

YTTRIUM¹

[Data in metric tons of yttrium oxide (Y₂O₃) content unless otherwise noted]

Domestic Production and Use: Rare earths were mined by one U.S. company in 2012. Bastnasite, a rare-earth fluorocarbonate mineral, was mined as a primary product in California. Principal uses were in phosphors for color televisions and computer monitors, temperature sensors, trichromatic fluorescent lights, and x-ray-intensifying screens. Yttria-stabilized zirconia was used in alumina-zirconia abrasives, bearings and seals, high-temperature refractories for continuous-casting nozzles, jet-engine coatings, oxygen sensors in automobile engines, simulant gemstones, and wear-resistant and corrosion-resistant cutting tools. In electronics, yttrium-iron garnets were components in microwave radar to control high-frequency signals. Yttrium was an important component in yttrium-aluminum-garnet laser crystals used in dental and medical surgical procedures, digital communications, distance and temperature sensing, industrial cutting and welding, nonlinear optics, photochemistry, and photoluminescence. Yttrium also was used in heating-element alloys, high-temperature superconductors, and superalloys. The approximate distribution in 2012 by end use was as follows: phosphors, 44%; metallurgical, 13%; and other, 43%.

Salient Statistics—United States:	2008	2009	2010	2011	2012^e
Production, mine	—	—	—	—	NA
Imports for consumption:					
In monazite	—	—	—	—	—
Yttrium, alloys, compounds, and metal ^{e, 2}	616	450	670	549	200
Exports, in ore and concentrate	NA	NA	NA	NA	NA
Consumption, estimated ³	616	450	670	549	NA
Price, ^e dollars:					
Monazite concentrate, per metric ton ⁴	480	480	NA	1,600	NA
Yttrium oxide, per kilogram, minimum 99.9% purity ⁵	10–85	10–85	38–41	165–185	90–110
Yttrium metal, per kilogram, minimum 99.9% purity ⁶	36–46	35–45	50–60	162–172	152–162
Stocks, processor, yearend	NA	NA	NA	NA	NA
Net import reliance ^{6, 7} as a percentage of apparent consumption	100	100	100	100	NA

Recycling: Small quantities, primarily from laser crystals and synthetic garnets.

Import Sources (2008–11): Yttrium compounds, greater than 19% to less than 85% weight percent yttrium oxide equivalent: China, 73%; Japan, 8%; Austria, 6%; France, 6%; and other, 7%.

Tariff: Item	Number	Normal Trade Relations 12–31–12
Thorium ores and concentrates (monazite)	2612.20.0000	Free.
Rare-earth metals, scandium and yttrium, whether or not intermixed or interalloyed	2805.30.0000	5.0% ad val.
Yttrium-bearing materials and compounds containing by weight >19% to <85% Y ₂ O ₃	2846.90.4000	Free.
Other rare-earth compounds, including yttrium oxide ≥85% Y ₂ O ₃ , yttrium nitrate, and other individual compounds	2846.90.8000	3.7% ad val.

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

Government Stockpile: None.

Events, Trends, and Issues: Yttrium consumption in the United States decreased in 2012 based on import data. The United States required yttrium for energy and defense applications such as electronics, phosphors, and yttria-stabilized-zirconia refractories. Owing to reduced demand, imports and prices of yttrium metal and oxide decreased significantly. Although prices for yttrium metal and oxides were relatively stable for first three quarters of 2012, prices decreased significantly in the fourth quarter.

YTTRIUM

China was the source of most of the world's supply of yttrium, from its weathered clay ion-adsorption ore deposits in the southern Provinces, primarily Fujian, Guangdong, and Jiangxi, with a lesser number of deposits in Guangxi and Hunan. Processing was primarily at facilities in Guangdong, Jiangsu, and Jiangxi Provinces. In India, a 10,000-ton-per-year monazite processing plant was expected to be commissioned by yearend. In Malaysia, the commissioning of a rare-earth-oxide-processing plant was delayed by appeals from environmental activists. Yttrium was consumed mainly in the form of high-purity oxide compounds for phosphors. Smaller amounts were used in ceramics, electronic devices, lasers, and metallurgical applications. Imports of yttrium declined because of economic conditions, economizing of materials, substitution, and increased imports of value-added products. In 2012, on a gross weight basis, about 95% of the imported yttrium-bearing materials and compounds containing by weight >19% to <85% Y₂O₃ were sourced from China (35%) and Japan (60%). The leading source of yttrium metal was China.

World Mine Production and Reserves: Reserve estimates for Australia have been revised based on new information available through Government reports. Mine production of rare-earth oxides in Australia, including yttrium oxide, was estimated to be 2,200 tons in 2011 and 4,000 tons in 2012. Domestic rare-earth oxide production in 2012 was estimated to be about 7,000 tons. The yttrium oxide content of these production estimates was not available.

	Mine production ^{e, 8}		Reserves ⁹
	2011	2012	
United States	—	NA	120,000
Australia	NA	NA	100,000
Brazil	15	15	2,200
China	8,800	8,800	220,000
India	55	56	72,000
Malaysia	4	4	13,000
Sri Lanka	—	—	240
Other countries	—	—	17,000
World total (rounded)	8,900	8,900	540,000

World Resources: The world's resources of yttrium are probably very large. Yttrium is associated with most rare-earth deposits. It occurs in various minerals in differing concentrations and occurs in a wide variety of geologic environments, including alkaline granites and intrusives, carbonatites, hydrothermal deposits, laterites, placers, and vein-type deposits. Although reserves may be sufficient to satisfy near-term demand at current rates of production, economics, environmental issues, and permitting and trade restrictions could affect the mining or availability of many of the rare-earth elements, including yttrium. Large resources of yttrium in monazite and xenotime are available worldwide in placer deposits, carbonatites, uranium ores, and weathered clay deposits (ion-adsorption ore). Measured yttrium resources have been documented in the Dubbo Zirconia deposit New South Wales, Australia. Significant yttrium resources are inferred to be in the Bokan Mountain deposit, Prince of Wales Island, Alaska. Additional resources of yttrium occur in apatite-magnetite-bearing rocks, deposits of niobium-tantalum minerals, non-placer monazite-bearing deposits, sedimentary phosphate deposits, and uranium ores, especially those of the Blind River District near Elliot Lake, Ontario, Canada, which contain yttrium in brannerite, monazite, and uraninite. Canadian resources are also present in allanite, apatite, and britholite at Eden Lake, Manitoba; allanite and apatite at Hoidas Lake, Saskatchewan; and fergusonite and xenotime at Thor Lake, Northwest Territories.

Substitutes: Substitutes for yttrium are available for some applications but generally are much less effective. In most uses, especially in electronics, lasers, and phosphors, yttrium is not subject to substitution by other elements. As a stabilizer in zirconia ceramics, yttria (yttrium oxide) may be substituted with calcia (calcium oxide) or magnesia (magnesium oxide), but they generally impart lower toughness.

^eEstimated. NA Not available. — Zero.

¹See also Rare Earths; trade data for yttrium are included in those data shown for rare earths.

²Imports based on data from the Port Import/Export Reporting Service, Journal of Commerce.

³Essentially, all yttrium consumed domestically was imported or refined from imported ores and concentrates.

⁴Monazite price estimated for 2007 through 2010; estimate for 2011 based on sale of concentrate to China from Vietnam; anonymous marketing source.

⁵Yttrium oxide prices for 5-kilogram to 1-metric-ton quantities from Rhodia Rare Earths, Inc., Shelton, CT; the China Rare Earth Information Center, Baotou, China; Hefa Rare Earth Canada Co., Ltd., Vancouver, Canada; Metal-Pages and Stanford Materials Corp., Aliso Viejo, CA.

⁶Yttrium metal prices for 500-kilogram quantities from Metal-Pages Ltd., Teddington, United Kingdom.

⁷Defined as imports – exports + adjustments for Government and industry stock changes.

⁸Includes yttrium contained in rare-earth ores.

⁹See Appendix C for resource/reserve definitions and information concerning data sources.