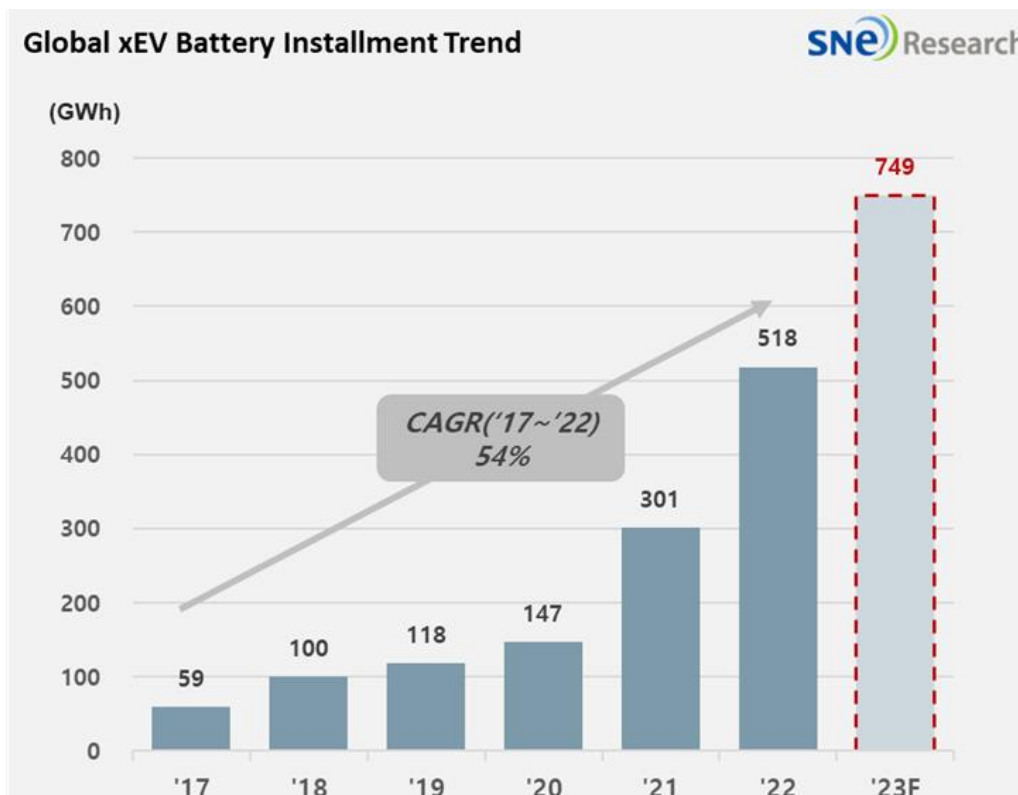


## Lithium 2023: Reality Check

Understanding the lithium market has never been more challenging. If you use google as a guide, you can find “proof” to support any theory about the market you want to believe. As always what follows are my opinions. Not always correct but hopefully useful food for thought. Just a reminder nothing that I write should be considered investing advice.

There was a lot of talk about slowing 2023 EV demand in China based on subsidy policy. I don't obsess about subsidies. China has always done a masterful job of adjusting their policies as necessary to achieve desired outcomes. More importantly EV demand has become a global story. North America, Europe and India will become increasingly significant in the EV, battery, and lithium narrative. Pundits and forecasters like to talk about EV penetration as the key metric in the electrification story. Unfortunately, there are too many variables in how those numbers are presented from varying battery sizes to BEV vs PHEV vs hybrids to be a useful surrogate for lithium demand.

From a lithium perspective, the best metric for determining demand is battery gigawatt hours (GWh) produced. One view of 2023 is below:

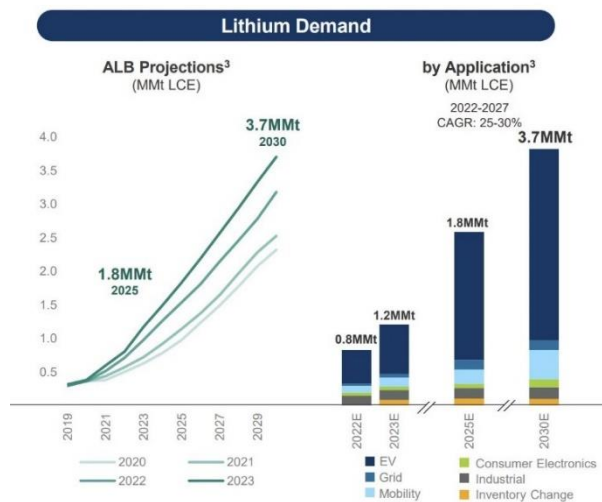


The graph above is only GWH for electric vehicles. If you add ESS and consumer battery to the SNE projection, 2023 demand approaches a terawatt hour. In December, JP Morgan projected total battery GWH of 716 for 2023 which is on the lower side. UBS predicts 811 GWH. In any case, each entity mentioned predicts substantial 2023 growth.

When doing the lithium use balance, you can quibble regarding when the cathode for installed battery GWH was produced; however, I find those details to be of limited value when looking at the demand big picture. At the risk of repeating myself, GWH demand for lithium batteries is still growing faster than supply. Sorry, Cathie Wood. Ms. Wood, the CEO of Ark (& noted Tesla bull) seems to be the most recent person to designate herself as an insightful lithium prognosticator spouting the “high prices quickly fix high prices mantra”.

Although there isn't universal agreement regarding conversion of GWH into LCEs, the typical ranges used are from .8 on the low end to 1.0 on the high end. In reality there isn't a perfect number given the differences in cathode and electrolyte used along with the processing efficiency of the particular supply chain. I tend to use a number closer to .8 than 1.0. So, if you believe 2023 GWH production will be a terawatt hour then at .8 lithium intensity, lithium demand would be 800K metric tons. Using EV penetration to forecast lithium demand requires an average battery size assumption, a BEV/PHEV/hybrid mix assumption and a cathode assumption.

As far as the lithium producers demand projections, Albemarle recently updated its demand forecast. More upside surprises.



**By the fourth quarter I believe it will be obvious that investors who worried about lithium demand in 2023 and focused on negative predictions for China without understanding the historic seasonality of the China market or had misguided concerns over Beijing's management of subsidy policy or focused on the potential impact of a global recession and let those concerns overshadow the long term growth trend simply came to the wrong conclusion. Of course, we all do that from time to time.**

## **Moving on..... Albemarle's Price Epiphany**

**If you have followed my writing or listened to the Global Lithium Podcast you know that I have been touting what I like to call the “oversupply myth” for several years. My belief and thesis were tested for a time in 2019 and early 2020 but now what was scorned as “the musing of a perpetual lithium price bull” has become a mainstream mantra that even Albemarle has embraced.**

**“(Lithium) pricing needs to remain elevated in order to support the incentives required to take on those investment risks,” Eric Norris, head of Albemarle's Energy Storage division, said during the company's 2023 Strategic Update presentation. “The (lithium) market is tighter than it was last year. Jan 24, 2023**

**The quote from Eric Norris is an ironic “back to the future” moment for me given his recent narrative on the market sounds almost exactly like mine for the first time since he joined Albemarle. Why do I call it ironic?**

**When Eric first joined FMC Lithium (now Livent) he was a peer that made several visits to Asia to attend customer meetings with me. Much to the confusion and chagrin of our Japanese customers, Eric often would repeat me leading the Japanese to ask me privately: “Lowry san, why does Mr. Norris just say what you say instead of making his own points?” I would smile and say: “he is just learning the business and really has nothing to say on his own”. Of course, over time Eric learned the business well enough to move to Albemarle and become President of their lithium business. Touché.**

**On the other hand in Eric's early days at Albemarle, the company clearly embraced a flawed view of the market that led to a misguided contracting strategy and very low prices vs competitors like SQM. Several of Albemarle's larger shareholders did expert calls with me in 2016 & 2017 in an attempt to understand why ALB underperformed SQM in price per LCE by such a wide margin despite having generally better quality. The answer was simple.**

SQM was much more adept in adjusting to market reality in 2016 and 2017. The same was true at the beginning of the current price rise but fortunately for ALB shareholders, the company (I'll give Eric the credit) finally figured it out.

On the other hand, my market views remain in conflict with Goldman Sachs and Morgan Stanley. Despite admitting they were wrong in the recent past, on February 8, Morgan Stanley reiterated their belief that they see “a price inflection point in 2023 as decelerating demand growth and increasing supply will ease market tightness”. Although Morgan thinks there will be a short term easing in market tightness, they predict the following:

	unit	2019	2020	2021	2022e	2023e	2024e	2025e	2026e	2027e	2028e	2029e	2030e
<b>Supply</b>													
Brine/DLE/Clay operations + committed	kt	145	178	234	324	433	514	564	590	595	602	602	602
Brine/DLE/Clay expansions/projects (uncommitted)	kt				0	4	10	23	62	112	167	186	188
Growth in brine supply	%	-1%	23%	32%	38%	36%	20%	12%	11%	8%	9%	2%	0%
Hardrock operations + committed	kt	214	203	268	325	402	466	500	513	535	540	540	540
Hardrock expansion/projects (uncommitted)	kt				0	1	17	52	120	166	198	225	243
<b>Total converted hardrock supply (LCE)</b>	<b>kt</b>	<b>204</b>	<b>203</b>	<b>268</b>	<b>309</b>	<b>383</b>	<b>459</b>	<b>524</b>	<b>601</b>	<b>665</b>	<b>700</b>	<b>727</b>	<b>743</b>
Growth in mineral supply	%	-7%	-5%	32%	21%	24%	20%	14%	15%	11%	5%	4%	2%
<b>Total World Supply</b>	<b>kt</b>	<b>348</b>	<b>381</b>	<b>503</b>	<b>617</b>	<b>797</b>	<b>956</b>	<b>1081</b>	<b>1221</b>	<b>1337</b>	<b>1431</b>	<b>1475</b>	<b>1494</b>
Growth in lithium supply	%	29%	9%	32%	23%	29%	20%	13%	13%	9%	7%	3%	1%
<b>Consumption by end-use</b>													
Rechargeable Battery	kt	182	232	374	492	619	765	917	1053	1208	1395	1610	1838
of which Electric Vehicle demand	kt	94	129	230	315	408	523	645	756	885	1043	1226	1423
Growth in battery demand	%	13%	27%	62%	32%	26%	23%	20%	15%	15%	15%	14%	14%
Industrial Demand	kt	136	130	138	143	147	150	154	158	162	166	170	174
<b>Total World Demand</b>	<b>kt</b>	<b>318</b>	<b>362</b>	<b>513</b>	<b>635</b>	<b>766</b>	<b>915</b>	<b>1071</b>	<b>1211</b>	<b>1370</b>	<b>1561</b>	<b>1780</b>	<b>2013</b>
Growth in lithium demand	%	7.9%	13.8%	41.6%	23.9%	20.7%	19.4%	17.1%	13.0%	13.1%	14.0%	14.0%	13.1%
<b>Market balance</b>	<b>kt</b>	<b>30</b>	<b>19</b>	<b>-10</b>	<b>-18</b>	<b>31</b>	<b>41</b>	<b>10</b>	<b>10</b>	<b>-33</b>	<b>-129</b>	<b>-305</b>	<b>-518</b>
Implied global inventory	kt	30	49	39	21	52	93	103	114	81	0	0	0
Weeks' consumption		5	7	4	2	4	5	5	5	3	0	0	0
Lithium carbonate (fob Latin America)	US\$/t fob	\$11,312	\$6,859	\$10,761	\$44,281	\$29,875	\$13,500	\$10,250	\$10,000	\$9,000	\$9,000	\$8,211	\$8,376
China spot 99.5% battery-grade	US\$/t	\$8,830	\$5,683	\$16,670	\$61,838	\$47,500	\$18,750	\$10,625	\$10,000	\$10,000	\$9,180	\$8,376	\$8,543
Spodumene price (cif China)	US\$/t	\$610	\$453	\$1,026	\$4,277	\$4,848	\$1,731	\$810	\$945	\$1,051	\$1,072	\$1,089	\$1,121
China spot 56.5% hydroxide	US\$/t	\$8,830	\$6,490	\$15,424	\$59,803	\$47,500	\$18,750	\$10,625	\$10,000	\$10,000	\$9,180	\$8,376	\$8,543

Source: Morgan Stanley Research

Interesting that Morgan Stanley predicts an oversupply in 2023 but lithium carbonate price of \$47,500/MT yet they predict a 518K MT shortage in 2030 with a price of \$8,543/ MT. Their spodumene price in 2030 of \$1,121/MT would yield a cost curve well above their carbonate price.

It should be noted that Morgan Stanley's 2030 demand number of ~2 million MT is little over half of what Albemarle predicts.

Morgan Stanley may have the most off base supply and demand projection for 2030 but several other big banks also predict demand exceeding supply for the remainder of the decade yet also show crashing prices.

I know you have heard all this from me before. Unfortunately, because of Morgan Stanley’s overall great franchise their off the mark lithium commentary gets a “halo effect” and is accepted by many investors.

## Lithium Price – Where to from Here?



NEW GENERATION ENERGY MARKET FORECASTS AND INSIGHTS

Battery Raw Material Price Update

[Methodology Guide](#) 14th February 2023



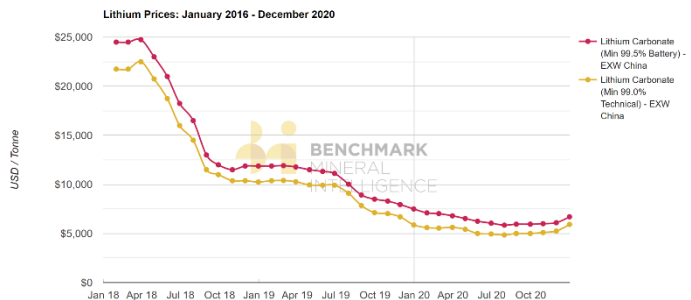
BATTERY GRADE PRICES	Code	Last Publication	Frequency	Current Price (Mid)	Current Price (High-Low Range)	Previous Price (Mid)	\$ Change	Month to date Average
Lithium Hydroxide monohydrate spot prices CIF China, Japan & Korea, \$/kg	MB-LI-0033	14-Feb-23	daily	75.50	77.00 - 74.00	76.50	-1.00	76.90
Lithium Carbonate spot prices CIF China, Japan & Korea, \$/kg	MB-LI-0029	14-Feb-23	daily	70.50	72.00 - 69.00	71.50	-1.00	72.70
Lithium Hydroxide monohydrate spot price, ex-works domestic China, yuan/t	MB-LI-0040	09-Feb-23	weekly	460,000	470,000 - 450,000	475,000	-15,000	467,500
Lithium Carbonate spot price, ex-works domestic China, yuan/t	MB-LI-0036	09-Feb-23	weekly	453,000	461,000 - 445,000	465,000	-12,000	459,000
Spodumene min 6% Li2O, Asia, \$/t	MB-LI-0012	02-Feb-23	fort-nightly	7,250	7500 - 7000	7,645	-395	7250

Towards the end of last year in interviews, I made the case that overall, 2023 would see continued upward price pressure but only after a brief correction that we are still in the middle of as I type this. Despite a correction, Fastmarkets price update from yesterday (2/14/2023) still shows very robust USD spot prices in the \$70s per kg.

Although I believe spot price dropping to the high 50s this year is possible, I don't think that happens. Wherever the low point lands, I believe spot price will be on an upward

trajectory again by Q4. When there is a clear oversupply, price drops fairly rapidly. In 2020, the China spot price for carbonate dipped below the equivalent of \$5,000/MT from the 2018 highs of \$25,000/MT.

Benchmark Min Price Data During the Last Price Correction

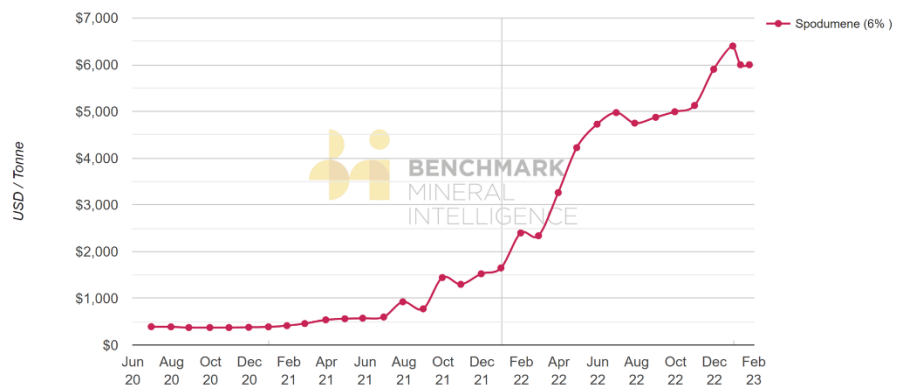


Benchmark’s price index for that period illustrates the decline.

Currently lithium prices are completely disconnected from the integrated producer (or left hand side) of the cost curve. On the other end of the curve, Chinese lithium chemical converters are paying thousands of dollars per ton for spodumene feedstock rather than a few hundred dollars as they did in mid-2020, bifurcating the cost curve between integrated and non-integrated producers.

In my opinion, the best indicator of future lithium chemicals pricing is what Chinese converters are paying for spodumene concentrate or DSO (direct shipped ore). When spodumene concentrate supply is again greater than demand, price will drop to the marginal cost of the high cost producer. I don't expect that to happen in this decade. Investors should thank Pilbara Minerals for creating the BMX exchange that provides clarity on what the marginal buyer will pay for spodumene,

**Benchmark Min Spodumene Price Data 6/20 – 1/23**



## **DLE – when will it make a difference?**

Investors love to tout DLE as a game changer making all sorts of fanciful claims. Currently, from a commercial production perspective, pure DLE is still a mythical beast although hybrid forms exist in China and Argentina. I expect the first commercial success of true DLE (no evaporation ponds) will be in the US by 2026. Major players in South America are piloting DLE which will be followed by demonstration plants. Given the time table, I do not foresee full scale DLE success in South America until 2027 or later. I don't believe geothermal projects touting DLE operate at scale any time soon.



# **The Rise of the North American Battery Supply Chain**

**In my opinion the Inflation Reduction Act is a big deal - stimulating EV/battery demand and investment in North America. Watch what Jigar Shah and the DOE loan office do as well. Obviously 2023 will be more about announcements of investments for North America that will bear fruit later in the decade.**

**It was great to see the General Motors investment in Lithium Americas for Thacker Pass. I believe this type of deal will be a trend going forward. I found it interesting that many of the Tesla faithful were sure Elon would secure Thacker Pass. I never thought we would be reasonable enough for a deal to happen.**

**Despite his brilliance and accomplishments in so many areas, Elon continues to act like an entitled child expecting the lithium industry to pander to him. The Tesla fanboys love to tell me “Elon is smarter than you are”. They believe Elon has a magic lithium bullet. Unfortunately, that doesn’t really matter to lithium producers. In today’s market, the top 6 lithium producers could sell 100% of their production without selling to the Tesla supply chain. That wasn’t true just a couple years ago. Of course, Elon isn’t used to being a supplicant. Reality Bites.....**

**Lithium demand is now dominated by battery that will be over 80% of total demand this year. That is a mixed blessing. I found the industry more interesting in the 1990s when the lithium demand pie was much more colorful with glass, grease, aluminum, and pharma having a meaningful place. Not a complaint, more of nostalgic comment. Back then few knew what lithium was. Now it is hard to find someone that doesn’t have it in their pocket.**

**There is a lot more to say about lithium in 2023 but I will leave that for the next installment.**