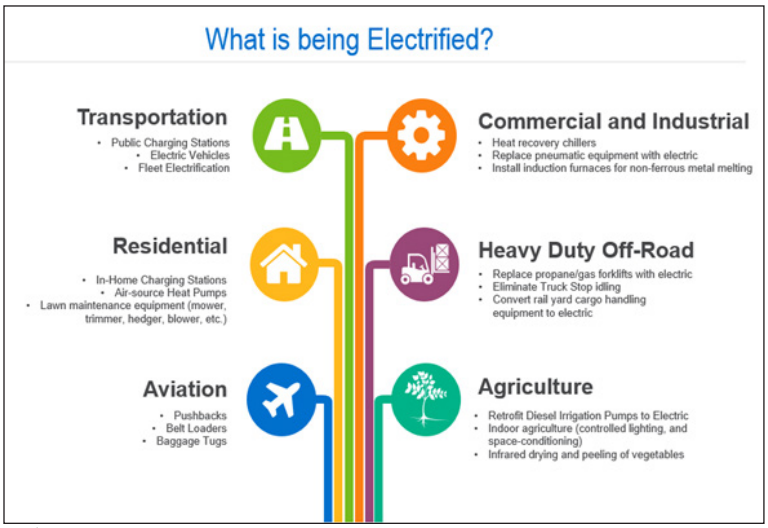
Solving the supply side for decarbonization

Author, Ian Weir, P.Eng. | Technical Manager, Mining Advisory
iweir@slrconsulting.com
+1 416 206 9719

Let's face it - mining gets a bad rap. The industry has long been vilified for its negative impact on the environment, intensive use of energy and resources, and clashes with local communities. Legacy issues continue to haunt us today with continued headlines of tailings dam collapses and protests from agricultural communities that are concerned about water contamination. Despite this negative reputation, over the past several years, vast improvements have been made in the mining industry as a whole – some changes are voluntary while others have been mandated by government.

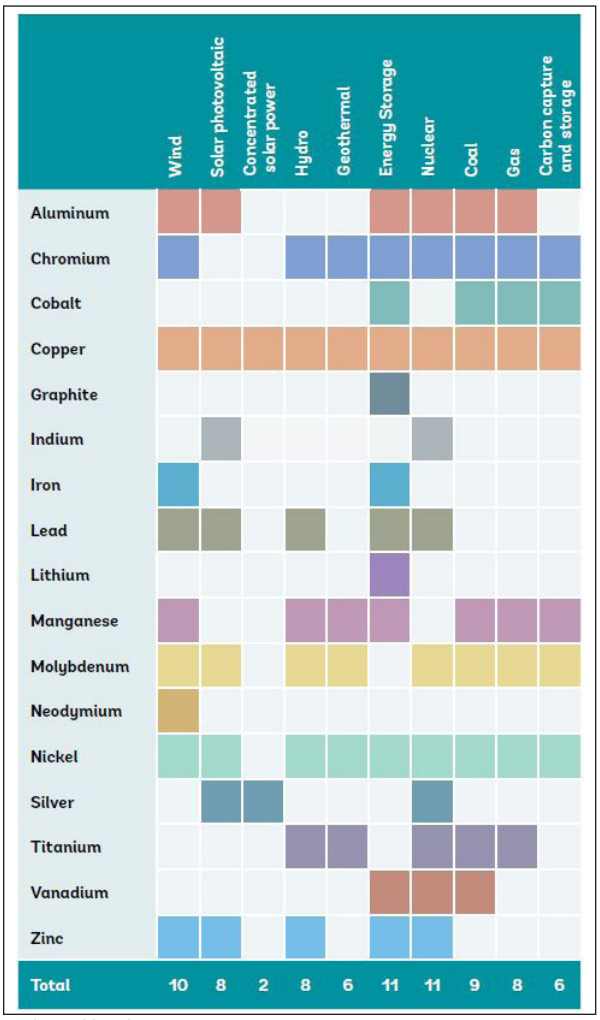
Under the 2015 Paris Agreement, 195 countries pledged to limit global warming to well below 2.0°C, and ideally not more than 1.5°C above preindustrial levels. Over the last decade or so there has been much lip service paid towards takings real steps towards reversing climate change, however some recent announcements have shown that the fight for climate change is here to stay – regardless of the state of the economy. For example, Blackrock – a hedge fund that controls nearly $9 trillion in assets – announced that all companies in its portfolio will be required *"to disclose a plan for how their business model will be compatible with a net-zero economy."*

Reversing climate change is not a trivial task – it will take a great deal of investment, energy, and resources to tackle it. Ironically, the mining industry – an historically environmental foe – will play a fundamental role in the fight against climate change and the decarbonization of our planet. A key to decarbonization is the replacement of our existing fossil fuel- based economy with global electrification powered by carbon neutral energy sources. Electrification will be carried out across many industries as illustrated in the figure below.



Credit: Nexant

This conversion will require vast quantities of metals, including copper to transport energy, as well as nickel, manganese, cobalt, lithium, and graphite for battery storage, and rare earth elements (REE) for renewable energy technologies. Many other metals will also play a key role in the world's transition to renewable energy technologies. The figure below shows the role of each of the metals in each of the key low-carbon technologies.



Credit: World Bank

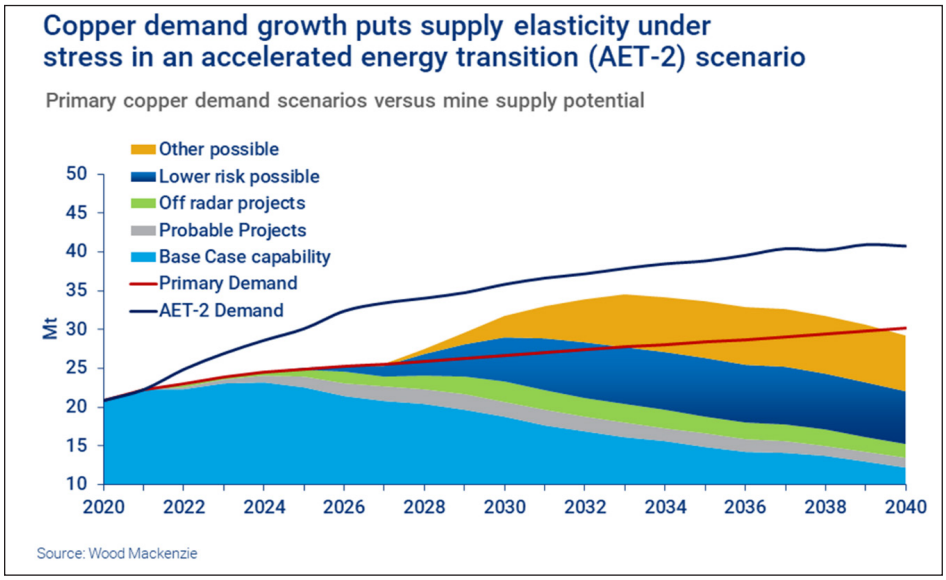
One of the major challenges for miners is the ability to produce the desired quantities of metals at the right time. With growing demand, there is a supply risk which will inevitably limit the advance of some of the low-carbon technologies. Often miners will hold off on developing projects due to economic risk – namely, fluctuating metals prices. Governments will need to step up to help miners finance these projects, especially those with critical metals, to ensure supply into the future – even when metal prices are currently low. The continual cycle of exploration and development of Mineral Resources and Mineral Reserves is required to ensure that projects continue to become operating mines and producers of metal.

Copper

In May 2021, Goldman Sachs touted "copper as the new oil' and the "strategically most important commodity" since it is unparalleled in its ability to conduct electricity, which is key for global electrification.

In a study by Wood Mackenzie (WM), the base case scenario demand for primary copper is estimated to grow by an average of approximately 2% annually over the next twenty years. This represents an incremental rise of around 9 Mt over the period. WM's Accelerated Energy Transition Scenario (AET-2), which limits the average global temperature increase to 2˚ C above 1990 levels, boosts annual copper demand growth to 3.5%. This scenario would double global primary demand by 2040, equivalent to an additional 10 Mt as shown in the figure below.

Clearly under the AET-2 scenario there is not enough copper to keep up with demand.

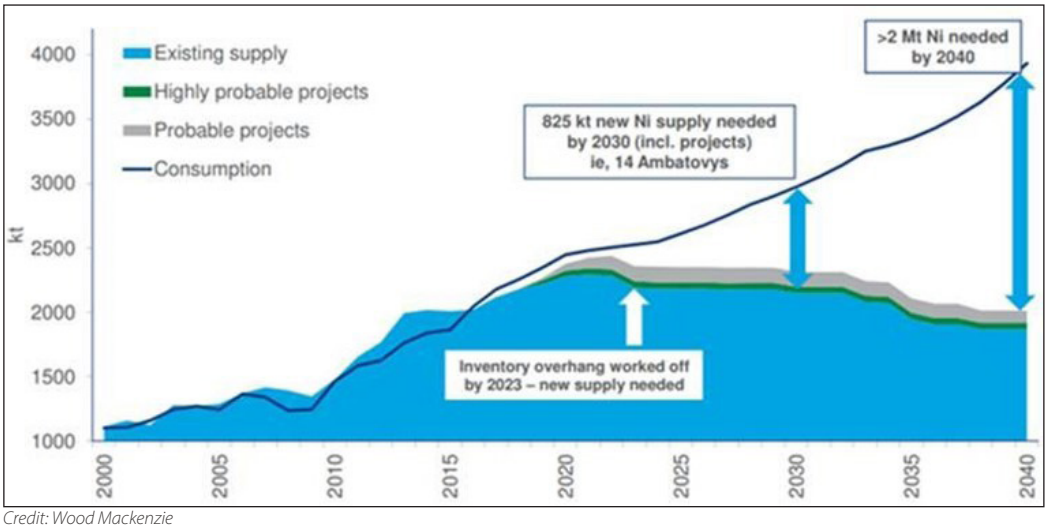


Building mines is becoming ever more challenging due to lack of quality large-scale projects, more challenging working environments, and increasing ESG requirements. Given the long lead time for projects to transition from exploration to development to construction to operations, more capital will be required for investments today to ensure that we have copper supplies 10 to 15 years from now.

Nickel

"Tesla will give you a giant contract for a long period of time if you mine nickel efficiently and in an environmentally sensitive way," said Elon Musk on a post earnings call in July 2020. The need for nickel is serious and, more so, the need for "green" nickel – that which is produced with a low carbon footprint, will be highest in demand. Not all nickel is created equal. Much of the world's nickel comes from nickel laterites is extremely carbon intensive as it uses either coal power for nickel pig iron (NPI) or high-pressure acid leaching (HPAL). Nickel sulphides, for example, those found in the Sudbury basin in Canada, require a much lower environmental footprint than nickel laterites.

Nickel is a vital component in batteries, particularly those used in electric vehicles. There are a variety of different chemical compositions, with the dominant being nickel-manganese-cobalt (NMC). While there has been much research done to modify the ratios of metals used in batteries (particularly to eliminate cobalt), nickel remains an essential component. Nickel demand is already outstripping supply and the number of projects coming online will need to increase to meet this demand as shown in the figure below.



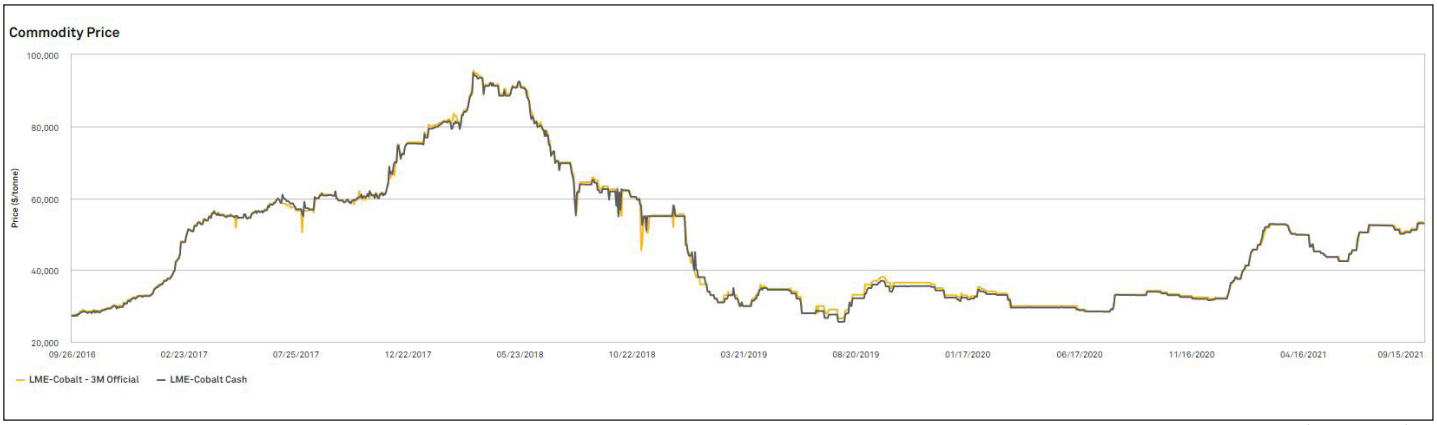
Credit: Wood Mackenzie

Cobalt

Cobalt is one of the three metals that comprise the cathodes in the NMC batteries and can account for a fifth of the metal in a lithium-ion cathode. Cobalt is important in the battery chemistry as it has a stabilizing effect and prevents cathode corrosion that can lead to a battery fire. Two of the main challenges with cobalt has been severe price fluctuation and ethical sourcing. While there has been much talk about trying to drastically reduce or eliminate cobalt from the NMC chemistry, it will likely remain an essential component for several years to come. The original NMC battery chemistry started off at a 1:1:1 NMC ratio, moving on to a 5:3:2 ratio and ultimately is heading towards 8:1:1, meaning the nickel quantity of nickel will continue to increase in every NMC battery produced.

Finding ethically sourced cobalt has proven challenging. Approximately 60% of all cobalt produced comes from the Democratic Republic of Congo (DRC), however much of the mining has been linked to human rights abuses, including child labour. This has led to some large pushback from companies that are becoming increasingly focused on ESG measures.

Cobalt supply outside of the DRC is largely a byproduct of primary nickel production, and this has led to serious market fluctuations over the last several years with prices more than tripling between 2016 and 2018 only to recede back to 2016 prices over 2019 and 2020, as outlined in the chart below.



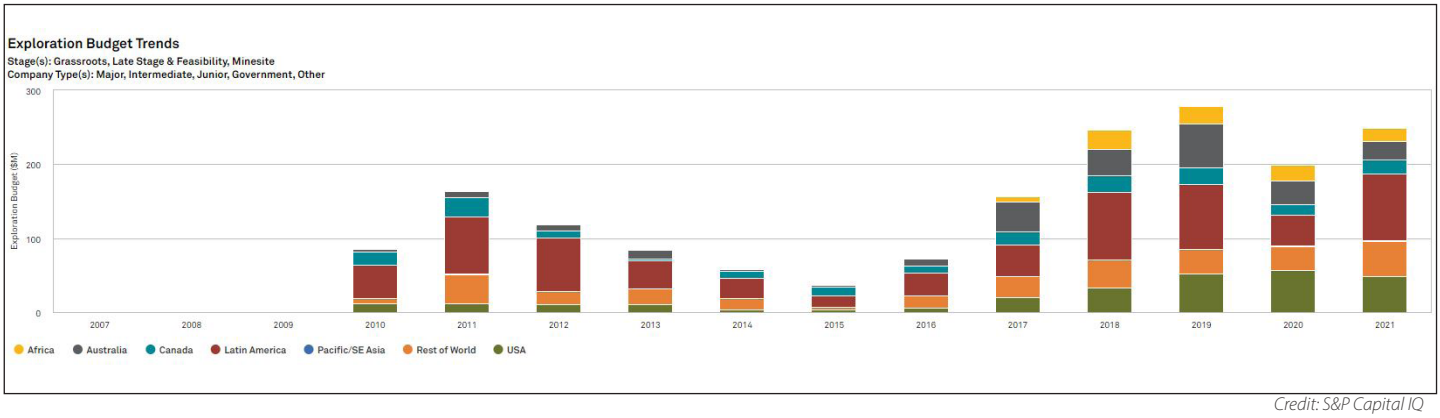
Credit: S&P Capital IQ

Lithium

Lithium is a key component in – you guessed it – lithium-ion batteries. What makes lithium unique is its ability to easily transfer electrons compared to other metals. It is also a lightweight metal making it very practical in a number of applications.

Lithium is generally sold as either a lithium hydroxide or a lithium carbonate and it is produced either from brine or from hard rock sources (i.e., spodumene). The majority of lithium production – approximately 70% - comes from five mines located in Australia and Chile. The limited number of producers has led to fluctuations in lithium prices over the last several years. As more lithium projects come online, and supply is spread amongst a larger group of producers, price stability should improve.

Global exploration budgets for lithium have been on the increase as shown in the chart below – this trend, which dropped off slightly in 2020 due to COVID, is likely to continue upwards in 2021 and beyond as miners look to meet global demand.



Credit: S&P Capital IQ

Rare Earth Metals

There are 17 elements in the periodic table that fall under the heading of rare earth elements (REE). Of this group, there is a further subdivision of light REE (LREE) and heavy REE (HREE). REE are used in a variety of industries, but the demand is surging especially in the use of permanent magnets which are a key component in energy generation (i.e., wind turbines).

According to Natural Resources Canada, China has dominated the REE space for many years and continues to.

Like many of the other metals mentioned above, pricing has been a problem – no commodity has seen more volatility in pricing than that of REE. In 2011 prices surged drastically. For example, Neodymium Oxide – a component used in magnets – surged over ten-fold in a very short period to nearly US$350/kg, only to drop back down to the ~US$50/kg range (see figure below). Price fluctuations, relatively opaque futures pricing, and uncertainty on revenue assumptions can make resource and reserve estimations difficult and capital for project development harder to attain. This has made it very challenging for REE exploration projects to develop into profitable operating mines.

Conclusion

Financial support from governments and investment by end-users is necessary to smooth issues of economic uncertainty and keep the conveyor belt of project development moving to ensure supply of commodities critical to a green economy. Waiting for the market to sort it out will result in shortages and delay in achieving decarbonization – time that we cannot afford to waste in the fight to limit global warming.