

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 2022, monazite may have been produced as a separated concentrate or included as an accessory mineral in heavy-mineral concentrates, but thorium was not separated or recovered by any domestic facility. 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 2022 was \$85,000 (based on data through August 2022), compared with \$175,200 in 2021.

Salient Statistics—United States:	2018	2019	2020	2021	2022^e
Production, mine (monazite) ¹	² 520,000	² 1,700,000	² 960,000	W	W
Imports for consumption:					
Ore and concentrates (monazite)	1,000	—	3,000	16,000	—
Compounds (oxide, nitrate, and so forth)	9,000	3,970	1,920	5,790	2,900
Exports:					
Ore and concentrates (monazite)	520,000	1,700,000	960,000	W	W
Compounds (oxide, nitrate, and so forth) ³	21,000	154,000	60,000	46,000	31,000
Consumption, apparent: ⁴					
Ore and concentrates (monazite)	1,000	—	3,000	W	W
Compounds (oxide, nitrate, and so forth)	NA	NA	NA	NA	NA
Price, average unit value of imports, compounds, dollars per kilogram: ⁵					
India	72	72	NA	NA	NA
France	29	29	29	29	26
Net import reliance ⁶ as a percentage of apparent consumption	NA	NA	NA	NA	NA

Recycling: None.

Import Sources (2018–21): Ores and concentrates (monazite): China, 80%; United Kingdom, 15%; and Canada, 5%. Thorium compounds: France, 56%; India, 43%; and other, 1%.

Tariff:	Item	Number	Normal Trade Relations 12–31–22
	Thorium ore and concentrates (monazite)	2612.20.0000	Free.
	Thorium compounds	2844.30.1000	5.5% ad valorem.

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. 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.

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Exports of unspecified thorium compounds were 20,300 kilograms through August 2022. About one-half of the exports had a unit value of less than \$50 per kilogram, so it is possible that they were misclassified. Owing to potentially misclassified material and variations in the type and purity of thorium compounds, the unit value of exports can vary 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 was recovered and consumed. Thailand 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; Thailand, Madagascar, Vietnam and Nigeria were China's leading import sources, in descending order of quantity.

The Eneabba mineral sands project (Australia) was producing monazite concentrates for export and, in April 2022, it completed a feasibility study for construction of a fully integrated rare-earths refinery. Monazite is a featured product at the Moma Mine (Mozambique); monazite resources were greater than 100 times the current mining rate (the mine increased production in the third quarter of 2022). The license application of the Kvanefjeld project (Greenland) is in arbitration. The Steenkampskraal Mine (South Africa) obtained a favorable ruling regarding its current mining rights and obtained substantial investment to progress mining activities.

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

World Mine Production and Reserves:⁷ Production and reserves are associated with the recovery of monazite in heavy-mineral-sand deposits. Without demand for the rare earths, monazite likely would not be recovered for its thorium content under current market conditions.

World Resources:⁷ 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 World Nuclear Association,⁸ worldwide identified thorium resources were an estimated 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, lanthanum, yttrium, and zirconium oxides can substitute for thorium in welding electrodes. Several replacement materials (such as yttrium fluoride and proprietary materials) are in use as optical coatings instead of thorium fluoride.

⁶Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

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

²Estimated to be equal to exports.

³Includes material that may have been misclassified.

⁴Defined as production + imports – exports. Production is only for ore and concentrates. Monazite is produced for the production of rare-earth compounds and not for thorium recovery. The apparent consumption calculation for thorium compounds results in a negative value for thorium compounds.

⁵Calculated from U.S. Census Bureau import data.

⁶Defined 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.

⁷See Appendix C for resource and reserve definitions and information concerning data sources.

⁸Source: World Nuclear Association, 2017, Thorium: London, United Kingdom, World Nuclear Association, February.