

# FRHYGE

## FULL QUALIFICATION IN FRANCE OF LARGE-SCALE HYDROGEN UNDERGROUND STORAGE AND REPLICATION FROM GERMANY TO ALL EUROPEAN COUNTRIES



|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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| Project ID                                | 101137892                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| PRR 2025                                  | Pillar 2 – H <sub>2</sub> storage and distribution                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Call topic                                | HORIZON-JTI-CLEANH <sub>2</sub> -2023-02-01                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Project total cost                        | EUR 27 240 481.25                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Clean H <sub>2</sub> JU max. contribution | EUR 19 994 886.40                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Project period                            | 01-03-2024 - 28-02-2029                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Coordinator Beneficiary                   | STORENGY SAS, FR                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Beneficiaries                             | GEOMETHANE, ECO MED, STORENGY DEUTSCHLAND BETRIEB GMBH, GRTGAZ, STORENGY DEUTSCHLAND GMBH, ESK GMBH, ARTELYS BELGIUM, GASNETZ HAMBURG GMBH, AXENS SA, STORENGY FRANCE, ENAGAS TRANSPORTE SA, CAPENERGIES ASSOCIATION, GEOSTOCK SAS, ARTELYS, ECOLE NATIONALE SUPERIEURE DES MINES DE PARIS, INSTITUT NATIONAL DE L'ENVIRONNEMENT INDUSTRIEL ET DES RISQUES - INERIS, ASSOCIATION POUR LA RECHERCHE ET LE DEVELOPPEMENT DES METHODES ET PROCESSUS INDUSTRIELS, IFP Energies nouvelles |

<https://frhyge-project.eu>

### PROJECT AND GENERAL OBJECTIVES

The limited technical feasibility and economic viability of large-scale hydrogen storage, as a solution to the intermittency of renewable energy sources, continues to hinder broad EU market adoption of renewables for decarbonising industry and mobility. Therefore, FrHyGe's main goal is to demonstrate and qualify the injection and withdrawal of hydrogen in an existing natural gas commercial storage site in industrial locations in France. FrHyGe will also consider the conversion process and scale-up strategies to foster replication of hydrogen storage in caverns within the EU, starting with an ongoing project in Germany to accelerate know-how transfer and economic viability. FrHyGe's objectives are:

- Development and implementation of two conversion processes from natural gas or brine caverns to hydrogen storage caverns.
- Demonstration of hydrogen storage and cyclability in a 3 000 tons potential cavern with 100 cycles from one hour to one week.
- Study of the local hydrogen value chain and the techno-economic impacts on local actors and the upscale and deployment of hydrogen storage along the European Hydrogen Backbone.
- Assessment of the risks and environmental impacts of hydrogen cyclic storage in salt caverns.
- Proposal for guidelines on safety, regulation and normative adaptations in Europe.

FrHyGe will open a path towards a potential of 38 kt of commercial hydrogen storage in several EU countries by 2030, and up to 1.5 Mt by 2050, through conversion and creation of caverns, leading to a CAPEX below 10 €/kg of stored hydrogen. Therefore, FrHyGe gathers a consortium of leading hydrogen industries and research centres in the EU, led by the worldwide underground storage actor Storengy, willing to realise large-scale and multi-site hydrogen storage in caverns.

### NON-QUANTITATIVE OBJECTIVES

- Propose a conceptual design for the demonstrator.

Carry out all the required studies, laboratory tests (kinetics of the hydrogen solubility in cavern brine, hydrogen permeation in salt during cycling etc.).

- Develop geomechanics and thermodynamic predictive models for hydrogen storage in largely brine-filled salt caverns.
- Provide guidance on mechanical integrity testing and tightness testing of hydrogen caverns, assess the impact of gas quality requirements on the deployment of salt cavern and porous media storage, and outline technical options for evolutive salt cavern completions with subsurface safety equipment. This guidance will enable industrial-scale replication (3 000-ton hydrogen storage potential) of findings obtained at demonstration scale and through technical and scientific studies.
- Deliver an off-grid layout connecting two neighboring caverns, including engineering and demonstrator design.
- Provide a cost-benefit-analysis for the hydrogen storage projects GeoH<sub>2</sub> and SaltHy.

Provide a market uptake plan for the hydrogen storage projects GeoH<sub>2</sub> and SaltHy.

Estimate the development costs for site-specific underground storage at European scale.

- Provide a comprehensive risk assessment and deliver a safety plan for the demonstrator. Test administrative permitting procedure for the demonstrator.

Assess the environmental impacts of salt cavern hydrogen storage, including greenhouse gases.

- Issue the project communication plan and carry out all communication actions.

Coordinate the logistics and communication for events such as workshops, congresses.

Support for scientific publications and conference participation.

- Prepare a summary of the results in "Horizon, the EU research and Innovation Magazine".

#### PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

- Project kick off - 20/03/2024.
- Participation in EU and national industry events: Club H<sub>2</sub> Sud, May and October 2024.
- HyUSPre final conference, Utrecht - June 19, 2024; EAGE - GET24, November 6, 2024.
- European Hydrogen Week, at Brussels - Nov 18-22, 2024.

- Method definition and conceptual design in progress for the demonstrator, achieved by the end of February 2025

#### FUTURE STEPS AND PLANS

- 2024-2025: Study analyses for the Manosque demonstration site and SaltHy site replicability.
- 2026-2027: Construction phase.
- 2027-2029: Implementing 100 injections and withdrawal cycles, at Geomethane site. Studying Hydrogen reactions under various pressures. Comparing results with theoretical model forecast.
- From 2029: Commercial operations: 6 000 t capacity at Manosque demonstration site, 5 200 t at Harsefeld.

#### PROJECT TARGETS

| Target source            | Parameter                                                                                                                                                                      | Target achieved?                                                                      |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Project's own objectives | To develop and implement two conversion processes from natural gas or brine cavern to hydrogen storage.                                                                        |  |
|                          | To perform 100 H <sub>2</sub> cycles with duration from 1 h to 1 week for a cavern having the potential of 3 000 tons of H <sub>2</sub> . Flow rate variation of up to 1 t/h.  |                                                                                       |
|                          | To study the local hydrogen value chain and the techno-economic impacts on local actors and to upscale and deploy H <sub>2</sub> storage along the European Hydrogen Backbone. |                                                                                       |
|                          | To demonstrate the safety and environmental acceptability of commercial storage of H <sub>2</sub> in salt caverns.                                                             |                                                                                       |
|                          | To deliver a replication roadmap of hydrogen storages at pan-EU level.                                                                                                         |                                                                                       |