January 25, 2021
Industry Report

Equity Research

GREEN METALS MACRO

A Green Economy and Electric Vehicles Start with Metals

THE WORLD IS CHANGING…

… for the better. Environmental, Social, and Governance (ESG) has been the clearest theme to emerge in Metals & Mining over our 20+ years of covering the sector. Better late than never. In this report, we focus specifically on the Environmental side of the Metals & Mining industry, and how it lays at the foundation of a Green Economy. More specifically, the industry has a critical role to play in supporting the roll-out of Electric Vehicles (EVs) globally, and is central to the theme of "Transitional Energy" including de-carbonization, renewables, and clean tech. The adage of "if it can't be grown it must be mined" serves as a reminder that Electric Vehicles, Transitional Energy, and a Green Economy start with metals.

FOCUS POINTS

Green Metals Equities to Watch:

Under Coverage	Ticker	Rating	Target	Upside
Millennial Lithium	ML-TSX	Restricted	N/A	N/A
Horizonte Minerals	HZM-TSX	Buy	C$0.40	142%
SolGold	SOLG-TSX	Buy	C$1.10 ↑	96%
Trilogy Metals	TMQ-NYSE	Buy	$3.50 ↑	64%
Taseko Mines	TGB-NYSE	Buy ↑	$2.00 ↑	55%
Seabridge Gold	SA-NYSE	Buy	$32.50 ↑	63%
Avino Silver & Gold	ASM-NYSE	Buy	$1.80	54%
Bear Creek Mining	BCM-TSXv	Buy	$5.20	94%
Alexco Resource	AXU-NYSE	Restricted	N/A	N/A
Cameco	CCJ-NYSE	Hold	$13.50	9%
Denison Mines	DNN-NYSE	Buy	$1.05	50%
Energy Fuels	UUUU-NYSE	Buy	$4.75	21%
Ur-Energy	URG-NYSE	Buy	$1.00	7%
Large-Cap	**Ticker**	**Metal(s)**	**MktCap BB$**	**Rating**
BHP	BHP-NYSE	Cu,Zn,Pb+	$184.1	N/A
Rio Tinto	RIO-NYSE	Cu,Al+	$100.3	N/A
Vale	VALE-NYSE	Cu,Ni+	$90.5	N/A
Freeport	FCX-NYSE	Cu,Au+	$44.1	N/A
First Quantum	FM-TSX	Cu,Ni+	$20.1	N/A
Albemarle	ALB-NYSE	Li	$19.2	N/A
SQM	SQM-NYSE	Li	$14.9	N/A
Watchlist	**Ticker**	**Metal(s)**	**MktCap MM$**	**Rating**
MP Materials	MP-NYSE	REE	$5,279.5	N/A
Critical Elements Li	CRE-TSXv	Li	$173.9	N/A
Imperial Metals	III-TSX	Cu,Pb,Zn	$473.4	N/A
Nova Royalty	NOVR-TSX	Cu,Ni	$262.4	N/A
Talon Metals	TLO-TSX	Ni,Co	$234.4	N/A
Altius Minerals	ALS-TSX	Cu,Ni+	$520.6	N/A

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See disclosure and a description of our recommendation structure at the end of this report.

A GREEN ECONOMY STARTS WITH METALS

With the peaceful transition of power and the new US administration having control of the house and the senate, the Biden Administration will have the opportunity to accelerate the USA's transition to a greener economy. The US private sector is well ahead of the world with technologies such as Electric Vehicles (EVs), autonomous vehicles, smart grid technology, and renewable and zero-carbon emission energy generation. However, it is behind on policy and implementation. As the US plays catch-up, we expect significant policy changes to promote EV adoption, emissions control and spending on upgrades to the electrical grid. The supply chain for batteries, wind turbines, solar panels, electric motors, transmission lines, 5G – everything that is needed for a Green Economy starts with metals and mining. Demand for these metals, principally lithium, nickel and cobalt on the battery side and copper, uranium and rare earth elements on the energy side is expected to rise rapidly. Concerns over availability and ethical sourcing of supply have been voiced by architects of this new economy such as Elon Musk of Tesla (TSLA-NYSE, Not Covered). While incumbent producers will provide sufficient material in the near term, the rapid uptake of EVs and the build-out of the zero-carbon infrastructure to support them could strain the supply of various metals and quickly become the limiting factor. As such, metals and mining companies are key to realizing this future and these equities deserve a place in Green Energy and ESG-related portfolios. In this report we discuss the impact this transition is having on the metals and miners and highlight various names to gain equity exposure.

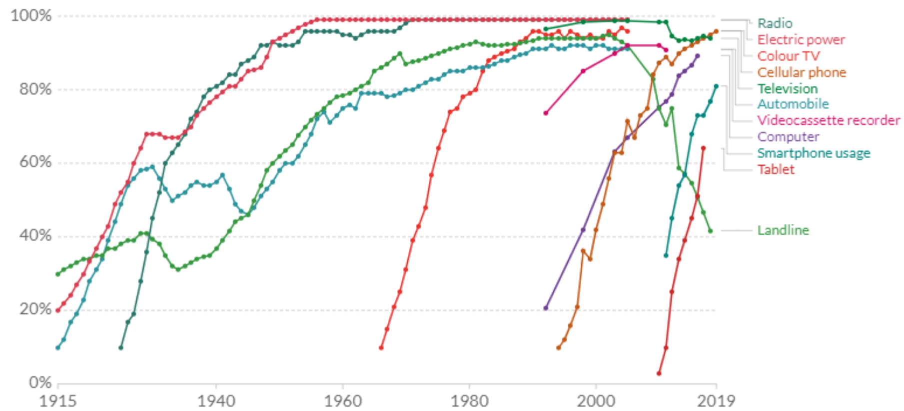
GREEN ECONOMY: ELECTRIC VEHICLE SUMMARY

In September 2020 Tesla Inc., maker of the best-selling EV in the United States, held its "Battery Day" where Elon Musk, CEO discussed its battery technologies and expressed its views on the future of electric vehicle (EV) market. Of note, Mr. Musk sees the global EV market growing to 30 MM vehicles per year in 2030 from ~3 MM vehicles today, or to a 30% share from ~3% today; a 10-fold increase. These projections are in-line with other auto manufacturers and industry observers and have significant implications for battery metal demand. The main technology enabling this uptake in EVs is the rechargeable lithium-ion battery which currently powers our cell phones, tablets, laptops and power tools. But while a phone carries a battery pack weighing about 30 g, a Tesla carries a battery pack weighing ~550,000 g (550 kg). While the architecture and chemistry of these batteries is variable and changing, the key ingredients are a variety metals, most of which are widely available but three in particular are potential near-term bottlenecks: lithium, nickel and cobalt. Concerns over the future availability and cost of raw materials have been voiced by Elon Musk and others. Incumbent metal producers are aware of the growth potential but despite the high demand expectations, developing new projects, expansions, and financing decisions are generally driven by current metal prices – which are still modest but recently on the rise. And unlike battery plants and car plants, which can take 1-3 years to build, taking a mining project from discovery to production can take 7-10 years (or more) largely due to environmental assessments and community consultations. If the uptake of EVs is as forecast, metal supply will quickly become the limiting factor which will be reflected in higher metal prices, especially if miners are to step up to their ESG efforts as well. As such we expect price volatility in these main battery metals with a bias to the upside. For security of supply as well as transparency and traceability of material supportive of clean/ethical brands, we expect original equipment manufacturers (OEMs) will need to look to direct investment in mining companies to secure an ethical supply or risk being left behind. This will likely take various forms including off-take agreements at established floor prices, direct investment at the project level and debt and equity financing at the corporate level.

ELECTRIC VEHICLE ROLL-OUT

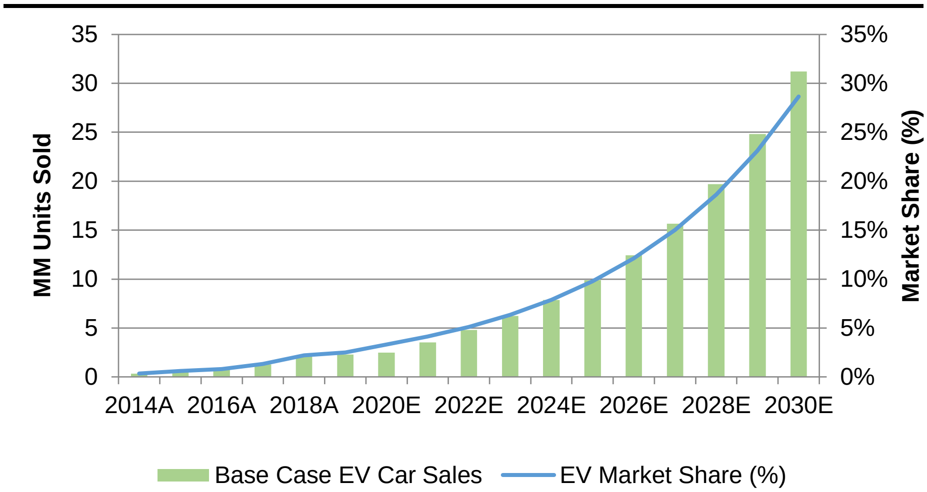
The growth in portable devices (phones, laptops, and tools etc.) has driven strong growth in lithium-ion batteries over the past decade. These new technologies were adopted quickly following the familiar adoption curves (Exhibit 1). EV penetration, which is currently less than ~3% of new car sales, is still largely the domain of early adopters, but projections for new car sales are accelerating as now all major car companies have committed to the space with more models and a greater proportion of their offerings being electric. By 2025 it is expected that EVs will comprise ~15% of new car sales, doubling to 30% (or close to 30 MM vehicles) by 2030, which is less than a decade away.

Exhibit 1. Diffusion of Innovation Curve



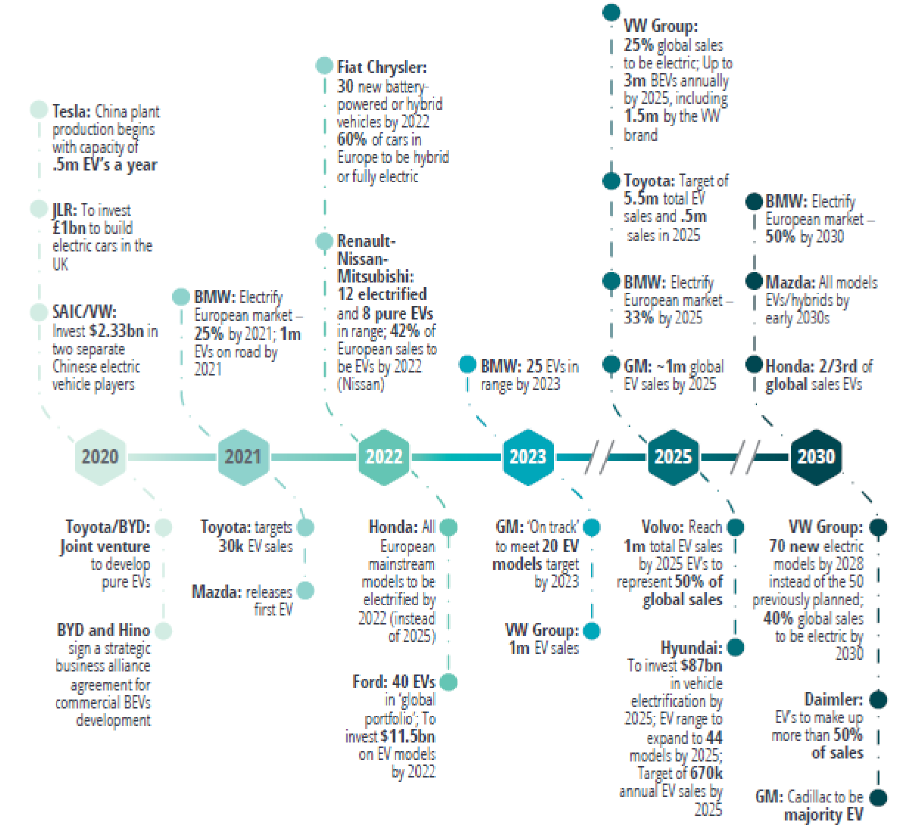
Source: ourworldindata.org

Exhibit 2. Electric Vehicle Penetration – Set to Soar



Source: Cantor Estimates based on EV Volumes, Tesla Inc.

Exhibit 3. Timeline of strategic OEM targets for EVs



Source: Deloitte Consulting

This has significant ramifications for key battery metals. Laptops and cell phones require only a few grams of battery metals but an EV requires orders of magnitude more; on the order of 15-30 kg of lithium, 5-15 kg of cobalt and 40-50 kg of nickel each (it varies depending on battery size and type). For lithium, we see supply needing to increase from ~320 kt to 1.8 MMt lithium carbonate equivalent (LCE) by 2030. Battery demand currently comprises ~140 kt of current nickel supply (~5%) but should accelerate quickly to be closer 1.5 MMt by 2030; a 10-fold increase in demand and requiring an almost doubling of total nickel production. For cobalt, which is growing off a much smaller base, this means growth from ~50 kt (~50% of demand) to 200 kt by 2030; a four-fold increase in battery demand and requiring total production growth of 2.5x (Exhibit 4).

Bottleneck Shifting to Metals: There is no question that electric vehicles are here to stay and will continue to take a larger share of the new car market. The main bottleneck to EV growth currently is battery production capacity but as more factories are built, the bottleneck will likely shift from battery capacity to battery inputs, specifically the cathode materials lithium, nickel and cobalt. The latest data from Benchmark's Lithium-ion Battery Megafactory Assessment shows there are now 181 battery megafactories in the pipeline with 3,010 GWh of capacity set to come online in the coming decade.

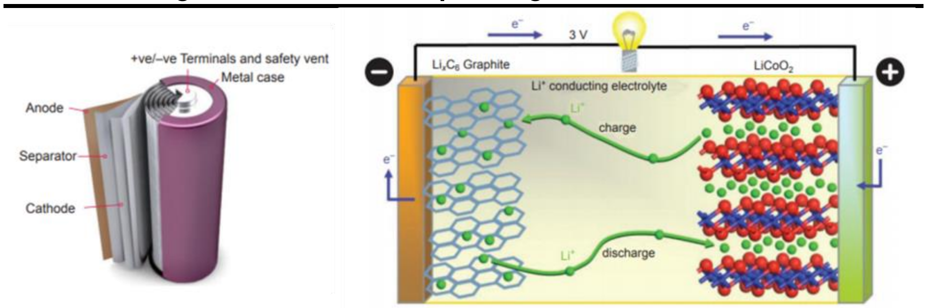
Exhibit 4. Incremental Metal Demand Due to Anticipated EV Growth

Source: Cantor Fitzgerald

LITHIUM-ION BATTERIES

Lithium-ion batteries (LiB) are made up of an anode (made of graphite), cathode (made from various metal oxides), separator electrolyte and two current collectors (positive and negative). Batteries power devices by moving positively charged lithium ions between the anode and cathode crystal structures creating an electric potential between the two sides of the battery and forcing the electrons to travel through the device it is powering to equalize the electric potential. When the battery is charging, lithium ions move through an electrolyte from the cathode to the anode and attach to the carbon. During discharge, the lithium ions move back from the carbon anode to the cathode.

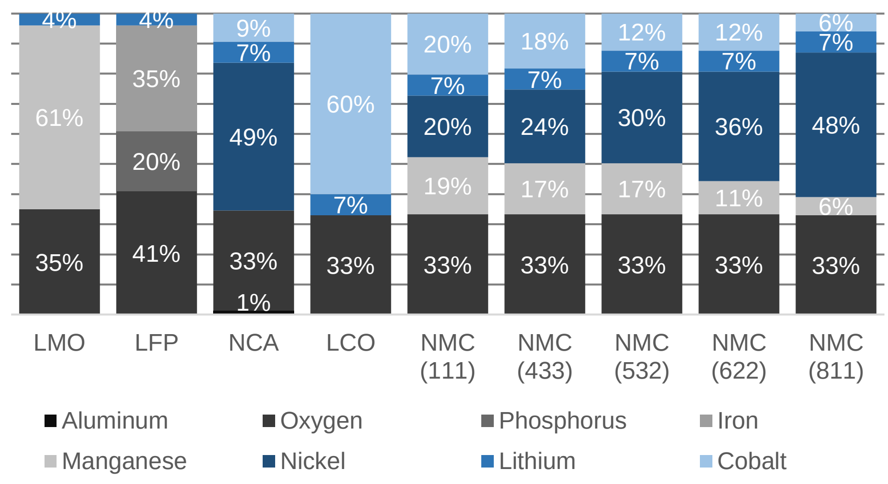
Exhibit 5. Diagrammatic View of Operating Lithium-Ion Cell



Source: Johnson Matthey

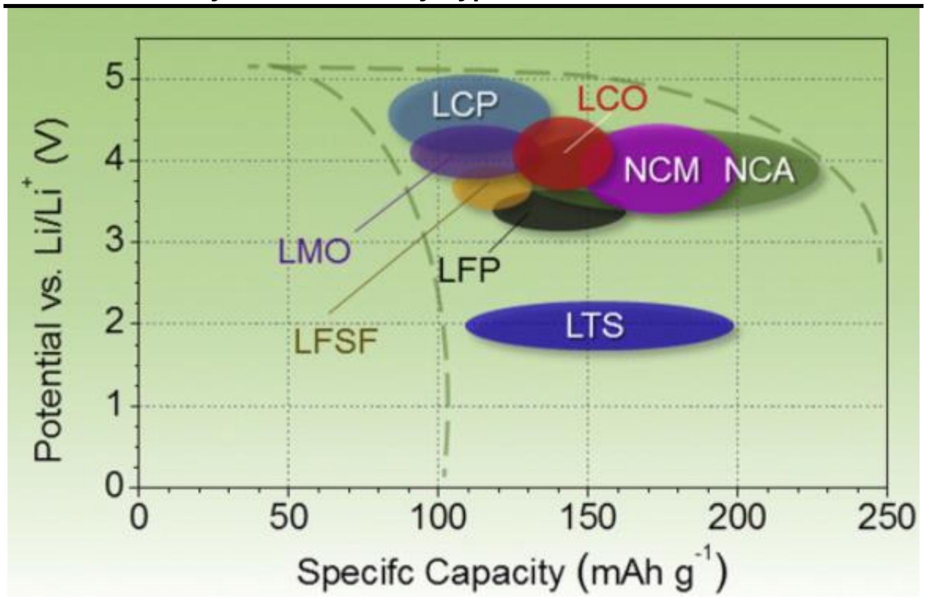
Energy capacity of a battery is determined by how many lithium ions can fit into the spaces in the anode and cathode. The graphite anode requires six carbon atoms to hold each lithium ion giving a theoretical maximum capacity of 372mAh/g. However, this may be replaced by cheaper and more plentiful silicon which has a theoretical maximum capacity of 4200mAh/g (4.4 Li for each silicon atom) once technical issues managing significant volumetric expansion is solved (Tesla is working on this). The different battery types or 'chemistries' are defined by the compositions of their metalliferous cathodes. There are five main battery chemistries which represent most of the LiB market. Of those, lithium-cobalt-oxide (LCO) is the dominant battery in portable electronic devices for its high energy density. The nickel-manganese-cobalt (NMC) and nickel-cobalt-aluminum (NCA) chemistries are the current industry standard for electric vehicle applications due to their favorable mix of high energy density, power, cost and safety. NMCs can be further subdivided by relative metal content into NMC111, NMC622 and NMC811 (lowest cobalt). Lithium-iron-phosphate (LFP) and lithium-magnesium oxide (LMO) types are also used in automotive, particularly in China, because they use lower cost raw materials but have lower energy density and LMO has had durability issues. However, there is a clear global trend to the adoption of NCM and NCA chemistry due to their higher energy densities, increased life cycle and the auto industry's preference for passenger vehicles with longer range.

Exhibit 6. Cathode Chemistry



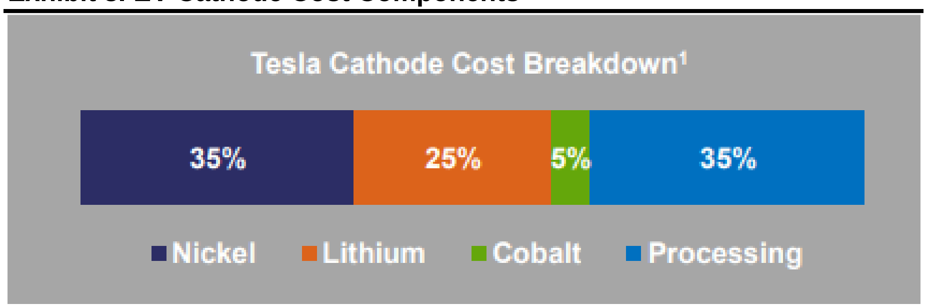
Source: Mining.com, Metals Bulletin

Exhibit 7. Battery Performance by Type



Source: MaterialsToday.com

Exhibit 8. EV Cathode Cost Components

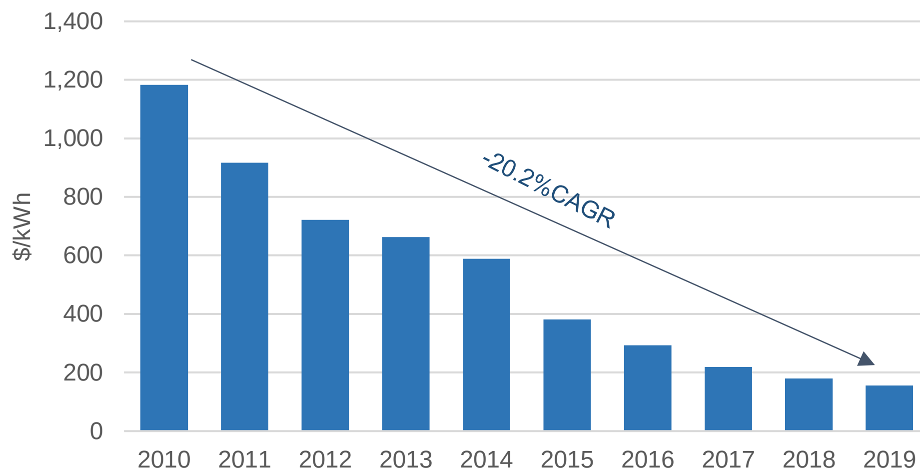


Source: Tesla Inc.

As noted above, the main metals of concern are lithium, nickel and cobalt. Raw materials represent a significant cost in the manufacturing of the battery packs;

50-70% depending on chemistry (and metal prices), and while recycling of batteries, changing chemistries, and economically driven compromises will ultimately lower the amount of new metal needed, the rapid growth in battery demand as EVs enter the critical adoption period points to looming deficits in the medium term. Since 2010 the cost of a lithium-ion battery per kilowatt hour (kWh) has fallen almost 90%, from $1,183 in 2010 to just $156 in 2019. It is estimated that when the cost reaches $100/kWh, EVs can be competitive to comparable internal combustion engine (ICE) vehicles and drive accelerated demand. That said, higher metal prices would work against this.

Exhibit 9. Cost of EV Battery Pack Over Time

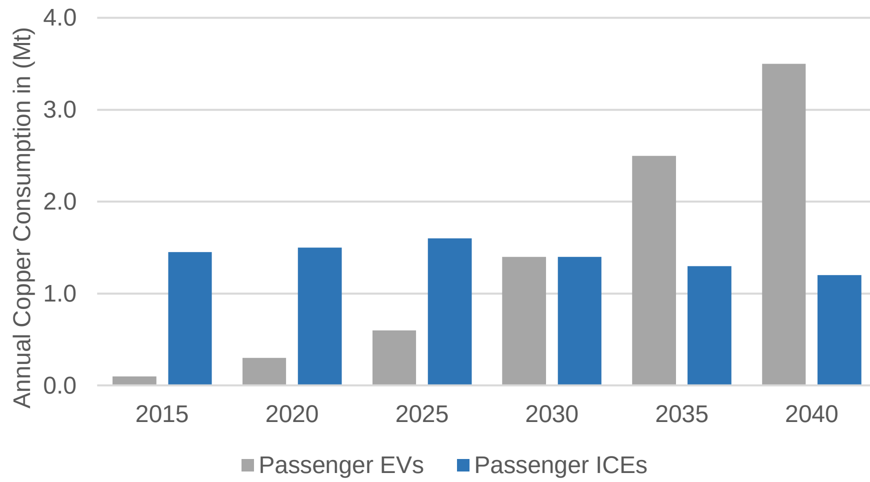


Source: Bloomberg NEF

ELECTRIC VEHICLE COMPONENTS (EXCL. BATTERIES)

The major change to supply brought on by the transition to EVs is replacing the internal combustion engine and transmission, which uses predominantly aluminium and steel alloys, with Li-ion batteries which require nickel, cobalt, lithium, copper and some aluminium for the cells as discussed above. The battery pack also requires aluminium, copper, and various thermal management materials including steel, glass fibre reinforced polymers, carbon fibre reinforced polymers, insulation, foams and fire-retardant materials. The other major component to compliment the batteries are electric traction motors for the drivetrain. The majority of the EV market is currently using motors with permanent magnet-based rotors which typically contain several rare-earths such as neodymium, praseodymium, and dysprosium which are used in relatively small quantity in the motor. These elements have a very geographically constrained supply chain and a volatile price history. However, some auto manufacturers have used induction-based electrical motors, which do not use permanent magnets and avoids this issue/risk associated with REEs but at a cost to efficiency and range. Outside of the battery itself the metal intensity of EVs is higher than traditional ICE vehicles due to the increased electrification of the cars. Copper, for example, is used in every major component from the motor to the inverter and electrical wiring. An average ICE vehicle uses ~55 lbs of copper per vehicle, while an average EV uses ~180 lbs. Annual copper consumption associated with EVs is forecast to exceed 3.5 MMt by 2040. Finally, EV powertrains require anywhere been 50-450% more silver than their standard ICE powered counterparts.

Exhibit 10. Annual Copper Consumption in EVs and ICE Vehicles



Source: Wood Mackenzie, Cantor Fitzgerald

EV IMMEDIATE INFRASTRUCTURE

With EVs accelerating in adoption, the infrastructure to deliver power to them will need to supplant the network of gas stations that exists to serve today's ICE vehicles. Charging stations at home will need to link to existing residential power voltages. Level 1 chargers use 120V, Level 2 chargers use 240V, and Level 3 chargers use 480V+. Level 3 chargers, or superchargers, can add 290 km of range to an EV in 15 minutes but will degrade the battery with overuse and are not recommended for everyday charging. All chargers use copper to transfer the energy to power the EVs, but total usage is low with Level 1 chargers using only ~2 lbs per charger and Level 3 chargers a higher but still modest 17 lbs. Currently there are 1 MM chargers installed worldwide and analysts expect there to be 20 MM charging stations by 2030. Using a 20:1 ratio slow/fast chargers (current European ratio), we estimate the total copper needed for charging infrastructure over the next 10 years to approximate a cumulative 52 MMlbs, immaterial in size to the overall copper market (~0.1% of annual mine supply).

EV SECONDARY INFRASTRUCTURE

To support the expansion of renewable energy generation one element that is often overlooked is the expansion of the transmission grid needed to accommodate the efficient movement of power. Because of the more dynamic supply and demand structures required by intermittent generation, a robust grid is needed to ensure reliability and efficiency. Some countries such as Germany and China are already facing bottlenecks in their transmission capacity which threatens to limit the expansion of renewables. One plan to support the availability of renewable energy is the construction of a Global Energy Interconnection (GEI) network, which is being spearheaded by the Global Energy Interconnection Development and Cooperation Organization (GEIDCO). The plan is to construct a web of transmission lines around a backbone of ultra high voltage (UHV) transmission lines that circle the globe and concentrate in areas of high demand. This is possible because modern technology permits energy to be transmitted over 2,000 km with a loss rate of just 3.5%/1,000 km at up to 6.4 GW of transmission capacity. The GEI plan calls for over 177,000 km of UHV lines to be installed to create the global grid, with the investment to cost over $390BB, half of which we estimate will be materials cost, comprising steel towers with steel-reinforced aluminum cables, and associated copper for power transmission.

Exhibit 11. GEI UHV Interconnection Map

Source: GEIDCO

GREEN ECONOMY: TRANSITIONAL AND SUSTAINABLE ENERGY

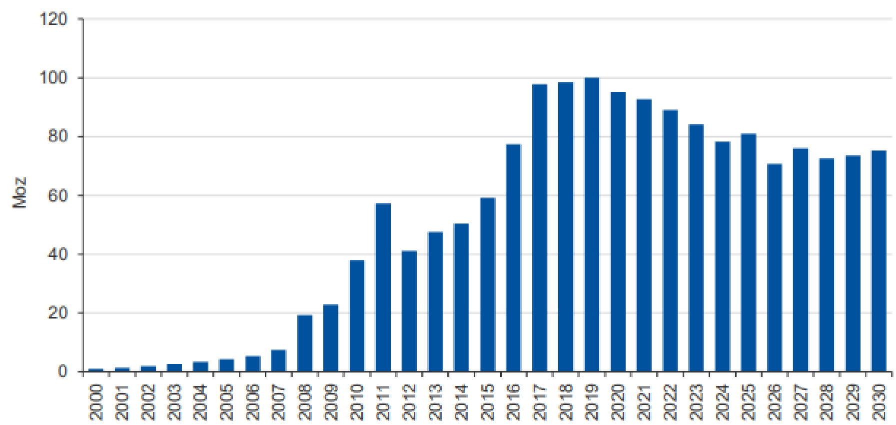
The following section will cover another clear theme of the "E" in ESG, "transitional and sustainable energy." Specifically, as the new green economy transitions away from fossil fuels and non-renewables, the energy sector of the future will be a far cry from its oil and gas centric past and is rapidly shifting to include metals that will play a key role in green infrastructure, such as copper, nickel, vanadium, silver, uranium and rare earth elements among others. The following section covers transitional and sustainable energy, specifically relating to renewables (solar/wind), large-scale batteries for storing renewable energy, energy efficiency, clean tech, green hydrogen, carbon avoidance/decarbonization, and zero-carbon emission nuclear.

RENEWABLE ENERGY AND LARGE-SCALE BATTERIES

Governments worldwide are moving toward zero-carbon energy generation (in the 2050-2060-time horizon), which includes renewable technologies (solar, wind, etc.), and power storage to manage the volatile nature of weather-based power generation. The primary technologies that are being implemented are solar photovoltaic (PV) and wind turbines, and to a lesser extent geothermal, solar thermal, and tidal. A mix of green (non-carbon generating) baseload power generation from technologies such as hydro and nuclear along with solar PV and wind energy can be sufficient to provide the total energy needs to comply with zero-carbon energy goals. In order to meet the Stated Energy Policy Scenario (STEPS) which are goals national governments have committed to achieving to meet the Paris Climate agreements, governments need to change the energy mix supplying their grids. The IEA estimates that to meet the STEPS, 4,019 TWh of wind generation and 4,813 TWh of PV need to be installed. To meet the Sustainable Development Scenario (SDS), which is what is actually needed to meet the Paris Climate agreements, 7,257 TWh of wind and 8,135 TWh of PV need to be installed. Put in context, wind and solar (PV) currently amount to 623 GW and 586 GW of the global energy consumption mix and will therefore need to be expanded by 10x and 12x, respectively. Moreover, the U.S. Department of

Energy (DoE) estimates that each electric vehicle requires 1.50-2.05 kW in incremental grid power, which at the STEPS scenario equates to additional capacity of 210-287 GW, and in the SDS scenario additional capacity of 368-502 GW. Industrial-scale energy storage capacity will need to be built to allow excess power from volatile sources such as PV and wind energy to be stored until needed. Energy storage is still in its early stages and governments are looking at several options including pumped hydro, compressed air, mechanical storage, and chemical batteries. Pumped hydro is currently the most widely used, at 94% of global installed capacity, but it is very limited by geography. The most promising wide-scale application currently being pursued is chemical storage batteries. Lithium-ion is the most advanced battery technology but seems ill suited for large scale application given its low cycle capacity. Vanadium redox is a promising option at the larger scale, and early research is also being conducted evaluating molten metal batteries. As technologies and costs improve in both the power generation and storage markets and adoption rates increase, the supplies of critical metals used to build the infrastructure will come under increasing strain. As it relates to the mining industry, new deposits will need to be discovered and developed to support an increasingly carbon emissions-free world.

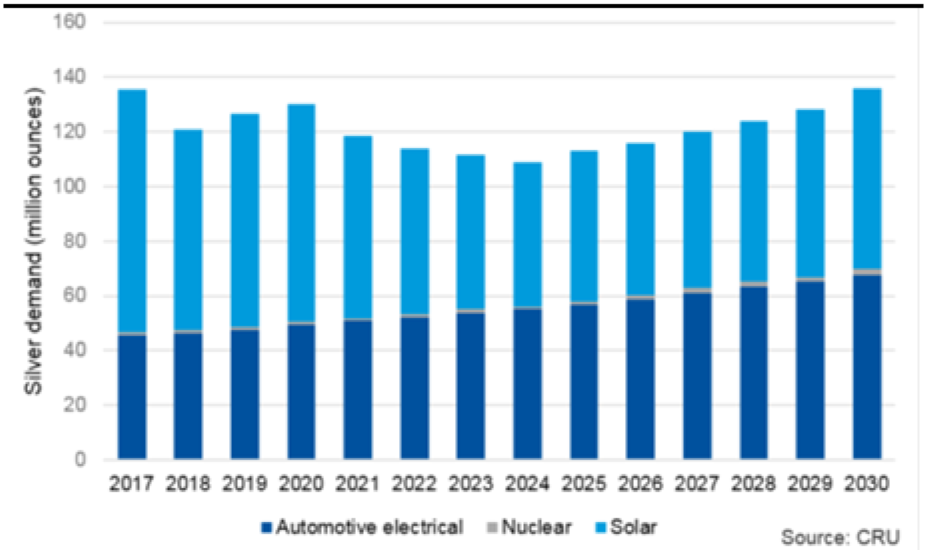
Exhibit 12. Silver Usage in PV Cell Production



Source: Silver Institute

Renewable Energy: Solar: PV cells are primarily made of silicon, which comprise the functional portion of the cell. Electricity collected from the PV cell is delivered via conductive silver paste at the front and back of the PV cell to a converter where it is switched to usable AC. At the turn of the millennium, PV fabrication was an immaterial portion of total silver demand but has grown consistently over the past 20 years to reach 100 MMoz or 10% of total demand. A report by the Silver Institute estimates that 2019 was peak silver demand in PVs and that, despite continued growth in installed capacity, total silver used in PV will slowly decline. This is due to two trends. The first is "thrifting" where manufacturers reduce the amount of silver needed per cell. Total silver usage per cell has dropped from 521 mg per cell in 2009 to 111 mg per cell in 2019. While there is a minimum amount of silver needed, manufacturers believe they can still reduce silver usage by another 50% over time. The second is PV efficiency. As the efficiency increases fewer cells are needed to achieve the same power output, reducing the silver needed per installed watt. Solar cells initially had efficiencies of 8% and advances in technologies have increased lab-tested efficiencies to 48%, and the improvements will likely continue. Because of these two trends we see the importance of silver in global electrification likely peaking at the present time, declining over the next several years, but then stabilizing in the 2023-2024 timeframe at ~80 MMoz, or ~8% of total demand.

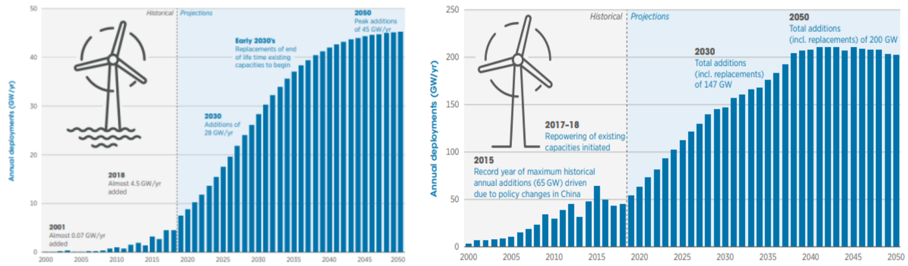
Exhibit 13. Growth of Silver Demand in Green Tech



Source: CRU

Renewable Energy: Wind energy generation has been a popular option due to its low cost and the availability of wind in areas where PV is not attractive due to low sunlight exposure. That said, wind turbines require significant resources to build given their size and scale, which have consistently grown with time. The world's largest wind turbine, the Vestas V164, stands at 220 m tall and weighs 1,300 tonnes. The tower and nacelle are made primarily with steel, and the blades of most turbines with either glass- or carbon-fibre reinforced plastic. While copper makes up only about 1% of the total weight of each turbine, it still amounts to approximately 3.6 t per installed MW. As of the end of 2019 there was 623 GW of installed wind energy generation capacity, slightly higher than solar at 586 GW. The International Renewable Energy Agency (IRENA) estimates that installed wind capacity could grow to as much as 6,044 GW (5,044 GW onshore, 1,000 GW offshore) by 2050, which represents total estimated copper demand of 43 BBlbs over the next 30 years. For context, Escondida, the worlds largest copper mine, produced 2.6 BBlbs Cu in 2019, and at that level of production would take 17 years to produce the copper needed to build-out the worlds wind turbine fleet to 2050. The only possible mitigating factors in this trend would be the substitution of other metals in the generating and transporting processes, or more efficient turbines. Manufacturers are already looking at aluminum as a substitute for copper despite its lower performance, though adoption rates are low. Larger turbines are also more difficult to install, given that the blades must be manufactured in one piece and transporting them overland becomes more difficult the longer they are. In our view, the most significant bottleneck or potential "threat" to the continued expansion of wind power in the global energy mix relates to several rare earth elements (REEs) in particular, neodymium, and praseodymium. These REEs have no natural substitutes and are necessary in the manufacturing of the permanent magnets used in the synchronous generators in both large-scale onshore and offshore wind turbines. The REE market itself is exceptionally small in comparison to base or industrial metals, and REE production is dominated by China at ~85% of global supply.

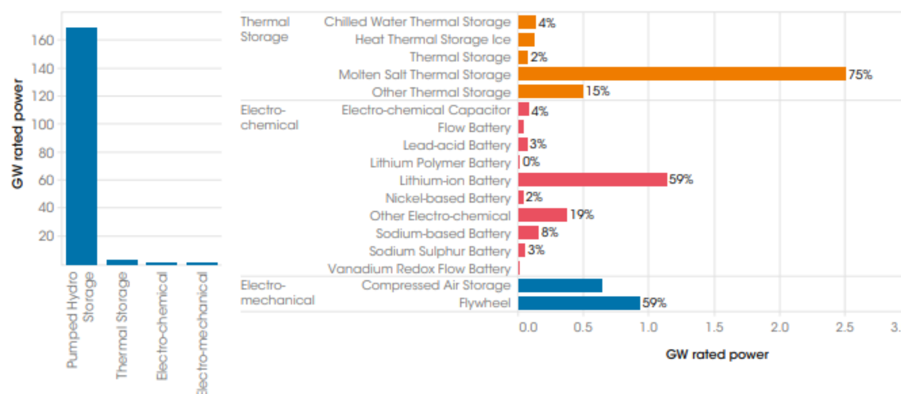
Exhibit 14. Wind Energy Capacity Installations (Offshore/Onshore)



Source: IRENA

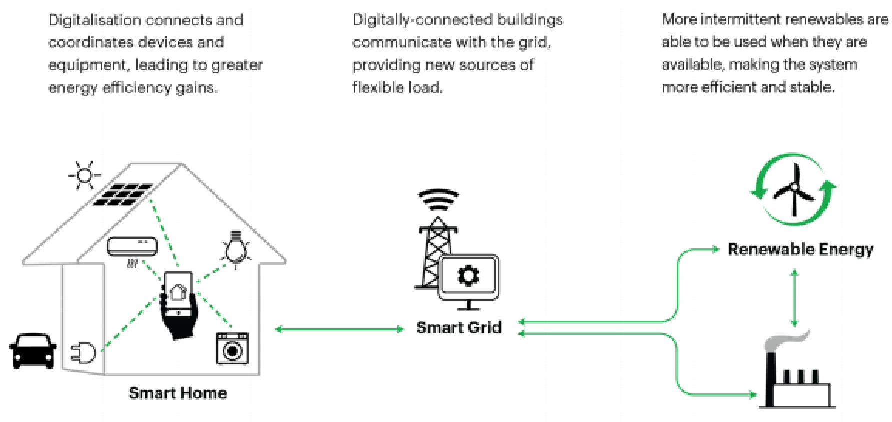
Renewable Energy: Large Scale Batteries: To help regulate the inconsistent nature of renewable energy, sufficient long-term storage capacity needs to be installed. Areas with higher reliance on renewables have the greatest need for and must move quickest to install the required capacity. As a recent example, earlier this month a New South Wales Utility announced its intention to build a 700 MW battery storage facility, and a French manufacturer said it is looking to build additional 500 MW and 300 MW facilities in the country (article linked here). As of mid-2017 59% of global installed electrochemical grid storage was lithium ion (Exhibit 15) and we see the trend continuing due to its low cost of installation and operation. Lithium-ion batteries do have inherent drawbacks and there are other technologies being researched that aim to be inexpensive at scale, geography independent, have greater depth of discharge, and do not lose capacity after thousands of charge cycles. The most likely candidate to fill these requirements are the redox flow batteries, which are forecast to become a $400-500 MM market by 2026. The two primary technologies are Vanadium and Zinc Bromine, and while costs are currently high, they are expected to drop from technology improvements increasing round-trip efficiencies from 60-85% in 2016 to 67-95% in 2030. Global production of vanadium in 2019 totaled 111 MMt and is currently dominated by China and Russia at a combined 76% of global production. Increased adoption of Vanadium Redox Flow Batteries (VRFBs) is expected to increase the demand for vanadium by approximately 6% per annum, with some industry experts predicting VFRBs taking a 10% share of the stationary energy storage market by 2027, equating to 55 MMt of demand. This will put upward pressure on the price of Vanadium in the medium term, a metal that is already prone to supply risk given that China and Russia are the primary producers.

Exhibit 15. Global Installed Energy Storage, mid-2017



Source: IRENA

Exhibit 16. Digitalisation and a More Efficient Energy System



Source: IEA

ENERGY EFFICIENCY AND CLEAN TECH

On the demand side of energy consumption there are several trends that have emerged which aim to reduce the amount of energy needed for daily activities. These trends can be categorized under primary energy intensity, technological efficiency, and energy management. Primary energy intensity relates to the mix and volume of primary energy generation such as coal and nuclear power plants, (higher intensity) relative to solar and wind farms, etc. (lower intensity). While the mix of energy intensity has been improving steadily for decades, its rate of improvement is steadily declining, reaching only 1.2% Y/Y in 2018. Part of this decline in improvement rate is due to poor weather, but also to increasing coal power generation. As renewables play a greater part in this mix, primary energy intensity should improve. Technological efficiency is defined as the amount of energy used per unit of activity and is following the same trend where improvements are still being realized but at a decelerating pace. Clean tech, such as EVs, EnergySmart appliances, LEED building standards adherence, and more efficient AC units have been helping reduce our reliance on energy generation and with the right policies and economic incentives, should play a role reducing our reliance on fossil fuels. In addition, the digitalisation of power grids has the potential to have a revolutionary impact on how energy is consumed. Digitalisation is essentially turning the grid from a "dumb" grid to a "smart" grid, allowing data to be gathered and analyzed in order to find efficiencies in operation, either automatically or through human intervention. The International Energy Agency (IEA) estimates it could generate savings across all sectors, including up to 30% for residential buildings, 30% in industrial applications, 10% in commercial applications, and 20-25% in transportation. The impact to metals and mining as it relates to energy efficiency and clean tech are pervasive.

- **Energy Intensity** – as ESG initiatives continue pushing for improvements to energy intensity, this will require additional usage of metals required for renewable energy generation, such as copper, aluminium, REE (wind), silver (solar), and vanadium (renewable energy storage) among many others.
- **Technological Efficiency** – the adoption of EVs and other "green" substitutes for products that are currently reliant on carbon-heavy fuels, is accelerating. This will drive increased demand for a multitude of metals including copper, nickel, cobalt, lithium, and silver (EVs, smart appliances, etc.)

- **Digitalisation** – effectively the "internet of things" and the data channels that connect day-to-day activities (housing, applications, devices, etc.) to a "smart" grid, powered via renewable or non-carbon baseload power. This will require a tremendous upgrade and improvement to the existing electrical grid and the build-out of new optical fibre networks.

As a recent case in point as it relates to Energy Efficiency/Intensity, Clean Tech, and Digitalisation, earlier this month (article linked here) in his "State of the State" address, New York Governor Andrew Cuomo unveiled plans to construct a 400-km, $2.5 BB "Green Energy Transmission Superhighway," as part of a larger strategy of transitioning New York State toward a "green economy." According to Governor Cuomo, the Transmission Superhighway would "create opportunities to maximize the use of renewable energy for the parts of the state that still rely on polluting fossil-fuel plants. Supercharging the new transmission superhighway will be vital to completing New York's nation-leading green economic recovery and accelerating renewable energy development programs." The proposed Transmission Superhighway would upgrade the state transmission grid, potentially connecting it to Canada's (specifically Hydro Quebec, the provincial utility) abundant, low-cost, and zero-emission hydro power stations. The Transmission Superhighway is consistent with Governor Cuomo's plans to build "nearly 100 renewable energy projects" including the "largest offshore wind program in the nation" consisting of two wind farms off Long Island generating a combined 2.5 GW in zero-carbon emission power.

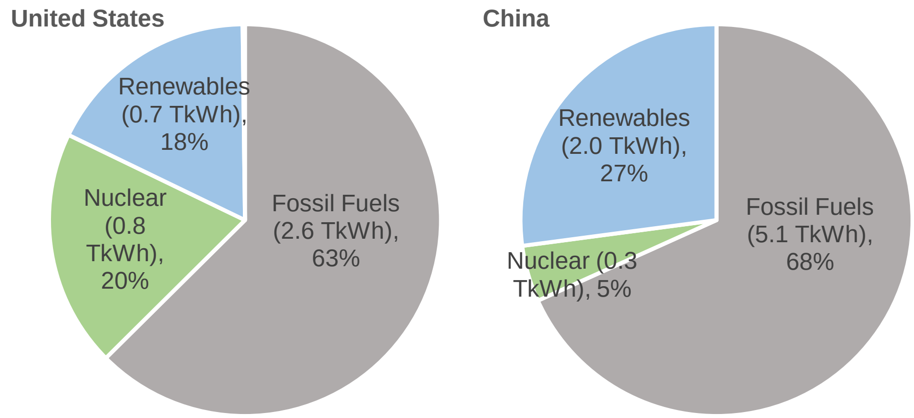
GREEN HYDROGEN

Although the majority of fossil fuel applications can be replaced with electricity use, there are still many applications where portable fuel is still required, such as aviation, marine shipping, and heavy industry. This is where hydrogen has a critical role to play. Hydrogen is a carrier of energy used in powering portable fuel cells that emit only water and heat as by-products (zero carbon emissions). As such, it has a clear role to play in the green economy of the future. The challenge is that hydrogen fuel cells require the storage of hydrogen in gaseous form, which it does not naturally occur as on earth, and the extent to which hydrogen can be considered "carbon neutral" depends on how it is produced. The lowest cost "gray" hydrogen for example, is created via burning fossil fuels (natural gas reforming process), which obviously emit CO_2 into the atmosphere. "Blue" hydrogen is created in the same way, but "carbon capture" technologies (discussed later in the report) prevent the CO_2 from being released, capturing it instead and securing it into an impermeable geologic formation underground. A key part of the "clean tech" revolution is the phasing-out of "Gray" and "Blue" hydrogen in favor of "Green" hydrogen, which is produced via electrolysis (chemically deconstructing water into hydrogen and oxygen via electricity) that while is carbon-free, is also the most energy intensive and therefore the most expensive to produce. At present, carbon-free "green" hydrogen costs anywhere from $3.00-7.50/kg to produce relative to "gray" hydrogen at ~$0.90/kg. For "green" hydrogen to therefore become viable in ultimately displacing fossil fuels in the aviation, shipping, and heavy industry sectors, will first depend upon large-scale carbon-free power generation (wind, solar, and/or nuclear).

DECARBONIZATION, CARBON REMOVAL/AVOIDANCE

Over 60 countries including the United States have pledged to be carbon neutral by 2050, with China, the world's largest coal consumer and polluter, more recently pledging to decarbonise its economy by 2060. As an important early step toward achieving this goal, next month China will launch its carbon "emissions trading scheme" (ETS) in an attempt to foster carbon "avoidance." More then 2,200 Chinese companies that collectively emit over 26 kt of greenhouse gasses per year will start trading their emissions quotas beginning February 1, whereby firms can purchase the right to pollute from others with a lower carbon footprint. Similar to the European Union's ETS launched in 2005, this carbon avoidance plan by China is expected to immediately drive down overall emissions as the set quotas will make it more costly to produce them. Approximately 68% of grid power in China is still provided by fossil fuels (coal, petroleum, natural gas), generating annual greenhouse gas emissions of ~15 Gt per annum, approximately 30% of the world's total that attributes to climate change. By contrast, the United States emits annual greenhouse gas emissions of ~7 Gt per annum, approximately 14% of the world's total that attributes to climate change. While the ETS being launched by China is still small relative to its overall carbon footprint, it is a step in the right direction toward "carbon avoidance" in the near-term. Over the longer-term, renewables (wind, solar, hydro, etc.) and nuclear (discussed later) will have critical roles to play as China and the world's other largest economies decarbonize. However, avoiding the worst aspects of climate change will not only require the reduction in carbon emissions and shift toward renewables, but also the removal of existing carbon dioxide (CO_2) from the atmosphere at a tremendous scale. The United States appears to be taking the lead in this initiative, referred to as "carbon removal" encompassing a wide range of strategies that are both natural (tree restoration, agricultural soil management, etc.) and technology-based (air/carbon capture, CO_2 pipelines, etc.) The lowest cost and most easily implementable "carbon removal" strategy relates to tree restoration, which has the potential to remove a cumulative 7 Gt CO_2 in the United States through 2050 without displacing agricultural land. Soil management, another natural pathway for "carbon removal," involves implementing strategies such as no-till farming and cropland retirement, with the potential to remove a cumulative 2 Gt CO_2 in the United States through 2050. As it relates to metals & mining, "carbon capture" technology will likely prove to be the single largest contributor to carbon removal over the longer-term (2030-2050), with cumulative removals estimated at anywhere between 2-7 Gt CO_2 in the United States depending on the rate of scale-up. On a global basis, power generation and manufacturing account for approximately 70% of total global energy-related greenhouse gas emissions, and as such, the "carbon capture" component of decarbonization is critically important. Direct air capture / "carbon capture" technology involves CO_2 that would otherwise be released into the atmosphere, to be "captured" at the source, then compressed and injected into underground impermeable geologic formations for secure permanent storage. Several different modular technologies for carbon capture are being advanced by various start-up companies to most of the world's largest energy producers. Some of the most advanced carbon capture technologies involves the use of carbonate fuel cell technology, with the cathode component of the fuel cell comprised of both lithium and nickel. While "carbon capture" technology will admittedly take longer to implement and scale-up (likely 2030+), it will eventually comprise one of the most significant components of decarbonization in the new green economy.

Exhibit 17. Electricity Generation by Energy Source (2019)



Source: EIA.gov, Cantor Fitzgerald

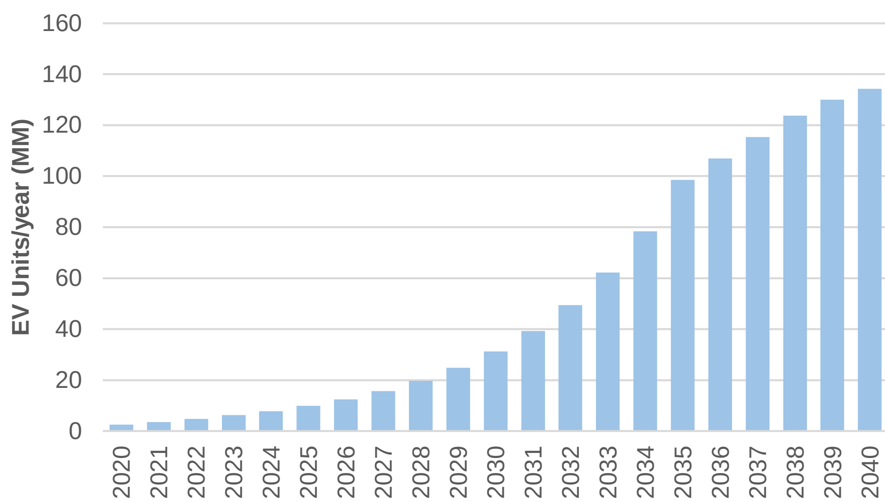
ZERO-CARBON BASELOAD: NUCLEAR

The two largest economies in the world, the United States and China produce a total of ~12 TT kWh of electrical power per annum, of which fossil fuels (coal, natural gas, and petroleum) account for ~66%, renewables (hydro, solar, wind) account for ~24%, and nuclear power accounts for the remaining ~10% of the electricity mix. The United States is currently the world's largest nuclear power producer (+80 GW), but China has by far the most ambitious nuclear power expansion plans globally, with its target set on total installed capacity of 400-500 GW by 2050, up from 2020 levels of ~52 GW currently in operation. At its current growth rate of ~3-4 new nuclear reactors per year (+10% annual growth rate in installed nuclear capacity), China will surpass the United States as the world's largest nuclear power producer sometime in the 2027-2029 period. While we would characterize the sentiment toward nuclear power in the United States as "mixed but improving", the reality is that nuclear energy is the most concentrated and highest density form of zero-carbon emission power technologically and commercially available in the world today. China has a clear understanding of this, as evidenced by its aggressive nuclear reactor build-out strategy. In the United States, the long-term nuclear strategy is less clear. While at the present time there appears to be no plans to expand the U.S. reactor fleet in any significant way, there also are no legitimate calls to action to shut down the U.S. nuclear industry either. In general, the Biden administration appears to be favorable toward nuclear power remaining a mainstay of U.S. electrical baseload power generation, in its current capacity of ~80 GW per annum. This is a significant improvement in sentiment that has plagued the U.S. nuclear industry since the Fukushima Daiichi disaster in Japan ten years ago. Nuclear power is no longer vilified in the way it has been for decades, but rather is now being seen as a necessary component to carbon-free power generation and "complimentary" in nature to renewables. Whereas renewables (solar, wind) are weather/climate dependant, and require large-scale battery storage to solve their intermittency challenges, nuclear power does not have these issues, and has been proven to produce reliable, low-cost, carbon-free power measurable in decades. The United States is currently the world's largest nuclear power producer (+80 GW) and consumer of uranium fuel (50+ MMlbs U_3O8_e/year) but produces negligible amounts of mined uranium domestically (<1 MMlbs U_3O_8e/year). While nuclear power may not be increasing its percentage of the energy mix in the United States, it certainly is in China, the world's largest energy producer by GW, and second largest economy. While the current global supply-demand macro environment for uranium is in balance over the short-term, over the medium and longer-term (+18 months), we expect a significant supply-demand deficit to manifest itself, and expand considerably in the years that follow, particularly as nuclear power continues to solidify itself as a key component of carbon-free baseload power generation globally.

IMPACT TO METALS

The Metals & Mining industry has critical roles to play in supporting a Green Economy, and specifically, the roll-out of Electric Vehicles and the theme of "Transitional Energy" including de-carbonization, renewables, and clean tech. The adage of "if it can't be grown it must be mined" serves as a reminder that Electric Vehicles, Transitional Energy, and a Green Economy start with metals. In the following section, we present our best estimates as to the supply/demand imbalances that are projected to occur as EVs and Green Economy infrastructure are built out over the coming 10-15 years. We highlight our resultant bullish outlook for commodities including copper, nickel, cobalt, lithium, cobalt, uranium, and REEs.

Exhibit 18. EV Build-out Forecast, Long-Term

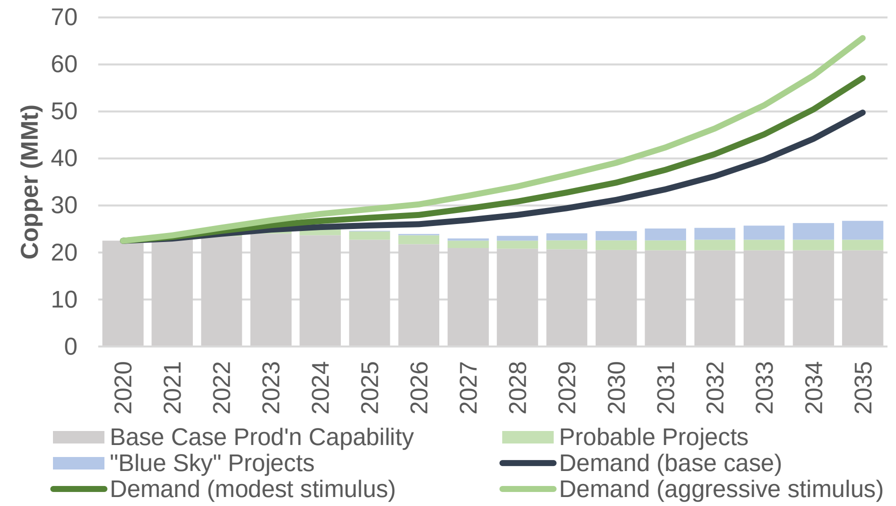


Source: Cantor Fitzgerald

IMPACT TO METALS: COPPER

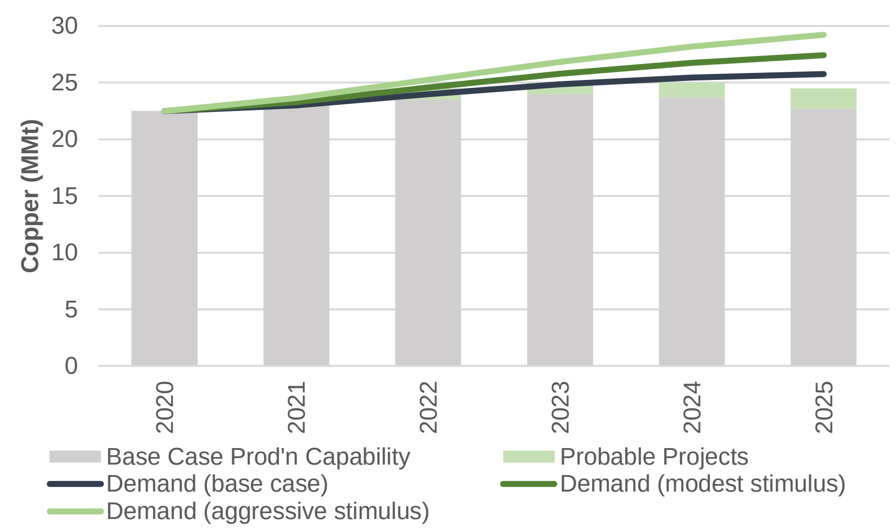
In our view, copper will stand to benefit more than any other metal as the world transitions to carbon neutrality and a green economy. While the copper market is currently balanced in terms of supply and demand, the adoption rate of EVs and associated "green infrastructure" will drive a modest supply-demand deficit over the short-term (2021-2024), after which point (2025+) the supply-demand imbalance expands exponentially. Baseline global copper consumption is relatively stagnant at 23-25 MMt Cu/year, in-line with global steady-state mine production, that is forecasted to decline by 1-2%/year (over the long-term) as Proven & Probable reserves are depleted and average mine head-grades continue their downward trend. Against this backdrop of flat/declining steady-state mine production is the build-out of EVs, that require approximately 180 lbs Cu per vehicle, over 3x the copper required per standard ICE vehicle (~55 lbs Cu). The build-out of EVs globally is currently accelerating and is forecasted to hit an "inflection point" in the 2025-2030 time period at which point adoption rates are projected to increase exponentially. Incorporating the EV build-out schedule in Exhibit 18, we expect modest copper supply deficits over the next 3-4 years, before exploding higher in 2025 (Exhibit 19) and continuing higher thereafter. Moreover, we note that our copper demand projections include only the additional copper required in the manufacturing of the EVs themselves (~180 lb/unit), and excludes any additional copper that will be required in EV infrastructure support (charging stations, upgrading electrical grids, etc.)

Exhibit 19. Copper Supply/Demand Projections (Long-Term)



Source: Cantor Fitzgerald

Exhibit 20. Copper Supply/Demand Projections (Near-Term)



Source: Cantor Fitzgerald

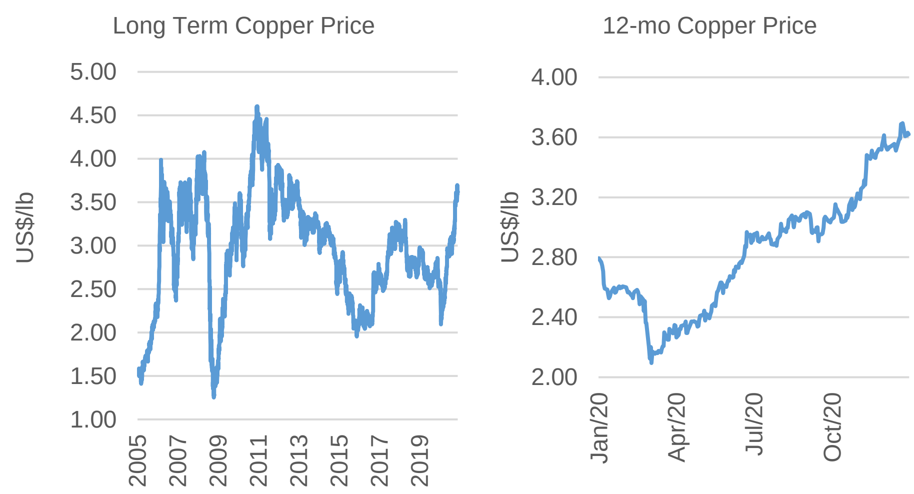
While we expect only a modest copper supply-demand deficit over the near-term (2021-2024), prior to the 2025 EV "inflection point", there are two variables to be considered that may accelerate our copper supply deficit projection; 1) the prospect of significant infrastructure stimulus, and 2) copper inventory builds ahead of the coming supply squeeze. At present, our "base case" scenario includes neither variable and is set at 2021 copper production of 23.0 MMt Cu falling in-line with demand of 23.0 MMt Cu. Over the medium-term, our "base case" scenario calls for 2025 copper production of 24.5 MMt Cu falling short of demand at 25.8 MMt Cu. Under a "modest" and "aggressive" stimulus scenario, both in the United States and abroad, our copper demand projections in 2025 increase to 27.4 MMt and 29.2 MMt, respectively. Over the longer-term (2025+), when the adoption of EV's enters its "exponential" phase, we project "base case" copper supply deficits of 2.3 MMt (2026) growing to 8.6 MMt (2030) and 27.0 MMt (2035), even without the prospect of any fiscal infrastructure stimulus. For context, the world's largest copper mine, Escondida, located in Chile and operated by BHP (BHP-NYSE, Not Covered), produces ~1.2 MMt Cu per year. We expect the copper market to be in a supply deficit of *at least* this amount by the year 2025 (base case), at which point the imbalance will only intensify at an exponential rate as the adoption of EVs accelerates globally. Increased infrastructure spending and fiscal stimulus in the United States and elsewhere over the coming years will only accelerate and intensify our forecasted supply-demand imbalance. While there are a number of large-scale development-stage copper projects (Udokan – Russia, Kamoa Kakula – DRC, El Arco – Mexico, Nueva Union – Chile, Pebble – United States, Quellaveco – Peru, Frieda River, Papua New Guinea, Agua Rica – Argentina, Wafi-Golpu – Papua New Guinea, etc.) only Ivanhoe's (IVN-TSX, Not Covered) Kamoa-Kakula project is slated to begin producing in the coming years (Phase I is expected to come on mid-2021 at the initial rate of +0.22 MMt Cu). The vast majority of other large-scale copper projects, capable of delivering into the coming supply-demand imbalance are in various stages of environmental permitting, feasibility, and/or advanced exploration. With this report we are increasing our near-term copper price forecasts to $3.60/lb (2021), $3.75/lb (2022), and $3.50/lb (2023), up from our previous price deck of $2.60/lb (2021), $2.80/lb (2022) and $3.00/lb (2023) that was lowered back in April/2020 amid peak COVID-19 uncertainty. With this report we are also increasing our long-term copper price deck from $3.00/lb to $3.25/lb (2024+) but note that this has considerable upside. We plan on revisiting this longer-term copper price forecast at year-end 2021 when we have more clarity on a) the level of fiscal stimulus and infrastructure spending planned in the United States and Eurozone, and b) confirmation that our "green economy" thesis, and particularly the roll-out of EVs, is proceeding in-line with or ahead of our forecasts.

Exhibit 21. Cantor Copper Price Forecast Update

Cu Price ($/lb)	2021	2022	2023	Long-term
Previous	$2.60	$2.80	$3.00	$3.00
Revised	$3.60	$3.75	$3.50	$3.25

Source: Cantor Fitzgerald

Exhibit 22. Copper Price

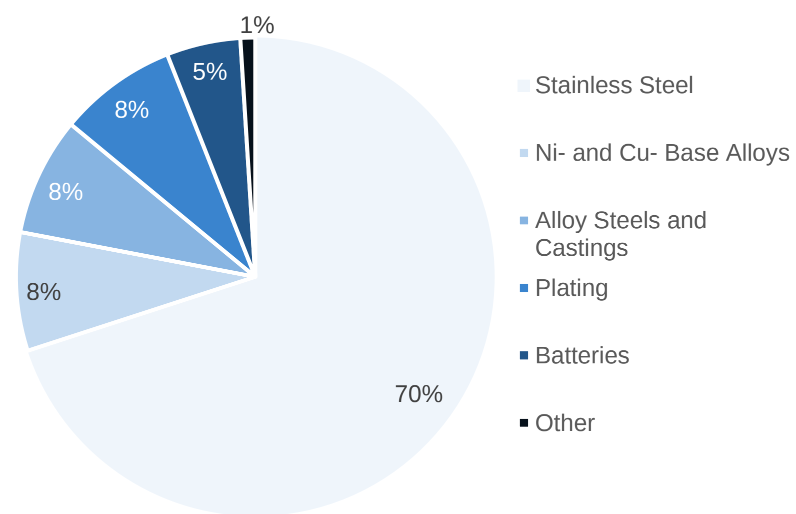


Source: Cantor Fitzgerald

IMPACT TO METALS: NICKEL

The current nickel market sees about 72% of primary production go to stainless steel and 5% to batteries (Exhibit 23).

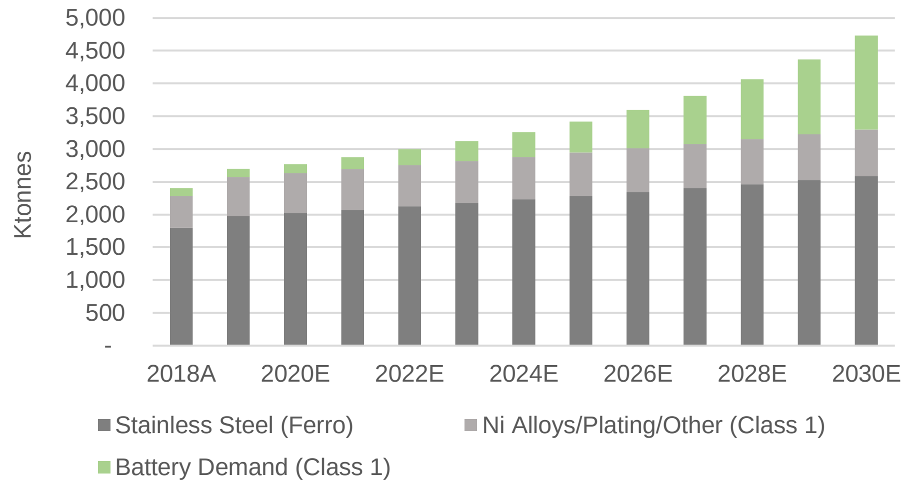
Exhibit 23. Nickel Usage



Source: Nickel Institute

With EV penetration looking to hit 30 MM new vehicles by 2030, the incremental nickel demand for the EV market should grow from ~115 kt in 2020 to over 1.4 MMt in 2030 of a 2019 global nickel production base of about 2.7 MMt. To put this into context, the Voisey's Bay nickel mine produces ~45 kt of nickel and 2,600 t of cobalt annually. The world's largest laterite nickel mine, the Ambatovy mine in Madagascar (which started production in 2015 at a cost of ~$8BB) produces ~60 kt of nickel and ~5,600 t of cobalt annually. So just to supply the incremental EV battery demand will require two new "Ambatovies" every year for the next 10-years.

Exhibit 24. Nickel Demand Forecast

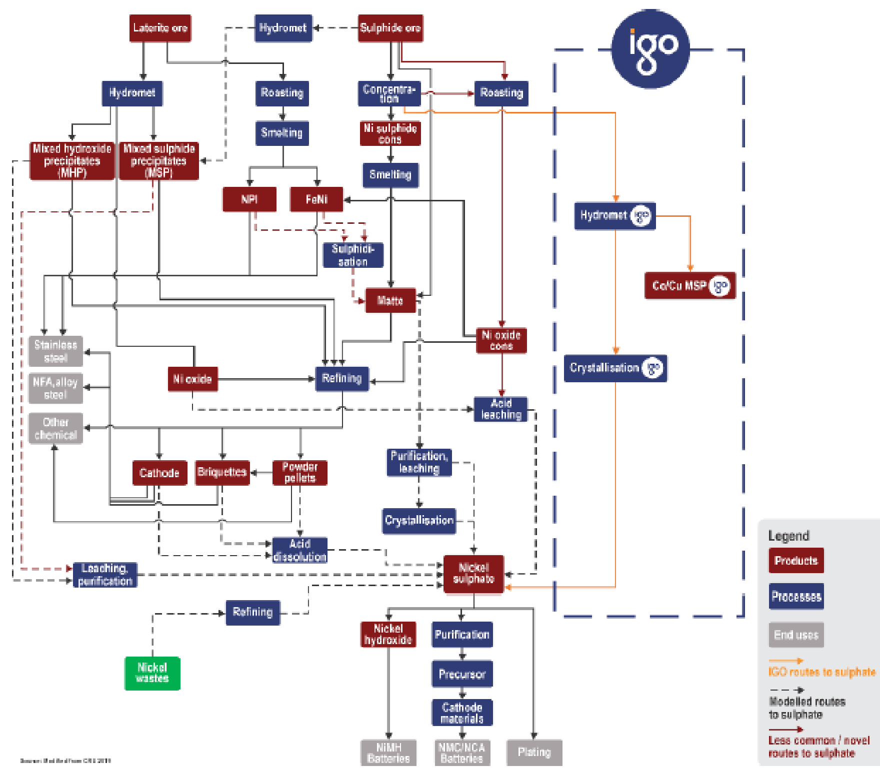


Source: Cantor Fitzgerald

While the nickel market is very large compared to lithium and cobalt, not all nickel is created equally when it comes to the manufacture of lithium-ion batteries. Battery makers need nickel in the form of a very pure hydrated nickel sulphate ($NiSO_4 \cdot 6H_2O$). Nickel sulphate can be made from almost any nickel product but the ease, cost effectiveness and environmental impact of doing so varies widely by ore/processing/product type.

Nickel Mining & Processing Adds to the Challenges: The two main sources of nickel are i) nickel sulphide deposits and ii) nickel laterite deposits. Nickel sulphides are mined, concentrated, and smelted to make a nickel matte (in various forms like powders and briquettes) to produce "Class 1" nickel with a nickel content of at least 99.8%. This very pure product is used mainly for alloys, plating, and as feed for stainless steel production. It can also be processed to make nickel sulphate, which is the main input for lithium-ion batteries, by dissolving it in a sulphuric acid. Nickel laterite deposits are far more plentiful than sulphide deposits and have come to dominate the industry. They are found in tropical locations (e.g. Brazil, Papua New Guinea, Indonesia, and the Philippines) and formed by the progressive weathering of bedrock making nickel oxide ores. Laterites generally contain two ore types; limonite and saprolite. Limonitic ores typically overlay saprolite and have a lower nickel content but higher iron and cobalt content and, importantly, lower magnesia content making them suitable for the high-pressure acid leach (HPAL) process and the production of Class 1 nickel and cobalt as well as nickel sulphate for battery production. Saprolitic ores are generally unsuitable for HPAL due to higher magnesium and are instead largely used to produce Ferronickel or Nickel Pig Iron (NPI) through pyrometallurgical processes. Ferronickel has about 35% nickel and NPI has ~13% nickel with the balance mostly iron which is attractive to the stainless-steel industry. Saprolite ores can also produce a Class 1 nickel product but it requires additional processing through a reduction kiln that injects high-sulphur fuel oil to make nickel sulphides which is then smelted to make a nickel matte; overall a fairly energy intensive (and environmentally unfriendly) process. Producing nickel (and cobalt) sulphates from Ni-concentrate through hydrometallurgical refinery could by-pass the smelter and increase payables as well as reduce the carbon footprint from smelting (and using sulphur that would otherwise be burned off in a smelter to make matte and added back in to make sulphate). Hydromet for sulphides is being looked at by several groups including Australian producer IGO Ltd. (IGO-ASX, Not Covered).

Exhibit 25. Complex Paths of Nickel Mining, Refining and Processing



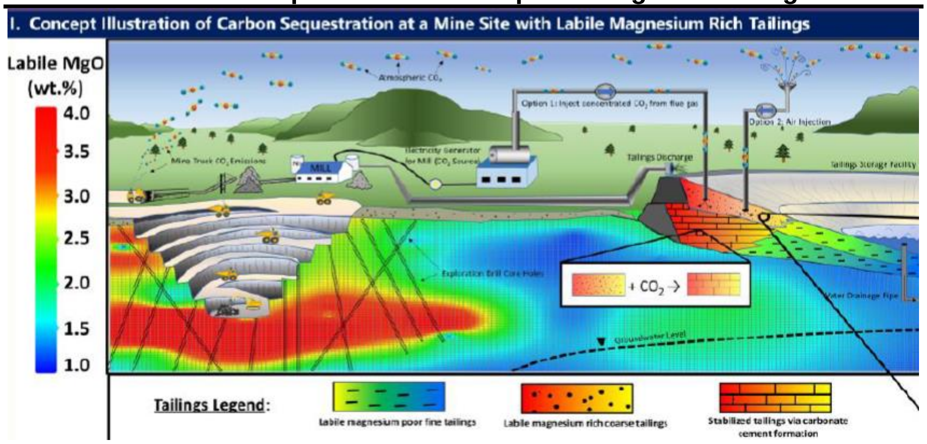
Source: IGO Ltd, CRU International Ltd.

Moving Toward Sustainability: In July 2020 Elon Musk put the call out for more nickel to be mined and produced, adding that "Tesla will give you a giant contract for a long period of time if you mine nickel efficiently and in an environmentally sensitive way". The mining industry has been moving towards more sustainable mining practices for many years now, but slowly. The cries from Tesla have sped this up. The challenge for nickel is that the processing of laterite ore to make ferronickel, and NPI in particular, can be very energy intensive driving a very high carbon footprint. Other practices such as deeps sea tailings displacement (DSTD) have tainted some PNG mines[1]. To offset this companies are looking to best practices such as dry-stack tailings (no risk of catastrophic dam failures), electric vehicle fleets with hydro-electric power (where available) or generators supplemented with wind and solar power. Those with nickel sulphide projects are looking to further offset the carbon footprint through carbon sequestration as the mafic and ultramafic rocks that typically host the sulphide deposits contain various magnesium silicates (or hydroxides like brucite) which absorb CO_2 through natural mineral carbonation. And as discussed above, producing nickel and cobalt sulphates from sulphide concentrates through hydrometallurgical refinery could by-pass the smelter and increase payables as well as reduce the carbon footprint from smelting (and using sulphur that would

[1] To be fair, PNG has steep topography and is a seismically active area so at the Ramu Mine for example, DSTD was chosen as the most environmentally sound practice (no risk of tailings dam failure or dry-stack collapse).

otherwise be burned off in a smelter to make matte and added back in to make sulphate). Work to accelerate this process and bring it into the flowsheet is ongoing. These efforts will no doubt increase the cost of nickel production but it is clearly the way forward for automakers.

Exhibit 26. Carbon Sequestration Concept with Mg-rich Tailings



Source: Vanderzee et al., “Carbon Sequestration in Mine Waste”, 2019

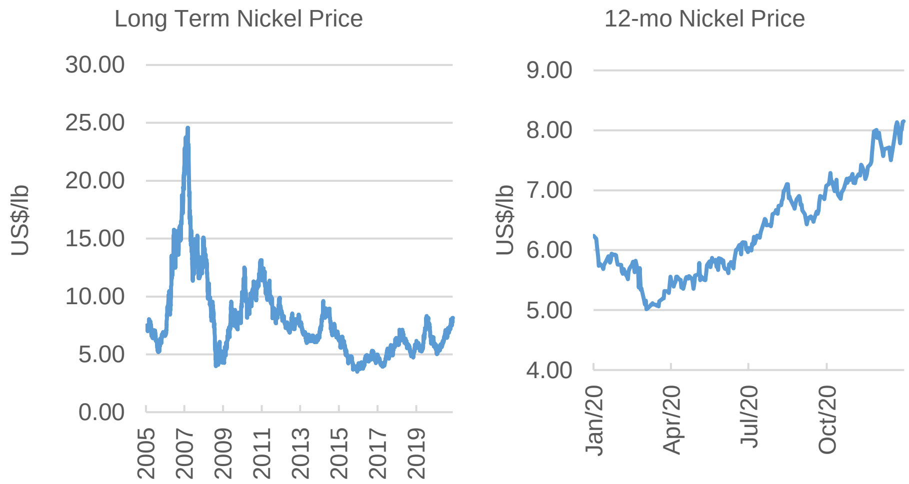
Prices and Volatility to Increase: To support growth of the EV market, it is expected that additional nickel demand will lean heavily on new sulphide deposits or HPAL laterite operations. Both allow for a more direct path to battery-amenable material and sulphides also have potential for reduce environmental impact. But advanced sulphide projects are in short supply and the HPAL projects can be very expensive to develop. While anticipation of demand is high, until recently nickel and cobalt prices have been relatively low so few new operations are in development. In part this is because the nickel market is much larger and the exploration and development of new resources is driven by spot metal pricing which, until recently, was modest by historical standards. Given nickel’s much larger market and the ability to divert some Class 1 nickel from stainless steel to battery production, a supply crunch is not imminent but continued low prices are not an incentive for many new projects. It is estimated that the incentive price for new sulphide operations requires a nickel price in the $18,000-$22,000/t range ($8 - $10/lb) which is in-line with our long-term Ni price estimate of $8.50/lb. While lateritic sources are more plentiful, (Indonesia has particularly large limonite nickel reserves and is now a major player) the HPAL process has a higher capital intensity such that the incentive price for operations is a nickel price is likely higher in the $20,000-26,000/t range ($10 - $12/lb). This is setting the industry up for potential shortfalls and price spikes as seen in 2007 and 2010, particularly with permitting and construction timelines for greenfields projects of 4-10 years. With this report we are increasing our near-term nickel price forecasts to $8.00/lb (2021), $10.00/lb (2022), and $9.00/lb (2023), up from $7.50/lb (2021), $8.00/lb (2022), and $8.50/lb (2023). Our long-term nickel price assumption remains $8.50/lb for nickel.

Exhibit 27. Cantor Nickel Price Forecast Update

Ni Price ($/lb)	2021	2022	2023	Long-term
Previous	$7.50	$8.00	$8.50	$8.50
Revised	$8.00	$10.00	$9.00	$8.50

Source: Cantor Fitzgerald

Exhibit 28. Nickel Historical Prices

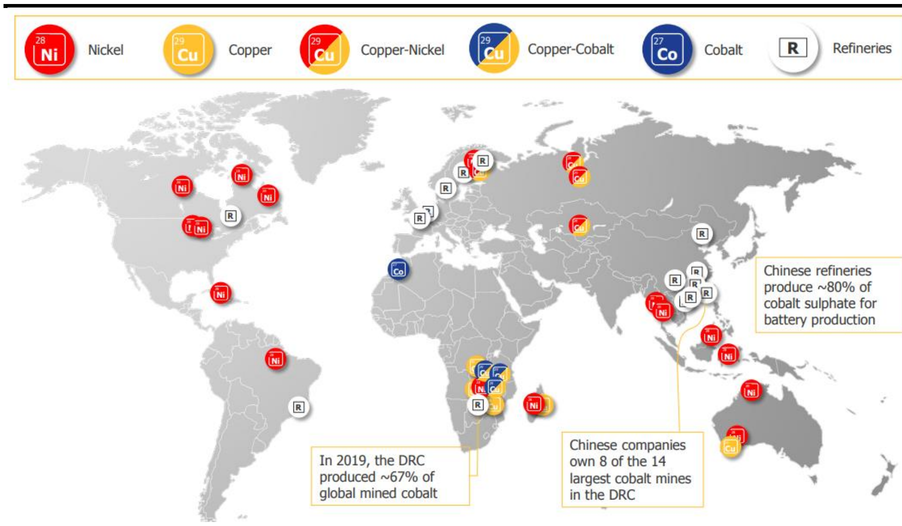


Source: Cantor Fitzgerald

IMPACT TO METALS: COBALT

Most cobalt is mined as a by-product of copper and nickel production with the bulk of it coming from the Democratic Republic of Congo (DRC) but also from sulphide deposits and laterite deposits around the word.

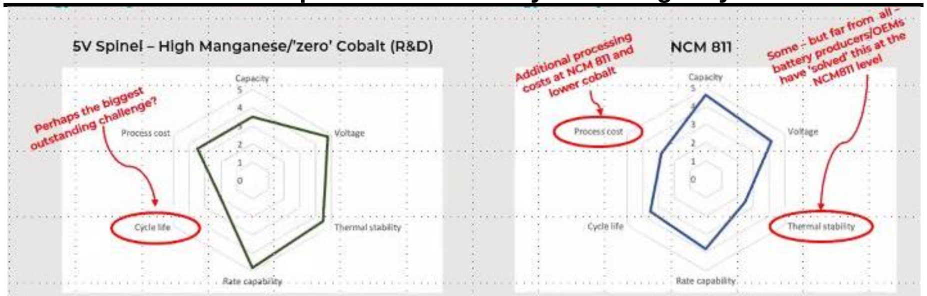
Exhibit 29. Main Cobalt Sources



Source: First Cobalt

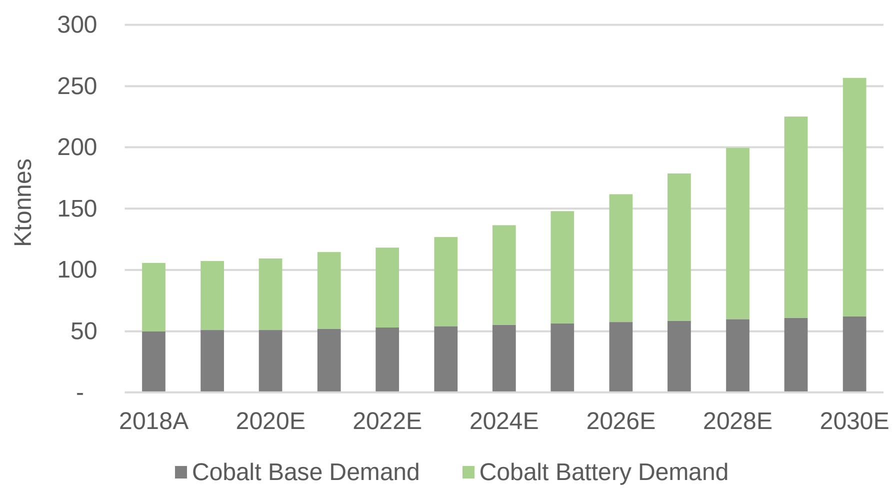
At its Battery Day in 2020, Tesla said it is doing its best out engineer out its reliance on cobalt through both new battery design the like the NCM 811 battery that uses half the amount of cobalt in the current NCM 2170 battery. The move away from cobalt is driven by security of supply (85% DRC and Chinese refineries) and some unacceptable mining practices in the DRC which has seen the rise of informal/ "artisanal" mining. While this type of mining accounts for only a small portion of global output, it has tainted the metal among consumers and raised ESG issues for buyers of the metal. Concerns are largely overblown as leading producers like Glencore have committed to providing an ethical supply of cobalt and employing global best practices at its operations in the DRC. But while cobalt is unpopular, its use remains key, particularly on smaller batteries like cell phones and laptops for high energy density, long cycle life and for stability in long-range EV battery packs (Exhibit 30). Even assuming reduced levels of cobalt in EV batteries, we expect demand to more than double by 2030 (Exhibit 31). And as cobalt is a small market subject to supply shocks, we expect volatility in the metal price.

Exhibit 30. Cobalt is Important for Stability and Longevity



Source: Glencore

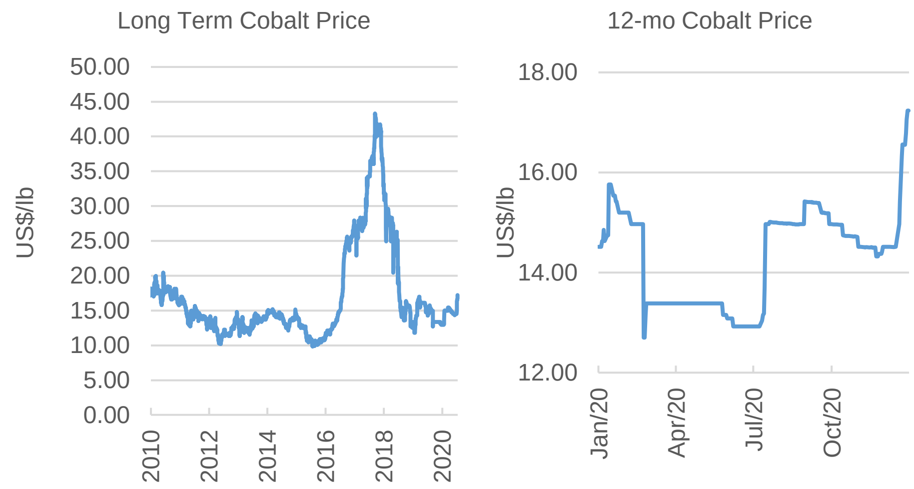
Exhibit 31. Cobalt Demand Forecast



Source: Cantor Fitzgerald

To mitigate supply and reputational risk, much of the industry has made a conscious effort to move away from the metal by using different battery chemistries and substituting nickel for cobalt. Cobalt will continue to be important in battery manufacture and any new supply outside of DRC would be highly sought after by auto and battery makers. Our long-term price assumption for cobalt is $24.00/lb and while we forecast a steady rise we expect price spikes and ongoing volatility as real demand materializes with increased uptake of electric vehicles and the supply-demand picture becomes clearer.

Exhibit 32. Cobalt Price

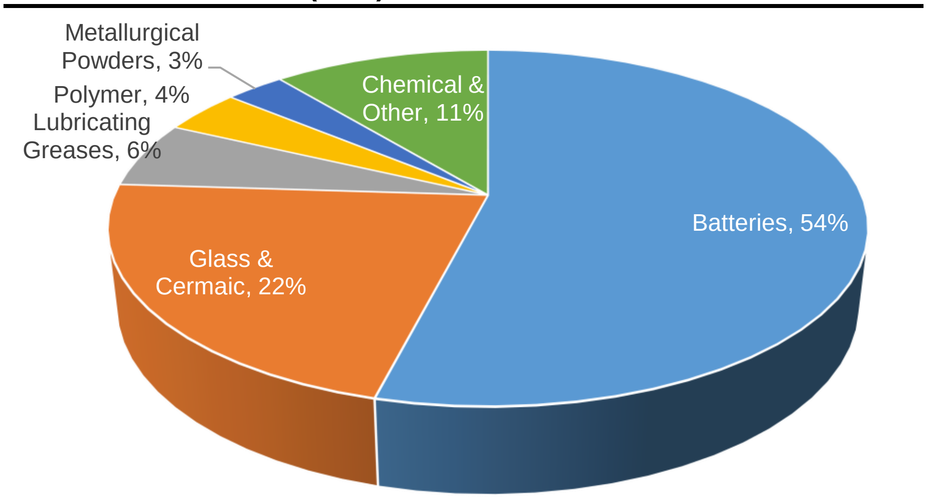


Source: Cantor Fitzgerald

IMPACT TO METALS: LITHIUM

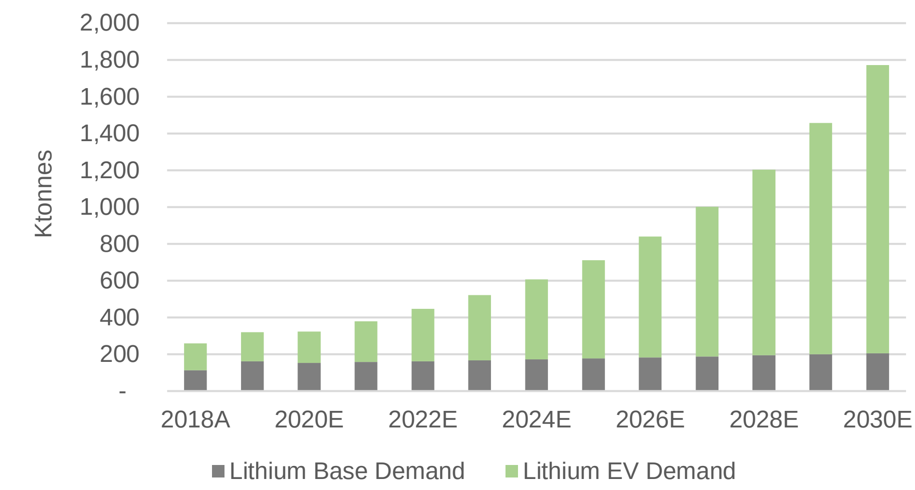
The market for battery-grade lithium carbonate and lithium hydroxide is forecast to remain tight in the near term resulting from growing acceptance of and increased demand for electric vehicles. From a 2019 production base of about 320 kt LCE, the market is expected to increase towards 1.8 MMt by 2030. While plenty of new lithium supply has been identified, getting it into production in time to meet demand should continue to be a challenge supporting elevated lithium prices over the medium term. Lithium chemicals are presently most directly linked to the auto industry with over 54% of demand coming from the manufacture of lithium-ion batteries with the balance going into other industrial applications including glass and ceramics, greases and metallurgical applications (Exhibit 33).

Exhibit 33. Lithium Use (2019)



Source: Roskill

Exhibit 34. Lithium Demand Forecast



Source: Cantor Fitzgerald

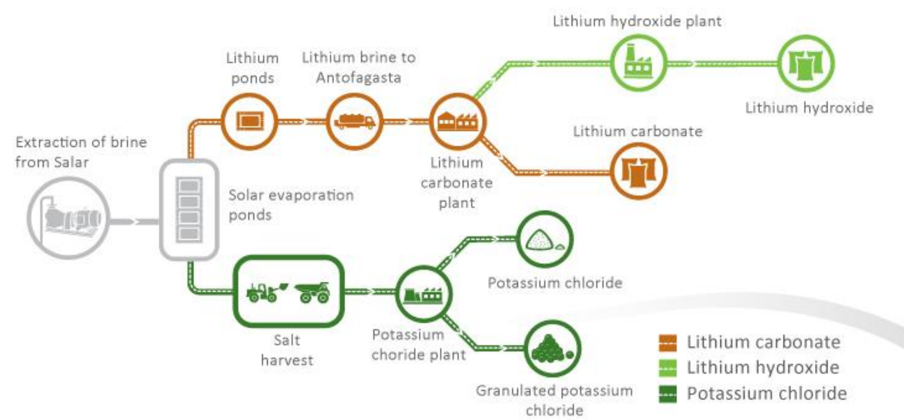
Currently, the bulk of lithium comes from two major sources: 1) hard rock mineral deposits (pegmatite) and 2) lithium-rich brines.

Exhibit 35. Lithium Triangle and SQM Brine Ponds

Source: The Economist, SQM

Extraction from Brines: Since the late 1990s, the primary source for lithium compounds are the lithium brines from salars (salt flats) in Chile and Argentina due to the significant cost advantage over hard rock sources. Lithium brine bodies in salt lakes are formed in basins where water which has leached the lithium from the surrounding rock is trapped and concentrated by evaporation. Lithium content in economic brines starts at ~160 ppm (e.g. Clayton Valley, USA) to over 1,500 ppm (Salar de Atacama, Chile) but must ultimately be reduced to produce battery-grade lithium carbonate of >99.5% purity and trace elements below buyer thresholds. In general, the process involves first increasing the concentration and purity of the brine using large solar evaporation ponds, which sequentially precipitate various (some saleable) mineral salts. The remaining, highly concentrated brine then undergoes various chemical treatments to remove impurities to finally precipitate lithium carbonate. The cost of this process for existing large producers can range from $1,400-$6,000/t Li_2CO_3 depending largely on the location, which determines starting concentration, evaporation rates and degree of processing needed to remove impurities. Lithium carbonate serves as the primary product which can be further processed into an abundance of other compounds including, for battery production, lithium hydroxide and battery-grade lithium carbonate. Over two thirds of the world's lithium production comes from lithium brines in the "lithium triangle", an area of the Andes Mountains encompassing parts of Argentina and Chile.

Exhibit 36. Brine Extraction Process

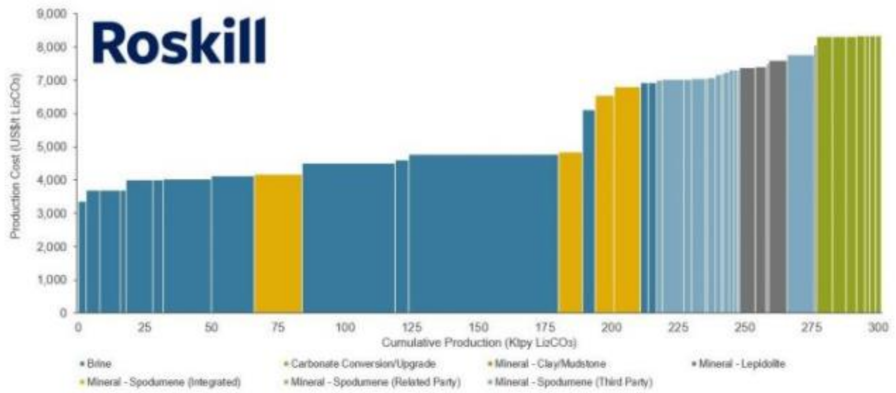


Source: SQM

Extraction from Pegmatite: The minerals spodumene, petalite and lepidolite provide the main sources of lithium from hard-rock sources. Spodumene is the most important commercially mined lithium mineral given its higher inherent lithium content. Typically, the mineralized rock contains approximately 12-20% spodumene, or approximately 1-1.5% lithium oxide. Pegmatites, the geological bodies that may host these lithium-bearing minerals, can be found all over the world but those with the winning combination of high grade, a large resource and access to infrastructure such as the Greenbushes Deposit in Australia are rare. Extraction is fairly simple. At Greenbushes, ore is extracted from an open-pit mine, is crushed and the spodumene concentrated through a combination of heavy media separation, flotation and/or magnetic separation for a market-ready spodumene concentrate to be consumed directly in the glass and ceramics industries or shipped as concentrate to converters (mostly in China) for the production of lithium carbonate. Conversion of spodumene to lithium carbonate is mainly accomplished by roasting the concentrate to ~1,100°C, followed by cooling, grinding, and leaching with sulphuric acid. A second roasting at about 250°C produces a lithium sulphate which, with the addition of lime and soda ash, produces lithium carbonate. The cost of converting spodumene to lithium carbonate is generally higher than extraction from brine and estimated to be in the \$6,000–\$8,000/t Li_2CO_3 range. However, processes involving ion exchange are becoming competitive to brines. However, when producing lithium hydroxide, spodumene has the cost advantage.

What to Produce: The two main lithium products for the production of lithium-ion batteries are lithium carbonate and lithium hydroxide. Lithium carbonate is mostly produced from concentrated lithium chloride brines in Chile and in Argentina, but it is also produced from lithium spodumene concentrate conversion, mostly in China. Lithium carbonate's main use is in rechargeable batteries, where is used as a cathode material. Lithium carbonate is also used as raw material in the production of other lithium derivatives, lithium hydroxide being the most important. Lithium hydroxide is produced from lithium carbonate in Chile and in the US, and it is also produced from lithium concentrate solutions in China. Lithium hydroxide is becoming more popular than lithium carbonate, at least in terms of manufacturing electric vehicle batteries. While lithium hydroxide is more expensive, it can also be used to produce cathode material more efficiently, and is actually necessary for some types of cathodes, such as nickel–cobalt-aluminum oxide (NCA) and (high nickel) nickel-manganese-cobalt oxide (NMC). Lithium carbonate is easily converted to lithium hydroxide so maintains an important place in the lithium-ion battery supply chain.

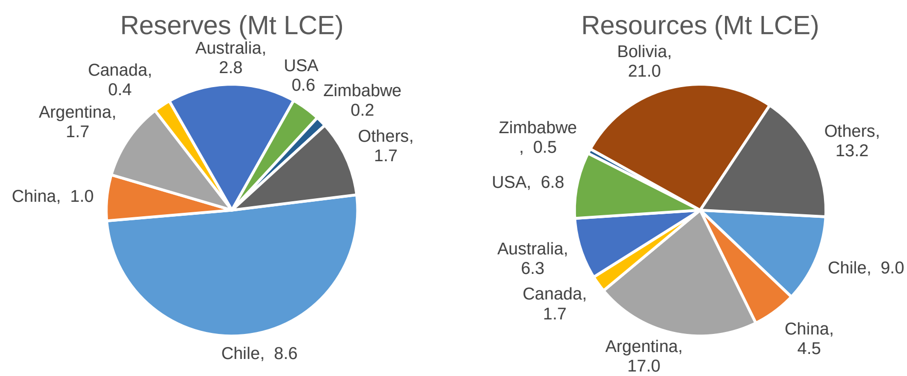
Exhibit 37. Lithium Cost Curve



Source: Roskill

Lithium Project Pipeline: Global lithium reserve estimates by the United States Geological Survey (USGS) are 17 MMt Li metal (90 MMt LCE) with resources in excess of 80 MMt (426 MMt LCE). Even at current growth rates, these reserves could sustain 100+ years of production so there is clearly no shortage of the metal. This is up from 13 MMt (69 MMt LCE) of reserves and 33 MMt (175 MMt LCE) in 2010, reflecting the success of ongoing exploration efforts. So while finding lithium does not appear to be an issue, accessibility, extraction and timely production are, which should support volatile and elevated lithium prices over the medium term and longer term.

Exhibit 38. Global Lithium Reserves & Resources



Source: USGS - 2019

Roskill sees the scheduled pipeline capacity as sufficient to meet demand growth but COVID and other potential shocks could impact development timelines, financing and commissioning of new lithium projects. This is true for established producers and new entrants alike. As such, lithium supply should remain tight going forward. Currently, the largest lithium chemical producer is Tianqi Lithium

Industries (China) that owns spodumene deposits in China and half of the Greenbushes spodumene deposit in Western Australia with partner Albemarle (ALB-NYSE, Not Covered), the third largest producer. SQM (SQM-NYSE, Not Covered) is the second largest producer of lithium, all from brines from its Salara de Atacama in Chile.

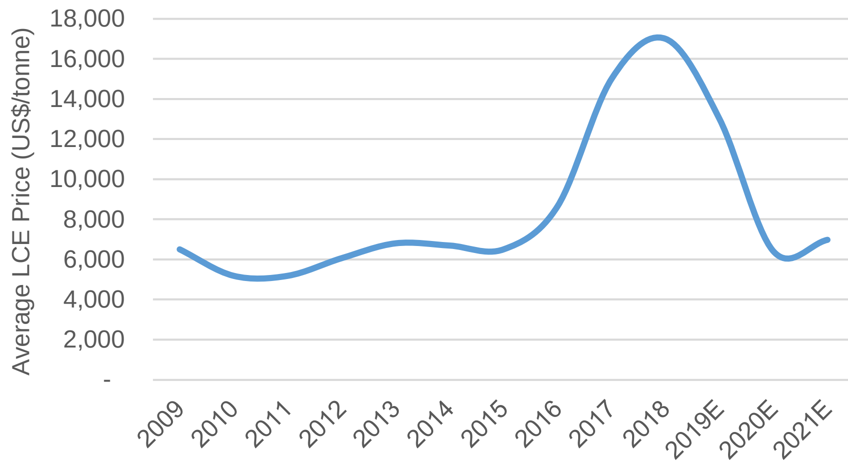
Lithium Prices: Lithium chemicals prices are largely set by contract negotiation between producers and customers (either end users or chemical brokers) but shorter-term contracts or buying on spot is becoming more common due to recent price volatility. Spot prices are also a good guide into the oversupply/undersupply status of the market. In 2015, after a decade of relatively stable prices in the $5,000-$6,000/t range for lithium carbonate, prices for lithium hydroxide started to rise quickly due to increased uptake of electric vehicles, anticipated growth, and uncertainty about future supply. In 2018 prices peaked at around $19,000/t for lithium carbonate and $22,000/t for lithium hydroxide and $900/t for battery grade spodumene concentrate. This allowed new projects to be financed and a rapid increase in mine output from Australia and product output in China which led to an oversupply situation and softening of prices. As a result, spot lithium carbonate prices slid significantly since May 2018 but have recently come off bottoms of ~$6,500/tonne. Lithium stockpiles have remained high as the COVID-19 crisis has impacted downstream users, battery makers and car manufacturers as well. While major producers note unclear pricing visibility in the near-term, expectations of increases in demand over the longer-term remains intact. With this report we have adjusted near-term lithium carbonate price forecast and increased our long-term lithium carbonate price to $12,000/t, up from $10,000/t.

Exhibit 39. Cantor Lithium Price Forecast Update

Li Price ($/t)	2021	2022	2023	Long-term
Previous	$8,000	$9,500	$10,000	$10,000
Revised	$7,500	$9,000	$10,000	$12,000

Source: Cantor Fitzgerald

Exhibit 40. Lithium Carbonate spot prices



Source: Fastmarkets.com, Cantor Fitzgerald

IMPACT TO METALS: SILVER

The Silver Market: Silver is an ideal metal for an electricity-based economy given that it has the highest electrical conductivity of all metals, allowing for low energy losses from friction. Copper is more commonly used for electrical wiring due to its substantially lower cost, though for cases where conductivity takes precedent over price, silver is the preferred alternative such as in most small electronics and PV cells. Industrial applications including PV typically accounts for 40-50% of the silver market, while the remaining demand comes from jewelry, silverware, and bar and coin investment. Silver has properties of both a precious metal (comparable to gold, platinum, etc.) and a base/industrial metal given the approximate 50/50 mix between "investment" demand and industrial usage demand. According to CRU research, while silver industrial demand for photovoltaics (approximately 100 MMoz of the ~1 BBoz silver market) is likely to decrease over the coming years despite increased adoption, this will more than be counterbalanced by the increased silver demand required for the build-out of Electric Vehicles globally. Silver usage related to EVs currently accounts for ~50 MMoz of global demand and is expected to increase to ~70 MMoz/yr by 2030 as EV powertrains require anywhere been 50-450% more silver than their standard ICE counterparts. On a combined basis (PVs and EVs) industrial silver demand related to "green energy" is expected to modestly decline over the 2021-2023 period, stabilize in 2023-2024, before consistently increasing 4-5% year-over-year through 2030+. While silver is a critical element in the development of green technologies, based on current projections, the increase in silver demand requirements for a green economy is immaterial relative to the size of total annual silver supply. This assumes relative stability in silver production over the medium term, which is typical as the vast majority of silver is mined as a by-product of base metals operations (there are no large primary silver mines that drive annual supply). As such, we view the impact on green technology adoption as minimal on the silver market and silver price. Despite the transition to a green economy and increased silver usage in PVs and EVs, the single most significant driver of silver prices will continue to be investment demand, which typically fluctuates between 175-225 MMoz per year of the ~1.0 BBoz silver market. Investment demand in silver is driven by its monetary properties (macro factors related to interest rates, currency debasement, inflation protection, and geopolitical uncertainty), rather than its industrial properties related to electrification, EVs and PVs. Our long-term metal price deck for silver is unchanged at $21.50/oz Ag.

Exhibit 41. Silver Demand vs. Supply (Cantor estimate)

(MMoz Ag)	2019A	2020E	2021E	2022E	2023E	2024E	2025E
Supply							
Mine Production	836.5	797.8	850.0	850.0	850.0	850.0	850.0
Recycling	169.9	169.4	170.0	170.0	170.0	170.0	170.0
Net Hedging Supply	15.7	10.0					
Net Official Sector Sales	1.0	1.0					
Total Supply	**1,023.1**	**978.1**	**1,020.0**	**1,020.0**	**1,020.0**	**1,020.0**	**1,020.0**
Demand							
Industrial	510.9	475.4	477.0	479.0	481.0	483.0	490.0
incl. photovoltaics	*98.7*	*96.1*	*95.0*	*90.0*	*85.0*	*80.0*	*80.0*
automotive incl. EVs	*48.0*	*50.0*	*52.0*	*54.0*	*56.0*	*58.0*	*60.0*
industrial (base)	364.2	329.3	330.0	335.0	340.0	345.0	350.0
Photography	33.7	30.5	30.0	30.0	30.0	30.0	30.0
Jewelry	201.3	187.5	190.0	190.0	190.0	190.0	190.0
Silverware	59.8	54.3	55.0	55.0	55.0	55.0	55.0
Net Physical Investment	186.1	215.8	225.0	225.0	225.0	225.0	225.0
Net Hedging Demand							
Total Demand	**991.8**	**963.5**	**977**	**979**	**981**	**983**	**990**
Market Balance	31.3	14.7	43.0	41.0	39.0	37.0	30.0
Net Investment in ETFs	81.7	120.0					
Market Balance incl ETFs	**-50.4**	**-105.3**	**43.0**	**41.0**	**39.0**	**37.0**	**30.0**

Source: Silver Institute, Cantor Fitzgerald

Exhibit 42. Silver Price

Source: Cantor Fitzgerald

IMPACT TO METALS: URANIUM

To power the world's existing fleet of nuclear reactors, approximately 180 MMlbs of mined uranium oxide (U_3O_8) equivalent is consumed every year. Over the last several years, primary uranium mine supply has been decreasing (or at best stagnating) and currently approximates ~120 MMlbs U_3O_8 per year. Secondary sources including recycling, inventory draw down, and underfeeding have been making up for the ~60 MMlbs annual deficit in primary mine supply, but various industry sources are reporting that this secondary supply is approaching exhaustion. This is reportedly due to several factors:

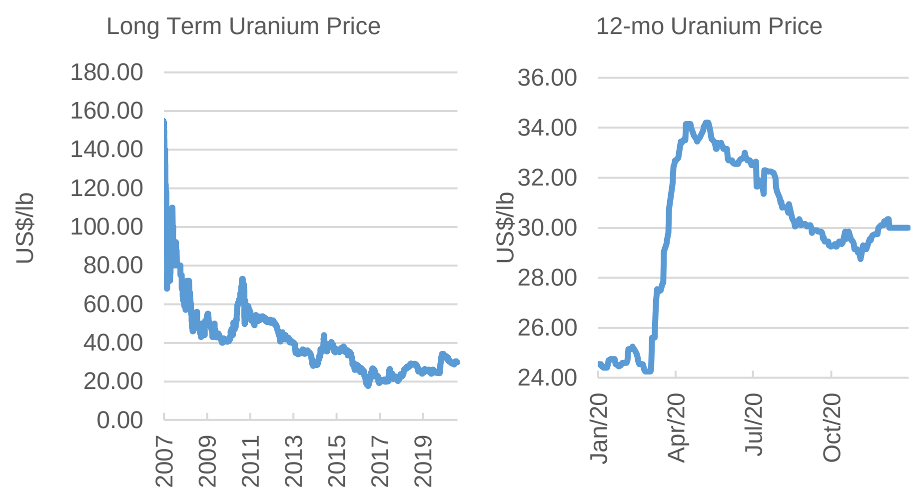
1) Higher SWU (separative work unit) prices relative to U_3O_8 prices over the last 12-24 months has reduced underfeeding by the enrichers from approximately 22-25 MMlbs U_3O_8e per year to less than 10 MMlbs U_3O_8e per year.
2) Global inventories with the utilities are reportedly sitting at approximately ~2.5 years, and no new significant long-term supply agreements have been signed in several years. Utilities have been reluctant to sign new long-term contracts (at higher prices to incentivize production) and have instead been drawing down on their inventories and making supplemental purchases from intermediaries via "carry trade." Over the recent months, spot market volumes have dried up considerably, effectively eliminating the "carry trade" whereby intermediaries had been purchasing spot material on margin and locking in deliveries to utilities at slightly higher prices over the medium term (1-3 years out). Typically, utilities will maintain inventories of no less than ~2 years, and as such, we expect to see either spot market buying or long-term contracting increase (and potentially both) by mid-2021. Either would have positive impact to uranium prices both spot and term.

While secondary uranium supply appears to be nearing exhaustion, the primary uranium supply outlook at current spot and term pricing is downright abysmal. Two of the world's largest and lowest-cost uranium mines, Cameco's (CCJ-NYSE/CCO-TSX, Hold - $13.50/C$17.50 target) Cigar Lake and McArthur River are currently on standby, and unable to operate profitably in the current spot market environment and absent higher-priced long-term contracts. While Cigar Lake is currently shut-down due to a COVID outbreak at the mine, the reality is that it is cheaper for Cameco to purchase material in the spot market (which it is currently doing) and deliver into its existing term contracts, than it is to operate either Cigar Lake or McArthur River and deplete its Proven & Probable reserves at a loss. With both operations currently down, a combined 43 MMlbs U_3O_8 of primary uranium production has been removed from the market. In our view, this is unlikely to come back unless incentive pricing of +$50/lb U_3O_8 can be secured (relative to current spot prices of $30/lb U_3O_8). With primary uranium supply being shuttered, and secondary uranium supply nearing exhaustion, the uranium market is poised to swing into a significant deficit in the coming 18-months (Cantor estimate) after 10+ year period of oversupply.

The bleak primary and secondary supply outlook for uranium stands diametrically opposed to the exceptionally strong demand outlook, driven by China, with plans to reach total installed nuclear power production capacity of 400-500 GW (equating to +225 MMlbs U_3O_8/year) by 2050, up from 2020 levels of ~52 GW (equating to ~32 MMlbs U_3O_8/year) currently in operation. As the most concentrated and highest density form of zero-carbon emission power technologically and commercially available in the world today, nuclear power has a clear role to play in the energy mix of the green economy of the future. We note that sentiment toward nuclear in the United States is "mixed but improving" and in general, the Biden administration appears to be favorable toward nuclear power remaining a mainstay of U.S. electrical baseload power generation, in its current capacity of ~80 GW per annum. While the current global supply-demand macro environment for uranium is in balance over the short-term, over the medium and longer-term (+18 months), we expect a significant supply-demand deficit to manifest itself, and expand considerably in the years that follow, particularly as nuclear power continues to solidify itself as a key component of carbon-free baseload power generation globally.

Our near-term uranium price forecast remains at $35/lb U_3O_8, and we continue to maintain that over the longer-term the +$50/lb U_3O_8 pricing level is necessary to incentivize production restarts and the construction of new uranium mines to meet the coming demand.

Exhibit 43. Uranium Price



Source: Cantor Fitzgerald

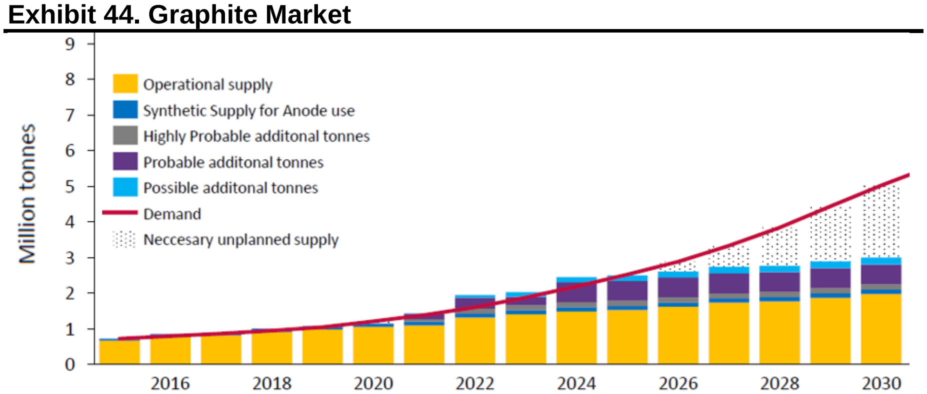
IMPACT TO METALS: RARE EARTH ELEMENTS

Regarding wind energy generation, potentially the most significant bottleneck or "threat" to its continued expansion in the global energy mix relates to several rare earth elements (REEs) in particular, neodymium and praseodymium. Conventional wind turbine technology uses a gearbox that connects the blades to the power generator, but these are slowly being phased out in favor of "Direct Drive" turbines that do not use a gearbox, and are therefore lighter, more reliable, cheaper to maintain, and provide better yield (less power loss). Direct drive turbines require permanent magnets of which REEs, specifically neodymium and praseodymium (NdPr), are a critical component with no substitutes. The permanent magnets contained in a standard 3 MW direct drive wind turbine contains 2 tonnes of REEs, and the wind turbine market is expected to account for ~30% of total REE demand over the next five years. Permanent magnets are also a key component to the traction motors / drive trains contained in the vast majority of EVs with 1-2 kg of REE per vehicle. Given the projected adoption rates as previously outlined in this report, EVs are expected to account for ~7% of total REE demand over the next five years, growing exponentially thereafter when adoption really begins to accelerate. Note that neodymium and praseodymium (NdPr), the critical metals required in permanent magnets, are a subset of total REE. EVs therefore, will be the most significant factor behind NdPr demand over the longer-term (2025+), ultimately overtaking the NdPr requirements from the wind turbine market, and driving total REE demand globally. To put the global supply/demand in context, Total Rare Earth Oxide (TREO) demand globally, of which NdPr is a subset, totaled 156.5 kt in 2017, 208.3 kt in 2019, and is estimated at 225.1 kt in 2020, equating to a CAGR of 12.9%. Incorporating the most recent projections for baseload REE consumption, and demand from wind turbines and EVs, total global REE demand is forecasted to reach 304.7 kt TREO by 2025, equating to a CAGR of 6.2%. On the supply side, 210 kt TREO was produced in 2019, a market that is thoroughly dominated by China (~85% of REE supply) and therefore potentially a supply risk to North American and European markets.

IMPACT TO METALS: GRAPHITE

Graphite is a natural form of carbon characterized by its hexagonal crystalline structure. Major producers of natural graphite include China (70%), North Korea (10%), and Brazil (8%). Uses can broadly be divided into three main categories; 1) Metallurgical (~40%) including refractories, crucibles, moulds and castings, high temperature lubricants and in alloys; 2) Electrical (~25%) mostly in alkaline, Li-ion and lithium batteries, fuel cells and for electrical contacts and 3) Technical (25%) such as brake linings/pads, polymers, fireproof products, thermal management applications and catalysts. Although there are ~200 graphite applications, the one with the most significant and enduring future demand is lithium-ion batteries. Graphite is currently the preferred anode material for lithium-ion batteries for its low electrode potential, high cycle efficiency, long cycle life, and good safety performance. While this market can be satisfied by synthetic graphite (made through the heating of a petroleum coke to between 2,500-3,000 ºC to create almost perfectly shaped graphite crystals) this method is expensive and energy intensive. Processing of pure, large flake natural graphite can produce battery-grade material at a fraction of the cost. Future graphite demand is driven primarily by the expanding lithium-ion battery markets (transportation and stationary battery markets) and due to the cost and performance efficiencies, many battery manufacturers are transitioning to natural graphite.

Exhibit 44. Graphite Market



Source: Benchmark Minerals

CANTOR'S PREFERRED GREEN ECONOMY NAMES

Lithium: Exposure to lithium can be had through incumbent producers such as Livent (LTHM-NYSE, Not Covered), Albemarle (ALB-NYSE, Not Covered), SQM (SQM-NYSE, Not Covered) and Orocobre (ORE-ASX, Not Covered), but we see better upside potential in the advanced developers including:

- **Millennial Lithium (ML-TSX, Restricted):** We are currently under Research Restriction on Millennial Lithium following the company's most recent equity financing in which Cantor participated as co-lead underwriter. See last note here.

Nickel and Cobalt: Exposure to rising nickel and cobalt can be had through incumbent diversified producers such as Vale (VALE-NYSE, Not Covered), Glencore (GLEN-NYSE, Not Covered), First Quantum (FM-NYSE, Not Covered), BHP and Rio Tinto (RIO-NYSE, Not Covered), but we see better upside potential in the advanced developers including:

- **Horizonte Minerals (HZM-TSX/LON, BUY, C$0.40/£0.23 per share target):** Horizonte offers good value to investors looking for exposure to the growing nickel market. The Company has two top tier nickel projects located in the Carajás Mining District in Pará State, north east Brazil. Project financing is underway for the lower-risk Araguaia project which will produce ferronickel for the stainless-steel industry while work continues to develop the Vermelho project into a producer of nickel and cobalt sulphate for the battery and EV markets. Both projects show robust valuations even at low nickel prices. See last note here.

Copper: Exposure to rising copper prices can be had through incumbent producers such as First Quantum, BHP, Rio Tinto, and Freeport (FCX-NYSE, Not Covered) but we see better upside potential in the advanced developers and smaller-tier producers including:

- **SolGold Plc. (SOLG-TSX/LON, BUY rating, ↑C$1.10/£0.60 per share target):** SolGold is a leading exploration company focussed on the discovery of new, world-class copper-gold deposits. Its world class Alpala copper-gold project hosts 10.9 MMt of copper and 23.2 MMoz of gold that will produce 456 MMlbs of copper and 438 koz of gold annually driving an $NPV_{8\%}$ of $4.3BB and an IRR of 25.9%. SolGold continues to leverage its top exploration team and 3,200 km^2 land position in Ecuador with new discoveries increasing the attractiveness of the Cascabel project. SOLG has attracted strategic interests from Newcrest Mining (NCM-ASX, Not Covered, 13.72%), BHP Billiton (13.79%) and Franco-Nevada (FNV-NYSE, Not Covered, 1.0-1.5% NSR). With this report and our revised copper price deck, based on an unchanged target multiple of 0.45x NAVPS we are maintaining our Buy rating on SolGold Plc and increasing our target price to C$1.10/£0.60 per share from C$1.00/£0.60 per share previously. See last note here.
- **Trilogy Metals (TMQ-NYSE/TSX, BUY rating, ↑$3.50/C$4.75 target):** Trilogy Metals and its partner South32 (S32-ASX, Not Covered) are advancing the Arctic Cu-Pb-Zn-Au-Ag project in northwest Alaska towards a construction decision while expanding the resource at the nearby Bornite Cu-Co project. Arctic is one of the highest-grade open-pit copper projects globally and has the backing of State and Federal

officials in addition to NANA, its Alaskan Regional Native Corporation partner. Bornite is one of the largest cobalt deposits in the United States and, while earlier stage in development, will likely prove to be strategically important as the adoption of EVs accelerates. The 50/50 JV company (Trilogy-South32) is well capitalized with $145 MM in cash and no debt. With this report and our revised copper price deck, based on an unchanged target multiple of 1.0x NAVPS we are maintaining our Buy rating on Trilogy Metals and increasing our target price to $3.50/C$4.75/share from $3.25/C$4.50/share previously. See last note here.

- **Taseko Mines (TGB-NYSE, TKO-TSX, ↑BUY rating, ↑$2.00/C$2.50 target):** Taseko has both operating and financial leverage and provides investors liquidity and exposure to the copper price. For every 10% move in copper price, 2021E CFPS is impacted by 40% and similarly, for every 10% adjustment to our long-term copper price deck, NAVPS is impacted by 44%. This sensitivity to copper price is higher than any of Taseko's peers. The Company is a well-established mid-tier copper miner producing ~130 MMlbs Cu/year at its 75%-owned Gibraltar open-pit mine in British Columbia, Canada. The Company is also in the final stages of permitting the in-situ recovery (ISR) Florence copper project located in Arizona, which would be one the most environmentally benign copper projects globally (no tailings or waste rock impoundments, very small surface footprint, etc.) With this report and our revised copper price deck, based on an unchanged blended target multiple of 1.0x NAVPS, 3.0x 2021E CFPS, and option value on its earlier-stage projects, we are increasing our target price on Taseko Mines to $2.00/C$2.50/share from $1.35/C$1.75/share previously. We are also upgrading our rating on the Company from Speculative Buy to Buy. See last note here.
- **Seabridge Gold (SA-NYSE, SEA-TSX, BUY rating, ↑$32.50/C$42.50 target):** While Seabridge's 100%-owned KSM project in British Columbia, Canada is more heavily weighted to gold, particularly given the recent accretive Snowfield acquisition, the multiple porphyry deposits on the property also contain massive amounts of copper mineralization. On a consolidated basis (open-pit + underground block cave) the KSM+Snowfield project contains combined resources (Measured & Indicated + Inferred) of 9.8 BBt grading 0.45g/t Au and 0.23% Cu, for total contained metal of 142 MMoz Au and 50.5 BBlbs Cu. At Seabridge's proposed mining rate of 170,000 tpd, the project would produce +1 MMoz Au/year with by-product copper production averaging +180 MMlbs/year from open-pit operations only. With this report and our revised copper price deck, based on an unchanged target multiple of 1.0x $NAVPS_{7.5\%}$, we are increasing our target price on Seabridge to $32.50/C$42.50 from $31.00/C$40.00/share previously. We are maintaining our Buy rating. See last note here.

Silver:

- **Avino Silver & Gold (ASM-NYSE/TSX, BUY rating, $1.60/C$2.00 target):** Avino Silver & Gold Mines Ltd. is primarily a silver and gold producer operating the Avino Mine and Mill located in Durango, Mexico. However, copper is also a significant by-product credit.

Increased development and optimization at the Avino mine should see throughput increase while exploration is focused on near-mine targets with good potential for new discoveries and resource replacement that will allow increased haulage and throughput from the mine and should push production to 3.0MMoz AgEq annually. See last note here.

- **Bear Creek Mining (BCM-TSX, BUY rating, C$5.20 target):** Avino Bear Creek Mining Corp. is a mine development company advancing its 100%-owned Corani silver-lead-zinc project in Peru towards production. The Corani project is fully permitted and has a 2019 Feasibility Study that boasts robust economics with a strong production profile over a long life of mine. The Corani open pit project boasts a 443 MMoz AgEq reserve base that supports the production of ~18 MMoz of silver equivalent annually over a +15-year life of mine. See last note here.
- **Alexco Resource (AXU-NYSE/TSX, Restricted):** We are currently under Research Restriction on Alexco Resource following the company's most recent equity financing in which Cantor participated as co-lead underwriter. See last note here.

Uranium: Exposure to rising uranium prices can be had through incumbent producers such as Cameco, and the physically backed uranium ETFs, namely Uranium Participation Corp (U-TSX, BUY rating, C$5.50 target) and Yellow Cake PLC (YCA-LN, Buy rating, £3.00 target). For greater leverage and torque, as well as exposure to near-term company-specific catalysts, we favor several advanced developers and smaller-tier producers including:

- **Ur-Energy (URG-NYSE, URE-TSX, BUY rating, $1.00/C$1.25 target):** Ur-Energy is the lowest cost uranium producer in the United States and is best positioned to ramp-up production the fastest. As such, we believe Ur-Energy is best positioned to capitalize on the recently announced $75 MM budget allocated for the U.S. government to make direct purchases of U.S. origin uranium. We believe Ur-Energy securing a long-term government supply contract is potentially a Q1/20 event and would be a significant de-risking catalyst for the Company. We recommend investors have exposure to Ur-Energy ahead of this potential catalyst. We expect the Company's Lost Creek ISR operation could be ramped back up to ~1 MMlbs U_3O_8/year for re-start CAPEX of $15-20 MM including working capital. See last note here.
- **Denison Mines (DNN-NYSE, DML-TSX, BUY rating, $1.05/C$1.35 target):** Denison Mines is a uranium exploration and development company focused on the Athabasca Basin in Northern Saskatchewan, Canada. Its 90%-owned Wheeler River project is one of the highest-grade uranium projects globally and will be in the lowest decile of the cost curve once production is achieved, likely in the 2025+ time frame. Moreover, both the Phoenix component of Wheeler River, and Denison's 66.9%-owned Waterbury Lake project will be developed as in-situ recovery (ISR) operations which is the most environmentally benign mining method currently employed anywhere in the world. ISR requires no blasting, waste rock removal, crushing, or grinding and generates no tailings. Denison has a project portfolio capable of supporting a Phase 1 production rate of 6 MMlbs U_3O_8/year and ultimately ramping-up to + 15 MMlbs U_3O_8/year. See last note here.

Rare Earth Elements: Given the comparatively small size of the REE market, there are only a handful of large-cap publicly traded companies for investors to consider in the sector. These include MP Materials (MP-NYSE, Not Covered) operating the Mountain Pass mine in California and Lynas Corp (LYC-ASX, Not Covered) operating the Mt Weld mine in Western Australia. For additional beta/torque, we favor an emerging American REE producer and established uranium miner:

- **Energy Fuels (UUUU-NYSE, EFR-TSX, BUY rating, $4.75/C$6.00 target):** Energy Fuels is currently producing REE concentrate at a small-scale via its 100%-owned White Mesa processing facility in Utah, and is actively looking to expand this business via securing a greater supply of monazite sands (15 kt/year). This would drive Total Rare Earth Oxide (TREO) production of ~6.4 MMkg per year, or approximately 50% of U.S. demand. The Company is also exploring low-cost options to potentially separate the REE concentrate on-site, which would make Energy Fuels the first and only company in the United States to do so. In addition to its emerging REE business, Energy Fuels is also the largest uranium producer in the United States and has the largest stockpile of domestic origin material (~675 klbs U_3O_8) that could be immediately sold to the U.S. government as the first material seeding the strategic reserve. This potentially a Q1/20 event and would significantly improve Energy Fuels' balance sheet. See last note here.

Exhibit 45. Green Metals Coverage Universe

Copper	Ticker	Market Cap (MM$)	Rating	Target	Upside
SolGold	SOLG-TSX	$941	Buy	C$1.10 ↑	96%
Trilogy Metals	TMQ-NYSE	$287	Buy	$3.50 ↑	64%
Taseko Mines	TGB-NYSE	$371	Buy ↑	$2.00 ↑	55%
Seabridge Gold	SA-NYSE	$1,500	Buy	$32.50 ↑	63%
Nickel/Cobalt	**Ticker**	**Market Cap (MM$)**	**Rating**	**Target**	**Upside**
Horizonte Minerals	HZM-TSX	$184	Buy	C$0.40	142%
Lithium	**Ticker**	**Market Cap (MM$)**	**Rating**	**Target**	**Upside**
Millennial Lithium	ML-TSX	$302		Restricted	
Silver	**Ticker**	**Market Cap (MM$)**	**Rating**	**Target**	**Upside**
Avino Silver & Gold	AVM-NYSE	$108	Buy	$1.80	54%
Bear Creek Mining	BCM-TSXv	$239	Buy	C$5.20	102%
Alexco Resource	AXU-NYSE	$373		Restricted	
Hecla Mining	HL-NYSE	$2,915	Buy	$7.25	35%
Coeur Mining	CDE-NYSE	$2,125	Buy	$11.50	34%
Excellon Resources	EXN-NYSE	$88	Buy	$5.00	84%
Uranium/REE	**Ticker**	**Market Cap (MM$)**	**Rating**	**Target**	**Upside**
Cameco	CCJ-NYSE	$4,912	Hold	$13.50	9%
Energy Fuels	UUUU-NYSE	$517	Buy	$4.75	21%
Ur-Energy	URG-NYSE	$162	Buy	$1.00	7%
Denison Mines	DNN-NYSE	$490	Buy	$1.05	50%
Uranium Participation	U-TSX	$462	Buy	C$5.50	28%
Yellow Cake	YCA-LN	$261	Buy	£3.00	36%

Source: Cantor Fitzgerald

ADDITIONAL COMPANIES THAT BENEFIT

The large-tier miners and smaller-cap names on our "watch list" best positioned to capitalize on higher commodity prices related to the Green Economy, EV build-out, and transitional energy theme are listed in Exhibit 46-47 below:

Exhibit 46. Green Metals Watchlist Large Cap

Copper	Ticker	Market Cap (MM$)	Other Metal	Rating
BHP	BHP-NYSE	$106,537	Cu,Zn,Pb+	N/A
Rio Tinto	RIO-NYSE	$102,732	Cu,Al+	N/A
Freeport	FCX-NYSE	$43,644	Cu,Au+	N/A
First Quantum	FM-TSX	$12,810	Cu,Ni+	N/A
Lundin Mining	LUN-TSX	$7,128	Cu,Ni+	N/A
Nickel/Cobalt	**Ticker**	**Market Cap (MM$)**	**Other Metal**	**Rating**
Vale	VALE-NYSE	$92,320	Cu,Ni+	N/A
Glencore	GLEN-LSE	$50,569	Cu,Ni, Co+	N/A
Lithium	**Ticker**	**Market Cap (MM$)**	**Other Metal**	**Rating**
Albemarle	ALB-NYSE	$18,780		N/A
SQM	SQM-NYSE	$6,883		N/A
Livent	LTHM-NYSE	$3,157		N/A
Orocobre	ORE-ASX	$1,528		N/A
Rare Earth Elements	**Ticker**	**Market Cap (MM$)**	**Other Metal**	**Rating**
MP Materials	MP-NYSE	$5,279	Nd,Pr	N/A
Lynas	LYC-ASX	$3,422	Nd,Pr	N/A

Source: Cantor Fitzgerald

Exhibit 47. Green Metals Watchlist Small Cap

Copper	Ticker	Market Cap (MM$)	Other Metal	Rating
Sierra Metals	SMTS-NYSE	$597	Zn,Pb,Ag,Au	N/A
Imperial Metals	III-TSX	$473	Zn,Pb,Au	N/A
Polymet	PLM-NYSE	$387	Ni, PGM	N/A
Nevada Copper	NCU-TSX	$218		N/A
Excelsior Mining	MIN-TSX	$209		N/A
Western Copper	WRN-TSX	$167	Au	N/A
Los Andes Copper	LA-TSXv	$132	Au	N/A
Surge Copper	SURG-TSXv	$50	Au	N/A
Highland Copper	HI-TSXv	$24	Au	N/A
Brixton Metals	BBB-TSXv	$32	Au	N/A
Nickel/Cobalt	**Ticker**	**Market Cap (MM$)**	**Other Metal**	**Rating**
Talon Metals	TLO-TSX	$234		N/A
Nova Royalty	NOVR-TSXv	$262	Cu	N/A
Canada Nickel Corp.	CNC-TSXv	$127		N/A
FPX Nickel	FPX-TSXv	$118		N/A
First Cobalt	FCC-TSXv	$102		N/A
Nickel 28	NKL-TSXv	$46		N/A
Giga Metals	GIGA-TSXv	$38		N/A
Lithium	**Ticker**	**Market Cap (MM$)**	**Other Metal**	**Rating**
Lithium Americas	LAC-NYSE	$2,417		N/A
Piedmont Lithium	PLL-NYSE	$689		N/A
Critical Elements Lithium	CRE-TSXv	$174	Ta	N/A
Cypress Development Corp.	CYP-TSXv	$148		N/A
Uranium	**Ticker**	**Market Cap (MM$)**	**Other Metal**	**Rating**
NexGen Energy	NXE-NYSE	$1,071		N/A
UEX Corp.	UEX-TSX	$86	Co	N/A
Other	**Ticker**	**Market Cap (MM$)**	**Metal**	**Rating**
Westwater Resources	WWR-NDAQ	$127	C	N/A
Altius Minerals	ALS-TSX	$521	Cu,Ni,Zn,Pb-	N/A

Source: Cantor Fitzgerald

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