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The race for critical raw material self-sufficiency

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In a nutshell

Green technology requires increasing amounts of critical raw materials

The U.S. and EU's reliance on Chinese resources raises security concerns

China could weaponize its mineral wealth as leverage in disputes

A secure supply of critical raw materials (CRMs) is essential for the stability of entire economic value chains. These CRMs have a wide range of commercial and military applications, extending well beyond renewable energies. They are crucial in everything from mobile phones and computer hard drives, to batteries for electric vehicles, as well as precision-guided missiles and high-tech ammunition.

China is the world's largest producer of lithium batteries for electric mobility and commands a 60 percent share of the global electric vehicle (EV) market. By strategically dominating the mining, metallurgy and material science sectors – often referred to as the “three Ms” – China dominates much of the world's clean-tech supply chains.

In contrast to China, the European Union and the United States are heavily dependent on imports of CRMs from abroad, and thus on international commodity markets and access to foreign mines. Currently, China accounts for 98 percent of the EU's supply of rare earth elements (REEs) and around 60 percent of its CRMs.

Much like Russia, China is prone to leveraging its natural resources at times of geopolitical tension. In 2010, China unexpectedly imposed an export ban on REEs to Japan during an episode of heightened friction.

Rising demand for critical raw materials

In 2017, a World Bank study explicitly warned that the global energy transition and climate protection policies would demand significantly greater use of CRMs than previously forecasted. This was confirmed by the United Nations Environment Programme, which stated that achieving the 2-degree Celsius target of global climate protection policy would require approximately 600 million tons more metallic raw materials than a 6-degree Celsius scenario by 2050.

The International Energy Agency has forecasted that global demand for CRMs could increase up to 40 times between 2020 and 2040. Specifically, for rare earths used in magnets, demand may increase fivefold by 2040. To achieve net-zero emissions targets, the world might need as much new copper as has been produced in all recorded history.

Although there are generally no severe geological shortages of CRMs, concrete challenges in extraction, processing or recycling arise due to numerous factors. These include instability in producing countries, restrictive environmental regulations, poor governance and resource nationalism at a time when the global demand and access to a stable supply of CRMs will further intensify in the next decades.

Mining projects and plants in the U.S. and the EU often face rocketing investment needs and budget overruns, leading to delays, missed production targets and insufficient commercial profitability. These projects must also contend with the challenge of competing against low, subsidized Chinese prices. Any goods made using critical materials sourced in North America or Europe inevitably see an increase in the cost of the final products, whether in renewable energy sectors or in manufacturing high-tech weaponry.

For example, rare earth magnets in the U.S. are about 50 percent more expensive than their Chinese counterparts. Moreover, even new reprocessing initiatives by American or European companies depend on Chinese technology, to which Beijing can restrict access. Indeed, last year, China banned exports of rare earth processing technology.

Efforts to enhance supply security

It was not until 2017 that the European Commission, along with member states including Germany, began to lay out industrial strategies to address the challenges of raw material supplies for electromobility and to start construction of newly planned battery gigafactories. Currently, the 27 EU countries can only produce 9 percent of the bloc's critical raw material needs.

In 2020, Europe accounted for just 5 percent of global mining, making it the only region in the world where the industry is declining. Global demand for lithium is expected to increase eighteenfold by 2030, while demand for REEs and cobalt could rise tenfold and fifteenfold respectively by 2030, and cobalt even sixtyfold by 2050.

In 2010, the EU and Germany introduced a “three-pillar strategy” for their raw materials policy, focusing on utilizing domestic raw materials, importing primary raw materials that are not available in Germany, and reducing dependence on primary materials through recycling, substitution and resource efficiency. Concerns about the EU's raw material supply security are mirrored in the commission's evolving list of CRMs, which has steadily expanded from 14 items in 2011 to 34 in 2023.

The escalating chip war between China and the West

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In March 2022, the EU launched the Critical Raw Materials Act (CRMA), addressing numerous challenges in securing raw material supplies and setting broad objectives to enhance self-sufficiency by 2030. Goals include increasing the EU's raw material extraction to at least 10 percent of its annual consumption, boosting processing capacity to 40 percent (a significant rise from the previous 0-20 percent), ensuring 15 percent of consumption through recycling, and limiting imports of any strategic raw material from a single third country to a maximum of 65 percent of annual consumption.

The CRMA also aims to reduce administrative burdens and shorten permitting procedures for CRM projects in the EU, while still ensuring a high level of social and environmental protection. Selected strategic projects will receive financial support (as in Spain, Portugal, Serbia, Sweden and Norway) and provide shorter approval periods (24 months for promotional projects and 12 months for processing and recycling projects).

Like the EU, the U.S. has supported domestic mining and similar initiatives in other G7 countries with democratic, market-based economies. The Mountain Pass mine in California, once the world's largest rare earth mine, resumed operations in 2012 and now contributes 15 percent to global rare earth production.

Over the past four years, the Pentagon has invested approximately \$1 billion in global rare earth projects through its Defense Production Act. Additionally, the National Defense Stockpile program maintains CRM inventories in preparation for potential conflicts with China or Russia. The Minerals Security Partnership (MSP) enhances cooperation, information exchange and joint financing for stable CRM supplies among the U.S., EU and 13 other countries.

The U.S. Inflation Reduction Act (IRA) and the CHIPS & Science Act also promote domestic and friendshoring projects of more resilient supply chains for CRMs.

The IRA and the Foreign Entity of Concern (FEOC) rules promote cooperation with partners to reduce their dependence on China. The FEOC rules mandate that to qualify for IRA tax credits, Chinese state-owned companies must not control more than 25 percent of a given operation in a non-FEOC country.

Scenarios

Most likely: Transatlantic progress amid insufficient de-risking from China

In this likely scenario, both the EU and U.S. will significantly enhance their supply security and resilience, yet they will still depend on China in the medium term. Despite establishing circular economies with expanded recycling capacities, their CRM strategies may prove insufficient. The EU, in particular, will face challenges like bureaucratic overregulation and local opposition due to environmental concerns. Additionally, Chinese counterstrategies in the global supply market could further complicate efforts.

The EU's raw material policies are hindered by the lack of coherent supranational sovereignty (in contrast to its gas and electricity sectors), which affects its ability to compete effectively with China in the global CRM extraction and processing markets. Unlike the U.S., neither the EU collectively nor its individual member states yet have CRM stockpiling strategies.

Uncertain: EU succeeds in boosting its CRM capacity

In the best-case scenario, the EU aims to produce 30 percent of its future CRM demand, though this goal remains highly uncertain despite increased financial support for extractive projects within Europe. Moreover, while introducing a circular economy (designed to minimize waste and make the most of resources) is critical for climate, industry and supply security, it does not address rapidly growing European demand for CRMs and the associated security risks over the next decade. Brussels is optimistic about recycling at least 22 percent of its expected rare earth demand by 2030. Europe has also restarted magnesium mining in Romania for the first time in over a decade after Beijing restricted and temporarily halted its magnesium exports in 2021.

But the EU is facing a conflict of goals: Local environmental standards may have to take a back seat in favor of national and international climate protection

policies and its agreed goals as well as with its CRM supply security. For the latter, European CRM mines are more necessary than ever for a faster implementation of electromobility, expansion of renewables and energy storage, and would also significantly lower carbon dioxide emissions due to stricter EU environmental regulations and shorter transport routes compared with CRM imports from Latin America, Africa and Asia.

However, to meet projected European CRM demand, approximately 300 new raw material mines would need to become operational in likeminded countries by 2035. Given that the average global lead time from planning to commissioning of raw material mines is seven years – and up to 15 years in Western democracies – a significant global supply bottleneck for CRMs looms.

Certain: U.S. to balance vulnerabilities with trade restrictions

Unlike Europe, the U.S. is able to retaliate against Beijing with reciprocal measures, such as export restrictions on semiconductors or other critical technology components vital for China's key high-tech industries. However, Washington still faces several vulnerabilities. It depends on China for up to 60 percent of its CRM supply: Currently, there is only one company in the U.S. producing the dominant type of rare-earth magnets and just four primary aluminium smelters in operation. The country operates only one lithium mine and, as of 2020, recognized it has no domestic production whatsoever for 14 minerals on its CRM list, rendering it entirely dependent on imports for these materials.

Furthermore, America's current stockpiling for national defense only covers 40 percent of the military's needs for a one-year conflict, followed by three years of recovery and replenishment. The expansive U.S. CRM list, which includes 50 elements – 45 defined as strategic minerals – is considered by experts too long and impractical, necessitating clearer priorities. Moreover, U.S. mineral security partnerships are compromised by the exclusion of key mineral producers such as Argentina and Brazil. The majority of CRM-producing countries lack free trade agreements with the U.S. and are not preferred trading partners. By 2035, these non-preferred producing countries could dominate up to 90 percent of the global nickel market.