TELLURIUM

(Data in metric tons of tellurium content unless otherwise noted)

Domestic Production and Use: In 2015, one firm in Texas produced commercial-grade tellurium as a byproduct from domestic copper anode slimes and lead refinery skimmings. The primary producer and intermediate producers further refined domestic and imported commercial-grade metal to produce tellurium dioxide, high-purity tellurium, and tellurium compounds for specialty applications. To avoid disclosing company proprietary data, U.S. tellurium production in 2015 was withheld.

Tellurium was used in the production of cadmium-telluride (CdTe) solar cells, which was the major end use for tellurium in the United States. Other uses were as an alloying additive in steel to improve machining characteristics, as a minor additive in copper alloys to improve machinability without reducing conductivity, in lead alloys to improve resistance to vibration and fatigue, in cast iron to help control the depth of chill, and in malleable iron as a carbide stabilizer. It was used in the chemical industry as a vulcanizing agent and accelerator in the processing of rubber and as a component of catalysts for synthetic fiber production. Other uses included those in photoreceptor devices and as a pigment to produce various colors in glass and ceramics.

Global consumption estimates for the end use of tellurium are as follows: solar, 40%; thermoelectric power generation, 30%; metallurgy, 15%; rubber applications, 5%; and other, 10%.

Salient Statistics—United States:	**2011**	**2012**	**2013**	**2014**	**2015[e]**
Production, refinery	W	W	W	W	W
Imports for consumption	71	36	64	111	102
Exports	39	47	42	28	55
Consumption, apparent	W	W	W	W	W
Price, dollars per kilogram, 99.95% minimum[1]	349	150	112	119	89
Stocks, producer, refined, yearend	W	W	W	W	W
Net import reliance[2] as a percentage of apparent consumption	>60%	<50%	>60%	>80%	>80%

Recycling: For traditional metallurgical and chemical uses, there was little or no old scrap from which to extract secondary tellurium because these uses of tellurium are highly dispersive or dissipative. A very small amount of tellurium was recovered from scrapped selenium-tellurium photoreceptors employed in older plain paper copiers in Europe. A plant in the United States recycled tellurium from CdTe solar cells; however, the amount recycled was limited, because CdTe solar cells were relatively new and had not reached the end of their useful life.

Import Sources (2011–14): Canada, 59%; China, 21%; Philippines, 9%; Belgium, 9%; and other, 2%.

Tariff: Item	**Number**	**Normal Trade Relations 12–31–15**
Tellurium	2804.50.0020	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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Events, Trends, and Issues: In 2015, estimated domestic tellurium production was less than production in 2014. The sole domestic producer shipped at least a portion of its anode slimes to Mexico for treatment and refining. World production of tellurium in 2015 is estimated at 400 tons. The price of tellurium in 2015 decreased sharply from its peak at the beginning of the year of $127 per pound to $50 per pound in October, the lowest price since 2008.

In China, the Fanya Metal Exchange Co. Ltd., which began trading tellurium in 2014, froze accounts in June, halting tellurium deliveries in or out of the exchange. Additionally, the Ri Jin Bao, an investment product that guaranteed annual returns of at least 13%, had its payments suspended in July. Investors were unable to buy or sell contracts, and the price of tellurium fell dramatically. By October 2015, Fanya reported that 170 metric tons (t) of tellurium were held in its approved warehouses; however, industry has questioned the accuracy of tellurium and other minor metal stock levels reported by Fanya.

Canada remained the leading source of domestic imports of tellurium, increasing its exports to the United States by over 400 percent and accounting for quadruple the imports from China, the next leading supplier. Sweden's new mine operations started to produce tellurium concentrate in 2012, increasing production from 7 tons to 31 tons in 2014.

CdTe solar cells continue to improve with respect to efficiency when compared with silicon-based solar cells. In February, researchers reported achieving an energy conversion efficiency of 21.5% for individual CdTe cells and a module efficiency record of 17.5%.

World Refinery Production and Reserves: The figures shown for reserves include only tellurium contained in copper reserves. These estimates are based on the assumption that more than one-half of the tellurium contained in unrefined copper anodes is recoverable. Reserves for Sweden were based on reported company data.

	Refinery production		Reserves[3]
	2014	2015[e]	
United States	W	W	3,500
Canada	9	10	800
Japan	32	35	—
Peru	—	—	3,600
Russia	32	35	NA
Sweden	31	40	700
Other countries[4]	NA	NA	16,000
World total (rounded)	NA	NA	25,000

World Resources: Data on tellurium resources, other than reserves, were not available. More than 90% of tellurium has been produced from anode slimes collected from electrolytic copper refining, and the remainder was derived from skimmings at lead refineries and from flue dusts and gases generated during the smelting of bismuth, copper, and lead-zinc ores. Other potential sources of tellurium include bismuth telluride and gold telluride ores.

Substitutes: Several materials can replace tellurium in most of its uses, but usually with losses in efficiency or product characteristics. Bismuth, calcium, lead, phosphorus, selenium, and sulfur can be used in place of tellurium in many free-machining steels. Several of the chemical process reactions catalyzed by tellurium can be carried out with other catalysts or by means of noncatalyzed processes. In rubber compounding, sulfur and (or) selenium can act as vulcanization agents in place of tellurium. The selenides and sulfides of niobium and tantalum can serve as electrical-conducting solid lubricants in place of tellurides of those elements.

The selenium-tellurium photoreceptors used in some plain paper photocopiers and laser printers have been replaced by organic photoreceptors in newer devices. Amorphous silicon and copper indium gallium selenide were the two principal competitors to CdTe in thin-film photovoltaic solar cells.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

[1]Average price published by Metal-Pages for 99.95% tellurium.

[2]Defined as imports – exports + adjustments industry stock changes.

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

[4]In addition to the countries listed, Australia, Belgium, Chile, China, Colombia, Germany, India, Kazakhstan, Mexico, the Philippines, and Poland produce refined tellurium, but output was not reported, and available information was inadequate for formulation of reliable production and detailed reserve estimates.