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Battery update

Can the Lithium-ion industry satisfy the growing demands of the auto market?

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The lithium ion battery market has been, without a doubt, one of the most talked about industries over the past three years, with journalists worldwide covering every angle of the market and every segment of the value chain. From the salt flats of Bolivia to the highways of America, and everywhere in between, the implications of lithium ion batteries have been studied. The market for battery production, spurred on by significant government investment, is now capable of supplying enormous quantities of batteries to the market, so much so that rumours of overcapacity are rapidly spreading. At the same time, several high profile bankruptcies of battery manufacturers have highlighted the delicate state of this industry to drive scale and reduce cost to achieve profitability. Consequently, a fundamental question remains – can battery manufacturers meet the price and performance expectations of the automotive market?

Do the numbers add up?

To answer this question, PwC's PRTM Management Consulting team conducted a Lithium-ion battery cost study. We looked slightly into the future, to those vehicles and programs slated for production in 2016 and beyond.

Most vehicles that are either currently in production or in an OEM's near-term pipeline have already been sourced, meaning their battery contracts have been secured. So, the question is really whether the next generation of battery deployments will see a significant cost reduction, such that the nascent market for plug-in vehicles can scale up and become profitable and sustainable for automotive OEMs and battery producers. There are, of course, other critical success factors, such as charging infrastructure deployment or customer acceptance, that need to be addressed for the industry to thrive; however, battery performance is consistently mentioned as one of the top three issues.

Our study took a multi-dimensional approach to assessing the market for lithium ion batteries, and included perspectives gained through discussions and interviews with OEM customers, battery suppliers, and industry technical experts as well as detailed component cost analytics. The goal was to understand what is expected and what is possible, and then to determine how well the market will align with these contrasting outlooks.

Creating the baseline

To enable a comparison of "like for like" batteries' costs and performance expectations, we established a reference case for xEV battery packs and their associated manufacturing facilities. This reference case addresses variations in key design parameters such as battery chemistry, technology, and form factor as well as operational factors such as capacity and utilization. Reference cases were developed in cooperation with industry participants and are outlined in Table 1.

Table 1: Reference cases

	2012	2016
Plant Capacity (packs)	100,000	100,000+
Production Volume(packs)	25,000	100,000+
Direct Labour Rate (fully burdened)*	$32/hr	$32/hr
Manufacturing Yield (Raw Material to Pack)	85%	90%
CAPEX useful life	6 years	6 years

	PHEV		EV	
Capacity	16kWh		24kWh	
Active Cathode Material	LMO		NMC	
Active Cathode Material	2012	2016	2012	2016
Energy Density (Wh/kg)**	480	480	590	650
Active Anode Material	Graphite		Graphite	
Cell Design	Prismatic		Prismatic	
Cooling System	Liquid		Air	
Calls per pack	96 (6 modules)		96 (6 modules)	

Understanding market expectations

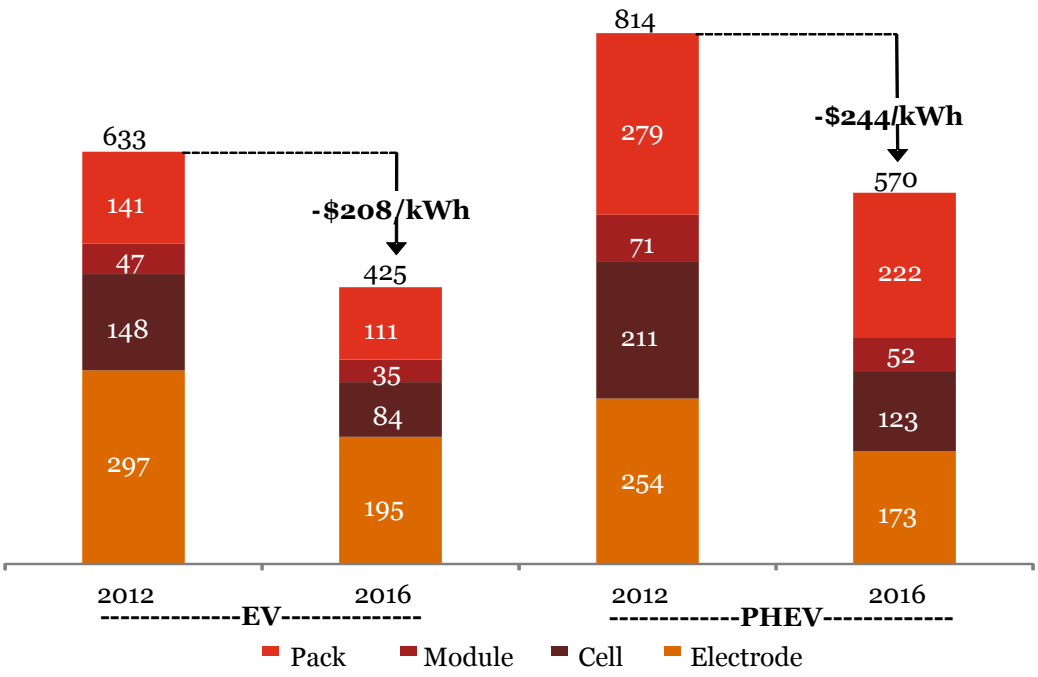
We interviewed OEMs across several geographies, with a focus on US and European manufacturers, and a mix of volume, luxury, and start-up companies. Battery producers were used to validate key assumptions about technology and operational cost drivers, and to gain an external perspective on OEM customer requirements. Industry experts were also interviewed to provide additional perspective on where technologies and prices are headed in the next three to five years. In addition, a bottom-up target cost model was created to incorporate market findings and, more importantly, to normalize different frames of reference (e.g., battery manufacturers tend to reference cells while auto OEMs focus on full pack cost). To align operational insights, we also normalized key operational assumptions (e.g., production volumes). This approach enabled a comparable perspective of targets for both cell and pack price levels across the different market participants.

On a cell level, the top-down market assessment and expectations for 2016 price levels were very much aligned between OEMs and suppliers, with the target cell cost of $280/kWh for OEMs and $288/kWh for producers.

The true cost of production

A detailed bottom-up assessment of current and future lithium ion battery cost enabled us to assess not only the cost for every intersection of the cost component – value chain component matrix, but also the impact of various cost and performance drivers on each intersection. Our detailed tear-down of battery cost and associated drivers, illustrated in Table 2, was cross-referenced and validated through market discussions and external experts. The results suggest an achievable battery cost of $425/kWh for the EV reference battery by 2016, and $570/kWh for the PHEV reference battery.

Table 2: Cost Breakdown by Value Chain Element [$]



The final verdict

The results of our study confirm that the industry is well on its target path to reach battery pack costs of $300/kWh by 2020. Our analysis also confirms that the majority of cost reductions in the next five to seven years will be driven by scale and manufacturing process enhancements. Technology advances will contribute a moderate amount during this timeframe, but will play a much more impactful role in 2020 and beyond.

Based on our comprehensive analysis, we believe it will be possible for producers to profitably deliver batteries at a target price that will help OEMs improve the cost competitiveness of their vehicles, thereby encouraging consumer adoption and industry scale. However, driving cost out of the value chain and manufacturing operations will not happen automatically; it will require a multi-faceted approach combining operational productivity enhancements with the right product, partnership, manufacturing, supply chain, and footprint strategies going forward.

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