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Rare Earth Supremacy: China's Ace in the Clean Technology Competition

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SYNOPSIS

In October 2024, China's first comprehensive regulation to tighten state control over the critical sector of rare earth resources took effect. Coming amid the global transition towards clean energy, the regulation demonstrates China's increased leverage of its rare earth monopoly to outpace its geopolitical rivals like the United States, which remains far behind China in this sector. Intensified competition for rare earth elements risks overshadowing collaborative efforts to develop clean technology.

COMMENTARY

In the race to develop clean technology, major polluting countries like the United States and China compete to lead in producing renewable energy products, striving to achieve environmental goals while enhancing national competitiveness. Rare earth elements (REE) — a group of 17 soft, heavy chemical elements — are major components for clean technologies like wind turbines, electric vehicles, and solar panels. The International Energy Agency projects that demand for REE could rise to 3–7 times current levels by 2040. Consequently, Western powers, such as the United States and the European Union, are under increasing pressure to secure essential REE for clean technologies needed to transition to a low-carbon economy. However, limited access to REE could hinder their ability to meet these goals.

China's Monopoly in the Rare Earth Sector

Despite US dominance in rare earth mining from the 1960s to 1980s, environmental movements and regulatory pressures eventually led companies to relocate to China or close the US mines. Subsequently, China's low costs, fuelled by state subsidies and lax environmental standards, allowed it to surpass the United States in the rare earth industry. Currently, China dominates the rare earth supply chain, controlling

approximately 60 per cent of global mining operations, over 85 per cent of processing capacity, and more than 90 percent of permanent magnet production.

Trade frictions between China and the United States, the world's two largest greenhouse gas emitters, are particularly hindering progress in the clean energy transition. In September 2024, the United States raised tariffs on Chinese electric vehicles to 100 per cent and significantly increased tariffs on other Chinese green technologies, including solar products. However, heavy reliance on China for the rare earths needed for the United States to independently produce these technologies has raised concerns that this dependency could become a significant vulnerability in the escalating tech war.

Global reserves of rare earths outside China include 19 per cent in Vietnam, 18 per cent in Brazil, 6 per cent in India, and 4 per cent in Australia. However, while alternative sources exist among these countries that the United States or its allies are friendly with, scaling up production to meet increasing demand remains a substantial challenge. For instance, China's exceptional processing capacity of 220,000 tonnes per year — five times the combined capacity of the rest of the world — would take other countries years to match.

China's Leverage of Rare Earth Elements

China is increasingly weaponising its dominance in REE to impose costs on its rivals in trade disputes. The resulting market dynamics are seen as producing externalities that adversely affect foreign clean technology businesses dependent on Chinese rare earth exports, potentially slowing the transition to renewable energy.

In October 2024, China's first comprehensive regulation on rare earth resources took effect. As illegal mining and smelting have persisted in the country, the regulations introduce stringent rules governing the mining, refining and separation, metal smelting, integrated utilisation, product distribution, import and export of rare earths. Companies violating the regulations may face fines of 5–10 times their illegal gains. Consequently, rare earth supplies are expected to tighten, and prices of REE are expected to increase.

The regulation is seen as a move that could undermine the competitiveness of foreign clean technology products reliant on China-supplied rare earths as business would pass these higher costs on to their customers. Ultimately, the adoption of clean technologies like wind turbines and electric vehicles in countries like the United States could be slowed.

Earlier, in June 2024, Beijing declared rare earth resources to be state-owned and placed the industry under government oversight, ensuring product traceability. While framed as securing national and industrial interests, the move is widely seen as ensuring leverage in the ongoing trade dispute between the United States and China.

The new regulation extends China's previous leverage over its control of the entire rare earth supply chain. In December 2023, China banned the export of technology for manufacturing rare earth magnets, which are essential components in many clean energy technologies, such as wind turbines. Additionally, in January 2022, Beijing

banned foreign direct investment in rare earth mining projects. The ban was described as having "injected even more urgency" into Western efforts to diversify their mineral supply chains away from China.

Furthermore, the Chinese government is reportedly planning to offer direct grants and low-interest loans to its rare earth industry. Such a move would lower operating costs and allow Chinese companies to thrive in market conditions that are challenging to others, thereby dominating global processing capacity.

Mountain Pass, owned by MP Materials, is the only large-scale rare earth mining and processing facility in North America. *Image from Wikimedia Commons.*

Obstacles to US Efforts to Reduce Dependence on China

China's geopolitical rivals view Beijing's rare earth monopoly as "a risk to national security" because of their strong dependence on Chinese exports.

As a challenger of China in the competition for developing clean technology, the United States is actively investing in various stages within the REE supply chain to reduce its reliance on China. Through its Manufacturing Capability Expansion and Investment Program, the US Defense Department (DOD) has launched a five-year strategy to establish a full domestic rare earth supply chain, covering sourcing, separation, processing, metallisation, alloying and magnet manufacturing. Australia's Lynas Rare Earths, the only commercial-scale source of separated rare earths outside of China, received over US$258 million from the DOD to establish a production facility in Texas. Additionally, the DOD awarded US$45 million to MP Materials, which claims to be the "only scaled producer of rare earth materials in the Western Hemisphere", to enhance domestic light and heavy rare earth processing capacity.

However, such efforts would not result in immediate challenges to China. The United States still lacks a complete domestic value chain from mining to magnet production. One of the primary reasons is that mining projects in the United States often have long

lead times, with records indicating it takes around 16 years to complete permits and construction for production to begin.

The United States has also launched the Minerals Security Partnership (MSP) with key countries like Australia, which ranks just behind China in "exploration investment, reserves, and capital expenditure"; India, known for its manufacturing capabilities; and Japan, which plays a major role in financing. This partnership aims to address supply chain vulnerabilities in essential minerals like REE.

Nevertheless, as of 2024, MSP has seen minimal investment and lacks technological expertise, raising doubts about the partnership's capacity to be a feasible alternative to China. Additionally, environmental concerns could be a significant hurdle to developing the partner countries' rare earth mining or production capability. Each ton of rare earth produced generates 13 kilograms of dust, 9,600–12,000 cubic metres of waste gas, 75 cubic metres of wastewater, and one ton of radioactive residue, all of which have harmful health effects. Notably, Mountain Pass, the only large-scale rare earth mine and separation facility in North America, closed in 2002 after a toxic waste spill and remained shut for years. US mining companies are also struggling to recruit skilled workers, slowing down the US ambition to boost its domestic production capability.

Conclusion

Geopolitical tensions over resources and technology are hampering the clean energy transition. Energy transition is not intended to be a zero-sum game as all can benefit from clean energy products in a free trade situation, and therefore from reductions in global greenhouse gas emissions. However, growing supply chain fragmentation increasingly sees major economies prioritising supply security through the lens of national self-interest. Additionally, the intensified drive for rare earth extraction could further environmental degradation, thereby undermining global efforts to achieve net-zero carbon emissions.

Although it is unlikely that other countries will surpass China in rare earth production in the foreseeable future, a promising pathway to create a less polarised geopolitical landscape around REE and to reduce pollution is emerging in the form of recycling this resource from obsolete equipment.

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