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 2016. Scandium that was previously produced domestically was primarily from the scandium-yttrium silicate mineral thortveitite and from byproduct leach solutions from uranium operations. Limited capacity to produce ingot and distilled scandium metal existed at facilities in Ames, IA; Tolleson, AZ; and Urbana, IL. The principal source for scandium metal and scandium compounds was imports from China.

The principal uses for scandium in 2017 were in aluminum-scandium alloys and solid oxide fuel cells (SOFCs). Other uses for scandium included ceramics, electronics, lasers, lighting, and radioactive isotopes. In SOFCs, 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. Aluminum-scandium 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:	2013	2014	2015	2016	2017[e]
Price, yearend, dollars:					
Compounds, per gram:					
Acetate, 99.9% purity, 5-gram sample size[2]	51.90	43.00	43.00	44.00	44.00
Chloride, 99.9% purity, 5-gram sample size[2]	148.00	123.00	123.00	126.00	124.00
Fluoride, 99.9% purity, 1-to-5-gram sample size	[2]253.00	[2]263.00	[2]263.00	[3]270.00	277.00
Iodide, 99.999% purity, 5-gram sample size[2]	228.00	187.00	187.00	149.00	183.00
Oxide, 99.99% purity, 5-kilogram lot size[4]	5.00	5.00	5.10	4.60	4.60
Metal:					
Scandium, distilled dendritic, per gram, 2-gram sample size[2]	213.00	221.00	221.00	228.00	226.00
Scandium, ingot, per gram, 5-gram sample size[2]	175.00	134.00	134.00	107.00	132.00
Scandium-aluminum alloy, per kilogram, metric-ton lot size[4]	155.00	386.00	220.00	340.00	350.00
Net import reliance[5] as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2013–16): Although no definitive data exist listing import sources, imported material is mostly from China.

Tariff: Item	Number	Normal Trade Relations 12–31–17
Rare-earth metals, unspecified, whether or not intermixed or interalloyed	2805.30.0090	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 other rare-earth carbonates, including scandium	2846.90.8075	3.7% ad val.
Mixtures of 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. The global scandium market remained small relative to most other metals, but the number of supply sources was increasing. In the United States, developers of multimetallic deposits, including the Bokan project in Alaska, the Round Top project in Texas, and the Elk Creek project in Nebraska, were planning to include scandium recovery in their project plans. Owners of the Elk Creek project announced a completed feasibility study, compliant with Canadian National Instrument 43-101, that was based on probable reserves of about 32 million tons of ore containing about 72 grams per ton of scandium. Concurrently, the Department of Energy was partnering with industry and academia to study the recovery of scandium and other rare-earth elements from coal and coal byproducts.

In Australia, a mining lease was granted for the Nyngan scandium project in New South Wales. Reserves at Nyngan were estimated to be 1.44 million tons containing about 590 tons of scandium using an effective cutoff grade of 155 parts per million scandium. Subject to financing, the developer expected to begin production in 2019 and was expected to produce as much as 38.5 tons per year of scandium oxide. Also in New South Wales, developers of the Syerston project were expecting to complete a feasibility study by yearend that would advance offtake agreements and project financing. The Syerston project's measured and indicated scandium resources increased 63% to 45.7 million tons containing 19,200 tons of scandium oxide equivalent using a 300-parts-per-million scandium cutoff grade. In Queensland, ownership of the Scandium-Cobalt-Nickel (SCONI) Project was consolidated and a 20-ton trial of ore was being processed at a demonstration plant. The measured and indicated resources of the SCONI Project were estimated at 12 million tons containing about 3,000 tons of scandium oxide using a 162-parts-per-million scandium cutoff grade. A feasibility study to help secure project financing was scheduled to be completed in 2018. In China, scandium oxide production capacity was reported to be expanding beyond 100 tons per year. In India, environmental clearance was being sought from the State of Odisha for a project to construct a 2.4-ton-per-year scandium oxide plant. India's scandium production was expected to be a byproduct of titanium dioxide production. The project also included a ferroalloy operation and a coal-fired powerplant. In the Philippines, construction of a commercial plant to recover 7.5 tons per year of scandium oxide equivalent from the leaching of nickel laterite for nickel-cobalt sulfide was underway at the Taganito high-pressure acid-leach facility. Production of an intermediate concentrate was expected to begin in 2018. Conversion of the intermediate product to scandium oxide was expected to take place at the Harima operation in Japan. In Russia, pilot-plant studies at an aluminum smelter in the Ural Mountains were ongoing. The pilot plant was reported to have produced scandium oxide with purity greater than 99%. Based on pilot test results, plans were in place for a commercial plant with 3 tons per year of scandium oxide production capacity. In Lermontov, Kurgan region, pilot studies were underway to test scandium recovery as a byproduct of uranium production. Previous studies produced a scandium fluoride concentrate from pregnant solutions. A 1.5-ton-per-year pilot plant was expected to produce finished scandium oxide in 2017. Future plans were to produce aluminum-scandium master alloys. In the European Union, recovery methods were being developed for the production of scandium compounds and aluminum alloys from metallurgical byproducts. In Turkey, one company was developing byproduct scandium recovery from laterite at an existing high-pressure acid-leach operation.

World Mine Production and Reserves:[6] 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 for 2017 were not available.

World Resources: Resources of scandium are abundant. Scandium's crustal abundance is greater than that of lead. Scandium lacks affinity for the common ore-forming anions; therefore, it is widely dispersed in the lithosphere and forms solid solutions with low concentrations in more than 100 minerals. There are identified scandium resources in Australia, Canada, China, Kazakhstan, Madagascar, Norway, the Philippines, Russia, Ukraine, and the United States.

Substitutes: Titanium and aluminum high-strength alloys, as well as carbon-fiber materials, may substitute in high-performance scandium-alloy applications. Light-emitting diodes displace mercury-vapor high-intensity lights in some 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 Sigma-Aldrich, a part of Millipore Sigma.
[4]Prices from Stanford Materials Corp.
[5]Defined as imports – exports + adjustments for stock changes.
[6]See Appendix C for resource and reserve definitions and information concerning data sources.