Demand arises from military or civilian procurement of critical minerals?

written by Jack Lifton | October 29, 2024

> *"The key issue facing the U.S. today is determining which industries are essential to national security and ensuring a reliable supply chain for critical minerals like rare earths. The U.S. government's current approach, particularly in securing rare earth permanent magnets (REPMs), is flawed due to its focus on the military needs without addressing broader civilian industry demands. A comprehensive, experiential understanding of the entire supply chain and collaboration with experienced industry leaders is necessary to secure the U.S.'s future economic and technological leadership." – Jack Lifton, Co-Chair, Critical Minerals Institute (CMI)*

Which minerals are critical depends on the answer to a question posed during World War I by a British governmental advisory committee formed for exactly that purpose. Lord Balfour, the committee's chairman, advised his government that the question was:

> ***"What industries are essential to the future safety of the nation, and what steps should be taken to maintain or establish them?"***

A reporter at the time noted the committee's recognition of a problem of identifying key industries (defined in 1916 as "trades") that has plagued committees such as Balfour's up to and including today:

> *"Unfortunately, (some of) these trades were not very adequately represented on the Committee, and there was practically no one member of it who was able to speak from his own knowledge of much that is comprised within so wide-embracing a phrase."*

The driving issue in 1916 was that Germany had displaced Great Britain as a powerhouse of innovation and technology, which displacement was seeded by Britain itself by moving much of its world-class chemical and metals manufacturing to (a more efficient at the time) Germany. The spread of and emphasis upon (what we now call) STEM education in Germany had then shifted the focus of innovation in those fields to Germany in support of an (Germany's) industrial policy focused on making Germany the leading power in Europe.

Today, in 2024, the issues for the United States' government arise from the same causes, and to resolve them the same questions must be asked and answered as in 1916.

What is the U.S. government doing wrong in trying to secure sufficient supplies of critical minerals?

The answer is that so-called industrial strategy (policy) lacks focus on the real economy due, I think, to an absence of specific experiential knowledge.

Notwithstanding the wisdom of Washington's credentialed class of advisors, It's not the price; it's the availability of and the accessibility to a secure, sufficient critical mineral, end-user form, and total domestically (controlled) supply chain that is the driver of an industrial policy focused on national security. This is what confuses both the policymakers and the pundits. They both assume that the focus on national security self-sufficiency is the same as a focus on the needs of the consumer economy and that the solution of the one automatically implies

the solution of the other. Thus, the U.S. Defense Department has financed a scheme that is designed to supply it with what it deems the necessary critical mineral-based materials for its defense supply programs. It, by design, pays no attention to any concomitant needs of the civilian economy and also pays no attention to the probability that its solution and its targeted funding for its in-house solution will succeed on time, on budget, or at all.

A perfect example is the current focus by the US Department of Defense on domestic sourcing of rare earth permanent magnets (REPMs). **The current law requires all DoD purchases of rare earth permanent magnets to have no Chinese content by and on October 1, 2027.** China now prohibits the export of any rare earth-related sourcing, processing, or fabricating technologies. So, no one making rare earth permanent magnets outside of China can license or legally copy Chinese rare earth permanent magnet-making technology to enter the business.

This leaves the legacy Japanese magnet makers and one European, who are currently in commercial production as the only possible existing sources for the DoD. But, even then, there is a problem. The non-Chinese rare earth permanent magnet makers, without exception, source nearly all of their rare earth metal and alloy feedstocks from China, and the exception is the German one, which buys less than a thousand tons of rare earth permanent magnet alloy from the lone remaining commercial rare earth metal/alloy maker in the West.

China will produce this year some 250,000 tons of rare earth permanent magnets, and it is estimated that 85% of that will go into domestic (Chinese) production. All of the Japanese, one Korean, and the one German REPM makers not only source their metals and alloy from China, they also manufacture all or a significant portion of their magnets in Chinese dominated (by

Chinese law) joint ventures in China.

Thus with a tiny exception there is no source at the moment of REPMs without Chinese content. Since the lone metal/alloy maker in the West sources its feedstocks from China there is NO REPM maker whose product is free of Chinese content!

Before we review the U.S. DoD's REPM agenda let's start with the non-Chinese sourcing picture for the rare earth minerals critical for their construction, the very first step in the total supply chain for REPMs.

I think that the key misconception is that there is just a unitary rare earths market and that it is focused on the supply of rare earth bearing minerals. This has allowed, for example, the U.S. DoD to choose vendors on the basis of the inherent value of their mineral resource rather than on proven competencies in mineral recovery, downstream value-adding processing and economics.

The two, existing, commercially operating rare earth mineral miners outside of Chinese direct ownership or control are Australia's Lynas Rare Earths Ltd. (ASX: LYC) and MP Materials Corp. (NYSE: MP) of the U.S.A.

No global-southern mineral rich country is asking either MP or Lynas for assistance in developing a native rare earth extraction or processing industry. Why? Because neither company is a proven state-of-the-art, competent, robust and economically efficient (aka consistently profitable) entity with proven comprehensive total rare earth permanent magnet supply chain capability. Even more importantly on a mundane level, neither company has the financial support (or internal financial resources) of a national bank or government to exchange technology for access to resources.

I recognize, of course, that China has now cut off its own rare earth industry from any nonofficial aid to other countries other than cash purchases, but this is a defensive move and does not aid MP or Lynas to replace China as a technology vendor.

At this point in time, the U.S. DoD believes it has solved its problem of obtaining a secure supply of the materials necessary to build the rare earth permanent magnets it requires for its warfighting machines. It also believes that this has solved its problem of actually being able to build these magnets away from Chinese control or oversight.

But, this is far from being demonstrated, much less proven or assured.

So, where does this leave the American consumer products industries with regard to their secured supplies of critical materials necessary for the production of their products?

Large scale American OEMs that still manufacture a significant fraction of their end-user consumer products in the United States or in North America have a seemingly insurmountable problem when it comes to a sufficient and secure supply of components using rare earth permanent magnet motors, if those components must have no Chinese content, although this is only required at the moment for the products of these companies to be eligible for a tax credit.

The only significant non-Chinese located, owned, or controlled producing rare earth mines are one owned and operated by MP Materials, located in Mountain Pass, California, and another by Australia's Lynas, in Australia. Most of what MP mines currently goes as an ore concentrate to a Chinese customer for processing and use in China (Form 10k 2023, Part I, Item 1, P02), though MP is in the process of building a processing facility in the U.S. that is expected to enter service in 2025. Lynas, meanwhile, has

a well-established relationship with Japanese clients. Since 2011, Sojitz Corporation has been the exclusive distributor of Lynas' rare earths in Japan, and Lynas supplies a substantial portion of its output to Japanese customers. This relationship is bolstered by significant investments from Japan, ensuring a stable supply of light and heavy rare earths to the Japanese market. Both companies, to the best of my knowledge, only commercially produce light rare earths at present.

What are the sizes of the American markets for rare earth permanent magnets?

First, I want to emphasize the difference between the military and the civilian markets for critical mineral based devices.

For the military, the sole issue is secure availability in the required quantity, not price. For the private sector, assuming sufficient availability, the sole issue is price. Will the proposed supply reduce costs or add to profit margins in the near term (the period in which all costs can be estimated accurately [A narrowing time frame in an inflationary period and one with uncertain political fallout (tariffs?)]. The lowest priced rare earth permanent magnets commercially available today are manufactured in China. It is foolish to try to understand actual Chinese costs, since they are not available to us in a truthful manner.

The military demand for rare earth permanent magnets, is, of course, "classified." It's risible that a military that sources its REPMs from non-Chinese suppliers who make those magnets, for the most part, in Chinese domiciled "joint ventures" should nonetheless think that other than themselves no one knows which magnets and how many of them they need and use. But, I suppose that military supply chains are to consumer supply chains as military music is to symphony music.

A 2013 U.S. government publication estimated a military need of 1,000 tons per year of rare earth permanent magnets (REPMs). I suspect that today's requirement is closer to 3,000 tons per year, which aligns with the stated initial capacity of the REPM factory to be built in South Carolina by VACUUMSCHMELZE GmbH & Co. KG (VAC), a formerly German group. This facility is partially funded and subsidized by the U.S. Department of Defense.

To calculate the size of the U.S. consumer market for REPMs, for 2024, let's use the figure, 1.25 million, for the number of EVs that will be sold into the U.S. market out of a total of 17 million cars and trucks.

It has been calculated that ICE vehicles, on the average use 0.5 kg of REPMs each, so this will require 7,875 tons of REPMs. Add to that the 2.5 kg required for one electric motor for each EV, and you get an additional 3,125 tons of REPMs, for a total requirement in 2024 by the OEM automotive industry in the U.S. of 11,000 tons of REPMs.

The total market and market growth for REPMs in the U.S. was estimated in a 2020 Federal Government report, which said: "Under high growth scenarios, total domestic demand is expected to more than double from 2020 to 2030, growing from just over 16,000 tons to 37,000 tons, and more than quadruple from 2020 to 2050, increasing to almost 69,000 tons."

So, let's conservatively calculate the 2024 U.S. total demand for REPM products at 25,000 tons.

The military demand is thus about 10% of the total demand.

But wait, there's more.

Like the military demand, the civilian consumer demand for REPMs

is invisible to the untrained eye. The only general consumer experience of magnets today, other than some fading from memory discussion in one of America's few remaining technical high schools and the non-mandatory general science courses in the few contemporary universities that still offer them, is for use to attach notes to (non-stainless steel) refrigerator doors when Post-it notes are not available.

Unnoticed is the fact that the miniaturization of any and all devices requiring or using mechanical automation or audio speakers REQUIRES the use of REPMs. Motor vehicles, of course, and Mobile phones, Television cameras and receivers, Video cameras, personal and main-frame computers, industrial motors, household appliances, aircraft control components, ocean going ship steering and mechanical controls (cranes, hatch covers, etc), printing presses and computer printers, garage door openers, etc and etc. You get the point.

On top of the enormous yet invisible consumer demand is the vanishingly small affordable amount of routine repair and maintenance available for such devices. They are intended to have a short life, so that you can buy "new" ones regularly as the irreparable old ones are discarded.

Although a crucial component of all of the technologies enumerated above, REPMs are NOT RECYCLED, because the cost of doing so exceeds the replacement cost anywhere but at the (domestically non-existent) manufacturing site. Thus the demand for REPM dependent technologies mirrors the demand for critical minerals necessary for their manufacturing.

The military, by the way, uses constant maintenance to keep its warfighting machines in ready condition, but this is very expensive, though absolutely necessary.

Which government agency or agencies or committees are competent

to identify and choose which civilian industries are necessary and which are just nice? Doesn’t it take actual consumers and actual consumer industry executives to answer this question?

Perhaps, government should stay out of the way other than to question those with actual experience.