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The Role of Cobalt in the Electric Vehicle Market

Stratas Advisors

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As part of our ongoing analysis of electric vehicles (EVs) and batteries, we recently assessed the supply chain of EV batteries with special attention paid to cobalt, battery chemistry, and the impact on cost of electric vehicles.

The following are the key takeaways:

- There remain uncertainties around the automotive supply chain and its ability to increase EV sales, particularly given the required infrastructure investments, and the supply of raw materials needed to produce these vehicles.
- Based on our analysis, which considers expected EV penetration, cobalt supply and demand factors, and changes in battery chemistries over time, cobalt will be an enduring hurdle that battery manufacturers and OEMs must overcome to ramp up the production of EVs.
- Additionally, the risks and the supply challenges will become substantially greater, the closer the industry approaches the targets associated with the increasingly aggressive climate goals being announced by governments and non-governmental agencies around the world.

Demand for cobalt will continue to grow – even with advancing battery technologies

Commonly generated through secondary refinement from nickel and copper ores, cobalt is a critical input for Lithium-ion (Li-ion) batteries and the growth of electrified vehicles in the global fleet. The NCM (nickel-cobalt-manganese) and NCA (nickel-cobalt-aluminum) battery compositions are dominant in the EV industry, accounting for over 90% of the global EV battery market. Excluding China, where LFP (lithium-iron-phosphate) has one-tenth market share, the battery market in the rest of the world is made of 26% NCA, 40% NCM 622, and 32% NCM 811. Further, 24% of total cobalt demand is associated with the EV industry.

The following are the main factors that will drive the future use of cobalt in EV batteries:

- Further adoption of EVs, which will be encouraged by increasing incentives, such as tax reduction and loan programs

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for electric vehicles, combined with growth in organic consumer uptake.

- Increasing energy density in batteries to address the demands of consumers for greater performance and range, which will encourage advancements in battery technology.
- Growing concerns about the reliability of future cobalt supply, given that the bulk of the production and reserves are in the Democratic Republic of the Congo (DRC), which is perceived to be unstable with a corrupt political and business environment.

With consideration of the above factors, Stratas Advisors developed a forecast for cobalt requirements for the dominant battery chemistries, by percentage and by weight, required to create a 75-kWh battery pack, which is consistent with a range of approximately 300 miles on a single charge. The forecast indicates that there will be a slow decline in the cobalt utilization, rather than a seismic shift away from cobalt, and is consistent with R&D trends.

The outlook for the future supply of cobalt is murky

The worldwide production of cobalt amounted to 140,000 metric tons in 2020, which is mostly from DRC, and followed by China, Canada, Russia, and Australia. The top five producers – Glencore (21%), China Moly (11%), ERG (11%), CNMC (5%), and Zhejiang Huayou (5%) – control 53% of global production, mainly sourcing from DRC. DRC has 51% of global cobalt reserves and generates nearly two-thirds of production.

However, there are significant risks associated with supply from DRC because of the political uncertainty associated with a weak central government and the prominence of local, violent factions, which hinder economic and business activities. Additionally, around 20% of DRC's production comes from small-scale artisanal miners with inadequate machinery, which limits scalability from current operations.

There are ongoing efforts to diversify supply, including several upcoming mining projects in Cuba, Australia, and Southeast Asia, which are slated to be in operation in 2025. As shown below, we estimate that planned investments will add 40,000 tons/year to current global cobalt production by 2022 and another 45,000 tons/year the production by 2025.

Additional potential supply could also come from fledgling recycling development. The current recycling rate for cobalt, however, is low. For Li-ion batteries specifically, less than 5% are recycled at their end of life. The nominal level of recycling is largely because of the design attributes of current EV batteries, which do not make recycling efficient. However, with advancements in battery technology, we expect that recycling will increase to 8% (roughly additional 1.2 million EV batteries) by the end of 2030.

The EV share of cobalt demand will increase

We have forecasted a supply/demand outlook for the cobalt market in aggregate, incorporating available and expected supply, with consideration of the supply risks associated with the geopolitical factors highlighted above. The demand side of the outlook uses a ground-up approach with consideration of future material prices, projected material requirements, and scaling of the global fleet using Stratas Advisors' vehicle outlook from Stratas AIM (Automotive Interactive Model) for electrified (Electric and Plug-In Hybrids) vehicles globally. Finally, a probability weighting of battery chemistries was

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generated, based on announced vehicle models from automotive manufacturers and expected technology adaptations.

Note: Our reference forecast for the sales of electrified vehicles considers total cost of ownership, including expectations pertaining to incentives and mandates at country and local levels. The forecasted increase in sales of electrified vehicles is significantly lower than recent IEA decarbonization scenarios, which range from 41% to 52%.

Considering the forecasted additional supply, EV demand growth, and battery chemistry changes, the share of global cobalt demand associated with electrified vehicles will be 42% by 2030, after peaking in 2028 at 43%.

Reducing battery costs to less than $100/kwh will be challenging

Widely viewed as one of the biggest barriers to EV adoption, the battery cost accounts for around 30% of the total cost of a vehicle in 2020 but has been declining as a portion of the overall vehicle cost. In contrast, the engine of ICE vehicles represents 16% of the total cost and has remained largely steady over time. The $100 per kilowatt-hour cost is the widely accepted level at which EVs will become competitive with gasoline ICE vehicles in terms of sticker price and will overcome the psychological barrier for many consumers who do not factor in the total cost of ownership (including fuel and vehicle maintenance) when making the initial purchase. Additionally, as batteries break the $100/kWh barrier, there is likely to be an uptick in availability and selection of vehicles for consumers.

By 2026, we expect that there will be a supply crunch, which will result in elevated prices for cobalt – and therefore, if EV manufacturers stick to high-content cobalt, it will be difficult for NCA and NCM 622 to break the $100/kWh barrier in this decade.

For more information, please reach out to Chris Brown, manager of the Global Automotive practice.

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