NAATBatt
Advanced Battery Weekly

Summary:

For the March 26th issue of NAATBatt's Advanced Battery Weekly, we highlight the ongoing sector activities. On April 5th, we will be hosting a webinar on *"Separator Films: The State of the Art and the State of the Market"*. In addition, we have included an interview with Michael Oster, CEO of Grid Storage Technologies.

The NAATBatt Index was flat while the U.S. and Asia Battery Indices increased 3.4% and 3.5%, respectively. The S&P 500 and the Russell 2000 each increased 1.3%.

Key Highlights:

- **Tesla Motors** will supply lithium-ion (li-ion) batteries to **Freightliner Custom Chassis** for an electric truck that is scheduled to be on the road in 2011. The battery pack is comprised of three 18.5 kilowatt-hour (kw-hr) modules that will provide a driving range of over 100 miles.

- **Nissan Motor** could join a potential alliance between its French partner **Renault** and **Daimler** should it occur. Nissan has bet heavily on electric cars, and a deal with Daimler could secure a steady customer. In addition, Renault and Nissan have signed an agreement with the Wuhan government to deploy EVs in the city. The Wuhan government will build 250 chargers to support vehicle operations in selected areas.

- **Better Place Australia (BPA)** will introduce the world's 3rd large-scale charge network to service electric cars across Australia in 2011. BPA expects up to 20% of local cars will be electric by 2020 with the entire national fleet shifting to electric by 2035.

- The **Chrysler** and **Fiat** alliance announced the plan to produce a plug-in electric version of the Fiat 500 in 2012. The power train will feature a lithium ion battery developed by **A123 Systems**.

- **Valence Technology** will supply battery cells to **GM** and **SAIC** for its EN-V concept car. The electric vehicles maximum speed of only 40 kilometers per hour (24 mph) -- even now China city roads average only 20 kilometers per hour (12 mph).

- Electric vehicles (EVs) are expected to play a significant role in helping **Hawaii** achieve a goal of deriving 70% of its energy from clean sources by 2030. The avg. car in Hawaii is driven 10,000 miles a year with gasoline costing $1,750. An EV driven the same distance uses $0.06 of electricity per mile would cost $625 annually.

- **Ultralife Corporation** was awarded approx. $2.4 million by **NYSERDA** for the development and installation of a 1 megawatt-hour (MW) li-ion energy storage system (ESS) on the corporate campus. The ESS will integrate li-ion batteries, ultracapacitors and renewable-energy generation sources, including wind and solar.

- The **ISO/RTO Council** serving U.S. and Canada stated that adoption of smart grid technologies and staggered charging times would reduce the EV potential impact on electric load. Of the million EVs potentially on the road over the next decade, the ISO/RTO would serve almost 2/3 of the EVs, which would amount to 3,785 megawatts of electric load -- if all were charged at the same time. However, power demand would increase by just 819 MW, if charging were staggered over an 8-hour period, and less than 546 MW, if it were staggered over a 12-hour period.

A Few More Details:

Tesla Motors will supply lithium-ion (li-ion) batteries to Freightliner Custom Chassis for an electric truck (see **Exhibit 1**) that is scheduled to be on the road in 2011. While the electric truck upfront costs will be higher, Freightliner indicated its vehicle will save $15,000 a year in fuel and maintenance costs. The battery pack is comprised of three 18.5 kilowatt-hour (kw-hr) modules that will provide a driving range of over 100 miles. The truck has the capacity to accommodate 5 modules (or 92.5 kw-hrs).
Source: Wired

Exhibit 1: Freightliner Custom Chassis Electric Truck

Source: Freightliner Custom Chassis

Nissan Motor could join a potential alliance between its French partner Renault and Daimler should occur. Japan's 3rd largest automaker will begin selling its electric car later this year. Nissan has bet heavily on electric cars, and a deal with Daimler could secure a steady customer. However, we also highlight earlier this month Daimler and BYD signed a preliminary agreement to jointly mass-produce an electric car. In addition, Renault and Nissan have signed an agreement with the Wuhan government to deploy EVs in the city. Renault-Nissan will begin a market feasibility study in 2011 with 25 Nissan EVs. The Wuhan government will build 250 chargers to support vehicle operations in selected areas.
Source: Nikkei and Bloomberg

Better Place Australia (BPA) will introduce the world's 3rd large-scale charge network (after Denmark and Israel) to service electric cars across Australia in 2011. BPA expects up to 20% of local cars will be electric by 2020 with the entire national fleet shifting to electric by 2035. BPA is planning to build a network of electric plug-in points and battery-swapping stations in Canberra and southern New South Wales from late 2011 before a national roll-out in late 2012.
Source: The Sydney Morning Herald

The Chrysler and Fiat alliance announced plans to produce a plug-in electric version of the Fiat 500 (see **Exhibit 2**) in 2012. The power train will feature a lithium ion battery developed by A123 Systems. The driving range has not been disclosed. Separately, Chrysler reiterated plans to produce a test fleet of 140 plug-in electric versions of its Dodge Ram pickup truck -- whose lithium-ion (li-ion) batteries will be supplied by Electrovaya (12 kw-hrs). The Ram EV will be able to travel up to 20 miles on the battery alone.
Source: Detroit Free Press

Exhibit 2: Fiat 500 Electric Car

Source: Detroit Free Press

Valence Technology will supply battery cells to General Motors and Chinese partner SAIC (Shanghai Automotive Industry Corporation) for their "Electric Networked-Vehicle" (EN-V) concept car. The trunk-less EN-V (see **Exhibit 3**) is 1.5 meters x 1.5 meters (about 5' x 5') and weighs 400 kilograms (880 pounds) -- including the passengers. The vehicle will use the same types of battery cells as the Segway. The EN-V's maximum speed is 40 kilometers per hour (or 24 mph) – current driving speed on China city roads average only 20 kilometers per hour (or 12 mph).
Source: Associated Press

Exhibit 3: The GM EV-N Concept Car

Source: Reuters

Electric vehicles (EVs) are expected to play a significant role in helping the state of Hawaii's achieve a goal of getting 70% of its energy from clean sources by 2030 — 40% in renewable electricity generation and another 30% in energy efficiency. According to the state's Renewable and Transportation Energy Program, the avg. car in Hawaii gets about 20 miles per gallon and is driven 10,000 miles a year with gasoline costing $1,750. An EV driven the same distance uses $0.06 of electricity per mile would cost $625 annually with recharging at $0.25 cents per kilowatt-hour. The electric car owner would save $1,125 a year over the fueling costs for a conventional car with an internal combustion engine.
Source: Honolulu Advertiser

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Ultralife Corporation was awarded approx. $2.4 million by The New York State Energy Research and Development Authority (NYSERDA) for the development and installation of a 1 megawatt-hour (MW) li-ion energy storage system (ESS) on the corporate campus. The ESS will integrate li-ion batteries, ultracapacitors and renewable-energy generation sources, including wind and solar. Integrated with the Smart Grid, the Ultralife system will intelligently manage energy for consumption or storage. The ESS will integrate two distinct power storage technologies, including a battery and ultracapacitor, on a distributed "off-grid" level, and then expand the system's capability for on-grid integration.
Source: Ultralife

The ISO/RTO Council serving U.S. and Canada stated that adoption of smart grid technologies and staggered charging times would reduce the EV potential negative impact on electric load. The ISO/RTO Council is comprised of 10 Independent System Operators and Regional Transmission Organizations. Of the million plug-in EV potentially on the road over the next decade, the ISO/RTO would serve almost 2/3 of the EVs, which would amount to 3,785 megawatts of electric load -- if all were charged at the same time. However, power demand would increase by just 819 MW, if charging were staggered over an 8-hour period, and less than 546 MW, if it were staggered over a 12-hour period.
Source: Reuters

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GRID STORAGE TECHNOLOGIES

Interview with Michael Oster, CEO of Grid Storage Technologies (GST):

Please describe Grid Storage Technologies (GST).
GST is an energy storage and battery technology development company. Our first battery to be commercialized is our rechargeable zinc air technology – which has a very long life (10,000 cycles) and a very low capital cost ($160 per kWh and $1,000 per kW). Our zinc air battery is safe and flexible. We are also in the process of developing a long life lead acid battery and a low cost capacitor.
The utility space is our primary focus, but we will soon focus on the vehicle market as well.

Discuss the GST value proposition over other advanced battery chemistries.
Simply, GST's zinc air battery is a fraction of the cost per kWh of other technologies. We also have a lower cost per kW (i.e. power), but our cost of energy is lower than even the 10-20 year projected cost of many other battery technologies. This means that we have a distinct advantage for applications that are energy intensive or that could benefit by adding energy capacity.

We believe that although grid regulation is power-intensive, a battery should be able to perform double duty – and provide regulation service while simultaneously doing peak shaving arbitrage, earning capacity and reserve payments, and providing an emergency backup.

An electric car should be able to accelerate, but it also needs to have a long range at reasonable cost in order to replace the internal combustion engine. We have some interesting ideas for a vehicle that we believe will enable us to achieve 300 miles of range at a total cost lower than that of a 40 mile range hybrid and possibly also at lower total cost than a gasoline engine.

A Ragone plot does not necessarily tell the whole story for utility use because weight is not as relevant in a stationary application. Even for a vehicle, weight is not critical if you only need a small power battery to augment a larger energy battery (i.e. the concept of a "hybrid battery"). Volume is somewhat more important, but even that is negligible compared to cost.

The key factor is cost per kW and cost per kWh, and we think we have a strong lead in both measures.

How much lower can GST drive cost while improving performance?
We designed manufacturability into our technology from the start so we can scale up quickly and start with low costs. We will improve our manufacturing and materials costs over time and we will also be able to increase the amount of zinc in the system which effectively reduces the cost per kWh for longer energy uses (e.g. a vehicle). We believe that at our current prices, we can achieve volumes significantly higher than those of today – which will help to accelerate our cost reductions.

Has GST entered into relationships with commercial partners? And in which market segment has the company garnered the most interest?
We are in several advanced discussions with major strategic partners. The utility industry has expressed the most interest because that is where we have been most active – and that is also where the grid stability problem is growing more critical as we adopt an increasing portion of wind and solar power.

Characterize the competitive landscape (include peers and other chemistry types).
We believe that Lithium Ion is a good battery technology for light weight power applications such as electronics and potentially for the acceleration of a car. We expect that Lithium Ion will not be widely used for grid applications in the future given its cost and limited flexibility.

Sodium Sulfur has issues with cost and safety, and so that would seem to be a placeholder if the utility industry needs a lower cost technology in order to grow its use of batteries.

Lead Acid is good for the cost of power but not optimal for cycle life at a full depth of discharge – which limits the potential use of this chemistry. That said, with longer life, lead acid could represent an interesting, low cost power technology. For example, lead acid could perform grid regulation or could be a good pair in a hybrid (i.e. part power, part energy) battery. Watch this space for a future announcement from us.

Flywheels are limited since they have so little energy and there are few utility applications that could not realize value with additional energy capacity.

Flow batteries have reliability issues and have difficulty scaling up to mass production, although they could potentially show some promise if they can also resolve the membrane cost and life limitation.

The real competitor of any battery technology is the natural gas turbine as that is what utilities currently use. We set and achieved the capital cost goal of $1,000 per kW with that competitor in mind. We also can compete on life with our projected 30 years. With the flexibility of use, flexibility of placement, and in a carbon-reduced world, we think we have some compelling long term advantages against gas turbines.

Discuss the current financial model (incl. Projected breakeven, capex, etc.).
We plan to have a MW connected to the grid by the end of 2010 and we will start shipping batteries to commercial customers in 1Q of 2011. We expect that we will be profitable the first half of next year. CapEx and ramp up time are minimal for us because of the optimized bill of materials and the straightforward manufacturability of the system – in other words, we have the ability to use idle existing plastic and metal fabricating capacity with minimal tooling.

Discuss the challenges and obstacles ahead.
There are very large and well capitalized companies that have the ability to shape the market with optimal technologies or with other technologies. We hope to co-opt some of them because we believe that the right technology at the right cost could quickly increase the market size by an order of magnitude.

There are always technological challenges, but then again there are always logical solutions if you have the right team and the right foundation to your technology.

Sometimes an industry can let great be the enemy of good. In other words, Lithium Air can provide power as light as a feather. We don't yet know how it will work or what it will cost. In other words, it is a hopeful technology (that we are exploring as well). However we need to focus on the problem and on the necessary cost to solve it – and we need to develop and adopt when we meet those profitability thresholds… which we think could be right around the corner for many uses with zinc air.

How large is the current addressable market opportunity?
I have seen projections between $1 and $60 billion per year. We look at it discretely. A single 100 MW wind farm is a $100 million project. There are 260 of those in the US and that number doubles every two years. And there are 1,600 of them in Europe. That represents a large market.

There are 250,000 substations in the US alone – and we would like to see 1-3MW of storage at a large number of them to peak shave, provide an emergency back-up, and to form a backbone for a smart grid. That represents a very large and very long term market opportunity.

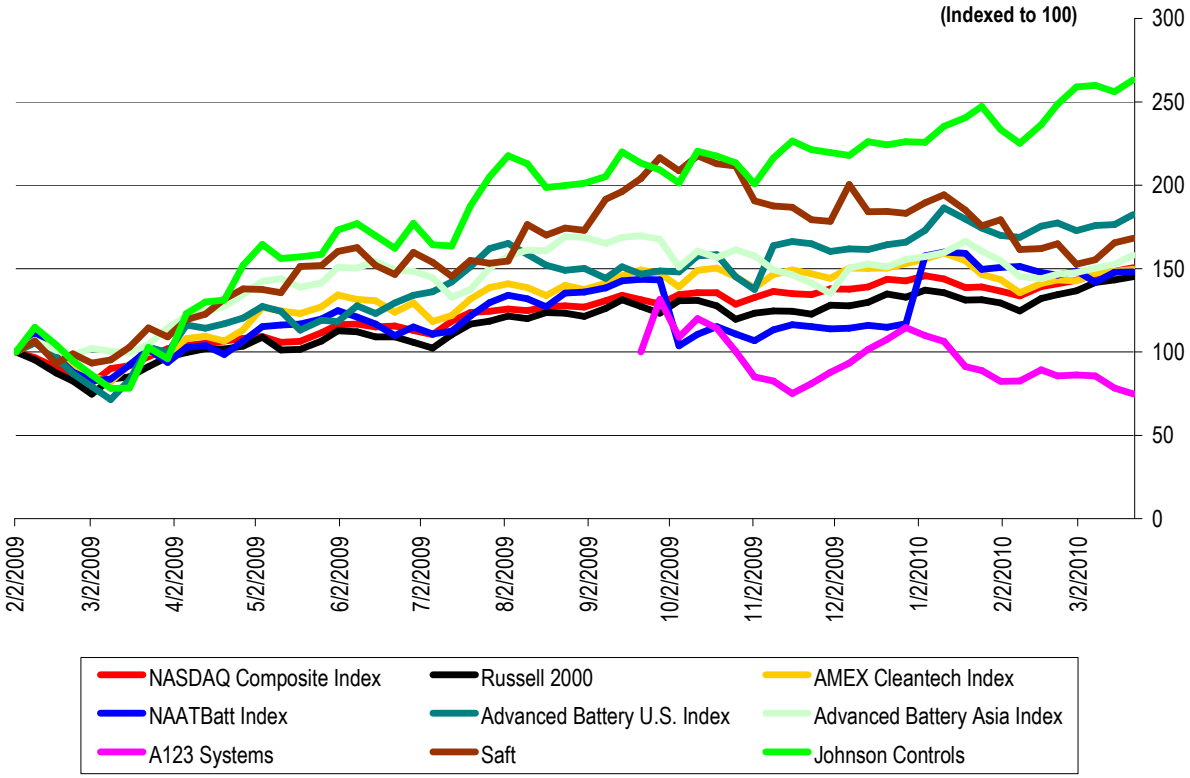
Roughly 50+ million cars are sold worldwide each year. Balancing acceleration and speed maintenance and taking into account the higher torque of electric motors, we might be able to get away with need an average power of 25-50 kW in a full electric vehicle. If electric cars could cost the same as internal combustion cars, we think that it is a logical assumption that a large percent of new cars sold would be electric only. In fact, if EVs were to cost the same as today's gasoline car, I expect that the number of new cars per year would increase drastically to shift the existing stock of cars that pollute and that are more expensive to drive. This market could add up to a lot of megawatts.

How large do you envision the electric vehicle and stationary opportunity will be by 2015? 2020?
As you can tell from my prior answer, I don't like to make big projections, especially over several years, because many things can happen to enable or block progress. I could say this… if we have a national renewable portfolio standard of 20% of our generating assets OR if we have a high cost of carbon that changes the relative cost of wind + storage OR if we do the math and include transmission costs and grid stabilization with the direct cost of wind projects such that they would not be economically viable without storage, then I would be very surprised if the market does not reach the thousands of MW in 5-10 years. There is one big IF ---- if batteries cost $1,000 per kW and have at least 6 hours of storage (which just so happens to be our cost and our starting energy capacity).

Where do you see GST in 3 years?
I see GST as having a portfolio of power storage technologies that have large and compelling market positions because of their performance and cost. I also see us having a couple of major strategic partners that bring the global market distribution capability that will enable us to focus on our strong suits of product conceptualization and lab development.

Any closing comments?
Yes. It is great and appreciated that your organization focuses on the battery industry. Today, batteries occupy a small part of the energy and industrial infrastructure. In the near future, batteries can become or enable engines, fuels, power generators, and also enhance utility and grid infrastructure. With low cost batteries, I can envision a society with no blackouts or brownouts like we seem to have during every major storm or hot summer. I can perceive the global economy and transportation network powered 100% by renewable sources which could bring our carbon footprint to a level that we have not seen in decades. We are in a very interesting place and this is a very opportune time for our industry.

Exhibit 4: Indices Performance
(From February 2, 2009)

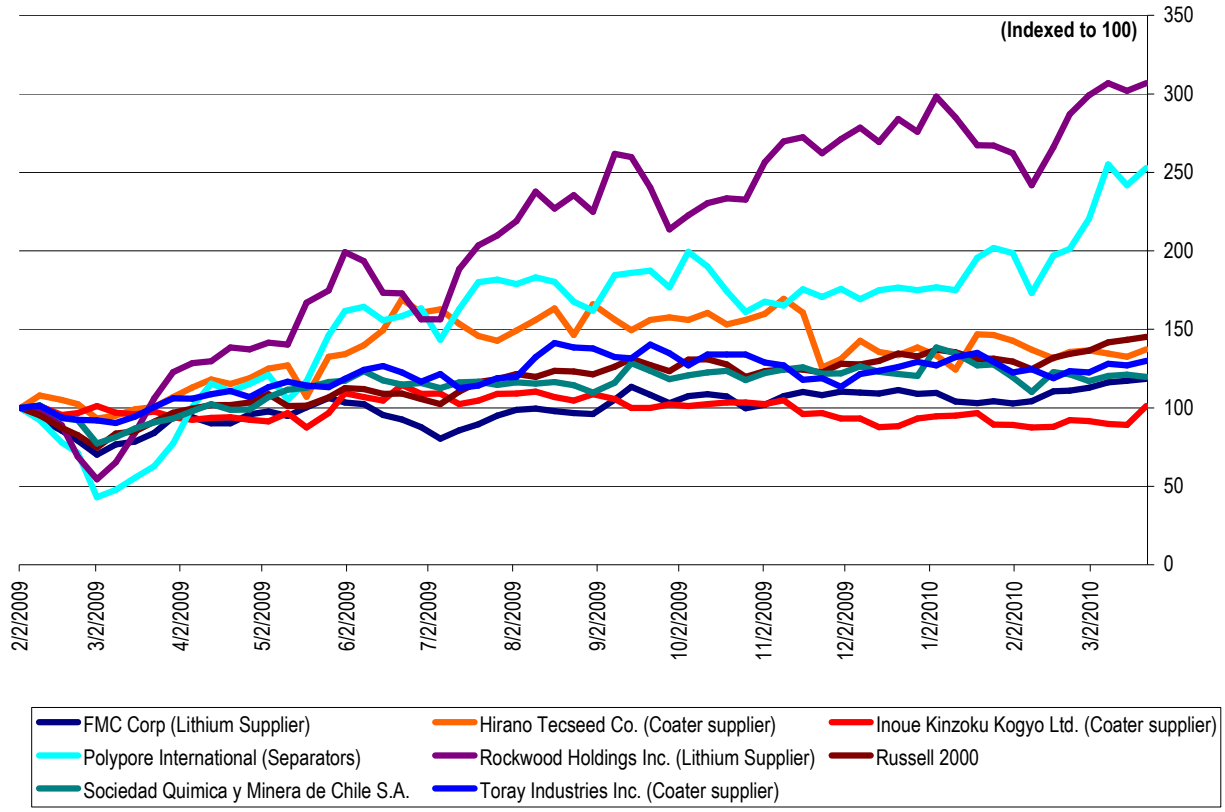


Index	Close on 3/22/2010	52-Wk High	% of 52-Wk High	Performance LTM	YTD	Week
Dow	10,785.9	10,869.6	99.2%	48.2%	3.4%	1.4%
S&P 500	1,165.8	1,169.8	99.7%	51.0%	4.4%	1.3%
NASDAQ	2,395.4	2,401.2	99.8%	60.6%	4.4%	1.4%
Russell 2000	682.9	686.9	99.4%	68.3%	8.7%	1.3%
AMEX Cleantech Index	1,037.4	1,112.5	93.2%	56.8%	(2.8%)	0.6%

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.

Exhibit 5: Supplier Performance
(From February 2, 2009)



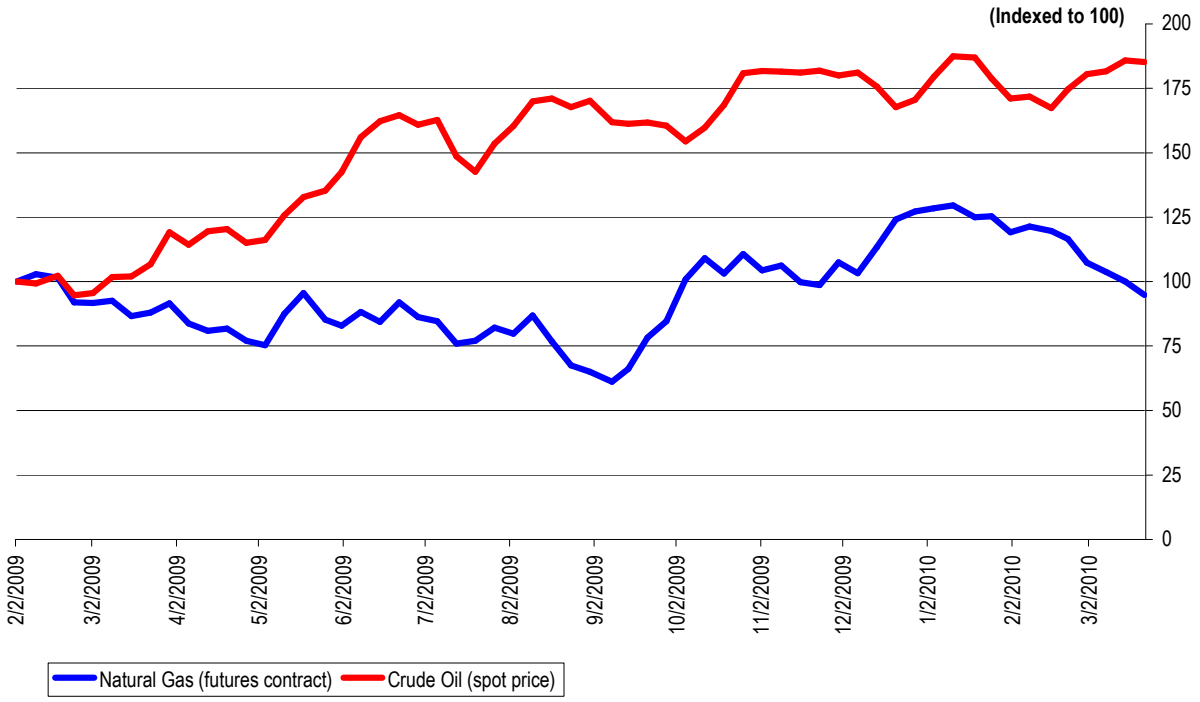
Source: Bloomberg

Exhibit 6: Commodity Prices

Commodity	Price on 3/22/2010	Price on 3/15/2010	Price on 2/22/2010	1 Week Change	1 Month Change
LME Nickel (Cash, $ per tonne)	21,850	21,290	20,530	2.6%	6.4%
LME Lead (cash, $ per tonne)	2,139	2,185	2,319	(2.1%)	(7.8%)

Source: LME

Exhibit 7: Natural Gas and Crude Oil
(From February 2, 2009)



Source: EIA

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THE HIGH COST OF BATTERIES CONCERNS MORE THAN JUST U.S. CONSUMERS

The importance of price to U.S. consumer decisions concerning electric vehicles is a theme I have touched upon repeatedly in this column. News this week out of China suggests that U.S. consumers have company in their price sensitivity.

BYD, which will likely become the first company to sell a PHEV in the mass market with the public launch of its F3DM PHEV later this year, disclosed that it has managed to sell only about 100 units to date to corporate customers. BYD remains optimistic about the marketability of the F3DM, and may have good basis to be so. But the $22,000 price tag of the vehicle seems to threaten a potential drag on sales.

The problem becomes clearer when one looks at BYD's success with the F3DM's older sibling, the F3 compact. Powered by a 4 cylinder, 1.5 liter ICE engine and a sticker price of approximately $14,000, the F3 was last year's best-selling car in China, with 448,397 units sold, representing a 162 percent increase over 2008.

So if the Chinese consumer seems unwilling to bear an $8,000 premium to drive an electric vehicle, what premium will U.S. consumers be willing to bear? A study last September by Synovate Motoresearch suggests that the median premium U.S. consumers would be willing to pay to drive a "green" automobile is about $2,000. Whether Synovate's estimate is a little high or little low, it is clear that we have a long way to go on price, both in the U.S. and in markets abroad, before electric drive finds a welcoming consumer market.

So how do we get there? As with any long journey, it starts by putting one foot ahead of the other. The next step in on our journey at NAATBatt is an examination of separator films. On April 5, 2010, Lie Shi, Vice President, Research & Development at Celgard, and Tim Feaver, President and CEO of Porous Power, will talk about "Separator Films: The State of the Art and the State of the Market."

Separator films are a critical and somewhat expensive component of lithium-ion cells. I hope you will join us at 2:00 p.m., EST, on Monday, April 5 to learn what is new in separator technology, what is coming to the market soon, and what effect all this will have on lithium-ion cell costs. Please contact Suzanne Schnitzer to register for the program at: Suzanne@McCloudCommunications.com.

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