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## **Sooo many power source prototypes, sooo little time**

By Brian Dunn Published: Oct 15 2008

Soaring fuel costs have left automakers reeling, with the impact on their bottom lines forcing many to slash jobs, close some plants and retool others to produce more fuel-efficient vehicles. The need to economize is driving a revolution of sorts: the rise of plug-in hybrid electric vehicles (PHEVs).

Electricity is 50 to 75 percent cheaper than the equivalent cost of a gallon of gas. The mix of energy sources used to generate North America's electricity supply is also lower priced and more stable than that of oil.

The race is on to come up with the best power source for electric vehicles, and there's no shortage of contenders. The two leading technologies appear to be lithium-ion and upgraded nickel-metal hydride (NiMH) batteries.

Tokyo-based automakers Toyota Motor Corp. and Honda Motor Co. Ltd., the leaders of PHEV technology, are leaning toward the NiMH battery, while Nissan Motor Co. Ltd. and NEC Corp., also based in Tokyo, are developing a high-power ed lithium-ion battery.

Electric vehicles are already on North American roads, but haven't made it onto highways yet because of their limited range and speed.

Eestor Inc., Cedar Park, Texas, is another contender with its electrical energy storage unit, which it claims will have more than three times the energy density than the top lithium-ion batteries today, will last longer and will recharge in less than five minutes compared with three hours for lithium-ion batteries. It also weighs 300 pounds vs. 752 pounds.

Those claims have been challenged by some experts, who maintain that it's difficult to compare different battery technologies when none is yet on the market and some are specifically designed to be charged overnight.

Altair Nanotechnologies Inc., Reno, Nev., is developing a battery that can power a PHEV for 150 miles and recharge in the same amount of time it takes to fill up a gas tank. The device is based on 40-nanometer-size particles of lithium and titanium to make a coating that covers a battery's anode, and an aluminum bar that carries electricity to and from the vehicle's motor.

In contrast, most hybrid cars use a graphite coating in conjunction with NiMH or lithium-ion batteries. The difference lies in the material. When a battery operates or recharges, ions pass through the coating of the anode. Graphite isn't very porous, so the ions literally deform the material as they force their way through.

"Graphite anodes produce an SEI (solid electrolyte interface) on the anode in a standard lithium-ion battery. This SEI is basically an internal electrical resistor in the battery cell," said Chet Sandberg, Altair's technical strategy manager. "The Altair nanotechnology has no SEI and

consequentially less internal heating. Our technology places our power storage cells between a super capacitor and a standard battery in operational characteristics."

Altair said its nano-titanate battery lasts for 20,000 full recharge cycles, or about 20 years-four times the life span of a comparable NiMH or lithium-ion battery.

What all these new developments mean for lithium-ion batteries is unclear, according to Prabhakar Patil, chief executive officer of Compact Power Inc., Troy, Mi., a major supplier of lithium-ion batteries. "The cost ratio of lead-acid batteries and lithium-ion is six to one in favor of lead-acid, but the lead-acid battery life cycle is only three years vs. 10 for lithium, and the space and weight ratio favors lithium by four to one," he said.

And while Toyota and Honda favor the NiMH battery, by 2010 they will start to shift to the improving lithium-ion technology, Patil predicted. "Lithium-ion batteries will be No.1 on the market within the next 15 years," he added.

As for numbers, Patil noted that General Motors Corp., Detroit, expects to sell 10,000 of its Volt PHEVs in 2010 and 60,000 annually by 2012, while all original equipment manufacturers (OEMs) expect to sell a total of 1 million PHEVs in 2015 in the United States alone.

"The Volt's highway model will have 150 to 200 horsepower, which will match the performance of gas-powered cars," Patil said.

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