GRAPHITE (NATURAL)

(Data in metric tons unless otherwise specified)

Domestic Production and Use: In 2023, natural graphite was not produced in the United States; however, approximately 95 companies, primarily in the Great Lakes and Northeast regions, consumed 76,000 tons valued at an estimated $180 million. The major uses of natural graphite were batteries, brake linings, lubricants, powdered metals, refractory applications, and steelmaking. During 2023, U.S. natural graphite imports were an estimated 84,000 tons, consisting of about 89.3% flake and high-purity, 10.4% amorphous, and 0.3% lump and chip graphite.

Graphite consumption is expected to continue to increase, owing largely to growth from the lithium-ion battery market. According to Benchmark Mineral Intelligence, global graphite consumption by the battery market has increased by 200% since 2019. The number of lithium-ion battery manufacturing facilities in the United States increased to 10 in 2023 from 3 in operation during 2019. An additional 28 facilities were under development.

Salient Statistics—United States:	2019	2020	2021	2022	2023[e]
Production, mine	—	—	—	—	—
Imports for consumption	50,100	36,000	53,000	89,200	84,000
Exports	5,880	5,920	8,660	9,500	8,400
Consumption, apparent[1]	44,200	30,000	44,300	79,700	76,000
Price, average unit value of imports, dollars per metric ton at foreign ports:					
Flake	1,340	1,340	1,330	1,200	1,200
Lump and chip (Sri Lanka)	2,380	2,940	2,010	2,590	2,500
Amorphous	511	567	629	563	565
Net import reliance[1] as a percentage of apparent consumption	100	100	100	100	100

Recycling: Refractory brick and linings, alumina-graphite refractories for continuous metal castings, magnesia-graphite refractory brick for basic oxygen and electric arc furnaces, and insulation brick was increasing, with material being recycled into products such as brake linings and thermal insulation. The abundance of graphite in the world market inhibits increased recycling efforts. Information on the quantity and value of recycled graphite is not available.

Import Sources (2019–22): China,[2] 42%; Mexico, 16%; Canada, 15%; Madagascar, 12%; and other, 15%.

Tariff: Item	Number	Normal Trade Relations 12–31–23
Crystalline flake (not including flake dust)	2504.10.1000	Free.
Powder	2504.10.5000	Free.
Other	2504.90.0000	Free.

Depletion Allowance: Lump and amorphous, 22% (domestic) and flake, 14% (domestic); 14% (foreign).

Government Stockpile: None.

Events, Trends, and Issues: U.S. natural graphite imports, by tonnage, were 6% lower during the first 8 months of 2023, compared with those in the same period in 2022. Some companies announced that they increased orders in the fourth quarter in anticipation of reduced graphite supply from China. U.S. imports for consumption and U.S. apparent consumption increased by 68% and 72%, respectively, from 2019 to 2023.

In 2023, China was the world's leading graphite producer, producing an estimated 77% of total world production. Approximately 15% of graphite produced in China was amorphous and about 85% was flake. In October, China announced export restrictions to take effect on December 1 on certain goods, including flake graphite, spherical graphite (natural and synthetic), expandable graphite, and some synthetic graphite products. Exporters would need to apply for a license, which according to one graphite producer, required export contracts, technical product specifications, and the identity of the end user as well as the specific end use. During the first 9 months of the year, China exported 58,000 tons of flake graphite concentrate, less than the 81,000 tons exported in the same period in 2022. The leading recipients were the Republic of Korea (18%), Japan (17%), India (14%), and the United States (8%). During the same period in 2023, China exported 39,000 tons of natural spherical graphite, less than the 45,000 tons exported in 2022. The leading recipients were the Republic of Korea (56%), the United States (23%), and Japan (19%).

Five companies were exploring or developing graphite-mining projects in the United States—two in Alabama, one in Alaska, one in Montana, and one in New York. In July, the project in Alaska was awarded a grant of $37.5 million

Prepared by **Andrew A. Stewart [(703) 648–7723, astewart@usgs.gov]**

through the Inflation Reduction Act. In November, a project in Alabama was awarded a grant of $3.2 million through the Defense Production Act.

Two spherical graphite plants, located in Kellyton, AL, and Vidalia, LA, were under construction in 2023; production was expected to begin during 2024. An additional five plants in the United States were under early development.

Production at a large graphite mine in Mozambique was paused for 4 months owing to unfavorable market conditions related to high anode production in China and lower prices. Operations resumed in the third quarter, but at a reduced rate. In September, the company was granted a conditional $150 million loan from the United States International Development Finance Corp. to help fund capital requirements at the mine.

A Canadian company continued to construct a graphite mine in Brazil. First production was on pace for early 2024; planned production during phase 1 was 5,000 tons per year, increasing to 50,000 tons in phase 3. In July, another Canadian company announced first production at its mine in Madagascar. Production capacity was planned to be 17,000 tons per year, potentially expanding to 150,000 tons per year in phase 2. An additional mine, with a capacity of 40,000 tons per year, was under construction in Tanzania.

Graphite production in Ukraine continued to face disruptions owing to the ongoing conflict with Russia, which began in 2022. After the winter season shutdown, production restarted in May but continued to face energy supply disruptions related to the conflict. Prior to Russian military action, graphite production in Ukraine was about 10,000 tons per year.

World Mine Production and Reserves: Reserves for Canada, China, India, Madagascar, and Turkey were revised based on company and Government reports.

	Mine production		Reserves[3]
	2022	2023[e]	
United States	—	—	([4])
Austria	500	500	([4])
Brazil	[e]72,000	73,000	74,000,000
Canada	13,000	3,500	5,700,000
China	1,210,000	1,230,000	78,000,000
Germany	170	150	([4])
India	11,000	11,500	8,600,000
Korea, North	[e]8,100	8,100	2,000,000
Korea, Republic of	23,800	27,000	1,800,000
Madagascar	[e]130,000	100,000	24,000,000
Mexico	2,000	2,000	3,100,000
Mozambique	166,000	96,000	25,000,000
Norway	10,380	7,200	600,000
Russia	[e]16,000	16,000	14,000,000
Sri Lanka	2,600	2,200	1,500,000
Tanzania	[e]6,120	6,000	18,000,000
Turkey	2,800	2,000	6,900,000
Ukraine	1,000	2,000	([4])
Vietnam	500	500	([4])
World total (rounded)	1,680,000	1,600,000	280,000,000

World Resources:[3] Domestic resources of graphite are relatively small, but the rest of the world's resources exceed 800 million tons of recoverable graphite.

Substitutes: Synthetic graphite powder, scrap from discarded machined shapes, and calcined petroleum coke compete for use in iron and steel production. Synthetic graphite powder and secondary synthetic graphite from machining graphite shapes compete for use in battery applications. Finely ground coke with olivine is a potential competitor in foundry-facing applications. Molybdenum disulfide competes as a dry lubricant but is more sensitive to oxidizing conditions.

[e]Estimated. — Zero.

[1]Defined as imports – exports.

[2]Includes Hong Kong.

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

[4]Included in "World total."