



PRICE POINT

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analysis for our clients.



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THE LITHIUM BATTERY BOOM AND ITS IMPACT ON RAW MATERIALS

T. Rowe Price has long suspected that consensus estimates for global electric vehicle (EV) penetration were too conservative. While Street analysis estimated 4% penetration in 2020 and 15% in 2025, key battery component makers in the Asian region, such as LG Chem and Samsung SDI, were predicting a notably higher 6-10% penetration by 2020. Our proprietary internal analysis of EV demand supported this notion that the Street's estimated 15% EV penetration by this date, looks potentially understated as EV's reach cost parity to internal combustion engines by the early 2020's. This insight enabled us to draw important conclusions for raw materials demand.

In this context, the mining/raw materials industry is, quite literally, at the heart of the EV growth story. The potential growth pattern of EVs globally could have an enormous impact on the sales volumes, and prices, of certain raw materials utilised in the production of EV batteries. Already we have seen a surge in demand for certain commodities, notably lithium and cobalt, with manganese, nickel, graphite and copper also expected to be material beneficiaries.

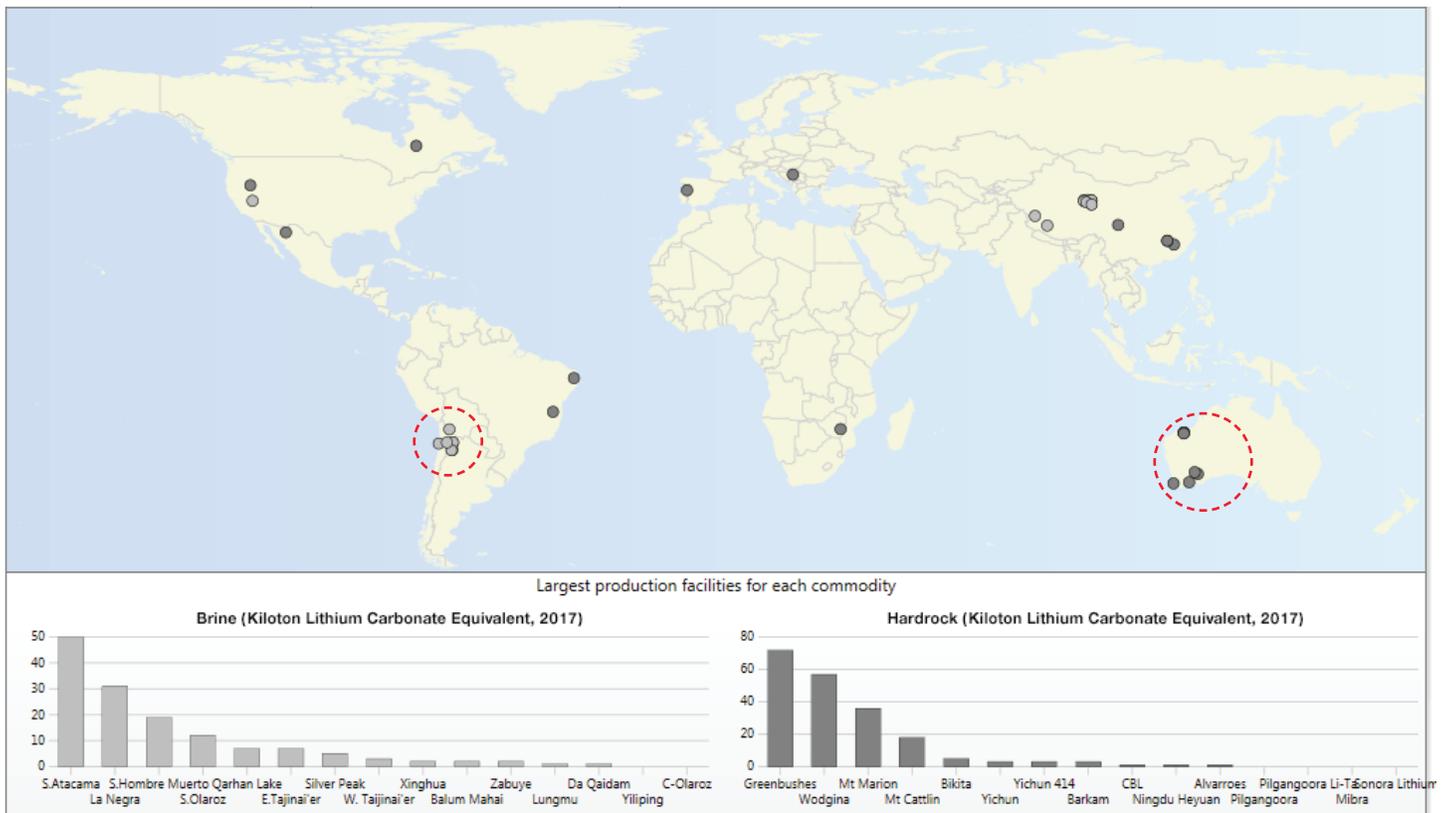
The Lithium Market

The lithium market experienced strong demand growth during FY18, buoyed by upward revisions to key forward indicators including EV plans of car manufacturers, further battery capacity expansions and government support for EV uptake. Lithium is now firmly part of almost all future development pathways for EV batteries and by 2025 we are expecting up to a six-fold increase in lithium demand, or a compound growth rate of 25% per annum.

With lithium's essential role in the development pathway of EVs, downstream companies are under considerable pressure to secure sustainable, long-term, access to high quality lithium. We are seeing growing evidence of this dynamic as battery material customers are looking to sign multi-year lithium supply contracts to underpin the EV model rollout intentions of the world's largest car companies who themselves are also investing directly into lithium supply chains.

On the supply side, while supply is also growing to meet the call on demand, not all lithium is sourced in the same way, with commercial lithium production currently extracted from both brine deposit mining and hard rock mining. Nearly one-half of the world's lithium production today comes from lithium brines in the Andes mountains' region encompassing parts of Argentina and Chile while in recent years, we have seen the emergence of new entrants into the hard rock lithium market including from new mines in Western Australia. While both sources of lithium will ultimately be needed to satisfy the demand growth profile over the medium term, it is

FIGURE 1: Major Lithium Production Hubs Around the World



Note: kt LCE: Kilotonne lithium carbonate equivalent
 Source: Morgan Stanley Research, February 2018

the brine-based assets that are expected to ultimately provide the lowest cost sources of lithium units.

Brine Deposit Mining – The Baseload Supply Base and the Lowest Cost Source of Lithium Units

Lithium brine bodies in salt lakes, or *salars*, are formed in basins where water which has leached the lithium from the surrounding rock is trapped and concentrated by evaporation. Lithium extraction involves pumping the brines into a series of evaporation ponds to crystallise other salts, leaving lithium-rich liquor which is then converted to either lithium carbonate or lithium hydroxide chemicals and subsequently sold into the battery raw material supply chain.

Hard Rock Mining – Quick to Market But Structurally Higher Cost Compared to Brine-based Assets

Lithium can also be contained within hard rock minerals with the commercial mining of spodumene, petalite and lepidolite by both open pit and underground mining methods. Once extracted, the lithium mineral ore is crushed but then needs to be subjected to a number of separation processes to upgrade the lithium content into battery grade lithium chemicals.

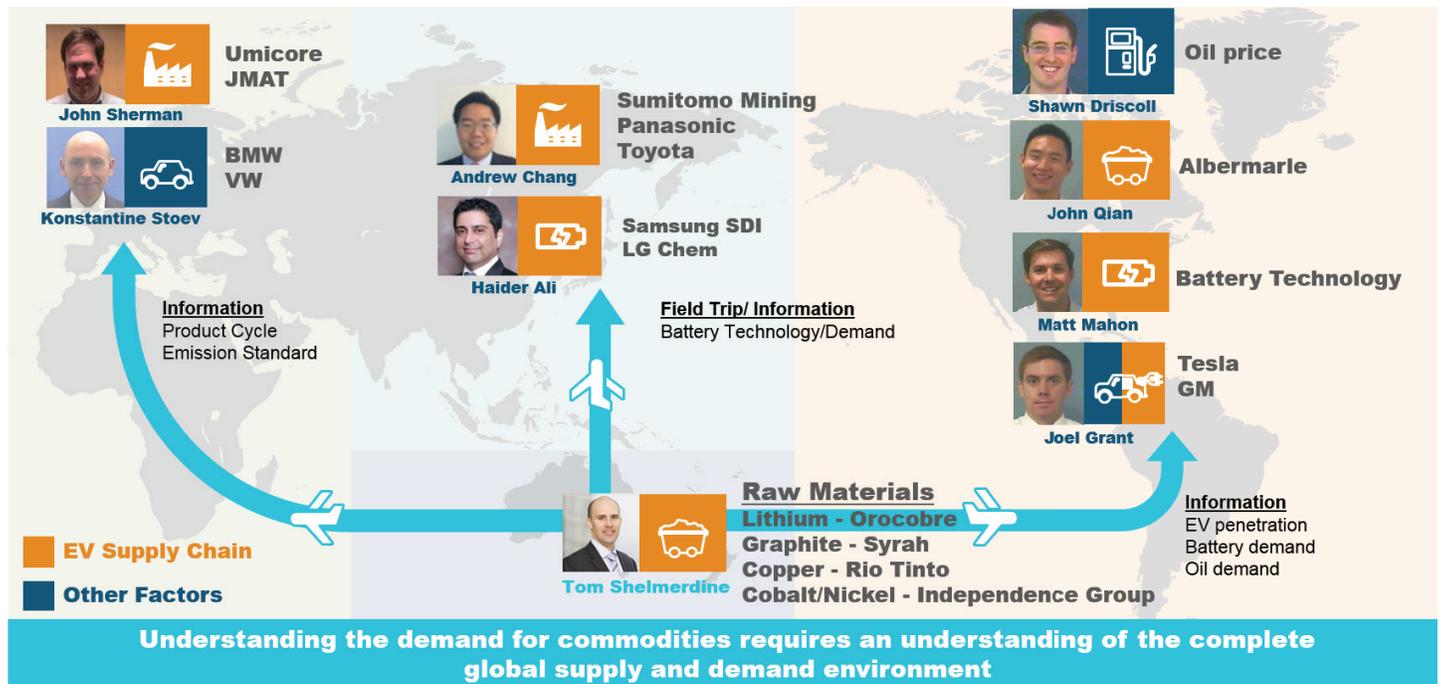
Global Research Collaboration in Action

Orocobre is an Australia-domiciled resources company that has a majority ownership in a brine-based lithium mining operation in Northern Argentina,

namely Olaroz. Tom Shelmerdine, identified Orocobre as a company poised to benefit from the strong demand dynamics for lithium, including conducting due diligence at the Olaroz asset prior to first production of lithium.

In order to support his own research and analysis, Tom sought the expertise within T. Rowe Price’s global research platform at both a country, industry and commodity level. At a country level, Martin Baylac, T. Rowe Price’s resources analyst specialising in the Latam region was able to provide insight into the local operating environment in Argentina, from politics, to regulation, to inflation, to taxation, to capital controls. Both Joel Grant and Konstantin Stoev, T. Rowe Price’s auto industry analysts in North America and Europe were able to validate the firm commitment of

FIGURE 2: Example of Global Collaboration – Electric Vehicle / Battery



The above is provided as an example of our collaborative process and is for informational purposes only. This material is not intended to be investment advice or a recommendation to take any particular investment action. The specific securities identified and described above do not necessarily represent securities that were purchased, sold, or recommended, and no assumptions should be made that the securities identified and discussed were or will be profitable. As of 31 October 2018.

both the auto manufacturers and the regulatory backdrop expected to drive EV adoption rates. Within the supply chain, John Qian, Andrew Chang, Haider Ali and John Sherman through their direct interactions with other battery raw material companies such as Albermarle and Sumitomo Metal Mining and cathode players such as Umicore and Johnson Matthey formed critical parts of the collaborative research process employed in piecing together the operating landscape.

Deep, Multi-Faceted, Research Underpins our Process

Orocobre was a relatively early mover in this space, indeed the Olaroz development was the first new brine-

based lithium asset to be built in over 20 years when it was commissioned in 2015 and was timed well to align with the rapidly increasing demand from the EV supply chain.

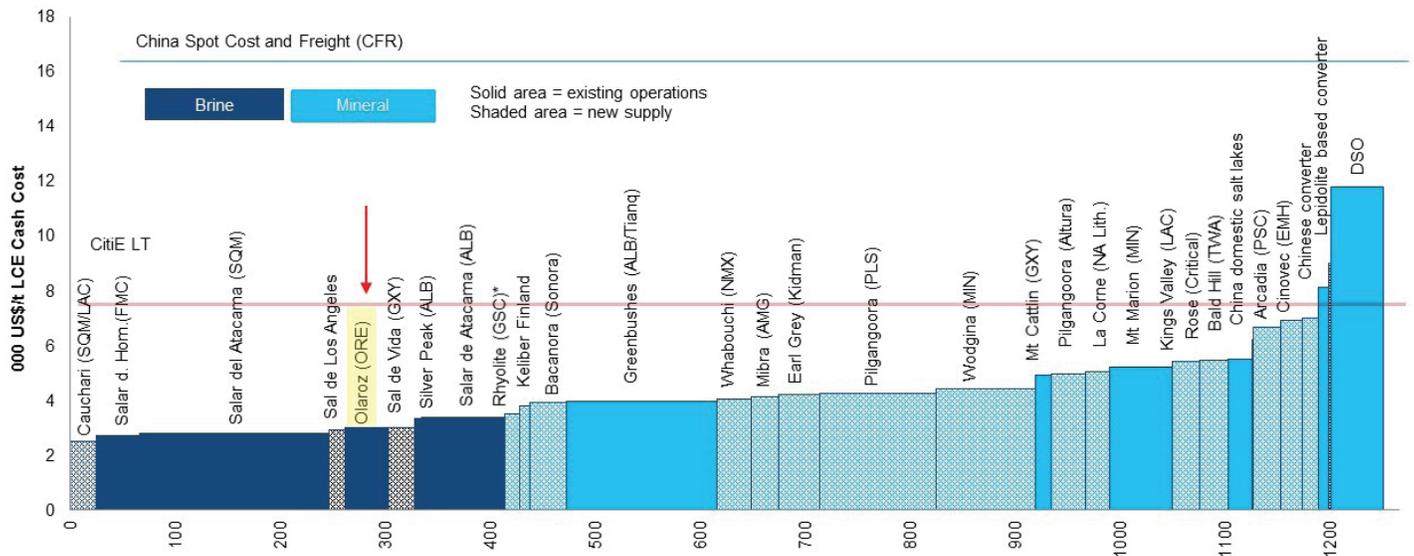
Within mining we aim to identify companies that are exposed to commodities with growing end demand that are able to benefit from strong macro trends with assets with a long resource life, a low-cost position, options over organic expansion opportunities and the support of strong stakeholder relationships. We identified Orocobre as being strongly aligned to this framework.

Geology and resource life: In terms of the geological properties and characteristics, we were able to

benchmark Olaroz as having brine properties well suited to meeting the worlds’ demand requirements for sustainable and high-quality lithium raw materials. Further, Olaroz has a resource life that will sustain decades of production and be a mainstay industry supply source.

Multiple options over expansion: The resource life of Olaroz lends itself to expansion over time to meet demand. Indeed, the company has plans to more than double production by next decade, as well as expand the breadth of its product suite via downstream processing in Japan. Brownfield expansion of an existing asset is naturally accretive to the company’s return profile.

FIGURE 3: Lithium Cost Curve Showing Position of Orocobre’s Olaroz Brine-based Asset



Source: Citigroup Research, October 2018

Long cost position: Being a brine-based asset with high-quality geological properties, Olaroz is positioned firmly in the first quartile of the lithium cost curve. Since commercial production in early 2016, average margins have been 62%¹. This is important, given lithium is also a commodity exposed to the cyclical vagaries of supply and demand and ultimately we want to be investing in companies that can generate strong margins, potentially in any part of the cycle.

Strong stakeholder relationships: Orocobre and the Olaroz asset is seeing growing endorsement as a sustainable

and high-quality source of lithium raw materials into the EV supply chain. In particular, while also having a 25% interest in the Olaroz joint venture, in January this year Toyota Tsusho Corporation (TTC) took a direct 15 per cent equity stake in Orocobre, as the car manufacturer sought to secure long term supplies of the critical ingredient for batteries to meet their projections of growing electric vehicle demand. The capital directly injected by Toyota will be used to fund Orocobre’s expansion projects and in our view signals a clear commitment to both the global deployment of electric vehicles and Orocobre.

In Conclusion

We believe raw materials producers exposed to the electrification of the global transportation fleet have a long growth runway which has been supported by insights that we have obtained across the T. Rowe Price research platform. Based on his own extensive research, and by incorporating insights into the EV industry from his T. Rowe Price colleagues around the globe, Tom Shelmerdine was well positioned to determine where the demand for the relevant commodities would be focused moving forward. And, in turn, more confidently zero in on the companies likely to be the key beneficiaries, such as Orocobre.

¹ Source: T. Rowe Price and Orocobre Group Annual Results, as of 30 June 2018.

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