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!

American OEM automotive industry’s big problem with lithium

written by Jack Lifton | February 24, 2023

… and why Elon Musk is wrong.

There isn’t enough lithium mined, and there can never be enough lithium mined and processed into end-user forms economically, to replace the use of fossil-fueled internal combustion engines in the powertrain systems of the current one and one-half billion personal and mass transportation vehicles with electric motors powered by rechargeable lithium-ion type storage batteries.

I think that most of the managers of the global OEM automotive, aerospace, and shipbuilding industries know this, but they are powerless in the face of the demands of politicians who have given in to the greens who are unaware of the limitations of

physical natural resource production and processing for non fuel minerals, and who rely on the advice of narrowly and poorly educated and just plain dumb “experts” who have credentials but no experience of business operations, real-world economics or even rudimentary geology. The more often these experts repeat such mantras as “settled science” (to prove that climate change is caused by or can be remedied by human activity) or proclaim the unlimited resources of “earth abundant minerals” (to prove that non-fuel natural resources are unlimited) the more destructive their ignorance impacts our cheap energy based (which they neither see nor understand) standard of living and quality of life.

In order to preserve their industry and their high paying jobs long enough until they can safely retire, the current top managers of the global OEM automotive industry have accepted the economic power and poison of the green energy “transition” in making their decisions rather than the free marketplace.

It is typically stated that a modern internal combustion engine powered vehicle has over 6,000 components and that an EV, an electric powered vehicle, is “much” simpler. In fact, the much simpler vehicle still has some 4,000 parts.

Henry Ford pioneered the vertical integration of his eponymous car company in the teens of the last century to avoid being controlled by the natural resource “trusts” (monopolies) of his time. By the early 1920’s the Ford Motor Company manufactured internally all of its necessary component parts except for tires (Ford was a personal and lifelong friend of Harvey Firestone) and produced all of its own needs for electricity.

As the decline of the auto-industrial age proceeded after the oil price shocks of the 1970s the OEMs shed their then advanced vertical integration (almost always in order to raise money to

cover losses and declining margins) and adopted just-in-time delivery of necessary parts from the then reborn and expanding external supply base. Rising American labor costs in the 1980s created a mass exodus of OEM automotive suppliers to Mexico and Asia. Shortly thereafter that Asian vehicle makers entered the US markets and rapidly learned enough to destroy the postwar global dominance of the OEM American car industry. Chrysler needed rescuing first, then GM. Ford survived the downsizing better than the others, but like them had to withdraw from the global markets of the heyday of the globalization of the pre-war (WW2) era.

Now, in 2022, the OEM American car and truck assemblers – for that is the correct term for a company that imports all of its components and assembles them into a vehicle – are being told that they must reduce and eliminate the use of imported components and find or develop domestic or friendly nation sources to redevelop domestic vertically integrated manufacturing.

At the same time, they are being told by the government that they must convert all power trains to electric drive fueled by rechargeable storage batteries.

The answer, of course, is to rebuild domestic factories to once again produce the 4000 components per vehicle they will need for EVs. There will be components which are common to both fossil-fueled and electric powertrains and vehicles, but such electromechanical marvels as modern multi-speed transmissions as well as efficient gasoline and diesel fueled internal combustion engines will cease to receive attention and the skills to build them will wither away.

The key component to be researched and manufactured domestically now has become the lithium-ion battery to be used to power the

battery electric vehicles to be built. No such mass production industry for this type of component has ever been successfully built or operated by a domestic American company. The supply chain for manufacturing lithium ion batteries for vehicle powertrains does not exist today in the USA.

Let me explain how the contemporary (legacy) global OEM automotive industry finds and chooses among its parts suppliers, so you can understand the dilemma that the contemporary geopolitics of globalization has caused, in particular, in the United States and Europe.

The outside OEM automotive suppliers, of course, must have experience in building and successfully selling the components for the same or same type of use. This is not taken for granted just because of the size or reputation of the seller. All production parts accepted for use by the domestic American OEM automotive industry must undergo the PPAP (production part approval process) and the suppliers must pass a financial due diligence.

PPAP involves real time passing of the test of operating under real-world conditions for at least three years in general and for the life of the part's warranty. For a lithium-ion powertrain battery, this means today's operation with no more than the stated degradation of capacity for up to 8 years.

Upon passing the PPAP, the due diligence requires that the component meet the following requirements:

- On-time delivery, to specification, in the volumes agreed, and at the agreed price,
- Just-in-time delivery to agreed locations, no matter the weather conditions,
- All parts must meet agreed customer specifications within a narrow quality range, and

- Prices are agreed for the life of a vehicle model

It has been the practice of the OEM automotive industry to make the direct supplier of the component or subassembly, the Tier One supplier, responsible for the all of its (sub) suppliers to meet their PPAP requirements, even if it is the assembler who PPAPs the mechanical and electrical quality of the sub-tier supplier.

Very recently, for the first time in 25 years, the OEM domestic American automotive assemblers have begun to look at the entire supply chains for critical (without them the vehicle cannot be sold) components.

In the last year, General Motors and Ford have announced "agreements" with domestic, non producing, semi-finished raw material suppliers, of lithium and the rare earths, to provide them with raw materials (lithium) and critical component parts (rare earth permanent magnets), which the companies will somehow get processed into the forms necessary to produce rechargeable storage batteries and electric motors from a currently non-existent domestic American manufacturing base.

Tens of billions of dollars have already been allocated by the domestic American OEM automotive industry to build 7 battery "gigafactories" and several EV platform (the battery plus the electric motor) factories. Among the domestic OEM assemblers nearly 100 billion dollars has also been allocated to the construction of dedicated and multi-functional BEV plants.

The OEM automotive assemblers have bet the farm that they can become domestic vertically integrated manufacturers of battery powered electric cars and trucks.

Yet, as of today, not one gram of ESG lithium or rare earths is produced in the United States or Canada.

Look at the following chart:

This chart from the IEAE tells you that there is no possibility of producing enough lithium to manufacture the batteries that would be required by the currently planned demand after this year.

I think that the ignorance, by politicians and journalists, of the steps universally and necessarily required in the operations of any and all global original equipment manufacturing business is due to intellectual laziness, intelligence limitations and the rapidly declining coverage and quality of American "education" at all levels. The attempt to eliminate selection by merit, rather than expand it, and replace it with superficial characteristics as the criteria for education has rapidly eroded the ability to select those best qualified for specialized education and training and given over world leadership in science and engineering to Asian nations.

I repeat that the success of a transformation of the fuel for vehicular transportation from liquid fossil fuels to electricity stored on board in rechargeable batteries depends entirely on the supply of the element lithium.

And that energy and resource illiteracy and innumeracy among our managerial and credentialed classes are the only reason that the domestic American OEM automotive assembly industry has blindly bet the farm on a green fetish pursued by some of the dumbest (or most corrupt, or both) politicians in the history of our Republic.

The BEV revolution will not engender a second Auto-Industrial age in America. It will, in fact, end the dominance of that industry, and ensure that BEVs survive only as luxury vehicles

to be driven between enclaves with charging facilities.

Elon Musk tweeted two weeks ago that Tesla may have to get into the lithium mining business. He said that although there is lithium everywhere and lots of it, the mining industry is very slow to bring it to market.

Elon Musk is a brilliant businessman and an even more brilliant financier, but he is a mineral economics moron.

I invite readers to please challenge my assumptions and conclusions with data, logic, experience, and educationally based counterarguments.

Jack Lifton on how the Windsor battery plant marks “the return of total vertical integration to North America”

written by InvestorNews | February 24, 2023

In this InvestorIntel interview, Tracy Weslosky is joined by Critical Minerals’ industry expert and InvestorIntel Editor-in-Chief Jack Lifton to discuss the Ontario government’s recent announcement to make the largest private sector investment in Ontario history in a $5B Windsor battery plant.

Jack discusses the cyclic history of vertically integrated OEM automobile manufacturing in the US and Canada and its decline, due to globalization by the domestically owned US automotive

manufacturing industry. Jack sees an imminent return to the industry of vertical integration, first in Canada's automotive manufacturing center, Ontario. Jack explains how the Windsor battery plant in fact marks "the return of total vertical integration to North America" making Windsor, perhaps, as a symbol of Ontario's natural critical resources and manufacturing capacities possibly "more important than Detroit in about 10 years in the North American OEM automotive industry."

To access the complete episode of this Critical Minerals Corner discussion, click here

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Investors in Technology Metals for EVs, Be Very Careful What You Wish For in 2022

written by Jack Lifton | February 24, 2023

The one-dimensional talking heads (aka, the elected officials, lifetime appointed bureaucrats, and academic "advisors" who make their decisions based upon the requirements of lobbyists) of Washington, D.C., have started off 2022 by choosing winners and losers for the parts of their home markets served by the domestic American OEM automotive industry. This is being done by fiat, not directly from the executive or legislative branch, but from the bureaucracy in the form of the Environmental Protection Agency, which last week decreed that all motor vehicles must have an average fuel use by 2026 of the equivalents of 55 miles per gallon of fossil fuel.

The consequences of this action, if it is not halted or overturned by the courts or a future election, will be catastrophic for the economy, because the only way such an edict could be fulfilled would be by the legerdemain practiced by the EPA when it measures the "range" of an electric vehicle without regard to its actual range in use real-time and under real conditions. In the world of EPA, an EV's loss of 40% of range in cold weather and its loss of 30% in hot weather seem simply not to be taken into account. Nor is the shortened working life of a lithium-ion battery due to the degradation caused by "fast charging" taken into account.

The printing of money by the Federal Reserve and its spending by the economic-logic-free Congress has had a very foreseeable effect on the prices of critical metals required for the transformation of the fossil fuel powered vehicle industry to battery electric power. As investors watched the Chinese government's fiats to its OEM automotive industry and anticipated the EPA's actions, as a feature of the current administration's commitment to the "greening" of the OEM automotive industry, they bid up the prices of the necessary critical materials for batteries and for electric traction motors for such vehicles to today's very high levels. This has ensured that the non-Chinese automotive industry's plans to produce and reduce the costs of batteries through economies of scale have been damaged fatally. The battery has been and remains the biggest cost of the parts needed to make EVs. The average EV sold in America in 2021 was $55,000 because of that. While an average ICE was $42,000. The national average income in the USA for a family of four is $64,000. Unless EVs for sale in America meet at least the average price for an ICE the price differential wipes out any possible fuel savings over the life of the vehicle.

The Washington one-dimensionals sort of figured this out, so

they proposed, in the traditional way of politics, not economics, to give a “tax credit” of up to $12,500 to subsidize the price of EVs for American made vehicles made by “union” workers. Congressional phones rang and rang as those outside of the DC bubble told their elected officials that this “tax credit” was in fact a gift to the wealthiest Americas who needed it least. The subsidy for the moment has disappeared from the conversation in Washington, much to the dismay of the American OEM automotive industry.

Meanwhile, back in the former Motor City the remaining two American legacy car makers, neither of which is in the top five OEM auto producers in the world, announced that they would, between them, build 5 “Gigafactories” to make lithium-ion batteries. Recently one of them, General Motors, announced that it had made critical raw material and finished goods “arrangements” for the supply of its factories with American companies that have either not produced any such materials or are only in the early stages of doing so. The procurement officers of the two relatively small American OEMs do not seem to understand the time frames required to not just bring a mine into production but also to achieve the multiple downstream processing steps required to turn a mineral into a battery, a magnet, or a motor in large volumes with on-time delivery, to specification, and at an agreed price! While all of this detail is not being addressed, the commodity metals continue to increase in price putting the OEM automotive purchasing paradigm of long term (at least three years) pricing in the toilet. The price of batteries alone has increased 20% just in 2021. The OEM auto and truck markets in the USA are now in turmoil due to technology parts supply limitations. What will it look like when the supply of EV battery and motor metals is recognized as permanently in deficit? Costs to make EVs will continue to increase and make them increasingly unaffordable to all but the

top earners.

If there is a stock market correction (aka, a crash) in metals in 2022, the far-sighted (aka Asian) battery makers who have done their part for pushing up raw material pricing by stockpiling lithium, cobalt, and the rare earths, thus, driving up the prices, could find their balance sheets corrected and be facing margin calls on their loans using lithium, et al., as collateral. The US OEM automotive industry will be facing a customer base that is reluctant to buy big ticket items if and when liquidity is under siege and government spending on necessary infrastructure for EVs in the US is reduced. Of course, non-producing auto factories will not need workers or parts either. Deflation could come and be worse than inflation.

I will end this essay on a positive note. There isn't enough lithium produced today to satisfy even the most conservative estimate of EV demand in 2025 and there may never be enough produced to satisfy the most conservative demand for the 2030 model year. Even if lithium prices dip during a correction, I think they will bounce back enough to support good mining and refining projects. If there is such a dip, buy into the EV material's supply chain markets then. If there is no dip, then hold on.

Nano One Strives For Sustainability and a Total

Domestic North American Lithium Ion Battery Supply Chain

written by InvestorNews | February 24, 2023

My biggest takeaway from COP26 is not so much climate action and emission reduction, but the message of sustainability. Without focusing on the importance of sustainability one risks thundering down a path of unintended consequences. What do I mean by this? Several years ago I read that if we could convert all coal fired power generation to natural gas it would achieve the Kyoto emission target. I can’t confirm if this is completely accurate or not, regardless it would have been a large step in the right direction (despite still being a fossil fuel based solution). At the time it would also have been achievable with existing, available resources and bought the world some time to continue building out renewable resources, which is the ultimate end game. However in 2021, with the lack of energy investment over the last several years due to a combination of factors, that isn’t the case today, and we are starting to see parts of the world where renewables haven’t developed enough by themselves to even keep people warm this winter. Meanwhile, the fossil fuel alternatives aren’t any longer as readily available as backup and may still not even provide enough for home heating. I understand the urgency of eliminating coal fired power, but if there aren’t enough alternative power options to keep people warm then who knows what happens next.

That’s why I think in order to successfully green our economy and reduce our global carbon footprint, the focus has to be on how to do it sustainably. One company that has to be at or near the top of the list in the transition to clean energy in a

sustainable way is Nano One Materials Corp. (TSX: NANO). Nano One is a clean technology company with a patented, scalable and low carbon intensity industrial process for the low-cost production of high-performance lithium-ion battery cathode materials. The technology is applicable to electric vehicle, energy storage, consumer electronic, and next generation batteries in the global push for a zero-emission future. Nano One's One-Pot process, its coated nanocrystal materials, and its Metal to Cathode Active Material (M2CAM) technologies address fundamental performance needs and supply chain constraints while reducing costs and carbon footprint.

Another facet of sustainability that is very applicable today is the supply chain. Currently, the cathode supply chain is long and complex. Nano One manufactures its cathode materials directly from nickel, manganese, and cobalt metal powder feedstocks rather than metal sulfates or other chemical salts. The metal powders used are one fifth of the weight of metal sulfates, avoiding the added costs, energy, and environmental impact of first converting to sulfate and then the shipping and handling of waste. The manufacturing process for all of its Cathode Active Material (CAM) uses lithium feedstock in the form of carbonate rather than of (lithium) hydroxide, which is costly, corrosive and harder-to-handle. The process is feedstock flexible which enables improved optionality of sourcing of raw materials. Nano One's technology aligns it with the sustainability objectives of automotive companies, investment communities and governmental infrastructure initiatives.

On Tuesday, November 10, 2021, Nano One announced the goal of building a fully integrated and resilient battery supply chain in North America, which must include responsible mining of battery metals, onshore refining, environmentally favorable cathode material production, and recycling. The Company believes there is a once-in-a-generation opportunity to create a secure

and cost competitive supply chain that is domestically integrated with a low environmental footprint. Accordingly, Nano One is shifting its LFP (lithium-iron-phosphate) cathode material strategic direction to large emerging markets outside of China, starting in North America, and has ceased joint development activities with Pulead Technology Industry.

LFP production is free from the constraints of nickel and cobalt, and although its origins are deeply rooted in Canada, its growth over the last decade is almost entirely based in China. Recent LFP cell-to-pack innovations have driven costs down and enabled greater EV range, setting the stage for EV pioneers to shift to LFP. The need has never been greater for a sustainable, responsible, and secure supply of LFP materials and batteries, to be established and supported in North America and Europe, proximal to where the EV's are manufactured. Canada has clean energy assets, responsibly sourced critical minerals, and a rich history in LFP technology and manufacturing. By leveraging these opportunities with the Company's simplified low-cost approach to cathode production, Nano One seeks to create a resilient value-added North American LFP supply chain in a collaborative ecosystem with a smaller environmental footprint.

There you have it. A company that sees the bigger picture and embraces sustainability in an effort to advance clean technology while reducing both costs and the overall carbon footprint. If this were a video, at this point I would simply drop the mic and walk away. Since it's an article and I need a conclusion I'll finish off by saying Nano One has the potential to have its technology in every EV built in North America and Europe, and that's going to be a pretty big number in the not too distant future.

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….

Well partnered (and well-funded) with key battery suppliers, Nano One charges forward on 'Mission Possible'…

written by InvestorNews | February 24, 2023

Nano One secures an additional $11 million in cash to provide a multi-year funding runway for their work on lithium-ion battery cathodes

For companies that are not yet producing revenues, the threat of running out of funding is a significant business risk. As the COVID-19 disruption deepens and some companies run low on cash, Nano One Materials has secured an additional $11 million in funding which will provide them with “a multi-year runway extending over three years.” This essentially removes the short-term funding risk making the stock a safer buy for investors.

Nano One Materials Corp. (TSXV: NNO) is working on making lithium-ion batteries better. Nano One has developed patented and scaleable industrial processes for producing low cost, high performance, battery materials typically used in the battery cathode. The processing technology enables lower-cost feedstocks, simplifies production, and advances performance for a wide range of cathode materials.

Nano One is working to make lithium-ion battery cathodes cheaper and better

Source

Nano One’s recent funding success

- $11m raised from private and institutional groups
- $5.25m grant from Sustainable Development Technology Canada (SDTC)

In connection with the closing of the $11m financing, Nano One issued 9,565,000 units at a price of $1.15 per unit with each

unit comprising of one common share in the capital of the Company (the “Shares”) and one-half of one common share purchase warrant (the “Warrants”). Each whole Warrant is exercisable into one share at an exercise price of $1.60 per until February 21, 2023.

The proceeds from the financing will be used for corporate development, facilities expansion, technology advancement and general working capital.

Nano One CEO Mr. Dan Blondal stated:

“We are thrilled with the capital market response to this latest placement. The proceeds from this financing will also be leveraged by an additional five million dollars in non-dilutive and non-repayable contributions, that was awarded to Nano One by Sustainable Development Technology Canada in May of 2019. ***The sum of sixteen million dollars*** *enables us to accelerate business plans and co-development activities including those already underway with Volkswagen, Pulead, Saint-Gobain and other undisclosed global automotive interests.”*

Note: Nano One also receives financial support from the National Research Council of Canada Industrial Research Assistance Program (NRC-IRAP).

Nano One – Why invest?

Nano One’s development partners

Nano One is very well partnered into key battery suppliers and some car manufacturers, including several big names – Pulead, Saint-Gobain and Volkswagen. Nano One is working with Pulead to develop better LFP batteries, with Saint-Gobain to improve thermal processing and to develop enhanced high temprature

cathode processing, and with Volkswagen to develop advanced materials for next generation batteries.

Apart from the partnerships discussed above and other undisclosed opportunities, Nano One has 16 patents with 30+ patents pending.

Nano One's business model

Nano One's goal is to achieve up to $1 billion in licensing fees revenue for their patented cathode technologies, by tapping into the rapidly growing cathode market that is forecast to be worth $23 billion by 2025.

Nano One is tapping into the battery cathode market which is forecast to be worth $23 billion in revenues by 2025

Source

Closing remarks

Nano One is ticking all the right boxes.

- Great patented technology – Check.
- Industry leading partners (Pulead, Saint-Gobain and Volkswagen) – Check
- Funding secured ($16 million in total) – Check
- Government backing – Check

With a potential up to $1 billion licensing fees opportunity and a market cap of just C$80 million, it is not too late for investors to get on board. If Nano One succeeds it will have been a great time for investors to have bought in now after the recent dip. Execution risk remains, but the rewards look large if Nano One can pull it off.

Dan Blondal on Nano One's collaboration agreement with Pulead Technology

written by InvestorNews | February 24, 2023
Recently during PDAC 2019, Dan Blondal, CEO, Director and Founder of Nano One Materials Corp. (TSXV: NNO), shared updates on Nano One's collaboration agreement with Pulead Technology with InvestorIntel's Tracy Weslosky.

Dan Said: "We put a joint development agreement with Pulead in mid-January. They are a very prominent cathode producer in China supplying the lithium iron phosphate market and supplying the lithium cobalt oxide market as well. That's the materials that go into your iPhones. Very exciting company to be working with. Pulead is the world's largest producer of lithium iron phosphate. That's the material that goes into electric buses, lower range electric vehicles…"

Nano One Materials Corp. has developed patented technology for the low-cost production of high performance lithium ion battery cathode materials used in electric vehicles, energy storage and consumer electronics. The processing technology addresses fundamental supply chain constraints by enabling wider raw materials specifications for use in lithium ion batteries. The process can be configured for the full range of cathode materials and has the flexibility to shift with emerging and future battery market trends.

Nano One has built a pilot plant to demonstrate high volume

production and to optimize its technology across a range of materials. The pilot plant is being funded with the assistance and support of the Government of Canada through Sustainable Development Technology Canada (SDTC) and the Automotive Supplier Innovation Program (ASIP) a program of Innovation, Science and Economic Development Canada ISED).

To access the complete interview, click here

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