

An integrated supply chain model for critical minerals

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Global clean energy transitions hinge upon reliable access to critical minerals. As countries expand their deployment of low-carbon technologies, the surge in mineral demand intensifies concerns about supply chain security and resilience. Existing analytical tools focus mostly on direct national exposures to foreign critical minerals, overlooking the wider network of indirect exposures embedded in the trade of processed and manufactured goods. Here, we present an integrated supply chain model that traces 36 minerals, including lithium, nickel, cobalt, platinum group metals, and rare earth elements, from extraction through intermediate processing to final use across 251 countries and regions. The model creates a granular map of critical mineral supply chains at an unprecedented spatial and thematic resolution, making hidden linkages and their associated environmental and social risks visible and actionable. We share experiences and challenges encountered during the development of this model to foster collaboration within our community.