GALLIUM

(Data in kilograms, gallium content, unless otherwise specified)

Domestic Production and Use: No domestic primary (low-purity, unrefined) gallium has been recovered since 1987. Globally, primary gallium is recovered as a byproduct of processing bauxite and zinc ores. One company in New York recovered and refined high-purity gallium from imported primary low-purity gallium metal and new scrap. In 2023, imports of gallium metal were valued at about $3 million and gallium arsenide (GaAs) wafer imports were valued at about $110 million, decreases in value of 40% and 50%, respectively, from those in 2022. GaAs was used to manufacture compound semiconductor wafers used in integrated circuits (ICs) and optoelectronic devices, which include laser diodes, light-emitting diodes (LEDs), photodetectors, and solar cells. Gallium nitride (GaN) was used to manufacture ICs and optoelectronic devices; ICs accounted for 74% of domestic gallium consumption, optoelectronic devices accounted for 25%, and research and development accounted for 1%. About 79% of the gallium consumed in the United States was in GaAs, GaN, and gallium phosphide wafers. Gallium metal, triethyl gallium, and trimethyl gallium, used in the epitaxial layering process to fabricate epiwafers for the production of ICs and LEDs, accounted for most of the remainder. Optoelectronic devices were used in aerospace applications, consumer goods, industrial equipment, medical equipment, and telecommunications equipment. Uses of ICs included defense applications, high-performance computers, and telecommunications equipment.

Salient Statistics—United States:	2019	2020	2021	2022	2023[e]
Production, primary	—	—	—	—	—
Imports for consumption:					
Metal	5,740	4,430	8,890	11,400	9,400
Gallium arsenide wafers (gross weight)	289,000	208,000	306,000	424,000	150,000
Exports	NA	NA	NA	NA	NA
Consumption, reported	14,900	15,700	17,100	19,700	19,000
Price, average unit value of imports, dollars per kilogram:					
High-purity, refined[1]	573	596	625	560	450
Low-purity, primary[2]	153	163	254	394	290
Stocks, consumer, yearend	2,850	2,920	2,810	2,780	2,700
Net import reliance[3] as a percentage of reported consumption	100	100	100	100	100

Recycling: Old scrap, none. Substantial quantities of new scrap generated in the manufacture of GaAs-based devices were reprocessed to recover high-purity gallium at one facility in New York.

Import Sources (2019–22): Metal: Japan, 26%; China, 21%; Germany, 19%; Canada, 9%; and other, 25%.

Tariff: Item	Number	Normal Trade Relations 12–31–23
Gallium arsenide wafers, undoped	2853.90.9010	2.8% ad valorem.
Gallium arsenide wafers, doped	3818.00.0010	Free.
Gallium metal	8112.92.1000	3% ad valorem.

Depletion Allowance: 14% (domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Imports of gallium metal, GaAs wafers, and GaN wafers and domestic production of GaAs and GaN wafers continued to account for all U.S. consumption of gallium. In 2023, gallium metal imports decreased owing to decreased imports from China, Japan, and Slovakia. Beginning in 2019, U.S. gallium metal imports decreased substantially from those in previous years because higher tariffs were placed on China's gallium exports to the United States. In August 2023, China's Government implemented gallium export controls, requiring licensing procedures to be carried out by China's gallium exporters.

Primary low-purity (99.99%-pure) gallium prices in China averaged $240 per kilogram in June 2023, a decrease of 23% from $310 per kilogram in January 2023, and a decrease of 53% from $510 per kilogram in June 2022. China's gallium prices decreased in the first half of 2023 owing to reduced gallium demand from the LED and neodymium (NdFeB) magnet markets and an increase in China's primary low-purity gallium production capacity. By October, gallium prices in China increased by 56% to $375 per kilogram owing to renewed gallium demand from the NdFeB magnet market and global concern about reduced gallium availability following China's implementation of gallium export controls.

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China reported that its primary low-purity gallium production capacity increased by 250,000 kilograms per year in 2022 to 1,000,000 kilograms per year. This latest increase followed a series of expansions from a capacity of 140,000 kilograms per year in 2010. China accounted for approximately 89% of worldwide primary low-purity gallium production capacity of an estimated 1,100,000 kilograms per year. China accounted for 98% of worldwide primary low-purity gallium production.

The remaining primary low-purity gallium producers outside of China included Japan, the Republic of Korea, and Russia. Germany, Hungary, and Kazakhstan ceased primary production in 2016, 2015, and 2013, respectively. Ukraine most likely ceased primary production in 2022. Owing to China's 2023 gallium export controls, the United States and other countries began considering the start or restart of domestic primary gallium production.

World high-purity refined gallium production in 2023 was estimated to be about 320,000 kilograms, a 3% increase from the revised 2022 figure of 310,000 kilograms. Canada, China, Japan, Slovakia, and the United States were the known principal producers of high-purity refined gallium. The United Kingdom ceased high-purity refined gallium production in 2018. Gallium was recovered from new scrap in Canada, China, Japan, Slovakia, and the United States. World high-purity refined gallium production capacity was an estimated 340,000 kilograms per year, and secondary high-purity gallium production capacity was an estimated 280,000 kilograms per year.

Beginning in 2002, Northrop Grumman has been awarded Defense Advanced Research Project Agency (DARPA) contracts by the U.S. Department of Defense to develop GaN Monolithic Microwave Integrated Circuits for military and commercial uses.

World Production and Reserves: Quantitative estimates of reserves were not available.

	Primary production		Production capacity
	2022	2023[e]	2023
United States	—	—	—
China	600,000	600,000	1,000,000
Japan[e]	3,000	3,000	10,000
Korea, Republic of[e]	2,000	2,000	16,000
Russia[e]	5,000	5,000	10,000
Other countries[4]	—	—	[e]88,000
World total (rounded)	610,000	610,000	[e]1,100,000

World Resources:[5] Gallium occurs in very small concentrations in ores of other metals. Most gallium is produced as a byproduct of processing bauxite, and the remainder is produced from zinc-processing residues. The average gallium content of bauxite is 50 parts per million. U.S. bauxite deposits consist mainly of subeconomic resources that are not generally suitable for alumina production owing to their high silica content. Some domestic zinc ores contain up to 50 parts per million gallium and could be a significant resource, although no gallium is currently recovered from domestic ores. Gallium contained in world resources of bauxite is estimated to exceed 1 million tons, and a considerable quantity could be contained in world zinc resources. However, less than 10% of the gallium in bauxite and zinc resources is potentially recoverable.

Substitutes: Liquid crystals made from organic compounds are used in visual displays as substitutes for LEDs. Silicon-based complementary metal-oxide semiconductor power amplifiers compete with GaAs power amplifiers in midtier third-generation (3G) cellular handsets. Indium phosphide components can be substituted for GaAs-based infrared laser diodes in some specific-wavelength applications, and helium-neon lasers compete with GaAs in visible laser diode applications. Silicon is the principal competitor with GaAs in solar-cell applications. In many defense-related applications, GaAs- and GaN-based ICs are used because of their unique properties, and no effective substitutes exist for GaAs and GaN in these applications. In heterojunction bipolar transistors, GaAs is being replaced in some applications by silicon-germanium.

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

[1]Estimated based on the average unit values of U.S. imports for 99.999%- and 99.99999%-pure gallium.

[2]Estimated based on the average unit values of U.S. imports for 99.99%-pure gallium.

[3]Defined as imports – exports. Excludes gallium arsenide wafers.

[4]Other countries estimated to still have primary low-purity gallium production capacity include Germany, Hungary, Kazakhstan, and Ukraine.

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