Critical Minerals Supply Chains for the Clean Energy Transition

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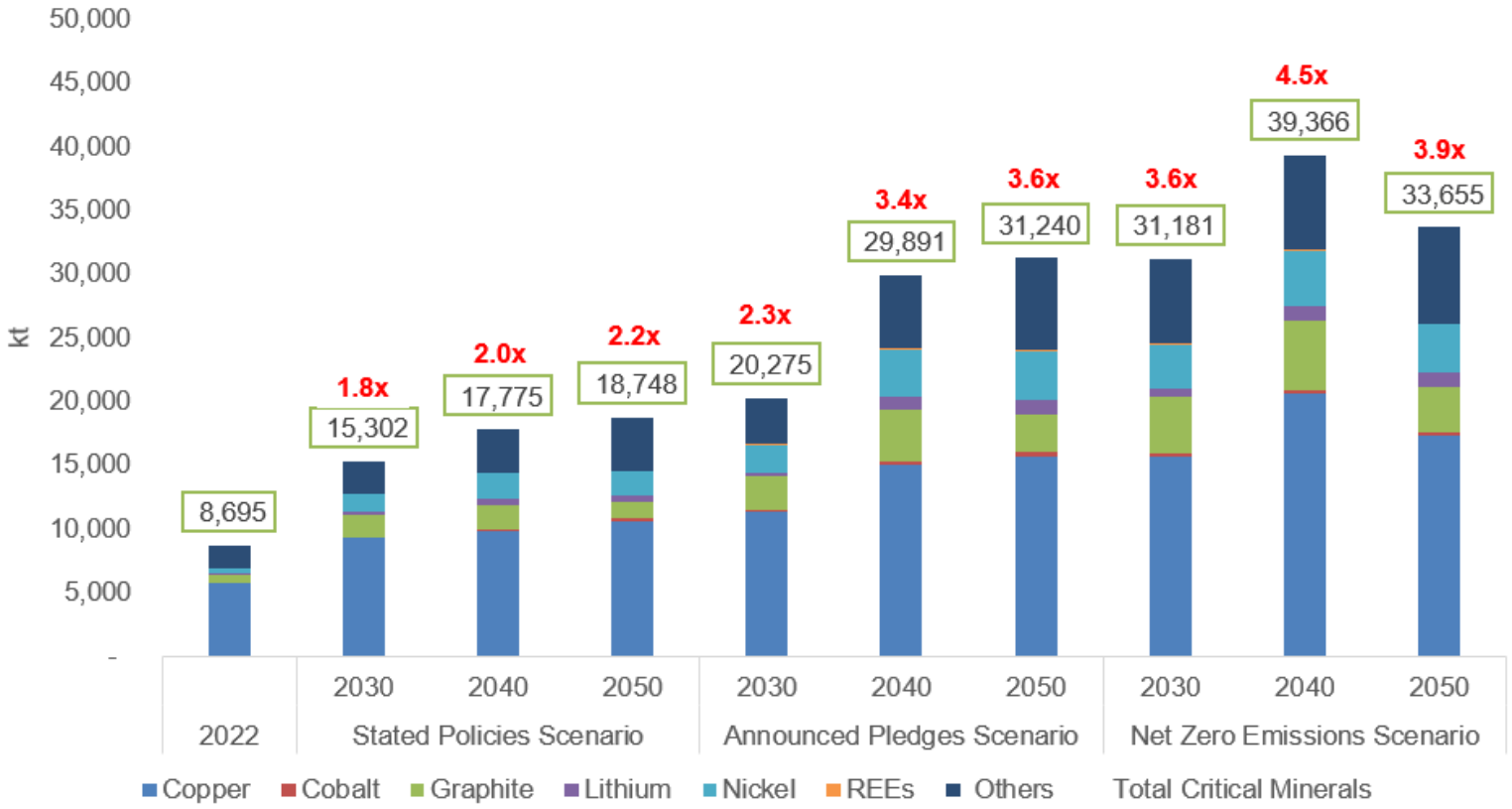
Projected growth in demand for selected CMs from clean energy technologies by scenario



REEs = rare earth elements. Text in red shows increase in demand indexed to 2022.
Source: ADB calculations based on data from the IEA Critical Minerals Data Explorer, data downloaded on 11 October 2023.

Demand for CMs is projected to rise dramatically in the next 2-3 decades due to climate pledges made under the Paris Agreement.

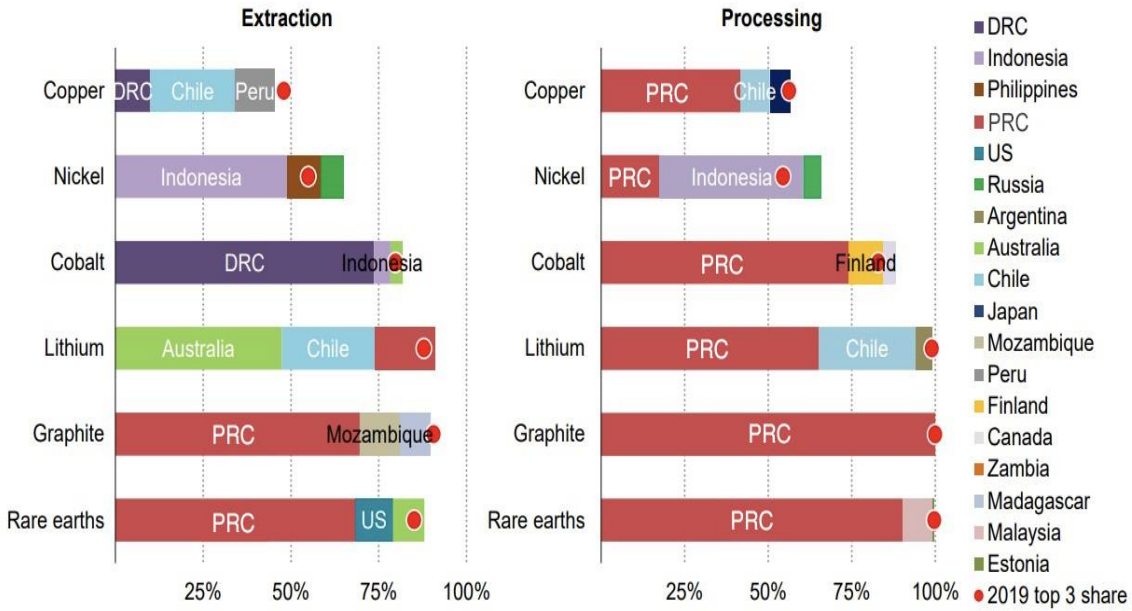
Electric vehicles and battery storage are the biggest drivers of this demand growth.

Critical Mineral Supply Chains at Glance

- High levels of concentration with a few dominant players.
- A majority of resource-rich DMCs are still limited to the upstream segment.
- Long lead times and significant financial risks.
  - Mines take an average of 16.5 years to move from discovery to first production.
  - The development of clean energy technology manufacturing facilities takes between 3 to 5 years, depending on the type of technology.

Source: IEA Critical Minerals Market Review 2023. https://iea.blob.core.windows.net/assets/afc35261-41b2-47d4-86d6-d5d77fc259be/CriticalMineralsMarketReview2023.pdf

Share of top three economies in total CM production and processing, 2022

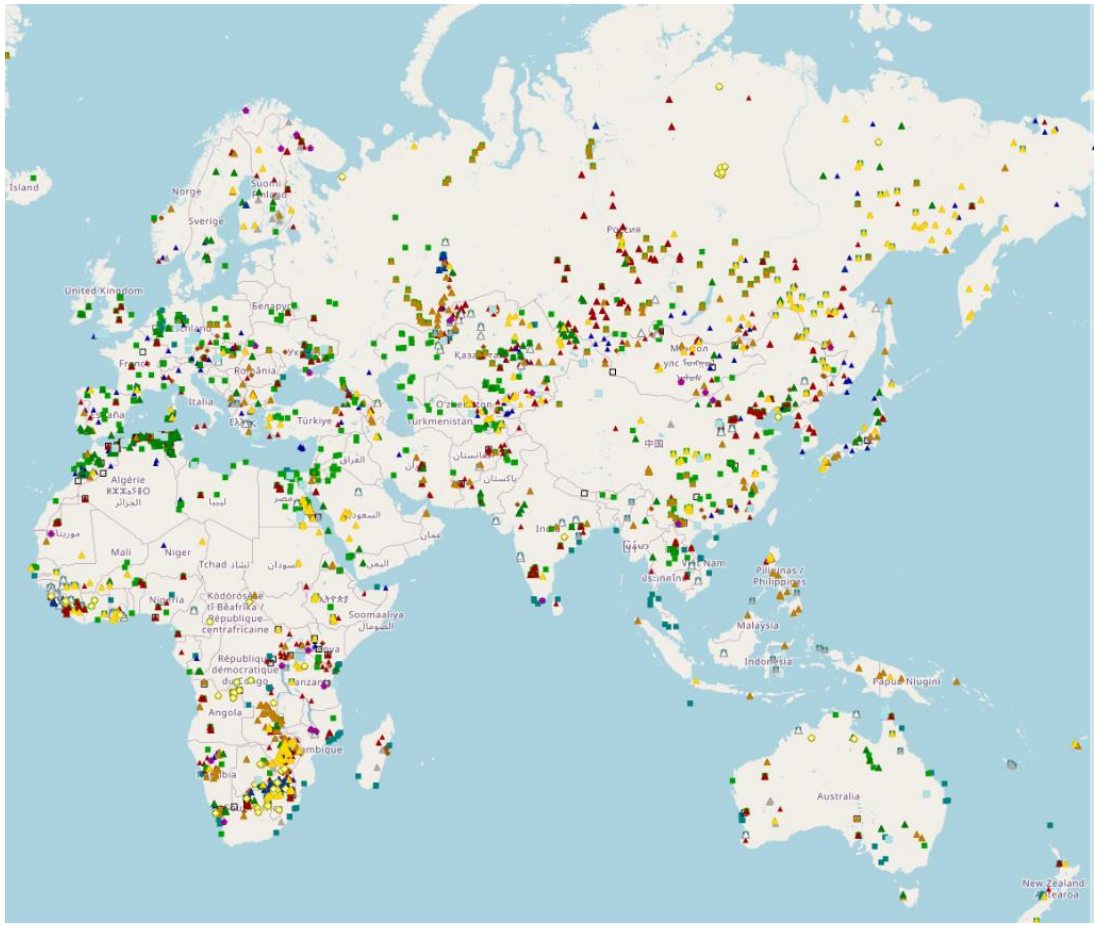


Source: IEA Critical Minerals Market Review 2023. https://iea.blob.core.windows.net/assets/afc35261-41b2-47d4-86d6-d5d77fc259be/CriticalMineralsMarketReview2023.pdf

There is a huge potential to bring together resource-rich and resource-seeking countries in Asia and the Pacific

- ✓Significant mineral resources
- ✓Favorable demographics
- ✓Existing base of related industries
- ✓Global supply chain integration
- ✓Untapped clean energy market

Major mineral deposits around the world



Source: US Geological Survey, https://mrdata.usgs.gov/major-deposits/map-us.html#home

New economic opportunities for DMCs with mineral wealth by building midstream and downstream capacities

Southeast Asian countries are well-positioned to meet ambitious goals by 2030

Solar PV

- 16 TW of solar PV technical potential regionally
- Malaysia, Thailand, and Viet Nam already produce 9%-10% of the world's solar PV cells and modules

70 GW → **125-150 GW**

Current footprint → Potential 2030 aspiration

Batteries

- The region holds 25% and 10% of global nickel and cobalt reserves respectively
- Indonesia and the Philippines produce ~50% of the world's nickel output

0 GWh → **180 GWh**

Current footprint → Potential 2030 aspiration

Electric 2-Wheelers

- Indonesia and Viet Nam account for ~16% of global 2W sales and 6%-10% of the world's E2W assembly capacity
- The region collectively makes up about 25% of the world's 2W market

1.4-1.6 million units → **4 million units**

Current footprint → Potential 2030 aspiration

2W = two-wheeler, **E2W** = electric two-wheeler, **GW** = gigawatt, **GWh** = gigawatt-hour, **PV** = photovoltaic, **TW** = terawatt

Sources: Solar PV: IRENA Renewable Energy Outlook for ASEAN (2022), InfoLink Consulting (Q1 2023); Batteries: US Geological Survey estimates as of 2022 E2W: A. Mahalana, Z. Yang and F. Posada (2021) "Indonesia transport electrification strategy"', company announcements, McKinsey Center for Future Mobility estimates as of 2022

Source: Asian Development Bank, Bloomberg Philanthropies, ClimateWorks Foundation, Sustainable Energy for All. 2023. Renewable Energy Manufacturing: Opportunities for Southeast Asia. https://www.adb.org/publications/renewable-energy-manufacturing-opportunities-southeast-asia

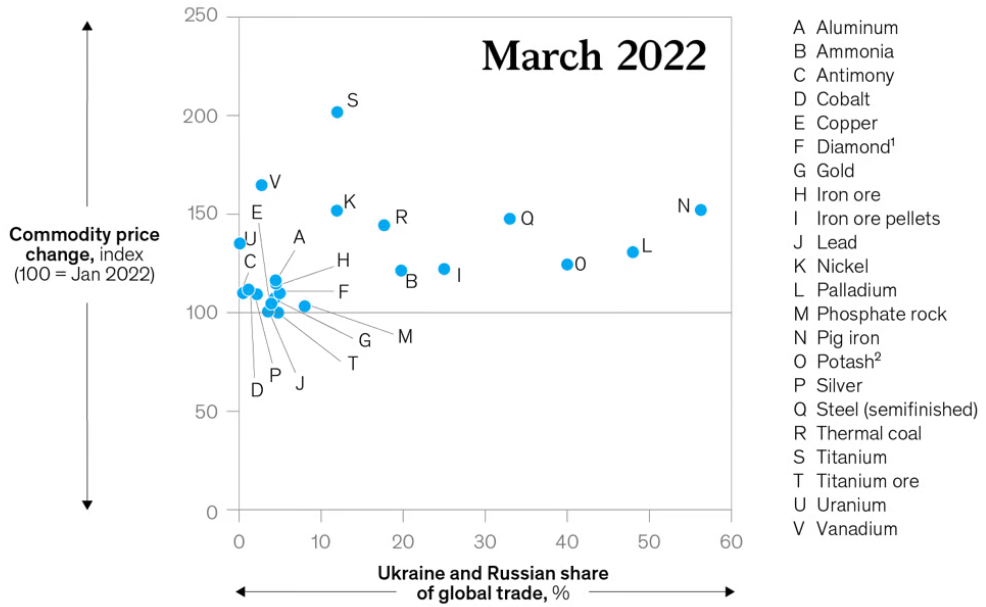
Critical Mineral Supply Chains are vulnerable to shocks due to various factors

Summary of supply chain risks

1	**External shocks**	Natural disasters, pandemics, wars, mine accidents, etc.
2	**Resource nationalism**	Tax disputes, expropriation, foreign investment screening, etc.
3	**Export restrictions**	Export quotas, export taxes, obligatory minimum export prices, licensing, etc.
4	**Mineral cartels**	Co-ordination of production, pricing, market allocation, etc.
5	**Political instability and social unrest**	Labour strikes, violence, corruption, etc.
6	**Market manipulation**	Short squeezing, market cornering, spoofing, insider trading, etc.

Source: IRENA 2023. Geopolitics of the energy transition critical minerals.

Immediate impact of Russian invasion of Ukraine on minerals prices



Note: Latest data refers to Apr 2023 except for palladium (Dec 2022), iron ore pellets (Feb 2023), and antimony (Mar 2023).
[1]Diamond price refers to IDEX diamond index for gem-quality diamond.
[2]Potash price refers to Brazil prices.
Source: Haver Analytics; Fastmarkets MB; Mysteel Global; SBB Steel; World Bank

Source: McKinsey&Co. 2023. War in Ukraine: Twelve disruptions changing the world—update.

How to Unlock Critical Mineral Potential towards a Just Transition

- Assess potential supply chain opportunities and challenges
- Build domestic production and downstream capabilities
- Investments in infrastructure and human capital development, and reforms to improve the overall business environment and build backward and forward linkages will have a bigger impact on domestic capacities than protectionist measures
- Government policies and incentives that encourage EV manufacturing, infrastructure development, R&D investment, and skills and education are critical
- Global partnerships are vital to unlocking investment potential and better management of environment, social, and governance risks