

## 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. A small amount of bismuth is recycled by some domestic firms. Bismuth is contained in some lead ores mined domestically, but the bismuth-containing residues are not processed domestically and may be exported. In 2014, the value of reported consumption of bismuth was approximately \$23 million.

Chemical production accounted for about two thirds of domestic bismuth consumption, principally in pharmaceutical applications. Bismuth use in pharmaceuticals included bismuth salicylate (the active ingredient in over-the-counter stomach remedies) and other bismuth medicinal compounds used to treat burns, intestinal disorders, and stomach ulcers in humans and animals. Other applications of bismuth chemicals and compounds included uses in superconductors and pearlescent pigments for cosmetics and paints. Bismuth has a wide variety of metallurgical applications, including use as a nontoxic replacement for lead in brass, free-machining steels, and solders. Bismuth is used as an additive to enhance metallurgical quality in the foundry industry, as a triggering mechanism for fire sprinklers, and in holding devices for grinding optical lenses.

<b>Salient Statistics—United States:</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014<sup>e</sup></b>
Production:					
Refinery	—	—	—	—	—
Secondary (old scrap) <sup>e</sup>	80	80	80	80	80
Imports for consumption, metal	1,620	1,750	1,700	1,710	2,100
Exports, metal, alloys, and scrap	1,040	628	764	816	600
Consumption:					
Reported <sup>e</sup>	636	696	647	774	900
Apparent	660	1,200	1,020	1,060	1,380
Price, average, domestic dealer, dollars per pound	8.76	11.47	10.10	8.71	11.39
Stocks, yearend, consumer	133	138	134	50	250
Net import reliance <sup>1</sup> as a percentage of apparent consumption	88	93	93	92	94

**Recycling:** All types of bismuth-containing new and old alloy scrap were recycled and contributed less than 10% of U.S. bismuth consumption, or about 80 tons.

**Import Sources (2010–13):** China, 59%; Belgium, 34%; Peru, 2%; United Kingdom, 2%; and other, 3%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–14</b>
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:** 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. Another application is the use of a bismuth-tellurium oxide alloy film paste for use in the manufacture of semiconductor devices. Bismuth also was used domestically in the manufacture of ceramic glazes, crystal ware, and pigments, and as an additive to free-machining steels and malleable iron castings. An emerging application is in display panels where lead will be replaced by bismuth metal. Researchers in China developed a low-melting-point bismuth-indium-tin-zinc alloy that allows the liquid alloy to be squeezed through tubes that could be used in the 3D printing of electronic components. The new alloy's low melting point requires little cooling, allowing for faster printing than is currently possible with higher melting point metals currently in use.

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A global increase in bismuth demand in 2014 was likely the result of consumer anticipation of higher prices owing to the creation of China's "rare metals" Fanya Metal Exchange, which began trading in Bismuth in March 2013. Buyers purchased bismuth as Chinese prices rose owing to investment demand on the Fanya Metal Exchange. Fanya has over 100,000 members and, during the first half of 2014, bismuth inventory rose by more than 120% to 11,500 tons. By early November, Fanya warehouses reportedly held about 17,000 tons of bismuth, more than a year's worth of global consumption. Concerns over availability and higher prices may have encouraged stockpiling by U.S. and European consumers. The large increase in the calculated U.S. apparent consumption in 2014 may reflect an increase in unreported domestic inventories, including underestimation of the increase in consumer stocks.

In July, Fortune Minerals Ltd fulfilled all permits allowing it to proceed with building the NICO gold-cobalt-bismuth-copper mine and concentrator in the Northwest Territories, Canada. In Peru, La Oroya Metallurgical complex, which had been shuttered in 2009 owing to financial and environmental problems and restarted zinc and lead operations in 2012, halted operations in May 2014 for a month owing to a shortage of concentrate. Following the announcement that creditors had plans to put the zinc-lead smelter up for sale by December, workers called an indefinite strike over disputed unpaid wages. La Oroya complex had been a significant producer of bismuth.

The U.S. domestic dealer price of bismuth, which had trended upward in 2013, started 2014 at \$9.30 per pound, increased steadily throughout the year, and ended October at \$12.67 per pound. In 2014, the estimated average price of bismuth was about 31% higher than that in 2013. Industry analysts attributed the sharp increase in price to the rise in inventory on the Fanya Metal Exchange that has tightened supply and encouraged consumer buying in anticipation of higher prices.

### World Mine Production and Reserves:

	Mine production		Reserves <sup>2</sup>
	2013	2014 <sup>e</sup>	
United States	—	—	—
Bolivia	10	10	10,000
Canada	35	35	5,000
China	7,500	7,600	240,000
Mexico	824	824	10,000
Russia	40	40	NA
Other countries	—	—	50,000
World total (rounded)	8,400	8,500	320,000

**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 based on bismuth content of lead resources because bismuth production is most often a byproduct of processing lead ores; in China, bismuth production is a byproduct 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 that produced bismuth from bismuth ore.

**Substitutes:** Bismuth 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.

<sup>e</sup>Estimated. — Zero.

<sup>1</sup>Defined as imports – exports + adjustments for Government and industry stock changes.

<sup>2</sup>See [Appendix C](#) for resource/reserve definitions and information concerning data sources.