

GRAPHITE (NATURAL)

(Data in metric tons unless otherwise noted)

Domestic Production and Use: In 2019, natural graphite was not produced in the United States; however, approximately 95 U.S. firms, primarily in the Great Lakes and Northeastern regions and Alabama and Tennessee, consumed 52,000 tons valued at an estimated \$44 million. The major uses of natural graphite were brake linings, lubricants, powdered metals, refractory applications, and steelmaking. During 2019, U.S. natural graphite imports were an estimated 58,000 tons, which were about 65% flake and high-purity, 34% amorphous, and 1% lump and chip graphite.

Salient Statistics—United States:	2015	2016	2017	2018	2019^e
Production, mine	—	—	—	—	—
Imports for consumption	46,700	38,900	51,900	70,700	58,000
Exports	11,600	14,300	13,900	10,400	6,600
Consumption, apparent ¹	35,100	24,700	38,000	60,300	52,000
Price, imports (average dollars per ton at foreign ports):					
Flake	1,710	1,920	1,390	1,520	1,300
Lump and chip (Sri Lankan)	1,800	1,880	1,900	1,890	2,370
Amorphous	454	571	451	310	438
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 led the way in the recycling of graphite products. The market for recycled refractory graphite material is expanding, with material being recycled into products such as brake linings and thermal insulation. Recovering high-quality flake graphite from steelmaking kish is technically feasible, but currently not practiced. 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 (2015–18): China, 33%; Mexico, 24%; Canada, 16%; India, 9%; and other, 18%.

Tariff:	Item	Number	Normal Trade Relations 12-31-19
	Crystalline flake (not including flake dust)	2504.10.1000	Free.
	Powder	2504.10.5000	Free.
	Other	2504.90.0000	Free.

Depletion Allowance: 22% (Domestic lump and amorphous), 14% (Domestic flake), and 14% (Foreign).

Government Stockpile: None.

Events, Trends, and Issues: Worldwide consumption of graphite has steadily increased since 2013 and into 2019. U.S. consumption has fluctuated over this time period. During 2015 and 2016, U.S. consumption decreased by 39% and by 30%, respectively. In 2017 and 2018, consumption increased by 54% and by 59%, respectively, to its highest point during the past 5 years. However, during 2019, consumption declined again by 14%.

In 2019, principal United States import sources of natural graphite were, in descending order of tonnage, China, Mexico, Canada, Madagascar, Brazil, Mozambique, the United Kingdom, Japan, Sri Lanka, and Austria, which combined accounted for 99% of the tonnage and 97% of the value of total United States imports. Mexico and China provided most of the amorphous graphite, and Sri Lanka provided all the lump and chip dust variety.

During 2019, China produced more than 60% of the world's graphite. Approximately 40% of production in China was amorphous graphite and about 60% was flake. China does produce some large flake graphite, but the majority of its flake graphite production is very small, in the +200-mesh range. North America produced only 4% of the world's graphite supply with production in Canada and Mexico. No production of natural graphite was reported in the United States, but two companies were developing graphite projects—one in Alabama and one in Alaska.

Large graphite deposits were being developed in Madagascar, northern Mozambique, Namibia, and south-central Tanzania. Some mines in Madagascar began ramping up production in 2018, and a mine in Tanzania started sampling production beginning in 2017. A graphite mine project in Mozambique commenced operations at the start of 2018 and was ramping up production during 2018 and 2019 at a high-grade graphite deposit, which was reportedly

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the largest natural graphite mine globally. The mine cut back production during 2019 in an effort to stabilize graphite prices. The mine is expected to operate for 50 years.

During the first half of 2019, crystalline flake graphite prices declined to levels similar to those of midyear 2017. The price decline was the result of oversupply, and some graphite mining companies cut back production in an effort to stabilize and increase graphite prices.

A U.S. automaker continued to build a large plant to manufacture lithium-ion electric vehicle batteries. The plant's completion was projected for 2020. A portion of the plant was operational and battery packs were being assembled in 2018 and 2019. When the plant is complete, it was expected to require 35,200 tons per year of spherical graphite for use as anode material for lithium-ion batteries.

New thermal technology and acid-leaching techniques have enabled the production of higher purity graphite powders that are likely to lead to development of new applications for graphite in high-technology fields. Innovative refining techniques have made the use of graphite possible in carbon-graphite composites, electronics, foils, friction materials, and specialty lubricant applications. Flexible graphite product lines are likely to be the fastest growing market. Large-scale fuel-cell applications are being developed that could consume as much graphite as all other uses combined.

World Mine Production and Reserves: Reserves for Mozambique and Tanzania were revised based on information reported by graphite-producing companies and the Governments of those countries.

	Mine production		Reserves ²
	2018	2019 ^e	
United States	—	—	(³)
Austria	1,000	1,000	(³)
Brazil	95,000	96,000	72,000,000
Canada	40,000	40,000	(³)
China	693,000	700,000	73,000,000
Germany	800	800	(³)
India	35,000	35,000	8,000,000
Korea, North	6,000	6,000	2,000,000
Madagascar	46,900	47,000	1,600,000
Mexico	9,000	9,000	3,100,000
Mozambique	104,000	100,000	25,000,000
Namibia	3,460	3,500	(³)
Norway	16,000	16,000	600,000
Pakistan	14,000	14,000	(³)
Russia	25,200	25,000	(³)
Sri Lanka	4,000	4,000	(³)
Tanzania	150	150	18,000,000
Turkey	2,000	2,000	90,000,000
Ukraine	20,000	20,000	(³)
Vietnam	5,000	5,000	7,600,000
Zimbabwe	2,000	2,000	(³)
Other	200	200	(³)
World total (rounded)	1,120,000	1,100,000	300,000,000

World Resources: Domestic resources of graphite are relatively small, but the rest of the world's inferred 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.

^eEstimated. — Zero.

¹Defined as imports – exports.

²See Appendix C for resource and reserve definitions and information concerning data sources.

³Included with "World total."