

Abstract

Environmental Impacts of Onshoring Lithium and Lithium-ion Battery Production

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Life cycle assessment was conducted to quantify prospective environmental impacts of a transition to onshore supply of lithium battery materials and onshore production of lithium-ion battery cells in the Americas. Life cycle assessments were compiled for current lithium raw materials and lithium-ion battery cell supply chain pathways, dominated by a Chinese midstream monopoly on refinement and lithium-ion battery component production, and compared with prospective American based supply chain pathways. Differences in global warming potential (GWP) (kg of carbon dioxide equivalents), water use, and land use of differing supply chain pathways were the primary environmental impacts under comparison and analysis. Both “Traditional” (current) and prospective American supply chain pathways were developed for lithium carbonates, lithium hydroxides, nickel-cobalt-aluminum (NCA) based battery cells, and lithium-iron-phosphate (LFP) based battery cells. Each product was modeled cradle-to-gate. Transition from Traditional lithium carbonate supply chain pathways to American based pathways resulted in a 66% reduction in the GWP of transportation of refined materials, thanks largely to elimination of the need for cross-Pacific freight shipping. Transition from Traditional supply chain pathways to American based lithium hydroxide pathways resulted in a 49% reduction in the GWP of electricity usage during refinement when transitioning from Chinese and Japanese electricity grids to United States counterparts, due largely to lower amounts of coal-based electricity generation within the United States electricity grid. During the simulated production of 100 kWh

of NCA and LFP based lithium-ion battery cells, NCA cells were found to produce 11% less GWP than LFP equivalents on average. Utilizing lithium raw materials sourced from the Americas, American based production of NCA and LFP cells was found to produce an average of 13% less GWP than traditional supply chain pathway counterparts.

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