



# Hydrogen underground storage services

Engineer the Future of Energy with  
Low Carbon Solutions



# Halliburton engineers custom hydrogen solutions

Hydrogen is becoming an essential part of a balanced energy mix and decarbonization strategy, but transportation and storage require understanding its unique properties. That’s why you need an execution company with an integrated approach to hydrogen transportation and storage to help facilitate safe, effective, commercially viable projects.

Halliburton draws upon more than 100 years of experience in well construction, planning, design, and monitoring to engineer custom hydrogen solutions. We provide services and technology to help safely and effectively transport and store hydrogen; including pipeline and subsea repurposing and maintenance, assist with site selection and subsurface modeling, new and repurposed well injection and monitoring, and long-term containment/MMV. Our collaborative approach with customers and third-party providers allows for more comprehensive solutions for storage and transportation-adjacent projects. The result is a lower total cost of ownership and smoother project completion.

## HOW WE DRIVE VALUE

- Full lifecycle project support. We help support hydrogen projects throughout their entire lifecycle, from planning and permitting through transportation, well design and construction, and measurement, monitoring, and verification (MMV).
- Address safety concerns. Established and tested cementing, completions tools, wireline, artificial lift, and project management all help to ensure reliable hydrogen transport and storage and assist with addressing safety concerns related to hydrogen’s unique properties.
- Identification of high-impact solutions. Our technology development processes, including software platforms, help with emissions management and conversion from grey hydrogen to blue hydrogen.

## Hydrogen transport and storage solutions

TRANSPORT	STORAGE DESIGN	STORAGE EXECUTION	
Pipeline and subsea	Assist with site selection and subsurface modeling	Repurposed/new well for injection and monitoring	Long-term containment (MMV)
<div>Pipeline repurpose, maintenance, and subsea</div> <ul style="list-style-type: none"><li>▪ Drying, inspection, and recommission of pipeline</li><li>▪ Maintenance, monitoring, and control</li><li>▪ Electric subsea testing units</li></ul>	<div>Project leadership, subsurface evaluation, and risk identification</div> <ul style="list-style-type: none"><li>▪ Help with site selection and assessment</li><li>▪ Subsurface modeling</li><li>▪ Injector well design</li><li>▪ Risk identification and MMV plan</li></ul>	<div>Well construction and completion</div> <ul style="list-style-type: none"><li>▪ Embrittlement Mitigation</li><li>▪ Formation evaluation</li><li>▪ Cement tests for H<sub>2</sub> interaction</li><li>▪ Experienced H<sub>2</sub> completion designs</li></ul> <div>Well repurposing and well integrity assessment</div> <ul style="list-style-type: none"><li>▪ Cement integrity analysis</li><li>▪ Well diagnostics</li><li>▪ Completions assessment</li><li>▪ Reservoir-fluid interactions</li></ul>	<div>Storage/well integrity monitoring</div> <ul style="list-style-type: none"><li>▪ Monitor H<sub>2</sub> expansion and migration</li><li>▪ Geomechanics monitoring, including caprock pressure measurement and 2D and 3D monitoring</li><li>▪ Corrosion monitoring and management</li><li>▪ Leakage detection</li></ul>



## Hydrogen transport

Hydrogen is classified as a hazardous substance and requires control mechanisms to transport safely. We help minimize the risks of hydrogen transportation by understanding its characteristics, project properties and goals, and how fluid dynamics influence the behavior of the hydrogen in the subsurface. Using next-generation software, we gain knowledge of hydrogen phase behavior, thermodynamics, dispersion and diffusion, expected hydrogen loss, and how to help mitigate those losses.

Halliburton offers pipeline drying, inspection, and recommissioning; maintaining, monitoring, and controlling pipelines; and electric subsea testing units to help safely transport hydrogen and meet requirements.

## Underground storage design

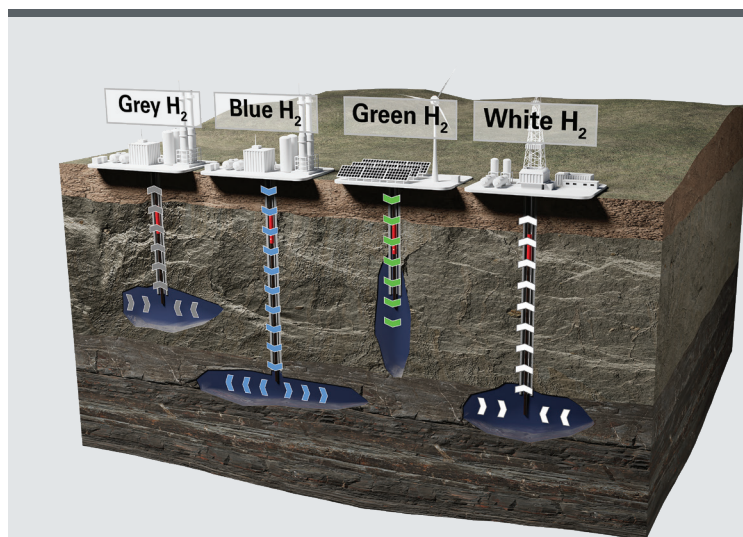
Well design for hydrogen storage requires the ability to mitigate hydrogen embrittlement and a plan for potential hydrogen interactions with cement compounds, water, hydrocarbons, and minerals in the formation. Additionally, the small size of the hydrogen molecule makes it difficult to contain, so the tightness and hydraulic integrity of the caprock must be considered.

To help ensure well and caprock integrity, Halliburton designs wells and injection systems by focusing on appropriate material selection for new wells and risk analysis of legacy wells. We evaluate how the subsurface reacts to hydrogen injection, help design an optimal injection system, and plan for MMV before the project begins.

## Storage execution

Embrittlement can compromise the cement and casing integrity of a hydrogen storage site. A well must be constructed to last the lifetime of a project to help ensure hydrogen can be stored and retrieved safely.

Halliburton helps mitigate corrosion with a combination of corrosion-resistant cements and software to deliver high-integrity wells that help ensure long-term zonal isolation and verify the dependability of storage barriers from surface to reservoir. Our well construction and completions services and technologies include metal corrosion inhibitors, formation evaluation, cement tests for hydrogen injection, and hydrogen-tested completions design.



## Subsurface solutions for hydrogen

- Methane reforming
- Methane reforming with carbon capture
- Renewable energy with underground storage
- Naturally occurring geologic hydrogen

## Cutting-edge hydrogen projects

Even with its similarities to Carbon Capture, Utilization, and Storage (CCUS) projects, hydrogen production, and storage is a relatively new area that is still being tested and examined for commercial viability as we explore new frontiers and developments in white hydrogen production and storage in salt caverns, depleted oilfields, and saline aquifers.

Halliburton has extensive experience with well repurposing and well integrity assessments, including cement integrity analysis, well diagnostics, completions assessments, and reservoir fluid interaction studies to help maximize existing resources and reuse infrastructure.

# Why Halliburton?



40 years of decarbonization and new energy project experience



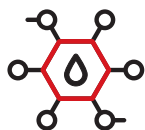
Strategic collaboration with leading partners worldwide



Industry-leading people, products, services, and technology for hydrogen project planning and execution



Successful execution of low-carbon and new energy projects globally



Integrated, full-cycle solutions for greater efficiencies and commercial viability



Onsite research and technology center to develop new and enhance existing decarbonization and new energy technology and solutions

**At Halliburton, we collaborate and engineer solutions to maximize asset value for our customers.** All products and service solutions are available as integrated offerings or as individual services, based on customer requirements.



For more information on Halliburton hydrogen services, go to [halliburton.com/hydrogen](https://halliburton.com/hydrogen)

To learn more about our comprehensive portfolio of low carbon solutions, visit [Halliburton.com/LCS](https://Halliburton.com/LCS)

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