

ARSENIC

(Data in metric tons of arsenic unless otherwise noted)

Domestic Production and Use: Arsenic trioxide and primary arsenic metal have not been produced in the United States since 1985. However, limited quantities of arsenic metal have been recovered from gallium-arsenide (GaAs) semiconductor scrap. The principal use for arsenic trioxide was for the production of arsenic acid used in the formulation of chromated copper arsenide (CCA) preservatives for the pressure treating of lumber used primarily in nonresidential applications. Three companies produced CCA preservatives in the United States in 2015. Ammunition used by the U.S. military was hardened by the addition of less than 1% arsenic metal, and the grids in lead-acid storage batteries were strengthened by the addition of arsenic metal. Arsenic metal was also used as an antifriction additive for bearings, to harden lead shot, and in clip-on wheel weights. Arsenic compounds were used in herbicides and insecticides. High-purity arsenic (99.9999%) was used by the electronics industry for GaAs semiconductors that are used for solar cells, space research, and telecommunications. Arsenic also was used for germanium-arsenide-selenide specialty optical materials. Indium-gallium-arsenide was used for short-wave infrared technology. The value of arsenic compounds and metal imported domestically in 2015 was estimated to be about \$5.6 million.

Salient Statistics—United States:	2011	2012	2013	2014	2015^e
Imports for consumption:					
Arsenic	628	883	514	688	600
Compounds	4,990	5,740	6,290	5,260	6,200
Exports, arsenic ¹	705	439	1,630	2,950	1,900
Consumption, estimated ²	5,620	6,620	6,810	5,940	6,800
Value, cents per pound, average ³					
Arsenic (China)	74	75	72	75	80
Trioxide (Morocco) ⁴	22	24	27	30	29
Net import reliance ⁴ as a percentage of estimated consumption	100	100	100	100	100

Recycling: Arsenic metal was recycled from GaAs semiconductor manufacturing. Arsenic contained in the process water at wood treatment plants where CCA was used was also recycled. Although electronic circuit boards, relays, and switches may contain arsenic, no arsenic was recovered from them during recycling to recover other contained metals. No arsenic was recovered domestically from arsenic-containing residues and dusts generated at nonferrous smelters in the United States.

Import Sources (2011–14): Arsenic: China, 89%; Japan, 9%; and other, 2%. Arsenic trioxide: Morocco, 58%; China (including Hong Kong), 32%; Belgium, 10%; and other, less than 1%.

Tariff: Item	Number	Normal Trade Relations 12–31–15
Arsenic	2804.80.0000	Free.
Arsenic acid	2811.19.1000	2.3% ad val.
Arsenic trioxide	2811.29.1000	Free.
Arsenic sulfide	2813.90.1000	Free.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: China and Morocco continued to be the leading global producers of arsenic trioxide, accounting for more than 90% of estimated world production, and supplied about 99% of U.S. imports of arsenic trioxide in 2015. China was the leading world producer of arsenic metal and supplied about 98% of U.S. arsenic imports in 2015.

Human health and environmental concerns continued to limit the demand for arsenic compounds. A voluntary ban on the use of CCA wood preservatives in most residential applications, effective yearend 2003, significantly reduced demand in wood preservative applications. Owing to the residential ban, imports of arsenic trioxide declined to an average of 5,700 tons per year gross weight during 2010 to 2014, from an average of almost 28,000 tons per year during 1999 to 2003. Concern over the adverse effects of arsenic from natural and anthropogenic sources has led to numerous studies of arsenic in food and water. Information on the U.S. Environmental Protection Agency standards for arsenic in drinking water may be accessed at <http://water.epa.gov/lawsregs/rulesregs/sdwa/arsenic/index.cfm>, and information on the U.S. Food and Drug Administration arsenic-related food studies and recommendations may be accessed at <http://www.fda.gov/Food/FoodbornIllnessContaminants/Metals/ucm280202.htm>.

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The U.S. Geological Survey (USGS) has been studying the natural occurrence of arsenic in groundwater as part of its National Water Quality Assessment Program. Arsenic in groundwater is largely the result of minerals dissolving from weathered rocks and soils. Information on USGS maps and related studies on arsenic in groundwater may be accessed at <http://water.usgs.gov/nawqa/trace/arsenic/index.html>.

Given that arsenic metal has not been produced domestically since 1985, it is likely that only a small portion of the material reported by the U.S. Census Bureau as arsenic exports was pure arsenic metal, and most of the material that has been reported under this category reflects the gross weight of compounds, alloys, and residues containing arsenic. Therefore, the estimated consumption reported under salient U.S. statistics reflects only imports of arsenic products.

High-purity (99.9999%) arsenic metal was used to produce gallium-arsenide (GaAs), indium-arsenide, and indium gallium-arsenide semiconductors that were used in biomedical, communications, computer, electronics, and photovoltaic applications. In 2015, global GaAs device demand increased by about 6% to \$7 billion, primarily owing to a growing wireless infrastructure in Asia, and increased use of feature-rich, application-intensive, third- and fourth-generation “smartphones,” which employ up to 10 times the amount of GaAs as standard cellular handsets. Based on the reported consumption of gallium, an estimated 24 metric tons of arsenic was consumed domestically to produce GaAs integrated circuits and optoelectronic devices in 2015. See the Gallium chapter for additional details.

World Production and Reserves:

	Production ⁵ (arsenic trioxide)		Reserves ⁶
	2014	2015 ^e	
United States	—	—	World reserves data are unavailable but are thought to be more than 20 times world production.
Belgium	1,000	1,000	
Bolivia	52	50	
China	25,000	25,000	
Japan	45	45	
Morocco	8,800	8,500	
Russia	1,500	1,500	
World total (rounded)	36,400	36,000	

World Resources: Arsenic may be obtained from copper, gold, and lead smelter flue dust as well as from roasting arsenopyrite, the most abundant ore mineral of arsenic. Arsenic has been recovered from realgar and orpiment in China, Peru, and the Philippines; has been recovered from copper-gold ores in Chile; and was associated with gold occurrences in Canada. Orpiment and realgar from gold mines in Sichuan Province, China, were stockpiled for later recovery of arsenic. Arsenic also may be recovered from enargite, a copper mineral. Global resources of copper and lead contain approximately 11 million tons of arsenic.

Substitutes: Substitutes for CCA in wood treatment include alkaline copper quaternary, ammoniacal copper quaternary, ammoniacal copper zinc arsenate, copper azole, and copper citrate. Treated wood substitutes include concrete, plastic composite material, plasticized wood scrap, or steel.

^eEstimated. — Zero.

¹Most of the materials reported to the U.S. Census Bureau as arsenic exports are probably arsenic-containing compounds or residues.

²Estimated to be the same as imports.

³Calculated from U.S. Census Bureau import data.

⁴Defined as imports.

⁵Chile, Mexico, and Peru were significant producers of commercial-grade arsenic trioxide, but have reported no production in recent years.

⁶See [Appendix C](#) for resource/reserve definitions and information concerning data sources.