

China Restricts Graphite Exports

Shaw and Partners Sector Report

Implications for Graphite Sector Coverage

Event

China has announced export controls of natural and synthetic graphite from 1 December, citing national security concerns. We expect this to be very positive for near-term graphite prices and reiterate our Buy recommendations across the sector.

Highlights

- China dominates graphite mining, processing and anode production and is set to produce 67% of global natural graphite this year according to Benchmark Mineral Intelligence.
- China also refines more than 90% of global battery anode material that is used in virtually all Electric Vehicle battery anodes.
- Such concentration of the critical minerals market poses a strategic challenge to the rest of the world that has seen the US, Europe, Australia and other countries announce funding aimed at diversifying supply and countering China's dominant position over minerals crucial to clean energy that includes graphite.
- While all details are yet to be released, in the short-term we expect this policy to be very supportive for graphite prices and reiterate our Buy recommendations across the graphite sector. Given the pre-existing forecasts for graphite supply shortages coming, and that there are few shovel-ready projects poised to meet the forecast demand anywhere in the world, graphite prices must move up to incentivise new production.
- In the medium-term the policy will accelerate the still nascent build-out of battery anode supply chains in the West.
- The US Department of Energy forecasts the US will reach 534GWh of battery capacity by 2026. This will require 500ktpa of active anode material by 2025, 80% from sources ex-China. There is virtually no material produced internally in the US today.
- The US has already designated graphite as a strategic critical mineral, and the combination of the strategic importance of graphite and the US Government's commitment to securing internal sources of supply of critical minerals presents Evolution with an exceptional opportunity for vertical integration.
- In 2022 the US Government awarded more than US\$2.8bn under an array of policy initiatives to incentivise domestic supply including the Inflation Reduction Act (combined US\$669bn next ten years), Bipartisan Infrastructure Law (US\$7bn in the form of grants) and the US Mineral Security Partnership.

Recommendation

Our graphite sector company preference is based on a combination of commodity price leverage, underlying asset quality and project lifecycle phase.

1. **Syrah Resources (SYR, Buy, \$1.30)** – Syrah Resources is the only vertically integrated natural graphite active anode material producer of scale in the world outside of China. Syrah is constructing a large scale 11.25ktpa active anode material facility in Louisiana and is pre-FID on expansion to 45ktpa. Tesla is a foundation customer.
2. **Black Rock Mining (BKT, Buy, \$0.46)** – Black Rock's 84% owned Mahenge Graphite Project in Tanzania is favourably positioned to provide low carbon intensity high quality premium graphite feedstock to an emerging supply chain between POSCO and the rest of the world.
3. **Evolution Energy Minerals (EV1, Buy, \$0.72)** - Evolution's 84% owned Chilalo Graphite Project in Tanzania requires low upfront capital for a favourably large flake sized product suitable for specialty end markets and optionality to move downstream in the US.

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Graphite 101

What is Graphite?

Graphite is a form of carbon that is known for its excellent thermal and electrical conductivity, high melting point, and its ability to form a soft and slippery material. Graphite is used in a wide range of industrial applications, including as a lubricant, a heat-resistant material, and as an electrode in electric arc furnaces for steel production. Graphite is also a large component in batteries and fuel cells.

Graphite can occur naturally in metamorphic rocks or can be produced synthetically by heating carbon-containing materials to high temperatures in the presence of a catalyst.

Natural graphite can be categorized in three different forms:

- Amorphorous
- Vein (lump)
- Flake

Amorphorous graphite lacks the crystalline structure found in other types of natural graphite: instead of layers of graphene sheets, amorphorous graphite is made up of small particles loosely bonded together. This type of graphite receives the lowest price and is easily substitutable for coal or carbon black.

Vein graphite is typically found in veins or fractures in metamorphic rocks. It is composed entirely of carbon and will fetch the highest price but comprises less than 1% of the natural graphite market.

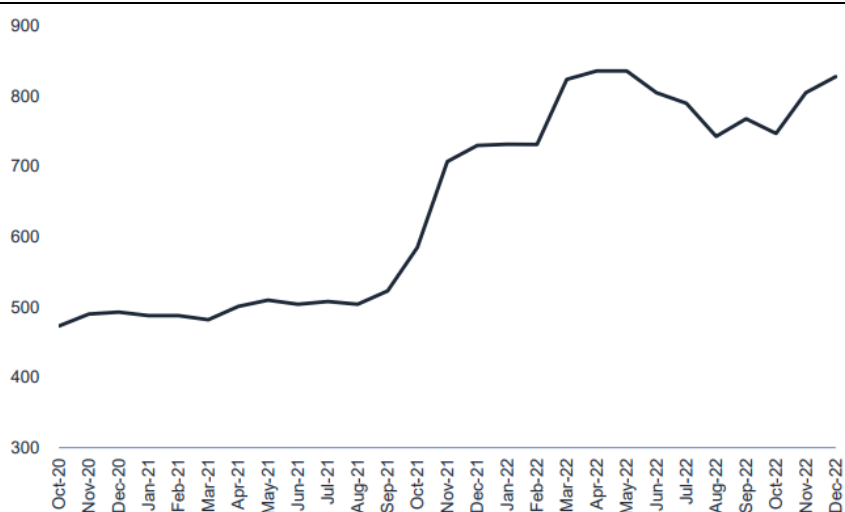
Flake graphite receives varying prices depending on flake size and carbon content, where larger flake sizes and higher carbon content tends to command a price premium.

Price outlook

Prices for graphite tripled between 2007 and 2011 which precipitated an explosion of exploration companies targeting graphite throughout the world. This bubble burst in early to mid-2012 as synthetic supply came on stream to fill the void. The start-up of Balama at the start of 2018 saw further price declines as Syrah Resources sought to find the market clearing price.

Prices remained steady notwithstanding the market being in surplus throughout Covid, however the a resurgence in EV demand saw prices increase throughout 2022 on increasing demand and lack of new supply. Fines prices have fallen some 30% during 2023 on a lower rate of EV demand and increased synthetic output in China.

Figure 1: Natural graphite fines prices (US\$/t)



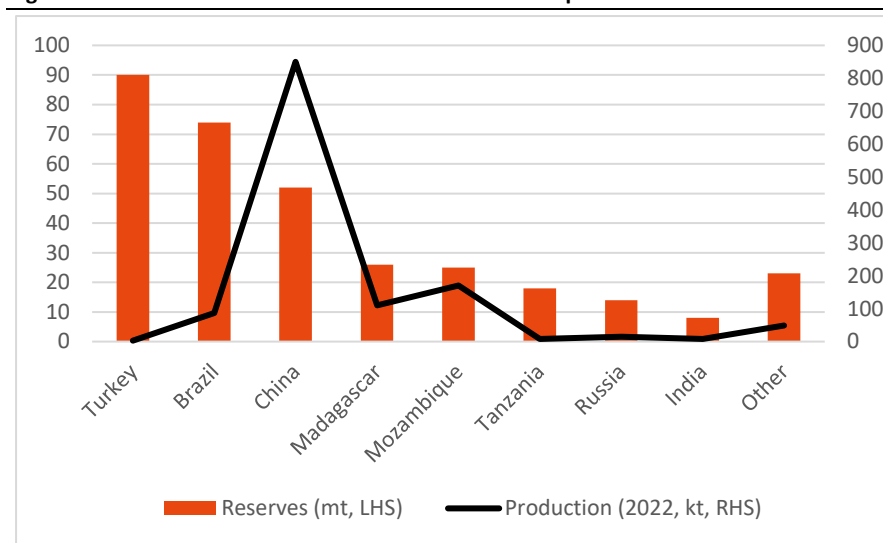
Source: Syrah Resources, Benchmark Mineral Intelligence

Supply

Turkey and Brazil hold the largest graphite reserves globally, but mine relatively small proportions. China is the world's major producer and end users remain heavily reliant on Chinese supply. Syrah Resources' Balama Graphite Project has 110mt in ore reserves at 16.4% total graphitic carbon for 18mt contained graphite, underpinning a 50 year mine life

based on Balama’s current 2mtpa process plant capacity, larger than any other ex-China project by a significant margin. Sri Lanka produces 100% of the vein graphite worldwide, which was just 3kt in 2022.

Figure 2: Global Reserves and Production of Natural Graphite



Source: US Geological Survey Mineral Commodity Summaries, 2023

Around 70% of Chinese natural graphite production is amorphous and the remaining 30% is flake. There are estimated to be around 28 small to medium-sized mining operations in Heilongjiang province producing mostly fines from the Jixi/Mashan and Luobei regions. Around 22 mines operate in Inner Mongolia, also producing fines and small flakes.

Around 16 mines operate in Shandong province, producing mostly coarse flake from the Pingdu region (processed in Qingdao) in northeast China. The majority of Chinese flake graphite production is very small, in the +200-mesh range.

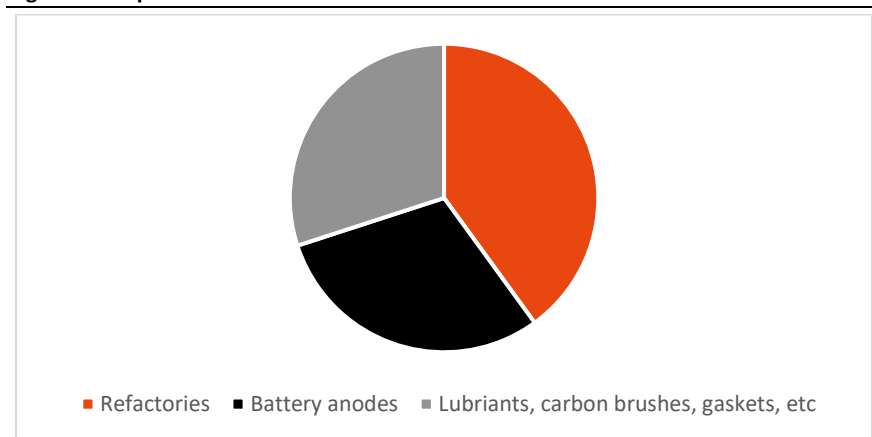
Synthetic graphite is produced using high temperature processes that transform carbon-containing raw materials, typically petroleum coke, into a crystalline form of graphite via milling, mixing and heat treatment. Graphitising occurs at up to 3,000°C to give the graphite its final crystalline structure. The key end use is blending with natural active anode material for use within battery anodes.

There are numerous ESG risks associated with synthetic graphite given the raw material input and high temperature processing. Syrah Resources quotes Minviro Ltd’s lifecycle assessment of the Vidalia project in its 2022 Annual Report that states SYR’s natural AAM has 50% less global warming potential than Chinese synthetic active anode material.

Demand

Natural graphite consumption is around 1mtpa according to Fastmarkets. 40% of global graphite supply is consumed in refractories production; lithium-ion battery anodes account for 30% of demand but this is outpacing industrial demand growth, and 30% goes into multiple smaller markets including thermal management in electronics, brake and clutch parts, gaskets, fire retardants and carbon brushes.

Figure 3: Graphite end markets



Source: Fastmarkets

The biggest refractory companies include RHI-Magnesita (Austria-Brazil); Vesuvius (UK); Imerys (France); Krosaki-Harima and Shinagawa (both Japan).

Synthetic graphite has historically accounted for around 50% of material usage in lithium-ion battery anodes, with a roughly a 50:50 share between natural and synthetic. Lower power prices and industrial activity have swung the balance towards synthetic in 2023, but this is likely to swing back towards natural in the medium term with ESG concerns a significant factor.

The biggest lithium-ion battery manufacturers include BYD (China), Panasonic (Japan), Foxconn (Taiwan) and LG Chem (South Korea).

Graphite transactions are largely based on direct negotiations between buyers and sellers, with some spot market activity in China but virtually all other material is sold through contracts of up to a year. Most Chinese material is sold FOB.

Chinese exports of anode material and ex-China transactions for other kinds of synthetic graphite are typically priced on 3, 6 or 12-month contracts.

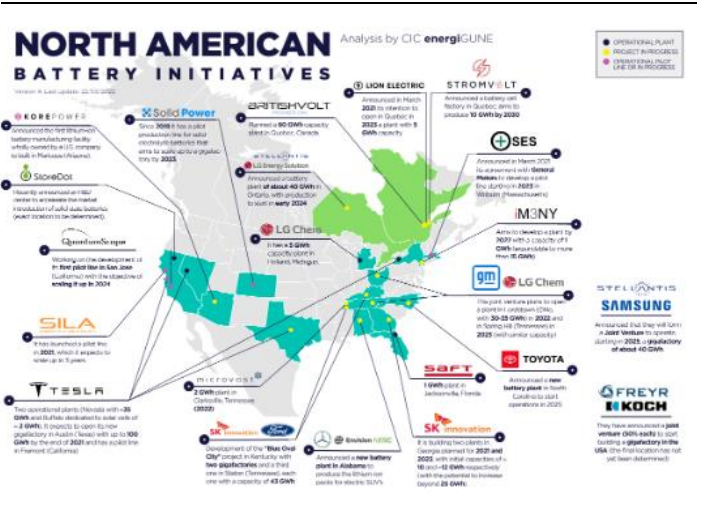
Graphite consumption is expected to continue to increase, owing largely to growth from the electric-vehicle market. The battery end-use market for graphite has grown by 250% globally since 2018. In the United States, 4 lithium-ion battery manufacturing plants are currently in operation, with an additional 21 in development. At full capacity, these plants are expected to require 1.2mt per year of spherical purified graphite, with perhaps half coming from synthetic.

Figure 4: European Gigafactories



Source: CIC energiGUNE, March 2023

Figure 5: European Gigafactories



Source: CIC energiGUNE, March 2023

Graphite processing

The processing of graphite is largely conventional, depending on the quality and purity of the material and intended end use. The natural graphite process flow sheet involves mining, crushing, floatation, purification and shaping. The final concentrates are 95% or higher pure graphite. Fines are sold to downstream precursor anode producers, who in turn supply active anode producers and cell manufacturers.

While a large portion of the Chinese market is vertically integrated, most concentrate produced outside China is shipped into China for further processing. With clean energy demand for critical minerals set to soar as the world pursues net zero goals, the on-shoring of processing facilities has seen producers such as Syrah announce plans to progress the product downstream outside China, before selling into US and EU cell manufacturers.

Of the many mooted graphite development projects globally, we believe most will announce plans to produce spherical graphite products in order to address the supply gap.

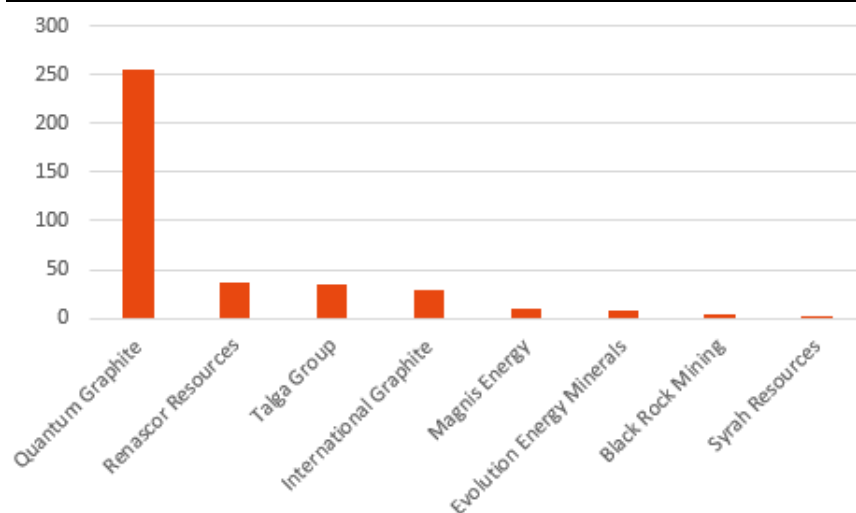
China currently produces around 90% of global spherical supply. Determining the marginal cost of production is difficult but current prices of US\$5,000/t to US\$8,000/t suggest breakevens around US\$5,000/t in a balanced market.

Figure 6: ASX-listed graphite peers

Company	Asset	Location	Ownership	Mkt cap \$m	Cash \$m	EV \$m	Resource (mt)	Grade %TGC	EV/Resource/ t	Reserve (mt)	Grade %TGC	EV/Reserve/t
Talga Group	Lulea/ Kiruna	Sweden	100%	509	39	470	72.7	18.6%	35	2.3	24.1%	847
Syrah Resources	Balama/ Vidalia	Mozambique/ Louisiana	100%	402	155	247	1,421	10.0%	2	107	16.0%	14
Renascor Resources	Siviour	South Australia	100%	368	129	239	87.4	7.5%	36	51.5	7.4%	63
Quantum Graphite	Uley	South Australia	100%	196	3	193	7.2	10.5%	255	-	-	-
Magnis Energy	Nachu	Tanzania	84%	106	22	84	174	5.4%	9	76.3	4.8%	23
Evolution Energy Minerals	Chilalo	Tanzania	84%	38	10	28	67.3	5.4%	8	8	10.5%	34
International Graphite	Springdale/ Collie	Western Australia	100%	30	4	26	15.6	6.0%	28	-	-	-
Black Rock Mining	Mahenge	Tanzania	84%	92	12	80	213.1	7.8%	5	70.5	8.5%	13

Source: Company reports

Figure 7: ASX-listed graphite peers – EV/ Resource t



Source: Company reports

Syrah Resources, Buy, \$1.30

- Syrah Resources is the only vertically integrated natural graphite active anode material producer outside of China.
- The company's Balama mine in Mozambique is globally significant with the world's largest graphite resource and a 350ktpa production capacity. The company is also moving downstream: commissioning 11.25ktpa in Louisiana is expected in September.
- 2022 production at Balama was a record 163kt, but less than half capacity. Basket prices received, although up 35% through the year, remain below the US\$1k/t assumed in the 2015 Feasibility Study.
- Balama has been operating under production campaigns since May 2023 as a result of higher synthetic supply in China. Balama produced 18kt in the September quarter and reported that fines market demand in China is improving ahead of historical lower Chinese production during winter.
- Syrah is constructing a large-scale Active Anode Material facility in Mississippi, Louisiana. The budget for the initial 11.25ktpa facility was revised from US\$176m to US\$198m in the September quarter, with commissioning expected before the end of 2023. FID for expanding the facility to 45kt is expected in 1HCY24 subject to financing.
- Tesla has signed up as an initial Vidalia customer: 8ktpa for an initial term of 4 years at an undisclosed price. Tesla has also exercised an option to take an additional 17ktpa from an expanded 45ktpa facility. In addition, SYR has non-binding MOU's in place for additional material with Ford, SKon and LG Energy Solution, subject to qualification and testing.
- At the end of September Syrah had cash US\$81m, including US\$31m of restricted cash relating to reserves associated with the US\$102m US Department of Energy loan. Syrah issued the A\$50m Series 5 Note in August and will issue the Series 6 Note for the same amount imminently.

Black Rock Mining, Buy, \$0.46

- Black Rock's 84% owned Mahenge Graphite Project in Tanzania contains a world-class ore body: 213mt at 7.8% TGC, that has an ability to produce a clean graphite concentrate free of deleterious elements in high demand.
- Black Rock's main point of differentiation vs peers is the existence of POSCO as corner stone to the project.
- POSCO, 11.5% shareholder and world's largest anode producer outside of China, has secured 100% of fines (<150 microns) from module 1 and recently provided a MOU for future options for fines from module 2 and additional equity investment of up to US\$40m.
- POSCO's qualification of Mahenge ore and their presence on the share register is the strongest possible indication of confidence in Black Rock and signals further de-risking of the company's funding strategy. We expect debt term sheets in 2H23 with Black Rock already through initial stages with a subsidiary of the Government of South Africa.
- An updated definitive feasibility study was released in October 2022 that confirms Mahenge as a standout high margin, low capex development-ready graphite project.
- Mahenge is expected to produce at a high operating margin at the bottom end of the cost curve thanks largely to access to grid hydro power at US\$0.08/KWhr.
- Access to hydro power also means graphite from Mahenge will have a very low carbon intensity compared to peers and is likely to have one of the lowest carbon footprints of any graphite project globally.
- Black Rock has signed a framework agreement with the Government of Tanzania that covers the ownership, development and management of the Project. The agreement provides for a special mining license and 30% tax rate, 4% royalty rate and 16% free carry to the Government.
- Black Rock are adopting a staged approach to construction of four modular processing plants, each with nameplate capacity of 1mtpa providing a concentrate at a grade around 8%.
- The combination of high margin and low cost means that Mahenge should be one of the first graphite producers to supply into a tightening graphite market.

Evolution Energy Minerals, Buy, \$0.72

- Evolution Energy Minerals' 84% owned Chilalo Graphite Project in Tanzania requires low upfront capital for a favorably large flake sized product suitable for specialty end markets and optionality to move downstream into Battery Anode Material (BAM).
- Construction is estimated to cost US\$120m and we assume first product in FY26.
- Chilalo is expected to produce at high operating margin which would place the operation at the top end of graphite producers ex-China.
- Chilalo's high grade reserve is 8.0mt at 10.5% total graphitic carbon. Drilling has also confirmed a new discovery of high-grade graphite mineralisation to the east of Chilalo.
- EV1 has attracted investment from ARCH Sustainable Resources Fund and has engaged Digbee ESG to provide an independent ESG rating.
- Evolution has partnered with BTR New Material Group (market capitalisation US\$3.4bn) with a view to establishing vertically integrated downstream battery anode material operations.
- BTR and EV1 have entered into a binding offtake agreement for 100% of the fine flake graphite from Chilalo for 3 years (+3yr option), conditional on a downstream agreement being executed by 31 March 2024.

Rating Classification

Buy	Expected to outperform the overall market
Hold	Expected to perform in line with the overall market
Sell	Expected to underperform the overall market
Not Rated	Shaw has issued a factual note on the company but does not have a recommendation

Risk Rating

High	Higher risk than the overall market – investors should be aware this stock may be speculative
Medium	Risk broadly in line with the overall market
Low	Lower risk than the overall market

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Distribution of Investment Ratings

Rating	Count	Recommendation Universe
Buy	74	96%
Hold	2	3%
Sell	1	1%

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