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Dialogue, Debate, and Discussion

Letter to the Editor: Complementing the Tesla Forum EV Discussion with a View Upstream

Dear Editor-in-Chief,

As a professional analyst of the auto sector, I found it rewarding to read the recent articles in the Dialogue, Debate, and Discussion section on the success of Tesla, the paradigm shifts in the global automotive industry, and the role of Chinese firms in this transition. Perkins and Murmann (2018) see the possibility of vehicles becoming commoditized with the increasing adoption of Mobility-as-a-Service and value migrating to new entrants catering to the digitization of vehicles. Western OEMs have historically prevented such value migration by leveraging their role as system integrators (MacDuffie, 2018). In the context of EVs, Chinese and Western OEMs have parity in R&D and technologies, though the local Chinese OEMs benefit from institutional support, mature local industrial ecosystem, and scale effects (Jiang & Lu, 2018).

The scholars make some compelling arguments to support their views. However, an important part of the puzzle on EV batteries has only received cursory attention. Jiang and Lu (2018) briefly touch upon the Chinese battery manufacturing capability and capacity of firms like BYD and CATL. Especially when focusing on the role of Chinese OEMs in electromobility, battery production and its supply chain as a key enabler for EVs deserves a deeper discussion given the criticality of batteries in EVs.

EV BATTERIES AS KEY DIFFERENTIATORS

We are currently witnessing a resurrection of EVs. While they comprised a significant share of vehicle offerings in the early twentieth century (Department of Energy, 2014), they were trumped by the range and convenience offered by internal combustion engine powered cars (ICEs). Scale effects due to mass production made ICEs more affordable for customers. The key technology differentiator here has been the powertrain components and their integration. Further, significant differences in the emission regulation norms and fuel consumption standards globally is a major entry barrier for new market entrants and a source of competitive advantage for industry leading incumbents. Industry benchmarks show that the powertrain and its associated components constitute 15–20% of the cost of an ICE, while they also contribute significantly in terms of revenues and profits in aftersales (Shaffer, 2017).

With the conventional ICE powertrain becoming redundant in EVs, the batteries take over the role of the major technology differentiator (Kerler, 2018). Key specifications include energy density, operating life between charges, performance over multiple charge-discharge cycles, and thermal management. Industry benchmarks show that in a typical EV today, about 40-50% costs arise from the battery, and a further 20% from other components of the electric powertrain including power electronics, motors, and wiring. The battery cost can be further broken down into battery cell production (about two-thirds of the cost) and the module and pack assembly. Current plans and moves of OEMs emphasize their preference to keep the module and pack assembly in-house, with a rationale that controlling battery pack space and thermal management is critical to range and performance. On the other hand, they seem to prefer outsourcing the battery cell production.

Battery costs have dropped from over 900 US$/kWh in 2010 to around 200 US$/kWh today and must sink further to about 80-100 $/kWh in the future for EVs to have a cost parity with ICEs. Apart from improvements in the manufacturing process, a major driver for reducing battery costs are the increasing production scale effects. Until recently, the biggest manufacturers of batteries, measured in GWh of installed production capacity, were Panasonic, Samsung SDI, and LGChem. However, the space is increasingly dominated by Chinese firms such as BYD, CATL, and Lishen. In fact, Chinese firms already constitute over 70% of the global EV battery production capacity today (Oliver Wyman, 2018). Further, the pipeline of planned plants in China is thrice as much as the rest of the world combined (Bennett & Munuera, 2017; Ma, Stringer, Zhang, & Kim, 2018).

Some industry analysts speculate that this could lead to a case of overcapacities link in the solar panels sectors, with supply far outstripping demand. However, with measures including incentives (i.e., *carrots*) and discussions on bans and complete exit from fossil fuels globally (i.e., *sticks*), it seems likely that EV adoption will in fact gather significant pace as the costs drop. China is already the largest EV market in the world and this dominance is only expected to grow, with a rising middle class willing to purchase premium products and the increasing sensitivity towards urban air pollution. The local EV market is hence well supported by the battery costs being driven down by the production scales of Chinese battery manufacturers.

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THE MATERIALS ANGLE

The rapid growth of Chinese battery manufacturers can be explained by the institutional support and China's role in strategically securing the EV battery supply chain in the last decade. Some analysts estimate that three quarters of global lithium production and over half of the cobalt production will be towards EV batteries by 2025 (Azevedo, Campagnol, Hagenbruch, Hoffman, Lala, & Ramsbottom 2018). As a consequence of massive investments in these crucial materials, Chinese firms control over the market for 60% of cathode materials, about 75% of anode materials, about 7% of electrolyte solution, and about 45% of the separators (Ayre, 2017).

China has the world's second largest lithium supplies. However, they are of low quality and present in remote regions at high-altitudes – making them expensive to extract. Consequently, Chinese firms have strategically invested in the last decade in a variety of mines, especially in Australia and Argentina which are respectively third and fourth largest global lithium reserves. Further, a Chinese firm is attempting to take a stake in a mine in Chile, which accounts for 27% of the global lithium reserves (Fulco, 2018). If successful, Chinese firms would control about half of the global lithium reserves. While over 95% of lithium occurs globally as a primary product, over 90% of the global cobalt supply is as a byproduct of copper and nickel mines worldwide and about two thirds of cobalt production are concentrated in the Democratic Republic of Congo. Through various arrangements, Chinese firms control about 85% of the global cobalt supply (Vella, 2018).

The explosive growth in EVs is a cause of concern for battery makers, and finally OEMs, since the lead time for increasing production capacity at mines and opening new mines is a lot longer. This has prompted some fears of a supply crunch and the effect has already been observed recently, with the costs of cobalt and lithium having more than doubled since 2015. Coupled with the meteoric increases in cobalt costs, the Chinese domination of the cobalt supply chain and the persistent questions over ethics and social responsibility in the cobalt mining have led to global efforts to switch to batteries with lower cobalt content. Apart from production scales and manufacturing technology innovations, this is a third potential lever touted for reducing battery costs.

Efforts are being directed at moving away from cobalt-heavy chemistries (like NMC111) to NMC622 currently, with the NMC811 chemistry being production-ready soon (Arcus, 2018). Li-ion batteries with no cobalt (eg. lithium iron phosphate) however don't offer sufficient energy density to be credible alternatives (Sanderson, 2016). Other alternatives such as solid-state, graphene-based, or metal-air batteries are still too nascent to be considered serious competitors. Even if one of these technologies matures sufficiently, commercialization and scale of production will take a few more years. This leaves batteries with significant lithium and cobalt chemistries as the only credible alternative in the foreseeable future.

IMPLICATIONS

Such a position of dominance over the upstream value chain primes Chinese battery manufacturers to exercise significant control and power over the key differentiators in EVs and puts them in a favorable position in the future EV constellation. It allows them to ensure the affordability of high-quality EV batteries when manufacturing them at scale through the access to vast amounts of lithium and cobalt, insulates them from potential supply crunches, and thus boosts their bargaining power in terms of favorable pricing (Brennan & Yu, 2018).

This also has implications for OEMs. On one hand, given that Asian OEMs historically have a closer relationship with their suppliers, a share of these advantages would also accrue to Chinese EV manufacturers. On the other hand, it raises question over the long-term sustainability of the extant strategy of western OEMs to outsource battery cell production. Their top management and executives are already besieged with paradigm shifts in the automotive sector, making it harder for them to further stretch their limited resources to secure upstream resources and invest in in-house battery production capabilities. A viable strategy, and increasing necessity, for them would therefore be to push for transparency in their supply chains (Williams, 2018) and building upstream partnerships.

The recent Dialogue, Debate, and Discussion section of MOR placed emphasis on OEMs building downstream opportunities and engaging technology companies in future mobility ecosystems. This response complements these arguments by looking up the value chain and recommends similar collaborations to secure key materials and capabilities. How these upstream and downstream partnerships play out in the future, in the face of increasing product commoditization, and their implications for OEMs, will continue to be an intriguing arena for research scholars and industry experts alike.

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