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Rare earths industry 2013–2014: Diversifying supply sources

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Two new large-scale rare earths plants outside of China started production in 2013. These were Molycorp (United States), and Lynas (Australia/Malaysia). They are expected to supply as much as 30 per cent of the world's demand in rare earths, breaking China's decade-long 95–98 per cent market share monopoly.

The rare earths prices reached a bottom line in the middle of 2013 after continuously declining since 2011's peak levels. The 2010–2012 rare earths panic is over; however, the market revival has a long road ahead.

What are rare earths?

Rare earth elements (REEs) are a group of 17 elements (15 lanthanides, plus yttrium and scandium). The make-up of these elements is unique in terms of their physical, chemical and light-emitting characteristics. In the last two decades, REEs have become crucially important for modern technologies, including renewable energy generation and storage, energy-efficient lights, electric cars and digital electronics, as well as for aerospace and military applications.

Despite similar basic properties, different REEs display unique characteristics for specific applications. For example, neodymium's magnetic properties are crucial for the production of the most powerful permanent magnets; an addition of dysprosium to the latter helps to improve heat resistance. Europium, terbium, and yttrium have superb optical characteristics that are much needed in energy-efficient lamps, and computer and television monitors. Lanthanum's catalytic properties are employed in the petrochemical industry, while cerium is used in car catalytic convertors; a mix of both elements is also used in polishing powders and in battery alloys.

The identified geological reserves for rare earths are significant, covering the current consumption level of these elements for several centuries; however, the concentration of REEs in many deposits is not high enough to make them economically feasible to extract.

The concentration and distribution of the individual REEs also varies greatly by mineral and deposit. The price for the individual element directly correlates to its relative abundance and market demand. Light rare earths (the lighter spectrum of lanthanides) usually dominate in the ore bodies, and are priced at a lower level (for example, cerium), while heavy rare earths are sold with a premium (for example, terbium).

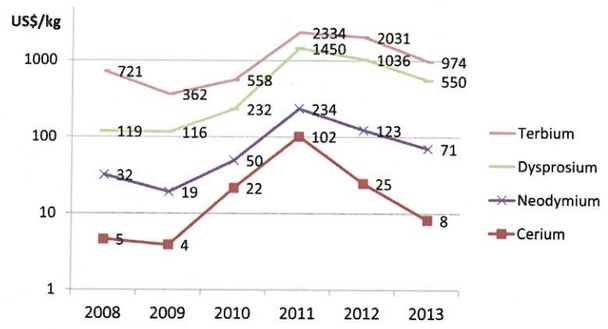
Market overview

The world market for rare earth oxides (the main intermediate product) is estimated at about 110,000 tonnes, or US$4 billion a year, which is not impressive compared with other metals; however, the market for final products that rely on these critical elements has to be multiplied by a factor of hundreds.

The volume of REEs required is small by traditional mining standards, but their impact on many modern and green technologies is large if product is not available,' said the Department of Natural Resources and Mines' Laurie Hutton at the University of Queensland Rare Earths Symposium in May last year.

> *Europium, terbium, and yttrium have superb optical characteristics that are much needed in energy-efficient lamps, and computer and television monitors*

Figure 1: Average prices (FOB China) for selected rare earths oxides.



Source: Metal-Pages.

China started to dominate the rare earths supply chain in the mid-1990s, largely due to its supply of world's best deposits, along with the fact that low labour costs and fewer environmental regulations provided Chinese producers with unbeatable economic advantages.

Since 2003, after the closure of Mountain Pass facility in the United States (historically the world's largest rare earths mine site), Chinese domination became absolute, accounting for between 95 per cent and 98 per cent of the market. In 2010, this was increased by a significant reduction in export quotas, raising concerns about securing REE supply in the United States, Japan, the European Union and other countries.

From 2010 to 2012, it resulted in skyrocketing prices and supply deficit for most REEs, leading to numerous new REE start-up companies around the world, with allocation of large investments in additional geological explorations and technology development.

It took more than two years for the market to accommodate supply difficulties. Some consumers were able to minimise their REE consumption relatively quickly by introducing reuse strategies (for instance, reusing polishing powders) or reducing the amount of REEs used in the final products (less of the expensive dysprosium is used in permanent magnets produced in Japan).

The recycling of REEs also became a hot topic for major electronics producers and research institutions; however, experts believe that the potential to use less REEs has almost reached its limit, while recycling is feasible only for a few end-of-life products when the concentration and type of REEs used is economically significant. It is expected that the demand for REEs is likely to grow at between eight and 10 per cent per annum. The low prices for rare earths over 2013, being almost back to the pre-crisis levels, are another supporting factor for the market to rebound.

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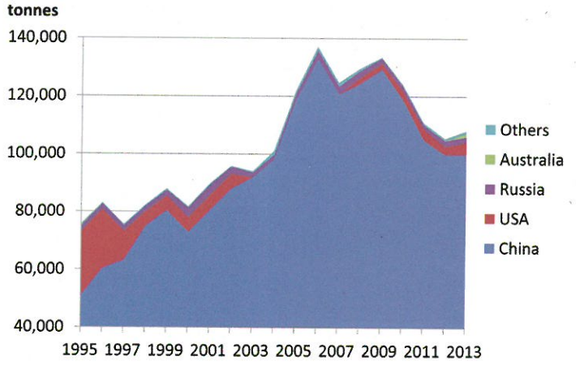
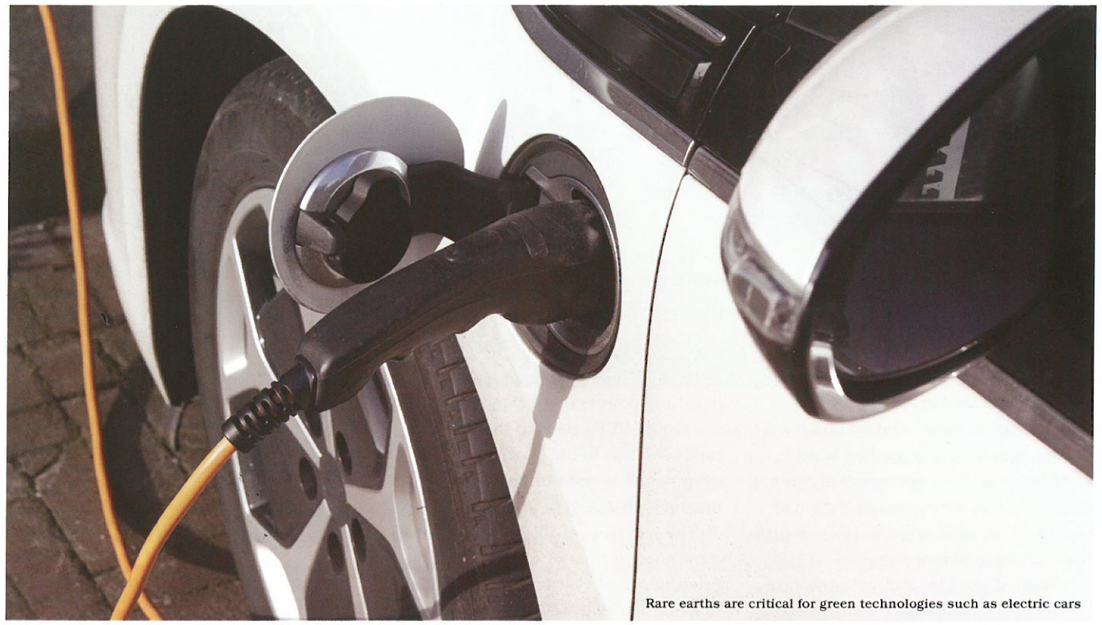
New major players: Molycorp and Lynas

After years of delays, 2013 finally brought two new large-scale plants outside of China into production. The fully rebuilt Mountain Pass facility in California (Molycorp Inc) has a production capacity of 23,000 tonnes per year. Lynas Advanced Materials Plant (LAMP) at Kuantan in Malaysia (Lynas Ltd) is designed for 22,000 tonnes per year, and relies on rare earths concentrate supply from Lynas's mining operations at Mount Weld in Western Australia.

Figure 2: World production of rare earths (100 per cent rare earths oxides).



Source: BGS, USGS, authors estimation.



Rare earths are critical for green technologies such as electric cars

Mountain Pass facility. Image courtesy of Molycorp

> *The environmental safety of LAMP's operations in Malaysia continues to be doubted by the local community*

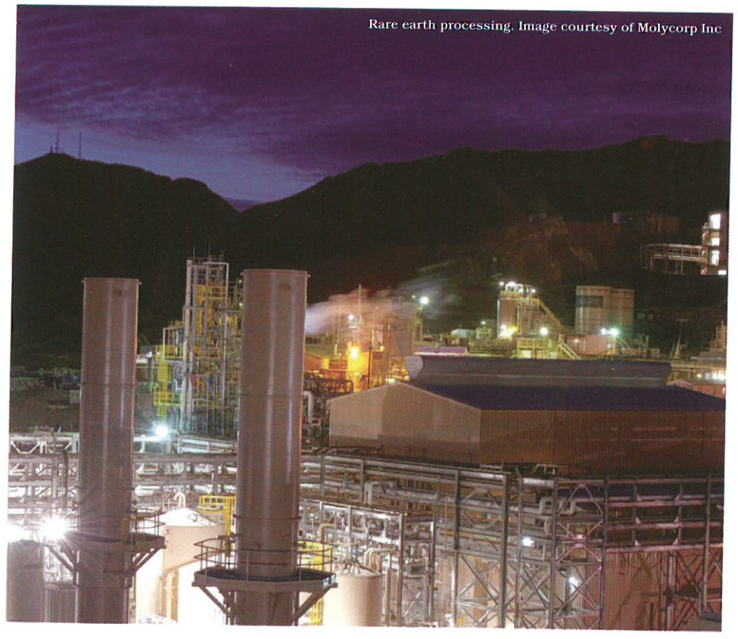
Challenged by several technical issues at the start-up, both companies achieved quite modest production in 2013, preliminary estimates were at 4000 tonnes of rare earth oxides at Mountain Pass, and about 1000 tonnes at LAMP.

The major concerns, however, are not of a technical nature, but surround community safety. The environmental safety of LAMP's operations in Malaysia continues to be doubted by the local community. The company still faces community protests, and currently works under a temporary operating licence. Molycorp's challenges mainly relate to economics: the costs of production and the market prices required to sustain the operations are of concern, and, to date, its financial results have disappointed investors.

Molycorp and Lynas could supply as much as 30 per cent of the global market share, challenging the existing monopoly from China while also covering most of the demand for REE outside of China; however, there is a clear distinction between light and heavy REE supply chains. Both Molycorp and Lynas mainly produce light rare earths and have only small amounts of heavies in their ore bodies. China's domination in heavy rare earths production is anticipated to remain, covering more than 90 per cent of the demand for elements such as dysprosium, terbium, europium and yttrium.

A few dozen junior rare earths miners that are preparing to start rare earths production over the next decade could change the industry profile. This includes companies in the United States, Canada, South Africa, Australia, Sweden and Brazil. The experts, however, believe that the market can accommodate no more than another two or three major players until 2020. The opportunity mainly remains for heavy rare earths producers.

Paste Tailings Plant. Image courtesy of Molycorp Inc



Rare earth processing. Image courtesy of Molycorp Inc

The Sustainable Minerals Institute (SMI), based at the University of Queensland in Brisbane, is the world's leading research institute dedicated to finding knowledge-based solutions to the sustainability challenges of the minerals industry. Rare earths research is part of the SMI's NextMine™ initiative, which is a collaborative effort between engineers, scientists, and social scientists researching new approaches to deliver step-wise, real-world improvements in the minerals and mining sector.
For more information please refer to www.csrm.uq.edu.au/rareearths.

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