European Hydrogen Week

24 - 28 October 2022

Brussels, Belgium

euhydrogenweek.eu

Hydrogen Europe

Flagship Expo

Clean Hydrogen Partnership

Large-scale hydrogen storage in depleted gas reservoirs

A solution for the energy storage of the future

Introduction | Snam structure and Stogit

An integrated natural gas infrastructure operator

Italy: ownership and operatorship

Europe: major player

METHANE

National production

Import

TRANSPORT & DISPATCHING

UNDERGROUND GAS STORAGE

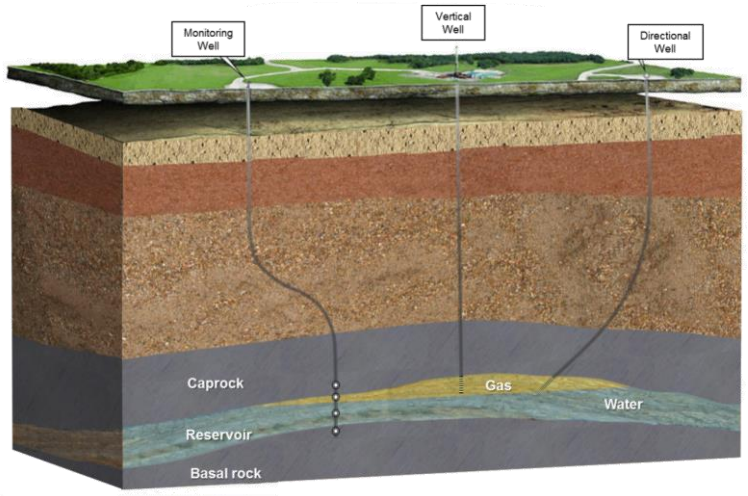
Stogit, a Snam subsidiary, is the largest European player of natural gas storage.

LIQUEFACTION & REGASIFICATION

- Power generation
- Industry
- Commercial and Residential
- Transport

Energy storage in Europe | Key numbers

5000 TWh*	Annual natural gas consumption
1,500 TWh*	Underground storage capacity (30% of the annual natural gas demand)
88%*	Share of gas storage in porous reservoir
250-1000 TWh*	Underground hydrogen storage capacity required by 2050



Depleted gas reservoirs:

- **Large-scale storage**: they allow to store high quantities of energy, typically intended for the storage on a seasonal basis
- **Proven containment**: been used for natural gas worldwide for decades, proving to be safe and reliable
- **Networked status**: distributed in Europe in an extensive and capillary way

Are they ready to play the same role with hydrogen?

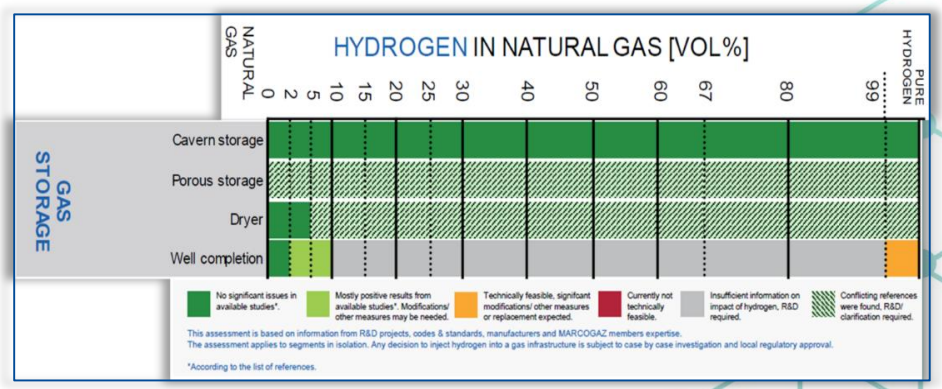
*Cavanagh, AJ, Yousefi, SH, Wilkinson, M & Groenenberg, RM. 2022: Hydrogen storage potential of existing European gas storage sites in depleted gas fields and aquifers. H2020 HyUSPRe project report. 44 pp incl. appendices.

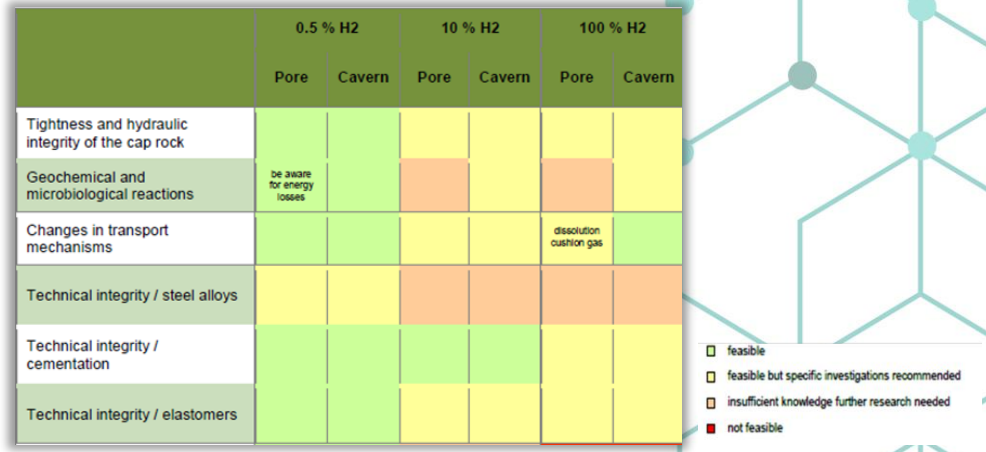
Underground Hydrogen Storage | State of the Art

With respect of hydrogen storage in porous rocks, **the available literature* does not agree in defining the "safe" hydrogen percentage**

- ✓ **No issues** are identified for **well completion** with hydrogen up to **2%**
- ✓ The percentage increases to **5% for dehydration plants**
- ✓ Regarding the **reservoir** itself**,** the **entire range 0 - 100% of H_2** in the mixture with NG **requires further studies and research**

Additionally, the **critical aspects and detailed studies** are identified





*"Overview of test results & regulatory limits for hydrogen admission into existing natural gas infrastructure & end use" – Marcogaz, 2019
"The effect of hydrogen injection for the Dutch underground storages" final report – DBI GUT, 2017

The way forward | Snam's vision

Collaboration with universities and research institutes

Snam/Stogit has launched **its own feasibility study** aimed at identifying, characterizing, investigating and simulating the physical, chemical and microbiological phenomena associated with the storage of a mixture of natural gas and hydrogen in natural gas fields.

Hydrogen Underground storage in porous Reservoir (HYUSPRE): Snam/Stogit participates as industrial partner in the HyUSPRe consortium, funded by Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership).

Collaboration with other sector leaders

H2 Gas Assets Readiness (H2GAR): collaboration among European natural gas Transmission System Operators (TSOs) with the aim of sharing knowledge about the impact of the injection of a limited amount of hydrogen into the elements which are part of their high pressure natural gas networks.

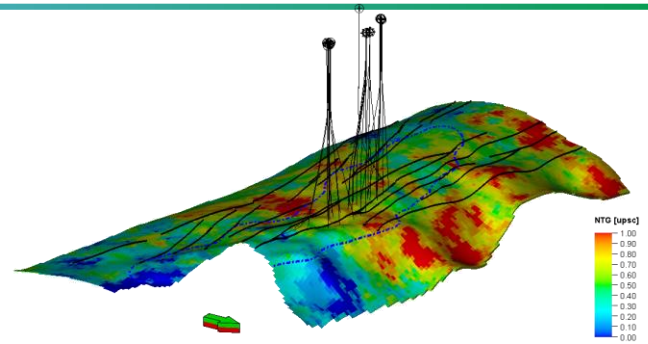
Looking for new ideas

Hyaccelerator: the worldwide first corporate accelerator for startups 100% focused on hydrogen technologies. The HyAccelerator is meant to accelerate breakthrough hydrogen technologies to lead the path to the energy transition.

The way forward | Research topics

Reservoir

- Cap rock
- Fluids mobility
- Geochemical reactions
- Microbiological reactions



Wells

- Diffusion and migration: cement and tubular couplings
- Material damage/deterioration: steel alloys and elastomers

Treatment plants

- Process fluids
- Treatment process type

Underground Hydrogen Storage | Focus on the reservoir

1 Cap rock

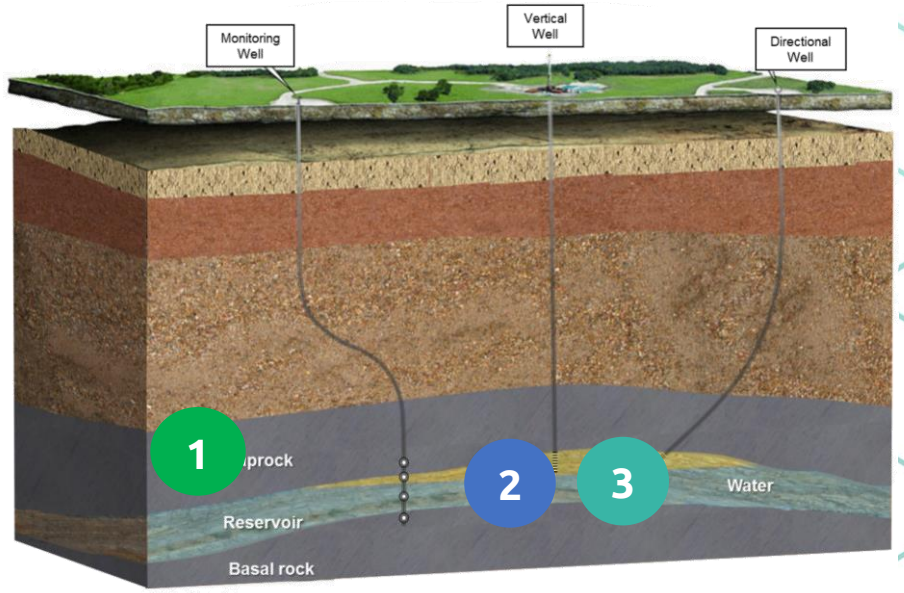
- Only small losses expected due to H2 dissolution in the formation water
- No major tightness problems due to H2 diffusion through the cap rock

2 Geochemical reactions induced by H_2

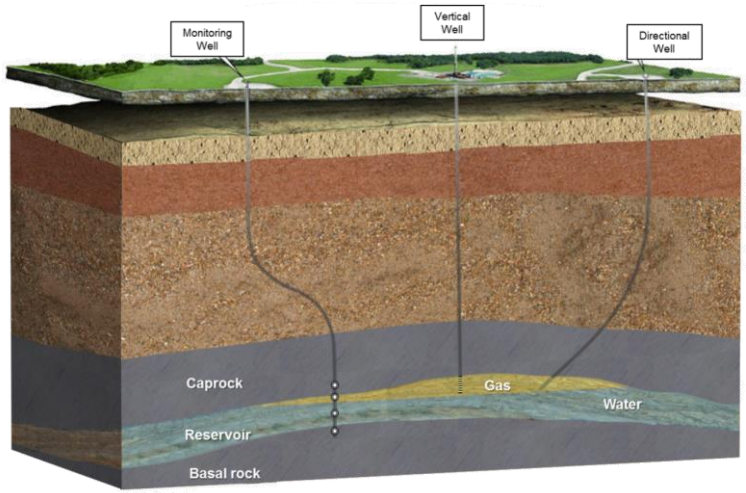
- Storage efficiency and performance could be affected (reduction in porosity & permeability of the reservoir rock).
- The effects could increase by bacterial activity
- Experimental test on rock mineralogy (up to 100% H_2) provided positive results (absence of significant interactions H_2-porous rock)

3 Microbiological reactions induced by H_2

- Impacts considered as the most serious, and depends on the conditions of each storage.
- Impacts could include: energy and pressure losses, fluids acidification and/or losses in storage efficiency (decreased porosity and permeability)
- Experimental test on microbial community provided positive results (absence of exponential microbial growth)



Underground Hydrogen Storage | Conclusions



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Are they ready to play the same role with hydrogen?

- Plenty of research to be completed, but first results are extremely positive
- Depleted gas reservoirs will likely play an important role in hydrogen storage

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