

Graphite – The diamond in the rough at the centre of the battery revolution



The odd one out among the “battery metals” is critical for the green revolution. But how can investors gain exposure to this complex industry?

Baker Steel Capital Managers LLP

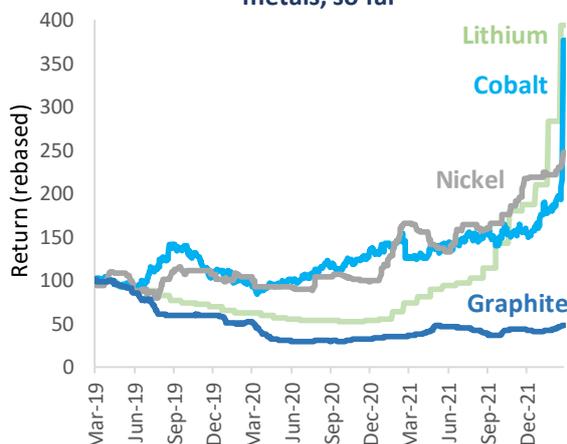
6th May 2022

Battery metals, often considered the building blocks of the green revolution, attract much attention from analysts and commentators. The bullish demand trends for lithium, cobalt and nickel in particular often dominate coverage of the sector, yet in this report we draw attention to another lesser-known battery material, graphite, which alongside several others such as copper, silver and rare earths, presents a particular opportunity for investors looking for exposure to the growth of green technology. While often overlooked, graphite is among the primary beneficiaries of the green energy revolution, being a core material for battery production and green steel, with demand forecast to soar:

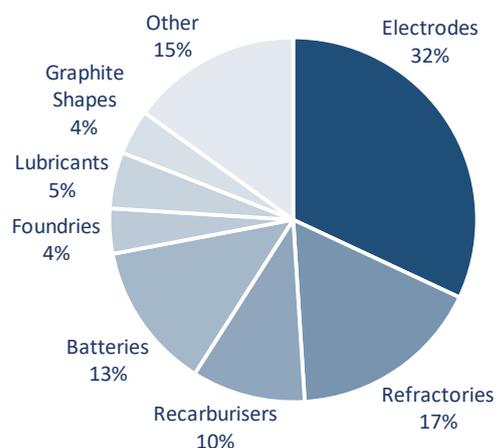
- Graphite is required for lithium-ion batteries used in electric vehicles (“EVs”), representing c.20-24% of the material needs in a battery. It is also used in refractory, metallurgy, and industrial applications, and plays a key role in the development of grid storage.
- From 2020 to 2040, a 22x increase in graphite for energy technology demand is forecast, and a 10x increase across all applications (Benchmark Mineral Intelligence), an increase second only to lithium.
- Graphite supply and processing for batteries is highly concentrated (>95% of processing is in China), yet there is an opportunity for new Tier 1 suppliers to emerge.
- As an active investment manager specialising in natural resources, our team has built exposure to high quality producers and processors of graphite, a strategic, fast-growing sub-sector of the mining sector.

The graphite market is often perceived to be complex not least because graphite, unlike lithium, cobalt and nickel, is not actually a metal, but also because most of what is thought of as graphite is actually coal or oil, in the case of artificial graphite and a mineral for natural graphite. Natural graphite is formed when carbon is subjected to heat and pressure in the earth’s crust and in the upper mantle. In a similar manner to diamonds, which are also composed purely of carbon, the graphite sector is best thought of as many segmented markets which nevertheless all ultimately impact on each other. A primary issue is that, despite strong demand growth in recent years, graphite has so far been a difficult sector for investors to generate returns from. Yet as specialists in the resources sector, the opportunity we see in the graphite sector illustrates the benefits of the sub-sector focus which we undertake as a core element of our Electrum strategy, as the new green commodity supercycle gains pace.

Graphite has lagged other key battery metals, so far



Graphite demand by end-product application



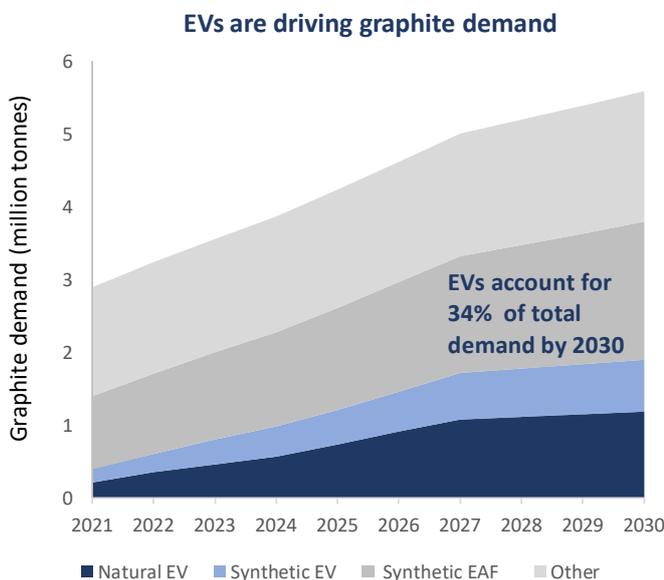
Source: Industry Reports, BMO Capital Markets, commodity prices taken at spot price.

In this report we address the major incremental sources of demand for graphite, most notably electric vehicles and electric arc furnaces. We then delve into the potential supply scenarios across the value chain, including consideration of the carbon intensity of production and offsets.

Electric vehicles and green steel production are driving graphite demand

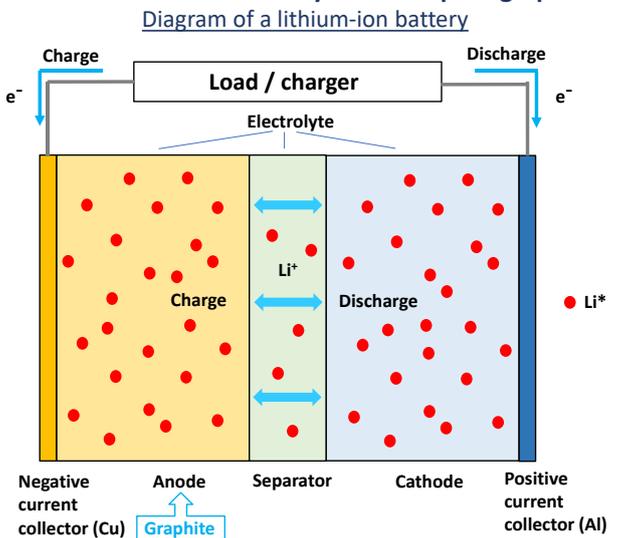
While graphite is used across a range of sustainable industrial applications, from steel recycling to nuclear energy, undoubtedly the most significant growth area for graphite demand is electric vehicles (“EVs”), due to the fact that graphite is a core material required for battery production. A lithium-ion battery has two opposing terminals, the cathode and the anode, which the lithium ions transfer between discharging energy as they do so. Typically, the active ingredients on the cathode side include lithium in a paste with other metals such as nickel, cobalt, iron, phosphate and manganese. Yet the anode is mostly pure graphite, which helps explain why typically twice as much graphite as lithium (on a carbonate equivalent basis) is required in a lithium-ion battery.

The graphite market is however significantly larger than the lithium market, and as such has been able to absorb this new demand more efficiently. Yet as we look ahead, we anticipate that EV demand for graphite will expand from c.14% of total demand in 2021 to c.34% by 2030, as illustrated in the chart below. New sources of supply will be needed to meet this substantial new demand.



Source: Baker Steel Capital Managers LLP.

The anode in an EV battery is almost pure graphite



As is often the case with industrial minerals, these high-level numbers conceal a more interesting and nuanced picture of demand. The first level of analysis is the demand for synthetic graphite versus natural graphite. Presently synthetic graphite is the preferred feedstock in batteries as the product quality is more consistent. Synthetic graphite is more expensive than natural graphite, yet we note that high energy ‘silicon’ doped anodes work better with a higher ratio of natural graphite. We therefore expect natural graphite prices to benefit more from rising EV sales relative to synthetic graphite.

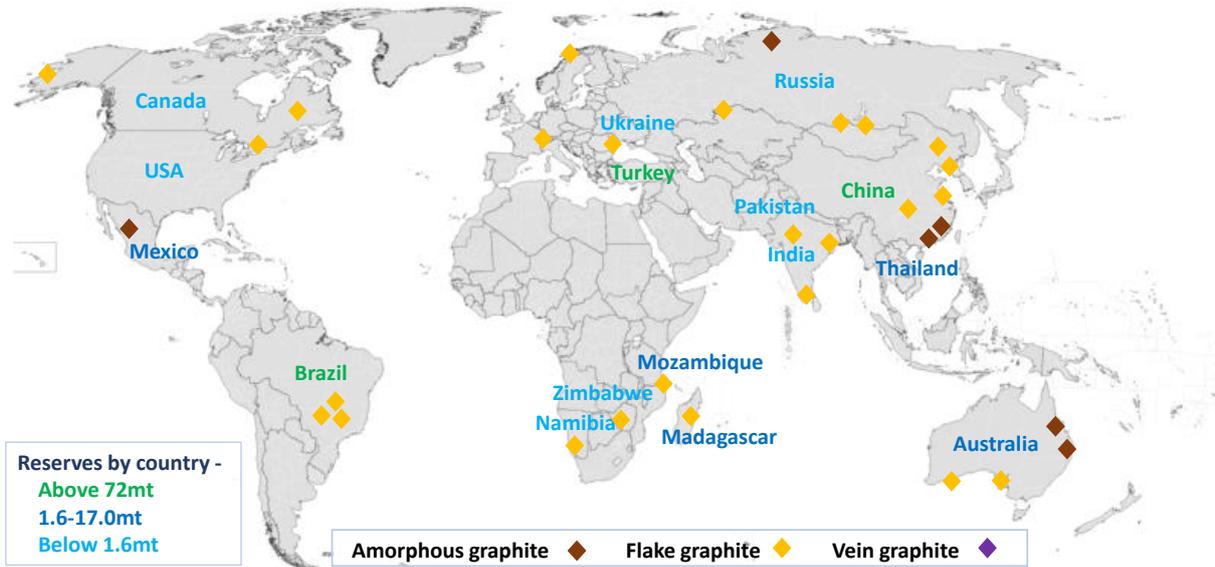
The second major growth area for graphite demand is from electric arc furnaces (“EAF”) for making steel. Steel production using EAF technology has a much lower carbon footprint than traditional blast furnaces (“BOF”) and are expected to continue to gain market share over the coming decades. Using an EAF, graphite is consumed in the furnace as the electrode via which electricity is transmitted to the furnaces. Depending on the quality of the electrode, between 1.7kg and 2.5kg of graphite is consumed for every tonne of steel produced. The graphite used is always synthetic.

Graphite supply is concentrated, but there is an opportunity for new Tier 1 suppliers to emerge

The largest supply increases over the last five years have come from the synthetic graphite market, which is a derivative of needle coke. Needle coke is produced from oil (petroleum or “petcoke”) or coal (coal tar pitch or pitch coke) through fluid catalytic cracking. Petcoke produces a higher quality product, more suitable for use in EAF or EVs. The current utilisation of needle coke capacity is low but forecast to increase substantially over the coming years. Substantial fresh

capacity is also being built. China makes up the bulk of needle coke production capacity, with an estimated 1.1mn t/yr of petroleum-based and 1.03mn t/yr of coal tar pitch-based capacity, although typical annual production is estimated to be only around half this amount.

Global natural graphite reserves and main production sites



Source: USGS, BMO Capital Markets, Baker Steel Capital Managers LLP.

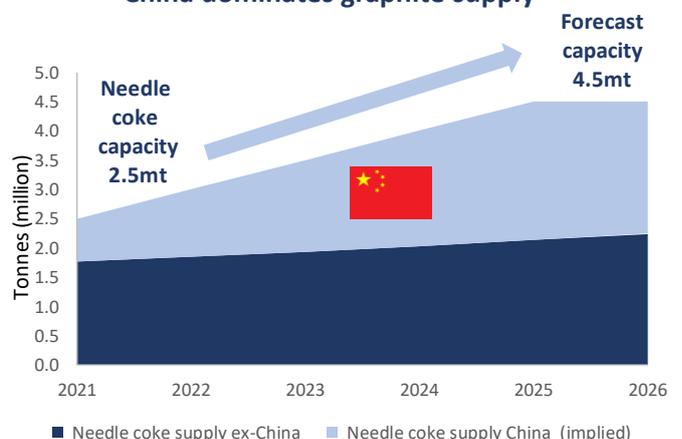
There is no shortage of natural graphite mines, however there are only a very limited number of processing projects outside of China to make it suitable for batteries. As of the battery materials, the graphite production outside China faces permitting, regulatory and technical challenges in Europe and North America. The ample level of graphite reserves and spare capacity hide several bottlenecks along the supply chain which must be addressed, the most obvious being that over 95% of the world’s natural graphite is processed in China. We see an opportunity for certain companies to unblock these supply bottlenecks and emerge to become Tier 1 suppliers, with a highly profitable outlook in the years ahead. With geopolitical tension remaining high, most notably as a result of the ongoing deeply troubling Ukraine conflict, the fragility of supply chains is increasingly being brought into sharp focus.

On a separate note, it is worth noting that end-markets for graphite have considerable pricing variations. We made the assertion at the start of this report that the graphite industry consists of multiple separate markets. This isn’t only driven by the different end uses but by the fact that each graphite mine produces a range of different flake sizes which dictates how they are used. To get the flakes into a usable form the material must first be mined and then processed into >95% concentrate. In many instances, notably for batteries, this concentrate is an intermediate step and it has to be purified to a level above 99.95%. The danger for non-battery market producers is that as this market increases in scale, more by-product non-battery grade material will be produced that swamps those markets.

Graphite pricing: Differing flake sizes and end markets

Flake size	Price	End user
X-Large, +50 mesh	USD 1,750	Niche applications using expandable graphite.
Large, +80 mesh	USD 1,400	Batteries, niche applications, industrial.
Medium, +100 mesh	USD 1,200	Batteries, niche applications, industrial.
Fines, -100 mesh	USD 700	Batteries, industrial (e.g brake linings, refractories).

China dominates graphite supply



Source: North American Graphite, Baker Steel Capital Managers LLP. Note, there are over 500 different specifications of graphite and these prices are for broad guidance only. Flake prices are determined based on a range of value in use variables such as graphite content, flake size and impurity levels with higher purity graphite commanding a premium. Prices based on 96-97% purity.

How can investors benefit from this niche, yet critical, market?

Amid rising graphite prices and strong demand projections from the fast-growing EV sector, our view is that the market opportunity for natural graphite producers is to go as far down the value chain as they can towards producing the anode itself for use in batteries. Doing so however is a costly, complicated and in many instances a “dirty” process. Production is also dominated by China and there continues to be a lack of technical expertise in the Western World regarding the construction and management of upgrading plants. In the West, fully or partially integrated suppliers of synthetic graphite will also increasingly attract a strategic premium over the coming years. The permitting and financing of needle coke production facilities remains a challenge, so those facilities which are already built and have the potential to expand will be major beneficiaries in our view.

Most graphite development companies understand this, and consequently aim to use their mines to develop industrial operations, with the goal to achieve superior margins. Of course, the skill set required to manage a mining company compared to an industrial operation is quite different, and we consider these differences go a long way towards explaining why the graphite sector has been a laggard in terms of generating investor returns. Successful industrial mineral companies must have extremely good customer relationships, which is also true of suppliers to the battery industry. As a result, when investing in the graphite sector the analysis must go well beyond the geology, as demonstrated by some high-profile business failures of world class deposits due to a lack of market and technical knowledge. As sector specialists with many decades of experience investing in resources market, our Investment Team seek selective opportunities in niche markets, such as the graphite sector, with the goal of identifying undervalued miners with strong margins and competent management, which offer exposure to the growth areas of the natural resources investment universe.

BAKERSTEEL Electrum Fund Anniversary – Three years of investing in the producers of critical “future facing” metals and materials required for the green revolution

It has been three years since Baker Steel launched the BAKERSTEEL Electrum Fund, with the goal of creating an actively managed equity fund investing in the producers, processors and recyclers of future facing speciality metals, alongside selected precious and industrial metals. The Fund’s disciplined investment strategy has a strong focus on value and risk management, alongside a particular focus on ESG research utilising Baker Steel’s proprietary in-house ESG screening and scoring framework.

The Fund has faced turbulent global markets since its launch in March 2019 and has delivered strong relative returns, compared to its peer group and the EMIX Global Mining Index (“the Index”). Alongside the Luxembourg-domiciled UCITS, the Electrum strategy has also been successfully launched as an Australian Unit Trust, as well as a UK OEIC (launch imminent, with seed terms available, please [contact Baker Steel](#) for more information).

About Baker Steel Capital Managers LLP

*Baker Steel Capital Managers LLP manages the **ES Baker Steel Gold & Precious Metals Fund, Baker Steel Gold Fund, BAKERSTEEL Precious Metals Fund, BAKERSTEEL Electrum Fund, and Baker Steel Resources Trust.***

*Baker Steel has a strong track record of outperformance relative to its peers and relative to a passive holding in gold or gold equities. Fund Managers Mark Burrige and David Baker have been awarded **two Sauren Gold Medals for 2021** and were awarded **Fund Manager of the Year at the 2020 & 2019 Mines & Money Awards.***

*BAKERSTEEL Precious Metals Fund is a **2021 winner** for the fourth year running of the **Lipper Fund Awards** while Baker Steel Resources Trust has been named **Investment Company of the Year 2021, 2020, 2019, Natural Resources, by Investment Week.***

Sources: American Chemical Society, Chemical & Engineering News, Benchmark Mineral Intelligence, Northern Graphite, USGS, BMO Capital Markets

Important

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