FrHyGe
Underground
Hydrogen
Storage

FrHyGe

France Hydrogen Germany

Full qualification in France of large scale Hydrogen underground storage and replication from Germany to all European countries

Co-funded by the European Union

Clean Hydrogen Partnership

The project is supported by the Clean Hydrogen Partnership and its members

A EUROPEAN PROJECT

- FrHyGe emerges from Horizon Europe Framework Programme (HORIZON) of the European Commission
- Call: HORIZON-JTI-CLEANH2-2023-02-01
- Period: 5 years, from 2024 to 2029
- The project is coordinated by Storengy

The project is financed by the European Commission with a total of 43 million euros of which 20 million euros are provided by the Clean Hydrogen Partnership.

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What is the FrHyGe Project ?

Project highlights:

- ✓ **EU consortium, gathering 17 partners,** with 4 different nationalities
- ✓ **Subsidy from the Clean Hydrogen Partnership (20 M€)**
- ✓ **Feasibility to convert caverns** from natural storage or brine to hydrogen storage
- ✓ At least, **H2 Storage 100 injection & withdrawal cycles** at various pressures/volumes of **100 tons of hydrogen**
- ✓ **TRL 7 to 8**
- ✓ Study the **local hydrogen value chain and the technico-economical impacts on local actors**
- ✓ **Safety and environmental acceptability** of commercial storage of H2 in salt caverns.
- ✓ **Replication** towards other salt fields, in EU, starting with **SaltHy project in Germany.**

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Focus on the Demonstrator

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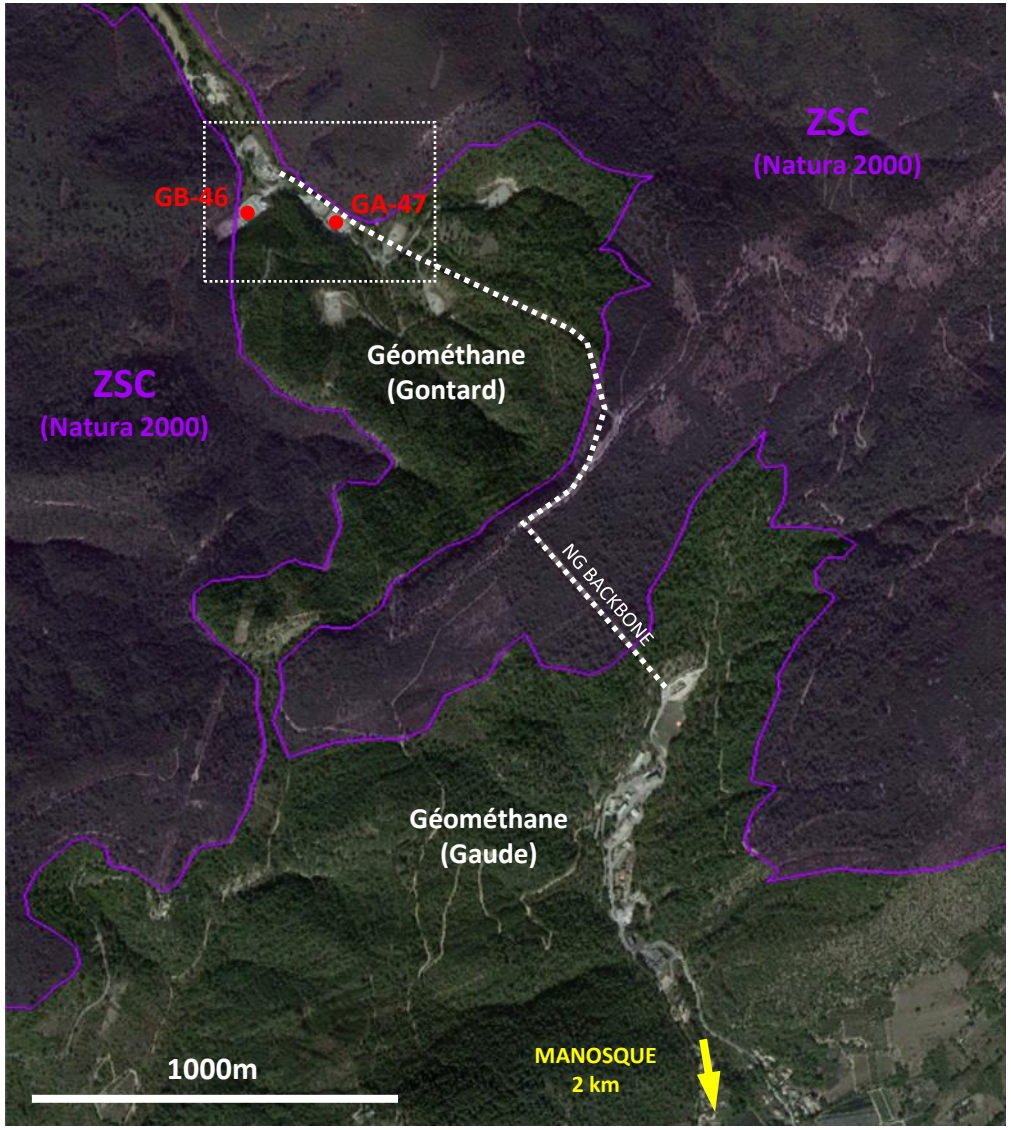
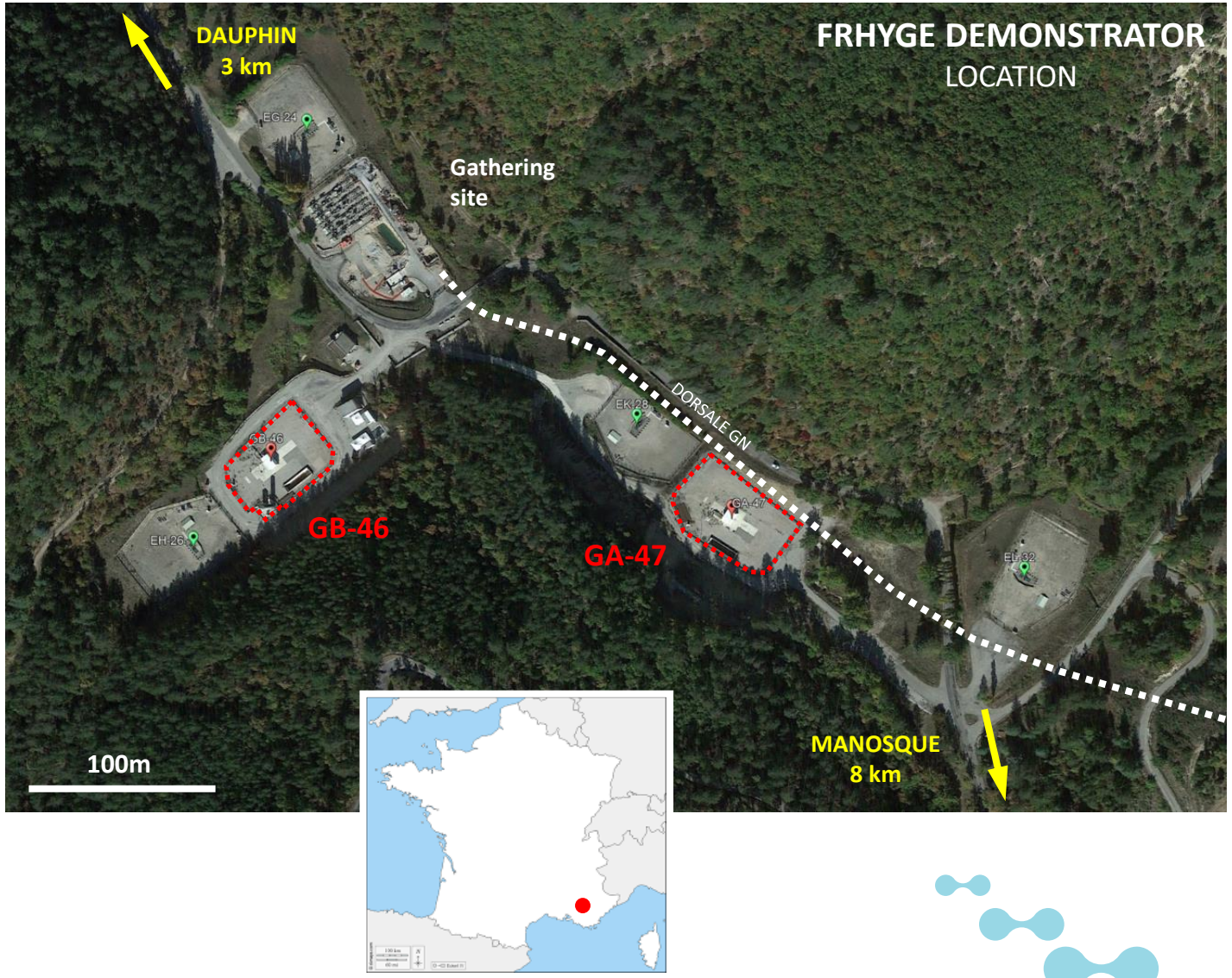
Manosque: demonstrator location





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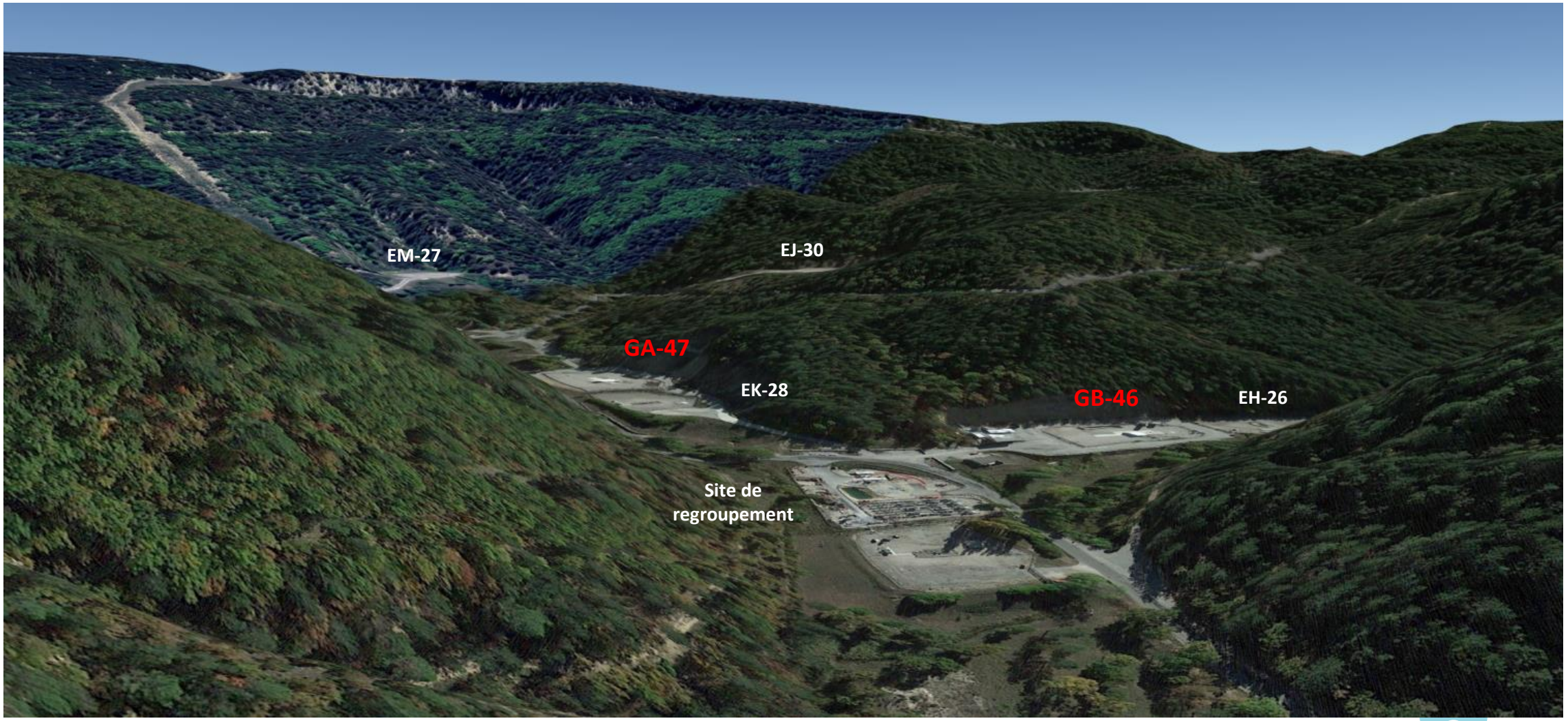
Manosque demonstrator – View from the South



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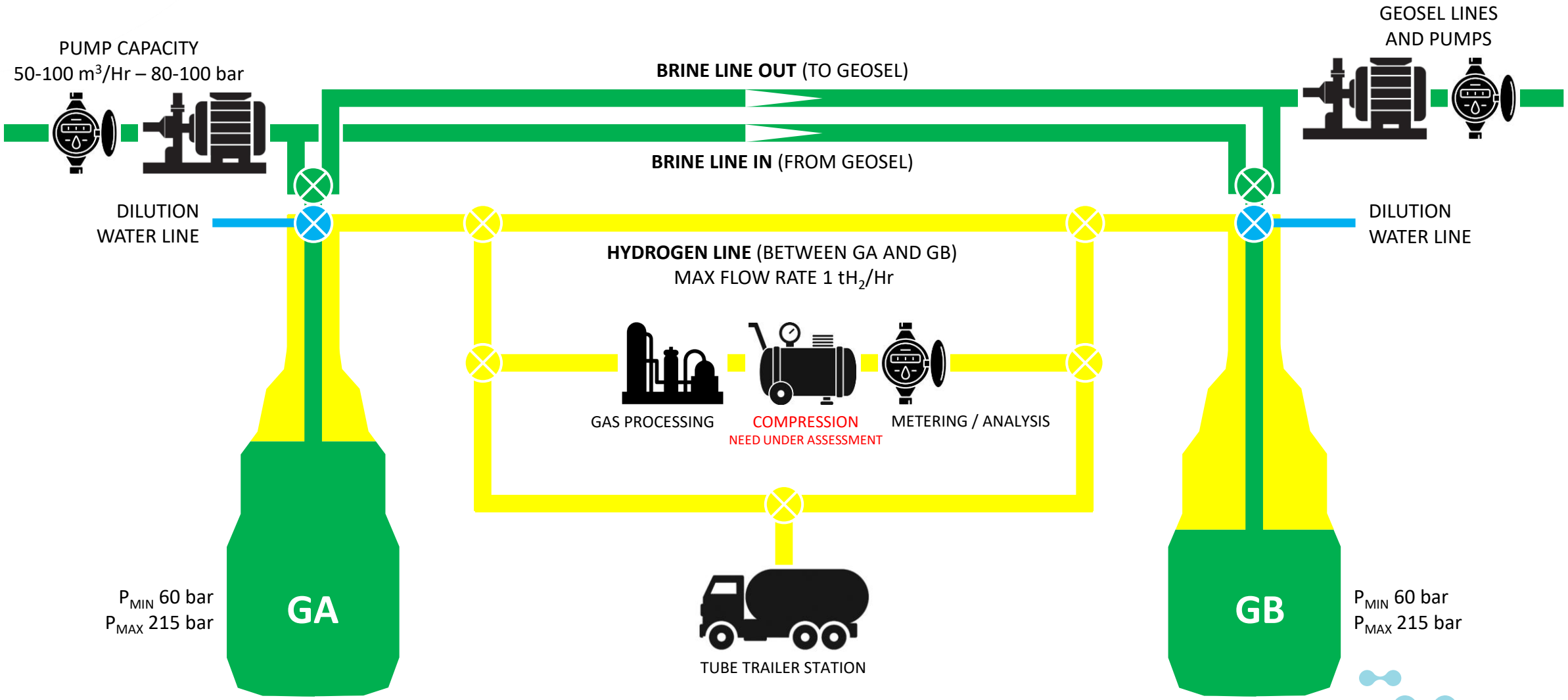
Manosque : demonstrator principles



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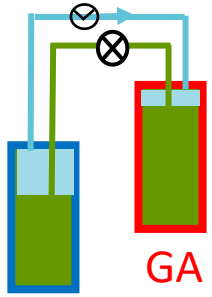
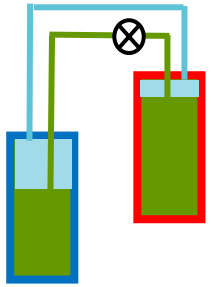
Daily cycle focus

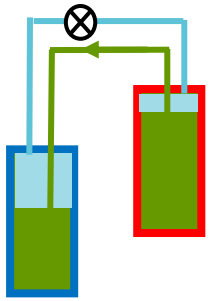
H2 from GB to GA



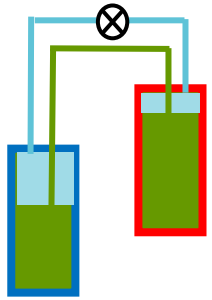
P_{H2} balancing GB & GA



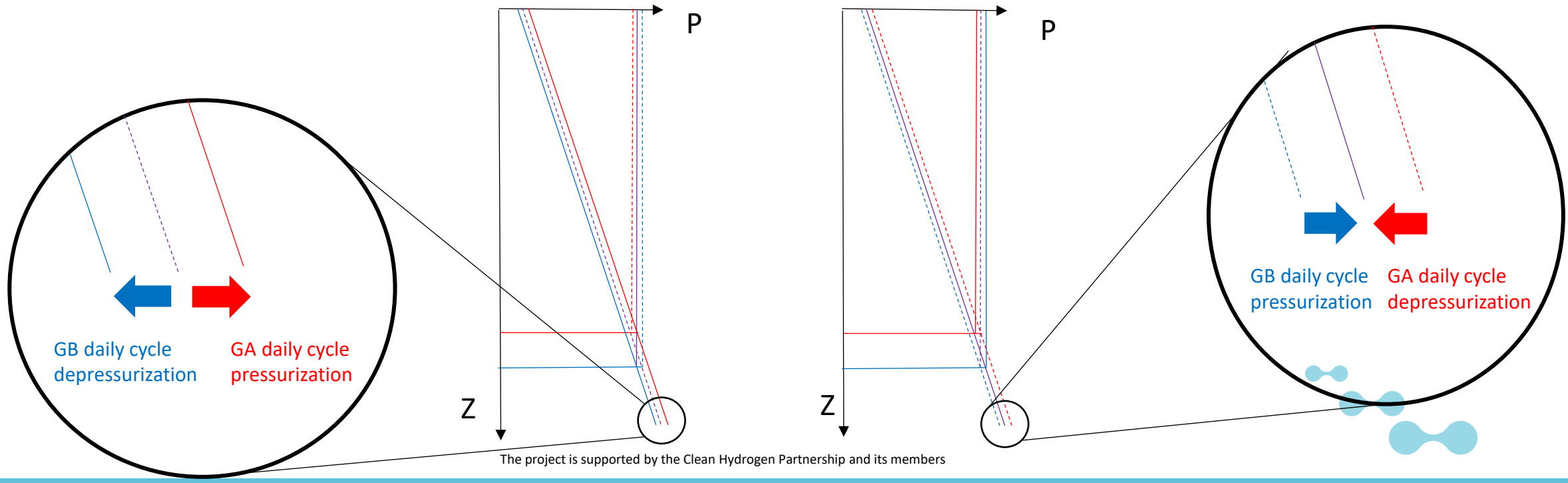
Brine from GA to GB



P_{brine} balancing GB & GA



Daily cycle



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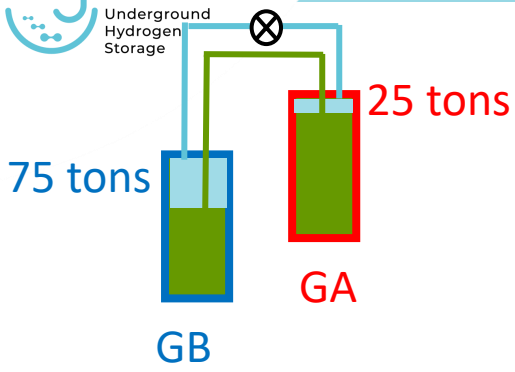
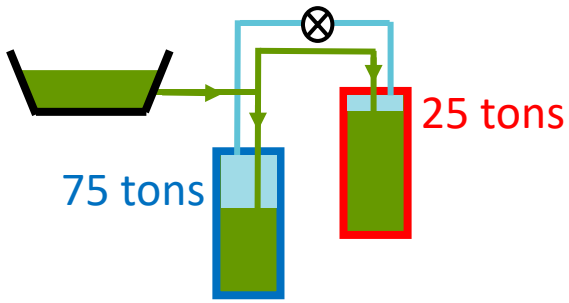
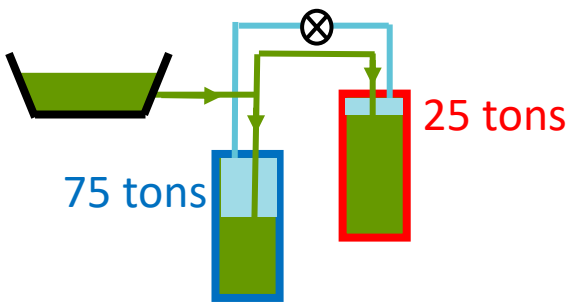
Series of cycles with various brine pressure

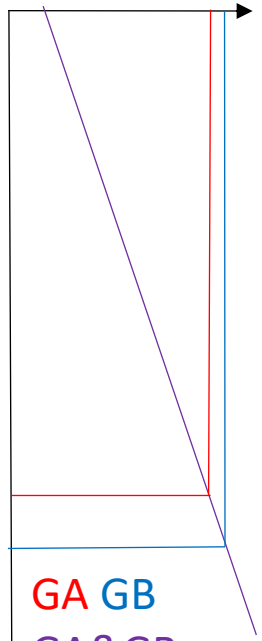






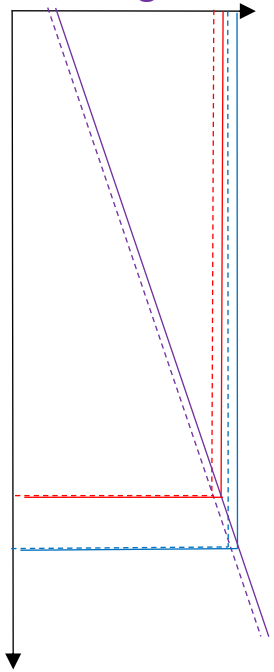
1st stagePres

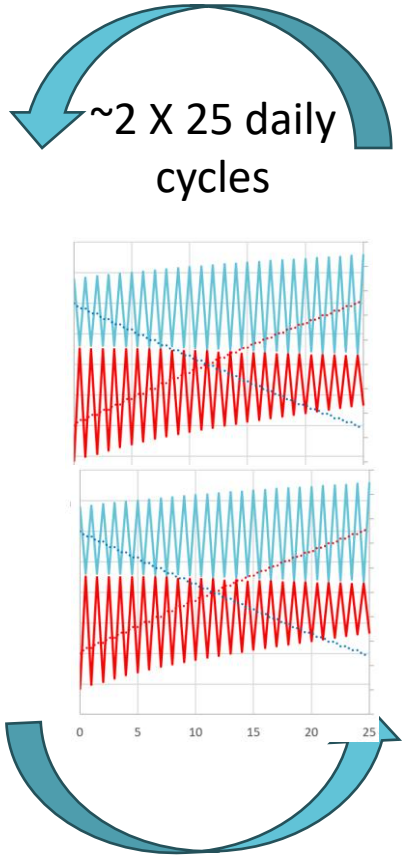
20 barg



2nd stage Pres

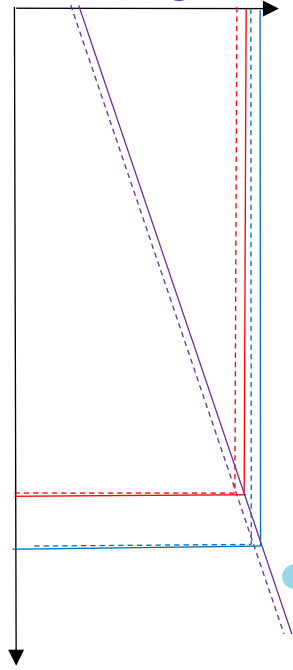
30 barg

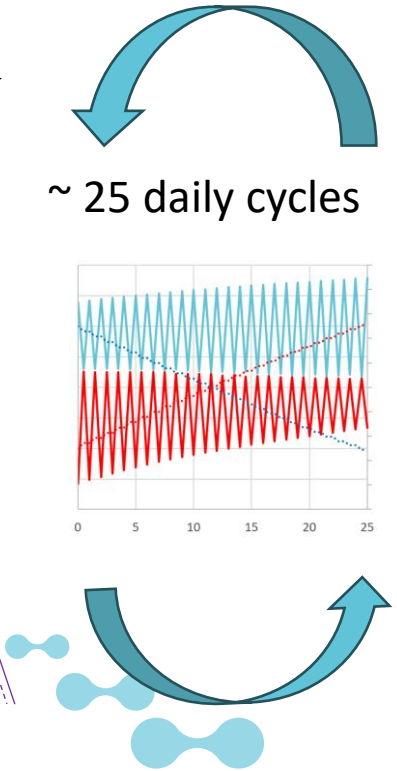




3rd stage Pres

40 barg





Top+x m:

1264 +37 m

1402+14 m

Depth

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Subsurface objectives and results

- ✓ Geomechanical and thermodynamical predictive modelling for H2 storage in largely brine-filled salt caverns
- ✓ Hydrogen permeation in salt during cycling
- ✓ Kinetics of the H2 solubility in NaCl-saturated cavern brine
- ✓ Impact of gas quality requirements on the deployment of salt cavern and porous media storages
- ✓ Mechanical Integry Test (MIT) tightness test of H2 cavern
- ✓ Evolutive salt cavern completions with a subsurface safety equipment
- ✓ Replication at industrial scale (3000 tons H2 storage potential)

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Timeline

2024 - 2025

- Conducting analyses for the Manosque demonstrator and SaltHy site replicability

2026 - 2027

- Construction phase

2027 – 2029

- Implementing 100 injections and withdrawals at Géométhane.
  Studying hydrogen reactions under various pressures.
  Comparing results with theoretical predictions

From 2029

- Commercial operations : 6,000 tonnes capacity at Manosque, 5,200 tonnes at Harsefeld

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Project coordination

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Partners

FrHyGe Underground Hydrogen Storage

storengy
A company of ENGIE

ARMINES
MINES PARIS | PSL

Artelys
OPTIMIZATION SOLUTIONS

Axens

Capenergies

ECO-MED
écologues et médiateurs

enagas

ESK

Géométhane

Geostock

GRTgaz

IFP Energies nouvelles

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

INERIS
maîtriser le risque pour un développement durable

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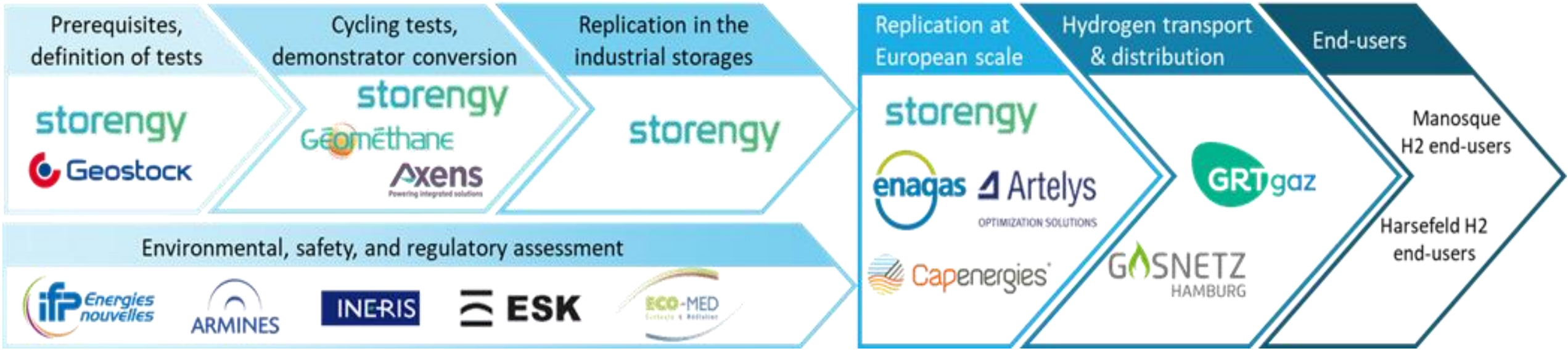
Roles and contributions of Partners in the project



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Work packages

WP1
Project management and coordination
storengy

WP2
Manosque Demonstrator objectives, conceptual design, scientific developments, application of both to industrial scale replicators
Geostock

WP3
Demonstration of hydrogen storage and cyclability
storengy

WP4
From regional implementation to market integration along the EU H2 value chain
Artelys OPTIMIZATION SOLUTIONS

WP5
Environmental safety and regulatory assessment
INERIS

WP6
Communication
Dissemination
Exploitation
Capenergies

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Main objectives, expected results, project outcomes

Main objectives

- Develop and implement **2 conversion processes from natural gas or brine cavern to hydrogen storage** (in France and Germany)
- Demonstrate **H2 storage and cyclability in a high capacity cavern**
- Study the local hydrogen value chain and the techno-economic impacts on local actors
- Upscale and deploy **H2 storage along the European Hydrogen Backbone**
- Demonstrate the **safety and environmental acceptability** of a commercial storage of H2 in salt caverns
- **Better integration of renewable energies and supporting industry decarbonisation**

Expected results

- **Qualify all technologies and their components in an integrated storage system (TRL 8)** by demonstrating large-scale hydrogen (energy) storage in underground salt caverns
- **CAPEX target** < 32 €/kg H_2 stored for salt cavern storage capacity between 1,000 and 3,000 t H_2
- Achievement of the **targets set out in the REPowerEU Plan and EU Hydrogen Strategy**
- **Higher integration of renewables** within the overall energy system

Project Outcomes

- **Completion of 100 H2 cycles** with duration from 1h to 1 week for a cavern, having the potential of 3000 tons of H2
- Variation of the flowrate, up to 1 ton per hour; Variation of pression: up to 220 bars
- 1 **replication roadmap of H2 storages** at Pan-EU
- **CBA for 2 storage projects** (GeoH2 and SaltHy) covering at least the 2030 and 2040-time horizons
- Potential investment options in **EU H2 infrastructure projects from 2030 to 2050**
- **Permitting procedure** for the demonstrator achieved in less than 9 months

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FrHyGe project ambition

Ambition: The Project aims at optimizing the whole energy value chain, by integrating the innovation of large - scale underground storage (UHS), to better understand how **renewable H2 can be supplied continuously to industrial, mobility and other end-uses, while H2 production be intermittent** (daily or seasonally), due to renewable electricity.

FrHyGe main strategy is to unlock the potential of H2 storage in salt caverns, by applying a methodology in 3 phases:

- Phase 1: **focus on Manosque demonstration site** in France, for full qualification (**TRL8**) of the system from predefined conversion strategy
- Phase 2: **commercial up-scale of Manosque site** (**TRL9**) and **know-how transfer for Germany up-take (SaltHy project)**
- Phase 3: **unlock EU replication** from technical conversion roadmap, along with risk and environmental assessment to feed the commercial exploitation strategy, in order to **create a real European hydrogen storage backbone**.

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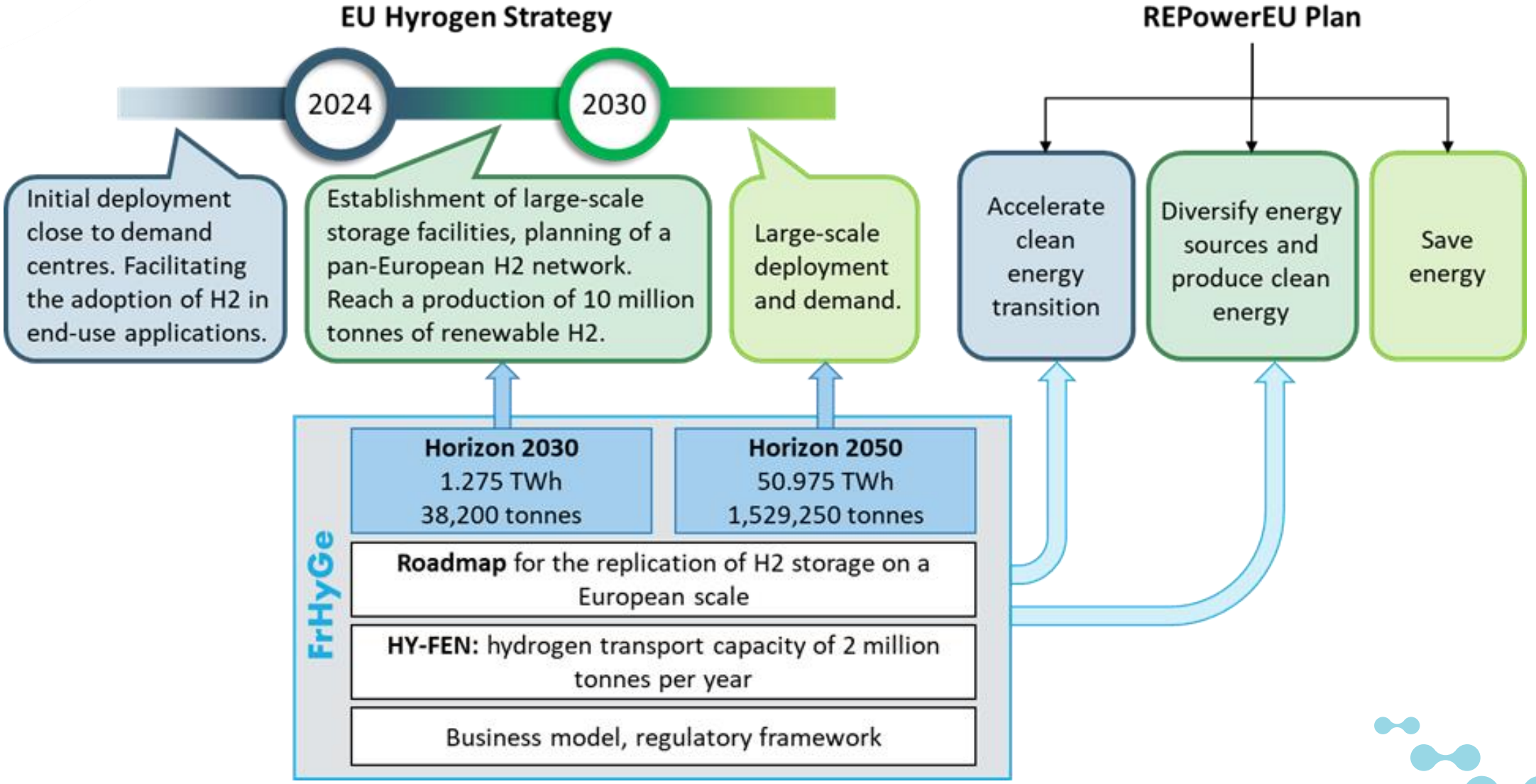
Contribution of FrHyGe to REPowerEU Plan and EU H_2 Strategy



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WWW.FRHYGE-PROJECT.EU

Your source for updates on the European hydrogen storage project in salt caverns, featuring research progress, partner collaborations, and industry events

A European Intiative

Learn about the FrHyGe partners, their roles, and their collaboration in making underground storage in salt caverns a reality

Scientific Publications

Throughout the project, results from work packages and academic research will be published

News and Events

Stay informed with updates on events, conferences, and new insights through our website and newsletters

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THANK YOU

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