



GEOLOGICAL FOR SERVICE EUROPE

Mapping & Managing Sustainable GeoEnergy Capacities in Europe

Underground Hydrogen Storage





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Sustainable Geo-Energy Resources

Security of Supply

Domestic supply Matching supply and demand

> Energy Trilemma





GEOTHERMAL

Efficient and sustainable low carbon heating and cooling for built environment, industry and agriculture

ENERGY STORAGE

Secure and reliable supply of large shares of variable renewable energy and heat & cold

CO₂ SEQUESTRATION

Effective reduction of emissions during and after the energy transition

Sustainability

Removal GHG emissions Low/Zero carbon technologies

Affordability

Grid services and balancing Efficiency Renewables Base load heat, lower marginal cost

Relevant EU Policy documents

- REPowerEU Plan, SET Plan
- Net Zero Industry Act
- Renewable Energy and Energy Efficiency Directives
- Hydrogen Roadmap Europe





Why Hydrogen storage

Hydrogen Storage Demand Assumptions and Estimations

EU 2030:

- Hydrogen demand 481 665 TWh¹ assumption 10 - 20% storage: ca. 16 bcm – 44 bcm
- HyStories 2022 UHS demand, E27+UK¹¹

7 – 14 bcm

EU 2050:

- Hydrogen demand 780 2.251 TWh⁶ assumption 24% storage^{4,5,7}: ca. 63 bcm – 180 bcm
- HyUsPre 2022 UHS demand¹⁰
 ca. 260 bcm (mid-range, 30% storage)
- HyStories 2022 UHS demand, E27+UK¹¹ 93 – 110 bcm

Global 20508:

- Hydrogen demand ca. 17.000 TWh
- Assumption 10% storage^{1,2,3}: ca. 580 bcm
- IRENA 2022 WETO⁹: 2.000 TWh storage

ca. 670 bcm



- 1) IEA 2020: Natural Gas Information: Overview
- 2) Grand View Research 2020: Natural Gas Storage Market Size, Share & Trends Analysis Report
- 3) BP statistical review of global energy (via www.ourworldindata.org)
- 4) GIE gas storage database (April 2021)
- 9) IRENA 2022, World Energy Transition Outlook
- 10) HyUSPRe, A. Cavanaghet al. 2022, D1.3, Hydrogen storage potential of existing European gas storage sites in depleted gas fields and aquifers
- 11) HyStories , J. Michalski & C. Kutz, 2022, D5.5-2, Major results of techno-economic assessment of future scenarios for deployment of underground renewable hydrogen storages



5) EC – DG Energy 2019: Quarterly Report Energy on European Gas Markets

8) IEA 2021, Net Zero by 2050 - A Roadmap for the Global Energy Sector

7) GIE 2021, Picturing the value of underground gas storage to the European hydrogen system

6) FCH-JU 2019: Hydrogen Roadmap Europe

Hydrogen storage: Building confidence from geology to society



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Mapping potential storage resources

Existing UGS sites (HyUSPRe)



H2020 – HyUSPRe: Cavanagh, AJ, Yousefi, SH, Wilkinson, M & Groenenberg, RM. 2022: Hydrogen storage potential of existing European gas storage sites in depleted gas fields and aquifers.



Porous reservoir traps (Hystories)

H2020 – HyStories: Ceri Vincent and Yann le Gallo, presented at 15th CO2GeoNet Open Forum, 20 September 2022

Salt caverns (Caglayan)



Caglayan, D.G., Weber, N., Heinrichs, H.U., Linßen, J., Robinius, M., Kukla, P.A., Stolten, D., 2020. Technical potential of salt caverns for hydrogenstorage in Europe







