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## How Big Oil's wastewater could fuel the EV revolution

By Hannah Northey, Shelby Webb | 09/12/2023 06:56 AM EDT



Storage tanks that are part of a system for holding wastewater and crude oil are seen in the Permian Basin region of Texas. Joe Raedle/Getty Images

Since oil and gas drilling began nearly 150 years ago, the salty wastewater it produces has been a nuisance for operators.

Now, the electric vehicle revolution could turn the industry's [billions of barrels of brine](https://www.epa.gov/radiation/tenorm-oil-and-gas-production-wastes) (<https://www.epa.gov/radiation/tenorm-oil-and-gas-production-wastes>) into dollars. Oil and gas companies are eyeing their own byproduct — along with naturally occurring brine found deep underground — as a source of lithium, a highly sought-after metal needed to make EV batteries.

Industry executives and experts say companies are close to bringing to market technologies that extract lithium from brine in producing wells, creating a new revenue stream in an energy transition that's threatening the oil industry's bottom line.

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This year, the CEOs of Exxon Mobil Corp., Chevron Corp. and Occidental Petroleum Corp. have said their companies are working on pilot projects to extract lithium from brine. A subsidiary of Occidental Petroleum, for example, has developed a technique to remove lithium from brine in new wells, oil and gas fields, geothermal power production and chemical operations. And in July, Exxon Mobil CEO Darren Woods told investors the company has been looking at lithium extraction “for quite some time.”

“The question is: Are they literally flushing away a value stream?” said Brent Wilson, founder and CEO of Galvanic Energy LLC, an exploration and consulting company that [sold Exxon](https://www.wsj.com/articles/exxon-joins-hunt-for-lithium-in-bet-on-ev-boom-1d72cdd6) (<https://www.wsj.com/articles/exxon-joins-hunt-for-lithium-in-bet-on-ev-boom-1d72cdd6>) 120,000

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acres in Arkansas for lithium production.

“We’ve been pushing for this for a decade and no one’s been listening,” he said. “Now we’ve gained a lot of interest from the majors. ... The industry is finally waking up.”

Demand for lithium — as well as other critical minerals like nickel, cobalt and graphite — is skyrocketing as automakers around the world ramp up production of EVs. Companies usually mine hardrock and clay for lithium or access the silvery-white metal through evaporation using massive ponds.

But oil and gas companies are looking to an emerging suite of methods called “direct lithium extraction.”

The term refers to technologies that directly remove lithium from brine in salt flats and bodies of water like California’s Salton Sea — or from the wastewater of oil and gas drilling. In 2021, researchers at the University of Texas, Austin, [found that a single week’s worth of water](https://cockrell.utexas.edu/news/archive/9333-new-way-to-pull-lithium-from-water-could-increase-supply-efficiency) (<https://cockrell.utexas.edu/news/archive/9333-new-way-to-pull-lithium-from-water-could-increase-supply-efficiency>) from hydraulic fracturing in Texas’ Eagle Ford shale could produce enough lithium for 300 EV batteries.

A region in Arkansas that is home to a geologic formation known as the Smackover has also emerged as a potential lithium hub. For decades, companies have tapped the formation — rich with saltwater brine that contains lithium — for oil and gas, as well as the bromine used in agriculture, sanitation and fire retardants.

Now, Exxon is reportedly planning to build one of the world’s largest lithium processing plants in the area.

Companies already active in the Smackover formation are keenly aware of the growing interest from Big Oil. Canada-based Standard Lithium Ltd., which has been operating a demonstration plant in the Arkansas region for three years, hopes to begin producing battery-quality lithium hydroxide monohydrate as early as 2027.

“The attention it’s getting from that sector is a validation of what we’re doing,” said Standard Lithium CEO Robert Mintak. “It’s an obvious choice for the energy sector because it’s in their backyard.”

But some say the oil and gas sector’s pivot toward critical minerals needs more oversight and scrutiny.

Brine can contain drilling chemicals, as well as minerals and radioactive material picked up from the underground formation, said Aaron Mintzes, senior policy counsel for conservation group Earthworks. But it is exempt from the federal law that governs most hazardous waste, known as the Resource Conservation and Recovery Act.

“This is one example of the oil and gas sector trying to extend the life of a business model that’s ending,” Mintzes said. “They do so through various carbon management techniques — carbon sequestration, use of hydrogen and now also lithium. They only have to go one, you know, one or two elements down the periodic table.”

## Easing a supply crunch

Globally, demand for lithium could grow by more than 40 times by 2040 [under a scenario](https://www.ica.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary) (<https://www.ica.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary>) in which the world stabilizes global warming below 2 degrees Celsius, according to the International Energy Agency.

Australia, Chile, Argentina and China currently dominate international lithium production, according to the U.S. Geological Survey. And China processes up to 70 percent of the world’s lithium, a grip the Biden administration has sought to ease through domestic production incentives in the Inflation Reduction Act. In the coming years, U.S. production is poised to increase through traditional mining projects like Nevada’s Thacker Pass mine, which is currently under construction.

But domestic and global supply will need to ramp up much more to meet the demand. According to the U.K. mining data firm Benchmark Mineral Intelligence, the lithium sector will [need to invest](https://source.benchmarkminerals.com/article/lithium-industry-needs-over-116-billion-to-meet-automaker-and-policy-targets-by-2030?mc_cid=f6c0a93fb5&mc_eid=f8b8d16924) ([https://source.benchmarkminerals.com/article/lithium-industry-needs-over-116-billion-to-meet-automaker-and-policy-targets-by-2030?mc\\_cid=f6c0a93fb5&mc\\_eid=f8b8d16924](https://source.benchmarkminerals.com/article/lithium-industry-needs-over-116-billion-to-meet-automaker-and-policy-targets-by-2030?mc_cid=f6c0a93fb5&mc_eid=f8b8d16924)) \$116 billion by 2030 for automakers around the world to achieve EV penetration targets and for countries to fulfill their decarbonization policies.

IEA has highlighted the need for new technologies like direct lithium extraction to ease the supply crunch and unlock new supplies.

Some of the largest U.S. oil and gas companies have signaled they are eager to seize the opportunity.

Occidental Petroleum, through wholly owned subsidiary TerraLithium, has already developed a direct lithium extraction technique for brine wastewater. And Chevron CEO Mike Wirth told Bloomberg [in an interview](https://www.bloomberg.com/news/articles/2023-07-24/chevron-considers-lithium-production-in-latest-ev-bet-by-big-oil) (<https://www.bloomberg.com/news/articles/2023-07-24/chevron-considers-lithium-production-in-latest-ev-bet-by-big-oil>) that his company is also considering getting into lithium but did not reveal specific plans.

Asked to elaborate, Chevron said in a statement to E&E News that it regularly assesses technology that can help the company “operate more efficiently, lower carbon intensity and launch viable new businesses.”

In a July earnings call, Woods, the Exxon CEO, told investors that the company has been looking at lithium extraction “for quite some time” but

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was still “early in evaluating the opportunity.”

“But we believe that by, again, applying our advantages in this space we can bring on a much needed resource — lithium — one that’s predicted to go short,” he said.

Exxon did not respond to multiple requests for comment. But in July, the *Wall Street Journal* reported that the company (<https://www.wsj.com/articles/this-arkansas-town-could-become-the-epicenter-of-a-u-s-lithium-boom-54ad7306>) is planning to build a lithium processing facility near Magnolia, Ark., with the ability to produce up to 100,000 metric tons of lithium a year. In June, Reuters reported that Exxon had purchased Saltwerx LLC, now a subsidiary, and had agreed to develop more than 6,100 lithium-rich acres in the Smackover formation.

Saltwerx did not immediately respond to a request for comment.

## A new industry

The concentration of lithium in brine varies geographically. South America has bodies of water with some of the highest concentrations of lithium on the planet, for example, at roughly 1,300 parts per million, according to Brent Elliot, a researcher and economic geologist with UT Austin’s Bureau of Economic Geology.

The average lithium concentration in the Smackover formation in Arkansas and Texas, meanwhile, hovers between 200 and 500 parts per million, with some rich areas closer to 800 parts per million. It’s even less in the oil-rich Permian Basin, with concentrations as low as 40 parts per million.

Such lower concentrations make it nearly impossible to extract lithium through evaporation of brine in massive ponds — as is the practice in South America. Weather is also a factor; the U.S. locations generally see more rain than those in South America.

Instead, companies in the U.S. will need to rely on technologies to strip the lithium from the brine.

Standard Lithium, for example, is testing out two methods. The first uses changes in pH levels to separate out the lithium, while the second uses a special resin that binds to the lithium molecules as brine passes over it.

The key for the fledgling U.S. industry, Elliott said, will be to match foreign countries’ lithium prices. That may be difficult, given the additional cost of using extraction technologies, rather than just evaporation.

Cameron Perks, an analyst at Benchmark, said it’s possible to extract lithium from brines from a variety of sources — such as oil fields, geothermal vents and even seawater — even if concentrations of the metal are low. The bigger question, he said, is whether it makes economic sense.

“There are a lot of claims of low-cost extraction from low-grade brines out there, but our independent modeling suggests higher costs are to be expected,” Perks said in an email. “It’s certainly viable, but the next question is, is there somewhere cheaper and less impactful to do this? How much fresh water and electricity will actually be required, etc.”

But oil and gas companies in the U.S. have at least one major advantage, Elliott said.

“On the oil and gas side, they were already producing it. That water is already coming out of the ground,” he said. “The process and the infrastructure is already there for taking that water somewhere.”

In comparison, it’s much harder to develop that infrastructure in the remote regions of Chile and China that currently produce lithium.

U.S. companies also may find the boost they need from the Inflation Reduction Act, which encourages automakers to use lithium sourced domestically or from countries that have free trade agreements with the United States.

“There’s the Salton Sea out in California, with some of these higher concentrations that are potential resources for extraction, where a lot of money is being pushed both from the federal government and from private industry,” Elliott said.

## ‘Early days’

This isn’t the first time the oil and gas sector has sought to rebrand itself or dabble in different sources of energy.

During the oil crisis of the 1970s and 1980s, a number of multinational oil and gas companies considered alternative ways to pump out energy — including coal, solar and wind — and increasingly dubbed themselves “energy companies.”

“The idea that oil companies will get into another energy business isn’t a new one, it’s an old one, and it happened at a time of crisis,” said Kevin Book, managing director of research firm ClearView Energy Partners LLC.

Oil and gas companies are playing off their core competencies that overlap with activities like mining, as well as carbon capture and sequestration and refining, Book said.

Erik Belz, who leads investment firm Engine No.1’s private capital business, agreed. If companies are able to commercialize direct lithium

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extraction technology, he said, it could change the outlook for supply — much like the shale revolution for oil and gas.

“This is early days. It needs to be proven that it can be done at scale, and I think that if it can, you have a meaningfully different supply,” Belz said.

Engine No. 1 is an activist investor that forced a board shake-up at Exxon to accelerate a move to clean energy. The San Francisco-based firm recently joined Manara Minerals Investment Co., a company backed by Saudi Arabia’s government, to ink a \$3.4 billion deal for a stake in Brazilian miner Vale Base Metals. The move signals the Gulf Kingdom’s pivot toward a push to control minerals deemed critical to the energy transition.

Further driving interest among the oil and gas sector is a rush of incentives under the Inflation Reduction Act’s \$360 billion in clean energy and climate incentives. For example, Mintak with Standard Lithium said his company’s direct lithium extraction pilot plant in Arkansas could be eligible for two types of tax credits under the climate law.

“They’re grabbing all the money they can,” said Ian Lange, director of the mineral and energy economics program at the Colorado School of Mines.

Environmental groups across the country are calling for closer scrutiny of how direct lithium extraction projects could affect water quality and quantity in a time of drought.

Jared Naimark, an organizer with Earthworks, said he’s not opposed to direct lithium extraction. But he warned against efforts to characterize the practice as “greener” than other forms of extraction.

Direct lithium extraction may end up using less water than evaporation ponds, he said, “but in the context of the Salton Sea, where every drop counts, if water gets diverted from the sea for lithium extraction, ... that’s something that needs to be carefully looked at.”

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