



develop its potential.

The oil industry itself is buying in, as Halliburton and others are turning there as well. After many companies pivoted away from wind and solar, it would seem geothermal is a better fit on the renewable side for oil and gas technology.



“Technology is rapidly changing what is possible.” Shuvajit Bhattacharya, PhD, a research associate professor and principal investigator for the HotRock (Geothermal) Industrial Affiliates Program at the University of Texas Bureau of Economic Geology, conducts a class on his specialty.

Schiermeier: Geothermal Is Not New to Us

It may not go all the way back to Erle Halliburton’s cementing developments, but the company he founded has used oilfield technology in geothermal for about 70 years.



That’s according to the company’s Global Survey Technical Advisor/Solutions Engineering, Sperry Drilling Services, Pete Schiermeier. Sperry is Halliburton’s drilling technology and well placement product service line.

“Halliburton has 70-plus years in the geothermal space,” he said, noting that the company has applied a number of high-temperature tools throughout the organization to geothermal. “There’s a large portfolio here that Halliburton offers to the geothermal industry.”

Schiermeier handles, among other things, the company’s magnetic ranging services portfolio,

including RangeStar Geothermal Well Spacing and Intercept Service. This system applies specifically to what are known as advanced geothermal systems (AGS), in which two parallel holes are drilled, merging at the bottom.

AGS closed-loop systems pump a fluid—water or supercritical CO₂—into one well, circulating it through a hot formation as a sort of radiator that absorbs heat, then bring it to the surface in the parallel hole. There the heat is harvested, and the fluid is recirculated through the system.

It is important to keep the wellbores exactly parallel, merging them at the toes in a precise location. To help with this, RangeStar well spacing and intercept service puts a magnetic sending unit on the bottom hole assembly (BHA) of one of the wells, with a receiving unit in the other.

By utilizing proven directional and ranging systems in the oil industry, drillers can accurately steer each BHA to keep them in the proper orientation at any depth.

“Maintaining the well plan and that underground radiator structure or closed loop structure is really important for the energy returns that you get,” he explained.

Schiermeier pointed out that one ranging determination is needed when the wellbores are farther apart, and a different one is needed for close-range detection, and RangeStar can adapt to the change without the tools being pulled and replaced—something he said can be an issue with competitive systems.

Born in the Oil Sands

RangeStar is a perfect example of oilfield technology being adapted for geothermal use. The predecessor to it came about in Canada’s oil sands, Schiermeier said. There it is used for the parallel wells needed for steam-assisted gravity drainage, or SAGD.

Oil sands crude is too thick to flow on its own, so every well there requires two parallel holes. Said Schiermeier, “One well is heating up the formation and the other well is recovering what you might call the ‘melting’ of that formation. That alignment is really critical. For oil and gas applications, it’s return recovery. For geothermal, it’s that heat gradient radiator pattern in that formation.”

Because RangeStar leverages longtime oil industry systems, it's very dependable. He noted, "We're leveraging off of proven platforms, meaning proven survey systems and ranging systems that we know how robust they are, how reliable they are, and how they act down hole."

In short, it is parallel industries, parallel holes, and parallel technology.

At this writing RangeStar has been proven in real holes at Halliburton's testing facility in Cameron, Texas—but has yet to be deployed in the field. He sees many applications domestically and internationally. In the United States, there are many possibilities in the Mountain West, where geothermal sources are closer to the surface.

Quaise: Oilfield People and Technologies

One step removed from an oilfield service company adapting technology internally, Quaise is a geothermal company—which still owes much to the oil field. It is based in Houston with a research facility in Cambridge, Massachusetts.

Quaise is combining traditional drilling with a radical new drilling concept to quickly and economically reach past the oil formation and into the hot rocks beneath. Said the company's Head of Manufacturing, Andres Calabressi, in an email interview, "First, we use conventional rotary drilling to get to basement rock. Then we switch to high-power millimeter waves to reach unprecedented depths."

The tech may be different, he said, but there's enough overlap that "we have opportunities to leverage entire workforces from [oil and gas] and introduce them into our processes with much reduced learning curves." He added, "Geothermal is becoming an oilfield-style, repeatable industrial process, and we're deliberately building on what already exists: oil and gas supply chains, standard rig equipment, and proven hardware."

Differing somewhat from Halliburton's AGS, Quaise focuses on another new geothermal technology, enhanced geothermal systems, or EGS. He explained, "Traditional hydrothermal and geothermal wells offer limited energy capacity for a given well, while EGS aims to maximize power output by increasing the surface area of the hot rock that the production fluid [water] loop comes into contact with."

They increase the surface area by using a form of the shale industry's key technology, hydraulic fracturing, but with a difference. "While frac'ing in an oil reservoir maximizes fracture size to increase production flow, in EGS we favor a higher quantity of smaller fractures to focus on contact area." Still the same services apply to both places.

Power from the People

"On engineering," he said, "we look at folks who understand the whole lifecycle of products before new product development. Engineers have been engrained with a detail-oriented mindset, a quality-first approach that ensures operational reliability where products are operated in extreme conditions and often times for lifecycles that extend into decades."

For the operations side, they like "Individuals with unparalleled instincts who have seen it all and can bring efficient and creative resolution to situations that arise in the field," who can "execute, no matter what."

Permian Technology Is Great, the Location Is Not

With current technology, the Permian is not ideal for traditional geothermal access because the temperatures needed for viability are too deep. The accompanying map shows that several states in the Mountain West are best suited for that. It does also show areas along the Gulf in both Texas and Louisiana where geothermal could be more economic.

Oil Plays Are Just *Too Cool*



In the ground, oil and geothermal don't mix, said Kenneth W. Wisian, PhD. "The basic issue is that oil tends to cook out at about the temperatures that geothermal starts to become good for electricity production." That's basically why most oil and gas fields "aren't hot enough to be really

juicy targets,” at least not for utility-scale electricity.

Wisian is Associate Director of the Bureau of Economic Geology (BEG) at the University of Texas Austin, a retired Major General of the U. S. Air Force, and a researcher at BEG’s HotRock Geothermal Program, a consortium whose purpose is “advancing conventional and next-generation geothermal technologies.” Contributors and participants include many major oil companies and service companies.



Halliburton’s RangeStar Geothermal Well Spacing and Intercept Service puts a magnetic sending unit on the bottom hole assembly of one of its twin wellbores, with a receiving unit on the other.

Geothermal Alternatives *Could* Work in the Permian

However, the same tight shale formations that cling tenaciously to their oil can also store energy | maintaining the pressure of compressed air injected from the surface—a great way to store wind solar energy without batteries. In fact, Wisian says “My grand vision would be to put a geotherma energy storage well next to every wind generator in West Texas and essentially convert wind into base load.”

Shuvajit Bhattacharya, PhD, agrees about the Permian’s possible strengths and adds another layer. “The Permian Basin is perfect for geothermal energy storage, either thermal storage or mechanical storage. With significant water production and good-quality reservoirs at a shallow

depth, geothermal energy storage is a great option,” he said.

Bhattacharya is research associate professor and principal Investigator for the HotRock (Geothermal) Industrial Affiliates Program, part of the University of Texas’ Bureau of Economic Geology.

“Companies like Sage Geosystems are already testing these concepts in the field in Texas. The basic idea is to use underground reservoirs or engineered fractures to store energy in the form of heat or pressure, then release it later when electricity demand is higher,” Bhattacharya noted.

Sage is already in the business in South Texas, with a next-generation (and first-in-Texas) system in use by the San Miguel Electric Cooperative Inc (SMECI), a rural electric cooperative in Christin Texas. Sage’s Pressure Geothermal energy storage system, a geopressured geothermal well, uses oil and gas technology in planning, drilling, and pressure management.

The 3 MW system stores 17-18 hours of dispatchable power. Its deep underground rock formation stores pressurized water that, when released, generates power on demand.

Could Geothermal Have a Future Here?

“The Permian may not have the hot geothermal resources seen in places like the Texas Gulf Coast, Nevada or California, but technology is rapidly changing what’s possible,” said Bhattacharya.

“Historically, geothermal power generation required temperatures around 300°F at commercially viable depths.” However, “Today, advances in drilling, heat extraction, turbine design, and working fluids—including supercritical CO₂ systems—are making lower-temperature geothermal resource much more economic.”

Additionally, Wisian believes there could already be some use, at least onsite, for the heat that does come from a Permian well. It’s “probably enough to run your own drilling and pumping operation.... Not enough for the grid or anything like that.”

The November issue of *Permian Basin Oil and Gas Magazine* will cover that and other options fo

using renewable energy to power wellsite operations.

Can't We Just Convert Abandoned Oil Wells?

In short, probably not, said Quaise's Calabressi. In most wells, "this is likely not practical or economical."

Why? "Oil wells are drilled with the purpose of reaching oil reservoirs and extracting the oil. The resultant wells are of typically shallow TVD [relatively speaking], with often large horizontal deviations and are relatively cool, typically below 125 degrees C. For a successful EGS project, we aim to reach geothermal temperatures of around 350 degrees C, so if we were to repurpose oil wells, we would have to significantly extend the hole depth," a task whose economics would likely not pay off.

Plus, oil wells also are surrounded by the wrong infrastructure. Instead of oil and gas pipelines, a geothermal site needs a nearby power plant and a connection to the power grid—both of which are already in short supply in the oil patch.

Chicken and Egg

The conundrum for any new technology is that, first, it needs research and development—which requires investment. But the catch is that money comes from investors who expect a return, which can't be proven until the technology has received enough investment for the testing to prove whether it is or it isn't.

And, noted Bhattacharya, "Geothermal projects typically require high upfront capital investment [CAPEX] for drilling and power plants, even though operating costs [OPEX] are relatively low once the system is running."

Key Points

In the Permian, geothermal offshoots, including energy storage, are seen positively, while any sort of geothermal harvesting is seen as a distant option, if at all

But geothermal's debt to the oil industry is huge, both in technology and expertise. Geothermal would be nowhere near its current state of advancement without it.



Paul Wiseman

Paul Wiseman is a longtime writer in the energy industry.

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