Oryx Insights

The Energy Transition: Impact on the Minerals Sector

The global energy transition, driven by the need for a sustainable, low-carbon future, is reshaping the energy landscape. Governments and corporations worldwide are making ambitious commitments to reduce carbon emissions, sparking a surge in demand for renewable energy systems, electric vehicles (EVs), and energy storage technologies. At the heart of this transformation are critical minerals such as lithium, cobalt, copper, and nickel, which are essential to enable these technologies.

For investors, understanding the interplay between energy transition and the minerals sector is crucial to capitalise on emerging opportunities and mitigate associated risks. The demand for minerals is set to rise significantly as the world moves away from fossil fuels, and supply constraints pose a substantial challenge that could derail progress if not addressed.

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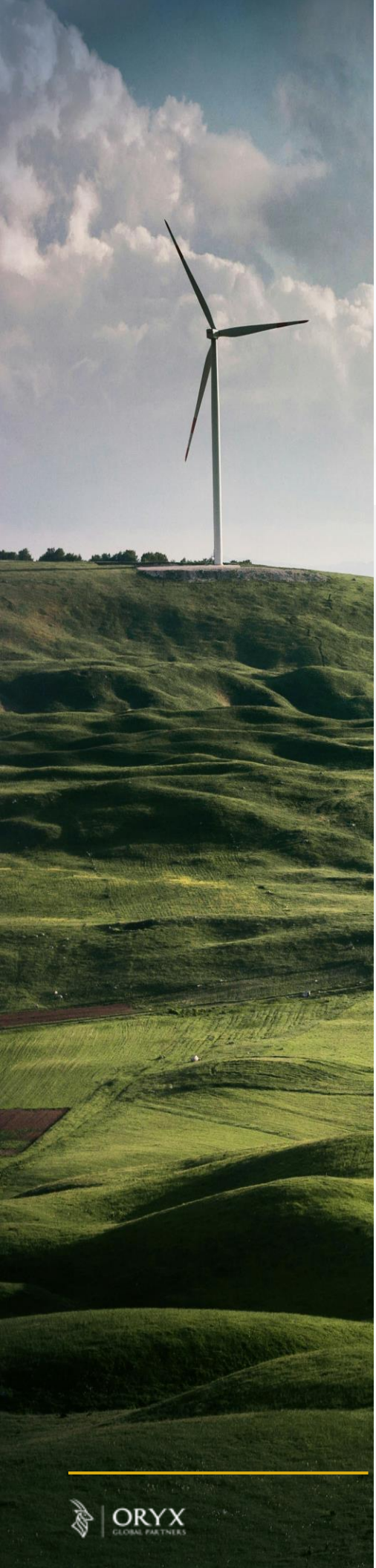


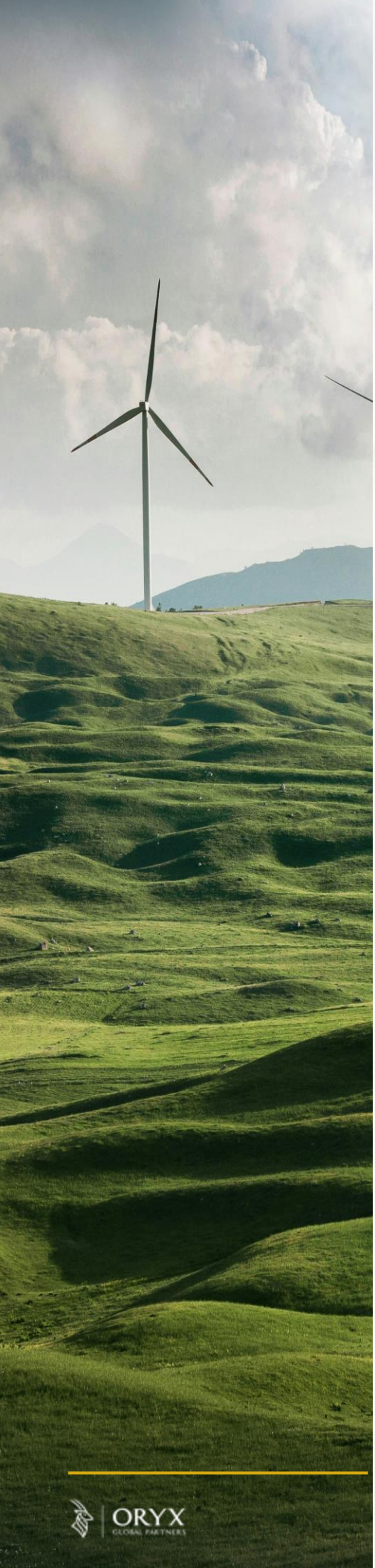
The Energy Transition

At the heart of the energy transition are ambitious commitments by governments and corporations worldwide to achieve net-zero emissions by 2050. All 195 countries who signed the 2015 Paris Agreement have put forward climate action plans and 145 countries have announced or are considering net zero targets, including major economies like the United States, China, and members of the European Union, representing nearly 90% of global emissions[1]. In support of these decarbonisation goals, Governments have actioned ambitious policies and allocated substantial funding such as the European Green Deal and the U.S. Inflation Reduction Act.

Inflation Reduction Act	European Green Deal
40% emission reduction by 2030	55% emission reduction by 2030
$370 billion over ten years	€1 trillion by 2030
Largest climate investment in US history	Climate neutral by 2050
	3 billion trees planted by 2030

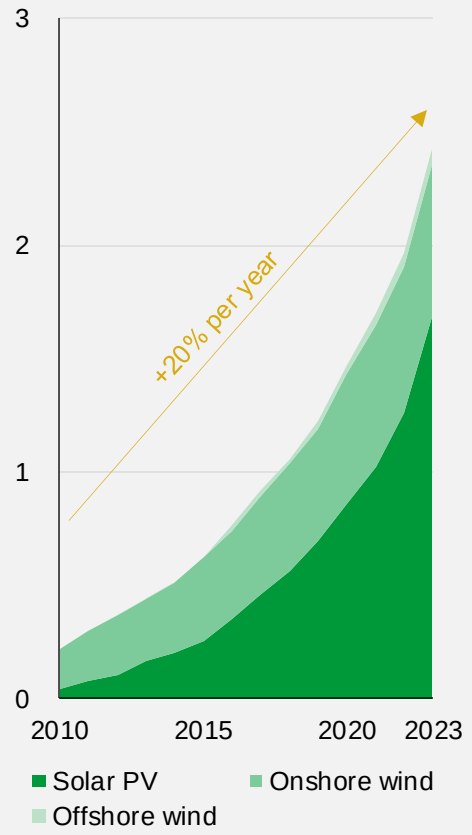
For corporates, 66% of Fortune 500 companies have made climate commitments[2] and more than 6,100 companies globally have joined the Science Based Initiative setting approved targets aligned with net zero goals[3].

Energy production and consumption are responsible for more than **85% of global carbon dioxide emissions**[4], making the transition to clean energy critical for achieving net-zero goals. Transforming the energy system — a vast and complex network with over **60,000 power plants**[4] and millions of kilometers of oil and gas pipelines — is essential for combating climate change. This energy transition involves integrating renewable energy technologies, electrifying transportation, decarbonising industries, and innovating in clean technologies like **hydrogen** and **battery storage.**

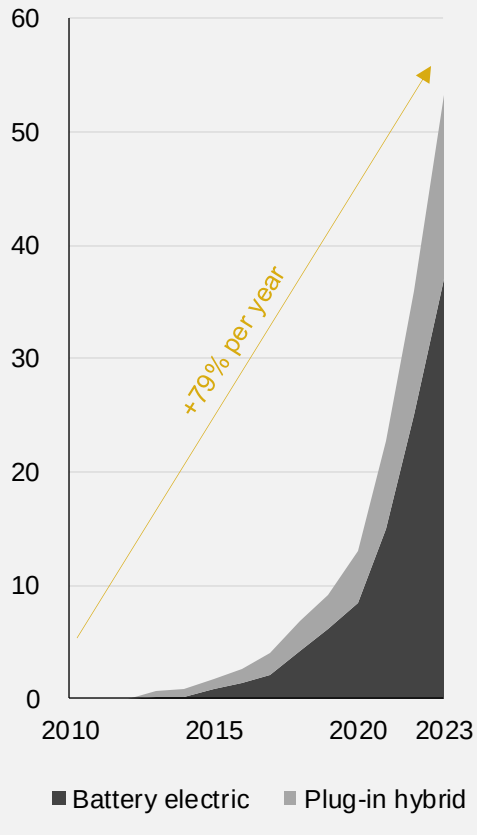


Unprecedented Growth in Renewable Energy and EVs

Installed Capacity of Wind and Solar
Terawatts



Electric Vehicle Passenger Car Parc*
Million Units



Source: McKinsey & Company, 2024.
*Note: Figures may not sum to 100%, because of rounding. *Battery electric vehicles and plug-in hybrid vehicles.*

Between **2010 and 2023**, global renewable energy capacity grew by **20% per year**, and the adoption of EVs surged with a compound annual growth rate of **79%**. Deployment of low emission power generation assets are only at **10% of what is required** to achieve net zero carbon emission goals by 2050, and EVs on the road would need to grow from **30 million today to 1 billion**[2]**.**

The **International Energy Agency (IEA)** estimates the *"world is on course to add **more renewable capacity in the next five years** than has been installed since the first commercial renewable energy power plant was built more than 100 years ago"* and increase global capacity **2.5x by 2030**[5].

Moreover, expanding energy access in emerging economies, where hundreds of millions still lack reliable electricity, is expected to further increase total installed capacity.

To deliver on these goals, substantial raw materials that make up the components of the energy system will be required.

The Role of Minerals in Supporting the Energy Transition

Renewable energy technologies, EVs, electrification, and energy storage systems heavily rely on critical minerals such as lithium, cobalt, copper, nickel, graphite, zinc, silicon and rare earth elements (REEs). These materials are essential for building the infrastructure needed to power the transition to a low-carbon economy.

Electric Vehicles

Each EV requires 80 kg of copper, about **4x** the amount used in conventional internal combustion engine vehicles[6]. EV batteries, primarily **lithium-ion**, also depend on significant amounts of lithium, cobalt, graphite and nickel. Roughly 1kg of REEs are required per electric motor in EVs.

Solar Panels and Wind Turbines

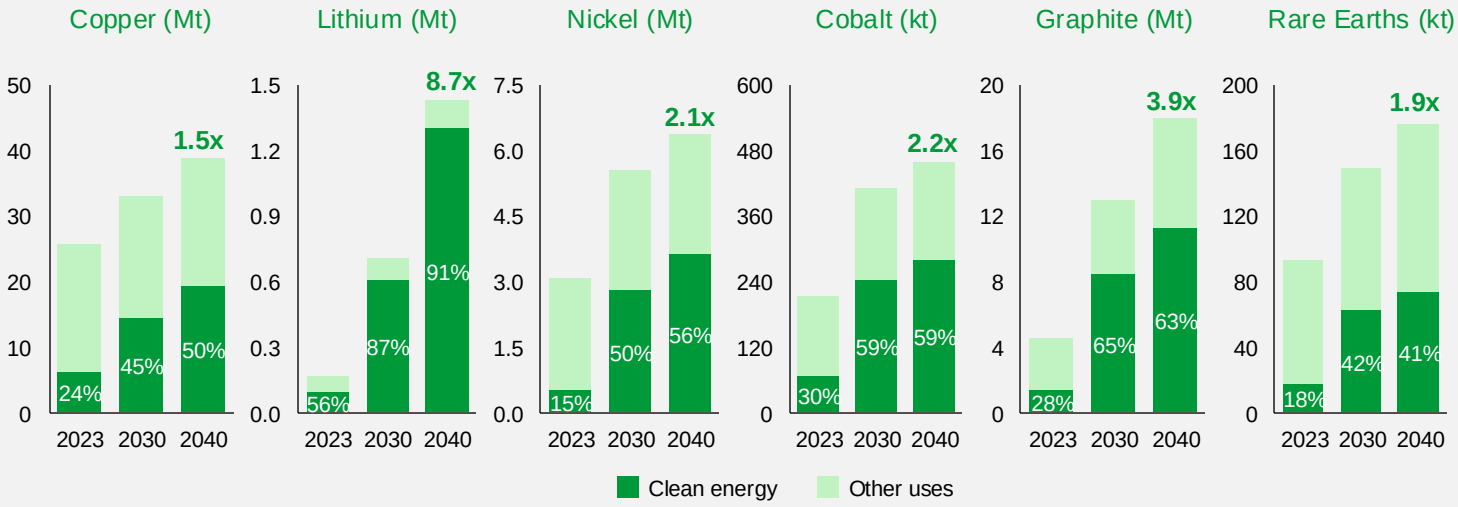
Renewable energy installations are heavily reliant on **copper** and **REEs**. **Solar photovoltaic (PV)** systems use approximately **5.5 tons of copper per megawatt (MW)** of installed capacity, while **onshore wind turbines** require **3.9 tons of copper per MW**, and **offshore wind turbines** need **10.5 tons per MW**[8]. Additionally, **REEs** are critical for the high-performance magnets used in wind turbine generators, significantly improving efficiency.

Energy Storage Systems

Like EVs, battery storage systems are crucial for supporting renewable energy grids and depend on a similar mix of minerals such as **lithium, cobalt,** and **nickel**.

The IEA projects **critical minerals demand growth** of **between 1.5x (copper) and 8.7x (lithium) by 2040**[7], with clean energy applications accounting for between 41% to 91% of total use.

Global Critical Minerals Demand*



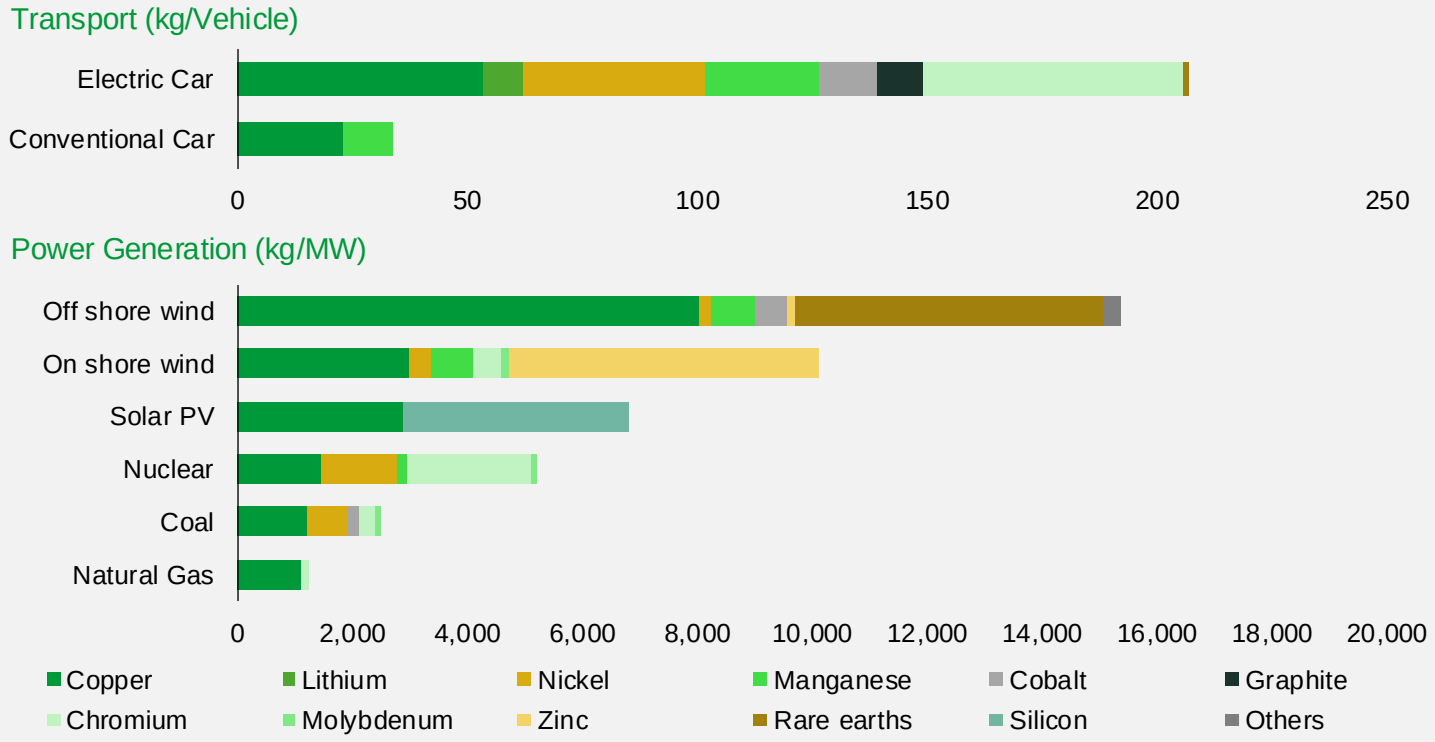
Source: IEA, 2024
*Notes: The figures for copper are based on refined copper. Those for rare earth elements are for magnet rare earth elements only. Growth rates (in green) are between 2023 and 2040. *Net Zero Emissions by 2050 Scenario*

Overall, energy transition technologies require significantly more minerals than traditional systems:

An electric vehicle requires **6x more minerals** than a conventional gasoline-powered car[8].

A wind turbine requires **9x more mineral** inputs than a gas-fired power plant[8].

Minerals Used in Selected Clean Energy Technologies



Source: IEA, 2022
Note: Steel and aluminium not included.

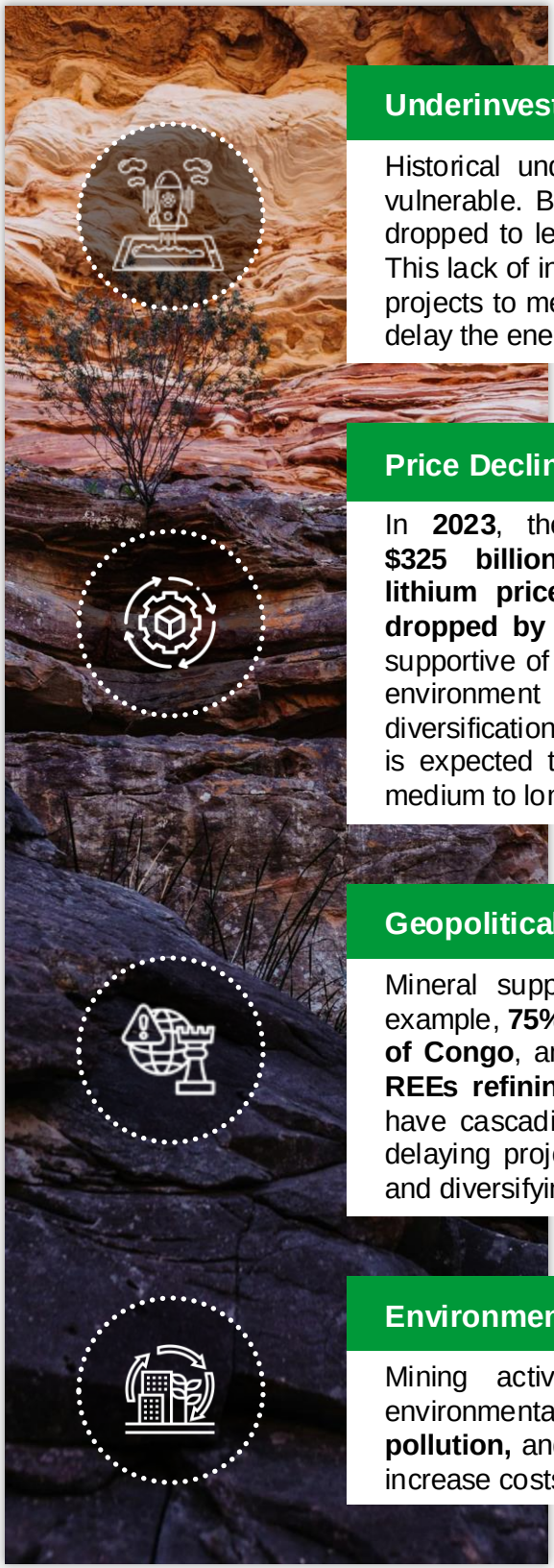
Market Value Growth

The global market for energy transition minerals is expected to more than double, reaching **$770 billion by 2040**[7]. Copper and lithium are expected to be the main beneficiaries of this growth accounting for 43% and 30% of the market respectively, underscoring their economic significance in the coming decades[7].

Without these critical minerals, the energy transition could stall. Current supply levels are only 10% to 35% of what is needed to meet demand projections by 2050[4]**. The IEA estimates that investment of $800 billion in the mining sector is needed by 2040 to meet net zero targets**[7]**.**

Challenges and Risks to Mineral Supply Chains

The growing demand for critical minerals presents several challenges and risks that could disrupt the energy transition:



Underinvestment in Exploration and Development

Historical underinvestment in mineral exploration has left supply chains vulnerable. Between **2013 and 2020**, global capital expenditure in mining dropped to less than **10% of revenue**, compared to **15% a decade ago**[9]. This lack of investment has resulted in an insufficient pipeline of new mining projects to meet forecast demand. By 2030, shortfalls in key minerals could delay the energy transition and significantly drive up prices.

Price Declines and Consequential Supply Dynamics

In **2023**, the global market for critical minerals shrank by **10%** to **$325 billion**[7], driven largely by sharp declines in mineral prices; **lithium prices fell by 75%**[7], and **cobalt, nickel and graphite prices dropped by 30-45%**[7]. 2024 performance has continued this trend. Whilst supportive of lower energy transition costs in the short term, the lower price environment has also led to reduced investment in new projects, diversification and the mothballing of upper quartile operational assets which is expected to exacerbate the supply shortfall as demand picks up in the medium to long term.

Geopolitical Risks

Mineral supply chains are highly concentrated in a few regions. For example, **75% of the world's cobalt** comes from the **Democratic Republic of Congo**, and more than **60% of cobalt, lithium, natural graphite and REEs refining** takes place in **China**[4]. Disruptions in these regions could have cascading effects on the global supply chain, driving up costs and delaying projects. This highlights the urgency of developing new projects and diversifying supply chains.

Environmental and Social Challenges

Mining activities have historically been associated with significant environmental and social impacts, such as **land degradation, water pollution,** and **social conflicts**. These issues can delay project approvals, increase costs, and complicate efforts to scale up mineral supply.

Investment Outlook and Opportunities

Despite the risks, the minerals sector presents substantial opportunities for investors. The IEA estimate of **$800 billion of investment required** in the minerals sector by **2040** to meet net zero targets[7] highlights the magnitude of the opportunity in the sector.

Demand Growth from Energy Storage Systems

Based on current technologies, lithium, nickel and cobalt are expected to see the most significant growth in demand, driven by the expansion of EV production and energy storage technologies. Subject to changes in technology, companies involved in the exploration and production of these metals may be well-positioned to benefit from the long-term demand growth.

Electrification

Copper is uniquely positioned to experience growth from the advancement of all the most important clean energy technologies given its conductivity. Energy transition related demand for copper is projected to increase by 50% by 2040[7], making it a valuable target for investment. In addition, higher copper prices combined with increased transmission requirements driven by growing electricity demand and renewable energy deployment are expected to boost the use of aluminium conductor steel-reinforced cables.

Sustainability Advantages

As sustainability becomes a more pressing concern for financiers and customers, minerals project developers and operators who prioritise responsible and sustainable operating standards will have a competitive edge and those who don't will face significant frictions to success. Investors can position themselves favourable by seeking opportunities in projects that emphasise appropriate standards of operation.

Innovations to Bridge the Supply Gap

To meet the growing demand for energy transition minerals, the mining sector must innovate. Several technologies and practices are emerging to address supply challenges. Investment in technological innovation allows companies to benefit from the value inherent in the technology at large as well as the value in any unlocked resource. Technologies include, for example:

- **AI-Driven Exploration:** Artificial intelligence is being used to identify new mineral deposits more efficiently, reducing exploration costs and accelerating the discovery of critical resources.
- **Direct Lithium Extraction (DLE):** The DLE process aims to improve the efficiency of lithium recovery from brines, reducing the environmental impact of traditional mining methods.
- **Low grade ore leaching:** Allows for the extraction of valuable metals from ores that would otherwise be uneconomic to process, maximising the recovery of existing and otherwise stranded resources.
- **Recycling Initiatives:** Recycling will play a critical role in addressing mineral shortages. As more batteries and electronics reach the end of their life cycles, recycling programs can reclaim valuable minerals, reducing the need for virgin mineral production. The European Union aims to meet 25% of its critical mineral needs through recycling by 2030[10].

Concluding Remarks

The energy transition is reshaping the global economy, putting certain minerals in strategic positions to benefit from macroeconomic tailwinds. Without immediate investment in exploration, development and recycling, mineral shortages could delay the energy transition, drive up costs, and derail efforts to combat climate change.

For investors, the minerals sector offers significant potential for those investors with the financial, technical and operational expertise to capitalise on the opportunity. By focusing on future facing minerals, responsible & sustainable practices, and innovation, investors can help accelerate the energy transition and achieving robust long-term financial returns.

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2. McKinsey & Company, "*The energy transition: Where are we, really?*", August 2024
3. Science Based Targets, https://sciencebasedtargets.org/
4. McKinsey Global Institute, "*The Hard Stuff*", August 2024
5. IEA, "*Renewables 2023*", January 2024
6. Reuters, "*Innovation in EVs seen denting copper demand growth potential*", July 2023, https://www.reuters.com/business/autos-transportation/innovation-evs-seen-denting-copper-demand-growth-potential-2023-07-07/
7. IEA, "*Global Critical Minerals Outlook 2024*", May 2024
8. IEA, "*The Role of Critical World Energy Outlook Special Report Minerals in Clean Energy Transitions*", March 2022
9. World Economic Forum, "*Securing Minerals for the Energy Transition*", December 2023
10. European Commission, Critical Raw Materials Act, https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials/critical-raw-materials-act_en

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