ISSUE BRIEF

From National Security to Consumer Electronics, It All Comes Down to Rare Earth Minerals

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The United States has the 7th largest reserves of rare earth minerals in the world and is the second largest miner of rare earth minerals. Unfortunately for the U.S., it still needs China to process them. So do most countries. China controls 90% of the processing capacity in the world.[1] Flipping that script takes time, tens of billions of dollars in capital investment and skilled workers the U.S. does not currently possess. The strategic importance of rare earth minerals can be seen in the United States and Ukraine's mineral deal announced on May 1st, and what is behind the (maybe not so idle) U.S. interest in the semi-autonomous Danish territory of Greenland. Rare Earth minerals are of extreme strategic importance in the modern world.

What Are Rare Earth Minerals?

Rare earth elements (REEs) are a group of 17 metallic elements found in the Earth's crust. Although REEs are not scarce in the typical sense, with the majority more abundant than gold or silver, they are dispersed in small quantities throughout the Earth's crust and are often comingled with other minerals. This makes larger, more economically viable deposits harder and more expensive to extract.[1]

From your Tesla to your TV, REEs are a crucial component in everyday items like batteries for cell phones, motors for electric and hybrid vehicles, and luminescent display technologies for flat screen monitors and televisions. Even though rare earth elements only constitute a small portion of a product's actual volume, they are crucial for its functionality. For instance,

within a laptop or desktop computer, REE-based magnets make up only a tiny fraction of the total weight, but they are indispensable for the operation of spindle motors and voice coils in the machine's hard drive.[2]

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In addition to their use in consumer products, rare earth elements are equally essential in various defense technologies. Particularly important elements include neodymium, dysprosium, yttrium, europium, terbium, samarium, and erbium, among others. Yttrium, used in laser rangefinders and target designators, is a key component in radar and sonar systems. Neodymium is vital for creating powerful permanent magnets used in guidance systems and can found in precision-guided missiles, drones, and aircraft engines while Dysprosium is used in laser targeting systems and enhances the temperature resistance of said neodymium magnets.[3]

REEs in Recent Day

Beginning in the 21st century, rare earth elements have garnered significant media attention. This heightened visibility stems from three main factors. Firstly, simply the public's growing recognition of the critical and specialized properties that REEs offer to modern technology. Secondly, China's dominant position in REE production and supply. And finally, and maybe most importantly, the global dependence on China for the majority of the world's rare earth elements.

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In the year 1993, China produced 38% of the world's rare earth elements, the United States contributed 33%, Australia 12%, and Malaysia and India each accounted for 5%, respectively. Other countries, including Brazil, Canada, South Africa, Sri Lanka, and Thailand, made up the remaining production. By 2008, China's share of global REE production had catapulted to over 90%, and by 2011, it had reached 97%.[4] Simultaneously, the Chinese government began heavily regulating REE production and export, imposing limits on the quantities and restricting the number of Chinese and Sino-foreign joint-venture companies authorized to export these elements. In 2010, China announced plans to reduce its REE exports, which caused considerable concern among nations heavily dependent on these elements for new technologies, such as Japan, the United States, as well as European Union members.

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Rare earth elements are vital for consumer electronics and defense technologies, and their importance to national security cannot be overstated. The concentration of REE production in China creates significant supply chain vulnerabilities, with geopolitical tensions or disruptions posing severe risks to national security and technological advancement. As a result, many countries are now striving to produce their own REE supplies. The future state of the rare earth elements landscape will be influenced by innovative advancements in REE exploration, environmental considerations, and potential shifting of global alliances.

What Are Countries Doing to Mitigate This Risk?

In response to these challenges, various countries including the US are implementing several different strategies to reduce reliance on Chinese rare earth elements. Aiming to create a more sustainable and independent supply chain, advancements in recycling and urban mining technologies are being pursued to recover REEs from discarded electronics and industrial waste. Scientists are researching methods to synthetically produce REEs or find rare earth replacements. Some nations are investigating the less "green" route of deep-sea mining to potentially extract rare earths from

the ocean floor in the case that there are no viable deposits to mine onshore.
Both solutions will come at a cost. While "reduce, reuse and recycle" has a nice ring to it, the actual process is not simple. Due to the small quantities of rare earths in each device and the need to separate them from other materials, the recovery process can be extremely complex and expensive. Environmental implications of mining and processing come with the typical risks of potential soil and water contamination by toxic and radioactive materials. Additionally, REE extraction, refinement and processing is associated with very high levels of energy consumption, greenhouse gas emissions, waste production and natural habitat destruction.

Unless alternatives to rare earth minerals are developed, the environmental pressure will remain high. It is unlikely countries will sacrifice access to rare earth minerals in a global race for energy storage, communication, and military dominance. In 1992, then leader of the communist party Deng Xiaoping, was prescient in his take on the importance of rare earth minerals: "The Middle East has Oil, China has Rare Earth Minerals."[5] With respect to their importance shaping global power, nothing has changed.

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