

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 two other refiners 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:	2004	2005	2006	2007	2008^e
Production, refinery	W	W	W	W	W
Imports for consumption, metal and dioxide	412	589	409	544	585
Exports, metal, waste and scrap	160	254	191	562	640
Consumption, apparent	W	W	W	W	W
Price, dealers, average, dollars per pound, 100-pound lots, refined	24.86	51.44	24.57	32.90	33.00
Stocks, producer, refined, yearend	W	W	W	W	W
Net import reliance ¹ as a percentage of apparent consumption	W	W	W	W	W

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 (2004-07): Belgium, 45%; Canada, 15%; Germany, 10%; Philippines, 10%; and other, 20%.

Tariff: Item	Number	Normal Trade Relations 12-31-08
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 increased in 2008 compared with that of 2007.

China, which remains the leading consumer of selenium, continued to use selenium as a fertilizer supplement and as an ingredient in glassmaking, and selenium dioxide as a substitute for sulfur dioxide in the manganese refining process. It is believed that consumption of selenium in China increased in 2007 and in the first half of 2008 owing to increases in consumption from the manganese refining industry.

Domestic use of selenium in glass and in copiers continued to decline. The use of selenium as a substitute for lead in free-machining brasses continued to increase as more stringent regulations on the use of lead were implemented. 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, Reserves, and Reserve Base: Reserve and reserve base estimates for Chile were revised upward based on new information from company reports.

	Refinery production		Reserves ²	Reserve base ²
	2007	2008 ^e		
United States	W	W	10,000	19,000
Belgium	200	200	—	—
Canada	120	120	6,000	10,000
Chile	75	75	20,000	40,000
Finland	60	60	—	—
India	14	15	—	—
Japan	806	840	—	—
Peru	75	75	5,000	8,000
Philippines	65	65	2,000	3,000
Sweden	20	20	—	—
Other countries ³	123	120	43,000	92,000
World total (rounded)	⁴ 1,560	⁴ 1,590	86,000	172,000

World Resources: The reserve base for selenium is 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. An assessment of U.S. copper resources indicated that total copper resources in identified and undiscovered resources totals about 550 million metric tons, almost eight times the estimated U.S. copper reserve base.

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. Amorphous silicon and organic photoreceptors are substitutes in plain paper photocopiers. 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.

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

¹Defined as imports – exports + adjustments for Government and industry stock changes.

²See Appendix C for definitions.

³In addition to the countries listed, Australia, China, Kazakhstan, Russia, 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.

⁴Excludes U.S. production.