

## THORIUM

(Data in metric tons of thorium oxide (ThO<sub>2</sub>) equivalent unless otherwise noted)

**Domestic Production and Use:** The world's primary source of thorium is the rare-earth and thorium phosphate mineral monazite. In 2017, monazite was not recovered domestically as a salable product. Essentially, all thorium compounds and alloys consumed by the domestic industry were derived from imports. The number of companies that processed or fabricated various forms of thorium for commercial use was not available. Thorium's use in most products was generally limited because of concerns over its naturally occurring radioactivity. Imports of thorium compounds are sporadic owing to changes in consumption and fluctuations in consumer inventory levels. The estimated value of thorium compounds imported for consumption by the domestic industry in 2017 was about \$730,000, compared with \$284,000 in 2016.

<b><u>Salient Statistics—United States:</u></b>	<b><u>2013</u></b>	<b><u>2014</u></b>	<b><u>2015</u></b>	<b><u>2016</u></b>	<b><u>2017<sup>e</sup></u></b>
Production, mine and refinery <sup>1</sup>	—	—	—	—	—
Imports for consumption:					
Thorium ore and concentrates (monazite), gross weight	—	—	—	16	—
Thorium ore and concentrates (monazite), ThO <sub>2</sub> content <sup>e</sup>	—	—	—	1	—
Thorium compounds (oxide, nitrate, etc.), gross weight	2.83	11.00	2.74	3.12	8.5
Thorium compounds (oxide, nitrate, etc.), ThO <sub>2</sub> content <sup>e</sup>	1.33	5.18	1.29	0.80	4.8
Exports:					
Thorium ore and concentrates (monazite), gross weight	—	—	—	—	—
Thorium compounds (oxide, nitrate, etc.), gross weight	1.01	<sup>2</sup> 14.80	2.16	<sup>2</sup> 63.9	<sup>2</sup> 83.0
Thorium compounds (oxide, nitrate, etc.), ThO <sub>2</sub> content <sup>e</sup>	0.74	10.90	1.60	<sup>3</sup> 3.00	<sup>3</sup> 2.2
Consumption, apparent <sup>4</sup>	0.59	( <sup>5</sup> )	( <sup>5</sup> )	( <sup>5</sup> )	2.6
Value, thorium compounds, gross weight, dollars per kilogram, <sup>6</sup>					
India	65	65	63	65	73
Net import reliance <sup>7</sup> as a percentage of apparent consumption	100	100	100	100	100

**Recycling:** None.

**Import Sources (2013–16):** Monazite: Canada, 100%. Thorium compounds: India, 99% and the United Kingdom, 1%.

<b><u>Tariff:</u></b>	<b><u>Item</u></b>	<b><u>Number</u></b>	<b><u>Normal Trade Relations</u></b> <b><u>12–31–17</u></b>
	Thorium ores and concentrates (monazite)	2612.20.0000	Free.
	Thorium compounds	2844.30.1000	5.5% ad val.

**Depletion Allowance:** Monazite, 22% on thorium content, and 14% on rare-earth and yttrium content (Domestic); 14% (Foreign).

**Government Stockpile:** None.

**Events, Trends, and Issues:** Domestic demand for thorium alloys, compounds, and metals was limited and believed to be largely for research purposes. Imports and existing stocks supplied essentially all thorium consumed in the United States in 2017. Globally, thorium's commercial uses included catalysts, high-temperature ceramics, research purposes, and welding electrodes.

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On the basis of data through September 2017, imports of unspecified thorium compounds were estimated to contain about 2.2 tons of thorium-oxide equivalent in 2017. The average value of imported thorium compounds decreased to \$83 per kilogram compared with the 2016 average of \$91 per kilogram (gross weight). India maintained its position as the primary source of imported thorium compounds in 2017. The unit value of imports from India increased to \$73 per kilogram compared with \$65 per kilogram in 2016. The unit value of imports from France and the United Kingdom were \$123 and \$673, respectively.

Exports of unspecified thorium compounds increased to 83 tons in 2017; however, 98% of the exports were reported to have a unit value less than \$65 per metric ton and may have been misclassified. Owing to potentially misclassified material and variations in the type and purity of thorium compound, the unit value of exports varied widely by month and exporting district from a low of \$2 per kilogram to a high of \$9,500 per kilogram.

Globally, monazite was produced primarily for its rare-earth-element content, and only a small fraction of the byproduct thorium produced was consumed. India was the leading producer of monazite. Thorium consumption worldwide is relatively small compared with that of most other mineral commodities. In regard to international trade, China was the leading importer of monazite, and Brazil and Thailand were the leading exporters.

Several companies and countries were active in the pursuit of commercializing thorium as a fuel material for a new generation of nuclear reactors. Thorium-based nuclear research and development programs have been or are underway in Belgium, Brazil, Canada, China, Czechia, France, Germany, India, Israel, Japan, the Netherlands, Norway, Russia, the United Kingdom, and the United States.

The U.S. Environmental Protection Agency (EPA) was seeking public comments to proposed revisions to the EPA's "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings." The new standards would be applicable to byproduct materials produced by uranium in situ recovery.

**World Refinery Production and Reserves:**<sup>8</sup> Production and reserves are associated with the recovery of monazite in heavy-mineral-sand deposits. Without demand for the rare earths, monazite would probably not be recovered for its thorium content under current market demand conditions.

**World Resources:** The world's leading thorium resources are found in placer, carbonatite, and vein-type deposits. Thorium is found in several minerals, including monazite, thorite, and thorianite. According to a report by the Organisation for Economic Co-operation and Development's Nuclear Energy Agency and the International Atomic Energy Agency, worldwide thorium resources were estimated to total more than 6 million tons of thorium. Thorium resources are found throughout the world, most notably in Australia, Brazil, and India. India's Department of Atomic Energy estimated 12 million tons of monazite was contained in heavy-mineral sands. India's monazite was reported to have an average thorium oxide content of 9% to 10%. Geoscience Australia estimated Australia's inferred resources to be about 0.5 million tons of thorium. Most of the identified thorium resources in Australia are within heavy-mineral-sand deposits. None of Australia's thorium resources were classified as economically recoverable. Brazil's thorium resources were estimated to be 0.6 million tons.

**Substitutes:** Nonradioactive substitutes have been developed for many applications of thorium. Yttrium compounds have replaced thorium compounds in incandescent lamp mantles. A magnesium alloy containing lanthanides, yttrium, and zirconium can substitute for magnesium-thorium alloys in aerospace applications. Cerium and lanthanum can substitute for thorium in welding electrodes.

<sup>0</sup>Estimated. — Zero.

<sup>1</sup>All domestically consumed thorium was derived from imported materials.

<sup>2</sup>Includes material that may have been misclassified.

<sup>3</sup>Low unit-value exports were excluded from ThO<sub>2</sub> content estimate because they were believed to have been misclassified.

<sup>4</sup>Defined as imports – exports. Excludes ores and concentrates.

<sup>5</sup>The apparent consumption calculation yields a negative value from 2014 through 2016.

<sup>6</sup>Based on U.S. Census Bureau customs value.

<sup>7</sup>Defined as imports – exports; however, all exports were derived from imported materials, and net import reliance is assumed to be 100%.

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