

## E2

# Sustainable and Secure Energy Future

Halliburton seeks to provide affordable, reliable, and sustainable products and services to our customers.

## Decarbonizing Our Customers' Core Oil and Gas Operations

Worldwide oil and gas remains an essential source of reliable and affordable energy and lower-carbon intensity oil and gas production is a critical part of facilitating a low-carbon future. At Halliburton, we are innovating and deploying solutions designed to help our customers lower the carbon intensity of their operations.

## Exploration

A range of Halliburton solutions help customers reduce the carbon intensity of their operations. Halliburton Landmark provides digital solutions to develop end-to-end subsurface, drilling characterization, and production, which leads to a better understanding of what drives upstream emissions. Operational tools from a range of Halliburton product lines, such as Cerebro® in-bit sensor package and iCruise® intelligent rotary steerable system, can improve the efficiency of hydrocarbon extraction for our customers. Cerebro® improves rock cutting and removal efficiency, while iCruise® helps our customers steer and place wells more precisely.



## Our Innovation Sustainability Commitments



- Lead the industry in innovation and conscientious stewardship of global resources.
- Provide solutions that support decarbonizing our customers' production base.

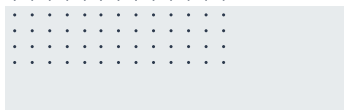
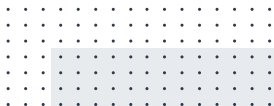
## Well Construction

### Cementing: EnviraCem™ and NeoCem™ E+ Reduced Portland, High-Performance Cement Systems

Halliburton has developed and commercialized the EnviraCem™ and NeoCem™ E+ cement systems to provide barriers with reduced Portland cement content to our customers. With EnviraCem™ providing greater than a 70% reduction in mass Portland cement by volume of the blend, and NeoCem™ E+ providing a 50% – 70% reduction in mass Portland cement by volume of the blend, Halliburton helps our customers lower their carbon emissions while providing thoughtfully engineered systems with enhanced sheath performance. The innovative designs of EnviraCem™ and NeoCem™ E+ incorporate more locally sourced, natural, and recycled materials. The reduced dependence on Portland cement to provide a dependable barrier enables flexibility with industry supply chain challenges and delivers a more sustainable barrier solution.

### Baroid: BaraShale®

BaraShale® Max water-based fluid (WBF) has the potential to replace invert emulsion fluids (IEF). This engineered WBF can be formulated using brines produced at the well instead of fresh water, which allows for a versatile IEF replacement. BaraShale® Max WBF reduces the need for containment, transport, and disposal of IEF and its associated drilling waste. The flexibility of using water as the base fluid and replacing IEF provides operators potential avenues to reduce their field emissions and related environmental impact.



### **Cementing: Barrier Integrity / Obex™ Well Barriers**

Cementing has focused on barrier integrity and emissions reduction related to cement systems. One example is the Obex™ casing annulus packers family. The Obex™ IsoLock™ packer collar is a new compression-set packer that prevents sustained casing pressure that could potentially lead to fugitive emissions.

## **Completion**

Halliburton is transforming our use of digital and electrification capabilities to drive actionable insights for reservoir and emissions management.

### **Completion Tools: Clariti® Digital Reservoir Management**

Clariti® digital reservoir management makes it possible to share data seamlessly and deliver real-time solutions from ideation to reservoir management. The customer-facing platform consists of five applications: Clariti® View, which provides remote well-data visualization with alarming; Clariti® Flow, which delivers zonal flow allocation with fluid refractions; and Clariti® React, Clariti® Manage, and Clariti® Predict, which provide full asset and production optimization by leveraging Halliburton's petro-technical capabilities with the functionality provided by SmartWell® completion systems.

### **Production Enhancement: Zeus™ Electric Pumping Unit and Tier 4 Dual-Fuel**

Halliburton has invested in electric fracturing and Tier 4 dual-fuel engines to improve our carbon footprint and help to reduce customer emissions. Because of these investments, our equipment demographics have changed, which has lowered our overall carbon intensity per horsepower hour of operation. These investments allow Halliburton and our customers to use available fuels, including wellhead gas and power equipment, as well as give the option to connect to the electric grid. These operational model changes have had many positive impacts, including reducing CO<sub>2</sub> per BOE produced.

## **Production**

### **Artificial Lift: Hydro-Helical® Gas Separator**

Artificial Lift's Liberator, a Hydro-Helical® gas separator, sets a new industry standard for flow rate, performance, and reliability. As the first new downhole dynamic gas separator design in decades, the Hydro-Helical® gas separator achieves extreme separation efficiency at high-flow rates – up to 40% greater than conventional separators. This translates into more oil production in higher gas applications. The improved efficiency and performance of Hydro-Helical® reduces energy consumption and delivers solutions to help advance our customers' decarbonization goals.

### **Testing and Subsea: FloConnect® Surface Automation Platform**

The FloConnect® surface automation platform is the industry's first fully automated and scalable solution for surface well testing operations. This innovative technology includes solutions for the continuous acquisition, storage, evaluation, monitoring, control, and reporting of emissions data. By supporting both environmentally conscious and real-time operational decision-making, FloConnect® reduces operational variabilities and optimizes workforce deployment by lowering exposure to hazardous and complex operations by taking personnel out of the red zone.

## **Midstream/Downstream**

### **Pipeline and Process Services: SureDcon™**

SureDcon™ chemistry provides decontamination cleaning using the vapor phase method, recirculation, sparging, or spraying. The efficiency of these chemicals significantly reduces system shutdown time and the resources required for decontamination. The small equipment footprint, low-water utilization, and significantly lower waste generated by SureDcon™ make it the ideal decontamination solution to help our customers decarbonize their operations.

### **Production Solutions: InnerVue™**

InnerVue™ is a non-intrusive diagnostic tool that can be used to identify blockages, profile deposits, and leaks in pipelines. It gives operators the ability to address production difficulties and maximize flow performance without mobilizing heavy resources. It also allows for a rapid fugitive emissions response in case of leaks.



## Advancing New Energy Frontiers

Sustainable energy will ultimately be an "all-of-the-above" proposition that includes oil, gas, renewable sources, and more. The most immediate opportunities to advance new energy frontiers exist in our fairway. We deploy our technologies in some of the fastest-growing new energy segments, such as carbon capture and storage, geothermal, and emissions management. The Company delivers relevant packaged solutions and technologies to advance these new energy frontiers, both individually (through our product lines) and in integrated solutions (via Halliburton Landmark, Consulting, and Project Management offerings).



### CCS Study Opportunity in Greece for Energean

In 2022, Energean, an independent company focused on energy resource development in the North Sea and Mediterranean, awarded Halliburton a contract to conduct a comprehensive subsurface review of the Prinos Basin in Greece. For this study, Halliburton CCS experts are collaborating with Energean to assess the carbon storage potential of the Prinos Basin.

The study began in March 2022 and includes long-term plume modeling, storage complex characterization, and creation of a conceptual development plan with performance modeling. To deploy a fully integrated CO<sub>2</sub> storage workflow, Halliburton is leveraging DecisionSpace 365® cloud applications, including Permedia® CO<sub>2</sub> software, which is a 2021 World Petroleum Congress excellence award winner.

## Carbon Capture and Storage

Carbon capture and storage is a critical technology to reduce carbon emissions in many industries. Thirty CCS facilities globally currently store more than 42 million metric tons of CO<sub>2</sub> every year. In 2022, many governments strengthened policies and provided incentives that improved CCS business cases, resulting in a growing pipeline of new projects. Halliburton provides reservoir characterization to develop underground CO<sub>2</sub> storage, monitoring technology to assure storage integrity, and advanced well construction for injection wells.

Halliburton's product lines are answering the needs posed by CCS initiatives with innovative technologies and solutions. Our Wireline and Perforating product line addresses various challenges related to CO<sub>2</sub> injection with technology and workflows designed to monitor the migration of the CO<sub>2</sub> plume over time and to de-risk reservoir properties, ensuring CO<sub>2</sub> is effectively contained in storage sites.

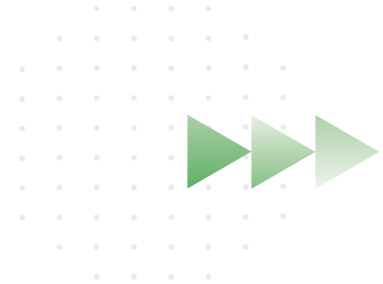
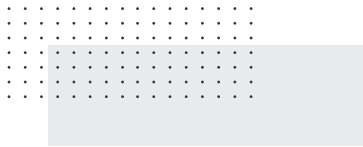


These technologies include the StrataXaminer™ borehole imaging service, which visualizes the geologic environment and pinpoints weaknesses in the rock that could lead to CO<sub>2</sub> leaks; the Reservoir Sampling and Description RDT™ tool, which evaluates cap rock opening and closure pressure to guide and limit CO<sub>2</sub> injection rates; Ingrain's PoreHD® and FastSCAL® Services, which quantifies rock properties of CO<sub>2</sub> reservoirs and the seal and trapping mechanisms that characterize each storage site under question; and the Xaminer® Magnetic Resonance (XMR™) service, which is calibrated by PoreHD® and improves the economics of operators' field scale monitoring. Our Cementing product line provides bore hole barriers that are inert in the presence of CO<sub>2</sub> and ensure it can be safely sequestered.

In 2022, Halliburton Landmark launched a single unified cloud solution for CO<sub>2</sub> storage modeling that provides an evergreen view of the carbon storage lifecycle to support a multi-year journey to a lower-carbon future. The solution uses a suite of industry-validated tools and workflows customized for effective CO<sub>2</sub> modeling to provide more insight and less uncertainty. This enables our customers to evaluate site suitability for CO<sub>2</sub> storage.

## eCompletions™ Clariti® View

eCompletions™ Clariti® View is a service that simplifies customer access to downhole pressure and temperature data from Halliburton gauges. The service provides automatic downhole gauge data collection as well as storage and access to an easy-to-use website where customers can see and download their data. The service is for carbon-capture well operators who are interested in monitoring their injection wells and for whom real-time data is important for regulatory reporting for their injection and monitoring wells. eCompletions™ Clariti® notifies users when observed pressures or temperatures exceed user-defined limits.



### Norway CCS Project

Halliburton delivered integrated drilling and well services on two CCS storage wells that are part of the first phase of a project in Norway. This project phase concerns the storage part of the Longship CCS project, which includes carbon capture facilities, transportation, and storage (full value chain) initiated by the Norwegian government.



### Supporting National CCS Planning in One of Africa's Largest Economies

Our expertise is contributing to the development of national capacity for CCS within one of Africa's largest economies. Funded by an International Development Bank, we are contributing to national technical resources and capacity building to advance the burgeoning CCS market in the country through national emissions mapping, geological screening, and pilot-site assessment.

## Geothermal

Conventional and unconventional geothermal exploration is increasing in the U.S., and Halliburton supports these explorations with our Pinnacle distributed temperature survey (DTS), DataSphere® ERD™ gauges, and CAST-I™ products. In addition, geothermal energy has played a role in Halliburton's California and other southwestern U.S. business for decades. This is particularly true of our work in The Geysers in Northern California (the country's largest geothermal field), the lithium-rich Imperial Valley on the border of California and Mexico, and the unconventional geothermal exploration occurring in Central Nevada.

Maintaining effective zonal isolation in the Imperial Valley has often been difficult, with bottom-hole temperatures in excess of 600 degrees Fahrenheit and the presence of highly corrosive CO<sub>2</sub>. However, Halliburton successfully overcame this challenge more than 20 years ago in collaboration with our customers by creating ThermoLock™ cement systems. The slurries, which we optimize with new technology whenever possible, remain in demand among customers who are expanding the power output of the Imperial Valley.

## Hydra-Jet™ TS Tools

Hydra-Jet™ TS tools provide an option to abrasively perforate multiple stages in a well on a single run without necessitating explosives. They also enable additional services to be added to the intervention, such as pre- and post-well cleanouts, or acidizing, without additional runs. Consolidating runs and improving efficiency correlates to a reduction in fuel consumption, helping our customers meet their GHG emissions reduction goals.

In 2022, Halliburton was awarded work that includes 26 Hydra-Jet™ jobs on the Kvitebjørn geothermal storage project in Tromsø. With the Kvitebjørn heat-storage project, excess heat from a waste incineration plant will be stored underground in the summer and extracted in the winter. It will begin in March 2023. Hydra-Jet™ will be used to increase heat exchange capacity in geothermal wells by creating fractures in the base rock between a set of geothermal wells drilled in a pattern.

## CeraPhi Energy Enters an Exclusive Drilling and Intervention Services Agreement with Halliburton

As we provide drilling and intervention services to CeraPhi Energy, we will harness our global well engineering expertise and seven decades of geothermal experience in support of CeraPhi's plan to develop a global geothermal energy development company. The first project in this engagement commenced in the UK in 2022. We are helping CeraPhi repurpose end-of-life oil and gas wells in the UK and are supporting the well engineering and development potential of their patented CeraPhiWell™ technology.

CeraPhiWell™ is a closed loop downhole heat exchanger. It draws up subsurface heat, which can then be applied for scalable baseload energy in multiple ways. This technology is at the center of CeraPhi's strategy to contribute to carbon reduction in line with the Paris 2050 Climate Accord. By using end-of-life and non-producing oil and gas wells, CeraPhi seeks to de-risk and prove the commercial potential of geothermal energy production.

In Nevada, increased demand for renewable energy has sparked a resurgence in legacy geothermal field expansion. Historically, Halliburton has provided completion tools, logging, horizontal pumping systems, and cementing, and continues to do so today.



Geothermal Site

## Neftex® Prospect

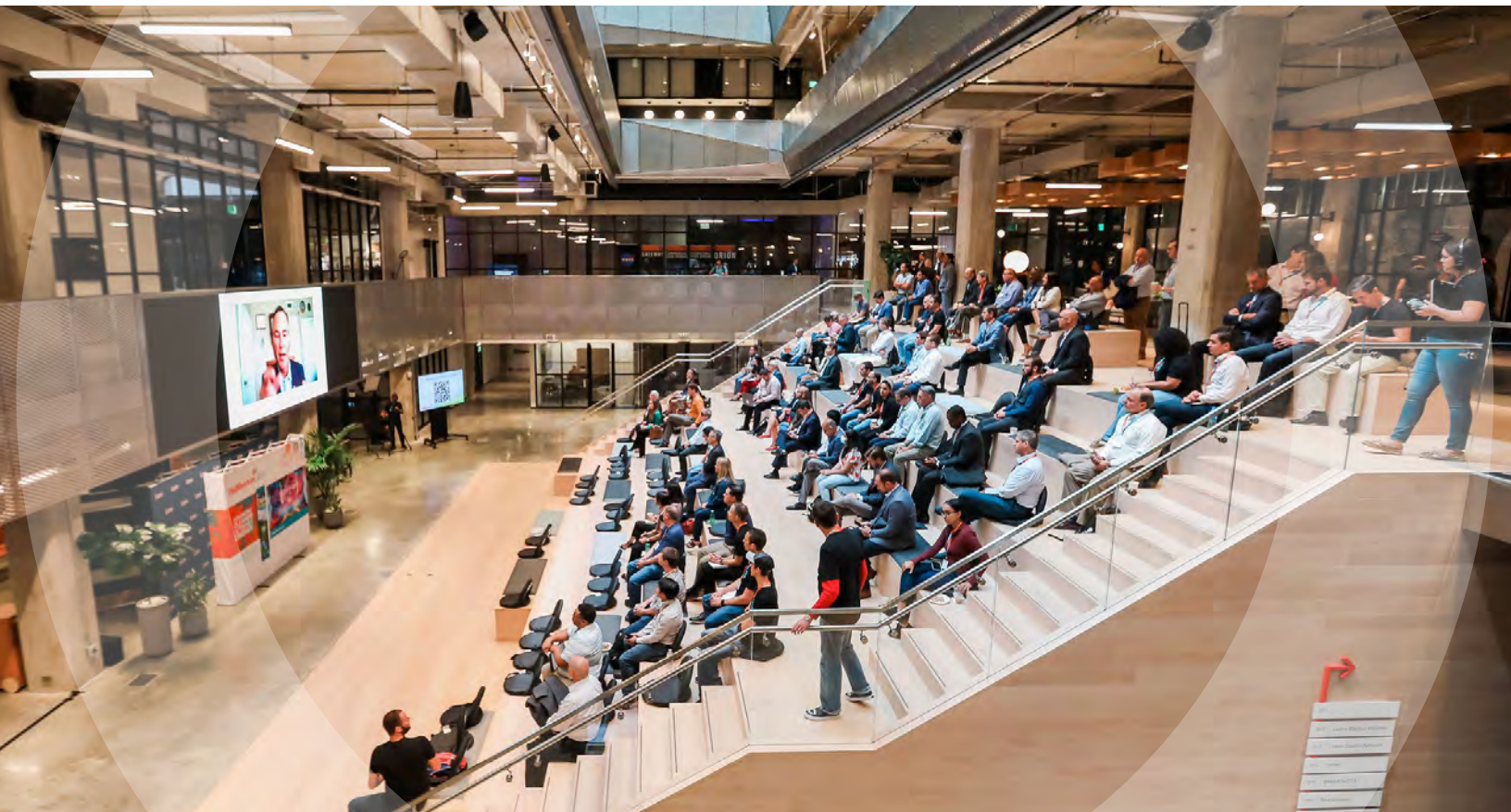
Electrification plays a key role in the energy transition. Global demand exists to modernize electricity grids and provide battery storage and charging capabilities, which requires the discovery and extraction of significant quantities of critical minerals, such as lithium, copper, and nickel. In 2022, the Neftex® portfolio expanded to include an offering that serves E&P operators and mineral and mining companies as they probe deeper into the subsurface or explore new geographies in search of mineral deposits. The subsurface framework that underpins the Neftex® portfolio workflows and knowledge bases can be utilized to provide our customers with geological context to help inform their investment decisions as they seek to electrify.

## Halliburton Labs: Advancing Cleaner, Affordable Energy

Through Halliburton Labs, we come alongside organizations in a range of energy sectors – including industrial decarbonization, utilization / efficiency, distribution, storage, generation, and circular economy – to provide support by delivering the expertise and infrastructure for their strategic goals. Participating start-ups gain access to Halliburton's powerful resources, including our global network, capacity to scale, and world-class technical expertise. We learn more about emerging energy markets, and discover new opportunities for exploration, investment, and growth.

In Halliburton Labs, we invest our expertise, resources, and team, but not significant capital, in pioneering, and expect to uncover gaps in the energy value chain and unlock opportunities for our own business.

The Halliburton Labs accelerator program opens the door for participant companies to engage directly with Halliburton. In exchange, we acquire insights and develop institutional learning about emerging technologies and nascent value chains, synthesizing our own perspective on a host of new industries, companies, and technologies.



Halliburton Labs participants enter into a financial agreement that secures an equity stake for Halliburton at their next round of institutional financing. The key value we provide is access to scaling resources, including practitioner expertise, industrial and lab facilities, and industry connections that do not require incremental cash outlay from Halliburton. Compared to many other accelerators, Halliburton Labs is a leader in the amount of industrial capability and connections we can make available for companies.

In 2022 we executed three Finalists' Pitch Day events in which we showcased almost 30 early-stage hard-tech companies that are innovating across the energy landscape. We closed out the year with 21 participants and alumni that represent all facets of energy production, storage, distribution, and efficiency as well as the critical industrial decarbonization sector and waste-to-value. We continue to see tremendous interest in Halliburton Labs from investors, start-ups, and academic institutions.

One of our 2022 Halliburton Labs participants is Novamera, a company enabling the efficient and sustainable mining of previously uneconomic or marginal narrow vein mineral deposits. The company's core technology is a downhole sensor that acts as a guidance system and enables conventional, commercially available drilling equipment to precisely extract ore and leave waste in the ground.

Novamera's engagement with Halliburton Labs has led to pilot testing plans with one of the world's top mining companies.

Ionada, a Halliburton Labs alumni, is a cleantech company that develops, manufactures, and markets carbon capture systems to reduce greenhouse gas emissions. In 2022, Ionada commissioned its first carbon-capture system at Halliburton's headquarters in Houston, TX with the support of Halliburton Labs. The pilot demonstrates Ionada's revolutionary membrane carbon-capture technology over competitive solutions.

Momentum, one of the first Halliburton Labs participants, has a modular Li-ion battery recycling solution that expects to transform end-of-life devices and battery waste into the high-quality critical materials needed for new battery production. Momentum has worked with Halliburton manufacturing for the design and construction of their modular units.

These examples demonstrate how Halliburton Labs creates value for early-stage companies in emerging energy sectors. Halliburton Labs also helps us think broadly and then dig deeply into emerging markets. We develop insights and institutional learning that will enable us to collaborate and engineer solutions to maximize value throughout the energy systems of the future.

### Halliburton Labs participants cover a broad spectrum of emerging energy market segments.



## Sustainability in the Research and Development Process

The Halliburton LIFECYCLE process governs all new product-related research and development at the Company. It incorporates technology, manufacturing, product management, operations, and marketing functions. Halliburton uses LIFECYCLE to review project progress at stage gates, mitigate risks, and improve product and service solutions.

Sustainability is embedded in LIFECYCLE. We take the following into consideration at product inception, detailed design, and commercialization stage gates:

1. People and environmental safety
2. Human capital requirements
3. Manufacturing, storage, and transportation costs
4. Emissions during manufacturing and use
5. Operational footprint
6. Overall product lifecycle
7. Cybersecurity

Halliburton's LIFECYCLE governance board also provides a thorough review of environmental impacts, business case, risks, time to market, and product development costs. These reviews coincide with sustainability reviews at project kickoff, detailed design, and commercialization. Inserting reviews into the product R&D process maximizes the influence of sustainability considerations on product development.

