GALLIUM

(Data in kilograms of gallium content unless otherwise noted)

Domestic Production and Use: No domestic primary gallium recovery was reported in 2012. One company in Utah recovered and refined gallium from scrap and impure gallium metal. Imports of gallium, which supplied most of U.S. gallium consumption, were valued at about $32 million. Gallium arsenide (GaAs) and gallium nitride (GaN) electronic components represented about 99% of domestic gallium consumption. About 71% of the gallium consumed was used in integrated circuits (ICs). Optoelectronic devices, which include laser diodes, light-emitting diodes (LEDs), photodetectors, and solar cells, represented the remaining 29% of gallium consumption. Optoelectronic devices were used in areas such as aerospace, consumer goods, industrial equipment, medical equipment, and telecommunications. Uses of ICs included defense applications, high-performance computers, and telecommunications.

Salient Statistics—United States:	2008	2009	2010	2011	2012[e]
Production, primary	—	—	—	—	—
Imports for consumption	41,100	35,900	59,200	85,700	58,000
Exports	NA	NA	NA	NA	NA
Consumption, reported	28,700	24,900	33,500	35,300	35,000
Price, yearend, dollars per kilogram[1]	579	449	600	688	556
Stocks, consumer, yearend	3,820	4,100	4,970	6,850	7,350
Employment, refinery, number	20	20	20	20	20
Net import reliance[2] as a percentage of reported consumption	99	99	99	99	99

Recycling: Old scrap, none. Substantial quantities of new scrap generated in the manufacture of GaAs-base devices were reprocessed.

Import Sources (2008–11): Germany, 32%; United Kingdom, 27%; China, 15%; Canada, 11%; and other, 15%.

Tariff: Item	Number	Normal Trade Relations 12–31–12
Gallium arsenide wafers, undoped	2853.00.0010	2.8% ad val.
Gallium arsenide wafers, doped	3818.00.0010	Free.
Gallium metal	8112.92.1000	3.0% ad val.

Depletion Allowance: Not applicable.

Government Stockpile: None.

Events, Trends, and Issues: Imports of gallium and GaAs wafers continued to supply almost all U.S. demand for gallium. Gallium prices decreased throughout 2012 when significant increases in gallium production exceeded the declining demand from LED producers. Chinese gallium capacity expanded tremendously in 2011 and 2012 on the expectation of a strong LED-based backlighting market, which failed to materialize. In January, the price for low-grade (99.99%-pure) gallium in Asia and Europe averaged $580 per kilogram. By July, the average low-grade price had decreased to $320 per kilogram. By early October, the average low-grade price had decreased to $280 per kilogram.

Market conditions continued to improve for GaAs- and GaN-based products in 2012. GaAs demand, while still driven mainly by cellular handsets and other high-speed wireless applications, increased owing to rapid growth of feature-rich, application-intensive, third- and fourth-generation “smartphones,” which employ up to 10 times the amount of GaAs content than standard cellular handsets. Smartphones accounted for 37% of all handset sales in 2012. Owing to the rise of GaAs content in smartphones and increased penetration of GaAs-based LEDs in general lighting and automotive applications, the GaAs substrate market was forecast to increase at a compound annual growth rate of nearly 11%, increasing to $650 million by 2017.

Owing to the large power-handling capabilities, high-switching frequencies, and higher voltage capabilities of GaN technology, GaN-based products, which historically have been used in defense and military applications, have begun to gain acceptance in cable television transmission, commercial wireless infrastructure, power electronics, and satellite markets. The GaN power device market was forecast to increase at an average growth rate of nearly 29%, to reach $178 million in 2015.

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GALLIUM

In 2012, the worldwide LED market, a significant driver for GaN-based technologies, increased by only 1.5% in revenues from that of 2011 owing to slower-than-expected growth in LED backlighting, LED supply outpacing demand, and to lower LED prices. Although televisions were increasingly built with LED backlighting in 2012, improvements in technology required up to 50% fewer LEDs. LED-backlit televisions accounted for 63% of the television market in 2012, and were forecast to account for 93% of the market in 2013. By 2014, the strongest segments of the LED market were expected to be in general lighting, followed by signs and automotive applications.

A Colorado-based rare-earth mining company purchased the parent company of the largest gallium refiner in Canada and the United States. The gallium refinery purchase was expected to enhance the specialty value-added rare metals-processing capability of the Colorado company. It also commenced operations of a new gallium trichloride plant in the Republic of Korea, which would primarily supply Asian markets.

Sustained high-energy prices continued to spark interest in solar energy in 2012. Copper-indium-gallium diselenide (CIGS), a thin-film photovoltaic technology, has been slow to enter the commercial market owing to a complicated manufacturing process that has impeded commercial mass production of CIGS panels. Decreased prices of silicon-based solar cells also slowed demand for the more expensive CIGS technology. These two factors resulted in a large oversupply of CIGS modules that caused prices to be reduced by 20% in 2011 and remain low throughout 2012. In an effort to keep CIGS technology viable and competitive, CIGS manufacturers, beginning in 2011, trimmed production costs, increased production capacities, improved module conversion efficiencies, and increased CIGS adoption in commercial rooftops.

World Production and Reserves:[3] In 2012, world primary gallium production was estimated to be 273 metric tons, 7% less than the 2011 world primary production of 292 tons. China, Germany, Kazakhstan, and Ukraine were the leading producers; countries with lesser output were Hungary, Japan, the Republic of Korea, and Russia. Refined gallium production was estimated to be about 354 tons; this figure includes primary gallium production and some possible scrap refining. China, Japan, the United Kingdom, and the United States were the principal producers of refined gallium. Gallium was recycled from new scrap in Canada, Germany, Japan, the United Kingdom, and the United States. World primary gallium production capacity in 2012 was estimated to be 474 tons; refinery capacity, 270 tons; and recycling capacity, 198 tons.

Gallium occurs in very small concentrations in ores of other metals. Most gallium is produced as a byproduct of treating bauxite, and the remainder is produced from zinc-processing residues. Only part of the gallium present in bauxite and zinc ores is recoverable, and the factors controlling the recovery are proprietary. Therefore, an estimate of current reserves comparable to the definition of reserves of other minerals cannot be made. The world bauxite reserves are so large that much of them will not be mined for many decades; hence, most of the gallium in the bauxite reserves cannot be considered to be available in the short term.

World Resources: The average content of gallium in bauxite is 50 parts per million (ppm). U.S. bauxite deposits consist mainly of subeconomic resources that are not generally suitable for alumina production owing to their high silica content. Recovery of gallium from these deposits is therefore unlikely. Some domestic zinc ores contain as much as 50 ppm gallium and, as such, could be a significant resource. World resources of gallium in bauxite are estimated to exceed 1 billion kilograms, and a considerable quantity could be present in world zinc reserves. The foregoing estimate applies to total gallium content; only a small percentage of this metal in bauxite and zinc ores is economically recoverable.

Substitutes: Liquid crystals made from organic compounds are used in visual displays as substitutes for LEDs. Researchers also are working to develop organic-based LEDs that may compete with GaAs in the future. Indium phosphide components can be substituted for GaAs-based infrared laser diodes in some specific-wavelength applications, and GaAs competes with helium-neon lasers in visible laser diode applications. Silicon is the principal competitor with GaAs in solar-cell applications. GaAs-based ICs are used in many defense-related applications because of their unique properties, and there are no effective substitutes for GaAs in these applications. GaAs in heterojunction bipolar transistors is being challenged in some applications by silicon-germanium.

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

[1]Estimated based on the average values of U.S. imports for 99.9999%- and 99.99999%-pure gallium.

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

[3]See Appendix C for resource/reserve definitions and information concerning data sources.