, demonstrating the potential of circular economy principles within the hydrogen value chain.

A key achievement of the project was the integration of artificial intelligence and machine learning tools to accelerate material discovery and optimisation. Through the development of dedicated data infrastructures, predictive models, unsupervised machine learning and visualization tools, and active-learning workflows, project partners were able to identify promising material formulations more efficiently and reduce experimental efforts.

MAST3RBoost also successfully bridged the gap between laboratory research and industrial implementation. The

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project scaled up the production of selected ultraporous materials from gram-scale synthesis to pilot-scale manufacturing and developed innovative densification methods to enable their integration into practical storage systems.

In parallel, advanced lightweight hydrogen storage vessels were designed and engineered using Wire Arc Additive Manufacturing (WAAM) technologies and supported by Digital Twin simulations. These developments culminated in the creation of an integrated demonstrator that combines innovative materials, advanced vessel design and operational control strategies for hydrogen storage under cryogenic conditions. Final commissioning and operational validation activities are currently being completed.

Beyond the technological achievements, MAST3RBoost placed sustainability and safety at the core of its developments. Comprehensive Life Cycle Assessment (LCA), Life Cycle Costing (LCC) and risk assessment studies evaluated the environmental, economic and operational performance of the proposed solutions, providing valuable insights for future industrial deployment and policy development.

The results achieved within MAST3RBoost contribute to strengthening Europe's position in the field of advanced hydrogen technologies while supporting the objectives of the European Green Deal and the transition towards a low-carbon economy. The knowledge generated throughout the project will continue to serve as a foundation for future research, industrial innovation and policy initiatives aimed at enabling safer, more sustainable and more efficient hydrogen storage systems.

As the project concludes, the consortium looks forward to seeing the technologies, methodologies and collaborations established through MAST3RBoost continue to inspire future developments in clean energy and sustainable industrial transformation

About MAST3RBoost

MAST3RBoost, a project funded by the European Union with a duration of 48 months, represents a pioneering initiative in the field of hydrogen storage. Based on a new generation of machine learning-enhanced ultra-porous materials, MAST3RBoost aims to pave a disruptive path to match the needs of different transportation sectors.

The project's main objective is to develop the world's first 1-kg scale demonstrator based on H_2 cryo-adsorption, leveraging the enhanced capabilities of ultra-porous materials obtained through machine learning. This innovative approach promises to offer revolutionary solutions for hydrogen storage, opening up new possibilities in the current energy landscape.

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The consortium is formed by 13 Partners from 9 European countries and South Africa: Envirohemp S.L. (Spain); Contactica S.L. (Spain); Agencia Estatal Consejo Superior de Investigaciones Científicas (Spain); CIDETEC Surface Engineering Institute (Spain); Spike Renewables SRL (Italy); EDAG Engineering GMBH (Germany); Nanolayers OU (Estonia); LKR Leichtmetall Kompetenzzentrum Ranshofen GMBH (Austria); University of Pretoria (South Africa); Council For Scientific And Industrial Research (South Africa); (Portugal); TWI Limited (UK); University of Nottingham (UK); CNH Industrial (Italy).

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