

BISMUTH

(Data in metric tons of bismuth content unless otherwise noted)

Domestic Production and Use: The United States ceased production of primary refined bismuth in 1997 and is highly import dependent for its supply. Bismuth is contained in some lead ores mined domestically, but the last domestic primary lead smelter closed at yearend 2013, and all lead concentrates now are exported for smelting. In 2016, the estimated value of apparent consumption of bismuth was approximately \$17 million.

About two-thirds of domestic bismuth consumption was for chemicals used in cosmetic, industrial, laboratory, and pharmaceutical applications. Bismuth use in pharmaceuticals included bismuth salicylate (the active ingredient in over-the-counter stomach remedies) and other compounds used to treat burns, intestinal disorders, and stomach ulcers. Bismuth also is used in the manufacture of ceramic glazes, crystalware, and pearlescent pigments. Bismuth has a wide variety of metallurgical applications, including use as a nontoxic replacement for lead in brass, free-machining steels, and solders, and as an additive to enhance metallurgical quality in the foundry industry. The Safe Drinking Water Act Amendment of 1996, which required that all new and repaired fixtures and pipes for potable water supply be lead free after August 1998, opened a wider market for bismuth as a metallurgical additive to lead-free pipe fittings, fixtures, and water meters. Bismuth is used as a triggering mechanism for fire sprinklers and in holding devices for grinding optical lenses, and bismuth-tellurium oxide alloy film paste is used in the manufacture of semiconductor devices.

Salient Statistics—United States:	2012	2013	2014	2015	2016^e
Production:					
Refinery	—	—	—	—	—
Secondary (old scrap) ^e	80	80	80	80	80
Imports for consumption, metal	1,700	1,710	2,270	1,950	2,200
Exports, metal, alloys, and scrap	764	816	567	519	500
Consumption:					
Reported	647	774	727	662	700
Apparent	940	978	1,420	1,370	1,740
Price, average, domestic dealer, dollars per pound	10.10	8.71	11.14	6.43	4.50
Stocks, yearend, consumer	134	50	329	464	500
Net import reliance ¹ as a percentage of apparent consumption	93	92	95	95	95

Recycling: Bismuth-containing new and old alloy scrap was recycled and thought to compose less than 5% of U.S. bismuth apparent consumption, or about 80 tons.

Import Sources (2012–15): China, 69%; Belgium, 22%; Peru, 2%; United Kingdom, 2%; and other, 5%.

Tariff: Item	Number	Normal Trade Relations 12–31–16
Bismuth and articles thereof, including waste and scrap	8106.00.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

Events, Trends, and Issues: In China, the Yunnan Provincial government instructed the municipal government of Kunming to launch an official investigation into the trading activities of the Fanya Metal Exchange Co. Ltd. (FME), which began trading bismuth in March 2013. The municipal government was instructed to determine if the FME had any physical assets in warehouses, concealed facts, created a capital pool and taken control of the funds within, and illegally possessed and used the funds that it had raised. In February, the owner of the FME was arrested and, in March, the Public Security Bureau announced that it was expanding its investigation into FME activities. The 19,228 tons of bismuth that was reported to be in FME warehouses has not been verified by the government or a third party.

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The U.S. domestic dealer price of bismuth, which had trended upward in 2014, started 2015 at \$10.90 per pound, decreased steadily throughout the year, and ended the year with a December average of \$4.56 per pound. The price then remained relatively stable throughout 2016, ranging between \$4.00 per pound and \$4.70 per pound. Industry analysts attributed the sharp decrease in price in 2015 to the events surrounding the FME.

Masan Resource Corp.'s Nui Phao Mine in Vietnam had its first full year of production in 2015, producing tungsten, fluorspar, copper, and bismuth. Masan did not report how much bismuth was produced, but its tungsten production increased by 63% in 2015 from that in 2014. In 2014, Nui Phao produced 4,945 tons of bismuth concentrate.² Based on original projections, Nui Phao was expected to produce up to 2,000 tons per year of bismuth.³

Bismuth vanadate, traditionally used as a yellow pigment, is being investigated as a heterojunction material for splitting water using light to generate hydrogen for use in fuel cells. Although still under development, advances have been made to improve the efficiency of the process.

World Mine Production and Reserves:

	Mine production		Reserves ⁴
	<u>2015</u>	<u>2016^e</u>	
United States	—	—	—
Bolivia	10	10	10,000
Canada	3	3	5,000
China	7,500	7,400	240,000
Mexico	700	700	10,000
Russia	40	40	NA
Vietnam	2,000	2,000	53,000
Other countries	—	—	<u>50,000</u>
World total (rounded)	<u>10,300</u>	<u>10,200</u>	<u>370,000</u>

World Resources: Bismuth, at an estimated 8 parts per billion by weight, ranks 69th in elemental abundance in the Earth's crust and is about twice as abundant as gold. World reserves of bismuth are usually estimated based on the bismuth content of lead resources because bismuth production is most often a byproduct of processing lead ores. In China and Vietnam, bismuth production is a byproduct or coproduct of tungsten and other metal ore processing. Bismuth minerals rarely occur in sufficient quantities to be mined as principal products; the Tasna Mine in Bolivia and a mine in China are the only mines where bismuth has been the primary product. The Tasna Mine in Bolivia has been inactive since 1996.

Substitutes: Bismuth compounds can be replaced in pharmaceutical applications by alumina, antibiotics, and magnesia. Titanium dioxide-coated mica flakes and fish-scale extracts are substitutes in pigment uses. Indium can replace bismuth in low-temperature solders. Resins can replace bismuth alloys for holding metal shapes during machining, and glycerine-filled glass bulbs can replace bismuth alloys in triggering devices for fire sprinklers. Free-machining alloys can contain lead, selenium, or tellurium as a replacement for bismuth.

Bismuth is an environmentally friendly substitute for lead in plumbing and many other applications, including fishing weights, hunting ammunition, lubricating greases, and soldering alloys.

^eEstimated. NA Not available. — Zero.

¹Defined as imports – exports + adjustments for industry stock changes.

²Masan Resources Corp., 2015, 2014 sustainable development report: Ho Chi Minh City, Vietnam, Masan Resources Corp., 39 p.

³Masan Resources Corp., 2016, 2015 annual report: Ho Chi Minh City, Vietnam, Masan Resources Corp., 192 p.

⁴See [Appendix C](#) for resource and reserve definitions and information concerning data sources.