Industrial Commodities Outlook

INDUSTRIAL METALS AND MINERAL COMMODITIES MAY NOT HAVE THE GLAMOUR OF GOLD OR DIAMONDS BUT THEY ARE JUST AS DESIRABLE. THEY ARE A NECESSITY

COBALT: NO SUBSTITUTE

by Peter Clausi

WHILE LITHIUM GRABBED world headlines in 2016, its battery-partner cobalt quietly gained roughly 50% on the year. The ballooning price was driven by Economics 101: demand greatly exceeded supply. It is expected this will continue in 2017 and beyond.

Roughly 55% of the world's cobalt comes from the Congo, as a trace by-product of copper mining. It is not possible to mine only the cobalt. With the horrible war in the Congo having claimed at least six million lives, copper production declined in 2016, taking cobalt production with it. As reported in December 2016 by the Congo's central bank, "Production of cobalt, the metal used in lithium-ion batteries and of which Congo is the world's leading producer, slipped 0.8% to 21,493 tonnes in the third quarter and is down 9% so far this year."

Cobalt production is also slated to fall from the Philippines as cobalt-bearing nickel mines there are shut-in for environmental reasons.

On the supply side, only one new source of cobalt claims to be coming on stream in 2017 (from **Katanga Mining Ltd.** [KAT-TSX], again in the Congo). Katanga claims it will increase its production of cobalt roughly 10 times to roughly 22% of global supply, a claim that is difficult to understand, not only because of normal logistical mine production issues but also for its location in conflict Africa.

In North America, the only viable near-term cobalt play is **eCobalt Solutions Inc.** [ECS-TSX], with a deposit in south Idaho

LEFT: Geoprobe work at the Dajin Resources Teels Marsh lithium project in the Clayton Valley, Nevada. Pediment Gold LLC is the operator. Photo by Dick Benoit/courtesy Dajin Resources Corp.

roughly 250 miles from Tesla Motors' Gigafactory. The average cobalt grade there is 0.5%. Production is scheduled to begin roughly two years after eCobalt raises the US $150 million in the CAPEX needed for the feasibility study; but even then, at peak production, this deposit would contribute only 1,500 tonnes of cobalt per year to a global market of 100,000 tonnes. (As an aside, eCobalt could be takeout target by Tesla.)

On the demand side, cobalt has been used for years in magnets, alloys, medical devices, radiation therapy and paints (totalling roughly 50,000 tonnes annually). The largest demand now, though, is in rechargeable batteries.

While physics demands they be called "lithium-ion" batteries, these storage devices contain far more cobalt than lithium. The battery in your cell phone, for example, is roughly 60% cobalt by weight. The battery in a laptop is roughly 15% cobalt by weight. In the batteries for electric cars, somewhere between 6 and 12% of the battery's weight is cobalt.

This demand is only going to increase. There are roughly 30 electric car manufacturers globally, from the well-known names like Nissan, Mercedes, Chevrolet and Tesla, to the lesser-known like Chery, SAIC, and CityEl, with more models appearing on the market annually. They all require cobalt for its energy density properties. Tesla's widely marketed Model 3, for example, by itself will consume roughly 7,500,000 kg of cobalt, or close to 8% of global production.

This demand is driven by bottom-up consumer demand and top-down government policy. For example, Germany has said it will ban the sale of combustion engines by 2030. There is nothing to take their place except electric batteries. There is no substitute for cobalt in these batteries. The amounts may vary depending upon the manufacturers' specs on a model by model basis, but these batteries cannot function without cobalt.

Declining production plus increasing demand equals opportunity. Expect cobalt to continue its run well past 2020.

GRAPHITE'S NEW CHAPTER

by Daniel McGroarty

GRAPHITE'S ROLE in the history of human technology is right there in its name: Graphein, derived from the Greek word meaning "to write," referring to the early use of the material in the form of what later came to be called lead pencils. And yet the 21st century may be graphite's most important yet: As the American Resources Policy Network puts it, "Graphite today is at the core of more than just your lead pencil – it is at the core of 21st century consumer technology." Laptops and LEDs, smartphone and solar cells, Electric Vehicle batteries, drones and satellites, energy storage devices – even nuclear reactors: each of these and many more applications depend on graphite as a key means for the efficient transmission of power.

Particularly as electric vehicles achieve higher levels of adoption and energy storage technology matures, growing graphite demand will put increasing pressure on supply. And the demand spike is dramatic. At least one private analytical firm projects demand for graphite to increase 200% between now and 2020, fueled by the rapid increase of lithium-ion battery anode production. Exploding demand for key graphite uses is one of the drivers behind the US and European Union identifying graphite as a "critical risk" material.

In some instances, to be sure, substitution for natural graphite is possible. Yet synthetic graphite, a material processed from petroleum coke, has its own limitations, both in terms of price – depending on the application, it can be two to 10 times as expensive as natural graphite, inhibiting its widespread use – and functionality, as some applications show a marked improvement in the performance of natural flake graphite over its synthetic counterpart.

Each of these factors combines to create pressure to bring new sources of natural flake graphite supply, especially in the form of high-purity Spherical Graphite, into the market. In the US, graphite import dependency is 100%, and has been for more than 25 years, since the last American graphite mine ceased operations. Globally, China accounts for roughly 65-70% of worldwide production, with India, Brazil, Turkey, Canada and North Korea combined providing almost 30% of the remaining annual supply. The concentration of such a large percentage of production in one country, a nation that increasingly puts a significant amount of that production into internal use, has led to concerns about surety of supply. One industry analyst asks rhetorically, "Could Beijing use its ownership stake [in graphite mines] to decide who can buy which resources and at what price? Yes."

Bringing new natural flake graphite mines into production will be critical to meeting rising tech demand, and with it, the ability to sustain advanced manufacturing in the 21st Century. All of which, when inventors, entrepreneurs and engineers are writing the next chapter of technological progress, makes graphite one of the world's most indispensable mineral resources.

The **Graphite One Resources Inc.** [GPH-TSXV] Graphite Creek Project, the US's largest known large flake graphite deposit, is located north of Nome, Alaska. Graphite Creek measures nearly 18 mil-

lion tonnes of indicated resources at 6.3% graphitic carbon. Tests using Graphite One material have produced premium spherical graphite of the kind sought for advanced technology applications. As of this writing, the company plans to release its maiden Preliminary Economic Assessment at the end of January 2017.

LITHIUM: DEMAND INTENSIFYING

LITHIUM MAY BE the lightest metal on Earth but it is a heavyweight in the rechargeable battery sector, in particular in the automotive and electronic device sectors. There are two types of lithium deposits – brines and hardrock (the mineral spodumene).

While worldwide lithium production is dominated by only four major lithium producers, there are currently over 50 junior exploration companies either seeking an economic lithium deposit or advancing known deposits. A few have partnered up with a lithium producer such as junior **Advantage Lithium Corp.** [AAL-TSXV] and producer **Orocobre Ltd.** [ORL-TSX]. Lithium brine production is the most cost-efficient mineral product and dominates world production; however, advanced-stage, hardrock lithium company **Nemaska Lithium Inc.** [NMX-TSX] has a mining and processing project in the works in Québec.

Besides the huge demand for rechargeable and non-rechargeable batteries, lithium is also used in grease, polymers, ceramics, glass, alloys, optics, lubricants, pharmaceuticals and other applications. There are a number of lithium chemical products produced, including lithium carbonate, lithium bromide, lithium chloride, butyl lithium and lithium hydroxide. Lithium is sold as brines, compounds, metal, or mineral concentrates depending on the end use. **Alcoa** has developed a lithium metal alloy to make lighter aircraft.

At present, there are a number of junior explorers targeting lithium brines in Nevada, where **Albemarle Corp**. [ALB-NYSE] is a producer. Brines are also being explored, called salars (salt lakes) in Argentina, including **Argentina Lithium and Energy Corp.** [LIT-TSXV], **Dajin Resources Corp.** [DJI-TSXV] and **Lithium X Energy Corp.** [LIX-TSXV].

There are actually only a few places in the world where lithium brines are found in economic quantities. To form a deposit, the lithium is concentrated in desert valleys that have no water exits, allowing the lithium levels to build up over thousands of years.

Several developments are coming together that point to a bright future for the lithium industry. The demand for electric cars has been slow to develop but the dropping price of batteries plus the longer driving range of newer models such as the affordable Chevrolet Bolt and Tesla coupled with more recharging stations are going a long way to relieve "range anxiety."

Consequently, we are seeing reports such as Bloomberg estimating that by 2022 electric cars will be cost-competitive on a lifecycle basis with gasoline cars. Indeed, a report in *The Australian* forecasts a +500% battery consumption over the next 10 years. Advantage Lithium notes that EV (electric vehicle) production is growing by 45% per year, energy storage demand is doubling each year and lithium demand is outstripping supply by 15% of total supply. ■