Rare Earth Elements Supply Chains, Part 1: An Update on Global Production and Trade

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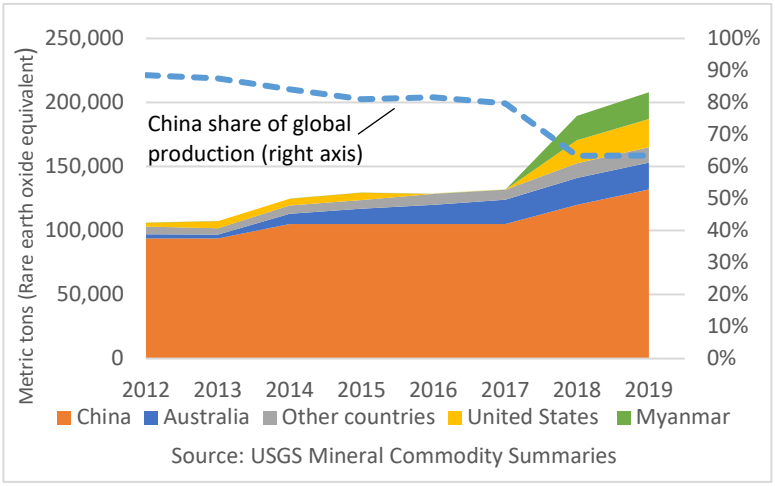
In 2019, China accounted for 78 percent of the total volume of U.S. imports of rare earth elements (REEs). While China's share of global REE mine production has decreased in recent years, it still accounted for 63 percent of global production in 2019. Meanwhile, global supply chains continue to be dependent on Chinese downstream processing facilities. Recent policy developments in the United States and beyond have called for decreasing reliance on China. To understand the urgency of these actions, this briefing examines the current state of REE supply chains.

Global REE Applications and Production

REEs are a group of 17 elements with similar chemical properties that, while existing abundantly, are often found in small, mixed deposits, making their extraction difficult and often damaging to the environment. These elements are critical inputs to many modern technologies such as electronics, batteries, fuel cells, catalysts, and fiber optics. While REEs have long been necessary for many U.S. industries including defense, medical, and information technology, recent increased demand has been driven by the growth of the green technology sector, where REEs serve as inputs in products such as wind turbines and hybrid vehicles.

Most REE applications require at least 99.9 percent purity. As a result, REEs go through several rounds of processing to separate the elements from the extracted deposits and increase the purity of the elements. While many countries have extraction capabilities, and some have partial processing abilities, very few countries can fully transform the raw material into its final usable form.

Figure 1: Global Mining Production of Rare Earths, 2012-19.



Source: USGS Mineral Commodity Summaries

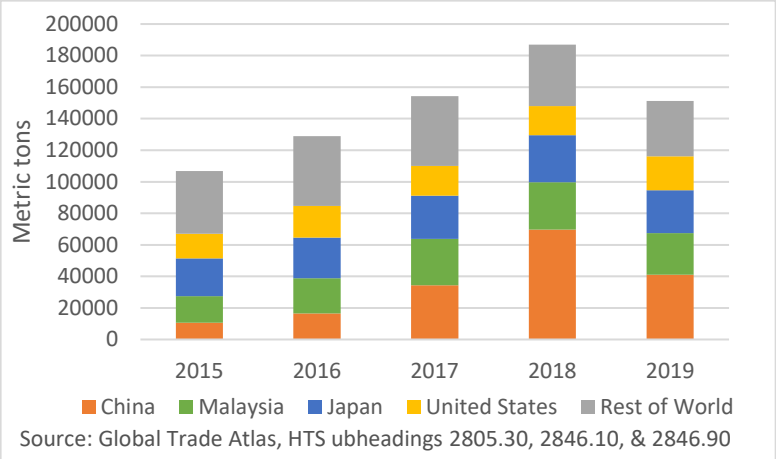
Global mining production of REEs[1] (figure 1) has been dominated by China since the 1990s, when Chinese production skyrocketed as U.S. production began to fade. In 2012, China accounted for nearly 90 percent of all reported production of REEs. However, during 2012-17, REE production in Australia grew from 3,220 to 19,000 metric tons per year (an average annual growth rate of 52 percent), driving China's share of production down to 80 percent. Australia's production growth more than offset the impact of a two-year stoppage of U.S. production of REEs following the closure of the California Mountain Pass Mine in late 2015, following a bankruptcy filing by its owner, Molycorp. A more recent decline in China's share of global production in 2018 was driven by a return to production in the United States following the purchase of the Mountain Pass Mine by MP Materials in addition to new production in Myanmar. Although MP Materials hopes to begin doing some processing soon, they are currently exporting all production for outside processing, principally to China. Despite global mine production becoming less concentrated, China continues to dominate in the processing of rare earths.

[1] REE mining production data is reported in rare earth oxide equivalent. It does not include production from further processing.

Global Trade in Rare Earths[2]

Since 2015, China's imports of REEs have increased by nearly 285 percent. In 2017, China became the world's largest importer by volume, and in 2019, a net importer of REEs for the first time in several decades (figure 2). While China's increased efforts to stop illegal domestic mining and uphold environmental regulations have increased demand for imports, this may also be explained by much of the new mine production outside of the country being sent to China for further processing. Another reason for China's high import levels is that many downstream industries that rely on REEs have moved to China to guarantee sourcing of these inputs. Although China's total volume of imports decreased in 2019, following an exceptional spike the previous year, 2020 saw significant growth in imports to China as well. Meanwhile, the United States, having exported 100 percent of its own production due to a lack of domestic processing options, was the fourth largest importer (predominantly of processed REEs), behind Malaysia and Japan. 75 percent of U.S. imports came from China, 9 percent from Malaysia, 4 percent from Estonia, and 3 percent from Japan. However, REEs from the latter three countries were only processed in those countries after importing semi-processed products from China, further indicating China's crucial role in the global processing of REEs. Other major REE importers include Vietnam and South Korea.

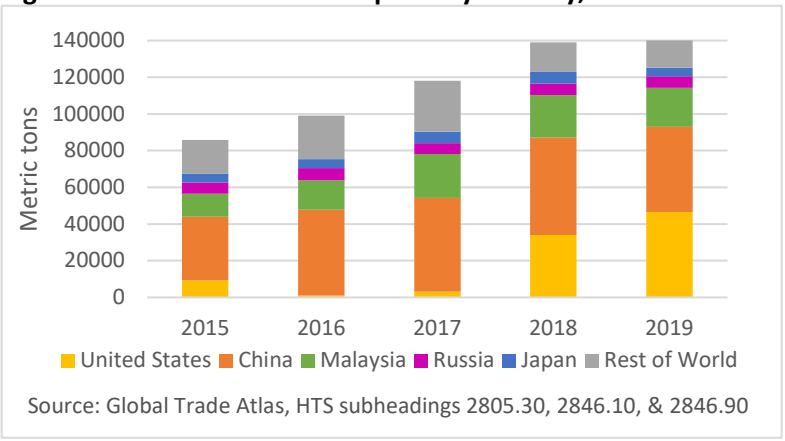
Figure 2: Global Rare Earths Imports by Country, 2015-19.



Source: Global Trade Atlas, HTS ubheadings 2805.30, 2846.10, & 2846.90

In 2019, the United States became the top global exporter of REEs by volume, surpassing China for the first time since China became dominant in the sector (figure 3). However, U.S.-mined REEs still require processing, which may explain why nearly 98 percent of U.S. exports were sent to China. Malaysia, Russia, and Japan have also served as major exporters in recent years.

Figure 3: Global Rare Earths Exports by Country, 2015-19.



Source: Global Trade Atlas, HTS subheadings 2805.30, 2846.10, & 2846.90

Looking Ahead

The continued reliance on China for REEs has motivated the United States and other countries to seek alternative reserve sources and develop new processing capacity and extraction avenues. Adding domestic processing capacity would reduce the need to export U.S.-mined REEs for further processing. The identification of further domestic REE reserves would also aid the United States in reducing import dependency. Part 2 of this EBOT series will cover these topics and ongoing initiatives by U.S. and foreign policy makers to reduce global dependence on China for REEs and invigorate domestic REE industries.

Sources: Daly, "China Becomes World's Biggest Importer of Rare Earths: Analysts." *Reuters*, 13 March 2019." China Rare Earth Market Report 2019-2023." PR Newswire, 24 May 2019. "Rare Earths Data Sheet – Mineral Commodities Summaries 2013- 2020." *USGS,* Accessed April 2020. "Mountain Pass Rare Earth Mine." *NS Energy*, Accessed April 2020. "Rare Earth Elements 101." *U.S. Department of Energy, Office of Fossil Energy,* Accessed April 2020, Yu & Mitchell, "State Interference Threatens China's Control of Rare Earth Production." Financial Times, October 28, 2020.

[2] Since HTS subheadings do not clearly separate REEs by levels of processing, imports/exports of raw materials versus processed REEs cannot be distinguished in the data.