# 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 2019, 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 2019 was about $533,000, compared with $567,000 in 2018.

| Salient Statistics—United States: | 2015 | 2016 | 2017 | 2018 | 2019[e] |
|---|---|---|---|---|---|
| Production, mine[1] | — | NA | NA | e, [2]500,000 | [2]1,200,000 |
| Imports for consumption: | | | | | |
| Thorium ore and concentrates (monazite) | — | 16,000 | — | 1,000 | 1,000 |
| Thorium compounds (oxide, nitrate, etc.) | 2,740 | 3,120 | 8,510 | 9,000 | 8,300 |
| Exports: | | | | | |
| Thorium ore and concentrates (monazite) | — | NA | NA | 520,000 | 1,200,000 |
| Thorium compounds (oxide, nitrate, etc.) | [3]2,700 | [3]6,000 | [3]6,100 | [3]3,000 | [3]3,200 |
| Consumption, apparent:[4] | | | | | |
| Thorium ore and concentrates (monazite) | — | 16,000 | — | ([5]) | 1,000 |
| Thorium compounds (oxide, nitrate, etc.) | 40 | ([5]) | 2,410 | 6,000 | 5,100 |
| Value, thorium compounds, gross weight, dollars per kilogram, India[6] | 63 | 65 | 73 | 72 | 72 |
| Net import reliance[7] as a percentage of apparent consumption | NA | NA | NA | NA | NA |

**Recycling:** None.

**Import Sources (2015–18):** Monazite: Canada, 100%. Thorium compounds: India, 89%; France 9%; and the United Kingdom, 2%.

| Tariff: Item | Number | Normal Trade Relations 12–31–19 |
|---|---|---|
| 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.

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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.

India maintained its position as the primary source of imported thorium compounds in 2019. The unit value of imports from India remained unchanged from 2018 at $72 per kilogram.

Exports of unspecified thorium compounds were 3,200 kilograms in 2019; however, 33% of the exports were reported to have a unit value of less than $50 per kilogram 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 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. Construction began at the Eneabba mineral sands project in Australia with production slated for 2020. 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.

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.

**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:** 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.

[e]Estimated. NA Not Available. — Zero.

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

[2]Estimates based on exports.

[3]Includes material that may have been misclassified.

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

[5]The apparent consumption calculation yields negative values for thorium compounds in 2016 and for thorium ores and concentrates in 2018.

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

[7]Defined 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.

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