Bridging the gap between battery supply and energy storage demand

Supply chain | The mismatch between supply and demand for lithium batteries presents a challenge to the global transition to sustainable energy and the role energy storage will play in it. Andy Colthorpe hears how the dynamics are playing out, and how the challenge can be overcome.

Credit: Imperial County Executive Board.

California's Salton Sea holds an opportunity to develop geothermal brine extraction from a region dubbed 'Lithium Valley'. Credit: Imperial County Board of Supervisors.

In the last edition of PV Tech Power, we took a dive into how various factors, both expected and unexpected, have caused disruptions in the supply chain for stationary energy storage.

Coupled with global economic and political factors, phenomenal rise in demand for lithium batteries, led primarily by the electric mobility sector, is leading to constraints, in turn delaying projects and investment decisions.

This time, we ask what mitigating strategies can be taken, from startups looking to deploy storage, to politicians looking to support the growth of economies based around clean energy.

The big picture

As second half of this year began, lithium carbonate pricing remained the main concern, according to Cormac O'Laire, senior manager for market intelligence with Clean Energy Associates (CEA). Even as additional lithium mining projects come online in Q4 2022, CEA expects supply will remain tight.

"To address potential lithium shortages, battery and nickel manganese cobalt (NMC) cathode makers are entering into long-term agreements with lithium miners. The price of commodity metals such as nickel and cobalt have begun to ease following significant volatility after Russia's invasion of Ukraine sparked nickel and copper supply fears," O'Laire says.

While the price trends of those commodity metals are expected to "remain flat until the end of the year," investment in battery raw materials mining in general is "woefully underfunded," with CEA forecasting that about US$5 billion will have been spent in this area during 2022 worldwide.

Whereas, to quote Battery Metals Review analyst Matt Fernley's forecasted figures, US$15 billion annual investment is required to meet battery demand just from electric vehicles (EVs) by 2030.

"More investment in raw materials, and particularly in lithium, is required by both governments and the private sector to resolve looming supply-demand constraints," O'Laire says.

Further downstream, in China, battery energy storage system-specific (BESS) cell factories are being built that will take the country's annual production capacity to more than 200GWh, which "should be enough" to meet global demand up to 2025. In Europe and the US however, BESS cell projects are taking place, but to a much smaller extent and would not be able to meet demand independent of China, according to the analyst.

Meanwhile, over 5 million tonnes of lithium iron phosphate (LFP) BESS cathode active material (CAM) capacity expansions have been announced in China, about 2TWh of CAM, which will far exceed projected demand by 2025. So, there's a chance, a "serious possibility" even, that LFP will be a surplus market as early as 2024, O'Laire says.

Startups vs big players

Some industry players believe the situation is beginning to ease, especially regarding the impact of COVID-19 on logistics.

Some calming of price volatility makes it likely BESS project developers will start to be able to consider Final Investment Decisions during Q3 2022, CEA analysis has indicated.

Credit: Controlled Thermal Resources.

Artist impression of how co-located geothermal power generation and lithium extraction could look in Lithium Valley.

After some of the biggest price increases in years, prices for key battery metals like cobalt, lithium and nickel have "turned the corner". With lithium chemical prices having the greatest impact among those commodity costs, CEA is expecting lithium prices to remain relatively flat, below the highs that were seen earlier this year, for at least the rest of 2022.

Supply-demand balance will remain precarious however, from Q4 into Q1 2023, and that could drive prices up into the New Year, according to Cormac O'Laire and his team.

The short-term disruption means the storage industry has had to swallow rising costs of batteries or pass them onto customers.

The good news appears to be that not many report a fall in demand, despite some introducing raw material index (RMI) based pricing, following the lead of the EV industry.

"Index-based pricing is a tool that was used in the past when lithium prices and demand were low to protect lithium miners. More recently battery manufacturers and miners are using index contracts alike to share price risks and secure supply," O'Laire says.

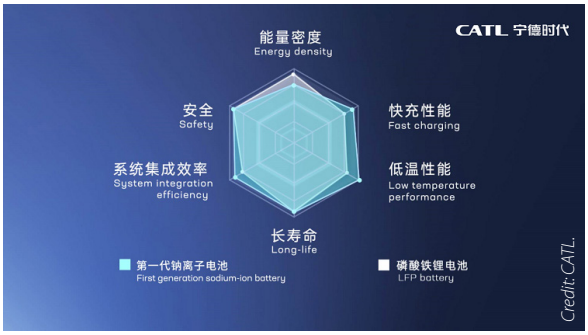
Index pricing helps protect developers against securing long-term contracts at high pricing, but that also makes it difficult for them to get visibility over their medium-term pricing forecasts or long-term purchase agreements.

Yet index-based pricing is likely to be in place in supply contracts across the industry for the foreseeable future, and in the US industry, that means BESS investors and stakeholders will need to develop finance strategies that include indexed agreements, CEA believes.

The impacts will likely affect bigger players in very different ways to startups. The likes of Fluence, Powin Energy and Honeywell, among the bigger system integrator and BESS manufacturers in the non-Chinese industry, have locked in deals for multiple gigawatt-hours of cell supply over several years. For smaller players, the scramble continues.

"Whoever is a small consumer of battery cells, is very much in a pickle at the moment," Dr Nicolo Campagnol, solution manager for McKinsey Battery Insights, says.

There's a need to think outside the box. One interesting thing is that companies developing second life battery solutions, repackaging used battery cells and packs from EVs into ESS applications, are flourishing, as are various second- and third-tier battery makers.



China's CATL has identified a commercialisation opportunity for sodium-ion batteries.

It's not just ESS companies. It's also in consumer electronics and even two-wheeled mobility applications. Anyone who isn't looking to buy about a gigawatt-hour of cells per year has to be agile in sourcing them and many are asking after second life or non-Tier One products, Campagnol says.

That's a freedom the smaller players and startups have that the bigger companies don't. Big, established players are still of a mindset that they need to use new, Top Tier, batteries. Yet second life batteries will have their place in the BESS sector. It may not be a dominant technology set by any means, but the McKinsey Battery Insights solution manager says it would be wrong to underplay its role, which may account for at least double-digit percentages of installations in the coming years.

Right technologies for the job

LFP is increasingly the cell chemistry of choice for BESS. In PV Tech Power Vol.31, we heard that the growing popularity of LFP for electric cars, particularly for shorter range, lower priced vehicles, erodes availability of cells for stationary storage.

Historically, NMC had been "the Gold Standard," for BESS, says Nicolo Campagnol, but this gave way to a recognition both in China and elsewhere that the less energy-dense, but cheaper, LFP could be a "great idea" for stationary storage. As CEA's Cormac O'Laire points out, China has even banned NMC for grid-scale storage over safety concerns.

Yet LFP requires a higher proportion of lithium in the cell than NMC, and lithium carbonate price rises affect LFP more than other chemistries, while growing demand from mobility means less LFP – at least until more LFP factories come online.

Unhappy with paying so much or being unable to get cells, the BESS industry and other consumers see innovation and diversification as an answer.

Some players are developing and commercialising sodium-ion cells, for example. Potentially cheaper and decoupled from demand from the EV sector, McKinsey sees the huge potential of this technology, yet, as for many other new products, only time will show whether claims of lower costs will hold true as R&D progresses and production capacity ramps up.

Looking further ahead, diversification in the BESS sector might be led by a different practical consideration, according to Steve Eglash, director of the Applied Energy Division of SLAC National Accelerator Laboratory.

SLAC, based at Stanford University, is one of three US National Laboratories based in the California Bay Area collaborating to accelerate the US battery industry.

The challenge facing stationary energy storage battery supply chains is fundamentally down to its symbiotic marriage of convenience with EVs, Eglash says. With many gigawatt-hours of batteries being made for cars, the BESS industry benefitted from the EV sector's cost reduction curves and scale.

"My feeling is that while the batteries being manufactured today are quite good, and more than sufficient for EVs, and that's why we're seeing the rapid expansion of EVs, they're still not quite what's needed for stationary storage," Eglash says.

"The thing that's limiting a more rapid growth of stationary storage is not the supply chain, but rather that we don't quite yet have the right batteries for stationary storage."

That means batteries that "maximise power density versus dollars, rather than power density versus weight, because weight matters for a vehicle, it doesn't matter for stationary [applications]," Eglash says, as well as batteries that discharge over much longer durations, anywhere from 12 to 24 or even 96 hours. Those will come, he believes, but they're not commercialised at scale yet today.

As Clean Energy Associates' Cormac O'Laire explains, the primary defining characteristic for EV batteries is energy density (watt-hours per kg) versus volumetric energy (watt-hours per litre) for ESS batteries. As the table below O'Laire provided shows, there are other differences in requirements for each application.

Battery manufacturers produce cells specific to EVs or ESS. The same cells are not used interchangeably, and Cormac O'Laire notes that even for LFP cells, the cathode

	EV batteries	ESS batteries
Service Life	5-8 years	20 years
Cycle Life	2,000	<4,000
Safety	High	Very high
Cost	Higher (80% of pack)	Lower cost (60% of BESS system)

Requirements

active material (CAM) used will differ in of terms electrolyte formation, material performance, cell capacity and charge/discharge rates. The increase in factories serving the stationary storage sector is likely to erode competition between EV and ESS from 2024 onwards.

"ESS-specific plants may alleviate current supply issues such as unfilled or cancelled supply agreements," O'Laire says.

However, both applications compete for the many of same raw materials. Higher profitability in electric cars may also steer more market actors in that direction.

Driven by a differing need, the increase in demand for long-duration energy storage, CEA thinks it likely there will be more ESS-specific energy storage technologies going forwards. Those technologies would struggle to compete for cost and scale with lithium in shorter duration applications. However, for applications that require "significantly more than four hours of storage," non-lithium technologies will have their best shot.

And ongoing lithium materials shortages and high prices mean some customers already ask Clean Energy Associates about alternatives including sodium-ion, sodium sulfur (NAS) batteries and flow batteries, particularly vanadium redox flow batteries (VRFB).

Away from China

The pandemic caused shipping delays and other logistical issues that showed how dependent global industry is on Chinese factories, technologies, and supply chains.

For the US, that's a concern given rocky relations between the two countries. But in a wider sense, dependency on any one region ties industry to a single point of failure. In the US and in Europe, there's also a desire to claw back economic competitiveness and bring at least some of the IP and manufacturing at home, or closer to home.

McKinsey Battery Insights' Nicolo Campagnol says there's a desire to onshore or nearshore production at various stages of the value chain. Fluence recently announced the opening of an ESS assembly plant in Utah, Powin Energy has partnered with a contract manufacturer based in Mexico. While many of the cells will be produced in Asia, both system integrators see it as a major step in bringing production closer to a major customer base at home.

Tony Van Buuren, deputy associate director Lawrence Livermore National Laboratory, one of the other two Bay Area national laboratories collaborating with SLAC – the other is Lawrence Berkeley (Berkeley Lab) – says innovating in the next generation of battery technologies is the best way to establish longer-term competitiveness.

"If you invest in technologies that are already going, lithium-ion technologies that are primarily in Asia right now, that is no way to repatriate. We need to innovate what the next generation of energy storage batteries are going to be," Van Buuren says.

The key word is 'leapfrog,' says Noel Bakhtian, director of Berkeley Lab Energy Storage Center. The three labs are working out how to "avoid having to spend decades on developing something" all the way from new material to commercialised product because of the manufacturing gap in-between.

One longstanding veteran of Europe's energy storage industry, Bo Normark, a strategist at European Union-backed innovation hub EITInnoEnergy said a while back that competing with China for market share is an unrealistic aim. However, Normark said, it should be unacceptable or unthinkable that Europe will capture no market share at all.

Berkeley Lab's Noel Bakhtian points out that the EU's European Battery Alliance (EBA) has already put billions into developing the continent's manufacturing ecosystem. Dozens of gigafactories are in construction or development in Europe and it's a lead Bakhtian hopes the US can follow.

European Union Commissioner Maros Sefkovic, a founder of the EBA, recently visited counterparts in Washington DC and there was talk of stronger collaboration. In the US, even before Joe Biden became president the White House's previous occupant signed off legislation to foster Critical Materials supply chains and launched the Energy Storage Grand Challenge, a competitive funding opportunity for promising long-duration energy storage tech.

Efforts have picked up pace since Biden took office. Around US$7 billion funding for batteries was unlocked by the Bipartisan Infrastructure Law. SLAC's Steve Eglash says that's "an order of magnitude greater" than existing R&D efforts in that area and emphasises that the money will go largely to industry, with the national laboratories "playing a supporting role".

There are numerous other policy initiatives, none of them bigger than the US' biggest-ever climate investment, as Biden has described it: the Inflation Reduction Act. Along with a standalone investment tax credit (ITC) to stimulate downstream demand, that key legislation will unlock support for manufacturing and R&D and includes a total US$369 billion of climate crisis mitigation and energy security pledges.

In the last edition of the journal, we heard about the "great disconnect" between raw materials supply and battery manufacturing plans, from Benchmark Mineral Intelligence analyst Caspar Rawles. There simply is no easy fix for that, but the fact is that investing in lithium and other raw materials supply is in the money, which is ironically driven by the same challenging conditions facing the market.

Today, there are efforts to develop direct lithium extraction from brine in Germany and California, to name just two examples. Lithium can be extracted in many ways, McKinsey's Nicolo Campagnol says, and through methods that have a lower footprint than others, such as geothermal brine.

"It's beautiful to see all these different technologies coming up, and many of them are actually very feasible," Campagnol says.

"On the other hand, not all elements can be done like this," he says, citing the example of cobalt.

"And so not all of the raw material 'basket', can be tackled with the same things. Obviously high prices will [have an] influence in general, but some elements are more prone to find a solution quicker than others."

As Noel Bakhtian from Berkeley Lab points out, the climate crisis has no borders. Water and air have no borders. Ultimately, these problems facing the energy transition are for all the world to solve together, no matter who might take the lead at any one time. ■