

## GERMANIUM

(Data in kilograms of germanium content unless otherwise noted)

**Domestic Production and Use:** In 2019, 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. 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. Although the consumption quantity was estimated to have remained level in 2019 compared with that in 2018, the estimated value of germanium consumed in 2019, based on the annual average germanium metal price, was \$37 million, about 20% less than that in 2018.

<b>Salient Statistics—United States:</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019<sup>e</sup></b>
Production:					
Primary refinery	—	—	—	—	—
Secondary refinery	W	W	W	W	W
Imports for consumption:					
Germanium metal	20,100	11,000	11,100	11,800	14,000
Germanium dioxide <sup>1</sup>	14,300	15,200	12,000	12,400	13,000
Total exports <sup>2</sup>	5,000	4,780	3,670	4,880	3,300
Shipments from Government stockpile	—	—	—	—	—
Consumption, estimated <sup>3</sup>	34,000	30,000	30,000	30,000	30,000
Price, annual average, dollars per kilogram: <sup>4</sup>					
Germanium metal	1,792	1,087	1,082	1,543	1,240
Germanium dioxide	1,211	830	731	1,084	920
Net import reliance <sup>5</sup> as a percentage of estimated consumption	>75%	>50%	>50%	>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. The United States has the capability to recycle new and old scrap.

**Import Sources (2015–18):**<sup>6</sup> Germanium metal: China, 59%; Belgium, 22%; Germany, 9%; Russia, 7%; and other, 3%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–19</b>
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:**<sup>7</sup>

<b>Material</b>	<b>Inventory As of 9–30–19</b>	<b>FY 2019</b>		<b>FY 2020</b>	
		<b>Potential Acquisitions</b>	<b>Potential Disposals</b>	<b>Potential Acquisitions</b>	<b>Potential Disposals</b>
Germanium metal	14,004	—	—	—	—
Germanium scrap (gross weight)	3,794	—	5,000	—	3,000
Germanium wafers (each)	68,671	—	—	—	—

**Events, Trends, and Issues:** The major global end uses for germanium were electronics and solar applications, fiber-optic systems, infrared optics, polymerization catalysts, and other uses (such as chemotherapy, metallurgy, and phosphors). Germanium-containing infrared optics were primarily for military use, but the commercial applications for thermal-imaging devices that use germanium lenses have increased during the past few years.

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The 2019 estimated average annual prices of germanium dioxide and germanium metal decreased by 15% and 20%, respectively, from prices in 2018; however, the 2019 average annual prices remained higher than those in 2016 and 2017. Global demand for fiber-optic cable was thought to have decreased in 2019 compared with that in 2018 owing to a slowdown in the rollout of fifth-generation cellular network technology and reduced spending on cable installation by major telecommunication companies. Fiber-optic cable manufacturing accounted for about one-third of global germanium consumption.

A Canada-based mining company lifted a partial force majeure on its germanium sales in February. The company imposed the partial force majeure in January 2018 after an explosion damaged a slag fuming furnace at its lead-zinc refinery in Canada. During the 13-month period, the company was able to fulfill about 60% of its contract sales for germanium.

According to China news sources, several germanium producers temporarily stopped production during the year either for maintenance or in response to low germanium prices. Most notably, a leading germanium producer in Yunnan Province reportedly shut down a 10,000-kilogram-per-year germanium metal production line in June. At full production, the company produced between 40,000 and 50,000 kilograms per year of germanium metal. The shutdown was expected to last 6 months. This company received nine Government subsidies totaling 3.6 million yuan between January 1, 2019, and June 27, 2019.

In October, the Government of Yunnan Province, China, auctioned 92,300 kilograms of germanium metal, which was previously held by the now-defunct Fanya Metal Exchange. Kunming Rongke New Material Co. Ltd. was awarded the full quantity.

### **World Refinery Production and Reserves:**<sup>8</sup>

	<b>Refinery production<sup>e</sup></b>		<b>Reserves<sup>9</sup></b>
	<b><u>2018</u></b>	<b><u>2019</u></b>	
United States	W	W	Data on the recoverable germanium content of zinc ores are not available.
China	94,900	85,000	
Russia	6,000	6,000	
Other countries <sup>10</sup>	<u>30,000</u>	<u>40,000</u>	
World total (rounded) <sup>11</sup>	130,000	130,000	

**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, Tennessee, and Washington. 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.

<sup>e</sup>Estimated. W Withheld to avoid disclosing company proprietary data. — Zero.

<sup>1</sup>Data has been adjusted to exclude low-value shipments, then multiplied by 69% to account for germanium content.

<sup>2</sup>Includes 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.

<sup>3</sup>Estimated consumption of germanium contained in metal and germanium dioxide.

<sup>4</sup>Average European price for minimum 99.999% purity. Source: Argus Media group-Argus Metals International.

<sup>5</sup>Defined as imports – exports + adjustments for Government stock changes.

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

<sup>7</sup>See Appendix B for definitions.

<sup>8</sup>Includes primary and secondary production.

<sup>9</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>10</sup>Includes Belgium, Canada, Germany, Japan, and Ukraine.

<sup>11</sup>Excludes U.S. production.