

## 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. 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 fertilizers, fireworks, 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 telecommunication. Arsenic was also 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 consumed domestically in 2013 was estimated to be about \$6 million.

<b>Salient Statistics—United States:</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013<sup>e</sup></b>
Imports for consumption:					
Metal	438	769	628	883	525
Trioxide	4,660	4,530	4,990	5,740	6,250
Exports, metal <sup>1</sup>	354	481	705	439	1,750
Estimated consumption <sup>2</sup>	5,100	5,300	5,620	6,620	6,780
Value, cents per pound, average <sup>3</sup>					
Metal (China)	121	72	74	75	73
Trioxide (Morocco)	20	20	22	24	26
Net import reliance <sup>4</sup> as a percentage of estimated consumption	100	100	100	100	100

**Recycling:** Arsenic metal was recycled from GaAs semiconductor manufacturing, and arsenic contained in the process water at wood treatment plants where CCA was used was also recycled. Electronic circuit boards, relays, and switches may contain arsenic, although 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 (2009–12):** Metal: China, 87%; Japan, 12%; and other, 1%. Arsenic trioxide: Morocco, 67%; China, 20%; Belgium, 12%; and other, 1%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–13</b>
Metal	2804.80.0000	Free.
Acid	2811.19.1000	2.3% ad val.
Trioxide	2811.29.1000	Free.
Sulfide	2813.90.1000	Free.

**Depletion Allowance:** 14% (Domestic and foreign).

**Government Stockpile:** None.

**Events, Trends, and Issues:** Human health and environmental concerns continued to reduce 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 6,500 tons per year gross weight during 2008 to 2012, from an average of almost 28,000 tons per year during 1999 to 2003. Effective January 1, 2013, Maryland, a major poultry-producing State, prohibited the sale and use of poultry feed additives that contained arsenic. The principal producer of roxarsone, the organic arsenic compound added to poultry feed to kill parasites and promote growth, had already suspended its sales in the United States in July 2011. Concern over the adverse effects of arsenic from natural and anthropogenic sources in the human food chain has led to numerous studies of arsenic in fruit juices and rice. In September, the U.S. Food and Drug Administration released the results of a sampling study of arsenic contained in rice, a crop that is grown in water and that is susceptible to arsenic uptake. The FDA recommended that consumers vary their grain intake pending a study on the risks that arsenic in rice pose.

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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 metal 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. Reported arsenic metal exports from 2005 to 2008 were at extremely high levels, and were likely to have also included arsenic acid and CCA that became available for export following the phaseout of the residential use of CCA preserved wood. Therefore, the estimated consumption reported under salient U.S. statistics has been revised to reflect only imports of arsenic products.

In 2008, the U.S. Environmental Protection Agency (EPA) issued a reregistration eligibility decision (RED) in which it determined that CCA wood preservatives were eligible for reregistration as a pesticide for use in treating lumber for certain outdoor applications, exclusive of those for use in most residential settings. The RED included labeling guidelines and detailed worker and environmental protection guidelines for wood-preserving plants using CCA. By December 31, 2013, all wood-preserving plants using CCA were to be upgraded to fully meet RED requirements.

In 2013, GaAs demand increased, still driven mainly by cellular handsets and other high-speed wireless applications, owing to rapid growth of feature-rich, application-intensive, third- and fourth-generation “smartphones.” See the “Gallium” chapter for details.

### **World Production and Reserves:**

	<b>Production</b> <b>(arsenic trioxide)</b>		<b>Reserves<sup>5</sup></b>
	<b><u>2012</u></b>	<b><u>2013<sup>e</sup></u></b>	
United States	—	—	World reserves are thought to be about 20 times annual world production.
Belgium	1,000	1,000	
Chile	10,000	10,000	
China	26,000	25,000	
Morocco	8,000	7,000	
Russia	1,500	1,500	
Other countries <sup>6</sup>	<u>200</u>	<u>200</u>	
World total (rounded)	46,700	45,000	

**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; 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, steel, plasticized wood scrap, or plastic composite material.

<sup>e</sup>Estimated. — Zero.

<sup>1</sup>Most of the materials reported to the U.S. Census Bureau as arsenic metal exports are arsenic-containing compounds and metal.

<sup>2</sup>Estimated to be the same as imports. Previously reported to be equal to net imports.

<sup>3</sup>Calculated from U.S. Census Bureau import data.

<sup>4</sup>Defined as imports.

<sup>5</sup>[See Appendix C for resource/reserve definitions and information concerning data sources.](#)

<sup>6</sup>Includes Bolivia, Japan, and Portugal. Mexico and Peru were significant producers of arsenic trioxide, but have reported no production in recent years.