ALTA 2022 26
20-27 May | Perth, Australia | Online

PROCESS MODELLING BASED PROSPECTIVE LIFE CYCLE ASSESSMENT: A CASE STUDY WITH PRIMARY LITHIUM PRODUCTION

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ABSTRACT

For the transition to a low-carbon economy, an unprecedented volume of critical metals is needed. Compared to 2018 production, it is anticipated that the lithium demand can grow by 500% by 2050. It is necessary that this lithium is sourced in a method that does not offset the improvement in environmental performance for which it is used downstream. Life Cycle Assessment (LCA) is a methodology to quantify environmental impacts associated with all stages of a product, process or activity.

Currently, life cycle assessment is not done until a project is close to commercial implementation or in operation, after the expenditure of considerable time effort and money. This also means that most environmental impacts are fixed and can no longer be mitigated. Early stage LCA would greatly reduce the risk of initially unappreciated environmental aspects stalling or even scuppering of the project and will allow for the integration of quantitative environmental impact metrics to supplement technological-economic decision making.

This paper presents an exercise in which four routes of lithium extraction are subjected to early-stage Life Cycle Assessment, using process modelling to generate the required data. The process selected for this exercise are:

- Lithium extraction from salar brine, using established technology.
- Lithium extraction from spodumene ore, using established technology.
- Lithium extraction from clay, using proposed technology.
- Lithium extraction from high-calcium brine, using novel technology.

In addition to the capital and operating costs, these four routes are examined for:

- Carbon dioxide emission.
- Water consumption.
- Impacts of wastes on water sources.
- Utilisation of land versus alternatives such as farmland or pristine wilderness.

The purpose of this paper is to show that process modelling can be used to generate the information needed for early-stage LCA and that the application of early-stage LCA allows informed process decision making that leads to lower overall project risk.

Keywords: Lithium, CO_2, water, environment, LCA, economics