SCANDIUM[1]

(Data in metric tons of scandium oxide content unless otherwise noted)

Domestic Production and Use: Domestically, scandium-bearing minerals were neither mined nor recovered from mine tailings in 2015. Scandium that was previously produced domestically was primarily from the scandium-yttrium silicate mineral thortveitite and from byproduct leach solutions from uranium operations. Domestic capacity to produce ingot and distilled scandium metal was at three facilities, in Ames, IA; Phoenix, AZ; and Urbana, IL. The principal source for scandium metal and scandium compounds was imports from China.

The principal uses for scandium in 2015 were in solid oxide fuel cells (SOFCs) and aluminum-scandium alloys. Other uses for scandium included ceramics, electronics, lasers, lighting, and radioactive isotopes. In SFOCs, electricity is generated directly from oxidizing a fuel. Scandium is added to a zirconia-base electrolyte to improve the power density and lower the reaction temperature of the cell. For metal applications, scandium metal is typically produced by reducing scandium fluoride with calcium metal. Scandium-aluminum alloys are produced for sporting goods, aerospace, and other high-performance applications. Scandium is used in small quantities in a number of electronic applications. Some lasers that contain scandium are used in defense applications and in dental treatments. In lighting, scandium iodide is used in mercury-vapor high-intensity lights to simulate natural light. Scandium isotopes are used as a tracing agent in oil refining.

Salient Statistics—United States:	**2011**	**2012**	**2013**	**2014**	**2015[e]**
Price, yearend, dollars:					
Compounds, per gram:					
Acetate, 99.9% purity, 5-gram sample size[2]	48.40	50.10	51.90	43.00	43.00
Chloride, 99.9% purity, 5-gram sample size[2]	138.00	143.00	148.00	123.00	123.00
Fluoride, 99.9% purity, 5-gram sample size[2]	235.80	244.00	253.00	263.00	263.00
Iodide, 99.999% purity, 5-gram sample size[2]	213.00	220.00	228.00	187.00	187.00
Oxide, 99.99% purity, 5-kilogram lot size[3]	4.70	4.70	5.00	5.40	5.10
Metal:					
Scandium, distilled dendritic, per gram, 2-gram sample size[2]	199.00	206.00	213.00	221.00	221.00
Scandium, ingot, per gram, 5-gram sample size[2]	163.00	169.00	175.00	134.00	134.00
Scandium-aluminum alloy, per kilogram, metric-ton lot size[2]	220.00	220.00	155.00	386.00	220.00
Net import reliance[4] as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2010–14): Although no definitive data exist listing import sources, imported material is mostly from 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.
Compounds of rare-earth metals:		
Mixtures of oxides of yttrium or scandium as the predominant metal	2846.90.2015	Free.
Mixtures of chlorides of yttrium or scandium as the predominant metal	2846.90.2082	Free.
Mixtures of rare earth oxides, including scandium	2846.90.2040	Free.
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.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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SCANDIUM

Events, Trends, and Issues: The global supply and consumption of scandium was estimated to be about 10 tons to 15 tons per year. Consumption of scandium contained in SOFCs and nonferrous alloys was reported to be increasing. Prices for small samples of scandium metal and scandium compounds varied significantly, but generally were unchanged compared with those in 2014. The global scandium market remained small relative to most other metals. In the United States, developers of multimetallic deposits, including the Round Top project in Texas and the Elk Creek project in Nebraska, were examining the incorporation of scandium recovery into project plans.

In New South Wales, Australia, definitive feasibility and economic assessment studies of the Nyngan scandium project neared completion. Using a 100-parts-per-million scandium cutoff grade, measured and indicated resources were 12 million tons containing about 3,100 tons of scandium. The developer expected to complete project financing and begin construction in 2016. The project was expected to produce as much as 36 tons per year of scandium oxide. Also in New South Wales, developers of the Syerston project were conducting demonstration plant studies, a drilling program, and expected to complete a feasibility study in 2016. Using a 600-parts-per-million scandium cutoff grade, the measured and indicated resource of the Syerston project was reported to be 1.2 million tons containing about 1,200 tons of scandium oxide. In northern Queensland, Australia, the developers of the SCONI project were seeking joint- venture partners. The measured and indicated resources of the SCONI project were about 11 million tons containing 2,700 tons of scandium oxide using a 100-parts-per-million scandium cutoff grade. The project's prefeasibility studies were based on an operation producing up to 50 tons per year of scandium oxide.

In Quebec, Canada, one company was developing technology to recover scandium and high-purity alumina from red mud (a residue generated during the production of alumina), fly ash, and mine tailings. In 2015, the company was commissioning a high-purity alumina plant and planned to add a scandium extraction unit in 2016. Feedstock for the plant was from the Grande-Vallée clay deposit in Quebec.

In Japan, efforts were underway to recover scandium and other metals from a titanium dioxide pigment production facility using ion-exchange extraction processes. If a pilot-plant study is successful, the proprietary technology could be scaled up and used at other titanium dioxide pigment production facilities.

In the Philippines, a 10-kilogram-per-month pilot plant was recovering scandium oxide following the leaching of nickel laterite for nickel-cobalt sulfide. At yearend, a decision to construct a commercial-scale plant had not been reached.

In Russia, an aluminum producer was conducting a pilot-plant study to produce scandium concentrate from red mud. The plant was reported to be capable of producing 2.5 tons per year of concentrate. Additional plans called for an additional 500-kilogram-per-year pilot plant to process the scandium concentrate into scandium oxide. In Lermontov, Kurgan region, a pilot study was underway to recover as much as 1.5 tons of scandium as a byproduct of uranium production. Scandium recovery projects were also being considered in Japan, Kazakhstan, and Ukraine.

World Mine Production and Reserves:[5] No scandium was mined in the United States. As a result of its low concentration, scandium is produced exclusively as a byproduct during processing of various ores or recovered from previously processed tailings or residues. In recent years, scandium was produced as byproduct material in China (titanium and rare earths), Kazakhstan (uranium), Russia (apatite), and Ukraine (uranium). Foreign mine production data in 2015 were not available.

World Resources: Resources of scandium are abundant 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. There are identified scandium resources in Australia, Canada, China, Kazakhstan, Madagascar, Norway, the Philippines, Russia, and Ukraine.

Substitutes: Titanium and aluminum high-strength alloys, as well as carbon-fiber materials, may substitute in high-performance scandium-alloy applications. Light-emitting diodes, also known as LEDs, displace halide and fluorescent lighting in industrial and residential applications. In some applications that rely on scandium's unique properties, substitution is not possible.

[e]Estimated.
[1]See also Rare Earths.
[2]Prices from Alfa Aesar, a Johnson Matthey company.
[3]Prices from Stanford Materials Corp.
[4]Defined as imports – exports + adjustments for stock changes.
[5]See Appendix C for resource/reserve definitions and information concerning data sources.