NAATBatt
Advanced Battery Weekly

Summary:

For the March 19th issue of NAATBatt's Advanced Battery Weekly, we highlight the ongoing sector activities. In addition, we have included an interview with Dr. Emile Greenhalgh, from the Department of Aeronautics at Imperial College London.

The NAATBatt Index increased 4.1% and the U.S. and Asia Battery Indices increased 0.4% and 1.5%, respectively. The S&P 500 and the Russell 2000 both increased 1.1%.

Key Highlights:

- **Coulomb Technologies** announced that real estate investment trust **UDR, Inc.** has purchased six ChargePoint® Networked Charging Stations for its 464-unit apartment community located in Dallas, Texas. The addition of charging stations to the property is helping the Belmont project qualify for Leadership in Energy and Environmental Design (LEED) certification -- for which it will apply through the **U.S. Green Building Council**.

- **Sanyo Electric** completed installation of two "Solar Parking Lots" incorporating solar panels and lithium-ion (li-ion) battery systems in Setagaya, Tokyo. The parking lot features solar panels installed on the roof whose energy is used to recharge the electric hybrid bicycle batteries and illuminate the LED parking lot lights.

- **Honda Motor Company** plans to introduce li-ion battery-powered hybrid cars. The company will use li-ion in place of nickel-metal hydride batteries in its Civic compact within the next 2 to 3 years.

- **BYD Company** plans to increase capital spending by 59% in 2010 (from 6.3 billion Yuan or $922 million in 2009) to expand its auto production. BYD is planning to open a U.S. sales headquarters in preparation for the all-electric vehicle (EV) E6 launch in 2H10.

- A group of major Japanese firms called the "CHAdeMO Association" is seeking to set a unified standard for EV recharging stations. The organization is comprised of **Toyota**, **Nissan**, **Mitsubishi**, **Fuji Heavy Industries** and **Tokyo Electric Power** – Japan's biggest utility.

- The largest global EV charging infrastructure is commencing as urban planners are deciding where to locate more than 11,000 charging stations in 11 major cities. The stations are targeted to be up and running when the first mass-market EVs from **Nissan** and **General Motors** go on sale at the end of this year.

- **Nissan** is planning for a production capacity of 500,000 Leaf all-EVs in North America, Japan and Europe by 2012. Nissan has stated that 56,000 Leafs have been ordered in the U.S. -- although that could be the number of dealers ordering, not consumers.

- **Tesla Motors** will continue producing the Roadster throughout 2011. Previously, the company had warned of a supply issues that could force a production stoppage of the $109,000 all-EV. Tesla stated that it had reached agreements with its suppliers to expand total production of the Roadster by 40% and to keep selling the car in 2012.

- **Firefly Energy** has indicated the company is in Chapter 7 bankruptcy after being unable to procure sufficient funding to sustain operations. The company has been focused on a lightweight lead acid battery with greater power and life than existing lead acid batteries.

A Few More Details:

Coulomb Technologies announced that real estate investment trust UDR, Inc. has purchased six ChargePoint® Networked Charging Stations for its 464-unit apartment community located in Dallas, Texas. The addition of charging stations to the property is helping the Belmont project qualify for Leadership in Energy and Environmental Design (LEED) certification -- for which it will apply through the U.S. Green Building Council. This will be the first among a number of new UDR apartment communities using LEED standards that will feature EV charging. The Belmont is the first installation of networked charging stations for an apartment housing development in the United States.
Source: Coulomb Technologies

Sanyo Electric completed installation of two "Solar Parking Lots" incorporating solar panels and lithium-ion (li-ion) battery systems in Setagaya, Tokyo. The parking lot features solar panels installed on the roof whose energy is used to recharge the electric hybrid bicycle batteries and illuminate the LED parking lot lights. The li-ion batteries feature AC power outlets that can be used to power external equipment during an emergency. The installed system incorporates a "DC charger." The "DC charger" enables the photovoltaic energy generated and stored in DC (direct current) to be used directly and effectively without AC (alternative current) conversion.
Source: Sanyo

Honda Motor Company plans to introduce li-ion battery-powered hybrid cars. The company will use li-ion batteries in place of nickel-metal hydride batteries in its Civic compact within the next 2 to 3 years. The li-ion batteries will be produced with Honda's joint- venture partner, GS Yuasa Corp., starting in 2H10. The venture is 49% owned by Honda
Source: Bloomberg

BYD Company plans to increase capital spending by 59% in 2010 (from 6.3 billion Yuan or $922 million in 2009) to expand its auto production. China is currently the world's largest biggest auto market – driven in part by the government stimulus to drive auto purchases. Sales in the country grew 46% to 13.6 million units. BYD is planning to open a U.S. sales headquarters in preparation for the all-electric vehicle (EV) E6 launch in 2H10.
Source: WSJ

A group of major Japanese firms called the "CHAdeMO Association" is seeking to set a unified standard for EV recharging stations. The organization is comprised of Toyota, Nissan, Mitsubishi, Fuji Heavy Industries and Tokyo Electric Power – Japan's biggest utility. "CHAdeMO" is an abbreviation of "CHArge de MOve," which translates to "charge for moving." Currently, 158 businesses and government bodies are expected to join the association. Businesses such as automakers, electric utilities, charger manufacturers and charging service providers are in the mix.
Source: Environmental Leader

The largest global EV charging infrastructure is commencing. Urban planners are deciding where to locate more than 11,000 charging stations (see **Exhibit 1** for an illustration) in 11 major cities. The stations are targeted to be up and running when the first mass-market EVs from Nissan and General Motors go on sale at the end of this year. eTec, an electric transportation research and development firm, is building EV charging networks in five states. 2,000 EV chargers are slated for the greater Seattle area in western Washington, and another 2000 at homes and public places in four Oregon cities.
Source: Voice of America

Exhibit 1: Charging Station Illustration

Source: ECOtality

Nissan is planning for a production capacity of 500,000 Leaf all-EVs in North America, Japan and Europe by 2012. The automaker wants to be able to respond to demand on any scale, and CEO Carlos Ghosn reiterated a prediction of a car market comprised of 10% all-EVs by 2020. Nissan has stated that 56,000 Leafs have been ordered in the U.S., although that could be the number of dealers ordering, not consumers. The company will begin to take orders in Japan and Europe soon.
Source: Chicago Tribune

Tesla Motors will continue producing the Roadster throughout 2011. Previously, the company had warned of a supply issues that could force a production stoppage of the $109,000 all-EV. Tesla stated that it had reached agreements with its suppliers to expand total production of the Roadster by 40% and to keep selling the car in 2012. The Model S sedan ($49,900 price) is scheduled to be rolled out in 2012.
Source: San Francisco Chronicle

Firefly Energy has indicated the company is in Chapter 7 bankruptcy after being unable to procure sufficient funding to sustain operations. The company has been focused on a lightweight lead acid battery with greater power and life than existing lead acid batteries. The primary market had been selling product into the truck market, which has been severely impacted by the economic conditions.
Source: Peoria Journal Star

Imperial College London

Interview with Dr. Emile Greenhalgh, Department of Aeronautics at Imperial College London:

Please describe your field of research.
At Imperial College, we are focused on lightweight structural battery materials. Weight is a premium on many components, and in such applications anything that does not contribute to the load-carrying capacity is structurally parasitic. Work in the US, Imperial College (supercapacitors) and at Swerea SICOMP, Sweden, has already demonstrated that such multifunctional materials can be synthesized at a laboratory level, and that the technology is ready to be developed for their maximal multifunctional potential and cost-efficiency towards use in specific industrial applications.

What is the name of the new composite material/battery technology?
The focus of the research in StorAge (and a national Swedish project, supported by the Swedish Foundation for Strategic Research (SSF)) is in materials that simultaneously carry mechanical loads whilst storing electrical energy. Since the laminated architecture of fiber composites mirrors the configuration of many current electrical storage devices, they offer an exciting opportunity to develop structural energy storage materials. Our name for these multifunctional polymer composite materials (structural batteries and super capacitors) is *Structural energy storage materials*.

The focus of the one part of the StorAge research is one such example; batteries. The conventional design approach attempts to maximize the efficiency of individual subcomponents, focusing on their ability to perform their individual task. The approach taken in StorAge is to create novel multifunctional materials, which simultaneously perform more than one function, offering significant savings in system level mass and volume, or performance benefits such as improved durability or redundancy. This design approach is relatively new, and faces significant engineering design, material and application challenges. However, the versatility of polymer composite materials offers an ideal opportunity to develop novel multifunctional materials which can store electrical energy required to power systems, whilst meeting the demands of the mechanical loading. Carbon fiber composites are particularly attractive as they are commonly used as both electrodes and high performance structural reinforcements, but usually the form of carbon is different.

The electrical vehicle market has been highlighted as a potential opportunity. How much of an improvement in performance will this new battery technology provide over current ones being used (such as lead acid, lithium-ion, etc.)?
A good example as to what these materials could offer in the future is that of the Tesla Roadster. This car weighs 1230kg, of which 450kg are batteries and 780kg are systems and structure. In the far future, the structure could be fabricated from our materials, negating the need for batteries, and thus reducing the weight of the car to 780kg. Clearly this will offer huge performance and longevity benefits. The materials we are developing will not improve battery performance per se, but will provide huge system savings in volume and weight.

What is the current timeline to have material available for commercial applications?
The materials are still at a very early stage; they have energy densities several orders of magnitude below existing devices. However, we are anticipating huge improvements in these materials through the EU finding.

Please discuss the incremental costs (such as materials and manufacturing) that would be incurred to incorporate the composite material across the various end-markets.
It is foreseen that manufacture and material costs for structural batteries will be similar to those for high performance composites today. Currently, great effort is made by e.g. aircraft manufacturers to automate manufacture with composites (tape-layers, infusion schemes, etc.). Hence, manufacture costs are expected to decrease with time. Material costs are high compared to, e.g. steel, with use of carbon fiber reinforced polymers (like the ones discussed here) in automotive applications, also the material costs are expected to decrease in the future. We believe a price of 30-50 Euro/kg structural battery material is likely as these are introduced on the market.

Since the new battery technology has been announced, in which markets have you received the most inquiries?
The industrial interests we have had to date have mainly been in automotive and aerospace. However, we have been approached by a number of more specialized applications, as well as areas such as consumer electronics, etc. In StorAge, Volvo Car Corporation is participating in elaboration of technical and cost specifications as well as in the cost benefit analyses and ownership issues. Also, Volvo has a role in demonstration of the technology.

What is Volvo's role in the development of this new technology? Is it an exclusive relationship?
It is foreseen that demonstrators (floor components for a Volvo car and components for the ECO Shell car developed at the Royal Institute of technology) will be available by 2012. The involvement of ETC Battery and Fuel Cells Sweden AB and Volvo Car Corporation will allow scaling up of production with these materials at that stage. We anticipate these materials will be in commercial applications in five to ten years, probably more towards the latter. However, we are looking at near-term specialist applications at the moment.

Where do you foresee the new material being eventually utilized? (i.e. consumer, transportation, stationary).
Outside automotive, we anticipate these materials will be introduced in specialized applications; luxury and high cost/low units. However, as the technology develops, we anticipate uptake in areas such as consumer and portable electronics, safety equipment, off-shore applications, mass-transport, energy generation, etc. The material can essentially be used for any engineering applications which are driven by weight and/or volume, and also require electrical energy.

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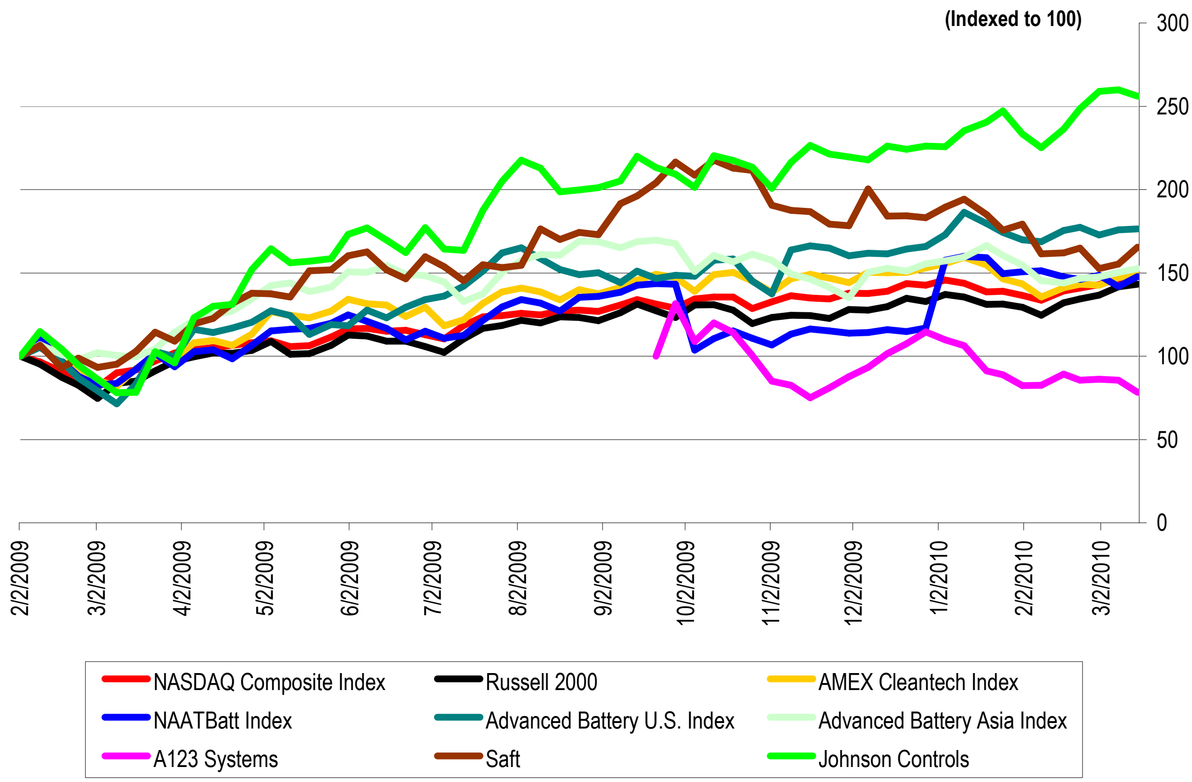
Exhibit 2: Indices Performance
(From February 2, 2009)



Index	Close on 3/15/2010	52-Wk High	% of 52-Wk High	Performance		
				LTM	YTD	Week
Dow	10,642.2	10,767.2	98.8%	47.3%	2.0%	0.8%
S&P 500	1,150.5	1,150.5	100.0%	51.6%	3.0%	1.1%
NASDAQ	2,362.2	2,326.3	101.5%	63.4%	3.0%	1.3%
Russell 2000	674.4	649.2	103.9%	70.6%	7.4%	1.1%
AMEX Cleantech Index	1,031.0	1,112.5	92.7%	58.5%	(3.4%)	0.8%

Source: Bloomberg and ThomsonOne

Note: The select NAATBatt Index is a market-value-weighted average and includes ALTI, BASF, COP, ENS and XIDE. The Advanced Battery U.S. Index is a market-value-weighted average and includes HEV, MGA, MXWL, UQM and VLNC. The Advanced Battery China Index is a market-value-weighted average and includes BYD, CBAK, GS Yuasa, LG Chem and Panasonic.

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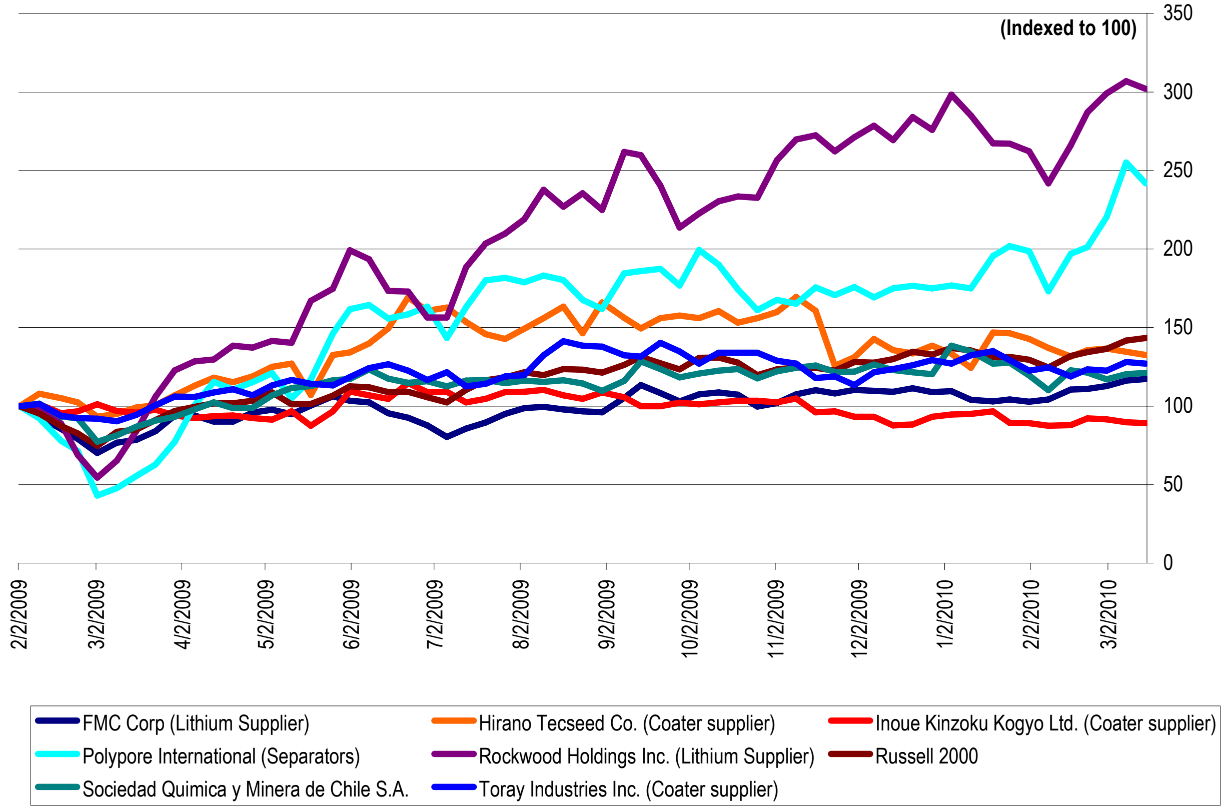
Exhibit 3: Supplier Performance
(From February 2, 2009)



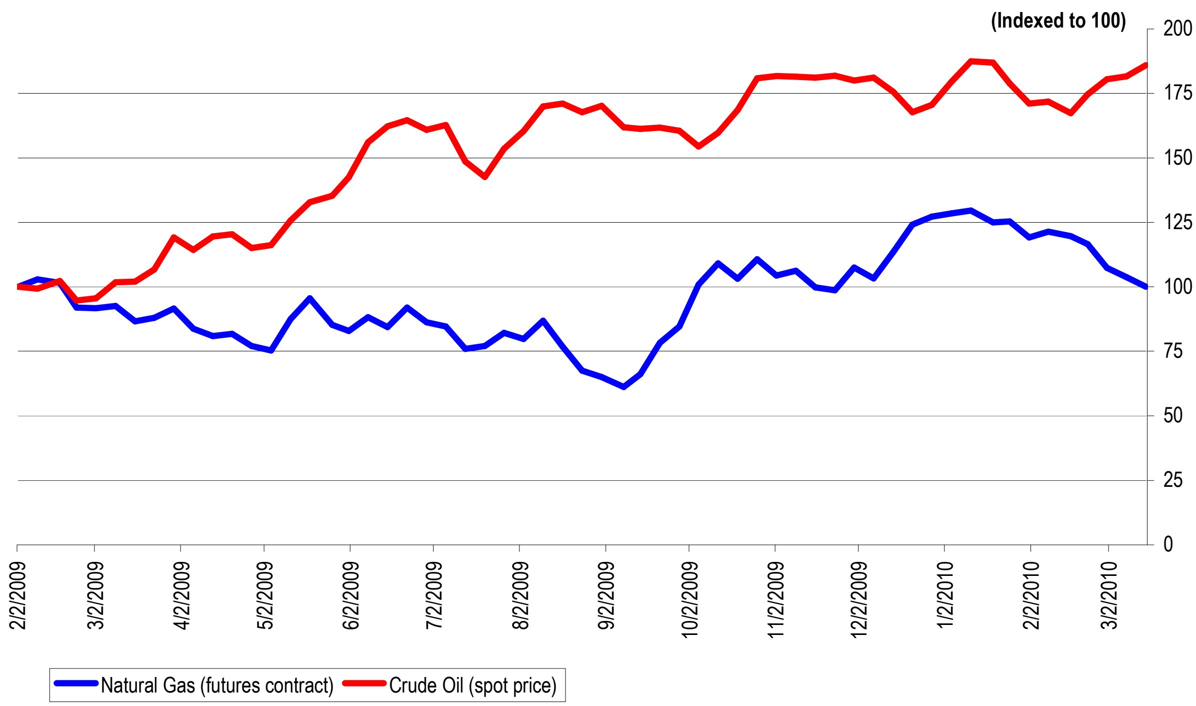
Source: Bloomberg

Exhibit 4: Commodity Prices

Commodity	Price on 3/15/2010	Price on 3/8/2010	Price on 2/15/2010	1 Week Change	1 Month Change
LME Nickel (Cash, $ per tonne)	21,290	22,525	18,995	(5.5%)	12.1%
LME Lead (cash, $ per tonne)	2,185	2,240	2,130	(2.5%)	2.6%

Source: LME

Exhibit 5: Natural Gas and Crude Oil
(From February 2, 2009)



Source: EIA

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SECURITY IN DIVERSITY OF SUPPLY

This week I attended the Technology and Rare Earth Metals for National Security and Clean Technology 2010 conference (TREM) in Washington, D.C. The conference was produced by the Institute for the Analysis of Global Security and the International Lithium Alliance.

The TREM conference focused primarily on the troubling concentration of rare earth metal supplies in China. Rare earth metals is a term that describes multiple elements, many of which are critical to the production of industrial magnets used in electric motors and in the wind turbines that generate renewable energy. China has invested heavily in rare earth metals production over the past three decades and has as a consequence come to dominate world supply.

This concentration of supply in China is disquieting, as domestic demand for rare earth metals in China is growing rapidly and will soon reduce dramatically the supply of such metals available for export. Without a reliable supply of rare earth metals, production of motors for electric vehicles and generators for wind turbines outside of China will be problematic at best. To address that problem Assistant Secretary of Energy David Sandalow announced at the TREM conference the creation of a strategic plan to ensure that rare earth metals will continue to be available to U.S.-based manufacturers.

Lithium, which is technically not a rare earth metal, also suffers from a supply concentration issue, though one not nearly as acute as that of rare earth metals. The public hysteria induced by last year's *New York Times* article suggesting that Bolivia was about to corner the market on lithium seems fortunately to have abated. Nevertheless, the experience of the rare earth metals industry is cautionary. As Winston Churchill once said, the only real security for sourcing a commodity lies in the diversity of supply, and in that alone.

The lessons learned in the metals industry have clear application to large format lithium-ion battery cells. Although the market for cells is early and substantial variation still exists among manufacturers in design and chemistry, it is likely that over time large format cells will become commoditized. But like rare earth metals, cells will be a commodity that takes decades to develop and for which having a strategic plan to ensure uninterrupted supply would be prudent.

So what is our strategic plan for battery cells? At NAATBatt we believe it should be maturing their market, perfecting their technology and keeping the doors open to new market entrants. The technology that eventually permits advanced batteries to compete economically with existing energy technologies will not come from one source, but from many. It will come from our largest companies and from our newest Silicon Valley start-ups. It will come from China, Korea, Detroit, California and a thousand places in between. We must nurture all those sources, because in that diversity lies our real energy security, and in that alone.

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