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Battery Metals Report 2021

Everything you need to know about the battery metals lithium, nickel, cobalt and copper!

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Preface

Dear Readers,

We are pleased to present the eleventh edition of our Battery Metals Report.

Our special report series started in the fall of 2016 with lithium, as we see this metal, as well as cobalt, nickel and copper, as one of the major energy metals of the future and as a great opportunity with a lot of potential. E-mobility is on the rise and for a good year now, the eagerly awaited hybrid and all-electric models from many well-known manufacturers have finally been coming onto the market. What began with the founding of Tesla Motors 18 years ago is now unstoppable. Volkswagen alone is planning around 70 new electric models by 2030, as are Mercedes, Audi and BMW. The electric car is well established and has won a place among consumers, partly because politicians have recognized that a world that is as CO_2-free as possible will only be possible with electric mobility and are promoting this accordingly by means of start-up funding.

Lithium, nickel and cobalt are the main components of all batteries and accumulators available in large series and thus the main link in the electric vehicle dream. The movements in Germany are interesting, where not only Tesla is building a factory (Gigafactory), but several well-known battery manufacturers have now pitched their tents.

All these factories will be enormous drivers of demand for lithium, cobalt and nickel, but also for copper. Millions of tons of copper will be needed in the future not only for cars, but especially for the charging infrastructure. 2020 was clearly the start of a decade for commodities, as they are – and will remain – the basis of everything we do economically. Supply will barely be able to keep up with the demand that will set in once the Corona virus is overcome.

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My team and I hope you enjoy reading the Battery Metals Special Report and we hope to provide you with lots of new information, impressions and ideas.

Yours, Jochen Staiger

Jochen Staiger is founder and CEO of Swiss Resource Capital AG, located in Herisau, Switzerland. As chief-editor and founder of the first two resource IP-TV-channels Commodity-TV and its German counterpart Rohstoff-TV, he reports about companies, experts, fund managers and various themes around the international mining business and the correspondent metals.

Tim Rödel is Manager Newsletter, Threads & Special Reports at SRC AG. He has been active in the commodities sector for more than 15 years and accompanied several chief-editor positions, e.g. at Rohstoff-Spiegel, Rohstoff-Woche, Rohstoffraketen, the publications Wahrer Wohlstand and First Mover. He owns an enormous commodity expertise and a wide-spread network within the whole resource sector.

Battery production is exploding! –
And with it the prices for battery metals!

How a fixed idea led to a world-wide revolution ...

Although the electric motor was invented in the mid-19th century, it was the South African Elon Musk who, at the beginning of the 21st century, had the obsession of electrifying locomotion on two or four wheels. When he founded Tesla Motors in 2003, he and his colleagues were probably not (yet) aware that it would take almost 20 years for the entire world to be electrified by his idea. Today, Tesla is a global brand and Musk is one of the richest people on the planet. However, this was certainly not the intention, which is why Musk took on a lot of risk and, in the meantime, a lot of ridicule as well as headwind from all kinds of opponents of electric mobility. For him, as a visionary, it was more about creating something new, away from old ways of thinking and towards a cleaner and smarter world.

... and now also electrifying the commodity markets

Almost 20 years later, well over 100 electric car models are already on the market worldwide. By 2022, there will be 500. In 2015, the number of new electric vehicles registered each year was just 450,000 worldwide. In 2020, the figure was 1.7 million. According to estimates by Bloomberg experts, there will be 8.5 million in 2025, 26 million in 2030 and 54 million in 2040. Mind you, per year, not in total. Taken together, there were about 8.5 million electric vehicles on the roads worldwide in 2020. In 2030, there will be about 120 million.
This requires vast quantities of materials and metals that are or were only used in small quantities or not at all in conventional vehicles with internal combustion engines. First and foremost, these include materials that are necessary for the battery and for the connections between individual components. These are primarily the battery metals lithium, nickel, manganese and cobalt, as well as copper and graphite. The good thing about this from the point of view of raw material investors is that the quantities required for this cannot even be provided with the current mines. There is a threat of supply bottlenecks, which will cause prices for most of these materials and metals to soar to previously unimagined heights. Some of these prices have already risen, but investors still have an excellent opportunity to enter the world of battery metals, as we will explain in detail below.

The „electric revolution“ is catching on ...

Electric locomotion is only one of several aspects of the electric revolution. The leap from the age of fossil combustion and the most immediate possible consumption to the decentralization of energy generation, the corresponding need for on-site storage of electrical energy and, ultimately, to a true revolution in mobility has begun, but the electric boom will really take off from now on, and not only in automotive engineering.

... and above all, electromobility is picking up speed!

However, the automotive industry is clearly playing a pioneering role here, as many countries have jumped on the electromobility bandwagon and introduced measures to accelerate the move away from the internal combustion engine and towards the electric motor at the same time, particularly in order to achieve the climate targets they have set themselves. Many cities, regions, and countries around the world have already made a concrete commitment to the end of the internal combustion engine. For example, most U.S. states have set an end to the sale of internal combustion vehicles for the years between 2030 and 2050. The EU officially wants only 30% sales of electric vehicles by 2030, although many member states have also already firmly planned a ban on the sale of internal combustion vehicles from 2030, such as Italy (2030), Spain (2040) and Germany (2050). In the event of a Green government participation, the phasing out of the combustion era in Germany will certainly be brought forward further. China officially wants 20% electric vehicles sold by 2025 and an end to the sale of internal combustion vehicles by 2050.

Car manufacturers plan to build many millions of electric vehicles

In the EU in particular, many internal combustion engines are likely to be phased out very quickly and the corresponding car manufacturers will have to switch to electric vehicles at an accelerated pace in order to comply with the strict environmental requirements of the EU. The following plans should only be seen as a basis, which will be increased year by year:

- **BMW:** By 2025, 15 to 25% of all vehicles produced are to be purely electric, which means a total of around 300,000 to 600,000 vehicles;
- The **Chinese automakers**, which now number more than 170, plan to put at least 4.5 million electric vehicles on the road starting this year;
- **Daimler**: Ten new electric models by 2022. 15 to 25% of all vehicles produced are to be purely electric by 2025, which means a total of around 300,000 to 600,000 vehicles;
- **Ford**: By 2022, at least 13 models are to be electrically powered, which is about 10 to 25% of the complete model range;
- **General Motors**: 20 new electric models by 2023 and complete conversion to electric mobility – timeframe still open;
- **Honda**: In 2030, two-thirds of all models are to run on electric motors – around 3.3 million as things stand today;
- **Hyundai**: At least 10% electric vehicle share by 2025 – 800,000 vehicles;
- **Peugeot**: 80% conversion to electric drive by 2023;
- **Porsche**: Conversion of 90% of the product range to electric drives;
- **Renault/Nissan**: 1.5 million vehicles from 2021;
- **Tesla**: 1 million vehicles as of now;
- **Toyota**: 50% conversion to electric drive and hybrid by 2030 ;
- **VW Group**: By 2025, 20 to 25% of all vehicles produced are to be purely electric, which means a total of around 2 to 3 million vehicles. By 2030, 300 electric models are to be launched on the market.

The lithium-ion battery will be the non-plus-ultra for many years .....

In addition to the engine, the heart of every electric vehicle is the energy storage unit, i.e., a rechargeable battery. In order to be operated economically in the long term, electric vehicles, but also increasingly emerging decentralized storage systems – for photovoltaic or wind power plants, for example – require ever more powerful rechargeable batteries. The lithium-ion battery has now emerged as the clear favorite. One of the reasons for this is that within a lithium-ion battery, the voltage is achieved by exchanging lithium ions. Because of their high energy density, lithium-ion batteries deliver constant power over the entire discharge period and do not exhibit any so-called memory effect, i.e., successive loss of capacity over many years of use or frequent partial discharge. The name „lithium-ion battery“ is only the generic term for a whole range of possible chemical structures, such as the lithium-cobalt (dioxide) battery, the lithium-manganese (dioxide) battery, the lithium-iron phosphate battery and – less commonly – the lithium-titanate battery and the tin-sulfur lithium-ion battery. The most common battery is currently the lithium-nickel-manganese-cobalt (abbreviated NMC) battery.

... but the development continues steadily – away from cobalt, towards nickel!

Although not much has changed in the basic principle of the lithium-ion battery over time, development continues all the time. The main focus is on efficiency and charging capacity (in the case of electric vehicles, this is often referred to as range), but also on the use of metals and elements. In this respect, a transformation is currently taking place away from high proportions of cobalt (NMC 111, where the numbers indicate the ratio of nickel, manganese and cobalt) to a higher proportion of nickel (NMC 811), although development is currently still at corresponding intermediate stages (NMC 622 / NMC 532). NMC 111 is considered the simplest battery version, based on an equal amount of the atoms of the three elements, NMC 532/622 have a higher energy density and a lower price than NMC 111 due to a lower cobalt content, and NMC 811 is the latest and most advanced battery version with the highest theoretical lithium and cobalt performance. It was precisely because of this trend toward higher nickel content that Tesla CEO Elon Musk literally begged relevant mining companies to develop new nickel mines in 2020.

Manufacturing facilities (gigafactories) for rechargeable batteries and corresponding materials are springing up like mushrooms

While European and North American manufacturing pipelines have increased significantly over the past 12 months, China remains by far the most aggressive country in building lithium-ion cell manufacturing capacity to support its electric vehicle and energy storage industries. Currently, 148 of the world‘s approximately 200 manufacturing facilities, or „gigafactories,“ are in the pipeline in China, while Europe and North America have only 21 and 11 gigafactories in the pipeline, respectively. 122 gigafactories are already in operation, with many of them currently ramping up production.

Asians dominate the battery sector

Today, China alone provides a large share of the total demand for lithium-ion batteries. China is expected to continue to see the strongest annual increase in lithium and cobalt demand of all major market players over the next 5 to 10 years, largely due to an expected multiplication in the number of units of rechargeable batteries. Other key suppliers of lithium-ion batteries, including South Korea and Japan, are also expected to guarantee robust growth in lithium and cobalt demand. Foremost among these are electronics giants Panasonic, Samsung, LG Chem, BYD, Boston Power, Lishen, CATL, Dynavolt and Great Wall. Experts estimate that by the end of 2021, 77% of global lithium-ion production capacity will be located in China. Based on current plans in the pipeline, China will still account for 67% of global lithium-ion battery capacity in 2030.

The EU is now really stepping on the gas!

The EU, which seemed to sleep through the development of battery production for years, has been able to catch up powerfully with China thanks to many governmental and also private support programs and not least thanks to its strong industrial base.

Tesla‘s Gigafactory near Berlin and Northvolt‘s Gigafactory in Skellefteå in northern Sweden are just a taste of what is to come in the next 10 years. By 2030 alone, more than 25 corresponding production sites for batteries and/or cathode materials are planned. Currently, the planned battery capacity is at least 800 GWh by 2030. (see graphic p. 30)

North America is Tesla country

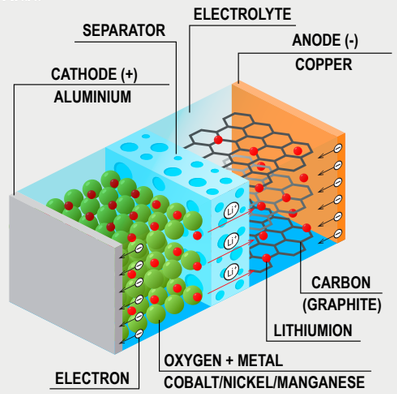
In North America, Tesla holds the dominant position in lithium-ion battery production. The company has been operating the so-called „Gigafactory 1“ in Nevada since 2016. Lithium-ion batteries, battery packs, electric mo-

Composition and operating principle of a lithium-ion accumulator

Composition of a lithium-ion accumulator

Essentially a lithium-ion accumulator consists of the following components and materials:

- **Positive electrode (cathode):**
  Lithium-Cobalt(III)-oxide
  Lithium-Nickel-Manganese-Cobalt-Oxide
  Oxygen
  Aluminum as conductor material
- **Negative electrode (anode):**
  Graphite or related carbon materials
  Silicon
  Tin dioxide
  Copper as conductor material
- **Electrolyte (solution)**
- **Polymer membrane separator**



Functionality of a lithium-ion battery

In simple terms a lithium-ion accumulator generates an electromotive force by the movement of lithium-ions. During charging the positive lithium-ions migrate through the electrolyte and the separator from the positive to the negative electrode. In the process the lithium-ions can move freely between the two electrodes through the electrolyte within the accumulator. Unlike the lithium-ions the transition metal and graphite structures of the electrodes are stationary and protected by a separator from a direct contact. The mobility of the lithium-ions is necessary for the compensation of the external current during recharging and discharging so that the electrodes stay largely electrically neutral. The negative electrode is a so-called graphite intercalation compound where lithium exists as cation. During discharge the intercalation compound emits electrons which flow back to the positive electrode viathe extern circuit. Simultaneously many Li+ ions migrate from the intercalation compound through the electrolyte also to the positive electrode. At the positive electrode the lithium-ions do not receive the electrons of the external circuit but the present structures of the transition metal compounds. Depending on the type of accumulator these are cobalt, nickel, manganese or iron ions that change their charge.

(Source: markus-spiske, unsplash)

tors and drive units for up to 500,000 electric vehicles per year are built there. „Gigafactory 2“ is a photovoltaic factory and is located in Buffalo, New York. „Gigafactory 3“ was completed in record time in China, near Shanghai, and is expected to produce the same number of vehicles as the Nevada plant.

More gigafactories are emerging in North America

Tesla is far from the only lithium and cobalt consumer planning major lithium-ion battery production. LG Chem already started production for Chevy in Michigan in October 2015. Foxconn, BYD (the world‘s largest producer of rechargeable batteries, especially for cell phones), Lishen, CATL and Boston Power are also working on the construction of their own gigafactories, including for so-called power banks, i.e., decentralized electricity storage.

Lithium-ion batteries are the current state of the art and market leader

In addition to the already mentioned raw materials lithium, cobalt, nickel and manganese, a lithium-ion battery essentially also consists of aluminum, copper, graphite, zinc, tin, silver and steel. The majority of (lithium-ion) batteries currently on the market are lithium-cobalt (dioxide) batteries, which is why this report deals primarily with the battery metals lithium, nickel and cobalt. We will also take a look at copper, which is becoming increasingly important.

Lithium

The element lithium

Lithium is a light metal from the group of alkali metals. It has the lowest density of all known solid elements. It is only about half as heavy as water, naturally silvery white and relatively soft. Lithium is highly reactive, which is why it basically always occurs as a lithium compound in the wild. It tarnishes rapidly in air, due to the formation of lithium oxide and lithium nitride. In pure oxygen, it burns with a bright red flame at 180°C to form lithium oxide. Lithium reacts very strongly with water to form lithium hydroxide.

[HE] $2s^1$ 3

Li

Melting Point 180,54° C
Boiling Point 1330°C

LITHIUM

Lithium extraction is either lengthy or expensive

The world lithium production is divided into several different branches, which produces the following types of lithium compounds:

1. Lithium carbonate,
2. Lithium hydroxide,
3. Lithium chloride,
4. Butyllithium and
5. Lithium metal.

Metallic lithium is usually produced from lithium carbonate in a multi-stage process and is usually traded with a purity of 99.5%. This metallic lithium is used as a catalyst in the chemical and pharmaceutical industries and for the production of aluminum-lithium alloys.

The industry essentially distinguishes between three types or qualities of lithium compounds:

1. „Industrial Grade“, with purity over 96%, mainly for glass, casting powder and lubricant,
2. „Technical Grade“, with a purity of about 99.5%, mainly for ceramics, lubricants and batteries, and
3. „Battery Grade“, with purity above 99.5%, mainly for high-end cathode materials in batteries and rechargeable batteries.

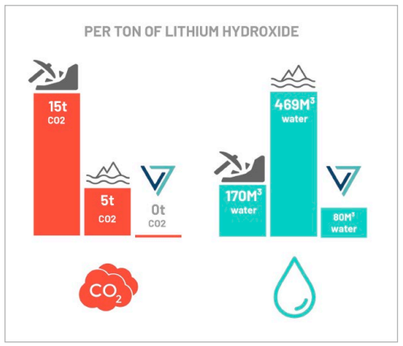
There are two types of lithium deposits

Lithium is generally obtained from two different sources.

1. So-called „brine“, i.e. (salt) sheet or brine deposits: Mainly in salt lakes, lithium carbonate is extracted from lithium-containing salt solutions by evaporation of the water and addition of sodium carbonate. To extract metallic lithium, the lithium carbonate is first reacted with hydrochloric acid. This produces carbon dioxide, which escapes as a gas, and dissolved lithium chloride. This solution is concentrated in a vacuum evaporator until the chloride crystallizes out.
2. So-called „hard rock spodumene“, i.e., hard rock pegmatite deposits: Here, lithium compounds are not extracted from the salt of lakes, but from spodumene, a lithium-bearing aluminum silicate mineral. Mined by conventional mining technology, the concentrate obtained is often converted to lithium carbonate with a purity of more than 99.5%. The intensive thermal and hydrometallurgical process required for this is considered to be very costly. Such deposits are currently exploited almost exclusively in Australia, with further processing largely taking place in Chinese facilities.

Advantages and disadvantages of the different funding sources

The two sources (brine deposits/hard rock deposits) each have opposite advantages and disadvantages with regard to the extraction of lithium. While the extraction of one ton of lithium hydroxide from brine deposits requires about 469 cubic meters of water, one ton of lithium hydroxide from hard rock deposits requires only about 170 cubic meters of water. The opposite is true for the CO_2 balance. While the extraction of one ton of lithium hydroxide from brine deposits produces only about 5 tons of CO_2, one ton of lithium hydroxide from hard rock deposits produces about 15 tons CO_2.
The question is: What weighs more with the battery and car manufacturers? And CO_2 neutrality seems to have the edge here. By the way, currently about 60% of all lithium hydroxide mined worldwide is extracted from hard rock deposits and only 40% from brine deposits.



(Source: Vulcan Energy)

New processing and lithium sources could revolutionize production

Recently, more and more exploration and development companies are focusing on new technologies that will help to extract lithium from brine deposits within days and even hours instead of using natural evaporation. The processes of Tenova Bateman and IBC Advanced Technologies are worth mentioning in this context.
In addition, several lithium development companies have identified a third lithium source. There is the possibility to extract lithium from old, exploited oil reservoirs. The lithium is extracted from the wastewater remaining in the reservoirs. It has already been proven several times that this process works. In addition, this unusual lithium extraction process also appears to be economically feasible. Thus, brine-bearing (former) oil fields are also becoming a focus of the lithium industry.

Major lithium deposits are concentrated in a few regions

Lithium accounts for about 0.006% of the earth's crust, making it slightly less abundant than zinc, copper, and tungsten, and slightly more abundant than cobalt, tin, and lead. Estimates from the U.S. Geological Survey suggest that about 21 million metric tons of lithium are recoverable as reserves and 86 million tons are recoverable as resources worldwide. About 53% of the reserves in the South American countries of Chile and Argentina alone. The largest lithium carbonate production currently occurs in the Salar de Atacama, a salt lake in the northern Chilean province of Antofagasta. However, about 49 percent of global lithium production of about 82,000 metric tons in 2020 came from Australia, but at a much higher cost than in South America. In addition, significant lithium deposits are found mainly in North America and China.

Lithium production is currently concentrated mainly in four countries and a few companies

Australia, Chile, China and Argentina currently account for around 95 percent of the world's total lithium production, which is shared among only a few companies. As a result, the entire lithium market is very opaque, which is why the large battery and accumulator manufacturers, such as Panasonic, have recently relied primarily on long-term supply contracts with relatively small development companies, some of which will not produce before 2023. As a consequence of this supply oligopoly, lithium is currently not traded on the stock exchange, the actual trading prices are strictly confidential.
One reason for this, which the few suppliers always like to give, is that the available and required lithium qualities are too different for a standardized exchange trading place.

Main applications are alloys, lubricants and accumulators

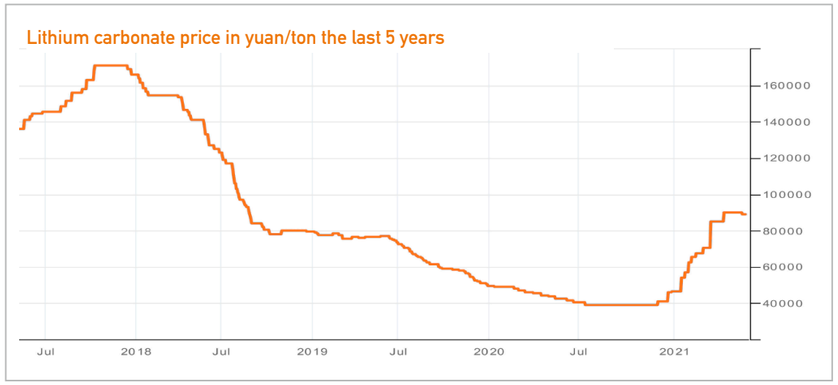
Its above-mentioned special and versatile properties make lithium a sought-after material in very many different areas of application. It should therefore come as no surprise that the main area of application for lithium has changed constantly in the past. Initially used mainly in medicine, the element began its triumphant advance in the 1950s as a component of alloys. Its low weight, but also its positive properties in terms of tensile strength, hardness and elasticity, made it an integral part of aerospace technology in particular. In the past 20 years, this picture has changed once again. As the electric revolution got underway, it was quickly recognized that its low normal potential made it almost perfect for use as an anode in batteries. Lithium batteries are characterized by a very high energy density and can generate particularly high voltages. However, lithium batteries are not rechargeable. Lithium-ion batteries, on the other hand, have this property, with lithium metal oxides such as lithium cobalt oxide connected as the cathode. However, as a raw material for the production of accumulators and batteries, purity levels higher than 99.5% are required. Lithium hydroxide in the „Industrial" grade is used, among other things, as a raw material for lubricants and coolants; with the higher „Technical" grade, it is also used in accumulator and battery production. Lithium carbonate – crystalline, granulated or in powder form – is used, for example, in the electrolytic production of aluminum, in the ceramics and pharmaceutical industries, and in alloying technology. Special purity grades of lithium carbonate in the form of very fine powder (battery grade powder) are suitable as a raw material for the production of lithium-ion batteries. The extraction and processing of (especially high-grade) lithium is considered very costly.

The production of lithium-ion batteries requires a large amount of lithium

A large amount of lithium is required for the production and operation of lithium-ion batteries. Each smartphone contains between 5 and 7 grams of lithium carbonate equivalent (LCE). For a notebook or tablet, the figure is 20 to 45 grams. Power tools such as cordless screwdrivers or electric saws require about 40 to 60 grams for their batteries. A 10 KWh storage unit for household use requires about 23 kilograms of LCE, while batteries for electric cars need between 40 and 80 kilograms. An energy storage system with 650 MWh capacity needs about 1.5 tons of LCE.

Lithium production will (and must) increase sharply

In 2020, global lithium production was around 430,000 tons LCE. Projections assume that this figure could rise to a maximum of about 580,000 tons LCE with today's mining activity, whereby only very few efforts for concrete mine expansions or new mines have been made so far, so that lithium is practically likely to run into a huge supply deficit. In addition, recent reports about several postponed mine starts caused additional uncertainty on the supply side.



(Source: own representation)

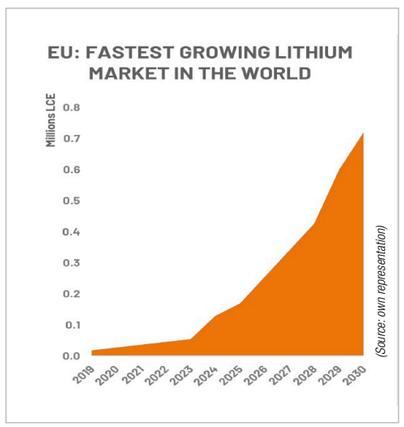
The decisive factor is always the price, but this is relatively insignificant for battery production!

Ultimately, it is the price alone that determines the economic recoverability of the existing lithium deposits. While the price was still around US$6,000 per ton of lithium carbonate in mid-2015, it has since peaked at over US$20,500. Currently, it has recently recovered to US$13,500 (90,000 yuan). Certainly, only a snapshot. It can be assumed that in the medium to long term it will settle between US$12,000 and US$14,000 per ton of lithium carbonate. Either way, this is a lucrative business for the producers, as the pure extraction costs for the current projects are only around US$1,800 (Chile) to US$6,700 (China) per ton. This is similarly the case for lithium hydroxide. **Since lithium makes up a significant part of a battery in terms of volume but is only responsible for about 4-5% of the costs of a battery, the lithium price is ultimately relatively insignificant for the production of lithium-ion batteries and should therefore be able to be maintained at an economic level for the lithium producers.**

Demand for lithium is increasing rapidly – high supply deficit foreseeable from 2023!

The demand for lithium appears to be almost gigantic, not only due to, but primarily because of the new boom sector of electromobility! While in the case of lithium this was still around 65,000 tons of LCE in 2000, by 2020 there was already 305,000 tons of LCE in demand per year. By 2022, experts expect LCE demand to rise to over 500,000 tons, and by 2025 to over 800,000 tons per year.

The main driving factor will be demand from the battery sector and the associated automotive industry. Assuming that a maximum of 580,000 tons of LCE can be extracted per year from existing mines and that new mines cannot be commissioned in the short term, a supply deficit of well over 200,000 tons is indicated for 2025 alone! For 2030, the outlook is even bleaker. A bottleneck of unimagined proportions is looming here.



Nickel

The element nickel

Nickel is a metallic, silvery shiny transition metal. It is medium hard, malleable and easily polished. Like cobalt, nickel is ferromagnetic and also highly resistant to air, water, hydrochloric acid and alkalis at room temperature, which makes it ideal for use in lithium-ion batteries.

Extraction

Most of the nickel is extracted from nickel- and copper-bearing iron ores. A multi-layer process is used to produce copper-nickel fines, which consist of about 80% copper and nickel and about 20% sulfur. To obtain the crude nickel, the nickel must be separated from the copper. To obtain pure nickel, the crude nickel is electrolytically refined. The purity of electrolytic nickel is about 99.9%.

Occurrence and production

Nickel occurs in the earth's crust with a content of about 0.008%, i.e. with about twice the amount of cobalt and somewhat more frequently than lithium. Solid nickel, i.e., in elemental form, occurs only rarely. As of 2020, only about 50 occurrences of native nickel were known worldwide. The most important deposits are found in Canada, New Caledonia, Russia, Australia and Cuba.

The majority of nickel production comes from sulfide ores. In addition, lateritic nickel ores are also mined as raw materials for nickel production. Due to the exploitation of the classic sulfide deposits, mining is increasingly shifting to lateritic nickel ores, which, however, means more expensive extraction.

In 2020, around 2.5 million tons of nickel were mined worldwide. The largest producer was Indonesia with around 760,000 tons. However, the country imposed an export ban on nickel at the beginning of 2020, mainly to promote its own stainless-steel industry and conserve its own resources. Other major producers include the Philippines (320,000 tons), Russia (280,000 tons) and New Caledonia (200,000 tons), which belongs to France. These countries account for about 62% of total nickel production worldwide.

Main application: steels and nickel alloys

Most of the annual nickel production (around 85%) goes into the production of stainless steels and nickel alloys. Nickel is one of the most important alloying metals, used mainly for steel refining. It makes steel corrosion resistant and increases its hardness, toughness and ductility. Steels highly alloyed with nickel are used in particularly corrosive environments. Around 20% of the nickel mined is used to produce nickel alloys such as constantan, nickel silver and monel.

Other uses

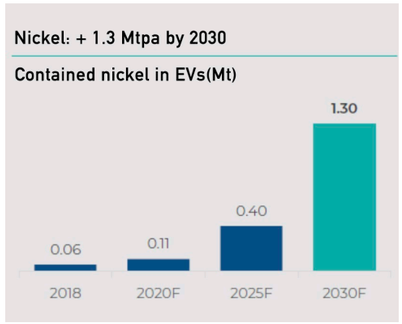
Pure nickel metal is used in finely divided form as a catalyst in the hydrogenation of unsaturated fatty acids. Due to its chemical resistance, nickel is used for apparatus in chemical laboratories and the chemical industry, such as nickel crucibles for digestions. Nickel alloys, for example for coins, are produced from nickel metal. Nickel-based superalloys are alloys specially designed for use at high temperatures and under corrosive media. They are used, for example, in aircraft turbines and gas turbines in power plants.

Nickel for accumulators and batteries

So-called class 1 nickel, with a purity of at least 99.98%, is required for batteries and rechargeable batteries. Only about 45% of the total nickel production of about 2.4 million tons per year is suitable for the production of class 1 nickel. Of this, more than half is required for alloys and other applications. Lower-grade Class 2 nickel goes exclusively into steel production.

Development from cobalt- to nickel-dominated batteries promotes supply deficit

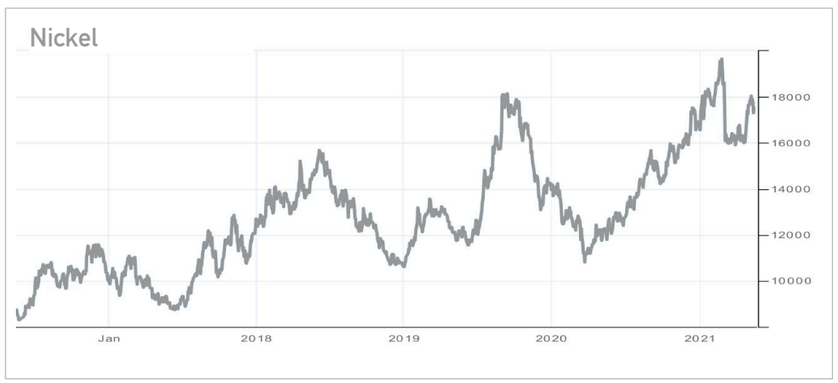
Due to the fact that the development of lithium-ion batteries is increasingly shifting from cobalt to nickel-dominant cathode materials and the required quantities will rise sharply, especially in the automotive sector, an expansion of an already existing supply deficit can be expected in the coming years. This has already been the case for the nickel market as a whole since 2016. For class 1 nickel, such a supply deficit is expected from 2023 at the latest, with a strong upward trend. For 2030, a shortage of 900,000 tons of nickel is expected. In 2040, the supply deficit is expected to widen to as much as 2 million tons per year – and this includes new nickel projects. It is estimated that demand for nickel from the automotive sector will increase more than tenfold from 110,000 tons in 2020 to 1.3 million tons in 2013.



Nickel contained in millions of tons (Source: Canada Nickel)

Supply deficit inevitable, first signs already noticeable

A foretaste of what may lie ahead was provided by LME inventories, which fell from around 400,000 to around 60,000 tons from the beginning of 2018 to the end of 2019. At the same time, the nickel price rose by about 60% during this period to around US$18,000 per metric ton but is still far from its highs of US$50,000. Due to the Corona crisis, the stock has since risen again to around 250,000 tons but is expected to fall again shortly. All in all, it looks as if nickel and its producers and developers will be the next big beneficiaries of the electric (mobility) boom! It is not for nothing that Elon Musk referred to nickel as the „New Gold“ in the middle of 2020 and literally begged the corresponding mining companies to develop new nickel mines.



Nickel price development over the last 5 years (source: own representation)

Cobalt

The element cobalt

Cobalt is a steel-gray, very tough heavy metal (ferromagnetic transition metal) with a density of 8.89 g/cm3. As a typical metal, it conducts heat and electricity well, the electrical conductivity is 26 percent of that of copper. In chemical behavior it is similar to iron and nickel, resistant to air by passivation; it is dissolved only by oxidizing acids.

Cobalt extraction is relatively simple and inexpensive

Cobalt extraction is a well-known, relatively simple process. Cobalt is mainly extracted as a by-product from copper and nickel ores. First, some of the iron sulfides present are converted into iron oxide by roasting and slagged with silicon dioxide as iron silicate. The result is the so-called crude stone, which contains nickel, copper and other iron as sulfide or arsenide in addition to cobalt. Further sulfur is removed by further roasting with sodium carbonate and sodium nitrate. In the process, sulfates and arsenates are formed from some of the sulfur and arsenic, which are leached out with water. The corresponding metal oxides remain, which are treated with sulfuric or hydrochloric acid. Only copper does not dissolve, while nickel, cobalt and iron go into solution. With chlorinated lime, cobalt can then be selectively precipitated as cobalt hydroxide and thus separated. This is converted to Co_3O_4 by heating and then reduced to cobalt with coke or aluminum powder.

The majority of cobalt deposits lie beneath the seabed

Cobalt is a rare element with a frequency of 0.004 percent in the earth‘s crust. This puts it in thirtieth place in the list of elements ordered by frequency. Cobalt is found in many minerals, but usually occurs only in small amounts. The element is always associated with nickel, often also with copper, silver, iron or uranium.

The world‘s known cobalt resources are about 25 million tons, with the largest deposits in the Democratic Republic of Congo, Zambia, Canada, Morocco, Cuba, Russia, Australia, Uganda, and the United States. Over 100 million tons of cobalt are believed to exist in the Earth‘s crust on the floors of the Atlantic, Pacific and Indian Oceans.

Cobalt mining mainly takes place in „problematic“ regions

The majority of the annual cobalt production of 140,000 tons comes from mines in the Democratic Republic of Congo. About 68% of total production in 2020 came from the Central African civil war country. Russia accounted for a further 4.5% at last count, the Philippines for 3.35% and China for 2.6%. All countries that are considered rather unstable or at least not necessarily trustworthy. The remaining production is divided between Canada (just under 2.3%), Australia (4%), South Africa (1.3%) and several other countries with even lower production volumes.

The future security of supply appears to be extremely critical on the basis of current producers, which is why more and more attempts have been made recently to develop new mines, especially in Canada, Australia and the USA, and to increase production accordingly.

Main applications are paints, alloys, medicine, magnets and rechargeable batteries

Historically, cobalt has been used in the form of oxides, sulfates, hydroxides or carbonates for heat-resistant paints and pigments. Probably the best-known decorative application is blue cobalt glass. Today, cobalt is used primarily as an alloying component to increase the high-temperature strength of alloyed and high-alloy steels, especially high-speed steel and superalloys, as a binder phase in hard metals and diamond tools, as a component of magnetic alloys, as a drier for paints and coatings, as a catalyst for desulfurization and hydrogenation, as a hydroxide or lithium cobalt dioxide ($LiCoO_2$) in batteries, in corrosion- or wear-resistant alloys, and as a trace element for medicine and agriculture. In addition, cobalt is used in the production of magnetic data carriers such as tape and video cassettes, where it improves magnetic properties through doping. Since the 1990s, cobalt has served as an anode material in the anode of lithium-ion batteries.

(Source: A.Ocram (CC BY-SA 3.0))

Electric vehicles in particular require a lot of cobalt

As with lithium, the quantities of cobalt used in the corresponding batteries are similar. Depending on the model, between 5 and 10 grams of cobalt are used in a single smartphone. For a notebook or tablet, the figure is 30 to 100 grams. Power tools need about 50 grams for their batteries. A 10 KWh storage unit for home use (such as Tesla's Powerwall) requires about 7 kilograms of cobalt, while the batteries for hybrid vehicles need about 4 kilograms and for purely electric cars 10 kilograms of cobalt. Tesla's Model S even comes in at 22.5 kilograms. A passenger plane gobbles up about 4,000 kilograms of cobalt.

Cobalt supply must be increased

An increase in supply is urgently needed, because the lithium-ion battery sector will demand ever larger quantities and therefore ever larger quantities of cobalt in the coming years – even if the further development of batteries suggests that cobalt will increasingly be replaced by nickel. While annual production in 2016 was still around 123,000 tons, leading experts assume that it will be difficult to expand production above 150,000 tons per year with the current mines. The fact is that Congo will nevertheless remain the absolute world market leader for the time being and will even expand its market share to up to 70%. The two largest mines in the world, Kamoto and Kolwezi, which alone produce (will produce) about 50,000 tons of cobalt per year, will have a large share in this. Outside Congo, several companies are working on expanding their existing mines (including Glencore, Norilsk, Umicore, Sumitomo and Vale), but these mine expansions are likely to be only a drop in the bucket due to the expected increase in demand.

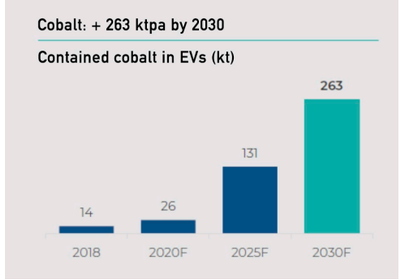
Cobalt price development (US$/ton) over the last 5 years
(Source: own representation)

Cobalt price gives a foretaste of the years to come!

Many market participants have already recognized that cobalt production cannot be expanded quite so easily from one day to the next, which is why the cobalt price has exploded from around US$5,000 to almost US$100,000 per metric ton since mid-2016 and currently stands at around US$45,000 per ton. A similar increase can be expected as soon as the leading carmakers drastically expand their model range.

Cobalt will experience an immense demand surge and supply deficit in the coming years!

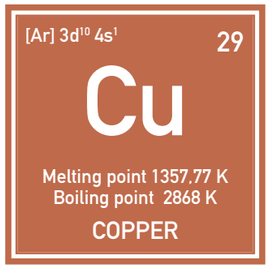
The demand for cobalt is expected to explode in the coming years! While this was still at around 60,000 tons in 2008, in 2017 it was already 125,000 tons that were demanded per year. By 2025, experts expect cobalt demand to rise to over 270,000 tons per year. The main driving factor will be demand from the battery sector. Experts estimate that demand for cobalt from the automotive sector alone will rise from 26,000 tons in 2020 to up to 130,000 tons in 2025 and 263,000 tons per year in 2030 (again for comparison: total annual global production in 2020 was 140,000 tons). Due to the current situation that demand is increasing strongly, but at the same time only a few existing mines have the possibility to ramp up their production at all, there are indications of a considerable supply deficit for cobalt in the coming years. This deficit is likely to widen successively and exceed the 10,000 ton per year mark as early as 2021.



Contained cobalt in thousands of tons
(Source: Canada Nickel)

Copper

Although copper is not a classic battery metal, nothing works without the red metal in the implementation of the electric revolution. After all, copper has the property of being the most conductive of all known metals after silver. And without reliable interconnection of the individual electrical components, a world of electromobility and electrical storage cannot function.



The element copper

Copper is a chemical element with the element symbol Cu and the atomic number 29. Like silver and gold, it is one of the transition metals that occur naturally as doped elements. The name copper comes from the Latin cuprum, which is derived from Cyprus, where the most important copper mines were located in ancient times. It is the 26th most common element in the earth‘s crust (share of about 0.006%) and has been mined for about 7,000 years. Copper has a reddish luster and, as a relatively soft metal, is easily malleable and ductile. It has a very high thermal and electrical conductivity.

Occurrence and production

There are several thousand sites around the globe. Significant copper production, however, exists in only a few regions. By far the most recent leader in copper production was Chile, with an annual production in 2020 of 5.7 million tons. It was followed by Peru (2.2 million tons), China (1.7 million tons), the USA (1.2 million tons) and the DR Congo with also 1.2 million tons. These five countries together account for about 60% of the world‘s production of about 20 million tons per year. The top 10 copper producing nations also include Australia, Zambia, Russia, Mexico and Indonesia. In terms of smelting, China (9.8 million tons) leads by a wide margin. In addition, there is recycled copper of around 900,000 tons.
Copper is extracted by smelting and refining. The corresponding processes have long been perfected, and processing is correspondingly simple and relatively inexpensive.

Main features: High thermal and electrical conductivity, soft, antibacterial, red.

By far the most important ability of copper is its high electrical conductivity. Its conductivity is only slightly worse than silver and significantly better than gold, but copper is far less expensive than the other two metals. Since all admixtures dissolved in copper, especially impurities such as phosphorus and iron, greatly reduce its conductivity, the highest degrees of purity are often sought for


(Source: D-Vi©Pixabay)

Copper price development over the last 5 years (source: own presentation)

conductor materials. Its softness and red color also make it interesting for the jewelry and art industries, among others in the form of alloys (brass, bronze, nickel silver, red gold). In addition, it has an antibacterial and partially antiviral effect and can render bacteria, viruses and fungi harmless within a few hours.

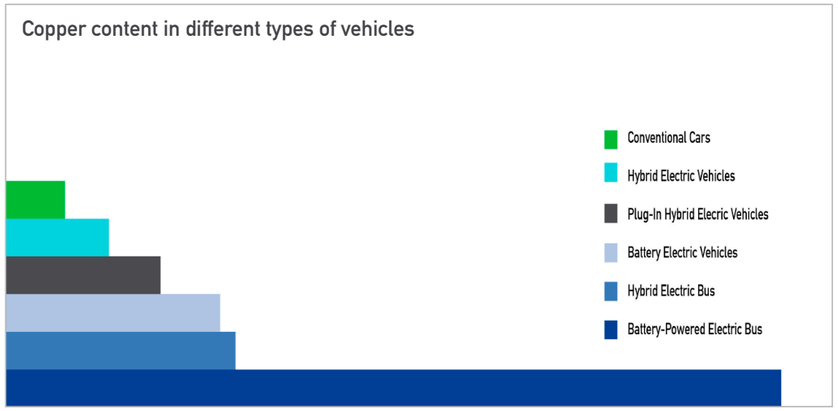
Main fields of application: Electrical engineering, piping, art, construction

By far the largest area of application for copper is electronics and electrical engineering as well as piping, i.e., infrastructure. It is used, among other things, for electrical lines, switching wires, power cables, overhead lines, conductors on printed circuit boards, wire windings in transformers, chokes/coils and in electric motors. Furthermore, as cable connection between electrical components like accumulators, motors and applications. Other applications include water piping, roofing, glass coatings, tableware, and in the arts and crafts sector for the production of printing plates for copper engravings and etchings, and in the jewelry sector for alloys.

Supply deficit already exists de facto – expansion very likely

The International Copper Study Group calculated a supply deficit of 340,000 tons for 2019. A supply shortfall of around 300,000 tons is estimated for 2020. Due to the fact that in the future more and more copper will be used in electromobility (an electric car requires about 90 to 100 kilograms of copper, while a combustion vehicle often gets by with 20 kilograms), but also in the connection of regenerative power generators to the electricity grid (an onshore wind power plant requires about 5,4 tons of copper per megawatt, an offshore wind power plant even 15.3 tons

Contained copper in million tons (Source: Canada Nickel)

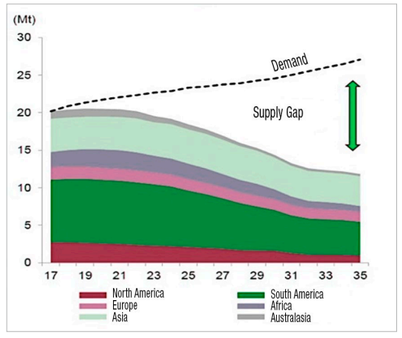


(Source: own illustration)

of copper per megawatt), experts expect that by 2035 there will be a gap of no less than 15 million tons per year, i.e. about 75% of current production. Furthermore, infrastructure and electric vehicle support programs of many governments are likely to lead to a further boom in demand for copper. Experts predict that copper demand from the automotive sector alone will increase tenfold from 300,000 tons in 2020 to 3 million tons per year by 2030.

Mining activities no longer keep pace with higher demand

In addition to an expected increase in demand from the current level of about 20 million tons of copper per year to 25 million tons in 2030 and 28 million tons by 2035, copper production with the current mines is expected to decrease to about 13 million tons at the same time. This is because at present it is mainly the expansion of existing mines that accounts for the bulk of new copper production, which is expected to come on stream by 2025. After that, new projects will be needed to close the growing gap expected by analysts. However, this will require significant investment. Many copper projects benefit from the production of valuable by-products such as gold, silver, cobalt and molybdenum, without which copper production would often not even be possible, i.e., profitable. Another aspect is the lack of exploration for large copper projects, which has been extremely sparse over the past ten years.



(Source: own illustration)

There must be a (further) copper price adjustment upwards

As a result, there is currently a shortage of high-quality development projects. As the quality of many new copper projects is far inferior to that of current mines, an increase in production, i.e. exploitation of poorer quality mines, can only be achieved by adjusting the price. Copper speculators have recently recognized that this is the case and have caused the copper price to break out to the upside, specifically above US$10,000 per ton.

Conclusion: The electric revolution is just picking up speed and will lead to a long-lasting boom in lithium, cobalt, nickel and copper!

The demand for lithium, cobalt, nickel and, to a lesser extent, copper will be determined by three different parties in the future:

1. From the Asian electronics companies, which are mainly targeting the mass production of powerful lithium-ion batteries and accumulators for daily use, in multimedia devices, etc.
2. From the car manufacturers, and (initially) first and foremost from Tesla Motors, but also from almost all established car manufacturers worldwide.
3. From the manufacturers of decentralized energy storage systems, which are used wherever electricity is generated by means of photovoltaic or wind power plants and is to be used later by means of storage.

This constellation will cause demand for lithium, cobalt and nickel to increase many times over in the coming years in some cases, and for copper it will also increase sharply, with decentralized storage in particular generating the greatest growth in demand and likely to dwarf even the other two areas.

It is therefore not too difficult to summarize what has been described above; a look at the most important numerical estimates is basically enough. The number of electric vehicles will multiply in the coming years: From 1.2 million electric cars in 2017 to at least 20 million electric vehicles per year from 2025. From 2030 onwards, 25 million electrically powered vehicles can be expected annually, and from 2040 onwards even 60 million vehicles per year. In parallel, lithium-ion battery demand increases from 21 GWh in 2016 to 1,550 GWh in 2028! In 2020, capacity was an estimated 250 GWh, driven by expansions by upcoming giants LG Chem, Samsung SDI, CATL, Lishen, Tesla and others.

Procurement from dubious sources as well as China‘s market power in reprocessing

In the EU and thus also in Germany, lithium, cobalt and graphite belong to the so-called „red group“, i.e. materials with a very high supply risk. For the most part, they come from countries with dubious mining methods or high political risk. In addition to the actual procurement risk, issues such as poor environmental compatibility or lack of social acceptance also play a role here. Another crucial point is that China currently controls a large part of the cobalt and lithium processing. A circumstance that will either lead to more projects outside China‘s sphere of influence or to higher prices in the future. Recycling does not play any role at the moment and therefore cannot be seen as a source of needed materials.

The upcoming supply deficit will reward especially the far advanced developers

Overall, there are signs of a supply deficit in the near future for the lithium, cobalt, nickel and copper markets, as the increase in demand is likely to (far) exceed the expansion in supply in the future. In this context, it is now assumed – due to the ongoing Corona crisis and the associated expectation of additional purchase incentives for electric vehicles – that the supply shortage will be brought forward from around 2025/26 to 2023. This is strongly indicated by recent reports of projects stalling, production being curtailed, and expansion plans being delayed. As there is no end in sight to the increase in demand beyond 2025 and, moreover, there are still no significant large production projects in the pipeline, this situation is likely to continue for the foreseeable future.
The development companies in particular, which have already advanced their respective projects, should offer the greatest share price opportunities in the coming months, also with regard to a possible consolidation, i.e., through takeover scenarios.
Some of these dedicated development companies, as well as prospective producers, are presented below.

Interview with Vincent Pedailles –
EU Advisor on Future Security of Supply

Vincent Pedailles

Dear Mr. Pedailles, can you give our readers a brief overview of your background and career to date?

I started my career in the lithium industry 10 years ago, when I start working for Talison Lithium in Western Australia, which runs the largest open pit lithium mine in the world, Greenbushes. Since then, I always had an interest in lithium and its supply chain and wrote my master thesis on the development and deployment of electric vehicles powered by lithium-ion batteries in 2012. Subsequently I worked as a consultant and analyst for consulting firms such as Roskill, a leader in the battery metals market analysis, and then joined IHS Markit where I created and led a lithium and battery materials research team covering the entire industry's supply chain from raw materials to E-mobility. I decided to go back to the industry in 2018 and joined the board of Infinity Lithium who is developing lithium production in Europe. I led the company to become the first project to secure EU funding. At the end of 2020, I decided to join Vulcan Energy to lead their business development department. Vulcan is developing a zero-carbon lithium and energy project in Germany and is perfectly aligned with what European automakers and battery makers are looking for which is a competitive source of local and sustainable lithium.

Among other things, you are also an advisor to the EU on issues relating to the future security of supply of lithium and other important materials for battery construction. How do you assess the current security of supply, specifically of the EU, for battery metals? Are there enough deposits in Europe to ensure its own supply security and how could gaps be closed?

In 2020 I advised the European Commission when they were looking at revising their Critical Raw Materials list. It was very clear to me that lithium needed to be added to this list and this metal will become vital for the success of our green transition. Today, there is no lithium extraction or refining in Europe and more than 80% of lithium hydroxide, which is the type of lithium you need in advanced batteries featuring a long driving range, comes from China. It is not simply a supply chain risk, but it is also an environmental risk. According to Minviro, a consulting firm based in London and specialising in Life Cycle Assessment (LCA), every ton of lithium hydroxide produced in China emits roughly 15 tons of CO_2 emissions. This is definitely not in line with automakers objectives such as Volkswagen, BMW or Daimler to become carbon neutral. The best alternative to hedge on those issues is to develop local and sustainable sources of lithium. However, change needs to happen soon because the European lithium market is the fastest growing in the world, led by E-mobility uptake. There is now more investment in electric vehicles (EV) in the EU than in China and adoption rates have also taken over the Chinese. The most important and the costliest part of an EV is its Lithium-ion battery, and we are seeing substantial investments across Europe in large battery factories or so called gigafactories leading Europe to become the second largest lithium-ion battery producer in the world after China. It is estimated that by 2030 in Europe, there will be around 800GWh of installed battery capacity, which is 80 times the size of the market in 2020. Within a lithium-ion battery, the cathode is the costliest component and it where nickel, cobalt, lithium or manganese are going to be used. Given the size of the battery industry in Europe by 2030, it is likely that the European lithium market will represent more than 700,000 tons of lithium chemicals, which is more than twice the size of the global market today. Whilst Europe doesn't currently produce lithium domestically, the continent has significant resources that can support the European E-mobility industry. For example, Vulcan Energy has a 15.95M tons Lithium Carbonate Equivalent (LCE) resource in the Upper-Rhine Valley in Germany, which is the largest lithium in Europe and one of the largest in the world and it is sufficient to support the production of more than 400 million EV. Other significant resources include European Metals (7.22Mt LCE), Rio Tinto (6.12Mt LCE) or Infinity Lithium (1.68Mt). There are a number of other projects across the region and many lithium projects will need to be successful to supply the European market, but it is unlikely that there will be enough local production. When developing a lithium project in Europe, there are many hurdles along the way. This would typically include permitting, financing, environmental impact and societal acceptance. A mining project, in particular open pit, will required a difficult permitting process that requires a lot of experience and time.

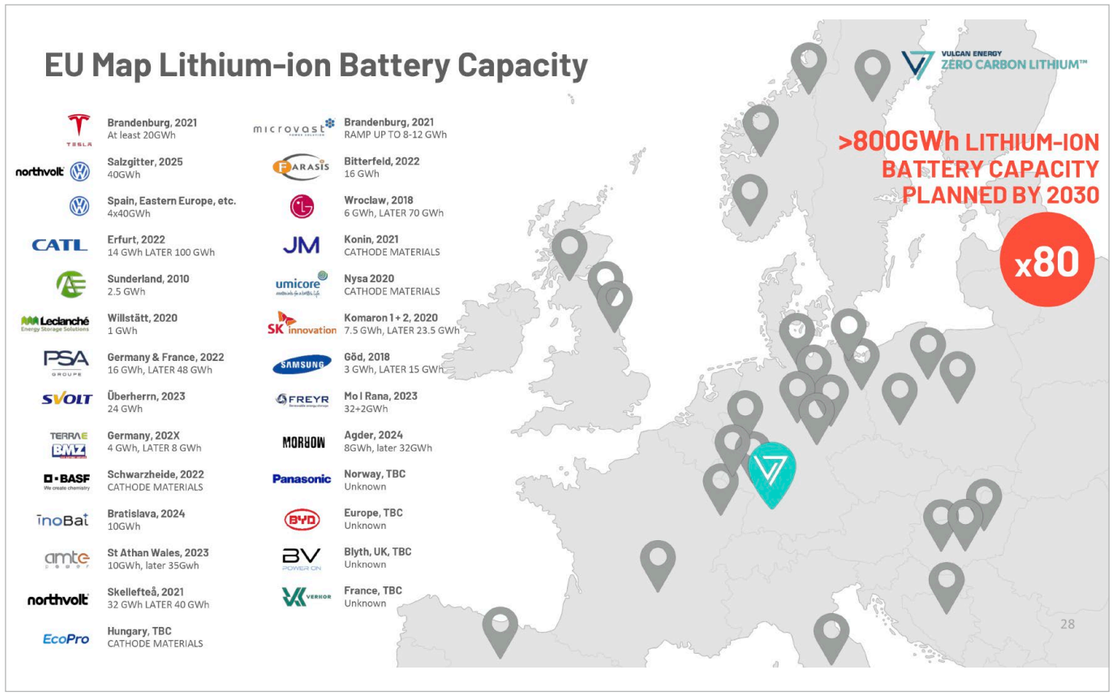
One of the main elements that needs to be addressed is the environmental impact of the mining and refining activity which will have a great influence on the permitting process but also on the societal acceptance of the project. Other issues could be linked to the size of some projects where the size of the deposit doesn't justify the construction of the refinery and requires import of feedstock once the deposit runs out. Several projects are also looking at importing spodumene to Europe to refine it into lithium chemicals. This is a similar approach to a number of non-integrated lithium converters in China, but they are the first one suffering when prices drop. The issue is also environmental because converting spodumene into lithium chemicals is energy intensive and depending on the energy mix used in Europe, could be very polluting. Similarly, the EU based converters would be importing 94% waste from Australia or Canada and would then have to dispose of their waste on the continent.

Vulcan Energy is alleviating most of those potential issues. The company is developing a project which is not relying on mining but on pumping a hot geothermal brine from an underground reservoir which has a high concentration of lithium. The extraction process all the way to the production of a lithium hydroxide battery quality has a negative carbon footprint and the project will be generating from renewable energy than it consumes itself. The project has the largest lithium in Europe and is fully funded to the final investment decision that will take place in mid-2022.

In addition to lithium, which metals or materials do you see as critical for the development of battery and electric vehicle production?

Most battery metals will be critical and that includes nickel, copper, cobalt and manganese for instance. Due to the rapid movement towards high nickel cathodes such as NMC811, the growth for nickel is even stronger than other metals such as cobalt. Cobalt usage is reducing in batteries, but its demand is still extremely strong due to the growth of the industry. There are large significant resources in Europe for all those metals especially in the Nordic. The company Kuniko, for example, is exploring for nickel, cobalt and copper in Norway. There is also refining capacity in this part of Europe and access to renewable energy. Manganese is always forgotten but high purity manganese is vital for NMC batteries and its production is concentrated in China.

The security of supply with corresponding basic components is one thing, the possibility of battery production is another. Until recently, it looked as if Europe was already far behind in this area. Recently, however, more and more production projects have become public. How do you see Europe positioned in battery manufacturing in the meantime?



(Source: Vulcan Energy)

There has been a tremendous amount of investment across the region (see map) and Europe has confirmed its strong position as the second largest lithium-ion battery producer in the world after China. Importing cells from Asia doesn't make sense and automakers want to have their battery suppliers located near the EV manufacturing facilities. There is also a growing trend in back integration where we see automakers now becoming battery producers but also cathode makers. We have seen it in the last year with Tesla looking at a regional and vertical integration which includes the production of EV, battery, cathodes and battery metals such as lithium in North America, all running under the same entity. Volkswagen has recently announced similar ambitions, with the construction of six gigafactories in Europe and stating that regarding vertical integration into mining and chemicals, everything was on the table.

In your opinion, is there serious competition for the lithium-ion battery (solid-state battery, zinc-phosphate battery or similar) and which metals or materials could play a more important role in the coming years?

Lithium-ion batteries are here to stay. Several years ago, there was a debate around Nickel Metal Hydride (NiMH – mostly used in hybrids by Toyota) versus Lithium-ion batteries. Today, NiMH represents less than 1% of batteries in EVs. More recently, there was an argument around hydrogen versus lithium-ion batteries. Hydrogen has a great future in many applications including industrial usage and heating and even in some forms of transportation (heavy vehicles) but for passenger cars the battle was won once again by lithium-ion batteries. Today in Europe, almost 100% of investments in EV power storage is in lithium-ion batteries. Every over day there is an announcement in the press about a new breakthrough in a new battery technology that will replace lithium-ion batteries. However, it took more than 20 years for lithium-ion batteries to arrive to the performance and costs they are at today, it will probably take the same amount of time for another technology to reach the same level of market penetration. Moreover, the industry has already committed billions of euros in this technology. What we see is an evolution of the lithium battery technology especially on the cathode, anode, and electrolyte side. One of the most interesting development from a battery metals perspective is solid state. Solid state batteries are still lithium-ion batteries but removing the liquid electrolyte solution and replacing it by a solid. On the cathode side, a similar mix of battery metals will be used in line with the evolution of the cathode technology trends, and towards nickel-rich materials, and still using lithium. Lithium is the only element you can't replace in a lithium-ion battery. On the anode side, lithium will also be used, in the from of lithium metal, which is a new growth opportunity for the white metal.

A quick look into the crystal ball: Where will we be in 10 years' time in terms of battery development and the supply of sufficient basic materials?

In 10 years time we can expect a well established lithium-ion battery industry in Europe, close to 800GWh capacity, supporting the E-mobility market and Energy Storage Systems. We should see more automakers vertically integrated in cells production but also cathode, refining and potentially mining. Most of this vertical integration will be regional, taking advantage of Europe's resources, renewable energy, and expertise. In 10 years time it will become too expensive for automakers and cell makers to import carbon heavy raw materials or components from outside Europe if there is a clean alternative on the continent. It is important to follow the development and deployment of the Carbon Border Adjustment Mechanism which will considerably impact purchasing decisions. Electric vehicles regulations in Europe will have long switched from tailpipe emissions to being based on life cycle emissions. Raw materials producers will be under constant pressure to supply sufficient volume, at increasing quality levels, and respecting best ESG standards. Given the last of investment in battery metals during the last few of years and given the time it takes to bring new supply on stream, there will be significant tightness in the market in the medium and long term.

Interview with Gianni Kovacevic –
Copper expert and book author

Gianni Kovacevic

Mr. Kovacevic, would you please give our readers a brief overview of your career so far? How did you go from electrician to Porsche driver?

As a Croatian, I was always fascinated by Nikola Tesla, the Serbo-Croatian scientist who invented modern A/C electrical systems. It's incredible to think that to this very day we are using his system and, in fact, as the world pivots to increased renewable energy, it will be applied at an even greater pace. The past 25 years I have participated in a few bull markets in commodities, but the set-up for the current bull market in electric metals, and copper specifically will be the strongest in history, you can quote me on that.

In your book, you describe copper as an elementary raw material for the future electrification of the world. What do you base this on?

The greener and cleaner we create, transfer and utilize electrical energy, the more that is demanded of copper. It really is that simple. Imagine how much copper was installed in the world since 1890. Industry and government will duplicate this in the next 25 years or so as final energy usage as electrification climbs from 20% today to over 50% the next 25 years. It's a breathtaking statistic and there is no highly efficient substitute for copper to enable this other than aluminum which is inefficient and will not work for many of the applications. Copper wins the marathon.

You also explicitly mention the example of China in your book. What can we learn from China in terms of electrification and urbanization?

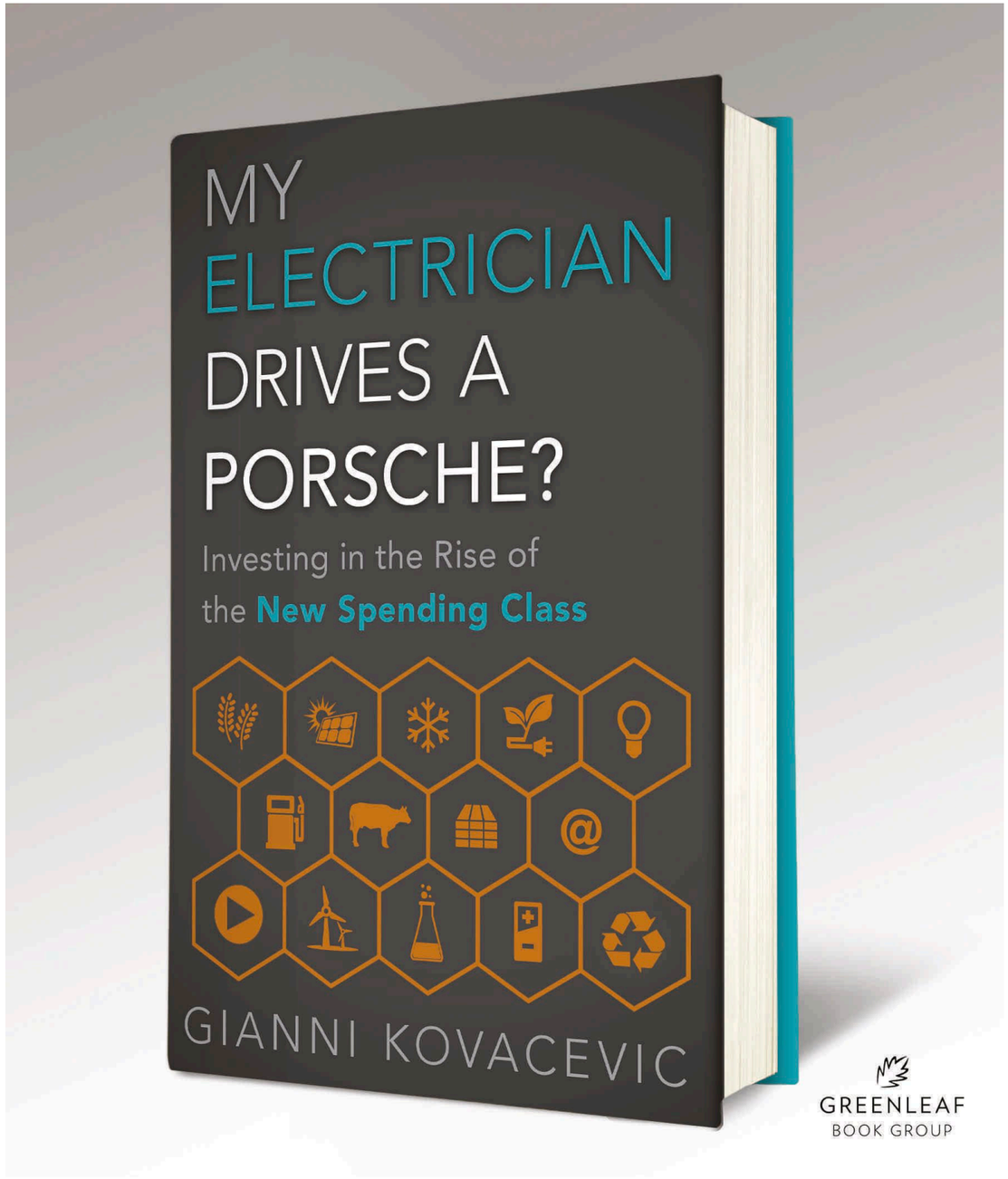
China has the largest electrical system in the world, and they are now the leaders in every category for wind, solar, batteries and electro-mobility. Furthermore, as part of China's 14th, five-year plan, it is heavily geared towards lower emissions, which as you now know is electrification. China will continue to be the largest consumer of copper, but the entire world will now follow this trend as we go through a global pivot to green energy, EVs and let's not forget the $10s of Trillions to re-stimulate the global economy.

The price of copper recently reached almost an all-time high. What is the reason for this?

Supply and demand fundamentals. The whole copper mining industry under-invested due to low copper prices, lack of investor confidence and project advancement. That finally caught up to reality and there is more demand than supply. That will only become more exacerbated as anyone who makes electrical cables, motors, transformers etc. booms in their business. They will continue to buy and that results in totally exhausted global warehouse supplies and really a scramble for material and industry chasing prices higher to secure copper supplies.

What do you think investors should look for when choosing a copper investment?

Investors should be looking at future resources and supply. Of course, that means I'm talking about the Junior copper names. Imagine the last time copper prices were $4.00 / lb, the assets were trading much higher. For example, CopperBank where I am the largest shareholder, acquired various projects during the bear market. In 2010/2011 those assets that were in listed companies were trading 5X higher than our market capitalization today. That is a tremendous opportunity for investors as the metal has moved significantly and the Jr.s with projects have only moved up a little. Now what happens if the copper prices go past all-time highs of $4.50/lb, or higher as many analysts are now warning? It would make sense that quality projects also pass previous all-time highs. It's going to a very exciting next few years for people who follow this space.



Energy supply, technology and the emerging markets will shape the next few years more than the most optimistic forecasts predict. My Electrician Drives a Porsche? is a compact guide for anyone who wants to survive as an investor in a rapidly changing world.

Gianni Kovacevic has been deeply involved in commodity investing and emerging markets, China, and realistic environmentalism for over fifteen years. He is a sought-after speaker and lives primarily in Vancouver, Canada, but also spends a lot of time in Europe. Kovacevic is fluent in English, German, Italian and Croatian.

Gianni Kovacevic
My electrician drives a Porsche?
Investing in the Rise of the New Spendig Class

GreenLeaf Book Group

Alpha Lithium

One of the last undeveloped high performers in the lithium sector, ready for the breakthrough

Brad Nichol, CEO

Alpha Lithium is a Canadian mining development company specializing in the discovery and development of high-grade lithium projects. The company has found a project in the South American lithium triangle, an area with a large number of high-caliber lithium deposits on the border of the three countries Argentina, Chile and Bolivia. There, the company is developing a project that is surrounded by several major projects or lithium mines.

Tolillar Salar – Location and infrastructure

Alpha Lithium‘s flagship project is called Tolillar and is located in the Tolillar Salar salt lake of the same name. The acquisition was made in March 2020, essentially through the acquisition of a private Canadian company through the issuance of treasury shares. The project comprises 10 concessions covering a total area of 27,500 hectares. Tolillar Salar is thus located in the well-known lithium triangle of Argentina, Bolivia and Chile and within the Puna geological region in northwestern Argentina. Tolillar Salar is surrounded by multi-billion-dollar lithium assets. The Hombre de Muerto Salar is only 10 kilometers away and is considered the leading lithium brine basin in Argentina with high grade lithium and only minor impurities (lithium to magnesium ratio less than 4). Livent‘s El Fenix operation there has been in production for over 20 years. Furthermore, there are several other high-grade operations active within a radius of only 50 kilometers, such as Galaxy Resources and POSCO.

Tolillar Salar is located approximately 3 hours by car from San Antonio de los Cobres (presence of all major services including fuel and medical supplies) and 6 hours by car from the provincial capital of Salta. The project site is served by a well-maintained paved and unpaved road network, as well as a gravel and dirt road that runs within 10 kilometers of the project. The nearest rail line in the region is an existing narrow-gauge railroad between Salta, Argentina and the Pacific Coast port of Antofagasta, Chile. A 600-megawatt, 375-kilovolt power line between Salta and Mejillones, Chile runs approximately 150 kilometers north of the property. A natural gas pipeline runs less than 10 kilometers east of the project area.

Tolillar Salar – Historical Exploration Activities

Several explorations have taken place on the project site since 2012, including surface brine sampling campaigns, trench brine sampling, shallow borehole sampling, and a Vertical Electrical Sounding (VES) survey. Exploration and drill samples were collected from shallow trenches and shallow drill holes in 2018. This included pumped samples during drilling. Laboratory results from the pumping tests showed, among other things, that the subsurface brine in the northern part of the concession area also has enriched lithium concentrations. Overall, lithium concentrations of up to 504 mg/L were detected in borehole samples. The ratio of magnesium to lithium appears to be very low at Tolillar Solar, which is favorable for traditional processing. Initial results for lithium & potassium concentrations from surface samples support a very favorable production scenario, especially since solar radiation is very intense, particularly during the summer months of October through March, resulting in extremely high evaporation rates. Despite the aforementioned exploration activities, much of the concession area has never been extensively explored using modern exploration methods.

Tolillar Solar – Own Exploration Activities and Resource Estimate

In November 2020, the Company announced that a VES survey suggests that the brine body that predominates in the northern part of the salar extends far to the south and also supports the concept that the basin in the Tolillar salar is similar to the neighboring prolific Hombre Muerto salar. Similar to Hombre Muerto and other nearby lithium-rich salar basins in the region, Tertiary sedimentary rocks form the basin-bounding rocks to the west of Tolillar Salar and likely resulted in similar basin-filling conditions. The potentially favorable aquifer target identified in the VES study extends beyond the southernmost extent of the surveyed area and appears to extend deeper than what the instruments could measure, yielding a thickness of at least 170 meters. In addition, the VES results showed that the brine body, which was identified as penetrative during the initial geophysical survey, extends an additional 10 square kilometers into the southern portion of Tolillar Salar. It is measured to be between 73 meters and at least 267 meters thick and extends deeper than what the VES equipment was able to measure.

Based on these findings, Alpha Lithium initiated a three-phase drilling campaign in December 2020, the purpose of which is to collect lithium brine samples from depth and use them to begin evaluating the Direct Lithium Extraction (DLE) process that the Company intends to deploy. By the end of April 2021, the first two phases of the drilling campaign could be completed with a total of 4 production holes. Based on promising historical data in the Tolillar Salar, Alpha Lithium decided to drill all holes as production holes rather than core holes. Core drilling, while faster to drill, does not result in pumpable wells where traditional aquifer testing can be conducted to obtain hydraulic parameters. Core samples provide lithologic data that can take months to analyze, with the goal being simply to improve knowledge of reservoir properties, such as drainable porosity. Production wells are immediately ready for production, can be logged to determine effective porosity and permeability, and can be flow tested to determine brine pumpability parameters and the chemistry of the composite brine ultimately required for lithium processing.

The Phase 3 drilling currently underway is expected to advance to a depth of at least 450 meters.
(Source: Alpha Lithium)

The Phase 3 drilling currently underway is expected to advance to a depth of at least 450 meters, far deeper than any previous drilling. The objective is to prepare and publish a maiden proprietary resource estimate for Tolillar Salar upon completion of the entire drilling campaign.

Intended DLE process offers many advantages

In November 2020, Alpha Lithium announced that it had signed an agreement with Beyond Lithium SA to provide in-house expertise related to brine processing and direct lithium extraction (DLE). Beyond Lithium consists of an internationally recognized team of chemical process engineers with decades of experience advising and managing global leaders in the lithium sector. Beyond Lithium‘s directors have previously worked extensively on high profile projects including SQM‘s Atacama project in Chile, Orocobre‘s Salar de Olaroz project and Lithium America‘s Salar de Cauchari project.

In parallel, Lilac Solutions Inc was engaged in April 2021 to conduct initial technical work on direct lithium extraction on brine samples from Alpha Lithium‘s Tolillar Salar. Lilac‘s technical work is intended to complement Alpha Lithium‘s internal technical work being conducted by Beyond Lithium SA.

Accordingly, Lilac has been contracted to commence Stage 1 engineering. This first stage requires that initial brine samples be sent directly from the Tolillar Salar to Lilac‘s offices in Oakland, California. The brine will be run through Lilac‘s proprietary lithium extraction modules for approximately three weeks and the results will be monitored and reported. This initial test will provide the company with information on lithium recovery rates, evaluation of lithium purity, determination of lithium chloride chemical analysis, as well as preliminary information on reagent quantities used and the preliminary range of operating costs that could be incurred in a future commercial production facility, among other things. Based on the results of Phase 1 engineering, the Company may decide to proceed with Phase 2 engineering, associated with refining initial OPEX numbers, establishing process design criteria and conducting lithium extraction tests for a feasibility study, and defining a customized process flow diagram for a pilot plant in the Tolillar Salar.
Strategically, Alpha Lithium intends to use the most technically advanced DLE methods known today to avoid the use of capital intensive, inefficient and environmentally damaging evaporation ponds. DLE also allows the company to minimize the use of harmful reagents, avoid massive upfront capital expenditures, and reduce operating costs compared to traditional production methods. Working with this team of brine chemistry experts enables Alpha to develop a deep understanding of various chemical parameters required to develop a comprehensive DLE process for the production of lithium hydroxide, lithium carbonate or other lithium chemicals.

Summary: Full throttle would be an understatement!

Alpha Lithium has already achieved more in just one year than many lithium explorers in 10 years. Right from the start, the company stepped on the gas and, in addition to exploration, evaluated the possibility of processing using a modern, environmentally friendly DLE process. The management around CEO Brad Nichol and Country Manager David Guerrero, who knows the area very well and has already had successes in the neighboring Salar, must be incredibly sure of the resource base, which has not yet been determined, if they are taking the second step before the first and are also having production drilling carried out. Just as confident as a dozen or so high-caliber investors from the lithium sector, who helped Alpha Lithium raise a full CA$23 million in fresh capital in February 2021 instead of the originally planned CA$10 million. A leap of faith that management should repay shortly with top results.

Exclusive interview with Brad Nichol, CEO of Alpha Lithium

What have you and your company achieved in the past 12 months?

See March 9, 2021 News Release. The company was formed on March 9, 2020 and on March 9, 2021 I released a comprehensive review of the past year’s accomplishments. When I was preparing this list of accomplishments, it shocked me (and anyone else who read the draft) at just how much we have accomplished in such a short period of time. Here’s the link: https://bit.ly/3uQQVga

1. We own 100% of a 27,500 Hectares (that’s larger than some countries) of an unexplored salar, which we’ve started exploring,
2. We now have $35 million in the bank and
3. We are in the hunt for a major, world-class asset to add to our asset base

What are the most important company catalysts for the next 6 to 12 months?

1. Significant Resource Report completed on flagship Tolillar Salar
2. Very significant acquisition(s) in world-class salar
3. Production of first lithium

How do you see the current situation on the market for battery metals?

The market is undeniably extremely strong for producers of battery metals. The pending lithium (and other metals) shortage is becoming clearer every day. I suspect 2022 or 2023 will see significant supply shortfalls due to increasing demand. When we saw prices fall in 2018 due to over-supply, EV’s were still mostly talking points. Now significant companies and countries are actually doing more than just speaking about EV’s – the demand is very near term and very real; there is no denying it. And data shows that the inventories that were previously built up, are now mostly diminished. We’ve seen prices rise steadily since last 2020. Since there is no magic button that producers can turn on to increase supply in the short term – we’ve learned over the past decade how difficult it is to ramp up production in a meaningful way – there will be a meaningful supply shortfall in the next few months/years.

Alpha Lithium Corp

ISIN: CA02075W1059
WKN: A2PNLY
FRA: 2P62
TSX-V: ALLI

Shares outstanding: 114.4 million
Options: 10.0 million
Warrants: 44.2 million
Fully diluted: 168.6 million

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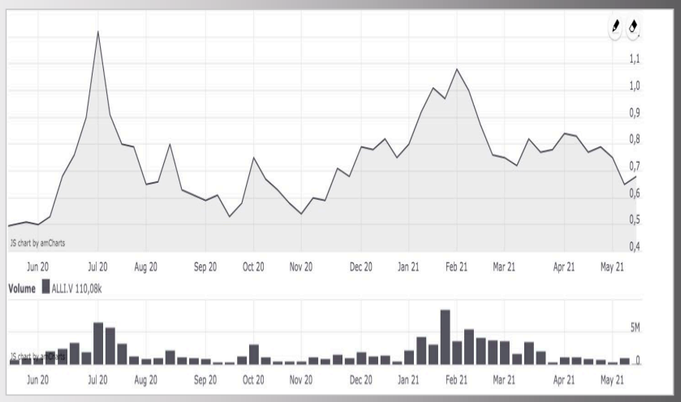

Canada Nickel

One of the largest nickel deposits that could even double again

Mark Selby, CEO

Canada Nickel is a Canadian mining development company specializing in the battery metal nickel. The company was listed on the stock exchange at the end of February 2020. Canada Nickel owns 100% of the Crawford nickel-cobalt sulfide project, which hosts one of the world‘s largest nickel deposits in an established mining camp and is adjacent to existing infrastructure north of Timmins, Ontario, Canada. A preliminary economic assessment is expected to be completed shortly.

Crawford flagship project – location and infrastructure

The approximately 2,300-hectare Crawford Nickel-Cobalt Core Project is located approximately 35 kilometers north of the mining town of Timmins, within the Timmins Mining Camp of the same name, which has a history of over one hundred years as a mining district. Highway 655 runs directly through the project site, as does a 550 kV power line. The Lower Sturgeon Falls hydroelectric power plant is just three kilometers away. Glencore‘s Kidd Creek mine and mill, including train service, is only about 10 kilometers away, and the Hoyle smelter/refinery is about 40 kilometers by road and 25 kilometers by rail from Kidd Creek. Timmins itself has sufficient experienced mining personnel.

Crawford Project – Limited Historical Exploration Activities

The Crawford project has only recently come into the focus of modern exploration. Inco drilled several holes in the 1960s, all of which indicated large nickel anomalies. Minimal exploration was conducted in the 1970s and 1980s. By 2011, the entire area was owned by forestry companies, so no exploration took place for several decades and the project was almost forgotten. In addition, no nickel outcrops were found on the property. In 2011, Noble Mineral Exploration Inc. („Noble“) finally acquired the project. Mineralization at Crawford is contained within a serpentinized ultramafic area that has a distinct geophysical signature. Crawford has several structures with a strike length of approximately 7.9 kilometers.

Crawford Project – Resource

In October 2020, Canada Nickel released a new resource estimate based on Canadian Resource Calculation Standard NI43-101. This revealed that Crawford hosts a higher-grade core resource of approximately 280.2 million tonnes of measured and indicated resources of 0.31% nickel, 0.013% cobalt and 0.040 g/t palladium + platinum within a total measured and indicated resource of approximately 653 million tonnes of 0.26% nickel and 0.013% cobalt. In addition, a higher grade inferred resource of approximately 109.9 million tonnes of 0.29% nickel and 0.013% cobalt within a total inferred resource of approximately 497 million tonnes of 0.24% nickel and 0.013% cobalt. This makes the Crawford resource one of the 12 largest nickel deposits in the world!

Crawford Project – Exploration Potential

Although the Crawford resource already appears huge, only about 4.2 kilometers of the total strike length of 7.9 kilometers have been drilled to date. This resource alone (Main Zone) is still open to the west. The higher-grade core area has been defined over a length of 2.6 kilometers with a width of 150-220 meters and to a depth of about 650 meters. There is still tremendous potential, especially at depth. For example, one hole was drilled to a vertical depth of 850 meters. The analyzed sample averaged 0.31% nickel, 0.013% cobalt, 0.022g/t palladium and 0.008g/t platinum over 901 meters. Continuous drilling has been conducted throughout 2020 and has produced some spectacular results. For example, 27 meters of 0.40% nickel plus cobalt, palladium and platinum. In addition, a new zone, called the East Zone, was discovered in May 2020. There 256 meters with 0.30% nickel and 0.05g/t palladium + platinum were proven. In October 2020, Canada Nickel announced the discovery of a third zone called the West Zone. The company initially drilled 4 holes and found 30 meters of 0.29% nickel and 0.014% cobalt ending in mineralization. Finally, in December, they were able to discover a fourth, the North Zone. This covers approximately 1,100 by 400 meters.
Metallurgical test results published at the end of 2020 confirmed a very good nickel recovery rate between 46 and 51%.

Crawford Project – Platinum-Palladium Discovery

In March 2020, Canada Nickel announced the discovery of a new palladium-platinum zone discovered by drilling. Multiple drill holes intersected this zone, starting at the bedrock contact and extending to a depth of 500 meters over a strike length of 600 meters. The separate PGM zone returned grades of up to 2.6 g/t palladium + platinum over 7.5 meters. With palladium prices in excess of CA$3,000 per ounce and few new palladium discoveries worldwide, the discovery of this new multi-gram, near-surface palladium-platinum zone, which parallels Crawford‘s existing nickel-cobalt-palladium resource, underscores Crawford‘s significant potential and provides additional options in the development of the project.

Crawford project – Glencore deal

In January 2020, Canada Nickel announced a sensational deal with Glencore that should greatly improve the economics of the Crawford project. This allowed for the signing of a non-binding letter of intent for the potential use of Glencore‘s Kidd concentrator and metallurgical site in Timmins, Ontario, for the treatment and processing of material from Crawford. Crawford is located 40 kilometers north of Glencore‘s operations. The facility has a rated capacity of 12,500 tonnes per day and has a full water intake and discharge permit and a thickened tailings storage facility. The site has inbound and outbound rail access via the Ontario Northland Railway.

Massive expansion of the Crawford project and another bull‘s eye

In March 2020 and April 2021, Canada Nickel announced that it had entered into an agreement with Noble Mineral Resources to expand the Crawford Project. under which Canada Nickel acquired 100% of the previous option areas, Crawford-Nesbitt-Aubin, Nesbitt North, Aubin-Mahaffy, Kingsmill-Aubin and MacDiarmid and Bradburn-Dargravel. In July 2020, Canada Nickel announced that it had identified a total of 7 nickel-bearing structures on the new concessions, extending over a strike length of approximately 30 kilometers with widths ranging from 150 to 600 meters. Airborne geophysical surveys were conducted in October 2020. This resulted in the identification of an 1,800 metre by 400 metre exploration target at MacDiarmid, which is 15% larger than the Crawford Main Zone.

Profitability analysis and First Nations relations + Mining fleet financing.

In June 2020, Canada Nickel commissioned an independent preliminary economic analysis (PEA), which is expected to be completed shortly. For this purpose, the company also appointed Christian Brousseau, an experienced engineer and project/study manager, as project manager.
At the end of 2020, Canada Nickel was able to sign several cooperation agreements with the local First Nations, which guarantee numerous benefits to the communities involved for future exploration and production.

Furthermore, in April 2021, the Company signed an agreement with the Taykwa Tagamou Nation for the purpose of financing the future mining fleet.

Emergence of NetZero Metals

In July 2020, a wholly owned subsidiary, NetZero Metals, was formed to begin research and development of a processing facility in the Timmins region to leverage existing technology to produce carbon-free nickel, cobalt and iron products. The Company has applied for trademarks for the terms NetZero NickelTM, NetZero CobaltTM and NetZero IronTM in the United States, Canada and other jurisdictions in connection with the carbon-free production of nickel, cobalt and iron products. Canada Nickel will explore the potential for producing nickel and cobalt products from existing pyrometallurgical processes such as roasting, sulfation and reduction using electric arc furnaces (which use natural gas as a reductant instead of coke or coal), with off-gases captured and vented to capture CO_2 from waste rock and residues from the Crawford Nickel Cobalt Sulfide Project.

Summary: PEA and Glencore deal are real game changers

Canada Nickel owns 100% of the Crawford nickel-cobalt sulfide project, a brand-new nickel discovery with huge potential in an established mining camp, one of the best infrastructures in Canada. Crawford is not only one of the top 10 nickel sulfide sources in the world, but also appears to have significant platinum and palladium potential that will be further explored in the coming months and provide a steady flow of news. Initial mineralogical test results also indicate that much of the nickel in the higher-grade resource areas is contained in nickel sulphide and nickel-iron alloy minerals. Crawford continues to have significant expansion potential as only a fraction of the existing anomalies has been tested to date, as recent discoveries have clearly demonstrated. The newly acquired regional exploration targets are also exciting as they share the same geophysical signatures that led to the Crawford discovery. Given Crawford‘s proven track record, this provides much larger areas for full development of Crawford and additional exploration targets that could potentially host nickel-cobalt deposits similar to Crawford. In this context, it is interesting to note that MacDiarmid may have been discovered as a sort of second Crawford. Initial knowledge of potential economic production will be made available shortly from the PEA currently being developed. Furthermore, the Glencore deal is likely to have a strong impact on the economics of the project, as this should eliminate high capital costs.

Exclusive interview with Mark Selby, CEO of Canada Nickel

What have you and your company achieved in the past 12 months?

In just 18 months since acquiring this new discovery, Canada Nickel has advanced the Crawford nickel sulphide project to one of the top ten nickel sulphide deposits globally on just a fraction of the overall land package. CNC is rapidly advancing the initial Crawford discovery to a PEA and feasibility study within the next 12 months while it continues to actively drill the remainder of its large land package with multiple nickel targets located just outside of the established mining camp of Timmins, Ontario in Canada.

The Crawford nickel-cobalt project is ideally positioned to deliver zero-carbon nickel-cobalt products for the electric vehicle market as the host mineralization for the deposit spontaneously sequesters CO_2 when exposed to air, the region’s electricity grid is based solely on zero-carbon hydroelectricity, and the region is supportive of local downstream processing. The Company formed a wholly owned subsidiary NetZero Metals to work to process and deliver trademarked net zero products to the market.

With a team that has successfully advanced and permitted other large scale nickel projects to be fully permitted and construction ready, the team is repeating its success with active support from the local First Nations and broader community and expects to advance the project towards construction.

What are the most important company catalysts for the next 6 to 12 months?

The key upcoming catalyst is our PEA, which will be released by May 20th, 2021 followed immediately by a feasibility study to be completed within 12 months.
As we advance Crawford, we will also begin aggressively exploring the much larger land package with multiple nickel targets during the coming year.

How do you see the current situation on the market for battery metals?

Nickel is headed towards a super cycle by the middle part of the 2020s as strong growth from electric vehicles builds on continued strong demand growth from stainless steel and alloys outpacing available supply as the nickel project pipeline, particularly outside Indonesia, has few projects ready to deliver the nickel required to meet this demand growth. Canada Nickel’s Crawford project is ideally positioned to meet this growth.

ISIN: CA13515Q1037
WKN: A2P0XC
FR**A:** 4E0
TSX-V: CNC

Shares outstanding: 79.8 million
Options/RSUs: 6.6 million
Warrants: 3.0 million
Fully diluted: 89.4 million

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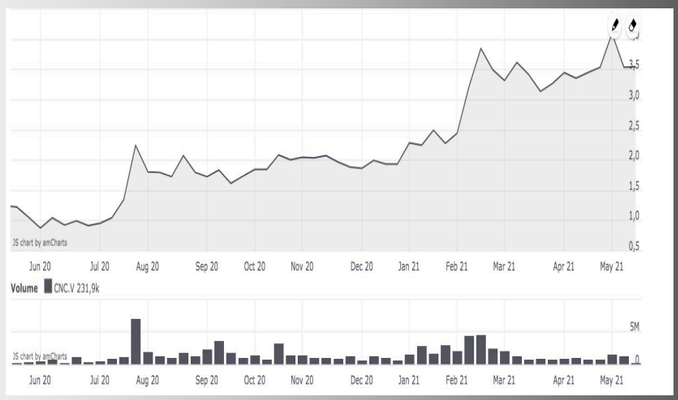
Canada Nickel Company



Copperbank Resources

Gigantic upside potential in many respects!

Gianni Kovacevic, CEO

The Canadian Copperbank Resources sees itself as a „mineral bank“, which secured potentially high-caliber copper projects in the top jurisdictions of Arizona and Nevada in bear market times and wants to profitably sell, option or further develop them by means of a joint venture in the coming copper boom. The company has already proven large copper deposits and has also established a royalty division, which is expected to provide further upside potential in the future.

Copper Creek Project – Location and Infrastructure

One of the two flagship projects is called Copper Creek, covers approximately 4,140 hectares and is located in Pinal County, Arizona. Copper Creek, located at the intersection of two major copper trends, is a large early halo porphyry copper deposit located 75 road miles northeast of Tucson and 15 miles northeast of San Manuel in an area with excellent and easily accessible infrastructure including power, rail, water, roads. The San Manuel/Kalamazoo deposit is located only 15 miles from Copper Creek. San Manuel was a major underground copper mine until its closure, producing over 50,000 tons per day (tpd). The nearest operating mining complex is the ASARCO Ray Mine near Hayden, 30 miles northwest of Copper Creek on Highway 77. At Hayden, ASARCO operates one of the two copper smelters in Arizona. Copperbank acquired Copper Creek in 2018.

Copper Creek Project – historical exploration and resource

Copper Creek first gained attention around 1900 when the massive outcrops of breccias occurring on the property came into focus for early claimholders. Over the years, the area was repeatedly explored for copper deposits and significant quantities were also mined. The breakthrough did not occur until the 1960s when several drill holes indicated major copper mineralization at depth. Many more drill holes (totaling about 220,000 meters) eventually led to the current resource of 4.9 billion pounds of copper equivalent (including molybdenum and silver) in the measured & indicated categories and 3.7 billion pounds of copper equivalent in the inferred category. At a cut-off grade of 0.20%, the average copper equivalent grade is 0.49% in the measured & indicated categories and 0.38% in the inferred category. At a 0.50% cut-off grade, the measured & indicated resource is 3 billion pounds at a significantly higher grade of 0.88% plus 1.3 billion pounds at 0.81% copper, which is high grade for a copper project. The resource estimate is from 2012 and is considered historical.

Copper Creek Project – Preliminary Economic Assessment

Based on this resource, the former owner Redhawk Copper prepared and published a preliminary economic assessment (PEA) in 2013. This produced a pre-tax net present value (NPV), discounted at 7.5%, of US$488 million and an internal rate of return (IRR) of 16% for an underground operation with a daily processing rate of 25,000 tpd and processing by conventional copper flotation concentrator with a molybdenum separation circuit, and based on a copper price of US$3.30 per pound. Copper production was estimated at 121 million pounds (55,200 metric tons) per year at a cost of US$1.74 per pound of copper excluding by-products. Initial capital costs were reported at US$857 million.

Copper Creek Project – Current work and optimization opportunities.

Although both NPV and IRR are improving dramatically at current copper prices of US$4 per pound, the Company is focusing on a very different strategy going forward to improve the economics of the project. In doing so, the company will soon begin a two-phase drilling program totaling 25 holes to confirm and update the historical open pit resource. This is because an open pit scenario in particular could improve Copper Creek‘s economics immensely and also depress its high capital costs. In addition, only 35 of the 400+ identified breccia pipes have been explored to date, and as few as 8 have been included in the 2012 resource estimate. Particular exploration potential exists above one drill hole that returned 280 meters at 1.4% copper. The possibility of an overburden is demonstrated by a 640-meter intercept that returned 0.48% copper.

Contact Copper project – location and infrastructure

Copperbank‘s second high profile copper project is called Contact Copper, covers approximately 2,400 acres and is located in Elko County, Nevada, 50 miles north of Wells, amid good infrastructure, highway, water, high voltage power line & services.

Contact Copper project – historical exploration and resource

Copperbank acquired the project in 2014 after previous owners had already drilled over 86,000 meters. A historical resource estimate from 2013 yielded a total of 831 million pounds of copper in the measured & indicated categories and 52 million pounds of copper equivalent in the inferred category at a copper grade of 0.20%. This already includes reserves totaling approximately 611 million pounds of copper at a grade of 0.22%. All these reserves and resources are surface resources!

Contact Copper Project – First Pre-Feasibility Study

Based on these resources and reserves, an initial pre-feasibility study was conducted in 2013. This resulted in an NPV of US$167.5 million discounted at 8% and an IRR of 35.2% after tax for an open pit operation with a daily processing rate of 41,000 tpd and processing by heap leach & SX-EW, based on a copper price of US$3.50 per pound. Copper production was estimated at 49.2 million pounds per year at a cost of US$1.73 per pound of copper. Initial capital costs were reported at US$189 million.

Contact Copper project – current work and optimization possibilities

Although these figures already look very good, Copperbank‘s management is already working on optimizing these economic indicators. Particular optimization opportunities are seen in the isolation and prioritization of high-grade pods. Drilling has shown that the project has several higher-grade areas that could be mined first. Drilling has returned 25 meters grading over 1% copper and 65 meters grading close to 0.70% copper. Further potential for optimization lies in alleviating bottlenecks in the heap leach system and SX-EW capacity. In addition, awarding production to a contractor and a two-phase development plan could dramatically reduce capital costs. In addition, the establishment of a royalty could create value for Copperbank shareholders (see below for more details).

Blue Sky Potential on the Copper Ridge Prospect

The Copper Ridge Prospect is located in the southern area of the Contact Copper project. Shortly before a pre-feasibility study was completed for Contact Copper in 2013, sampling at the Copper Ridge Prospect detected up to 12.4% copper directly at surface. Grab samples were collected in an area of approximately 2,500 by 600 meters. This area has never been drill tested before and previous activity has been limited to shallow, historic trenching. The purpose of the sampling program was to determine if additional geolo-

gical work was warranted to identify drill targets in this area. The results confirmed previous sample results and warrant follow-up work to identify near-surface copper oxide material that could expand the Contact resource.

Establishment of a separate royalty company

Copperbank has already created a copper royalty division. The idea behind this is simple: by tapping into the potential of the Contact Copper and Copper Creek development projects, Copperbank can cost-effectively create an entirely new business line for shareholders. In the future, Copperbank will evaluate opportunities to acquire additional royalty and equity positions and potentially take the royalty business public as an equity spin-out.

Current progress and catalysts

Copperbank plans to conduct an ongoing evaluation of planned drilling and resource expansion at Copper Creek and Contact, with a focus on blue sky potential at each project. Further, the Company is focused on reviewing the potential for optimization work at Copper Creek and Contact, with the objective of updating existing economic studies. In addition, the Company is advancing joint venture opportunities and pursuing the evaluation of consolidation opportunities in the copper and royalty sectors.

Summary: Huge NPV offers enormous upside opportunities based on current puny valuation

Compared to an NPV of over US$1.4 billion, Copperbank appears downright puny valued at a current market capitalization of around CA$45 million. Or, to put it another way, the upside potential appears enormous. Even more so because the company is currently working feverishly to improve its profitability. On the one hand, through a possible classification of Copper Creek as an (initial) open pit project, and on the other hand, through a possible expansion of Contact Copper to include a higher-grade deposit on the Copper Ridge Prospect. Furthermore, the establishment of a separate royalty company could mean additional share price potential and even some kind of dividend for Copperbank shareholders. With a current copper price of US$4.50 per pound, the opportunities for Copperbank appear almost gigantic.

Exclusive interview with Gianni Kovacevic, CEO of Copperbank Resources

What have you and your company achieved in the past 12 months?

The team at CopperBank has been assessing important next steps for our portfolio. There are not many listed copper companies that offer investors 2 advanced stage development projects, complemented by three world-class blue sky exploration projects and an organic royalty business that we have established from the previously mentioned projects. Most importantly, we own the entire portfolio 100% with no debt and we have no joint venture obligations. Due to the hard work the team has put into the assessments, we will have a very active next 12 months as we cost-effectively advance the entire portfolio. What this means for investors is very accretive value creation on a per share basis.

CopperBank.

What are the most important company catalysts for the next 6 to 12 months?

As noted in the previous questions, we are endeavouring to allocate a few million dollars into the CopperBank portfolio to answer some unanswered questions. This should be very important for attentive investors because it could result in a quantum leap of value creation. This is very rare in junior mining. To be more clear, exploration for junior mining is ruinously expensive, it takes countless tens of millions of dollars to complete medium sized drill programs. It would take in excess of $120 M USD to duplicate the work programs already completed on our portfolio. So, allocating a few million to really increase the size and quality of the projects is a potential game changer for the projects, the company and more importantly our shareholders of which the team and I are the largest.

How do you see the current situation on the market for battery metals?

There is an almost perfect set-up for copper going into this entire decade. The trend to electrification is well publicized, I don't think investors should lose much sleep on the future demand of copper. Supply, however, will be constrained no matter how high the copper prices rise the next few years. Recently, analysts are starting to really cover this opportunity. In fact, a recent Wood Mackenzie report has started to state the obvious that the top major mining companies will inevitably need to start acquiring growth or they will A., not have the future reserves to grow, and B., will be punished by investors if they do not show this growth. It takes over 20 years from discovery hole to construction decision when developing a future copper project. CopperBank's two flagship projects are at year 15 of that arc and that is why our projects will be important for larger companies. Time: as they do not have 15 years to get the point we are at. Cost: it now takes $0.04 to delineate a measured and indicated copper pound in the ground. CopperBank is trading at one half of one penny per pound in the ground for our current historical all category resources.

Copperbank Resources Corp.

ISIN: CA2176212009
WKN: A2P8K5
FRA: 9CM
CSE: CBK

Shares outstanding: 81.5 million
Options: 7.5 million
Warrants: 1.3 million
Fully diluted: 90.3 million

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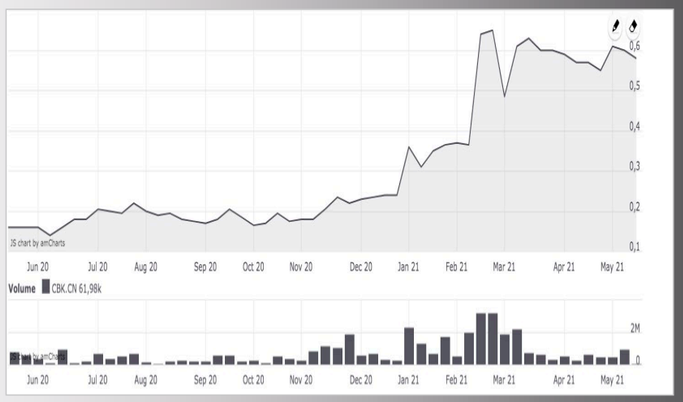

Hannan Metals

On elephant-hunting with a mega-partner

Michael Robert Hudson, CEO

Hannan Metals is a Canadian mining development company focused on discovering and developing well-located, high-grade battery and precious metals projects in secure jurisdictions. In 2018, the company recognized an opportunity to diversify its base metals portfolio and staked claims for copper in Peru. Not only do they hold one of the 10 largest land packages of any foreign mining company there, but they were also able to secure JOGMEC, a real big player in the mining industry, as a joint venture partner.

San Martin project – location and infrastructure

The flagship project, named San Martin and 100% owned by Hannan, covers 937 square kilometers and is located 30 kilometers northwest of the city of Tarapoto. The concessions cover a total of 120 kilometers of the prospective host horizon. Hannan Metals has already received an exploration permit for 329 square kilometers. Access to the project is excellent via a nearby paved highway, while elevations range from 400 to 1,600 meters in a region of high rainfall and predominantly forest cover.

San Martin Project – Geology

San Martin hosts a newly identified, high-grade copper-silver system that extends across the eastern Andes in Peru and adjacent countries. Geologically, this has striking similarities to sedimentary copper-silver deposits, including the giant copper shale deposits in Eastern Europe and the African Copper Belt deposits in sub-Saharan Africa, two of the largest copper areas on Earth. Hannan recognized the exceptional potential for large copper-silver deposits in this part of Peru and has aggressively staked out a dominant land position.

San Martin project – JOGMEC deal

In November 2020, Hannan Metals entered into a binding agreement for an option and joint venture agreement with Japan Oil, Gas and Metals National Corporation („JOGMEC“), an independent administrative agency of the Japanese government formed in 2004 by the merger of the former Japan National Oil Corporation with the former Metal Mining Agency of Japan. Under the Agreement, JOGMEC has the option to acquire up to 75% in the San Martin Project by spending up to US$35,000,000 to provide a feasibility study to the joint venture. This is not Hannan Metal‘s entire San Martin project, but approximately 656 of the 937 square kilometers of area.

Under the agreement, JOGMEC is granted the option to earn an initial 51% interest by funding project expenditures of $8,000,000 over a four-year period, which may be accelerated at JOGMEC‘s discretion. In addition, JOGMEC has agreed to reimburse Hannan for all project-related costs since April 1, 2020.

JOGMEC may receive an additional 16% share thereafter by either conducting a pre-feasibility study or making an additional $12,000,000 in project expenditures.

The Company will receive an additional 8% if it either conducts a feasibility study or funds an additional $15,000,000 in project expenses.

Should JOGMEC fail to complete a pre-feasibility study or spend a total of US$20,000,000, Hannan Metals has the option to buy back a two percent 2% interest for as little as US$1.00, returning a 51% majority interest in the joint venture.

Upon completion of a feasibility study, JOGMEC has the option to receive either an additional 10% at a „fair“ value or an additional 10% in exchange for JOGMEC agreeing to fund the development of the project by providing Hannan with a loan until the San Martin project generates positive cash flow.

After JOGMEC has spent US$35,000,000 and before a feasibility study has been completed, both parties will fund the expenditure on a pro rata basis or dilute through an industry standard dilution formula. If either party‘s interest in the joint venture is diluted to less than 5%, that party‘s interest will automatically convert to a 2% net smelter royalty.

Benefits of the JOGMEC deal for Hannan Metals

Hannan Metals receives several benefits with the JOGMEC deal. First, they will continue to manage exploration at least until JOGMEC acquires a 51% interest, with JOGMEC assuming all exploration and development costs retroactive to April 1, 2020. Thereafter, JOGMEC can take over the development of the project, with JOGMEC initially providing all of the financing itself, at least up to US$20 million or the preparation of a pre-feasibility study. Hannan Metals will not have to re-invest in the development of San Martin until JOGMEC has not completed a pre-feasibility study or spent at least US$35 million.

San Martin – exploration activities & first successes

On the JOGMEC project area, Hannan Metals has already identified several potentially high-grade copper-silver zones. For example, in July 2020, they completed a 17,500 square kilometer regional remote geological survey that highlighted prospective mineralized trends over a strike length of 120 kilometers, as well as identifying several new stratiform copper-silver targets.

This led to the discovery of copper-silver mineralization over a strike length of 73 kilometers. There, trenching intercepts included 2.0 meters of 5.9% copper and 66 g/t silver, 0.6 meters of 8.7% copper and 59 g/t silver, 3.0 meters of 2.5% copper and 22 g/t silver, and 0.2 meters of 6.9% copper and 32 g/t silver.

In another sub-area called Tabalosos, the combination of seismic and modern remote sensing of the surface from high resolution satellite imagery led to the discovery of 4 mineralized zones. This included trenching detecting 2.0 meters of 4.9% copper and 62 g/t silver, 1.3 meters of 3.5% copper and 86 g/t silver, 1.0 meter of 6.3% copper and 101 g/t silver, 1.8 meters of 3.7% copper and 42 g/t silver, and 2.2 meters of 2.4% copper and 29 g/t silver.

Since mid-March, Hannan Metals has been back in the field with exploration teams for further preliminary work.

Ucayali project – the second hot iron in the fire

Until Hannan Metals does not have to make its own exploration expenditures on the JOGMEC joint venture, it has the option to focus its own resources on its other projects.

As a result, in January 2021 Hannan Metals announced the acquisition of another project area called Ucayali in Peru. The Ucayali project, comprising 906 square kilometers of mining concession applications, consists of two sub-projects, Previsto and Belen, and was identified 6 months through remote studies and reprocessing of government petroleum exploration data. Hannan Metals believes Previsto is highly prospective for alkaline porphyry copper-gold systems. Ingemmet, Peru‘s geological, mining and metallurgical institute, has a history of detecting intrusions on the project area.

Also in January 2021, Hannan Metals announced initial exploration success and a real bull‘s eye from Previsto. Initial reconnaissance work has identified a large-scale hydrothermal system within a 6 kilometer by 3-kilometer area on the project site that has the potential to host a porphyry copper-gold mineral system with an associated skarn. Several copper and gold mineralized float samples were taken in the process, with the best float sample returning 25.6% copper and 28 g/t silver in an interpreted supergene enrichment zone. The work carried out focused on an area extending 10 kilometers north-south and

remaining open to the north, west and south. Copper and gold mineralized porphyritic intrusive rocks were also detected within flotation samples in streams, along with iron oxides, copper oxides and pyrite. Another anomalous copper and gold target was identified in the Belen area.

Upcoming catalysts and targets for 2021

At the San Martin JOGMEC joint venture, a total of US$2 million in exploration costs has been budgeted for 2021. The objective for 2021 at San Martin is to continue to expand the project at basin scale and confirm some continuity.
An initial budget of US$700,000 has been budgeted for Previsto. The primary objective is to prove a significant gold-copper porphyry deposit.

Well-rehearsed management team can already show several successes

Hannan Metals‘ management knows how to find and develop significant deposits.

CEO Michael Hudson has been instrumental in the discovery of advanced projects including Broken Hill (zinc, lead), in Pakistan (zinc), Peru (Accha – zinc, Bongara – zinc), Olary (copper-gold) as well as in Sweden (Norra Kärr – heavy rare earths). Together with President Lars Dahlenborg and Director Georgina Carnegie, he forms part of Mawson Gold‘s successful team that discovered, among others, the high-caliber Rompas-Rajapalot gold deposit in Finland.

Summary: Now it‘s really getting started

Basically, not much has happened at Hannan Metals yet. And yet, even in the early stages of exploration at San Martin, a mega-partner like JOGMEC is securing a foot in the door. Even a major player in the industry doesn‘t spend US$35 million just for fun. The company‘s own due diligence must have been correspondingly promising. While JOGMEC is initially pushing the development of San Martin financially alone, Hannan Metals can use its own money for the development of the second promising project and thus possibly land a second top-class project.

Exclusive interview with Michael Robert Hudson, CEO of Hannan Metals

What have you and your company achieved in the past 12 months?

Hannan is Peruvian exploration company opening up search spaces in new frontiers to find the next generation of large-scale global copper-silver and copper-gold deposits. With 2,154 sq km of mineral tenure, we are now a top 10 concession holder in a country which is dominated by some of the world’s largest exploration and mining companies. Hannan is one of the few juniors to acquire such a significant land position.
In 2020 we completed one of the larger joint venture agreements in the junior space by partnering with the Japan Oil, Gas and Metals National Corporation („JOGMEC“) at the San Martin JV project. JOGMEC has the option to earn up to a 75% beneficial interest in the San Martin Project by spending up to US$35,000,000 to deliver to the joint venture a feasibility study on 815 sq km.
The San Martin Project covers a new, basin-scale high-grade sediment-hosted copper-silver system situated along the foreland region of the eastern Andes Mountains. Hannan recognized the significant potential for large copper-silver deposits in this part of Peru and has aggressively staked a commanding position of prospective where mineralized outcrops and boulders have been discovered in context with a consistent mineralized horizon geology over 120 km of combined strike. Geologically, analogues include the vast Kupferschiefer deposits in Eastern Europe. Sediment-hosted stratiform copper-silver deposits are among the two most important copper sources in the world, the other being copper porphyries.
Hannan is also exploring in its own right over 277 sq km of mining concessions prospective for copper-silver 100% in the San Martin area for sediment-hosted copper and silver, outside of current joint venture areas and also holds over 1,062 sq km of mining concessions prospective for back-arc copper-gold porphyries in central-eastern Peru. Hannan also has 100% ownership of the zinc-silver County Clare project in Ireland.

What are the most important company catalysts for the next 6 to 12 months?

Simply put we are looking to repeat our success in 2020 with further discovery within both our joint venture and 100% held exploration areas. In 2021, we have a C$3M grassroots exploration program aimed at targeting large scale discoveries.

How do you see the current situation on the market for battery metals?

A generational shift is occurring as the world moves away from carbon. That means we need a lot more metal as the world electrifies. Especially copper. We do not have enough to meet demand and need big new discoveries. Full stop. Get on board!

ISIN: CA4105841064
WKN: A2DJ8Y
FRA: C8MQ
TSX-V: HAN

Shares outstanding: 84.5 million
Options: 5.3 million
Warrants: 21.4 million
Fully diluted: 111.2 million

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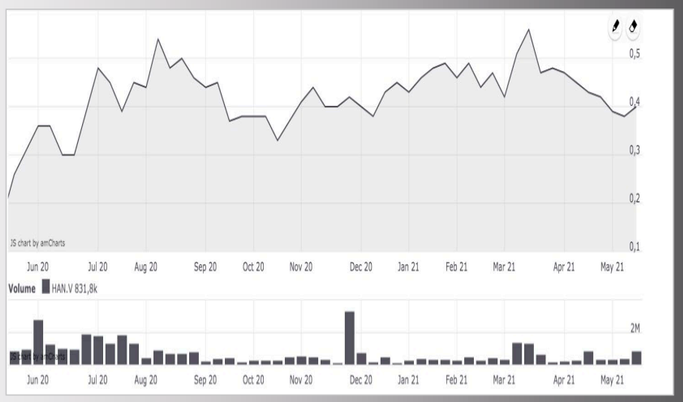
Hannan Metals Limited



ION Energy

Young lithium developer takes off right on China‘s doorstep

Ali Haji, CEO

ION Energy is a brand-new Mongolian mining development company specializing in the aggressive development of lithium brine projects, which just listed on the TSX Venture Exchange and in Frankfurt in August 2020. Management has a high level of experience with resource projects in Mongolia, which is why ION Energy‘s flagship projects are also located in Mongolia. The company benefits from a first mover advantage and has the largest battery market(s) right on its doorstep as potential customers.

Baavhai Uul Lithium Brine Project – Location

ION Energy‘s flagship Baavhai Uul project is located in southeastern Mongolia, only about 24 road kilometers from the Chinese border and thus from the world‘s largest battery producer. The project site covers 80,000 hectares, making it one of the largest approved exploration licenses and also the first lithium brine license in Mongolia‘s history. The project is located in one of Mongolia‘s largest and also least explored salars.

Baavhai Uul Lithium Brine Project – First Exploration Successes

Baavhai-Uul has high potential for a high-caliber lithium brine resource, as drilling has already confirmed. Average lithium grades of 426ppm (parts per million) were detected directly at surface. The highest lithium concentration was 810.6ppm. All holes drilled contained lithium concentrations and also had low potassium and magnesium ratios, favoring the formation of large crystals at the present elevation and sometimes low temperatures. The project area is characterized by extremely high evaporation and concurrent low precipitation. It is a so-called endorheic basin, which has no outflow to external water bodies or the sea. Furthermore, it hosts shallow aquifers. Such Cretaceous volcanic and sedimentary rocks are the most suitable aquifers for lithium enrichment. Another advantage that lithium brine deposits possess is that they are cheaper to extract than hard rock projects.

Baavhai Uul Lithium Brine Project – Upcoming Exploration Work

The Company has recently commenced a geophysics program (CSAMT) which will be followed by a seismic program. In addition, they have acquired a truck-mounted rig capable of drilling to depths of 20 meters, which will be mobilized by the second quarter of 2021. This takes a strategic and efficient drilling approach and plans to drill aggressively starting in the second quarter of 2021. The first two targets are considered to be L8 and L11, where cross sections of 8 and 12 kilometers, respectively, are to be drilled at 50-meter intervals.

Urgakh Naran Lithium Brine Project

In February 2021, ION Energy acquired the Urgakh Naran Lithium Brine Project, which covers approximately 19,000 hectares and is located approximately 150 kilometers west-northwest of Baavhai-Uul. Previous work conducted at the project site included an extensive hydrochemical sampling program of identified shallow brine lithium. Although still in its early stages, this program has been extremely successful in identifying several targets for follow-up exploration. ION Energy is already in the midst of planning follow-up exploration of the best of these new targets.

Mining-friendly Mongolia with unexplored raw material potential and major location advantages

Mongolia is generally considered a very mining-friendly country. Overall, Mongolia‘s mining industry contributes 20% to Mongolia‘s GDP and 80-90% to the country‘s exports. The big advantage is that it is a neighbor of two huge markets: China & Russia. For the raw material companies, especially the low transport costs to the Chinese raw material markets are a big location advantage. Moreover, for decades there has been no historical exploration of battery metals. The current government emphasizes an investment-friendly environment: the Mongolian People‘s Party (MPP) won another resounding victory in 2020, with a majority mandate for four years. Low corporate income tax and government royalties are the result. The government‘s anti-investment regulations were lifted in 2014. The country has untapped and unlimited potential for lithium: no historical exploration in and new, under-explored projects for battery minerals, but at the same time a geologically well-equipped and high-quality destination or jurisdiction.

Strong analyst coverage

Although ION Energy is still in its infancy, three analyst firms – Couloir Capital, Stonegate Capital and First Republic Bank – have already put out feelers for ION Energy. So far, the price targets range from 88 to 96 Canadian cents per share.

Strong management team

ION Energy has a very strong management team that has successfully operated in Mongolia for over a decade and has over 100 years of combined mining and exploration experience.
Chairman Matthew Wood is also currently Chairman of Steppe Gold. He was also the founding Chairman of Avanco Resources (sold in March 2018 for AU$440 million) and HunnuCoal (sold in 2012 for US$500 million). CEO Ali Haji is a current director of Antler Hill Mining Ltd and Spirit Banner II Capital Corp. He has over 13 years of international experience in asset management, risk analysis and program governance. He is also an advisor to ATMA Capital Markets Ltd and Steppe Gold and holds a BSc from the University of Western Ontario.

Director Bataa Tumur-Ochir is a Mongolian citizen who serves as CEO and Director of Steppe Gold. He is an advisor to the Ministry of Mines and Heavy Industry, holds a bachelor‘s degree in business administration and a diploma in international business administration and marketing from Australia and Singapore.

Director Enkhtuvshin Kishigsuren has over 30 years of experience in resource projects for multinational companies. He has discovered several prospective gold, molybdenum and copper deposits, including the multi-million-ounce Olon Ovoot gold deposit.

Consultant Paul Fornazzari has been involved in the lithium industry since 2008, when he was the initial Chairman of Lithium Americas Corp. (currently under mine construction with its partner Ganfeng Lithium) and secured the initial strategic investments from Mitsubishi and Magna International that helped launch this world-class lithium brine plant. Subsequently, he was a director of Neo Lithium Corp. (currently in the feasibility study phase). He has been involved in the resource industry for many years and has gained insight and experience in the company formation process through various directorships and as legal counsel.

Consultant Don Hains is president of Hains Engineering Company Limited and managing director of Hains Technology Associates. He is an industrial mineral exploration and economic geologist with more than 30 years of experience in the exploration, development, exploitation and analysis of industrial mineral properties and materials. He has a particular focus on critical and energy-related minerals such as lithium, working on projects around the world, including lithium and other industrial mineral projects in China and Mongolia.

His lithium experience spans all types of deposits, processing routes, and stages of project development from exploration to plant construction. He has authored numerous NI 43-101 technical and due diligence reports on lithium projects in Canada, the United States, South America, Africa, Europe, the Middle East and Asia.

Dr. Khashbat Dashteseren also joined ION Energy‘s advisory team in February 2021. Dr. Dashteseren is a geologist and scientist with extensive experience in the exploration of various minerals in Mongolia and has worked for the Ministry of Urban Development and Investment in Mongolia. Dr. Dashteseren was also the Chief Geologist at Geolink LLC before assuming the role of CEO. Subsequently, Dr. Dashteseren worked as an exploration manager for Resource Partners Group. He also spent a significant amount of time researching laboratory analytical methods for lithium at Akita University in Japan.

Summary: The first bull‘s eye could come soon

ION Energy was one of the first to recognize Mongolia‘s major location advantages. Especially the proximity to the largest battery market China is almost unbeatable. ION Energy‘s management team is considered a pioneer in the mining industry in Mongolia and has been operating in the country for more than 10 years. During that time, they have been able to identify potentially high-grade lithium deposits, ultimately securing the current flagship Baavhai-Uul project and, more recently, Urgakh Naran. Both projects are so huge that they could even host multiple high-grade lithium brine deposits. If the proof of this is successful from 2021 onwards, an extremely cost-effective lithium production could be established, also due to the special climatic conditions (high evaporation, hardly any precipitation). The company is sufficiently funded for the first drilling (close to the surface) (in March and April 2021 they were able to generate CA$ 5.75 million in fresh funds through an oversubscribed financing) and should provide a continuous newsflow from exploration activities from mid-2021 onwards.

Exclusive interview with Ali Haji, CEO of ION Energy

What have you and your company achieved in the past 12 months?

ION Energy is really proud of what we‘ve achieved in the midst of a global pandemic. We were close to going public on the heels of last year’s PDAC, having received conditional approval from the TSXV in April while the whole world was locked down. We went public on TSXV in August 2020. Since then, we‘ve added strong expertise to our team, commenced exploration on our flagship +80,000 hectare Baavhai Uul lithium brine project, increased our exposure to US investors by trading on the OTCQB, acquired an additional licence in-country to ensure ION’s strategic advantage in Asia, and most recently, completed a $5.75 Million public offering, confirming strong institutional investor support for ION Energy’s value proposition. We have no need to go back to market for the next 2 years and have warrants that can add a further $11M to the treasury. We are fully funded. A great position to be in.

What are the most important company catalysts for the next 6 to 12 months?

ION is embarking on an extremely exciting period, with our +100,000 hectare highly prospective lithium brine projects kilometres away from China, the world’s largest battery manufacturer. We are fully cashed up: allowing us to intensify our on-the-ground site efforts and ensuring that our exploration and acquisition objectives will be fully funded for the next two years. Importantly, as stated, we won‘t have to go back out to market to raise more capital, which truly sets us apart from other juniors.
We will further strengthen expertise on our team and share preliminary micro-seismic results from our flagship site. In the coming months, we will continue to deliver on our strategic commitments to our shareholders by: focusing our resources on de-risking our assets by deploying our company-owned truck-mounted auger rig, sharing early resource estimates with our shareholders and then deploying diamond core rigs to better quantify our licences‘ lithium production capabilities. Our final goal on this journey is to bring in a strategic investor.

How do you see the current situation on the market for battery metals?

The world changed in 2020, and one of the positives coming out of this unfortunate pandemic has been a shift from fossil fuels to cleaner, greener technology. Our team has been prepared for this shift since 2017, and finally government stimulus announcements across the globe are more coordinated and focused on the green revolution. President Biden’s $2 trillion infrastructure bill focused on critical metals for the energy transition, electric vehicle supply chains in Europe, local community transit companies electrifying their fleets, lithium price increases in China and recent strategic corporate announcements like the $4 Billion merger of Orocobre and Galaxy in Australia, all validate that the battery metals demand is continuing to rise.

ION Energy Ltd.

ISIN: CA4620481099
WKN: A2QCU0
FRA: 5YB
TSXV: ION

Shares outstanding: 60.2 million
Options: 3.7 million
Warrants: 20.6 million
Fully diluted: 84.5 million

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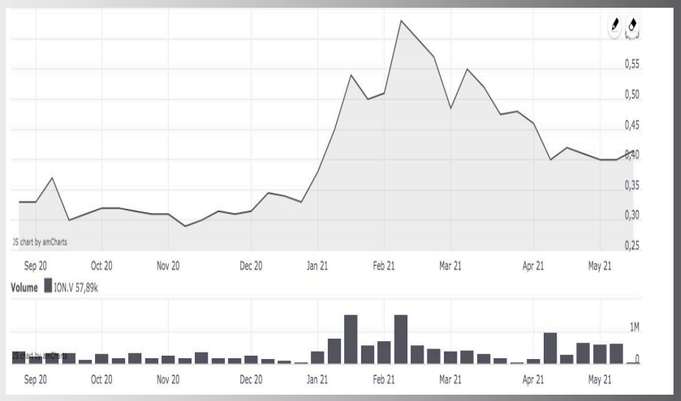


Kutcho Copper

With strong development partner on the way to a feasibility study

Vince Sorace, CEO

Kutcho Copper is a Canadian mining development company specializing in the development of high-grade copper deposits in British Columbia. There, the company was able to secure the eponymous Kutcho Copper project, which not only hosts a resource, but already an appealing reserve. A pre-feasibility study (PFS) has already come to an overwhelmingly positive conclusion. A bankable feasibility study is expected to be completed in the third quarter of 2021, removing the last major risk from the project. Kutcho is thus already very advanced and could soon attract potential takeover bidders. The company already has a strong development partner in Wheaton Precious Metals.

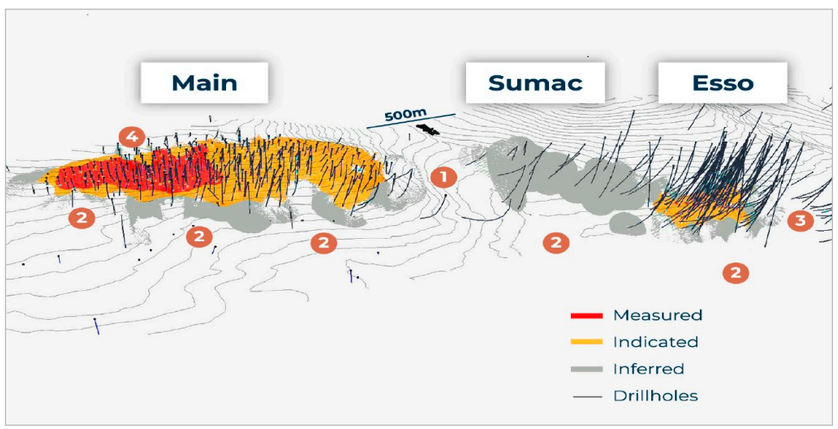
Kutcho Copper Project – Location and Infrastructure

The flagship Kutcho project is located approximately 100 kilometers east of Dease Lake in northern British Columbia and consists of a mining lease and 46 mineral exploration claims covering an area of approximately 17,060 hectares. The site is accessible by a 900-meter gravel airstrip for small aircraft located 10 kilometers from the deposit and a 100-kilometer seasonal road from Dease Lake suitable for tracked and low-use vehicles. A deep-water port is located in Stewart, approximately 400 kilometers from Dease Lake. Existing infrastructure has been greatly improved over the past 10 years with numerous infrastructure improvements. Among other things, Highway 37 runs through northern British Columbia.

Kutcho Copper Project – Geology and Mineralization

The Kutcho Copper Project lies within the King Salmon Allochthon, a narrow belt of Permo-Triassic island arc volcanic rocks and Jurassic sediments that lies between two north-dipping overthrust folds: the Nahlin fault to the north and the King Salmon fault to the south. The belt of volcanic rocks is thickest in the area where it hosts the VMS deposits, due in part to primary deposition but also to stratigraphic repetition by folding and possibly overthrusting. The volcanic rocks are folded, and triple repeat the mineralized horizon on the project, including the deposit. The massive sulphide deposits are oriented east-west and dip 15° to the west.

Mineralization comprises three known „Kuroko-type“ VMS deposits aligned on a west-dipping linear trend. The largest, the Main deposit, comes to surface at the eastern end, followed by Sumac at depth and Esso at the western end, which occurs at a depth of approximately 400 meters below surface. „Kuroko-type“ VMS deposits are typically associated with felsic volcanism in island arc or back-arc tectonic settings. The characteristics of Kutcho-type deposits indicate that they formed at or near the water-soil interface in a structurally controlled depression, for example, in a „half-graben“ type structure. The chemical composition of the alteration around the Kutcho deposits is well zoned around the hydrothermal vent zones. Mineralization consists of a pyritic footwall with zoned copper and zinc towards a sharp hanging wall contact.



Rock formation by type targets
(Source: Kutcho Copper)

Kutcho Copper Project – Reserves and Resources

The Kutcho Copper Project already has a high-caliber reserve and resource base, primarily from the Main Zone. A 2017 estimate indicated a potential reserve of 10.4 million tonnes averaging 2.01% copper, 3.19% zinc, 34.61g/t silver and 0.37g/t gold.

The most recent resource estimate to date, from February 2021, returned measured and indicated resources of 18.6 million tonnes averaging 1.78% copper, 2.58% zinc, 0.05% lead, 32.8g/t silver and 0.47g/t gold, and inferred resources of 13.2 million tonnes averaging 1.11% copper, 1.60% zinc, 0.03% lead, 20.6g/t silver and 0.25g/t gold.

Kutcho Copper Project – Exploration Potential

The Kutcho Copper Project has great exploration potential.

The Main-Sumac Gap identifies a 400-meter-wide gap between the Main and Sumac lenses that has not yet been drill tested. A conductive geophysical anomaly coincides with this area and is 360 meters long. The easternmost hole, which intersected the Sumac lens and is located on the western edge of the gap, returned 5.12 meters at 1.29% copper, 0.49% zinc and 7g/t silver.

The Footwall Zone is stratigraphically below the Main Zone and represents a stacked massive sulphide horizon open in all directions. The last hole drilled to the east and down dip intersected 1.5 meters of 3.54% copper, 6.94% zinc, 316.9g/t silver and 1.47g/t gold.

MCF is located at the eastern end of the main deposit and coincides with a conductive VTEM geophysical anomaly and a copper-zinc soil anomaly. Three historic drill holes returned approximately 35 meters of semi-massive sulfide, while one hole intersected long intervals of strongly altered lapilli tuff with 2-8% pyrite, traces of chalcopyrite and sphalerite.

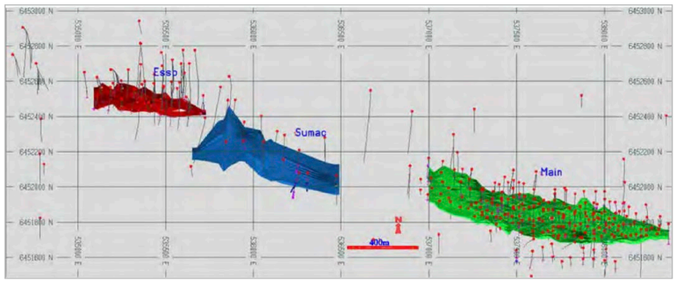
Overall, 36% of the Main Zone, 50% of the Esso Zone and 100% of Sumac remain open down dip and outside of the current resource model.

In addition to the deposits located close to the Main Zone, the project area hosts a number of other greenfield targets that remain to be explored.

These include the so-called IRJ Northwest, which was first identified as a conductor in a ground-based survey in 1990 and tested with two drill holes. The holes intersected strongly altered and weakly copper mineralized intervals as well as a thick sequence of altered lapilli and ash. The size and strength of alteration in both holes indicates a prospective target down dip from previous drilling.

In the IRJ Northeast area, three holes drilled in 1990 returned massive to semi-massive sulphide layers up to 1 meter wide associated with clayey material. One of the holes returned approximately 3 meters of what is known as a stringer zone averaging 20% pyrite containing some massive bands and returned 7.3 meters of 0.27% copper with a high sample of 0.45% copper. Geochemical trends indicate that the hydrothermal vent area is located further east, and target acquisition should focus on this vector.

In addition, there are several other promising target areas.



Esso, Sumac and Main Deposits with Drillhole Collars and Traces (Source: Kutcho Copper/JDS (2017))

Kutcho Copper Project – Pre-Feasibility Study

In 2017, Kutcho Copper published a positive pre-feasibility study for the Kutcho Copper Project. The study was based on a copper price of US$2.75 per pound and a zinc price of US$1.10 per pound. For a production capacity of 2,500 tonnes per day (tpd), the study resulted in an after-tax NPV of CA$265 million and an after-tax IRR of 27.6%. Initial capital costs were estimated at CA$221 million and all-in sustaining costs at US$0.97 per pound of copper. An estimated mine life of 12 years would result in after-tax cash flow of CA$550 million. With assumed metal prices now much higher, flotation testing now yielding higher recoveries than assumed in the pre-feasibility study, and an expanded resource estimate, the Company is currently working on a feasibility study to be released in the third quarter of 2021.

Development deal with Wheaton Precious Metals

To rapidly develop the Kutcho Copper Project, Kutcho Copper was able to enter into a US$100 million development deal with silver streaming company Wheaton Precious Metals. As part of the 2017 acquisition of the Kutcho Project from Capstone Mining, Kutcho Copper, still under its former name Desert Star, received a commitment from Wheaton Precious Metals to receive up to US$100 million in total. In return, Wheaton Precious Metals is entitled to acquire 100% of the silver and gold production from the Kutcho project until 5.6 million ounces of silver and 51,000 ounces of gold have been delivered, at which time the interest will decrease to 66.67% of silver and gold production for the life of mine. Wheaton Precious Metals will make an ongoing cash payment equal to 20% of the respective spot price of silver and gold for each ounce delivered under the agreement. Since entering into the agreement, Wheaton Precious Metals has committed US$7 million to fund the feasibility study. Another US$58 million has been paid to develop the project. Kutcho Copper will receive up to US$20 million more if it expands to a 4,500 tpd operation. Further, Kutcho Copper executed a CA$4 million financing with Wheaton Precious Metals in December 2017. Kutcho Copper also received a CA$20 million loan from Wheaton Precious Metals.
It is important to note that only about 8% of the estimated project revenues are impacted by the stream. 61% of the projected revenues generated will be attributed to copper, 31% to zinc, 5% to silver and 3% to gold.

Summary: Attractive resource, high exploration and development potential, upcoming feasibility study.

Kutcho Copper already has an attractive resource base at its eponymous copper project, although the site has yet to reveal its vast resource potential. Several potentially high-caliber exploration areas are waiting to be extensively investigated. First of all, however, the focus is clearly on the completion of the feasibility study, which is to be published in the third quarter of 2021. This would take a lot of risk off the project and possibly attract other interested parties besides the top development partner Wheaton Precious Metals to what is probably one of the most exciting copper-zinc projects in the world.

Exclusive interview with Vince Sorace, CEO of Kutcho Copper

What have you and your company achieved in the past 12 months?

In the past 12 months, Kutcho Copper has been preparing for and has commenced its feasibility study on its high-grade copper-zinc project in British Columbia, Canada. With significant progress made to date, we are expecting completion in Q3, 2021. This is a key milestone for the Company on its path to production.

What are the most important company catalysts for the next 6 to 12 months?

Over the next 6 to 12 months, Kutcho Copper will be engaging in several activities to add additional value to the Company. Completing its feasibility study will be a significant milestone which provides a high level of confidence in derisking the project and will showcase the economics of this advanced, high grade copper asset. The Company will also continue moving forward with the permitting process and drive towards the most efficient path to production. In addition, there remains significant exploration upside potential, both brownfield and greenfield targets have been identified and will be aggressively pursued through 2021 and 2022.

How do you see the current situation on the market for battery metals?

Battery metals will have a bright future for many years to come. As the world's initiative for cleaner energy and ultimate decarbonization gains significant momentum, demand for these metals will continue to grow.

ISIN: CA5013771053
WKN: A2JAMG
FRA: 1QV
TSX-V: KC

Shares outstanding: 88.1 million
Options: 8.0 million
Warrants: 17.5 million
Fully diluted: 113.6 million

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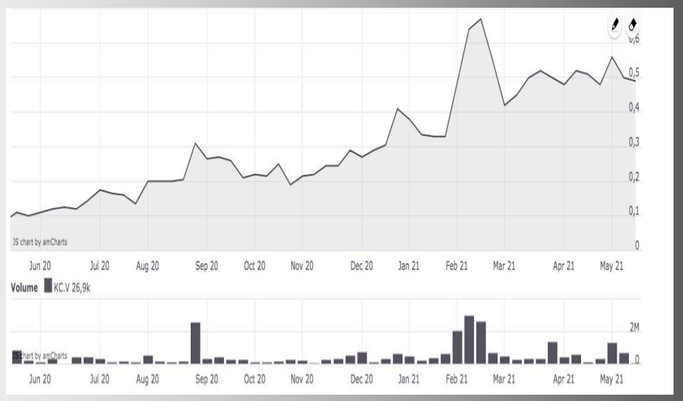
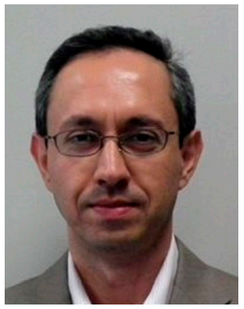
Kutcho Copper Corp.



Millennial Lithium

Full in permitting and mine financing + 99.96% lithium carbonate



Farhad Abasov, CEO

Millennial Lithium is a Canadian mining development company focusing on lithium projects in Argentina. The company is in pole position as it has already completed a feasibility study. A pilot production plant including extensive evaporation ponds was recently put into operation. In parallel, the company is working on the approval of the future production plant with a capacity of 24,000 tons of lithium carbonate per year as well as on the project financing. In the process, CA$ 34.5 million could be generated most recently.

Pastos Grandes Lithium Project – Location and Acquisition

The flagship project is Pastos Grandes, a lithium project in the northwestern Argentine province of Salta. Pastos Grandes is a salt lake that is part of a whole series of similar lakes that run like a string of pearls through the provinces of Salta and Catamarca.
Millennial Lithium‘s Pastos Grandes project consists of several sub-areas, currently covering 8,664 hectares, which have been progressively acquired since approximately mid-2016. The Company initially conducted geophysical work, an extensive drilling program, preparation of a resource estimate, and construction of evaporation ponds, a pilot processing plant and camp. Furthermore, a hybrid solar power system was commissioned to provide electricity.

Pastos Grandes Lithium Project – Very good connection to existing infrastructure

The biggest plus point is the relative proximity to the provincial capital Salta. While most of the competitors‘ projects are literally located in the pampas, Millennial Lithium‘s project has a direct connection to the city of Salta, which is about 235 kilometers away by road and has a population of about 350,000. At the same time, there is a direct road connection of around 490 kilometers to the Chilean port city of Antofagasta, which not only has a Pacific deep-sea port but is also considered one of the leading mining cities in South America. A 600-megawatt, 375-kilovolt high-voltage transmission line connecting Salta and Chile‘s Mejillones runs 53 kilometers north of the project area. A natural gas pipeline also runs about 26 kilometers northwest of the project.

Pastos Grandes Lithium Project – Exploration and Development Successes

In fall 2016, Millennial Lithium started its first own drilling campaign at Pastos Grandes. Already the first drilling (to 192 meters depth) encountered three water-bearing brine layers of different depths, which showed densities of 1.19 g/cm3 to 1.22 g/cm3. The second well (to a depth of 352 meters) encountered as many as eight intervals, each about one meter long. This drilling success led the Company to drill a third hole. In total, lithium grades of up to 471mg/L were detected by these drill holes.
In June 2017, Millennial Lithium encountered an average lithium grade of 535mg/L over 381.5 meters via another drill hole.
A subsequent pump test in another well yielded average lithium contents of about 430mg/L over a period of 60 hours. This also showed a slight decrease in lithium levels from only 439 to 431mg/L over the entire test period.
In August 2017, Millennial Lithium was able to demonstrate that the brine-bearing layer continues outside the Salar center. Among others, a near-surface layer of 33 meters with an average of 523mg/L and a deeper layer with 545mg/L over a whole 211.3 meters were encountered!
Additional drilling in 2018 returned up to 701mg/L lithium within a 545-meter-thick interval. In November 2018, a 236-meter intercept was also encountered averaging 566mg/L lithium. Recent pump testing returned lithium grades between 482mg/L and 518mg/L over a 24-day period.

In January 2019, Millennial Lithium was able to laboratory confirm that it can produce a 99.92% battery-grade lithium carbonate concentrate using brine from Pastos Grandes.

Pastos Grandes Lithium Project – Resource

In April 2019, Millennial Lithium released an updated resource estimate for Pastos Grandes based on the Canadian NI43-101 resource calculation standard. According to the estimate, the project has 4,120,000 tonnes of lithium carbonate (Li2CO3) equivalent (LCE) and 15,342,000 tonnes of potash (KCl) equivalent in the measured and indicated categories, with an additional 798,000 tonnes of LCE and 2,973,000 tonnes of KCl in the inferred category. Compared to the December 22, 2017 resource estimates, the updated resources represent a nearly 100% increase in measured and indicated LCE tonnage (2017 value of 2,131,000 tonnes LCE). This provides the Company with significant measured and indicated lithium resources that have the potential to be converted into reserves.

Pastos Grandes Lithium Project – Positive Feasibility Study

Based on this resource estimate, Millennial Lithium published a positive feasibility study for Pastos Grandes in July 2019. According to this, the project has a net present value (NPV) of US$1.03 billion (discounted at 8%), assuming production of an average of 24,000 tonnes of battery grade lithium carbonate per year (>99.5% LCE). Operating costs were estimated at a low US$3,388 per tonne of lithium carbonate over the full 40-year mine life. Initial capital costs are US$448.2 million. The payback period is 5.4 years. On this basis, the internal rate of return (IRR) is an exceedingly strong 24.2% after tax. The cost of capital includes indirect costs and a buffer totaling around US$96.6 million, which may still be reduced.

Pastos Grandes Lithium Project – Permitting Process and Pilot Production Plant

In June 2020, Millennial Lithium received Environmental and Mining Authority approval for the environmental impact assessment for the construction and operation of the proposed 24,000 tonne per year battery grade lithium carbonate production facility.
Pending final permitting of the production facility, Millennial Lithium is operating a pilot production plant with a monthly capacity of 3 tonnes of lithium carbonate, which the Company commissioned in October 2020. The pilot plant, located adjacent to the Pastos Grandes Salar, is a complete flowsheet design and is fed with concentrated lithium-rich brine from the smaller feed ponds that has reached a grade of 3% Li.
In April 2021, Millennial Lithium announced that it had succeeded in producing battery-grade lithium carbonate with a purity of 99.96% using the pilot production plant. This was well above the required 99.5% and proved that such purities can be achieved outside of a laboratory with material from Pastos Grandes.

Cauchari East Lithium Project

In 2016, Millennial Lithium acquired another lithium project called Cauchari East. This covers 2,990 hectares and is located on the eastern side of the Cauchari-Olaroz Salar, adjacent to Orocobre‘s producing Salar de Olaroz and Lithium Americas Corp.‘s advanced Cauchari-Olaroz project. Millennial Lithium‘s new project has the same geological characteristics as the two producing and advanced projects of its adjacent competitors, respectively, and particularly high potential in the lower Salar strata. Assays carried out by Orocobre on their own project suggest that the corresponding lithium brine resources extend to the eastern part of the Salar and thus also to the Cauchari East project. This has now

MILLENNIAL LITHIUM

been confirmed by Millennial Lithium through geophysical studies.
In June 2017, Millennial Lithium was able to expand its Cauchari East project by an additional 8,742 hectares.

Top management for rapid project development

A top management team was put together for the rapid further development of the company‘s own projects.
CEO Farhad Abasov‘s career has included leading Allana Potash to a $170 million acquisition by Israel Chemical Ltd. and Energy Metals to a $1.8 billion acquisition by Uranium One. He also co-founded Potash One, which was acquired by Germany‘s K+S for $430 million in 2010.
Chairman Graham Harris was senior vice president and director of Canadian investment firm Canaccord for five years. He raised more than $250 million in capital for listed and private companies. Harris is also an owner of Sunrise Drilling, which provides a critical advantage for exploration.
Peter Ehren is a specialist in evaporation plants when it comes to lithium production. He has worked for several big names in the industry (SQM, BHP) and was jointly responsible for the design and construction of the evaporation ponds at Orocobre‘s Salar de Olaroz project.

Summary: Permitting and funding as upcoming milestones

Millennial Lithium has what other lithium developers can only dream of for a lifetime: A high-grade lithium resource, excellent drilling and pumping results, an extremely good infrastructural location (unlike many competitors) and a positive feasibility study. Furthermore, a pilot test plant has been commissioned to test the exact processing on a small scale and is capable of producing 99.96% premium battery grade lithium carbonate. In addition, the Company is working on engineering studies and the permitting process, as well as financing for the proposed mine. The Company remains in a top financial position with a current cash balance of approximately CA$50 million, allowing all upcoming programs to proceed smoothly. Commercial production starting in 2024 remains on the agenda.

Exclusive interview with Farhad Abasov, CEO of Millennial Lithium

What have you and your company achieved in the past 12 months?

Millennial Lithium has advanced its Pastos Grandes project during this difficult year of the Covid 19 virus which affected many parts of Argentina. Millennial pilot program continued through the year with evaporation ponds reaching optimal grade of 3 % Li in Q3. Millennial completed construction of its lithium carbonate processing pilot plant and achieved battery grade quality production of Li2CO3 with a purity of 99.96% and very low impurities from its first batch of brine.

In addition to technical milestones reached over the past 12 months Millennial was very active on the corporate front. Millennial received approval from the Environmental and Mining Authority in Salta for its comprehensive Environmental Impact Report (EIR), the main permit required for operations. The final acquisition of the Remsa licenses was also an important milestone for the Company and expanded our land position to almost 13,000 ha. An additional milestone was Millennial’s financing in early 2021 which was over-subscribed and raised $34.5M CDN. The Company continues with off-take negotiations with a number of interested parties as well as discussions with various organizations on project financing.

What are the most important company catalysts for the next 6 to 12 months?

The main technical catalysts for the Company in the next 6-12 months include expanding production at the Pastos Grandes pilot plant to 300 kg followed by 500 kg per month, providing large samples to interested off-takers for quality assessment studies, to advance early engineering studies such as finalizing process and pond design, and lastly to continue to advance gas pipeline permitting and general permitting for the project. The corporate catalysts for the Company include finalizing off-take agreements, selection of a strategic partner for the project, or securing project financing. We believe we are one of the most advanced development projects in the world right now.

How do you see the current situation on the market for battery metals?

The current situation for battery metals remains very positive and can be seen in the recent price jumps for all battery materials including lithium. Battery plant construction announcements have started in Europe as major car manufacturers look to have a reliable source of batteries as many undergo significant expansions to their EV fleets. In China Tesla and BYD’s recently announced preference for LFP batteries indicates strong future demand for lithium carbonate and BMW’s recent announcement of its securing LiOH from Livent for nickel-cobalt based batteries indicates strong future demand for these metals as well.

Millennial Lithium Corp.

ISIN: CA60040W1059
WKN: A2AMUE
FRA: A3N1
OTCQX: ATWGF
TSXV: ML

Aktien ausstehend: 97,8 Mio.
Optionen/RSUs: 11,8 Mio.
Warrants: 4,3 Mio.
Vollverwässert: 113,9 Mio.

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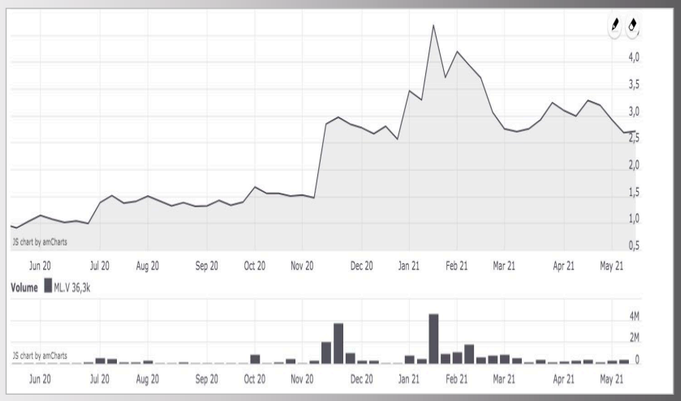


Standard Lithium

Large strategic resource + mega partners and own unique technologies for greatest possible success

Robert Mintak, CEO

Standard Lithium is a Canadian mining development company specializing in the development of high-grade lithium deposits in the USA. The company is increasingly using new technologies to extract lithium in a relatively environmentally friendly way, which shortens the corresponding permitting processes and thus gives the company an additional time advantage. Standard Lithium‘s proprietary technologies for direct lithium extraction and AI-assisted lithium crystallization are key to the development of a globally significant domestic critical mineral resource in the USA.

Arkansas Smackover Lithium Project – LANXESS Deal

Standard Lithium has had a collaboration with LANXESS Corporation (Bayer spin-out) since 2018, with the goal of testing and demonstrating the economic viability of extracting lithium from tail-brine in the U.S. state of Arkansas, produced by LANXESS‘ bromine extraction business at its three plants in southern Arkansas. LANXESS‘ operations in southern Arkansas cover 150,000 acres that include 10,000 brine leases. LANXESS extracts brine from wells located throughout the region, and the brine is transported through a network of 250 miles of pipelines to three facilities where the brine is processed for bromine recovery, with the final brine then reinjected into the aquifer. The three bromine extraction plants employ about 500 people, have been in operation for nearly five decades, and produce about 5.3 billion gallons of brine annually.

Arkansas Smackover Lithium Project – Resource Estimate

The most recent resource estimate for the project area, developed in conjunction with LANXESS, revealed in June 2019 that it has at least 3.140 million metric tons of lithium carbonate equivalent in the indicated category.

Arkansas Smackover Lithium Project – Economic Viability Estimate

Also in June 2019, Standard Lithium released a preliminary economic assessment (PEA) for the Arkansas Smackover Lithium Project. This identified a pre-tax net present value (NPV) of US$1.3 billion at a discount rate of 8% and a pre-tax IRR of 42%.

Capital costs have been estimated at a total of US$437 million, including a 25% buffer on both direct and indirect capital costs. The mine life is 25 years, with production of 20,900 tons battery-grade lithium carbonate per year when all three plants are operating (production ramped up to full capacity over 5 years). Non-optimized reagent cost per ton of lithium carbonate was determined to be US$3,107. All-in operating costs, including all direct and indirect costs, working capital, insurance and mine closure costs are estimated at US$4,319 per tonne of lithium carbonate.

Arkansas Smackover Lithium Project – Proprietary Patent Pending Technologies

Standard Lithium plans to use two proprietary, patent-pending extraction technologies. The direct lithium extraction LiSTR (abbreviation for Lithium Stirred Tank Reactor) and the lithium carbonate crystallization SiFT. LiSTR selectively extracts lithium ions from raw brine, so no pre-concentration is required. The technology can be used regardless of weather conditions and guarantees very fast production within hours instead of months, as is the case with „normal“ evaporation operations. This results in a much smaller environmental footprint, as only a few dozen hectares are required compared to thousands of hectares, and all lithium-free brine is returned to the aquifer. The proven bolt-on process uses the approved infrastructure of the largest brine processing facilities in North America, which is why implementation can occur relatively quickly. SiFT is a continuous crystallization process controlled by artificial intelligence to produce Li2CO3 of the highest purity of over 99.9% for next generation lithium-ion batteries.

Arkansas Smackover Lithium Project – commercial scale pilot plant + conversion process + successful production of high purity lithium carbonate.

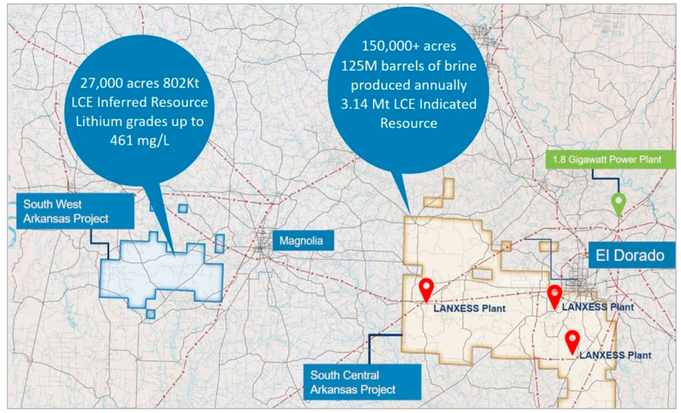
The company‘s world‘s first Direct Lithium Extraction Demonstration Plant is installed at LANXESS‘ South Plant near El Dorado, Arkansas. The demonstration plant utilizes LiSTR technology and is designed to continuously process an input brine flow of 50 gallons per minute from the LANXESS South Plant, which is equivalent to 100-150 tons of lithium carbonate per year.

To further reduce the risk of the South Arkansas project, the company is also conducting a two-track test program for the conversion of lithium chloride to lithium carbonate.

The company‘s commercial-scale lithium carbonate SiFT crystallization pilot plant in Richmond, B.C., has been operating successfully since mid-July 2020, using a lithium chloride solution produced at the company‘s mini-pilot direct lithium extraction plant. The SiFT plant has produced high-purity lithium carbonate crystals from this lithium chloride. In the process, they most recently managed to successfully convert lithium chloride produced in Arkansas into 99.985% pure lithium carbonate.

Arkansas Smackover TETRA Lithium Project – Acquisition, Location and Resource

In 2018, Standard Lithium was able to enter into an option agreement with TETRA Technologies to acquire exploration rights in the



Arkansas Smackover Lithium Projects

(Source:Standard Lithium)

Smackover Formation in Arkansas. This involves 27,000 acres of brine licenses in one of the most highly productive brine producing regions in southern Arkansas. Annual brine production in Arkansas averaged 42.6 million cubic meters from 2010 to 2016. Well-developed infrastructure and low-risk, well-established geology make the project a company-maker. In January 2019, it was possible to present a first resource estimate for the TETRA project area. According to this, this has at least 802,000 metric tons of lithium carbonate equivalent in the inferred category. The lithium concentration is up to 461mg/L.

Bristol Lake Lithium Project

Standard Lithium‘s second prospective project is called Bristol Lake and is located in the Mojave region of San Bernadino County, near the town of Amboy in southeastern California. Amboy is located on old Route 66, near the current Interstate Highway 40, and is 200 kilometers from Las Vegas and about 330 kilometers from the Port of Los Angeles. There is also an active rail line within 5 kilometers. Through several acquisitions, Standard Lithium has secured a total of over 45,000 acres of license area within the Bristol

Lake area and Cadiz Dry Lake, 20 kilometers away. Bristol Lake is a classic salt lake with significant lithium content, but was not previously part of the mining strategy. Historical drilling by the United States Geological Survey encountered 110 mg/L lithium in corresponding brines. Within the Cadiz Dry Lake, lithium grades between 112 and 139mg/L have been detected in corresponding sampling. The fact that chloride has been mined there for over 100 years makes Bristol Lake one of the most infrastructurally developed projects in North America. At the same time, the project has a high exploration potential for the raw material lithium. After all, up to now only chloride has been mined by the previous miners, while the significant lithium content has not been considered at all. This results not only in a high exploration potential but also in a high production potential for lithium and possible by-products. Standard Lithium has already conducted evaporation tests there. It was found that the brine originally contained an average lithium grade of 146mg/L. After four weeks, only passive evaporation concentrated the lithium content to an average of 686mg/L within 7 weeks. In 2018, Standard Lithium conducted a large-scale gravity geophysical survey in the Cadiz Dry Lake area which concluded that it was a backfilled basin with a maximum depth of 700 meters.

Summary: Standard Lithium holds all the trumps itself

Standard Lithium has recently successfully demonstrated two separate crystallization flowsheets capable of converting lithium chloride from the Smackover formation brine into high purity battery grade lithium carbonate. As the company continues to move toward commercialization, the successful demonstration of alternative technologies in key areas of the flowsheet enables a reduction in project execution risk and provides greater flexibility regarding the final flowsheet that will be deployed at commercial scale. The collaboration with major partner LANXESS is expected to quickly elevate Standard Lithium into entirely different realms. At the latest when the commercial phase of the joint venture is underway.
Together with the TETRA project area, Standard Lithium has approximately 3.942 million metric tons of lithium carbonate equivalent in the Arkansas Smackover. This is the largest lithium brine deposit in the United States. This is so special because the U.S. classifies lithium as a particularly critical and strategic metal and is focused on being as independent as possible from corresponding imports. Therefore, Standard Lithium holds all the trump cards and could soon be targeted by one of the big players in the industry.

Exclusive interview with Robert Mintak, CEO of Standard Lithium

What have you and your company achieved in the past 12 months?

Standard Lithium has established itself as the front runner as the most rapidly advancing and de-risked lithium project in the U.S. Despite the covid travel restrictions of the past year that have slowed or paused numerous projects, we completed the installation and commissioning of our industrial scale “LiSTR” advanced direct lithium extraction demonstration plant at our project partner LANXESS facility in Arkansas. The LiSTR plant has been running in a continuous state 24/7 extracting and producing high purity lithium for a number of months. While lots of companies are talking about how they plan to use a DLE technology we are the only company that has actually built an operating facility of scale. This is a first-of-its-kind anywhere in the world technology that is a global showcase for sustainable lithium extraction. We also commissioned our “SiFT”, A.I. powered next generation lithium carbonate pilot plant and successfully completed the conversion of Arkansas-produced lithium chloride into better than 99.95% pure lithium carbonate using both our SiFT process and conventional OEM crystallization technology.

In the capital markets we raised over $50M CDN and added several significant institutional investors to our register. We achieved an all-time high share price in Q1 2021 and we are making steady progress in our efforts to up list to the NYSE American, which if successful will unlock a large pool of investors to the company.

What are the most important company catalysts for the next 6 to 12 months?

First up is finalizing and executing of our JV arrangement with LANXESS this is expected in Q2 and at the project level we are steadily advancing towards the final investment decision for the first commercial extraction plant, and we expect that in H2 2021.

How do you see the current situation on the market for battery metals?

Very exciting, and a great time to be an advanced, sustainable, project in the US. We are entering a period of exponential growth the lithium battery market. While massive investments have been made in battery mega factories and by auto OEM’s entering the EV space the upstream supply chain has been overlooked and offers the best opportunity for investors. Projects that are permitted, aligned with strong strategic partners in geo-politically stable business friendly regions like Arkansas should be at the top of everyone’s list.

ISIN: CA8536061010
WKN: A2DJQP
FRA: S5L
TSX-V: SLL

Shares outstanding: 105.5 million
Options/warrants: 24.0 million
Fully diluted: 129.5 million

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Standard Lithium Ltd.

Surge Copper

About 7 billion pounds of copper equivalent and a processing plant right next door

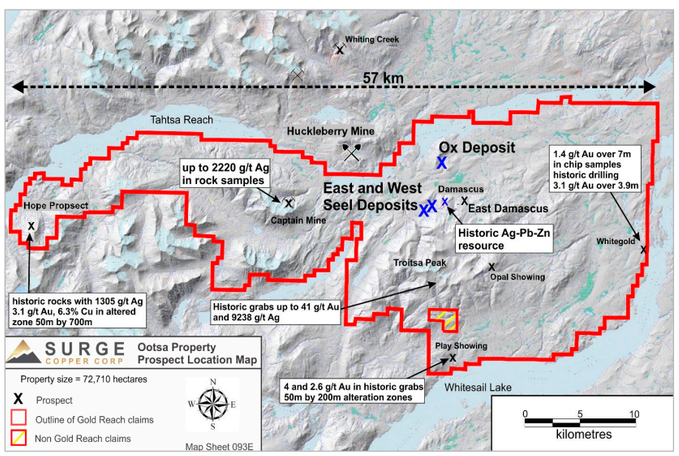
Leif Nilsson, CEO

Surge Copper is a Canadian mining development company specializing in the development of high-grade copper deposits in British Columbia. There, it holds majority interests in two copper projects that are directly adjacent to each other and cover a total of 121,800 hectares. The entire area is rich in copper, molybdenum, gold and silver and is also well developed in terms of infrastructure. Surge Copper is working aggressively to further expand its already very large resource base.

Ootsa – location and infrastructure

The Ootsa project, which is 100% owned by Surge Copper, is located approximately 120 kilometers south of the city of Houston, British Columbia and has good all-weather road access. The claims, totaling approximately 87,000 hectares, contain a network of logging roads that provide excellent road access through the central and eastern portions of the claim block. Ootsa is bordered to the north by the Huckleberry mine and mill complex, which is owned by Imperial Metals Corporation, is currently in care and maintenance status, and hosts only minor remaining reserves. Ootsa has a 35-man exploration camp that is typically operational from May through November. However, the relatively mild climate allows for year-round exploration activity.

The Ootsa project is 100% owned by Surge Copper (Source: Surge Copper)



Ootsa – geology and resource

Ootsa hosts at least three advanced copper-gold-molybdenum-silver porphyry deposits located in the northeastern portion of the project area.
The East and West Seel deposits represent two distinct styles of porphyry mineralization that form a large contiguous mineralized zone. The deposits are located in a gently dipping area of confined bedrock, only about 6 kilometers from Huckleberry Mill. The East Seel deposit is a smaller, higher grade mineralized zone containing copper-gold mineralization associated with quartz-magnetite-chalcopyrite veins. The West Seel deposit is a large zone of copper-gold-molybdenum-silver mineralization associated with quartz-pyrrhotite-chalcopyrite-molybdenite veins that extends from surface to a depth of over 1000 meters and is not yet fully delineated. Both deposits have high tonnage and copper mineralization, some of which extends for several hundred meters. For example, in the East Seel area, Surge Copper has proven 238 meters of 0.73% copper equivalent and 186 meters of 0.78% copper equivalent. In the West Seel area, the intersections included 817 meters of 0.45% copper equivalent, 1,013 meters of 0.42% copper equivalent and 585 meters of 0.57% copper equivalent including 164 meters of 0.68% copper equivalent.
The third advanced deposit is called Ox and is located approximately 4 kilometers northeast of East and West Seel and contains a crescent-shaped zone of disseminated and vein-controlled porphyritic copper-molybdenum mineralization. This mineralization contains pyrite, chalcopyrite and molybdenite occurring in hornfelsic sedimentary rocks near the western margin of a granodiorite porphyry deposit. There, the Company encountered 359.4 meters of 0.41% copper equivalent and 227.7 meters of 0.53% copper equivalent, among others.

For all three advanced deposits combined, Surge Copper last published a resource estimate in early 2016 based on over 350 drill holes totaling 144,000 meters of drilling. According to this, Ootsa has a total of 1.109 billion pounds of copper, 1.062 million ounces of gold, 104 million pounds of molybdenum and 20.457 million ounces of silver within these deposits alone. Converted, this equates to approximately 1.85 billion pounds of copper equivalent. As stated, this resource estimate is from 2016, and all drilling conducted thereafter is not included in this estimate.
In addition, Ootsa has at least 7 other potentially high grade deposits that have already produced some high grades. For example, Troitsa Peak, where historical sampling has produced up to 41g/t gold and 9,238g/t silver, or the Hope Prospect, which has historically produced up to 6.3% copper and 1,305g/t silver in a 700 by 50-meter area.

Ootsa – PEA

An initial assessment of the project‘s economic viability (Preliminary Economic Assessment (PEA)) also dates from 2016. This was based on – from today‘s perspective – extremely conservative raw material prices of US$3.00 per pound of copper, US$1,260 per ounce of gold, US$10.30 per pound of molybdenum and US$17 per ounce of silver. In addition, only about one-third of the total resource was factored in. The result was an after-tax net present value (NPV/5% discount) of CA$186 million and an internal rate of return (IRR) of a sensational 81%. Accordingly, the mine life is 12 years, and the payback period is 1 year. This is based on the assumption that Ootsa can be exploited by contract mining and toll milling in the Huckleberry Mill, which is why the initial capital costs – for this type of mine – would be a mere CA$64 million.
At the moment, all assumed raw material prices are in part far above those from the PEA, which is why the profitability of the project can currently be estimated even better.

Ootsa – Current work and catalysts

Surge Copper‘s current focus is clearly on expanding resources and improving economics. Additional drilling outside the current resource area has the potential to significantly increase tonnage. The target is a large pit covering the deeper high-grade area at West Seel. In addition, the newly formed management sees increased potential for a higher grade, lower strip ratio extension. In this regard, the coming weeks and months should be dominated by drill results, an update on the resource estimate and optimization of metallurgy. In addition, the Company will evaluate the extent to which the recently acquired Berg project will have a positive synergistic effect on the available data.

Berg – acquisition and location

In December 2020, Surge Copper announced that it had entered into a definitive option agreement with Thompson Creek Metals Company Inc, a wholly owned subsidiary of Centerra Gold Inc, giving Surge Copper the right to earn a 70% interest in the Berg copper-molybdenum-silver project. This requires Surge Copper to transfer CA$5 million worth of common shares and make CA$8 million in capital expenditures over 5 years. Berg hosts a large porphyry copper-molybdenum-silver deposit located approximately 28 kilometers northwest of Ootsa. Berg covers a total of 34,798 hectares, is directly adjacent to Ootsa and was expanded again in April 2021 to include the Bergette Claims in the eastern area.

Berg – resource

Berg hosts several near-surface and high-grade zones potentially suitable for low-grade mining. Historical metallurgical studies indicate suitability for conventional flowsheets for the production of copper and molybdenum concentrates. Some of the existing drilling,

which includes 176 meters at 0.75% copper equivalent and 63 meters at 1.44% copper equivalent, is widely spaced. In addition, the main deposit remains open at depth and radially outward.
In March 2021, Surge Copper released a resource estimate that truly had it all. For example, Berg has 3.65 billion pounds of copper, 419 million pounds of molybdenum and 59.1 million ounces of silver in the measured and indicated categories. In total, this equates to 5.126 billion pounds of copper equivalent.

Berg – Current work and catalysts

Currently, Surge Copper is working to improve the access infrastructure to allow for long-term, low-cost exploration. Another important item is the review of existing drill core and drill core waste for precious metals, as approximately half of the historical drilling has not been assayed for silver and none at all for gold. This should allow better definition of the higher-grade zones and reveal the best geochemical and geophysical anomalies.

Summary: Something really big is growing up!

The bare facts and figures speak for themselves: nearly 7 billion pounds of copper equivalent, with above average grades, including over one million ounces of gold alone. Two huge project areas, contiguous and including an inactive but reactivatable processing plant on two sides. A PEA that is no longer quite dewy, but which delivered very good results, and at commodity prices that are in some cases far below current ones, and which included only a fraction of the resources of the much smaller deposit. Exploration potential based not only on possible additional deposits, but also on the fact that the re-evaluation of historical drill core alone could give an additional boost to by-products. A newly formed management team that has already impressively demonstrated in the past that it can both land major new discoveries and finance large sums. All of this, combined with a strong increase in demand for copper and silver in the foreseeable future, makes for an explosive mix that could catapult Surge Copper into entirely different price spheres. By the way, the current market capitalization is well below CA$100 million. Given the above facts, this is an exceedingly expandable value.

Exclusive interview with Leif Nilsson, CEO of Surge Copper

What have you and your company achieved in the past 12 months?

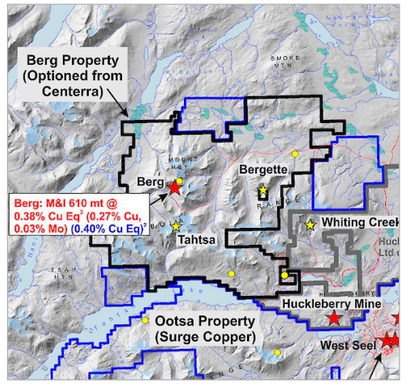
Surge Copper was kickstarted in September last year when we raised $6.5 million. Our strategy is based on consolidating prospective copper districts in British Columbia (a top-tier copper mining jurisdiction) with a focus on projects with a clear path to production, where we can create value through exploration and development. Right now, we have a clear focus on the Huckleberry district in central BC, which we believe is one of the most prospective copper porphyry districts in North America and is anchored by the idled Huckleberry mine and mill complex which is being evaluated for restart by its owner Imperial Metals. We have completed two acquisitions in the last few months which give us a dominant land position in the district, essentially surrounding the Huckleberry mine. Today, we control the four most advanced porphyry deposits in the district, and we are advancing drill programs that will seek to both grow resources and test regional targets for new discoveries. We have also aggressively grown the team, with several highly experienced senior executives joining the board, management team, and advisory team in recent months.

What are the most important company catalysts for the next 6 to 12 months?

Our investment program over the next several months is focused on resource expansion and discovery drilling. We anticipate a steady stream of exciting drill results and exploration updates, particularly as we get into our summer programs. In the background, additional work is taking place to shape, plan, and progress development aspects of the projects as we prepare to undertake future economic studies.

How do you see the current situation on the market for battery metals?

This is the most exciting metal market I have seen in my career, likely set to surpass the China-led super cycle from the 2000s. There are multiple factors at play, ranging from structural supply deficits to climate-change-combatting megatrends like accelerating EV adoption, growth in renewable energy generation, and large-scale infrastructure investment (backed by record breaking fiscal stimulus programs around the world). Not to mention the megatrend of urbanization in the developing world which continues unabated. Copper is perhaps the best positioned metal to capture upside on many of these trends, and compared to other electrification and battery metals, it does not suffer from substitution risks. Copper is the quintessential electric metal!



Berg hosts a large porphyry copper-molybdenum-silver deposit located approximately 28 kilometers northwest of Ootsa.
(Source: Surge Copper)

ISIN: CA86881M1041
WKN: A2JENX
FRA: G6D2
TSX-V: SURG

Shares outstanding: 133.2 million
Options/warrants: 58.4 million
Fully diluted: 191.6 million

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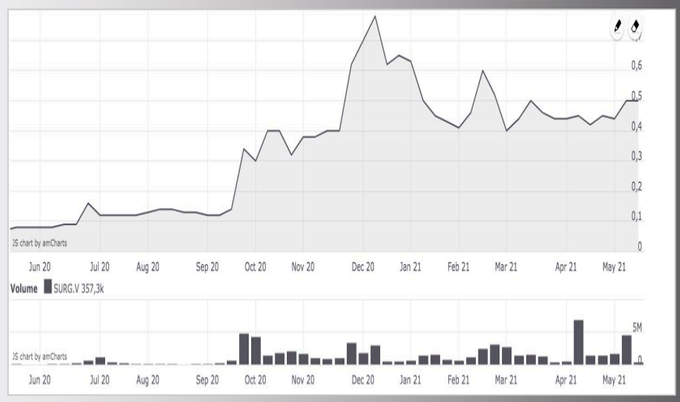
Surge Copper Corp.



Overview of **SRC's communication programs**

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World wide Resource TV-Channels

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Partnership with Dukascopy-TV – worldwide **7 Mio views** p.a. •

Commodity-TV · Rohstoff-TV · Dukascopy Swiss Financial Television · YouTube · CORE FINANCE

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• Professional **roadshows in Europe & Switzerland** in citys like: Zurich, Zug, Geneva, Lugano, St. Gallen, Vaduz, Milan, Munich, Frankfurt, Hamburg, Oslo, Stockholm, Monaco, Paris, Luxemburg, Vienna

• **Write-ups** through our editors & third party authors up to 200 different websites like Wallstreet-Online.de, Ariva.de, Finanzen.net

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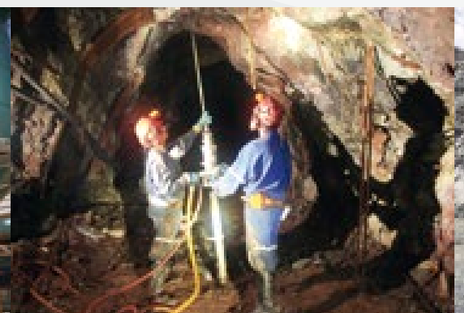


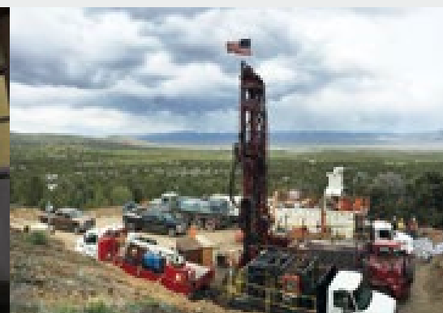

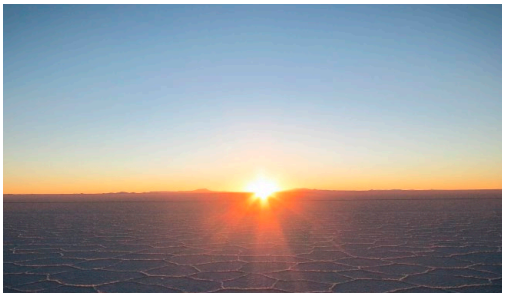

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