

Practical and Legal Hurdles to Lithium: The Next Extraction Revolution?

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There has been much talk within the oil and gas industry about the potential for lithium extraction from produced water, a waste byproduct produced during hydraulic fracturing and drilling. Is this only talk, or are we approaching another extraction revolution? The answer is that the revolution is knocking on the door, but there remain significant practical and legal hurdles to overcome. To become viable, lithium extraction must become both economically and environmentally sustainable. Thus far, these technologies have not proven to be economically scalable, nor could their environmental impacts be justified.

The legal hurdles involving lithium extraction can be summed up in one question: Who owns the lithium? Is it the surface owner, the mineral owner (where the two differ), or the operator? As seen below, the standard lawyer answer applies: it depends.

Incentives for overcoming these hurdles could not be higher. Whoever masters lithium extraction technology from produced water will be able to name their own price for licensing that technology. Just as importantly, the oil and gas industry will be a major contributor to solving the obstacles currently facing the U.S. in sourcing lithium. Current U.S. dependence on foreign suppliers of lithium, especially China, raises significant geo-political concerns that can be cured by sourcing lithium domestically. Current estimates are that 40% of the country's lithium needs are contained within the Appalachian Basin alone.

LITHIUM IN CONTEXT

A. Lithium as a Commodity

Produced water contains a variety of constituents – sediment, salts, hydrocarbons, minerals, and metals. Lithium is one of these constituents, and when extracted and processed, lithium has numerous uses and applications.

Lithium batteries are used to power the cell phone or computer that you're reading this article on, the alarm system that keeps your home safe, and the electric vehicle that you drive. Lithium batteries power medical devices like pacemakers. If you're a golfer, your golf cart is likely powered by lithium batteries. If you're an avid photographer, that digital camera that you use to take photos is powered by lithium batteries. As technology develops and improves, lithium batteries will continue to become even more ubiquitous. In fact, lithium consumption is expected to more than quadruple in the next ten years alone.

B. Lithium: Then & Now

In the 1990's, the United States was one of the largest producers of lithium. Today, less than 2% of the world's lithium is produced here. In 2022, the U.S. government designated lithium as a critical mineral, recognizing lithium as essential to economic and national security. The U.S. government has directed that all lithium be produced domestically by 2030, an unrealistic goal. In reality, the U.S. cannot meet current domestic lithium needs and must rely heavily on top producing nations like China, Chile, and Australia.

China currently dominates the lithium market, with vast reserves of lithium and a monopoly over both lithium processing and production of lithium batteries. The U.S. government is determined to prioritize critical mineral resource initiatives and has dedicated billions of dollars towards processing lithium and other critical minerals for

battery production, with the ultimate goal of reducing dependence on China and other nations. Additional funding has been allocated towards direct lithium extraction initiatives and lithium-ion battery plants.

C. Lithium in the U.S.

Despite the U.S. sourcing the vast majority of its lithium needs from foreign nations, there are numerous lithium sources in our own backyard. Yet, the Albermarle Silver Peak Mine in Nevada is the only active lithium producing mine in the U.S. This site utilizes direct lithium extraction and produces most of the less than 2% of the world's lithium that comes from the U.S.

In 2024, scientists discovered a massive lithium deposit in wastewater from Marcellus Shale wells in Pennsylvania, with potential for even more in West Virginia and Ohio. As noted above, these untapped Marcellus Shale sources could contain enough lithium to meet up to 40% of current domestic needs.

Another recent discovery in the Smackover Formation in Southwestern Arkansas contains potentially 19 million tons of lithium. There currently is a new pilot lithium extraction site in Northeast Pennsylvania operated by Canadian company Avonlea Lithium. According to Avonlea, a pilot test conducted at this site in June 2025 yielded extremely promising results, producing lithium phosphate solids from produced water with a purity of 94.2% and a lithium recovery rate of 69.3%.

Additional lithium extraction methods currently being developed and refined include Solar Evaporation Brine Extraction, Direct Lithium Extraction, Solar Transpiration-Powered Lithium Extraction and Storage, and Redox-Couple Electrodialysis. However, seemingly successful processes like the "Closed Loop" process used at Eureka Resources' site in Williamsport, Pennsylvania have faced significant challenges. This method was initially successful, extracting 97% pure lithium carbonate from oil and natural gas brine with an up to 90% success rate. But the plant was subsequently closed in 2024 and cited for numerous permit and OSHA violations, workplace safety issues, and environmental violations. This illustrates how some promising lithium extraction methods face significant scalability, economic, and environmental issues that may impede their viability.

D. Lithium Ownership: Title and Lease Rights

The starting point as to who owns the produced water's lithium requires determining whether there has been a severance of the mineral rights. In other words, has a prior owner of those mineral rights somewhere in a chain of title reserved or retained ownership of those minerals in the course of transferring ownership of their surface rights. As with any title examination, the specific language in the severance deed determines exactly what the surface owner retained: minerals, oil, gas or some combination of the three.

If there has been a severance of the mineral rights, then it is unlikely that the current surface owners own the lithium under their property. More importantly, the current surface owners likely have no legal authority to lease the lithium to an operator. Thus, the operator must lease that lithium from its true "severed" owner instead.

But even if an operator has a lease with the lithium owner, they still may not have the right to extract it unless the lease's granting clause arguably includes lithium. Granting clauses can contain a variety of terminology to identify what rights the lessor is being given. These include "oil," "gas," "their constituents," "hydrocarbons" and even the generic "minerals."

Note, however, that a "mineral" can have different legal definitions in different states. For instance, in Texas "mineral" includes oil, gas, uranium and sulphur. In both West Virginia and California, the definition is even broader and includes sand and gravel. Oklahoma defines only hydrocarbons as a mineral. Ohio excludes coal but includes oil and gas within its definition of a mineral, while Pennsylvania excludes both of those from its definition.

While no court has yet to explicitly rule on whether lithium is a mineral, that is the most likely conclusion, particularly since lithium is a metal and certainly not a hydrocarbon. Thus, unless a lease's granting clause explicitly identifies lithium, it should at least include "minerals" if the lessor is to claim rights to the lessee's lithium.

E. Rights to the Produced Water

So, is an operator who doesn't own lease rights to lithium out of luck? The answer is maybe not because that operator may still be able to argue ownership of the produced water within which the lithium resides.

As of this writing, only one case has specifically addressed who owns the produced water. In June of this year, in *Cactus Water Services, LLC v. COG Operating, LLC*, the Texas Supreme Court held that produced water is a waste byproduct of the oil and gas drilling process "product stream" and therefore owned by the operator.

The facts of the case are somewhat involved, but can be simplified as follows: The operator, COG, had an oil and gas lease with the severed mineral owner. *Cactus Water*, however, entered into a "produced water lease" with the surface owner for the same acreage to pay royalties for monetizing that produced water. In contrast, COG's lease made no mention of the produced water, yet it still claimed ownership of that water. The Texas Supreme Court agreed with COG. Yet it also noted that COG's lessor could have expressly reserved ownership of the produced water in its lease.

The case's unique facts, combined with the Court's strained rationale behind its decision, raise doubts as to whether *Cactus Water's* decision will be adopted in less oil and gas friendly states.

TAKEAWAYS

The economic and political upsides to lithium extraction are simply far too great to ignore. Investors are showing an increasing willingness to dedicate the necessary resources to overcome economic scalability and environmental sustainability challenges.

The legal impediments surrounding lithium should be easier to overcome. Operators must perform their title analysis with an eye specifically geared to determining lithium ownership rights. New leases must contain language explicitly granting rights to lithium. Where operators lack defensible positions that their existing leases grant such rights, they should consider lease amendments explicitly doing so. Where lithium remains owned by surface owners not subject to oil and gas leases, operators should enter into separate leases with those surface owners to monetize their produced water. Finally, all of these agreements and leases should plainly state that royalties paid for extracting lithium, as well as other possibly valuable constituents from produced water, must be paid on a net basis so an operator can deduct its extraction expenses.

Thus, there can be no doubt that the lithium extraction revolution is coming. The ability to successfully extract lithium from produced water is not a question of "if," but rather of "when."

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