

Waste-to-Hydrogen: Experimental Green Hydrogen Generation for Circular and Responsible Bio-Innovation

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The transition toward a climate-neutral European economy requires scalable solutions for producing low-carbon hydrogen while addressing the growing challenge of waste management. This study presents the ongoing development of an experimental modular system for green hydrogen generation integrating renewable-powered electrolysis with thermochemical conversion of waste-derived syngas obtained through pyrolysis and gasification processes.

The research explores the potential conversion of hydrocarbon-rich waste streams, including used tires and other residual materials, into hydrogen as a clean energy carrier. The proposed system architecture combines waste-to-syngas conversion, catalytic reforming, hydrogen separation, and digital monitoring of key operational parameters such as temperature, pressure, gas composition, and energy efficiency. At this early stage of development, the study focuses on system design, technological integration, and the identification of key performance indicators for future experimental testing.

Beyond technological development, the project situates hydrogen production within the broader framework of circular bioeconomy and responsible innovation. The research also promotes the involvement of early-stage researchers and interdisciplinary collaboration between energy engineering, environmental sustainability, and circular economy studies.

Developed at Lucian Blaga University of Sibiu in collaboration with the National Research and Development Institute for Cryogenic and Isotopic Technologies –ICSI Râmnicu Vâlcea, this initiative aims to contribute to emerging European innovation ecosystems supporting sustainable hydrogen and circular energy systems.

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