

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, which are gradually being 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:	2005	2006	2007	2008	2009^e
Production, refinery	W	W	W	W	W
Imports for consumption, metal and dioxide	589	409	544	518	286
Exports, metal, waste and scrap	254	191	562	545	540
Consumption, apparent ¹	590	410	545	520	300
Price, dealers, average, dollars per pound, 100-pound lots, refined	51.44	24.57	32.90	32.29	23.00
Stocks, producer, refined, yearend	W	W	W	W	W
Net import reliance ² as a percentage of apparent consumption	57	53	E	E	E

Recycling: The amount of 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 (2005-08): Belgium, 46%; Canada, 14%; Germany, 13%; Japan, 7%; and other, 20%.

Tariff: Item	Number	Normal Trade Relations 12-31-09
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 unchanged in 2009 compared with that of 2008.

China, which remained the leading consumer of selenium, continued to use selenium as a fertilizer supplement and ingredient in glassmaking, and selenium dioxide was used as a substitute for sulfur dioxide in the manganese refining process. It is believed that consumption of selenium in China increased in the first half of 2008 owing to increases in consumption from the manganese refining industry. In the second half of 2008 and into 2009, consumption and price dropped because of the decrease in production of manganese in China.

Domestic use of selenium in glass and in copiers in 2009 continued to decline. The use of selenium as a substitute for lead in free-machining brasses was also lower owing to the economic downturn. The use of selenium in fertilizers and supplements in the plant-animal-human food chain and as human vitamin supplements increased as its health benefits were documented. Although small amounts of selenium are considered beneficial, it can be hazardous in larger quantities. An increased interest in solar cell technologies has increased the consumption of selenium in CIGS solar cells.

World Refinery Production and Reserves: Reserves estimates for Peru and the Philippines were revised based on new information derived from government and industry reports.

	Refinery production		Reserves ³
	2008	2009 ^e	
United States	W	W	10,000
Belgium	200	200	—
Canada	156	150	6,000
Chile	78	70	20,000
Finland	60	60	—
India	14	14	—
Japan	754	755	—
Peru	45	45	9,000
Philippines	65	65	500
Russia	110	110	20,000
Sweden	20	20	—
Other countries ⁴	9	10	23,000
World total (rounded)	⁵ 1,510	⁵ 1,500	88,000

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.

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 copper indium diselenide 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 definitions](#). Reserve base estimates were discontinued in 2009; see [Introduction](#).

⁴In addition to the countries listed, Australia, China, Kazakhstan, and the United Kingdom 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.