Lithium Prices Soar as Demand Surges Amid EV Boom, But Is the Bull Run Sustainable?

written by InvestorNews | February 24, 2023

Most commodities are cyclical in nature. The ebb and flow of demand, potentially from a new application or general growth, which in turn makes the supply of that commodity scarce can cause prices to rise, sometimes dramatically. This is followed by a supply response that typically is too effective (because everyone wants to partake in the high commodity price) and eventually, the demand is outstripped by supply, commodity prices in turn fall or outright collapse and the cycle repeats.

In the case of lithium, we've been seeing demand surge as the electric vehicle (EV) revolution accelerates while the ever-increasing supply is failing to keep pace. There are lithium headlines in the news all the time now, with the likes of General Motors Co. (NYSE: GM) and Tesla, Inc. (NASDAQ: TSLA) inking supply deals with producers or the speculation of deals. It would appear we are in the heart of a bull market for lithium….or are we?

Lithium Boom – 1950s

This isn't the first lithium boom the world has seen. You may be surprised to learn that the first one began in the 1950s when the world's primary source of lithium came from North Carolina. Lithium was extracted from spodumene (hard rock) and was a key component of the military's H-bomb program. As a reference point, by the mid-1970s U.S. lithium production was roughly 2,900 tons per year. (1 US ton = 0.97 metric tonne)

Lithium Boom – 1990s

Lithium's next rally occurred in the early 1990s when Sony first began production of the lithium-ion battery used in consumer electronics. By the end of 1991, Sony had ramped up production to 100,000 batteries a month. Enter Sociedad Química y Minera de Chile S.A., or SQM, the Chilean fertilizer and mining company which began selling lithium (from brine) in late 1996, almost immediately lithium carbonate prices fell by a third, to US$2,000 a ton. This marked the end of the existing American lithium industry.

Current Lithium Production By Country (2021)

Rank	Country	2021 Production (tonnes)	% of Total
#1	Australia	55,416	52%
#2	Chile	26,000	25%
#3	China	14,000	13%
#4	Argentina	5,967	6%
#5	Brazil	1,500	1%
#6	Zimbabwe	1,200	1%
#7	Portugal	900	1%
#8	United States	900	1%
	Rest of World	102	0.1%
	Total	**105,984**	**100%**

Source: World Economic Forum

Lithium Boom – Today!

Fast forward to today and in November we saw lithium prices surge above US$80,000/tonne in a sign that supply was definitely not keeping pace with the huge increase in demand sparked by

EVs. You have wildly bullish forecasts suggesting supply needs to grow somewhere between 150,000 to 200,000 tonnes every single year.

For more perspective, consider that Tesla is targeting the manufacture of 20 million EVs per year by 2030. In order to produce those vehicles in a year, Tesla will need more lithium than was produced in the world last year, which could explain why the market was all excited when Bloomberg reported Tesla has been discussing a possible bid for Sigma Lithium Corporation (TSXV: SGML | NASDAQ: SGML).

And speaking of Sigma Lithium, have a look at their 2 year chart!

Source: StockCharts.com

Investors should be very happy with a 10x move in just under 2 years. There have also been some pretty good runs for some of the Canadian hard rock lithium names. A quick look at the one-year chart for Critical Elements Lithium Corporation (TSXV: CRE | OTCQX: CRECF) and Patriot Battery Metals (TSXV: PMET | OTCQX: PMETF) and you'll see a double and another 10 bagger. It suggests that we may not be in the early innings of this game.

When all this starts to become prevalent in the news cycle, I start to get a little concerned. It’s almost like fanatic optimism is a harbinger that the cycle is about to end. I know that isn’t very scientific, but let’s look a little closer at what I’m getting at. Capital solves problems. With the lithium price at current levels, lithium mines are some of the most profitable in the whole mining sector. One could surmise that supply might respond more rapidly than currently forecast with lots of capital being thrown at exploration and development at present. I wouldn’t be surprised if Investment Bankers are cold-calling anyone involved with lithium right now to see if they would like to raise capital. On top of that, when you have the likes of Tesla, GM, etc. buying into producers it tends to stretch valuations beyond anything that would otherwise seem reasonable. M&A, especially by companies not actually in the mining business, can often be considered a sign that we are getting close to a top. Again, not scientific by any stretch of the imagination but it also typically isn’t sustainable behaviour.

Is this a Market Top?

I’m not suggesting lithium is going back to US$2,000/ton but we have seen the price retreat to just over US$60,000/tonne largely due to the Chinese market seeing lower subsidies for electrified vehicles and weak consumer confidence. With that said, lithium is still worth eight times more than it was before 2021 and still wildly profitable for both hard rock and brine producers. Is this a sign that the current bull run for lithium prices is over or just taking a breather before it settles into a new price range or perhaps starts to climb again? I guess it depends on your time frame. Traders may want to look at taking a little profit off the table for now, long term buy and hold investors may not even be paying attention to the day-to-day noise in the

market and be comfortable holding lithium equities for the foreseeable future.

My caution to anyone wildly bullish on lithium prices and the corresponding mining companies is this – there are a lot of smart capitalists out there and if a component becomes the most expensive part of your product, a lot of effort will be spent to try and find a replacement or an alternative. I also have a nagging concern that at some point in time, the rapid adoption of EVs may overwhelm the electric grid and put a hard stop to EV growth (at least temporarily). Either of these scenarios could have a sudden and very negative impact on lithium prices but not likely in the near future. So when it comes to investing in lithium, make sure your risk tolerance matches your investment exposure.

Economy of Scale – A Misused Metric in Mining

written by Jack Lifton | February 24, 2023

I was surprised earlier this week to see an article in the Wall Street Journal in which the rule of "economy of scale" was mistakenly used with regard to the output of a mine to predict that the price of lithium would fall as mine output increased. The author did not seem to understand, and his quoted "experts" didn't seem to care, that mines are not organic, they don't continuously renew their ore bodies, nor are concentrations of hard rock minerals uniform, so that such mines have limited useful lifetimes. The concentrations of the minerals first sought out for extraction are always the highest in the deposit,

so that as the extraction of the ore continues lower and lower grades are encountered until it becomes uneconomical, at the price then realized for the ore, to continue “mining” it. Economic assessments of the value of the mine describe this metric as the “life of the mine.” The enormous cost of setting up a mining and beneficiating (concentrating) operation assumes that it is unlikely that some new and more economical method of beneficiation will be discovered, and be experimented upon and proven effective, during the life of a mine, so that the life of the mine could be extended economically by enabling the economically effective processing of lower grade ores. Mines are designed with “best practices’ at the time of the construction. It is not assumed that new technologies will be discovered during the life of the mine that will extend its life.

Yet, on the 23rd oif January, the following sentence appeared in an article about the future supply and price of lithium: “Increasing production, which typically has the effect of reducing unit costs through economies of scale, will likely be the primary source of growth in the industry this year.”

Mine production decisions will of course be dependent upon the price of the mineral being mined. Gold mines are typically opened and shut down and then reopened, for example, by the price of gold dropping to less than the cost of extracting it and then bouncing back. Note well that gold is often mined in grades of just a few parts per million, because its value is as much as $2,000.00/oz or more than $60/gram.

Lithium, today, is produced from two types of “deposits.” One, is hard rock minerals, the best known of which is spodumene and the largest deposits of which are in Australia. The other is from brines typically found in deserts, which may range in “grade” from the 3000+ grams per ton in the vast brine deposits of Chile to, more typically, 300-1000 grams/ton in the more

typical desert brines of Chile, Argentina, and Bolivia.

Most of the lithium produced today comes from spodumene mining in Australia. The golden triangle of South American nations contribute less than 40% from their brines due to the enormous costs and time required to dry and process the brine to recover the lithium.

One may ask why are brines, in particular the vast ones in Chile, which have uniform concentration not dominant in the production of lithium. The answer, always, is cost including the cost of time. The brines must be evaporated in order to bring the lithium concentration to 20,000 parts per million (2 percent), at which concentration they can be processed to selectively recover the lithium. The Wall Street Journal writer would probably ask why not just increase production to lower costs? The answer here is cost, and the cost involved is that of time. It takes 18 months for the brine to be evaporated in the sun (the amounts necessary are simply too vast, one million tons of water must be evaporated to produce 3,000 tons of lithium in Chile's Atacama Desert, for example, to even consider pumping the brines to fossil fuel heated tanks. Note, by contrast, that the production of one million tons of spodumene can recover 60,000 tons of lithium. But again that is an energy and reagent (sulphuric acid at high pressure and temperature) intensive operation, so it is very costly.

I have been told, privately, by the CEO of a large brine operation that his judgement is that lithium production may double by 2025, but that even holding that level of production, economically, depends entirely on the market price of lithium and the price of energy, so that the very high prices of today, a response to the law of supply and demand caused by the lithium industry's inability to keep up with the surging demand for EV and stationary storage batteries, are, as always, the driver of

supply. Should the price of lithium drop as precipitously as it has risen, or if the cost of energy rises too much, that part of the lithium supply dependent on high prices will close (at least in the capitalist “free market” economies).

Economy of scale does not apply here. It is an inapplicable metric in mining. Miners always want the prices of minerals to rise, not decline!

Jack Lifton on how the lithium shortage makes the EV dream – a nightmare.

written by InvestorNews | February 24, 2023
In this video, Critical Minerals Institute’s (CMI) Co-founder and Chairman Jack Lifton talks about the growing lithium demand from the electric vehicle industry. Discussing the current state of domestic American lithium supply, Jack explains why the target outlined by President Biden of 50% electric vehicle sales share in 2030 with 100% domestic content is impossible to achieve.

Speaking on the United States’ Inflation Reduction Act, Jack discusses how the automotive industry has failed to accept the problem of an adequate domestic American lithium supply chain. He goes on to say, “If it is not even possible to buy enough lithium to make enough batteries in the United States for half of our own production, what about the rest of the non-Chinese world?”

To access the full episode, click here

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About The Critical Minerals Institute

The Critical Mineral Institute (CMI) is an international organization for companies and professionals focused on battery materials, technology metals, defense metals, ESG technologies and practices, the general EV market, and the use of critical minerals for energy and alternative energy production. Offering an online site that features job opportunities that range from consulting roles to Advisory Board positions, the CMI offers a wide range of B2B service solutions. Also offering online and in-person events, the CMI is designed for education, collaboration, and to provide professional opportunities to meet the critical minerals supply chain challenges.

Can Standard Lithium’s DLE technology be the miracle that helps solve the forecast lithium deficits ahead?

written by Tracy Weslosky | February 24, 2023

The widely forecast lithium deficits this decade and next will need a miracle to solve the problem. Enter ‘Direct Lithium Extraction’ or DLE for short.

DLE is a promising new set of technologies designed to extract lithium from projects that are considered unconventional or have lower lithium concentrations. There are several types of DLE such as lithium bonding (adsorption), ion exchange, and solvent extraction.

Today we look at the latest progress of arguably USA's leading DLE company, Standard Lithium Ltd.

Standard Lithium Ltd. (TSXV: SLI | NYSE American: SLI) is a lithium development company using Direct Lithium Extraction ("DLE") at their projects in the USA. The lithium extraction projects are:

- Southern Arkansas Projects (flagship) – LANXESS JV Project and the SOUTH–WEST ARKANSAS Project.
- Mojave Project – Located at the Bristol Dry Lake in the Mojave Dessert, California.

Standard Lithium uses their propriety 'LiSTR' DLE process and typically partners with existing projects where they already have a brine product, such as at the LANXESS Project (where Lanxess already produces bromine from brine, but not lithium). Standard Lithium simply 'bolts' on their DLE technology to extract the lithium and achieve a high purity lithium chloride solution that can then be converted into battery grade lithium carbonate or hydroxide.

Standard Lithium state that they have the "most advanced direct lithium extraction technology – industrial scale pre–commercial demonstration plant in installed at the project. Over 5,000 hours of operation."

Standard Lithium 'LiSTR' DLE technology can be used to bolt onto existing bromine or brine operations to extract the unused lithium

Source: Standard Lithium company presentation

As announced on September 7, 2022 Standard Lithium is now proceeding with a Front End Engineering Design ("FEED") Study and a Definitive Feasibility Study ("DFS") for the first commercial plant, at their LANXESS Project. This progress by Standard Lithium is as a result of their successful demonstration plant validating their technology.

Standard Lithium states:

"*This project contemplates processing the brine that is currently being handled by Lanxess at its South Facility, where the Company's continuously operating pre-commercial Direct Lithium Extraction (DLE) Demonstration Plant is located. The existing brine flow at this location is approximately 3,000 US gallons per minute (usgpm), and using the design criteria of 90% lithium recovery during the DLE process, results in expected annual production of between 5,000 to 6,000 tonnes per annum (TPA) of battery quality lithium carbonate. This first project at Lanxess South, designated as Phase 1A, forms part of a staged development of commercial lithium projects contemplated by Standard Lithium:*

- *Phase 1A Existing brine flow at Lanxess South Plant (design 5-6,000 TPA lithium carbonate);*
- *Phase 1B Expansion at Lanxess South Plant (expected approximately 5,000 TPA);*
- *Phase 2 Lanxess West Plant…..,*
- *Phase 3 Lanxess Central Plant……*"

Added to this Standard Lithium plan to develop their stand alone South West Arkansas Project (~30,000tpa lithium hydroxide) and others.

The results of the FEED study will be summarized in a NI 43-101 DFS report in H1 2023.

Elon Musk says the lithium refining business (what Standard Lithium is working towards) is a license to print money

In July 2022, at Tesla's Q2 Earnings Call (transcript here), Elon Musk made his famous comment regarding lithium refiners/processors making great money. He explicitly stated:

"I would like to once again urge entrepreneurs to enter the lithium refining business. The mining is relatively easy. The refining is much harder…….So, it is basically like minting money right now. There is like software margins in lithium processing right now. So, I would really like to encourage, once again, entrepreneurs to enter the lithium refining business. You can't lose. It's licensed to print money."

Source: Yahoo Finance

All of this is great news for Standard Lithium investors and good news for the auto manufacturers desperate to get future lithium supply.

Of course all of the above takes time and does not solve today's lithium deficit; however, it could be the miracle we need to help solve the increasingly large lithium deficits forecast post-2025.

Standard Lithium trades on a market cap of US$622M.

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A look at the lithium market leaders as EV manufacturers face generational challenge to keep factories running

written by Matt Bohlsen | February 24, 2023
Investors are starting to realize the lithium boom is likely to last the next 1-2 decades. EV manufacturers are now facing a generational challenge to secure enough lithium supply to keep their factories running.

In 2021, the IEA forecast that the world will need **13-42x more lithium by 2040 (from 2020 levels)**. The 13x increase was based on the stated policies track (as of 2021) and the 42x increase was based on the sustainable development scenario (we move rapidly towards a world of zero emissions). Just this past week Benchmark Mineral Intelligence forecast: "Lithium has to scale **twenty times by 2050** as automakers face generational challenge". This was **based on 2021 levels**. Our exclusive research at Trend Investing forecast a **35x increase** in lithium demand **from 2020 to 2037**.

As of October 2022, the best positioned EV manufacturers are Tesla & BYD Co, and perhaps Ford & GM. These companies have made good preparations including multiple lithium off-take agreements and investments in the lithium companies or projects. Examples are Ford's July 2022 off-take and A$300 million debt facility agreement with Australian lithium junior Liontown Resources Limited (ASX: LTR), and the August 2022 GM off-take and US$198 million pre-payment deal with Livent. Both these recent deals show the new reality of what it takes to secure future lithium supplies.

Tesla Model 3 – A global leader in electric car sales the past 5 years

Who are the lithium leaders?

The lithium leaders are those lithium companies that are currently the leading producers and who have potential to significantly ramp their lithium production this decade.

Sociedad Quimica y Minera S.A. (NYSE: SQM) – A Chile company with a 51% share of the world's best lithium brine mine at the Atacama Salar in Chile. They also own 50% share of the Mt Holland spodumene project (with Wesfarmers) set to begin production in Q4, 2023. SQM is targeting lithium carbonate equivalent ("LCE") sales in 2022 of 150,000t, 210,000t in 2023, and 240,000t in 2024.

Albemarle Corporation (NYSE: ALB) – An American company often seen as the lithium leader. They own 49% of the Atacama Mine (with SQM JV) and 49% of the world's best spodumene mine Greenbushes in Australia. They also have a 50% JV ownership (with Mineral Resources) of the massive Wodgina Mine in Western Australia, which recently began producing again with plans for a large ramp ahead. The JV also has a recently completed hydroxide

conversion plant (60% ALB; 40% MIN) in Kemerton, WA. Albemarle's production is targeted to increase from ~130,000t LCE in 2022 to ~220,000t LCE in 2025.

Ganfeng Lithium Group Co., Ltd. (SHE: 002460 | HK: 1772 | OTC: GNENF) – A Chinese lithium company focused on lithium refining, however now has multiple projects around the world including 49% of Mt Marion in WA and a 50% JV with Lithium Americas at the massive Cauchari-Olaroz project in Argentina due to start production soon. Ganfeng aims to boost production from ~90,000t in 2022 to 200,000tpa by 2025.

The other leaders with large projects include Pilbara Minerals Limited (ASX: PLS) with their massive Pilgangoora Mine in Western Australia (~90,000tpa in 2022/23), Mineral Resources Limited (ASX: MIN), Tianqi Lithium Corporation, Livent Corporation (NYSE: LTHM) and Allkem Limited (ASX: AKE | TSX: AKE).

Together the names above represent the biggest eight lithium producers and they produce most of the world's lithium today.

Some others such as AMG Advanced Metallurgical Group NV and a few smaller Chinese producers make up the balance of global lithium production.

The next or near term producers set to come online include (in rough order) Argosy Minerals Limited (ASX: AGY), Lithium Americas Corp. (NYSE: LAC | TSX: LAC), Core Lithium Ltd (ASX: CXO), – SIGMA Lithium Corporation (NASDAQ: SGML | TSXV: SGML), Sayona Mining Limited (ASX: SYA | OTCQB: SYAXF)/Piedmont Lithium (Nasdaq: PLL | ASX: PLL) (NAL Project in Canada), and Liontown Resources Limited (ASX: LTR).

There are also a bunch of other very promising lithium junior miners with potential to become new lithium producers after

2025. Three of the biggest projects could be in Canada with Critical Elements Lithium Corporation (TSXV: CRE | OTCQX: CRECF), Patriot Battery Metals Inc. (TSXV: PMET | OTCQB: PMETF) and Frontier Lithium Inc. (TSXV: FL | OTCQX: LITOF).

Closing remarks

It may seem like there is a lot of lithium supply coming online in the next few years, but of course demand is rising faster than supply, assuming EV sales growth continues at a 50%+ growth rate as expected.

Could there be some periods of short term oversupply? Yes, but only likely if EV sales falter. Either way the decade or two ahead looks set to be a very exciting time for lithium investors and the lithium leaders discussed in this article.

Disclosure: The author is long Tesla, BYD Co and most of the lithium stocks mentioned in the article.

Lithium: The Haves and the Have Nots

written by Jack Lifton | February 24, 2023

Too little attention is being paid in all of the chatter, both informed and uninformed, about a lithium supply "deficit" and its longevity, to the culling of both battery and vehicle manufacturers that such a deficit would (will[?]) entail.

There is not even the remotest possibility that global lithium (measured as metal) production could grow to this week's prediction, for example, by the child-like prognosticators at Deloitte, that in 2030 32% of all newly manufactured motor vehicles would be battery electric vehicle (BEV). Even assuming no growth in total OEM automotive production, a CAGR of zero, there would be 100,000,000 cars and trucks manufactured in 2030, and, under this prediction, 32,000,000 of them would be BEVs. Using an average lithium-ion battery capacity per vehicle of 100 kWH and the requirement of 16 kg of lithium per 100 kWH this means a need in 2030, just for BEVs and excluding stationary storage (the so far un-named gorilla in the battery needs zoo) and personal portable electronics, of 512,000 tons of lithium or six times the new production level of 2020!

China's **new economic plan** "only" calls for 20% of its domestic OEM automotive production in 2025 to be BEVs. Again assuming no growth in OEM automotive output from 2020 levels this would mean the production in 2025 of 5,000,000 BEVs in and for the Chinese domestic market. This would require, under the above usage of Lithium requirements, 100% of the lithium produced in 2020. But China is different. Today, in 2021, it already controls (owns or owns the output of) 60% of global lithium production and has today 82% of the global installed capacity for manufacturing

lithium ion batteries of all types. Assuming that 65% of current lithium production is used for lithium ion batteries and the 100 kWH size of the average car battery and that it takes 9 GWH of battery making capacity to outfit 100,000 BEVs, this means that China today, with its installed capacity (in 2021) of 455 GWh of battery making capacity, could already produce 5,000,000 BEVs a year domestically. **In other words, China today has already enough battery making capacity to match its current supply of lithium that is allocated to BEV battery manufacturing, and, further, to already be in a position to achieve its 2025 target production of BEVs!**

There's really no comparison between the efficiency and **effectiveness** of China's mandarins as state resource allocation experts/executives and the bureaucrats/advisors of former Soviet Russia or today's Washington and Brussels.

China continues to acquire global lithium sources, build processing and manufacturing capacity for lithium-ion batteries, and increase production of BEVs to meet long-term state planning goals. In the West bureaucrats "study" the needs for capital allocation to do the same thing.

China seems acutely aware of the balance its needs for steady societal growth (in the standard of living) required when set against its need to allocate capital efficiently to meet security of supply. This is where Western politicians who lack even a rudimentary understanding of economic planning have completely failed in their governance.

Yesterday I heard the chairman of a lithium junior in Argentina criticize China's Ganfang Lithium, the world's largest producer of lithium chemicals for batteries, for announcing that it is acquiring ownership of, what he called, a "crap" lithium junior in Argentina, Millennial Lithium Corp. (TSXV: ML | MLNLF:

OTCQB). He failed to note that just this year Ganfeng has gone ahead with the building of a 20,000 ton per annum, lithium chloride production plant to be powered entirely by a 120 megawatt (Chinese manufactured) solar cell installation in Argentina, and also agreed to complete its purchase of Mexico's Bacanora Lithium PLC. Ganfeng with its $120 billion market cap and its own cash along with the permission of the People's Bank of China is valuing Millennial above its current market price primarily for its holdings and its recent PEA and pilot plant success.

Investing in junior lithium miners is not a bet on the US or the EU's future demands it is a bet on the value that China puts on its critical resource supply security.

The "free" market allocation of capital in the West is not for the societal benefit it is for economic growth, supposedly for the benefit of society, but increasingly for the benefit of an oligarchy now in control of finance. China seems to be taking a different path to economic growth and perhaps a better one for the long haul.

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

vehicle demand?

written by Jack Lifton | February 24, 2023

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….