

## 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 thus 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. The value of reported consumption of bismuth was approximately \$19 million.

The Safe Drinking Water Act Amendment of 1996 required that all new and repaired fixtures and pipes for potable water supply be lead free after August 1998. As a result, a wider market was opened for bismuth as a metallurgical additive to lead-free pipes. Bismuth use in water meters and fixtures is one particular application that has increased in recent years. An application with major growth potential is the use of zinc-bismuth alloys to achieve thinner and more uniform galvanization. Another promising new application is the use of a bismuth-tellurium oxide alloy in a film paste for use in the manufacture of semiconductor devices. Bismuth was also used domestically in the manufacture of ceramic glazes, crystal ware, and pigments; as an additive to free-machining steels; and as an additive to malleable iron castings.

<b><u>Salient Statistics—United States:</u></b>	<b><u>2008</u></b>	<b><u>2009</u></b>	<b><u>2010</u></b>	<b><u>2011</u></b>	<b><u>2012<sup>e</sup></u></b>
Production:					
Refinery	—	—	—	—	—
Secondary (old scrap)	100	60	80	80	80
Imports for consumption, metal	1,930	1,250	1,620	1,750	1,830
Exports, metal, alloys, and scrap	375	397	1,040	1,030	900
Consumption:					
Reported	1,080	820	884	715	840
Apparent	1,560	1,010	660	796	998
Price, average, domestic dealer, dollars per pound	12.73	7.84	8.76	11.47	10.17
Stocks, yearend, consumer	228	134	134	138	150
Net import reliance <sup>1</sup> as a percentage of apparent consumption	94	94	88	90	92

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

**Import Sources (2008–11):** China, 52%; Belgium, 36%; United Kingdom, 5%; and other, 7%.

<b><u>Tariff: Item</u></b>	<b><u>Number</u></b>	<b><u>Normal Trade Relations</u></b>
		<b><u>12–31–12</u></b>
Bismuth and articles thereof, including waste and scrap	8106.00.0000	Free.

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

**Government Stockpile:** None.

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**Events, Trends, and Issues:** Owing to its unique properties, bismuth has a wide variety of applications, including use in free-machining steels, brass, pigments, and solders, as a nontoxic replacement for lead; in pharmaceuticals, including bismuth subsalicylate, the active ingredient in over-the-counter stomach remedies; in the foundry industry, as an additive to enhance metallurgical quality; in the construction field, as a triggering mechanism for fire sprinklers; and in holding devices for grinding optical lenses. Researchers in the European Union, Japan, and the United States are investigating the possibilities of using bismuth in lead-free solders. Researchers also are examining liquid lead-bismuth coolants for use in nuclear reactors. Work is proceeding toward developing a bismuth-containing metal-polymer bullet.

A strike, which lasted most of the past 3 years, at Peru's only bismuth producer eliminated Peru's bismuth output.

The price of bismuth started 2012 at \$11.75 per pound and decreased slightly throughout the year, ending October at \$9.25 per pound. The estimated average price of bismuth in 2012 was about 11% below that in 2011. Industry analysts attributed the lower price to decreased world demand.

### World Mine Production and Reserves:

	Mine production		Reserves <sup>2</sup>
	2011	2012 <sup>e</sup>	
United States	—	—	—
Bolivia	100	100	10,000
Canada	92	100	5,000
China	7,000	6,000	240,000
Mexico	980	1,000	10,000
Other countries	130	200	50,000
World total (rounded)	8,300	7,400	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 a 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, on the other hand, 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.