ARE “WE” ASKING TOO MUCH OF ELECTRICITY MARKETS?

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Critical Minerals Supply Chains
Raw materials can become the bottleneck for new energy technology deployment

• Battery storage, wind turbines, and solar PV technologies are expected to grow phenomenally over the next decade
• There will be a massive demand for raw materials used in manufacturing
• The raw materials comprise some of the most critical materials
• Absence of substitutes and efficient recycling makes end-users even more vulnerable
Lithium in lithium-ion batteries
Electric vehicles, consumer products, grid energy storage
Lithium demand will double by 2025 even in base assumptions

Data source: USGS, IEA, Roskill Information Services
Market response to increased demand is good

Data source: USGS, IEA, Corporate reporting
...But new projects are costlier and some are based on unproven processes

New capacity projects and operating cost

- Continental brine
- Pegmatite
- Hectorite

Operating cost ($/metric ton LCE)

Data source: Corporate reporting
Cobalt in lithium-ion batteries
Electric vehicles, consumer products, grid energy storage
Cobalt demand will more than double to match battery demand
Cobalt supply will be constrained by 2018 at current production and new projects

Update: A new mine cleared environmental clearance in Minnesota for 320 metric tons cobalt
Other critical markets

- Lithium
- Cobalt
- Graphite

- Neodymium
- Dysprosium

- Tellurium

- Europium
- Terbium
- Yttrium
Current criticality measurements do not account for commercial frameworks

• Current measures of criticality include
  • Price volatility
  • Governance indicators
  • Market concentration
  • Primary production growth

• Commercial framework analysis will include
  • Resource countries’ laws and policies
  • Industry structure: national companies, private companies, artisanal mines
  • Analysis or risks and uncertainties in host countries
Scope for future research

• Commercial frameworks in resources countries
• Resource allocations, mine production capacity, refining capacity
• Supply-demand drivers
• Material demand breakdown by end user
• Geopolitical risk, bottlenecks, trade issues