

THORIUM

(Data in metric tons of thorium oxide (ThO₂) 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 the United States, thorium has been a byproduct of refining monazite for its rare-earth content. Monazite itself is recovered as a byproduct of processing heavy-mineral sands for titanium and zirconium minerals. In 2012, monazite was not recovered domestically as a salable product. Essentially all thorium compounds and alloys consumed by the domestic industry were derived from imports, stocks of previously imported materials, or materials previously shipped from U.S. Government stockpiles. About eight companies processed or fabricated various forms of thorium for nonenergy uses, such as catalysts, high-temperature ceramics, and welding electrodes. Thorium's use in most products has generally decreased because of its naturally occurring radioactivity. The estimated value of thorium compounds used by the domestic industry was \$400,000, unchanged compared with the revised value for 2011.

Salient Statistics—United States:	2008	2009	2010	2011	2012^e
Production, refinery ¹	—	—	—	—	—
Imports for consumption:					
Thorium ore and concentrates (monazite), gross weight	—	26	—	30	43
Thorium ore and concentrates (monazite), ThO ₂ content	—	1.82	—	2.10	3.0
Thorium compounds (oxide, nitrate, etc.), gross weight ²	0.69	2.25	3.03	5.71	4.6
Thorium compounds (oxide, nitrate, etc.), ThO ₂ content ²	0.47	1.66	2.24	4.22	3.4
Exports:					
Thorium ore and concentrates (monazite), gross weight	61	18	1	—	—
Thorium ore and concentrates (monazite), ThO ₂ content	4.27	1.26	0.07	—	—
Thorium compounds (oxide, nitrate, etc.), gross weight ²	2.00	4.73	1.50	4.28	2.1
Thorium compounds (oxide, nitrate, etc.), ThO ₂ content ²	9.32	3.51	1.11	3.17	1.6
Consumption, apparent ²	(³)	(³)	1.13	1.05	1.8
Price, thorium compounds, gross weight, dollars per kilogram: ⁴					
France	138	193	131	158	153
India	NA	51	58	58	60
Net import reliance ⁵ as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2008–11): Monazite: United Kingdom, 100%. Thorium compounds: India, 76%; and France, 24%.

Tariff:	Item	Number	Normal Trade Relations 12–31–12
	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 mine production of thorium-bearing monazite ceased at the end of 1994 as world demand for ores containing naturally occurring radioactive thorium declined. Imports and existing stocks supplied essentially all thorium consumed in the United States in 2012. Domestic demand for thorium alloys, compounds, metals, and ores has exhibited a long-term declining trend.

On the basis of data through September 2012, the average value of imported thorium compounds decreased to \$68 per kilogram from the 2011 average of \$70 per kilogram (gross weight). The average value of exported thorium compounds increased to \$424 per kilogram based on data through September 2012, compared with \$178 for 2011. The increase was attributed to variations in the type and purity of compounds exported in each year.

THORIUM

In 2012, thorium consumption was thought to be primarily in catalysts, microwave tubes, and optical equipment and was thought to have increased. Increased costs to monitor and dispose of thorium have caused domestic processors to switch to thorium-free materials. Real and potential costs related to compliance with State and Federal regulations, proper disposal, and monitoring of thorium's radioactivity have limited its commercial value. It is likely that thorium's use will continue to decline unless a low-cost disposal process is developed or new technology, such as a nonproliferative nuclear fuel, creates renewed demand.

In Australia, mining at the Mount Weld, Western Australia, operation entered its second year. As of September, 14,400 tons of concentrate containing 5,200 tons of rare-earth oxides containing trace amounts of thorium were ready for export pending the startup of processing operations in Malaysia. In South Africa, plans were underway to resume mining and processing of monazite at the Steenkampskraal operation for the production of rare earths. When commissioned, thorium produced during the production of rare earths may be sold or stored onsite in a recoverable form. In 2012, a National Instruments 43-01 report for Steenkampskraal included an indicated resource of about 14,000 tons of rare-earth oxides.

World Refinery Production and Reserves:

	Refinery production		Reserves ⁶
	2011	2012	
United States	—	—	440,000
Australia	NA	NA	⁷ 410,000
Brazil	NA	NA	16,000
Canada	NA	NA	100,000
India	NA	NA	290,000
Malaysia	—	—	4,500
South Africa	—	—	35,000
Other countries	NA	NA	90,000
World total	NA	NA	1,400,000

Reserves are contained primarily in the rare-earth ore mineral monazite and the thorium mineral thorite. Without demand for the rare earths, monazite would probably not be recovered for its thorium content. Other ore minerals with higher thorium contents, such as thorite, would be more likely sources if demand significantly increased. New demand is possible with the development and testing of thorium nuclear fuel in Russia and India. Reserves exist primarily in recent and ancient placer deposits and in thorium vein deposits such as those in the Lemhi Pass area of Idaho. Lesser quantities of thorium-bearing monazite and thorite reserves occur in certain iron ore deposits and carbonatites. Thorium enrichment is known in iron (Fe)-rare-earth-element-thorium-apatite (FRETA) deposits, as found in the deposits at Mineville, NY; Pea Ridge, MO; and Scrub Oaks, NJ.

World Resources: The world's leading thorium resources occur in placer deposits. Resources of more than 500,000 tons are contained in placer, vein, and carbonatite deposits. Disseminated deposits in various other alkaline igneous rocks contain additional resources of more than 2 million tons. Large thorium resources are found in Australia, Brazil, Canada, Greenland (Denmark), India, South Africa, and the United States.

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.

⁶Estimated. NA Not available. — Zero.

¹All domestically consumed thorium was derived from imported materials.

²Thorium compound imports from the United Kingdom were believed to be material for nuclear fuel reprocessing or waste and were not used in calculating domestic apparent consumption. Thorium compound exports to Mexico were believed to be waste material shipped for disposal and were not used in calculating domestic apparent consumption. Apparent consumption calculation excludes ore and concentrates.

³Apparent consumption calculations in 2008 and 2009 result in negative numbers.

⁴Based on U.S. Census Bureau customs value.

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

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

⁷Includes thorium contained in mineralized sands.