ARSENIC

(Data in metric tons of arsenic content[1] unless otherwise noted)

Domestic Production and Use: Arsenic trioxide and primary arsenic metal have not been produced in the United States since 1985. 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 2019. 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 to produce gallium-arsenide (GaAs) semiconductors for solar cells, space research, and telecommunications. Arsenic also was used for germanium-arsenide-selenide specialty optical materials. Indium-gallium-arsenide (InGaAs) was used for short-wave infrared technology. The value of arsenic compounds and metal imported domestically in 2019 was estimated to be about $7.2 million. 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 alloys, compounds, residues, scrap, and waste containing arsenic. Therefore, the estimated consumption reported under salient U.S. statistics reflects only imports of arsenic products.

Salient Statistics—United States:	**2015**	**2016**	**2017**	**2018**	**2019[e]**
Imports for consumption:					
Arsenic metal	514	793	942	929	400
Compounds	5,920	5,320	5,980	5,540	7,000
Exports, all forms of arsenic (gross weight)[2]	1,670	1,760	698	107	20
Estimated consumption, all forms of arsenic[3]	6,430	6,120	6,920	6,470	7,400
Value, dollars per kilogram, average[4]					
Arsenic metal (China)	1.85	1.89	1.56	1.43	2.10
Trioxide (China)	0.45	0.46	0.45	0.44	0.44
Trioxide (Morocco)	0.64	0.68	0.68	0.75	0.77
Net import reliance[5] as a percentage of.					
estimated consumption, all forms of arsenic	100	100	100	100	100

Recycling: Arsenic metal was contained in new scrap recycled during GaAs semiconductor manufacturing. Arsenic-containing process water was internally recycled at wood treatment plants where CCA was used. Although scrap electronic circuit boards, relays, and switches may contain arsenic, no arsenic was known to have been recovered during the recycling process 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 (2015–18): Arsenic metal: China, 93%; Japan, 4%; Hong Kong, 3%, and other, <1%. Arsenic trioxide: China, 50%; Morocco, 47%; Belgium, 2%; and other, 1%. All forms of arsenic: China, 55%; Morocco, 42%; Belgium, 2%; other, 1%.

Tariff: Item	**Number**	**Normal Trade Relations 12–31–19**
Arsenic metal	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.

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ARSENIC

Events, Trends, and Issues: China and Morocco continued to be the leading global producers of arsenic trioxide, accounting for about 90% of estimated world production and supplied almost all of United States imports of arsenic trioxide in 2019. China was the leading world producer of arsenic metal and supplied about 90% of United States arsenic metal imports in 2019.

High-purity (99.9999%) arsenic metal was used to produce GaAs, indium-arsenide, and InGaAs semiconductors that were used in biomedical, communications, computer, electronics, and photovoltaic applications. Almost one-half of global GaAs wafer production took place in China. See the Gallium chapter for additional details.

World Production and Reserves (gross weight):

	Production[e, 6] (arsenic trioxide)		Reserves[7]
	2018	2019	
United States	—	—	
Belgium	1,000	1,000	World reserves data are unavailable but are thought to be more than 20 times world production.
Bolivia	40	40	
China	24,000	24,000	
Iran	110	110	
Japan	45	40	
Morocco	6,000	6,000	
Namibia	700	700	
Russia	1,500	1,500	
World total (rounded)	33,400	33,000	

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 orpiment and realgar 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. Arsenic trioxide was produced at the hydrometallurgical complex of Guemassa, near Marrakech, Morocco, from cobalt arsenide ore from the Bou-Azzer Mine.

Substitutes: Substitutes for CCA in wood treatment include alkaline copper quaternary, ammoniacal copper quaternary, ammoniacal copper zinc arsenate, alkaline copper quaternary boron-based preservatives, copper azole, copper citrate, and copper naphthenate. Treated wood substitutes include concrete, plastic composite material, plasticized wood scrap, or steel. Silicon-based complementary metal-oxide semiconductor power amplifiers compete with GaAs power amplifiers in midtier third generation 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. GaAs-based integrated circuits are used in many defense-related applications because of their unique properties, and no effective substitutes exist for GaAs in these applications. GaAs in heterojunction bipolar transistors is being replaced in some applications by silicon-germanium.

[e]Estimated. — Zero.

[1]Arsenic content of arsenic metal is 100%; arsenic content of arsenic compounds is calculated at 77.7% for arsenic acids, 60.7% for arsenic sulfides, and 75.71% for arsenic trioxide.

[2]Most of the materials reported to the U.S. Census Bureau as arsenic exports are thought to be arsenic-containing compounds (such as arsenic acids, sulfides, and trioxides) or residues, waste, and scrap and was reported as gross weight.

[3]Estimated to be the same as imports.

[4]Calculated from U.S. Census Bureau import data.

[5]Defined as imports - exports.

[6]Includes calculated arsenic trioxide equivalent of output of elemental arsenic compounds other than arsenic trioxide; inclusion of such materials would not duplicate reported arsenic trioxide production. Chile, Mexico, and Peru were thought to be significant producers of commercial-grade arsenic trioxide but have reported no production in recent years.

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