

SUPPLIES OF CRITICAL RARE EARTHS TO U.S. INDUSTRIES ARE CONSTRAINED BY CHINA’S POLICIES

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The United States’ increasing reliance on China as virtually the sole source of rare earth elements (rare earths)—critical raw materials used in numerous technologies, including electronics manufacturing and renewable energy applications—exposes the U.S. economy to China’s export restriction policies, which are aimed at encouraging domestic use of these elements. These policies, coupled with China’s near monopoly of global production, have contributed to significant global price increases and led affected U.S. industries to pursue strategies aimed at reducing dependence on imports from China.

GLOBAL RARE EARTHS PRODUCTION AND APPLICATIONS

- Rare earths are a group of 17 elements that are relatively abundant in the earth’s crust but rarely occur in high enough concentrations for mining to be economically viable.
- Because of mining reductions in other countries (for both environmental and economic reasons), China now accounts for 97% of global rare earth production.
- China’s dominance in producing rare earths, coupled with the many uses of these elements—including clean energy technologies (fig. 1) and various other industries, such as the automotive, petroleum, electronics, and medical device industries (fig. 2)—causes China’s policies to have far-reaching effects on the U.S. economy.

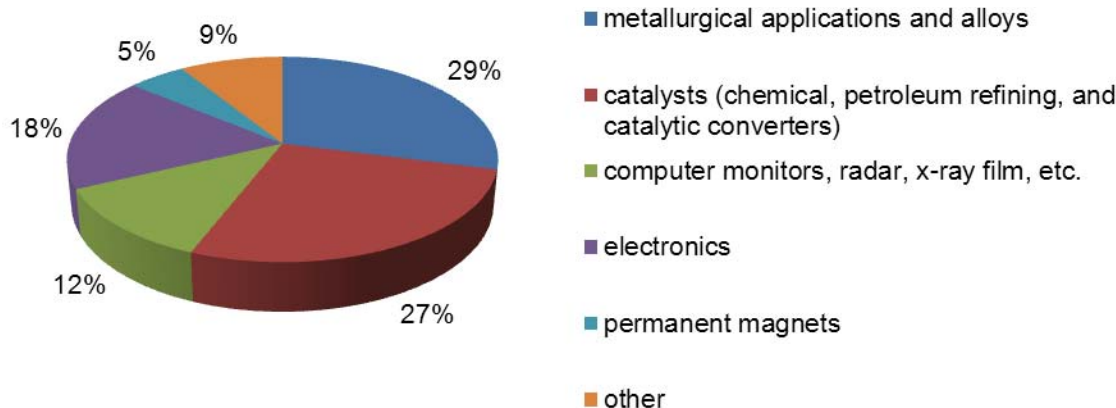
Figure 1 Rare earths are used in numerous clean energy technologies

	Wind turbines	Electric and hybrid vehicles		Efficient lighting
Rare earth element	<i>Magnets</i>	<i>Magnets</i>	<i>Batteries</i>	<i>Phosphors</i>
Lanthanum			✓	✓
Cerium			✓	✓
Praseodymium	✓	✓	✓	
Neodymium	✓	✓	✓	
Samarium	✓	✓		
Europium				✓
Terbium				✓
Dysprosium	✓	✓		
Yttrium				✓

Source: U.S. Department of Energy.

- China mines 96%–99% of the rare earths most critical to the United States’ renewable energy sector, including dysprosium, terbium, neodymium, europium, and yttrium.
- As the U.S. clean energy industry continues to develop, its demand for rare earths may compete with demand from other industries, especially if significant supply shortages occur. Further, such shortages could raise the cost of renewable energy technologies, which already struggle to compete with conventional energy sources.
- By 2014, U.S. industries are expected to account for 11% of total global demand for rare earths. The United States is the third-largest market behind China (65%) and Japan (17%).

Figure 2 U.S. end uses of rare earths by share in 2009 reveal that rare earths are critical to a wide variety of U.S. industries



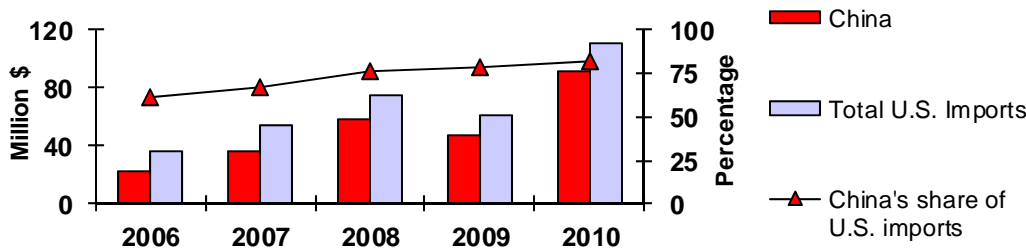
Catalysts—most notably used for refining petroleum and in automotive catalytic converters (which control a vehicle’s emissions)—now account for 27% of U.S. demand and are expected to keep driving much of this domestic demand.

Source: U.S. Geological Survey.

INCREASING U.S. RELIANCE ON RARE EARTHS IMPORTED FROM CHINA

- The United States increasingly depends on Chinese-mined rare earths. U.S. imports of rare earths from China rose by 314% between 2006 and 2010, from \$22 million to \$91 million (fig. 3). Similarly, from 2005 through the first 10 months of 2010, China's share of total U.S. rare earth imports, by volume, rose from 89% (3,780 kg) to 93% (7,081 kg).

Figure 3 China accounts for an increasing amount of total U.S. rare earth imports, 2006–10



Source: Data compiled from official statistics of the U.S. Department of Commerce.

Note: Compiled from data for Harmonized Tariff Schedule numbers 2846.90.2010, "rare earth oxides except cerium oxides" 2846.10, "cerium compounds," and 2846.90.20, "mixtures of rare earth oxides or of rare earth chlorides."

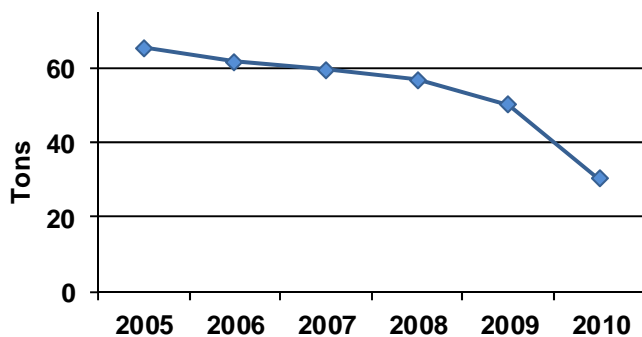
- China leads the world in rare earth exports; during the first half of 2010 alone, the value of the country's rare earth exports was \$233.6 million—\$211.1 million more than Japan, the world's second largest exporter.

CHINA'S EXPORT POLICIES AND THE IMPACT ON RARE EARTHS PRICES

Rare earth exports from China are subject to both export quotas and export taxes, which may lead foreign downstream industries to relocate production to China in order to avoid export restrictions.

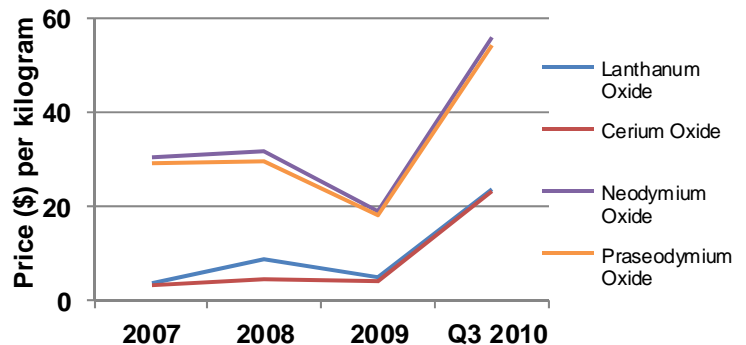
- Rare earths from China face an export tax of either 15% or 25% depending on the element. For 2010, China reduced its annual rare earth export quota by nearly 20 tons (fig. 4) and announced a further reduction of 11% for the first half of 2011. (In December 2010, the U.S. Trade Representative indicated that it would consider filing a World Trade Organization (WTO) case on rare earth export restraints if China does not change its policies; Japan considered submitting a similar complaint to the WTO in October 2010).
- These policies have caused rapid global price increases (fig. 5) and led to large differences between the Chinese domestic market and export market prices; according to the Organization of Economic Co-operation and Development, companies producing outside of China pay about 31% more for raw rare earth metals than Chinese producers.

Figure 4 China reduced rare earths export quotas by 35 tons (54%) during 2005–10



Source: U.S. Department of Energy.

Figure 5 Global prices of key rare earths have risen sharply during 2007–10



Source: Compiled from Lynas Corporation statistics.

U.S. INDUSTRY RESPONSES TO CHINA'S POLICIES ON RARE EARTH EXPORTS

In response to price increases and potential shortages, U.S. industries are pursuing diverse strategies:

- Recycle:** Many companies have increased rare earth recycling efforts. One global electronics company for instance, estimates that recycling could fulfill 10% of its rare earth needs.
- Reduce/Replace:** U.S. companies and research labs are developing alternative technologies that reduce or replace rare earth usage. For example, electromagnets are seen as an alternative to permanent rare earth magnets in motors for electric and hybrid vehicles. Similarly, General Electric (GE)—the leading U.S. wind turbine manufacturer—has been using non-rare earth elements, such as rhenium, to make engine turbine blades. GE is also working with the U.S. Department of Energy to reduce the rare earth content in permanent magnets by up to 80% using nanotechnology.
- Diversify suppliers:** The expected emergence of rare earth mining facilities in both the United States and Australia over the next two years may provide U.S. industries with alternative suppliers of these elements. (The United States, once the world's largest supplier of rare earths, halted production in 2002 due in large part to environmental concerns).

Although all these measures have the potential to reduce U.S. dependence on imports of rare earths from China over the next several years, supply limitations, import dependence, and price volatility are likely to continue in the short term.

Sources: Bloomberg, ClimateWire, Congressional Research Service, IMCOA, USDOE. For a full list of sources contact the authors.