RARE EARTHS

(Data in metric tons of rare-earth oxide (REO) content, unless otherwise noted)

Domestic Production and Use: Rare earths were mined by one company in 1996. Bastnasite, a rare-earth fluocarbonate mineral, was mined as a primary product by a firm in Mountain Pass, CA. The United States was a leading producer and processor of rare earths, and continued to be a major exporter and consumer of rare-earth products. Domestic ore production was valued at an estimated $64 million. Refined rare-earth products were produced primarily by three companies; one with a plant in Mountain Pass, CA; another with operations in Phoenix, AZ, and Freeport, TX; and a third with a plant in Chattanooga, TN. The estimated value of refined rare earths consumed in the United States was more than $500 million. The approximate distribution in 1995 by end use was as follows: automotive catalytic converters, 44%; petroleum refining catalysts, 25%; permanent magnets, 11%; glass polishing and ceramics, 9%; metallurgical additives and alloys, 8%; phosphors, 3%; and miscellaneous <1%.

Salient Statistics—United States:

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Production:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bastnasite concentrates</td>
<td>20,700</td>
<td>17,800</td>
<td>20,700</td>
<td>22,200</td>
<td>20,000</td>
</tr>
<tr>
<td>Monazite concentrates</td>
<td>W</td>
<td>W</td>
<td>W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imports:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thorium ore (monazite)</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Rare-earth metals, alloys</td>
<td>352</td>
<td>235</td>
<td>284</td>
<td>905</td>
<td>442</td>
</tr>
<tr>
<td>Cerium compounds</td>
<td>806</td>
<td>1,270</td>
<td>1,890</td>
<td>4,091</td>
<td>4,723</td>
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<tr>
<td>Mixed REO's</td>
<td>295</td>
<td>249</td>
<td>354</td>
<td>678</td>
<td>918</td>
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<tr>
<td>Rare-earth chlorides</td>
<td>728</td>
<td>1,080</td>
<td>2,410</td>
<td>1,249</td>
<td>988</td>
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<tr>
<td>Rare-earth oxide, compounds</td>
<td>3,100</td>
<td>3,730</td>
<td>5,140</td>
<td>6,499</td>
<td>13,669</td>
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<tr>
<td>Ferrocerium, alloys</td>
<td>94</td>
<td>105</td>
<td>92</td>
<td>78</td>
<td>97</td>
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<tr>
<td>Exports:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thorium ore, monazite</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>27</td>
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<tr>
<td>Rare-earth metals, alloys</td>
<td>44</td>
<td>194</td>
<td>329</td>
<td>444</td>
<td>272</td>
</tr>
<tr>
<td>Cerium compounds</td>
<td>1,930</td>
<td>1,620</td>
<td>4,460</td>
<td>5,117</td>
<td>5,913</td>
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<tr>
<td>Other rare-earth compounds</td>
<td>1,310</td>
<td>1,090</td>
<td>2,410</td>
<td>1,546</td>
<td>2,524</td>
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<tr>
<td>Ferrocerium, alloys</td>
<td>2,430</td>
<td>4,270</td>
<td>3,020</td>
<td>3,471</td>
<td>2,685</td>
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<tr>
<td>Consumption, apparent</td>
<td>21,400</td>
<td>17,000</td>
<td>18,200</td>
<td>25,400</td>
<td>29,500</td>
</tr>
<tr>
<td>Price, dollars per kilogram, year end:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bastnasite concentrate, REO basis</td>
<td>2.87</td>
<td>2.87</td>
<td>2.87</td>
<td>2.87</td>
<td>2.87</td>
</tr>
<tr>
<td>Monazite concentrate, REO basis</td>
<td>.41</td>
<td>.40</td>
<td>.46</td>
<td>.44</td>
<td>.47</td>
</tr>
<tr>
<td>Mischmetal, metal basis</td>
<td>12.68</td>
<td>12.68</td>
<td>12.68</td>
<td>9.50</td>
<td>9.50</td>
</tr>
<tr>
<td>Stocks, producer and processor, year end</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment, mine and mill, number</td>
<td>372</td>
<td>352</td>
<td>350</td>
<td>280</td>
<td>NA</td>
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<tr>
<td>Net import reliance as a percent of apparent consumption</td>
<td>33</td>
<td></td>
<td></td>
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<td>6</td>
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</tbody>
</table>

Recycling: Small quantities, mostly permanent magnet scrap.

Import Sources (1992-95): Monazite: Australia, 89%; and Malaysia 11%. Oxides, compounds, and metal: France, 48%; China, 35%; India, 11%; Japan, 4%; and other, 2%.

Tariff: Item

<table>
<thead>
<tr>
<th>Item</th>
<th>Number</th>
<th>Most favored nation (MFN) 12/31/96</th>
<th>Non-MFN 12/31/96</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thorium ores and concentrates (monazite)</td>
<td>2612.20.0000</td>
<td>Free</td>
<td>Free</td>
</tr>
<tr>
<td>Rare-earth metals, whether or not intermixed or interalloyed</td>
<td>2805.30.0000</td>
<td>5.0% ad val.</td>
<td>31.3% ad val.</td>
</tr>
<tr>
<td>Cerium compounds</td>
<td>2846.10.0000</td>
<td>6.5% ad val.</td>
<td>35% ad val.</td>
</tr>
<tr>
<td>Mixtures of REO's except cerium oxide</td>
<td>2846.90.2010</td>
<td>Free</td>
<td>25% ad val.</td>
</tr>
<tr>
<td>Mixtures of rare-earth chlorides, except cerium chloride</td>
<td>2846.90.2050</td>
<td>Free</td>
<td>25% ad val.</td>
</tr>
<tr>
<td>Rare-earth compounds, individual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REO's (excluding cerium compounds)</td>
<td>2846.90.8000</td>
<td>3.7% ad val.</td>
<td>25% ad val.</td>
</tr>
<tr>
<td>Ferrocerium and other pyrophoric alloys</td>
<td>3606.90.3000</td>
<td>5.9% ad val.</td>
<td>56.7% ad val.</td>
</tr>
</tbody>
</table>

Prepared by James B. Hedrick, (703) 648-7725 [Fax: (703) 648-7722].
RARE EARTHS

Depletion Allowance: Percentage method, monazite, 22% on thorium content and 14% on rare-earth content (Domestic), 14% (Foreign); bastnasite and xenotime, 14% (Domestic and Foreign).

Government Stockpile:

Stockpile Status—9-30-96

<table>
<thead>
<tr>
<th>Material</th>
<th>Uncommitted inventory</th>
<th>Committed inventory</th>
<th>Authorized for disposal</th>
<th>Disposals Jan.-Sept. 96</th>
</tr>
</thead>
<tbody>
<tr>
<td>REO in sodium sulfate</td>
<td>—</td>
<td>454</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Events, Trends, and Issues: Domestic demand for rare earths in 1996 was higher than in 1995. Compared with 1995, the use of rare earths continued to increase as the domestic economy improved through the first two quarters of the year. In the third quarter the domestic economy slowed sharply, keeping interest rates stable and inflation on the decline. Imports were very strong going into the third quarter for individual rare-earth compounds, including cerium compounds. Rare-earth prices remained competitive throughout 1996, with firming of domestic prices for cerium and neodymium because of strong demand. Demand continued to grow for cerium used in automotive catalytic converters and for neodymium used in permanent magnet applications. China remained a major source of separated rare-earth compounds and alloys, and is expected to continue as a major world supplier.

The 21st Rare Earth Research Conference was held in the United States in Duluth, MN, on July 7-11, 1996. The Third International Conference on f Elements is scheduled for September 14-19, 1997, in Paris, France.

World Mine Production, Reserves, and Reserve Base:

Mine production* | Reserves§ | Reserve base§
---|---|---
United States | 22,200 | 20,000 | 13,000,000 | 14,000,000 |
Australia | — | — | 5,200,000 | 5,800,000 |
Brazil | 400 | 400 | 280,000 | 310,000 |
Canada | — | — | 940,000 | 1,000,000 |
China | 48,000 | 50,000 | 43,000,000 | 48,000,000 |
India | 2,700 | 2,700 | 1,100,000 | 1,300,000 |
Malaysia | 448 | 400 | 30,000 | 35,000 |
South Africa | — | — | 390,000 | 400,000 |
Sri Lanka | 120 | 120 | 12,000 | 13,000 |
Thailand | — | — | 1,000 | 1,100 |
Former Soviet Union | 6,000 | 6,000 | 19,000,000 | 21,000,000 |
Zaire | 11 | 10 | 1,000 | 1,000 |
Other countries | — | — | 21,000,000 | 21,000,000 |
World total (rounded) | 79,900 | 79,600 | 100,000,000 | 110,000,000 |

World Resources: Rare earths are relatively abundant in the Earth’s crust, but discovered minable concentrations are less common than for most other ores. It is expected that substantial additional resources will be discovered as the industry completes its fourth decade of major industrial expansion. U.S. and world resources are contained primarily in bastnasite and monazite. Bastnasite deposits in China and the United States constitute the largest percentage of the world’s rare-earth economic resources, while monazite deposits in Australia, Brazil, China, India, Malaysia, South Africa, Sri Lanka, Thailand, and the United States constitute the second largest segment. Xenotime, rare-earth-bearing (ion adsorption) clays, loparite, phosphorites, apatite, eudyalite, secondary monazite, cheralite, and spent uranium solutions make up most of the remaining resources. Undiscovered resources of rare earths are thought to be very large relative to expected demand.

Substitutes: Substitutes are available for many applications, but generally are less effective.

*Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data.
§Data includes lanthanides and yttrium, but excludes most scandium. See also Scandium and Yttrium.
§As reported in Unocal Corp. annual reports and as authorized from Molycorp, Inc., personnel. Data rounded to three significant digits.
§REO equivalent or contents of various materials were estimated. Data from U.S. Bureau of the Census. Data rounded to three significant digits.
§Monazite concentrate production was not included in the calculation of apparent domestic consumption and net import reliance. Data rounded to three significant digits. Net import reliance defined as imports - exports + adjustments for Government and industry stock changes.
§See Appendix B.
§See Appendix C for definitions.
§Number reported in published reports or from company representatives.