Don't Throw Caution to the Wind:
In the green energy transition, not all critical minerals will be goldmines

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Perrine Toledano, Martin Dietrich Brauch, Solina Kennedy, and Howard Mann

Columbia Center on Sustainable Investment
A JOINT CENTER OF COLUMBIA LAW SCHOOL AND THE EARTH INSTITUTE, COLUMBIA UNIVERSITY

Summary

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KEY MESSAGES

- The green energy transition will be mineral intensive. Manufacturing wind turbines, solar panels, geothermal heat pumps, and batteries is set to significantly increase demand for so-called "critical" minerals.
- Forecasts of increased demand for critical minerals—including as a result of post-COVID-19 stimulus plans—prompt high expectations in mineral-rich countries and suggest promising opportunities for developing countries.
- However, projects to increase the primary extraction of critical minerals rest on bullish forecasts and uncertain terrain, because of factors including ever-adapting technology leading to increased mineral performance; substitutions due to high mineral prices or supply scares; reduced primary extraction due to increased recycling, reuse, and the circular economy; and greater reliance on agromining and biomining.
- Investments in the primary extraction of critical minerals could become obsolete and economically stranded. Over-investing in production may outstrip demand and lead to minimal benefits for many countries.
- Governments, international actors, and mining advocates seeking to optimize the value of green energy mineral reserves should heed caution when pursuing and promoting the mining of critical minerals. We provide specific recommendations.

VOLATILITY IN MINERAL DEMAND PROJECTIONS AND THE NEED FOR CAUTION

The need for a sense of caution is evidenced by two World Bank reports on climate-smart mining. A 2017 report had projected a 965% increase in the global demand of lithium by 2050, and a six-fold increase in cobalt during the same period. However, the figures in the new report released on May 11, 2020 are far more conservative, estimating that the production of minerals such as cobalt, graphite, and lithium could increase up to 500% by 2050.

The primary explanation for this difference is how the World Bank factored recycling and reuse into the estimated numbers in 2020, which it had not done in 2017, and signals the importance of understanding how estimates for use of materials might not translate into extracting new materials. This distinction is part of what we explore below.

ANTICIPATED MINERAL DEMAND IS ALREADY FUELING GREAT EXPECTATIONS—AND ACTIONS—IN RESOURCE-RICH COUNTRIES

These demand forecasts prompt high expectations. Some governments—including Bolivia, Chile, the Democratic Republic of Congo, and Western Australia—are already taking policy and investment actions to build out and cash in on mineral demand prospects.

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TECHNOLOGY DEVELOPMENTS MAY RESULT IN REDUCED DEMAND

Building hopes on the anticipated boom in demand for critical minerals poses serious risks because today's technology—and its associated mining requirements—can become yesterday's news at a speed that far outpaces the adaptability of mines. Technology development could take several pathways leading to reduced demand for some commodities:

1. ***Ever-increasing material performance –*** Lithium-ion batteries are the current commercial battery of choice, but they have their shortcomings, and a substantial amount of R&D investment has been directed to accelerating battery technology as well as optimizing photovoltaic cell technology for solar-to-electrical energy conversion.

2. ***Substituting due to high mineral prices –*** When minerals have become economically problematic in the past, industries adapt their behaviors to reduce or replace particular minerals. Such was seen in the 1980s when neodymium iron boron magnets replaced samarium-cobalt magnets due to the high price spike of cobalt.

3. ***Substituting due to supply scares –*** Substitutions are also made when minerals become inaccessible due to political conflicts or leveraging. China's ban on rare earth elements to Japan in 2010 prompted Toyota to greatly reduce their use of terbium and dysprosium in their 2016 Prius, and Honda eliminated the need entirely.

4. ***Reduce primary mineral extraction through recycling, reuse, and the circular economy –*** Rapidly evolving technology trends, the abundance of e-waste, and the push towards a circular economy signal promising prospects for the reduction in primary extraction of certain minerals and offer development opportunities.

5. ***Exploring increased reliance on agromining and biomining –*** Certain plants or bacteria can be used to remove minerals from mine tailings and polluted soils, or to mine for valuable elements in mineral-rich soils. These low-impact and low-cost alternatives to traditional mining can be highly profitable.

RISKS OF ADOPTING A HERD MENTALITY

Too many countries and companies rushing to produce the minerals needed for *today's* energy technology constitutes serious risks.

1. ***Risks of overproduction –*** Production supported by development agencies and banks can lead to a flooded market, resulting in a market value crash, as was witnessed in the coffee sector in the 1990s when Vietnam—boosted by government assistance—ramped up production, and more recently in the 70% drop in cobalt prices in 2018 following the "cobalt rush."

2. ***Resource curse and "presource" curse risks –*** Countries rich in non-renewable resources tend to experience the resource curse. These countries are also at threat of experiencing slower economic growth *before* minerals are produced due to overly zealous expectations driving suboptimal behaviors such as risky overspending or overborrowing—a phenomenon recently dubbed the "presource curse."

RECOMMENDATIONS: HOW TO HEDGE AGAINST THE RISKS OF INFLATED EXPECTATIONS

1. ***Recognizing that not all minerals will be the same –*** Globalized forecasts cannot be assumed to guarantee positive project results.

2. ***Considering several factors in evaluating each project***

   a. *Understanding global levels of investment in any given commodity*: Over-investment in a commodity can kill the market price for all producers and make the cost of production the critical factor in a mine's success or failure.

   b. *Understanding competing pathways of industry for that commodity and risks of technology change*: The more diversified the uses of the commodity, the more likely it will find a market if one of the uses becomes outdated.

   c. *Building scenario and sensitivity analysis capacity*: To assess the viability of a proposed mine, governments must understand how to model and interpret different demand and price scenarios.

3. *Understanding economic spillover effects from new mining technology*

a. Local employment, local inputs of goods and services, shared use of infrastructure, and social development benefits of a project are among the factors that form part of a careful assessment of the potential value of a proposed mine. Spillover effects must be considered in the context of the technology and design being put forward—especially when they reduce local opportunities—and tied to actual planning, not theoretical assumptions.

b. Whether the mine provides an anchor for economic diversification (through downstream, knowledge transfer, and horizontal linkages opportunities) should also be taken into account.

4. *Understanding potential fiscal revenues from a proposed mine*

a. Fiscal revenues should be carefully assessed with government-owned fiscal models taking into account tax and royalty revenues, tax planning, and treaty-shopping enabling transfer pricing, profit shifting, and minimization of withholding taxes on dividends, among others.

b. Governments must carefully consider the need for any tax or other incentives, particularly with regards to tax holidays.

5. ***Thinking outside the box –*** The COVID-19-induced global halt in mining production has also brought to light the importance of securing a steady mineral supply chain. New challenges present new opportunities to rethink old approaches to mining. For example, governments can proactively sign long-term agreements and strategic partnerships with consumer industries or seek to satisfy the increased mineral demand by exploiting urban e-waste, laying the basis for a circular economy.