Challenges of Water Use Impact Assessment of Lithium Production from South American Salar Deposits using Life Cycle Assessment

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Lithium is a critical raw material for the energy transition due to its use in battery technologies. The primary sources of lithium are spodumene pegmatites and salar brine deposits, with the salar deposits of South America hosting 70% of global lithium resources. Salars are complex groundwater systems where lithium-rich brine is abstracted by pumping. They are also home to valuable ecosystems, reliant on surface water ponds associated with the salar. Due to the region's elevated water scarcity and the salar system's ecological sensitivity, there are sustainability concerns regarding the water use, and associated impacts, of lithium production from salar deposits.

Life cycle analysis (LCA) is a method becoming increasingly prevalent in the assessment of raw materials sustainability. There are several approaches to measuring water impacts or scarcity. LCA utilises a water scarcity footprint methodology called AWARE for water use impact assessment. However, this methodology is widely regarded as deficient for thoroughly capturing and assessing water use impacts of lithium production from salar deposits.

This study investigated the intersection of salar deposit systems, with their complex and often poorly understood geology and hydrogeology, with LCA water use impact assessment. The study identified and explored challenges and opportunities for improvement, broadly categorised as those relating to a) the complexity and uncertainty involved with salar systems hindering impact assessment and allocation, b) generic issues with the data and models that underpin LCA methodology, and c) the limited accuracy and representativeness of current LCA methods when applied to salar systems, specifically assessment of groundwater and the interaction of varying aqueous phases, i.e., brines and water, in the same system.

This work will aid the development of LCA methodology and enable improved assessment of the sustainability of lithium production from salar deposits in South America, and by extension the resourcing of the green transition.