Critical Minerals for Energy Storage: Lessons From Lithium and Electromobility

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Abstract

Energy storage is a cornerstone of the energy future. How societies produce and consume energy is changing fundamentally. In the past, a linear relationship characterized resource extraction through generation and finally energy consumption. As renewable energy sources and electromobility over time supplant conventional fossil fuel systems, this relationship becomes more circular. Renewable energy systems imply higher upfront capital costs. These upfront costs are then offset over time by lower operational costs implied by effectively free feedstock replacing fossil fuels. This shift has implications on the relationship between energy systems and the critical minerals that underlie them. Lithium's role in energy storage for transportation applications provides a salient example of this fundamentally changing relationship. While lithium is frequently described as the "new oil" or "white petroleum", this mischaracterization obscures crucial differences between how energy systems and minerals will be coupled in the future. Firstly, many of the critical minerals markets in the battery supply chain must both grow exponentially and change drastically to meet the scale and quality ramifications, respectively, that are required by battery makers vs. more established and less strict markets such as glass or ceramics. Secondly, while storage is an integral part moving energy across space (electrification of transportation) and over time (matching generation with consumption), there is no one-size-fits-all solution for energy storage. There is room for multiple solutions even within the battery supply chain, and within each technology are opportunities for different critical minerals. Understanding this differentiation is key to understanding both investment opportunities, as well as emerging professional opportunities for the field of geology. Finally, understanding the different categories of

technological innovation across the battery supply chain illustrates the decoupling of critical materials prices from battery prices. It may seem counterintuitive that lithium raw material prices can increase while battery prices are decreasing, but during the period of transition, falling prices for end products and parity with conventional energy solutions drives adoption and thus creates entirely new demand markets. Lithium's growth story has lessons for other battery minerals. By understanding how critical minerals markets must grow and change to serve the energy storage supply chain, professionals can be in a position to facilitate and benefit from the transition.

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