« Honda unveils planned production model VEZEL; gasoline and hybrid versions | Main | Ideal Power, developer of new indirect power conversion technology, prices IPO »

Print this post

Anderman report sees strongest growth for full-hybrid systems; Li-ion batteries for hybrids may be in short supply

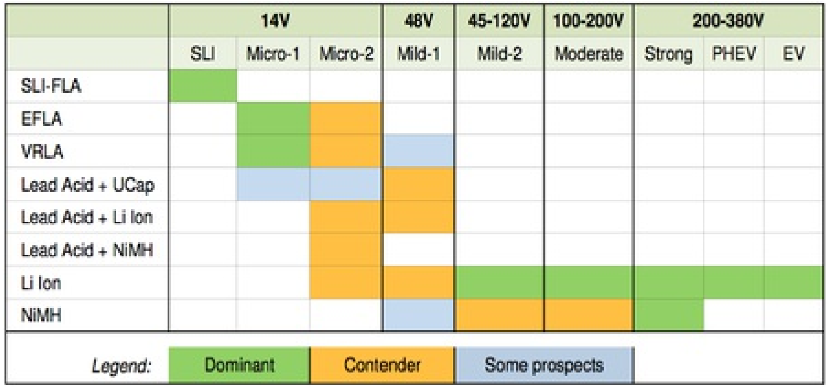
22 November 2013

Low-cost 14V micro hybrid systems and full (strong) hybrid (i.e., systems with limited electric drive) architectures at 140-300V are entering strong growth phases, while the future of intermediate systems—those falling between the high-voltage full hybrids and the low-voltage stop-start systems—is less clear, according to "Assessing the Future of Hybrid and Electric Vehicles: The 2014 xEV Industry Insider Report" by Dr. Menahem Anderman of Advanced Automotive Batteries (AAB), to be released next week.

The 170-page report also finds that while the combined global EV and plug-in Hybrid (PHEV) market share is expected to grow to about 1.5% of total vehicle sales by 2020, the more significant story is the rapid expansion of strong-hybrid vehicles led by Toyota, Ford, and Honda, followed by Hyundai, Nissan and others. The current market share in Japan already exceeds 20%, and the world market share is estimated to exceed 5% by 2020.

Although NiMH is still the dominant battery in the high-voltage hybrid market, Li-ion technology started to take market share around 2009 and is expected to continually increase its share with time. According to the report's baseline estimate, the global Li-ion xEV business will reach $3.8 billion in 2015 and $9.2 billion in 2020.

Stop-start vehicles, also termed micro-1 hybrids, are positioned to continue expanding rapidly in Europe and Japan, and at a slower pace in the US and elsewhere.



Energy storage technology solutions for advanced vehicles by vehicle category. Source: AAB. Click to enlarge.

The report is based on on-site interviews with senior battery technologists and business development executives at 18 major automakers and 20 battery-system suppliers on 3 continents. Among the other key findings are:

- Honda's recent and rapid transition from moderate to strong-hybrid production will be superimposed on the consistent expansion at Toyota and Ford, driving demand for Li-ion batteries for this type of application.

  Li-Ion batteries for strong hybrids are in short supply. The top four Japanese producers—Blue Energy Japan, PEVE, Sanyo, and Hitachi—are all expanding production and/or investing in new lines. All four produce prismatic cells with nickel-based cathodes, a design favored by the HEV industry leaders Toyota, Ford, and Honda.

  Of those battery makers, Blue Energy Japan, PEVE and Sanyo are already either at or close to full capacity utilization for 2014.

- Sales of plug-in hybrids (PHEVs) have typically only picked up in the past with the offer of substantial discounts from automakers (in addition to sizeable government subsidies). The future of the market is particularly dependent on government policies, with that of the California Air Resources Board (CARB) being the most important driver.

- The EV market is smaller than projected by market leader Nissan-Renault. As expected, the marketability of cars with driving ranges under 100 miles is limited; here again, automakers offer heavy discounts "to move the metal."

- EV- and PHEV-battery costs are dropping, although not as fast as market pricing. The current intense price war is likely to continue forcing the less experienced producers (and those with shallower pockets) out of the market.

- While Tesla's success in selling luxury EVs with price tags in the range of $70,000 to $100,000+ surprised the industry, most automakers see in this success a niche-market story that cannot be duplicated with a mass-market vehicle. According to the report, most automakers agree (as does

Anderman) that a similar Tesla success with an economical mass-market EV with a range exceeding 200 miles and a price tag of $35,000 seems unlikely.

The automotive industry is being forced to develop multiple technologies to address these governmental initiatives [to reduce fuel consumption], but faces significant challenges. The latter include technological readiness and cost, product reliability and durability, and above all customer interest and willingness to actually pay for the technology. In addition to electrification, other technologies with some environmental benefits, such as ultra-efficient IC engines, clean turbo-diesel engines, and bio-fueled IC engines, are also evolving. In many cases, these alternative technologies are less expensive and less risky to the automakers, thus explaining the latter's interest in pursuing them in parallel to, or instead of, the electrification approach. However, automotive engineers are discovering that many of the alternative solutions will also require increased electrical power, which reinforces the desirability of at least some level of vehicular hybridization.

—"The 2014 xEV Industry Insider Report"

High-voltage Li-ion batteries for hybrids. The important parameters for hybrid-vehicle batteries are i) the cost of usable energy under conditions of high-power discharge; ii) their life in the application; and iii) the volume and weight of the energy-storage device capable of delivering the required power for the required length of time, derived from the energy density (Wh/liter and Wh/kg) and power density (W/ liter and W/kg), Anderman notes. The first two parameters (cost and life), in combination, represent the economic cost of an energy-storage system capable of providing the hybridization function over the vehicle's life.

Four energy-storage technologies—Lead-Acid (Pb-A), Nickel-Metal Hydride (NiMH), and Lithium-Ion (Li-Ion) batteries and Ultracapacitors (UCaps)—are used in current HEVs and are the only technologies of interest for the foreseeable future (10+ years), the report asserts.

Li-ion battery technology entered the HEV market in 2009 and is the preferred technology for most hybrid electric applications in the future, according to the report. Li-ion power density is 50 to 100% greater than that of existing HEV NiMH batteries, and early field data support the laboratory testing that indicates good life.

For a given application, current Li-Ion technology offers a battery that is about 20% smaller and 30% lighter than existing NiMH batteries, which is a notable, if not overwhelming, advantage. In the long run, it is anticipated that Li Ion will increase its performance margin over NiMH batteries, strengthen its record for reliability, and also offer lower cost—a most critical factor for the market.

The lower cost can be achieved by increasing manufacturing yields and simplifying pack electronics, but mainly by enhancing low-temperature power and reducing power-fading over life. This approach will substantially eliminate the current practice of using an oversized battery to meet the specifications for low-temperature power and provide sufficient margin for fading.

Plug-in hybrids and EVs. The report finds that the specific energy of state-of-the-art EV cells is between 110 to 160 Wh/kg with typically 60-65% of these values available at the pack level. (The cylindrical consumer cells from Panasonic used by Tesla in the Model S are an outlier, with 248 Wh/kg.) The corresponding data for PHEV cells and packs are about 10-20% lower.

	Cell Maker	Chemistry	Capacity	Configuration	Voltage	Weight	Volume	Ener dens	Spec Ener	Used in:	
		Anode/Cathode	Ah		V	Kg	liter	Wh/liter	Wh/kg	Company	Model
1	AESC	G/LMO-NCA	33	Pouch	3.75	0.80	0.40	309	155	Nissan	Leaf
2	LG Chem	G/NMC-LMO	36	Pouch	3.75	0.86	0.49	275	157	Renault	Zoe
3	Li-Tec	G/NMC	52	Pouch	3.65	1.25	0.60	316	152	Daimler	Smart
4	Li Energy Japan	G/LMO-NMC	50	Prismatic	3.7	1.70	0.85	218	109	Mitsubishi	i-MiEV
5	Samsung	G/NMC-LMO	64	Prismatic	3.7	1.80	0.97	243	132	Fiat	500
6	Lishen Tianjin	G-LFP	16	Prismatic	3.25	0.45	0.23	226	116	Coda	EV
7	Toshiba	LTO-NMC	20	Prismatic	2.3	0.52	0.23	200	89	Honda	Fit
8	Panasonic	G/NCA	3.1	Cylindrical	3.6	0.045	0.018	630	248	Tesla	Model S

Li-ion cells employed in current EVs. Source: AAB. Click to enlarge.

In the next generation of cells and packs to be commercialized in 2016-17, the report finds a modest enhancement (by 15-20%) of these figures through the use of higher capacity NMC cathodes possibly charged to a slightly higher voltage (4.3V versus the current 4.15V) and accompanied by a modest improvement in cell engineering.

At the pack level, the integration of the pack into the structure of the car (rather than modifying an existing platform), will provide opportunities for weight reduction.

> *This study revealed that PHEV-EV batteries through the end of the decade will all feature Li-Ion technology with further optimization of existing chemistries, and cell and pack designs. The largest step forward in performance will require the implementation of higher-voltage cathodes and silicon-containing anodes. Such designs are expected to support a 50% improvement in performance coupled with potential for a substantial reduction in cost. However, the main challenge for these higher performance chemistries will be to ensure that they continue to provide an adequate life and in no way compromise safety.*
>
> *In recent years development work has been directed at technologies that may supersede Li Ion, the most visible of which presently are the programs on lithium- oxygen. While some of these futuristic chemistries and approaches offer interesting prospects, replacing Li Ion with a battery of overall better value for the EV and PHEV market would be a formidable task. For the foreseeable future, it seems likely that the combination of high gravimetric and volumetric energy and power density with very high cycle life offered by the Li-Ion technology will remain unique.*
>
> —"The 2014 xEV Industry Insider Report"

A note on Tesla. Among the different components of its analysis, the report provides a cost estimate for a 60-kWh battery using 18650 cells as employed by Tesla in two volumes: i) 25,000 packs per year for the current 2013 production year, and ii) 50,000 packs per year for 2016 production year.

Although the inherent cost of integrating 18650 cells into a large-capacity pack is higher than that of integrating larger-capacity cells, the report notes, the total Tesla pack cost per kWh is lower due to three factors: i) the lower cost per kWh of the 18650 cells; ii) the overall higher production volume (in kWh); and iii) the lower cost per kWh of pack components and integration for larger-capacity packs.

The analysis determines a pricing of around $343/kWh for the Tesla packs for this year and $279/kWh for 2016 at the specified volumes for those years.

For the period through 2016, the report finds that the Renault-Nissan Alliance will continue to hold the largest global share of EV sales, but that its actual sales are likely to be a fraction of what it had anticipated. Tesla is positioned to hold second place and BMW, third place.

November 22, 2013 in Batteries, Electric (Battery), Forecasts, Hybrids, Plug-ins | Permalink | Comments (12) | TrackBack (0)

TrackBack

TrackBack URL for this entry:
http://www.typepad.com/services/trackback/6a00d8341c4fbe53ef019b017d0a9d970b

Listed below are links to weblogs that reference Anderman report sees strongest growth for full-hybrid systems; Li-ion batteries for hybrids may be in short supply :

Comments

This report/forecast is based on current and yesterday's battery technology.

Future lower cost ($100/kWh to $150/kWh) higher performance (400 to 600 Wh/Kg) EV batteries and future lower cost higher performance (over 3 kWh/Liter) FCs could change the game and make this type of forecast outdated.

Industries will adjust and will meet increased demands for EV batteries and FCs. There will be no shortages of either.

Posted by: HarveyD | November 22, 2013 at 01:54 PM

Tesla's way of making the battery pack with lots of small high energy density cells will go from niche to mainstream once the other EV producers realize that this is the superior approach.

The problem with using large high energy density cells in a large EV battery pack is that they contain 5 to 10 times as much energy per cell and whenever a thermal runaway happens in such a large cell it is much harder to prevent it from propagating to other cells in the battery pack than it is in a battery pack with small cells like the Tesla pack. There are two ways to make a safe battery pack using large cells: 1) use a chemistry that has little chance of thermal runaway and