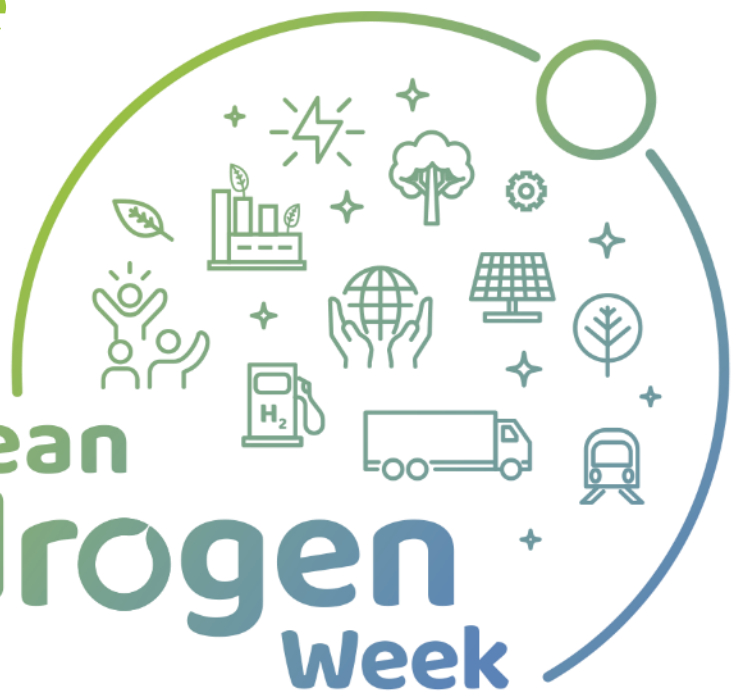
HyPSTER
Hydrogen Pilot STorage for large Ecosystem Replication

hypster
Hydrogen Storage



M. Schlichtenmayer

Work Package Manager

#EUResearchDays
#PRD2022
#CleanHydrogen

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EUROPEAN PARTNERSHIP
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SUMMARY OF THE PRESENTATION

- Overview of the project
- Status of on-site work
- Adaptation of EZ53 Cavern & Process for Tightness Test
- HyPSTER – Cyclic Test Operation

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European Hydrogen Week

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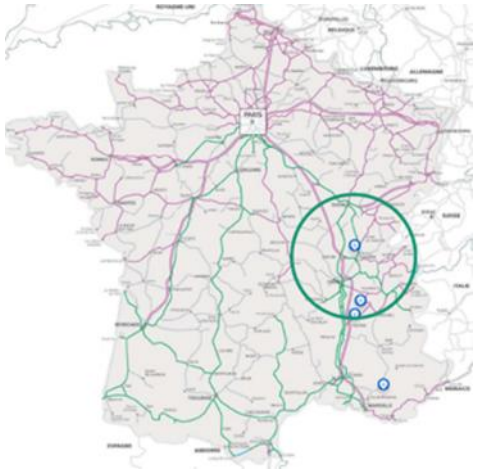
Project start : January 2021
Location : Etrez (Ain) France
H2 Production : Electrolyzer 1MW
End of Pilot Phase : December 2023
Storage Capacity : 3 – 44 tons

Test industrial scale renewable hydrogen production and storage in salt caverns supported by technical and economic reproductibility of the process to other sites throughout Europe



Consortium Partners

H2 & Subsurface expertise

storengy, ESK, ARMINES, BROUARD CONSULTING

Regulation & Safety

INERIS

Storage replication potential

inovyn, storengy

Technical and economic assessments

elementenergy

Bacteriology Purification

equinor

Communication

axelera – ENSEMBLE, CATALYSONS LES RÉUSSITES

Coordination

storengy, elementenergy

9 partners, 4 countries

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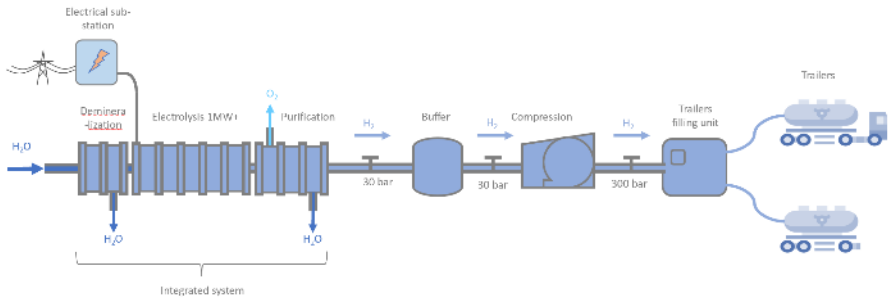
HyPSTER project is divided into two parts

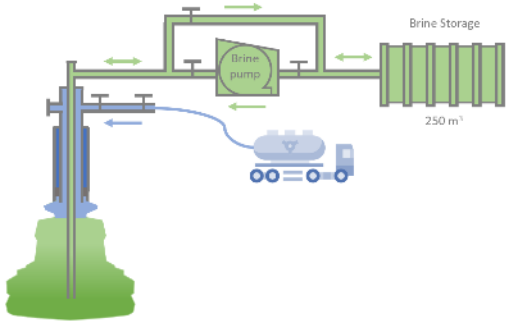
Renewable Hydrogen Production Platform

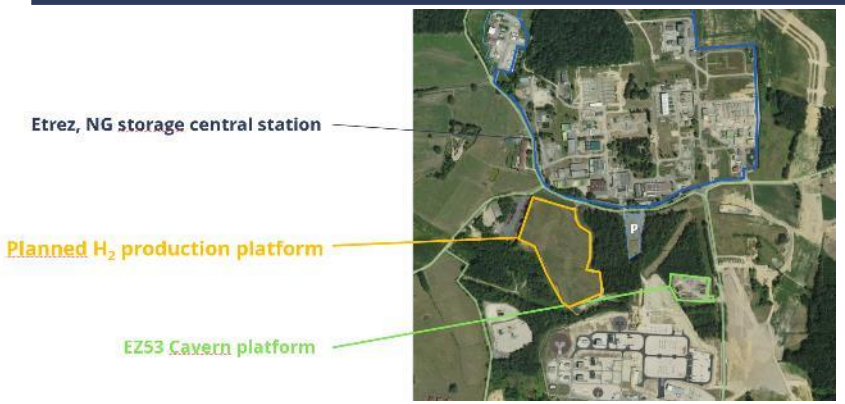
- Electrolyzer 1MW
- Hydrogen transportation by tube trailers



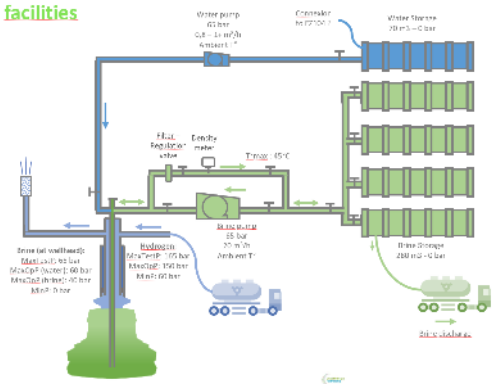
Pilot of Hydrogen Storage in Salt Cavern

- Use of an experimental existing cavern
- Tightness tests
- Pressure variation cycles





Surface facilities



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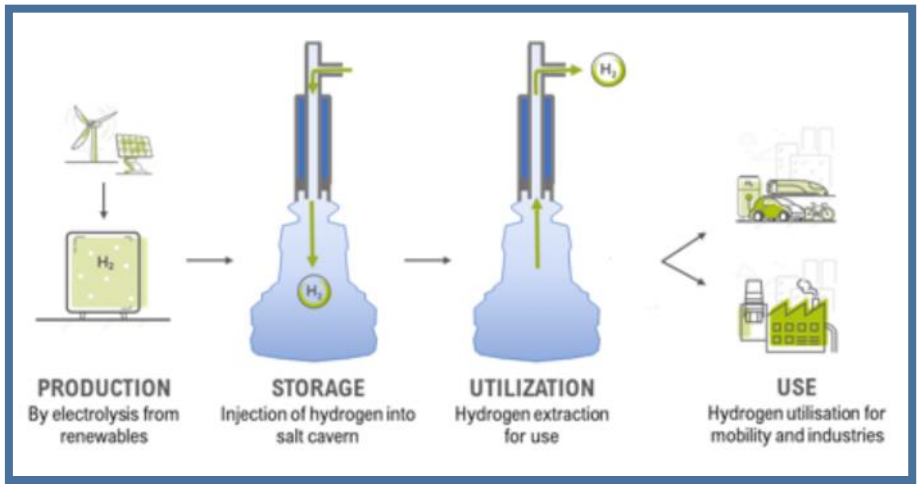

- ✓ Demonstration of the technical feasibility of H2 storage in salt caverns (safety of operations, environmental and geological impact)
- ✓ Adaptation of the equipment to hydrogen (piping, completion): grade of steel, elastomer, welds, etc.
- ✓ Hydrogen tightness of the salt cavity
- ✓ The thermodynamic behavior of hydrogen in the cavity
- ✓ The interaction of hydrogen in a salt cavity
- ✓ Feedback on the quality of the H2 leaving the storage facility

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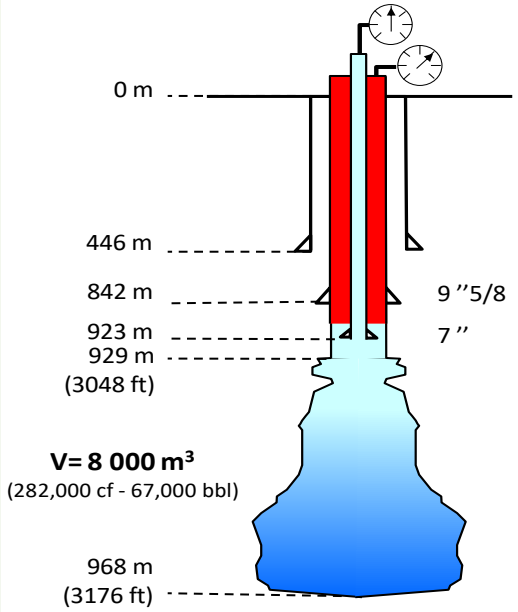
Status of on-site work
(from end Sept‘22)

H2 production platform

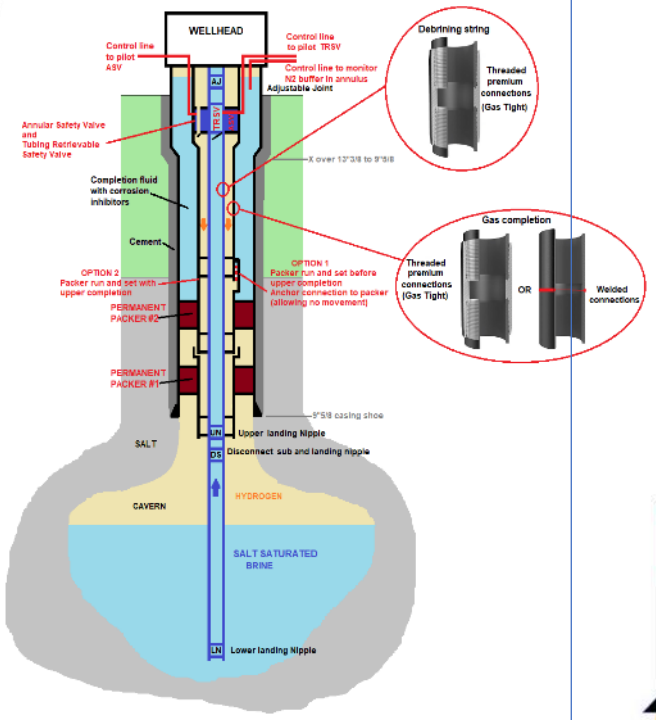
Cavern platform

Well head

Adaption of EZ53 Cavern & Process for Tightness Test

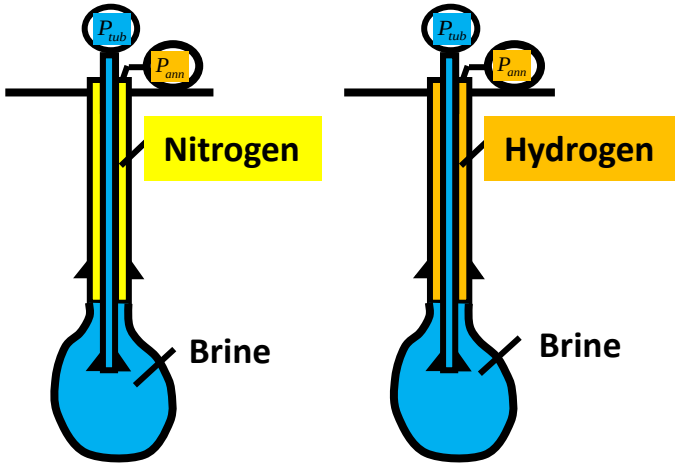


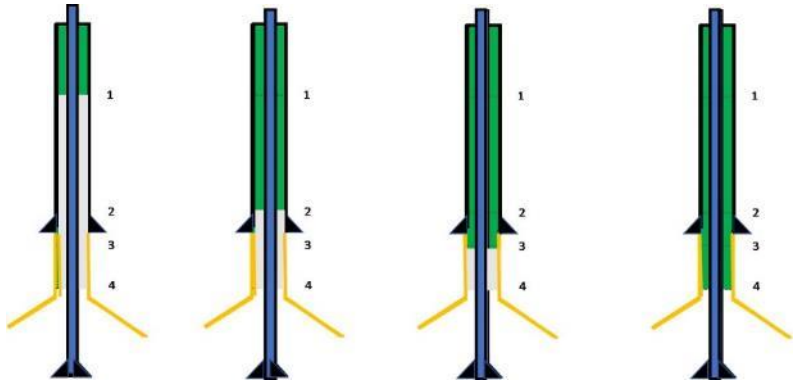
Current EZ53 installations



Cavern completion for H2 storage by brine compensation method

Perform a tightness test with N2 and H2, successively (for demonstration projects)





Set the interface at 4 different depths during the tests (for HyPSTER project)

Aim: Validate if standard method from natural gas storage is suited for hydrogen

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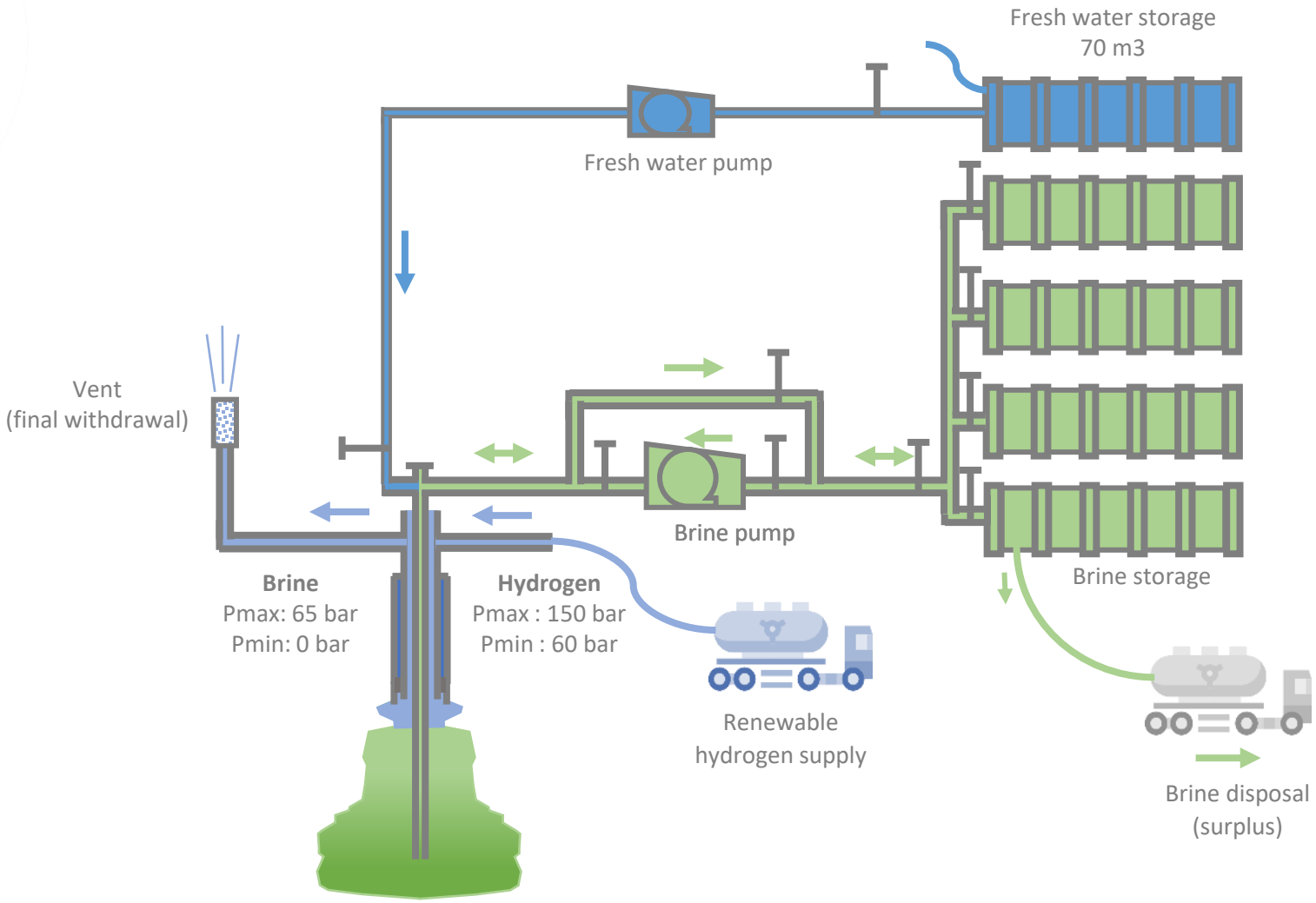
HyPSTER - Cyclic Test Operation



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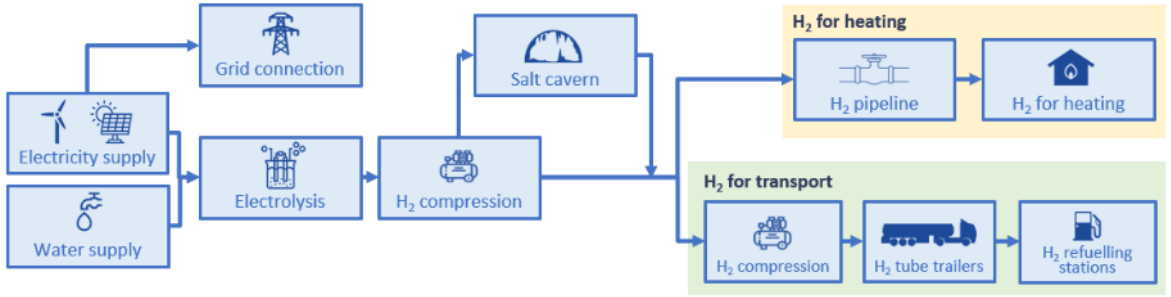
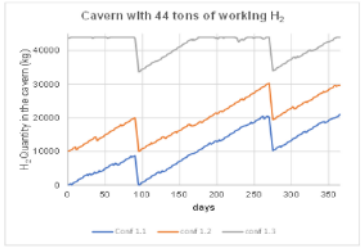
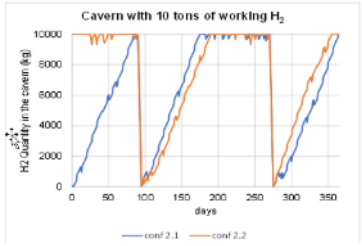
HyPSTER – Test Cycle Definition

Modeling of exemplary hydrogen ecosystems





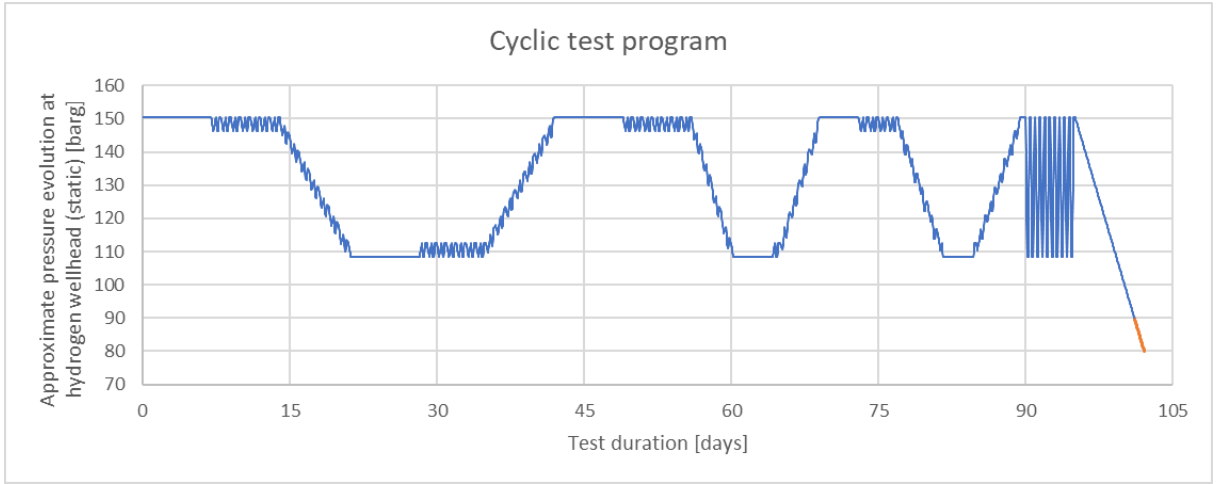


Scenarios investigated for Etrez storage:

- Electrolysis using wind/solar power or grid supply
- Usage for transport or heating
- Backup storage inculded

Planned cyclic testing program at EZ53 :

- ✓ Subject to technical limitations (pressure range)
- ✓ Relevant operating regime (idealized, but containing realistic features)
- ✓ Allowing calibration of software models
- ✓ Facilitating the monitoring of cavern tightness



Integrated test cycle with >100 intraday cycles, standstill periods for calibration and different pressure ramps to test various operation modes. A final hydrogen withdrawal can be added if possible.

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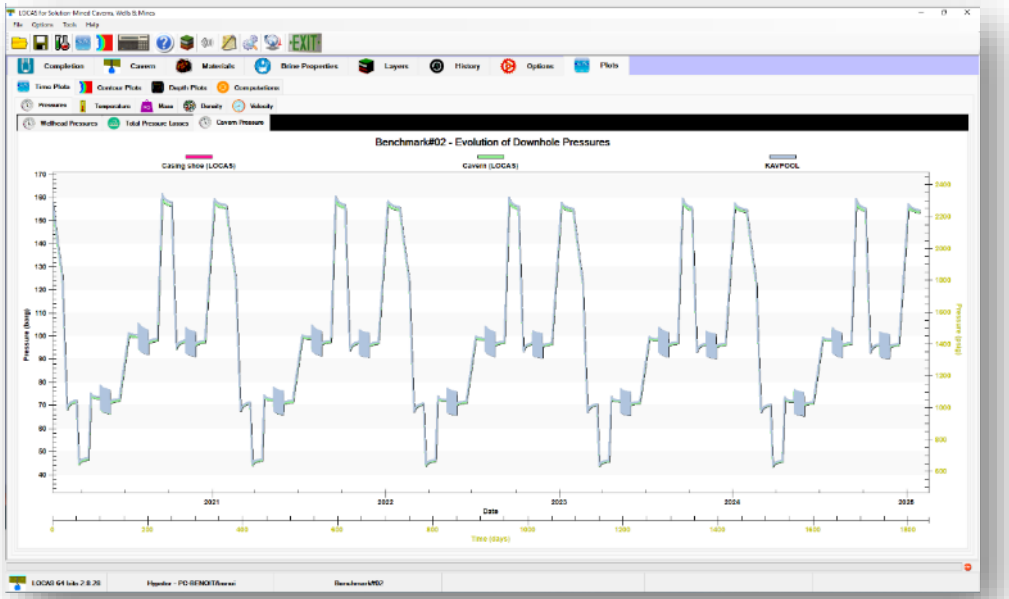
HyPSTER – Adaption & Validation of Salt Cavern Models

Thermodynamical & geomechanical models are **prerequisite** for storage design, approvability, safe operation
-> **commercial applicability**!



Comparison of software models **LOCAS** (Brouard Consulting) & **KAVPOOL/FLAC3D** (ESK/Itasca):

- ✓ Comprehensive benchmarking at relevant operating conditions
- ✓ **Agreement** for main model characteristics **confirmed** (e.g. cavern pressure development)
- ✓ Minor model differences identified, subject to model calibration

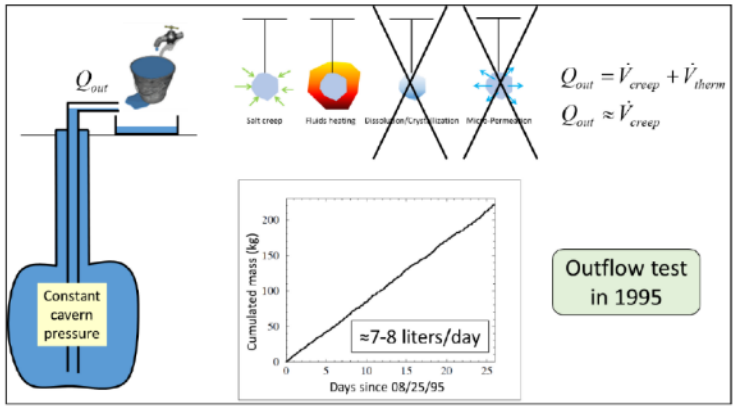
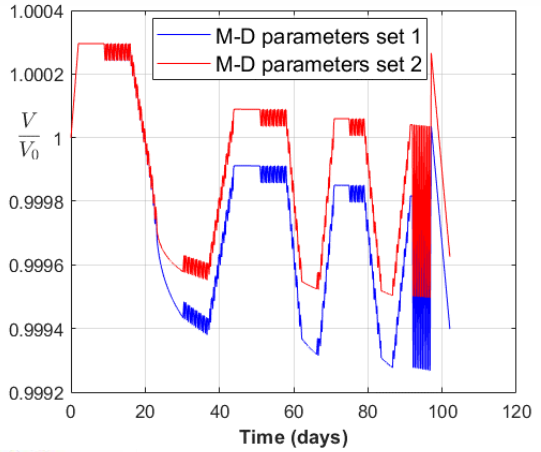


Figure 18. Example of a brine outflow test performed in 1995.

- ✓ Calibration of rock mechanical model on historical data
- ✓ First simulations of EZ53 cyclic tests



Modeled volume change during EZ53 cyclic test due to salt creep (computed using two different sets of parameters)

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Summary:

- Project is on track & within budget
- Approvals have been granted
- Groundwork started
- EZ53 suited for demand scenario
- Models successfully cross-checked
- Website & podcasts available online
- Workshop with stakeholders held

Next steps (extract):

- Continue on-site work (H2 production & cavern platforms)
- Perform tightness test & cyclic test
- Confirm applicability of tightness test method & cavern models
- Analyze delivered hydrogen purity & microbiological activity
- Provide lessons learned on safety & environmental impact
- Model industrial scale storage application
- Assess techno-economic replicability & develop roadmap
- Engage with other potential storage operators & partners
- Develop recommendations for national & EU policy makers
- Publish scientific project results

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Thank you for your attention!

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Project information:
https://hypster-project.eu

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