RARE EARTHS[1]

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

Domestic Production and Use: Rare earths were not mined domestically in 2007. In October, processing of previously mined rare-earth concentrates resumed at Mountain Pass, CA. Initial production was to be lanthanum concentrate and didymium (75% neodymium, 25% praseodymium). Rare-earth concentrates, intermediate compounds, and individual oxides were available from stocks. The United States continued to be a major importer, exporter, and consumer of rare-earth products in 2007. The estimated value of refined rare earths consumed in the United States was more than $1 billion. Based on final 2006 reported data, the estimated 2006 distribution of rare earths by end use was as follows: automotive catalytic converters, 25%; petroleum refining catalysts, 22%; metallurgical additives and alloys, 20%; glass polishing and ceramics, 11%; rare-earth phosphors for lighting, televisions, computer monitors, radar, and X-ray intensifying film, 10%; permanent magnets, 3%; medical and lasers, 3%; and other, 6%.

Salient Statistics—United States:	**2003**	**2004**	**2005**	**2006**	**2007[e]**
Production, bastnäsite concentrates[e]	—	—	—	—	—
Imports:[2]					
Thorium ore (monazite)	—	—	—	6	—
Rare-earth metals, alloy	1,130	804	880	867	831
Cerium compounds	2,630	1,880	2,170	2,590	3,090
Mixed REOs	2,150	1,660	640	1,570	2,250
Rare-earth chlorides	1,890	1,310	2,670	2,750	1,240
Rare-earth oxides, compounds	10,900	11,400	8,550	10,600	10,300
Ferrocerium, alloys	111	105	130	127	126
Exports:[2]					
Rare-earth metals, alloys	1,190	1,010	636	733	1,470
Cerium compounds	1,940	2,280	2,210	2,010	1,690
Other rare-earth compounds	1,450	4,800	2,070	2,700	1,470
Ferrocerium, alloys	2,800	3,720	4,320	3,710	3,230
Consumption, apparent	9,340	5,480	6,030	9,530	10,000
Price, dollars per kilogram, yearend:					
Bastnäsite concentrate, REO basis[e]	4.08	4.08	4.08	4.08	4.08
Monazite concentrate, REO basis[3]	0.50	0.59	0.54	0.54	0.54
Mischmetal, metal basis, metric ton quantity[4]	5-6	5-6	5-6	5-6	5-6
Stocks, producer and processor, yearend	W	W	W	W	W
Employment, mine and mill, number	90	NA	NA	NA	NA
Net import reliance[5] as a percentage of apparent consumption	100	100	100	100	100

Recycling: Small quantities, mostly permanent magnet scrap.

Import Sources (2003-06): Rare-earth metals, compounds, etc.: China, 84%; France, 6%; Japan, 4%; Russia, 2%; and other, 4%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-07**
Thorium ores and concentrates (monazite)	2612.20.0000	Free.
Rare-earth metals, whether or 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	2846.90.2010	Free.
Mixtures of rare-earth chlorides 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.

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

Government Stockpile: None.

Prepared by **James B. Hedrick [(703) 648-7725, jhedrick@usgs.gov, fax: (703) 648-7757]**

RARE EARTHS

Events, Trends, and Issues: Domestic demand for rare earths in 2007 increased based on apparent consumption, although rare-earth imports and exports were estimated to be lower than in 2006. Prices were higher in 2007 than in 2006 for most rare-earth products amid increased demand and a stable supply. Demand increased for cerium compounds used in automotive catalytic converters, glass polishing, and glass additives; rare-earth compounds used in automotive catalytic converters and many other applications; and yttrium compounds used in fiber optics, lasers, oxygen sensors, phosphors for fluorescent lighting, color televisions, electronic thermometers, X-ray intensifying screens, pigments, superconductors, and other applications. Demand was also higher for mixed rare-earth compounds and for rare-earth metals and their alloys used in permanent magnets, base-metal alloys, superalloys, pyrophoric alloys, lighter flints, and armaments. U.S. demand, however, was substantially lower for rare-earth chlorides used in the production of fluid cracking catalysts used in oil refining. The rare-earth separation plant at Mountain Pass, CA, resumed operations in October. Bastnäsite concentrates and other rare-earth intermediates and refined products continued to be sold from the mine stocks at Mountain Pass. 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. Rechargeable batteries were used in both electric and hybrid vehicles. Exploration for rare earths increased in 2007, and economic assessments continued at Hoidas Lake and Thor Lake in Canada, and Kangankunde in Malawi, Africa. Removal of overburden at the Mt. Weld rare-earth deposit in Australia was expected to be completed by yearend 2007.

World Mine Production, Reserves, and Reserve Base:

	Mine production[e]		Reserves[6]	Reserve base[6]
	2006	2007		
United States	—	—	13,000,000	14,000,000
Australia	—	—	5,200,000	5,800,000
Brazil	730	730	48,000	84,000
China	119,000	120,000	27,000,000	89,000,000
Commonwealth of Independent States	NA	NA	19,000,000	21,000,000
India	2,700	2,700	1,100,000	1,300,000
Malaysia	200	200	30,000	35,000
Thailand	—	—	NA	NA
Other countries	NA	NA	22,000,000	23,000,000
World total (rounded)	123,000	124,000	88,000,000	150,000,000

World Resources: Rare earths are relatively abundant in the Earth's crust, but discovered minable concentrations are less common than for most other ores. 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, secondary monazite, loparite, phosphorites, rare-earth-bearing (ion adsorption) clays, 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.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]Data include lanthanides and yttrium, but exclude most scandium. See also Scandium and Yttrium.
[2]REO equivalent or contents of various materials were estimated. Data from U.S. Census Bureau.
[3]Monazite price based on monazite exports from Malaysia for 2003 and 2004, and estimated for 2005 through 2007.
[4]Price range from Elements—Rare Earths, Specialty Metals and Applied Technology, Trade Tech, Denver, CO, and Web-based High Tech Materials, Longmont, CO.
[5]Defined as imports – exports + adjustments for Government and industry stock changes.
[6]See Appendix C for definitions.