

# GRAPHITE (NATURAL)

(Data in metric tons unless otherwise noted)

**Domestic Production and Use:** In 2021, natural graphite was not produced in the United States; however, approximately 95 U.S. companies, primarily in the Great Lakes and Northeastern regions and Alabama and Tennessee, consumed 45,000 tons valued at an estimated \$41 million. The major uses of natural graphite were batteries, brake linings, lubricants, powdered metals, refractory applications, and steelmaking. During 2021, U.S. natural graphite imports were an estimated 53,000 tons, which were about 57% flake and high-purity, 42% amorphous, and 1% lump and chip graphite.

<b>Salient Statistics—United States:</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021<sup>e</sup></b>
Production, mine	—	—	—	—	—
Imports for consumption	51,900	70,700	50,300	36,000	53,000
Exports	13,900	9,950	5,890	5,930	8,400
Consumption, apparent <sup>1</sup>	38,000	60,700	44,400	30,000	45,000
Price, average value of imports, dollars per ton at foreign ports:					
Flake	1,390	1,520	1,350	1,540	1,600
Lump and chip (Sri Lanka)	1,900	1,890	2,380	2,940	2,700
Amorphous	451	319	498	687	630
Net import reliance <sup>1</sup> 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. Recycling of refractory graphite material is increasing, 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 (2017–20):** China, 33%; Mexico, 21%; Canada, 17%; India, 9%; and other, 20%.

<b>Tariff:</b>	<b>Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–21</b>
	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:<sup>2</sup>**

<b>Material</b>	<b>FY 2021</b>			<b>FY 2022</b>	
	<b>Inventory as of 9–30–21</b>	<b>Potential acquisitions</b>	<b>Potential disposals</b>	<b>Potential acquisitions</b>	<b>Potential disposals</b>
Graphite	—	—	—	900	—

**Events, Trends, and Issues:** U.S. natural graphite exports decreased each year from 2017 to 2019, remained essentially unchanged in 2020, and then increased by 41% in 2021. This was still an overall 40% decline for the 5-year period of 2017 to 2021. U.S. imports for consumption and apparent consumption peaked in 2018, and imports and apparent consumption declined during 2019 and 2020. During 2021, U.S. imports for consumption and apparent consumption increased by 48% and 50%, respectively, as recovery from the COVID-19 pandemic began.

During 2021, China was the world's leading graphite producer, producing an estimated 79% of total world output. Approximately 24% of production in China was amorphous graphite and about 76% was flake. China produced some large flake graphite, but much of its flake graphite production was very small, in the +200-mesh range. China also processed most of the world's spherical graphite. Globally, during 2021, graphite supplies began recovering from the effects that the global COVID-19 pandemic had during 2020. In 2021, global graphite production was estimated to have increased by 7.6% from 2020 production. In China, the recovery was quick, which was demonstrated by China's pattern of exports. Chinese producers quickly increased production after a few months of closures in 2020. This allowed China to gain a more dominant position in the market for 2021 and slowed down the diversification of the supply chain.

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North America produced only 1.2% of the world's graphite supply with production in Canada and Mexico. Two companies were developing graphite mining projects in the United States—one in Alabama and one in Alaska.

Large graphite deposits were being developed in Madagascar, northern Mozambique, Namibia, and south-central Tanzania. A graphite mine in Mozambique in a high-grade graphite deposit was reportedly the largest natural graphite mine globally. The mine was expected to operate for about 50 years.

A U.S. automaker continued building a large plant to manufacture lithium-ion electric vehicle batteries. The completed portion of the plant was operational, and it produced battery cells, battery packs, drive units, and energy storage products. At full capacity, the plant was expected to require 35,200 tons per year of spherical graphite for use as anode material for lithium-ion batteries.

An Australian company was producing purified coated spherical graphite for use as lithium-ion battery anode material from its plant in Vidalia, LA, challenging China's hold on global production of purified coated spherical graphite.

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 Tanzania were revised based on information reported by graphite-producing companies and Government reports.

	Mine production		Reserves <sup>3</sup>
	2020	2021 <sup>e</sup>	
United States	—	—	( <sup>4</sup> )
Austria	500	500	( <sup>4</sup> )
Brazil	63,600	68,000	70,000,000
Canada	8,000	8,600	( <sup>4</sup> )
China	762,000	820,000	73,000,000
Germany	300	300	( <sup>4</sup> )
India	6,000	6,500	8,000,000
Korea, North	8,100	8,700	2,000,000
Madagascar	20,900	22,000	26,000,000
Mexico	3,300	3,500	3,100,000
Mozambique	28,000	30,000	25,000,000
Norway	12,000	13,000	600,000
Russia	25,000	27,000	( <sup>4</sup> )
Sri Lanka	4,000	4,300	1,500,000
Tanzania	—	150	18,000,000
Turkey	2,500	2,700	90,000,000
Ukraine	16,000	17,000	( <sup>4</sup> )
Uzbekistan	100	110	7,600,000
Vietnam	5,000	5,400	( <sup>4</sup> )
World total (rounded)	966,000	1,000,000	320,000,000

**World Resources:**<sup>3</sup> 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.

<sup>e</sup>Estimated. — Zero.

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

<sup>2</sup>See Appendix B for definitions.

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

<sup>4</sup>Included with "World total."