

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 the recycling of domestic industry-generated scrap. Germanium for domestic consumption also was obtained from imported germanium chemicals that were directly consumed or consumed in the production of other germanium compounds. Germanium was recovered from zinc concentrates produced at mines in Alaska and Washington and exported to Canada for processing. A zinc smelter in Clarksville, TN, produced and exported germanium leach concentrates recovered from processing zinc concentrates from its mines in Tennessee. A germanium processor in Utica, NY, produced germanium tetrachloride for optical-fiber production. A refinery in Quapaw, OK, processed scrap and imported chemicals into refined germanium and compounds for the production of fiber optics, infrared optical devices, and substrates for electronic devices. The domestic end-use distribution was estimated to be: fiber optics, 40%; infrared optics, 30%; electronics and solar applications, 20%; and other uses, 10%. Germanium was not used in polymerization catalysts in the United States. The worldwide end-use pattern for 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%. In 2015, estimated domestic consumption of germanium declined from that in 2014 by about 6%. Consumption for fiber optics and substrates for space-based applications increased from that in 2014, but use in infrared optics declined. Germanium-containing infrared optics are primarily for military use, and defense-related spending has declined during the past few years. Growth in the commercial and personal markets for thermal-imaging devices that use lenses containing germanium partially offset the decline in defense consumption. The estimated value of germanium metal consumed in 2015, based on the annual average producer price, was about \$56 million, 16% less than that in 2014.

Salient Statistics—United States:	2011	2012	2013	2014	2015^e
Production, refinery ^e	3,000	W	W	W	W
Total imports ¹	38,500	48,500	45,700	36,200	37,000
Total exports ¹	5,900	15,300	12,500	12,000	12,000
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, estimated	36,000	38,000	38,000	32,000	30,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	1,450	1,640	1,900	1,900	1,760
Dioxide, electronic grade	1,250	1,360	1,230	1,300	1,170
Stocks, producer, yearend	NA	NA	NA	NA	NA
Net import reliance ² as a percentage of estimated consumption	90	85	85	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 is also recovered from the window blanks in decommissioned tanks and other military vehicles.

Import Sources (2011–14):³ China, 63%; Belgium, 20%; Russia, 9%; Canada, 4%; and other, 4%.

Tariff: Item	Number	Normal Trade Relations 12–31–15
Germanium oxides and zirconium dioxide	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: The Defense Logistics Agency (DLA) Strategic Materials did not allocate any germanium for sale in the fiscal year 2016 Annual Materials Plan, and it was possible that the DLA could acquire up to 1,600 kilograms of germanium metal. As of October 2015, there were 101,899 germanium epitaxial wafers (upgraded from germanium metal from the stockpile in 2014) held for the stockpile at private warehouses.

Stockpile Status—9–30–15⁴

Material	Inventory	Disposal Plan FY 2016	Disposals FY 2016
Germanium	13,364	—	—

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Events, Trends, and Issues: Germanium dioxide prices were relatively stable during the first half of 2015, remaining close to 2014 levels, and were nearly double those in 2010. Prices began to decline in the second half of the year and reached \$1,170 per kilogram in October. The decline was partially attributed to China's elimination of a 5% export tax on germanium dioxide in May in an effort to help domestic producers lower prices and become more competitive in the international market. The germanium metal price began the year at about \$1,900 per kilogram, remained there until June, and then steadily declined to \$1,760 per kilogram by early October. The price declines were partially attributed to the cessation of a buildup of germanium in Fanya Metal Exchange warehouses and to the end of purchases by the State Reserve Bureau in China. Stockpiling activities contributed to global price increases from 2012 through 2014 by limiting the amount of germanium that was available to consumers.

In 2015, China remained the leading global producer of germanium. The four leading suppliers produced an estimated 90 metric tons in 2015. China consumed about 26 tons of germanium in 2015, a slight increase from that in 2014. A significant quantity of germanium stocks were held in China: the State Reserve Bureau held 30 tons, the Fanya Metal Exchange warehouses reportedly held more than 91 tons at the end of September, and producers held an estimated 20 to 40 tons. Germanium producers in China continued to integrate downstream operations in order to sell more value-added products, and exports of germanium metal have steadily declined since 2012. Germanium use in fiber optics increased substantially in China from 2012 to 2015 and was its leading germanium consumption growth area. In May, China's Ministry of Commerce issued a preliminary antidumping ruling against imports of fiber-optic preforms (rods used to make fibers) from Japan and the United States. It was thought that antidumping measures would reduce imports and increase domestic production.

The operator of a leading zinc smelter in Australia was upgrading capacity and adding a facility that would be able to separate base metals from minor metals and produce indium and germanium.

In early 2015, scientists from a major university in the United States and a partner company developed a multijunction solar cell that used germanium quantum dots on a standard silicon wafer and was capable of capturing energy across a wider light spectrum than competing solar-cell technology, making it a potentially more efficient option for solar-cell installations.

World Refinery Production and Reserves:

	Refinery production ^e		Reserves ⁵
	<u>2014</u>	<u>2015</u>	
United States	W	W	Data on the recoverable content of zinc ores are not available.
China	120,000	120,000	
Russia	5,000	5,000	
Other countries ⁶	<u>40,000</u>	<u>40,000</u>	
World total	<u>⁷165,000</u>	<u>⁷165,000</u>	

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 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.

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

³Import sources are based on the gross weight of wrought and unwrought germanium.

⁴See [Appendix B](#) for definitions.

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

⁶Includes Belgium, Canada, Germany, and others.

⁷Excludes U.S. production.