BATTERY POWER

Solutions for OEM Design Engineers, Integrators & Specifiers of Power Management Products

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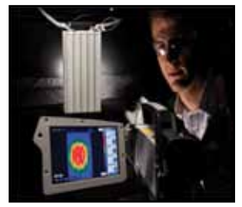

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World Primary Lithium Battery Markets Becomes Dynamic and Vibrant With the Development of New Battery Chemistries

Frost & Sullivan has released a new report titled "*World Primary Lithium Battery Market*", which provides revenue and unit market forecasts, geographic analysis, competitive analysis and market drivers as well as restraints. In this research, Frost & Sullivan's expert analysts thoroughly examine the following technologies: lithium/sulfur dioxide battery (Li/SO_2), lithium/thionyl chloride battery ($Li/SOCL_2$), lithium/manganese dioxide battery (Li/MnO_2), lithium/polycarbon monofluoride battery (Li/CFx) and other primary lithium battery chemistries.

Primary lithium battery markets all over the world have witnessed growth, with escalating defense budgets and spending on sophisticated, technologically advanced equipment creating a huge market for them. Manufacturers have been developing novel chemistries for an increasing number of new and specific applications. Further, increasing industrial automation and automation of the manufacturing sector are bolstering the need for primary lithium batteries. The spurt in demand for these batteries over the past several years has been in response to the advancements and breakthroughs occurring in portable and miniaturized electronic and medical products. The batteries for such applications need to be lightweight, compact and have wide operating temperatures. Several lithium chemistries can already meet these requirements due to their high energy density storage and efficient performance in rugged atmospheres.

Even though primary lithium batteries have many desirable features, some inherent features dampen the demand for these batteries. Some of the primary lithium batteries are still not considered safe for wide temperature ranges and disposal, as they could explode at high temperatures. Similarly, anode passivation, which is the formation of a salty layer when the anode and cathode touch each other, also reduces the performance and efficiency of the batteries. The threat from other primary chemistries and secondary lithium-ion batteries could also hinder the growth of primary lithium batteries for certain applications. However, the market could grow for the next four to five years before the threat from alternative chemistries starts manifesting. The medical, industrial, automotive and military applications markets are developing and are expected to buoy the primary lithium batteries market for the next five to seven years.

Electric Vehicle Market Finds Growth in New Markets

For years, advertising from government and car companies alike have boldly stated that it was only a matter of time before electric vehicles took over the car industry. Now, electric vehicles, in the form of hybrids that combine gas and electric motors, are finally beginning to do just that.

According to SBI Energy's latest market study, "*Electric Vehicle and Plug-In Hybrid Electric Vehicle Markets Worldwide*", the US and Japan currently make up the largest segments of the hybrid electric vehicle marketplace, with 42 percent and 48 percent market share, respectively.

"SBI Energy forecasts the market to double, for a total of 1.5 million passenger hybrid vehicles sold in 2014," says Shelley Carr, SBI Energy publisher. "The majority of growth will stem from smaller HEV markets such as Europe, Australia and South Korea, as well as new markets such as India and China. These countries, SBI Energy forecasts, will see a phenomenal 47 percent growth rate over the next four years."

In the global perspective, future growth of the electric vehicle market will depend on three key motivators: pain at the pump, government support and price differential.

Success of the EV market is also incumbent upon the EV infrastructure manufacturing industry. Infrastructure components include the smart grid, advanced battery research and vehicle charging stations that enable drivers to refuel their vehicles conveniently and effectively.

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Webcom Communications Corp.
7355 E. Orchard Rd., Suite 100
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Phone 720-528-3770 • Fax 720-528-3771
www.BatteryPowerOnline.com

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Li-Ion Battery Monitoring and Protection System for Energy, Industrial and Automotive Applications

Lithium-ion batteries are growing in popularity as energy storage reservoirs for high-voltage energy, industrial and automotive applications, such as wind turbines, photo-voltaic cells and hybrid electric vehicles, and this has spurred demand for safer, higher performing battery monitoring and protection systems. Analog Devices, Inc. has addressed the requirements of Li-ion battery manufacturers and power system designers with unveiling a Li-ion battery monitoring and protection system that integrates all necessary components including voltage and current measurement, signal isolation and safety monitoring.

Compared to NiMH batteries, Li-ion batteries have a better energy-to-weight ratio, offer more efficient storage capacity over multiple charge-discharge cycles and suffer less charge leakage when not in use. Unlike NiMH batteries traditionally used in high-voltage applications, battery stacks using Li-ion technology can comprise a large number of individual cells totaling hundreds of volts. Each cell must be properly monitored and balanced to ensure user safety, improve battery performance and extend battery life. ADI's new Li-ion battery monitoring and protection system performs these functions while also allowing power system designers to replace costly discrete components, decrease power consumption and reduce system space.

NEMA Criticizes US DOT Proposals on Transportation Of Lithium Batteries

Regulatory proposals put forward by the US Department of Transportation (DOT) to restrict transportation of lithium batteries and products that contain them are unnecessary, misdirected and would not achieve the safety goals stated by the agency, according to the National Electrical Manufacturers Association (NEMA) in comments it has submitted to the DOT.

Instead of creating new rules that would increase confusion in the market and reduce safety, the DOT should move quickly to adopt regulations that are largely harmonized with international standards for lithium-battery safe transport that are already in use in the rest of the world. The DOT should also devote sufficient resources to ensure compliance and enforcement with its regulations.

"Many of the agency's proposals, although perhaps well-meaning, would have the opposite effect of what is intended," said Kyle Pitsor, NEMA vice president for government relations. "NEMA and its member companies are committed to safe transportation of their products."

NEMA filed formal written comments with DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) on behalf of its Dry Battery Section, which represents manufacturers of lithium metal batteries, and on behalf of industrial and electrical equipment manufacturers that use batteries in several electro-industry sectors including industrial automation, utility equipment and medical equipment.

Moving the US Hazardous Materials Regulations for lithium batteries and products that contain or are packed with lithium batteries further away from transportation requirements agreed upon at the international level will merely increase confusion, will not increase compliance and has the potential to result in greater instances of non-compliance and reduced levels of safety.

Underwriters Laboratories Signed MOU with Industrial Technology Research Institute in Taiwan to Develop Safety Requirements for Electric Vehicles

Underwriters Laboratories Inc. (UL), a provider in product safety testing and certification services, has signed a memorandum of understanding (MOU) with Taiwan's Industrial Technology Research Institute (ITRI) to develop safety testing methodologies and requirements for power systems in electric vehicles.

The electric vehicle (EV) industry has become a major emerging focus worldwide. One of the critical factors driving the widespread adoption of EVs is product safety. To address product safety concerns and to help EV manufacturers to get their new products to the global market timely and efficiently, UL has been developing new safety standards for the EV industry.

"We expect our alliance with ITRI, the organization that has leading R&D capabilities and strong industry ties, to accelerate Taiwan's development of electric vehicles that combine performance and security," said Gary Savin, UL's vice president and general manager of global power and controls business. "We are contributing our technological expertise, which is backed by more than a century of experience in safety testing, certification and standards development."

After releasing a new set of requirements for electric vehicle charges in 1998, UL has been delivering a broad range of testing solutions and safety standards for electric vehicles and associated components. In the next five years, UL and ITRI plan to develop testing methodologies for safety of electric vehicles, including charging systems (on and off-vehicle), power batteries and electric power systems.

In 2009, UL also established the Advanced Energy Safety Center (AESC) to conduct research for safety of emerging technologies in Taiwan. AESC focuses on safety-testing technologies that support development of EV power systems as well as systems that generate power from renewable energy sources, such as solar and wind.

Is It Time for a Lithium-Ion Recycling Revolution?

Dr. Kerry Lanza
Palladium Energy

Lithium-ion batteries have earned and substantiated their label as a "green technology." The US Environmental Protection Agency (EPA) considers lithium-ion batteries "safe" for disposal in contrast to nickel-cadmium and lead-based battery products, which can cause environmental issues with careless disposal.

In the US, we typically do not see consumer electronics recycling as much of a money maker. Some electronics makers charge a premium for devices that include "ease of recycling" among their green credentials, while others charge to reclaim their devices for recycling. Nevertheless, as the auto industry races toward bringing hybrid and electric vehicles to market, environmentalist groups and government agencies such as the Department of Transportation, worry about the ability to properly recycle the lithium-ion batteries that power those cars. Unfortunately, there is almost no recycling infrastructure in place today. Does this mean that we have we reached the birth of the lithium-ion battery recycling industry? Some experts say that the need is still a decade away, while others are currently beginning to design and build recycling facilities.

The Economics of Recycling

At a minimum, recycling batteries is appropriate for two reasons. First, Americans will demand it, especially since the impetus for the development of lithium-ion and electric car technology are, at their very nature, environmentally friendly. Second, recycling makes economic sense if the revenue from the recovered materials, plus the avoided disposal costs, is greater than the cost for collection and processing. Although the developed world has a robust system to manage lead-acid battery recycling (more than 99 percent of lead-acid batteries are recycled in the US), the lithium-ion battery has a long way to go to catch up[1]. Lead-acid batteries are essentially blocks of valuable metals; lithium-ion batteries simply do not contain much valuable metal to make them economically useful.

Lithium-ion batteries are not nearly as toxic as lead-acid batteries, so not only is the urgency to recycle not there, but in fact, lithium-ion batteries are classified by the US Government as safe to dispose of in conventional landfills. So, is that good news or bad news? Maybe both. Each year, Americans annually dump two billion lithium-ion batteries into the waste stream[2]. However, the scrap value of lithium-ion batteries is perhaps only $100/ton, compared to $1,000 to 3,000/ton for lead. By contrast, the cost of collecting, sorting and shipping lithium-ion batteries to a recycler far exceeds the scrap value. However, this could be off-set by the fact that the cost of other materials in lithium-ion batteries, such as cobalt, have a lower recycling cost than mining new material.

Global Lithium Supply and Demand

It may be time to look to the future. With our mobile lifestyle (driving the development of portable electronics) and the predicted increase in demand for electric vehicles, will the cost of lithium increase and thus making recycling more economically attractive? In 1975, the US Geological Survey convened a symposium on lithium demand and resources. Their concern was that by the year 2000, there would not be enough lithium to meet the demand for fusion power and load-leveling lithium storage batteries. In 1985, there was another predicted shortage when aluminum-lithium alloys were forecast to be used in aircraft construction. Recently, concern was expressed again about lithium availability because of the potential large scale use of lithium-ion batteries in electric and hybrid vehicles.

However in a recent study performed by Argonne National Labs, the global supply of lithium was found to be more than adequate to meet the demand to 2050, even with the optimistic view of how quickly electric vehicles will be adopted[3]. Bolivia has the world's largest reserves of lithium, followed by Chile and Tibet. Lithium-ion batteries account for only 25 percent of the worldwide demand for lithium, but that percentage has risen quickly over the past 10 years. Ceramics, glass and lubricating greases are other major uses of lithium and collectively account for 30 percent of global lithium demand. While 2050 may seem like a long way off, in that time 10 million metric tons of lithium will have been thrown away.

Lithium Economics

Is it wise to begin taking the necessary steps to develop an infrastructure for recycling now? The US Department of Energy recently granted $9.5 million to a company in California that plans to build a recycling center for lithium batteries. With $2 billion of grants awarded for the development of lithium batteries, this seems like a drop in the bucket, but it is a start. Although, the lithium part of a battery pack is a negligible cost when compared to other metals; nickel and cobalt tend to be the bigger drivers of recycling.

Cobalt, a by-product of copper and nickel mining, is a scarce metal and half of the global supply comes from politically unstable regions of the world. In addition, some lithium-ion chemistries are even less cost effective to recycle. For example, lithium iron phosphate batteries will not yield a high recycling return, and while this chemistry has advantage over other competitive products, it also makes it less economical to recycle.

In Europe, lithium battery recycling is supported through subsidies. Even with rising prices for metals, subsidies, in the form of a tax added to each cell manufactured, are still necessary and are collected from manufacturers, agencies and governments to support the recycling programs.

Current Status and the Future of Lithium Recycling

Current battery recycling methods require high amounts of energy. It takes six to 10 times the amount of energy to reclaim metals from recycled batteries than it would through other means of metal reclamation processes[4]. The current process of recycling batteries starts by removing the combustible material, such as insulation and plastic, with a gas-fired thermal oxidizer. This process leaves the clean cells containing the metals. The cells are cut into smaller pieces and then heated until the metal liquefies. After removing the slag, the different alloys settle according to their weights and are skimmed off. Cadmium is light and vaporizes at high temperatures. The cadmium vapor is collected, cooled and condensed to a very pure form.

Let's face it; recycling larger lithium-ion automotive batteries has to be much easier than recycling smaller lithium-ion cells. The collection mechanism and logistics has to be more straightforward, and more in line with the lead-acid recycling model. Secondly, the large format will warrant separation by type to maximize the value of the recovered materials, which will be in fairly large pieces to justify product disassembly. It is even plausible to remove the cell windings to recover the clean aluminum from the cans.

The investment and innovation pouring into lithium-ion technology for electric cars could be a major advantage for the emerging green power grid. When an auto battery degrades and needs to be replaced, the auto companies could find a healthy market in the utility grid for recycled lithium-ion batteries for use in energy storage. This may eliminate the lithium recycling stumbling block the auto industry is facing. Enter: recycle and reuse.

Future Work

As an industry, we need to make sure the newly developed lithium-ion batteries can be recycled. There has to be a complete estimate of the material available for recycling and the economics of doing so, and these estimates must include the possibility of reuse for lower-duty performance applications. Building on past work and recycling processes, we need to understand the total energy, social and environmental costs to maximize recovery and minimize impact. The lithium-ion recycling revolution may not quite be here today. But, "a revolution is not an apple that falls when it is ripe. You have to make it fall." - *Che Guevara*

Dr. Kerry Lanza is strategic marketing manager at Palladium Energy. They have helped many clients move from lead-acid and nickel-based batteries to greener lithium technologies.

References

1. Cost of Lithium-Ion Batteries for Vehicles. (2007). U.S. Department of Transportation Special Report, 1-73.
2. Green, H. (2009, August 17). Li-Ion Recycling Gets Attention. Technology Review Today, 2(1), 12-15.
3. Hamilton, T. (2009, August 11). Lithium Battery Recycling Gets a Boost. MIT Technology Review.
4. Buchmann, I. (2009). Battery University. Retrieved from www.batteryuniversity.com.

Advancements in Li-Ion Battery Manufacturing Give Designers a Greener Choice

Dr. Ake Almgren
International Battery

With today's focus on designing more environmentally friendly products and taking advantage of the latest energy storage technologies, it behooves designers to look at the process by which batteries are manufactured. It would not make sense if we are actually putting more toxins and pollutants in our environment in the quest to be green.

Traditionally, Li-Ion electrodes are made using a slurry-based process, which uses large amounts of organic solvents to homogeneously mix the components of active materials. The solvent predominantly used in the Li-Ion industry is N–Methylpyrrolidone (NMP). For the solvent-based process extensive and expensive recovery equipment, hoods and other precautions are necessary.

A significant advancement has been made with water-based processing aimed at reducing battery costs and protecting the environment at the same time; giving designers a greener choice when specifying Li-Ion batteries.

At International Battery, the focus is on manufacturing Li-Ion cells using a water-soluble binder (WSB) based process for both the cathode and anode. By eliminating the solvent from the manufacturing process, the capital expenditure cost and the manufacturing cost can be reduced considerably. The WSB process uses water as a medium to dissolve and disperse the binders and the electrode materials respectively.

Figure 1.

Another important advancement are the large format prismatic battery cells. Different from their smaller cousins used in flashlights and iPods, large format Li-Ion prismatic batteries (see Figure 1) provide more optimal building blocks to deliver higher amounts of energy and scale up as energy demands increase.

Designing a battery system with large format prismatic cells mean less connections and wiring, which reduces cost and also helps the thermal management and maintaining a high energy density of the system. With large format prismatic cells each individual cell can be monitored. It enables the battery management system (BMS) to more precisely know the state of the battery and provide active balancing of the cells. It results in a more efficient utilization of the stored energy in the system.

Large format Li-Ion cells are now being manufactured and deployed using the water-based manufacturing process. Applications currently using or testing large format cells include military vehicles on silent watch, diurnal (renewable) energy storage, backup power for telecommunications as well as hybrid vehicles and distributed energy storage for utilities.

One example of the latter is Community Energy Storage (CES). Coined by utility, American Electric Power, CES is part of the utility's Ohio gridSMART demonstration project. As part of this first-of-its-kind project, AEP and system integrator, S&C will test large format Li-Ion batteries.

Another interesting project utilizing energy storage has been deployed in Maui, Hawaii. With electricity rates the highest in the country, the Maui Economic Development Board wanted to assess the effectiveness of storing solar energy using efficient battery technology. The renewable energy system is comprised of sixty 224-watt photovoltaic panels, a bi-directional three-phase inverter system and a state-of-the-art charge-controller network provided by HNU Energy in Maui. A 48 V, 16.4 kWh Li-Ion based energy storage system was integrated, complete with battery management and controls, to store the energy generated from the solar array.

Figure 2. International Battery's lithium ion battery modules with battery management system.

The energy storage system includes four battery modules, totaling 32 160 Ah lithium iron phosphate (LFP) cells and a battery management system (BMS) that is integrated into a standard 19-inch portable rack mount chassis and enclosure (see Figure 2). As with the CES project, large-format Li-Ion batteries were chosen because of their proven high-energy density, robust thermal and cycling performance as well as easy system expandability.

The Future

As exciting applications such as electric vehicles and the smart grid drive innovations and transform their respective industries, the role and significance of Li-Ion batteries continues to increase.

From an economic and environmentally-sustainable perspective, the future looks very bright for energy storage incorporating Li-Ion cells. At International Battery we believe, based on performance results and cost analyses, that water-based processing and new large format form factors will help expand Li-Ion adoption in many key industries.

Contact International Battery at www.internationalbattery.com.

Batteries Play Significant Role in One of the World's Greenest Data Centers

Steve Vechy, Director, UPS and Utility Marketing
EnerSys

Syracuse University is well-known for the energy generated by the crowds watching its top-ranked basketball team. Soon it will be well-known for a different kind of energy: green energy. In January, Syracuse University opened the Green Data Center, its new primary production data center reputed to be one of the most efficient Green Data Centers in the US. It was developed jointly by Syracuse University, IBM and New York State Energy Research and Development Authority (NYSERDA). Backing up the power in this innovative data center is a unique uninterruptible power system (UPS) powered by EnerSys DataSafe batteries.

The $12.4 million, 12,000-square-foot Green Data Center is designed as the primary production center for the entire university campus and provides mission critical functions to all members of the university community. In addition to providing many administrative systems including class registration and scheduling, accounting, payroll and personnel management, the data center also supports critical research and security functions as well. The ability to operate the Green Data Center indefinitely in a utility outage, with an automatic and seamless transition, is a tremendous benefit to the Syracuse University community economically, academically and from a safety and security standpoint.

To power the Green Data Center, Syracuse University built a nominal 650 kW micro-turbine based Combined Heat, Cooling and Power (CHCP) plant. The design of the CHCP system comprises two n+1 arrays of six newly developed, natural gas-fueled Capstone model C65 Hybrid UPS packaged micro-turbines. The center is capable of operating seamlessly off-grid in the absence of utility power, when necessary.

Each micro-turbine array can direct the turbine exhaust heat from the unit to a discrete heat exchanger for use in comfort heating and/or to a dedicated double-effect absorption chiller, which will provide cooling for IT equipment, air-conditioning for the data center and air-conditioning for an adjacent office building. Power generated by the micro-turbines will be utilized to supply the IT equipment in the data center, the mechanical support equipment in the data center and any other available loads within the university's South Campus power system.

A DC power system provides a 150 kW, 400 VDC source to directly feed IT equipment. The use of both AC and DC power to run the system both online and as a backup power source is a unique feature of the Green Data Center. Some IT equipment is able to utilize DC power directly; notably, the first IBM Z10 supercomputer configured for DC is now running at this site.

The Importance of Wet Cell Batteries

There are two identical power supply chains, each connected to the six micro-turbines and separate banks of batteries. IT equipment with dual power supplies has been utilized throughout, to increase redundancy, isolate possible failures and maximize uptime.

This unique approach uses flooded wet cell batteries, in conjunction with the C65 Hybrid UPS microturbines, to provide all the power reliability of a traditional, standalone UPS system at substantial net capital savings.

The battery strings for the facility provide the UPS function normally found at a data center and also provide power peaking and black start capabilities required for the micro-turbine array. This integration is a first in the UPS industry. EnerSys DataSafe DXC19 flooded cell batteries are utilized in a conditioned environment in order to extend battery life in this duty to approximately 15 years, as opposed to the battery life of more common VRLA batteries, which typically must be replaced after five years or less.

"The application required small footprint flooded lead acid

cells to supply online power to the micro-turbines that would have reliable operability in this application for at least 10 years and that would also be easy to maintain. EnerSys DataSafe DXC 19 batteries were selected to provide energy storage and emergency battery power," said Marco Migliaro, principal of ESA Consulting Engineers, Penn., a consulting engineering company that specializes in services related to emergency power systems.

Green Features

In a typical data center, AC power generated by a central power plant is delivered through the local utility's electric grid. At a typical data center, this power can be transformed in voltage and converted from AC to DC (and back) several times. These multiple conversions result in significant energy loss. By directly generating power on site at the Green Data Center and utilizing a central DC power system, transmission and conversion losses are greatly reduced.

Under normal operation the micro-turbines operate with two separate, synchronized AC connections: one parallel to the utility grid and a second connection to the data center load. The power output of the turbine engines can match that load, or if more is needed, power is imported from the grid. If less is required, the excess power is then utilized by other nearby university facilities.

In the event of a loss of utility power, there is virtually no change in the voltage waveform supplied to the data center load. The data center thus operates powered solely by the micro-turbine array with an essentially seamless transition. Once the regular utility source resumes, inverters synchronize to the grid and dispatch of the micro-turbines returns to normal. In extremely unusual conditions, where both utility power and natural gas become unavailable, the system can operate without the micro-turbine engines operating, using the energy stored in the batteries. In this configuration performance is identical to a redundant series UPS.

EnerSys Continued on Page 14

The system is expected to deliver significant environmental benefit by substantially reducing emissions largely as a result of the lean-burn technology employed by the Capstone microturbines. For instance, SO_2 emissions should be reduced by 10,500 pounds per year, NO_x by 1,970 pounds per year and PM by 29,380 pounds per year.

The design for the Green Data Center also reduces the energy consumption and costs. Operational since January 2010, it will use about 50 percent less energy than a typical data center in operation today, making it one of the world's "greenest" computer centers. A typical data center uses up to 30 times more energy than a typical office building, and total data center energy use is doubling every five years.

Integral to reducing energy usage is the incorporation of IBM's latest energy-efficient servers, computer-cooling technology and system management software. Because the Green Data Center was constructed in accordance with LEED "Green Building" principles, more than 99 percent of all construction waste was recycled: more than 1,200 tons that did not go to a standard landfill.

In addition to being Syracuse University's primary computing facility, the Green Data Center also supports an IBM-sponsored Analysis and Design Center, which offers research and analysis services for others who want to build new energy efficient data centers or optimize the efficiency of their current facilities.

The Green Data Center at Syracuse University is one-of-a-kind, producing its own energy and its own cooling. It's no surprise that some experts expect that hybrids that combine energy storage with power generation will become a much more integral part of the future with clean energy.

A battery business veteran for more than 20 years, Stephen Vechy is the marketing director for UPS and Utility at EnerSys. Stephen is a member of the Institute of Electrical and Electronics Engineering (IEEE) and has been active in the IEEE Stationary Battery Committee and SCC-21. He is the chairman of the Battery Council International Industrial Battery and Charger Committee and a member of the Intelec Management Committee.

For more information see Syracuse University Green Data Center Web site at www.syr.edu/greendatacenter.

The views expressed are those of the author and do not represent those of EnerSys.

A Green Value Proposition

The Real Cost

Anu Cherian, Industry Analyst, Energy & Power Systems
Frost & Sullivan

The term "green" is perceived to be attached with a price premium. The hype around green technology has created a buzz for more than a decade. This has also created a green marketing agenda for almost all organizations. Companies that have placed their entire value proposition around their ability to be green have gained more recognition. From the use of recycled paper to the decline in use of plastics, the term green has multifaceted dimensions. Energy vampires, carbon footprint, sustainability, 3R's (reduce, reuse, recycle), renewable energy, climate change, biodiversity, biodegradable and even vegan are terms that identify a green agenda.

The energy storage industry has gained considerable attention in its green value proposition from technologies such as lead acid batteries to the very popular lithium ion. This topic brings our attention to a technology with a truly green value proposition: the ultracapacitor.

The working of the ultracapacitor, in basic terms, can be described as the physical separation of positive and negative charges. In other words, the method of separation of charges differentiates the ultracapacitor from batteries, which do it chemically. This perspective enables one to imagine that the ultracapacitor is unable to store energy for long periods of time as there is no external stimulator to keep the momentum going. Termed as low in energy density, the ultracapacitor is able to compensate in its ability to provide power. Inherent to its natural existence, is its ability to be regenerative. This means the high power provided can be captured and released at very high cycles called charge and discharge cycles. In the light of its working, it has many advantages along with disadvantages.

The True Technological Value Proposition Of the Ultracapacitor

The ultracapacitor has three significant characteristics among others, around which its existence is likely to create a revolution in the application of energy storage.

High Power Density

Its high power density cannot be compared to any other existing energy storage technology with citations of 30 kW/kg (by the University of California). This is its most significant enabling characteristic and its highest value proposition. However, as the term 'specific power density' indicates, it is the power released in one second.

Frost & Sullivan Continued on Page 17

Battery Power 2010

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Battery Power 2010, an international conference and expo highlighting the latest developments and technologies in the battery industry, will be held October 19-20 in Dallas, Texas.

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Long Lifetime

Its ability to continuously sustain this power density for 500,000 and more charge or discharge cycles emphasizes its longevity through the life of the equipment.

To truly explain the significance of lifetime, let's look at an illustration. One can easily identify with the frustration experienced when laptop batteries run out of charge. As a result, there are only two options: either keep it plugged in and work, or in a situation where one is on the move, sacrifice the worth of working documents by watching it shutdown. After a period of two years, which is normally the warranty period for a laptop battery, its ability to provide power will diminish significantly. Progressively, this degeneration of power continues until its ability to power the laptop lasts less than five minutes. For high investment in an expensive laptop, the degeneration of its energy storage component fails to justify the associated price premium. This significantly reduces the value of a laptop with numerous features that cannot be well supported by its mobile power source.

The presence of the ultracapacitor alleviates this frustration due to its inherent ability to remain purposeful and useful through its entire lifecycle. Degeneration does exist to a certain level; however, it is not comparable with that of a dying battery, which exhibits signs within two to three years. Having gained this perspective, it is pertinent to understand the ultracapacitor is not a replacement for the battery but a complementary technology that has the capability to bring greater value to a battery and sustain its lifetime.

To explain its ability to sustain the life of a battery while working in conjunction, it is important to know the area of shortfall in a battery that causes its failure to perform. The battery does not have the required proficiency to provide power density. Nevertheless, with little or no alternatives available to the commercial market, batteries are forced into this role. As a result, the battery is strained from its forced functioning beyond its ability to provide power. This constant strain in the battery results in the situation described earlier while illustrating the laptop battery.

Charging Time

The ultracapacitor charges in a few seconds. The significance of this feature is understood while taking our earlier comparison with the battery in a laptop. We are all familiar with the process of charging a laptop battery for a minimum of six to eight hours during the initial installation. Subsequently, a laptop battery at half charge takes one to two hours to completely charge. As mentioned earlier, this charging time either increases over the years, or eventually fails to reach full power causing degeneration over time. Coming back to the ultracapacitor, the user faces none of these problems due to its inherent ability to charge in a few seconds throughout its lifetime. An ultracapacitor can be charged from either an AC or a DC power source that must be designed to suit the application in which it is placed.

The technology exposition above proves that the ultracapacitor has definitive advantages over the battery. However, from an application perspective, the first question is why is this technology not visible in the market? Or, what are the reasons for its minimal penetration in the application world?

A Realistic Perspective of its Market Value

When comparisons between an ultracapacitor and a battery are made, the logical conclusion tends to be that the ultracapacitor must fit into the same ubiquitous role that the battery has assumed over the century. This perspective is certainly wrong and is the reason for the lack of market penetration for the ultracapacitor. The ultracapacitor is essentially an enabling energy storage technology supporting the performance of the battery in its current commercial state.

The Ultracapacitor and its Niche

As every application that is discovered has always found its niche, the ultracapacitor technology and the people promoting this technology are identifying its niche. Its stand-alone use continues to be an unresolved topic of debate. Its true market value, however, can be established when it is put to use to highlight its key benefits while marrying it with the correct technology that complements its technological drawbacks. In most cases, the best combination is its suggested use with batteries. This combination entails options that range across the entire gamut of available battery technologies such as lead acid, nickel metal hydride, nickel cadmium and lithium ion among others. The logistics of such combinations are constantly being worked out by researchers globally.

Price Concerns

An area of key concern has always been its price premium over the battery. This challenge has placed a significant strain on the market traction of this technology. However, as mentioned earlier, its comparison with the ever-present battery has prevented end users from looking beyond the price of the battery for any energy storage application.

The price status of the battery has been realized by the historical influence of many market forces over centuries. Some of these forces have been achieved early in the century beginning with economies of scale, ubiquitous and irreplaceable market propaganda, intense global competition, as well as an increase in flexibility and power requirements of all applications. The socio-economic nature of the workforce has shifted from stationary to global and is constantly on the move.

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Interstate Batteries Introduce Golf Car/RV Power Technology

Interstate Batteries has introduced an advanced new golf car battery that offers 10 percent more drive time per cycle than other batteries, along with an increased number of cycles.

The line, including the GC2-XHD, is used in golf cars and RVs and extends life cycle without a price increase. Other design improvements include better recharge acceptance for longer life, enhanced plate stability alignment for reliability and more out-of-the-box power.

New Lithium Iron Phosphate Battery Provides 65 Hours of Operation for High Frequency Radio Systems

Codan has released its new 17 Ah Lithium Iron Phosphate ($LiFePO_4$) rechargeable battery. The 17 Ah battery provides 65 hours of operation from a single charge for its 25 W high frequency (HF) 2110M manpack transceiver. It is lighter than a standard 13 Ah NiMH battery, provides 30 percent more capacity and maintains the charge five times longer when in storage. With the 2110M's smart battery interface, the user can view critical data including battery life expectancy.

New 12 Volt Lithium-Ion Batteries Based on LFP Technology to Replace Common Lead-Acid Batteries

K2 Energy Solutions (K2), a manufacturer and seller of rechargeable battery systems, has announced two new battery systems that will alter the way companies design and power their commercial and consumer products.

Known as K2B12V7 and K2B12V10, K2's latest energy storage devices are 12 volts and 6.4 Ahr/9.6 Ahr batteries respectively and make it possible to power a variety of equipment in a way that is lighter, longer lasting and more powerful than any lead-acid battery currently on the market.

The two batteries have been developed for a variety of commercial applications that can provide power to a varied number of systems while reducing weight and enhancing performance. These devices were targeted for use in the medical, military and industrial fields but are also suitable for consumer applications ranging from portable yard equipment like lawn trimmers to recreational equipment such as electric bikes and scooters.

The K2B12V7 and K2B12V10 weigh two and three pounds respectively and contain no hazardous heavy metals or dangerous chemicals, making them an environment friendly battery.

Synchronous Boost Regulator from Microchip Enables Longer-Lasting Battery Applications

Microchip Technology, Inc. has released the MCP1640 Synchronous Boost Regulator, which features an operating voltage down to 0.35 V, quiescent current as low as 19 microamperes and shutdown current of less than one microampere. With integrated dual FET transistors and output currents up to 350 milliamperes, the 500 kHz MCP1640 regulator enables compact, longer-lasting battery applications in the consumer electronics market.

The MCP1640 regulator's operating voltage of down to 0.35 V and start-up voltage of 0.65 V allows use with even a single, completely drained alkaline, NiMh or NiCd battery cell. A PWM/PFM option enables the device's low quiescent and shutdown currents and provides up to 96 percent efficiency, allowing for longer battery run times. The regulator's two integrated FET transistors reduce component count, resulting in smaller overall designs.

The MCP1640 Synchronous Boost Regulator is available in six-pin SOT-23 and 2 mm by 3 mm DFN packages, for $0.41 each, in 10,000-unit quantities.

New Battery Management Data Acquisition Front-End IC

austriamicrosystems has released the AS8510, a high precision data acquisition front-end IC for automotive battery current, voltage, temperature sense applications and in general for sensor interface applications where precise measurement of small signals close to ground is required.

The new flexible sensor interface IC offers advantages over alternative solutions including being the first to feature a 16-bit dual-channel ADC + PGA architecture with less than one LSB of offset and noise. Highly configurable, the AS8510 allows systems tailored to individual needs making it well suited for a wide range of present and future battery management applications. The AS8510 in combination with austriamicrosystems "System Basis Chip" and a micro controller provides an entire battery sensor semiconductor solution for both high-side or low-side.

The AS8510 data acquisition front-end IC features two independent analog input channels with 16-bit ADCs, each with individually programmable sampling rates. Each channel has a low-drift programmable gain amplifier for handling +/- 160

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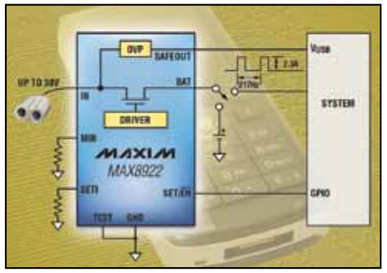
mV signals or 0 V to 1 V when by-passing PGA, thus battery currents from the mA range to the kA range can be measured from 100 uOHM shunt. A highly linear sigma delta architecture and wide range of sampling rates allows the AS8510 to provide flexible support of EV (electric vehicle) applications. The offset auto-zero feature (both channels) allows high accuracy measurements with low value shunt resistance (to 100 uOHM) with negligible insertion loss. Also, various operating modes include low power standby with current monitoring for active wake-up.

The AS8510 operates with the current shunt sensor in a 12 V system either at a battery's ground terminal or at the plus terminal in conjunction with dedicated level shift companion IC, or it can be used as a general purpose sensor interface for precise measurement of signals close to ground. Fully differential inputs allow the AS8510 to capture differential signals with 300 mV of common mode above ground and 160 mV below ground. The two-channel architecture enables digital error correction techniques like "delta by sigma" division or capture of bridge current / voltages with subsequent error correction in an external microcontroller. In addition, the AS8510 draws 40 uA in standby mode. The AS8510 is available in a SSOP20 package, operates from 3.3 volts, and has an ambient operating temperature range of -40 to 125°C.

Li+ Battery Charger has GSM Test Mode In a 6 mm² TDFN

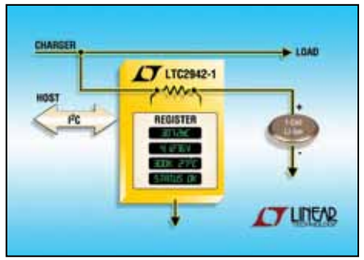
Maxim Integrated Products has introduced the MAX8922L, a 30 V, single-input lithium-ion (Li+) charger with a 2.3 A GSM test mode. The inclusion of a GSM test mode facilitates production-line calibration and testing of devices with a Micro-USB connector. Using this charger, designers can calibrate their GSM phones without having to install a battery. The MAX8922L is well suited for GSM, EDGE, UMTS and CDMA cell phones.



The MAX8922L's input is overvoltage protected to 30 V, eliminating the need for an external overvoltage-protection IC. The device includes a 4.94 V LDO output to safely power the low-voltage Vbus input. The fast-charge current and top-off current thresholds can be configured using an external resistor for design flexibility. The MAX8922L also allows the fast-charge current and GSM test mode to be programmed through a single-wire interface. The charger status and valid input power are indicated by two open-drain outputs. The MAX8922L is packaged in a 3 mm by 2 mm, 10-pin TDFN package. Prices start at $1.60 (1,000-up, FOB USA).

I2C Battery Gas Gauges for Single Li-Ion Cells Offers 1 Percent Accuracy

Linear Technology Corp. has introduced the LTC2941/LTC2942 battery gas gauges with an I2C interface for 2.7 V to 5.5 V systems. Unlike most coulomb counters that infer charge by sampling the current and integrating digitally, the LTC2941/LTC2942 use a continuous-time analog integrator to measure charge directly, resulting in minimal offset and gain error and better overall charge accuracy. The LTC2941 measures the charge flowing in and out of a battery to within 1 percent accuracy at room temperature. The LTC2942 does the same while also incorporating a 14-bit No Latency ΔΣ ADC to measure battery voltage and die temperature to within 1.3 percent and ±5°C accuracy, respectively.



The LTC2941 and LTC2942 are well suited for single-cell Li-Ion applications including cell phones, cameras, MP3 players and GPS receivers. Battery current is measured by monitoring the voltage across an external sense resistor and integrating this information to infer charge. A bidirectional analog integrator accommodates either current polarity (battery charge or discharge), and a programmable prescaler allows for a wide range of battery capacities. Charge, voltage and temperature information are communicated to the host system over an I2C/SMBus compatible two-wire interface that is also used to configure the gas gauge. The host can program high and low thresholds for all measured parameters, which if tripped, signal an alert using either the SMBus Alert protocol or by setting a register flag.

TI Switch-Mode Standalone Battery Charge Controllers for 5 Volt to 28 Volt Applications

Texas Instruments, Inc. (TI) has introduced three new switch-mode standalone battery charger ICs for lithium-based battery-powered applications with a 5 V to 28 V input. These devices provide highly accurate and efficient charging in a small package for mass market applications such as industrial handhelds, mobile Internet devices (MIDs), netbooks, power tools and portable medical devices.

These devices offer a constant-frequency synchronous switching pulse-width modulation (PWM) controller with highly accurate charge current and voltage regulation, charge preconditioning, termination, adapter current regulation and charge status monitoring. The battery is charged in three phases: preconditioning, constant current and constant voltage. A programmable charge timer provides a safety backup.

Motorola Introduces IMPRES Fleet Management for Two-Way Radio Batteries and Chargers

The Enterprise Mobility Solutions business of Motorola, Inc. has introduced IMPRES Fleet Management for Motorola's exclusive IMPRES two-way radio batteries and chargers. As soon as a battery is inserted into an IMPRES charger, information is collected and shared with administrators to easily determine proper actions, such as proactively removing poorly performing batteries from the fleet or ensuring each user has the appropriate capacity battery based on their needs. Accumulated data is managed through pre-defined or customizable reports that provide key information to ensure users operate their batteries and chargers to maximum efficiency.

IMPRES Fleet Management allows system administrators to run reports that allow them to proactively manage their fleet of IMPRES batteries and chargers. They are no longer guessing when batteries need to be replaced within their fleet or keeping a significant stock of spare batteries on hand.

IMPRES Fleet Management is most beneficial for mid-to-large sized organizations that have at least 100 IMPRES batteries in their fleet such as public safety agencies, public works, utilities and manufacturing companies. IMPRES Fleet Management is scalable from a single site to a multi-site networked system and supports up to 25,000 IMPRES batteries in the same location or over geographically dispersed areas.

2,500 Watt, Rectifier/Battery Charger for 120 Volt Batteries in Heavy-Duty Industrial Environments

The BCH 2K5-120-EQ rugged, industrial quality battery charger uses field-proven high-frequency conversion technology to deliver up to 2,500 W continuous output power. This charger accepts an input voltage range of 190 V to 264 VAC, and in float-mode it provides 135 VDC/16 A for charging a 120 V (60 cell) battery.

This design also has a manually initiated equalize cycle. Activated by a push-button EQ/ON, the equalize function elevates the output voltage to 141 VDC for the battery. The equalize time is controlled by a built in timer, adjustable in the one to nine hour range. This mode can be manually de-activated at any time.

The BCH 2K5-120-EQ is rated for heavy-duty applications with -40°C to 70°C temperature rating for full specification. Cooling is by convection via louvers on the cabinet. The absence of fans, low component count and the use of components with established reliability result in a high MTBF. The chassis was designed for a wall-mounted application.

This charger is constructed with internal modules, connected in parallel, which also provide inherent redundancy: the failure of one module would only cause a minor loss in total output power. The charger output is equipped with a built-in crossbar diode and output breaker as a safety feature against accidental reverse battery connection. Other protection includes input inrush current limiting, over-voltage protection, short circuit protection and a self-resetting thermostat for thermal protection. An optional Charger Fail Alarm Form C indicates loss of AC input power. The BCH 2K5-120-EQ is priced in the $2,211 range at low quantities, depending on options required.

Flux Power Introduces Lithium Battery Management System's For Wind, EV, Solar, Industrial and Hybrid Applications

Flux Power, Inc. has introduced its new Battery Management System. The Flux BMS has three critical functions. The first function is monitoring and reporting cell parameters including voltage, temperature, state of charge and current. These parameters are key to determining the health, safety and capabilities of each cell in the system. Without proper

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monitoring, the system is blind to problems such as cells going over or under voltage, cell temperatures becoming too hot or cold, or any impedance issues caused by chemistry or connection issues. This data can be used by the system controller to determine when the batteries are depleted and to warn the user before system shutdown. This data can also be used by the charger to efficiently charge and maintain the battery pack. The monitoring system has two communication channels; one is an industry standard CAN-BUS interface and the other is a redundant safety communication channel in case of any primary communication channel issues.

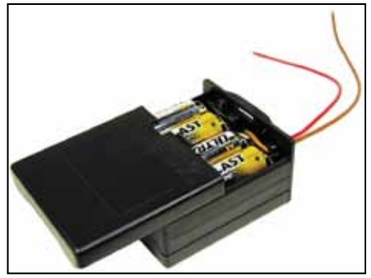
The second function is balancing the cells. As most experts agree, cell balancing is an integral part of extending the life of lithium batteries. Each lithium cell has chemical and electrical variances that over time can degrade performance of an entire pack. The Flux BMS has a variable current mechanism that can control the amount of energy fed to or taken from each cell in the system. Regulating the amount of current going into and coming out of any single cell reduces the chance of charge irregularities and potential damage. This allows the other cells in the system to all balance to the same charge levels, which increases total system cycle life up to four times. The Flux BMS also has redundant hardware shutoffs that can be triggered by individual cell voltage or temperature to prevent cells from being discharged excessively even if accidentally setup to do so or if external environmental issues occur.

The third function is data logging. Each BMS records the complete charge and discharge history of each cell, allowing an accurate account of usage. This data is important for determining second life applications and evaluating warranty issues. If all parameters of the cell's condition are known and recorded, warranty issues can be managed and a value can be calculated for a system's worth after primary use.

In addition to the functionality, the Flux BMS is designed for harsh environments with an IP67 rating and true high-voltage isolation. "We intend to set the industry benchmark for active cell management and reporting," said Jason Touhy, Flux Power's COO. "Our sleek modular design keeps critical components completely isolated from harsh elements and can be easily integrated with a number of existing cell manufacturers."

A 12 Volt AA Battery Holder with Sliding Covers And Switch

Memory Protection Devices has introduced the BK-6049 for holding eight AA batteries. It offers 12 volts output with 8 AA alkaline batteries in series or 9.6 volts with rechargeable batteries. A built in sliding switch in the case is recessed below the surface to prevent accidental activations and is rated for 0.5 A. Dual sliding covers have snap locking tabs and allow for quick battery changes without the use of tools.

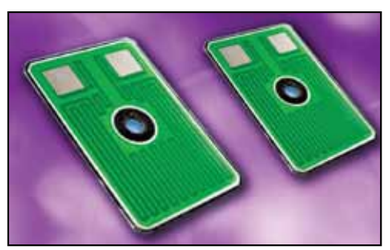


Made using premium materials like UL94V-0 rated polypropylene for the case and covers, it has a temperature range of -40°C to 180°C, making it well suited for harsh environments common to automotive applications. Spring steel nickel-plated springs and contacts apply pressure to the AA batteries for a long-lasting, trouble-free connection. The 18 gage wires meet UL2468 specifications and are more then adequate for the 12 volt battery pack. Rugged enough for industrial, automotive and consumer applications by providing power for portable devices.

IRC's Planar Power Resistors Provide External Thermal Dissipation for Battery Packs in Hybrid Electric Vehicles

Giving alternative-energy automotive design engineers a rugged resistive device capable of dissipating significant amounts of heat generated during the battery charging cycle, TT electronics IRC has developed a series of planar power resistors for hybrid electric vehicles. Designated the WDBR series, the planar thick-film resistors carry surge power ratings up to 7 kW and feature a steel substrate that provides direct transfer of thermal energy to an external heat sink.

"In alternative energy vehicles with battery packs, charging of the individual battery cells within the module has to be balanced, since the overall cell bank can only be effectively charged to the level of the highest capacity cell and discharged to the lowest and most limiting capacity cell," said Wilson Hayworth, application engineer for TT electronics IRC. "The WDBR series resistors are used to bypass higher state of charged cells so that the other cells can continue charging, resulting in the battery bank's ability to hold a higher overall charge."



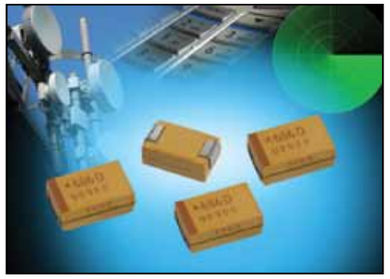
The WDBR series resistors can also be used in bleeder circuits to safely absorb excess energy that results when alternative energy systems such as fuel cells or onboard generators are switched off.

The WDBR series planar power resistors are rated for 0.5, 1.0, 2, 3, 5 and 7 kW (maximum pulse power rating). Standard resistance values include 12, 22, 47, 100 and 150 ohms, with tolerances to ±10 percent (custom resistance values and tolerances are also available). Minimum dielectric withstanding voltage is specified at 2,500 VDC. Inductance values range from less than 3 µH to less than 6 µH.

The thick film resistive element is printed on an insulated stainless steel substrate, with a high temperature overglaze for protection. The closely matched thermal expansion coefficient between the steel substrate and the dielectric film enable the WDBR series resistors to withstand severe temperature cycling (up to 400°C). Dimensions for the resistor range from 1.94 inches by 1.41 inches to 4 inches by 6 inches, with substrate thickness of either 0.035 or 0.059 inches.

AVX'S Multi-Anode Mirror Design TPM Tantalum Capacitors Feature Low ESR

AVX Corp. has expanded its TPM series of multi-anode mirror design tantalum capacitors that offer improved robustness and feature low ESR. The D sized TPM series 47 µF/25 V part offers a low ESR: 55 mΩ. In comparison, a single anode part in the same package has an ESR of 100 mΩ and the E case device (same footprint, bigger case size) provides a minimum ESR of 80 mΩ. By reducing the ESR value by 30 percent, the new capacitors offer a significant improvement in filtering capability, even to the extent that one part can sometimes replace two standard single anode devices.



AVX has developed the first mirror design multi-anode parts rated at 35 V. The TPM series D 22 µF/35 V is suitable for use in circuits with high current and voltage spikes where the profile is limited to 3 mm. It is well suited for automotive battery applications running on 12/14 V with low impedance, where it offers enhanced robustness and lower ESR than single anode capacitors. In addition, since the D and E case sizes use an identical footprint, the pad design does not need to be changed if the D-case part can be used to replace the larger capacitor. For higher operating voltages the TPM D 10 µF/50 V with an ESR of 140 mΩ is also available.

Eaton Hybrid Systems Achieve 30 Million Miles of Service Worldwide

Eaton Corp. has released that customers using the company's hybrid systems have collectively accumulated more than 30 million miles of clean, reliable service throughout the world. The more than 2,400 Eaton hybrid systems in use today are on delivery trucks, buses, refuse and utility vehicles and other commercial applications.

"Eaton hybrid commercial vehicles are true work horses that are helping our customers complete the job at hand while also helping them reduce their fuel consumption and level of pollutants," said Dimitri Kazarinoff, vice president and general manager of Eaton's Hybrid Power Systems Division. "This milestone has taken 10 years to achieve, but as the technology becomes even more mainstream and the benefits better understood, we are confident that we can reach the next 30 million miles in a fraction of the time."

Of the 30 million miles accumulated, FedEx alone, operator of the largest fleet of commercial hybrid parcel delivery trucks in the US, accounts for more than five million miles on its Eaton-powered hybrid trucks and vans.

"Together we are demonstrating that hybrids are very reliable at reducing fuel consumption and emissions," said John Formisano, vice president, Global Vehicles, FedEx Express. "Since 2004, with the help of Eaton, we have reduced our fuel use by nearly 200,000 gallons and carbon dioxide emissions by nearly 2,000 metric tons. This is the equivalent of removing more than 300 cars from the road annually."

KEMET and US Department of Energy Sign Contract For $15.1 Million Government Grant

KEMET Corp., a manufacturer of tantalum, multilayer ceramic, solid aluminum, plastic film, paper and aluminum electrolytic capacitors, has signed a $31.7 million contract with the US Department of Energy's (DOE) National Energy Technology Laboratory. This contract is based on the $15.1 million grant awarded on August 5, 2009 as part of the American Recovery and Reinvestment Act Electric Drive Vehicle Battery and Component Manufacturing Initiative plus a $16.6 million matching investment by KEMET.

KEMET has been working with the DOE on the details of the contract since that original announcement. The contract will enable the company to produce film and aluminum electrolytic capacitors within the US to support alternative energy products and emerging green technologies such as hybrid electric drive vehicles.

"We are aiming to have two production lines operational by the last quarter of the current calendar year with an additional two lines coming on board by the end of 2011 and another two by the end of 2012," said Dr. Johnny Boan, KEMET's senior director of Business Development, and the project lead in securing this grant.

University of Central Florida Researchers Confirm Battery Breakthrough Developed by Planar Energy

Researchers at the University of Central Florida's (UCF) Advanced Materials Processing and Analysis Center (AMPAC) have verified findings by Planar Energy that could lead to cost and performance improvements in large format batteries required for practical electric vehicles.

"AMPAC scientists independently confirmed that Planar Energy's new generation of solid state electrolytes have ionic conductivity metrics comparable to liquid electrolytes used in traditional chemical batteries," said Dr. M.J. Soileau, a UCF professor of optics, electrical & computer engineering and physics, who is the university's vice president for research & commercialization.

"This fundamental materials breakthrough, coupled with our proprietary low-cost manufacturing process, will render traditional chemical batteries obsolete," said Scott Faris, president and CEO of Planar Energy. "It will allow solid state battery fabrication that will enable manufacturers to increase their capacity by 200 to 300 percent, while reducing costs more than 50 percent," he continued. "This is what the automotive industry needs to make electric vehicles practical and affordable."

Balqon Corp. to Develop a Battery Management System for Large Format Li-Ion Batteries

Balqon Corp., a developer and manufacturer of zero emissions heavy-duty electric vehicles for Class 7 and Class 8 applications, has released its new Battery Management System (BMS) designed to optimize battery cycle life of large format lithium-ion batteries used in its product line of heavy-duty electric trucks and tractors. Each BMS board is equipped with multiple temperature sensors and a flash microcontroller together with Balqon's proprietary software that works with any electric vehicle's battery cell chemistry.

"The development of our Battery Management System is a continuation of our strategy to develop customized and configurable core technologies that provide application specific solutions for our customers that are energy efficient and reliable"

"Our Battery Management System incorporates a Society of Automation Engineers (SAE) J1939 controller area network (CAN Bus) capable network which allows seamless communication between the different components of our electric vehicles, such as our automatic transmission, charger and proprietary flux vector inverters. This development increases our ability to utilize data from the key components of our electric vehicles more intuitively during charge and discharge cycles, and thereby increase the energy efficiency of our vehicles," said Balwinder Samra, president and CEO of Balqon Corp. "The development of our Battery Management System is a continuation of our strategy to develop customized and configurable core technologies that provide application specific solutions for our customers that are energy efficient and reliable."

Neuton Lawnmowers Now Powered by Duracell

Neuton Power Equipment, manufacturer of a line of battery-powered lawnmowers, has tapped Duracell to supply the

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The price of ultracapacitors is expected to decrease as the technology identifies ideal application markets, achieves economies of scale and can adapt to the changing power requirements of newer applications. In the meantime, the current high cost can be justified by considering its lifetime savings, total cost of ownership, as well as its ability to sustain the life of the battery while used in tandem.

That brings us to the original thought on going green. Does going green always need to be attached with a price premium? In the light of a green technology such as ultracapacitors, the technology is just beginning its visible commercial lifecycle. It is a century behind the battery in 'mind share.' Technical circles know of this technology, but unless it becomes a buzz word in every home akin to the battery, it will take time before the price comparison with the battery can become a meaningful one. Its gamut of applications does not near that of batteries in 2010. Perceived areas of potential applications exist, but unless that translates into a high demand-supply equation, the comparison between the two energy storage technologies is not based on apples to apples.

The Light at the End of the Tunnel

The market has witnessed the entry of many companies over the past five years. The application realm has increased significantly from wind power applications to smart meters and the very popular automobile market. Transportation markets that cover heavy vehicles such as buses and trucks already use ultracapacitors to conserve energy, capitalizing on its regenerative breaking feature. Its potential application markets range from automotive to renewable energy storage. This involves technological tweaks and paradigm shifts in thinking to leverage its technological features and complement its technological drawbacks.

Contact Frost & Sullivan at www.Frost.com.

rechargeable battery for its 2010 lineup of walk-behind mowers.

The rechargeable Duracell battery will come as standard equipment in all 2010 model Neuton Battery-Powered Mowers. Available in two configurations: 14 inch cut CE 5 and 19 inch wide-cut CE 6 models, the Duracell-Powered Neuton mowers can be charged on 10 cents worth of electricity. The 19 inch wide-cut Neuton, which is powered by a 36 volt Duracell battery, will mow up to 1/3 of an acre on a single charge. The 14 inch model, which is powered by a 24 volt Duracell battery, will handle up to 1/4 of an acre before needing to be charged. Both models start with a simple push of a button and feature and easy-to-use drop-in battery that can be charged inside or outside of the mower.

The mower has become an ambassador of the green movement through Neuton Power Equipment's regular participation in dozens of regional lawn mower exchange programs, in which municipalities offer their residents a chance to turn-in their old, gasoline-powered mowers for steep discounts on a new Neuton mower. To-date, it is estimated that Neuton mowers have helped prevent over 59 million pounds of greenhouse gas pollution from entering the atmosphere.

Toda America Signed Contract with US Department of Energy for Battery Manufacturing Investment

Toda America, Inc., a subsidiary of Toda Kogyo Corp. in Japan, has announced the conclusion of an award contract with US Department of Energy (DOE), which was granted by DOE under the Recovery Act - Electric Device Vehicle Battery and Component Manufacturing Initiative in August, last year. The amount of the award is $35 million, one half of Toda America's total planned investment in the manufacturing plant of $70 million.

Toda America plans to build its manufacturing plant of cathode materials for lithium-ion batteries in Battle Creek, Mich. as soon as the site remediation work is completed and regulatory approvals are obtained in the next one to two months. Toda expects to complete Phase 1 and plans to start its operation in February, 2011. The plant will be expanded step by step until 2013, reaching its full manufacturing capacity of 4,000 tons of finished product per year. The total sales volume based on the full capacity operation at the facility will be around $130 million.

"This is a critical step for Toda Kogyo Group in our quest to maintain our global leadership as the premier supply chain partner to both battery and electric vehicle manufacturers around the world," said Junichi Nakano, president and CEO of Toda America.

Micro Power Awarded New Patent for Battery Charger Technology

Micro Power Electronics, Inc. has been awarded a patent covering a battery charger configuration to reduce thermal conduction. The newly issued US patent describes a method for separating a housing containing circuit charging components from a housing containing battery charging contacts and a rechargeable battery pack for the purpose of minimizing heat transfer from the components of the battery charging circuit to the rechargeable battery pack. This patent ensures that battery does not receive excessive heat while charging, which extends battery pack life and minimizes the risk of battery overheating during charging.

"This innovative and novel use of a passive system architecture is not only very cost effective for our clients, but is a reliable and safe method of minimizing the heat transferred to the battery while charging," said Ron Pitchel, vice president of Engineering and Continuous Improvement for Micro Power. "This system performs nearly as well as the conventional approach of embedding a fan within the charger enclosure for thermal management."

TÜV Product Service Becomes UK's Only CTIA Authorized Battery Testing Laboratory

The Cellular Telecommunications and Internet Association (CTIA) has appointed TÜV Product Service as the only UK authorized testing laboratory for mobile device battery certification. This represents an extension of scope for TÜV SÜD, which had already been appointed by the CTIA to assess the safety of battery systems in mobile handsets in its Singapore laboratory.

The CTIA Battery Certification Programme requires third-party testing for all cellular products before they can be sold in the US. The service will be used by manufacturers of mobile phones and other devices with embedded cellular modules to ensure that their products meet CTIA and network operator requirements for safe power management.

The new service is in response to demand from TÜV Product Service's clients in both Northern Europe and the US, making it one of only two independent European laboratories that are CTIA accredited. TÜV Product Service is also the only UK laboratory to offer a full range of complementary services, including EMC, RF and product safety testing, which will reduce the product test cycle and help manufacturers decrease time to market.

Envia Systems Awarded Grants to Develop Next Generation Batteries for Electric Cars

Envia Systems was awarded a $4 million grant from the US Department of Energy's (DOE) newly formed Advanced Research Projects Agency-Energy and $1 million from the California Energy Commission. The grants are an important catalyst for Envia's development strategy focused on producing battery technology that will enable more fuel efficient vehicles.

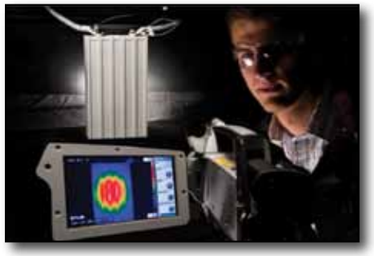
Envia's technology for high energy density, low cost next generation Lithium-ion batteries will deliver the higher performance necessary for energy storage in Electric Vehicles and Plug-In Hybrid Electric Vehicles. Envia uses nano silicon-carbon composite anodes and high capacity manganese composite cathodes to create batteries with energy density triple that of existing electric vehicle batteries. Envia recently received an R&D 100 Award for developing a PHEV battery with the highest energy density.

NREL Battery Testing Capabilities Get a Boost

Batteries are the heart of today's advanced electric drive vehicles, and many manufacturers have their own preference for specific battery geometry and chemistry including their choice of materials for cathodes and anodes. However, all manufacturers are concerned about the performance, life, safety and cost of lithium ion batteries, even though their designs are varied. The US Department of Energy (DOE) is looking to help the US battery industry with a simple goal, to mass-produce better batteries domestically while addressing safety, affordability, life and performance.

As a result of DOE's support, more work and funding for battery research is coming to NREL via both indirect and direct avenues thanks to the American Recovery and Reinvestment Act (ARRA). In March, President Obama announced $2.4 billion to help drive the development of the next generation of electric drive vehicles in the US. As part of that announcement, DOE released a competitive solicitation for up to $1.5 billion in federal funding for manufacturing advanced batteries and related drive components.

The funding will spur faster development of batteries for cars with electric powertrains including hybrid electric, plug-in hybrid electric, all-electric and fuel-cell vehicles. Battery thermal management is crucial in optimizing the performance and reducing the life-cycle costs for these types of batteries. Once manufacturers start cranking out new and more efficient prototypes, they'll turn to NREL for thermal testing and validation.



Engineer Dirk Long uses thermal imaging equipment to capture a battery's infrared fingerprint to diagnose its behavior. Photo courtesy of Pat Corkery.

"Right now, we already have a back-log of batteries for thermal testing," said NREL principle engineer and Energy Storage Task Leader Ahmad Pesaran. "We know that in one or two years, when the battery companies start producing new batteries to evaluate, we wouldn't have been able to keep up without the new investment in equipment."

NREL Garners Big Bucks for Battery Lab Improvements

Last fall, DOE recognized that NREL would be a key laboratory in the development of these advanced vehicle batteries. The lab was awarded $2 million from ARRA for the Battery Thermal and Life Test Facility.

"ARRA has already funded the battery industry to design and build new batteries. DOE also recognized that they needed to equip the national labs to test the new batteries that will be manufactured as a result of the ARRA investments," Pesaran said.

The $2 million coming to NREL will be used to upgrade and enhance the capabilities of the lab with new testing and analysis equipment. Some of the money will also be used to upgrade the utilities and facilities where the researchers perform the testing.

NREL will be purchasing up to 20 new battery testers, which will nearly triple the lab's ability to test batteries. NREL will also purchase two new calorimeters to measure the heat and the efficiency of small and medium sized cells; augmenting NREL's two existing larger calorimeters.

"The team is very excited," Pesaran said. "There have been times where we haven't been able to accomplish all the technical studies that we wanted to do because of lack of equipment. This is going to help resolve that issue."

Pesaran noted that US testing equipment manufacturers also will benefit from NREL's ARRA award because the new testing equipment will be ordered from US suppliers.

Why Better Batteries are Needed

Batteries are the centerpiece for advanced electric-drive vehicles. Making cars more energy efficient means using less fuel, which helps reduce oil consumption and the nation's dependence on foreign oil. Furthermore, batteries allow vehicles to drive on electricity, adding diversity to the fuel supply and increasing national energy security.

NREL researchers seek to improve the thermal performance of batteries by studying how heat affects the performance and life of batteries. NREL experts analyze fluid flow (liquid or air) through different types of battery packs to determine how the flow affects the pack's performance and life-cycle costs. Researchers measure and analyze the heat generation, efficiency and specific heat of battery modules under specified charge/discharge cycles using the state-of-the-art calorimeters in NREL's energy storage laboratory. Incorporating thermal imaging (still and time-lapse video) helps researchers determine temperature distributions and identify potential hot spots in battery modules and packs.

Dirk Long holds a liquid-cooled battery module consisting of 12 cylindrical lithium ion cells. The unit was tested for Saft America as part of a DOE/FreedomCAR project. Photo courtesy of Pat Corkery.

"Measuring heat generated from a battery tells you how ef-

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Calendar of Events

May
- *17-19* - BATTCON International Stationary Battery Conference, Hollywood, Fla.
- *17-21* - 10th International Advanced Automotive Battery Conference, Orlando, Fla.

June
- *5-10* - INTELLEC 2010, Orlando, Fla.
- *24-26* - CIBF2010 (9th Annual China International Battery Fair), Shenzhen, China

September
- *21-24* - 12th European Lead Battery Conference, Istanbul, Turkey
- *29-1* - Batteries 2010, French Riviera

October
- *19-20* - Battery Power 2010, Dallas Texas

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ficiently the battery is operating," Pesaran said. "The data on the heat generation is used by battery companies to determine how much cooling is needed to keep the battery at optimal temperatures because higher temperatures cause the battery to degrade faster.

"It's then up to the battery company to make some decisions. Can they reduce the amount of heat by changing the cell or material design? Or will they design a cooling system to keep the battery at an optimal temperature? Cooling is easier; but because of the battery size, you need to make the cooling system as small and as efficient as possible without adding weight to the car," said Pesaran.

Senior Engineer and Battery Lab Manager Matt Keyser, Principal Engineer Ahmad Pesaran and Engineer Dirk Long discuss projects in NREL's Thermal and Life Test facility. Photo courtesy of Pat Corkery.

In the end, the goal at NREL is to help the industry develop better batteries. And NREL has lots of companies lined up for future testing, many of which, according to Pesaran, wrote strong letters of support for NREL's ARRA funding application.

The battery research team will also spend time generating data to be used for validating battery thermal and electrochemical models. Modeling and simulating advanced energy storage systems in vehicles will help designers and researchers accelerate finding solutions for innovative battery designs and best ways to enhance overall vehicle performance.

NREL's team evaluates energy storage devices, such as batteries and ultracapacitors by constructing computerized representations of energy storage devices and vehicles which simulate real world driving conditions and environments including temperature changes and driving styles. Researchers then look at the data to determine how much heat was generated under various driving conditions.

"The data that we generate is going to help us validate the battery models that we have developed," Pesaran said. "This is really important because NREL has developed a number of models that are being used for industry, but in some cases we haven't had sufficient data to validate them. So, new equipment is essential to generate the data to validate the models so that industry can use them with greater confidence."

ABOUT ARBIN:

Arbin Instruments was established in 1991 as a manufacturer of multi-channel potentiostat/galvanostat for battery and electrochemical research. Arbin continues to lead the way in innovation and customer support in the battery, supercapacitor, and fuel cell testing markets.

KEY PRODUCTS:

Arbin's **EVTS** is an automatic system for testing high power Electric Vehicle (EV) and Hybrid Electric Vehicle (HEV) batteries, packs, and modules.

The **BT2000** is a multi-channel testing system designed for R&D and production of batteries and other electrochemical energy storage devices.

The **MSTAT** is a multiple independent - channel testing system designed for pure electrochemical research.

WHERE YOU CAN MEET US:

Advanced Automotive Batteries - May 19-21, 2010 - Orlando, FL - **Booth #209**
44th Power Sources Conference - June 14-17, 2010 - Las Vegas, NV - **Booth # 206**
International Meeting on Lithium Batteries - June 27-July 3, 2010 - Montreal, Canada

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