

## GERMANIUM

(Data in kilograms of germanium content unless otherwise noted)

**Domestic Production and Use:** In 2020, zinc concentrates containing germanium were produced at mines in Alaska and Tennessee. Germanium-containing concentrates in Alaska were exported to a refinery in Canada for processing and germanium recovery. A zinc smelter in Clarksville, TN, produced and exported germanium leach concentrates recovered from processing zinc concentrates from the Middle Tennessee Mines. Germanium in the form of compounds and metal was imported into the United States for further processing by industry. A company in Utah produced germanium wafers for solar cells used in satellites from imported and recycled germanium. A refinery in Oklahoma recovered germanium from industry-generated scrap and produced germanium tetrachloride for the production of fiber optics. Although the consumption quantity was estimated to have remained level in 2020 compared with that in 2019, the estimated value of germanium consumed in 2020, based on the annual average germanium metal price, was \$30 million, about 19% less than that in 2019.

| <b>Salient Statistics—United States:</b>                                  | <b>2016</b> | <b>2017</b> | <b>2018</b> | <b>2019</b> | <b>2020<sup>e</sup></b> |
|---|-------------|-------------|-------------|-------------|-------------------------|
| Production, refinery:   |             |             |             |             |                         |
| Primary   | —           | —           | —           | —           | —                       |
| Secondary   | W           | W           | W           | W           | W                       |
| Imports for consumption:  |             |             |             |             |                         |
| Germanium metal   | 11,000      | 11,100      | 11,900      | 14,100      | 16,000                  |
| Germanium dioxide <sup>1</sup>  | 15,200      | 12,000      | 12,200      | 21,000      | 10,000                  |
| Exports <sup>2</sup>  | 4,780       | 3,670       | 4,880       | 4,600       | 8,000                   |
| Shipments from Government stockpile                                       | —           | —           | —           | —           | —                       |
| Consumption, estimated <sup>3</sup>                                       | 30,000      | 30,000      | 30,000      | 30,000      | 30,000                  |
| Price, annual average, dollars per kilogram: <sup>4</sup>                 |             |             |             |             |                         |
| Germanium metal   | 1,087       | 1,082       | 1,543       | 1,236       | 1,000                   |
| Germanium dioxide   | 830         | 731         | 1,084       | 913         | 720                     |
| Net import reliance <sup>5</sup> as a percentage of estimated consumption | >50%        | >50%        | >50%        | >50%        | >50%                    |

**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 is also recovered from the windows in decommissioned tanks and other military vehicles. The United States has the capability to recycle new and old scrap.

**Import Sources (2016–19):**<sup>6</sup> Germanium metal: China, 58%; Belgium, 21%; Germany, 10%; Russia, 8%; and other, 3%.

| <b>Tariff:</b> | <b>Item</b>                            | <b>Number</b> | <b>Normal Trade Relations<br/>12–31–20</b> |
|----------------|--|---------------|--|
|                | Germanium oxides and zirconium dioxide | 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:**<sup>7</sup>

| <b>Material</b>                | <b>Inventory<br/>as of 9–30–20</b> | <b>FY 2020</b>                    |                                | <b>FY 2021</b>                    |                                |
|--------------------------------|------------------------------------|-----------------------------------|--------------------------------|-----------------------------------|--------------------------------|
|                                |                                    | <b>Potential<br/>acquisitions</b> | <b>Potential<br/>disposals</b> | <b>Potential<br/>acquisitions</b> | <b>Potential<br/>disposals</b> |
| Germanium metal                | 14,004                             | —                                 | —                              | —                                 | —                              |
| Germanium scrap (gross weight) | 3,794                              | —                                 | 3,000                          | —                                 | 3,000                          |
| Germanium wafers (each)        | 68,671                             | —                                 | —                              | —                                 | —                              |

## GERMANIUM

**Events, Trends, and Issues:** The major global end uses for germanium were electronics and solar applications, fiber-optic systems, infrared optics, polymerization catalysts, and other uses (such as chemotherapy, metallurgy, and phosphors). Germanium-containing infrared optics were primarily for military use, but the commercial applications for thermal-imaging devices that use germanium lenses have increased during the past few years.

Demand for fiber-optic cable in the United States reportedly decreased during 2020 owing to decreasing demand from related industrial end use markets as a result of the COVID-19 pandemic. However, this decrease was partially offset by Federal funding to increase broadband infrastructure in rural communities and a nationwide increase in remote work. Domestic demand for fiber-optic cable was still expected to increase as wireless carriers continue to expand and upgrade their networks.

The government of Yunnan Province, a significant area of nonferrous and minor metals production in China, created a stimulus plan directing companies to purchase and stockpile nonferrous metals in response to lower demand caused by the COVID-19 pandemic. Under the plan, the government had targeted a “commercial” stockpile of about 800,000 tons of metals, including 20 tons of germanium, and set aside \$141 million to subsidize the interest on any loans taken out by companies to stockpile these metals. China’s germanium exports in January through August 2020 increased by 18% compared with those in the same period of 2019. A leading Chinese producer of processed germanium products, based in Yunnan Province, reported that production of germanium wafers for satellites in January through June 2020 was more the seven times higher than wafer production in the first half of 2019 as production ramped up at its new germanium wafer production line.

### World Refinery Production and Reserves:<sup>8</sup>

|                                     | <b>Refinery production</b> |                         | <b>Reserves<sup>9</sup></b>   |
|-------------------------------------|----------------------------|-------------------------|---|
|                                     | <u>2019</u>                | <u>2020<sup>e</sup></u> |   |
| United States                       | W                          | W                       | Data on the recoverable germanium content of zinc ores are not available. |
| China                               | 85,700                     | 86,000                  |   |
| Russia                              | 5,000                      | 5,000                   |   |
| Other countries <sup>10</sup>       | <u>40,000</u>              | <u>40,000</u>           |   |
| World total (rounded) <sup>11</sup> | <u>131,000</u>             | <u>130,000</u>          |   |

**World Resources:**<sup>9</sup> The available resources of germanium are associated with certain zinc and lead-zinc-copper sulfide ores. Substantial U.S. reserves of recoverable germanium are contained in zinc deposits in Alaska, Tennessee, and Washington. Based on an analysis of zinc concentrates, U.S. reserves of zinc may contain as much as 2,500 tons of germanium. Because zinc concentrates are shipped globally and blended at smelters, however, the recoverable germanium in zinc reserves cannot be determined. On a global scale, as little as 3% of the germanium contained in zinc concentrates is recovered. Significant amounts of germanium are contained in ash and flue dust generated in the combustion of certain coals for power generation.

**Substitutes:** Silicon can be a less-expensive substitute for germanium in certain electronic applications. Some metallic compounds can be substituted in high-frequency electronics applications and in 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. Antimony and titanium are substitutes for use as polymerization catalysts.

<sup>e</sup>Estimated. W Withheld to avoid disclosing company proprietary data. — Zero.

<sup>1</sup>Data has been adjusted to exclude low-value shipments, then multiplied by 69% to account for germanium content.

<sup>2</sup>Includes Schedule B numbers: 8112.92.6100, 8112.99.1000, and 2825.60.0000. Data have been adjusted to exclude low-value shipments. Oxide data have been multiplied by 69% to account for germanium content.

<sup>3</sup>Estimated consumption of germanium contained in metal and germanium dioxide.

<sup>4</sup>Average European price for minimum 99.999% purity. Source: Argus Media group—Argus Metals International.

<sup>5</sup>Defined as imports – exports + adjustments for Government stock changes.

<sup>6</sup>Import sources are based on gross weight of wrought and unwrought germanium metal and germanium metal powders.

<sup>7</sup>See Appendix B for definitions.

<sup>8</sup>Includes primary and secondary production.

<sup>9</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>10</sup>Includes Belgium, Canada, Germany, Japan, and Ukraine.

<sup>11</sup>Excludes U.S. production.