

## CURRENT ISSUES

**No. 22: Rare Earth Elements: A Wrench in the Supply Chain? (10/05/10)**

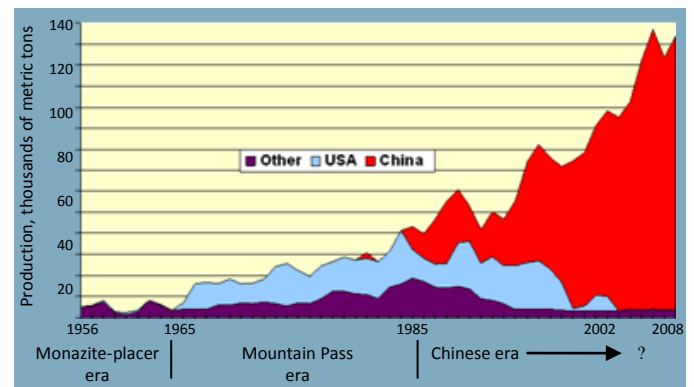
On 23<sup>rd</sup> September 2010, exports of rare earth elements (REEs) from China to Japan apparently stopped due to a dispute over maritime boundaries. This use of economic leverage to influence policy raised concerns about the impact of China's strategic hold on these precious metals. REEs have long been considered the "enhancers" of global products and are used to manufacture defense and commercial high-technology items. Their availability today, however, could be jeopardized since China controls over 97 percent of their production and refinement. The U.S. Magnetic Materials Association (USMMA) cites this problem as a *silent crisis* to the industry's on-time acquisition of critical supplies.<sup>1</sup> This Current Issue will examine supply and production, defense-related issues, and policy options related to REEs.

**REEs in today's economy**

Many products contain REEs. Makers of hybrid cars use these elements in their lanthanum nickel magnets to give them greater rechargeable capabilities. Portable x-ray units can function much more effectively with thulium. Erbium-doped fiber optic cables can amplify the speed of communication. The defense industry uses REEs in its hardware as well. The DDG-51 Hybrid Electric Drive Ship Program uses neodymium iron boron magnets which help power the guided destroyers. Night vision goggles and rangefinder equipment use rubidium to increase accuracy and visibility. The Aegis Spy-1 Radar uses the samarium cobalt magnet to withstand stresses as it has the highest temperature rating of any rare earth magnet. Even with a threefold increase in REE demand over the past ten years, demand is expected to increase even further, by anywhere from 8 to 790 percent over the next five years.<sup>2</sup> This in turn

has increased a few specific REE prices upwards of ninefold.<sup>3</sup>

While REEs have been produced for almost a century, the companies supplying them have changed. In the mid-twentieth century, almost all rare earth mining was done at Mountain Pass, California. Today, more than 97 percent of mining and refinement is done in China. The shift occurred mainly due to the elaborate separation and refining processes, which is labor intensive and raises safety and environmental concerns. Not only do the Chinese mine most of rare earths today, they possess 36 percent of world reserves.<sup>4</sup>

**Figure 1: REE Production Trends**

Source: United States Geological Survey, formatted by CSIS

This Chinese dominance has raised concerns within industry regarding prices and lead times for critical defense hardware. With demand increasing, the problem of purchasing and shipping REEs for products is concurrently growing. Chinese quotas limit the amount of REEs exported for commercial sale and have been reducing significantly since 2005. Quotas in 2010 declined by 40 percent compared to 2009 with only

<sup>1</sup> Green, [Congress Responds to Magnet Materials Supply Chain Push on Impending Rare Earths Crisis](http://www.reuters.com/article/idUS208848+17-Mar-2010+BW20100317), Reuters, <http://www.reuters.com/article/idUS208848+17-Mar-2010+BW20100317>

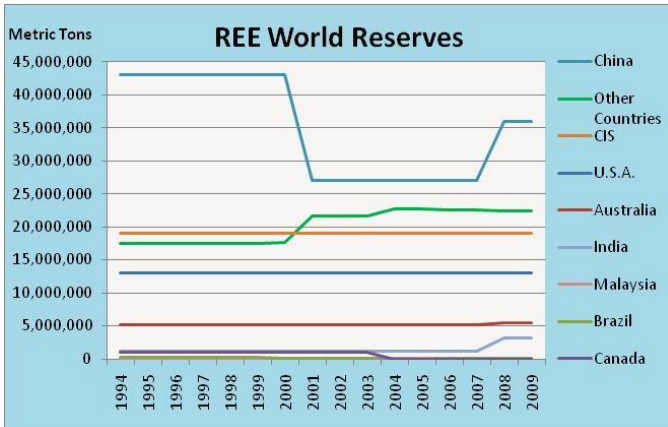
<sup>2</sup> Kientz, [Rare Earth Investment Potential is Great... If you are Patient](http://seekingalpha.com/article/227291-rare-earth-investment-potential-is-great-if-you-are-patient), Seeking Alpha, <http://seekingalpha.com/article/227291-rare-earth-investment-potential-is-great-if-you-are-patient>

<sup>3</sup> Scott, [Arafura in Funding Talks for \\$964 Million Rare Earths Project](http://www.bloomberg.com/news/2010-09-30/arafura-in-funding-talks-for-964-million-australian-rare-earths-project.html), Bloomberg News, <http://www.bloomberg.com/news/2010-09-30/arafura-in-funding-talks-for-964-million-australian-rare-earths-project.html>

<sup>4</sup> Papp et. al (2010), [Rare Earths](http://minerals.er.usgs.gov/minerals/pubs/commodity/rare_earths/mcs-2010-raree.pdf), United States Geological Survey, [http://minerals.er.usgs.gov/minerals/pubs/commodity/rare\\_earths/mcs-2010-raree.pdf](http://minerals.er.usgs.gov/minerals/pubs/commodity/rare_earths/mcs-2010-raree.pdf)

30,258 metric tons exported by the end of July.<sup>5</sup> In addition, export taxes on all rare earth metals increased during the same period from 15 to 25 percent.<sup>6</sup> In parallel, REE prices have risen threefold overall since 2001.

**Figure 2: REE World Reserves**



Source: United States Geological Survey Mineral and Commodity Summaries

**U.S. defense-related issues and policy options**

The rare earth supply concern is a major reason for the U.S. defense industry to reexamine its REE policy. This supply chain provides one of the starkest single points of failure for both commercial- and defense industrial-related companies. A GAO report from April 2010 identified four rare earth elements that have already caused some kind of weapon system production delay.<sup>7</sup>

For all DOD acquisitions, the Defense Acquisition Guidebook (DAG) provides the existing criteria for identifying and investigating supplier base concerns. DAG 2.3.9.2 states that elevating industrial capabilities to a level of concern occurs when a single or sole-source produced item meets one or more of four criteria.<sup>8</sup> REEs meet at least three of the DAG criteria yet they have not been elevated to a level of concern. Furthermore, other U.S. acts and provisions provide a murky definition and responsibility for “critical” or “strategic” elements,

<sup>5</sup> Reuters Africa (2010), [China Cuts 2010 rare earth export quota 40 pct-paper](http://af.reuters.com/article/metalsNews/idAFTOE67A03H20100811), <http://af.reuters.com/article/metalsNews/idAFTOE67A03H20100811>

<sup>6</sup> Cox (2010), [Rare Earths: Facing new challenges in the new decade](http://www.smenet.org/rareEarthsProject/SME_2010_Kingsnorth.pdf), Industrial Minerals Company of Australia Pty Ltd, [http://www.smenet.org/rareEarthsProject/SME\\_2010\\_Kingsnorth.pdf](http://www.smenet.org/rareEarthsProject/SME_2010_Kingsnorth.pdf)

<sup>7</sup> Martin (2010), [Rare Earth Materials in the Defense Supply Chain](http://www.gao.gov/new.items/d10617r.pdf), Government Accountability Office,

<http://www.gao.gov/new.items/d10617r.pdf>

<sup>8</sup> Ibid.

which clouds precise acquisition guidelines. Clarifying these definitions instead of the current ad hoc utilization of them would provide clearer policy directives for defense acquisition managers.

Should DOD want to mitigate this security of supply risk, defense policymakers will need to explore new REE acquisition options. Stockpiles of military items are an option currently used for petroleum, helium, and medical supplies.<sup>9</sup> This option would secure supplies needed for critical production capabilities and alleviate price spikes due to market fluctuations.

Another option is to build a buffer into the supply chain for critical non-US-produced items. This would mean more on-time deliveries of rare earths. The April 2009 National Defense Stockpile report mentioned the Defense Production Act as a possible solution. It would require businesses to sign contracts to fulfill REE orders, establish mechanisms to allocate materials to promote national defense, and would authorize the President to oversee the REE market so that scarce materials are available for national defense.

A solution suggested by the U.S. mining industry is for the United States to re-start mining REEs domestically to reduce the dependency on China sources. Similar efforts were initiated in Canada and Australia to rejuvenate their supplies, but these are still in the early stages of rebuilding the necessary infrastructure. The barriers to entry include large amounts of investment capital, advanced mining techniques, and dangerous environmental impact stipulations. There is also a need for greater domestic R&D effort on REE refining techniques as this capability is currently weak in the U.S.

With such a long lead time for developing a solid domestic mining base, a combination of stockpiling supplies and building future capacities appears to be the most viable option for the U.S. defense industry to resolve REE security of supply concerns.

–Reed Livergood

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<sup>9</sup> National Research Council (2008), [Managing materials for a twenty-first century military](http://www.nap.edu/catalog/12028.html), <http://www.nap.edu/catalog/12028.html>