Environment of the Salton Sea

Lithium and the Salton Sea

Author: Sumaya Troy Alaama
Center for Health Disparities Research
University of California, Riverside

Abstract

As lithium increasingly powers modern technologies like rechargeable batteries, the exploration of geothermal brines emerges as a promising avenue for domestic lithium production. The Salton Sea Geothermal Field (SSGF), recognized as a significant geothermal electricity producer, presents unique challenges due to the high salinity of its brines, necessitating innovative solutions for scaling and corrosion. However, recent developments, including the entry of Controlled Thermal Resources and investments by CalEnergy, signal a shift in leveraging the SSGF's geothermal resources to include lithium extraction. By capitalizing on the growing demand for lithium, the SSGF emerges as a potential major player in advancing renewable energy adoption and fostering a sustainable, low-carbon future.

Introduction

Have you ever wondered what comprises the battery that powers your phone? Depending on the type of phone you have, it very well could be a lithium battery! Lithium is a soft, light metal found in rocks and subsurface fluids called brines. It is a relatively rare metal, is critical for rechargeable batteries, and has been deemed a material essential for the economic and national security of the United States. Researchers have been exploring how geothermal brines may be a critical resource for future lithium supply, especially as the United States is trying to reduce carbon emissions and reach renewable energy targets.

California has some of the most aggressive greenhouse gas (GHG) mitigation and renewable energy generation targets in the world and will likely mandate even more ambitious goals on both fronts. Reductions in emissions and increased use of renewable energy will be required across multiple sectors to achieve these goals. Geothermal electric power production from the Salton Sea Geothermal Field (SSGF) is one source of renewable energy that will help California meet its targets. Potential production of lithium from the SSGF geothermal brines can also reduce import reliance and lower the costs of manufacturing batteries for electrical vehicles and devices, furthering the goals of the state and nation. In 2020 California Assembly Bill 1657 established a Commission on Lithium Extraction in California to review, investigate, and analyze certain issues and potential incentives regarding lithium extraction and use in California.

The Salton Sea Geothermal Field

The Salton Sea Geothermal Field (SSGF), located at the southeast edge of the Sea, is the second largest geothermal electricity producer in the state. A recent estimate of the SSGF's geothermal reserves indicates that this reservoir has very large geothermal reserves capable of generating 2,950 megawatts for 30 years. As the water level of the Salton Sea continues to drop, additional dry land will be exposed that is suitable for new geothermal development.

A unique feature of the SSGF's geothermal resources that has slowed its development is the unusually high salinity of the hot reservoir brines that causes corrosion and scaling. This problem was overcome at each of the power plants operating at the SSGF today by creative but expensive chemical engineering, mainly the addition of a reactor/clarifier circuit to remove solids from reinjected brines. Because of the major penetration of relatively inexpensive solar power in California in a competitive power market, new cost-effective power purchase agreements are more difficult to obtain for more costly geothermal plants at the SSGF.

Today, new developments are turning the high dissolved mineral content of the SSGF brines from a liability into a potential major asset. Recently a new geothermal operator, Controlled Thermal Resources, announced its intention to construct a new 300 MW geothermal plant utilizing new wells in the northern part of the SSGF. This expansion is promoted as being more economically feasible because of the additional revenue that will be generated at this new plant by extracting lithium, manganese, and other metals from the SSGF brines. In recent years, the market for lithium for use in lithium batteries has grown enormously. In 2020 CalEnergy, the operator of ten of the existing geothermal plants at the SSGF, announced that it will spend up to $12 million to build a pilot plant to extract lithium from the SSGF brines, supported by a $6 million grant from the California Energy Commission.

Currently, lithium is produced globally from both hard rock mineral mining (mainly in Australia and China) and the evaporation of salt-lake brines (mainly Argentina, Chile, and China, using methods that have significant detrimental impacts on the surrounding environment. The World Bank estimates that global lithium production would need to increase 500% by 2050 to meet the total demand for clean energy technologies, including electric vehicles, batteries for mobile devices, and energy storage batteries. The technology for extracting lithium from saline brines is in development, and has the potential for large scale extraction without the environmental hazards associated with more conventional methods. At scale, lithium production from the SSGF (17 to 40 ktpa) has the potential to meet the U.S.'s current demand (2 ktpa) and eliminate its import reliance, as well as supply a significant fraction of the current global production.

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