Does "Abundant Materials" Equal "Environmentally Benign"? Life-Cycle Impacts of Sodium-Ion Batteries

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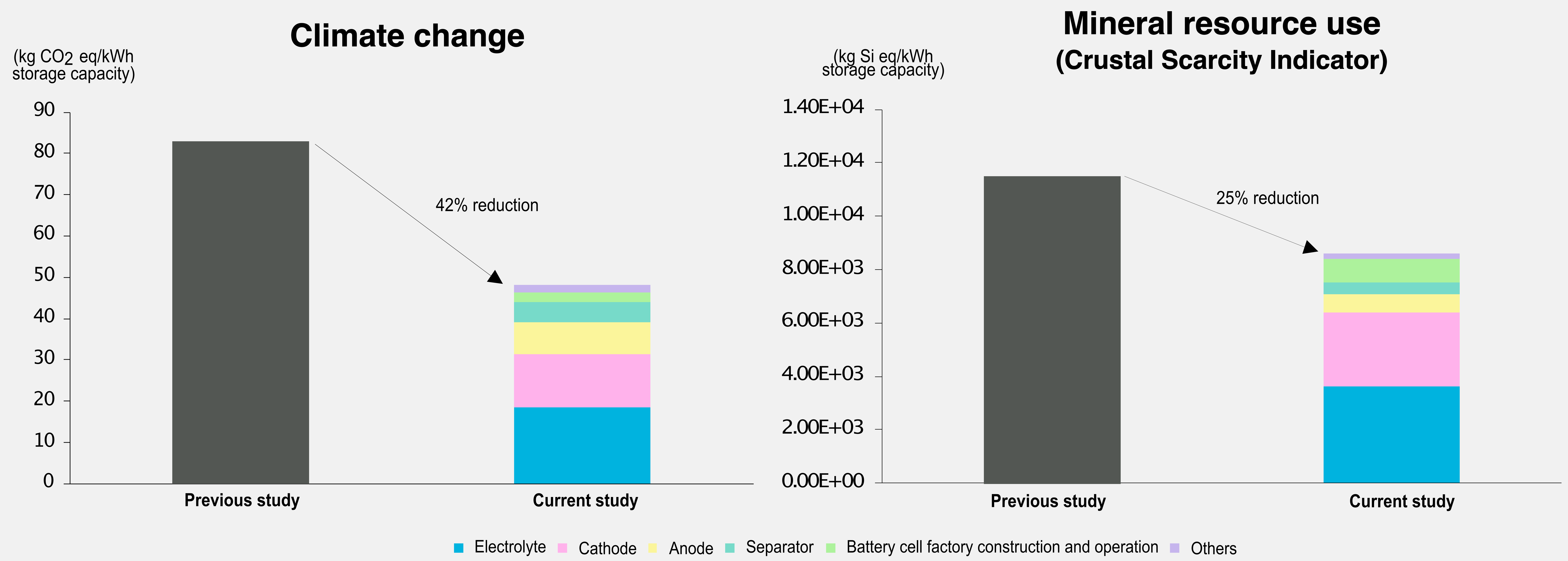
1 Introduction

- Lithium-ion batteries (LIBs) are today's dominating rechargeable battery technology.
- Sodium-ion batteries (SIBs) are a promising next generation battery type, as they can be made without any scarce or critical metals.
- Our aim is to assess whether the abundancy of the SIB constituents equals "environmentally benign" from a cradle-to-grave perspective.
- We have previously conducted a cradle-to-gate study of SIBs using prospective life cycle assessment (pLCA), but the battery cell production was largely dependent on LIB-generated data and the background database was not adjusted to the prospective time horizon.
- In this poster, we show preliminary cradle-to-gate results, where the battery cell production has been adjusted to SIBs combined with prospective background data.

2 Methods

- As SIBs are an emerging technology, pLCA was used. With pLCA, the technology is modelled at a future point in time when it has matured and been scaled up. Around 2030 was estimated to be a plausible time period.
- The cell production was modelled departing from a parameterized gigafactory model developed for LIBs. One gigafactory process was removed completely, while others were adjusted to SIBs.
- The parameterized model required the cell composition and performance data as input data, which were both retrieved from a SIB cell producer.
- Prospective background processes, reflecting energy policy trajectories which aim to limit global warming to 1.5°C, were linked to the studied system using the python tool Premise.
- The functional unit was set to 1 kWh of theoretical storage capacity to enable comparison with previous results.



3 Results and Conclusion

- Reductions in the two impact categories, compared to our previous work, are due to more SIB-specific cell production (for example, no solvent recovery was modelled for the cathode production as water is assumed to be the solvent) as well as prospective background data.
- These preliminary results indicate that the battery cell production model needs to be battery technology-specific. They also show that decarbonization is important to lower cradle-to-gate impacts, such as climate change and mineral resourse use, of SIBs.
- Important to know is that the decarbonized background system is responsible for the majority of the reduction.
- Is the title question true? We still need an analysis including all life cycle stages, and compare the results to those of LIBs.

4 Continuation of the study

- An important next step is to include the whole life cycle of the SIBs, from cradle to grave.
- A grid support system (regulating the frequency of the electrical grid) consisting of a SIB installation is currently being modelled for the use phase.
- Different recycling scenarios will be modelled, accounting for future policy targets such as the EU Battery directive.
- Several prospective background databases will be considered, again utilizing Premise.
- Additional impact categories will be addressed.

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