

Inside the CMI Hitlist: The Five Critical Minerals Shaping Global Supply Chains

written by Alastair Neill | October 10, 2024

In my role with the [Critical Minerals Institute](#) (CMI), I am responsible for overseeing and tracking 11 international **critical minerals lists**, which are essential for the future of industries like energy, technology, and defense. You can access these lists [here](#). With nearly five decades of experience in engineering and metallurgy, and three decades dedicated to Critical Minerals—particularly rare earths—I've had the opportunity to travel the world, gaining firsthand insight into global supply chains and resource management. This experience has allowed me to identify a significant pattern: **five key minerals—Cobalt, Gallium, Graphite/Carbon, Platinum Group Metals (PGMs), and Rare Earths—consistently appear on 10 of the 11 critical lists** we monitor at the CMI. Today, I'll share my insights on the strategic importance of these minerals and their role in shaping the future of critical industries.

Unsurprisingly, the common thread among these minerals is China's dominance in their supply chains. For three of these five minerals, China controls the vast majority of production, while it's deeply embedded in the supply chain for **Cobalt** through its influence in the Democratic Republic of Congo (DRC). This dominance presents a significant risk to global supply chains, especially as the world transitions to a greener economy.

In the global push toward a greener economy, a handful of critical minerals—**Cobalt, Gallium, Graphite/Carbon, Platinum**

Group Metals (PGMs), and Rare Earths—are emerging as the backbone of modern technology and renewable energy. These minerals are indispensable for electric vehicles (EVs), wind turbines, and advanced electronics. However, a crucial fact overshadows this transition: China controls the lion's share of their supply and production.

Across sectors, from automakers to tech giants, the reliance on China and a few geopolitically sensitive regions like the Democratic Republic of Congo (DRC) is raising alarms. As nations and industries aim to secure supply chains while adhering to environmental and ethical standards, China's dominance, coupled with complex ESG challenges, is increasingly seen as a vulnerability.

Cobalt: The DRC's Ethical Minefield

Cobalt, essential for lithium-ion batteries, is primarily mined in the DRC, which produces roughly two-thirds of the world's cobalt. These reserves are vital for the production of EVs and renewable energy storage systems, both cornerstones of the energy transition. However, cobalt mining in the DRC is fraught with human rights abuses, including child labor and unsafe working conditions, creating major ESG (Environmental, Social, Governance) concerns for global corporations.

The DRC holds more cobalt reserves than the rest of the world combined, making it the epicenter of supply. Yet, China dominates the refining process and has deep ties to the Congolese mining industry, controlling significant parts of the cobalt supply chain. As demand for EVs and energy storage surges, companies face the challenge of balancing the need for this critical resource with ethical sourcing practices—a tension that is becoming harder to resolve.

Gallium: A Critical By-Product in Short Supply

Gallium, while less well-known, is pivotal in the tech world, particularly for semiconductors and LEDs. It is not mined directly but produced as a by-product of bauxite and zinc ore processing. In 2022, China accounted for 98% of the world's gallium production, according to US Geological Survey (USGS) figures. Last year, China imposed export restrictions on gallium and germanium, leading to a 50% price surge in early 2023 and halving exports from 2022 to 2023.

These restrictions reflect China's strategic use of its mineral dominance, disrupting global supply chains. As Western countries scramble for alternatives, the dependency on China has become a stark reminder of the fragile nature of critical mineral supplies. Securing alternative sources of gallium, however, is proving difficult, with few countries able to step in.

Graphite: The Unsung Hero of Battery Tech

Graphite, both in its natural and synthetic forms, plays an essential role in the anodes of lithium-ion batteries. In 2023, China produced around 75% of the world's natural graphite, with similar dominance in the synthetic market. China's export volume for synthetic graphite is double that of the next four largest producers—Germany, Japan, the U.S., and South Korea—combined.

As the demand for EVs and energy storage continues to grow, graphite's role becomes more critical. However, China's dominance in the market creates vulnerabilities, particularly as synthetic graphite is also a precursor to graphene, a high-tech material with enormous potential. The West's dependence on China for graphite, like cobalt, is an emerging concern for companies seeking to ensure secure supply chains.

Platinum Group Metals: Russia and South Africa Lead the Way

Platinum Group Metals (PGMs), particularly platinum and palladium, are primarily used in catalytic converters, which reduce emissions in gasoline-powered vehicles. According to the USGS, global production of palladium in 2022 reached 210,000 kilograms, with Russia and South Africa producing the bulk—88,000 kg and 80,000 kg, respectively. Platinum production reached 190,000 kg, with South Africa contributing the lion's share at 140,000 kg.

While PGMs are critical today, especially in conventional vehicles, the rise of EVs is expected to diminish demand for catalytic converters. However, their use in fuel cells and other technologies may keep PGMs relevant in the longer term, despite shifting market dynamics.

Rare Earths: China's Stronghold on Magnet Production

Rare earth elements have become synonymous with cutting-edge technology, used in everything from wind turbines to EV motors. China dominates both the mining and refining of these materials. While there are alternative sources of rare earths, such as [Lynas Rare Earths Ltd.](#) (ASX: LYC) in Australia and [MP Materials Corp.](#) (NYSE: MP) in California, China still controls the critical step of separating and refining rare earths into usable products.

One of the most significant applications of rare earths is in the production of rare earth magnets, vital components in electric motors and wind turbines. Although some non-Chinese companies, like Lynas, have invested in expanding their

production capabilities, the global market remains heavily reliant on Chinese refiners, raising concerns about supply chain security.

The Race for Alternatives

China's overwhelming dominance in these critical minerals has sent governments and industries scrambling to secure alternative supply chains. Both the U.S. and Europe have passed legislation aimed at developing domestic production of critical minerals. The **U.S. Inflation Reduction Act (IRA)** and the **European Critical Raw Materials Act** are steps toward reducing dependence on China, but it will take years for these initiatives to bear fruit.

In the meantime, industries reliant on these minerals face a balancing act. They must manage the geopolitical risks associated with heavy reliance on China while navigating the complex ESG issues tied to mining in places like the DRC.

Securing the Future

As the global economy increasingly hinges on clean energy technologies and advanced electronics, the strategic importance of critical minerals will only grow. With China exerting considerable control over much of the supply chain, securing reliable, ethical, and diversified sources of these materials has become a top priority for companies and governments alike. The race is on—not just for control over critical minerals but for the future of key industries driving the 21st-century economy. For now, China holds a strong hand, but the pressure to develop alternative supply routes is mounting.

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