GERMANIUM

(Data in kilograms of germanium content unless otherwise noted)

Domestic Production and Use: The value of domestic refinery production of germanium, based upon an estimated 2008 producer price, was $7.4 million. Germanium production in the United States comes from either the refining of imported germanium compounds or 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 two domestic zinc mines, one in Alaska and the other in Washington. These concentrates were exported to Canada for processing. Another mine in Tennessee had begun producing germanium-rich zinc concentrates in the first half of 2008.

A germanium refinery in Utica, NY, produced germanium tetrachloride for optical fiber production. Another refinery in Oklahoma produced refined germanium compounds for the production of fiber optics, infrared devices, and substrates for electronic devices. The major end uses for germanium, worldwide, were estimated to be fiber-optic systems, 30%; infrared optics, 25%; polymerization catalysts, 25%; electronics and solar electric applications, 15%; and other (phosphors, metallurgy, and chemotherapy), 5%. Domestically, these end uses varied and were estimated to be infrared optics, 50%; fiber-optic systems, 30%; electronics and solar electric applications, 15%; and other (phosphors, metallurgy, and chemotherapy), 5%. Germanium is not used in polymerization catalysts in the United States.

Salient Statistics—United States:	2004	2005	2006	2007	2008[e]
Production, refinery[e]	4,400	4,500	4,600	4,600	4,600
Total imports[1]	23,800	23,500	50,000	52,400	65,500
Total exports[1]	13,800	10,100	12,400	11,700	18,200
Shipments from Government stockpile excesses	7,190	4,510	4,580	6,900	—
Consumption, estimated	25,000	27,000	55,000	60,000	55,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	600	660	950	1,240	1,600
Dioxide, electronic grade	400	405	660	800	975
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, plant[2] number[e]	65	65	65	65	70
Net import reliance[3] as a percentage of estimated consumption	70	65	85	80	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 was also recovered from the window blanks in decommissioned tanks and other military vehicles. In the European Union, recent technological advancements in the production of optical fibers has reduced, somewhat, the available supply of germanium scrap.

Import Sources (2004-07):[4] Belgium, 37%; Canada, 22%; Germany, 19%; China, 12%; and other, 10%.

Tariff: Item	Number	Normal Trade Relations 12-31-08
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: The Defense National Stockpile Center (DNSC), Defense Logistics Agency, suspended sales of germanium metal in November 2007 while it awaited the passage of the National Defense Authorization Act for fiscal year 2008. The sale of germanium is limited by a revenue cap that is adjusted by legislation each fiscal year.

Stockpile Status—9-30-08[5]

Material	Uncommitted inventory	Authorized for disposal	Disposal plan FY 2008	Disposals FY 2008
Germanium	16,531	16,531	8,000	714

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Events, Trends, and Issues: Consumption of germanium continued to grow in 2008 as fiber-optic network construction occurred in many parts of the world. Accelerated construction was particularly evident in North America and Japan. As of September 2008, fiber-to-the-home network connections were available to nearly 13.8 million homes in North America, up about 45% from those in 2007. Recent technological advancements in fiber-optic cable design have allowed for more installations of fiber-optic networks in multiple-dwelling buildings such as apartment and condominium buildings. Unlike the typical fiber-optic cable used in the past, this new cable design can be bent around tight corners and routed through buildings with virtually no signal loss. Significant domestic growth also was seen in the infrared optics sector owing to its continued military use in navigation systems, detection and search devices, and optical imaging and target evaluation systems. Commercial use of germanium in night-vision lenses for automobiles continued to be offered by select manufacturers. Germanium-based nuclear radiation detection equipment was used by the military, as well as by law enforcement agencies, for national security purposes. Use in solar energy conversion systems was seen as an expanding market for germanium, in view of technological advancements utilizing germanium substrates as the building blocks of multilayer solar cells. In 2008, demand for the germanium substrates as key components of the solar cells commonly used in satellites and earth-based applications continued to be strong. On a global scale, several new projects that utilized germanium substrates in terrestrial solar power generation systems were either operational or under construction in 2008. Recently, a university in Utah announced that it had developed a new technique for slicing germanium into the wafers that act as the substrate in the production of solar cells. The new process was more efficient than current slicing methods and had the potential to reduce the overall costs associated with germanium-based solar cells.

Germanium prices continued to move upward in 2008 as demand grew and supplies remained tight. The availability of germanium metal in North America was further limited in 2008 owing to the suspension of sales from the Government stockpile. In June, a major producer of infrared optical devices and germanium substrates announced plans to expand capacity at its location in Oklahoma. The new facility, scheduled to open in 2010, was expected to eventually double the firm's germanium substrate production capabilities and support anticipated growth in the terrestrial solar cell market. In July, an Australian company reported that surface sampling had identified widespread germanium occurrences in a coal seam at an existing uranium project site in North Dakota.

Silicon-germanium (SiGe) continued to gain interest as a viable semiconductor material. Research and development efforts have resulted in the capability to produce smaller integrated circuits that exhibit reduced electronic noise pollution, thereby prolonging the life of cells while ensuring steady operation in an ultra high-frequency environment.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production[e]		Reserves[6]	Reserve base[6]
	2007	2008		
United States	4,600	4,600	450,000	500,000
Other countries	95,000	100,000	NA	NA
World total	100,000	105,000	NA	NA

World Resources: The available resources of germanium are associated with certain zinc and lead-zinc-copper sulfide ores. Significant amounts of germanium are contained in ash and flue dust generated in the combustion of certain coals for power generation. Reserves and reserve base figures exclude germanium contained in coal ash.

Substitutes: A new sintered zinc sulfide lens has been developed for use in far-infrared-ray cameras, and is reported to be competitive with germanium lenses. Silicon can be a less expensive substitute for germanium in certain electronic applications. Although some metallic compounds that contain gallium, indium, selenium, and tellurium can be substituted for germanium, germanium is more reliable than these materials in many high-frequency electronics applications, and is a more economical substrate for 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. Titanium has the potential to be a substitute for germanium as a polymerization catalyst.

[e]Estimated. NA Not available. — Zero.

[1]In addition to the gross weight of wrought and unwrought germanium and waste and scrap that comprise these figures, this series includes estimated germanium dioxide metal content. This series does not include germanium tetrachloride and other germanium compounds for which data are not available.

[2]Employment related to primary germanium refining is indirectly related to zinc refining.

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

[4]Imports are based on the gross weight of wrought and unwrought germanium and waste and scrap; includes estimated germanium dioxide, metal content but does not include germanium tetrachloride and other germanium compounds for which data are not available.

[5]See Appendix B for definitions.

[6]See Appendix C for definitions.