

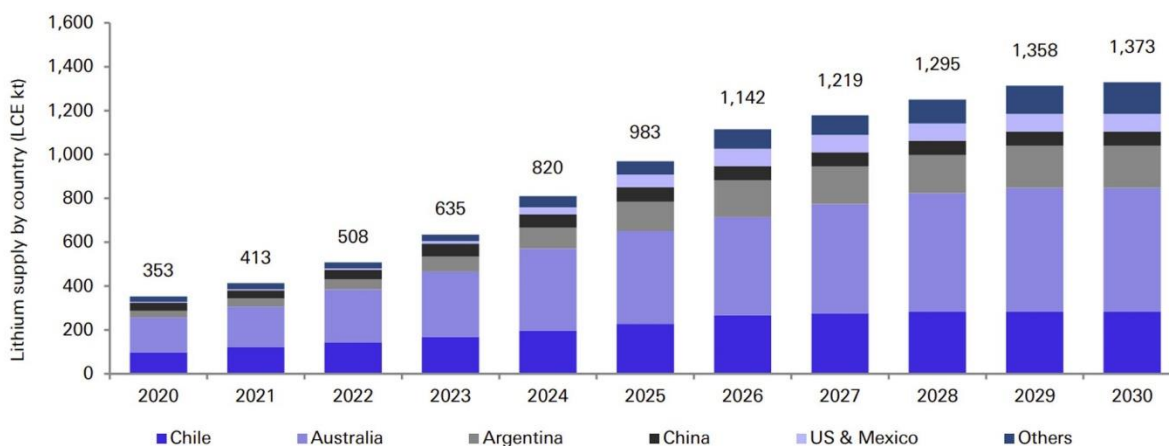
It has been over a year since I wrote the first installment of “Lithium Still Wins” and eleven months since I posted part two. Over the past year demand estimates from the likes of **Albemarle** and several big banks that prognosticate the future of the lightest metal are up substantially. Yet, investment in new lithium projects continues to lag. The Biden Administration has added their voice to the chorus calling for regionalization with the call for a “robust US battery supply chain”.

Despite extended Covid lockdowns around the world, things have never looked better for lithium – especially for those currently or soon to be producing battery quality lithium chemicals. The potential Covid “silver linings” for lithium that I closed part one with seem to have come to pass.

Let me state the obvious. As the world moves steadily toward post pandemic life, at least the Covid 19 version, it seems clear that the call for a lower carbon world requiring massive amounts of lithium in batteries for e-transport, ESS and the continuing growth of hand-held gadgets powered by the movement of electrons is stronger than ever.

Deutsche Bank recently published a lithium report. Their supply projection is below. If the numbers are close to correct, the second half of this decade is going to be a real challenge for battery makers.

DB on Supply to 2030 – Something Needs to Change Soon

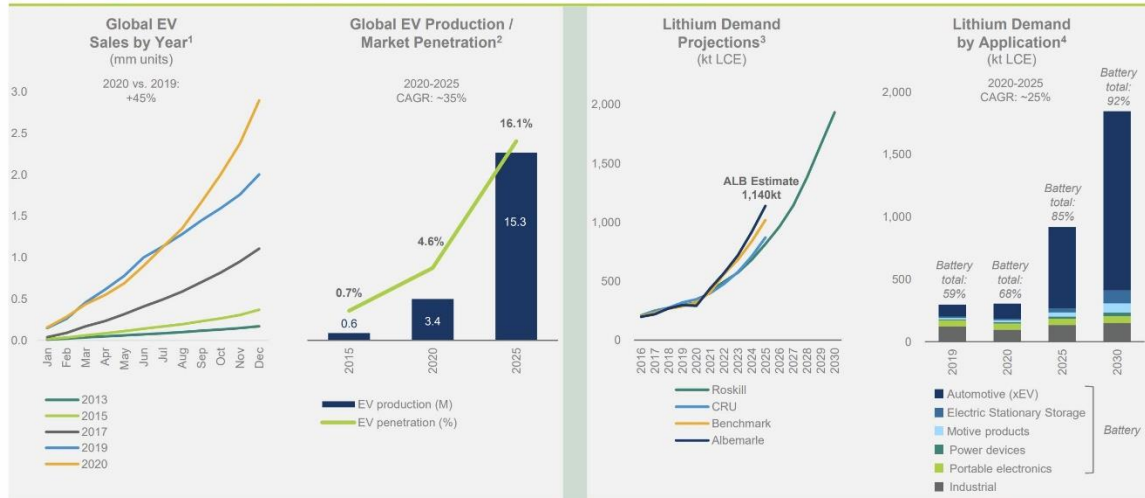


Source : Bloomberg Finance LP, CRU, Deutsche Bank. Others include Brazil, Portugal, Serbia and Zimbabwe. China only includes domestically sourced brines or hardrock, not imported material

As always, I give no investing advice. Rather I present thoughts the reader can use to help assess the market or reject as misguided musings of someone who stayed too long at the lithium party. My contention is that the “Big 4” lithium companies and the best of the rest (more on that later) are poised to do very well over the next decade as global EV penetration rises, ESS installations increase and lithium supply is in an extended period of “catch up”.

The experts that made our Covid influenced predictions for the EV market in 2020-21 were overly pessimistic – let’s give them a pass. Covid is a wonderful excuse for poor predictions. I also underestimated lithium demand growth in 2020. Albemarle’s latest demand estimate to 2025 and beyond is below. My demand number in 2025 is about 100K less than Albemarle but you get the point – the market grows at least 3X to 2025.

Strong Lithium Demand Driven by EVs



EV Producers Require Accelerated Lithium Supply Growth

I didn’t believe the market would tighten until late 2021 or 2022. No excuses, I was wrong on that count but I was correct about 2020 being the year of the “lithium enema”.

All the “experts” telling you in early to mid-2020 that China had “almost a year” of excess spodumene inventory and only slightly lower inventories of lithium chemicals were clearly wrong. The China “spot price” spike that began in Q4 2020 proved that excess inventory was consumed and resulted in a steady rise to more than triple the lowest level price in the past cycle.

To bring in some other “voices”; **Canaccord** may not think a shortage happens in the next year but they clearly see the market staying short once it happens as depicted below. I will be surprised if Canaccord doesn’t push the shortage year up very soon.

		2019a	2020a	2021e	2022e	2023e	2024e	2025e	2026e	2027e	2028e	2029e	2030e
Supply													
Brines	t LCE	150,059	150,222	166,348	207,587	280,325	325,119	354,274	428,024	508,935	532,665	532,665	532,665
% brines		49%	44%	40%	40%	43%	43%	40%	43%	47%	46%	48%	48%
Hard rock mine prod'n	t LCE	240157	225040	254304	308903	434500	506335	607715	634350	635377	632602	633276	634061
Converter capacity	t LCE	159138	193133	250878	313250	370624	435650	530840	573840	575940	575940	575940	575940
% converted mineral		51%	56%	60%	60%	57%	57%	60%	57%	53%	52%	52%	52%
Total supply	t LCE	309197	343355	417226	520837	650948	760769	885114	1001864	1084875	1108605	1108605	1108605
YoY chg %													
Demand													
Industrial applications	t LCE	108058	104496	106063	107654	109269	110908	112571	114260	115974	117713	119479	121271
% market share		44%	39%	31%	25%	20%	17%	13%	11%	9%	7%	6%	5%
LiB's - Evs	t LCE	73354	104859	185895	275617	401068	553353	756655	1002590	1313024	1660919	1964783	2280437
LiB's - other	t LCE	88620	89359	95043	103119	111999	125714	140892	158330	179930	209891	246438	294582
Total LiB's	t LCE	161974	194218	280938	378737	513066	679067	897547	1160920	1492954	1870810	2211220	2575019
% market share		56%	61%	69%	75%	80%	83%	87%	89%	91%	93%	94%	95%
Total demand	t LCE	270033	298713	387001	486391	622335	789975	1010119	1275180	1608928	1988524	2330700	2696290
YoY chg %													
Surplus/(deficit)	t LCE	39164	44642	30225	34447	28613	-29206	-125005	-273316	-524053	-879918	-1222094	-1587685
%		15%	15%	8%	7%	5%	-4%	-12%	-21%	-33%	-44%	-52%	-59%

Source: Canaccord Genuity estimates

So, what about the future balance between carbonate and hydroxide? The “hydroxide dominance” narrative that has in vogue over the past few years has largely been debunked. Yes, hydroxide has and will likely continue to have a higher rate of growth than carbonate (albeit from a much lower base) but the developments in LFP battery packs enabling longer range vehicle options via the currently safest, least expensive cathode used in EVs will prevent hydroxide from becoming the dominant lithium chemical used in batteries. Remember only versions of NMC cathode with a nickel content $> .6$ require hydroxide.

By the time solid state batteries are more than a tiny niche, lithium producers will have a new challenge - adapting to changing product requirements. Change remains the only constant – at least according to one famous Greek philosopher.

The western world bellwether of low pricing, **Orocobre**, recently announced their price has risen from the low \$3,000s/MT range to high \$5000s/MT in the most recent quarter and is expected to be in the mid \$7,000s next quarter (see their most recent presentation). Orocobre pricing shows how bifurcated the market became during the period of excess supply of low-quality material. For perspective, battery quality lithium carbonate imported by Japan and Korea stayed, on average, above \$10,000/MT throughout the period of oversupply. I will repeat my mantra “quality matters”. That said, during a shortage even the low-end product will sell for attractive margins. Just consider the performance Orocobre and SQM (who to be fair makes more high-quality material than low end product) before and after the last shortage.

Ironically as I was writing this post someone from Orocobre reached out to me to make the case that “you are making a big assumption (read: mistake) by saying product quality can be deduced from price”. Let’s unpack his criticism.

I have never made the blanket statement about price that the young manager from Argentina believes I made. Discussing price requires more nuance – the dynamics are different in periods of oversupply than they are in a shortage. I pointed out to the young man that: “before your time at ORE, during the last shortage, Orocobre actually got a premium for “primary grade” over Albemarle’s standard quality at accounts where Albemarle could not supply the full customer demand”. I went on to say that during a period of oversupply the situation changes and it becomes quite clear that a company that has a product yielding a price (clearly stated in company disclosures) that is one-third the price of battery quality material in key markets there is an issue that goes beyond signing foolish agreements. The issue is quality – more specifically producing too much low-quality product. As Warren Buffet says, “you never know who’s swimming naked until the tide goes out”.

I acknowledge that some Orocobre customers have indicated quality improvements of Olaroz product yet I stand by my statement that the main reason for Orocobre’s price performance since the last shortage ended is largely due to quality. I am happy to have someone from Orocobre on the **Global Lithium Podcast** to explain their thoughts on

quality, price as well as the recent “Galacobre” merger announcement. I don’t expect a “yes” to my invitation but you never know. Remember Eduardo Bitran accepted a podcast invitation and the episode got > 80K downloads.

I am often asked: “why is the currently developing lithium shortage different than what happened in 2016-18? Won’t “market forces” move lithium quickly back to oversupply?”

Below I offer a few reasons why lithium oversupply isn’t returning any time soon.

1) Global BEV market penetration was < 1% when the last spike in lithium market price began. Based on increased EV sales beyond the China market and **Tesla**, LCE demand will grow more than twice as much in 2021 than in did it 2016 and 2017 combined. Next year, lithium demand will grow by more than 100K MT LCE on the back of low to mid-single digit EV penetration. Those that believe EV penetration in 2025 will be in the mid-teens need to reassess – it is already too late for the lithium industry to supply the quantity and quality of lithium required for 15% pure EV penetration in 2025.

2) More industry discipline. During the last cycle multiple mines came online over a brief period of time – **Mt Cattlin** restarted, **Mt Marion** began producing as did the **Pilbara** and Altura operations. A “mini tsunami” of DSO moved from **Wodgina** to China. **Bald Hill** had a brief tenure as a producer. EV growth in China stalled just as Australia overproduced spodumene concentrate and DSO taking precursor prices down to below the cost of many WA operators and temporarily altering the cost curve for converters in China.

Is **Mineral Resources** selling DSO in this cycle? No, **Chris Ellison** has gotten religion regarding the benefits of selling a value-added lithium chemical in partnership with ALB. Wodgina is now capable of shipping concentrate rather than DSO but currently remains on care and maintenance. The Altura operation is now part of Pilbara which ensures that profitable pricing happens before Pilbara runs at 100%. This will keep the China converter cost curve at elevated levels as demand continues to outstrip capacity restarts and expansions.

All the capacity that currently exists in WA will be needed before 2025 but the supply spigot will be better managed this time around. The lithium shortage beginning this year will continue for an extended period. The fact is you can build cathode and battery capacity much more quickly than a lithium resource can be identified, permitted, financed and result in the production of lithium chemicals.

3) Regionalization of battery supply chains is becoming “a thing” but lithium supply is well behind investment in battery capacity in places like the EU and the US. Regionalization should create more lithium opportunities.

Although investment in lithium is still lagging. On the positive side, companies from **Lithium Americas** to **Sigma** to **Piedmont** have been able to raise funds via capital markets but many junior mining projects still cannot access sufficient capital to bring

their projects online. Of course, majors like Albemarle and SQM have also tapped equity markets recently too.

I recently began listening to the “All – IN” podcast where **Chamath Palihapitiya** and three of his well-heeled investor pals have a weekly discussion of issues of the day. Chamath, the CEO of Social Capital also known as the “SPAC King”, seems to have a real interest in energy transition related investments such as rare earth producer MP Materials. I would love to see Chamath make a move into lithium. He seems to have both the interest and the capital. Eventually I believe “deep pockets” will be attracted to lithium.

Auto OEMs announcing dozens of new EV models and battery producers announcing new gigafactories are living in a fool’s paradise by assuming the lithium required for their new capacity will magically appear. I am aware that many people believe that the OEMs must have a plan for battery raw materials before they commit capital to electrification. I wish that were true.

Many industry watchers believe that **recycling** will make a major contribution to lithium raw material supply in this decade. Unfortunately, that appears to be wishful thinking as much of the “black mass” will be from recycling battery cells that don’t meet spec and can’t be used. The reality is the lithium used to make the cathode in the unusable cells is lithium supply that is delayed on the way to market increasing the shortage. Recycling this black mass is helpful but not truly adding to supply – in this case it is delayed lithium supply. It will be years before sufficient inventory of end of useful life batteries contribute sufficient “black mass” that represents a meaningful contribution to the circular EV economy.

The stage is set for the Big 4 (Albemarle, **Ganfeng**, **SQM** and **Tianqi**) to prosper over the next decade unless they are the victim of self-inflicted blunders. Tianqi’s ill timed investment in SQM almost resulted in bankruptcy. Even a company with great assets can be brought down by hubris. In Tianqi’s case they avoided ruin by selling a portion of their flagship asset.

Galacobre, my moniker, for a merged **Galaxy** and Orocobre may do well. If you want more detailed thoughts - I recorded a short podcast on the merger. It can be found at globallithium.net/podcast. Livent continues to talk a good game but given their resource capacity is now dwarfed by all of the “Big 4” they may end up profitable but irrelevant given their limited scale. In the case of both Galacobre and **Livent** I believe the best outcome would be a takeover by a large mining or energy company looking to enter the lithium space. Both entities would benefit from owners willing and able to invest and expand at something beyond the current glacial speed exhibited by all concerned in Argentina.

Strategically positioned to progress Olaroz, Sal de Vida, Naraha and James Bay in parallel

- Strong financial position to support development of projects in parallel
- Leverage combined technical and financial resources to develop growth pipeline and deliver the key milestones in parallel
- Apply Orocobre's brine project development expertise and combined financial strength to assess the potential for an accelerated single stage 32ktpa LCE project at Sal de Vida
- Leverage significant hydroxide expertise developed at Naraha to assess and develop an integrated downstream strategy for James Bay
- Sufficient scale and talent to deliver key milestones in parallel to one another

KEY PROJECT MILESTONES

Project	Milestones	Date (Calendar Year)
Olaroz	• Complete Stage 2 construction	• H1 2022
	• Complete Stage 3 DFS	• H1 2022
	• Optimisation of Olaroz Stage 1	• 2022
Naraha	• Complete Stage 1 commissioning	• Q1 2022
	• Options study for Stage 2 expansion	• H1 2022
Accelerated Sal de Vida Project	• Continuing current plan of developing Sal De Vida in 3 stages of 10.7ktpa ¹	
	• The merged entity to progress a study for an accelerated single stage 32ktpa development	• ~6 months after Transaction close
James Bay	• Complete DFS for upstream project	• H2 2021
	• Complete DFS for vertically integrated downstream project	• H1 2022

Fair question: Orocobre & Galaxy each have a legacy of poor project execution (Olaroz & SDV). Why does this change with a merger?

Of the emerging junior lithium chemical producers, it will be no surprise that Lithium Americas is my favorite given they have two world class projects in **Cauchari** and **Thacker Pass**, a great partner in Ganfeng and a first-class management team.

I am also hopeful that the **Standard Lithium/Lanxess** partnership results in the first true DLE production at commercial scale.

Pilbara after taking on the Altura asset has cemented their position as the top independent spodumene producer that hopefully will extend their franchise to participation in lithium chemicals.

Mineral Resources has played the lithium game well and benefits from partnerships with both Albemarle and Ganfeng. You have to love the way Chris Ellison has negotiated with and extracted value from Albemarle. That said over the long term I believe Albemarle is better off with Min Res as a partner. They may have learned a thing or two about negotiating along the way.

Those concerned that higher lithium prices will slow EV growth need to harken back to **Elon Musk's** "lithium is the salt on the salad" comment. Lithium is not a major cost driver in EV battery packs. Economies of scale will continue to bring battery cost per KWH down no matter what lithium shortages do to price. On the other hand.....

Unfortunately, inadequate lithium supply will slow the growth of e-transportation and storage for renewable energy for at least a few years but in that scenario lithium investors should win big even if their win has negative consequences for the speed of the energy transition. The battery industry, car companies and governments from Europe to North America have no one to blame but themselves.