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GREEN ENERGY MINERAL: KEY FACTS

Graphite

US CRITICAL MINERAL? YES

MAIN USES IN GREEN ENERGY TECHNOLOGY

Energy storage

KEY DEVELOPMENT ISSUES IN MINING

Environment

Labor and working conditions

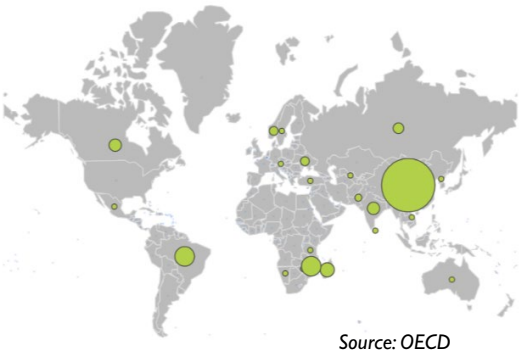
Conflict

DEMAND PROJECTIONS

Graphite is a form of carbon that is used in a variety of applications including brake linings, lubricants, and steelmaking. Lithium-ion batteries used in electric vehicles and renewable energy storage use graphite as the anode. The stable structure of graphite hosts the charged lithium ions before they move through the electrolyte towards the cathode releasing the electrical current.

Graphite is projected to account for over 50% of minerals used in batteries by 2050, far surpassing lithium and cobalt (Hund et al., 2020). Lithium-ion batteries now account for 25% of graphite demand and this is set to increase in the coming decades (Northern Graphite, n.d.a). By 2050 under a two-degree scenario, over 4.5 million tons of graphite will be needed each year, which is 494% higher than 2018 production levels. However, like cobalt there is uncertainty as battery technologies evolve. For example, graphite demand will be less should there be widespread adoption of solid-state batteries, for example, in which graphite is not required.

PRODUCTION/RESERVES



Source: OECD

China has been the world's leading graphite producer for some time. In 2020, China produced an estimated 650,000 tons or 62% of total world output. China is followed by **Mozambique** and **Brazil** who produce around 10% of world production each. **China, Turkey,** and **Brazil** have the largest known reserves. There are also significant reserves in **Madagascar** and **Mozambique**.

Graphite is not traded in the open market so price data is not readily available. In addition, prices vary widely depending on flake size. The average flake graphite imported into the US in the last 5 years varied between $1,350 (2019) and $1,920 (2016) according to USGS data. However, the price has been relatively stable between 2017 and 2020 at around $1,500 per ton.

MINING IN USAID-PRESENCE COUNTRIES

As noted **Mozambique** and **Brazil** were the second and third largest graphite producers in 2020 respectively, though both combined were less than a third of China's output. Other USAID-presence countries with current or expected graphite mining are **Madagascar, India, Pakistan, Vietnam, Mexico, Sri Lanka, Tanzania, Uzbekistan, Zimbabwe,** and **Namibia**. Countries with particular growth potential are Mozambique and Madagascar.

MAJOR INDUSTRIAL COMPANIES

China has dozens of mines and intermediaries, making it hard to pinpoint dominant companies. However, **BTR** is cited as the largest supplier of natural graphite from its own mines as well as other mines, accounting for up to 75% of China's supply (Whoriskey, 2016; BTR, n.d.). In Mozambique the main producer is Australian company **Syrah Resources** (Syrah Resources, n.d.a). Brazil's main graphite mining companies are privately held and information is hard to come by, but **Nacional de Grafite** is apparently an important player (*Nacional de Grafite*, n.d.).

ARTISANAL AND SMALL-SCALE MINING (ASM)

None known

ISSUES IN USAID-PRESENCE COUNTRIES

Graphite mining has garnered relatively little attention compared to other minerals. In China there have been concerns about the health effects of dust from graphite mines on miners and surrounding communities, though no such issues have been raised in USAID-presence countries with graphite mining.

In Mozambique, the largest graphite mine is located in Cabo Delgado, which is a region faced with terrorist groups affiliated with Al Qaeda. The future of Mozambique's graphite mining therefore depends on how the security-development challenges in this region are dealt with (Ker, 2018).

Madagascar is also emerging as a place of interest. While the country's 100-year-old graphite industry has been in the northwest, southern Madagascar is emerging as a new hub with several projects in the pipeline. This area has many areas of biological importance (Reach Markets, 2019).

MINE DEVELOPMENT AND SUPPLY CHAIN DYNAMICS

Graphite is not inherently scarce but economic resources are highly influenced by world market prices. China dumped graphite on the world market in the 1990s to raise foreign reserves which depressed prices for over a decade and led to little investment in new projects until prices began recovering in 2005 (Northern Graphite, n.d.b). The graphite supply chain is also complex with many intermediaries and privately held companies making it difficult to get clear information.

In recent years, relatively high graphite prices and speculation around the green energy transition and need to diversify from China has led to several new projects being developed in Mozambique, Tanzania (ECOGRAF, n.d.), Brazil (GRAPHCOA, n.d.), India, Namibia (Mining Journal, 2020), and Madagascar. Junior companies listed in Australia, Toronto, and London are involved in these projects (Mining Technology, n.d.b; Mining Technology n.d.c).

ORGANIZATIONS AND INDUSTRY GROUPS

There are no major graphite-focused industry organizations or supply chain initiatives.