

## BORON

(Data in thousand metric tons unless otherwise specified)

**Domestic Production and Use:** Two companies in southern California produced borates in 2023, and most of the boron products consumed in the United States were manufactured domestically. Estimated boron production increased in 2023 compared with 2022 production. U.S. boron production and consumption data were withheld to avoid disclosing company proprietary data. The leading boron producer mined borate ores, which contain the minerals kernite, tincal, and ulexite, by open pit methods and operated associated compound plants. Kernite was used to produce boric acid, tincal was used to produce sodium borate, and ulexite was used as a primary ingredient in the manufacture of a variety of specialty glasses and ceramics. A second company produced borates from brines extracted through solution-mining techniques. Boron minerals and chemicals were principally consumed in the north-central and eastern United States. In 2023, the glass and ceramics industries remained the leading domestic users of boron products, accounting for an estimated 65% of total borates consumption. Boron also was used as a component in abrasives, cleaning products, insecticides, insulation, and in the production of semiconductors.

### **Salient Statistics—United States:**

	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023<sup>e</sup></u>
Production	W	W	W	W	W
Imports for consumption:					
Refined borax	161	174	232	168	170
Boric acid	41	39	54	48	42
Colemanite (calcium borates)	42	18	3	1	1
Ulexite (sodium borates)	38	41	49	38	17
Exports:					
Boric acid	251	257	280	240	250
Refined borax	598	594	607	651	640
Consumption, apparent <sup>1</sup>	W	W	W	W	W
Price, average unit value of imports, cost, insurance, and freight, dollars per metric ton	373	380	394	485	620
Employment, number	1,370	1,330	1,330	1,400	1,400
Net import reliance <sup>2</sup> as a percentage of apparent consumption	E	E	E	E	E

**Recycling:** Insignificant.

**Import Sources (2019–22):** All forms: Turkey, 90%; Bolivia, 5%; Chile, 1%; and other, 4%.

<u>Tariff:</u>	<u>Item</u>	<u>Number</u>	<u>Normal Trade Relations</u> <u>12–31–23</u>
Natural borates:			
Sodium (ulexite)		2528.00.0005	Free.
Calcium (colemanite)		2528.00.0010	Free.
Boric acids		2810.00.0000	1.5% ad valorem.
Borates, refined borax:			
Anhydrous		2840.11.0000	0.3% ad valorem.
Non-anhydrous		2840.19.0000	0.1% ad valorem.

**Depletion Allowance:** Borax, 14% (domestic and foreign).

**Government Stockpile:** None.

**Events, Trends, and Issues:** Elemental boron is a metalloid with limited commercial applications. Although the term “boron” is commonly referenced, it does not occur in nature in an elemental state. Boron combines with oxygen and other elements to form boric acid or inorganic salts called borates. Boron compounds, chiefly borates, are commercially important; therefore, boron products are priced and sold based on their boric oxide (B<sub>2</sub>O<sub>3</sub>) content, varying by ore and compound and by the absence or presence of calcium and sodium. Four borate minerals—colemanite, kernite, tincal, and ulexite—account for 90% of the borate minerals used by industry worldwide. Although borates were used in more than 300 applications, more than three-quarters of world consumption was used in ceramics, detergents, fertilizers, and glass.

## BORON

China, India, Mexico, Malaysia, and Japan, in decreasing order of tonnage, are the countries that imported the largest quantities of refined borates from the United States in 2023. Domestic shipments of boric acid were sent to China, the Netherlands, the Republic of Korea, Japan, and Taiwan, in decreasing order of tonnage. Because China has low-grade boron reserves and demand for boron is anticipated to rise in that country, imports from the United States were expected to remain steady during the next several years.

Interests and investments in boron derivatives increased domestically and abroad. The National Defense Authorization Act for fiscal year 2024 included an amendment to study boron supply chains, particularly in regard to ferroboration and boron carbide production. The Under Secretary of Defense for Acquisition and Sustainment was expected to complete the report by the first quarter of 2024.

Turkey opened its first boron carbide facility in March and began construction of a ferroboration facility in September 2022. Boron carbide is produced in only five countries in the world. Turkey's new boron carbide facility has a capacity of 1,000 tons per year. Boron carbide is used in the manufacturing of body armor and ferroboration is used in the production of permanent magnets.

Continued investment in new borate refineries and the continued rise in demand were expected to fuel growth in world production for the next few years. Two Australian-based mine developers previously confirmed that production of high-quality boron products would be possible from their projects in California and Nevada, respectively. These companies continued to make progress on their respective projects by acquiring some of the permits and funding necessary to begin and continue construction. The project in California continued construction as it neared the completion of its first phase. This project was expected to have a focus on specialty boron products for industries related to global decarbonization and food security once production starts. These companies have the potential to become substantial boron producers when their projects are fully developed. The project in Nevada was offered a conditional commitment loan of up to \$700 million with a 10-year term from the U.S. Department of Energy to fund the project. If work begins at the Nevada project, it was anticipated to create 600 construction jobs and up to 300 operation positions.

**World Production and Reserves:** Reserves data for China, Turkey, and the United States were revised based on Government and company reports.

	Production—All forms <sup>e</sup>		Reserves <sup>3</sup>
	2022	2023	
United States	W	W	48,000
Argentina, crude ore	130	130	NA
Bolivia, ulexite	170	170	NA
Chile, ulexite	360	360	35,000
China, boric oxide equivalent	200	200	20,000
Germany, compounds	60	60	NA
Peru, crude borates	200	200	4,000
Russia, datolite ore	80	80	40,000
Turkey, refined borates	2,200	2,200	950,000
World total <sup>4</sup>	XX	XX	XX

**World Resources:**<sup>3</sup> Deposits of borates are associated with volcanic activity and arid climates, with the largest economically viable deposits in the Mojave Desert of the United States, the Alpidic belt along the southern margin of Eurasia, and the Andean belt of South America. U.S. deposits consist primarily of tincal, kernite, and borates contained in brines, and to a lesser extent, ulexite and colemanite. About 70% of all deposits in Turkey are colemanite, primarily used in the production of heat-resistant glass. At current levels of consumption, world resources are adequate for the foreseeable future.

**Substitutes:** The substitution of other materials for boron is possible in detergents, enamels, insulation, and soaps. Sodium percarbonate can replace borates in detergents and requires lower temperatures to undergo hydrolysis, which is an environmental consideration. Some enamels can use other glass-producing substances, such as phosphates. Insulation substitutes include cellulose, foams, and mineral wools. In soaps, sodium and potassium salts of fatty acids can act as cleaning and emulsifying agents.

<sup>e</sup>Estimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

<sup>1</sup>Defined as production + imports – exports.

<sup>2</sup>Defined as imports – exports.

<sup>3</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>4</sup>World totals cannot be calculated because production and reserves are not reported in a consistent manner by all countries.