Building a Domestic Lithium Supply Chain

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Summary Points

The degree to which the U.S. lithium battery supply chain relies on foreign imports poses a threat to U.S. national and economic security.

California's efforts to support lithium extraction from geothermal facilities and attract other steps of this supply chain is one piece of a broader national effort to "onshore" lithium battery manufacturing.

If California can successfully build "Lithium Valley," there will be an opportunity to ensure that this new supply chain is environmentally sustainable and produces real economic opportunities for marginalized communities.

Global Lithium Supplies

Lithium is a naturally occurring silvery-white metal used in most rechargeable batteries, including those found in battery electric vehicles and grid-scale energy storage technologies. As demand for these applications has grown, so has global consumption of lithium. Between 2007 and 2022, global lithium consumption increased by more than 500%. Demand for lithium is expected to keep increasing at an accelerated pace, driven in large part by the growing demand for electric vehicles.

At present, less than 1% of the world's lithium is mined in the United States. Most lithium is mined in Australia (47%), Chile (30%), and China (15%). Lithium must be refined before it can be used in rechargeable batteries. China controls the majority of the world's lithium refining (60-70%) and battery manufacturing capacity (75%). The U.S. has virtually no refining capacity and only 7% of the battery manufacturing capacity.

The degree to which these clean energy technologies rely on foreign imports—particularly from one with whom the U.S. has strained trade relations—poses a threat to U.S. national and economic security.

Lithium Battery Supply Chain

Mining
Critical minerals necessary for lithium-ion batteries are extracted, including lithium, nickel, cobalt, manganese, and graphite.

Refining & Processing
Impurities are removed from the minerals. Minerals may be converted to chemical intermediates (like lithium hydroxide).

Battery Cell Production
Minerals are used to create battery cell components, including anodes and cathodes.

Battery Packs Assembled
Individual battery cells are combined into battery packs.

End Products
Batteries are integrated into end products, like electric vehicles or laptops.

Reuse & Recycling
Batteries are reused and/or materials are recovered.

Disaster Resilience

Ongoing, complex, and intersecting disasters—including climate change, extreme heat, power outages, and the COVID-19 pandemic—are radically disrupting the ways in which Californians live and work. CCST is committed to delivering science and technology advice to improve our resilience to disasters, reduce harm, and improve the lives of all Californians.

Select Experts

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Towards a Domestic Lithium Supply Chain

In response to these supply chain vulnerabilities, the Bipartisan Infrastructure Law provided more than $7 billion in incentives to support domestic battery supply chains and manufacturing. In 2022, the U.S. Department of Energy created **Li-Bridge**—a public-private alliance charged with developing recommendations that, if implemented, would facilitate a "robust and secure domestic supply chain for lithium-based batteries."

According to Li-Bridge, the U.S. must 1) improve the attractiveness of investing in domestic battery technology and material production; 2) support research and accelerate commercialization of battery innovations; 3) help U.S. companies secure critical minerals and energy materials (including lithium, but also other minerals required for lithium-ion batteries, like cobalt and manganese); 4) invest in workforce training; and 5) support a long-term formal public-private partnership in support of a domestic lithium battery supply chain.

Li-Bridge is coordinated by **Dr. Venkat Srinivasan** and other experts at Argonne National Laboratory.

Attracting Battery and EV Manufacturing to California

Brines of the Salton Sea Geothermal Field in southern California contain an estimated 1 to 5 million tons of dissolved lithium. If this resource can be successfully extracted at scale, it would be an important step towards reducing vulnerability in the U.S. lithium battery supply chain. It could also drive economic development in the Salton Sea region, which currently has among the highest unemployment and poverty rates in California.

Lithium extraction from these brines could generate more than $7 billion annually.

While the tax revenue this will generate for local counties is significant, lithium mining or extraction composes a relatively small share of the economic value of the lithium battery supply chain. Most of the economic value and workforce benefits are generated after minerals have been mined or extracted.

For these reasons, there is strong interest in attracting more of the supply chain to the Salton Sea region and California more generally. However, there are numerous challenges that must be overcome if California is to be successful in this endeavor.

Dr. Chris Benner at UC Santa Cruz is part of a team that is examining California's strengths and weaknesses in attracting manufacturing facilities to the State. Their upcoming report on this topic discusses a series of recommendations that will help California develop a "high road" lithium industry—one that is environmentally sustainable and produces real economic opportunities for marginalized communities.

Building Lithium Valley

Closer to the ground, there are other challenges to supporting a novel industry in the Salton Sea region, not least of which are the region's socioeconomic and environmental challenges. Infrastructure must be in place to support this new industry; for example, some existing bridges are currently incapable of supporting the weight of heavy duty trucks.

Much like many other rural communities in California and the United States more broadly, communities near the Salton Sea have poor access to healthcare due to a scarcity of healthcare facilities. Incoming workforces will place even greater strain on this system.

John McMillan at San Diego State University is convening a team with representatives from nearly 40 different organizations across Southern California and Western Arizona that is considering how to create a localized, environmentally responsible ecosystem of mineral extraction, battery manufacturing, and utilization.

Reducing the Impact of Lithium Battery Supply Chains

Direct lithium extraction from geothermal brines will be among the most environmentally friendly methods to produce lithium and can help "green" the lithium battery supply chain. However, lithium extraction could still negatively impact nearby communities.

For example, more trucks in the area will generate more dust—exacerbating the region's already high rates of asthma caused by the receding Salton Sea. In addition, lithium batteries require other critical minerals that have their own environmental and social consequences.

Dr. Alissa Kendall's research at UC Davis examines the broader consequences of scaling the electric vehicle industry, how these impacts can be reduced, and how other methods of decarbonizing transportation should fit into California's portfolio for an environmentally just clean energy future.

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