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# The role of hydrogen storage for a flexible, resilient and optimised energy system



# Overview

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4. Two typical use cases

5. Different perspectives: RFNBO vs low-carbon

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# Storengy bundles the ENGIE Group's global natural gas storage activities




**No. 1**
Operators of underground natural gas storage facilities in Europe

**12.2 billion. m³**
Storage Capacity for natural gas

**No. 4**
Operators of underground natural gas storage facilities worldwide

**70**
Years of expertise in the development of energy solutions

employees

**~ 800**
in France

**~ 150**
in Germany

**~ 50**
in the UK



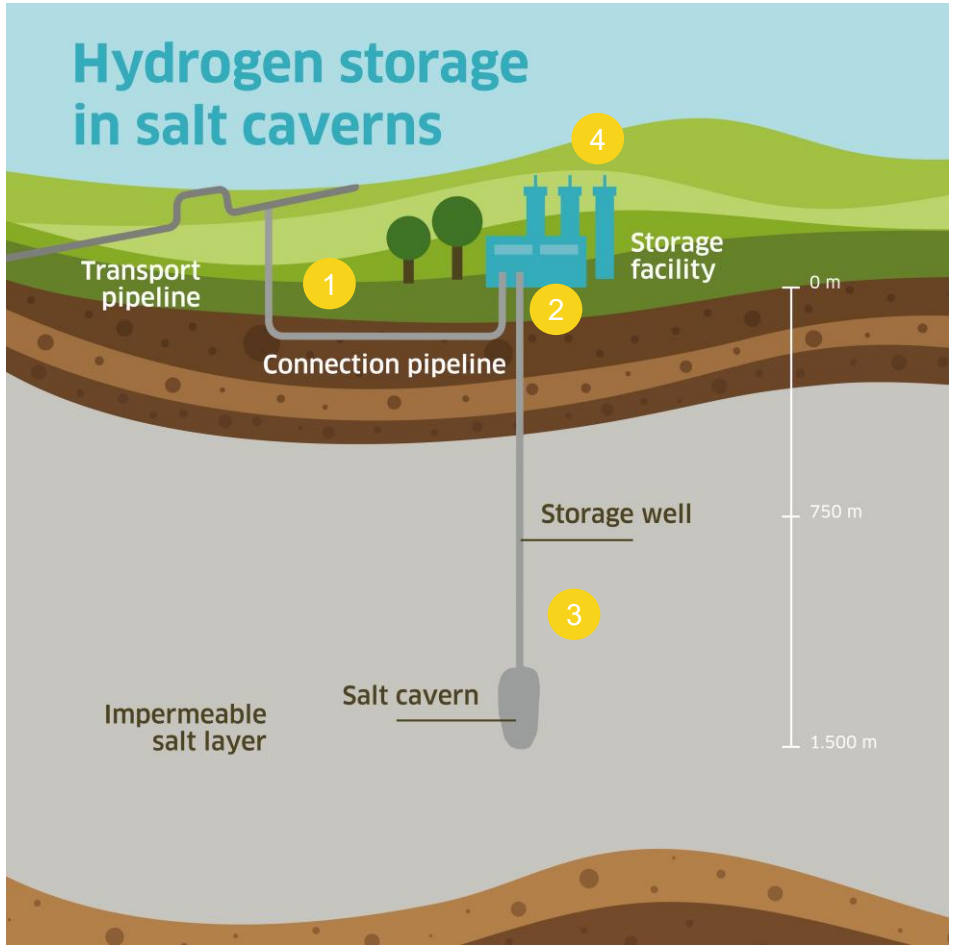
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# Underground storage in salt caverns (natural gas, hydrogen)

## Main components

1. Connection to the gas transport network (high pressure, 18-84 bar) with gas flow measurement
2. Injection section with compressor station for injecting the gas into the underground cavern
3. Storage well and cavern in the salt (cavern operating pressure 66-213 bar, leaching period 3-5 years depending on cavern size)
4. Withdrawal section with gas drying system

**One cavern** of our hydrogen storage project SaltHy (Harsefeld) could store up to **260 GWh (6700 t) of hydrogen**






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# The value dimensions of hydrogen storage

| | | |
|---|---|---|
| **Arbitrage value** | Use of cheapest energy sources available across time (decoupling hydrogen production from demand) | **Lower hydrogen prices** and decreased price volatility |
| **Insurance value** | Protection against hydrogen supply disruptions (production, import & transport) | Increased **security of supply** and **resilience** (hydrogen & power) |
| **System value** | **Efficient layout** of the entire energy system by providing flexibility and seasonal energy storage ($H_2$ turbines) | Lower CAPEX & OPEX for energy infrastructure and production capacities |
| **Environmental value** | Reduction of renewable energy curtailment and fossil-based hydrogen production | Lower greenhouse gas emissions |
| **Kick-start value** | **Improvement of hydrogen business models** (providing flexibility and lowering electrolyser OPEX) | Faster hydrogen market ramp-up and decarbonisation |

*Source: Own representation based on Frontier Economics study on behalf of H2eart for Europe and on Artelys study on behalf of GIE*



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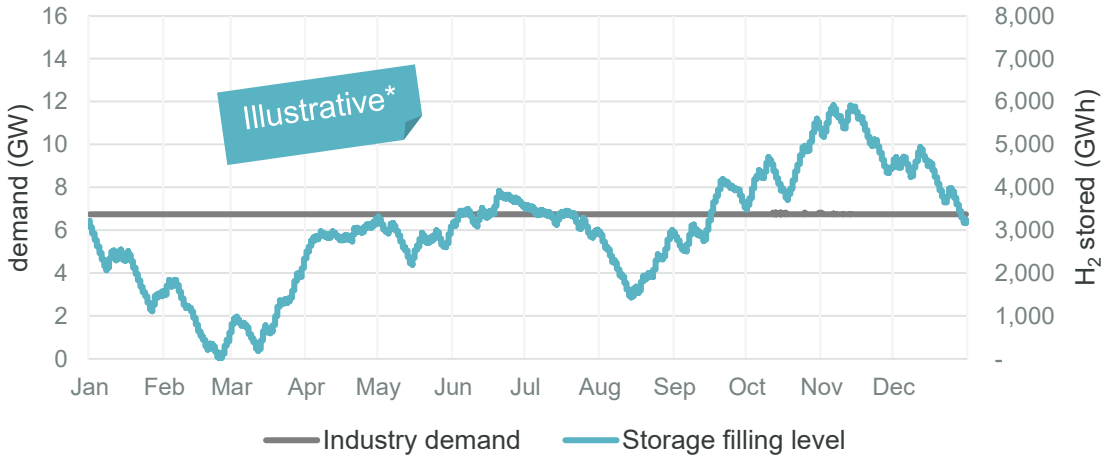
# Two typical use cases of $H_2$ storage

**Industry** (supplied with domestic RFNBO):

- **5-10+** cycles per year → low working gas volume
- Injection rate ≈ withdrawal rate
- **15-50%** of demand stored

(depending on electrolyser full load hours)

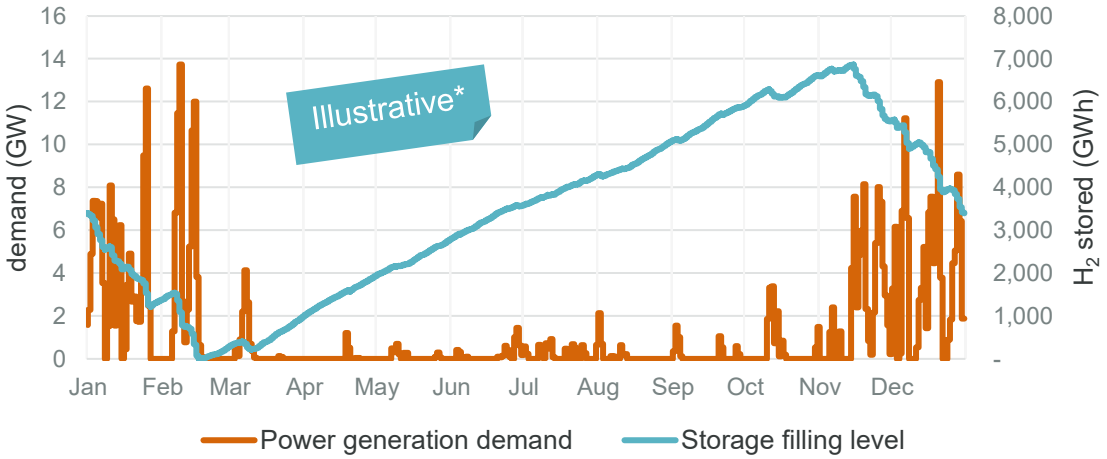





**Power plants** (supplied with domestic RFNBO):

- **1-2+** cycles per year → high working gas volume
- Injection rate < withdrawal rate
- **85-100%** of demand stored






**Actual storage usage profiles will also vary based on:**

- synergies between use cases → multi-use storage facilities are more efficient
- share and profile of imports as well as production portfolio effects

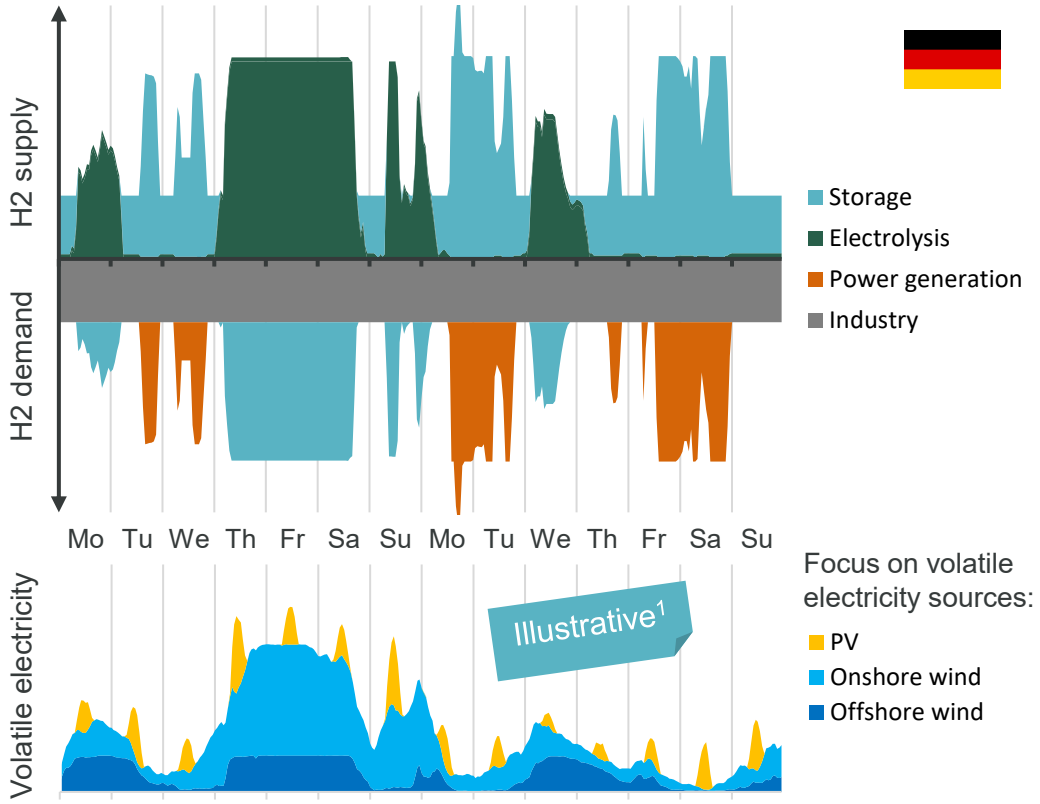


**Source for illustrations: Own representations based on data from Langfristszenarien 2024 (BMWK)*

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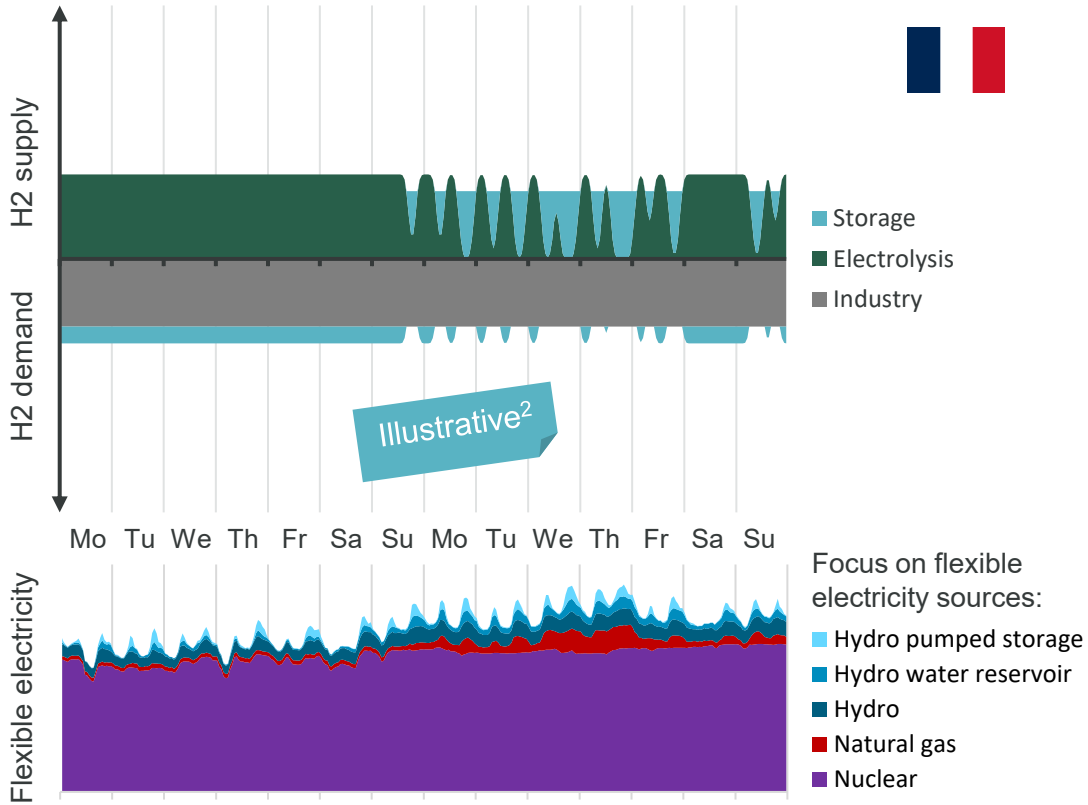
# Different perspectives: RFNBO vs low-carbon hydrogen

**Germany:** example of volatile production of renewable hydrogen




[1]*Source: Own representations based on data from Langfristszenarien 2024 (BMWK)*

**France:** example of flexible production of low-carbon hydrogen

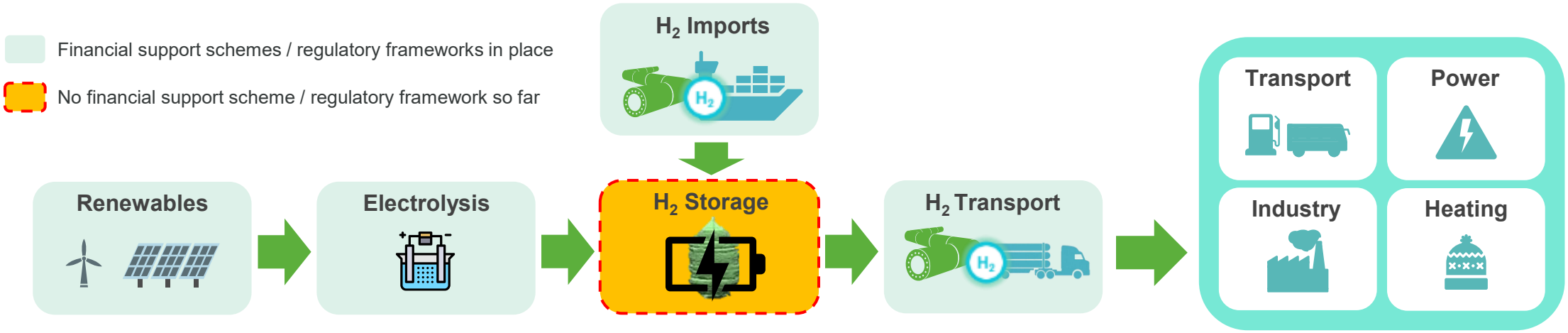



[2]*Source: Own calculations and representations based on data from SMARD (BNetzA)*



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# Investments in $H_2$ storage need government de-risking




**Major investment risks:**

- \+ **Longest lead times** in the value chain (5-10 years)
- \+ No regulatory framework for $H_2$ storage, immature $H_2$ market
- \+ Unbundling of the value chain
- = **High price and volume risks**
  → delayed FIDs for $H_2$ storage

**Solutions:**

- Accelerated implementation of the **regulatory framework** for $H_2$ storage (transposition of EU gas package directive)
- **Government coordination** of the development of the hydrogen value chain (e.g. storage development plan)
- **Dedicated financing instrument** to support $H_2$ storage ramp-up, e.g.:
  - revenue-based contracts for difference (CfDs)
  - inter-temporal cost allocation



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Thank you
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