

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 2007 producer price, was \$5.7 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 planned to begin producing germanium-rich zinc concentrates in the fourth quarter of 2007.

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. Six companies account for most of the U.S. germanium consumption. The major end uses for germanium, worldwide, were estimated to be fiber-optic systems, 35%; infrared optics, 30%; polymerization catalysts, 15%; 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:	2003	2004	2005	2006	2007^e
Production, refinery ^e	4,700	4,400	4,500	4,600	4,600
Total imports ¹	18,600	23,800	23,500	50,000	52,000
Total exports ¹	6,200	13,800	10,100	12,400	14,500
Shipments from Government stockpile excesses	1,760	7,190	4,510	6,080	7,500
Consumption, estimated	20,000	25,000	27,000	55,000	60,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	380	600	660	950	1,240
Dioxide, electronic grade	245	400	405	660	800
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, plant ² number ^e	65	65	65	65	65
Net import reliance ³ as a percentage of estimated consumption	NA	NA	NA	NA	NA

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. In the European Union, recent technological advancements in the production of optical fibers has reduced, somewhat, the available supply of germanium scrap.

Import Sources (2003-06):⁴ Belgium, 37%; Canada, 28%; Germany, 13%; China, 10%; and other, 12%.

Tariff: Item	Number	Normal Trade Relations 12-31-07
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, continued the Basic Ordering Agreement sales program for germanium using weekly postings on Thursdays on the DNSC Web site. In April 2007, the DNSC also announced the offer for sale of germanium metal through the Department of Defense Electronic Mall (DOD EMALL).

Stockpile Status—9-30-07⁵

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2007	Disposals FY 2007
Germanium	17,529	90	17,529	8,000	7,336

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Events, Trends, and Issues: Demand for germanium continued to grow in 2007 as fiber optic network construction was begun in many parts of the world. Accelerated construction was particularly evident in North America and Japan. Fiber optic demand worldwide was reported growing at about 15% per year, having recovered from the downturn in activity during the early part of this decade. 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 grow, as did its commercial use in gamma ray detection instrumentation, the latter a result of an increased focus on homeland security. Use in solar energy conversion systems was seen as an expanding market for germanium, in view of technological advancements utilizing germanium single crystals as a component of solar cells to improve the photovoltaic conversion efficiency.

Germanium prices continued to move upward in 2007 as demand grew and supplies remained tight. China removed toll trading tax benefits for germanium and most other minor metals in April, effectively decreasing the supply of germanium to the world market. As a result, renewed interest was shown in the reopening of mines previously producing significant quantities of germanium concentrate byproduct. In October, a Canadian company entered into a technology development agreement to evaluate and recommend processes to optimize the recovery of germanium from zinc concentrate smelter residues at its Tennessee mining complex, which last operated in 2002. Another Canadian company continued to move toward zinc and germanium production in late 2008 at its previously operated mine in northern Mexico. The current supply-demand status continued to generate further interest in the recovery of germanium from coal fly ash.

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. SiGe chips, with high-speed properties, can be made with low-cost, well-established production techniques of the silicon-chip industry.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production ^e		Reserves ⁶	Reserve base ⁶
	2006	2007		
United States	4,500	4,600	450,000	500,000
Other countries	85,500	95,000	NA	NA
World total	90,000	100,000	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. Its uses range from automotive night-vision systems and home appliance control equipment to various security systems. 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.

^eEstimated. NA Not available.

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

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

³Defined as imports – exports + adjustments for Government and industry stock changes.

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

⁵See Appendix B for definitions.

⁶See Appendix C for definitions.