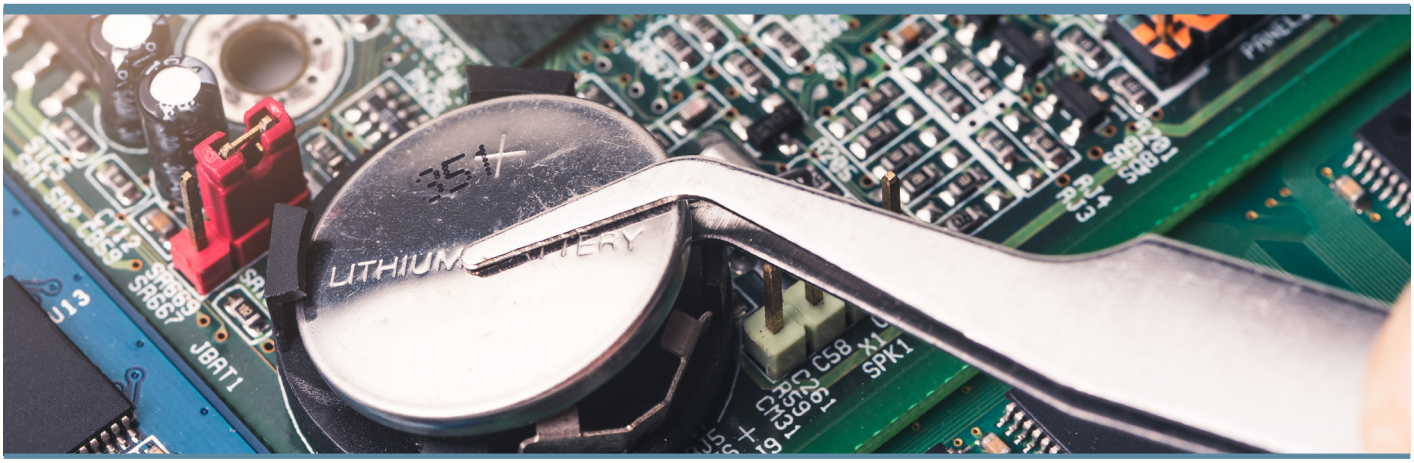

Executive Insights

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Why are Battery Companies Investing in Mines? — Strategies for Vertical Integration in the Mining Industry

As the market in batteries for electric and autonomous vehicles develops, the downstream players that traditionally participate in chemical and battery fabrication have shown a propensity for investment in upstream mineral extraction and processing.

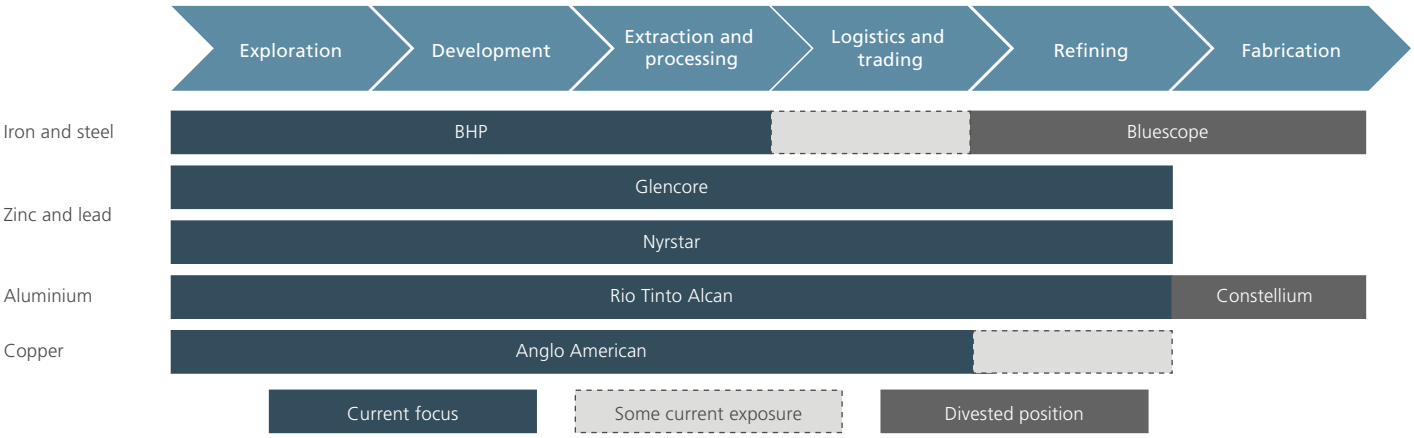
The battery mineral mining sector is currently one of the hottest for merger and acquisition activity and companies such as Ningbo Shanshan, Toyota Tsusho and Great Wall Motors have all taken steps to become participants in upstream mineral assets over the past 24 months. While these are all examples of direct investments in minority interests, other peers have taken an indirect investment approach through long-term offtake agreements (think Ganfeng Lithium, LionEnergy and Tesla).

The common thread in all this activity is a desire for vertical integration. In this paper, we consider the rationale for companies to take a vertically integrated position in the mining sector, review the application of these rationales for vertical integration in the battery minerals sector (using lithium as an example), and examine the impact that this has on the capabilities necessary for success.

Vertical integration in the mining sector

Vertical integration in the mining sector is not a new phenomenon (Figure 1). A cursory glance at the histories of

Figure 1
Vertical integration in the mining sector



Why are Battery Companies Investing in Mines? — Strategies for Vertical Integration in the Mining Industry was written by **Philip Wheeler**, **Yong Teng** and **David Ogilvy**, Partners at L.E.K. Consulting. Philip and David are based in Melbourne. Yong is based in Shanghai.

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companies such as BHP, Rio Tinto and Anglo American identifies dozens of examples of investments in companies downstream of the extraction and processing value chain. As time has progressed, the majors have divested a number of these positions, and so Bluescope, Constellium, Scaw Metals and their peers were reborn. But vertically integrated positions still remain in commodities such as aluminium (Rio Tinto), copper (Anglo American's Chagres copper smelter) and zinc (Glencore, Nyrstar).

There are four typical reasons to vertically integrate in the mining value chain:

1. To reduce the impact on a downstream position (e.g., refining or fabrication) from the market supply cycle (i.e., being caught short on raw materials input) or volatility of pricing in upstream raw materials.
2. To take advantage of improved margins or mineral value in an adjacent sector of the value chain.
3. To improve the channel to market for an upstream mining position through downstream integration.
4. To generate new or incremental demand in a commodity.

Reduce volatility on a downstream position

Mineral pricing is inherently volatile, and insulation from this volatility is one of the main reasons for vertical integration, particularly when the ability to pass price volatility on to the next customer is diminished. Price volatility is in turn driven by supply-demand dynamics, but the volatility is asymmetrical. While microeconomics tells us that the low point of prices is driven by the marginal cash cost of production (in the long term), there is no such barrier to the upside in pricing. Arcelor Mittal's venture into iron ore and metallurgical coal production in the late 2000s was at least in part driven by a desire to reduce volatility in the cost of goods for its steel production facilities.

Take advantage of improved margins

The extraction and conversion of minerals into product can be highly capital-intensive. This limits the potential for new entrants and can create a more attractive market dynamic that drives higher relative margins than in lower capital-intensive activities. In addition, minerals are not equally distributed across the world but tend to show high concentrations in certain geographic districts. In the iron and steel value chain, the returns available to iron ore and metallurgical coal are typically superior to steel, albeit more volatile as per the previous section. Superior mineral returns can be attributed to a much better market structure for iron ore and met coal, which have a small number of large producers developing privileged and often isolated assets in a minority of countries. By contrast, the steel industry is characterised by an oversupplied and fragmented market where national champions can be, and are, developed in almost any country.

Improved channel to market

All businesses need a link to their customers, and the relative strength of that relationship is a factor in driving the returns available to each participant. There are instances where the channel to market for minerals can be more challenging given a differentially strong position held by a particular stage of the value chain that results in it capturing a disproportionate share of the value created. For instance, the smelting and trading activities of the zinc and lead markets are held by a small number of large organisations. A new player in zinc mining may be encouraged to invest in its own smelting capacity if the returns were greater than those offered by existing participants (subject, of course, to a realistic and objective assessment of the specific economics of the investment opportunity and likely competitive response).

Generating incremental demand

Mineral producers are motivated to ensure that the demand for their products steadily increases. Demand growth provides a larger absolute market for sales but also ensures that the supply-demand balance remains in check against any overinvestment in extraction assets. Brazil produces almost 90% of the world's niobium and CBMM is the largest local producer. Since its early days, CBMM has operated a market development programme, working with and investing alongside its steel-making customers to seek new applications for niobium-alloyed steels and improved performance outcomes — and in doing so, increase demand for niobium. In the 2000s, niobium demand doubled from c. 30 kilotonnes per annum (ktpa) to c. 60ktpa of niobium content in concentrate, and the market has maintained those high levels since that time.

Vertical integration in battery minerals

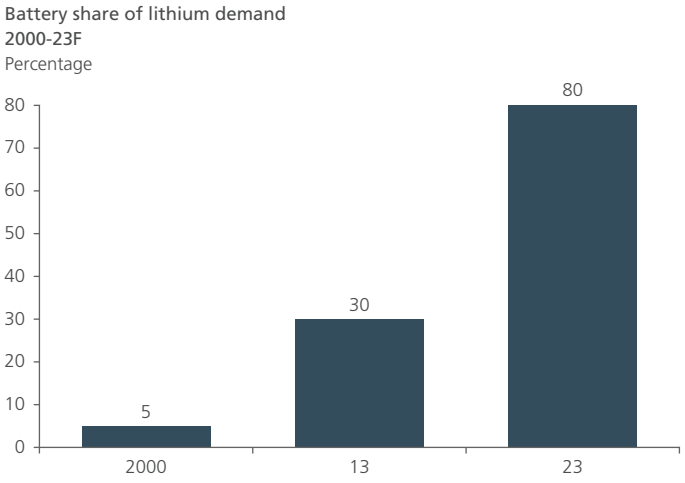
With four potential rationales for vertical integration in the mineral sector, we can now turn our attention to battery minerals. While examples of vertical integration can be identified in cobalt, nickel and other minerals, this paper will focus on lithium-based minerals.

Recent market evolution

A decade ago, the market for lithium minerals was relatively mature, primarily driven by uses in glass / ceramics, greases, air treatment and other nonbattery sources. Prices were stable, aligned to the cash costs of the marginal producer. In 2000, demand for lithium-based batteries contributed c. 5% of lithium demand. The demand placed on this sector from the use of lithium

for batteries has rapidly increased (Figure 2). By 2013, it had grown to c. 30% of demand, and in five years' time we expect this to be 80%. In addition, the end-use demand source has shifted from traditional, small-scale, lithium ion batteries for electronics and smartphones into the much larger and rapidly growing sector of electric vehicles. This rapid change of environment has pushed the lithium market back into a period of "immaturity" characterised by high levels of demand growth (upwards of 20% per annum), the application of new technologies for production and use, a rapidly changing supply-demand dynamic, the entry of new supply participants, rapidly increasing industry value, and highly volatile prices as demand periodically outstrips supply.

Figure 2
Battery share of lithium demand

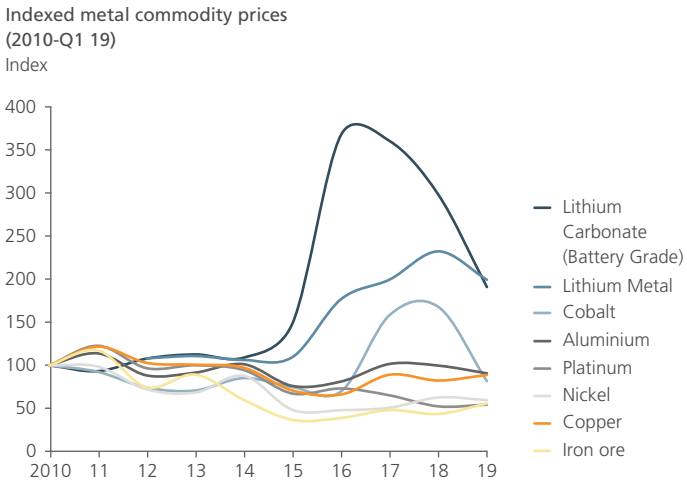


The rationale for vertical integration for downstream lithium players

The "immature" market described above has proven to be a troublesome one at times for lithium ion battery chemical and cell fabricators. While they look to build capacity to satisfy the rapidly increasing customer and end-user demand for batteries and precursor chemicals, the (real and perceived) volatility in lithium supply and prices has remained a threat since the initial price spikes of 2015 (Figure 3).

It is no wonder that vertical integration has been considered. Taking our framework for vertical integration in mining, the downstream battery players have been regularly exposed to the market supply cycle and volatility of pricing in upstream raw materials. Vertical integration is a valid and obvious strategy to managing this volatility, and both direct and indirect investments provide some level of support and insulation to that volatility.

Figure 3
Indexed metal commodity prices



Sources: Thompson Reuters Datastream; Roskill; L.E.K. analysis

The rationale for vertical integration for upstream lithium players

Interestingly, our framework for vertical integration also encourages the existing and emerging upstream players to vertically integrate, and this may explain why so many deals have been achieved recently. The manufacture of spodumene is relatively low complexity and producers, therefore, receive relatively low pricing and margins for the product as a concentrate (c. $600/tonne of spodumene or c. $4,000/t of lithium carbonate equivalent). Investment in a lithium refinery, converting spodumene into lithium carbonate (or lithium hydroxide), unlocks pricing of over $10,000/t. In doing so, the spodumene producers have moved into an adjacent value chain segment, which appears to have improved returns, even after considering the capital investment. In addition, investment in a spodumene refinery improves the channel to market for lithium mineral producers, with refined material finding a broader range of customers in battery chemical and cell fabricators rather than being dependent on the relatively high concentration of refining partners in Albermarle, Tianqi, Ganfeng and SQM.

Case study: Lithium Australia

One interesting example of vertical integration, which we might look to rename "cyclical integration," is evident in Lithium Australia. Its strategy covers the full life cycle for lithium including mineral extraction, conversion to refined products, manufacture of battery cathodes and recycling of spent lithium. This strategy may be redefining what vertical integration means for the sector.

Realising value from a vertical integration strategy

It seems clear that the lithium battery chemical and cell fabricators are being driven by a concern for market supply and the pricing of lithium to invest in upstream lithium extraction. However, the strategy is not without risks and a number of considerations must be made before investments are considered.

Risk factors

1. While vertical integration upstream can reduce earnings volatility at the macro level, there are a large number of new variations introduced into the enlarged business. On mine, these can include mineral grade variation, differential rock formations and blast outcomes, processing throughput and recoveries, and machine utilisation variation. And in the broader market, demand and price volatility are typically higher than for fabricators, with the balance sheets of extraction companies brought under stress during periods of low pricing.
2. The investment in a new business segment can significantly distract management from the existing core business and spread their available time and energy across a number of diverse business sectors. This is particularly high during acquisition close and integration, when senior management is required to performance-manage the new entity.
3. Internal challenges with transfer pricing and performance management can increase and a focus on increased internal transparency, as well as the use of external benchmarking, may be required to resolve these challenges.
4. Sovereign risk can increase when investments are made in countries where beneficiation policies are being considered and governments dictate requirements to bring some manufacturing to the country of mineral extraction.
5. Operational risks need to be managed between the upstream and downstream assets to ensure that supply disruption from owned upstream facilities does not impact the downstream production. Third-party supply provides options for reparations in the event of nonsupply, which is not available to vertically integrated companies.
6. Customers of the upstream assets may perceive a channel conflict and divert purchases of minerals to other independent producers.
7. As the market becomes mature again and the rationale for vertical integration dissipates, it may be difficult to unwind the strategy.

Risk management strategies

In order to best manage these risks, it is critical that investors think carefully about their operating models and investment horizons to ensure that the strategic value in vertical integration is captured and that returns on investment exceed the stand-alone net present value. A clear set of guidelines for integration should be developed — one that considers the options to acquire any new capabilities — as well as providing a basis for decision-making on the degree of managerial integration, system and process choices, and internal price / risk sharing. In addition, strategic benefits should be identified as part of due diligence and a process put in place to secure them as part of the post-merger integration process.

Conclusion

We have applied our framework for investments in vertically integrated mining positions to the lithium industry and shown that both downstream lithium battery chemical and cell fabricators and upstream extraction companies are encouraged at this time to vertically integrate.

Although the rationale for investment differs, the two stories coalesce in the current period of market immaturity for lithium-based minerals. The characteristics of that market immaturity are likely to persist until a more stable demand environment is achieved, with growth in the single digits instead of the current levels of 20% p.a.

As market participants look to vertically integrate, they will need to consider the incorporation of new capabilities within their organisations to manage the different risks inherent in the new value chain steps and in a vertically integrated strategy. That capability may develop as an internal team, likely hired from within the existing mining community, or be accessed through external partnerships. Companies will also need to consider the most valuable operating model to place around the newly integrated business to ensure that the strategic value is captured and that returns on investment exceed the stand-alone net present value.

About the authors

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Philip Wheeler is a Partner in L.E.K.'s Industrials practice. He has nearly 20 years' experience working across the natural resources value chain and in industrial products and distribution, industrial services, and logistics. He has worked with a variety of international clients on strategy development and implementation, and post-merger integration. He holds a Bachelor of Science in Industrial Chemistry from the University of New South Wales.

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