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Geothermal brines as a carbon neutral source of critical raw materials - BrineRIS project

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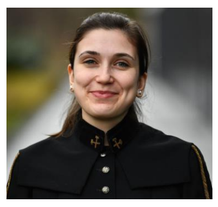

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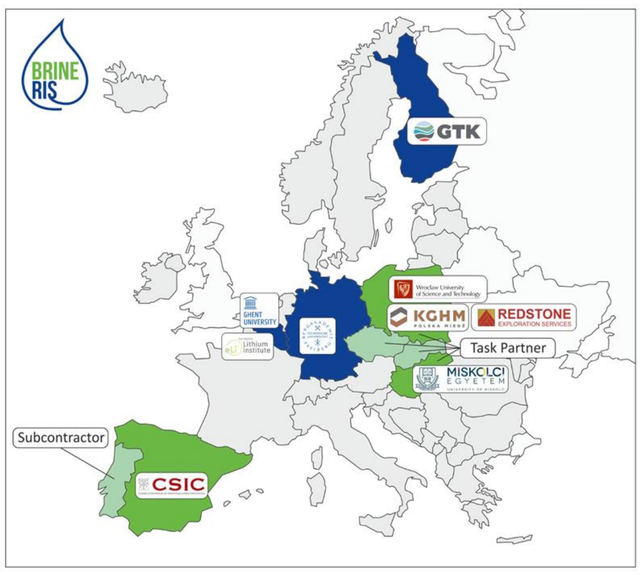
Introduction

The demand for lithium as a critical material is fast-growing because of its cruciality for the battery market. The occurrence of lithium in geothermal brines was the impetus for researchers to develop a recovery technology that would efficiently extract lithium and other minerals from brines and do so in an emission-free manner using only geothermal heat. **BrineRIS - Brines of RIS countries as a source of CRM and energy supply** project, working with nine partners (Fig. 1), is focused on mapping the potential sources of geothermal brines in six selected countries included in the so-called EIT Regional Innovation Scheme (EIT RIS). The project covers Poland, Hungary, Czech Republic, Slovakia, Spain and Portugal, and developing an appropriate technology that would allow recovery of critical materials (CRM) (including lithium) from geothermal brines in an emission-free and thus economical and environmentally friendly way. The project duration is three years (2022-2024).

BrineRIS supports the transition of the EU's Economy for a sustainable future and meets six criteria of the European Green Deal: Increasing the EU's climate ambition for 2030 and 2050; Mobilising industry for a clean and circular economy; Mobilising research and fostering innovation; Supplying clean, affordable and secure Energy; A zero pollution ambition for a toxic-free environment; Accelerating the shift to sustainable and intelligent mobility.



PARTNERS

- Agencia Estatal Consejo Superior de Investigaciones Cientificas M.P., CSIC (Spanish National Research Council) [Spain, CLC South Core Partner]
- European Lithium Institute eLi [Belgium/Germany, CLC Central, Associated Third Party]
- Geologian tutkimuskeskus, GTK (Geological Survey of Finland) [Finland, CLC Baltic Core Partner]
- Ghent University [Belgium, CLC West Core Partner]
- KGHM Polska Miedz Spółka Akcyjna [Poland, CLC East Associate Partner]
- Politechnika Wroclawska (Wroclaw University of Science and Technology, WUST) [Poland, CLC East Core Partner]
- Redstone Exploration Services Sp. z o.o. [Poland, CLC East Project Partner]
- Technische Universität Bergakademie Freiberg (TUBAF) [Germany, CLC East Core Partner]
- University of Miskolc [Hungary, CLC East Core Partner]

Figure 1: BrineRIS - partners

Project description

The project consists of nine work packages (Fig.2) and involves several simultaneous action paths. First, the participants intend to collect all available information on the occurrence and composition of brines - especially on their lithium content, as there is currently no single place where data (available for entrepreneurs) on geothermal brines are collected.

The project's first step will be a sampling campaign organized by the RIS partners. This part will be followed by technological testing and modeling at Ghent University and GTK in cooperation with WUST. The project will also create a portal for those interested in investing in brine installations - with access to the information and analysis prepared within **BrineRIS**. Furthermore, open workshops on the potential of geothermal brine, scientists' study visits, and a summer school for students in Karlsruhe organized by Vulcan Energie Ressourcen are also planned.

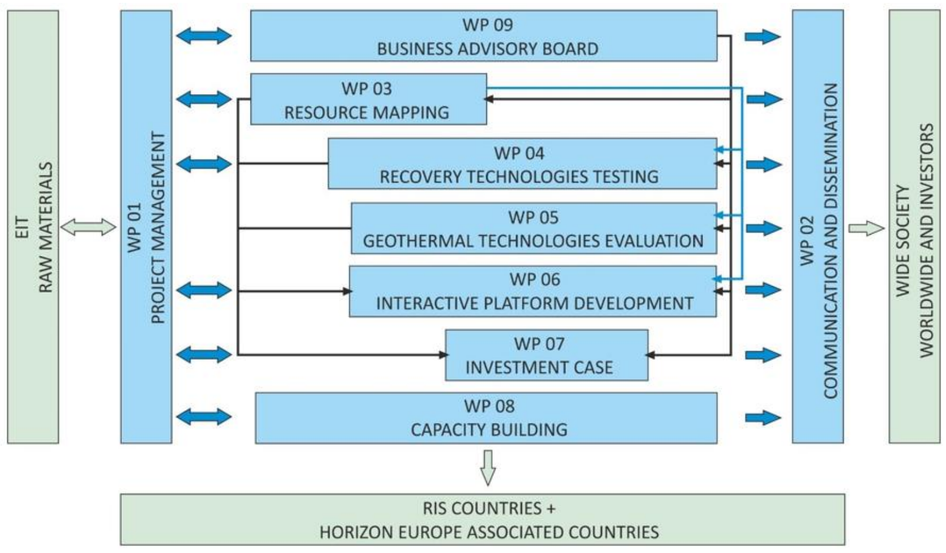


Figure 2: BrineRIS structure

Technology

A significant step in the project will be to analyze the CRM and lithium recovery rate of selected brines with three direct lithium extraction (DLE) technologies:

Electrochemical process for Li extraction from high salinity water. The technologies will be applied ex-situ on two different sources from one RIS country. The first step will be the concentration of Li in solutions free of other cations, for which capacitive deionization (CDI) will be used to concentrate Li to a level of 500 ppm. For higher lithium concentrations, membrane electrolysis (ME) will be used. In the second step, solutions concentrated by the CDI process (500 ppm Li) will be treated with ME to recover Li as Li_2CO_3. The ME process will be designed by Ghent University.

The adsorption method will be handled by the Geological Survey of Finland (GTK). This process allows selective separation of lithium by adsorption in hydrochloric acid solution. The advantage of this technology is that lithium sorbents used in the direct extraction of lithium from brines can be used as cathode materials in lithium-ion batteries.

Solvent extraction, which is also developed by GTK in cooperation with WUST. It is one of the most developed methods of separating metals from aqueous solutions. In this technology, metals extracted into the organic non-polar phase are usually recovered using an aqueous removal medium.

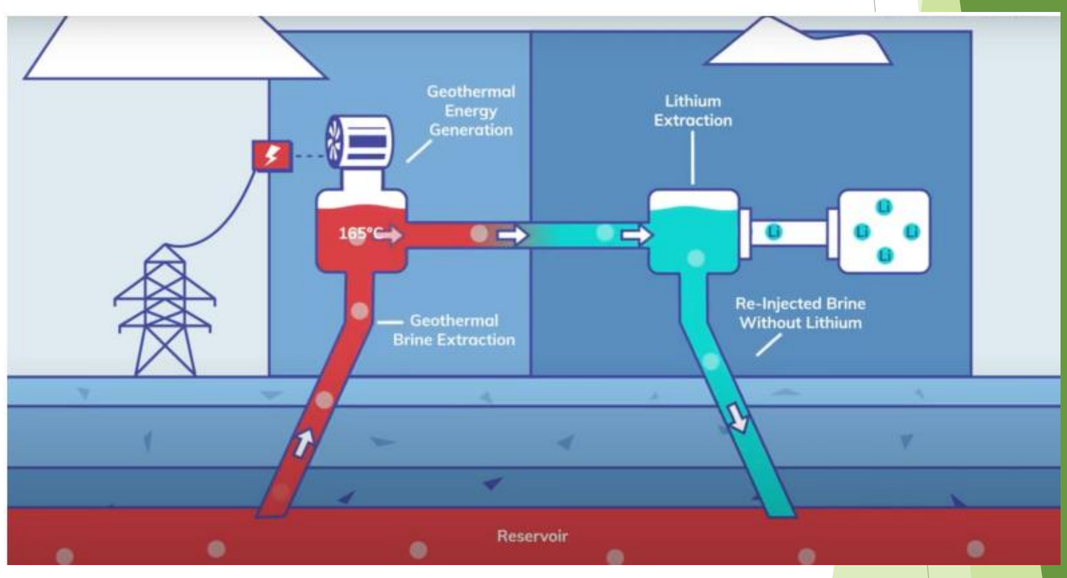


Figure 3. Ideation of carbon-neutral Lithium extraction from geothermal brines source: https://www.unav.edu/web/global-affairs/the-battery-race-surfacing-geothermal-lithium-trapped-below-therhine-river

The study will take into account the metal content of a given source and its temperature, stability, and yield because all of these factors are important in assessing the viability of extracting metals from brine.
Developed technologies are also energy-consuming. Therefore, TUBAF will analyze brines with very high temperatures to assess zero-emission electricity production for the recovery process (Fig.3). On the other hand, brines that are colder (around 40 or 60 degrees C) and unsuitable for generating electricity may be valuable for producing heat. That is why the TUBAF scientists will classify those brines from which the heat could be used to improve the technological process itself, e.g., heat cooler water, and improve the efficiency of the tested technologies, reducing their costs.

Summary

The international **BrineRIS** project focuses on recovering (CRM) using emission-free methods. Through the collaboration of outstanding scientists and the technologies developed, the project will reduce the carbon production footprint of lithium-ion batteries by producing lithium compounds with zero carbon footprint from European geothermal brines. The project uses naturally occurring, renewable geothermal energy to power the CRM extraction process and create a renewable energy by-product. As a result, it uses no fossil fuels, requires less water, and does not impact the land use as much as the most popular evaporation method of lithium recovery from brines.

https://dmc.pwr.edu.pl/index.php/brineris/