

## 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primary electronic use was as a photoreceptor on the replacement drums for older plain paper photocopiers; these have been replaced by newer models that do not use selenium in the reproduction process.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.

<b>Salient Statistics—United States:</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011<sup>e</sup></b>
Production, refinery	W	W	W	W	W
Imports for consumption, metal and dioxide	544	519	263	480	630
Exports, metal, waste and scrap	592	562	618	919	1,200
Consumption, apparent <sup>1</sup>	544	519	263	480	630
Price, dealers, average, dollars per pound, 100-pound lots, refined	33.08	32.29	23.07	37.83	65.00
Stocks, producer, refined, yearend	W	W	W	W	W
Net import reliance <sup>2</sup> 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 (2007–10):** Belgium, 34%; Germany, 15%; Canada, 11%; China, 9%; and other, 31%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12-31-11</b>
Selenium metal	2804.90.0000	Free.
Selenium dioxide	2811.29.2000	Free.

**Depletion Allowance:** 14% (Domestic and foreign).

**Government Stockpile:** None.

## SELENIUM

**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 lower in 2011 compared with that of 2010.

Domestic use of selenium in glass in 2011 reversed its downward trend and increased because of increased glass production. The use of selenium as a substitute for lead in free-machining brasses also was slightly higher owing to improvement in global economic conditions. 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. Continued increased interest in solar cell technologies has increased the consumption of selenium in CIGS solar cells.

**World Refinery Production and Reserves:** Selenium reserves in Peru were revised substantially upward because of an increase in copper reserves based on Government reports.

	Refinery production		Reserves <sup>3</sup>
	2010	2011 <sup>e</sup>	
United States	W	W	10,000
Belgium	200	200	—
Canada	79	95	6,000
Chile	90	90	20,000
Finland	60	60	—
Germany	650	650	—
Japan	753	630	—
Peru	45	45	13,000
Philippines	65	70	500
Russia	140	140	20,000
Other countries <sup>4</sup>	38	40	23,000
World total (rounded)	<sup>5</sup> 2,120	<sup>5</sup> 2,000	93,000

**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 copper indium gallium diselenide in thin-film photovoltaic power cells.

<sup>e</sup>Estimated. E Net exporter. W Withheld to avoid disclosing company proprietary data. — Zero.

<sup>1</sup>Imports for consumption were used as a proxy for apparent consumption.

<sup>2</sup>Defined as imports – exports + adjustments for Government and industry stock changes.

<sup>3</sup>See [Appendix C for resource/reserve definitions and information concerning data sources.](#)

<sup>4</sup>In addition to the countries listed, Australia, China, 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.

<sup>5</sup>Excludes U.S. production.