Lithium by the numbers, is there enough to deal with battery-powered electric vehicle demand?

Understanding the looming lithium supply crisis is perhaps the cure for the environmentalists' movement's bipolar approach to the profligate use of critical materials. On the one hand, they want to believe that everyone can have an electric car and on the other hand they refuse to understand the practical and economic limits of natural resource recovery and fabrication for use.

The earth's resources available to us are only those we can afford to recover because we get more value from them than the cost of obtaining them. Up until now the actual use per person of critical technology metals has been small enough so that the extremely high cost of obtaining them and processing them into useful forms can be distributed widely enough across their end-uses in the market to justify and recover that cost.

This distributed cost of critical technology metals has served to make the use cost per manufactured product low enough to enable the mass production and use of miniaturized electronic devices such as mobile phones, personal computers, and entertainment devices accessible almost universally across the contemporary economic classes of mankind.

The rechargeable lithium-ion battery and the miniaturization of electronics, so that on an individual basis they use very little power and very little material, and so can be kept operating for hours, even days, has severed the need for massive devices using large amounts of materials and needing to be wired to a main power distribution hub (a wired home,

fed from the grid, with wall sockets).

Rechargeable batteries themselves underwent a long evolution from the lead-acid behemoths to nickel-iron, nickel-cadmium, nickel metal hydride (rare earth based), to today's lithium-ion chemistry. Each step in the evolution of rechargeable batteries allowed for smaller lower mass devices delivering the same power.

But, with the advent of the battery-powered electric vehicle (BEV) a threshold has been approached. The barrier to the widespread manufacturing and use of BEVs is the need for kilograms, not grams, per BEV, certainly of lithium and probably of copper, nickel, cobalt, and the magnet rare earths, in that order. Moving one or two tons of steel up to 500 km before its power source needs to be refreshed requires an irreducible minimum of scarce raw materials. That "minimum" in the case of lithium is thousands of times more mass than are needed to power a mobile phone for days!

The accessible and economically available resources of those metals simply do not exist on the scale that would be required to convert even the contemporary global internal combustion engine (ICE) transportation fleets of 1.5 billion motor vehicles alone, to BEVs.

The case of lithium is the one I will discuss here because its supply is the necessary prerequisite for a BEV revolution.

There is not enough lithium produced today to convert more than a tiny fraction of the global fossil-fueled internal combustion engine fleet of cars, trucks, railroad engines, boats and ships, aircraft, home utilities (generators), and industrial equipment (earth movers, trains, lift-trucks, etc) to rechargeable battery electric power. In addition, the other existing uses of rechargeable lithium-ion batteries for personal electronics, such as mobile phones, personal computers, digital cameras, play stations, and other toys need

a significant fraction of global lithium production, and the use of lithium-ion batteries for stationary storage also needs a growing fraction of global production.

So, how much lithium is there actually for BEV manufacturing now and in the future, and just where, geographically, can and will that manufacture take place?

The electronic properties of lithium require that it takes 160g of lithium, measured as metal, to have one kilowatt hour of storage. Therefore a 100-kWh lithium-ion battery needs 16 kg of lithium. This is the irreducible minimum amount of lithium required to move two tons of steel on low friction tires at 60 kph for 500 km.

Global production of lithium in 2020 was 86,000 tons, or 86,000,000 kg, measured as metal.

If ALL the lithium produced in 2020 had been used to make 100 kWh batteries for BEVs then a total of 5.375 million such vehicles could have been (**but were not**) built.

But, according to the USGS, the use of lithium for batteries in 2020 was just 65% of global production.

So, only 56,000,000 kg were turned into batteries, so if this were entirely devoted to 100 kWh units for vehicles then 3.5 million could have been built.

Global production of vehicles in 2020 was 78,000,000 units, but the average of the three previous years was 95,000,000, so 2020 was an anomaly due to Covid.

One more thing: What percentage of global lithium for batteries is available outside of China? The answer is 40%. China today processes 60% of global lithium into battery and other use grades and produces 82% of the Li-ion batteries manufactured.

Therefore, the world is today totally dependent upon Chinese

owned or based manufacturers for its supply of lithium chemicals used in batteries and for lithium-ion batteries of all types for all uses!

It is predicted that China will produce only 50% of lithium-ion batteries for BEVs by the end of the decade, but predictions as to the percentage of lithium processing that will be done in China are less optimistic.

Today’s lithium producers say that they can double annual lithium production by 2025 to, perhaps, 200,000 tpa, measured as lithium. I’m going to predict that lithium used for vehicle batteries will reach 75% of that total by 2025. But China will still process 60% of all the lithium for batteries, so that if all of the Chinese lithium industry’s output were devoted to BEVs then the 120,000,000 kg of Lithium produced could be used to make 7.5 million vehicles leaving the rest of the world with just enough lithium for about 2 million BEVs.

The Chinese have mandated that 20% of their new vehicle production in 2025 be BEVs. This would be about 5 million BEVs. Thus the rest of the world will be left with just enough lithium to make 4.5 million BEVs. This means that Chinese BEVs as a proportion of total OEM automotive production will be 20% while the rest of the world will have an aggregate 7% proportion. I predict that the European and Japanese automakers will produce the lion’s share of non-Chinese BEVs with most of the American OEM domestic production being that of Tesla.

The nonsensical, really just ignorant, predictions of the financial analysts of skyrocketing production of lithium are not even remotely possible due to the unbearable costs of increasing production from declining grade deposits and the fantasies of large high-grade new deposits being miraculously found and developed. All of this while keeping lithium prices in line, of course.

The financialization of the stock market is now complete. Value has been divorced entirely from momentum.

Until politicians wake up to the fact that they are being played by the financializers investing in lithium and other “battery metals” will be a good idea, since the supply can never meet the (political) demand.

Rare earths, by contrast, will always be a good investment, because personal motor transportation will always use rare earth permanent magnets and to get the best mileage per kWh the lightest traction motors for vehicles will always be the rare earth permanent magnet type.

More on this next week….

Lithium demand is surging but soon supply should catch up

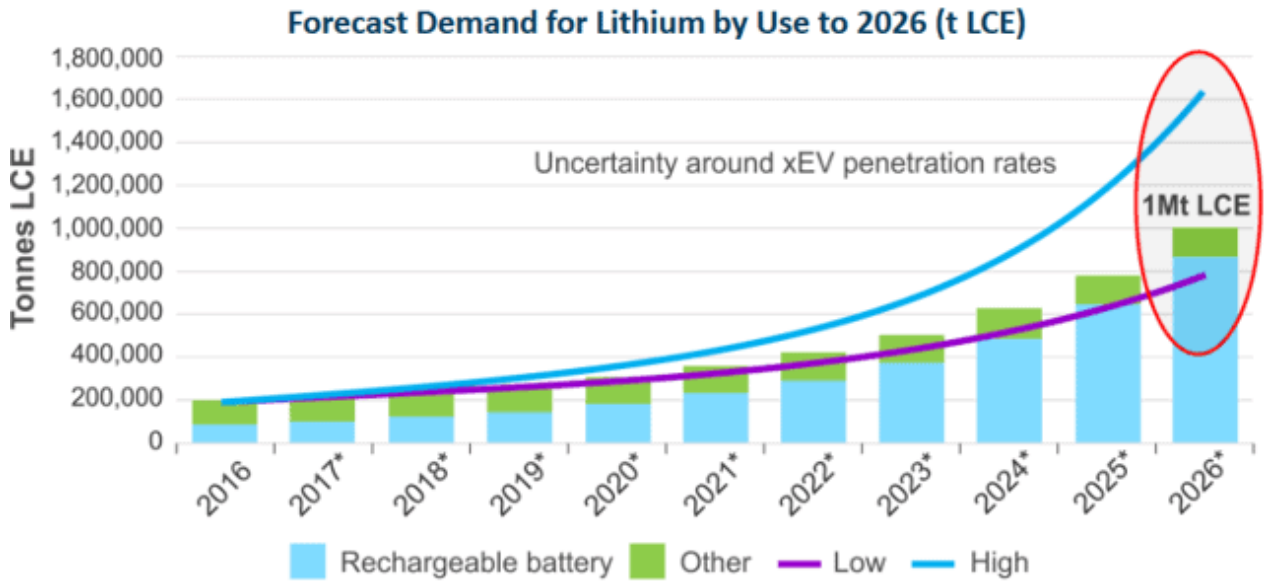
The first wave of the lithium boom has come and gone. This saw tremendous gains for early investors who got in before 2016 and rode the wave all the way through to the end of 2017. Then in 2018 we have had endless negative reports on the sector, many of which seem miss-informed or plain wrong. The underlying theme is that many groups are totally underestimating the speed of change towards electric vehicles, and hence the surging lithium demand.

By way of example many see the EV sector as growing slowly, when in reality global electric car sales grew by 58% last year, and by 59% in Q1 2018. The number of EV models available is set to jump from 155 at the end of 2017 to 289 by 2022. Another sign demand there is the 30 new lithium-ion

gigafactories on the way.

Lithium demand

My lithium demand model based on some reasonable assumptions such as 15% EV penetration by the end of 2025 (China already hit 3.7% in April 2018, and global EV penetration should exceed 2% in 2018), forecasts Lithium Carbonate Equivalent (LCE) from Electric Vehicles (EVs) to reach 1.1mtpa by the end of 2025. By way of a comparison in May last year Roskill tripled their forecast for LCE demand to ~1mtpa by 2026.



"The impact of automotive electrification on lithium: 1TWh and 1Mt LCE in 10 years"

Roskill lithium demand forecast ~1Mt LCE by 2026

The key to understand is that demand is not just from booming electric car sales. There is plenty more demand from other EVs – e-buses, e-trucks, e-ships and e-boats, e-bikes, soon e-planes, the energy storage and electronics sectors.

For now e-buses especially in China have been a huge demand driver for lithium. Soon we will have e-semis and all kinds of electric trucks. Just this last week Daimler announced two new electric trucks for the US market to take on the Tesla semi that was slated for 2019 production. A full size electric

semi-truck will need about 10-16 times more batteries (and hence lithium) than an electric car.

Daimler’s new electric semi truck set to go into production by 2021

Lithium supply

Meanwhile lithium supply at the mining level is responding to the surging demand picture described above. In 2018 we will see four new lithium miners become producers – Tawana Resources NL, AMG Advanced Metallurgical Group, Altura Mining Limited and Pilbara Minerals Limited. This will certainly boost lithium spodumene supply; however most industry experts see a shortage of converting capacity.

In any event the boosted 2018 lithium supply should bring the lithium demand/supply situation back to a more balanced level, and some moderation in lithium prices (especially China lithium spot prices). In 2019 we are likely to see some expansion from existing lithium miners to meet the demand

surge, and by 2020/2021 some new lithium juniors such as Lithium Americas Corp., Bacanora Minerals Ltd. and some others like Nemaska Lithium Inc., A.I.S. Resources Limited, Neo Lithium reach production.

We may also see further consolidation in the sector such as the SQM/Kidman joint venture deal. New lithium processing plants are also on the way, such as the Tianqi/Albemarle Kwinana facility in Western Australia currently under construction. SQM/Kidman also recently announced plans for a new Kwinana lithium processing facility.

In conclusion, EV uptake and lithium demand will be a lot stronger than what many currently think. Due to surging lithium demand the supply response has been very strong. This should mean that new lithium supply should be able to keep up with demand from now to 2020. We may see periods of small over or under-supply, and the LCE contract price range between US$12,000 and US$20,000/tonne. Currently it is at US $16,400/tonne. For investors this will mean the lithium miners that can expand production, and the juniors that can make it to production should still reward investors very well. As we move further into the new EV and energy storage world the lithium miners sector should have an excellent one to two decades ahead.