## RARE EARTHS1

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

<u>Domestic Production and Use</u>: In 2009, rare earths were not mined in the United States; however, rare-earth concentrates previously produced at Mountain Pass, CA, were processed into lanthanum concentrate and didymium (75% neodymium, 25% praseodymium) products. Rare-earth concentrates, intermediate compounds, and individual oxides were available from stocks. The United States continued to be a major consumer, exporter, and importer of rare-earth products in 2009. The estimated value of refined rare earths imported by the United States in 2009 was \$84 million, a decrease from \$186 million imported in 2008. Based on final 2008 reported data, the estimated 2008 distribution of rare earths by end use, in decreasing order, was as follows: metallurgical applications and alloys, 29%; electronics, 18%; chemical catalysts, 14%; rare-earth phosphors for computer monitors, lighting, radar, televisions, and x-ray-intensifying film, 12%; automotive catalytic converters, 9%; glass polishing and ceramics, 6%; permanent magnets, 5%; petroleum refining catalysts, 4%; and other, 3%.

Salient Statistics—United States:	<u> 2005</u>	<u> 2006</u>	<u> 2007</u>	<u>2008</u>	2009 <sup>e</sup>
Production, bastnäsite concentrates	_				_
Imports: <sup>2</sup>					
Thorium ore (monazite or various thorium materials)	_				20
Rare-earth metals, alloy	880	867	784	679	210
Cerium compounds	2,170	2,590	2,680	2,080	1,190
Mixed REOs	640	1,570	2,570	2,390	2,760
Rare-earth chlorides	2,670	2,750	1,610	1,310	390
Rare-earth oxides, compounds	8,550	10,600	9,900	8,740	2,160
Ferrogerium, alloys	130	127	123	125	100
Exports: <sup>2</sup>					
Thorium ore (monazite or various thorium materials)	_	_	1	61	23
Rare-earth metals, alloys	636	733	1,470	1,390	6,500
Cerium compounds	2,210	2,010	1,470	1,380	690
Other rare-earth compounds	2,070	2,700	1,300	663	420
Ferrocerium, alloys	4,320	3,710	3,210	4,490	2,540
Consumption, apparent (excludes thorium ore)	6,060	9,350	10,200	7,410	(3)
Price, dollars per kilogram, yearend:					
Bastnäsite concentrate, REO basis <sup>e</sup>	5.51	6.06	6.61	8.82	5.73
Monazite concentrate, REO basis <sup>e</sup>	0.54	0.87	0.87	0.87	0.87
Mischmetal, metal basis, metric ton quantity <sup>4</sup>	5-6	5-6	7-8	8-9	8-9
Stocks, producer and processor, yearend	W	W	W	W	W
Employment, mine and mill, number at yearend Net import reliance <sup>5</sup> as a percentage of	71	65	70	100	110
apparent consumption	100	100	100	100	100

**Recycling:** Small quantities, mostly permanent magnet scrap.

Import Sources (2005-08): Rare-earth metals, compounds, etc.: China, 91%; France, 3%; Japan, 3%; Russia, 1%; and other, 2%.

Tariff: Item	Number	Normal Trade Relations 12-31-09
Thorium ores and concentrates (monazite) Rare-earth metals, whether or	2612.20.0000	Free.
not intermixed or interalloyed	2805.30.0000	5.0% ad val.
Cerium compounds	2846.10.0000	5.5% ad val.
Mixtures of REOs (except cerium oxide) Mixtures of rare-earth chlorides	2846.90.2010	Free.
(except cerium chloride)	2846.90.2050	Free.
Rare-earth compounds, individual		
REOs (excludes cerium compounds)	2846.90.8000	3.7% ad val.
Ferrocerium and other pyrophoric alloys	3606.90.3000	5.9% ad val.

<u>Depletion Allowance</u>: Monazite, 22% on thorium content and 14% on rare-earth content (Domestic), 14% (Foreign); bastnäsite and xenotime, 14% (Domestic and foreign).

Government Stockpile: None.

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Events, Trends, and Issues: Domestic consumption of rare earths in 2009 decreased substantially, based on apparent consumption (derived from 8 months of trade data). Only one of seven rare-earth import categories increased when compared with those of 2008—the category "mixtures of REOs (except cerium oxide)." Prices were generally lower in 2009 compared with those of 2008 for most rare-earth products amid decreased consumption and a declining supply. Consumption for most rare-earth uses in the United States decreased as a consequence of the worldwide economic downturn. The economic downturn lowered consumption of cerium compounds used in automotive catalytic converters and in glass additives and glass-polishing compounds; rare-earth chlorides used in the production of fluid-cracking catalysts used in oil refining; rare-earth compounds used in automotive catalytic converters and many other applications; rare-earth metals and their alloys used in armaments, base-metal alloys, lighter flints, permanent magnets, pyrophoric alloys, and superalloys; yttrium compounds used in color televisions and flat-panel displays, electronic thermometers, fiber optics, lasers, and oxygen sensors; and phosphors for color televisions, electronic thermometers, fluorescent lighting, pigments, superconductors, x-ray-intensifying screens, and other applications. The trend is for a continued increase in the use of rare earths in many applications, especially automotive catalytic converters, permanent magnets, and rechargeable batteries for electric and hybrid vehicles.

The rare-earth separation plant at Mountain Pass, CA, resumed operations in 2007 and continued to operate throughout 2009. Bastnäsite concentrates and other rare-earth intermediates and refined products continued to be sold from mine stocks at Mountain Pass. Exploration for rare earths continued in 2009; however, global economic conditions were not as favorable as in early 2008. Economic assessments continued at Bear Lodge in Wyoming; Diamond Creek in Idaho; Elk Creek in Nebraska; Hoidas Lake in Saskatchewan, Canada; Nechalacho (Thor Lake) in Northwest Territories, Canada; Kangankunde in Malawi; Lemhi Pass in Idaho-Montana; Nolans Project in Northern Territory, Australia; and various other locations around the world. At the Mount Weld rare-earth deposit in Australia, the initial phase of mining of the open pit was completed in June 2008. A total of 773,000 tons of ore was mined at an average grade of 15.4% REO; however, no beneficiation plant existed to process the ore into a rare-earth concentrate. Based on the fine-grained character of the Mt. Weld ore, only 50% recovery of the REO was expected.

<u>World Mine Production and Reserves</u>: Reserves data for Australia, China, and India were updated based on data from the respective countries.

	Mine	production <sup>e</sup>	Reserves <sup>6</sup>	
	<u>2008</u>	<u>2009</u>		
United States		_	13,000,000	
Australia		_	5,400,000	
Brazil	650	650	48,000	
China	120,000	120,000	36,000,000	
Commonwealth of Independent States	NA	NA	19,000,000	
India	2,700	2,700	3,100,000	
Malaysia	380	380	30,000	
Other countries	NA	NA	<u>22,000,000</u>	
World total (rounded)	124,000	124,000	99,000,000	

<u>World Resources</u>: Rare earths are relatively abundant in the Earth's crust, but discovered minable concentrations are less common than for most other ores. U.S. and world resources are contained primarily in bastnäsite and monazite. Bastnäsite 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. Apatite, cheralite, eudialyte, loparite, phosphorites, rare-earth-bearing (ion adsorption) clays, secondary monazite, spent uranium solutions, and xenotime make up most of the remaining resources. Undiscovered resources are thought to be very large relative to expected demand.

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

<sup>&</sup>lt;sup>e</sup>Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

<sup>&</sup>lt;sup>1</sup>Data include lanthanides and yttrium but exclude most scandium. See also Scandium and Yttrium.

<sup>&</sup>lt;sup>2</sup>REO equivalent or contents of various materials were estimated. Data from U.S. Census Bureau.

<sup>&</sup>lt;sup>3</sup>Without drawdown in producer stocks (withheld), apparent consumption calculations in 2009 resulted in a negative number.

<sup>&</sup>lt;sup>4</sup>Price range from Elements—Rare Earths, Specialty Metals and Applied Technology, Trade Tech, Denver, CO, and Web-based High Tech Materials, Longmont, CO, and Hefa Rare Earth Canada Co. Ltd., Richmond, British Columbia, Canada.

<sup>&</sup>lt;sup>5</sup>Defined as imports – exports + adjustments for Government and industry stock changes. For 2007 through 2009, excludes producer stock changes.

<sup>&</sup>lt;sup>6</sup>See Appendix C for definitions. Reserve base estimates were discontinued in 2009; see Introduction.