

TELLURIUM

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

Domestic Production and Use: In 2014, one firm in Texas produced commercial-grade tellurium from domestic copper anode slimes and lead refinery skimmings. Primary and intermediate producers further refined domestic and imported commercial-grade metal and tellurium dioxide, producing high-purity tellurium and tellurium compounds for specialty applications.

Tellurium was used in the production of cadmium-tellurium-based 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: 40% solar, 30% thermo electric production, 15% metallurgy, 5% rubber applications, and 10% other.

Salient Statistics—United States:	2010	2011	2012	2013	2014^e
Production, refinery	W	W	W	W	W
Imports for consumption, unwrought, waste and scrap	42	71	36	64	68
Exports	59	39	47	42	44
Consumption, apparent	W	W	W	W	W
Price, dollars per kilogram, 99.95% minimum ¹	221	349	150	112	117
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 cadmium-tellurium-based solar cells; however, most of this was new scrap because cadmium-tellurium-based solar cells were relatively new and had not reached the end of their useful life.

Import Sources (2010–13): Canada, 46%; China, 17%; Philippines, 13%; Belgium, 10%; and other, 14%.

Tariff: Item	Number	Normal Trade Relations
Tellurium	2804.50.0020	<u>12–31–14</u> Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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Events, Trends, and Issues: In 2014, estimated domestic tellurium production was less than production in 2013, due to anode slimes, previously processed domestically, being shipped to Mexico for treatment and refining. Although detailed information on the world tellurium market was not available, world tellurium consumption was estimated to have increased in 2014. The price of tellurium continued to exhibit a seasonal price fluctuation during 2014, with the peak price occurring in the summer months due to China's increased demand for thermoelectrics. Canada remained the leading source of US imports of tellurium, nearly tripling their exports to the United States, and outpacing the next largest supplier (Belgium), by nearly 20 times. China, a historically large supplier of tellurium to the United States, supplied less than one percent of the tellurium consumed to the United States. Although not a major domestic use, in China, tellurium is used with bismuth in thermoelectric cooling devices, such as refrigerators and water dispensers because of increased energy efficiency.

In solar cells, tellurium is mostly used in Cadmium Telluride (CdTe) thin film technologies. In 2013, thin film solar cells constituted about 9% of photovoltaic (PV) module shipments, down significantly from 2012, and CdTe PV module production declined, accounting for 1.4% of the total world PV module production.

A leading producer of high-purity tellurium metals and dioxides in the Philippines shut down their tellurium production, ending 25 years of tellurium production. China's Fanya minor metals exchange began trading tellurium in 2014. By October, 135 metric tons (t) of tellurium were held in Fanya warehouses, which have a total capacity of 1,000(t).

World Refinery Production and Reserves: The figures shown for reserves include only tellurium contained in copper reserves. These estimates assume that more than one-half of the tellurium contained in unrefined copper anodes is recoverable.

	Refinery production		Reserves ³
	2013	2014 ^e	
United States	W	W	3,500
Canada	12	10	800
Japan	48	45	—
Peru	—	—	3,600
Russia	35	40	NA
Other countries ⁴	NA	NA	16,000
World total (rounded)	NA	NA	24,000

World Resources: Data on tellurium resources 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. In copper production, tellurium was recovered only during electrolytic refining of smelted copper. Other potential sources of tellurium include bismuth telluride, gold telluride, and lead-zinc ores.

Substitutes: Several materials can replace tellurium in most of its uses, but usually with losses in production 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 electrically conducting solid lubricants in place of tellurides of those metals.

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 PV power cells.

^eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

¹Average price published by Metal-Prices for 99.95% tellurium.

²Defined as imports – exports + adjustments for Government and industry stock changes.

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

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