

**Thesis Project Portfolio**

**Design of a Processing Plant for Direct Lithium Extraction from Geothermal Brine in the  
Salton Sea Region**

(Technical Report)

**Using the Social Construction of Technology to Study the Effect of Political Strife in Bolivia  
on their Domestic Production and Export of Lithium**

(STS Research Paper)

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## Executive Summary

Industrial processes have employed fossil fuels as a source of energy to promote production since roughly the 18th century. The emissions from these fuel sources have led to human-induced climate change and, consequently, continually increasing support for renewable energy. Occasionally, the methods used to support the renewable energy transition juxtapose the message behind sustainability. Global electrification to minimize fossil fuel dependence is one such example where the processes used to gather the materials needed for such an application sometimes defeat the idea of sustainable conservation. Lithium extraction is a relevant example of a process that obtains a mineral for sustainable efforts but simultaneously uses mass amounts of energy and resources. The technical research report, *Lithium Extraction from Geothermal Brines in the Salton Sea Region of Southern California*, details a process that attempts to extract lithium with less of a global footprint than methods currently used. The technical process discussed would also minimize the need for the US to import lithium, which is often obtained in countries who experience exploitation and social injustice because of their resource reserves. Due to the humanitarian issues behind lithium extraction and distribution, the socio-technical research report focuses on lithium extraction and exportation in Bolivia. Bolivia holds more lithium than any other nation, but they were responsible for less than a percent of lithium exports worldwide as recently as 2022. The socio technical report discusses possible reasons regarding the treatment of different social groups in Bolivia in relation to resource development over the years and how that may affect their exportation statistics. Both the technical and sociotechnical research detailed in this report are connected due to the fact that one of the primary reasons to conduct a project on lithium extraction from geothermal brine is to decrease the chance that the

US will import lithium from countries such as Bolivia that struggle with social justice issues as a result of the variety of resources they hold in a large supply.

The technical work in this paper employs several unit operations, known as adsorption and regeneration, electro dialysis, and crystallization, to extract lithium from geothermal brine. When brine flows into the adsorption unit, lithium ions adsorb onto the sorbent within the beds. Lithium ions are desorbed from the sorbent using a regeneration solution that accepts the transfer of one electron from the sorbent and, consequently, promotes the removal of lithium. The solution concentrated with lithium ions is delivered to electro dialysis where voltage drives ionic movement and generates aqueous lithium hydroxide. Following, aqueous lithium hydroxide is filtered, purified, and dried in the crystallization unit to form lithium hydroxide monohydrate that is pure enough for usage in batteries. Lithium hydroxide monohydrate is highly needed for battery development and production in the renewable energy transition. The technical processing plant discussed was deemed as economically viable, with a 163% annual return on investment and net present value of almost \$2.7 billion USD.

The socio-technical section of this study asks, “How have political differences and strife between varying social groups within and related to Bolivia affected their lithium production, export success, and foreign relationships in the 20-21st century?”. The chosen social groups and their experiences relating to the study are reviewed using the Social Construction of Technology (SCOT) framework, which supports the idea that societal change is promoted by humans but can be inspired and helped by technology. The technology in question, lithium, cannot lead to change by itself. However, the perceptions and opinions in the chosen social groups have likely affected the lithium industry in Bolivia. Therefore, historical analysis was used to gather data relating to

the experiences in each of these social groups in hopes to hypothesize why there is minimal lithium production and exportation in a nation with a copious supply of “white gold”.

Since the 1500s, the area that Bolivia now resides in has been coveted for their resources. Initially, the Spanish forced indigenous peoples into servitude in the 16th century to gather silver. Fast-forwarding through decades of civil war and revolution in Bolivia, social injustice and resource exploitation concerns are still observed today. Stemming from this and the continual discovery of several precious resources in the area of Bolivia, including tin, natural gas, and lithium, resource nationalism is one of the biggest themes in indigenous and working class social groups. Research supports the idea that many Bolivian citizens fear that encouraging the development of lithium production and exportation in their country will lead to further abuse by unreliable leaders and foreign nations. However, some indigenous communities and working class individuals hope that their supply of lithium will support their economy.

Bolivia is one example of a country that has been continually abused by foreign nations hunting for resources in an inexpensive fashion. The technical process described above is motivated by the need to stop sourcing highly demanded resources, including lithium, in areas where profit is prioritized over people, and thus proves the inevitable relationship between the technical and socio-technical topics discussed in this research.