

# Get ready for the winter:

## A toolkit to master the basics of underground gas storage



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## About the author

**Gas Infrastructure Europe (GIE)** is the association of the European gas infrastructure operators. Its members operate the gas transmission networks, underground storage facilities, and LNG terminals. GIE has around more than 65 members from 26 European countries, thus embodying the multiple transitional decarbonization pathways of the EU regions. GIE members are committed to delivering EU's goal in being the first continent achieving climate neutrality by 2050.

For further information, please visit [www.gie.eu](http://www.gie.eu) or contact [gie@gie.eu](mailto:gie@gie.eu).



# Introduction

Underground gas storage is the first flexibility provider in Europe’s energy system today, creating market value, optimising gas and electricity system costs and ensuring security of supply in case of unexpected supply-demand imbalances.

Tomorrow, as Europe transitions to a climate-neutral future, it will be the driving force of the integration of renewable and low-carbon energy into the energy mix.

**Here is everything you need to know to master the basics of underground gas storage.**

## Underground: What does it mean?

In Europe, **three main types of underground reservoirs**, with distinct physical and economic characteristics, provide large-scale, seasonal and cyclical storage of natural gas:

Depleted fields	Aquifers	Salt caverns
<p>Underground structure that naturally contained hydrocarbons for millions of years</p>	<p>Porous sedimentary rock structure that naturally contained water</p>	<p>Artificial structure constructed in underground rock salt formation</p>
<p>Large storage capacity</p>	<p>Large storage capacity</p>	<p>Lower storage capacity</p>
<p>Injection and withdrawal capacities limited by the permeability of the rock</p>	<p>Injection and withdrawal capacities limited by the permeability of the rock</p>	<p>High injection and withdrawal capacities</p>
<p>Fair potential for the storage of hydrogen</p>	<p>Fair potential for the storage of hydrogen</p>	<p>Proven technology for the storage of hydrogen</p>

## A much-needed technology in Europe

With **1,148 TWh<sup>1</sup> of technical working volume**, underground gas storage largely contributes to the security of supply of the European Union (EU). Since February 2022, with Europe's domestic production fast declining, high uncertainties on import supplies and the indispensable need for a back-up to highly intermittent renewable electricity production, gas storage facilities have been increasingly recognised as **highly strategic assets**. By making the **diversification of supply sources** easier for European energy players and their procurement options more flexible and cost-effective, underground gas storage and, especially relevant in the future, underground hydrogen storage will contribute to a more independent Europe.

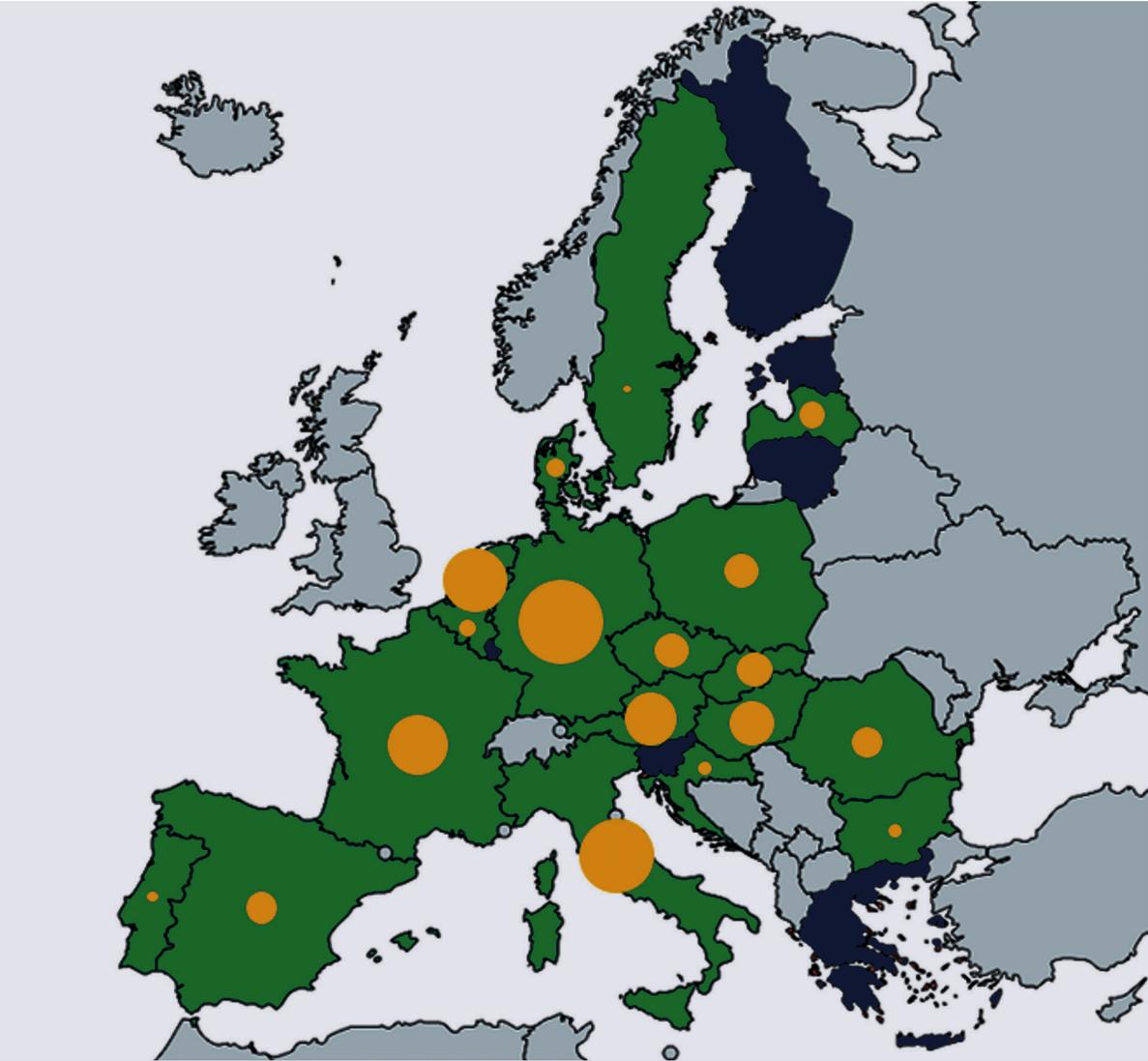
In this context, the Commission proposed some **storage filling obligations** – 80% by 1st November 2022, 90% from 2023 onwards –, which entered into force in July 2022 following a fast-track but intense approval process. Along with these mandatory filling targets and trajectories, the new EU gas storage regulation<sup>2</sup> has also **introduced some solidarity mechanisms**. Indeed, EU Member States which are not equipped with underground gas storage must now establish storage arrangements or burden-sharing mechanisms with Member States which have storage facilities on their territory.

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1. Gas Infrastructure Europe (2021), storage database. Available at: <https://www.gie.eu/transparency/databases/storage-database/>

2. Regulation (EU) 2022/1032 of the European Parliament and of the Council of 29 June 2022 amending Regulations (EU) 2017/1938 and (EC) No 715/2009 with regard to gas storage

Figure 1 - Underground gas storage capacities in the European Union



Source: GIE (2022)

Underground gas storage capacities (TWh)



- Member States equipped with underground gas storage technologies
- Member States that must establish storage arrangements or burden-sharing mechanisms

## What are the values brought by underground storage?

Beyond their role in strengthening Europe’s security of supply, storage facilities deliver numerous benefits to the energy system and market. In fact, they will become quickly essential as Europe transitions to a climate-neutral society fueled by renewable and low-carbon energy:

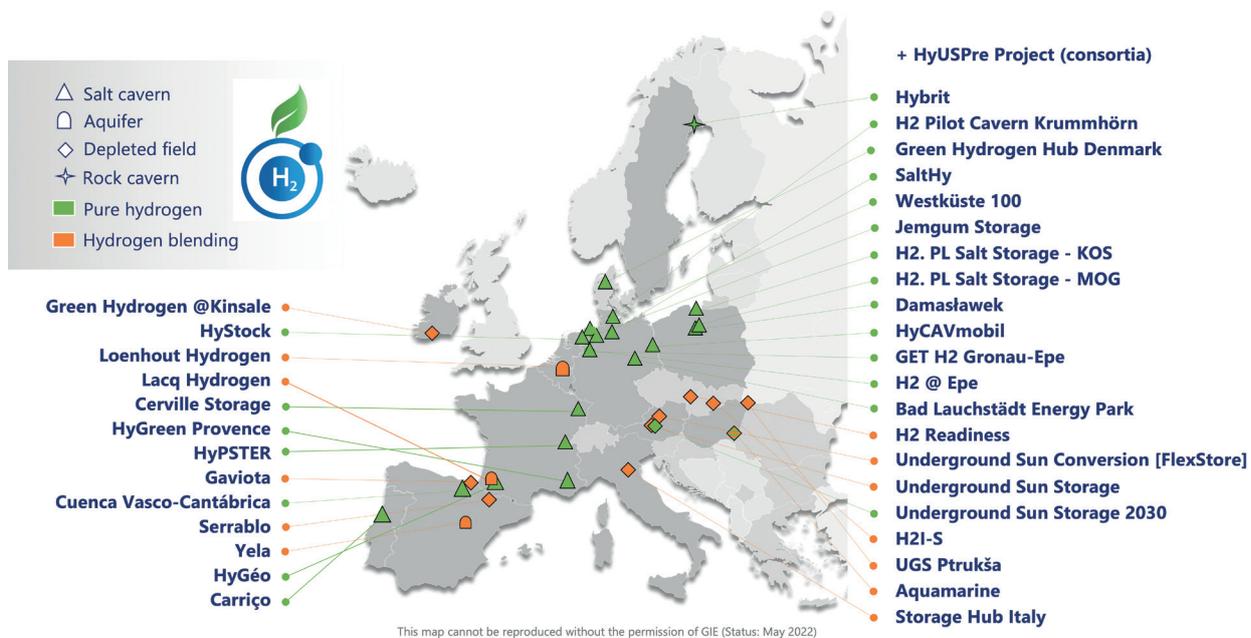
<b>1</b>	<b>Market value</b>	Making a better use of the cheapest energy sources in competitive market, reducing the consumers’ exposition to the volatility of prices
<b>2</b>	<b>System value</b>	Avoiding over-investment in other infrastructures, across the entire energy sector, to ensure the energy demand can be met in a secure and efficient way
<b>3</b>	<b>Insurance value</b>	Ensuring sufficient volumes and injection rates are available to end-uses subject to uncertain demand levels (e.g. turbines, heating technologies) enhancing energy security and diversification
<b>New Values</b>		
<b>4</b>	<b>Kick-start value</b>	Optimally sizing investment in RES capacity in order to comply with transition targets, thereby facilitating the emergence of a hydrogen ecosystem and a more independent Europe
<b>5</b>	<b>Environmental value</b>	Helping avoid electric redispatch and fossil-based hydrogen production and to avoid RES curtailment

Source: Artelys (2022)

# The journey towards hydrogen

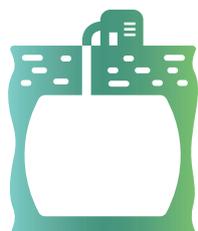
With more than 35 projects and studies publicly announced in the field of underground hydrogen storage, SSOs all over Europe are actively preparing tomorrow's world:

**Figure 2 - Projects and studies publicly announced in the field of underground hydrogen storage**



## Main parameters

Each underground gas storage site is unique. To assess its performance, various parameters can be used:



### Gas in storage (TWh)

Amount of gas contained in the underground gas storage site at a particular time



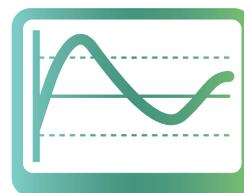
### Storage filling level (%)

Amount of gas contained underground compared to the total capacity of the storage site



### Working gas volume (TWh)

Amount of gas that can be injected, stored and withdrawn during the normal commercial operation of a storage facility



### Cushion gas (TWh)

Amount of gas required to stay permanently in the underground storage to maintain necessary pressure, injection and withdrawal rates



### Injection capacity (GWh/d)

Amount of gas that can be injected into a storage facility

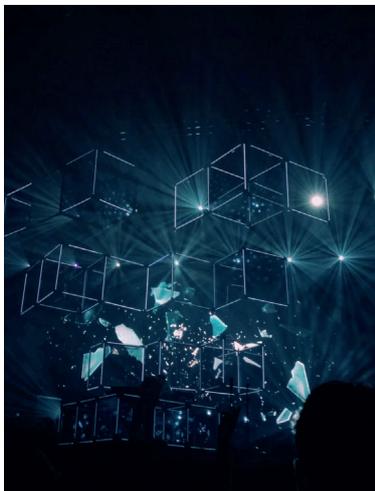


### Withdrawal capacity (GWh/d)

Amount of gas that can be withdrawn from a storage facility

## Interested in further data?

Looking for the data corresponding to these parameters?  
GIE has made various tools available.



### AGSI, GIE Aggregated Gas Storage Inventory

The **Storage Transparency Platform** delivers every day online data regarding the European storage market, namely: gas in storage, storage filling level, injection and withdrawal rates, etc. All figures are reported per site by Storage System Operators and then aggregated per country.

Relying on voluntary contributions, AGSI covers today approximately 99% of EU technical storage capacities.



### GIE Storage Database

The **Storage Database** shows the operational data such as working gas volume, injection and withdrawal capacities of storage facilities. It also lists the existing, under construction and planned storage sites. It is used as a basis to create the GIE Storage Map.

The 2021 database is available in an open format and includes details on the different storage system operators and their facilities.



### GIE Storage Map

The **Storage Map** illustrates geographically the data from the Storage Database.

It is updated every second year with first-hand information provided by GSE members, making it a reliable source of information for the storage business. It is available in two different formats: online or in a printed version.

**Do you wish to use data derived from these sources?  
Do not forget to quote GIE as a reference.**