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FACTSHEET

H_2-STORAGE REQUIREMENTS IN GERMANY

In a fully renewable energy system with volatile renewable electricity production, the production of green hydrogen is also volatile. For hydrogen applications with constant demand or spikes in demand, but also as a seasonal storage, such a system must contain sufficient storage capacities.

Necessity of hydrogen storage facilities

Industrial applications often require a constant flow of hydrogen for their production processes, yet hydrogen produced from renewable electricity does not produce constant flows. This poses the requirement of installing sufficient storage facilities to buffer periods with limited hydrogen production. Storage facilities will also play a crucial role in balancing imports and consumption and thus in stabilising the logistics chain. Germany also envisions hydrogen power plants to stabilize the electricity system, leading to peak demands that can only be met with sufficient storage capacities.

The long-term scenarios predict a demand for hydrogen storage of initially about 2 TWh in 2030 and up to 74 TWh in 2045, as can be seen in Table 1. In order to be able to cover this storage demand, the conversion of existing natural gas and crude oil storage facilities is the main option.

In TWh	T45 Electricity	T45 H_2
2030	2	2
2035	15	5
2040	47	25
2045	74	72

Table 1 Hydrogen storage demand in Germany based on two scenarios from the German long-term scenarios[1]

In addition to the forecasts for the total volume requirements, modelling in the long-term scenarios was undertaken to determine the varying storage levels over the course of the year 2045. The curves show a central importance of hydrogen storage as seasonal intermediate storage. The stronger the restrictions of the scenarios for the energy system, the higher the storage demand, with almost parallel curves over the course of the year.

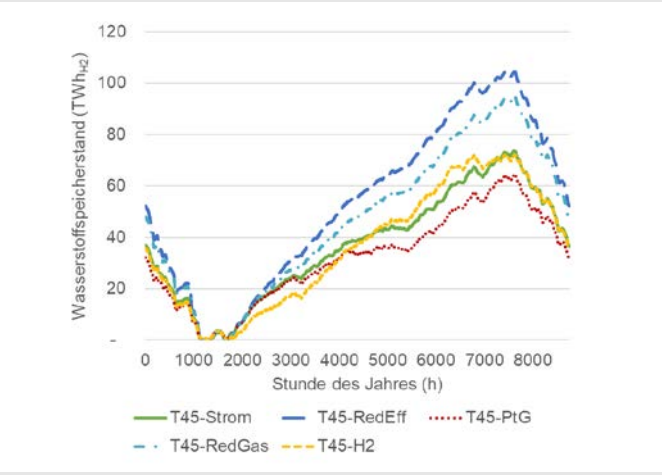

Figure 1 Hydrogen storage level during 2045 in TWh

1 Fraunhofer ISI et al.

Germany's hydrogen storage potential

Germany currently has 262 TWh of natural gas storage capacity with 168 TWh of cavern storage and 94 TWh of pore storage. The cavern storage facilities are mainly located in northwestern Germany. The pore storage facilities, on the other hand, are mainly in the south of Germany.

In a joint study of several associations and research institutes, the technical possibilities for adapting gas storage facilities for the use of hydrogen were examined.

It is assumed that all cavern storage facilities located in Germany are fully available for the storage of up to 100 % hydrogen as well as 4 out of 16 pore storage facilities can be considered suitable for storing up to 100 % hydrogen. However, the suitability of a pore storage system for hydrogen storage must be analysed individually. In total, a hydrogen storage capacity of 32.4 TWh could be provided by the assumed suitable pore and cavern storage facilities. The construction of additional storage facilities is therefore required.

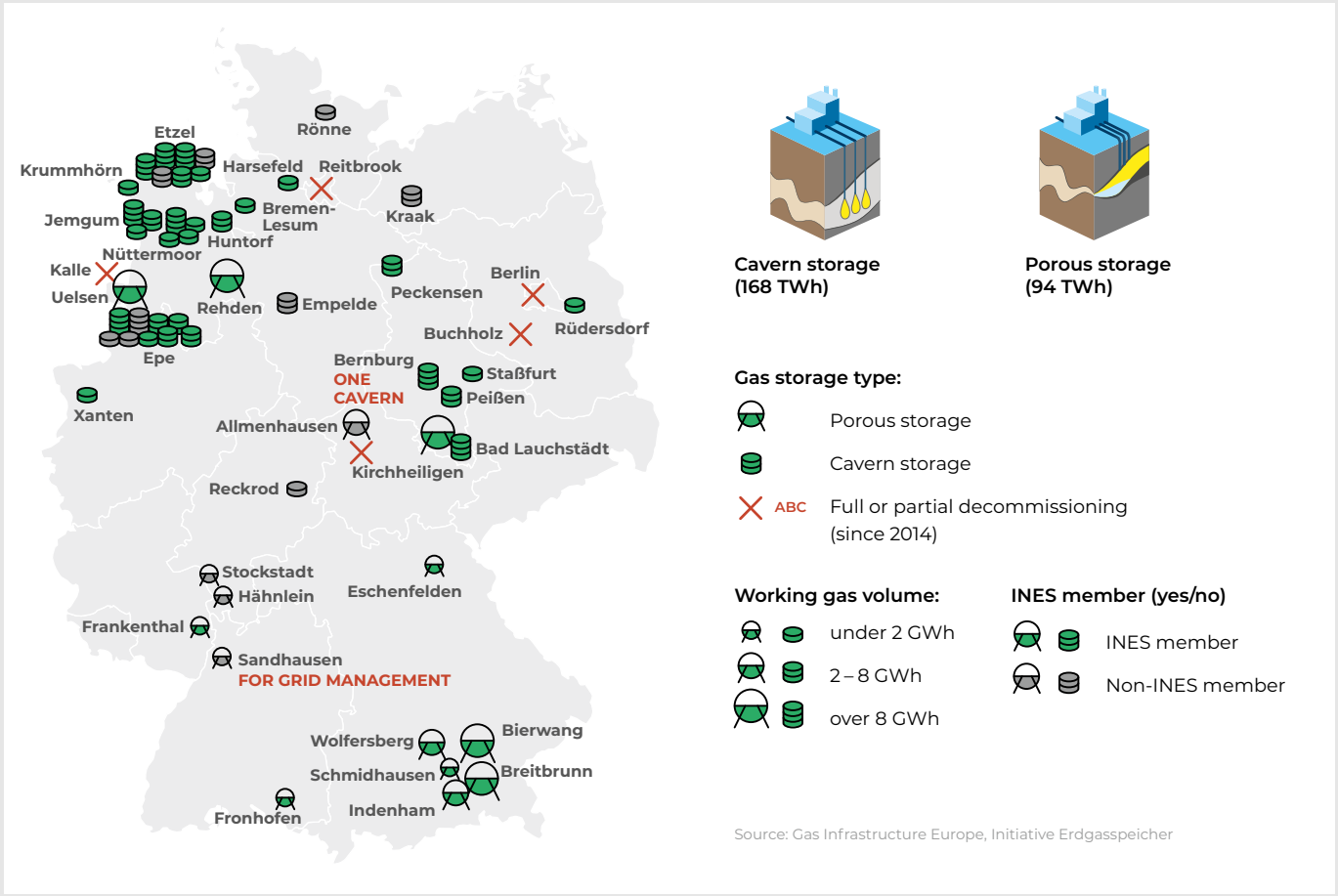

Figure 2 German National Hydrogen Council (2022): Hydrogen storage roadmap 2030 for Germany

Germany's geological storage potential is sufficient to meet the storage demand of all portrayed storage scenarios*. However, the requirements for storage must be adapted to increased cyclical use, requiring both underground and aboveground facilities to be adapted. The associated costs for the transformation of storage facilities are estimated at about 12.8 billion euros by 2050, with average conversion costs of 45 million euros per cavern storage facility and 46.5 million euros per pore storage facility.[2] However, actual costs may be higher as cost aspects such as cavern rights, land usage rights and new installations for hydrogen treatments are not considered.

According to the "Hydrogen storage roadmap 2030 for Germany" of the German National Hydrogen Council, only cavern storage projects have been announced in Germany as of November 2022, with a total storage volume of about 0.3 TWh. Currently, the regulatory framework and a viable business model are missing to enable final investment decisions. With a lead time for approval and retrofitting of approximately five years, these decisions would have to be taken until 2025 in order to be able to meet the commissioning date of 2030.[3]

Germany's National Hydrogen Strategy 2.0 published in 2023 points out the importance of hydrogen storage, especially for the envisioned role of hydrogen as a seasonal storage for renewable energy and therefore its application in hydrogen power plants.

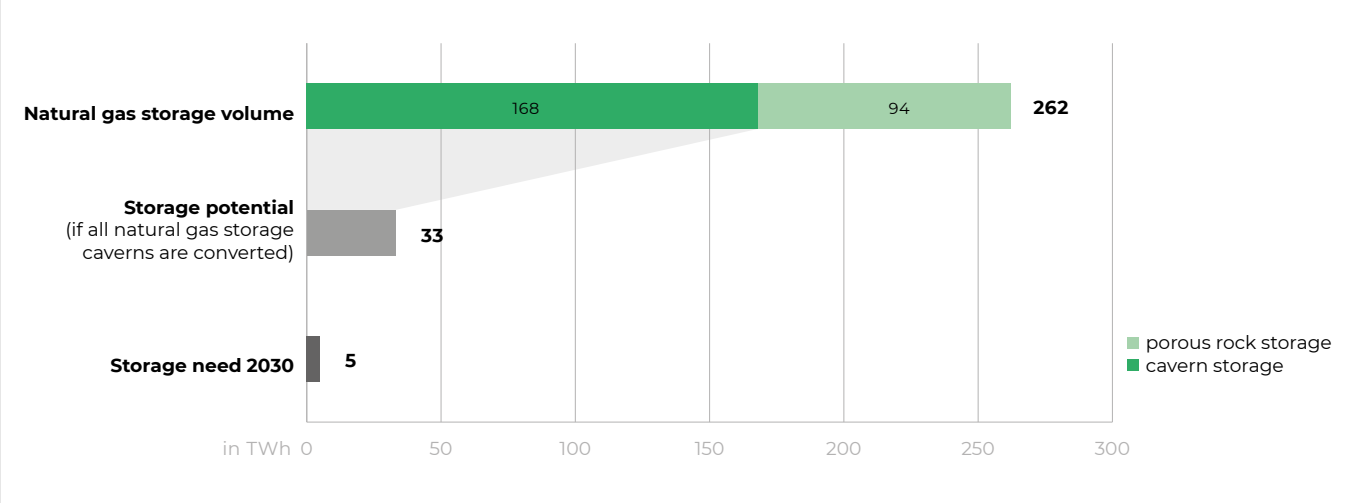

Figure 3 German National Hydrogen Council (2022): Natural gas storage potential for hydrogen vs. demand for hydrogen storage in 2030

2 DBI Gas- und Umwelttechnik GmbH (June 2022)

3 German National Hydrogen Council (November 2022)

Legal information

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