

THORIUM

(Data in kilograms, gross weight, unless otherwise noted)

Domestic Production and Use: The world's primary source of thorium is the rare-earth and thorium phosphate mineral monazite. In 2020, monazite may have been produced as a separated concentrate or included as an accessory mineral in heavy-mineral concentrates. 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 2020 was \$55,000, compared with \$213,000 in 2019.

Salient Statistics—United States:	2016	2017	2018	2019	2020^e
Production, mine ¹	NA	NA	² 520,000	² 1,700,000	² 600,000
Imports for consumption:					
Ore and concentrates (monazite)	16,000	—	1,000	—	—
Compounds (oxide, nitrate, etc.)	3,120	8,510	9,000	4,000	1,900
Exports:					
Ore and concentrates (monazite)	NA	NA	520,000	1,700,000	600,000
Compounds (oxide, nitrate, etc.) ³	6,000	6,100	3,000	3,200	400
Consumption, apparent: ⁴					
Ore and concentrates (monazite)	16,000	—	1,000	—	—
Compounds (oxide, nitrate, etc.)	(⁵)	2,410	6,000	800	1,500
Price, average value, compounds, India, ⁶ dollars per kilogram	65	73	72	72	NA
Net import reliance ⁷ as a percentage of apparent consumption	NA	NA	NA	NA	NA

Recycling: None.

Import Sources (2016–19): Monazite: Canada, 100%. Thorium compounds: India, 82%; France, 17%; and the United Kingdom, 1%.

Tariff:	Item	Number	Normal Trade Relations 12–31–20
	Thorium ore 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.

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Events, Trends, and Issues: Domestic demand for thorium alloys, compounds, and metals was limited. In addition to research purposes, various commercial uses of thorium included catalysts, high-temperature ceramics, magnetrons in microwave ovens, metal-halide lamps, nuclear medicine, optical coatings, tungsten filaments, and welding electrodes.

Exports of unspecified thorium compounds were estimated to be 400 kilograms in 2020. Because 99% of the exports were reported to have a unit value of less than \$50 per kilogram, those quantities were not included in the total export estimate because it is likely that they were misclassified. Owing to potentially misclassified material and variations in the type and purity of thorium compounds, the unit value of exports varied widely by month and by exporting customs district.

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 international trade, China was the leading importer of monazite; Brazil, Madagascar, Thailand, and Vietnam were China's leading import sources. The United States exported monazite to China and Hong Kong. Operators of the Eneabba mineral sands project (Australia), the Kvanefjeld project (Greenland), and the Steenkraampskraal Mine (South Africa) plan to start producing within the next year.

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 Australia, Belgium, Brazil, Canada, China, Czechia, Denmark, Finland, France, Germany, India, Israel, Italy, Japan, the Netherlands, Norway, the Republic of Korea, Russia, the United Kingdom, and the United States.

World Refinery Production and Reserves:⁸ 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 conditions.

World Resources:⁸ 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 the Organisation for Economic Co-operation and Development's Nuclear Energy Agency, worldwide identified thorium resources were estimated to total 6.4 million tons of thorium. Thorium resources are found throughout the world, most notably in Australia, Brazil, India, and the United States. India has the largest resources (850,000 tons), followed by Brazil (630,000 tons) and Australia and the United States (600,000 tons each).

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. Several replacement materials are in use as optical coatings instead of thorium fluoride.

⁰Estimated. NA Not available. — Zero.

¹Monazite may have been produced as a separate concentrate or included as an accessory mineral in heavy-mineral concentrates.

²Estimates based on exports.

³Excludes estimates of material that may have been misclassified.

⁴Defined as production + imports – exports. Shown separately for ore and concentrates and for compounds. Production is only for ore and concentrates.

⁵The apparent consumption calculation yields negative values for thorium compounds in 2016.

⁶Based on U.S. Census Bureau customs data.

⁷Defined as imports – exports; however, a meaningful net import reliance could not be calculated owing to uncertainties in the classification of material being imported and exported.

⁸See Appendix C for resource and reserve definitions and information concerning data sources.