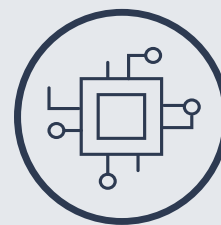


## E3

# Sustainable Energy Evolution

Halliburton provides the world with access to affordable and reliable energy in parallel with our work to support the transition to a lower-carbon future. To do this, we deploy our world-class technical expertise, resources, and versatile capabilities to develop new technologies that minimize our environmental impact. Our most significant contribution toward our sustainability goals is to help customers reduce their own environmental impact by using our oilfield technologies. To learn about our vast product and service portfolio, please visit the [Halliburton](https://www.halliburton.com) website.



## Our Value Creation Technologies and Solutions / Continuous Improvement Sustainability Commitments

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

## 2021 HIGHLIGHTS

### Sustainability in the R&D Process

The LIFECYCLE process, which governs new product R&D, incorporates all of our Company's major functions, including technology, manufacturing, product management, marketing, and operations. We use this process to improve our product and service solutions, mitigate risks, and review project progress at stage gates.

Embedded within the LIFECYCLE process is sustainability. At the critical stage gates of product inception, detailed design, and commercialization, we consider the following:

- People and environmental safety
- Human capital requirements
- Manufacturing, storage, and transportation costs
- Emissions during manufacturing and use
- Operational footprint
- Overall product lifecycle
- Cybersecurity

Coinciding with sustainability reviews at project kickoff, detailed design, and commercialization, our governance board also provides a thorough review of environmental impacts, along with business case, risks, time to market, and product development costs. The insertion of these reviews into the process maximizes the influence of sustainability considerations on product development.



University Relationships

Sponsored Research Agreements

Halliburton engages with major universities in countries around the world to facilitate the research studies of advanced-degree students. Our PSL technology groups work with students to identify research topics that address our Company’s technology challenges, along with the competencies of the specific university. We help define the research scope, gather resources, and, on occasion, make financial contributions. Through this endeavor, Halliburton uses external competencies to advance the R&D goals of our PSLs and, ultimately, to improve our products and solutions for our customers as well as our internal processes.

STEPS Program

Our program, Science and Technology for Exploration and Production Solutions (STEPS), targets master’s-level students at universities who are working on their theses. We give these students the opportunity to conduct a research project in collaboration with Halliburton and our industry and academic partners. Participating students can conduct research focused on real-world datasets, receive relevant training and mentorship from STEPS team

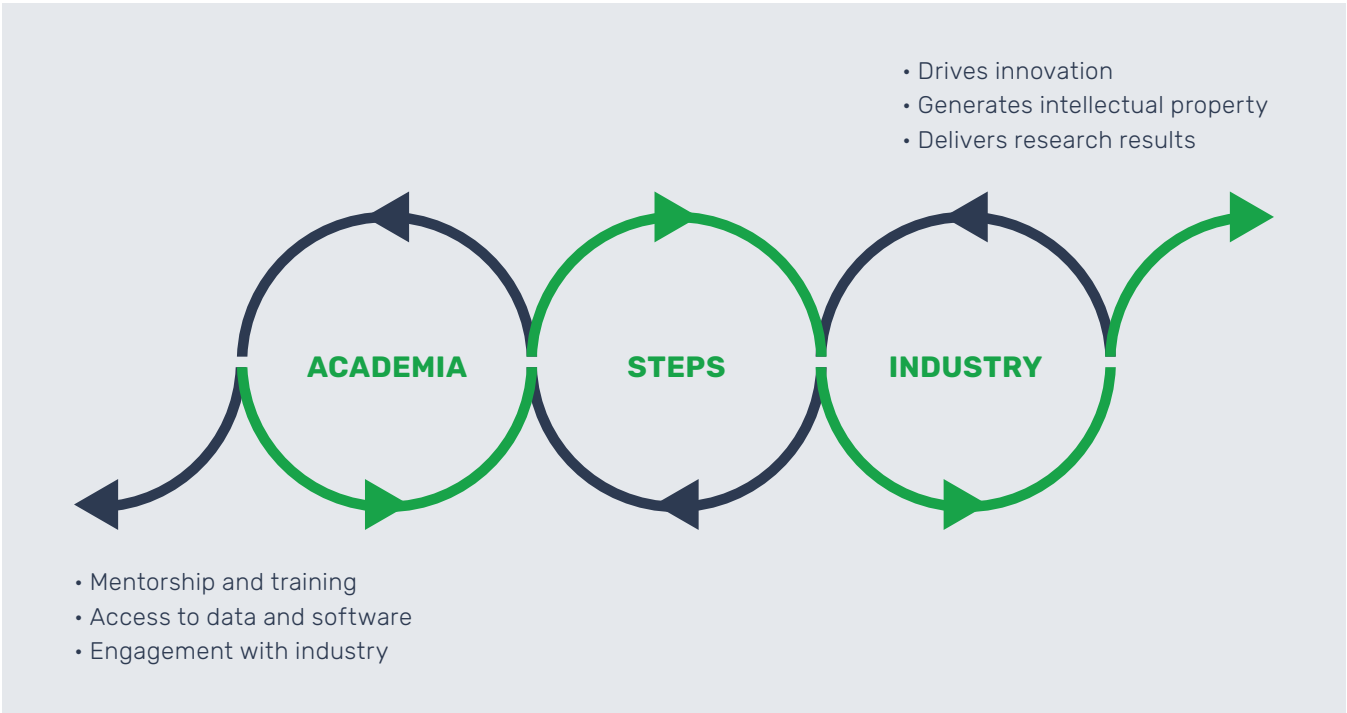
members, and gain experience with Halliburton Landmark software, products, and knowledge base.

Halliburton facilitates regular, meaningful contact between students, industry representatives, and academics through our STEPS program, and builds a collaborative research network with the robust participation of all parties.

Each year, the STEPS Scientific Advisory Board selects a research theme within which students select a research topic of their choosing. The theme for the 2020–2021 academic year was the 21st Century Energy Transition. The theme for the 2021–2022 academic year was the Subsurface Characterization of Energy.

In addition to supporting research projects, STEPS hosts a Distinguished Lecture series aligned with the current research theme to encourage more interaction with the exploration and production (E&P) community.

To learn more about the STEPS program, including how to apply, please visit the [STEPS](#) page on our website.



Our Technology Highlights

Featured here are examples of our technologies that reduce our customers' emissions and aim to decarbonize the process of oil and gas extraction.

Tier 4 Engines and E-Frac

Halliburton has the largest fleet of Tier 4-compliant engines — both diesel and dual fuel — in operation in the U.S. and the Gulf of Mexico. Tier 4 is the U.S. Environmental Protection Agency's (EPA) strictest regulation for nitrogen oxides and particulate emissions.

Our Tier 4 dual-fuel engines enable operators to use natural gas instead of diesel fuel as the majority of their fuel source. The option to use field gas minimizes flaring, which reduces emissions and is less costly for our customers. Because of the way that Halliburton developed our technology, we can convert our diesel engines to Tier 4 dual-fuel.

We also offer all-electric fracturing capabilities using our second-generation Zeus™ electric pumping unit, ExpressBlend™ electric blending system, eWinch™ electric wireline unit, and an electric Tech Command Center. All this equipment can run on electric power, generated using natural gas or taken directly off the grid, for the lowest possible emissions profile. This solution also allows for additional electrification of fracturing locations, such as lighting and water transfer.

An active focus on our e-frac capabilities is underway.

North America Industry Leader in EPA Tier 4-Compliant Diesel Engines

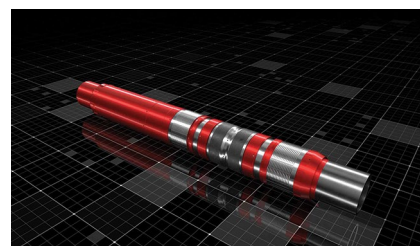
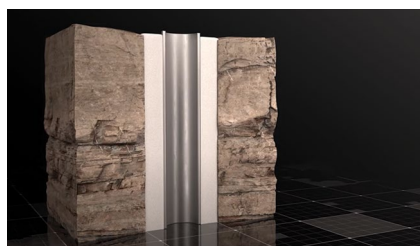
Percentage of Tier 4 Diesel Engine Penetration	2019	2020	2021
Hydraulic fracturing pumping equipment (HHP) that meets Tier 4 compliance for non-road diesel engine emissions	52%	56%	53%

In August 2021, Halliburton announced the industry's first deployment of an advanced e-frac solution with Chesapeake Energy Corporation. The project combines our all-electric fracturing spread with VoltaGrid's power-generation system. By using this technology in its local field gas network, Chesapeake Energy reduced emissions by 32% and applied more than 25 megawatts of lower-carbon power generation without sacrificing operational performance or reliability. This project is a major step forward in our customer's goal of achieving net-zero emissions.



## Cementing Products

The Cementing PSL has two main focus areas: to reduce the carbon footprint of the solutions that we provide to our customers and to stop fugitive gas emissions for the life of a well.



### NeoCem™

The NeoCem™ cement system reduces the amount of Portland cement in the wellbore isolation barrier by an average of 40% by mass Portland. (Portland cement accounts for the majority of the carbon footprint in a cementing job, as its manufacture and transport releases air pollutants.)

### IsoBond™

The IsoBond™ cement system prevents sustained casing pressure over the life of a well, which helps improve well integrity and stop fugitive gas emissions from releasing into the environment. The system accomplishes this through:

- Low fluid loss and fast transition times to prevent the flow of gas through cement as it sets.
- Enhanced shear bond, in which the ability of the cement to adhere to steel casing improves by as much as 40% compared to other cementing systems.
- Reduced cement permeability by more than 70% compared to other cementing systems, which prevents gas and other wellbore fluids from migrating through the cement after it sets.

### Obex™

Our Obex™ family of compression-set, mechanical packers (Obex GasLock™ packer, V0 rated; Obex IsoLock™, V3 rated; and Obex EcoLock™, V6 rated) enhance well integrity and therefore prevent fugitive gas emissions. By offering a powerful mechanical barrier, Obex™ packers improve zonal isolation and mitigate sustained casing pressure to avoid failures leading to annular gas migration.

## Baroid



### BaraHib™ Gold

BaraHib™ Gold high-performance water-based mud eliminates the requirement for the containment, transport, and treatment of oily cuttings onshore. Fluid makeup includes approximately 15% industrially produced materials (except water and barite) by volume, compared to approximately 60% in a typical non-aqueous fluid. With trackable inhibitor technology, BaraHib™ Gold fluid also has a longer run life than typical water-based fluids.

## Production Solutions

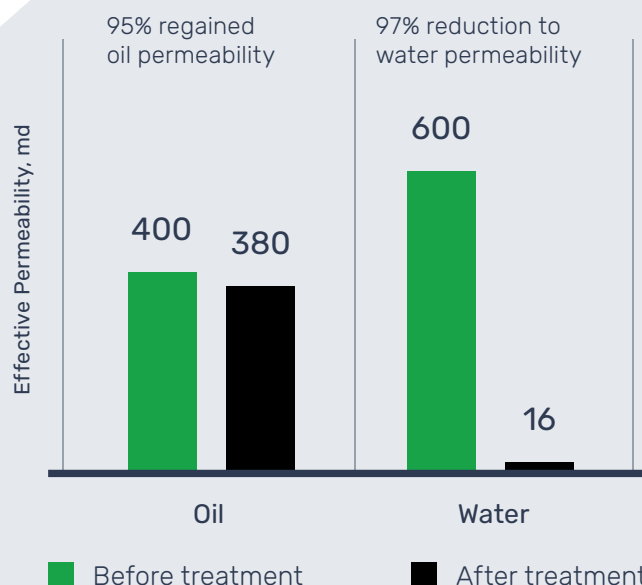


### WaterWeb®

Our WaterWeb® conformance service gives operators the ability to lower the treatment and disposal costs of produced water, along with the associated environmental impacts. To accomplish this, the WaterWeb® service uses a polymer chemistry to impede water flow while enhancing hydrocarbon flow to the wellbore in any type of reservoir — including sandstone and carbonate formations. This technology absorbs into the rock surface and creates resistance that holds water back while allowing oil and gas to pass freely, decreasing water permeability by more than

90% with little to no damage to hydrocarbon permeability. By reducing the water column, the WaterWeb® service improves the natural lift to residual oil and gas. It also helps prolong and sustain production by enhancing reservoir drainage.

As an example of this technology's capabilities, Halliburton deployed the WaterWeb® service in an offshore carbonate reservoir, where it reduced the water cut by 22% and increased hydrocarbon production to more than 600 barrels of oil per day.





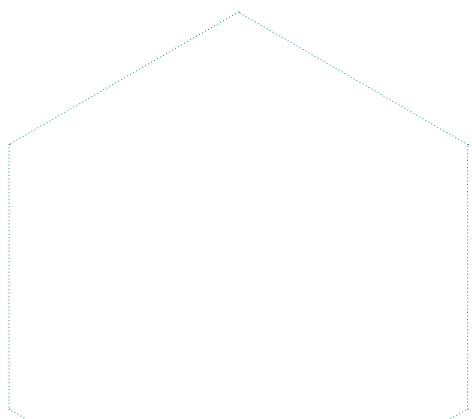
## Reduction in Battery Use

To improve the sustainability of operations, Halliburton aims to eliminate the use of lithium batteries in our downhole tools. Batteries require complex logistics and safety precautions, as well as recycling. The development of solutions to generate downhole power or to continuously provide power from the surface will make a step change toward reducing our environmental footprint. Because of this, many of our PSLs, including Sperry Drilling and Production Solutions, focus on technology development that does not rely on battery power.

As an example, a downhole generator powers our iCruise® rotary steerable system, removing the batteries that we used in our previous generation of rotary steerable technology. One of the design goals of our new iStar™ intelligent drilling and logging platform was to reduce the number of downhole batteries that we used. In 2022, we will deploy an additional turbine-based generator to enable further reductions in battery use.

Our SPECTRUM® FUSION real-time hybrid coiled tubing services integrate fiber optic and electric communication and power to eliminate battery use. Doing so results in operations not limited by power or time constraints. The system also combines intervention and diagnostic capabilities and is fully compatible with mechanical and wireline tools. This unlimited flexibility lessens logistical constraints.

Additionally, we have invested in a company that produces ultra-capacitors, a rechargeable solution that delivers the power required for our challenging downhole applications.



## 2021 Technology Sustainability Matrix

Additional portfolio items can be seen on [Halliburton.com](http://Halliburton.com).

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## Digital Transformation

Halliburton deploys digital technology across all business lines and geographies to improve efficiencies and outcomes. Many of these capabilities reduce GHG emissions through optimization and efficiencies and provide high-quality data for enhanced decision-making and continuous improvement.

Digital unlocks the potential to structurally lower costs, shorten time to first oil, increase efficiency in exploration and production, and enhance performance across the entire value chain.

In 2021, the Company made great strides in our digital transformation by developing, deploying, and maturing Halliburton 4.0.

### Well Construction 4.0: Digitally Transforming the Well Construction Lifecycle

With digitally enhanced well construction, we reduce costs and planning time and optimize well design and placement to improve drilling performance for a safer, more productive well.

Well Construction 4.0 incorporates all of Halliburton's digital technologies and allows integration and collaboration between our well engineering applications, such as Digital Well Program® and Digital Well Operations, as well as any third-party applications that an operator or contractor may use. These technological advances enabled us to reduce well planning and design time by up to 80% in the North Sea.

Well Construction 4.0 automates many drilling processes. In a mature field in the Middle East, Halliburton improved drilling performance and shortened drilling time by 43% by integrating our Cerebro® In Bit Sensing, Logix™ Automated Drilling Solution, N-Flow™ 325 filter cake breaker, Pason AutoDriller, and project management services.

Additionally, with our remote operations, Well Construction 4.0 helps reduce the number of people required on-site. For the first two sections of a job at an offshore rig in Southeast Asia, Halliburton decreased the number of people at the wellsite by 21%, which also reduced helicopter rides and international commercial flights to the rig.

## Halliburton 4.0

In 2021, Halliburton 4.0 accelerated our digital approach over the well lifecycle including subsurface, well construction, reservoir and production, and our own enterprise.

Our deployment of software, hardware, AI, machine learning, and sensors gives us access to more data and operational insight than ever before. This data allows us to improve project planning, design, and execution; monitor and optimize operations in real time; enhance decision-making; shift to automated controls and remote operations; make data more accessible to all business units; and advance data storage and data analytics capabilities — all while enabling a more collaborative, connected workforce.

Halliburton 4.0 increases efficiency, saves costs, and mitigates health and safety risks associated with manual labor. It also reduces our environmental impact through the elimination of paper waste and the reduction of personnel required to work at wellsites, which means fewer emissions associated with transportation, lodging, and sustenance on both land and offshore settings.

Launched in the first quarter of 2021, our new cloud-based platform, Real-Time-as-a-Service (RTS), uses modern digital technology to stream real-time data to all employees and customers who have subscribed to these feeds and are authorized to receive them.

A customer in Norway, the first operator to adopt RTS, uses the platform to monitor six offshore rigs. In the customer's experience, RTS is 83% faster than our legacy real-time system, with uptime reliability of nearly 99.9%. Equally important, RTS is less energy intensive than its predecessor, relying on cloud computing that can be scaled up or down based on consumer demand.

As a result of using RTS, Halliburton retired a number of on-premise data centers that had dedicated services and reduced personnel required to keep the legacy real-time system functional. Our goal is to convert 100% of our real-time requirements to the RTS platform in the first half of 2022.

For more information about Halliburton 4.0, please visit the [Halliburton 4.0](#) page on our website.



## Halliburton Landmark

To support Halliburton 4.0, Halliburton Landmark offers a suite of geoscience software products that enable our customers to explore and produce hydrocarbons. In 2021, Halliburton shifted Landmark products further into the sustainability space. Here are a few examples of our products that support the world's energy transition:

Neftex® PROSPECT software, which we developed in 2021 and will launch in the first quarter of 2022, supports critical mineral exploration. Electrification of transport and industrial processes is a key component of global decarbonization ambitions. However, this initiative requires a vastly increased supply of metals and minerals for success. Renewed investment in discovering additional resources will be the key to meet this demand. Landmark adapts proven oil and gas exploration workflows to aid in the hunt for minerals that are critical to the energy transition.

Storage of carbon dioxide (CO<sub>2</sub>) in ancient rock strata is set to become a major contributor to emissions reduction. We can identify suitable aquifers for this purpose by using a similar approach to how we uncover hydrocarbon-bearing strata. With Neftex® Predictions and DecisionSpace® 365

software, Landmark adapts E&P workflows to consider the parameters that are important for safe CO<sub>2</sub> storage, identify suitable aquifers, screen areas for further investigation, and model them using technologies that we developed to understand the injection and migration of captured CO<sub>2</sub>. Our technology helps customers answer critical questions such as:

- Where can we store CO<sub>2</sub>?
- How much CO<sub>2</sub> can we inject, and can we inject CO<sub>2</sub> at a sufficient rate?
- Can we store it safely?
- What is a site's storage capacity over its lifetime?
- Will the CO<sub>2</sub> remain in the geological storage tank over time without leaking?

We also focus our efforts to enhance our iEnergy® platform, the industry's first hybrid cloud environment dedicated to E&P. By using machine learning, we can better manage and mitigate carbon emissions from our operations.

For more information on Landmark, please visit the [Landmark](#) page on our website.



This database is included in Neftex® PROSPECT software. Areas in color denote when Earth's tectonic features were active. Because many critical minerals are found in zones of active tectonism, this information can help to identify areas for closer attention in the search for specific minerals.

## Support for Renewable Energy Sources

In addition to using our digital capabilities, Halliburton applies our existing technologies to the renewable energy space for a greater environmental impact.

### Carbon Capture, Utilization, and Storage

Halliburton actively participates in the carbon capture, utilization, and storage (CCUS) industry, and has developed technologies to support carbon transport and storage projects. Our capabilities include geological storage site selection and development, in addition to well repurposing, construction, and monitoring, and pipeline and subsea construction and maintenance.

In 2021, Halliburton applied a unique, machine learning-based 3D model for a Japanese company to estimate the availability of pore space over large areas for CO<sub>2</sub> storage. This model increased operational efficiency, with a fivefold reduction in time spent compared to conventional approaches, along with increased accuracy.

### Geothermal

For decades, Halliburton has offered our advanced technologies and experience to customers developing complete geothermal solutions around the world. Our products and services address every aspect of developing a geothermal energy production facility, including project management, drilling, cementing, fluids, logging, completions, stimulation, and geofluids transfer.

Geothermal energy demand has expanded to more shallow-source, lower-heat applications for heating and cooling. For electricity generation, the geothermal market has expanded to deeper, higher-heat sources. Although these geothermal sources are much more efficient in generating electricity, they require advanced geothermal systems to overcome technical challenges, and Halliburton is working to service these emerging markets.

In Indonesia, which is the world's top geothermal market, Halliburton has supported geothermal activity for more than 30 years. In this time, we have drilled and produced more than 220 wells, and completed approximately 40 wells with Halliburton Project Management's Integrated Services. In 2021, Halliburton continued to contribute to the Sarulla Geothermal project. For this project, we have worked with a market leader for more than 15 years to provide drilling and cementing services in the development of this clean, renewable energy source. During this time, we helped our customer produce clean electricity from geothermal wells safely, efficiently, and cost-effectively, and enabled a larger number of wells to produce from a single pad for less environmental impact.



## Halliburton Labs

Halliburton Labs gives early-stage, clean-tech companies access to our world-class facilities, technical and scientific experience, and business network. Halliburton Labs is a collaborative environment in which entrepreneurs, academics, investors, and industrial labs come together to advance cleaner, affordable energy.

Halliburton Labs also is a clean-tech accelerator. Participating companies take part in a 12-month program in which they can benefit from our vast, global resources that include knowledgeable and experienced personnel who cross a range of disciplines as well as an established infrastructure.

Halliburton Labs helps these companies with a variety of services, such as:

- Introductions to investors and potential customers
- Development of supplier networks, using our broad supply base
- Design of manufacturing processes, with a key focus on HSE
- Cost reductions for manufactured products

While some offer a corporate venture capital model, Halliburton is unique for our founder-friendly environment and for granting companies regular access to our corporate campus, industrial facilities, executives, and subject matter experts. These elements are essential to reduce friction points, enhance collaboration, and increase the probability of each company's success.

Halliburton Labs is a low-risk, low-capital endeavor for us, and yet this initiative is critical for delivering the support that participants require to progress beyond their initial years and to make a positive, lasting impact on the world around us.



For Halliburton, other benefits of Halliburton Labs include:

- Strategic value in working closely with people, companies, and new technologies with the potential for high growth as the energy industry changes
- Ability to understand the development of new value chains associated with the energy transition
- Opportunity to evaluate how we can best use our core competencies to accelerate cleaner, affordable energy solutions and earn returns in new markets

*Halliburton Labs is a unique front door to engage with the innovative companies and people who are ready to scale solutions for clean, affordable energy. To learn more about this endeavor, please visit the [Halliburton Labs](#) website.*



Application Process

Halliburton Labs is an open, non-exclusive program. The application to participate is always available on [our website](#).

Three times per year – January, May, and September – we accept applicants into our program, which lasts for one year.

After companies submit their applications, we evaluate them based on factors such as whether their technology has progressed sufficiently and whether their business requirements align well with our capabilities, so that we can offer them the most value from this experience.

We invite a narrow list of applicants to our Finalists’ Pitch Day, which involves a seven-minute business pitch by company leaders followed by a live Q&A with our panel. From there, we select a handful of companies to begin the program. We are selective so that we can give each participant at Halliburton Labs the high level of attention and collaboration they deserve.

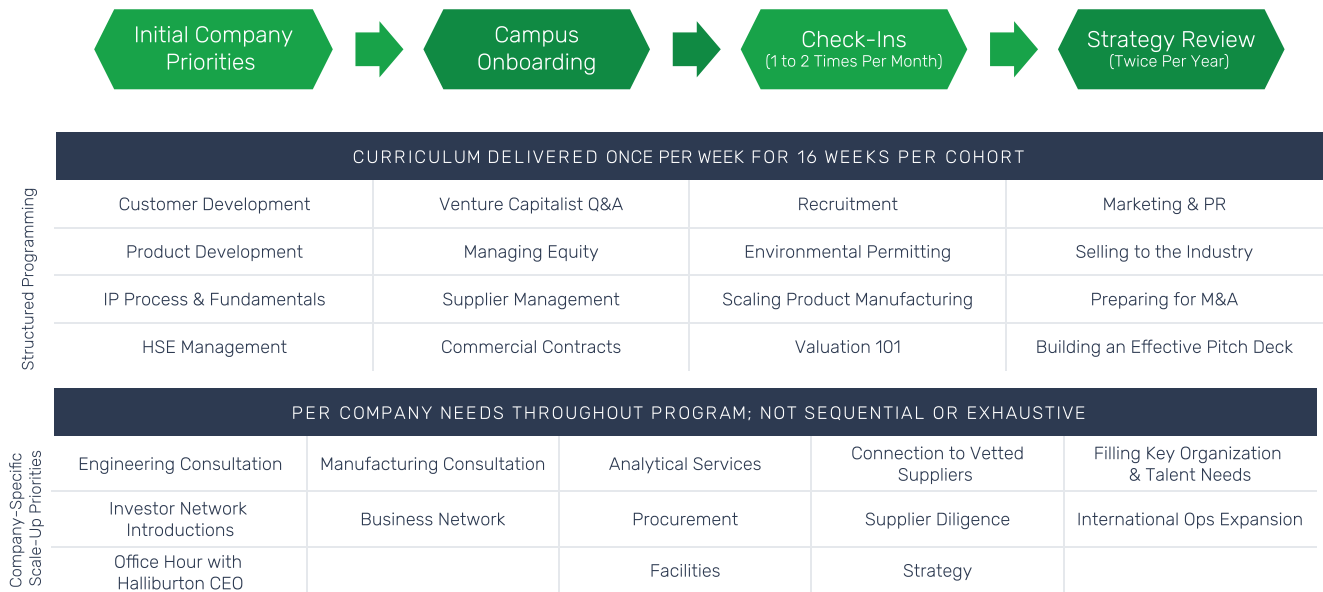


Curriculum

Over a 12-month period, we open our doors to companies for unlimited education, mentorship, and consulting.

Our structured curriculum covers the core topics that any entrepreneur must address while their business scales. Meanwhile, Halliburton is available to meet with participants about more unique, company-specific requirements and priorities.

Operating Model to Support Accelerator Companies



Operating Model to Support Accelerator Companies

## Participating Companies

Since we launched Halliburton Labs in 2020, we have attracted and onboarded many qualified and outstanding companies that are on the cusp to become game changers in their industries and our collective clean energy future.

### NANOTECH, INC.

Houston, TX

Thermal insulation and fireproofing nano-coatings

### ENEXOR BIOENERGY

Franklin, TN

On-site bioenergy conversion systems for waste

### MOMENTUM TECHNOLOGIES

Dallas, TX

Lithium battery recycling technology and rare earth recovery

### OCOCHM

Richland, WA

Carbon dioxide-to-formate conversion technology

### HELIX POWER

Somerville, MA

Flywheel energy storage technology

### SOLVCOR

Princeton, NJ

Liquid additive that reduces energy consumption and CO<sub>2</sub> emissions

### ALUMINA ENERGY

Los Angeles, CA

Thermal energy storage

### PARASANTI

Austin, TX

Edge computing hardware and software solutions

### SURGEPOWER MATERIALS

New Braunfels, TX

High-quality graphene from renewable feedstock

### IONADA

Toronto, Ontario, Canada

Carbon capture for small- to mid-sized industrial emitters

### ICARUS RT

San Diego, CA

Power boosting and energy storage for solar PV systems

### STRAYOS

Buffalo, NY

Uses AI to sustainably extract raw minerals

## 2021 Participating Company Achievements

**Momentum Technologies** raised \$20 million in a round led by Freestone.

**Enexor** raised \$10 million in a round led by BorgWarner.

**Enexor** gained acceptance to the Google Climate Change Program and the 100+ Accelerator program.

**Alumina Energy** joined the Shell/National Renewable Energy Laboratory (NREL) Game Changer program.

**NanoTech** won the 2021 Energy Transition Award presented by InnovationMap.

## Rice University named Halliburton Labs Advisory Board Member Reginald DesRoches as its next president.

### The advisory board of Halliburton Labs has added two new\* members:

- Reginald DesRoches, Rice University's Provost and Professor of Civil and Environmental Engineering, and Mechanical Engineering
- John Grotzinger, the Fletcher Jones Professor of Geology at the California Institute of Technology, and Chair of the university's Division of Geological and Planetary Sciences
- Walter Isaacson, the Leonard Lauder Professor of American History and Values at Tulane University in New Orleans, Louisiana
- Jennifer Holmgren, CEO of LanzaTech\*
- Maynard Holt, CEO of Veriten\*
- Jeffrey A. Miller, Chairman of the Board, President and Chief Executive Officer of Halliburton
- Dale Winger, Managing Director of Halliburton Labs



## What Our Participants Say



[Halliburton is] not just providing curriculum and courses, they are providing physical infrastructure for start-ups to go from their garages to production. Halliburton Labs is the next tailwind for start-ups.

Access to Halliburton Labs' resources and world-class facilities will help accelerate our growth and deliver our transformative line of products. Through this collaboration, we intend to fundamentally shift the fireproofing and thermal insulation markets toward more effective and environmentally friendly solutions."

**Mike Francis**  
CEO, NanoTech, Inc.



Our goal is to make SurgePower Materials the key enabler of the forthcoming graphene age with plant-based graphene as an essential component of many new technologies. Our strategic collaboration with Halliburton Labs allows us to leverage their world-class engineering expertise to rapidly scale our production and accelerate the adoption of new graphene-based solutions."

**Dr. Michael Opoku**  
CEO, SurgePower Materials



Halliburton Labs is the ideal environment to scale our cutting-edge lithium battery recycling technology. We are excited to tap into Halliburton Labs' engineering and supply chain expertise and global business network to accelerate Momentum to the forefront. Participation in Halliburton Labs has signaled to the market that we are an established company."

**Preston Bryant**  
CEO, Momentum Technologies



None of anyone's climate change ambitions get done unless you build something big that works and is cost efficient, and Halliburton has experience in doing that. Halliburton Labs can benefit you if (1) you are serious about manufacturing products and bringing them to market, (2) you want partners who can assist, critique, and support what you are doing, and (3) you want to expand your horizons. Halliburton is looking forward and helping build the future.

The valuable industrial expertise and network of Halliburton Labs will support our build, deployment, and demonstration of a full-size commercial-grade system — the next step on our commercialization journey toward an industrial-scale plant."

**Todd Brix**  
CEO, OCOchem



We are receiving tremendous interest from industrial emitters around the world for modular carbon capture systems. Halliburton Labs' engineering, supply chain expertise, and global network provide the ideal launching platform for us to scale our business to meet demand. Halliburton Labs has opened a lot of doors for us, virtually every touch point."

**Edoardo Panziera**  
CEO, Ionada



We are honored to join Halliburton Labs. Their broad global network and deep manufacturing expertise will assist Enexor in meeting its significant worldwide demand while making a significantly positive environmental impact. This is a major step forward in our worldwide launch."

**Lee Jestings**  
Founder and CEO, Enexor BioEnergy

