

GERMANIUM

(Data in kilograms of germanium content unless otherwise noted)

Domestic Production and Use: 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. The mine in Washington was placed on temporary care-and-maintenance status in February. Another mine complex, in Tennessee, which had begun producing germanium-rich zinc concentrates in early 2008, was closed in October 2008 owing to declining market conditions. No germanium was recovered from these concentrates before the complex was shuttered. The latter complex was subsequently acquired by a leading zinc producer in May 2009.

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. The estimated value of germanium metal consumed in 2009, based upon the annual average U.S. producer price, was about \$52.7 million.

| Salient Statistics—United States: | 2005 | 2006 | 2007 | 2008 | 2009^e |
|---|-------------|-------------|-------------|-------------|-------------------------|
| Production, refinery ^e | 4,500 | 4,600 | 4,600 | 4,600 | 4,600 |
| Total imports ¹ | 23,500 | 50,000 | 52,400 | 67,600 | 55,000 |
| Total exports ¹ | 10,100 | 12,400 | 11,700 | 17,900 | 13,900 |
| Shipments from Government stockpile excesses | 4,510 | 4,580 | 6,900 | 102 | 100 |
| Consumption, estimated | 27,000 | 55,000 | 60,000 | 54,000 | 46,000 |
| Price, producer, yearend, dollars per kilogram: | | | | | |
| Zone refined | 660 | 950 | 1,240 | 1,490 | 950 |
| Dioxide, electronic grade | 405 | 660 | 800 | 960 | 580 |
| Stocks, producer, yearend | NA | NA | NA | NA | NA |
| Employment, plant ² number ^e | 65 | 65 | 65 | 70 | 70 |
| Net import reliance ³ as a percentage of estimated consumption | 65 | 85 | 80 | 90 | 90 |

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.

Import Sources (2005-08):⁴ Belgium, 46%; China, 24%; Germany, 13%; Russia, 13%; and other, 4%.

| Tariff: Item | Number | Normal Trade Relations 12-31-09 |
|---------------------|---------------|--|
| 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) continued the Basic Ordering Agreement sales program for germanium using monthly postings on the DNSC Web site. The disposal limit in the fiscal year 2009 Annual Materials Plan was unchanged from that of fiscal year 2008.

Stockpile Status—9-30-09⁵

| Material | Uncommitted inventory | Authorized for disposal | Disposal plan FY 2009 | Disposals FY 2009 |
|-----------------|----------------------------------|------------------------------------|----------------------------------|------------------------------|
| Germanium | 16,365 | 16,365 | 8,000 | 170 |

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Events, Trends, and Issues: The global market for germanium metal and germanium dioxide generally weakened through the first 10 months of the year. The estimated market price of germanium metal (99.99%) in late September was \$950 per kilogram, a 33% decline from that of January, when it was about \$1,425 per kilogram. Germanium dioxide prices also declined during the year and as of late September, germanium dioxide was selling for about \$580 per kilogram. Slumping demand for germanium appeared to be a product of the overall downturn in the global economy in 2009. Throughout much of the year, many Chinese suppliers, accounting for the majority of the germanium produced globally, held an excess supply of material as the market continued to decline, in anticipation of an eventual turnaround, instead of selling at reduced prices. As a result of the falling prices, some consumers became hesitant to place large orders, expecting that cheaper material would be available in the future. Demand for germanium dioxide from polyethylene terephthalate manufacturers, used primarily to make plastic beverage containers in Asia, declined from that of the previous year. Consumption of germanium tetrachloride through the first half of the year declined as well when compared with the same time period in 2008 owing to reduced demand for fiber-optic cable. In May, the Yunnan Province in China announced that it would attempt to reinvigorate the Chinese germanium market by stockpiling 8 metric tons of germanium ingots. Domestically, demand for germanium was fairly stable owing to the continued use of germanium lenses and window blanks by the military for various infrared applications. Ongoing military engagements have led to increased spending on thermal weapon sights and related thermal imaging technology over the past several years.

In most satellite applications, germanium substrates continued to be favored for use in photovoltaic solar cells, and the development of terrestrial-based applications was ongoing. In August, a leading manufacturer of solar cells announced that it had manufactured a multijunction solar cell with a germanium substrate that set a new world record for terrestrial concentrator solar cell efficiency, converting 41.6% of sunlight into electricity. A high-efficiency solar cell such as this would potentially allow energy producers to generate more electrical power from typical industrial solar panels and pass on lower costs to consumers. Another producer reported that sales of germanium substrates through the first half of 2009 were greater than those in the corresponding period of 2008 owing to their increased use in high-brightness, light-emitting diodes for backlighting liquid crystal display screens and in vehicle headlights.

A company from the United Kingdom that developed a tarnish-resistant silver alloy containing germanium in the early 1990s called Argentium continued to market the material to jewelry manufacturers. Several jewelry manufacturers in Asia and Europe began incorporating Argentium silver into their collections during the past 2 years.

World Refinery Production and Reserves:

| | Refinery production ^e | | Reserves ⁶ |
|-----------------|----------------------------------|---------------|-----------------------|
| | 2008 | 2009 | |
| United States | 4,600 | 4,600 | 450,000 |
| China | 100,000 | 100,000 | NA |
| Russia | 5,000 | 5,000 | NA |
| Other countries | <u>30,000</u> | <u>30,000</u> | <u>NA</u> |
| World total | 140,000 | 140,000 | 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 exclude germanium contained in coal ash.

Substitutes: 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.

^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 includes 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 stock changes; rounded to nearest 5%.

⁴Imports are based on the gross weight of wrought and unwrought germanium and waste and scrap; metal content but 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. Reserve base estimates were discontinued in 2009; see [Introduction](#).