HALLIBURTON

Hydrogen transportation and 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)**
Pipeline repurpose, maintenance, and subsea ▪ Drying, inspection, and recommission of pipeline ▪ Maintenance, monitoring, and control ▪ Electric subsea testing units	Project leadership, subsurface evaluation, and risk identification ▪ Help with site selection and assessment ▪ Subsurface modeling ▪ Injector well design ▪ Risk identification and MMV plan	Well construction and completion ▪ Embrittlement Mitigation ▪ Formation evaluation ▪ Cement tests for H_2 interaction ▪ H_2-rated completions design Well repurposing and well integrity assessment ▪ Cement integrity analysis ▪ Well diagnostics ▪ Completions assessment ▪ Reservoir-fluid interactions	Storage/well integrity monitoring ▪ Monitor H_2 expansion and migration ▪ Geomechanics monitoring, including caprock pressure measurement and 2D and 3D monitoring ▪ Corrosion monitoring and management ▪ Leakage detection

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-rated completions design.

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?

Halliburton advantages

The future of energy is a balanced transition that includes produced and renewable sources. Halliburton actively collaborates with customers to bring the future of energy to your business, whether that includes carbon capture and storage, geothermal, hydrogen, or emissions management. From the earliest stages of planning to implementation and beyond, we are your trusted resource for low-carbon and new energy projects.

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 discrete services, based on customer requirements.

To learn how Halliburton can bring value to your hydrogen projects, please visit Halliburton.com/LCS.

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