Environmental stewardship through green technologies and services

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Technological innovation in the industry during the past 10 years has focused on efficiency – faster drilling, longer laterals, and more horsepower – with the ultimate goal of boosting production. During the next decade, the industry has a compelling opportunity to become a leader in global environmental stewardship by not only producing more with less, but by employing a smarter approach that uses technology to enhance production while using less equipment, deploying cleaner chemistry, reducing water usage and lowering emissions.

The technological advances that will propel the industry to a leadership position are on the horizon, and are already being implemented before the well is drilled and during the drilling, cementing and completion phases. Reducing the industry's environmental footprint is a philosophical change as much as it is a change in process – requiring a combination of best practices and systems, and technologies that build upon one another to provide ongoing sustainable benefits.

Schlumberger has adopted a unique engineered approach that raises the bar for planning and making good decisions based on reservoir understanding and the integration of state-of-the-art technologies and services. Good planning that includes an environmental stewardship approach can result in fewer but better wells, which in turn translates to a reduced use of water and chemicals, less truck traffic and lower emissions.

An engineered approach is particularly important as the industry seeks to meet the world's growing demand for primary energy while also replacing the supply that is naturally lost to decline. As the industry seeks to gain access to new arenas, such as expanding unconventional development to international markets, it needs to assure communities and governments that it can drill and complete wells safely and responsibly.

Understanding the reservoir

Environmental stewardship begins with the reservoir. Conventional sandstone and carbonate reservoirs have high-quality, high-permeability rock that enables hydrocarbons to flow naturally. Conversely, unconventional shale reservoirs have poor rock quality with low permeability and porosity. Therefore, for unconventional wells to be economically viable, operators drill a high number of wells, and often horizontal wells that must be hydraulically fractured using water, sand or proppant and chemicals. When using a common geometric completion approach, approximately 40 per cent of the perforation clusters and more than 40 per cent of the hydraulic fracture networks do not contribute to production, resulting in 40 per cent of the unconventional wells in North America being uneconomical.

A broad array of reservoir characterisation tools, workflows and modeling techniques have been developed to refine the industry's ability to understand the subsurface. These include basin, reservoir and petroleum systems modeling, as well as petrophysical analyses to gain a clearer picture of the reservoir's production potential.

Reservoir data is critical in building a basin-specific, three-dimensional model that can be fine-tuned as new wells uncover even more data from core samples and other downhole data. When integrated into a comprehensive workflow, this information provides an even more detailed picture of the reservoir.

A detailed view of the subsurface allows operators to identify "sweet spots" to better position and drill wells, and design more effective completions. This reservoir-centric approach significantly improves the likelihood of drilling fewer, more productive wells and minimises the use of resources to drill and complete wells that cannot be productive.

Even the early steps of the data gathering process provide an opportunity for the industry to lead the way by engineering technologies with environmental stewardship in mind. For instance, three-dimensional seismic acquisition vessels that use advanced surface marine cables, or streamers, designed with a special casing, benefit from reduced drag and fuel consumption. When the casing is damaged, the streamer can be refurbished and used for its original purpose, which adds another three years to its life. The next time the streamer needs refurbishing, it can usually be repurposed and used for another eight to 10 years. Recycling these streamers at the end of their life saves money and avoids waste of tons of useful materials.

Minimising drilling impact

Today, technologies and processes developed specifically for shale-drilling enable operators to drill highly deviated trajectories through hard reservoir rock of varying thickness and orientation, while at the same time to minimise the impact on local communities in terms of noise, traffic and emissions. Sophisticated measurement-while-drilling and logging-while-drilling tools enable geo-steering to keep the drill bit in the target reservoir's sweet spot, ensuring that wells are delivered in a timely manner. Adjustments to the trajectory can be made in real time, thus raising the potential productivity of every well drilled.

The practice of drilling multiple wells from a single location, known as pad drilling, reduces rig and truck traffic and delivers greater operational efficiency. Schlumberger has developed an extensive portfolio of non-aqueous, synthetic-based drilling fluids that meet regulatory standards and provide environmentally friendly alternatives to oil-based muds.

One non-aqueous drilling fluid system was designed so that cuttings can be used as a soil or soil amendment. Developed to biodegrade rapidly, the base fluid has a low terrestrial toxicity. Other drilling fluid components were designed to minimise conductivity and enhance plant growth. The system offers an attractive alternative to traditional treatment and disposal of cuttings.

Less water and greener chemicals

Hydraulic fracturing, a methodology that has been used for more than 50 years to stimulate tight gas and tight oil reservoirs, results in economic flow rates. Early in the shale revolution, the approach involved geometrically placing stimulation treatments equally across the entire lateral. Due to the varying nature of shales, however, an estimated 30 to 40 per cent of a typical well did not contribute to production using this methodology. Thanks to advances in technology, companies can now strategically place treatments by modeling fractures and refining and reducing the actual materials required for the process.

For example, a completion and design software platform enhances field design, by modeling the fracture propagation to determine the optimal spacing for stimulation treatments. By stimulating sections of the reservoir with the most production potential, companies are eliminating unnecessary use of resources in sections that will not contribute to production.

Schlumberger has developed a number of technologies to improve production while reducing water and proppant requirements. These include a service platform that sequentially isolates fractures to ensure that every cluster in each zone is fractured and contributes to productivity. For example, flow-channel fracturing opens pathways in the fracture to enable the flow of hydrocarbons. This technique is now being used in one out of every four stimulation treatments Schlumberger pumps globally.

Modern chemistry has also enabled Schlumberger to conserve freshwater supplies through the use of brackish water and other water sources not viable as drinking water or for agricultural purposes. Schlumberger recycles and reuses as much produced water as possible for repeated stimulation treatments. This closed-loop system – use, recycle, reuse – reduces the hazardous waste from water treatment and filtration, and helps limit the need for costly disposal wells.

An engineered approach can lead to fewer but better wells

In the offshore environment, our mobile water treatment system separates waste water from drilling fluids, which allows recovery and reuse of the drilling fluid. In addition, the water recovered from the treatment process meets the discharge limits for offshore discharge and therefore reduces the emissions associated with shipment of the waste back to shore for treatment.

Just as technological innovation has been key to revolutionising shale development, it will continue to play a critical role as the industry promotes a smarter, less-is-more philosophy going forward. Using an integrated, reservoir-centric approach that combines new methodologies, state-of-the-art technologies, modern chemistry and greater transparency is already proving to be effective in reducing resources and emissions. By continuing to build upon the advances already in place, the industry is poised to take global environmental stewardship to a new level by demonstrating that hydrocarbon recovery can be productive with a significantly reduced footprint.