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**BHE Renewables Comments on the Preliminary Draft Utility-Scale Renewable Energy Generation Research Roadmap**

*Additional submitted attachment is included below.*



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Docket Office, MS-4  
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1516 Ninth Street  
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**RE: Docket 19-ERDD-01: BHE Renewables Comments on the Preliminary Draft Utility-Scale Renewable Energy Generation Research Roadmap**

BHE Renewables appreciates the opportunity to submit comments with respect to the Preliminary Draft Utility-Scale Renewable Energy Generation Research Roadmap. We have one proposal to make, which is to add lithium recovery from Salton Sea geothermal brine as a new initiative for Section 7 (geothermal) of the roadmap.

California's geothermal wells adjacent to the Salton Sea in Imperial County bring up – and reinject – more than 50,000 gallons per minute of geothermal brine that also contains many dissolved metals, including lithium, which is the key ingredient in the rechargeable lithium-ion batteries that power virtually every cell phone, laptop computer, tablet, and electric vehicle on the market today. Lithium is also a critical material required for utility-scale batteries that are expected to play a significant role in supplying the rapidly growing demand for electrical grid storage. Driven by the fast-growing battery markets, world demand for lithium is expected to grow as much as tenfold in the next decade. However, with the exception of a very small plant in Nevada, no lithium is produced in the United States. Instead, almost all of the global supply today is mined in Argentina, Chile, China and Australia.

Imperial County's existing geothermal plants are well positioned to become a competitive source of supply that could satisfy as much as 40% of today's worldwide lithium demand, thus providing the United States with a secure, strategic, domestic supply of lithium to meet increasing demands from electric vehicles, energy storage, and other end-use applications.

There are many new technologies being developed to recover lithium from this geothermal brine. However, none has been proven on a commercial scale, which is a critical financing requirement. The consensus among experts who have studied this issue – in the private sector, academia, and at meetings at the California Energy Commission (November 15, 2018 workshop and May 22, 2019 meeting of the California Lithium Recovery Initiative) – is that a demonstration plant utilizing one of these new technologies must be built before mining companies will invest billions of dollars to produce lithium in Imperial County. Unfortunately, the private sector is hesitant to take on this early stage development risk, which became evident in 2017, when BHE Renewables issued a request for proposals for a brine supply and mineral sales agreement. All the major global lithium mining companies and battery manufacturers showed strong interest, but all said the technology must be proven first.

The world today is in the midst of a global battery arms race in which the U.S. is presently a bystander. There is a national security rationale for obtaining a domestic supply of lithium, especially as the United States moves to a clean energy economy and relies more and more on lithium-ion batteries. Indeed, lithium has been listed as a critical mineral pursuant to Executive Order 13817, which states that the “United States is heavily reliant on imports of certain mineral commodities that are vital to the Nation’s security and economic prosperity,” and that this dependency “on foreign sources creates a strategic vulnerability for both [the U.S.] economy and military to adverse foreign government action, natural disaster, and other events that can disrupt supply of these key minerals.”

California alone is home to twelve electric vehicle manufacturers and half of the U.S. electric vehicle sales. With production costs estimated to be well below those for Australia-China hard rock lithium mining processing operations, California could help the United States take market share away from China and secure domestic supply. In addition, the adverse environmental concerns about the way lithium is recovered in South America and in Australia/China do not exist at the Salton Sea, where lithium recovery would be in an already closed-loop system. Lastly, lithium production has the potential to unleash billions of dollars of new economic opportunities, infrastructure development, and hundreds of new jobs for the residents of Imperial County, one of the most impoverished regions of California, as well as significant new tax revenue.

There are ample supplies of lithium throughout the world. Thus, it likely is a question when, not if, these supplies will be developed. This means time is of the essence. If the United States does not develop its ability to produce lithium domestically, the major global lithium mining companies will most likely expand their investments in these other countries, leaving the United States dependent on China and other countries for its battery raw material supplies. Lithium recovery from Salton Sea geothermal plants should be a top priority for California, and EPIC funding should be used to initiate the research and development needed to bring this to fruition.

There are multiple potential lithium recovery processes that have been confirmed at laboratory scale. However, there is minimal information about their performance robustness, scalability, economics, and ability to perform under actual operating conditions. Without improving the fundamental understanding of these emerging technologies and processes, lithium recovery from Salton Sea geothermal brine is perceived as a high-risk undertaking and, therefore, limited private capital is available to undertake this work.

EPIC funding to move lithium recovery forward would begin with a benchmarking analysis and process validation of current and proposed lithium recovery technologies to be applied to Salton Sea geothermal brine. This would include the following steps:

- Technology selection using computation-based modeling. There are a number of proprietary extraction technologies, both existing and under development, which need to be studied for suitability for lithium extraction from Salton Sea brine.
- Technology qualification: laboratory testing.
- Technology validation: on-site development of a laboratory pilot plant (approximately 5 gallons per minute of brine processing). This would later proceed to the development of a one-tenth commercial scale demonstration plant (approximately 500 gallons per minute brine processing). Depending on the extraction technology utilized, customized process engineering and design will be required for brine preparation and post-extraction purification.

This project would look to establish a lithium research center focused on de-risking lithium recovery at scale from geothermal brine at the Salton Sea in an open and transparent manner that will help trigger the U.S. lithium mining industry and use the most efficient and cost-effective technology to make the United States an effective competitor in the world lithium market. In this regard, it is also important to note that BHE Renewables is not alone in calling for this project. On March 19, 2019, the Geothermal Resources Council, a non-profit geothermal industry professional association with over 1,300 members that supports the development of geothermal energy resources, wrote to California Gov. Gavin Newsom to express the geothermal industry's "support for California's efforts to encourage lithium recovery from geothermal brine."

EPIC funding could also be used to study the overall environmental impact of extracting lithium from geothermal brine versus the other methods (evaporation ponds and open-pit mining) used in other countries today to determine which method of lithium production will have the lowest environmental impact.

Funding research and development on lithium recovery from Salton Sea geothermal brine would meet at least three key EPIC principles: expanding the use of renewable energy; advancing electric technologies for buildings, businesses, and transportation; and improving the affordability, health, and comfort of California's communities.

Expanding the use of renewable energy will be accomplished because lithium recovery would provide a secondary source of income for geothermal plants that would help make geothermal energy more competitive in the renewable energy market and spur growth, which, as the Renewable Energy Roadmap points out, has been lacking for some time. It would also assist in overall renewable expansion by promoting the production of increased lithium-ion storage, and more storage on the grid from lower costs will cascade in helping other renewable resource technologies prosper.

Achieving a lithium mining industry would meet the second principle – advancing electric technologies for buildings, businesses, and transportation – because it would result in increased

electrification of the transportation sector by having a more reliable domestic source of lithium for battery production.

The third principle – improving the affordability, health, and comfort of California’s communities – would be accomplished because of the lesser impact that lithium recovery from geothermal brine would have on the environment compared to the current methods of lithium extraction using hard rock mining or brine evaporation technologies. Having a cost-effective lithium extraction method that does not result in the polluting of waterways from acid mine drainage or increasing air pollution from large transportation emissions of mined ore will maintain the health of the people and environment in California communities and around the world.

For the above reasons, BHE Renewables proposes the inclusion of lithium recovery from Salton Sea geothermal brine as a new initiative for Section 7 be added to the Renewable Energy Roadmap.

Respectfully submitted,



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