

GERMANIUM

(Data in kilograms of germanium content unless otherwise noted)

Domestic Production and Use: In 2017, zinc concentrates containing germanium were produced at mines in Alaska, Tennessee, and Washington. Germanium-containing concentrates in Alaska and Washington were exported to a refinery in Canada for processing and germanium recovery. A zinc smelter in Clarksville, TN, produced and exported germanium leach concentrates recovered from processing zinc concentrates from the Middle Tennessee Mines, which were temporarily idled in 2015 and restarted during the second quarter of 2017. Germanium in the form of compounds and metal was 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 uses for germanium were, in descending order of quantity consumed, fiber optics, infrared optics, electronics and solar applications, and other uses. The estimated value of germanium consumed in 2017, based on the annual average price, was about \$41 million, 23% more than that in 2016.

Salient Statistics—United States:	2013	2014	2015	2016	2017^e
	W	W	W	W	W
Production, refinery					
Imports for consumption:					
Germanium metal	34,200	23,700	20,100	11,000	11,900
Germanium dioxide ¹	11,400	12,500	14,300	15,200	11,500
Total exports ²	12,500	12,000	5,000	4,780	2,490
Shipments from Government stockpile excesses	—	³ 3,000	—	—	—
Consumption, estimated	38,000	32,000	34,000	30,000	30,000
Price, annual average, dollars per kilogram: ⁴					
Germanium metal	1,778	1,918	1,792	1,087	1,358
Germanium dioxide	1,307	1,291	1,211	831	944
Net import reliance ⁵ as a percentage of estimated consumption	>75%	>75%	>75%	>50%	>50%

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 (2013–16):⁶ Germanium metal: China, 61%; Belgium, 24%; Russia, 6%; Germany, 4%; and other, 5%.

Tariff: Item	Number	Normal Trade Relations
		12–31–17
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 Annual Materials Plan for 2017 allocated 5,000 kilograms of germanium metal for potential upgrade/disposal and included a ceiling acquisition of 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 1,843 kilograms of germanium scrap by the end of September 2017. As of October 2017, 101,939 germanium epitaxial wafers were held for the stockpile at private warehouses.

Stockpile Status—9–30–17⁷

Material	Inventory	Disposal Plan	Disposals
		FY 2017	FY 2017
Germanium metal	13,364	5,000	—

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Events, Trends, and Issues: In 2017, estimated domestic consumption of germanium was essentially unchanged from that in 2016. The global end uses for germanium were fiber-optic systems, infrared optics, electronics and solar applications, polymerization catalysts, and other uses (such as phosphors, metallurgy, and chemotherapy). Germanium-containing infrared optics were primarily for military use, but the demand for thermal-imaging devices that use germanium lenses increased during the past few years.

Germanium dioxide and germanium metal prices trended downward from the beginning of 2016 through the end of February 2017 and then gradually increased from March through September 2017. The prices of germanium dioxide and germanium metal increased by 28% and 39%, respectively, during the first 9 months of 2017. Sources attributed the price increases to a recovery in the germanium market following a period of low prices in 2016 after the collapse of the Fanya Metal Exchange Co. Ltd. the prior year. In 2017, significant quantities of germanium stocks reportedly were held in China. China's State Reserve Bureau held 30 metric tons and was expected to continue to stockpile germanium during the next several years.

In 2017, China remained the leading global producer of germanium. Germanium producers in China continued to integrate with downstream operations in order to sell more value-added germanium products. In 2017, China's production was expected to be higher than that of 2016. However, China's germanium production growth rate in the next several years may be negatively affected by the implementation of stricter environmental standards. Germanium's use in fiber optics, infrared, and photovoltaic products increased in China from 2012 through 2017. Production of germanium tetrachloride for fiber optics increased in China in 2017 owing to an additional production line commissioned with one of the country's top germanium producers.

In 2017, the operator of a leading zinc smelter in Australia continued to upgrade production capacity at its smelter in Hobart, Tasmania. The upgrades included construction of a side-leach plant that would enable the smelter to split base metals from minor metals and produce indium and germanium concentrates. The company expected to open the new facility by yearend 2018.

World Refinery Production and Reserves:

	Refinery production ^e		Reserves ⁸
	<u>2016</u>	<u>2017</u>	
United States	W	W	Data on the recoverable germanium content of zinc ores are not available.
China	80,000	88,000	
Russia	6,000	6,000	
Other countries ⁹	<u>40,000</u>	<u>40,000</u>	
World total ¹⁰	126,000	134,000	

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. W Withheld to avoid disclosing company proprietary data. — Zero.

¹Data have been adjusted to exclude low value shipments, then multiplied by 69% to account for germanium content.

²Includes Schedule B numbers: 8112.92.6100, 8112.99.1000, and 2825.60.0000. Data have been adjusted to exclude low-value shipments. Oxide data have been multiplied by 69% to account for germanium content.

³Germanium metal from the National Defense Stockpile that was upgraded to epitaxial wafers.

⁴Average Europe price for minimum 99.99% purity. Source: Argus Media group-Argus Metals International.

⁵Defined as imports – exports + adjustments for Government stock changes.

⁶Import sources are based on gross weight of wrought and unwrought germanium metal and germanium metal powders.

⁷See [Appendix B](#) for definitions.

⁸See [Appendix C](#) for resource and reserve definitions and information concerning data sources.

⁹Includes Belgium, Canada, Finland, Germany, Japan, and others.

¹⁰Excludes U.S. production.