“Our cells should be called Nickel-Graphite, because primarily the cathode is nickel and the anode side is graphite with silicon oxide [there’s] a little bit of lithium in there, but it’s like the salt on the salad”

– Elon Musk, CEO Tesla Motors
OVERVIEW

Highlights

Growth of lithium-ion battery production driven by electric-vehicle adoption will massively increase graphite demand over the next decade.

Synthetic graphite is considerably more expensive than natural graphite.

Lithium ion batteries primarily use synthetic graphite today.

The majority of natural graphite production is currently in China, but tightening of environmental regulations places this supply in doubt.

New upcoming and reliable supplies of high quality natural graphite are expected to displace synthetic graphite use in batteries.

The greater use of natural graphite is also expected to significantly reduce the cost of batteries.

The majority of this new supply of natural graphite will come from sources being developed by early stage companies.
Graphite derives its name from graphein, meaning to write/draw in Ancient Greek. The first graphite deposit was discovered in Borrowdale, England, in the 16th century, and began its use as pencil lead. In the 19th century, graphite began being used as refractory material, with the graphite crucible being used to hold molten metal. In the 1890s, Edward Acheson invented a process to produce synthetic graphite by heating silicon carbide until the silicon evaporates, leaving behind graphitic carbon. Around the same time, graphite mining boomed in Sri Lanka under British rule, becoming its primary export and peaking at half of world production in 1912.

In the late 20th century, battery production for portable electronics began driving a continuous increase in graphite demand, and low labour costs and rapid industrialization caused China’s share of natural graphite production to increase from 10% in the 1970s to 66% by 2015.

Today, continuing increase in battery demand by mass proliferation of consumer electronics and the nascent electric vehicle industry, combined with tightening environmental and export restrictions in China, create opportunities for non-Chinese producers to take advantage of the resulting supply gap.

**Beneficial properties of graphite include the following:**

- It is a very good conductor of electricity and heat.
- It has the highest natural strength and stiffness of any material.
- It is one of the lightest of all reinforcing agents.
- It can maintain its strength and stability to temperatures above 3,600°C.
- It is a highly lubricating material.
- It is chemically inert.
- It is highly corrosion resistant.

**Exhibit 1: Modern Uses for Graphite**

Source: Edison Investment Research, IMERSYS
TYPES OF GRAPHITE

Natural

Flake

Flake graphite is a naturally occurring form of graphite that is typically found as discrete flakes ranging in size from 50-800 micrometers in diameter and 1-150 micrometers thick. This form of graphite has a high degree of crystallinity, which equates to near theoretical true density, high thermal and electric conductivity, and low springback (excellent molding characteristics).

Flake graphite is used in many applications including but not limited to powder metallurgy, fuel cell bi-polar plates, coatings, thermal materials, friction moderators, electrically conductive materials, refractories, general lubricant applications, pencils, gaskets, rubber compounds, and other advanced polymer systems.

Vein

Vein graphite, also known as lump vein, crystalline vein graphite, Sri Lankan graphite, or Ceylon graphite, is a naturally occurring form of pyrolitic carbon (solid carbon deposited from a fluid phase). Vein graphite has a morphology that ranges from flake-like for fine particles, needle or acicular for medium sized particles, and grains or lumps for very coarse particles. As the name implies, this form of graphite occurs as a vein material. Vein fillings range in size from 1-150 cm. “As mined” material is available in sizes ranging from fine powder to 10 cm lumps.

Many of the highest quality electrical motor brushes and other current-carrying carbons are based on formulations using vein graphite. Vein graphite is used in battery anodes, refractories, advanced brake and clutch applications, and lubricants.
### TYPES OF GRAPHITE

#### Amorphous

Amorphous graphite is a naturally occurring seam mineral that forms from the geologic metamorphism of anthracite coal. The term “amorphous” is applied to this form of natural graphite because the extremely small “crystallite” particles that make this material do not form crystal faces that are visible to the naked eye (anhedral opposed to euhedral). To the untrained eye, a piece of amorphous graphite simply looks amorphous, like a lump of anthracite coal. “As mined” material is available in sizes ranging from mixed 1 cm and smaller particles to 10 cm lumps.

Amorphous graphite is used in many lubricant products especially greases, forging lubricants, etc. In applications where higher ash contents are acceptable or preferred, this type of graphite is a good choice.

### Selected Properties of Graphite Types

#### Exhibit 2: Selected Attributes of Natural Graphite Types

<table>
<thead>
<tr>
<th>Description</th>
<th>Flake</th>
<th>Vein</th>
<th>Amorphous</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crystalline graphite flakes; course &gt; 150 µm; fine &lt; 150 µm</strong></td>
<td>Interlocking aggregates of coarse graphite crystals, typically &gt;4 cm</td>
<td>Microcrystalline, soft earthy graphite; mostly &gt;40 µm</td>
<td></td>
</tr>
<tr>
<td><strong>Syngenetic; regional metamorphism of organic matter in metasedimentary rocks</strong></td>
<td>Epigenetic; regional metamorphism; metasomatism involving CO2-CH4-H2O fluids</td>
<td>Syngenetic; contact and/or regional thermal metamorphism of coal seams</td>
<td></td>
</tr>
<tr>
<td><strong>2-30% graphite; stratabound, tabular or lenses</strong></td>
<td>&gt;90% graphite; veins and fracture infill</td>
<td>&gt;70% graphite; in anthracitic coal layers, typically folded and faulted</td>
<td></td>
</tr>
<tr>
<td><strong>China, Brazil, India, Canada</strong></td>
<td><strong>Sri Lanka</strong></td>
<td><strong>China, Mexico, North Korea, Turkey</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: JCMI Research
TYPES OF GRAPHITE

Synthetic

Synthetic graphite is a manufactured product made by high-temperature treatment of amorphous carbon materials. In the United States, the primary feedstock used for making synthetic graphite is calcined petroleum coke and coal tar pitch, both of which are composed of highly graphitizable forms of carbon.

Synthetic graphite is used in many applications including but not limited to friction, foundry, electrical carbons, fuel cell bi-polar plates, coatings, electrolytic processes, corrosion products, conductive fillers, rubber and plastic compounds, and drilling applications.

GRAPHITE USES

Refractories

Alumina-graphite shapes are used as continuous casting ware, such as nozzles and troughs, to convey molten steel from ladle to mold, and carbon magnesite bricks line steel converters and electric-arc furnaces to withstand extreme temperatures. Graphite blocks are also used in parts of blast furnace linings where the high thermal conductivity of the graphite is critical. High-purity monolithics are often used as a continuous furnace lining instead of carbon-magnesite bricks.

Steel

Natural graphite in steelmaking mostly goes into raising the carbon content in molten steel, and can also be used to lubricate the dies used to extrude hot steel. Carbon additives are subject to competitive pricing from alternatives such as synthetic graphite powder, petroleum coke, and other forms of carbon. A carbon raiser is added to increase the carbon content of the steel to the specified level.
CEYLON GRAPHITE

We exclusively mine the purest form of graphite on the planet.
**GRAPHITE USES**

**Pencils**

Modern pencil lead is most commonly a mix of powdered graphite and clay. Low-quality amorphous graphite is used and sourced mainly from China.

**Energy Storage**

**Lithium Ion Batteries:**
Graphite is used as the anode component in lithium-ion batteries. Although lithium is the best-known component of lithium-ion batteries, there is far more graphite than lithium in a battery. Elon Musk has stated that his batteries are more graphite-nickel than lithium: "Our cells should be called Nickel-Graphite, because primarily the cathode is nickel and the anode side is graphite with silicon oxide [there’s] a little bit of lithium in there, but it’s like the salt on the salad"
The per-kW cost of lithium-ion batteries is expected to fall dramatically in the next few years, with the price of the graphite component falling by almost 50% from 2016 to 2019. This will be driven by battery manufacturers’ need to reduce costs in order to support mass adoption of electric vehicles (EVs). A key consequence is the increase in use of purified natural graphite, which is more cost-competitive than synthetic graphite, for battery applications.

In terms of individual components in a battery, graphite is by far one of the largest.

Exhibit 4: Lithium-ion Battery Composition by Mass

<table>
<thead>
<tr>
<th>Lithium-ion Battery Composition by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
</tr>
<tr>
<td>90%</td>
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<tr>
<td>80%</td>
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<td>70%</td>
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<td>60%</td>
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<td>30%</td>
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<tr>
<td>20%</td>
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<tr>
<td>10%</td>
</tr>
<tr>
<td>0%</td>
</tr>
</tbody>
</table>

Source: Argonne National Laboratory

Exhibit 5: Projected Reduction in Battery Components

<table>
<thead>
<tr>
<th>Cost Components of Average Lithium-ion Battery, 2016 and 2019 ($/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>2016</td>
</tr>
<tr>
<td>2019</td>
</tr>
<tr>
<td>$ Decrease</td>
</tr>
<tr>
<td>% Decrease</td>
</tr>
</tbody>
</table>

Source: Cairn Energy Research Advisors

<table>
<thead>
<tr>
<th>Anode Component Material Cost, 2016 and 2019 ($/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coated Graphite</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>2019</td>
</tr>
<tr>
<td>$ Decrease</td>
</tr>
<tr>
<td>% Decrease</td>
</tr>
</tbody>
</table>

Source: Cairn Energy Research Advisors
Growth in battery applications such as EVs and energy storage has been and will be the main growth driver for graphite demand in the coming decade.

Exhibit 6: Recent Shift in the Demand Mix for Graphite

Tesla’s Gigafactory 1, when complete in 2020, will require 93,000 tonnes of flake graphite annually to produce 35,000 tonnes of spherical graphite for use as anode material for lithium-ion batteries. Tesla has plans for at least two more such Gigafactories, one in the US and another in Europe.

Exhibit 7: Cars Will Overtake Electronics as the Biggest User of Batteries

Source: Informed Industrial Mineral Forums & Research
Source: Bloomberg New Energy Finance
Source: Bloomberg New Energy Finance
Energy Absolute of Thailand has plans for a $2.9 billion factory in Asia, with an annual production capacity of 1 gigawatt-hour per year, scaling to 50 gigawatt-hours a year by 2020.

Johnson Controls unveiled proposals for two Chinese plants with a combined annual capacity of 13.5 million batteries. The company already has production capacity for 16 million batteries a year, from a factory in Chongqing and one in Zhejiang, and is looking invest $250 million in a new plant that could produce up to 7.5 million units a year in Shandong from 2019. A second plant would follow in 2020. The increased capacity is aimed at satisfying growing demand from the start-stop engine market.

Overall, Bloomberg reports that global battery-making capacity is set to more than double by 2021, topping 278 gigawatt-hours a year compared to 103 gigawatt-hours at present.

This increase in production facilities will result in a corresponding surge in the demand for battery components and materials. In particular, graphite on a per tonne basis.
GRAPHITE USES

Flame Retardant

When treated with acid and heat, graphite flakes split apart and increase in volume by up to 300 times. This “expandable graphite” can be pressed into sheets and used for heat and fire protection. New legislation in China, the European Union, Japan and Korea has either required flame retardants in building codes and/or banned brominated and asbestos-based flame retardants.

Demand for this product will continue to grow and has the potential to exceed the battery market as new building compliance and retrofitting of existing buildings becomes necessary over combustibility and safety concerns.

INDUSTRY TRENDS

Natural Graphite

Worldwide consumption of natural graphite steadily increased since 2013 and into 2017, totalling 1.2 million tonnes. This increase resulted from the improvement of global economic conditions and its impact on industries that use graphite. Worldwide economically-recoverable reserves total 270 million tonnes and inferred resources of are estimated at 800 million tonnes.

Exhibit 10: 2017 Natural Graphite Reserves

Source: United States Geological Survey
2018 Asia-Pacific Exploration Mining Company of the Year

Ceylon Graphite is honoured to be named Mines and Money Asia’s 2018 Asia-Pacific Exploration Mining Company of the Year!
INDUSTRY TRENDS

During 2017, China produced two-thirds of the world’s natural graphite. Approximately 70% of production in China is amorphous graphite and about 30% is flake. Graphite production decreased in Madagascar and increased in Mexico and North Korea from that of 2016. New deposits are being developed in Madagascar, Mozambique, Namibia, and Tanzania, and mines are projected to begin production in the near future. During 2017, some of the mines in Mozambique and Tanzania began producing graphite. North America produced only 3% of the world’s graphite supply with production in Canada and Mexico.

Advances in thermal technology and acid-leaching techniques that enable the production of higher purity graphite powders are likely to lead to development of new applications for graphite in high-technology fields. Such innovative refining techniques have enabled the use of improved graphite in carbon-graphite composites, electronics, foils, friction materials, and specialty lubricant applications. Large-scale fuel-cell applications are being developed that could consume as much graphite as all other uses combined.

Exhibit 11: 2017 Natural Graphite Production
Source: United States Geological Survey
**INDUSTRY TRENDS**

**Chinese Supply**

China’s current and past dominance in natural graphite supply has mainly been due to its low-cost profile arising from lax enforcement of environmental regulations. This has resulted in negative consequences for villages surrounding graphite mines.

For example, graphite dust is carried by wind and blankets surrounding villages, destroying crops, spreading foul odours, and covering homes and belongings in soot. Moreover, chemicals used during production are directly discharged into local waters. This results in the water becoming undrinkable and poisoning crops.

This has led to China’s increasing environmental crackdown on mining companies, including graphite miners, calling into question the ability of Chinese supply to satisfy future battery-graphite demand.

**Synthetic Graphite**

The annual supply of synthetic graphite is approximately 1.5 million tonnes, with the majority also originating from China. Synthetic graphite competes with natural graphite for use in lithium-ion battery anodes. However, this comes at an extremely high cost (as much as $20,000/tonne). Battery makers are therefore turning to upgraded natural graphite, which also has a high production cost, but is still more competitive than synthetic, at $5,000/tonne. As such, synthetic graphite will be less favoured for use in battery applications unless there is a shortage in natural graphite.

**Market Characteristics**

Unlike other commodities, which are typically traded via organized commodities exchanges, graphite is sold via informal supply networks and specialist traders. Pricing therefore tends to be opaque. Graphite grades are based on flake size, measured in US Mesh, with higher prices for larger flake sizes, as well as purity, with higher prices for higher carbon.
Production Economics

After graphite ore is extracted from a deposit, it is crushed and ground, and passes through several.

The total cost of this process depends on the type and grade of graphite produced, and typically falls in the following ranges:

- **Vein**: $250 - $350/tonne
- **Flake**: $400 - $600/tonne
- **Amorphous**: $150 - $250/tonne

As vein graphite typically has a higher carbon content in situ and is found in locations with abundant low-cost labour, it is the most attractive resource for graphite producers. It is particularly attractive for use in battery applications due to the lower cost of purification.
INDUSTRY TRENDS

Upgrading to Battery Grade

Battery anodes require coated spherical graphite at over 99.9% purity. Approximately 3 tonnes of natural graphite yield 1 tonne of spherical coated graphite, and 1 kg of spherical coated graphite is needed for 1 kWh of battery capacity.

The initial flotation process is required to bring graphite ore to concentrate grade (>95% C); this step is minimized for vein graphite, as the ore is already at high purity. To achieve purity beyond 99%, two chemical methods are typically used. Caustic baking at elevated temperature dissolves impurities such as feldspar, quartz and mica followed by acid washing, and hydrofluoric leaching followed by sulfuric acid washing removes silicates. The higher the initial purity, the lower the cost of chemical purification, as fewer treatment cycles are required. Other steps include micronizing, rounding, and heat treatment, producing uncoated spherical graphite. This upgrading process is expensive and wastes up to 70% of the initial graphite, which is why uncoated spherical graphite sells for over 3 times the price of untreated graphite concentrate.

Finally, the spherical graphite is coated with another layer of carbon using proprietary technology, producing coated spherical graphite, which can sell for up to $10,000/tonne.
INDUSTRY TRENDS

List of Publicly Traded Natural Graphite Companies

There is very little production currently being supplied in the market from these publicly traded companies as most are still in their early stages of development. In situ purity and ultimately the related cost to bring battery grade supply to market will ultimately determine which of these potential sources of supply will join the Chinese supply of natural graphite.
As graphite uses and applications continue to trend toward more advanced technological uses, the demand for purer and higher quality will continue to increase.

At Ceylon Graphite, we rise to meet this global demand by increasing in the exploration, mining and extraction of high-yield, and highest quality vein graphite, found exclusively in Sri Lanka.
FORWARD LOOKING STATEMENTS: This news release contains forward-looking information as such term is defined in applicable securities laws, which relate to future events or future performance and reflect management’s current expectations and assumptions. The forward-looking information includes statements about Ceylon Graphite’s grids, Ceylon Graphite’s plans to undertake additional drilling and to develop a mine plan, Ceylon Graphite’s a Mining License application and to commence establishing mining operations. Such forward-looking statements reflect management’s current beliefs and are based on assumptions made by and information currently available to Ceylon Graphite, including the assumption that, the drilling exercises will confirm the presence of high quality graphite, sufficient financial resources will be available, the records from the drilling exercises prove to be accurate, there will be no unanticipated delays or costs materially affecting Ceylon Graphite’s exploration, development and production, there will be no material adverse change in metal prices, all necessary consents, licenses, permits and approvals will be obtained, including various Local Government Licenses and the market. Investors are cautioned that these forward-looking statements are neither promises nor guarantees and are subject to risks and uncertainties that may cause future results to differ materially from those expected. Risk factors that could cause actual results to differ materially from the results expressed or implied by the forward-looking information include, among other things, an inability to reach a final acquisition agreement, inaccurate results from the drilling exercises, a failure to obtain or delays in obtaining the required regulatory licenses, permits, approvals and consents, an inability to access financing as needed, a general economic downturn, a volatile stock price, labour strikes, political unrest, changes in the mining regulatory regime governing Ceylon Graphite, a failure to comply with environmental regulations and a weakening of market and industry reliance on high quality graphite. Ceylon Graphite cautions the reader that the above list of risk factors is not exhaustive. These forward-looking statements are made as of the date hereof and, except as required under applicable securities legislation, Ceylon Graphite does not assume any obligation to update or revise them to reflect new events or circumstances. All of the forward-looking statements made in this press release are qualified by these cautionary statements and by those made in our filings with SEDAR in Canada (available at www.sedar.com)