SELENIUM

(Data in metric tons of contained selenium unless otherwise noted)

Domestic Production and Use: In 2021, the only domestic selenium-producing copper refinery halted production of refined selenium but produced selenium-bearing anode slime. The two other electrolytic copper refineries, operating in Arizona and Utah, did not recover selenium domestically, but did produce selenium-bearing anode slimes. U.S. selenium production in prior years and consumption and stock data were withheld to avoid disclosing company proprietary data. Estimates for end uses in global consumption were, in descending order, metallurgy (including manganese production), glass manufacturing, agriculture, chemicals and pigments, electronics, and other uses.

Selenium is used in blasting caps to control delays; in catalysts to enhance selective oxidation; in copper, lead, and steel alloys to improve machinability; in the electrolytic production of manganese to increase yields; in glass manufacturing to decolorize the green tint caused by iron impurities in container glass and other soda-lime silica glass; in gun bluing to improve cosmetic appearance and provide corrosion resistance; in plating solutions to improve appearance and durability; in rubber compounding chemicals to act as a vulcanizing agent; and in thin-film photovoltaic copper-indium-gallium-diselenide (CIGS) solar cells.

Selenium is an essential micronutrient and is used as a human dietary supplement, a dietary supplement for livestock, and as a fertilizer additive to enrich selenium-poor soils. Selenium is also used as an active ingredient in antidandruff shampoos.

Salient Statistics—United States:	2017	2018	2019	2020	2021[e]
Production, refinery	W	W	W	W	—
Imports for consumption:					
Selenium metal	450	445	496	366	360
Selenium dioxide	19	12	5	18	77
Exports,[1] metal	242	158	361	147	240
Consumption, apparent,[2] metal	W	W	W	W	W
Price, average,[3] dollars per pound	15.55	16.85	9.15	6.61	8.00
Stocks, producer, refined, yearend	W	W	W	W	W
Net import reliance[4] as a percentage of apparent consumption, metal	E	<25	<25	<50	>75

Recycling: Domestic production of secondary selenium was estimated to be very small because most scrap from older plain paper photocopiers and electronic materials was exported for recovery of the contained selenium.

Import Sources (2017–20): Selenium metal: Philippines, 18%; China,[5] 16%; Mexico, 14%; Germany, 13%; and other, 39%. Selenium dioxide: Republic of Korea, 29%; China, 24%; Germany, 18%; Canada, 14%; and other, 15%.

Tariff: Item	Number	Normal Trade Relations 12–31–21
Selenium metal	2804.90.0000	Free.
Selenium dioxide	2811.29.2000	Free.

Depletion Allowance: 14% (domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: The supply of selenium is directly affected by the supply of the materials from which it is a byproduct—copper and, to a lesser extent, nickel—and it is directly affected by the number of facilities that recover selenium. The estimated annual average price for selenium was $8.00 per pound in 2021, a 21% increase from that in 2020. Average weekly prices have risen steadily from the beginning of 2021. Copper producers in China had opted to stop sales from their inventories, reducing availability of selenium. Selenium prices increased owing to a rise in crude selenium feedstock costs.

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In China, selenium suppliers and consumers both experienced difficulties acquiring adequate materials. Electrolytic manganese production was the main metallurgical end use for selenium in China, where selenium dioxide was used in the electrolytic process to increase current efficiency and the metal deposition rate. Manganese production decreased in 2021, owing to output reductions by major manganese producers in China. The reductions were put in place to reduce spot availability and raise prices. The manganese industry alliance had a commitment to shut down operations for 30 days every 4 months, with a total of 90 days in 2021.

World Refinery Production and Reserves:

	Refinery production[6]		Reserves[7]
	2020	2021[e]	
United States	W	—	10,000
Belgium	200	200	—
Canada	60	60	6,000
China	1,200	1,100	26,000
Finland	84	100	—
Germany	300	300	—
India	14	10	—
Japan	740	750	—
Peru	35	40	13,000
Poland	74	65	3,000
Russia	340	300	20,000
Sweden	10	20	—
Turkey	50	50	—
Other countries[8]	14	25	22,000
World total (rounded)	[9]3,120	3,000	100,000

World Resources:[7] Reserves for selenium are based on identified copper deposits and average selenium content. Coal generally contains between 0.5 and 12 parts per million selenium, or about 80 to 90 times the average for copper deposits. The recovery of selenium from coal fly ash, although technically feasible, does not appear likely to be economical in the foreseeable future.

Substitutes: Silicon is the major substitute for selenium in low- and medium-voltage rectifiers. Organic pigments have been developed as substitutes for cadmium sulfoselenide pigments. Other substitutes include cerium oxide as either a colorant or decolorant in glass; tellurium in pigments and rubber; bismuth, lead, and tellurium in free-machining alloys; and bismuth and tellurium in lead-free brasses. Sulfur dioxide can be used as a replacement for selenium dioxide in the production of electrolytic manganese metal, but it is not as energy efficient.

The selenium-tellurium photoreceptors used in some plain paper copiers and laser printers have been replaced by organic photoreceptors in newer machines. Amorphous silicon and cadmium telluride are the two principal competitors with CIGS in thin-film photovoltaic solar cells.

[e]Estimated. E Net exporter. W Withheld to avoid disclosing company proprietary data. — Zero.

[1]There was no exclusive Schedule B number for selenium dioxide exports.

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

[3]Selenium metal powder, free on board, U.S. warehouse, minimum 99.5% purity. Source: Argus Media group—Argus Metals International.

[4]Defined as imports – exports + adjustments for industry stock changes; export data are incomplete for common forms of selenium, which may be exported under unexpected or misidentified forms, such as copper slimes, copper selenide, or zinc selenide.

[5]Includes Hong Kong.

[6]Insofar as possible, data relate to refinery output only; thus, countries that produced selenium contained in blister copper, copper concentrates, copper ores, and (or) refinery residues but did not recover refined selenium from these materials indigenously were excluded to avoid double counting.

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

[8]Australia, Iran, Kazakhstan, Mexico, the Philippines, and Uzbekistan are known to produce refined selenium, but output was not reported, and information was inadequate to make reliable production estimates.

[9]Excludes U.S. production.