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 2004 producer price, was $10 million. Industry-generated scrap, imported concentrates, and processed residues from certain domestic base-metal ores were the feed materials for the production of refined germanium in 2004. The domestic industry was based on two zinc mining operations, one in Alaska and the other in Washington State. The germanium-bearing ore was exported to Canada for processing. A Tennessee operation, which closed in mid-2003, was sold to a limestone producer that will not process zinc or the germanium-rich residue.

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 polymerization catalysts, 35%; infrared optics, 25%; fiber-optic systems, 20%; electronics/solar electrical applications, 12%; and other (phosphors, metallurgy, and chemotherapy), 8%. Domestically these end uses varied and were estimated to be fiber-optic systems, 40%; infrared optics, 30%; electronics/solar electrical applications, 20%; and other (phosphors, metallurgy, and chemotherapy), 10%. The main difference is that the United States does not use germanium in polymerization catalysts.

Salient Statistics—United States:	2000	2001	2002	2003	2004[e]
Production, refinery[e]	23,000	20,000	15,000	12,000	15,000
Total imports[1]	8,220	8,240	13,100	8,380	10,000
Exports	NA	NA	NA	NA	NA
Consumption, estimated	28,000	28,000	28,000	20,000	25,000
Price, producer, yearend, dollars per kilogram:					
Zone refined	1,250	890	620	380	640
Dioxide, electronic grade	800	575	400	245	410
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, plant,[2] number[e]	90	90	85	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. About 2,000 kilograms of germanium were estimated to be consumed as old scrap in 2004. 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 (2000-03):[4] Belgium, 31%; China, 29%; Taiwan, 15%; Russia, 10%; and other, 15%.

Tariff: Item	Number	Normal Trade Relations 12-31-04
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—9-30-04[5]

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2004	Disposals FY 2004
Germanium	34,198	540	34,198	8,000	5,691

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Events, Trends, and Issues: China's production of germanium declined in the early part of 2004 because of power shortages. However, many of the mines and smelters have since increased their output. A new zinc mine in the United States (Washington State) began producing germanium-rich ore, which was processed in Canada. In Mexico, a zinc-germanium mine was in the early developmental stage. Recycling of new scrap continued to grow and remained a significant supply factor, as the primary supply of germanium was well below the level of consumption. 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 2004 because of increases in infrared applications, especially in automobiles as a safety device; also the potential replacement of gallium arsenide by silicon-germanium (SiGe) in wireless telecommunications devices portends a bright, long-term future for germanium. SiGe chips combine the high-speed properties of germanium with the low-cost, well-established production techniques of the silicon-chip industry. Optical fiber manufacturing increased slightly as compared with that of 2003; however, the telecommunications industry was reluctant to invest a large amount of capital in a fiber-optic program because of the high risk and the long time until revenue generation. 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 consumption as a catalyst for polyethylene terephthalate (PET) production was stable, but as the price of germanium climbs, consumers in China and Japan will probably switch to the cheaper catalysts.

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]
	2003	2004		
United States	12,000	15,000	450,000	500,000
Other countries	32,000	35,000	NA	NA
World total	44,000	50,000	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: 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.

New catalysts are being investigated as substitutes for germanium in plastics. Most tend to discolor the plastic, but a new aluminum- and titanium-base PET catalyst appears to overcome this coloration problem and is less expensive to produce.

[e]Estimated. NA Not available.

[1]Gross weight of wrought and unwrought germanium and waste and scrap. Does not include imports of germanium dioxide 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, unwrought, and waste and scrap.

[5]See Appendix B for definitions.

[6]See Appendix C for definitions.