

The first of three parts in the “Lithium Still Wins” trilogy was published two years ago at the beginning of Covid. Parts two and three followed within the space of thirteen months. In this update, I discuss where the industry is today and provide my thoughts on the future. Periodically I like to look back and see what I got right and more importantly what I got wrong.

I understand that many people reading my posts and listening to the Global Lithium Podcast invest in lithium companies. I do not give advice on specific investments but I do share my perspective on the industry. I have been fortunate to benefit greatly from investing in several lithium companies over the years. When I said “lithium still wins” in March of 2020 it was a statement that I believed despite the fact that many so called experts were forecasting doom, gloom, low prices and long term oversupply. Covid and the resulting short term stock market crash created fantastic opportunities for those with a long term view. Buy low / sell high – words to live by.

As the industry grows and attracts attention as the major “limiting factor” to the energy transition, understanding the lithium market is no longer optional for governments, battery makers, auto OEMs and other stakeholders in the quest for a “greener” world. You should be careful who you trust regarding the lithium/battery metals space and that includes me. No person is without bias. I have included my comments below within the original post. The updated portion is in blue. The original in black.

Below are my thoughts on where the lithium industry is heading despite the current global economic disruption. It is still a little early to make specific projections regarding the next six to twelve months but, counterintuitively, the longer term “big picture” seems clearer to me. I can always adjust the short term scenario next month in part two.

There are few situations in my lifetime that match the uncertainty created by the Corona Virus. As an American, the Cuban Missile Crisis in the early 1960s and 9/11 come to mind but in neither case was our freedom of movement restricted or economy shut down as it is today. It is hard to predict what a protracted season of “shelter in place” will do to the collective global psyche but I have some thoughts.

As the Covid transitions from pandemic to endemic status, we now have Russia’s attempted land grab war crimes in Ukraine causing chaos in the world and taking those of us in the baby boom generation back to our childhood “cold war” memories. I will not try to minimize the tragedy of

what is happening in Ukraine. Yet, the current global tensions may create more buying opportunities for those with cash on hand and an appetite for risk. DYOR.

A few days of upward stock market price movement this week after the most significant and fastest Dow Jones drop in market history is just a respite before more downward movement as the virus spreads across the world leaving a wake of disruption, death and economic paralysis. It is a “blood in the streets” situation market wise which would lead Baron Rothschild to tell you it is the time to buy. Of course, I would never give you investing advice. That said I did a nice 48 hour flip of Livent this week. Buying at 4. Remember the IPO price not too long ago was 17.

The lack of tax consequences of trading in my retirement accounts brought out my inner trader, I flipped several lithium stocks multiple times in 2020 and 2021 as my comfort level grew range trading during market volatility.

Despite the current chaos, I have never been more positive about where the lithium market is headed. Two years from now I think we will see that, if anything, the virus was ironically a positive for lithium long term.

As you will read below, for the most part I got the broad strokes correct but my timing on the upside for lithium wasn't aggressive enough.

Why?

Point one - rightly or wrongly the fear and vulnerability countries around the globe are feeling about their supply chains and dependence on others is likely to accelerate a transition to greater emphasis on both supply diversification and regionalization creating more lithium chemical investment outside of China. Significant investment in lithium projects by companies from Koch Industries to Rio Tinto over the past year validate my point. Yet China continues to lead lithium investment even outside their borders.

No, this isn't a case of me espousing “anti-globalization” or xenophobia.

Let's call a spade a spade. The fear of China controlling the battery metals supply chain has been “out there” for a few years. The current situation is simply exacerbating the fear. Whether it is the US mostly talking rather than acting about securing stable supply of critical strategic metals or the

EU trying to “catch up” with China/Asia in creating a rechargeable battery eco-system, it is clear there is growing concern around the world with respect to having diversified supply chains. Many companies frame this phenomenon as wanting at least one supply route for critical materials that “doesn’t involve China”. This doesn’t necessarily mean totally excluding China but is more about common sense diversification.

In the US, [Executive Order 13817](#) dated December 20, 2017, called for “A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals,” the Secretary of the Interior on February 16, 2018, presented a draft list of 35 mineral commodities deemed critical under the definition provided in the Executive Order.

Lithium was on the list but little has improved regarding the US policy toward supporting lithium investment. In fact, it has gotten worse because the US government HAS made it clear investment from China is NOT welcome. Exclusion of Chinese investment in the absence of concrete action to support lithium investment is, at best, unfortunate.

China tends to set a strategy and act quickly, the US tends to create draft lists, write papers and have indecisive meetings. We clearly have lost our “Manhattan Project” mojo here in America although the national unity created in battling the current virus situation may help in that regard.

Take Tesla (and don’t forget Elon is a South African import) and foreign investment by the likes of Panasonic, LG and Saft out of the equation and America has no meaningful home grown battery ecosystem. So much for the “Federal Strategy” unless it is framed: “completely rely on others”.

What does this have to do with the Corona Virus? Give me a minute.

Initially the virus that began in the Chinese city of Wuhan was considered to be a domestic China issue that might have a limited impact on Chinese exports. However, it quickly spread, gained pandemic status and became a global issue impacting worldwide pharma and auto supply chains as well as causing a significant death toll elsewhere in Asia then Europe and North America before arriving in South America.

During the month of March there has been much hand wringing in the US about why we allowed ourselves to become “hostage” to China for so many

critical items. For the record, I don't blame China for bad supply chain decisions by the US.

I expect as a reaction to the virus situation we will see a more aggressive call for regionalization of many supply chains including battery metals like lithium. In the short term, the lithium world will be even more dependent on China as their lithium operations have mostly recovered from the virus while the rest of the world is early in the viral cycle.

Many believed the former US President wasn't aggressive enough in pushing a "green agenda." You are free to believe as you wish but it is clear that the new President is great at talking about change and the energy transition but with respect to critical metals has done little more than talk.

While Mr. Biden largely ignores the success of Tesla; he touts GM and Ford as the EV future. Let's look at the record. GM managed to sell 26 (that's right **26 not 2,600 or 26,000 in Q4 2021. That performance was, of course, after having to recall 100% of their flagship EV, the Bolt, for battery problems. No, I am not blaming Mr. Biden for the GM recall but I am saying that his lack of leadership isn't helping the US EV effort. People seem to like Ford's electric offerings – if they can get them. If Tesla had a union, likely they would get more love from the White House. Politics.**

Mr. Biden claims he wants a "robust battery supply chain" yet he has had no success to date in changing the climate for battery metals extraction projects but he can claim credit for the highest US gas prices on record and damaging the overall energy independence of the US.

If his strategy was to create high gas prices to spur EV demand, I might be able to accept that if his policies had enabled more EVs to be available to US buyers. The fact is the wait for an EV was weeks when he was elected but now the wait time is, in many cases, a year or in some cases, more.

It is also both sad and comical that the Biden Administration seems to have decided unproven lithium production via geothermal power plants is the "way to go" perhaps because they think GM will finance it and nobody is protesting it. Of course, the WH likes the idea that "green lithium" is being produced from "green power." The problem is that the environmental benefits are not all they are purported to be, the lithium extraction technology is not commercially viable yet and GM isn't footing that much of

the cost. Meanwhile, the administration dithers with respect to a project like Thacker Pass. I guess California has more influence in DC than Nevada.

Virus created shutdowns of countries like Argentina will result in the delay of critically needed lithium projects and expansions already in-progress (read: Cauchari & Hombre Muerto), and a further delay in financing for other projects such as NeoLithium and Piedmont. We still don't know the extent of virus impact on operations and expansions in the Atacama.

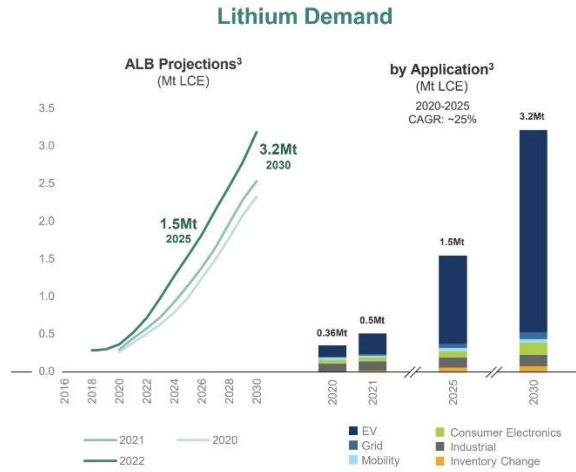
While it is still too early to know how significant the virus impact will be on supply; in my opinion, a meaningful shortage of battery quality lithium chemicals emerges in 2021. Of course, demand will also suffer too but I believe even with a recession lithium demand will be more delayed than destroyed. Apparently, Albemarle believes the same thing.

Over the past two years we know the virus slowed down the completion the few fully financed new lithium projects as well as some expansions yet EV demand in China and the EU grew significantly driving the China spot price for lithium chemicals up several hundred percent.

Just this week, Albemarle published the graphs below stating that they still believe that demand will reach a million metric tons by 2025. They have also published what they believe their contribution to supplying that demand will be. The problem is Albemarle has an absolutely atrocious record expanding capacity. In my opinion they will achieve less than 50% of their stated capacity expansion by 2025 which certainly impacts the overall supply/demand scenario. Please see my Sept 2017 article on ALB's Reality Distortion Field for more on their record: <https://www.linkedin.com/pulse/albs-reality-distortion-field-joe-lowry/>

Albemarle's recently updated demand graph for 2025 is below. It is approximately 50% higher than the one it replaced in the original version of this article which is below it:

New Albemarle Forecast as of March 2022



The sad reality is we will never know if demand will reach 1.5 million MT in 2025 because it is too late for the lithium industry to bring that much capacity online or even close.

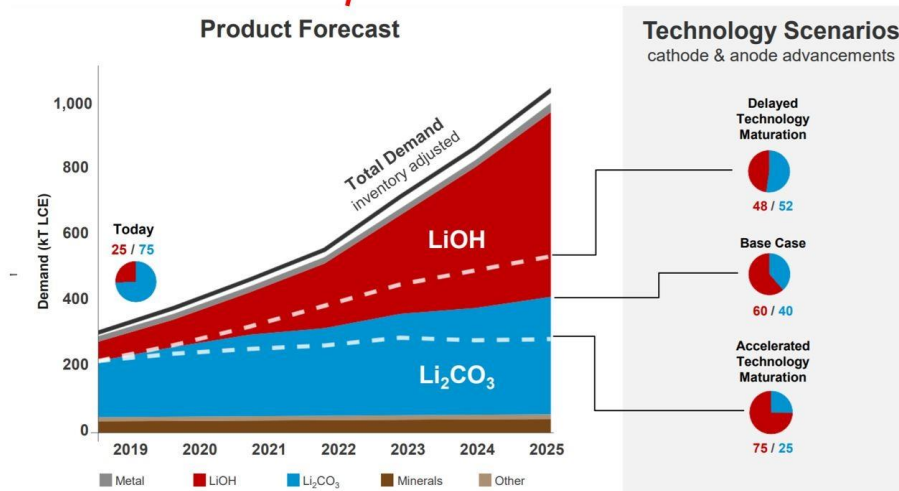
Albemarle's demand projection in March 2020

Lithium: Our Growth Engine



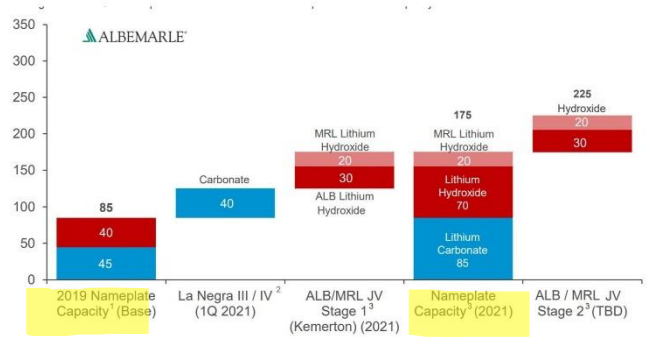
Key Takeaways

- Broadest range of resources, manufacturing capabilities, products, and customer relationships in the Lithium industry
- Global Lithium demand is on track to reach 1 million MT LCE by 2025, a 20%+ CAGR driven by EV penetration of new car sales
- We anticipate that the **current excess supply will diminish** in the mid-term as demand increases, particularly for hydroxide



The timetable below will not be achieved. Check the record – it wasn't. Not even close. Albemarle produced 88K MT LCE in 2021. They plan to hit 200K MT by 2025 which probably means 170K MT. If they had 175K MT of capacity in 2021 during a shortage they would have produced more than 88K MT.

Disciplined and Measured Plan to Expanding Conversion Capacity

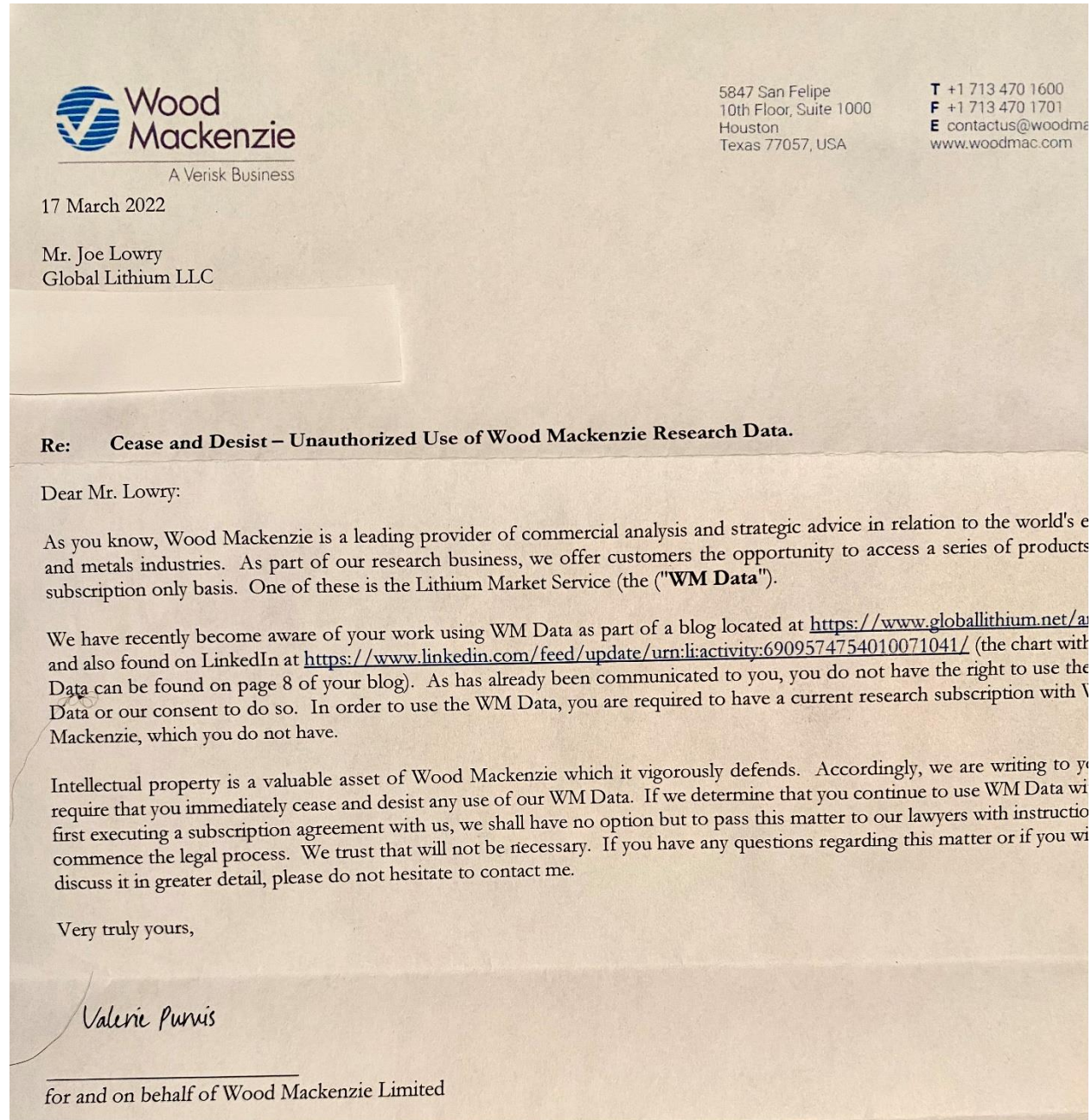


According to my friends at Benchmark Mineral Intelligence lithium chemical supply stood at 338K MT in 2019. Most demand estimates for 2019 range between 285K MT and 310K MT. My number was 306K MT. SQM's 307K MT. You get the picture - in aggregate there was an oversupply in 2019. Why I still say there is an "oversupply myth" is because only about 50% of that supply was tier 1 battery quality and perhaps 10 - 15% more could be used in tier 2 and tier 3 batteries. In 2019, approximately 60% of lithium demand was battery related. By 2025 the percentage of battery related lithium demand will exceed 85%.

It seems the banks that follow lithium continue to overestimate supply. The original issue of this document showed data from a "large information provider" whose analysis I challenged. There were two issues: 1) counting all mineral production – a portion is not converted to lithium chemicals but is used in the mineral form and 2) it was too optimistic in many cases but but optimism is a common mistake in forecasts. Had lithium chemical supply been 440K MT in 2020 when demand was ~ 310K MT; prices wouldn't have spiked in Q4 of that year and continued to move higher.

Unfortunately I can no longer show you the chart. Below is the letter I received today 4/12/2022 although it is dated 3/17/2022. The company seems too parsimonious to use a courier service. As you can see, they don't want me to use their data. I don't think they are on solid ground with their

complaint but I am happy to take the table down. As I indicated, my opinion on the numbers is a bit different. I replace the table with their “kind request missive”.



What did Morgan Stanley say about supply and pricing for 2022?

MS view remains prices easing only in 2H22. We expect the market to remain tight in the next 6-9 months, but as supply catches up and the rate of demand growth slows, we see the current tight market returning to an oversupplied one through next year. **Therefore, we see China's carbonate spot price gradually normalizing from 2Q22 onwards to \$13k/t by year end.** See our latest Price Deck

It remains a shock to me that Morgan Stanley continues to stick with their long term oversupply story. How is supply going to “catch up” in 2022? Where is the Morgan Stanley fact checker?

Point 2: Lack of investment exacerbated by virus related project delays will cause total demand to outstrip supply again within two years. Battery quality materials will be short sometime in 2021. The math isn't complicated. Two years later, it is clear that I was directionally correct but wrong on timing. The price spike beginning in Q4 2020 surprised everyone including me.

My demand forecast for 2025 is marginally lower than Albemarle's 1,000K MT LCE and my product mix still favors carbonate marginally over hydroxide but that difference is not worth focusing on. Neither of us will be exactly correct. And to intentionally repeat myself, what I am much more certain about is that Albemarle will not be able to bring on more than half of the capacity they project with battery quality and, going forward, battery quality is all that matters. Albemarle's struggles with project execution are well documented. Starting early in the last decade with their King's Mountain hydroxide plant and continuing with the debacle in Chile: the LaNegra II carbonate expansion that took almost five years to ramp up.

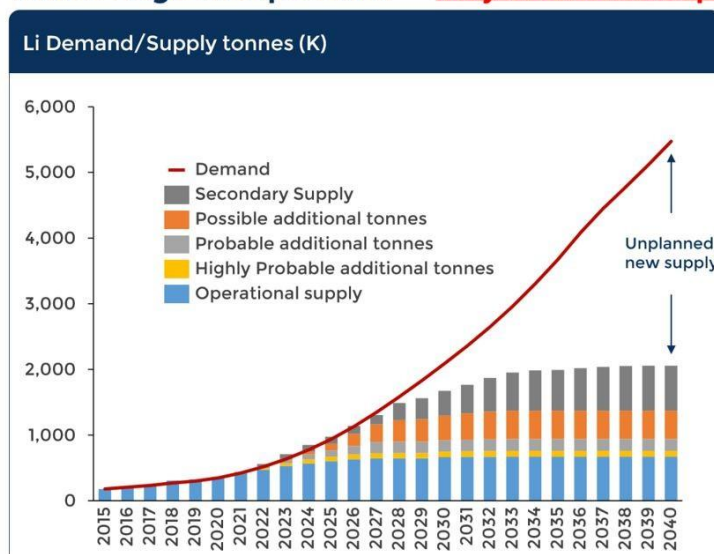
Albemarle's latest demand forecast has already been included in this update. It is worth repeating that demand estimates that cannot be supplied by the industry become theoretical exercises. The question to be asking yourself is: will lack of supply create a demand destruction scenario or simply defer it?

In 2020 Albemarle also insisted that hydroxide demand would overtake carbonate by 2023; it is clear now the LFP going mainstream in EVs has proven Albemarle called the market wrong. Even during the cult like mantra that high nickel cathode/hydroxide was taking over the EV market; I

maintained that carbonate demand would stay above hydroxide for many years to come.

Benchmark also shows robust growth in lithium demand and agrees with my lithium shortage thinking. Again, the math only seems difficult for the analysts at Morgan Stanley. If you look at even modest EV growth and the lack on new supply coming online, shortage is a matter of when, not if, and higher prices will result.

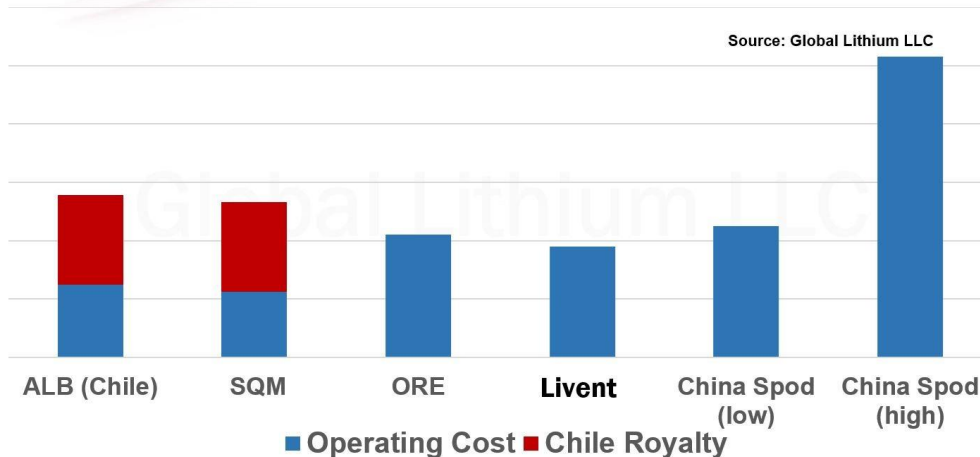
However, projected severe shortages of lithium chemicals still plague the industry, which begs the question – **why aren't more people investing?**



- The demand outlook for lithium is undoubted, the speed and rate of demand growth is the major question
- Entering a period of transition with new supplies beginning ahead of the roll out of megafactory capacity
- Major supply expansions still required to reach demand requirements of 2021 onwards
- The slow introduction of new projects into the market is a warning sign for a market which is only in the early stages of its growth cycle

Benchmark agrees that severe lithium shortages are likely

I intentionally took dollar cost off the scale of the carbonate cost curve graph below to avoid the debate about what the low cash cost of carbonate actually is - the important point isn't whether the low cost is \$3500 or \$3750/MT; it is the high end of the curve that sets the price when the market is behaving rationally. Of course, the high end of the cost curve will be defined by what converters in China are paying for spodumene. The current oversupply of spodumene has brought price down to an unsustainable level in the \$400s/MT. My cost curve is based on a long term average price well above \$500/MT which is closer to \$600 delivered to conversion facilities. As long as there is a significant gap between the high cost and low cost producers, profits will be significant for those with low cost unless like Livent you throw away your carbonate cost advantage by making hydroxide with it.



- Chile royalty makes Livent lowest cost lithium carbonate producer
- China spodumene (low) is ALB/Tianqi cash cost converting Talison spodumene in China
- China spodumene (high) represents purchased spodumene converted
- Exports from China must bear an additional cost: 13% VAT based on sales price

As spodumene prices continue to rise independent China converters feedstock costs will increase but that is a moot point in the near term as the severe shortage of lithium chemicals will keep prices well above the high end of the cost curve until relative supply and demand balance is restored at some point in the future. Let me state the obvious for the record, while Morgan Stanley got it wrong with their oversupply narrative. For my part, I was wrong on long term pricing and have to say my new normal in 2023 – 2027 is likely to be double what I thought the new normal would be a few years ago. Once annual and longer term contracts reset and battery quality carbonate (ex-China) goes over \$20,000/MT – it won't average below that again in this decade. For perspective, even with China spot prices going north of \$50,000/MT in 2021, SQM's average yield per LCE for 2021 was about \$10,000 and their Q4 price was below \$15,000/MT. The market average import price in Korea and Japan for lithium carbonate was also roughly \$10,000/MT on average in 2021. The contract price pain for cathode and battery markers is just beginning.

Even if you disagree with ALB and assume 2025 lithium demand is only 800K MT, approximately 680K MT will need to be battery quality. The current "Big 4" lithium companies are not capable of producing that much BQ material. I have already mentioned ALB's inability to expand on schedule, SQM is struggling with the expansion of their Atacama resource - go back and read what they said about expansions each of the last three years, they have under-performed both on volume and quality. Tianqi has further delayed their hydroxide start-up in WA. Their misguided debt funded

purchase of ~24% of SQM has weakened them substantially from a financial perspective. Of the top four companies only Ganfeng has managed to expand on a timely basis. Ganfeng's Vice Chairman and my old friend, Wang Xiaoshen, likes to talk about "globalization by localization". Ganfeng now has resource investments around the world. Their strategy was validated by contracts with Tesla, VW, BMW, LG, etc. A backlash against Chinese investment/supply chain involvement will not hurt Ganfeng significantly as they have already established global partnerships and alliances such as the Minera Exar JV with Lithium Americas in Argentina. No doubt they would also fund Thacker Pass given their equity position in and relationship with Lithium Americas but US regulations prevent Ganfeng from investing in Thacker Pass.

After Cauchari starts up, look for Ganfeng to struggle bringing new project capacity outside of China online. Good partners and stable geopolitics are important for a company like Ganfeng so while I believe they win with Cauchari, I do not assume Marianas, Bacanora or Goulamina will be online anywhere near expectations. More on that in a later post. Ganfeng will remain a top player but they have a new learning curve to navigate.

In order to support E-transportation and ESS growth companies like Livent, Orocobre need to up their game, juniors like LAC need to execute and Galaxy needs to decide if it really wants to be in the lithium business. Unfortunately, for now, Argentina's Covid-19 shutdown has delayed the progress of all of these companies.

In part two I will discuss in more detail how a combination of delayed projects, the desire for "China free" supply options and even 4% penetration of EVs in the next two to three years will create a BQ lithium supply shortage that will move up price significantly (think 2016 level) and finally bring in some large entities from outside China that are willing to finance projects like Lithium Americas' Thacker Pass, Neo Lithium's 3Qs and Piedmont. Europe desperately wants lithium chemical production "on the continent" even if the hard rock has to be sourced from Australia, Brazil or North America. More on that too.

The spread of this virus may be the most significant global human tragedy in our lifetime but some of the impacts may have a silver lining for lithium. Stay safe and stay home.

My mantra as of March 2022 is that it is time to get back on the road and see things for myself. It is hard to stay current without leaving home. Stay safe but get out of the house.

On December 31, 2019, I released a podcast calling the 2020's "The Lithium Decade". In a time of significant spodumene and technical grade carbonate oversupply, I believed I understood the supply dynamic and the coming EV demand well enough to call for an extended shortage based on lack of investment. I expected the shortage of battery quality material to drive prices up in late 2021. I was a year too late.

Despite the fact it is clear that "lithium still wins" that does not mean most of the aspiring producers are destined for victory. The current top six to eight players will do very well but I believe a few of these companies will be acquired or merged in the next five years.

Buy quality assets but never ignore the importance of great management. Lithium will be in oversupply again at some point but by that time I won't be writing about it.