

SCANDIUM¹

(Data in kilograms of scandium oxide content unless otherwise noted)

Domestic Production and Use: Domestically, scandium-bearing minerals have been neither mined nor recovered from mine tailings since 1990, although quantities sufficient to meet demand were available in domestic mine tailings and process residues. Principal sources were imports from China, Russia, and Ukraine. Domestic companies with scandium-processing capabilities were in Mead, CO, and Urbana, IL. Capacity to produce ingot and distilled scandium metal was in Ames, IA; Phoenix, AZ; and Urbana, IL.

The principal use for scandium in 2013 was in aluminum alloys for aerospace components and sporting equipment. Other uses for scandium included analytical standards, electronics, high-intensity metal halide lamps, lasers, metallurgical research, solid oxide fuel cells (SOFCs), and oil-well tracers.

Salient Statistics—United States:	2009	2010	2011	2012	2013^e
Price, yearend, dollars:					
Per kilogram, oxide, 99.99% purity ²	1,620	1,620	4,700	4,700	5,000
Per kilogram, oxide, 99.999% purity ²	2,540	2,540	5,200	5,200	5,000
Per kilogram, oxide, 99.9995% purity ²	3,260	3,260	5,900	5,900	6,000
Per gram, dendritic, metal ³	189.00	193.00	199.00	206.00	213.00
Per gram, metal, ingot ⁴	155.00	158.00	163.00	169.00	175.00
Per gram, scandium acetate, 99.9% purity ^{5, 6}	NA	47.00	48.40	50.10	51.90
Per gram, scandium chloride, 99.9% purity ⁵	60.40	62.40	138.00	143.00	148.00
Per gram, scandium fluoride, 99.9% purity ⁵	224.60	229.00	235.80	244.00	253.00
Per gram, scandium iodide, 99.999% purity ⁵	203.00	207.00	213.00	220.00	228.00
Per kilogram, scandium-aluminum alloy ²	74.00	74.00	220.00	220.00	155.00
Net import reliance ⁷ as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2009–12): Although no definitive data exist listing import sources, imported material is mostly from China.

Tariff: Item	Number	Normal Trade Relations 12–31–13
Rare-earth metals, scandium and yttrium, whether or not intermixed or interalloyed, including scandium	2805.30.0000	5.0% ad val.
Compounds of rare-earth metals:		
Mixtures of rare-earth oxides, other, including scandium	2846.90.2045	Free
Mixtures of oxides of yttrium or scandium	2846.90.8050	3.7% ad val.
Mixtures of chlorides of yttrium or scandium	2846.90.8060	3.7% ad val.
Mixtures of rare-earth carbonates, other, including scandium	2846.90.8075	3.7% ad val.
Other rare-earth compounds, including scandium	2846.90.8090	3.7% ad val.
Aluminum alloys, other, including scandium-aluminum	7601.20.9090	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: In northern Queensland, Australia, measured and indicated resources of a scandium-cobalt-nickel deposit were estimated to include 3,970 tons of scandium oxide, using a 1% nickel-equivalent cut-off grade. If developed, the deposit could become a leading source of scandium. In New South Wales, ownership of the Nyngan scandium project was consolidated to a single Australian company following the resolution of a legal dispute, allowing the project to proceed. In the Philippines, a 10-kilogram-per-month pilot plant was under construction to recover scandium oxide following the leaching of nickel laterite for nickel-cobalt sulfide. A commercial scale plant was contemplated for 2015.

SCANDIUM

The supply of domestic and foreign scandium metal remained stable. Global scandium consumption was estimated to be less than 10 tons per year in 2013. Scandium-aluminum alloys for sporting goods and aerospace applications remained the leading use of scandium. Consumption of scandium for SOFCs doped with scandium was reported to be increasing. Scandium's use in metal halide lighting continued. Scandium, as the metal or the iodide, was added to halide light bulbs to adjust the color to simulate natural sunlight. A radioactive scandium isotope was used as a tracing agent in oil refining.

In 2013, nominal prices for domestically produced scandium oxide changed little, although prices for other scandium compounds increased compared with those of the previous year. Scandium metal prices increased moderately, but the total market remained very small.

World Mine Production and Reserves:⁸ No scandium was mined in the United States. Scandium was produced as byproduct material in China, Kazakhstan, Russia, and Ukraine. Foreign mine production data were not available. Scandium occurs in many ores in trace amounts, but has not been found in sufficient concentration to be mined as a primary product. As a result of its low concentration, scandium has been produced exclusively as a byproduct during processing of various ores or recovered from previously processed tailings or residues.

World Resources: Resources of scandium are abundant, especially when considered in relation to demand. Scandium is rarely concentrated in nature because of its lack of affinity for the common ore-forming anions. It is widely dispersed in the lithosphere and forms solid solutions in more than 100 minerals. In the Earth's crust, scandium is primarily a trace constituent of ferromagnesium minerals. Concentrations in these minerals (amphibole-hornblende, biotite, and pyroxene) typically range from 5 to 100 parts per million scandium oxide equivalent. Ferromagnesium minerals commonly occur in mafic and ultramafic igneous rocks. Enrichment of scandium also occurs in aluminum phosphate minerals, beryl, cassiterite, columbite, garnet, muscovite, rare-earth minerals, and wolframite. Scandium that was produced domestically was primarily from the scandium-yttrium silicate mineral thortveitite and from byproduct leach solutions from uranium operations. One of the principal domestic scandium resources is the fluorite tailings from the mined-out Crystal Mountain deposit near Darby, MT. Tailings from the mined-out fluorite operations, which were generated from 1952 to 1971, contain thortveitite and associated scandium-enriched minerals. Resources also are contained in the tantalum residues previously processed at Muskogee, OK. Smaller resources are associated with molybdenum, titanium-tungsten, and tungsten minerals from the Climax molybdenum deposit in Colorado and in crandallite, kolbeckite, and variscite at Fairfield, UT. Other lower grade domestic resources are present in ores of aluminum, cobalt, iron, molybdenum, nickel, phosphate, tantalum, tin, titanium, tungsten, zinc, and zirconium. Process residues from tungsten operations in the United States also contain significant amounts of scandium.

There are identified scandium resources in Australia, China, Kazakhstan, Madagascar, Norway, Russia, and Ukraine. Resources in Australia are contained in nickel and cobalt deposits in Lake Innes and Syerston, New South Wales. China's resources are in iron, tin, and tungsten deposits in Fujian, Guangdong, Guangxi, Jiangxi, and Zhejiang Provinces. Resources are in apatites and eudialytes in Russia's Kola Peninsula and in uranium-bearing deposits in Kazakhstan. In Madagascar, scandium is contained in pegmatites in the Befanomo area. Resources are dispersed in the thortveitite-rich pegmatites of the Iveland-Evje Region in Norway and in a deposit in the northern area of Finnmark. In Ukraine, scandium is recovered as a byproduct of iron ore processing at Zheltye Voda. An occurrence of the mineral thortveitite is reported in Kobe, Japan. Undiscovered scandium resources are thought to be very large.

Substitutes: In applications such as lighting and lasers, scandium is generally not subject to substitution. Titanium and aluminum high-strength alloys, as well as carbon fiber and carbon nanotube material, may substitute in sporting goods, especially baseball and softball bats and bicycle frames. Light-emitting diodes, also known as LEDs, are beginning to displace halides in industrial lighting, residential safety and street lighting, and buoys and maritime lamp applications.

⁰Estimated. NA Not available.

¹See also Rare Earths.

²Scandium oxide and scandium-aluminum master alloy (with a 2% scandium metal content and sold in metric ton quantities) from Stanford Materials Corp.

³Scandium pieces, 99.9% purity, distilled dendritic; prices converted from 2-gram prices, from Alfa Aesar, a Johnson Matthey company.

⁴Metal ingot pieces, 99.9% purity, from Alfa Aesar, a Johnson Matthey company.

⁵Acetate, chloride, and fluoride, in crystalline or crystalline aggregate form and scandium iodide as ultradry powder from Alfa Aesar, a Johnson Matthey company; fluoride price converted from 5-gram quantity.

⁶Scandium acetate, 99.9% purity listing beginning in 2010.

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

⁸[See Appendix C for resource/reserve definitions and information concerning data sources.](#)