We are taking energy forward

The path to net-zero and a sustainable energy future
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Letter from the CEO

The energy industry has been built on invention and reinvention. The ‘energy transition’ in fact, isn’t a new concept. We’ve witnessed a number of transitions in our own lifetime, from coal to the rise of natural gas, to the shale revolution, and the advent of renewable energy. We have always been an industry in transition – managing volatility, advancing technology and innovation to power the world’s progress and economic development.

Yet, it’s clear that, today, we are at a new and critical inflection point. How do we meet the world’s growing demand for energy, and the world’s demands from energy – to be safer, cleaner, and more efficient?

We believe the answer lies in technology. As an energy technology company, this is the core of our mission – to deliver the highest efficiency solutions today and advance the path towards energy decarbonization. This company, this industry, knows energy. We have the power to change it for the better.

Lorenzo Simonelli, Chairman and CEO
Baker Hughes is an energy technology company

Taking energy forward is the core of our growth strategy

We are bringing our core technology capabilities to enable a path to net-zero for energy and industry.

OUR AMBITIONS
Reach net-zero carbon emissions by 2050
Lead in energy transition and digitalization and be a critical decarbonization partner
Deliver the highest efficiency, productivity outcomes for broader energy and industry

OUR STRATEGY FOR HOW WE GET THERE
Transform the core
Invest for growth
Position for new frontiers
We were one of the first in the oil and gas industry to make a net-zero carbon commitment

And we hope we’re not the last.

Baker Hughes is committed to reducing our emissions by 50% by 2030 and net-zero by 2050

- **15%** reduction in scope 1 and scope 2 emissions year-over-year versus 2019 baseline
- **22%** of our electricity comes from renewables and zero-carbon sources
- **850+** global facility energy audits and weekend energy walk-throughs completed in the last two years
We see three hard truths:

#1 Without major acceleration, the industry will not meet net-zero targets

While technologies in use today can deliver significant emission reductions, they are insufficient on their own to meet the Paris Agreement goals. We need a dual approach to implement efficiency measures today and invest in new energy solutions for the future.

#2 Reliance on hydrocarbons will not disappear, so efficiency matters

For at least the next 30 years, oil and gas will continue to play an important part of meeting global energy demand—even in the most aggressive of energy transition scenarios. Efficiency solutions are critical to reducing emissions, representing 37% of total emissions reductions needed to meet Paris Agreement goals.

#3 There’s no path to net-zero without partnership and collaboration

Our business was built on partnership and service. Today, we know this matters more than ever. We believe it will take energy producers, technology and service providers, energy buyers, policymakers, and the community at large working closely together to achieve our collective ambitions.

Why future technology is critical to meeting net-zero ambitions

% OF CUMULATIVE CO₂ REDUCTIONS BY TECHNOLOGY READINESS TO MEET NET-ZERO BY 2070

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Source: IEA
How we help our customers on the path to net-zero

2.5% efficiency gains in CO₂ emissions could be achieved with just 1% efficiency gains from gas turbines

Upgrades to high efficiency technology
Efficient technology solutions are at the core of reducing emissions from energy operations. It’s also core to what we do. From our oilfield technology to our high-efficiency turbomachinery, we develop technology that runs cleaner and more efficiently.

46% of global vented methane emissions are estimated to come from pneumatic control valves

Managing emissions at the source, at scale
Tackling emissions means addressing the small in a big way. No-bleed valves, methane monitoring, reducing flaring, and intelligent asset optimization at scale can deliver material reductions in methane and other greenhouse gas emissions.

35% cumulative CO₂ emission reductions to meet net-zero targets will come from technologies currently in prototype and demonstration stage

Advancing a new energy era
New energy solutions are not new to us. We are advancing the long-term energy technology solutions needed for a decarbonized era – hydrogen energy, carbon capture and storage, geothermal, and other integrated solutions to make energy ‘net zero’. 

Sources: Baker Hughes analysis, US EPA, and IEA
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Energy technology is the heart of the energy ecosystem, and it has never been more vital.

Our capabilities are critical to the future of energy.
We take a dual approach to a sustainable energy future

Solve for the largest sources of scope 1 and 2 emissions in energy operations today by deploying the most efficient and least emissive technologies.

And invest in sustainable energy technology for tomorrow by accelerating the adoption and deployment of new fuel sources and emissions solutions.

THE PATH TO NET-ZERO TODAY
1. Efficient power
2. Efficient oilfield
3. Emissions management
4. Industrial asset management

DECARBONIZING ENERGY FOR TOMORROW
1. Carbon capture, utilization, and storage
2. Hydrogen
3. Geothermal
4. Energy storage
If today’s oil and gas operations were 10% more efficient, we would save ~0.5 Gt CO₂-equivalent per year

That represents a contribution of 5% per year of the emissions reduction target of the Paris Agreement climate goals.

Reducing emissions from core oil and gas operations is a first and critical step to meeting global and industry emissions targets. These solutions can be relatively lower in capital investment and provide more immediate results in terms of emissions reductions.

We are focused on developing and deploying these technologies in our own operations and for our customers to ensure we are cutting emissions while we invest in and advance a sustainable energy future.

Sources: IEA
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Achieve lower emissions with the most efficient and reliable turbomachinery

FEATURED OFFERINGS

Clean industrial power solutions
Our NovaLT™ family of high efficiency turbines for industrial cogeneration offers lower consumption and emissions as low as single digit ppm. Our combined heat and power, and waste heat recovery enhances energy efficiency and provides reliable power for a range of industries.

High-efficiency power generation and compression for oil and gas
Our gas turbines and compressors are some of the world’s most efficient – lower carbon intensity, high availability, and low NOx emissions. Our LM9000 is the most efficient and powerful aeroderivative gas turbine in its class.

Upgrade equipment for emissions reductions
Replace turbomachinery fleets across plant operations to reduce emissions. Leverage planned outages to improve performance with vent recovery, compressor re-bundling, and other opportunities.

Modular and decentralized power plant solutions
Design and develop new power generation concepts to suit the needs of your project. We provide combined cycle, alternative fuels, and renewables integration solutions to reduce emissions for operations in oil and gas and industrial applications.

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2.5%

Efficiency gains in CO₂ emissions could be achieved with just 1% efficiency gains from a gas turbine

Source: Baker Hughes internal data and analysis
The LM9000 is the world’s most efficient simple cycle gas turbine

FEATURES

• Powerful and efficient gas turbine derived from the GE90-115B, which has been on Boeing 777s since 2004
• Compact, modular package for fast installation and lower costs than field-erected units; ideal for stringent space requirements
• Designed for easy inspection and condition-based maintenance — delivering high reliability and maintainability

BENEFITS

• 44% efficiency in simple cycle, 80% in cogeneration
• Higher availability thanks to long maintenance intervals, and modular package allowing 24-hour engine swap
• Pressurized LNG compressor startup capability without a helper motor
• Power output 15% higher compared to industry peers. This efficiency is key to driving lower carbon intensity and combined with lower NOx emissions (15 ppm in dry condition, 40% lower than competing technology)

CASE STUDY

NOVATEK’s Arctic LNG 2 Project
Amidst COVID-19 restrictions, LM9000 gas turbine technology successfully completed First Engine to Test (FETT). The FETT confirmed LM9000’s best-in-class availability, efficiency, and lower NOx emissions, ideal for LNG operators to reduce their total cost of ownership and overall carbon footprint. The project includes gas turbine, compression and turboexpander technology for power generation and three liquefaction trains on gravity-based structures (GBS).
Improve oilfield efficiency and lower emissions

FEATURED OFFERINGS

Drill leaner wells
Our reservoir experts design lean drilling programs to achieve a customer’s recovery goals with fewer wells. Operations personnel apply drilling technology to ensure predictable, flawless execution — saving days, cutting waste and eliminating unnecessary emissions.

Achieve peak productivity
Our reliable completions and production technology keep wells flowing at peak efficiency, with minimal downtime and fewer interventions. These products and services eliminate the need to construct new wells when production declines.

Execute from anywhere
Our robust remote infrastructure ensures 99.99% uptime and keeps our global subject matter experts connected to wellsite technology 24/7/365 – reducing the number of people on the rig. Automating key processes eliminates unnecessary delays, rework, and travel related to human error.

Benefit from alternative power sources
Mobile and modular, our e-frac packages replace diesel power with electrical pumps and can even use associated gas to power operations and reduce flaring. Our permanent magnet motors reduce the amount of power required to run downhole pumps.

10% of upstream greenhouse gas emissions in extraction and drilling can be addressed by efficiency and electrification.
Identify, control and reduce emissions from operations

FEATURED OFFERINGS

Detect and identify methane emissions
Accurately and efficiently identifying sources of methane emissions enables faster response, reduces emissions and lowers cost. Our emissions monitoring systems provide localization and quantification of methane emissions, general asset inspections, and alert customers of any anomalies.

Flare management and optimization solutions
Flaring is one of the largest causes of carbon emissions across the oil and gas sector. We ensure high-efficiency flare combustion and reduce steam usage. Using modular gas processing, our turbomachinery solutions can capture flare gas for use as a highly efficient power source.

Address venting with pipeline and valve solutions
We can replace or retrofit control systems in natural gas operations with no-bleed valves to cost-effectively reduce methane emissions. Our pipeline maintenance and environmental services address critical venting challenges.

Reduction of methane emissions needed to meet Paris goals – the single biggest opportunity to reduce greenhouse gas emissions

Source: IEA
Cost effective methane monitoring and emissions management

FEATURES

• Using advanced drone technology, our solution meshes optical gas imaging (OGI), associated imagery, and proprietary computer vision algorithms, to efficiently and accurately provide detection and quantification of methane emissions, as well as precise localization with automated component recognition.
• Ability to use additional sensor types as applications require (TDLAS for example)

BENEFITS

• Cost effective solution to detect, localize and quantify leaks to enable emissions reduction
• Flexible offering, with large area surveys, as well as detailed regulatory compliant surveys available
• Cloud based platform for ingesting, analyzing and reporting on emissions findings
• Automated visual analytics enable efficient solutions with insights beyond methane detection
• Safer compared to existing manual techniques, reducing windshield time and physical inspections on site

CASE STUDY

Since 2018, the Shell-Baker Hughes team has tested drones equipped with methane detection cameras and sensors in the Permian Basin. The teams have conducted over 500 test flights, using drones and drone-mounted sensors, combined with artificial intelligence (AI) enabled software platforms.

This effort is contributing to meeting Shell’s goals of maintaining methane emissions intensity below 0.2% by 2025.
Combining engineering expertise and the power of analytics

FEATURED OFFERINGS

Asset performance management and optimization
We combine our engineering expertise with our advanced analytics and software platforms to help customers monitor, predict, and prevent disruption to assets and systems. Our capabilities promise performance and outcomes that increase asset availability.

Asset health and strategy
We analyze and develop asset health strategies to ensure improved performance while controlling costs and managing risk exposure. To deliver these connected outcomes we combine asset and process expertise, supported by connected technical solutions.

Asset control and protection
We bring together our ability to independently offer control solutions for assets in customer sites with a cybersecurity capability that is critical across plants.

Asset inspection and integrity
We utilize the best in industrial X-ray, ultrasound, video boroscope, EMAT tools, pipeline solutions, and advanced robotic inspection to protect industrial infrastructure and deliver NDT inspection.

3,000+
Number of wells
Baker Hughes delivers remote services for each day
New energy – It’s not new to us

We have been working to advance sustainable energy for decades – from our early CCUS pilot projects in the 2000s and in 2008, when we built the first turbine in the world to run on 100% hydrogen for the Fusina Hydrogen Power Project in Italy.

Now, we are taking our experience to focus on developing and deploying solutions to enable a net-zero future for the energy sector and beyond.
Advancing the hydrogen revolution

Solutions across hydrogen value chain
Our technologies are enabling the next era in hydrogen projects. From production, to transportation, use and storage – our critical technologies make projects possible. Our teams partner with customers to identify feasibility and project development opportunities, helping to navigate a fast-changing industry.

Proven and available today – up to 100% hydrogen turbine
Our gas turbine technology is commercially available today for applications with various levels of blended fuel gas from 10% and up to 100%. Our technology can be integrated and adapted to work with existing gas infrastructure, making it easier to deploy.

Expanding our compression leadership to hydrogen technology
We are established leaders in compression technology and our High Pressure Ratio Compressors (HPRC) provide significant improvements in overall green H₂ plant footprint, reliability, availability and weight.

WIDE RANGE OF EXPERIENCE IN BURNING HYDROGEN

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Number of Baker Hughes units of hydrogen reciprocating and centrifugal compressors that are installed today across multiple applications.

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Partnerships to advance hydrogen technology

Advancing hydrogen systems
We are partnering with NOVATEK to retrofit existing turbines to run on hydrogen blends, supporting NOVATEK’s emissions reduction, raising efficiency and supporting long-term sustainability.

Hydrogen power and storage
Our partnership with Bloom Energy pairs their solid-oxide fuel cell (SOFC) technology and solid-oxide electrolyzer cells (SOEC) with our turbomachinery and compression technology to provide integrated and efficient power and hydrogen solutions.

Financing hydrogen projects
We have made a $60 million cornerstone investment in the FiveT Hydrogen Fund, which will combine our financial, strategic, and technical expertise with Plug Power and Chart Industries and will exclusively finance projects in the production, storage, and distribution of clean hydrogen.
Snam and Baker Hughes test the world’s first hydrogen blend turbine for gas networks

RESULTS

Hydrogen at scale in Europe’s most extensive gas transmission and storage network
Baker Hughes and Snam, Europe’s largest gas network operator, successfully completed the testing for the operation of the world’s first “hybrid” hydrogen turbine designed for a natural gas transportation infrastructure. The test paves the way to implement the adoption of hydrogen (up to 10%) blended with natural gas in the current infrastructure, thanks to Baker Hughes NovaLT™12 gas turbine technology.

Enabling the adoption of hydrogen with the industry’s first family of high-performance gas turbines
The NovaLT has the robustness of a heavy duty but the performance in terms of start up time and low emissions of an aeroderivative. With this family of turbines we have demonstrated the capacity to burn 100% hydrogen in wet conditions/wet combustion and we have a multi-year program to complete the NovaLT family with dry low NOx capabilities.

CASE STUDY

7B cubic meters of hydrogen could be introduced into the Snam network each year

5M potential tons of CO₂ emissions that could be reduced each year by the hydrogen network
CCUS solutions for the path to net-zero

Our experts partner with customers to design CCUS solutions to meet the specific needs of a project. Our leading portfolio of technologies provide a range of solutions to solve complex challenges in the energy and industrial sectors.

**TECHNOLOGY AND SERVICES INCLUDE**
- Pre-FEED and FEED consultation and project design
- Carbon capture solutions
- Carbon transportation
- Carbon utilization
- Carbon storage

5.6B tons of installed CCUS capacity is needed by 2050 to meet the Paris Agreement climate goals.

**INNOVATION IN CARBON CAPTURE**

**Chilled Ammonia Process (CAP)**
A post-combustion, solvent-based carbon capture technology, CAP is commercially available today for greenfield and retrofit projects. CAP is well suited for power generation and industrial plant applications.

**Compact Carbon Capture**
Breakthrough technology that provides compact and cost competitive solutions to drive net zero in small and mid size plants in oil and gas and industrial applications. The technology uses centrifugal acceleration for more efficient mass transfer – resulting in a smaller footprint and lower cost solution.

**Mixed Salt Process technology (MSP)**
Using a widely-available and sustainable solvent, MSP employs a novel flow configuration that has been optimized to improve absorption kinetics, minimize ammonia emissions, and reduce water use compared to state-of-the-art ammonia–based and amine technologies. MSP is currently in field testing and development.
Groundbreaking CCUS projects to decarbonize our world

Polaris carbon storage project in Norway
We will jointly explore with Horisont Energi development and integration of technologies for the Polaris carbon storage project in Norway.

Horisont Energi’s Polaris offshore carbon storage facility is part of its “Barents Blue” project, which is the first global and full-scale carbon neutral “blue” ammonia production plant. The Polaris project is expected to have a total carbon storage capacity in excess of 100 million tons, which is equivalent to twice Norway’s annual greenhouse gas emissions.

The Borg CO₂ “industrial cluster” project
We will partner on the Borg CO₂ project, which aims to capture and store up to 90% of the CO₂ emissions from industrial facilities located in the cities of Fredrikstad, Sarpsborg and Halden.

The combined industrial cluster is currently responsible for approximately 700,000 tonnes of CO₂ emissions annually. After being captured, the CO₂ will be liquified, shipped and eventually stored underneath the seabed of the North Sea. This will play an important role in contributing to the Paris Agreement goals, the United Nations Sustainable Development Goals and the Norwegian national emissions reduction targets.
Energy technology for renewable energy through geothermal projects

Our advanced technology tackles challenging rock formations, high temperatures, and harsh well conditions to tap geothermal energy’s potential.

Our focus on geothermal technology ranges from emulating the wellbore conditions of geothermal wells, to testing high-temperature materials and components, full bottomhole assemblies, and power generation.

OUR OFFERING

- Subsurface systems
- Closed-loop underground designs
- Pressure control
- Power generation

1,800+
Number of geothermal wells using our technology, representing 144 total projects
300°C directional drilling system drilled deepest, hottest geothermal well in Iceland

CHALLENGE
An operator in Iceland wanted to harvest energy from an enhanced geothermal system (EGS) at supercritical well conditions. Next-generation drilling technology was needed to effectively build a well under the extreme environment with a measured depth of 5000 m and a static temperature of 550°C.

RESULTS
We developed a prototype metal-to-metal mud motor with a mud-lubricated bearing assembly and a titanium transmission. Engineers also developed a new roller cone bit with all-metal cone seals, all-metal bellow for grease pressure compensator, and a new grease that maintain lubricity at high temperatures.

4659m

Health, safety, and environmental (HSE) issues

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Building a future for large-scale energy storage solutions

Large-scale energy storage is integral to any energy system with high renewables penetration to provide grid stability.

We are leveraging our core technology capabilities to advance innovative thermomechanical energy storage technology, including LAES (liquified air), CAES (compressed air) solutions and developing partnerships for fuel cell technology.

PRODUCTS AND SERVICES INCLUDE

• Centrifugal compressors
• Steam turbines
• Expanders
• Electric motor integrated solutions
• Plant and module technology
• Energy underground storage
• Reliability and inspection solutions

63 GW
Estimated global cumulative capacity of energy storage solutions by 2024

Source: Wood Mackenzie
We are transforming what we make and how we work.

Composites and thermoplastics
We designed our Composite Reinforced Thermoplastic Pipe (RTP), with uses in multiple applications in oil and gas and other industries, to provide some of the highest strength to weight ratios and longest lengths per reel. These solutions offer lower carbon intensity from the materials, manufacturing process, and supply chain compared to traditional steel pipes.

Redesigning subsea systems for less waste, less footprint
We designed our Aptara™ lightweight compact subsea tree to transform the footprint of conventional trees. Our breakthrough design is 50% lighter than previous models, making manufacturing, installation, and use less carbon intensive over the life of the tree.

Additive manufacturing for efficient supply chain
We have produced more than 25,000 additive parts and qualified more than 450 individual parts from our centers in the United States, Europe and Middle East. By designing parts with less materials waste and weight, and manufacturing ‘on demand’ to reduce shipping times, we are creating an efficient supply chain.

Refurbish and redeploy for a circular economy
We have been manufacturing drill bit technology for over 100 years. Our drill bits are designed to work hard, and our service and manufacturing centers refurbish drill bits for redeployment or melt them down to be reused as stock for new drill bits – reducing waste and materials.
Environmentally superior, lightweight non-metallic solutions

FEATURES

• Strong as steel with greater durability – an option for transporting hydrocarbons and industrial applications especially in environments facing corrosion, permeation, and paraffin buildup
• Serving pressures up to 2250 PSI and temperatures up to 180°F, our pipe is now able to be used in higher flow oil, gas and water transport applications

BENEFITS

• The lightweight, spoolable design allows the pipe to be shipped on reels and deployed quickly with minimal manpower
• Easy, low-cost installation combined with ultralow permeation, resistance to corrosion, and elimination of paraffin buildup leads to greater lifecycle health of the pipe system – all contributing to lower total cost of ownership

CASE STUDY

During the process of expanding operations in Central California, a customer created more produced water than their current system could accommodate. To address this issue, an additional pipeline would be required. Concerned by the installation time of steel pipe, the customer turned to us. We were able to successfully leverage our 8-inch non-metallic RTP product offering to deliver a faster installation time with full non-metallic construction – delivering fiberglass polyethylene encased reinforcement layers that prevent corrosion.
The Qatargas LNG trains that changed the industry

CHALLENGE

Following up on three compression trains installed at Qatargas 1, we were asked to support a series of major expansion projects for Qatargas and Ras Laffan LNG Company, as part of the Qatargas 2 project—this would require significantly more power per compression train than Qatargas 1 and updated design and installation requirements for the new liquefaction “mega-trains”.

RESULTS

We supplied two game changing liquefaction “mega-trains”, with an unprecedented LNG capacity of 7.8 MTPA each—this more than doubled the production capacity of the three older trains at Qatargas 1.

7.8 MTPA 300 MW
production capacity of each liquefaction train at Qatargas 2 total power required by refrigeration cycles at Qatargas 2
There is no path to net-zero without partnership.

Consulting and Advisory Services

Industry leading consultation for feasibility and economics

- GaffneyCline consulting offers expertise in new energy projects from CCUS to regulatory policies. Services include quantification of carbon intensity, verification of emissions reductions, evaluation of policy and regulation, and assessment of solutions to avoid, reduce, offset or sequester emissions.

- io consulting works in the early front-end development of low carbon projects, with project expertise including CCUS, hydrogen, emissions reduction, energy storage, carbon neutral facilities, and negative emissions and offsetting.

Policy and Stakeholder Engagement

Performance-based policy drives innovation

Because energy will never be one size fits all, we support policies that do not pick technology winners and losers, instead supporting performance standards supported by flexible incentives. We believe this market-driven approach best supports a dynamic energy mix across different geographic settings.

Partnering to be a voice for change

Our stakeholder engagement is more than just policy. It also includes local community engagement and partnering with leading organizations across a variety of sectors to learn from each other, such as the Hydrogen Council, Fuel Cell & Hydrogen Energy Association, the European Clean Hydrogen Alliance, Global CCS Institute, Stanford Natural Gas Initiative, Open AI Energy Initiative (OAI), FiveT Hydrogen Fund, and more.