Cheap Lithium-ion Batteries for EVs vs. The Cobalt Cliff

Since early March I've written five articles that focus on supply and demand dynamics in the cobalt mining sector and explain why I believe the lithium-ion battery industry is facing a raw materials shortage of epic proportions. Today I'll drill down into market dynamics within the lithium-ion battery industry and explain why I believe cheap lithium-ion batteries for electric vehicles (EVs) will be the first casualties of the Cobalt Cliff.

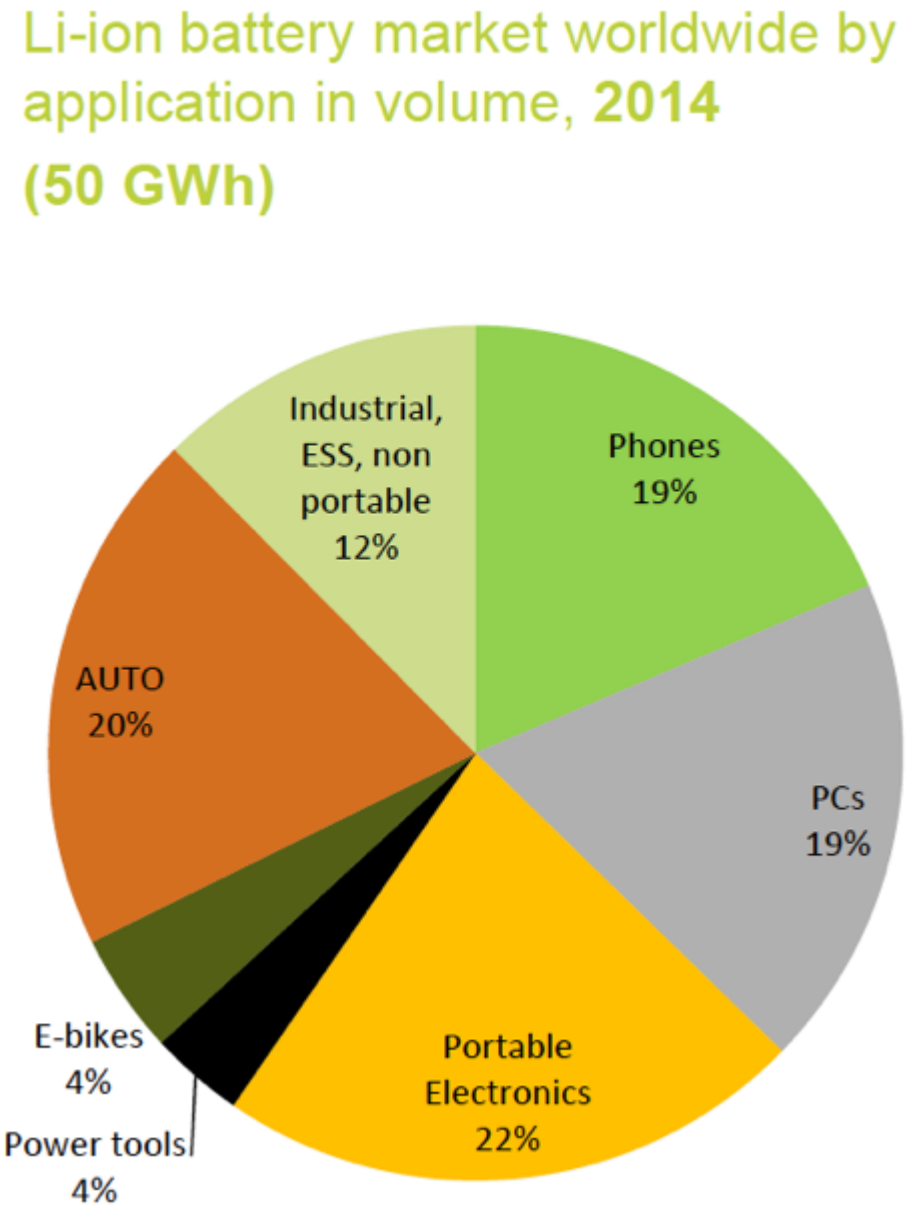
I want to begin with an explanation that I've derived most of the numbers in this article by digitizing graphs from Avicenne Energy's presentation at AABC 2016 in Mainz, Germany, a process that's inherently imprecise. While I believe my estimates are close enough to offer a good overview, digitization is dependent on the visual acuity of the human being running the software and like most humans I'm imperfect on my best days.

Based on a careful analysis of Avicenne's graphs I've estimated that in 2015 the lithium-ion battery industry manufactured cells with 61,500 MWh of capacity and generated $17.2 billion in revenue, which works out to an industry-wide average revenue of $280 per kWh at the cell level. Total battery sales to automakers were roughly 15,000 MWh and total revenue from those sales was roughly $5.4 billion, which works out to an average revenue of $360 per kWh. That average will seem high to readers who are accustomed to an endless stream of EV hucksters' happy-talk about $150 per kWh batteries, but it's pretty accurate when you factor in the more costly cells used in PHEVs and HEVs.

In 2014, total lithium-ion cell production was 50,000 MWh and sales to automakers were 10,000 MWh. So while the lithium-ion

battery industry grew at an overall rate of 23% in 2015, automaker sales grew by 50%. Without the Cobalt Cliff, I'd expect the 2014 growth trends to continue, if not accelerate.

While Avicenne's AABC presentation didn't offer a detailed breakdown by end-use sector for 2015, it did include this graph for 2014.



In my view the key takeaway from the graph is that four different end-use sectors; smartphones, portable computers, other portable electronics and automobiles, had roughly equivalent battery capacity requirements. As cobalt supplies decline, I expect each of these end-use sectors to become an

aggressive and powerful competitor for the available supply of high-energy lithium-ion batteries.

In my first article on graphite, lithium and cobalt supplies, I explained that all high-energy lithium-ion batteries use cobalt as an essential raw material in their cathode formulations. I also estimated that cells with LCO chemistry need about 1.44 kg of cobalt per kWh of battery capacity while cells based on NCM and NCA chemistries only need 0.36 kg, and 0.22 kg, respectively. That leads to an easy conclusion that a significant cobalt shortage and the attendant cobalt price increases will make LCO less desirable over time while making NCM and NCA more desirable. In my mind, the key unanswerable questions are "When will the inevitable transition away from LCO begin in earnest?" and "How long will that transition take?" Since the answers to those questions will ultimately be driven by end-users that buy large volumes of lithium-ion batteries for integration into their high-value products, I won't even venture a guess.

At the outset, it's important to understand that even large swings in cobalt prices will only have a modest impact on lithium-ion battery prices. At the current price of $10.21 for a pound for cobalt, LCO batteries need $32.40 of cobalt per kWh of capacity while NCM and NCA need $8.10 and $4.95 of cobalt, respectively. So while cobalt represents 12% of the iImplied cost of LCO cells, it only represents 1% to 2% of the implied cost of NCM and NCA cells. With a return to the $50 a pound cobalt prices we saw in late 2007 and early 2008, the implied cost of LCO cells would increase by about 46%. However the implied cost of NCM and NCA cells would only increase by 6% to 9%. Flow through raw material cost increases of that magnitude simply aren't big enough to materially impact consumer product prices or severely dampen end-user demand.

While I don't expect the Cobalt Cliff to have a substantial direct impact on lithium-ion battery prices, I

believe a cobalt shortage will give cell manufacturers who have secure cobalt supply chains a critical business advantage they haven't enjoyed for the better part of a decade – ***pricing power!***

The most troubling number in Avicenne's AABC presentation is that lithium-ion battery manufacturers struggle to survive with average gross margins of less than 10%. For many, the gross margins on lithium-ion cells are negative, but they're less negative than the cost of idle factories. This is not a sustainable dynamic when lithium-ion battery users routinely target gross margins of 25% or more. Frankly, unless everybody in a value chain earns a reasonable margin, the value chain itself is inherently unstable.

The biggest reason for today's horrible battery industry margins is that the industry over-built capacity during the last decade and the ensuing capacity glut gave battery buyers immense negotiating power. As a result, most big battery buyers brought brass knuckles to negotiating sessions and cell manufacturers acquiesced to unreasonable demands out of fear that they might lose key customers to competitors.

As cobalt supplies tighten, cell manufacturing capacity will become less relevant and supply chain security will take center stage. Almost overnight, the negotiating dynamic of the last decade will reverse itself and cell manufacturers that have secure supply chains will find themselves holding the aces. Instead of meekly accepting threadbare profit margins to keep their factories working, cell manufacturers with secure supply chains will be able to say, *"We can't make more than XXX MWh of cells per year because our supply chains won't support larger volumes. If you want to be a priority customer for our cells, you'll have to pay a price that gives us a reasonable profit margin."* Heck, we may even see some cell manufacturers pull out their own brass knuckles as they try to recover some of the operating losses and asset write-downs they've absorbed over the last few years.

I can’t predict what will happen when the battery industry regains it’s pricing power, but I will invite you to engage in a simple thought experiment. Imagine for a moment that battery manufacturers find themselves with unlimited pricing power and decide to charge $1 per watt-hour (wh) for cells instead of the current industry average of $0.28 per wh. Outfits like Apple and Microsoft that need 10 wh of battery capacity for a smartphone or 50 wh of capacity for a portable computer or tablet should be able to absorb the cost increases or pass them along to consumers without losing a step. In the EV space where 24,000 wh packs are “so yesterday” and 60,000 to 90,000 wh packs are the new normal, the impact would be devastating. There’s no way EV manufacturers can absorb the cost increment and doubling EV sticker prices will be a non-starter with consumers.

The example is extreme bordering on the absurd, but it highlights the inescapable reality that manufacturers of high-value products like smartphones, portable computers and other portable electronics who only need a little battery capacity will be better positioned to survive the Cobalt Cliff than manufacturers of highly price-sensitive products like EVs that need massive amounts of battery capacity.

It’s going to be fun watching this battle of industrial titans unfold.