

SELENIUM

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

Domestic Production and Use: Primary selenium was recovered from anode slimes generated in the electrolytic refining of copper. One copper refinery in Texas reported production of primary selenium. One copper refiner exported semirefined selenium for toll-refining in Asia, and one other refiner generated selenium-containing slimes, which were exported for processing.

In glass manufacturing, selenium is used to decolorize the green tint caused by iron impurities in container glass and other soda-lime silica glass and is used in architectural plate glass to reduce solar heat transmission. Cadmium sulfoselenide pigments are used in plastics, ceramics, and glass to produce a ruby-red color. Selenium is used in catalysts to enhance selective oxidation; in plating solutions, where it improves appearance and durability; in blasting caps and gun bluing; in rubber compounding chemicals; in the electrolytic production of manganese to increase yields; and in brass alloys to improve machinability.

Selenium is used as a human dietary supplement and in antidandruff shampoos. The leading agricultural uses are as a dietary supplement for livestock and as a fertilizer additive to enrich selenium-poor soils. It is used as a metallurgical additive to improve machinability of copper, lead, and steel alloys. Historically, the primary electronic use was as a photoreceptor on the replacement drums for older plain paper photocopiers; these have been replaced by newer models that do not use selenium in the reproduction process. Selenium is also used in thin-film photovoltaic copper indium gallium diselenide (CIGS) solar cells.

Salient Statistics—United States:	2008	2009	2010	2011	2012^e
Production, refinery	W	W	W	W	W
Imports for consumption, metal and dioxide	519	263	480	601	475
Exports, metal, waste and scrap	562	618	919	1,440	1,000
Consumption, apparent ¹	519	263	480	601	475
Price, dealers, average, dollars per pound, 100-pound lots, refined	32.29	23.07	37.83	66.35	58.00
Stocks, producer, refined, yearend	W	W	W	W	W
Net import reliance ² as a percentage of apparent consumption	E	E	E	E	E

Recycling: Domestic production of secondary selenium was estimated to be very small because most scrap xerographic and electronic materials were exported for recovery of the contained selenium.

Import Sources (2008–11): Belgium, 25%; Germany, 12%; Japan, 12%; China, 11%; and other, 40%.

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

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

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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. Estimated domestic selenium production was slightly higher in 2012 compared with that of 2011 owing to a slight increase in copper production.

In 2012, the price of selenium dropped owing to the decrease in consumption in China. During the first half of 2012, Chinese manganese producers were operating at 30% to 40% of capacity because of higher energy costs, export tariffs, and drop in demand for manganese. As a result, they consumed less selenium dioxide. Domestic and global use of selenium in glass increased with an increase in glass production. The use of selenium in fertilizers and supplements in the plant-animal-human food chain and as human vitamin supplements also increased as its health benefits were more widely documented. Although small amounts of selenium are considered beneficial, it can be hazardous in larger quantities. Selenium consumption in solar cells decreased, because in 2012, the solar cell market was oversupplied, which led several solar manufacturers to file for bankruptcy or curtail some of their production.

World Refinery Production and Reserves: Selenium reserves in Chile were revised substantially upward because of an increase in copper reserves based on company reports and new developments.

	Refinery production		Reserves ³
	2011	2012 ^e	
United States	W	W	10,000
Belgium	200	200	—
Canada	35	35	6,000
Chile	90	90	25,000
Finland	60	60	—
Germany	650	650	—
Japan	630	650	—
Peru	59	60	13,000
Philippines	65	70	500
Russia	145	145	20,000
Other countries ⁴	46	40	23,000
World total (rounded)	⁵ 1,980	⁵ 2,000	98,000

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

Substitutes: High-purity silicon has replaced selenium in high-voltage rectifiers. Silicon is also the major substitute for selenium in low- and medium-voltage rectifiers and solar photovoltaic cells. 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.

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

^eEstimated. E Net exporter. W Withheld to avoid disclosing company proprietary data. — Zero.

¹Imports for consumption were used as a proxy for apparent consumption.

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, China, India, Iran, Kazakhstan, Mexico, Poland, the United Kingdom, and Uzbekistan are known to produce refined selenium, but output is not reported, and information is inadequate for formulation of reliable production estimates.

⁵Excludes U.S. production.