TELLURIUM

(Data in metric tons, tellurium content, unless otherwise specified)

Domestic Production and Use: Tellurium is primarily recovered as a byproduct of the electrolytic refining of copper, where it accumulates in the residues of copper anodes. In 2023, two electrolytic copper refineries operated in the United States, one in Texas and one in Utah, and produced copper telluride from tellurium-bearing anode slimes. Copper telluride from both domestic facilities was exported for further processing. Downstream companies refined imported commercial-grade tellurium to produce high-purity tellurium, tellurium compounds for specialty applications, and tellurium dioxide. Domestic tellurium production, consumption, and stocks were withheld to avoid disclosing company proprietary data.

Tellurium was predominantly used in the production of cadmium telluride (CdTe) for thin-film solar cells. Another important end use was for the production of bismuth telluride (BiTe), which is used in thermoelectric devices for cooling and energy generation. Metallurgical 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 and thermoelectric devices, blasting caps, and as a pigment to produce various colors in glass and ceramics.

Salient Statistics—United States:	2019	2020	2021	2022	2023[e]
Production, refinery[1]	W	W	W	W	W
Imports for consumption	59	12	42	37	10
Exports	1	(2)	2	1	3
Consumption, apparent[3]	W	W	W	W	W
Price, average, dollars per kilogram:					
United States[4]	68.11	59.37	69.72	70.34	80
Europe[5]	60.45	56.05	67.26	68.10	78
Stocks, producer, yearend	W	W	W	W	W
Net import reliance[6] as a percentage of apparent consumption	>95	>75	>95	>75	>25

Recycling: For traditional metallurgical and chemical uses, there was little or no 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 photocopiers in Europe. A plant in the United States recycled tellurium from CdTe solar cells, but the amount recycled was limited because most CdTe solar cells were relatively new and had not reached the end of their useful life.

Import Sources (2019–22): Canada, 38%; Germany, 34%; Philippines, 15%; Japan, 6%; and other, 7%.

Tariff: Item	Number	Normal Trade Relations 12–31–23
Tellurium	2804.50.0020	Free.

Depletion Allowance: 14% (domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: The supply of tellurium is directly affected by the supply of materials from which it is a byproduct, primarily copper. In 2023, recovery of copper telluride from domestic copper anode slimes was estimated to have decreased from that in 2022, reflecting lower output of copper cathode from electrolytic refineries in the United States. In July 2023, the leading U.S. producer of solar modules announced plans to build a fifth plant in the United States that would increase the company's domestic manufacturing capacity to 14 gigawatts (GW) of solar modules by 2026. The annual average price for tellurium in U.S. warehouses increased by 14% to an estimated $80 per kilogram in 2023 from $70.34 per kilogram in 2022, primarily owing to strong global demand.

In 2023, China was the leading producer of refined tellurium and accounted for 67% of estimated global output. A new refinery in China with a production capacity of 50 tons per year of tellurium was expected to begin operating in October. The Government of India selected 11 companies to construct approximately 40 GW of photovoltaic manufacturing capacity, a fourfold increase from current capacity. Estimated end uses for tellurium in global consumption were solar power cells, 40%; thermoelectric production, 30%; metallurgy, 15%; rubber applications, 5%; and other, 10%.

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World Refinery Production and Reserves: The values shown for reserves reflect the estimated tellurium content of copper reserves with the exception of China and Sweden, which represent reported reserves of tellurium. Reserves for China and Russia were revised based on Government reports, and reserves for Sweden, the United States, and "Other countries" were revised based on company reports.

	Refinery production[e, 7]		Reserves[8]
	2022	2023	
United States	W	W	4,000
Bulgaria	3	3	NA
Canada	24	27	800
China	380	430	3,100
Japan	68	75	—
Russia	70	75	5,800
South Africa	4	5	800
Sweden	[9]33	25	700
Uzbekistan	[9]3	3	NA
Other countries[10]	NA	NA	21,000
World total (rounded)	[11]584	[11]640	36,000

World Resources:[8] Reserves for tellurium are based on identified copper deposits and average tellurium content. More than 90% of tellurium has been produced from anode slimes as a byproduct of 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. Amorphous silicon and copper-indium-gallium selenide are the two principal competitors of CdTe in thin-film photovoltaic solar cells. Bismuth selenide and organic polymers can be used to substitute for some BiTe thermal devices. 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 metals.

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

[1]Tellurium content of copper telluride recovered from copper anode slimes.

[2]Less than ½ unit. Export data reported by the U.S. Census Bureau in 2020 were adjusted by the U.S. Geological Survey.

[3]Production + imports – exports ± adjustments for industry stock changes.

[4]Average annual price for 99.95%-minimum-purity tellurium, free on board, U.S. warehouse. Source: Argus Media Group, Argus Non-Ferrous Markets.

[5]Average annual price for 99.99%-maximum-purity tellurium, in warehouse, Rotterdam. Source: Argus Media Group, Argus Non-Ferrous Markets.

[6]Defined as imports – exports ± adjustments for industry stock changes.

[7]Insofar as possible, data relate to refinery output only; countries that produced tellurium contained in blister copper, copper anodes, copper concentrates, copper ores, and (or) refinery residues but did not recover tellurium from these materials were excluded.

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

[9]Reported.

[10]In addition to the countries listed, Australia, Belgium, Chile, Germany, Indonesia, Kazakhstan, Mexico, and the Philippines may have produced refined tellurium, but available information was inadequate to make reliable estimates of output.

[11]Excludes U.S. production.