September 27, 2021

Technical Memorandum (TM) #6.1

Prepared by: Charlie Chesney, UC Santa Cruz

Reviewed by: Jean Debroux, PhD, Kennedy Jenks

Subject Area: Other Infrastructure (e.g. geothermal, hydropower, salt, lithium)

Topic: Lithium and Geothermal Resources

This Technical Memorandum (TM) was prepared as part of the Salton Sea Water Importation Proposal Review to provide information to support and reflect the Independent Review Panel's evaluation of submitted ideas to restore the Salton Sea by water importation and provide the Salton Sea Management Program (SSMP) with approaches that are feasible. Parts of this TM may be used in the Panel's Screening Report, Fatal Flaw Report, Feasibility Report, and/or Summary Report (Reports). In the event that any discrepancies are found between the Reports and this TM, the Reports shall take precedence.

1.0 Lithium Overview

Lithium is a light-weight metal used in batteries. Its demand is growing alongside increasing demand and policies associated with electric vehicles.

1.1 Global Supply & Demand

Lithium is found in rocks, clay, and brine. Most lithium is in Australia, Argentina, Chile, and China with additional developing sites in Cornwall, England, Thacker Pass, Nevada, Sonora, Mexico, and in the southern region of the Salton Sea (Early, 2020; Carleton, 2021; Croft, 2021).

The current demand is 370,000 tons per year with an expected growth to 1 million tons per year by 2025, 2 million tons per year by 2030 (Croft, 2021), and 3 million tons per year by 2050 (LVC, 2021b). The lithium demand grows with the demand for electric vehicles, which increases from 3.4 million in 2020 to 12.7 million in 2024 (Croft, 2021). This demand is partly fueled by California policy stating all new vehicles sold in the State be zero-emission by 2035 (Spagat, 2021).

1.2 Extraction Methods & Environmental Impact

There are three lithium extraction methods: hard rock mining, open pit evaporation, and direct lithium extraction from geothermal brines. Each method has different environmental impacts.

Hard rock mining mostly takes place in Australia. This method is energy intensive; raw lithium is shipped to China for processing, producing 15 tons of CO_2 per ton of lithium (Early, 2020).

Open pit evaporation occurs in South America and requires a large land area and water usage. In the Salar de Atacama salt flat in Chile, 65% of the region's water is used for lithium extraction (Croft, 2021). Open pit evaporation leads to groundwater depletion and soil contamination from hydrochloric acid, which is used in the extraction process (Deslandes, 2020).

Direct lithium extraction (DLE) from geothermal brine has been used in Argentina for 20 years, 5-10 years in China and has been proposed in the Salton Sea region (LVC, 2021c). This method uses less water and is less energy-intensive than the other methods. Lithium can be extracted from geothermal brines, which are reinjected into the earth after extraction, minimizing water loss (Croft, 2021); DLE requires about 90% less water than open pit evaporation (LVC, 2021c). Additionally, DLE requires a much smaller footprint than other extraction methods; some of the refinement process occurs within the existing geothermal power plant, meaning only an additional facility must be added to a geothermal power plant's footprint (LVC, 2021c). Due to geothermal brine heat, little power is needed in the process (LVC, 2021c). There are multiple methods of DLE, including those that use steam instead of reagents in the lithium extraction process, further reducing environmental impact of DLE (CTR, 2021).

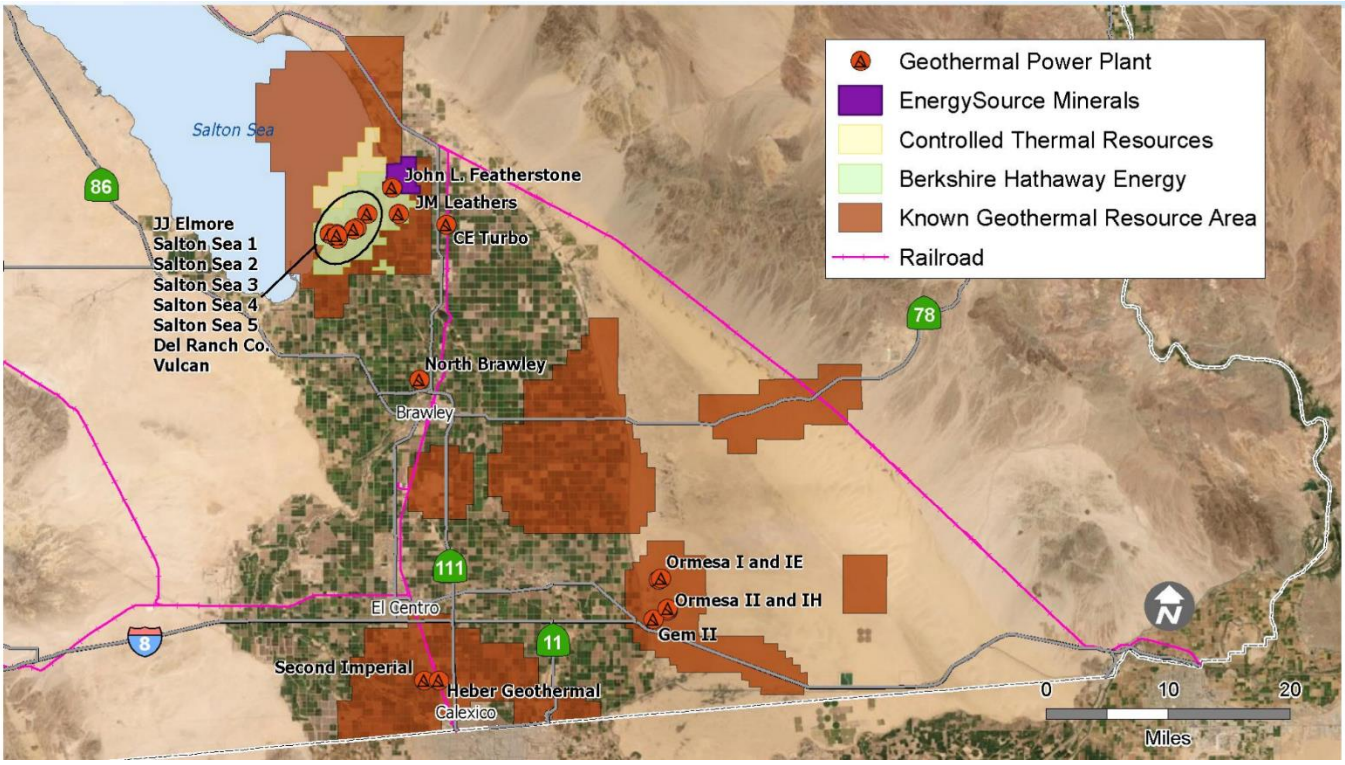
2.0 Salton Sea Context

2.1 Lithium Supply

The suspected lithium supply in the Known Geothermal Resource Area (KGRA) (Figure 1) at the southern end of the Salton Sea may be the largest lithium source in the world (Carleton, 2021). Predictions state it could supply 40% of global demand (Carleton, 2021). There is an estimated 15 million tons of lithium in the KGRA brine, at about a 250 ppm concentration (LVC, 2021d). This amounts to 600,000 tons per year worth $7.2 billion (Croft, 2021). The region is known as the Lithium Valley.

The Salton Sea lithium extraction method is DLE. The high geothermal temperature and pressure within this region keeps solids within the brine from precipitating, meaning less energy is needed to keep the brine in a liquid state (LVC, 2021c). This region also has a low pH and oxidation-reduction potential, resulting in other minerals remaining dissolved in the water and are reinjected into the earth, reducing waste (LVC, 2021c).

Figure 1. Known Geothermal Resource Areas in Imperial County, geothermal plant locations, and the ESM, CTR, and BHE lease hold regions (de Jong, 2020).



2.2 Legislation & Lithium Valley Commission

Legislation is supporting the demand for lithium. On the Federal level, the government is supporting development for a domestic lithium battery supply chain, including lithium extraction, attracting the battery industry to the U.S., supporting battery recycling, supporting research and development, and creating jobs (LVC, 2021b). There is potential for the entire lithium battery supply chain to be located within the Lithium Valley (LVC, 2021b).

California Assembly Bill 1657 mandated the State of California and the California Energy Commission (CEC) to form the Lithium Valley Commission (LVC) (LVC, 2021a). The LVC must submit a final report on October 1, 2022 that analyzes, discusses, and provides policy recommendations for the development of the lithium industry in the Lithium Valley (LVC, 2021a). The LVC meets monthly and is in early stages of this evaluation.

There are three additional bills that focus on supporting the lithium industry in the region. California SB-423 requires the CEC to assess how to merge renewable energy and zero carbon resources, increase procurement of renewables, and ways for California to become a global leader in solar and lithium development (LVC, 2021b). SB-983 establishes community workforce agreements and authorizes public

entities to utilize agreements for construction projects for battery manufacturing and lithium-based technology in the Salton Sea region (LVC, 2021b). California SB-551 created an electric vehicle authority in the California Governor's office focusing on infrastructure deployment, supporting and improving the battery supply chain, and supporting the lithium industry in the Salton Sea region (LVC, 2021b). SB-551 was not put up for a vote but may make a reappearance in a 2022 congressional session (LVC, 2021d).

2.3 Operations

No commercial-scale lithium operation currently exists in the Salton Sea region.

2.3.1. Simbol Materials

Simbol Materials was the first company to carry out a lithium extraction pilot at the Salton Sea in 2014 (Warren, 2021). After turning down Elon Musk's offer to purchase the company in 2015, they were unable to secure commercial financing and the project was ended (Warren, 2021). Simbol never released cost and performance data, so current commercial costs for the region are all estimates (Warren, 2021). The market conditions have improved since their failure to secure commercial funding (Spagat, 2021).

2.3.2. Energy Source Minerals (ATLiS)

EnergySource Minerals (ESM) will be the first commercial lithium extraction facility (known as ATLiS) in operation in the region. The ATLiS pilot was completed at the Featherstone Geothermal Plant in 2020 after 5 years of feasibility testing. They are awaiting final permits to begin construction of their commercial facility, located at Hudson Ranch 1 at the end of McDonald Rd, just north of Sonny Bono Wildlife Refuge (Energy Source Mineral, 2021; LVC, 2021c).

2.3.3. Controlled Thermal Resources (Hell's Kitchen)

The first lithium agreement in the region was finalized between General Motors (GM) and Controlled Thermal Resources (CTR) for GM to source lithium for electric vehicle batteries from CTR. The lithium will come from the Hell's Kitchen Lithium and Power Development project and will begin selling lithium to GM by 2024 (Carleton, 2021). CTR has a 7,000-acre leasehold in the northern most section of the KGRA, including areas that are currently inundated by the Salton Sea. They expect to extract 300,000 tons of lithium per year from their geothermal brine (CTR, 2021). CTR is in the final phase of permitting and awaiting financing to begin construction on Hell's Kitchen (LVC, 2021c). CTR is currently in negotiations for a second lithium offtake agreement (LVC, 2021d).

CTR has partnered with Lilac Solutions as their technology partner. Lilac Solutions is an Oakland-based start-up working in lithium extraction technology and has received investments from Bill Gates, Jeff Bezos, and Michael Bloomberg (Croft, 2021).

2.3.4. BERKSHIRE HATHAWAY ENERGY RENEWABLES

Berkshire Hathaway Energy Renewables (BHER) will begin constructing their pilot project in the fall of 2021. It will be located within an existing geothermal power plant in Calipatria, which is operated by CalEnergy Resources, LTD (BHER Minerals, LLC, 2020). The pilot project includes 2 small-scale demonstration projects, the first of which will be in operation in spring 2022 (LVC, 2021c). The pilot project is intended to de-risk prior to commercial operations (LVC, 2021c), which will begin in 2024 (Spagat, 2021). Their research has been funded through a public-private partnership where government funding has aided in the de-risking process (LVC, 2021d).

2.4 LOCAL ENVIRONMENTAL IMPACTS

BHER, ESM and CTR have yet to publicly provide exact environmental impact data, but are likely to do so at the October 2021 LVC meeting focusing on environmental impacts (LVC, 2021c). Only ESM has released a draft EIR for their ATLiS facility. The BHER demonstration project focuses on producing proof of an environmentally friendly process, thus no data of impacts yet exists, and is exempt from CEQA at this stage due to their small footprint (less than 10,000 sqft of new construction) (BHER Minerals, LLC, 2020).

Positive environmental impact discussions focus on the opportunity for the expansion of geothermal power plants, and thereby the lithium industry, to suppress dust by locating facilities on the exposed lakebed (Ventura et al, 2020). CTR, for instance, has a development master plan for the playa within their leasehold, but has yet to release it (LVC, 2021c). They are also looking to remove nonnative vegetation around their leasehold and install native plants (CTR, 2021).

Water consumption is the most commonly discussed environmental impact. The California Energy Commission requires that lithium extraction water use remain under 50,000 gallons per metric ton of lithium (Energy Source Mineral, 2021; LVC 2021c). Each lithium extraction facility may require a different amount of water per metric ton of lithium because there are many DLE technology alternatives (LVC 2021c). For example, BHER currently requires 15,000 AFY (LVC, 2021d; BHER Minerals, LLC, 2020) to produce 90,000 tonnes of lithium per year (81,600 metric tons per year) (Sanderson, 2019), or about 54,400 gallons per metric ton of lithium. ESM's ATLiS currently requires 3,400 AFY to produce 19,000 metric tons of lithium per year (Energy Source Mineral, 2021), or about 58,600 gallons per metric ton of lithium. The lmperial Irrigation District (IID) has 23,800 AFY available for non-agricultural development in Imperial County (LVC, 2021d), meaning IID can support the lithium operations within the region for about 30 years (Energy Source Mineral, 2021). IID has senior Colorado River water rights and thus is unlikely to be subject to reductions (LVC, 2021d). Further, because water used in the lithium extraction and refinement process must be clean and desalinated, companies are incentivized to recycle water to reduce costs (LVC, 2021c). For this same reason, Salton Sea water cannot be used without desalination (LVC, 2021c). Some DLE technologies could utilize steam from geothermal power plans to produce water for use (McKibben et al., 2021), further reducing reliance on IID.

The other discussed environmental impact is facility footprints and the effect on wildlife. There is overlap between the KGRA and the Sonny Bono Wildlife Refuge (SBWR), which is a designated Important Bird Area. Geothermal plants have existed in the area for some time, showing how wildlife can still exist near geothermal facilities (Shafique, 2021). The primary impact of geothermal and lithium facilities is the construction; ESM's ATLiS draft EIR states there will be no significant impact from construction or operation after burrowing owls are relocated (Energy Source Mineral, 2021) and CTR's Hell's Kitchen will need to offset Yuma Ridgeway Rail habitat loss from constructing in Morton Bay (Shafique, 2021). The Red Hill Bay restoration project in the SBWR is stalled due to lithium development potential (Shafique, 2021). Geothermal plants are typically 40-50 acres each and a lithium facility would only add an additional building on or adjacent to a geothermal site as some facilities will combine brine pre-treatment with lithium recovery (LVC, 2021d; BHER Minerals, LLC, 2020). No new wells are required for lithium extraction, but are required for new geothermal plants meaning lithium extraction from existing geothermal power plants in the region will have low footprints (LVC, 2021d).

Other potential environmental impacts are less often discussed. These include the high corrosive potential of geothermal brines (Hell's Kitchen Geothermal LLC, 2020), the increase in the disposal of silica as toxic waste as more geothermal power plants are built (McKibben et al., 2021), and the potential impact to the geothermal reservoirs from reinjecting cooler brine after extracting lithium (Warren, 2021). Lithium itself can impact wildlife. Bradley et al., (2017) report that lithium can impact invertebrate development, reduce the number and weights of rats born to a litter, kill earthworms at 70 mg/kg after 7 weeks of exposure, kill fish above 100 mg/L, and stop fish embryo formation above 1.7 mg/L (pk16).

2.5 Local Socio-economic Impacts

There are likely to be economic benefits to the region from lithium extraction. Two lithium compounds can be extracted from the region's geothermal brine and sell for similar prices: lithium carbonate (Li_2CO_3) sells for $11,000 per metric ton and lithium hydroxide monohydrate ($LiOH\text{-}H_2O$) sells for $12,267 per metric ton (p19, Warren, 2021). Profitability is highly dependent on the lithium concentration found in the specific geothermal well's brine, meaning some regions and companies will be more profitable than others (Stringfellow and Dobson, 2020). The Salton Sea region has high concentrations of lithium (400 mg/L), meaning success and profitability are likely in the KGRA (p27, Stringfellow and Dobson, 2020). Simbol Materials estimated they would bring in $80-100 million in annual gross revenue (Harrison, 2014).

Taxes and land lease royalties can bring revenue to IID. An estimated $900 million in annual revenue amounts to about $20 million per year in taxes to IID (p79, McKibben et al., 2021). IID could receive 3% of gross revenue of lithium recovery as royalties (Gagne et al., 2015) and because IID owns 44,000 acres of the KGRA (LVC, 2021d), the industry is likely to be economically beneficial to the region. ESM's ATLiS is estimated to bring $80-90 million per year to Imperial County from taxes, royalties, and jobs (Spagat,

2021). There is thus potential to bring income to social projects, such as schools and infrastructure improvements (Carleton, 2021). Others have mentioned the possibility for lease and mineral recovery revenue to support Salton Sea restoration (LVC, 2021a; Ventura et al, 2020).

Another benefit is job creation. The estimated number of new employees varies. An estimated 230 monthly workers are required for the construction of new lithium facilities and 400 full time employees are needed for operation: 220 operation, 130 maintenance, and 50 for management and administration (p79, McKibben et al., 2021). A 2008 IID feasibility study reported new geothermal power plants could support 7,000-9,000 jobs, many of whom would be within CalEnviroScreen's disadvantaged communities (Ventura et al, 2020). ESM's ATLiS will employ 62 fulltime onsite employees (p2.0-10, Energy Source Mineral, 2021) while CTR's Hell's Kitchen will employ 1,980 people and support 2,500 ancillary jobs (LVC, 2021c). While Simbol Materials never launched a commercial operation, they stated they could employ 100 people (Harrison, 2014). While the potential for job creation is evident, the community is skeptical of local employment; prior promises for new local employment from the solar industry went to outsiders rather than residents (Carleton, 2021).

There are other potential benefits of supporting the lithium industry in Lithium Valley. Both BHER and CTR report they can reduce the cost of geothermal power by 35% to be sold at $50MWhr (BHER Minerals, LLC, 2020; Hell's Kitchen Geothermal LLC, 2020). BHER states the expanded lithium industry can support lithium-ion-based grid storage, decreasing grid cost, enabling solar and wind storage, and increasing the reliability of the local grid (BHER Minerals, LLC, 2020). There is also the potential to bring other industries to the region, including battery and electric vehicle manufacturing and other minerals found in geothermal brine (LVC, 2021c).

The lithium industry could have negative impacts on the community. The first concerns the increased traffic on local roads. ESM's ATLiS draft EIR requires an additional turning lane be added to a main local road for transportation safety (Energy Source Mineral, 2021). Community members are also concerned about potential health impacts of expanding lithium and geothermal (LVC, 2021a). While no poisoning events have been reported from the lithium industry, above 5 g of lithium ingestion can be fatal in humans, impacting cells, metabolism, and neuronal communication (Bradley et al, 2017).

3.0 Water Importation Considerations

Water importation will not impact the lithium concentration directly, but could negatively impact the industry's growth potential. The Salton Sea surface water is independent of the geothermal brines, located 4,000 (Spagat, 2021), 6,000 (Grant, 2021), or 8,000 ft (Spagat, 2021) below the surface (Grant, 2021). Imported water to the Salton Sea will therefore have no impact on lithium within the geothermal brine (Grant, 2021).

Increasing the Sea's elevation, however, would limit the potential of lithium extraction. Half of the KGRA is under the Salton Sea (LVC, 2021d) and if geothermal plants are built on the 11,000 acres of projected exposed playa within the KGRA by 2030, an additional 270-570 MW of geothermal power can be developed (page xii, Gagne et al., 2015). We can assume this means lithium extraction potential is also increased. There is currently no publicly available map of proposed development on exposed lakebed or inundated land because the exact siting is still speculative; exploratory wells are required to discover the geothermal energy capacity as temperature varies from well to well (LVC, 2021d). CTR plans to develop on playa and portions under the Salton Sea that will be exposed under a no action plan in the future (CTR, 2021). Refilling the Sea would hinder this development as geothermal wells built over surface water would increase difficulty, cost, and environmental impacts associated with the corrosive nature of the soils in and around the Salton Sea (LVC, 2021d; Wardlow, 2021). Creating islands to house new geothermal wells has been discussed in the past to establish habitat, such as ponds, around wells (Wardlow, 2021).

Using imported water or water from the Salton Sea is unlikely to increase lithium potential in the region. The lithium in desalinated ocean water brine is 1,000 times less concentration than geothermal brine (LVC, 2021c). Imported water could, however, be used to provide water for the lithium extraction and refinement process if it is first desalinated.

Another impact to consider may be the additional pressure on roads and the electrical grid. As mentioned previously, expanding the geothermal and lithium industries will require road changes to mitigate increased pressure on transportation infrastructure. Construction, operations, and maintenance of facilities related to water importation could further increase this pressure. Analysis relating to roads for the water importation project should take into consideration the potential changes that the lithium industry will make to current transportation data. Similarly, the expansion of geothermal and lithium will likely change current electrical grid and transmission infrastructure. IID's baseload grid power is 560 MW with a historic peak load of 1,133 MW and a total energy consumption in 2020 of 3,511,825 MWh (LVC, 2021d). The average summer month peak load is 1,023 MW and 533 MW in the winter months (LVC, 2021d). IID is planning to upgrade existing transmission and construct new transmission to accommodate the geothermal power and lithium expansion (LVC, 2021d).

Some water importation proposals mention lithium or geothermal. Geothermal Worldwide is the only proposal that incorporates lithium extraction. Binational Water includes one sentence stating that lithium recovery investors could provide additional income to the project. Sephton does not specifically state lithium, but mentions opportunities for future energy recovery methods from geothermal brine. Several proposals mention expanding geothermal or using geothermal to power their operations. Proposal updates or new proposals may further discuss lithium or geothermal based on media coverage associated with the CTR-GM deal. The permitting process for new geothermal or lithium facilities in the region should be considered in our feasibility analysis as the permitting process is slow, complex, and requires CEQA (LVC, 2021c). Some have stated that Salton Sea restoration plans should coordinate with

geothermal expansion plans to maximize employment and revenue for Imperial County (McKibben et al., 2021).

4.0 Citations

Carleton, A. (2021). An Incredible Toxic Lake Will Become One of the US' First Lithium Mines, VICE, July 12, 2021. Available online at: https://www.vice.com/en/article/epn5j7/an-incredibly-toxic-lake-will-become-one-of-the-uss-first-lithium-mines

BHER Minerals, LLC (2020). Salton Sea Geothermal Lithium Recovery Demonstration Project. Grant Request Form. New Agreement # EPC-19-020. California Energy Commission, State of California. Available online at: https://www.energy.ca.gov/filebrowser/download/293

Bradley, D.C., Stillings, L.L., Jaskula, B.W., Munk, LeeAnn, and McCauley, A.D., (2017). Lithium, chap. K of Schulz, K.J., DeYoung, J.H., Jr., Seal, R.R., II, and Bradley, D.C., eds., Critical mineral resources of the United States—Economic and environmental geology and prospects for future supply: U.S. Geological Survey Professional Paper 1802, p. K1–K21, https://doi.org/10.3133/pp1802K.

Carleton, A. (2021). An Incredible Toxic Lake Will Become One of the US' First Lithium Mines. Motherboard Tech by Vice. July 12, 2021. Available online at: https://www.vice.com/en/article/epn5j7/an-incredibly-toxic-lake-will-become-one-of-the-uss-first-lithium-mines

Croft, A. (2021). How miners of a key electric-car component are trying to go green, Fortune, Tech, Lithium, June 11, 2021. Available online at: https://fortune.com/2021/06/11/lithium-electric-cars-extraction-green-brine-geothermal/

CTR (2021). Personal Communication with Lauren Rose from Controlled Thermal Resources on August 12, 2021. Online.

De Jong (2020). Innovation and Support: California's Lithium Recovery Initiative Symposium. Presentations of California's Lithium Recovery Initiative – Symposium. Feb 12, 2020. Docket number 17-GRDA-01.

Deslandes, A. (2020). Mexico's lithium discovery is a double-edged sword, Mexico, Dialogo Chino. Feb. 14, 2020. Available online at: https://dialogochino.net/en/extractive-industries/33491-mexicos-lithium-discovery-is-a-double-edged-sword/

Early, C. (2020). The new 'gold rush' for green lithium, BBC, Future Planet, Mining. Nov 24, 2020. Available online at: https://www.bbc.com/future/article/20201124-how-geothermal-lithium-could-revolutionise-green-energy

Energy Source Mineral (2021). Draft environmental impact report: ATLiS Project. Imperial County, CA: Planning and Development Services Department, County of Imperial. Prepared by Chambers Group, Inc. Available online at: https://files.ceqanet.opr.ca.gov/266414-3/attachment/1WAuc8St0q6pOKUU198nvMAjVyToYppAVahm_j0pGKvijQDseTzebhSqUWzg_s9AsKTPbLRQ_XPG7h4b0

Gagne, D., Haase, S., Oakleaf, B., Hurlbut, D., Akar, S., Wall, A., Turchi, C., Pienkos, P., Melius, J., and Melaina, M. (2015). The Potential for Renewable Energy Development to Benefit Restoration of the Salton Sea: Analysis of Technical and Market Potential. National Renewable Energy Laboratory, US Department of Energy, Technical Report, Nov 2015. Available online at: https://www.nrel.gov/docs/fy16osti/64969.pdf

Grant, A. (2021). Email correspondence with Alex Grant, Principal at Jade Cove Partners. August 16, 2021.

Harrison, S. (2014). Technologies for Extracting Valuable Metals and Compounds from Geothermal Fluids. Simbol Materials. California Energy Commission. Publication Number: CEC-500-2015-023. Available online at: https://wayback.archive-it.org/5763/20171222133218/http:/www.energy.ca.gov/2015publications/CEC-500-2015-023/CEC-500-2015-023.pdf

Hell's Kitchen Geothermal LLC (2020). Hell's Kitchen Geothermal Lithium Extraction Pilot. Grant Request Form. New Agreement # EPC-19-018. California Energy Commission, State of California. Available online at: https://www.energy.ca.gov/filebrowser/download/1599

LVC (2021a). May Lithium Valley Commission Meeting. May 27 2021. Online.

LVC (2021b). June Lithium Valley Commission Meeting. June 24 2021. Online.

LVC (2021c). July Lithium Valley Commission Meeting. July 29 2021. Online.

LVC (2021d). August Lithium Valley Commission Meeting. August 26 2021. Online.

McKibben, M.A., Elders, W.A., and Raju, A.S.K. (2021) Chapter 7 Geothermal Resources: Lithium and Other Geothermal Mineral and Energy Resources Beneath the Salton Sea in Crisis at the Salton Sea: The Vital Role of Science. University of California Riverside Salton Sea Task Force, EDGE Institute and Center for Science to Policy. https://doi.org/10.5281/zenodo.5149222

Sanderson, H. (2019). Buffett's lithium venture promises secure supply for US car makers, Electric Vehicles, Financial Times, Jan 20, 2019. Available online at: https://www.ft.com/content/c9760a4e-1a76-11e9-9e64-d150b3105d21

Shafique, R. (2021). Email correspondence with Razia Shafique, Resident Biologist at Sonny Bono Wildlife Refuge. August 18, 2021.

Spagat, E. (2021). Lithium fuels hopes for revival on California's largest lake. AP News. August 30, 2021. Available online at: https://apnews.com/article/lifestyle-technology-business-environment-and-nature-california-5c7490656ced02a938fdacb10e99c8a3

Stringfellow, W., and Dobson, P. (2020). Retrospective on Recent DOE-Funded Studies Concerning the Extraction of Rare Earth Elements & Lithium from Geothermal Brines. Lawrence Berkeley National Laboratory. DOI: 10.5072/FK2KS6SS2Z. Available online at: https://escholarship.org/content/qt2j7688zb/qt2j7688zb.pdf

Ventura, S., Bhamidi, S., Hornbostel, M, and Nagar, A. (2020). Selective Recovery of Lithium from Geothermal Brines, SRI International. Prepared for California Energy Commission, contract number EPC-16-020. Energy Research and Development Division, Final Project Report. Available online at: 2020 https://www.energy.ca.gov/sites/default/files/2021-05/CEC-500-2020-020.pdf

Warren, I. (2021). Techno-Economic Analysis of Lithium Extraction from Geothermal Brines. National Renewable Energy Laboratory. Technical Report NREL/TP-5700-79178. Available online at: https://www.nrel.gov/docs/fy21osti/79178.pdf

Wardlow, C. (2021). Email correspondence with Charlene Wardlow, Geothermal Project Manager at California Department of Conservation. Sept 13, 2021.