

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 was recovered from zinc concentrates produced at a mine in Alaska and exported to Canada for processing. A zinc smelter in Clarksville, Tennessee, produced and exported germanium leach concentrates recovered from processing zinc concentrates from its Middle Tennessee Mines. 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: fiber optics, 30%; infrared 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 2014, domestic consumption of germanium for fiber-optic systems increased compared with that in 2013 but use in infrared optics declined. The estimated value of germanium metal consumed in 2014, based on the annual average producer price, was about \$67 million.

Salient Statistics—United States:	2010	2011	2012	2013	2014^e
Production, refinery ^e	3,000	3,000	W	W	W
Total imports ¹	44,700	38,500	48,500	45,700	45,000
Total exports ¹	8,000	5,900	15,300	12,500	11,000
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, estimated	40,000	36,000	38,000	38,000	35,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	1,200	1,450	1,640	1,900	1,900
Dioxide, electronic grade	720	1,250	1,360	1,230	1,300
Stocks, producer, yearend	NA	NA	NA	NA	NA
Net import reliance ² as a percentage of estimated consumption	90	90	85	85	95

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 (2010–13):³ China, 65%; Belgium, 15%; Russia, 11%; Canada, 4%; and other, 5%.

Tariff: Item	Number	Normal Trade Relations 12–31–14
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 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 October 2014, the germanium was converted to 101,939 germanium epitaxial wafers and held for the stockpile at private warehouses.

Stockpile Status—9–30–14⁴

Material	Inventory	Disposal Plan FY 2015	Disposals FY 2015
Germanium	13,364	—	—

GERMANIUM

Events, Trends, and Issues: In 2014, a zinc mine in Washington that was placed on temporary care-and-maintenance status in February 2009 was reopened. The operator began ramping up operations and planned to produce the first concentrates by yearend 2014. It was estimated that at full capacity, the mine could produce 5 to 6 metric tons of germanium per year. Concentrates from the mine would be processed at the company's metallurgical plant in Canada.

Germanium dioxide prices were relatively stable during the first three quarters of 2014, remaining close to 2013 levels, and nearly double those in 2010. Germanium metal began the year at about \$1,900 per kilogram, increased to \$1,950 per kilogram in March, and was about \$1,900 per kilogram by late October. 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. Stockpiling in China may have contributed to global germanium metal price increases.

Germanium consumption is heavily reliant on military use and consumption declined in 2014 owing to cuts in defense-related spending. Outside of China, less germanium was used for infrared optics, substrates for terrestrial-based solar cells, and light-emitting diodes than in 2013. Germanium consumption increased for use in fiber optics.

In 2014, China remained the leading global consumer and producer of germanium. A handful of leading manufacturers in China account for most of global production. Stockpiling activities in China have contributed to global price increases since 2010 by limiting the amount of germanium that is available to consumers. In 2014, China's State Reserve Bureau purchased 30 metric tons of germanium for its national stockpile (20 metric tons was stockpiled in 2013) and analysts expected that China would continue to stockpile germanium during the next several years. The Fanya Metal Exchange in China, established for investing in "rare" metals, had more than 91 metric tons of germanium in warehouses as of late November and had the capacity to hold 200 metric tons. National and Provincial governments in China 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. China's exports of germanium metal during the first 10 months of 2014 declined by 52% from those in the same period of 2013.

World Refinery Production and Reserves:

	Refinery production ^e		Reserves ⁵
	<u>2013</u>	<u>2014</u>	
United States	W	W	Data on the recoverable content of zinc ores are not available.
China	110,000	120,000	
Russia	5,000	5,000	
Other countries	<u>40,000</u>	<u>40,000</u>	
World total	⁶ 155,000	⁶ 165,000	

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. Antimony and titanium are substitutes for use as polymerization catalysts.

^eEstimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.

¹In 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.

²Defined as imports – exports + adjustments for Government stock changes; rounded to nearest 5%.

³Imports 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.

⁴See [Appendix B](#) for definitions.

⁵See [Appendix C](#) for resource/reserve definitions and information concerning data sources.

⁶Excludes U.S. production.