Prove Reserves Quickly and Economically
Shale Gas and Tight Oil
Shale gas and tight oil development is becoming a significant part of the global energy mix—but many companies entering these plays are challenged by scarce subsurface data, higher development cost and limited experience.

In underdeveloped fields where reservoir properties are not well defined, acquiring sufficient reservoir data is imperative to identify commercially viable prospects and reduce the number of wells required to prove reserves.

By partnering with Baker Hughes you leverage reservoir expertise, technical knowhow and a comprehensive offering to effectively and economically explore and exploit the full potential of your reservoir.

Drawing on best practices captured from thousands of wells across North America’s lucrative shale plays, we’ve established a data-driven approach that combines the knowledge, technology and technique necessary to:

- Assess and invest in economically viable acreage
- Identify sweet spots and determine best intervals for stimulation
- Construct quality wells quickly and effectively
- Generate fractures that yield greater returns
- Extend the productive life of the well

The result: a robust baseline for field development that reduces technical and commercial risk and establishes repeatable, more profitable recovery.

Data-driven workflows that deliver the perfect balance of efficiency and effectiveness

**Formation Evaluation**
The XMAC™ acoustic logging service helped our customer identify ideal lithology and mechanical properties along the lateral, resulting in precise fracture stage placement and a 32% increase in production.

**Drilling Services**
The AutoTrak™ Curve rotary steerable system has drilled more than two million feet in unconventional shale plays. For one customer, it saved five days drilling time off each new well—reducing drilling costs by USD 200,000 to 300,000 per.

**Water Management**
H2prO™ water management services helped one customer recycle 30% flowback water for fracturing, minimizing disposal costs.

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Invest in economically viable acreage

Exploration begins with a basin screening, where existing geology, seismic, well data, core measurements, basin studies and outcrops are gathered for a regional assessment of commercial potential. Ideal information used in this assessment includes total organic carbon (TOC), maturity level, mineralogy, thickness, stress regime, mechanical properties, natural fractures and faults, porosity and water saturation.

Data for the region may be limited, but preliminary screening can help eliminate plays that fail to meet minimum subsurface requirements. Piecing together and standardizing the various sources of data can take a considerable amount of time and effort. Available 2D and 3D seismic surveys were likely shot and processed independently using different acquisition parameters. And, vintage logs from conventional wells may not capture the interval of interest, or measurement units and calibrations may be unknown.

Investing in economically viable acreage is crucial. Many are considering or have already secured a solid acreage position in these rapidly developing plays, but determining where to invest, even where to begin drilling can be challenging with hundreds of thousands of acres at your disposal.

Exploring untested shale gas and tight oil plays can be a lengthy and expensive process. However, by assessing the geophysical, geomechanical, petrophysical and geochemical properties on a regional level and near the wellbore in early exploration you can identify sweet spots, begin to optimize well placement and determine economic feasibility—saving a considerable amount of unnecessary time and investment by focusing drilling and evaluation in areas with higher production potential.

Mapping key performance parameters

Identify sweet spots and determine best intervals for stimulation

In shale, vertical and lateral heterogeneity varies considerably from basin to basin and well to well. For many regions, where subsurface data may be scarce, history matching alone is often ineffective and fails to deliver reliable predictions. Acquiring additional data will provide the insight necessary to optimize operational decisions, reduce uncertainty and increase economic success.

Through our alliance with CGG, we can seamlessly integrate seismic acquisition, processing, interpretation and inversion into the exploration program.

Early exploratory wells can be widely spaced across a target area and designed for intensive data collection. These wells typically consist of a logging and coring program to acquire the critical performance data required to identify sweet spots, prioritize drilling locations and determine the best intervals for stimulation. Quality core samples and analysis are also required to calibrate qualitative interpretations from wireline logs. The Formation Evaluation Suite™ of logging and coring services can be customized to meet data requirements. Services also include access to geoscience expertise, captured analyses from other known plays and core laboratories experienced in handling and testing ultra-low permeability rocks.

The acquired reservoir properties are then used to further refine predictive reservoir models in order to validate hydrocarbons in place and determine whether the resource warrants proceeding to appraisal.

Seismic is typically shot over a prospective area for basin-wide and field-level evaluation of hydrocarbon indicators, rock properties and structural complexity. Calibrating the seismic information with existing wireline data refines the initial subsurface model, enabling our experts to identify primary locations to begin exploratory drilling.

It is not uncommon to fracture a vertical pilot well to test the formations ability to fracture and produce. Oftentimes, a vertical well is followed by a horizontal sidetrack for further testing. Our Formation Evaluation Suite can be seamlessly integrated with drilling, completion, fracturing and microseismic capabilities to ensure optimal investigation of fracturability and recoverability.
Investigating recoverability and determining economic feasibility

With encouraging results from early exploration wells and growing confidence of hydrocarbons in place, one must investigate the formations ability to fracture and produce, and establish best practices for cost-effective exploitation. Our goal is to identify processes and technologies that optimize your costs while improving productivity.

Construct quality wellbores quickly and effectively
The unique reservoir characteristics found in these formations present challenges that can impact the overarching goal of optimizing costs and performance. Applying a total systems approach that integrates application engineering, drilling systems, drill bits and drilling fluids provides the directional control and stability you need to drill through these complex formations quickly and effectively, while optimizing reservoir contact, surface area exposure and environmental compliance.

Plan the details of your well. The quality of planning impacts drilling expenditure and ultimate recovery. Using reservoir analytics, geosciences, knowledge-based systems and downhole conditions to plan the details of your well can reduce risk. From modeling optimal well paths and pore-pressure trends to pairing the most effective tool string with a compatible drilling fluid, our application engineers help you design purpose-built systems that drive drilling performance and precision to total depth.

Maintain placement within the targeted interval. The AziTrak™ deep azimuthal resistivity measurement tool delivers a 360° peripheral of approaching bed boundaries to ensure precise placement in the prospective interval for maximum reservoir exposure. Acquired measurements can also be used to identify faults and areas drilled out of zone to eliminate unnecessary fracture stage placement.

Drill a straight, smooth wellbore, in less time. Drill the curve and lateral in one run using Autotrak™ rotary steerable systems. In addition to delivering precise steering control and near-bit inclination measurements, rotary steerable systems reduce tortuosity (typically caused by mud motors) making it easier to run casing, characterize the lateral and install intelligent completion systems—which are pertinent technologies used to enhance completion and fracture performance. When paired with our premium PDC bit technology, you optimize performance using a custom-fit, aggressive cutting structure that maximizes penetration rates and minimizes trips.

Stabilize boreholes in reactive formations. Drilling through high-pressure, high-temperature formations with an invert-emulsion drilling fluid, combined with optimum mud weight window determination and drilling practices, can help you maintain wellbore stability, prevent formation damage and reduce lost circulation. With the onset of stringent environmental regulations, high-performance water-based fluids, such as the TERRA-MAX™ drilling fluid system, can deliver the performance of an invert emulsion while minimizing environmental impact.

Create fractures that yield greater returns
Production performance is highly dependent on reservoir characteristics, fracture stage placement and stimulation treatment; Studies show that geometric fracturing techniques can result in stimulated reservoir intervals with unfavorable rock properties and producability—contributing to lower production performance. This can also lead to unnecessary cost related excessive stage placement, horsepower and fluids.

By understanding the distribution of critical formation properties along the lateral, you can target productive zones, determine optimal stage placement and design effective stimulation treatments that optimize reservoir contact, conductivity and productivity.

Characterize mineralogy. Eliminate zones with limited production potential by analyzing lateral lithology, mineralogy and porosity with CGG Robertson RoqSCAN™ cutting analysis.

Azimuthal resistivity measurements acquired while drilling can also be used to identify faults and areas drilled out of zone to eliminate unnecessary fracture stage placement.
Simulate fracture geometry, conductivity and interactivity. The MFrac™ and MShale™ hydraulic fracturing software calibrates reservoir and geomechanical characteristics to favorable fracture geometry and conductivity, compare various treatment scenarios and optimize economics. Simulate fluid volume and proppant mass at different injection points to predict fracture dimensions and conductivity. And, determine effective pump rate, proppant concentration and hydraulic horsepower (HHP) requirements. The software also allows you to compare various treatment scenarios and forecast net present value and return on investment for each stimulated well, resulting in effective planning and economics.

Design an effective fracture treatment.
Applying the Understand the Reservoir First™ (UTRF) workflow, the most effective combination of proppants, fluids and pumping technologies are selected to improve proppant distribution and stimulated reservoir volume (SRV). The HydroCare™ slickwater fracturing system protects your well from a microbial attack, improves fluid recovery, stabilizes the formation and reduces HHP. In addition to reduced horsepower, ClearStar™, the guar-alternative fracturing fluid system, uses a high-molecular-weight that requires less polymer and improves friction properties. The improved transport properties of LiteProp™ ultra-lightweight proppants minimize residual proppant pack damage, offering greater fracture length, in addition to slow settling rates that support fracture height containment. And, with Bifuel™ fracturing services, you reduce environmental footprint by replacing up to 70% of the diesel used to generate HHP with cleaner-burning natural gas.

Ensure optimal reservoir contact and treatment delivery. It’s difficult to control proppant distribution when you’re treating multiple clusters at the same time. Often, proppants and fluids are diverted to unwanted areas of the reservoir, preventing you from achieving the desired SRV. The Opti-Port™ coiled-tubing (CT) activated fracture assembly stimulates through a single point of entry for optimal proppant distribution to the intended reservoir zone—maximizing SRV. Treating individual initiation points one at a time will also reduce HHP needs and fluid requirements for pump-down operations.

Complete longer laterals efficiently and effectively. At longer lateral depths, CT completions can be unreliable. They buckle and lose stiffness. This makes it difficult to mill out plugs or open frac sleeves—resulting in lost stages and compromising ultimate recovery. Longer laterals also lengthen fracturing cycle time, with conventional plug-and-perf completions taking up to three hours per stage to rig up and rig down. With the Frac-Point™ ball-activated completion system, you don’t need wireline or CT to fracture or produce the well—eliminating risk and simplifying logistics. FracPoint also eliminates pumping downtime between stages for non-stop fracture stimulation. This drastically reduces cycle time from weeks to days. When paired with the Frac-Point completion system, IN-Tallic™ disintegrating frac balls optimally divert treatment and prevent wellbore blockage for unimpeded production.

Monitor fracture activity to refine fracture design. With Magnitude microseismic monitoring services you understand how the current perforation pattern and fracture design impacted fracture propagation. This provides insight to the most effective fracture spacing, height and length for maximum drainage—allowing you adjust geometry, proppant concentration, fluid volume and pumping requirements on future fracture designs.

On average, the oilfield industry produces three to five barrels of water for every barrel of oil. And, it spends billions of dollars every year to source, treat, reuse, store, transport, and dispose of it. Cost-effectively managing produced and flowback water can mean the difference between economic success and failure in many oilfield operations. This is particularly critical in unconventional plays. Our H2prO™ water management service provides solutions for technical, economic and regulatory issues related to oilfield water. We can design the most effective water management strategy to meet production objectives and lower operating expenses associated with water sourcing and disposal.

Our comprehensive, integrated approach to overcoming surface water management challenges incorporates your specific reservoir and wellbore characteristics and hydraulic fracture design. Our experts ensure produced and flowback waters are reused safely and effectively by deploying the appropriate solution from our comprehensive suite of water management technologies.
You can counter steep decline curves by taking the necessary steps to maintain and optimize production flow.

Predict potential threats early to prevent costly intervention. Using reservoir data and offset well experiences, petroleum engineers predict post-stimulation problems to prevent post-frac intervention costs related to scale, organic deposition, bacteria and corrosion. By pumping long-term inhibitors, such as our STIMPLUS™ chemical system, deep into the reservoir during stimulation, we ensure formation fluids are treated before they can cause production flow problems. Automation technologies can also ensure chemicals are applied optimally throughout late-life production.

Optimize production lift per stage. The FLEX™ series pump increases lift per stage, allowing for more drawdown with a shorter system that improves uptime by reducing cyclic shut downs. Higher lift per stage also lowers motor temperatures for increased run life and superior overall system efficiency. Combined with WellLink VISION™ downhole monitoring software, you can avoid production shut-ins by monitoring bacteria cultures, scale inhibitor residuals, corrosion and other deposits that impact wellbore integrity and production flow.

Whether your next shale gas or tight oil project requires formation evaluation, well construction expertise or full-scope field development and management services, Baker Hughes Integrated Operations offers comprehensive oilfield engineering and services packaged around a single point of contact, making it easy for you to remain focused on project goals.

Explore your shale gas and tight oil reservoir with confidence

With Baker Hughes by your side, you leverage unconventional reservoir experience, a data-driven approach and a comprehensive technology portfolio to identify commercially viable acreage and key performance parameters, as well as the right technique and technology to establish repeatable, economically-profitable results.

For more information contact your Baker Hughes representative or visit bakerhughes.com/shale.