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A Layman's Guide to the Rare Earths Crisis

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Brian McCarthy

It won't take long to develop alternatives to China's exports – it's already happening.

I set out to try to get a handle on how serious the brewing shortage of rare earth minerals might be from a macroeconomic perspective. With the caveat that what I don't know about today's topic could fill a medium-sized graphite mine, I share my findings.

The rare earths trade is comically small.

- US imports of rare earths totaled $170 million in 2024.
- That's *million*, with an *m*.

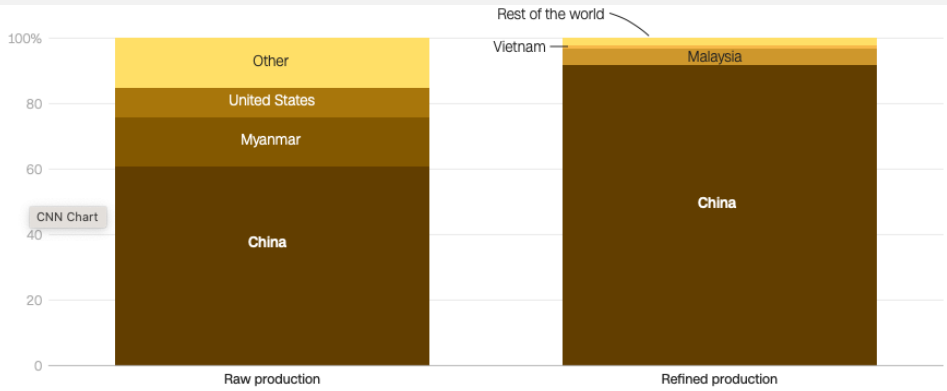
To be fair, that figure is deceptive because we don't import many rare earth elements for processing into the magnets essential to automakers. However…

- The market for rare earth magnets is only $19.5 billion *globally*.

Because the value of the rare earth magnet market is a macroeconomic spit in the ocean, the only relevant question is, can the problem be solved by simply throwing money at it?

The answer to that question is almost always "yes." *But the bottleneck is processing.*

Share of rare earth magnet production, globally



Note: Magnet rare earth elements — including neodymium, praseodymium, dysprosium and terbium — are a subset of 17 metals commonly referred to as rare earths.

Source: International Energy Agency. CNN, Macrolens calculations

Brian McCarthy

Our guest analyst for this report is a long-time friend: Brian McCarthy, Chief Strategist at Macrolens, a Massachusetts-based macroeconomics research firm with a special expertise on China. Previously, Brian was Chief Strategist and Portfolio Manager at Emerging Sovereign Group, where he managed the Nexus Fund, a China-focused macro hedge fund.

Send Brian an email, or visit his Substack

Update to strategic view

US MACRO, ASIA MACRO: Dominated by Chinese exports, US importation of rare earth minerals is miniscule. The entire global market is quite small, but critical to certain industries. For all its faults, the Trump Administration would not likely undertake strategic decoupling from China without planning for the curtailment of Chinese rare earths exports. US and global competition for rare earth magnets – essential for electric vehicles – is arising, as it already has for gallium – essential…

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China is proficient along a vertically integrated rare earths supply chain, with ample access to mineral supply both domestically and along the Belt and Road, China is dominant. *China dominates processing*. The world's rare earths vulnerability to China is well-known.

- *We may be about to find out just how incompetent Western governments really are. If the US is forced to back off defending its position as global hegemon because we're unprepared for a Chinese rare earths embargo that everyone knew was coming, then maybe it's time for a new hegemon.*
- China first used export controls as a diplomatic weapon in the famous dispute over the collision of a Chinese fishing trawler with a Japanese coast guard patrol boat off the Senkaku Islands in 2010.
- Since 2023, China has increasingly controlled rare earths exports in response to the increased tightening of US export controls on sensitive technologies:
    - July 2023: Global licensing requirements for gallium and germanium (used in semiconductor manufacturing and defense applications).
    - December 2023: Applied export controls to rare earths processing technologies
    - June 2024: Issued new rare-earth management regulations to tighten state control over the industry
    - December 2024: Ban on sales of gallium, germanium and antimony to the US.
    - April 2025: Added 7 heavy-rare earth elements to the export control list.
- *None of this should have caught anyone by surprise. It is inconceivable that the Trump Administration would have launched into an economic fight with China without gaming out a Chinese ban on rare earths exports.*

US processing capacity is emerging. The US has been throwing money at the rare earths problem for several years. This from Gracelin Baskaran at the Center for Strategic and International Studies:

> *"In its 2024 National Defense Industrial Strategy, the Department of Defense (DOD) set a goal to develop a complete mine-to-magnet REE supply chain that can meet all US defense needs by 2027.*
>
> *"Since 2020, the DOD has committed over $439 million toward building domestic supply chains. In 2020, the Pentagon awarded MP Materials $9.6 million through the DPA Title III program for a light rare earths separation facility at Mountain Pass, California. In 2022, the Pentagon awarded an additional $35 million for a heavy rare earths processing facility.*
>
> *"These facilities would be the first of their kind in the United States, fully integrating the rare earths supply chain from mining,*

[Continued from first page]

… for chip production. China's rare earths weapon, once unholstered, will begin to lose effectiveness at an accelerating pace as rising prices make global competition possible after years of Chinese price-suppression. With an Operation Warp Speed for rare earths processing, the process could be accelerated.

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separating, and leaching in Mountain Pass to refining and magnet production in Fort Worth, Texas.

"The DOD has thrown its support behind Lynas Rare Earth's US subsidiary, Lynas USA, as well. The company was awarded a $30.4 million DPA Title III grant in 2021 for a US separation facility for light REEs and another $120 million in 2022 for a heavy REE processing facility."

Baskaran points out that these efforts are all "early stage" and "significant work remains to turn production of samples in a laboratory into full-scale commercial production capable of reducing reliance on China."

However, there is an emerging rare earths processing infrastructure in place already. From the Institute of Electrical and Electronics Engineers:

"In mid-January, a top United States materials company announced that it had started to manufacture rare earth magnets. It was important news—there are no large US makers of the neodymium magnets that underpin huge and vitally important commercial and defense industries, including electric vehicles

"The press release, from MP Materials, was light on details. The company disclosed that it had started producing the magnets, called neodymium-iron-boron (NdFeB), on a "trial" basis and that the factory would begin gradually ramping up production before the end of this year. According to MP's spokesman, Matt Sloustcher, the facility will have an initial capacity of 1,000 tonnes per annum and has the infrastructure in place to scale up to 2,000 to 3,000 tonnes per year. The release also said that the facility, in Fort Worth, Texas, would supply magnets to General Motors and other US manufacturers.

"Vacuumschmelze GmbH, a magnet maker based in Hanau, Germany, has begun constructing a plant in South Carolina through a North American subsidiary, e-VAC Magnetics. To build the US $500 million factory, the company secured at least $100 million from the US government. The plant being built is reportedly designed to produce around 1,500 tonnes a year.

"In another intriguing US rare-earth magnet project, Noveon Magnetics, in San Marcos, Texas, is producing what it claims are 2,000 tonnes of NdFeB magnets per year. The company is making some of the magnets in the standard way, starting with metal alloys, and others in a unique process based on recycling the materials from discarded magnets

"'The US imports just 7,000 tonnes of NdFeB magnets per year,' MP Materials's Sloustcher points out. "So in total, these [US] facilities can supplant a significant percentage of US imports, help re-start an

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> *industry, and scale as the production of motors and other magnet-dependent industries" returns to the United States, he argues."*

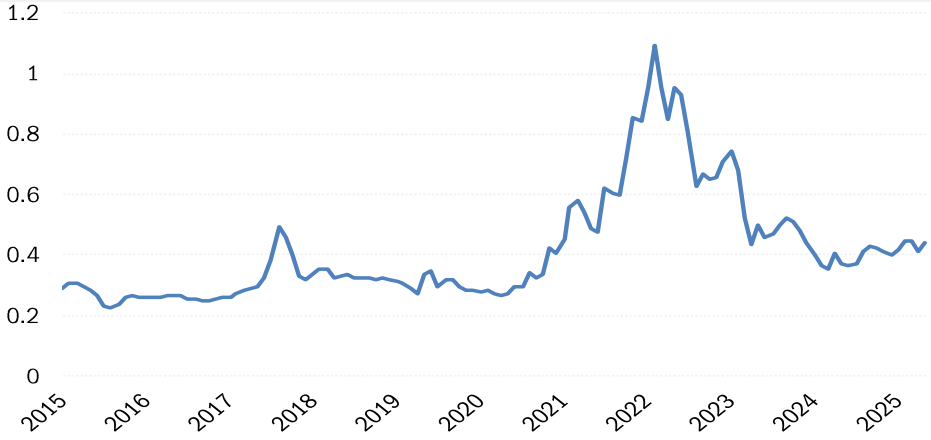
While it is true that the US could nearly meet its import demand of 7,000 tons of imported magnets a year, the figure is deceiving because it excludes imported rare earth magnets that are embedded in finished products like electric motors, wind turbines, and smartphones. Including magnets embedded in products, the total import figure is more like 25,000 tons. Those magnets need to come from somewhere. *If not China, where?*

Global capacity is growing, too. Because the rare earths supply chain vulnerability is so glaring, governments around the world have been supporting the expansion of domestic processing capabilities. From Argus:

> "Attempts to establish commercial-scale rare earth separation and processing outside China are growing in number and progressing gradually with a view to ramping up output over the next two years.
>
> "Mineral resources developers are scrambling to reassess and upgrade their estimates of mineable rare earth element (REE) content as Western governments attempt to encourage producers to establish production closer to home. And new efforts to develop high-volume processing capacity outside China — which currently accounts for more than 80pc of global refining — are emerging."

This article lists 22 major mining and processing projects operational or under development outside of China. *The problem with ramping them up is pricing* (and we all know why prices are so weak).

Praseodymium-Neodymium (key input for high-performance magnets) CNY/tonne, millions



Source: Shanghai SteelHome E-commerce, Macrolens calculations

- *The problem with developing domestic rare earths capacity is that the Chinese have assured that there's no money in it. The antidote to short supply is always high prices – and because the global market for rare earths is so small, there's no significant inflation concern.*

From the *New York Times*:

> "A succession of administrations has tried to restart the industry ever since China drew attention to its dominance by imposing a two-month embargo on shipments of rare earths to Japan during a territorial dispute in 2010.
>
> "But little has happened because of a gritty reality: Making rare earth magnets requires considerable investments at every stage of production. Yet the sales and profits are tiny."

From Benchmark Mineral Intelligence:

> "At current rare earth prices, no planned rare earth projects outside of China can achieve a 15% return on investment, according to Benchmark's Rare Earth Forecast. Almost 40% of pipeline ex-China rare earth mines require prices of between $75/kg to $85/kg, according to Benchmark. 15% of this pipeline requires even higher prices, at above $85 a kilogram.
>
> "'Prices right now are simply too low for the ex-China market. There is great policy support from USA and Australia, but ex-China realized prices need to grow, or the economics of these assets needs to be otherwise augmented for the market to develop, and for critical mineral supply chains to be more geo-politically secure,' Daan De Jonge, an analyst at Benchmark, said.
>
> "'More needs to be done if you want to diversify the supply chain – OEMs need to accept that higher prices are required outside of China, or governments need to step in.'"

If China causes a shortage of high-performance magnets, this pricing problem should be resolved rather quickly.

> "Arafura Rare Earths has secured offtakes with Hyundai and Kia, as well as wind turbine producer Siemens Gamesa. It is targeting having 85% of its planned production from the Nolans project committed via binding offtake agreements, up from 53% currently.
>
> "And US rare earth miner MP Materials signed a long-term supply agreement with General Motors in 2021. MP Materials will supply US-sourced and manufactured rare earth materials, alloy, and finished magnets for the electric motors."

- Industrial users of rare earth magnets are no doubt scurrying to contract for future supply from non-Chinese producers at substantial premiums to Chinese market prices.
- Despite low production ex-China, there is considerable global capacity that is likely to be ramped up if industrial buyers bid up prices in fear of a sustained shortage.

- *And remember, if we increased the domestic price of rare earth magnets by 10x it wouldn't make a macroeconomic ripple*.

Necessity is the mother of invention. If shortages remain acute, manufacturers will find workarounds to reduce rare earths demand. From the *Wall Street Journal*:

> "The lack of magnets hits EVs and hybrid vehicles harder than conventional cars and trucks. A typical EV contains far more rare earths than a gasoline-powered model, but rare-earth magnets are found throughout any modern vehicle.
>
> "Producing more gas-powered cars instead of EVs isn't a solution, because companies would risk falling short of federal fuel-economy standards, which could result in fines."

Fortunately, those standards are in the process of being abolished (see "Deregulate, Sanction and Tariff, Baby, Deregulate, Sanction and Tariff!" March 26, 2025).

> "Another option to conserve dwindling magnet supplies is reverting to older electric-motor technology that doesn't make use of rare-earth magnets. Carmakers stopped using those motors because the current versions are cheaper and more efficient.
>
> "Carmakers are also considering stripping out some premium features, such as adjustable seats, that make use of several tiny electric motors. High-end speaker systems that use rare-earth magnets could also be replaced with downgraded versions."

While Tesla's publicly announced plans to eliminate rare earth elements from its next-generation vehicle seems a stretch (they've reduced consumption by 25% from 2017 to 2023), EV automakers across the board are working to reduce their consumption of the China-controlled products.

To the extent alternative materials and workarounds are functionally suitable yet more expensive, the rare earths shortage might only cause some marginal margin compression as opposed to product shutdowns.

Now… about gallium. Have you seen all the headlines about the crash in the semiconductor industry because the Chinese put a clamp on exports of gallium, a key component of high-end chips? Me neither. Perhaps that's instructive. From Reuters:

> ***"A gallium lens on China's minerals dominance and how to break it***
>
> "The price of gallium has been rising ever since China started restricting exports of the exotic metal in August 2023.

> “This is not surprising since China has a near monopoly on global gallium production, just as it does across the critical materials spectrum.
>
> “China's alumina refineries aren't the only ones that can generate gallium. It's just that Western companies stopped doing so after China flooded the market at the start of the last decade.
>
> “That's changing. Rio Tinto and Indium Corporation have just announced the successful extraction of pure gallium from what was previously a waste stream at Rio's Vaudreuil alumina refinery in Quebec. The next stage will be a pilot plant with capacity of 3.5 tons per year.
>
> “Greek aluminum producer METLEN is planning to produce 50 tons per year by 2028 as part of a project to lift bauxite and alumina processing capacity. It is one of the European Union's 47 strategic minerals projects.
>
> “Both had been operating for many years without anyone thinking it worthwhile to separate out the critical metals in the waste stream.
>
> “…It is clear that Western operators are having to learn, or in the case of gallium, re-learn, the processing technology needed to separate and refine them.
>
> “This will take time, particularly since China is in many instances also restricting exports of such technology.
>
> “But the higher prices ensuing from China's export controls are providing the incentive for ever more Western companies to go back to metallurgy school.”

Let’s do an Operation Warp Speed for rare earths. Just for fun, I asked ChatGPT what the timeline was for US self-sufficiency in rare earths processing, with and without an Operation Warp Speed. The results:

ChatGPT’s estimates for developing rare earths capacity to replace China

Milestone	Normal Timeline	Warp Speed Estimate
Full NdPr oxide processing	2026	**2025**
Domestic NdFeB magnet production at scale	2028	**2025–2026**
Heavy rare earth separation (e.g., Dy, Tb)	2032	**2027–2028**
Complete mine-to-magnet supply chain	2030–2035	**2026–2028**

Source: ChatGPT, Macrolens calculations

Is this doable? I don't know – Jake, it's ChatGPT. While ramping up rare earths processing capacity is not just a matter of flipping a switch, estimates that the US could be only 5 to 10 years away from supply chain self-sufficiency are based on current trends, which include perpetually suppressed market prices and half-hearted government support efforts.

The chatbot's suggestion for the program included $5 to 10 billion in immediate funding, guaranteed offtake agreements from EV manufacturers, fast-track permitting, the funding of allied facilities in Australia, Canada, and elsewhere, and the formation of recycling hubs (increasingly important as EV's hit end-of-use, but expensive). And so what if we curbed the production of EVs for a couple of years while supplies are developed? The Trump administration's roll-back of fuel-efficiency standards is going to do that anyway.

It seems reasonable to me. And so what if the $5 to10 billion actually had to be $50 billion? And it's not sensible to assume the expenditures of that order would not be made, to ensure that a mere $20 billion market could bring the global economy to its knees.

I don't doubt that a brewing rare earths shortage is nettlesome for auto manufacturers and likely to cause some temporary supply chain difficulties in other industries like renewable energy and consumer electronics. But let's not conflate a fairly isolated supply-chain disruption with the potential for economic crisis.

Bottom line

Dominated by Chinese exports, US importation of rare earth minerals is miniscule. The entire global market is quite small, but critical to certain industries. For all its faults, the Trump Administration would not likely undertake strategic decoupling from China without planning for the curtailment of Chinese rare earths exports. US and global competition for rare earth magnets – essential for electric vehicles – is arising, as it already has for gallium – essential for chip production. China's rare earths weapon, once unholstered, will begin to lose effectiveness at an accelerating pace as rising prices make global competition possible after years of Chinese price-suppression. With an Operation Warp Speed for rare earths processing, the process could be accelerated.