

SCANDIUM¹

(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 2016 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:	2012	2013	2014	2015	2016^e
Price, yearend, dollars:					
Compounds, per gram:					
Acetate, 99.9% purity, 5-gram sample size ²	50.10	51.90	43.00	43.00	44.00
Chloride, 99.9% purity, 5-gram sample size ²	143.00	148.00	123.00	123.00	126.00
Fluoride, 99.9% purity, 1-to-5-gram sample size ²	² 244.00	² 253.00	² 263.00	² 263.00	³ 270.00
Iodide, 99.999% purity, 5-gram sample size ²	220.00	228.00	187.00	187.00	149.00
Oxide, 99.99% purity, 5-kilogram lot size ⁴	4.70	5.00	5.00	5.10	4.60
Metal:					
Scandium, distilled dendritic, per gram, 2-gram sample size ²	206.00	213.00	221.00	221.00	228.00
Scandium, ingot, per gram, 5-gram sample size ²	169.00	175.00	134.00	134.00	107.00
Scandium-aluminum alloy, per kilogram, metric-ton lot size ⁴	220.00	155.00	386.00	220.00	340.00
Net import reliance ⁵ as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2012–15): Although no definitive data exist listing import sources, imported material is mostly from China.

Tariff: Item	Number	Normal Trade Relations 12–31–16
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 rare-earth oxides, including scandium	2846.90.2040	Free.
Mixtures of chlorides of yttrium or scandium as the predominant metal	2846.90.2082	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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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 Round Top project in Texas and the Elk Creek project in Nebraska, were planning to include scandium recovery in their project plans. 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 New South Wales, Australia, a definitive feasibility study was completed on the Nyngan scandium project. With an effective cutoff grade of 155 parts per million scandium, reserves were estimated to be 1.44 million tons containing about 590 tons of scandium. The developer expected to begin production in 2018. The project 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 conducting pilot plant studies that produced scandium-rich liquor and scandium oxide. In August, a feasibility study of the Syerston project estimated reserves of 1.2 million tons containing about 700 tons of scandium using a 600-parts-per-million-scandium cutoff grade. In northern Queensland, Australia, the developers of the Scandium-Cobalt-Nickel (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. 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 2016, the company continued to commission a high-purity alumina plant and planned to decide on the timing for the addition of a scandium extraction unit by yearend. In China, Guangxi Metallurgy Research Institute was commissioning production capacity of up to 1.5 tons per year of scandium oxide. In India, the Odisha government approved a proposal to set up a 2.4-ton-per-year scandium oxide plant in the State of Orissa. Scandium production was expected to be a byproduct of titanium production and was scheduled to begin in 2018. In Japan, pilot studies to recover scandium and other metals from a titanium dioxide pigment plant at Yokkaichi were technically successful; however, further development of the project was suspended. In the Philippines, plans were underway to recover 7.5 tons per year of scandium oxide equivalent from the leaching of nickel laterite for nickel-cobalt sulfide. A scandium recovery plant was expected to be in production by 2018 at the Taganito high-pressure-acid leach facility. In Russia, pilot-plant studies at an aluminum smelter in the Ural Mountains successfully produced scandium oxide from a red-mud concentrate. In 2016, a pilot plant was reported to have produced scandium oxide with purity greater than 99% and achieved a 98-kilogram-per-year production rate. In 2015, a separate study produced a scandium concentrate from red mud. In Lermontov, Kurgan region, a pilot study was underway to recover scandium as a byproduct of uranium production. Pilot studies to extract up to 400 kilograms per year of scandium were expected to begin by yearend 2016. Extraction methods were being developed for the separation and purification of scandium as part of a European Commission-funded project.

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 2016 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.

⁶Estimated.

¹See also Rare Earths.

²Prices from Alfa Aesar, a Johnson Matthey company.

³Prices from Sigma-Aldrich, a part of Millipore Sigma.

⁴Prices from Stanford Materials Corp.

⁵Defined as imports – exports + adjustments for stock changes.

⁶See [Appendix C](#) for resource and reserve definitions and information concerning data sources.