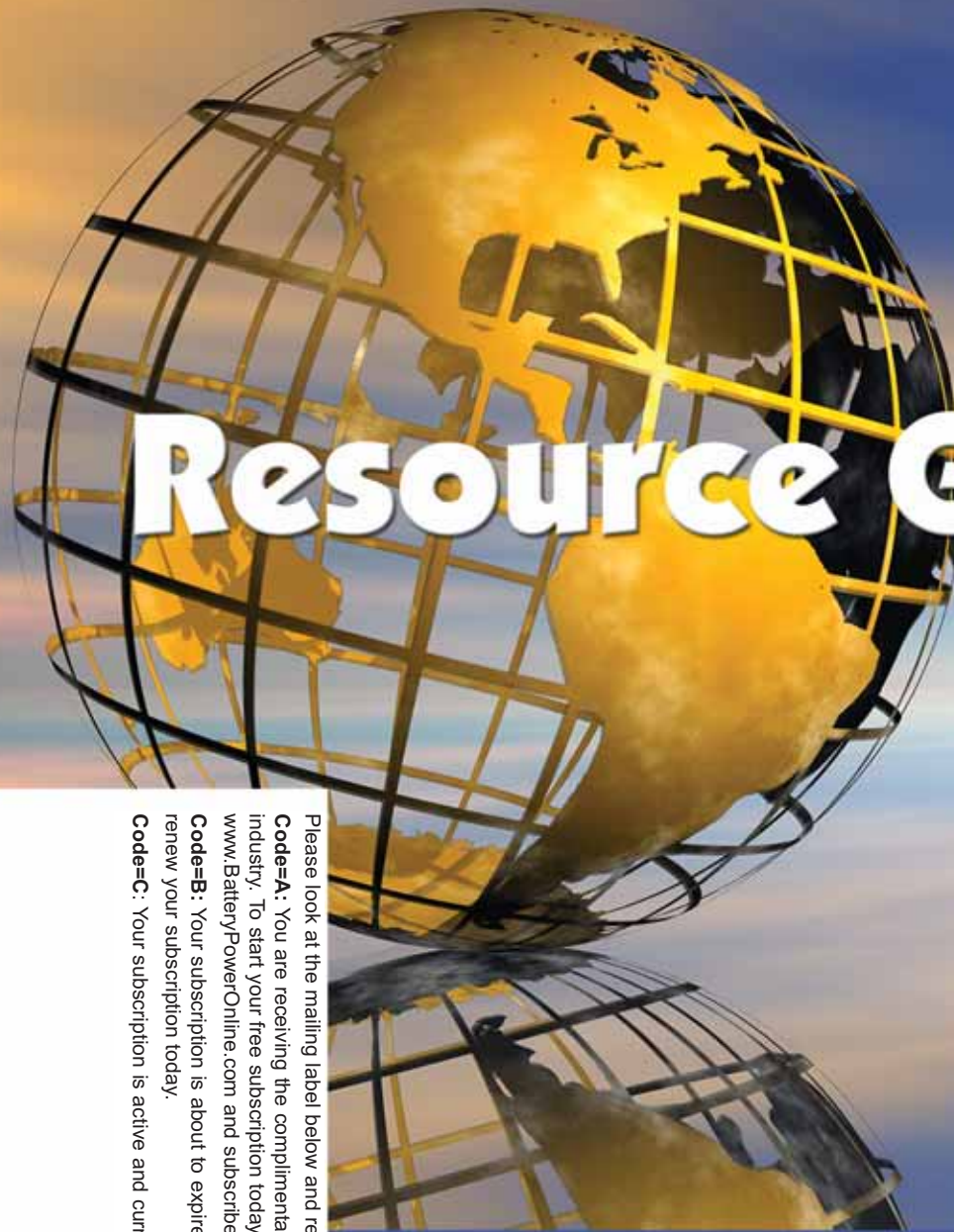


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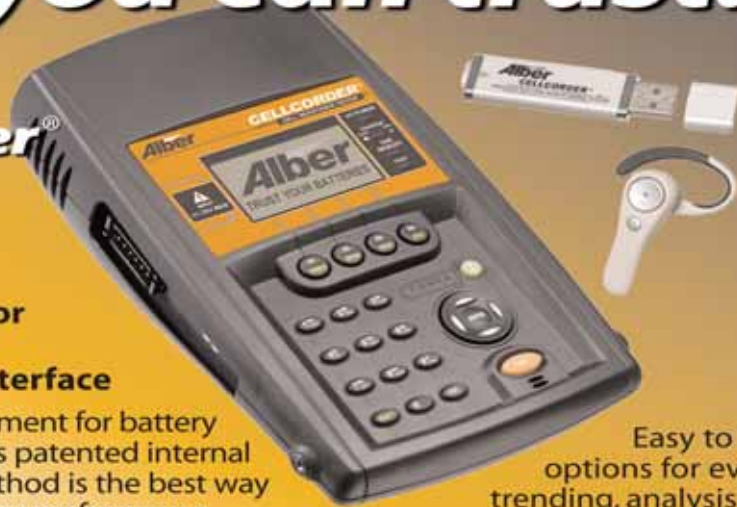
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Welcome to the second annual stand-alone issue of the Battery Power Products & Technology Resource Guide. Within these pages you will find listings of manufacturers and suppliers in the battery industry and the products and markets they serve. Batteries are categorized by chemistry and type for easy reference. The guide also covers battery supplies, from cables and enclosures to integrated circuits and watering systems.

Additionally, The Rechargeable Battery Association (page 4) and Frost & Sullivan (page 9) have both contributed feature articles on industry trends and challenges. There is also a preview of Battery Power 2009 on page 20.

We hope you will find the 2009 Resource Guide and useful reference tool. As always, we welcome your feedback.

*Shannon Given, Director of Content
shannong@infowebcom.com*

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Battery Collection and Recycling Initiatives and Transport Regulations Present Unique Challenges for Industry in 2009

George Kerchner, Executive Director

The Rechargeable Battery Association (PRBA)

An onslaught of legislative and regulatory proposals in North America relating to battery transportation and recycling has created a “perfect storm” that will impact all battery and electronics manufacturers, distributors and retailers. If these proposals are adopted, consumers also could be impacted as companies address the costs associated with these new regulations.

Since 1991, The Rechargeable Battery Association (PRBA) has served as the voice of the rechargeable power industry. We have represented our members on legislative, regulatory and standards issues at the state, federal and international level.

PRBA and its members, and many others, are now faced with navigating through this perfect storm, a challenge made all the more challenging during this particularly difficult economic climate. Indeed, the scope of these challenges is so great that non-member companies who in recent years have been less supportive of industry-wide efforts should be rethinking whether they are really bearing their fair share of the burden of responding.

Air Line Pilots Association Take Its Case to Capitol Hill

Over the past several years, the Air Line Pilots Association (ALPA) has tried to secure changes to the international dangerous goods regulations that apply to lithium ion and lithium metal batteries. ALPA has been particularly frustrated by its inability to convince the US Department of Transportation (DOT) when that agency in 2004 banned the carriage of cargo shipments of lithium metal batteries on passenger aircraft, to extend that ban to lithium ion batteries or cargo aircrafts.

Until recently, ALPA focused its strategy on the international level. In 2006 and 2007, it filed several proposals with the bodies that develop regulations governing transport of dangerous goods: the UN Subcommittee of Experts on the Transport of Dangerous Goods and International Civil Aviation Organization Dangerous Goods Panel. These included proposals to:

- Prohibit the transport of lithium metal batteries aboard both passenger and cargo aircraft.
- Eliminate the lithium battery “exception” provisions in the hazardous materials regulations that facilitate the air transport of consumer-product-sized lithium ion and lithium metal batteries, and keep such transportation economically-realistic.
- Change the classification of lithium metal batteries from a Class 9 “Miscellaneous” dangerous good to a Class 4.3 “Dangerous When Wet.”

All of ALPA’s proposals were rejected by the UN and ICAO by overwhelming majorities. As a result, ALPA turned its attention to Capitol Hill in Washington, D.C. where it has found sup-

port in key committees in the House of Representatives.

ALPA’s most recent public presentation of its case occurred on May 14, 2009 before a Congressional Subcommittee. It used the same arguments that failed to convince international regulators at the UN and ICAO in urging that all lithium ion batteries be shipped only as fully-regulated Class 9 materials when offered for air transport. Consistent with its presentation at an ICAO working group meeting in 2007, ALPA took the opportunity to gratuitously show a video clip of a fire involving a notebook computer, while at the same time proclaiming its concern was only with cargo shipments, not carry-ons. ALPA also skirts the issue of whether it wants more restrictive regulatory requirements to apply not only to battery shipments, but also to cargo shipments of products containing or packed with batteries.

ALPA thus is advocating US adoption of a set of regulations that are inconsistent with international regulations. (The international rules allow shipments of the lithium ion batteries with lesser (but still enhanced) restrictions. If ALPA succeeds, it would create a complex domestic and international regulatory system that is significantly different for lithium battery shipments into, from or within the US. This would substantially increase the cost of these batteries, and would discourage the continued maintenance of R&D and manufacturing facilities in the US, which would encourage shipment of jobs offshore.

Although the future of the legislation ALPA advocates is uncertain, its efforts already have led Congressional staff to urge additional regulatory action by the US DOT. As a result, DOT is in the process of drafting a Notice of Proposed Rulemaking. As currently conceived, the proposed rule would eliminate the exceptions for small consumer-type lithium ion batteries shipped by air, and lithium ion battery-powered products. Such a change in the regulations would obviously have a significant impact on any company that ships these small cells and batteries and equipment packed with or containing them. The proposed rule will probably emerge by year-end.

Battery Collection and Recycling Initiatives in Canada

But Washington, D.C., is not the only focus of activity. Disruptive issues also are receiving serious attention north of the US border.

The Province of Ontario, Canada is moving to expand its mandatory “municipal hazardous and special waste” diversion program to cover rechargeable batteries. The program is being developed under the auspices of Waste Diversion Ontario (WDO), a quasi-governmental organization, and Stewardship Ontario, a similar organization that reports to WDO.

The goal is to expand a program, already underway, that divert from the waste stream nonrechargeable household batteries (and

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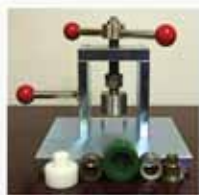
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many other used products). Under that program, “stewards”, defined as brand owners or those who import products into the province, are being assessed the equivalent of \$0.125 kg for batteries sold into the province. That assessment is expected to increase as much as five-fold in the next several years.

PRBA, working in an informal coalition with Rechargeable Battery Recycling Corp. (RBRC) and the Battery Council International (BCI), is seeking to convince the Canadian authorities to accept RBRC’s existing program as fully-satisfactory to meet all rechargeable battery program requirements. To this end, the Rechargeable Battery Corp. of Canada, a subsidiary of RBRC, is currently preparing an application to have its Call2Recycle program recognized as an “Industry Stewardship Plan” (ISP) in Ontario. If the ISP application is approved, RBRC intends to expand its program in Ontario to cover nonrechargeable, as well as rechargeable batteries. Importantly, if the Call2Recycle is approved as an ISP, there will be no new fees imposed on current RBRC licensees.

Furthermore, if the RBRC ISP is approved, companies covered by it will not be subject to fees assessed to support the alternative program being developed by Stewardship Ontario. Stewardship Ontario estimates the first year cost of its expanded program at \$9.7 million. Those costs, and the costs of every future year, would be assessed against rechargeable battery “stewards” including companies who sell battery-powered products into Ontario.

Unfortunately, it is proving to be a considerable task to convince authorities in Ontario that there is no need to disrupt the existing Call2Recycle program. This is surprising considering the success of the RBRC program in Ontario and the more than 1,900 RBRC collection sites currently operating in Ontario.

Ontario is not the only Canadian province addressing battery recycling. In December 2008, the Province of British Columbia amended its recycling regulations to require development of collection programs for a variety of previously-unaffected products as of July 1, 2010 and July 1, 2012. In general terms, the 2010 deadline applies to small electrical, electronic and telecom equipment and lighting devices and, significantly, batteries that “could be used” to power them. The 2012 deadline applies to larger appliances and tools, “other than large-scale stationary industrial tools,” and batteries that “could be used” to power them.

Under the British Columbia law, producers, brand-owners or “first sellers” in the Province must either participate in an approved product stewardship plan or otherwise provide specified recycling opportunities. To date, British Columbia has been far more receptive than Ontario in recognizing the success of the RBRC program and appears that it may satisfy the new regulations’ requirement for portable rechargeable batteries, but this is yet to be confirmed.

And, in recent months, the provinces of Quebec and Manitoba have indicated their intention to follow the Ontario and/or British Columbia lead.

Battery Collection and Recycling Initiatives in the US

After about a decade of quiet, there also recently has been a flurry of battery-related activity on the US state level. Often, the issue arises in the context of broader “product stewardship” legislation applicable to many products, but with used batteries singled out for attention. The most notable proposals include:

- Global warming legislation introduced in Washington State included producer responsibility provisions targeted at rechargeable batteries, among other products. Producers of rechargeable batteries would have been responsible for developing and implementing highly detailed and burdensome product stewardship plans.
- In Oregon, comprehensive rechargeable battery recycling legislation was introduced that would have required retailers to accept rechargeable batteries and battery manufacturers to operate the battery collection and recycling program.
- New York legislation that would require reverse distribution collection of used rechargeable batteries. Covered batteries are defined to include all chemistries of less than 25 pound batteries except vehicle batteries, including wheelchair batteries, and backup power and memory storage batteries. Disposal of covered batteries would be prohibited and retailers and distributors would be required to accept returned batteries and deliver them to a collector, recycling facility or, as a last resort, authorized hazardous waste facility.

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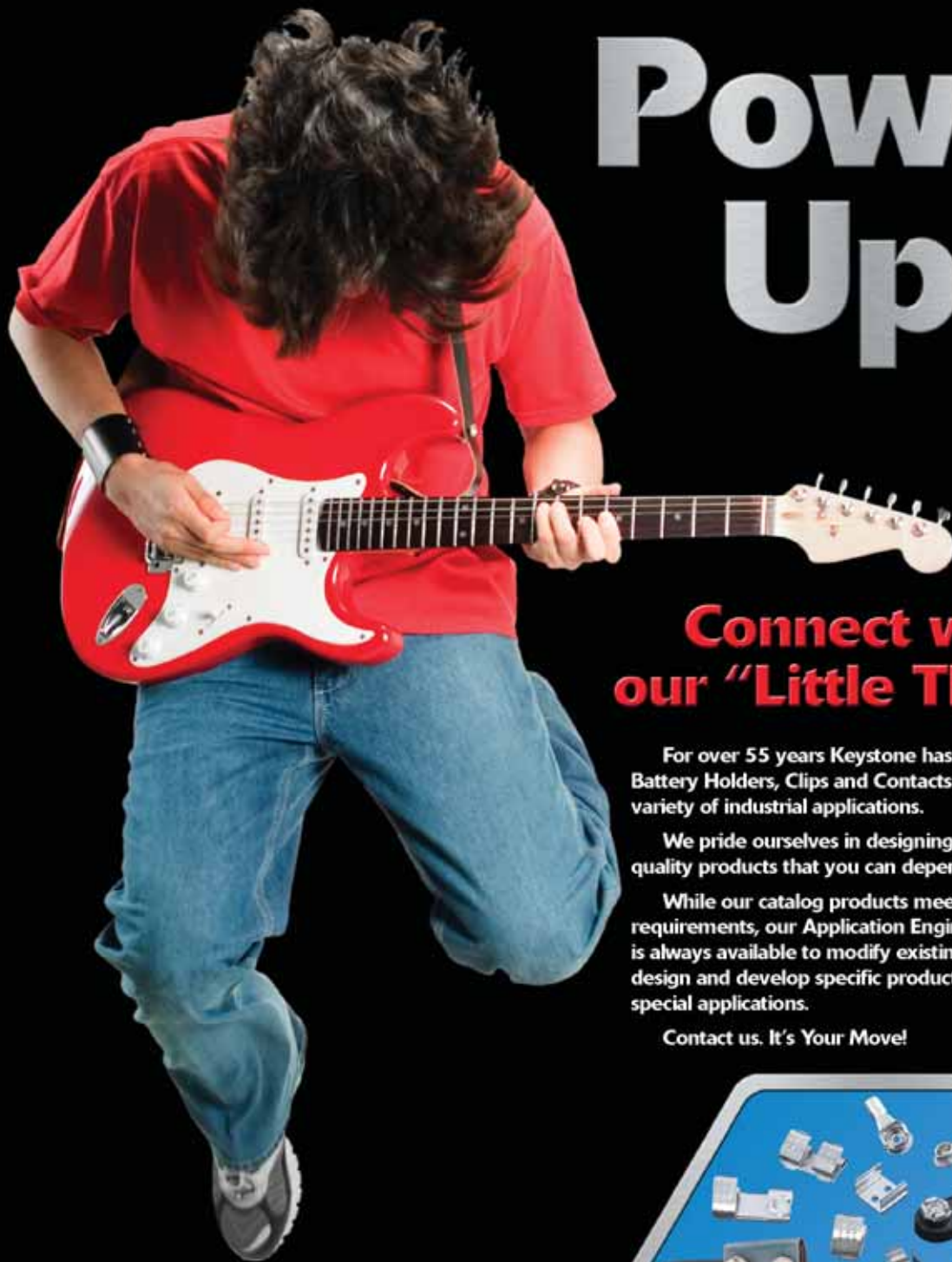
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US DOT Safety Advisory on Recycling Shipments

On April 2, 2009, DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) issued a general safety advisory addressed to "All battery recyclers and battery collection points and related associations." It was intended to convey the Agency's concerns regarding non-compliance with the US hazardous materials regulations during battery recycling activities.

In the advisory, PHMSA noted that non-compliant shipments of spent batteries may have led to several recent fires in ground

transportation, including one in November 2006 in which a vehicle was completely destroyed.

PHMSA pointed out that "all batteries" are subject to requirements in the hazardous materials regulations because they have two types of hazards: (1) the chemicals or other materials contained in the battery, and (2) the electrical potential of the battery. The advisory also listed the various battery entries in the HMR and the provisions that apply to the different battery chemistries.

In a related matter, PHMSA's Office of Hazardous Materials Enforcement mailed dozens of "warning letters" to shippers of spent batteries after its agents observed at battery recycling facilities "probable violations" of the HMR. Most of these related to failure to package batteries to prevent short circuits. The strongly worded letters referenced the Agency's authority to assess civil penalties and impose criminal fines against shippers who fail to comply with the HMR and raised concerns on the part of many companies.

Summary

It is hard to imagine how any company involved in the battery or electronics industries will not be impacted by these issues at some point over the next 12 months. In order to stay current on such matters, members of PRBA are sent regular weekly and monthly correspondence and have an opportunity to have their voices heard at state, federal and international forums. PRBA has a solid record of success, but faces continuing challenges.

At this point in time, it will be especially important for the rechargeable power industry to work together to ensure regulators and legislators in the US and internationally understand the impacts these new regulatory and legislative proposals will have on small and large companies during these particularly difficult economic times. Many companies who have been comfortable letting others carry the burden of protecting their interests should be reconsidering whether this is fair and appropriate.

George Kerchner is executive director of PRBA. He represents PRBA at domestic and international forums such as the United Nations Subcommittee of Experts on the Transport of Dangerous Goods and International Civil Aviation Organization (ICAO) Dangerous Goods Panel. Mr. Kerchner also works as a regulatory analyst with the law firm of Wiley Rein LLP in Washington, D.C., and provides dangerous goods training for shippers of batteries and battery-powered products.

Those interested in receiving more information on PRBA activities and membership should contact George Kerchner at 202-719-4109 or prbatt@gmail.com.



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Redefining Energy Storage in Transportation Markets: *The Lithium Revolution*

Anu Elizabeth Cherian, Industry Analyst
Frost & Sullivan

Almost two decades ago, North America was the leading oil user in the world, especially in light of the automotive market. Light and heavy vehicles alike required a lavish supply of oil for performance, features and the ultimate driving experience. As the political relationships between different continents has significantly influenced the price and supply of natural gas, there is an increasing need among the global gas consumers to look for more efficient and successful alternatives to sustain industrial growth while preserving earth's natural resources and refraining from the exploitation of its rich treasures.

Reminiscing on the evolution of the energy storage market from lead acid to lithium ion brings credibility to the future direction this market is likely to take. Lithium has been around since the 1800s, but its potential in energy storage mechanisms was discovered more than a century and a half later. Lithium was identified as a very good anode material for batteries in the 1970s. When lithium is placed as a metal at the anode, there is a serious safety hazard involved. The groundbreaking discovery and the combination of the use of graphite anode and a workable cathode, were officially launched by Sony in 1991. After almost two decades, our experience with the many benefits of the lithium-ion battery has only become better.

The third decade holds high expectations. This battery type is expected to leverage and revolutionize the transportation market in providing efficient energy storage mechanisms, thereby reducing the amount of gas used in the combustion engine. Currently, there are several types of lithium-ion chemistries that exist in the market, such as lithium manganese, lithium titanate and lithium phosphate, among others.

Hybrids

Hybrid electric vehicles (HEVs) and electric vehicles (EVs) are a few of the applications in which lithium-ion batteries are expected to create a spur in the market. HEVs are widely used in North America. Nearly 15 different types of HEVs manufactured by major automotive manufacturers are projected to be launched in 2009. Along with an increased focus on newer vehicle technologies, the core energy storage mechanism

also projects to display a dynamic shift of focus.


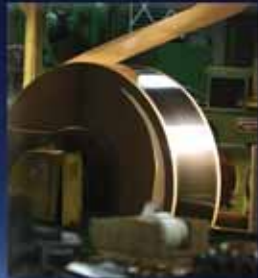
The traditional nickel metal hydride (NiMH) chemistry currently powers all HEVs. However, there are great expectations from the lithium-ion chemistry to be a viable and winning competitor to the NiMH battery. Several prototypes were on display at all global auto shows, displaying newer additions such as the


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lithium-ion and the ultracapacitor. The HEVs and EVs powered by this chemistry are undergoing vigorous testing and modifications to tailor to the needs of the highly cost-conscious end user.

HEVs utilize the features of a conventional engine as well as a battery, reducing its dependence on both. The features required for HEV/EV batteries that make it desirable are high energy density, high specific power, long shelf life, less maintenance, lightweight, compact size, quick charge and discharge capabilities and competitive price.

Many major automotive manufacturers have entered an alliance or a multi-year contract with Li-ion battery manufacturers to develop Li-ion batteries suitable for HEV/EVs. These automotive manufacturers have started testing their HEV/EVs using Li-ion batteries and are expected to launch Li-ion powered HEVs and EVs by the end of 2009.

Automotive Partnerships with Lithium-ion Battery Manufacturers

- Toyota is closely working with Matsushita Electric Industrial and Panasonic EV Energy, which recently acquired Sanyo to build its Prius's and other concept cars.
- Volkswagen relies on Panasonic for its hybrids with the Audi brand while working with Toshiba for its electric vehicles.
- Daimler is working with JV Company and Evonik to develop its electric vehicle
- GM, now owned by the government, is working with LG

Chem on its Chevy Volt while its subsidiary Saturn associates with Hitachi Vehicle Energy Ltd., a combined partnership with Hitachi and Shin-Kobe Electric Machinery.

- Mitsubishi is working with its parent company along with GS Yuasa and Lithium Energy Japan.
- Ford and Daimler are also in a consortium with BYD in sponsoring research on battery technology with Johnson Controls-Saft.
- Tata Motors from India is working closely with Electrovaya to create a revolution in the electric vehicle market just as they accomplished with the Nano.

The Tesla Roadster

The car that has gained significant attention in the past year has been the Tesla Roadster. Initially slated for production in October 2007, the production did not go live until March 2008. The Tesla Roadster is based on the Lotus Elise and is powered by 6,831 lithium-ion cells with 248 hp output. The basic chassis design is from Lotus Cars and it shares less than 10 percent of its components from the Lotus Elise. The light weight of this car is maintained by the RTM carbon fiber body panels, the only one of its kind provided by the French company SOTIRA.

The end of 2008 saw the delivery of the first 100 Tesla Roadsters. However, the first quarter of 2009 witnessed more than double that number in sales, despite the high price premium placed on this car. The car produced in the model year 2008 was sold at a price of \$100,000 while the 2009 model starts at a base price of \$109,000 due to the improvements made in the transmission reliability. The significant feature of this car is the achievement of 0 to 60 mph in four seconds powered by the lithium battery. The distance traveled between batteries charges averaged at 227 miles.

The Energy Storage System

The Energy Storage System or ESS, is the combination of innovation and technology to sustain the heart of a car such as the Roadster. The cells used in the Tesla Roadster are called 18650 based on its individual dimensions, 18 mm diameter by 65 mm length. The basic intent is to have a smaller cell so that the impact of a failure from a single such cell will be lesser than a cell many times larger. The total weight of the energy storage unit alone is 450 kg.

Arranged similar to the laptop batteries, the 6,831 lithium-ion cells are placed in 11 sheets in series. However, a brick of 69 cells is connected in such a way that failure in one cell will not affect neighboring cells. This is highly essential for the safety of the car, especially while it is moving and there are ample opportunities to spark a fire. It is the safety aspect of the lithium-ion which is a great concern among end users. Nevertheless, essential safety measures have been devised in the Tesla Roadster to protect from all possible disasters.

Safety Measures

- It has an internal positive temperature co-efficient (PTC) current limiting device. It limits short circuit in individual cells.
- At the individual cell level, a Current Interrupt Device (CID)

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is present that protects each cell from excess internal pressure.

- Packaging of cells is done in steel cans, providing strength to the battery unit. Steel also offers good thermal conductivity thus extending the life of the battery in addition to dissipating excess heat from causing sparks in the material of the battery.
- The battery pack is enclosed with aluminum as opposed to plastic used for laptops. Aluminum has excellent ability to withstand heat.

There are several other features incorporated into the design of each battery on a micro-level to ensure the ultimate in safety and abuse protection.

A recent and very significant development is the equity position that Daimler AG has taken in Tesla Motors to propel and significantly accelerate the commercialization of the lithium-ion battery. This is in addition to the relationship with Evonik, and an interim arrangement until Evonik has its batteries ready for the electric vehicle.

The Issue of Material Shortages

A question that arises is the availability of lithium and its ability to sustain growth in the batteries market, especially in a high demand transportation sector. The answer is fairly unclear right now; however, the following facts remain.

- Lithium is the 35th most abundant element on the planet.
- Raw material prices overall have been extremely volatile over 2008 and continue to remain unsteady in 2009 as a result of

the economic situation.

- Lead and steel in particular, have witnessed several deficiencies in supply and, as a result, prices began to increase.

However, with the already commercialized Tesla and upcoming models by the end of 2009, the issue on the availability of lithium and its extraction and use is another issue that needs to be addressed at large, before getting too comfortable with the technology.

The Future of Lithium is at Hand

As we stand on the threshold of the third decade of lithium-ion batteries and their revolutionary role in powering our lives, the journey begins in the transportation world. Although the keys have unlocked the technology, there are several holes to fill, such as more power in a smaller size and weight of the battery. However, the two most important tests the automotive lithium-ion battery must take from an end-user perspective is cost and safety for its road suitability. Its proven record in these two areas will increase confidence and bring us closer to the use of lithium over natural gas.

For more information regarding this article, please contact Johanna Haynes at johanna.haynes@frost.com.

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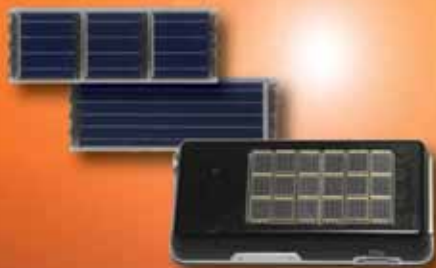
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