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(Data in metric tons of thorium oxide (ThO_2) equivalent, unless otherwise noted)

Domestic Production and Use: The primary source of the world's thorium is the rare-earth and thorium phosphate mineral, monazite. Monazite was not recovered as a salable product during domestic processing of heavy mineral sands in 2001. Past production had been as a byproduct during processing for titanium and zirconium minerals, and monazite was recovered for its rare-earth content. Essentially all thorium compounds and alloys consumed by the domestic industry were derived from imports, stocks of previously imported materials, or materials shipped from U.S. Government stockpiles. About eight companies processed or fabricated various forms of thorium for nonenergy uses, such as high-temperature ceramics, catalysts, and welding electrodes. The value of thorium metal, alloys, and compounds used by the domestic industry was estimated to be about $100,000.

Salient Statistics—United States:	1997	1998	1999	2000	2001[e]
Production, refinery[1]	—	—	—	—	—
Imports for consumption:					
Thorium ore and concentrates (monazite), gross weight	20	—	—	—	—
Thorium ore and concentrates (monazite), ThO_2 content	1.40	—	—	—	—
Thorium compounds (oxide, nitrate, etc.), gross weight	13.50	7.45	5.29	11.10	1.80
Thorium compounds (oxide, nitrate, etc.), ThO_2 content	10.00	5.51	3.91	8.20	2.00
Exports:					
Thorium ore and concentrates (monazite), gross weight	—	—	—	—	—
Thorium ore and concentrates (monazite), ThO_2 content	—	—	—	—	—
Thorium compounds (oxide, nitrate, etc.), gross weight	0.24	1.13	2.52	4.64	6.86
Thorium compounds (oxide, nitrate, etc.), ThO_2 content	0.18	0.84	1.86	3.43	7.60
Shipments from Government stockpile excesses ($ThNO_3$)	—	—	—	—	—
Consumption: Reported, (ThO_2 content[e])	13.0	7.0	7.0	6.0	NA
Apparent	12.0	4.7	3.1	7.7	E
Price, yearend, dollars per kilogram:					
Nitrate, welding-grade[2]	5.46	5.46	5.46	5.46	5.46
Nitrate, mantle-grade[3]	27.00	27.00	27.00	27.00	27.00
Oxide, yearend:					
99.9% purity[4]	82.50	82.50	82.50	82.50	82.50
99.99% purity[4]	107.25	107.25	107.25	107.25	107.25
Stocks, industrial, yearend	12.8	NA	NA	NA	NA
Net import reliance[5] as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (1997-2000): Monazite: France, 100%. Thorium compounds: France, 72%; Canada, 11%; Japan, 4%; Singapore, 2%; and other, 11%.

Tariff: Item	Number	Normal Trade Relations 12/31/01
Thorium ores and concentrates (monazite)	2612.20.0000	Free.
Thorium compounds	2844.30.1000	5.5% ad val.

Depletion Allowance: Monazite, 23% on thorium content, 15% on rare-earth and yttrium content (Domestic); 14% (Foreign).

Government Stockpile:

Stockpile Status—9-30-01[6]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2001	Disposals FY 2001
Thorium nitrate (gross weight)	3,219	—	2,947	3,218	—

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 2001. Domestic demand for thorium ores, compounds, metals, and alloys has exhibited a long-term declining trend. Thorium consumption in the United States decreased in 2000 to 2.0 tons; however, most material was consumed in a nonrecurring application. In 2001, thorium consumption, primarily for use in catalyst applications, is estimated to decrease. On the basis of data through August 2001, the average value

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of imported thorium compounds decreased to $36.58 per kilogram from the 2000 average of $47.76 per kilogram (gross weight). A researcher at Los Alamos National Laboratory announced it had derived the first estimates of thorium abundances from the Lunar Prospector mission to Earth's moon. The elemental distribution maps from the Lunar Prospector mission provide twice the resolution of previous missions. Thorium is an important element in modeling lunar evolution because it is a constituent of the mixture potassium-rare earth elements-phosphorous and known to geologists by its acronym, KREEP. KREEP is the last material to solidify from a geologic melt and are evidence of the original material beneath the moon's crust. The existence of KREEP on the moon's surface is indicative of a lunar volcanic event or strong meteor impact that penetrated the crust.[7]

A company in the United States announced that it had developed all-oxide thorium fuel seed, which is reportedly standard for domestic nuclear reactors. Previous thorium fuel seeds had been metallic. In addition the company's fuel technology group developed an 18-month thorium fuel cycle, an increase from the previous 12-month cycle.[8]

The use of thorium in the United States has decreased significantly since the 1980s, when consumption averaged 45 tons per year. Increased costs to monitor and dispose of thorium have caused the 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 forecast that thorium's use will continue to decline unless a low-cost disposal process is developed or new technology creates renewed demand.

World Refinery Production, Reserves, and Reserve Base:[9]

	Refinery production		Reserves[10]	Reserve base[10]
	2000	2001		
United States	—	—	160,000	300,000
Australia	—	—	300,000	340,000
Brazil	NA	NA	16,000	18,000
Canada	NA	NA	100,000	100,000
India	NA	NA	290,000	300,000
Malaysia	—	—	4,500	4,500
Norway	—	—	170,000	180,000
South Africa	—	—	35,000	39,000
Other countries	NA	NA	90,000	100,000
World total (rounded)	NA	NA	1,200,000	1,400,000

Reserves and reserve base are contained primarily in the rare-earth ore mineral, monazite. 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. No new demand, however, is expected. Reserves exist primarily in recent and ancient placer deposits. Lesser quantities of thorium-bearing monazite reserves occur in vein deposits and carbonatites.

World Resources: Thorium resources occur in provinces similar to those of reserves. The largest share are contained 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, India, South Africa, and the United States.

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

[e]Estimated. E Net exporter. NA Not available. — Zero.
[1]All domestically consumed thorium was derived from imported materials.
[2]Source: U.S. Department of Defense, Defense Logistics Agency. Based on sales from the National Defense Stockpile.
[3]Source: Rhodia Canada, Inc., f.o.b. port of entry, duty paid, ThO_2 basis.
[4]Source: Rhodia Rare Earths, Inc., 1-950 kilogram quantities, f.o.b. port of entry, duty paid.
[5]Defined as imports - exports + adjustments for Government and industry stock changes.
[6]See Appendix B for definitions.
[7]Los Alamos National Laboratory, 1999, Thorium maps reveal complicated lunar history: Los Alamos, NM, Los Alamos National Laboratory, news release, March 16, 1 p.
[8]Thorium Power, Inc., 2001, What's New—2001: Washington, DC, Thorium Power, Inc., February, 1 p.
[9]Estimates, based on thorium contents of rare-earth ores.
[10]See Appendix C for definitions.