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Technical Information Resource on Rare Earth Elements Now Available to Public and Private Sector Stakeholders

Background

Rare earth elements (REEs) include the series of 15 lanthanide metals, plus scandium and yttrium. REEs have become increasingly important in recent years because their unique chemical and physical properties have contributed to technological advances in many areas, such as electric car batteries (lanthanum), high-power magnets (holmium, thulium, dysprosium, neodymium), lasers (erbium, dysprosium, yttrium, neodymium, holmium), solar panels (ytterbium), magnetic resonance imaging (gadolinium), liquid crystal displays (LCDs) and fluorescent lighting (europium), televisions and computer monitors (yttrium).

Recovery of REEs is accomplished through complex processing methods to chemically break down the minerals containing the REEs. Although several minerals contain REEs, three relatively abundant ores include: bastnasite, xenotime, and monazite.

In 1984, the Mountain Pass mine in California supplied nearly all of U.S. demand and a third of the world's demand for REEs. Since that time, China has become the world's leading producer of REEs, with approximately 95 percent of worldwide production. Due to rising demand and the reduction in supply, the cost of

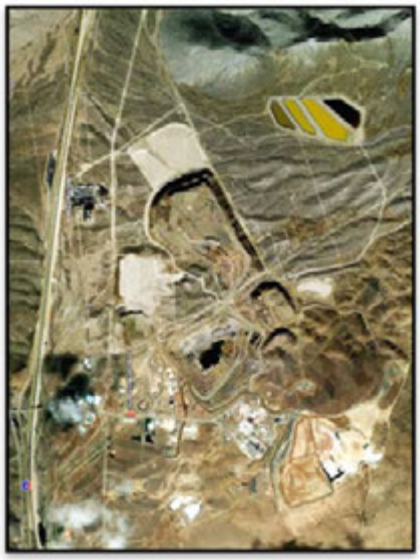
The rare earth element yttrium is used in the production of computer monitors, camera lenses, energy efficient lighting, and cubic zirconia gems.

REEs has increased dramatically in recent years.

REE mines outside of China are currently being evaluated or are in development, including sites in the U.S. For example, the Mountain Pass mine has been ramping up production over the last few years. This mine, along with other potential sites in the western United States, may represent the principal future domestic supply of REEs.

Recycling of REEs is a growing industry. When compared with primary processing from mining, recycling may provide significant environmental benefits with respect to air emissions, groundwater protection, acidification, eutrophication, and climate protection.

Research into alternative materials is another strategy that is being explored in response to the REE supply issues. Generally, this can fall into two main categories: research into alternatives to REEs, or research into alternative product designs that require fewer or no REEs.



Aerial view of Mountain Pass Mine, which in 1984 supplied 100% of REEs in the U.S. (With Permission of GoogleEarth (© 2012 Google) and USDA Farm Service Agency and © 2012 GeoEye)

Product Details

An EPA technical information report, **"Rare Earth Elements: A Review of Production, Processing, Recycling, and Associated Environmental Issues"** has been produced as an introductory resource for those interested in learning more about REE mining and alternatives to

meet demand. Contents of the report include:

- Resource Processing
- Rare Earth Element Recovery/Alternative Material Use
- Potential Human Health and Ecological Issues of Production, Processing, and Recycling of REEs
- Mine conceptual site model and exposure pathways
- Research on Alternatives to REEs
- Summary, Key Findings from Literature Review, and Potential Next Steps

Outcomes and Impacts

Analysis of the future supply and demand for each of the REEs indicates that, by 2014, global demand could exceed current production by 60% (as compared to July 2011 levels).

This EPA report is a timely introductory information resource during an invigorated growth phase of this industry. The report serves as a technical information resource to mining industries. It can also be a resource for environmental managers, policy makers, those investigating alternatives to mining, and other stakeholders**.** It is valuable to anyone concerned with identifying the potential environmental impacts and health effects across the REE supply chain. The report also identifies areas where further information gathering may be needed.

Products containing REEs in 2008

End Use of REE	Percentage
Metallurgical alloys	29%
Electronics	18%
Chemical catalysts	14%
Phosphors for computer monitors, radar, X-ray intensifying film, and television	12%
Catalytic converters (Autos)	9%
Glass polishing & ceramics	6%
Permanent magnets	5%
Petroleum refining catalysts	4%
Other	3%

The environmental impacts from mining operations to extract REE ores may be as significant as current metals/minerals mining practices.

Currently, commercial recycling of REEs is limited; however, it was reported in the literature that, several new facilities will soon begin operation. When compared with primary processing of metals, controlled recycling of REEs may provide significant benefits with respect to air emissions, groundwater protection, acidification, and eutrophication. The focus of these new commercial efforts will be on magnets, batteries, lighting/luminescence, and catalysts.

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