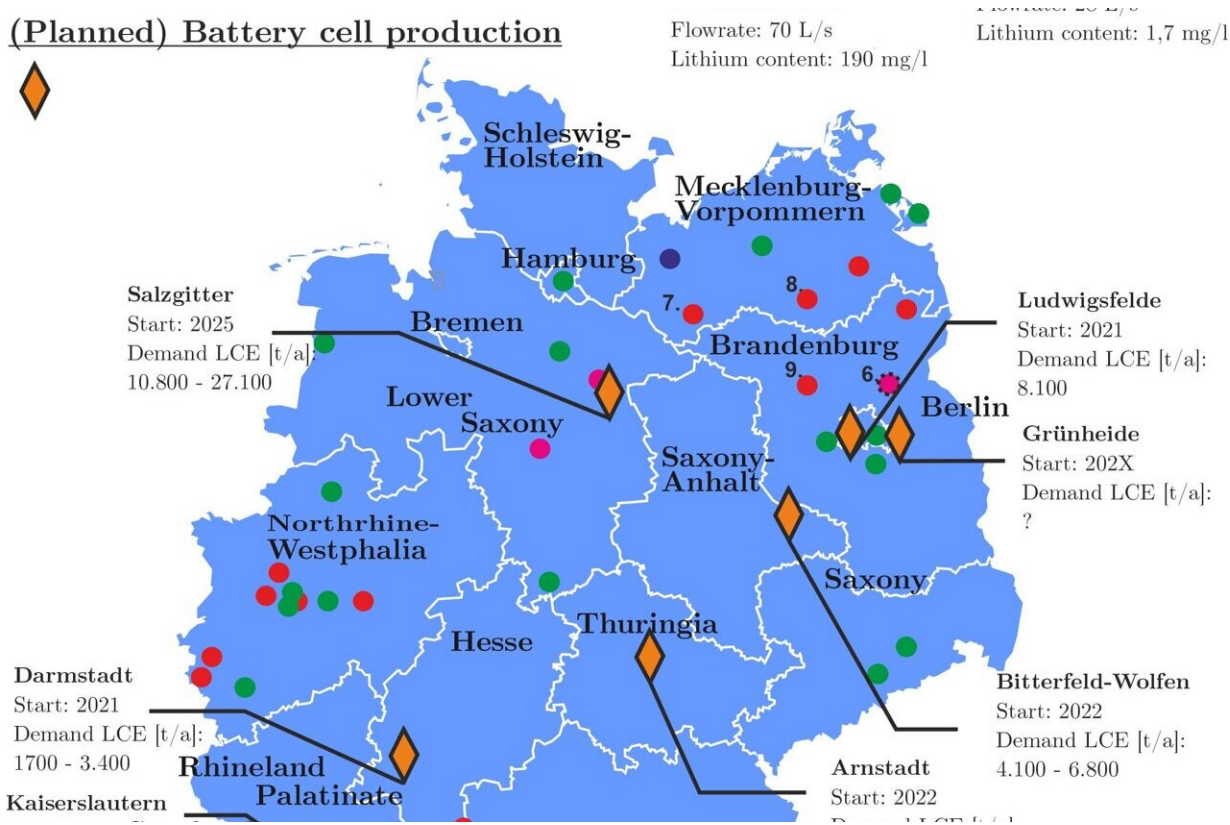


Limits of lithium extraction from thermal water

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Credit: Goldberg et al, 2022

Pumping up thermal water, separating lithium, and using it to produce batteries for electric mobility—the idea of lithium as an environmentally compatible and regionally available by-product of geothermal energy

plants appears highly promising. However, it has not been clear so far whether domestic lithium extraction is really worthwhile.

A team of researchers from Karlsruhe Institute of Technology (KIT) has now summarized the state of the art, analyzed raw materials markets, and assessed technologies. According to them, it might be possible in theory to extract thousands of tons of lithium every year in Germany, but crucial aspects still need to be clarified.

For the energy transition, Europe needs a lot of batteries and sufficient lithium to produce them. The European Union (EU) accordingly classifies lithium as a critical resource. There is a danger of a lithium shortfall. "We are entirely dependent on imports. Worldwide, 80% of lithium resources come from Chile and Australia," says Valentin Goldberg from KIT's Institute of Applied Geosciences (AGW). "At the same time, we deliberately accept major environmental expenses due to the conventional [extraction](#) of lithium in these countries, including negative impacts on groundwater."

Lithium extraction in geothermal power plants, by contrast, is planned to be based on existing infrastructure in Europe, where large volumes of thermal water with a sometimes high lithium concentration are being extracted. Following [energy production](#), lithium will be separated and the remaining water will be fed back into the underground, as usual during operation.

"In principle, we are very positive about this technology. Hardly any space would be needed, environmental and transportation costs would be low," Goldberg says. To realistically determine the potential future share of domestic lithium, Goldberg and his colleagues from AGW have collected the available knowledge, analyzed it, and for the first time calculated the potential for Germany.

The potential lithium extraction volume does not only depend on the water's lithium concentration, but also on the location-dependent flow rate and reservoir dimension. For their estimations, the researchers analyzed potential locations in Germany, studied markets of raw materials, and assessed various technologies in terms of efficiency, applicability, and integration in geothermal energy production.

"On this basis, we have obtained an optimistic annual production estimate of about 2600 to 4700 tons lithium carbonate equivalent, provided that all relevant [geothermal energy](#) plants are equipped with the necessary systems," says Dr. Fabian Nitschke, AGW, who was also involved in the studies. "With this, we could cover about 2% to 13% of the annual quantity needed for planned battery production in Germany."

Construction of additional geothermal power plants might increase the extraction volumes. However, it will take at least five years for a newly planned power plant to start operation. "In view of the predicted global lithium shortfall and planned battery production, the situation in Germany will deteriorate soon. For this reason, lithium from geothermal power plants will nothing but complement imported resources in the medium term," Nitschke says.

Direct comparison of different technologies

Prognoses still are subject to many uncertainties: The dimensions and the origins of lithium resources in geothermal systems as well as the response of the reservoirs to continuous extraction are being studied at the moment. Moreover, extraction technologies are far from mature—essential development processes and long-term tests remain to be carried out.

"But direct comparison already reveals specific advantages and drawbacks that are of particular relevance to economically efficient

lithium extraction," says Dr. Tobias Kluge, AGW, another author of the study. "The need for additional resources, damage caused by deposits in boreholes and extraction units, and energy consumption directly affect economic efficiency."

Still, it is not further technology development or suitable locations that will decide on whether [lithium](#) will be extracted at German geothermal power plants. Public support and acceptance will be required, Valentin Goldberg emphasizes. "Our publications in the journal *Grundwasser* (*Groundwater*) do not only address experts. We rather want to give [decision-makers](#) in politics and industry as well as the interested public the chance to inform themselves directly and independently about opportunities and challenges."

More information: Valentin Goldberg et al, Herausforderungen und Chancen für die Lithiumgewinnung aus geothermalen Systemen in Deutschland—Teil 1: Literaturvergleich bestehender Extraktionstechnologien, *Grundwasser* (2022). [DOI: 10.1007/s00767-022-00522-5](#)

Valentin Goldberg et al, Herausforderungen und Chancen für die Lithiumgewinnung aus geothermalen Systemen in Deutschland—Teil 2: Potenziale und Produktionsszenarien in Deutschland, *Grundwasser* (2022). [DOI: 10.1007/s00767-022-00523-4](#)

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