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Element Three: Is Producing Brine to Extract Lithium the New Gold Rush?

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What Am I Talking About?

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Brine Mining – the extraction of useful materials (minerals, elements, compounds) which are naturally dissolved in water of high salinity.

What Am I Not Talking About?

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Solution Mining or In-Situ Leaching – methods of injecting water or chemicals to dissolve materials in a solid state.

What is it?

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Brine Water v. All Others

Freshwater

- Ponds, Rivers, Streams, Shallow Aquifers
- 0-.5 ppt

Brackish Water

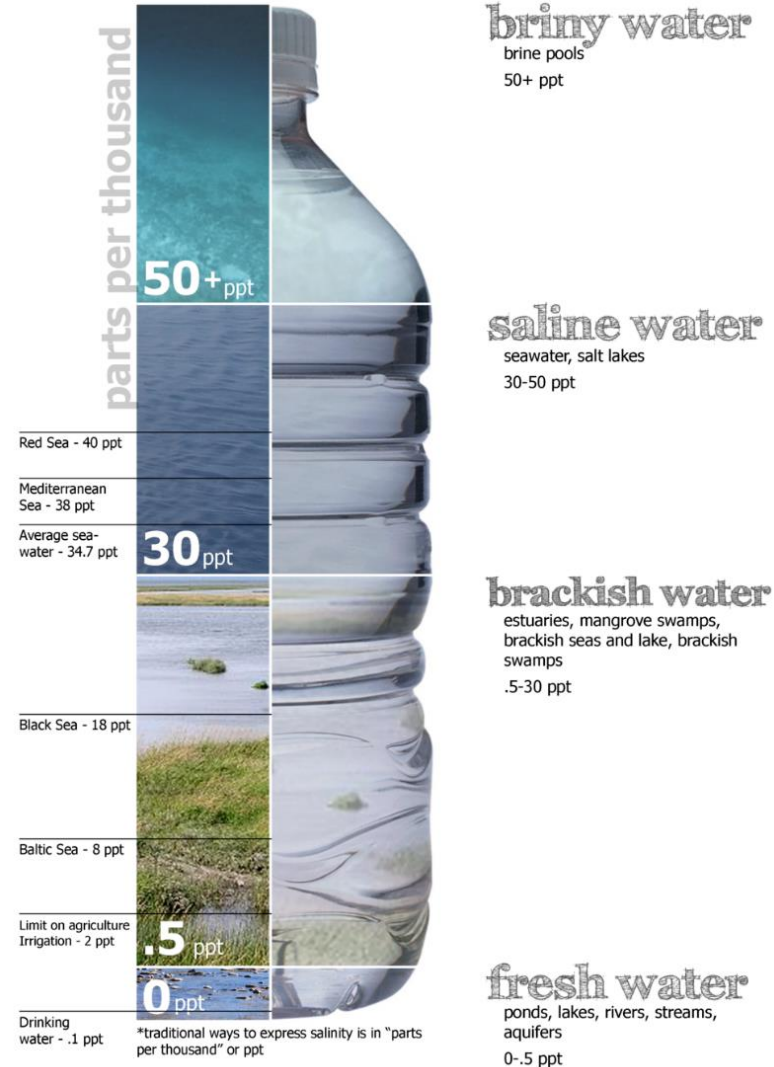
- Estuaries, Mangrove Swamps, Certain Lakes
- .5-30 ppt

Saline Water

- Seawater, Salt Lakes
- 30-50 ppt

A Graphic Comparison

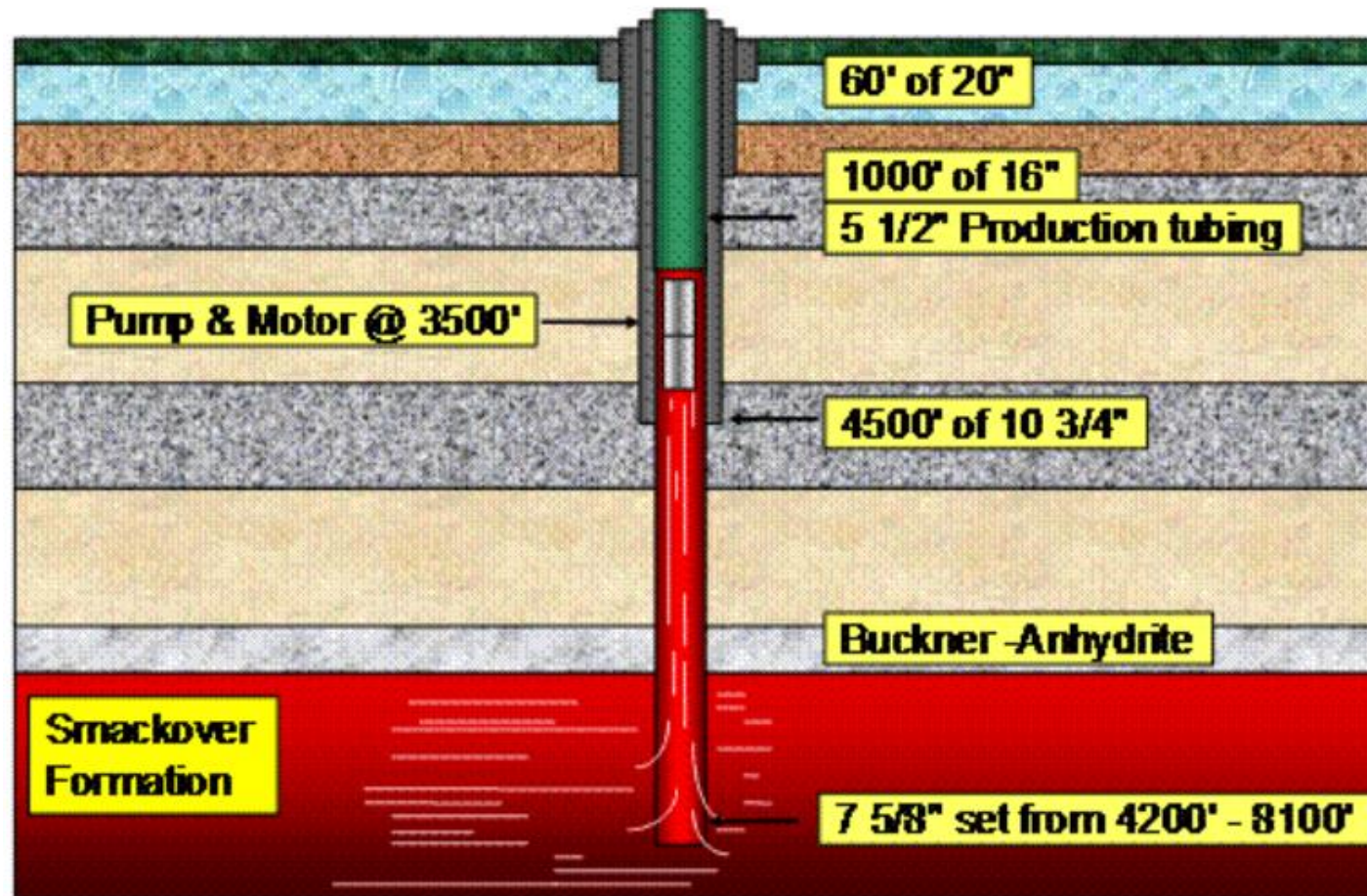
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How Does It Come Out of the Ground?

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Typical Brine Production Well



What's On Top?

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AUSTIN | DALLAS | FORT WORTH | HOUSTON | SAN ANGELO | SAN ANTONIO | JW.com



What is in it?

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**BROMINE, MAGNESIUM, POTASSIUM,
LITHIUM, CHLORINE,
IODINE, CALCIUM, STRONTIUM, SODIUM,
SULFUR, BARIUM**

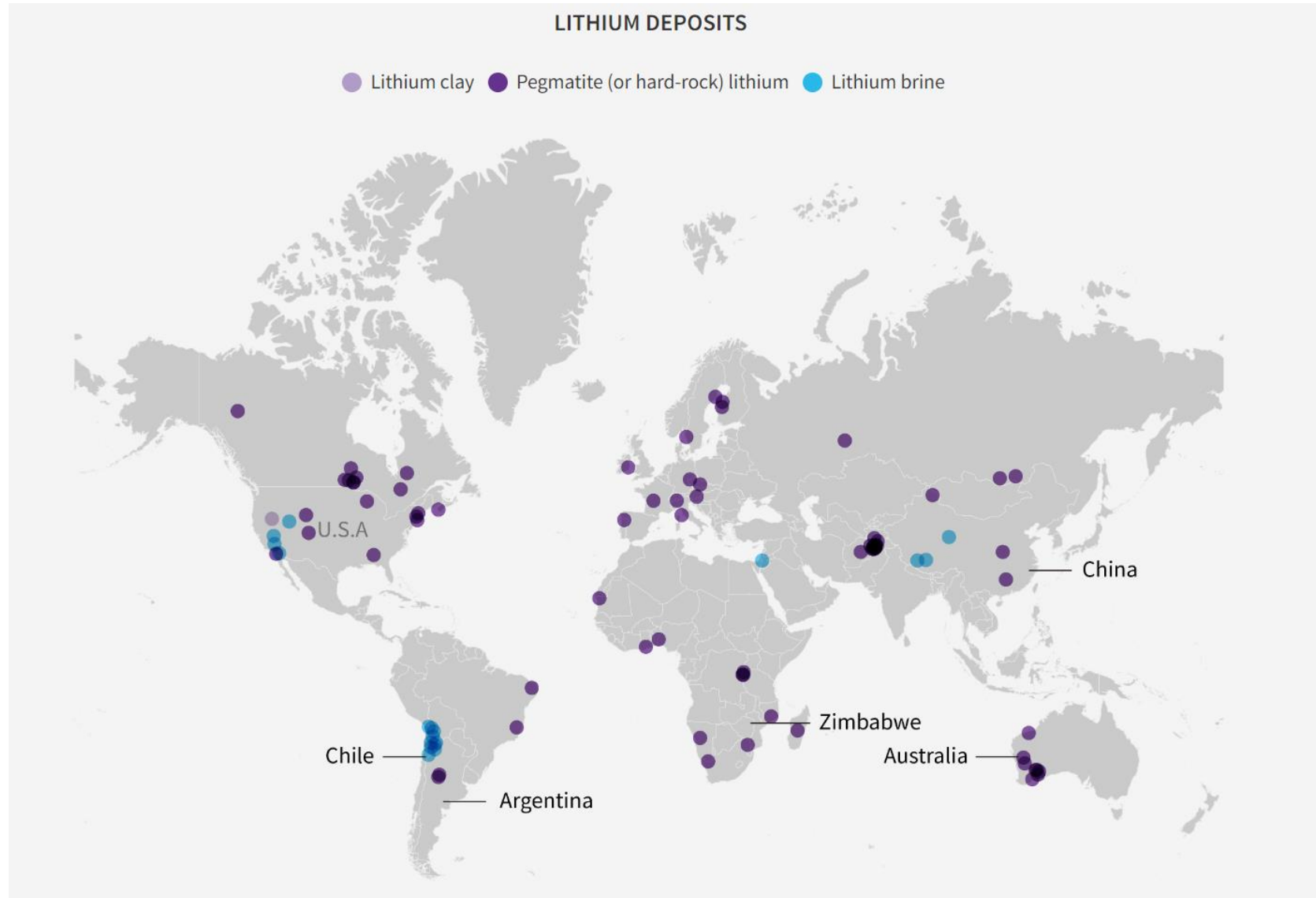
Chasing White Gold – Companies in USA

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Lithium Mines Across USA

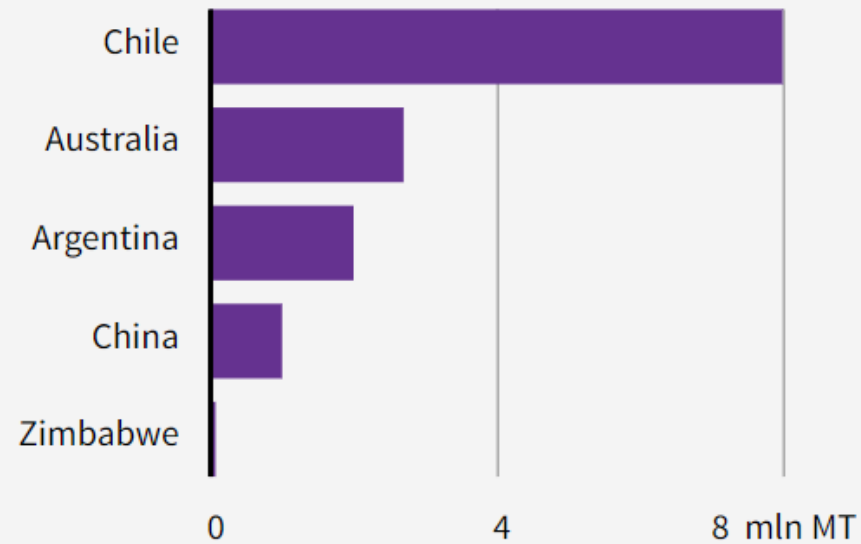
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Game of Mines
Reuters, 2019

Lithium Production Globally

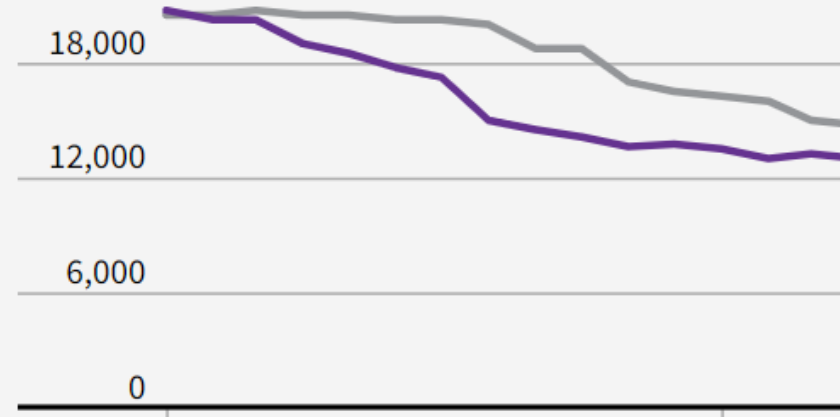
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PRICE

— Lithium carbonate — Lithium hydroxide

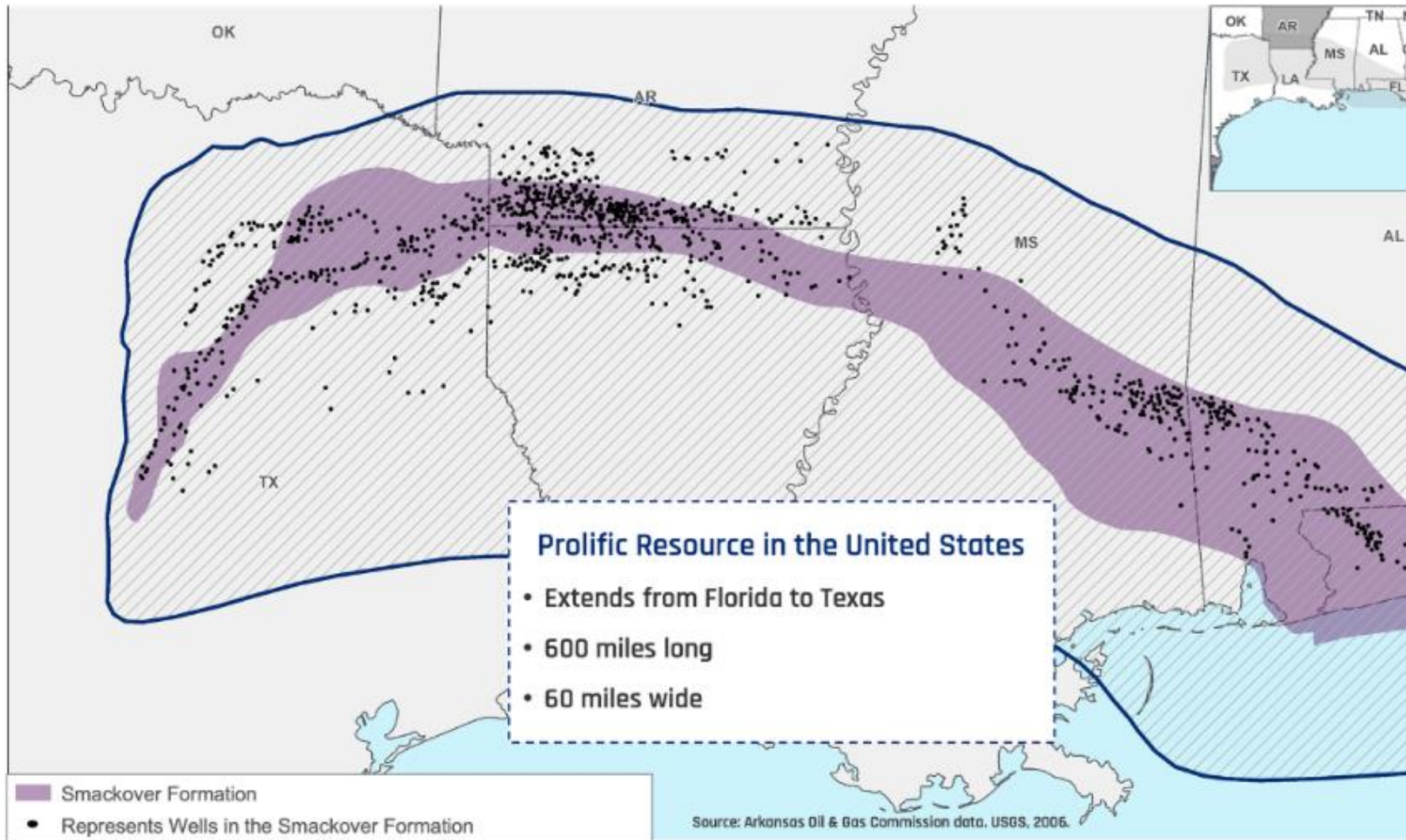
\$24,000 per MT



Game of Mines
Reuters, 2019

Smackover Formation

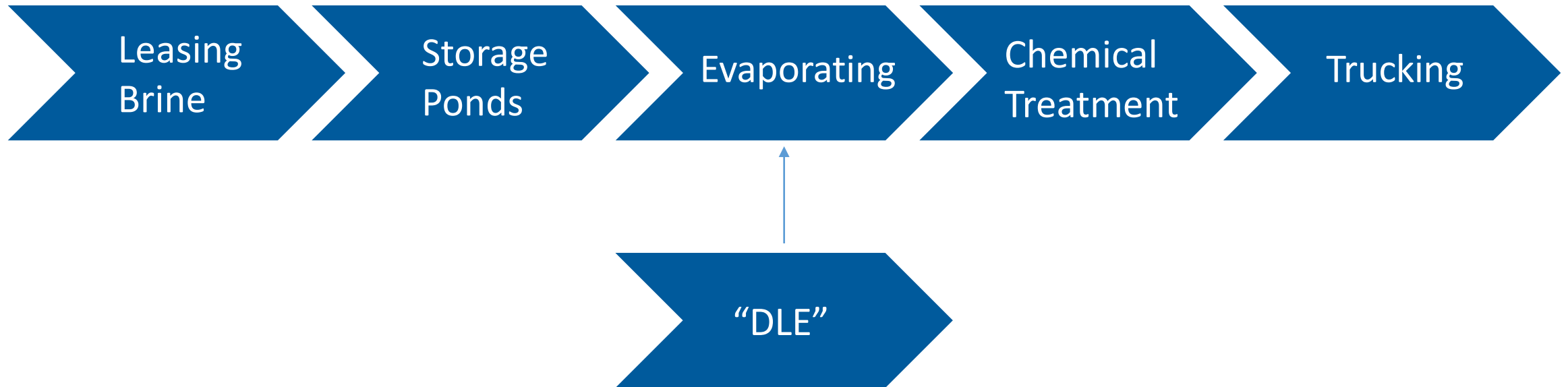
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**Arkansas Oil
and Gas
Commission**

The Lithium Extraction Process

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Evaporation v. DLE

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Evaporation (Ponds)

- Large Volumes of Brine Placed into Ponds
- 12-18 Month Process
- Treated with Calcium Hydroxide and Sodium Carbonate

Direct Lithium Extraction (Plant)

- Placed into Processing Facility
- Lithium Absorbed Using Material in Matter of Hours
- Washed with Hydrochloric Acid

Direct Lithium Extraction Plant

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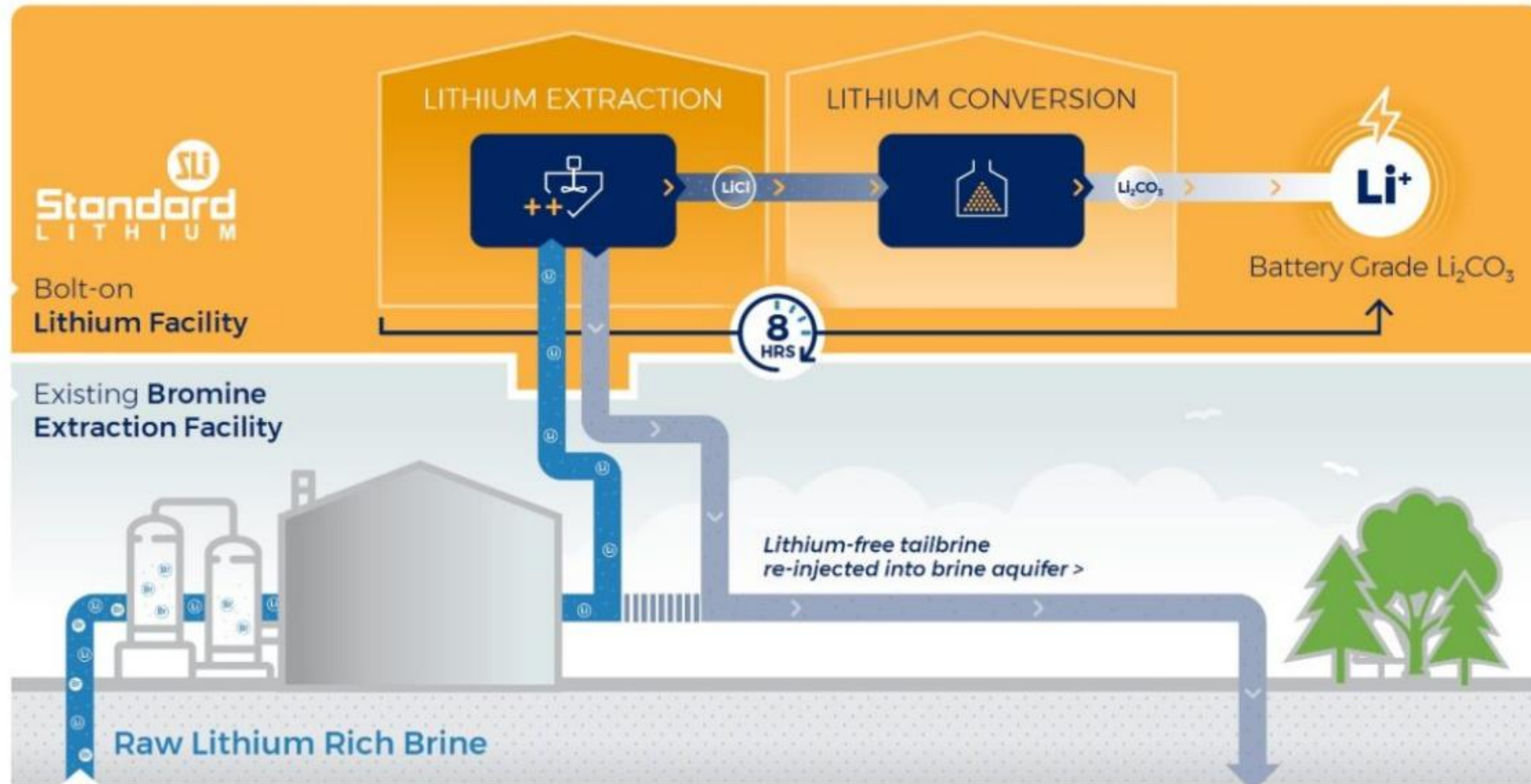


The LiSTR direct lithium extraction facility has been installed at LANXESS' South Plant facility near El Dorado, Arkansas, pictured here. *(Image courtesy of Standard Lithium).*

Direct Lithium Extraction Process

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Direct Lithium Extraction Process



Evaporation

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The Numbers

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- Case Study: Standard Lithium's "SWA Project"
 - 15 Miles West of Magnolia, Arkansas
 - 36,000 Acres
 - Operating Costs of \$4,073 per tonne
 - 1.4 million tonnes estimated reserves
 - 30,000 tonnes produced annually
 - Lithium concentration of 437 milligrams per liter
- Why is this so significant?
 - March 2023 test of Cass County, Texas brine showed lithium concentrate of 634 mg/L.

The Numbers

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Location	Lithium concentration	Source
Ocean	0.17 mg/L	Seawater
Clayton Valley, Nevada	300 mg/L (0.30 g/L)	Shallow brine beneath dry lake
Cornwall, United Kingdom	220 mg/L (0.22 g/L)	Geothermal waters
Paradox Basin, Utah	142 mg/L (0.142 g/L)	Brine at depth (Cane Creek well)
Salar de Olaroz mine, Argentina	690 mg/L (0.69 g/L)	Shallow brine beneath dry lake
Salton Sea, California	170 mg/L (0.17 g/L)	Geothermal brine

Who Owns the Brine?

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- Texas: Brine produced from oil and gas operations remains a part of the surface estate, but is available for reasonable use by an operator for the purpose of developing the mineral estate. *Robinson v. Robbins Petroleum Corp.*, 501 S.W.2d 865 (Tex. 1973).
 - Operator took produced brine from one mineral lease and used it to waterflood entire unit.
 - Court held use of brine elsewhere was unreasonable use of “surface owner’s estate.”

Who Owns the Brine?

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- Arkansas: Brine is an attribute of the mineral estate. ARK. CODE ANN. § 15-56-301 (2018).
 - “[M]ineral” as used herein shall include oil, gas...and salt water[.]”

Who Owns the Elements in the Brine?

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- Texas: Unresolved.
 - Technically, the water and solutes in brine are minerals (aka a naturally occurring inorganic substance).
 - Texas courts specifically excluded “water” from a grant of “all other minerals”. *Fleming Foundation v. Texaco, Inc.*, 337 S.W.2d 846 (Tex. Civ. App. 1960).
 - Follows the “ordinary and natural meaning test” for mineral severances post-1983 but surface destruction test pre-1983. *Moser v. United States Steel Corp.*, 676 S.W.2d 99 (Tex. 1984).

Who Owns the Elements in the Brine?

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- Arkansas: Probably the mineral owner.
 - The word “mineral” as used herein shall include oil, gas...and salt water whose naturally dissolved components or solutes are used as a source of raw materials for bromine and other products derived therefrom in bromine production. ARK. CODE ANN. § 15-56-301 (2018).
 - Subject to this weird case: *Missouri Pac. R. Co. v. Strohacker*, 202 Ark. 645, 152 S.W.2d 557 (1941).

So Who Do We Lease in Texas?

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- Answer: Right now, both surface and minerals.
 - Until Lithium is determined to be a mineral, it does not get the benefit of the “dominant estate.”
 - Thus, a company developing Brine in Texas needs the imprimatur of the surface owner in order to produce Brine and extract lithium.
- Can attack this one of two ways:
 - Enter into SUA with surface owner; or
 - Lease surface owner that includes payment for Brine and stipulation that mineral owner owns constituent elements.

The Brine Lease – The Lease Itself

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- Granting Clause

- Magic Words: “demise, lease, and let”
- Purpose: extracting subterranean salt water and all other constituent minerals and elements including but not limited to lithium, etc. produced with or extracted therefrom from strata beneath the land by any lawful method.
- Ingress/Egress/Transportation/Processing/Storage.

The Brine Lease – The Lease Itself

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- Rental Clause
 - Rent. “Rent” shall be paid to the owners of the surface as follows:
 - i. During the Development Term, \$__.00 per acre, per year;
 - ii. During the Primary Term, \$__.00 per acre, per year;
 - iii. During the Secondary Term, \$__.00 per acre, per year.

The Brine Lease – The Lease Itself

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- Royalty Clause*
 - Royalty. “Royalty” shall be paid to the owners of the constituent elements and minerals as follows:
 - On constituent elements and minerals including but not limited to bromine, salt, lithium, calcium, iodine, magnesium, and potassium, 3/16ths of the market value at the well of all constituent elements and minerals produced, saved, and marketed by Lessee to those persons entitled thereto.
 - *Major difference between Arkansas and Texas

The Brine Lease – The Lease Itself

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- Misc. Clauses

- Right of Re-entry: the right to re-enter abandon oil and gas wells.
- Unitization and Pooling: broad right to unitize and pool.
- Right to Test: right to test all water wells.
- Incidental Oil and Gas Production: right to pay royalty, or in the alternative, deliver to oil and gas lessee if land is leased.
- Proportionate Reduction Clause: NPRIs, conveyances, etc.
- Express Consent to Farmout: right to Farmout acreage from lessee in odd scenario that OGML covers brine.

Regulatory & Legislative Issues

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- **HB 1318/SB 1186:** Established RRC Authority over Brine Production Wells and give framework for RRC to seek primacy over Class V injection wells.
- **Chapter 122 Natural Resources Code:** Transfers rights to brine and “other mineralized substances” (aka “fluid oil and gas waste”) if acquired for beneficial use.
- **SB 785/HB 1336:** Established geothermal energy owned by surface owner but does not include “minerals dissolved or otherwise contained in groundwater.”

Takeaways

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- Brine production for lithium extraction is about to be big business in Texas.
- Produced water, when no longer recycled for drilling and completions, will likely be a valuable source of lithium.
- Desperately needs a legislative solution.
- For now, lease both surface and minerals with an agreement between the two.
- Texas lease structures do and will continue to look different than Arkansas.

- “Arkansas’ Brine Production Business: How You Make Something from Less Than Nothing.” Thomas A. Daily.
- “One Man’s Trash is His Community’s Treasure: Ownership and Uses of Produced Brine.” Stephan Owings.
- “California Dreaming.” Forthcoming, Rod Wetsel.
- “Element Three: Is Producing Brine to Extract Lithium the New Gold Rush?” Forthcoming, Reagan Marble.
- *Cactus Water v. COG Operating, LLC* (holding produced water included in OGML grant and properly classified as oil and gas waste).

Questions?



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