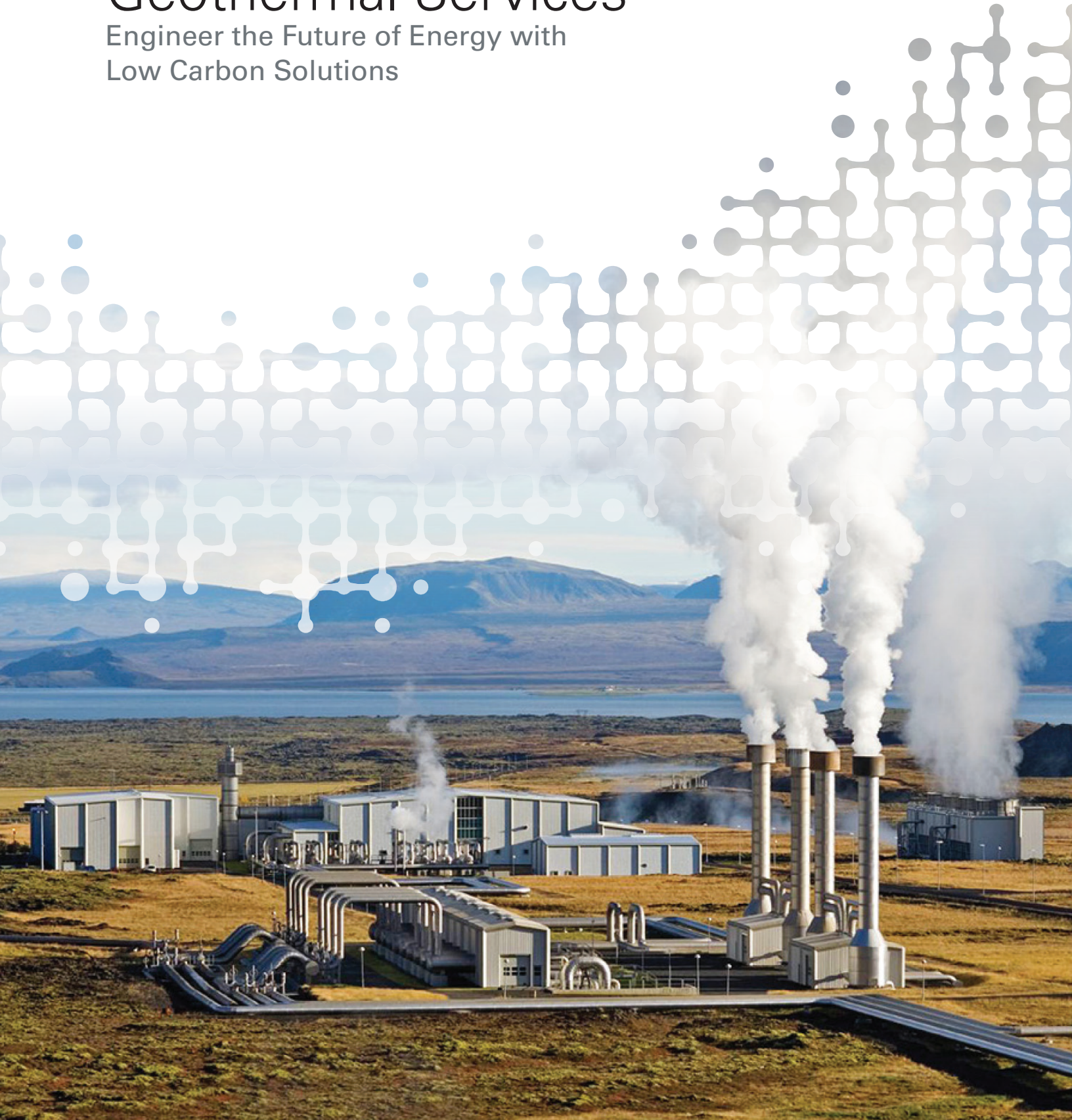




Geothermal Services

Engineer the Future of Energy with
Low Carbon Solutions



Halliburton engineers fully integrated geothermal solutions

Since the 1950s, Halliburton has pioneered the development of geothermal resources across the globe. We offer a full array of products, technology, and integrated services to help reduce resource development costs and assist with risk mitigation in low-and high-enthalpy geothermal projects. Halliburton collaborates with customers to aid in identifying and developing the best solutions for conventional (hydrothermal), enhanced (stimulated), advanced (closed loop), and direct heating geothermal projects. Our comprehensive approach guides you through all four stages of a geothermal well lifecycle: subsurface understanding and testing, well construction, completions, and production.

GEOTHERMAL ADVANTAGES

- Geothermal energy is a cost-effective, reliable, renewable, and environmentally friendly resource offering a virtually endless supply of power. This abundant energy source can be accessed and harvested nearly anywhere in the world.
- Geothermal energy is clean, reliable, and can be utilized to generate power or provide direct heating to industrial applications, as well as heating or cooling of residential and commercial buildings.
- Geothermal power plants can help to produce electricity or heat 24/7, as geothermal systems are not affected by weather and occupy a much smaller footprint than other forms of renewable power generation.

Geothermal solutions by lifecycle



CONSULTING & PROJECT MANAGEMENT	SUBSURFACE	<ul style="list-style-type: none"> ▪ Software ▪ Formation evaluation
	WELL CONSTRUCTION	<ul style="list-style-type: none"> ▪ Drilling ▪ Drilling fluids ▪ Completion tools ▪ Cementing
	COMPLETIONS	<ul style="list-style-type: none"> ▪ Completion tools ▪ Perforating ▪ Well testing
	PRODUCTION	<ul style="list-style-type: none"> ▪ Artificial lift ▪ Chemicals ▪ Well integrity and diagnostics ▪ Surface and well monitoring ▪ Water management ▪ Formation evaluation

Subsurface

Ultra-high temperatures and thermal expansion in conventional geothermal wells may harm equipment, accelerate cement fatigue, and eventually result in casing collapse. Enhanced and advanced geothermal systems require detailed subsurface knowledge so horizontal and vertical wells can optimally target the reservoir for maximum heat exchange. Halliburton designs tools and services specifically for these difficult conditions.

Our software solutions and technical expertise support the three major geothermal system types, including conventional high temperature, advanced closed loop, and enhanced geothermal systems. We also provide comprehensive heat flow maps, reservoir characterization, and geologic modeling to help provide accurate information regarding the formation's capacity, conductivity, and structure (fault proximity).

Well Construction

The hard granite and basalt formations targeted for conventional geothermal wells often are highly fractured. These conditions lose excessive fluid during drilling and cementing operations, which could cause decreased rates of penetrations (ROPs), stuck pipe, loss of zonal isolation, and wellbore instability. Halliburton helps to control these factors with products designed for severe loss conditions.

At Halliburton, we collaborate to determine the applicable drill bits, tool specifications, directional drilling, managed pressure drilling (MPD), drilling fluids, and cementing for each geothermal well. This integrated team tackles challenges such as borehole and bottomhole stability, high temperatures, hard rock formations, well control issues, lost circulation, corrosion, pore pressure, and ROP reliability. Additionally, our drilling team implements solutions to provide reliable measurements of well trajectory, borehole temperature and pressure, and drill string vibration, even in ultra-high temperatures.

Completions

Two characteristics of conventional geothermal resources are ultra-high temperatures and large fracture systems. To characterize the resources and their production capacity, testing and imaging tools must make reliable and focused measurements in highly variable environments with hostile downhole conditions. Enhanced and advanced geothermal systems require tailored completion solutions to help maximize heat exchange with the geothermal reservoir.

Halliburton offers completion hardware, packers, interval control valves (ICVs), stimulation, and material selections to manage conductivity, flow, and thermal cycling in geothermal wells. Cost-effective downhole tool solutions include bidirectional anchoring devices, sensors designed for use in ultra-high-temperature environments, and hangers and packers optimized for reliable liner installations.

Production

Production monitoring and logging operations help to ensure well integrity, conductivity, and flow assurance; aid in mitigation of corrosion and scaling; improve proppant efficacy; and arrange for brine (heavy minerals) extraction.

Halliburton offers the latest in production logging tools, including mechanical well integrity measurements, real-time fiber monitoring of injection and production well flow, and integrated sensor diagnostics (ISD). We provide mechanical and chemical scale treatment to help maintain economic production rates and reliable water management in geothermal energy production with electric submersible pumps (ESPs).



Why Halliburton?

Halliburton collaborates and engineers solutions across the geothermal lifecycle in order to reduce the cost per megawatt for our customers.



More than 70 years of experience in geothermal development



Strategic collaboration with leading geothermal operators worldwide



Industry-leading people, products, services, and technology adept in geothermal field development planning and execution



Successful execution of geothermal operations globally by utilizing our in-country experience to streamline the field development process



Integrated, full-cycle solutions for greater efficiencies and to help mitigate risk during geothermal resource exploration, planning, and execution

Halliburton engineers solutions to help maximize asset value for our customers. All products and service solutions are available as integrated offerings or as bespoke services, based on customer requirements.



For more information on Halliburton geothermal services, please go to halliburton.com/geothermal.

To learn more about our comprehensive portfolio of Low Carbon Solutions, visit Halliburton.com/low-carbon-solutions.

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