The World's Rare Earth China Fiasco

But just as fracking broke U.S. dependence on foreign oil, will there be alternatives that break China's rare earth monopoly?

By Philip K. Verleger, Jr.

On April 25 and October 9, 2025, China announced new regulations limiting access to rare earth minerals. While the restrictions were then deferred for one year, it seems likely that access to rare-earth magnets, which account for most of the country's rare-earth exports, will become more difficult and perhaps, on occasion, will be blocked. This control threatens to handicap other nations' economies, leaving China in a position to dominate the production of magnets and the high-tech equipment and devices that depend on them, just as the United States dominates global finance.

In response, the United States and other OECD nations are seeking to expand their rare earth production and processing capacities to create alternative supplies. U.S. administration officials have characterized this as the equivalent of "Operation Warp Speed," which enabled the development of the Covid-19 vaccine in a year. Such hopes are fanciful. The demand for rare-earth magnets is projected to double (2.5 percent to 3 percent growth per year) by 2050. China will maintain its market dominance if the projections are realized, according to most forecasts. Only a concerted effort to increase manufacturing efficiency and reuse and recycle or substitute away from rare earths can moderate China's near-monopoly. The experience of President Richard Nixon's 1973 attempt to eliminate the United States' dependency on imported oil warns that programs aimed at breaking entrenched monopolies require imagination, as well as decades, to be effective. Success is not guaranteed.

Visiting Inner Mongolia in 1992, Deng Xiaoping advised an audience that "the Middle East has its oil, China has rare earths." In April 2025,

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THE INTERNATIONAL ECONOMY
THE MAGAZINE OF INTERNATIONAL ECONOMIC POLICY
220 I Street, N.E., Suite 200
Washington, D.C. 20002
www.international-economy.com
editor@international-economy.com

Australia Broadcast Corporation's chief business correspondent, Ian Verrender, noted that "Deng envisioned a China with a dominance in rare earths that would transcend the Organization of the Petroleum Exporting Countries' power over oil." Deng's idea, according to Verrender, was for the then-agrarian nation to transform itself past the simple extraction of minerals, which, despite their name, can be found in many countries, into a country that "incorporated the refining of rare earths, research into their use and, in more recent years, their deployment in highly specialized applications."

China enjoys a near-monopoly on processing rare-earth minerals into the required materials and products. It also defends this monopoly.

Thirty-four years later, Deng's vision has been more than realized. Today, China dominates the global rare-earth system—from processing the minerals to producing the specialty magnets required for weapon systems, robotics, and electric vehicles. Almost all inputs for these products are manufactured in China, even though rare-earth minerals are produced globally. China enjoys a near-monopoly on processing rare-earth minerals into the required materials and products. It also defends this monopoly.

THE RARE-EARTH BUSINESS

The production of rare-earth materials, such as those used in magnets for fighter jets, electric vehicles, and other applications, involves a sequence of processes similar to those found in industries like oil and gas. The method for producing plastics, for instance, illustrates the process.

With plastics, the raw material (oil) must first be found. Once reserves are located, they must be extracted and transported to refineries. Finally, the refined products must be delivered to manufacturing facilities, where they are converted into the myriad products and applications in which plastics appear.

More specifically, for plastics, oil or natural gas resources must be located and wells must be drilled to obtain the reserves. Then the produced oil and gas are transported by ship, pipeline, railroad, or truck to refineries that may be thousands of miles distant. At these facilities, the oil and gas are refined into various outputs. Some of these go to petrochemical factories that produce resin pellets, which are then compounded and formed or extruded into end products such as plastic bottles.

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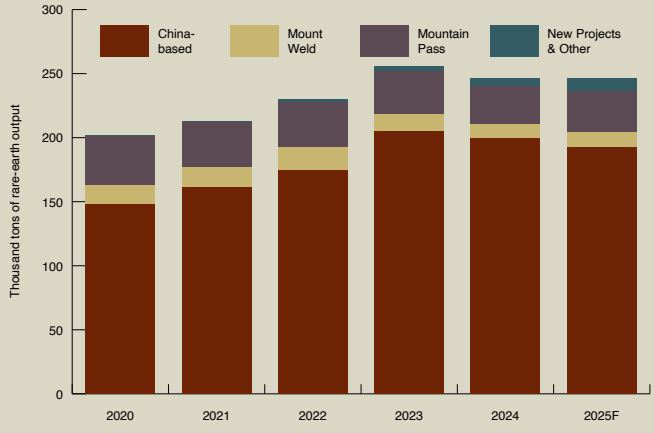
For rare-earth minerals, the process also begins with exploration and development. Deposits are found and reserves are developed across the world. According to 2025 U.S. Geological Survey data, China's estimated reserves are 44 million metric tons, Brazil's 21 million metric tons, Australia's 5.7 million metric tons, India's 6.9 million metric tons, and the United States' 1.9 million metric tons. The USGS also noted that "rare earths are relatively abundant in the earth's crust, but minable concentrations are less common than for most other mineral commodities. A 2025 estimate puts total reserves at the end of 2024 at 392 million metric tons.

Figure 1 Rare Earth Supply by Source, 2020–2025



Note: Mount Weld is a mine owned by Lynas (Australia) and Mountain Pass is a mine owned by MP Minerals (United States).
Source: Argus Media

Argus Media has become a leading supplier of information on rare-earth minerals and other materials. Figure 1 shows their estimate of rare-earth mine production by country of origin. They believe China will account for 78 percent of production in 2025, with that share declining to 58 percent by 2040.

Rare-earth minerals are not found in high concentrations. Whereas an oil well may produce crude or crude mixed with some water that gets separated before the crude is shipped, the ore taken out of a rare-earth mine contains mostly other minerals. Mined ore can range from less than 1 percent to more than 10 percent by weight.

Once taken from the earth, the ore is upgraded at the mine through a process known as "beneficiation." Beneficiation involves treating raw material to improve its physical or chemical properties, creating a mineral concentrate that includes a mixture of rare-earth elements. The concentrate is then shipped, like crude oil, to a refinery.

Almost all concentrate goes to China. For example, in a 2025 report, the Center for Strategic and International Studies noted that until recently, the United States sent most of the rare-earth minerals from the Mountain Pass Mine in California there for processing.

Referring to Chinese rare-earth refiners as "mineral processing hubs," the CSIS researchers, Gracelin Baskaran and Meredith Schwartz, described these facilities as "a centralized location or facility where raw mineral ores are transformed into refined materials suitable for industrial use. These hubs typically manage several key stages of the value chain, transforming raw ore into high-purity metals and alloys suitable for manufacturing." They also noted that China refines 90 percent of the world's rare-earth minerals and then the refined output is used by domestic manufacturers or exported for incorporation into various products and applications.

Table 1 breaks down the data on rare-earth uses collected by Argus Media. As shown, these minerals have numerous applications, in addition to the magnets that have received much attention lately. While presenting these data, Argus also observed that "rare earth demand grew from around 160 thousand tons in 2020 to 209.5 thousand tons in 2024, driven by a 75 percent increase in demand for REEs (rare earth elements) in permanent magnets."

Magnets are the key product from rare earth materials, as Argus noted:

> *Magnet applications accounted for 35 percent of RE demand volume in 2025, with the glass industry representing 25 percent, followed by catalysts (14 percent). In terms of value, magnet applications represent 80 percent, compared with 6 percent for glass. By 2040, magnets will represent*

Table 1 Demand for Rare Earths by Application (Tons of Rare-Earth Output)

	2020	2021	2022	2023	2024	2025F
Magnets	36,752	45,676	51,146	59,192	64,100	71,376
Batteries	20,872	20,431	20,421	18,602	15,915	12,253
Catalysts	27,483	30,511	32,178	33,511	33,910	34,329
Glass Industry	39,747	45,429	48,840	51,626	53,324	55,109
Phosphors	5,070	5,241	5,328	5,404	5,211	5,029
Ceramics	9,707	11,032	12,213	13,220	13,881	14,575
Metal Alloys	10,507	11,091	11,312	11,539	11,770	12,005
Others	8,967	10,681	10,960	11,182	11,585	12,017
Total	**159,105**	**180,092**	**192,398**	**204,275**	**209,696**	**216,693**

Source: Argus Media

over half the volume and almost 95 percent of the rare earth market.

Table 2 shows the estimated 2025 rare-earth consumption by use and the estimated value of each use.

CHINA'S RARE-EARTH MARKET DOMINANCE

China has aggressively expanded its capacity to produce rare-earth permanent magnets. Argus estimates that the country now accounts for over 90 percent of global production. It also noted that global rare-earth magnet production was 282,400 tons in 2023, increasing to 311,000 tons in 2024. A further rise to between 325,000 and 340,000 tons may be achievable in 2025.

China's dominance is not accidental. The country has repeatedly flooded the market with various products to undermine its competitors. One of the few U.S. producers of rare earth minerals, the aforementioned Mountain Pass mine in California, fell victim to China when the latter flooded the rare-earth market in 2015, driving prices down and forcing Mountain Pass's owner, Molycorp, into bankruptcy.

The data clearly indicate that China has won the battle for rare earths. It is also clear that it will take years, if not decades, to overcome its market supremacy.

For example, the United States today has only three companies that domestically produce rare-earth magnets. These are Electron Energy, Noveon, and eVAC, an affiliate of Germany's Vacuumschmelze, which completed construction of a rare-earth facility in South Carolina in 2025. On a visit there, U.S. Treasury Secretary Scott Bessent told Fox News, incorrectly, that "this is the first magnet made in the United States in twenty-five years—we're ending China's chokehold." Another article from *Rare Earth Exchanges* describing his visit added this claim:

> *For the first time in decades, America is melting, separating, and pressing magnetic alloys on home soil. The administration calls it a manufacturing comeback; investors call it a test of whether Washington's industrial reawakening can outlast the headlines.*

Rare Earth Exchanges, a specialty organization covering rare-earth issues, noted that the announcement was "preliminary," explaining that the plant assembled magnets but did not yet separate or refine rare-earth oxides at scale. The article then added the following:

> *Technically, U.S. refining capacity for critical heavy rare earths such as dysprosium and terbium remains nascent, to say the least. Current domestic*

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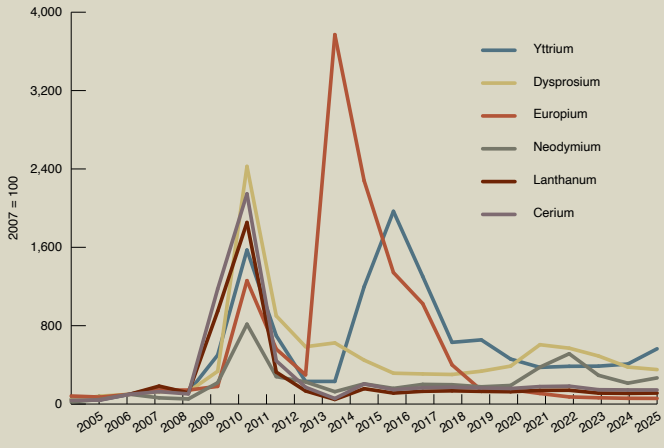
Table 2 Rare-Earth Application Share of Total Rare-Earth Market Value in 2025 and 2040

Application	Share of Total Market Value in 2025 (percent)	Estimated Share of Total Market Value in 2040 (percent)
Magnets	80	94.2
Glass	6	1.2
Phosphors	5	0.5
Catalysts	3	0.1
Batteries	2	0.6
Other	2	1.2
Ceramics	1	0.9
Metallurgy	1	1.3

Source: Argus Media

Figure 2 Price Indices for Various Rare-Earth Minerals, 2005–2025



Source: Argus Media

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separation and purification projects are years away from full throughput, according to a Rare Earth Exchanges (REEx) analysis. For now, the "chokehold" Bessent referenced is loosening only slightly based on the REEx assessment.

Today, almost all capacity outside China is in Australia and Vietnam, facilities co-financed or built by Japanese firms after China embargoed shipments of rare-earth magnets to Japan in 2010. The cutoff followed the Japanese coast guard's arrest of a Chinese fishing boat captain after he rammed coast guard vessels in the East China Sea.

THE JAPANESE EXPERIENCE

The construction of the Vietnamese facilities was part of Japan's effort to find alternative sources and reduce its reliance on rare-earth metals in response to China's embargo. While the embargo lasted only two months and apparently did not affect the volume of Japan's imports, the threat raised concerns among industry and government. An end-of-year decision by China to limit exports of rare earth minerals to all nations clearly intensified these concerns. As Keith Bradsher of the *New York Times* reported, "The reduction in quotas for the early months of 2011—a 35 percent drop in tonnage from the first half of this year—is the latest in a series of measures by Beijing that has gradually curtailed much of the world's supply of rare earths." By May, the prices of some metals had increased by 500 percent. Figure 2 tracks the prices of two rare-earth minerals from 2010 to 2025.

In a paper prepared for the World Economic Forum, Tatsuya Terazawa, CEO of Japan's Institute of Energy Economics, delved deeper into Japan's attempt to wean itself from China's rare-earth dominance. In it, he explained that Japan relied on China for 90 percent of rare earth materials. Following the tenfold price increase in 2011, the Japanese government took action to address its dependency. These actions included providing support for developing technologies and equipment to reduce rare-earth use, including those that use alternative materials, and technologies and facilities to recycle rare earths; investing in mines outside China; and creating a rare-earth stockpile, like the country's emergency petroleum reserve.

Terazawa reported that thirteen years after the incident, "Japanese dependence on Chinese rare earths dropped from 90 percent at the time of the incident to 60 percent today." Furthermore, Japanese consumption of rare earths had declined by 50 percent. (We note that these numbers represent consumption by manufacturers of magnets and other products. Part of the reason Japan's use declined is that rare earths were embedded in imported intermediate and final products and not counted as "consumption.")

Data on absolute Japanese consumption are difficult to find. However, the limited statistics available suggest use declined from 28.5 thousand tons in 2010 to 17.4 thousand tons in 2020, a drop of 40 percent. This implies that Japan's purchases of rare earth materials from China declined from around 25,000 tons to 10,000 tons.

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A search for substitutes was a key element in the Japanese program. Honda, the Japanese auto manufacturer, for example, developed a hybrid car motor that did not require heavy rare-earth minerals. Other Japanese companies are striving to develop rare-earth magnets. However, these developments have yet to realize commercialization.

Quest Metals, a recycling firm, also prepared a comprehensive analysis of Japan's response to China's actions. In it, Quest described Japan's efforts to shift industry away from rare-earth metals and to expand recycling. The analysis also noted that, fifteen years after the 2010 embargo, Japan's "commercial-scale recycling remains on the horizon, with expectations for more robust operations emerging around the 2030s," observing that "these efforts represent a critical long-term strategy for reducing overall dependency and building a sustainable supply chain."

Creating new sources of rare-earth mineral supplies outside China has been a key part of Japan's efforts. It has, for example, invested significant sums in Australia, a nation with known rare-earth resources and a long history of mining. Most notably, it has invested in the Australian firms Lynas and Iluka Resources. Lynas constructed a rare-earth processing plant in Malaysia in 2010, which became operational in 2012 and is currently producing some volumes. Iluka Resources began constructing a processing plant north of Perth in 2021, following the Australian government's promise to provide AUS$1 billion in funding.

The plant is expected to become fully operational in 2027, following the injection of additional government funds. If it does, it will produce 5,500 tons of rare-earth oxides, roughly 2 percent of China's total production.

THE DIFFICULTY IN BREAKING CHINA'S MONOPOLY

The Japanese experience described by Terazawa and Quest warns that attempts to diversify away from China's rare earths will be a long, arduous task. It also illustrates the challenge the United States and other nations face in freeing themselves from China's monopoly on key products made from rare-earth minerals. Concerns regarding the supply of rare earth metals increased in April 2025, October 2025, and November 2025 when China imposed a series of stringent regulations on the sale and resale of these metals, regulations identical in some respects to those implemented by the United States regarding the distribution of advanced computer chips. The Chinese measure caused a short-term panic in U.S. financial markets.

Researchers at the Institute for Progress suggested that we can resolve the rare-earth issue quickly, recalling "Operation Warp Speed," where the Trump administration "marshaled a variety of policy levers—purchase guarantees, regulatory streamlining, and whole of government commitment—to deliver the first covid vaccine in just nine months, more than ten times the normal speed, and far faster than any vaccine ever developed."

The IFP authors reported that Treasury Secretary Bessent called for a warp-speed effort in mid-October 2025. They then recommended that the rare earth metals version should involve fostering competition and innovation, working with international partners to build resilient supply chains outside of China, reforming environmental permitting to restore predictability, and committing to making national security-motivated U.S. technology restrictions non-negotiable."

The IFP authors, as well as many others offering policies to address the United States' rare-earth supply constraints, would be wise to read President Nixon's November 3, 1973, speech on energy and to consider what followed. Speaking after the Arab oil embargo had happened, Nixon called on U.S. citizens to unite in a "major new endeavor":

> *Let us set as our national goal, in the spirit of Apollo, with the determination of the Manhattan Project, that by the end of this decade we will have developed the potential to meet our own energy needs without depending on any foreign energy sources.*
>
> *Let us pledge that by 1980, under Project Independence, we shall be able to meet America's energy needs from America's own energy resources.*

A year after the embargo, Nixon's Secretary of State Henry Kissinger convened the Washington Energy Conference at which the International Energy Agency was created. The IEA was designed to and has succeeded in "working with international partners," providing a model for the approach to rare earths offered by the IFP and others. Success came, but slowly.

It was not until 2019 that the United States achieved President Nixon's goal of energy independence, some forty-six years after he spoke. It took innovative technological developments that led to vast increases in the production of renewable energy and oil from reserves deemed useless in 1972 to make independence possible.

The story for rare-earth minerals will likely be the same, especially as U.S. investors focus on building massive data centers and creating increasingly sophisticated AI models. Whether China continues to dominate the rare earth market over the next few decades will depend critically not on the ability of consuming countries to develop alternative supply sources, but rather on their ability to find substitutes for rare earths. The demand for these minerals, particularly those used in magnets, is projected to increase. Most forecasters expect China's market control to intensify. The success of the diversification effort will require an innovative focus among all industries, along with government support. The current prospects for widespread substitution are not good.

China's dominance will continue unless consumers of rare earth magnets seek alternatives.

The Economist made this clear in a December 4 article titled "Lessons from Japan's efforts to wean itself off Chinese rare earths," noting in the report subtitle that "it's a lot harder than it sounds." *The Economist* editors listed three lessons. First, "China holds the cards." Second, reducing reliance on China's rare-earth supply is "extremely difficult" because "industries need a wide variety of rare

earths." And finally, "the third, somewhat demoralizing, lesson is that it is hard to replicate China's command of the entire production process, let alone its scale, which together give it considerable pricing power."

The bleak chances for diminishing China's market dominance can be demonstrated by comparing historical oil market developments with demand projections for rare-earth minerals. The International Energy Agency has forecasted that future demand will double between 2024 and 2050. It expects China's market share to decline by only 16 percent, from 91 to 75 percent, by 2040. (The IEA projected use does not extend to 2050.)

The consulting firm McKinsey expects even greater use, although its outlook extends only to 2035: "Global demand for magnetic REEs [rare earth elements] is expected to triple from 59 kilotons in 2022 to 176 kilotons in 2035, driven by strong growth in electric vehicle adoption."

McKinsey projects a 9 percent annual rise in use, while the International Energy Agency sees growth of only 4 percent. The difference is partially explained by McKinsey's assumption of rapid electric vehicle adoption, an assumption absent from the International Energy Agency's base case forecast.

Attempts are being made, however, to break China's control of rare earth minerals. Representatives from fifty-five nations met on February 4 with the United States to discuss how to address vulnerabilities in critical metals supply chains. Jamieson Greer, the United States Trade Representative, stated that the United States, the European Commission, and Japan would "develop coordinated trade policies and mechanisms, such as border-adjusted price floors, that can mitigate critical mineral supply chain vulnerabilities."

In his speech at the meeting, Vice President JD Vance announced the creation of a price-stabilization mechanism and a preferential trade zone for nations joining the U.S. program. The goal is to maintain price stability. As Vance explained without naming China, "Over time, our goal within that zone is to create diverse centers of production, stable investment conditions, and supply chains that are immune to the kind of external disruptions that we've already talked about."

Time, though, is of the essence. U.S. Secretary of State Marco Rubio noted, as the conference ended, that the International Energy Agency came into being in the same room at the State Department fifty years earlier. Students of energy history understand it took decades for the IEA to achieve its stated purpose: energy market stabilization. The world's manufacturers cannot wait that long for China's control of the rare earth market to be broken.

Again, China's dominance will continue unless consumers of rare earth magnets seek alternatives. That search is underway. Bloomberg reported that "in India, automakers and parts suppliers have begun accelerating testing of ferrite-based magnets as a less efficient but geopolitically safer substitute for the heavy rare earths they previously relied on." Japan, as noted, has already cut consumption by 50 percent. Toyota, for example, has found ways to reduce the use of rare earths in its motors by half, and Tesla has already eliminated the use of rare earths in its motors.

One can be sure that the world will find alternatives that will break China's monopoly. One can also be sure that it will take years.

Such efforts, while admirable, are unlikely to have much market impact in the short term. In a 2021 paper, University of Pennsylvania researchers Hyong-Min Kim and Deep Jariwala compactly captured the primary stumbling block to rare earth substitution:

> *Replacing REEs with other more widely available materials can reduce general global demand for REEs as well as making various technology sectors more resilient to supply disruptions and price fluctuations of REEs. Unfortunately, REEs play crucial and exclusive roles in many industries and cannot be easily substituted. As of 2020, the U.S. National Minerals Information Center maintains that "substitutes [for REEs] are available for many applications but generally are less effective," which is true especially for cutting-edge technologies.*

One can be sure that the world will find alternatives that will break China's monopoly on rare earth production and processing, just as the development and implementation of fracking broke the United States' dependence on imported oil. One can also be sure that it will take years to find and commercialize such alternatives. Meanwhile, China will maintain its market control. The idea of developing and implementing a "warp speed" program that will quickly wrest from China the dominance it has built over thirty years is, today at least, nothing more than a pipe dream. ◆