



# MISIONES ZEPPELIN PROJECT



The ZEPPELIN project has been funded by the Centro para el Desarrollo Tecnológico Industrial (CDTI), within the framework of the 2021 call for the MISIONES CIENCIA E INNOVACIÓN program (Plan de Recuperación, Transformación y Resiliencia), and has support from the Ministerio de Ciencia e Innovación. The funding granted to the project is financed by the European Union through the Next Generation EU Fund.

## Research on innovative and efficient technologies for the production and storage of green hydrogen based on the circular economy



# ZEPPELIN

### Project description

Hydrogen (H<sub>2</sub>) as an energy vector has been postulated as one of the most promising ways to mitigate and adapt to climate change, since it can produce electrical, mechanical and thermal energy without generating direct CO<sub>2</sub> emissions.

Currently, 96% of the H<sub>2</sub> in market is produced on an industrial scale from the reforming of fossil fuels, a process that is associated with a high environmental impact (11.5 kgCO<sub>2</sub>/kg H<sub>2</sub>) and makes it unfeasible as a means of producing H<sub>2</sub> in a decarbonizing environment. Likewise, it is essential that the energy transition is based on the principle of the circular economy, with waste management as one of the key elements to mitigate and curb the climate and economic impact of its generation. Industrial symbiosis must be promoted in order to allow converting by-products or waste from one industry into raw materials for another one.

The ZEPPELIN project arises in response to this challenge, with the general

objective of investigating a flexible set of green hydrogen production and storage technologies based on the use of waste and by-products, seeking to significantly improve the production costs and efficiency of this energy vector. In this way, the project will address the different technological challenges linked to biogas and bioethanol reforming, dark fermentation (DF), microbial electrolysis (ME), gasification and H<sub>2</sub> storage, establishing new models for obtaining green H<sub>2</sub> complementary to electrolysis with renewable energies, integrated into a decarbonized energy model under the principles of the circular economy and digitization, in a scenario of water stress aggravated by phenomena derived from climate change.

To meet the global objective of ZEPPELIN, the following specific objectives are established:

- To establish new alternative and complementary green H<sub>2</sub> production pathways to electrolysis associated



**Location:** Algeciras WWTP (Cádiz)

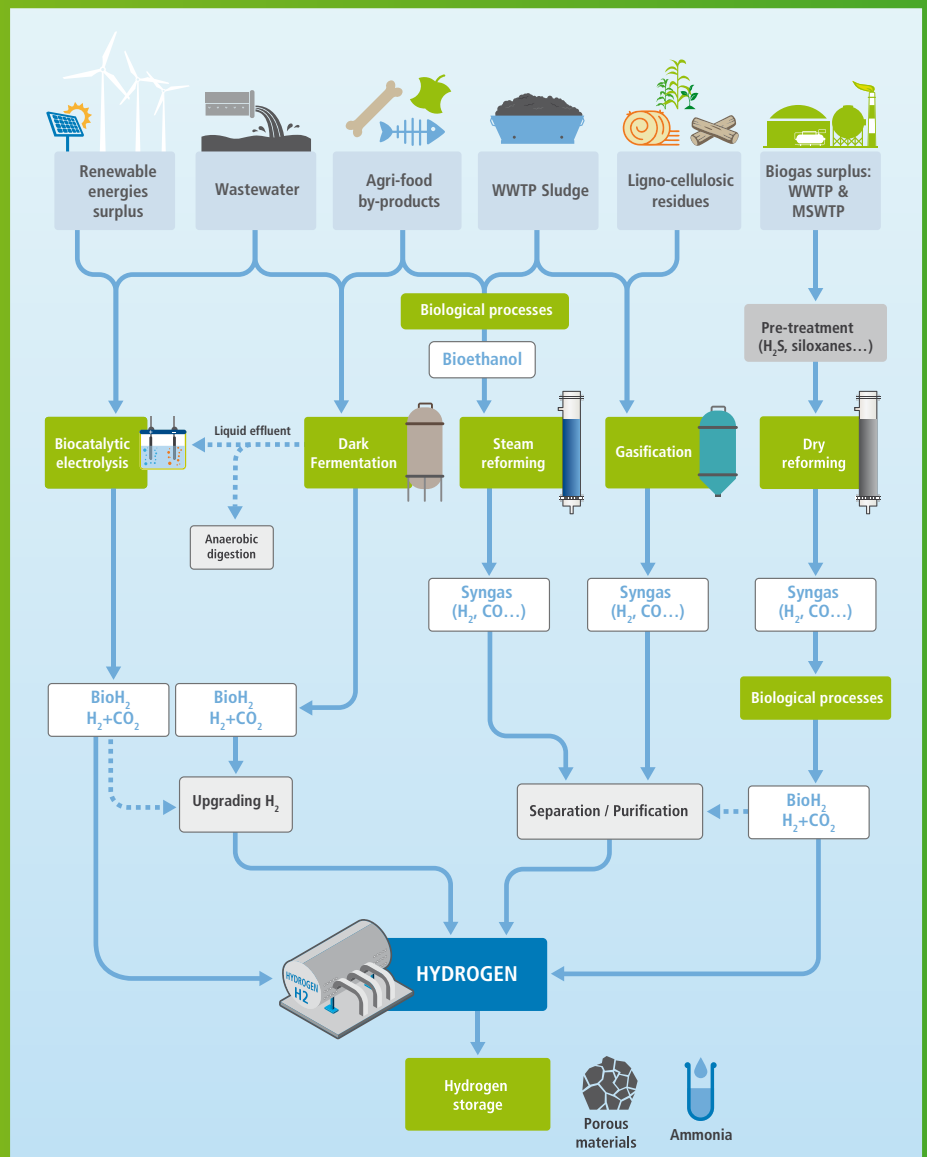
**Duration:** From the 1st of November 2021 to the 31st of December 2024

**Total Budget:** 7,108,584 € **Aqualia:** 1,211,393 €



with the use of by-products and waste from different sectors, integrating green H<sub>2</sub> production and circular economy.

- To study the complementarity of the technologies developed through research in proofs of concept under real operating conditions.
- To investigate new ways of seasonal storage of H<sub>2</sub> by modeling systems based on NH<sub>3</sub> and studies on new porous materials, to reduce costs on a small scale, tripling the energy density of compressed H<sub>2</sub> storage.
- To demonstrate the technical feasibility of a flexible model for obtaining H<sub>2</sub> complementary to electrolysis, decoupling its production from the use of renewable energy and water.
- To obtain a digital modeling and decision-making tool that allows evaluating the potential for H<sub>2</sub> production based on the waste and the technology used.
- To establish a delocalized model of green H<sub>2</sub> production applicable to different environments.
- To reduce the cost of green H<sub>2</sub> production by 30% compared to production with electrolysis (€4.6/kgH<sub>2</sub>), achieving a 70% reduction in associated CO<sub>2</sub> emissions.
- To establish a model for the use of waste with the potential to generate more than 133,800 t/year of green hydrogen at national level, covering nearly 30% of the national demand for H<sub>2</sub> and optimizing it.



**PROJECT PARTICIPANTS**

- Aqualia (coordinator)
- Naturgy
- Norvento Enerxía
- Perseo Biotechnology
- Redexis
- Reganosa
- Repsol
- Técnicas Reunidas



**RESEARCH CENTRES**

- CETIM
- CIEMAT
- Energylab
- Instituto IMDEA Energía
- CSIC/ITQ y UPV/ITQ
- ITMATI
- CIDAUT
- FUNGE-UVA



**FUNDING DETAILS**

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