GERMANIUM

(Data in kilograms of germanium content unless otherwise noted)

Domestic Production and Use: Germanium production in the United States comes from either the processing of imported germanium compounds or recycling domestic industry-generated scrap. Germanium for domestic consumption also was obtained from materials imported in chemical form and either directly consumed or consumed in the production of other germanium compounds. Germanium contained in concentrates produced at a zinc mine in Alaska was exported to Canada for processing. During the third quarter of 2012, a producer began to recover an intermediate germanium concentrate from concentrates at a zinc mine and smelter complex in Tennessee. The company continued to work on increasing germanium concentrate production efficiency during 2013.

A germanium refinery in Utica, NY, produced germanium tetrachloride for optical fiber production. Another refinery in Quapaw, OK, produced refined germanium and compounds from scrap and imported materials for the production of fiber optics, infrared devices, and substrates for electronic devices. The worldwide end-use pattern of germanium was estimated to be: infrared optics, 30%; fiber optics, 20%; polymerization catalysts, 20%; electronics and solar applications, 15%; and other uses (such as phosphors, metallurgy, and chemotherapy), 15%. The domestic end use distribution was different and was estimated to be: fiber-optic systems, 40%; infrared optics, 30%; electronics and solar applications, 20%; and other uses, 10%. Germanium was not used in polymerization catalysts in the United States. In 2013, domestic consumption of germanium for fiber-optic systems increased compared with that in 2012 but use in infrared optics declined. The estimated value of germanium metal consumed in 2013, based on the annual average U.S. producer price, was about $71 million.

Salient Statistics—United States:	**2009**	**2010**	**2011**	**2012**	**2013[e]**
Production, refinery[e]	4,600	3,000	3,000	W	W
Total imports[1]	60,200	44,700	38,500	48,500	45,000
Total exports[1]	21,200	8,000	5,900	15,300	12,000
Shipments from Government stockpile excesses	68	—	—	—	—
Consumption, estimated	44,000	40,000	36,000	38,000	38,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	940	1,200	1,450	1,640	1,875
Dioxide, electronic grade	580	720	1,250	1,360	1,340
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, plant,[2] number[e]	70	100	100	100	100
Net import reliance[3] as a percentage of estimated consumption	90	90	90	85	85

Recycling: Worldwide, about 30% of the total germanium consumed is produced from recycled materials. During the manufacture of most optical devices, more than 60% of the germanium metal used is routinely recycled as new scrap. Germanium scrap was also recovered from the window blanks in decommissioned tanks and other military vehicles.

Import Sources (2009–12):[4] China, 60%; Belgium, 15%; Russia, 15%; Germany, 5%; and other, 5%.

Tariff: Item	**Number**	**Normal Trade Relations 12–31–13**
Germanium oxides	2825.60.0000	3.7% ad val.
Metal, unwrought	8112.92.6000	2.6% ad val.
Metal, powder	8112.92.6500	4.4% ad val.
Metal, wrought	8112.99.1000	4.4% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: In fiscal year 2012, the Defense Logistics Agency, DLA Strategic Materials awarded two contracts to convert 3,000 kg of the germanium ingots held in the stockpile to epitaxial wafers for use as substrates required by National Security Space Strategy photovoltaic solar cell applications. As of late 2013, the germanium had not been upgraded. The DLA did not allocate any germanium for sale in the fiscal year 2013 Annual Materials Plan.

Stockpile Status—9–30–13[5]

Material	**Uncommitted inventory**	**Authorized for disposal**	**Disposal plan FY 2013**	**Disposals FY 2013**
Germanium	16,362	*—	—	—

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Events, Trends, and Issues: Germanium dioxide prices were relatively stable during the first three quarters of 2013, remaining close to 2012 levels, and nearly double those in 2010. Germanium metal began the year at about $1,640 per kilogram, increased to $1,800 per kilogram in May, and was about $1,875 per kilogram by late September. At current price levels, some consumers were finding it cheaper to purchase germanium metal instead of dioxide owing to the lower unit cost of the germanium contained in metal. This, and Chinese stockpiling activities, may have contributed to germanium metal price increases.

China remained the leading global consumer and producer of germanium in 2013. The industry has become relatively concentrated with a handful of leading manufacturers in China accounting for most of the production. Recent reports indicated that total refined germanium production capacity in China was as much as 200 metric tons per year, and in 2013, producers operated at about 55% of capacity. Chinese National and Provincial governments have encouraged producers to integrate operations and focus on producing value-added products. China's trade policies during recent years, such as a 5% export tax placed on germanium dioxide, have been aimed at reducing exports of minor metals and encouraging the export of downstream products such as infrared devices. Chinese consumption of germanium in infrared devices reportedly increased significantly in 2013 as its military spending soared. In 2012, China's State Reserve Bureau purchased 20 metric tons of germanium metal for its national stockpile and was expected to purchase a similar quantity, or slightly more, for the stockpile by yearend 2013.

Outside of China, germanium consumption patterns reflected declines in defense spending. Leading domestic and European producers reported declines in sales of germanium lenses for use in infrared optics in 2013 compared with 2012. Consumption of germanium substrates for use in terrestrial solar cells declined in 2013 as did use in light-emitting diodes. Conversely, germanium consumption for use in solar cells for satellites and in fiber optics increased in 2013. The continued global expansion of fiber-optic networks was expected to be a growth area for germanium. The sustained high germanium prices caused some consumers to seek less expensive substitutes. In Japan, germanium dioxide consumption for use in polymerization catalysts declined, with imports decreasing to 8 metric tons in the first half of 2013 from 13 metric tons during the same period of 2012.

World Refinery Production and Reserves:

	Refinery production[e]		Reserves[6]
	2012	2013	
United States	W	W	NA
China	105,000	110,000	NA
Russia	5,000	5,000	NA
Other countries	40,000	40,000	NA
World total	[7]150,000	[7]155,000	NA

World Resources: The available resources of germanium are associated with certain zinc and lead-zinc-copper sulfide ores. Substantial U.S. reserves of recoverable germanium are contained in zinc deposits in Alaska and Tennessee. Based on an analysis of zinc concentrates, U.S. reserves of zinc may contain as much as 2,500 metric tons of germanium. Because zinc concentrates are shipped globally and blended at smelters, however, the recoverable germanium in zinc reserves cannot be determined. On a global scale, as little as 3% of the germanium contained in zinc concentrates is recovered. Significant amounts of germanium are contained in ash and flue dust generated in the combustion of certain coals for power generation.

Substitutes: Silicon can be a less-expensive substitute for germanium in certain electronic applications. Some metallic compounds can be substituted in high-frequency electronics applications and in some light-emitting-diode applications. Zinc selenide and germanium glass substitute for germanium metal in infrared applications systems but often at the expense of performance. Titanium has the potential to be a substitute as a polymerization catalyst.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

[1]In addition to the gross weight of wrought and unwrought germanium and waste and scrap that comprise these figures, this series includes estimated germanium content of germanium dioxide. This series does not include germanium tetrachloride and other germanium compounds for which data are not available.

[2]Employment related to primary germanium refining is indirectly related to zinc refining.

[3]Defined as imports – exports + adjustments for Government stock changes; rounded to nearest 5%.

[4]Imports are based on the gross weight of wrought and unwrought germanium and waste and scrap, but not germanium tetrachloride and other germanium compounds for which data are not available.

[5]See Appendix B for definitions.

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

[7]Excludes U.S. production.

*Correction posted on March 27, 2014.