Geostock

WE MAKE THE EARTH THE BEST PLACE
FOR STORING ALL ENERGIES

FRENCH CHAMBER OF GREAT BRITAIN
Established in 1883

SUSTAINABILITY LEADS CLUB

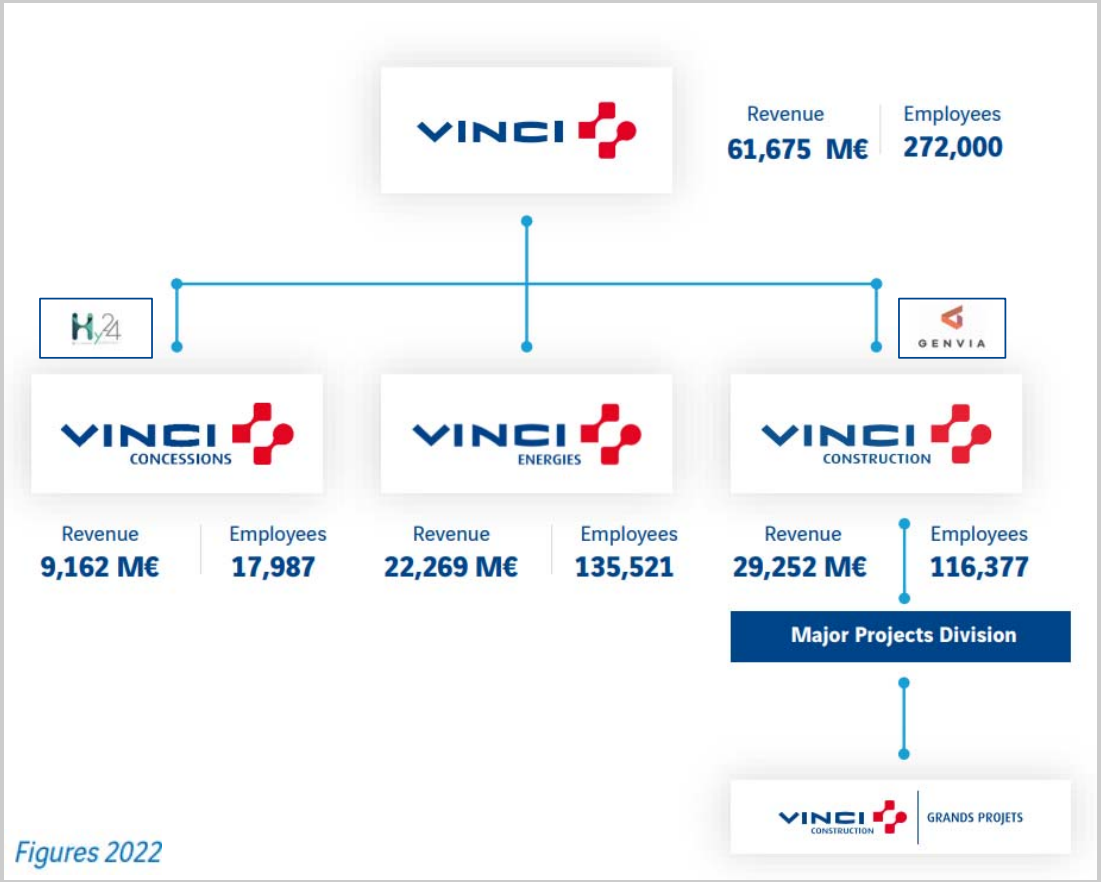
H_2 to achieve net zero: Why & how to store on a large-scale?

Content

- 1- Introduction of Geostock
- 2- Role of H_2
- 3- What is the potential market ?
- 4- Different ways to store H_2

1- GEOSTOCK Introduction

VINCI Group organization



VINCI Construction Grands Projets (VCGP) is a subsidiary of VINCI group, global player in concessions, energy and construction

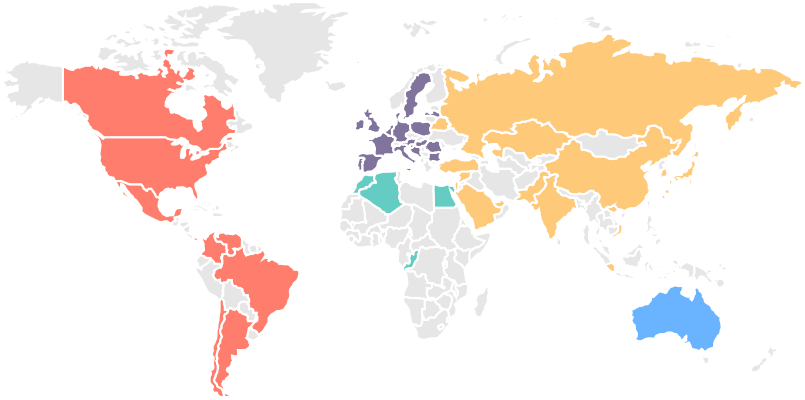
GEOSTOCK belongs to VCGP

Geostock group organization

A global presence

VINCI CONSTRUCTION | GRANDS PROJETS

Geostock



* **Geostock** owns minority shareholdings in underground storage assets operated by or in association with us.

ASIA MIDDLE EAST

SINGAPORE GEOSTOCK ASIA	100%
BANYAN CAVERN STORAGE SERVICES	100%
UEA - BRANCH GEOSTOCK FUJAIRAH	100%
GEOSTOCK ABU DHABI	100%
TURKEY - BRANCH GEOSTOCK ANKARA	100%

EUROPE

FRANCE GEOSTOCK	100%
GEOMÉTHANE*	1% CNP ASSURANCES 49% STORENGY 50%
GERMANY UGS	60%

AMERICAS

USA GEOSTOCK SANDIA	100%
BRASIL GEOSTOCK DO BRASIL	100%
MEXICO GEOSTOCK MEXICO	100%
GEOSTOCK OPERACIÓN	100%
SHALAPA LPG STORAGE*	5% CYDSA 95%

Our Fundamental Commitments (QHSE)

Our SAFETY Objectives

0 ***ZERO***
Severe Accident

0 ***ZERO***
HIPO 1 or 2

Certification

ISO 9001 (QMS),
14001 Environmental
& 45001 (OH&S MS)

GEOSTOCK Green Storage Transformation Plan in 3 parts

1

OUR COMMITMENT

reduce by 40% our direct CO_2 emissions in 2030

2

SUSTAINABLE SOLUTIONS

Support our customers improving their Environmental Footprint

3

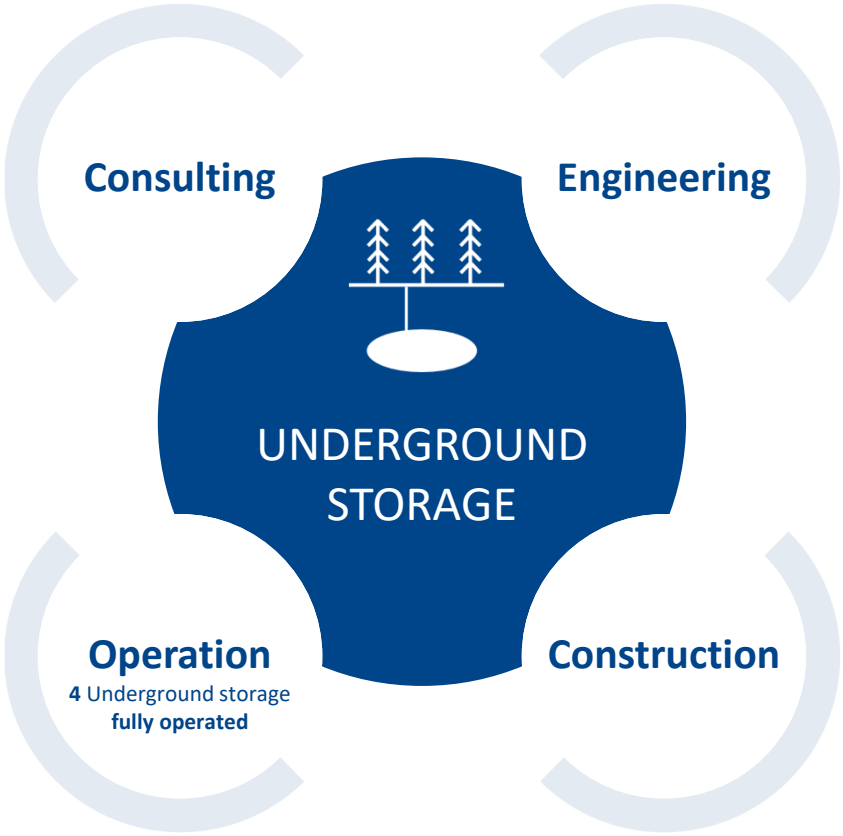
NET-ZERO SOLUTIONS

Promote Energy Transition through Decarbonized Energy Storage & CCUS

Underground Storage Excellence

- An **international Group**
- We do: **Consulting, Engineering, Construction management, Operation & Maintenance**
- On **all Underground Storage Techniques** (Porous reservoir, Salt & Mined rock caverns)
- **For all energies** (Liquid, Liquefied and Gaseous Hydrocarbons, H_2, NH_3, Compressed air and CO_2)

A **key player for Underground Storages** for all energies



…BY RELYING

on the synergies between our services

Geostock in a few figures

55 years of experience in **Underground Storage**

Expertise in the **4 ways** to store Underground

462 **Employees** with expertise

Presence in **50 countries**

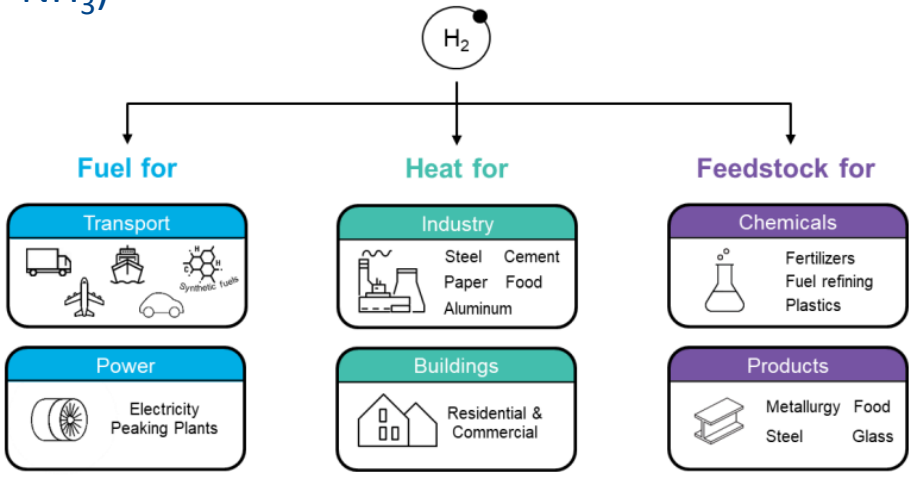
4 Underground storage **fully operated**

A **Green Storage Program** with **3** axes

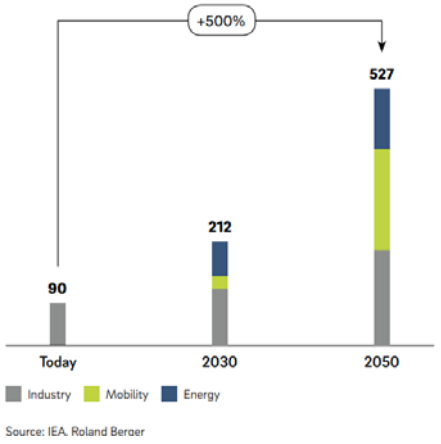
2- Role to be played by Hydrogen tomorrow

Today,
The uses of many sources of Energy

Tomorrow,
the many uses of H_2 (and its derivatives NH_3)



Source: BloombergNEF

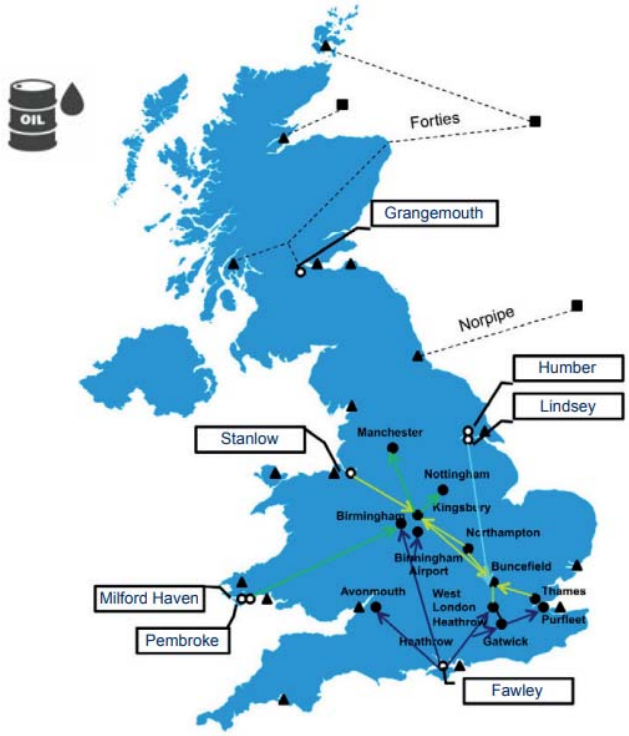


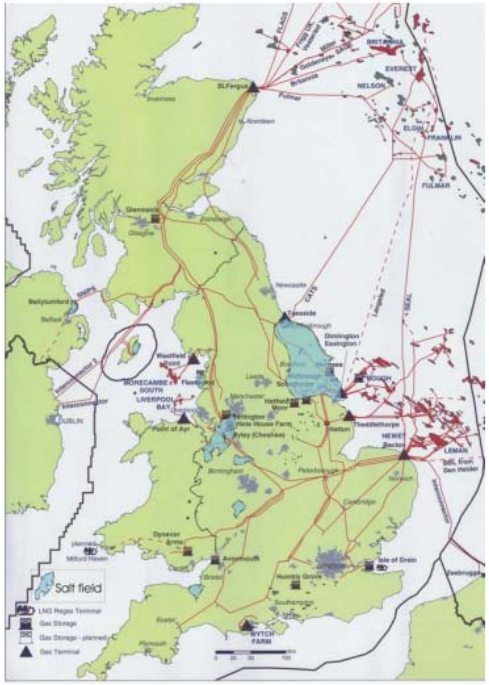
Source: IEA, Roland Berger

H_2 consumption in the IEA's Net Zero Emission Scenario [Mt]

Other solutions to support the net zero transition : biofuels, e-fuels, green electricity, etc.
⇒ Focus on H_2 in the presentation

UK: Location of the current storages (Oil & Gas)





Underground storage

TODAY
Underground storage and above ground storage provide comprehensive national coverage

TOMORROW with H_2 ?

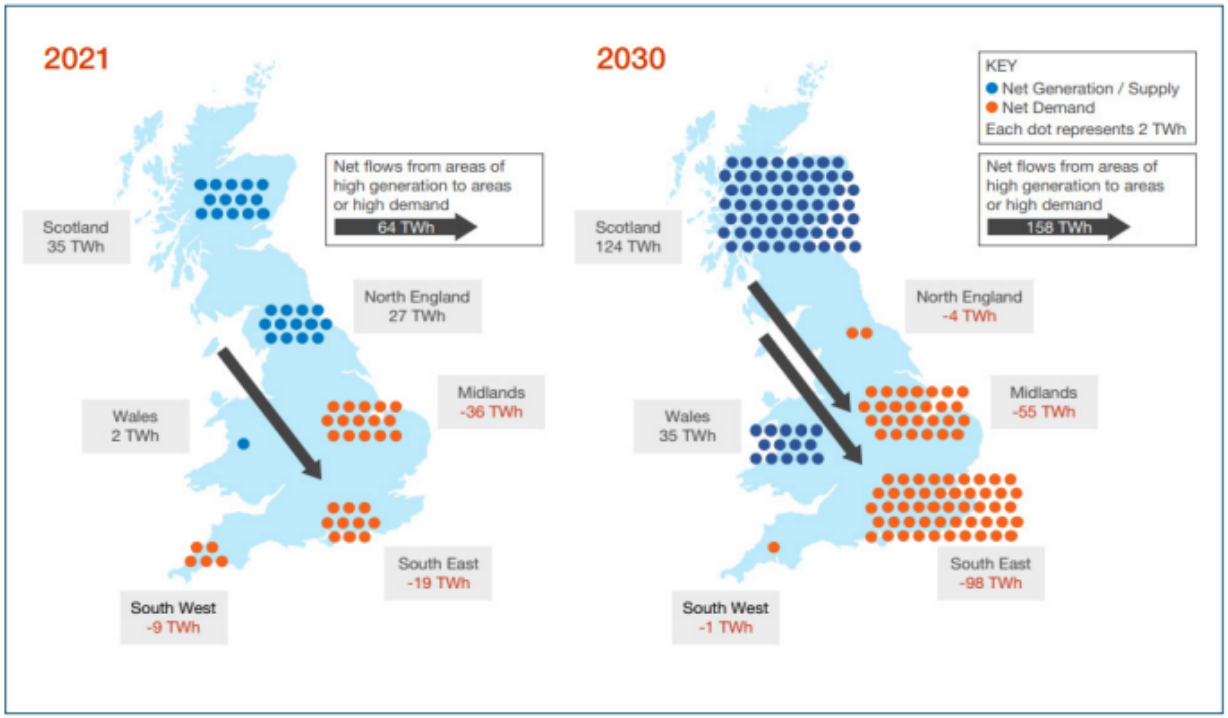
Source: Deloitte based on UK PIA Statistical Review 2012 (p. 9) and Finding an unusual suspect (p. 34) by BP

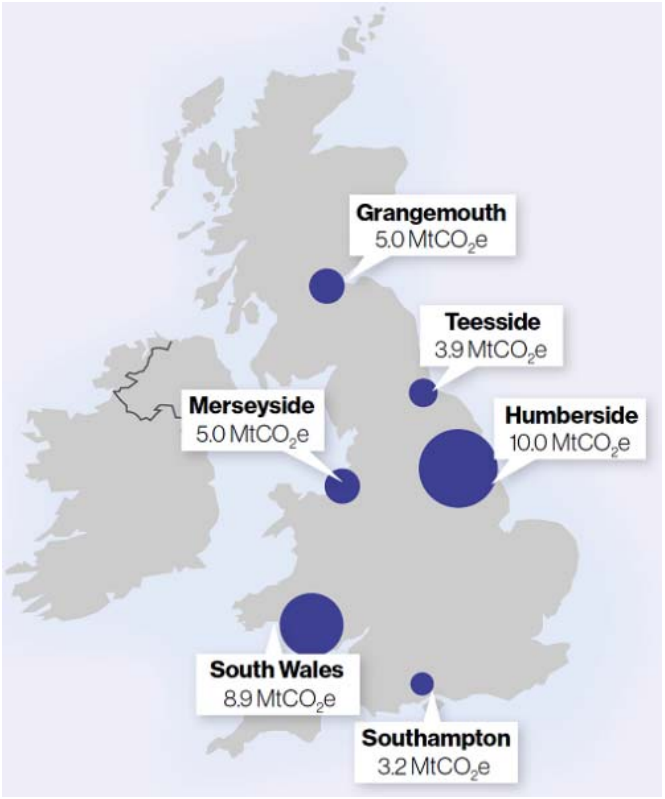
3- Différents drivers for storage H_2 & H_2 market

Different drivers for hydrogen storage

Robust supply chain	Continuity of supply in the event of failure/maintenance of H_2 production equipment – especially for sales to industries
Balance energy supply	To meet the daily & seasonal fluctuating needs (domestic - heating, industry, etc..)
Energy resilience	Strategic stocks to provide national energy security & resilience
Energy security	To balance H_2 produced with intermittent renewables Vital in a world of ever-increasing EnR capcity
Power generation	Renewable electricity generation is intermittent. During low generation supplied maintain by CCGT with the use of H2 instead of NG
Arbitrage	Optimisation of production according to the cost and availability of electricity (erasure or resale surplus)
Efficiency of CCUS	With H_2 storage, CCUS enabled H_2 plants can operate at a constant high load capacity

Geographical disparity between H2 production and industrial emissions





Hydrogen_Networks_Recommendations_from_Hydrogen_UK__1675337272.pdf

Massive storage infrastructure will be needed to deliver H_2 at scale
VISION by 2030

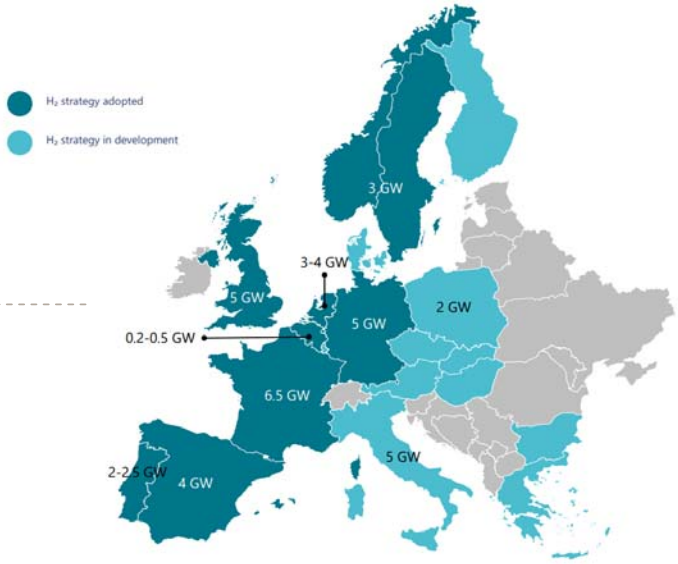
Assumption : 5% Storage Capacity

PRODUCTION CAPACITY
10 GW of Electrolysers
(British Energy Security Strategy, 2022)

STORAGE CAPACITY
20 to **40** Caverns

PRODUCTION CAPACITY
40 GW of Electrolysers
(European Commission, 2020)

STORAGE CAPACITY
125 to **250** Caverns

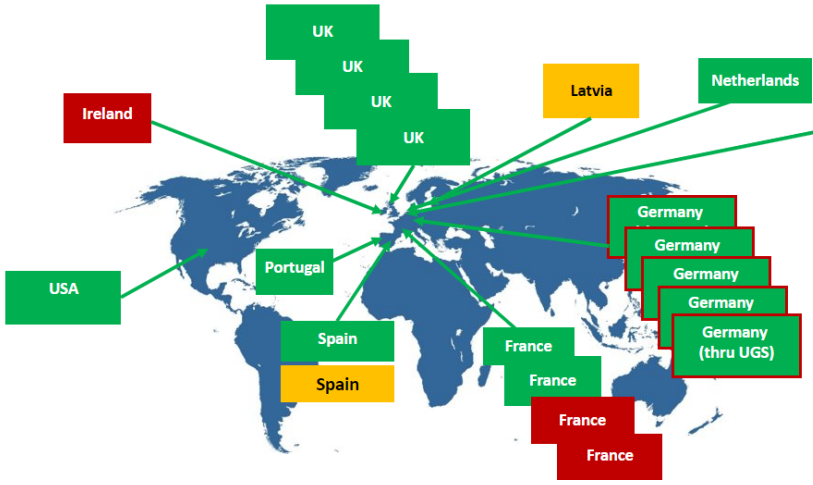


PRODUCTION CAPACITY
(Hydrogen Council, 2021)

STORAGE CAPACITY
> 400 Caverns

Acceleration in demand for H_2 underground storage & CCS

Hydrogen Contracts since 2020



Public Funded Collaborative Projects

hystories

European Commission (Horizon Europe)

Led by Geostock, includes 7 partners. Gathers a dozen of European Gas storage operators/TSO in its Advisory Board

Porous Reservoir

Salt Cavern

Lined Rock Cavern

Knowledge Management actions taken to develop NZS

- Liner for Lined Rock Cavern (H_2, NH_3, CO_2)
- H_2 impact on well casings/completions, microbio activity
- Surface Equipment (Compression, Hydrogen-methane separation, Hydrogen purification, etc.)
- Increase the number of people working for NZS (70% today)

4- Different ways to store massive quantities of H_2

How **to Store H_2**? and why go **underground**?

Storage capacity (tons)

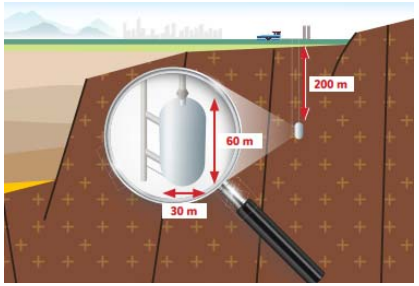
Cost / m^3

4 t

High

200 t

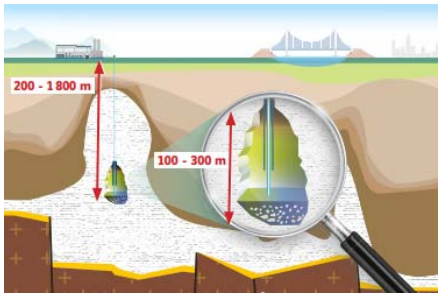
Medium



Lined Mined Rock Cavern

500 – 1000 t

Medium



Salt Cavern

> 3 000 t

Low

Solution 2: Porous media for hydrogen storage

DEPLETED FIELD & AQUIFERS

- Natural Gas
- Compressed Air, CO_2
- **HYDROGEN**

SOLUTION TO STORE MASSIVE VOLUME OF HYDROGENE

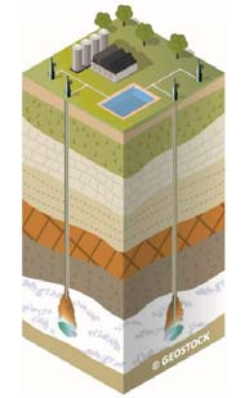
- Very common technique for Natural Gas storage
- Could be in depleted Oil/Gas fields or in saline aquifers
- Operated between 60 bar and 200 bar

hystories Geostock, as the Project Leader

- **Very large volume, average 500 millions Sm^3**
- **Working gas capacity around 45 000t**
- **Cost**

- **Required geology not available everywhere**
- **High cushion gas, not recoverable**
- **Integrity of product quality (microbioligical activity) to be checked on case by case basis**

Solution 1: Salt cavern – Existing H_2 storage



SALT CAVERNS

- Liquid & Liquefied Hydrocarbons
- Natural Gas
- **HYDROGEN**
- Compressed Air & Effluents

MOST COMMON TECHNIC FOR **H_2 UNDERGROUND STORAGE**

- No Technical Show Stopper
- Nearly 2 000 existing storage Salt Caverns Worldwide
- 50 years industrial experience with up to 6 Hydrogen Caverns (incl. 3 in the UK)

- **Large volume, up to 1 000 000 m3**
- **Working gas up to 10 000t**
- **High flowrate**
- **Cost**
- **Conversion of existing salt cavern storage can be studied case by case**

- **Required geology not available everywhere**
- **Water for salt leaching**
- **Brine disposal**
- **Cushion gas (but potentially recoverable)**

Lined Rock Caverns for hydrogen storage

LINED ROCK CAVERN

- Natural Gas
- Liquid & Liquefied Hydrocarbons
- **HYDROGEN**

UNDERGROUND STORAGE IN THE HEART OF THE INDUSTRIAL CLUSTER

- More flexible from a geological point of view to be located in the heart of industrial clusters
- Agile, highly responsive and accurate

A unique know how in Rock Cavern : For more than 50 years, Geostock has been involved in 30% caverns commissioned or under construction, worldwide.

- **Can be done almost everywhere**
- **High flowrate & Flexible storage**
- **Low volume of cushion gas**
- **Suitable for NH_3, CO_2**

- **Cost**
- **Liner choice to be optimised**

Thank you

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