

## TELLURIUM

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

**Domestic Production and Use:** In the United States, one firm produced commercial-grade tellurium at its refinery complex in Texas, mainly from copper anode slimes but also from lead refinery skimmings, both of domestic origin. Primary and intermediate producers further refined domestic and imported commercial-grade metal and tellurium dioxide, producing tellurium and tellurium compounds in high-purity form for specialty applications.

Tellurium's major use is as an alloying additive in steel to improve machining characteristics. It is also used 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 is 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. Tellurium was increasingly used in the production of cadmium-tellurium-based solar cells. Production of bismuth-telluride thermoelectric cooling devices decreased owing to the reduced manufacturing of automobiles containing seat-cooling systems. Other uses include those in photoreceptor and thermoelectric electronic devices, other thermal cooling devices, as an ingredient in blasting caps, and as a pigment to produce various colors in glass and ceramics.

<b>Salient Statistics—United States:</b>	<b><u>2007</u></b>	<b><u>2008</u></b>	<b><u>2009</u></b>	<b><u>2010</u></b>	<b><u>2011<sup>e</sup></u></b>
Production, refinery	W	W	W	W	W
Imports for consumption, unwrought, waste and scrap	44	102	84	42	50
Exports	15	50	8	59	55
Consumption, apparent	W	W	W	W	W
Price, dollars per kilogram, 99.95% minimum <sup>1</sup>	82	211	150	220	360
Stocks, producer, refined, yearend	W	W	W	W	W
Net import reliance <sup>2</sup> as a percentage of apparent consumption	W	W	W	W	W

**Recycling:** For traditional uses, there is little or no old scrap from which to extract secondary tellurium because these uses of tellurium are nearly all dissipative. A very small amount of tellurium is recovered from scrapped selenium-tellurium photoreceptors employed in older plain paper copiers in Europe. Currently, there is a plant in the United States recycling tellurium from cadmium-tellurium-based solar cells; however, most of this is new scrap because cadmium-tellurium-based solar cells are relatively new and have not reached the end of their useful life.

**Import Sources (2007–10):** China, 47%; Canada, 23%; Philippines, 11%; Belgium, 6%; and other, 13%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations</b>
Tellurium	2804.50.0020	<b><u>12-31-11</u></b> Free.

**Depletion Allowance:** 14% (Domestic and foreign).

**Government Stockpile:** None.

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**Events, Trends, and Issues:** In 2011, estimated domestic tellurium production was slightly less than production in 2010. Although detailed information on the world tellurium market was not available, world tellurium consumption was estimated to have increased in 2011. The price of tellurium significantly increased in 2011 because of increased use of tellurium in solar cells.

**World Refinery Production and Reserves:** Significant upward revisions were made to global reserves because of an increase in recovery factors. Tellurium reserves in Peru were substantially revised upward because of an increase in copper reserves based on Government reports.

	Refinery production		Reserves <sup>3</sup>
	<u>2010</u>	<u>2011<sup>e</sup></u>	
United States	W	W	3,500
Canada	8	10	800
Japan	51	40	—
Peru	30	30	3,600
Russia	34	35	NA
Other countries <sup>4</sup>	<u>NA</u>	<u>NA</u>	<u>16,000</u>
World total (rounded)	NA	NA	24,000

**World Resources:** 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 actually recovered. With increased concern for supply of tellurium, companies are investigating other potential sources, such as gold telluride and lead-zinc ores with higher concentrations of tellurium, which are not included in estimated world resources.

More than 90% of tellurium is produced from anode slimes collected from electrolytic copper refining, and the remainder is derived from skimmings at lead refineries and from flue dusts and gases generated during the smelting of bismuth, copper, and lead ores. In copper production, tellurium is recovered only from the electrolytic refining of smelted copper. Increased use of the leaching solvent extraction-electrowinning processes for copper extraction, which does not capture tellurium, has limited the future supply of tellurium supply from certain copper deposit types.

**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 of the refractory metals can function as high-temperature, high-vacuum lubricants in place of tellurides. 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 xerographic copiers and laser printers have been replaced by organic photoreceptors in newer machines. Amorphous silicon and copper indium diselenide are the two principal competitors to cadmium telluride in photovoltaic power cells.

<sup>e</sup>Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

<sup>1</sup>For 2007 through 2009, the price listed was the average price published by Mining Journal for United Kingdom lump and powder, 99.95% tellurium. In 2010 through 2011, the price listed was the average price published by Metal-Prices for 99.95% tellurium.

<sup>2</sup>Defined as imports – exports + adjustments for Government and industry stock changes.

<sup>3</sup>Estimates include tellurium contained in copper resources only. [See Appendix C for resource/reserve definitions and information concerning data sources.](#)

<sup>4</sup>In addition to the countries listed, Australia, Belgium, Chile, China, Colombia, Germany, Kazakhstan, Mexico, the Philippines, and Poland produce refined tellurium, but output is not reported, and available information is inadequate for formulation of reliable production estimates.