

GERMANIUM

(Data in kilograms of germanium content unless otherwise noted)

Domestic Production and Use: In 2016, primary zinc concentrates containing germanium were produced at mines in Alaska and Washington and exported to Canada for processing and germanium recovery. A zinc smelter in Clarksville, TN, produced and exported germanium leach concentrates recovered from processing zinc concentrates from its mines in Tennessee, but the mines were closed temporarily during 2016 and were expected to be restarted in mid-2017. Germanium in the form of compounds and metal were imported into the United States for further processing by industry. A company in Utah produced germanium wafers for solar cells used in satellites from imported and recycled germanium. A refinery in Oklahoma recovered germanium from industry-generated scrap and produced germanium tetrachloride for the production of fiber optics. The domestic end-use distribution for germanium was estimated to be: fiber optics, 40%; infrared optics, 30%; electronics and solar applications, 20%; and other uses, 10%. The estimated value of germanium metal consumed in 2016, based on the annual average producer price, was about \$33 million, 45% less than that in 2015.

Salient Statistics—United States:	2012	2013	2014	2015	2016^e
	W	W	W	W	W
Production, refinery					
Total imports ¹	48,500	45,700	36,200	34,400	30,000
Total exports ¹	15,300	12,500	12,000	5,000	5,500
Shipments from Government stockpile excesses	—	—	² 3,000	—	—
Consumption, estimated	38,000	38,000	32,000	34,000	30,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	1,640	1,900	1,900	1,250	950
Dioxide, electronic grade	1,360	1,230	1,300	1,000	625
Stocks, producer, yearend	NA	NA	NA	NA	NA
Net import reliance ³ as a percentage of estimated consumption	85	85	84	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 windows in decommissioned tanks and other military vehicles.

Import Sources (2012–15):⁴ China, 62%; Belgium, 22%; Russia, 7%; Canada, 5%; and other, 4%.

Tariff: Item	Number	Normal Trade Relations 12–31–16
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 2017 Annual Materials Plan, and it was possible that the DLA could acquire up to 1,000 kilograms of germanium metal. In fiscal year 2015, the DLA started a program to recover germanium scrap from end-of-life U.S. Army components and had recovered 834 kilograms of germanium scrap by the end of October 2016. As of October 2016, 101,899 germanium epitaxial wafers (upgraded from germanium metal from the stockpile in 2014) were held for the stockpile at private warehouses.

Stockpile Status—9–30–16⁵

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

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Events, Trends, and Issues: In 2016, estimated domestic consumption of germanium declined from that in 2015 by about 12%. Consumption for fiber optics and substrates for space-based applications increased from that in 2015, 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.

Germanium dioxide and germanium metal prices trended downward from the middle of 2015 through the end of October 2016. The prices of germanium dioxide and germanium metal declined by 38% and 24%, respectively, during the first 10 months of 2016. As was the case during the second half of 2015, the price declines in 2016 were partially attributed to the cessation of the purported buildup of germanium in Fanya Metal Exchange (FME) warehouses in China and to cessation of purchases by China's State Reserve Bureau (SRB). Stockpiling and trading activities contributed to global price increases from 2012 through 2014 by limiting the amount of germanium that was available to consumers. In 2016, a significant quantity of world germanium stocks were held in China: The SRB held 30 tons, the FME warehouses reportedly held more than 91 tons, and producers held an estimated 20 to 40 tons. The future status of the germanium held in the FME was uncertain owing to potential legal issues. An official investigation into the trading activities of the FME continued in 2016 and in February, the owner of the FME was arrested. It was reported that some producers in China were curtailing or temporarily stopping germanium dioxide and metal production owing to the lower prices and reduced sales volumes.

In 2016, despite the cutbacks, China remained the leading global producer of germanium. 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. In 2016, China's leading germanium producer received a \$744,000 subsidy from the local city government to add capacity to produce downstream germanium products. Germanium use in fiber optics increased substantially in China from 2012 through 2016 and it was the leading germanium consumption growth area. Production of infrared optics and substrates for solar cells was also increasing.

In 2016, the operator of a leading zinc smelter in Australia continued to develop a facility that would enable the smelter to separate base metals from minor metals and produce indium and germanium concentrates. The company expected to open the new facility in 2018.

World Refinery Production and Reserves:

	Refinery production ^e		Reserves ⁶
	2015	2016	
United States	W	W	Data on the recoverable germanium content of zinc ores are not available.
China	115,000	110,000	
Russia	5,000	5,000	
Other countries ⁷	40,000	40,000	
World total	160,000	155,000	

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 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.

²Germanium metal from the stockpile that was upgraded to epitaxial wafers.

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

⁴Import sources are based on the gross weight of wrought and unwrought germanium.

⁵See [Appendix B](#) for definitions.

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

⁷Includes Belgium, Canada, Germany, and others.

⁸Excludes U.S. production.