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 2005 producer price, was $2.7 million. Germanium production in the United States comes from either the refining of imported germanium compounds or industry-generated scrap. The production series for refined germanium was revised significantly downward to avoid double-counting of material imported in chemical form and 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 that were exported to Canada for processing. Another mine in Tennessee produced germanium-rich zinc concentrates until its closure in mid-2003.

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 polymerization catalysts, 31%; fiber-optic systems, 24%; infrared optics, 23%; electronics/solar electric applications, 12%; and other (phosphors, metallurgy, and chemotherapy), 10%. Domestically, these end uses varied and were estimated to be fiber-optic systems, 40%; infrared optics, 30%; electronics/solar electric applications, 20%; and other (phosphors, metallurgy, and chemotherapy), 10%. Germanium is not used in polymerization catalysts in the United States.

Salient Statistics—United States:	**2001**	**2002**	**2003**	**2004**	**2005[e]**
Production, refinery[e]	5,400	4,900	4,700	4,400	4,500
Total imports[1]	15,200	19,900	15,500	24,400	23,400
Total exports[1]	31,400	20,100	6,200	13,800	26,500
Shipments from Government stockpile excesses	5,730	681	1,760	7,190	5,000
Consumption, estimated	28,000	28,000	20,000	25,000	27,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	890	620	380	600	610
Dioxide, electronic grade	575	400	245	400	405
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, plant[2] number[e]	90	85	65	65	65
Net import reliance[3] as a percentage of estimated consumption	NA	NA	NA	NA	NA

Recycling: Worldwide, about 35% of the total germanium consumed is produced from recycled materials. During the manufacture of most electronic and optical devices, more than 60% of the germanium metal used is routinely recycled as new scrap. Little domestic germanium returns as old scrap because there is a low unit use of germanium in most electronic and infrared devices. Because new European directives on Waste Electrical and Electronic Equipment (WEEE) mandate the recycling of electronics, the supply of old scrap within the European Union is expected to increase.

Import Sources (2001-04):[4] Canada, 28%; China, 22%; Belgium, 21%; Russia, 8%; and other, 21%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-05**
Germanium oxides	2825.60.0000	3.7% ad val.
Waste and scrap	8112.30.3000	Free.
Metal, unwrought	8112.30.6000	2.6% ad val.
Metal, wrought	8112.30.9000	4.4% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile:

Stockpile Status—9-30-05[5]

Material	**Uncommitted inventory**	**Committed inventory**	**Authorized for disposal**	**Disposal plan FY 2005**	**Disposals FY 2005**
Germanium	30,036	—	30,036	8,000	4,870

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Events, Trends, and Issues: For 2004, an estimated 87 metric tons of germanium was produced worldwide, with Canada and China the leading producers (29% and 27%, respectively), while world consumption was estimated to be 88 metric tons. This slight deficit continued and grew some in 2005. The germanium supply-demand balance was projected to continue in a deficit at least through 2007. Recycling of new scrap continued to increase and remained a significant supply factor, as the primary supply of germanium was well below the level of consumption. Supply capacity, which is defined as availability of primary material, recyclable waste material, and processing facilities, was expected to meet future demand. Also, there has been some renewed interest in the recovery of germanium from coal fly ash in areas outside of China and Russia.

Demand for germanium increased in 2005 because of the growth of fiber-optic use in the Far East, the increased use of germanium-base infrared lenses for night-vision applications in luxury cars, and the continued demand for military night vision equipment. Germanium consumption as a catalyst for polyethylene terephthalate (PET) production has remained stable.

A new use is the potential replacement of gallium arsenide by silicon-germanium (SiGe) in wireless telecommunications devices. SiGe chips combine the high-speed properties of germanium with the low-cost, well-established production techniques of the silicon-chip industry. A tarnish-proof sterling silver alloy, trademarked Argentium, requires 1.2% germanium. The recent rise in energy cost has improved the economics of solar panels, a potential major new use of germanium. Research continued on germanium-on-insulator substrates as a replacement for silicon on miniaturized chips and on germanium-base solid-state light-emitting diodes (LEDs).

Germanium has little or no effect upon the environment because it usually occurs only as a trace element in ores and carbonaceous materials and is used in very small quantities in commercial applications.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production[e]		Reserves[6]	Reserve base[6]
	2004	2005		
United States	4,400	4,500	450,000	500,000
Other countries	82,600	85,500	NA	NA
World total	87,000	90,000	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 titanium-base catalyst for PET production was used in Asia at the beginning of 2005. Silicon is less expensive and can be substituted for germanium in certain electronic applications. Although some metallic compounds that contain gallium, indium, selenium, and tellurium can be substituted for germanium, it is more reliable than competing materials in many high-frequency and high-power electronics applications and is more economical as a substrate for some LED applications. Zinc selenide and germanium glass substitute for germanium metal in infrared applications systems but often at the expense of performance.

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

[1]In addition to the gross weight of wrought and unwrought germanium and waste and scrap, 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.

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

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

[4]Imports 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.

[5]See Appendix B for definitions.

[6]See Appendix C for definitions.