

THE ARCHIMEDES SCREW

Pumped-Hydro Batteries to Restore the Great Basin — A Concept Brief

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A NOTE FROM THE AUTHOR

In 2020 I gave a TEDx talk called “Using Ancient Technologies to Terraform the Earth, First.” The room loved it. TEDx never published it, and never told me why — so I’m publishing the idea myself, because the Great Salt Lake can’t wait for permission. This brief puts numbers to the vision. They are order-of-magnitude, honestly labeled, and ready to be refined by the feasibility study this paper asks for.

1. THE PROBLEM

The Great Salt Lake ended the 2025 water year at 4,191.1 feet — the third-lowest level since 1903, six to seven feet below the 4,198-foot minimum healthy level identified by Utah’s 2026 Strike Team report. The lake holds 29.7% of its natural volume. More than 1,227 square miles of lakebed — over 57% of the lake’s footprint — sits exposed. To recover by 2055, the lake needs roughly 800,000 acre-feet of additional inflow every year.

What’s at stake: a \$2.5 billion-per-year economy supporting 9,000 jobs — mineral extraction, a brine shrimp industry supplying about 40% of the world’s *Artemia* (\$40.1 million in direct output, 574 jobs), and recreation (\$44.5 million in direct spending, 615 jobs). And 2.5 million Utahns live downwind of the exposed playa, facing toxic dust with estimated health costs of \$6.6–22.3 million per year.

Owens Lake, California, is the warning. Drained by the Los Angeles Aqueduct starting in 1913 and dry by 1926, it became the largest human-caused source of PM10 dust in America — at one point 100 times federal standards. The Los Angeles Department of Water and Power has spent over \$2.5 billion on dust control there since 2000, and still uses some 60,000 acre-feet of water per year — roughly a city’s worth — just to keep the dust down. That is the bill for letting a saline lake die. Utah is watching the same bill come due.

Meanwhile the grid has the mirror-image problem. The U.S. Department of Energy estimates 225–460 gigawatts of long-duration energy storage will be needed by 2050 — a roughly \$330 billion market. Pumped-hydro storage is 93% of America’s utility-scale storage today. It is proven technology, not an experiment.

2. THE CONCEPT

The Archimedes Screw is a chain of roughly ten pumped-hydro installations running from the California coast, up over the Sierra Nevada at Donner Summit (7,239 ft), along the I-80 corridor — some 735 miles — into the Great Basin, with its final stop at the Great Salt Lake.

The water is seawater, pumped directly from the Pacific — and conveyed unchanged: no treatment, no desalination in transit. The destination lakes receive real seawater. That single choice dissolves the hardest problems. Seawater is not subject to prior appropriation, interstate compacts, or closed-basin rules — nobody owns the ocean. And the destination lakes are already saline — the Great Salt Lake runs 12–18% salt against seawater's 3.5% — so seawater doesn't just refill them; it dilutes the south arm back toward the 12–16% range its brine shrimp and bird food webs need. Seawater pumped storage is proven: Japan's Okinawa Yanbaru plant (30 MW) operated from 1999 using fiber-reinforced plastic penstocks, stainless-steel turbines, and lined reservoirs. Corrosion is a priced engineering line item, not a mystery.

Each installation is a battery made of water: pump uphill into a staging reservoir when renewable energy is surplus — power that is curtailed and thrown away today — and discharge downhill through turbines when the grid needs it. Past Donner, the corridor runs effectively downhill all the way to the lake: Reno sits at ~4,505 ft, the lake at ~4,191 ft.

Here is the elegant part. Nearly every dried saline lake in the Great Basin sits beside a small ridge where an upper reservoir could be placed. As water moves east through the chain, each lake gets recharged in turn — Owens, Walker (down 181 feet since 1882, 90% of its volume gone, no fish since 2009), the Carson and Humboldt sinks, Sevier Lake — and finally the Great Salt Lake. Energy storage and ecological restoration, in the same infrastructure. The region gets its water back while continuing to use the freshwater it depends on.

3. BY THE NUMBERS — AN ILLUSTRATIVE SCENARIO

These are back-of-envelope figures to establish that the idea is in the right order of magnitude — not a proposal. A feasibility study refines them.

- **Storage:** 10 installations × 1 gigawatt × 12 hours = 120 gigawatt-hours of long-duration storage — five times the largest pumped-storage plant in the United States (Bath County, Virginia: 3,003 MW / 24 GWh).
- **Water:** conveying roughly 1.5 million acre-feet per year — on the order of the Central Arizona Project's annual delivery, and nearly twice the Great Salt Lake's 800,000 acre-foot annual deficit.
- **Reservoirs are modest:** each installation needs roughly 7,300 acre-feet of working storage — small by Western water-project standards.
- **Lifting that water over the Sierra** takes on the order of 12 terawatt-hours per year — drawn from renewable surplus that would otherwise be curtailed.
- **Program cost:** on the order of \$25–45 billion (benchmark: Australia's Snowy 2.0, 2.2 GW / 350 GWh, budgeted at ~US\$8 billion). A Hoover-Dam-class national project, with a 50-to-80-year design life.

4. JOBS AND NEW INDUSTRIES

This is where the project stops being an environmental rescue and becomes an economic engine.

Construction employment. Heavy civil construction supports 13,000 to 28,500 jobs per \$1 billion invested (White House Council of Economic Advisers; Associated General Contractors). A ~\$30 billion build therefore represents roughly 400,000 to 850,000 job-years of employment — a multi-decade program across California, Nevada, and Utah. For scale, Snowy 2.0 directly employs 4,000 to 5,200 workers on a single A\$12 billion project.

Permanent operations. Pumped-hydro plants run for generations. At the industry benchmark of \$30/kW/year in fixed O&M, a 10-gigawatt chain represents about \$300 million per year in ongoing operations spending — operators, maintenance crews, engineers, and support staff anchored in rural counties for half a century or more.

Pump-turbine manufacturing. A project of this scale reindustrializes American hydro manufacturing. Voith Hydro's plant in York, Pennsylvania — 135-plus years of U.S. manufacturing, home to North America's only hydraulic test laboratory for hydro machinery — is already retooling for pumped-storage machines under federal incentives. Dozens of domestic suppliers (steel, penstocks, valves, controls, tunneling) follow the anchor orders.

Grid services. The chain is a revenue-generating battery inside a \$330 billion long-duration storage market — capacity payments, arbitrage, and ancillary services repay the investment while the water does its ecological work.

Desalination at the point of use. The cheapest place to desalinate is at the lakes, not the coast — for three reasons. First, the lift is already paid for: the water was pumped uphill to store energy, and grid revenues amortize the conveyance, so freshwater production rides on infrastructure that pays for itself. Second, brine disposal — one of the largest costs and permitting burdens of coastal desalination — drops to near zero, because the brine goes into already-hypersaline lakes instead of through regulated ocean outfalls. Third, power is on site: the turbines generate electricity on every discharge, and reverse osmosis needs only about 3–4 kWh per cubic meter. Desalinating 150,000 acre-feet a year — enough for roughly 300,000 households — takes about 0.65 terawatt-hours: a rounding error next to the chain's roughly 44 terawatt-hours of annual storage throughput.

Brine minerals and lithium. A living Great Salt Lake is a mineral asset. Compass Minerals has identified approximately 2.4 million metric tons of lithium-carbonate equivalent in its Ogden brines, and EnergyX's 2026 agreement targets a 30,000-ton-per-year direct-lithium-extraction facility — a ~\$400 million investment supporting ~200 jobs, with no incremental lake withdrawal. Restoration protects a domestic lithium supply chain.

Dust-health savings. Every dry lakebed avoided is a dust-mitigation bill never sent. Owens Lake cost \$2.5 billion-plus; the Great Salt Lake's dust threatens \$6.6–22.3 million per year in health costs alone.

Recreation and tourism. The \$44.5 million, 615-job recreation economy at risk around the Great Salt Lake is the floor, not the ceiling — restored lakes create restored economies. Walker Lake's fishery died in 2009. It can come back.

Engineering exports. The firms that learn to build water-moving energy storage at continental scale will sell it to the world. Every drying saline lake on Earth — the Aral Sea, Lake Urmia, the Dead Sea — is a future customer for American engineering.

Inland marine aquaculture. The reservoirs and refilled lakes hold seawater hundreds of miles from the coast — the basis for marine fish and shrimp farming far inland. The United States imports the vast majority of its seafood, and coastal aquaculture permitting has stalled domestic production for decades; inland marine aquaculture sidesteps that bottleneck entirely, and desert marine farming (Israel's Negev) plus Asia's inland shrimp industry prove the biology works. It is a phase-two opportunity with real caveats — working reservoirs fluctuate with pump and generation cycles, and biosecurity must be managed — but the water, the salt, and the rural jobs are already there.

5. HONEST OPEN QUESTIONS

A serious proposal names what it hasn't solved. Specifying seawater intake resolves the water-rights obstacle — but ocean intake design (marine-life protection, following California's Carlsbad precedent), corrosion-resistant materials at gigawatt scale, and per-lake salt mass balance modeled over decades (terminal lakes have no outlet; evaporation leaves salt behind) remain genuine engineering work for the study.

6. THE ASK

Fund a federal-state feasibility study. The institutional pieces are falling into place: Utah has a dedicated Great Salt Lake Commissioner (Brian Steed, appointed 2023); the Bureau of Reclamation directed \$50 million toward lake transactions and restoration in 2025; Utah secured a \$60 million federal land agreement for the lake in September 2026; and a \$1.0 billion FY2027 Interior Department request for comprehensive restoration is on the table. The momentum exists. This is the bold option to put on it.

Contact: zachmoses.com — “Using Ancient Technologies to Terraform the Earth, First” (TEDx 2020), now public on YouTube.

SOURCES & NOTES (selected)

Great Salt Lake status and deficit: 2026 Great Salt Lake Strike Team report via Grow the Flow (growtheflowutah.org, Jan 2026); Utah Business (Jan 9, 2026). Economic stakes: Lake Powell Chronicle (2023); ECONorthwest & Martin & Nicholson (2019) via Marketplace (Sept 2023); ECONorthwest “Potential Costs of Declining Water Levels” (Jan 2021). Owens Lake costs: LADWP News (2014; ~2022). Walker Lake: USGS; Sierra Nevada Ally (June 2024). Pumped-hydro costs: International Forum on Pumped Storage Hydropower capabilities & costs (Sept 2024); Snowy 2.0 via WAMC (Dec 2025). Job multipliers: White House CEA via Marketplace (2014); AGC via Multifamily Executive. Lithium: Compass Minerals; EnergyX investor news (May 2026). Storage market: U.S. DOE via pv-magazine-usa.com (June 2023). Federal funding: Bureau of Reclamation press release (Oct 2025); EIN News (Sept 2026); CRS Report R48928 (Apr 2026). Water law: Deseret News (Feb 2024); Gov. Cox proclamation closing GSL basin (2022). Engineering figures in Section 3 are the author's order-of-magnitude calculations ($E = pghV$, 80% round-trip efficiency) — illustrative, not a proposal.