YTTRIUM[1]

[Data in metric tons of yttrium oxide (Y_2O_3) equivalent content unless otherwise noted]

Domestic Production and Use: Rare earths were mined in the United States by one company in 2015. Bastnaesite, a rare-earth fluorocarbonate mineral, was mined as a primary product at Mountain Pass, CA. Domestic production of total rare-earth mineral concentrate was estimated to be 4,500 tons of rare-earth oxide equivalent in 2015, down from an estimated 5,400 tons in 2014. Yttrium was estimated to represent about 0.12% of the rare-earth elements in the Mountain Pass bastnaesite ore; however, it was not processed domestically owing to its low concentration.

The leading end uses of yttrium were in ceramics, metallurgy, and phosphors. In ceramic applications, yttrium compounds were used in abrasives, bearings and seals, high-temperature refractories for continuous-casting nozzles, jet-engine coatings, oxygen sensors in automobile engines, and wear-resistant and corrosion-resistant cutting tools. In metallurgical applications, yttrium was used as a grain-refining additive and as a deoxidizer. Yttrium was used in heating-element alloys, high-temperature superconductors, and superalloys. 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 was used in phosphor compounds for flat-panel displays and various lighting applications.

Salient Statistics—United States:	2011	2012	2013	2014	2015[e]
Production, mine[2]	—	NA	NA	NA	NA
Imports for consumption:					
Yttrium, alloys, compounds, and metal[e, 3]	550	160	200	200	200
Exports, in ore and concentrate	NA	NA	NA	NA	NA
Consumption, estimated[4]	550	160	200	200	200
Price,[e] dollars:					
Yttrium oxide, per kilogram, minimum 99.999 purity[5]	136–141	86–91	23–27	15–17	8–9
Yttrium metal, per kilogram, minimum 99.9% purity[5]	162–172	141–151	60–70	55–65	47–54
Net import reliance[e, 2, 6] as a percentage of apparent consumption	100	>95	>95	>95	>95

Recycling: Small quantities, primarily from phosphors.

Import Sources (2011–14): Yttrium compounds:[7] China, 78%; Japan, 9%; Germany, 5%; Austria, 2%; and other, 6%. Nearly all imports of yttrium metal and compounds are derived from mineral concentrates produced in China.

Tariff: Item	Number	Normal Trade Relations 12–31–15
Rare-earth metals, scandium and yttrium, whether or not intermixed or interalloyed	2805.30.0000	5.0% ad val.
Mixtures of rare-earth oxides or of rare-earth chlorides	2846.90.2000	Free.
Yttrium-bearing materials and compounds containing by weight >19% to <85% Y_2O_3	2846.90.4000	Free.
Other rare-earth compounds, including yttrium and other 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: China produced 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, and from a lesser number of deposits in Guangxi and Hunan. Processing was primarily at facilities in Guangdong, Jiangsu, and Jiangxi Provinces.

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YTTRIUM

In 2015, global consumption of yttrium oxide was estimated to be 6,000 tons. Globally, yttrium was mainly consumed in the form of high-purity oxide compounds for phosphors. Lesser amounts were consumed in ceramics, electronic devices, lasers, and metallurgical applications. In October, the Mountain Pass mining and separation operations were idled indefinitely. Price declines were cited as a key factor in the suspension of operations.

Owing to shrinking demand in some markets and excess supply, prices for yttrium metal and oxide continued to decrease in 2015, approaching historic lows. According to industry reports, increasing popularity of light-emitting-diode (LED) lighting over traditional fluorescent lighting has reduced the consumption of yttrium-based phosphors. New designs for LEDs using remote phosphors may reverse this trend in the coming years. Remote phosphors can improve energy efficiency and are applied on to a separate component rather than directly on the LEDs.

According to China's preliminary export statistics, yttrium oxide exports increased in 2015. During the first three quarters of 2015, China exported 1,100 tons of yttrium oxide, primarily to Japan (53%), Italy (16%), and the United States (10%). China's other exports of yttrium included 110 kilograms of yttrium chloride, 1.17 tons of yttrium fluoride, 5.06 tons of unspecified yttrium compounds, and 13 tons of yttrium metal. China continued efforts to manage its rare-earth industry through industry consolidations, crack downs on illegal production, and stockpiling.

In 2015, the Defense Logistics Agency (DLA) Strategic Materials was seeking comments on the potential market impact of the proposed Fiscal Year 2017 National Defense Stockpile Annual Materials Plan. The plan included a maximum acquisition of 10 tons of yttrium oxide as a potential addition to the national stockpile. The DLA awarded a research contract to a domestic firm using a rhyolite feedstock from the Round Top rare-earth deposit in Texas to produce high-purity yttrium oxide.

World Mine Production and Reserves:[8] World production of yttrium was almost entirely from China. In 2015, world production was estimated to be 8,000 to 10,000 tons. Programs to stem the undocumented production of rare earths in China were ongoing. Reserves of yttrium are associated with those of rare earths. Global reserves of yttrium oxide were estimated to be more than 500,000 tons. The leading countries for these reserves included Australia, Brazil, China, India, and the United States.

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 other 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). 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.

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, yttrium oxide may be substituted with calcium oxide or magnesium oxide, but the substitutes generally impart lower toughness.

[e]Estimated. NA Not available. — Zero.
[1]See also Rare Earths; trade data for yttrium are included in the data shown for rare earths.
[2]Includes yttrium contained in rare-earth ores and mineral concentrates.
[3]Based on data from the U.S. Census Bureau and the Port Import/Export Reporting Service, JOC Group Inc.
[4]Essentially, all yttrium consumed domestically was imported or refined from imported materials.
[5]Free on board China from Metal-Pages Ltd., Teddington, United Kingdom.
[6]Defined as imports – exports. Insufficient data were available to determine exports and were excluded from the calculation.
[7]In 2013 and 2014, import sources were expanded to include chlorides (HTS 2846.90.8060), oxides (HTS 2846.90.8050), and yttrium compounds greater than 19% to less than 85% weight percent yttrium oxide equivalent (HTS 2846.90.4000).
[8]See Appendix C for resource/reserve definitions and information concerning data sources.