

# Power Currents

Periodic Coverage of the Energy Technology Industry

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## Fallout from the Blackout

With their stocks up anywhere from 20% to 200% following the August blackout, distributed generation and transmission technology companies were quick to ring the register. American Superconductor, Plug Power and Quanta Services were among the many companies that took advantage of their more generous market caps to raise capital — nearly half a billion dollars, depending on how you count it.

In power equipment product markets, the payday is further out. Sales cycles for transmission hardware are notoriously long. For example, siting and building new power lines can take 5-10 years from start to finish.

Ultimately, one consequence of the blackout should be a significant rise in transmission grid investment. Certain upgrades, such as improvements to the Midwest transmission authority's network monitoring, command and control system, are obvious candidates, and in some cases are already underway.

However, broader-based investment may be held up by disagreements over the principal causes of the blackout and the appropriate solutions, as well as by the ongoing conflicts over transmission asset ownership, governance and allowable rates of return.

In the meantime, we expect to

see targeted spending to solve specific problems and relieve specific bottlenecks. This will likely mean increased spending on at least two kinds of technologies — devices such as static VAR compensators that allow more power to move through existing circuits, and real-time network management systems that optimize power flows and provide early warning of potential trouble.

Longer term, the solution may be a reconfigured grid based on DC power interconnects plus composite or superconducting cables or other next-generation technologies.

## In This Issue

### Publication Information

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Please see p. 42 for important disclosures and notices.

Blackouts on both sides of the Atlantic in August and September kept utilities scrambling. Rather than regurgitate the details of the outages, we have focused on stories that call attention to trends, technologies and projects that point to transmission network solutions. (We will publish a separate report on the North American blackout shortly)

Two other developments of

note are covered. First, the ongoing rally in energy tech stocks got a further lift from the August blackout, and in the more supportive market environment, a number of energy tech companies were able to issue debt and equity on attractive terms. Please refer to the *TapeTalk* and *Capital Markets Monitor* sections for more on this.

The other noteworthy event is

an acceleration in the rate of recovery of technology hardware spending. As we document in *DataWerks*, there was a large spike in business activity in August, roughly when the tax cut began to take effect. Follow-through momentum has been generally strong.

Also found in this issue is discussion of solar markets and technologies, advanced vehicles and natural gas prices.

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# GridWatch

## Energy and Power Industry Announcements and Developments

**Overview.** The lights went out in August and September. Blackouts struck North America, London, Scandinavia and Italy (*we are providing an extensive analysis of the North American outage in a separate document*). Not surprisingly, news about the transmission grid filled the headlines. In *GridWatch* we have focused on those news items that draw attention to transmission network solutions — power flow controllers, direct current power cables, advanced conductor materials, and system upgrades of various sorts.

Other issues covered in *GridWatch* and *Energy* Techline include high natural gas prices, biomass, solar manufacturing technologies, automotive policies and vehicular and power plant emissions.

### Transmission Goes High-Tech

*October 21.* **Dynex Semiconductor Ltd.**, a power semiconductor technology company, completed delivery of 90 GTO-based power electronic “link” assemblies for a £1.5 million (US\$2.7 million) order placed by **Alstom**’s Transmission and Distribution division. The equipment is part of a STATCOM (Static Synchronous Compensator) installation for **Northeast Utilities** and its **Connecticut Light & Power** subsidiary. The STATCOM will improve the reliability of supplies during the peak load summer months by providing rapid support for momentary and long-term voltage fluctuations.

*October 21.* After many delays, **Hydro One**, Ontario’s biggest power transmission company, expects to switch on two phase-shifting transformers next summer, improving Ontario’s ability to move electricity in both directions across the U.S. border. The phase-shifters were initially projected to start operating in 2002. The installation cost all in is C\$45 million (US\$34 million). The two new transformers will help control the flow of electricity, allowing Ontario to increase power exports by 1,000MW and power imports by 500 MW.

**Comment.** These articles describe the installation of advanced transmission power flow control technologies — a STATCOM (Static Synchronous Compensator), which is a high-speed power switching device built with high-power semiconductors; and a phase-shifting transformer, which is a robust transformer capable of rapid in-line adjustments to its output voltage in response to changing system conditions. Both technologies offer transmission system operators a key benefit — they make it possible to increase the flow of power through existing circuits much faster and cheaper than building new transmission lines or power plants.

The regulatory uncertainty surrounding transmission asset ownership, along with the possibility of earning higher returns elsewhere, have for many years created disincentives to investment in the transmission grid. However, in the wake of the August 2003 blackout, we expect to see more installations such as these, as transmission system operators seek to squeeze more capacity out of existing assets.

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## GridWatch (cont'd)

### Energy and Power Industry Announcements and Developments

*October 6.* The **National Renewable Energy Laboratory** (NREL) and **DuPont** announced a \$7.7 million agreement to develop the world's first integrated "bio-refinery" that uses corn or other renewable resources to produce fuels and value-added chemicals. The agreement is part of the larger \$38 million DuPont-led Integrated Corn-Based Bioproducts Refinery (ICBR) project, which also includes NREL, **Diversa Corp.**, **Michigan State**, and **Deere & Co.** The ICBR will use the entire corn plant – purified sugars from the corn kernel will be the primary source of value-added chemicals, while the rest of the plant will be converted into fuel-grade ethanol and electrical power.

*October 2.* The **California Public Utilities Commission** approved a plan to place fiber optic phone and TV cables inside natural gas pipelines operated by **Southern California Gas Co.** and **San Diego Gas & Electric Co.**, subsidiaries of San Diego-based **Sempra Energy** that serve homes and offices in Southern California. Large gas transmission pipelines that deliver gas to smaller distribution pipes will not carry any fiber. Sempra states that the technology has been tested in small projects in California, North Carolina and Texas. Communications companies showing interest in the technology include **SBC Communications**, **AT&T Corp.**, and **AOL Time Warner**. Other gas utilities have also indicated interest.

*October 2.* **GridAmerica** took over management of 14,000 miles of high-voltage transmission lines for **Northern Indiana Public Service Co.** (NIPSCO) and **FirstEnergy Corp.** Pending regulatory approval, GridAmerica also plans on managing the transmission system of Missouri-based **Ameren Corp.** NIPSCO, FirstEnergy, and Ameren will pay GridAmerica a combined total of \$3.5 million per year for the first three years of their contract.

Because GridAmerica is joining the **Midwest Independent Transmission System Operator** (MISO), power transported across NIPSCO and FirstEnergy wires will be subject to a simplified, single tariff. GridAmerica will manage "day ahead functions" including planning and scheduling maintenance of high-voltage facilities, planning long-term investment, and providing capacity information to the MISO. The MISO will still maintain operational authority over NIPSCO and FirstEnergy, and monitor all critical facilities in the Midwest.

**Comment.** For GridAmerica, a subsidiary of **National Grid USA**, these management contracts could be the beginning of a major Midwest expansion program. The company has reportedly set aside \$500 million to invest in the Midwest, which would likely mean buying up transmission assets already in place. By first managing the transmission systems of other utilities, GridAmerica is effectively getting paid to figure out if it wants to acquire and operate its own transmission assets in MISO.

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## GridWatch (cont'd)

### Energy and Power Industry Announcements and Developments

#### A Nasty Flu Going Around???

*September 28.* Geneva, Switzerland and most of Italy were hit by a massive blackout caused by a chain reaction that started in Switzerland and moved through France. A falling tree took down a power transmission line in Switzerland, causing another line to overload. At about the same time, lightning strikes from a heavy storm disabled two high-voltage lines in France.

*September 23.* A fault on the main transmission line connecting Sweden and Denmark left 4 million people in Copenhagen and southern Sweden without power.

**Comment.** These two blackouts, following on the heels of the sweeping power outage in North America and a brief power failure in central London, certainly made it seem like a contagion was spreading through utility networks on both sides of the Atlantic. The numerous recent blackouts call attention to the need for investment in the transmission grid; specifically, for spending on power cables, substation equipment, network command and control systems, and voltage support solutions. This should be good news for suppliers of grid-level power equipment, like **ABB**, **Alstom**, **GE**, **Siemens**, **Sumitomo** and **Waukesha**. Although decision-making about transmission investments usually occurs at a frustratingly slow pace, we are confident that ultimately the decisions will be made, and power equipment providers will benefit.

*September 19.* **Tokyo Electric Power Co.** (TEPCO), Japan's biggest power utility, and 17 other Japanese firms will launch a marketplace to trade electricity in April 2005. Nine major electric power firms, including TEPCO and **Kansai Electric Power**, and nine firms that entered the industry after Japan partially deregulated the market in 1995 will join the scheme. The 18 firms together account for 90% of Japan's overall power sales. An advisory panel to the Trade Ministry has proposed that Japan's power market be further deregulated from April 2005 to include all high-voltage power customers, and that talks on total deregulation, which would include residential customers, should begin from April 2007.

*August 28.* Scientists at Hiroshima University have developed a new substance capable of storing three times more hydrogen than an existing alloy. In addition, the substance can store hydrogen at lower temperatures, making fuel-cell vehicles and other fuel-cell based devices safer. To make the new substance, the group ground two types of lithium powders into tiny particles inside a pressurized container holding hydrogen along with a metal catalyst. The substance was found to be quick to react and easy to control so it could improve the safety of hydrogen storage devices, and was able to discharge hydrogen at temperatures between 150-200 degrees Celsius if atmospheric pressure was lowered.

## GridWatch (cont'd)

### Energy and Power Industry Announcements and Developments

#### Shifting Into High Gear — Transmission Upgrade and Expansion Programs

*September 9.* Based on its annual 10-year assessment, **American Transmission Company** has proposed \$2.8 billion of system investment over the next decade. The Assessment found that the system is operating with little or no margin for growth. The issues include limitations on power transfers, immediate and emerging voltage problems in a numerous areas, and an inability of the system to serve growth or accommodate new generation without transmission system reinforcement. Among the proposed solutions include new transmission lines, implementing transmission reinforcements and constructing facilities to interconnect new generation.

*October 2.* The California Public Utilities Commission authorized **Pacific Gas & Electric Co.** to build new transmission lines into San Francisco to add badly needed capacity to the local power grid. The city's power supply currently depends on a transmission circuit with a history of reliability issues, and two aging natural gas-fired power plants that San Francisco officials and nearby residents want to close because of concerns about pollution. The \$20 million transmission project will add an extra 135MW of electricity.

*September 17.* **Trans-Elect's New Transmission Development Company** (NTD) finalized financing for a public-private partnership that will allow construction to expand California's Path 15 to begin immediately. NTD will finance and own long-term capacity rights in the transmission line expansion; the U.S. Department of Energy's **Western Area Power Administration** will build and own the line; and **Pacific Gas & Electric** will finance and build the substation expansions at Los Banos and Gates.

The expansion will eliminate a major congestion point between central and northern California's electrical grid, reducing congestion costs, improving electric reliability and lowering utility bills. The cost is expected to be below prior estimates of \$306 million. Equity financing was provided by affiliates of **ArcLight Capital Partners**, **EIF Group**, and a third private equity fund.

*September 9.* **ITC Holdings Corp.**, a vehicle owned by **Kohlberg Kravis Roberts** (KKR) and **Trimaran Capital Partners**, have agreed to invest \$200 million in **Conjunction LLC** to facilitate the construction of Conjunction's Empire Connection project. The Empire Connection will carry up to 2,300MW of low-cost power to the New York City metropolitan area. The project is comprised of two underground direct current (DC) cables running 130 miles along railroad and highway rights-of-way from upstate New York to New York City, and will cost over \$2.5 million a mile, for a total of \$750 million. Conjunction is already considering a possible third circuit.

Conjunction estimates Empire Connection will save New York City and Westchester County residents and businesses more than \$600 million per year in electric costs starting in 2006, when the project comes online. Approval from a number of public regulators and authorities is required before the project can begin.

**Comment.** Although these projects were in the works well prior to the August blackout, they point the way to the kinds of solutions needed to upgrade the transmission network – voltage support, transmission reinforcement, capacity upgrades and new AC and DC lines. Only recently has the regulatory framework begun to offer incentives for these kinds of investments. Congress is seeking to halt further progress on certain transmission grid restructuring programs, so it remains to be seen what effect this might have on new transmission investment.

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## GridWatch (cont'd)

### Energy and Power Industry Announcements and Developments

#### Paving the Electricity Superhighway with Next-Generation Conductors

*August 27.* An advanced power-line cable from **3M**, designed to reduce transmission congestion by increasing overhead power-line capacity, is undergoing advanced field testing by utilities in three states. It is also the subject of a pilot program under way at the National Transmission Technology Research Center at **Oak Ridge National Laboratories**.

The 3M composite conductor is capable of transmitting two to three times more electricity than conventional power cables of the same diameter without the need for more towers, which enables utilities to reduce transmission bottlenecks without additional structures or easements. Field tests are being conducted by **Hawaiian Electric**, **Xcel Energy** and **Western Area Power Administration**.

*August 6.* **Intermagnetics General** announced that **BOC**, a supplier of industrial gases, refrigerants and related equipment, has joined the team developing a high-temperature superconducting (HTS) cable for the Albany, New York, power grid. BOC will be a strategic partner in the \$26 million project, which has received \$19 million in government funding. Intermagnetics' energy technology subsidiary, **SuperPower, Inc.**, **BOC**, and **Sumitomo Electric Industries** will share the remaining \$7 million of project costs.

BOC will be responsible for developing the large-scale cryogenic refrigeration system that will cool the superconducting cables. It will also monitor and operate the refrigeration system for the duration of the four-year project.

**Comment.** The articles on page 2 about the installation of STATCOMs and phase-shifting transformers illustrated one way to increase transmission capacity — with rapid adjustments of voltage and current, perhaps 20%-40% more power can flow through existing circuits. The news items above about the development of advanced conductors by **3M** and **Intermagnetics** point to another approach. By replacing traditional copper and aluminum cables with cable made with composite materials or superconductors, transmission capacity along existing rights of way can be expanded, not by 20%, but 200%.

The issue with these next-generation conductors is that they are still next-generation, i.e., they are not yet commercial. It could take anywhere from 1-5 years for 3M, Intermagnetics and other developers of advanced conductors to complete the necessary test work and field trials, prove out techniques for mass production, and achieve sufficient sales volumes to bring down costs to competitive levels.

At some point we expect utilities will be able to add transmission capacity, in modest increments but quickly, with power flow control technologies; or to double and triple capacity by restringing circuits with advanced conductors, in what would likely be a slower process. Tradeoffs between time, cost, conductivity and installation complexity are among the factors that will determine which solution will be deployed in any particular project. The pressing need for capacity upgrades suggests that there should be substantial business opportunities for developers of a range of transmission technologies.

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## GridWatch (cont'd)

### Energy and Power Industry Announcements and Developments

*August 19.* **GreenWood Partners** announced the grand opening of **GreenWood Ranch Estates**, an off-grid solar community. This project marks the first substantial privately financed solar community in operation in the U.S. The planned project will provide cost-effective solar electric power for 487 five-acre homes on forested lots near Kingman, Arizona. **Perfect-Power Inc.**, an alternative energy corporation, was awarded the contract to provide power systems to serve GreenWood Ranch Estates.

**Comment.** Projects such as this are absolutely invaluable to the solar power industry. Solar has long been on the fringes of the power infrastructure and the construction industry. Until quite recently, solar power has mostly found itself in remote locations in industrialized countries and in rural areas of the developing world, generating electricity for such things as navigation aids, wireless telecom repeater stations and water pumps. Only in the last five years or so have solar power systems become a more common feature on grid-connected homes and buildings. In the process, public awareness of solar power as something not just for the “sandals and granola” set has slowly begun to grow.

The GreenWood Ranch Estates development is unusual in that it will use solar power to take its residents off the utility grid. Its significance here is that it is a housing development that is serving as a sales channel for solar power systems. This is crucial. For solar to become a truly mass market application, it needs to become a building material – just like sheet rock, windows, flooring and plumbing, solar power systems should be integrated into a building during the construction process; they should not be an afterthought bolted onto the roof by a well-intentioned homeowner or property manager.

Very gradually, and in selective areas, homebuilders are starting to offer solar power as part of a standard package of design options. Equally slowly, architects are beginning to do the same for prospective commercial building owners. Solar power systems that perform double duty as roofing materials or windows suddenly become much more economic than those that are simply additions to existing buildings, and for US homeowners, the cost of the solar system gets rolled into the mortgage and the interest becomes a tax deduction.

The value of a building-integrated solar power system extends to both the owner and the utility. The building owner reduces its energy consumption and cost, less pollution is produced to power the buildings, and the decrease in demand for grid power is greatest precisely when the economic value of that power is highest – during peak hours in the middle of the day, when the weather is the hottest, the sun is at its zenith and the solar power systems are generating their maximum output.



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## GridWatch (cont'd)

### Energy and Power Industry Announcements and Developments

For the utility, a reduction of peak summer demand means it is less likely to find itself short of power in the middle of a heat wave, forced to buy power on the spot market at prices that can range from 10 – 100 times higher than it can charge its customers. A decrease in peak demand also means that power generators do not have to own and maintain inefficient capacity that might be used only a few weeks a year. For all these reasons and more, we at Vortex Energy would like to see local, state and federal governments doing much more than they are now to promote the integration of solar power systems into the design of residential and commercial buildings.

*August 18.* The **Energy Information Administration's** administrator, Guy Caruso, predicted that gas prices will average \$5.34/mmbtu this year, and next year may fall to almost \$5, and that if the temperature varies by 10% from average, prices could go to \$9/mmbtu. Low storage numbers have kept prices high, which has restrained demand this year and should cut next year's demand. However, supply is expected to remain tight, since declining resources in Canada limit the volume of imports from that country, and imports of liquid natural gas are growing too slowly to keep pace with market need.

**Comment.** The fundamentals of natural gas markets have been very favorable for suppliers, and will likely remain so for at least the next several years, and sustained periods of natural gas prices of \$2-\$3/mmBtu will remain a memory. High natural gas prices have wide-ranging consequences for the energy technology industry, including the following.

**Natural gas supply development.** Suppliers will undoubtedly continue their efforts to bring more natural gas on line, through increased drilling activity and construction of pipelines and liquid natural gas receiving and re-gasification terminals. Implications for energy tech should include demand for geophysical imaging systems, process management and asset optimization software, natural gas trading and risk analysis software, and advanced natural gas processing and storage systems.

**Demand for clean coal technologies.** To the greatest extent possible, power generators with a choice of fuel types will tend to switch out of natural gas and into coal. Because the combustion of coal is so polluting, and emissions standards for coal continue to get more stringent, the result could be increased demand for current and next-generation clean coal technologies.

**Demand for energy management and energy efficiency solutions.** Expensive natural gas raises the cost of electricity generation in many service areas, which will prompt utility regulators to approve higher prices for power. The result will likely be



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## GridWatch (cont'd)

### Energy and Power Industry Announcements and Developments

increased demand for an array of energy conservation, energy efficiency and energy-management solutions, to the benefit of numerous energy technology companies and energy service providers.

**Demand for combined heat and power systems.** Combined heat and power (CHP), also called cogeneration, involves running a genset or turbine to create electricity, and using the heat produced along the way for space or process heating and cooling. Because CHP is so efficient – total energy efficiency exceeds 80%, well above the levels of even the most efficient combined-cycle turbines used in central power plants – during times of high power prices, it becomes an attractive way for commercial and industrial users of heat and power to reduce their energy bills.

**Demand for renewable energy systems.** Under a high natural gas price regime, coal prices also tend to rise as power generators switch over to coal, and steeper prices for both will drive up the price of fossil fuel-based power. Accordingly, renewable energy sources such as biomass, geothermal, solar and wind will become increasingly economic, and sales of renewable power generation equipment could get a big lift.

*August 12.* The **California Air Resources Board** (CARB) has reached an agreement with automakers and car dealers that will end litigation over the state's Zero Emission Vehicle (ZEV) regulation. The litigation involved three lawsuits -- filed by **DaimlerChrysler, General Motors, Isuzu** and several car dealers -- challenging CARB's authority to promulgate the regulation. The agreement calls for the plaintiffs to dismiss their lawsuits once the new 2003 ZEV regulation is finalized. The new 2003 ZEV regulation gives automakers greater flexibility, allowing automakers to earn credits by selling clean hybrid-electric or natural-gas vehicles, extremely clean conventional vehicles, or vehicles powered by fuel cells.

## Energy Techline

### Company News Releases

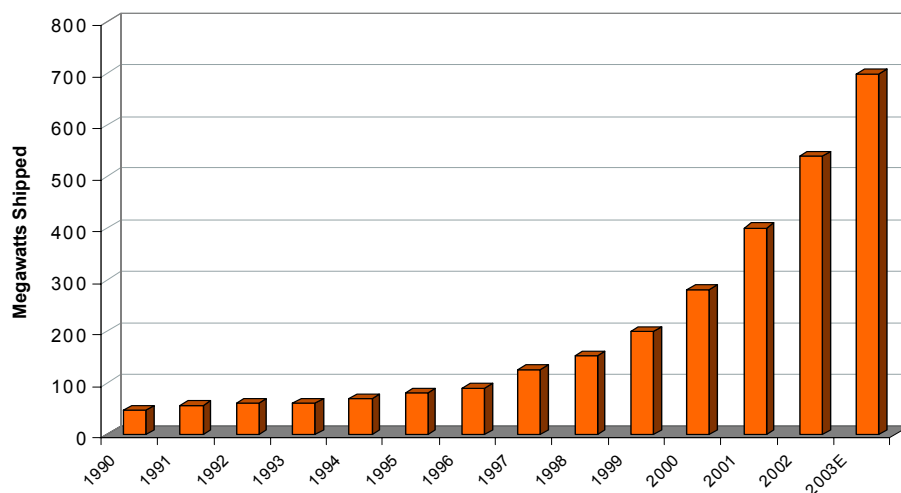
October 7. There has been a spate of recent announcements from Japanese solar power producers about their manufacturing capacity expansion plans. **Sharp Corp.**, the world's largest solar power producer, with a global market share of 22%, is investing 3.5 billion yen (US\$32.6 million) to increase solar cell production capacity to 248MW from the current 200MW. Sharp aims for solar cell sales of 60 billion yen (US\$558.5 million) in the March 2004 fiscal year.

Meanwhile, **Kyocera Corp.**, the number 3 solar cell producer last year, will spend 4 billion yen (US\$37.2 million) to double annual solar cell output to 120MW from 60MW at the end of 2002. **Sanyo Electric Co.** intends to expand annual solar cell production to 65MW, almost double the current level, by January 2004, and to 120MW by March 2005. **Mitsubishi Electric Corp.** plans to double annual solar cell output to 100MW by the end of March 2004.

**Comment.** These companies are responding to strong demand, both in the domestic Japanese market and in the rest of the world. The solar power industry has racked up over two decades of exceptional 20% annual shipment growth; and over the past five years, generous subsidy programs in a growing number of countries helped drive the annual growth rate to nearly 35%. Global solar industry revenue in 2002 was about \$3-4 billion.

Sharp, Kyocera, Sanyo and Mitsubishi clearly expect continued substantial growth, and are determined to maintain and expand their presence. All in, they intend to build 250MW of new capacity by March 2005, representing an increase over current levels of about 70%. To put their capacity increases in perspective, global cell production in 2002 was 560MW, and solar cell production in 2003 is expected to reach 700MW. Sharp, Kyocera, Sanyo and Mitsubishi held a combined market share of about 42% in 2002. If these companies build 250MW of new capacity by March 2005, they could command a combined market share of 75% - 85%.

### Annual Solar Power Shipments, 1990-2003E (in MW)



Source: *Photon International, Strategies Unlimited.*

## Energy Techline (cont'd)

### Company News Releases

#### Automotive Producers and Automotive Policy

*Some Take the High Road, Some Take the Low Road*

September 28. Auto dealerships peddling sport-utility vehicles have benefited from the Bush administration's supply-side economic stimulus package enacted in May. The President's \$330 billion tax-cut plan raised the deduction for business equipment from \$25,000 to \$100,000, and allows small business owners to write off the entire cost of vehicles that weigh 6,000 pounds or more. Apparently intended to help farmers and ranchers buy pickup trucks, the tax deal makes it possible for dentists, Web-page designers, beauty shop proprietors and other non-ranching, non-farming business owners to claim the deduction for SUVs.

September 23. **Ford** is delaying plans for a high-mileage, high-technology hybrid truck. This follows DaimlerChrysler's announcement last year that it was canceling plans for a hybrid version of its Dodge Durango SUV. Ford had said it would sell hybrid Escapes to business fleets this year as a test program, then sell to retail buyers next year. But a Ford spokeswoman said that the company was delaying sales to fleets and that hybrid Escapes would now go on sale in late summer of 2004. So far, Toyota Motor Corp. and Honda Motor Co. are the only automakers offering hybrids.

September 26. **Toyota's** US sales unit has racked up nearly 10,000 pre-orders for its redesigned Prius hybrid gas-electric car. These advance orders alone equal about 50% of the 20,000 Prius hybrids sold during all of 2002. Demand for the new Prius is stronger than expected, and the US sales operation may ask for additional production. Toyota's current plan is to build 36,000 Prius cars in 2004. The new model, which starts at \$19,995, has more interior room and gets about 55 miles per gallon, a 15% increase over the previous model. Later this year, Toyota expects to launch a hybrid version of the full-size Tundra pickup truck and the Lexus RX 330.

September 30. **ZAP** announced that it has acquired a fleet of electric cars, which it plans to offer for rent at locations that include two sites in Las Vegas on the main Casino strip. CEO Steve Schneider explained that ZAP's marketing plan emphasizes rentals because customers will have an opportunity to try out ZAP's new vehicles as they are introduced. Founded in 1994, ZAP offers a variety of advanced technology vehicles, including electric cars, bicycles, scooters, motorbikes, underwater scooters and more.

**Comment.** These articles point to a lot that is wrong with the auto industry and automotive policy, as well as to a few things that are right. The promulgation of tax incentives favoring purchases of the most gas-guzzling vehicles available at a time when 180,000 US troops are in Iraq is a difficult circle to square. If there is strategic value in promoting greater national independence from foreign energy sources, then subsidizing the purchase of hybrid-electric vehicles (HEVs) like the Prius, or even ZAP's electric cars, makes more sense. And clearly, customer interest in HEVs is real.

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## Energy Techline (cont'd)

### Company News Releases

Which brings us to the Ford press release. The US automakers continue to push back the introduction of their own HEVs. In doing so, they are ceding to Toyota and Honda a segment of the market that is small but growing rapidly. Building automotive manufacturing capacity takes years. From the day that Detroit commits to hybrid-electric vehicles (if such a day arrives), many more days will pass before they achieve volume production.

From the perspective of the energy tech industry, all of this represents a significant opportunity cost. HEVs require a range of energy technologies, including lead-acid batteries, nickel-metal hydride batteries and/or ultracapacitors for energy storage; battery charge controllers; electric motors and drives; and power electronics systems. Were tax incentives tilted toward fuel-efficient, low-emission HEVs instead of HumVee's, and were US automakers moving more rapidly to make hybrid-electric models available to the public, numerous energy technology companies would benefit (as would the environment).

As for ZAP, the electric vehicles it sells are another source of demand for energy technologies such as advanced batteries and power electronics. Our issue with electric vehicles is that, by and large, they are destroyers of the ozone layer even as they masquerade as its savior. Electric vehicles appear to be green because they produce no tailpipe pollution when on the road. The problem is not in the driving, but in the charging – the electricity that charges up the batteries, often as not, comes from greenhouse gas-emitting, acid rain-causing coal-fired power plants. Ultimately, electric vehicles are only as green as their source of power.

All of the articles above focused on passenger cars. This next news item draws attention to a positive trend in the world of heavy-duty vehicles. Municipal and county governments with fleets of buses and other types of service vehicles have shown a willingness to try out a variety of alternative fuel systems and powertrains, including natural gas-powered vehicles, fuel cell buses, and hybrid-electric buses and trucks. The support that local governments are providing for next-generation heavy-duty vehicle technologies at least partly make up for the shortcomings of federal energy and transportation policies.

*October 20.* King County in Washington State plans to buy 235 diesel hybrid buses for its transit system, one of the largest orders to date for city buses with hybrid technology. The **King County Metropolitan Transit Authority** will pay about \$47 million more up front for the hybrids versus conventional diesel buses, but county managers expect to save \$27 million over 12 years by using 800,000 less gallons of fuel and 39,000 fewer quarts of engine oil, and by reducing maintenance costs. The buses, expected to be on the streets by May, will reduce smog-forming emissions by 60%-90%. The hybrid engine systems will be made by **General Motors**, and the buses will be built by **New Flyer**.

## Energy Techline (cont'd)

### Company News Releases

#### Reaching for the Sun Without Getting Burned

*September 30.* **ST Microelectronics**, a semiconductor device manufacturer, is developing two advanced materials that it believes will substantially reduce the cost of solar power. The first is a variant on the Graetzel cell, in which an organic dye absorbs light, a nanoporous metal oxide layer transports electrons, and holes are transported back by a liquid electrolyte. ST Micro's design would replace the liquid electrolytes with a conductive polymer. ST researchers are working on a second approach, which involves the use of a mixture of fullerene (i.e., nanostructured carbon) and a copper-based organic compound sandwiched between the cell's electrodes.

*September 29.* **AstroPower** announced it has engaged **SSG Capital**, a specialty investment bank focusing on special situation financings and M&A, to help raise cash. The company also reported that cash flow remains negative largely because its inability to purchase sufficient raw materials for production has affected sales volumes. Reasons for its difficulty buying adequate raw materials were not disclosed. In recent weeks, AstroPower has reduced headcount by about 10%, and stopped paying rent on the 300,000 square-foot manufacturing facility it opened with much fanfare about eighteen months back. Employees and production equipment have been relocated to nearby properties.

*September 25.* The assets of **Ebara Solar** were placed on the auction block, and the winning bidder was Florida-based King of Fans, one of the nation's largest manufacturers of ceiling fans and garden lights. **Ebara**, a Japanese maker of industrial pumps, turbines and other machinery, and the parent company of Ebara Solar, had placed the assets into state receivership after financial difficulties at home rendered it unable to continue funding operations.

King of Fans has been selling a line of solar-powered garden accent lights for about two years, and has been buying its solar cells from Shell Solar. With a \$900,000 bid, King of Fans took title of the assets of Ebara Solar, whose estimated book value was \$10 – 12 million. The purchase should significantly accelerate the company's existing solar power development efforts.

**Comment.** These three short articles speak volumes about the solar power industry – the promise of newly discovered low-cost methods and materials; the financial commitment required to bring them to maturity; and the high price of failure. The standard practice for producing solar power cells involves casting an ingot of crystalline silicon, slicing the ingot into wafers, treating and coating the wafers and printing them with current collectors and interconnects. About half the silicon is lost during ingot slicing, wafer processing is batch rather than continuous, and the resulting solar cells are simply too expensive.

The companies mentioned above – Ebara Solar, AstroPower and ST Microelectronics – have been pursuing alternative solar cell technologies that dangle the tantalizing promise of breakthrough cost reduction. Ebara Solar and AstroPower, each in their own way, reached for the prize; and both, for their own reasons, have thus far fallen short.

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## Energy Techline (cont'd)

### Company News Releases

Ebara started funding development of **Westinghouse Electric's** thin-film flexible solar power technology nine years ago as a way to remotely power its water pumps for use in Third World countries. Four years ago it bought the assets outright and formed Ebara Solar; and in 2001, a \$7 million production facility was opened. But by late 2002, the parent company's financial woes forced it to cut off funding, and in 2003 Ebara Solar declared bankruptcy.

The underlying issue seems to have been more financial than technical (although if the technology was on its way to cash-flow positive, the question should be asked why Ebara would not finance it just a bit further). But the case of Ebara Solar illustrates an important point – commercializing solar power technologies generally requires a significant financial commitment.

AstroPower appears to have run into more fundamental problems. The company has been producing solar cells profitably for years with a technique for reclaiming silicon wafers discarded by semiconductor manufacturers. Since the availability of recyclable wafers would ultimately constrain its growth, the company developed its proprietary "Silicon-Film" production technology, which was designed to use a more abundant source of silicon raw material.

As we saw it, AstroPower bet the solar farm on Silicon-Film and lost. In 2000, management trumpeted plans to expand Silicon-Film production at warp speed. Nameplate capacity from a just a few megawatts that year to 25 - 30 times that amount by 2003. In [2001] the company raised [\$60 million] from the public to help underwrite the ambitious project, and tens of millions of dollars were spent on or earmarked for capital equipment. But Silicon-Film apparently proved difficult to scale without sacrificing yield. AstroPower badly missed its revenue projection for the June 2002 quarter, then went on to disclose material accounting discrepancies and inventory and receivables issues. The founding CEO and the CFO stepped down, the company failed to meet SEC and NASD filing requirements, the stock was delisted, and the company is now in the hands of turnaround and restructuring specialists.

And so ST Microelectronics steps into the maelstrom. In its favor, ST Micro has deep expertise in materials science, deposition techniques and high-volume, high-quality manufacture, as well as ample financial resources. ST Micro's chosen technologies, based as they are on organic dyes and nanostructured carbon, will likely require several years of development before they are production-ready. Nonetheless, we are encouraged by the company's entry into solar, as it provides important validation of the market opportunity and reaffirms the image of solar power as a serious endeavor rather than fringe science.

# TapeTalk

## Energy Tech Company Share Price and Earnings Performance

Overall energy tech stock returns for the last several months have been solid (+9%), generally in line with the Nasdaq and S&P 500 indexes. The gains in energy tech came primarily from power semiconductor and power electronics companies. Shares of distributed generation companies eased after sharp price increases in the aftermath of the August blackout. Meanwhile, speculative micro-cap names in the clean fuels and energy storage segments continued to race ahead—examples include Beacon Power (+424% YTD), Ultralife Batteries (+255% YTD) and Quantum Fuel Systems (+185% YTD).

Company	Price 19-Dec-03	Mkt Cap (\$MM)	Share Price % Change				Price/Earnings		Price/ Book	Price/ Cash	Price/ LTM Sales
			2003 YTD	Nov	Oct	Last Yr.	FY 03	FY 04			
<b>Distributed Generation</b>											
Ballard Power Systems	11.25	1,303	1.6%	-5.1%	-8.5%	-62.6%	n/a	n/a	1.7	3.7	10.9
Capstone Turbine	1.48	123	64.4%	-14.5%	-13.1%	-83.4%	n/a	n/a	0.8	1.0	9.6
Distributed Energy System	2.83	89	-5.7%	8.0%	-7.7%	-63.6%	n/a	n/a	0.8	0.8	42.3
Energy Conversion Devices	8.34	205	-14.9%	-3.0%	-20.4%	-48.3%	n/a	n/a	2.1	12.4	3.2
Evergreen Solar	1.59	19	23.3%	-20.5%	-24.5%	-62.1%	n/a	n/a	1.0	0.8	1.9
FuelCell Energy	12.05	573	84.0%	-10.5%	-11.9%	-63.9%	n/a	n/a	2.2	3.4	16.9
Hydrogenics	5.70	303	61.5%	-1.6%	-12.1%	-52.7%	n/a	n/a	3.4	5.9	11.4
Millennium Cell	2.33	80	-2.5%	-11.1%	-21.3%	-54.2%	n/a	n/a	10.1	10.2	133.7
Plug Power	6.44	393	43.4%	11.4%	-8.5%	-48.6%	n/a	n/a	3.9	6.0	30.2
<b>Average</b>			<b>28.3%</b>	<b>-5.2%</b>	<b>-14.2%</b>	<b>-59.9%</b>			<b>2.9</b>	<b>4.9</b>	<b>28.9</b>
<b>Clean Fuel &amp; Combustion Technology</b>											
Catalytica Energy Systems	3.32	59	20.3%	-5.1%	-20.3%	-39.6%	n/a	n/a	1.0	1.0	14.4
Fuel Tech N.V.	3.15	63	-24.8%	-25.7%	-4.7%	-30.7%	78.8	31.5	3.4	10.8	1.6
Headwaters	19.60	545	26.4%	2.7%	1.5%	35.3%	12.6	10.7	3.8	25.1	1.4
Methanex Corp.	10.75	1,285	28.3%	7.7%	1.1%	51.3%	n/a	n/a	1.4	4.2	1.0
Quantum Fuel Systems Tech	6.70	152	185.1%	-4.1%	-23.4%	-59.5%	n/a	n/a	3.7	13.5	5.4
Syntroleum Corp.	4.13	163	138.7%	4.8%	-2.0%	-75.6%	n/a	n/a	(6.0)	13.1	9.8
<b>Average</b>			<b>62.3%</b>	<b>-3.3%</b>	<b>-8.0%</b>	<b>-19.8%</b>			<b>1.2</b>	<b>11.3</b>	<b>5.6</b>
<b>Energy Information Technology</b>											
Intergraph Corp.	23.50	1,077	32.3%	-7.5%	-2.5%	29.3%	75.8	53.4	1.7	2.2	2.1
Itron	18.09	372	-5.6%	-5.7%	-6.3%	-36.7%	15.9	13.2	2.1	35.4	1.2
<b>Average</b>			<b>13.3%</b>	<b>-6.6%</b>	<b>-4.4%</b>	<b>-3.7%</b>			<b>1.9</b>	<b>18.8</b>	<b>1.7</b>
<b>Energy Storage</b>											
Active Power	3.00	126	68.5%	-12.8%	10.3%	-73.8%	n/a	n/a	1.4	1.7	13.1
Arotech Corporation	1.94	83	203.1%	-24.5%	41.2%	-61.4%	n/a	n/a	14.9	46.0	5.4
Beacon Power Corp.	1.10	47	423.8%	-6.0%	53.9%	-83.8%	n/a	n/a	3.7	3.5	n/a
C&D Technologies	18.51	472	4.8%	-7.5%	0.5%	-22.7%	31.9	21.3	1.8	69.4	1.5
Medis Technologies	10.25	251	105.0%	14.5%	-5.1%	-32.0%	n/a	n/a	3.6	29.2	n/a
Ultralife Batteries	13.14	178	255.1%	-5.9%	-19.7%	-17.6%	30.6	18.3	5.9	71.2	2.8
Valence Technology	3.80	279	192.3%	5.6%	-6.2%	-61.4%	n/a	n/a	(7.2)	45.7	48.9
<b>Average</b>			<b>179.0%</b>	<b>-5.2%</b>	<b>10.7%</b>	<b>-50.4%</b>			<b>3.5</b>	<b>38.1</b>	<b>14.3</b>
<b>ENERGY TECHNOLOGY INDUSTRY</b>											
Mean			<b>91.3%</b>	<b>20.0%</b>	<b>3.6%</b>	<b>-46.4%</b>			<b>2.7</b>	<b>16.3</b>	<b>9.9</b>
Median			<b>65.1%</b>	<b>3.9%</b>	<b>0.1%</b>	<b>-53.1%</b>			<b>2.4</b>	<b>6.2</b>	<b>3.3</b>
<b>SECTOR &amp; MARKET INDEX PERFORMANCE</b>											
Vortex Energy Technology Index			<b>51.3%</b>	<b>2.1%</b>	<b>12.0%</b>	<b>-33.5%</b>					
Nasdaq Composite Index			<b>46.8%</b>	<b>1.5%</b>	<b>8.1%</b>	<b>-31.5%</b>					
S&P 500			<b>20.3%</b>	<b>0.7%</b>	<b>5.5%</b>	<b>-24.0%</b>					

Note: Sources for data presented in *TapeTalk* and *Capital Markets Monitor* are I/B/E/S, Market Guide and Vortex Energy LLC estimates



# TapeTalk (cont'd)

## Energy Tech Company Share Price and Earnings Performance

October and November were exceptional months for the power conversion universe. Power electronics stocks did very well in October as third quarter earnings results confirmed that segment fundamentals are improving. SatCon was the breakaway winner (+322% in November), as investors responded favorably to signs that the company's financial situation has stabilized and its order book is improving. Year to date, power semiconductor stocks have been particularly strong, but lagged power electronics shares recently as investors favored companies without current earnings. This mirrors a broader trading pattern in the technology world.

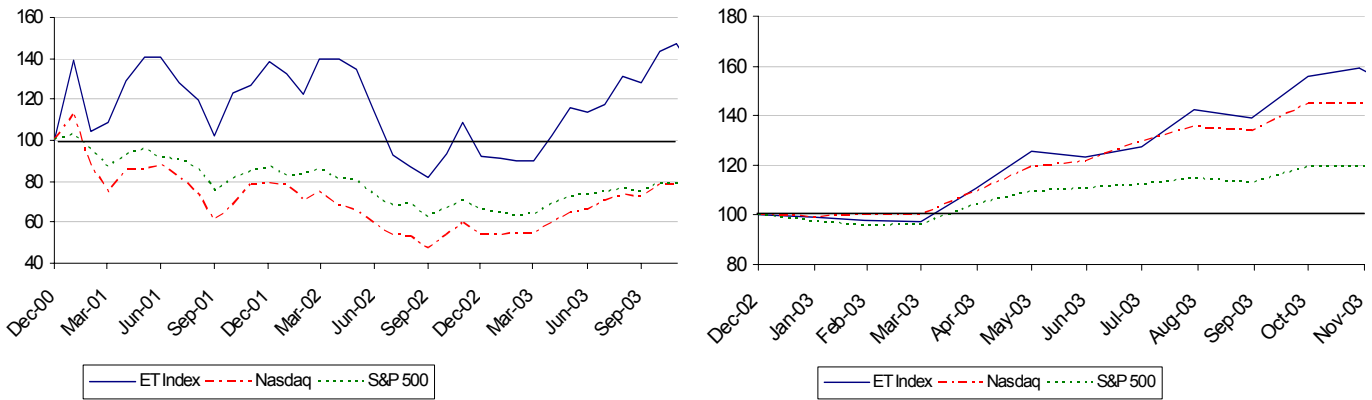
Company	Price 19-Dec-03	Mkt Cap (\$MM)	Share Price % Change				Price/Earnings		Price/ Book	Price/ Cash	Price/ LTM Sales
			2003 YTD	Nov	Oct	Last Yr.	FY 03	FY 04			
<b>Power Semiconductors</b>											
Advanced Power Technology	8.27	86	155.2%	0.9%	8.6%	-72.1%	n/a	63.6	1.2	4.7	1.8
AVX Corp.	16.38	2,844	67.1%	49.6%	-0.4%	-58.5%	n/a	96.4	2.1	4.2	2.7
Fairchild Semiconductor	23.61	2,780	120.4%	85.2%	-0.3%	-62.0%	112.4	29.9	2.4	4.5	2.0
International Rectifier	48.10	3,093	160.6%	74.3%	2.9%	-47.1%	33.2	22.1	3.0	4.3	3.5
IXYS Corporation	8.00	262	13.3%	8.1%	-7.4%	-12.7%	88.9	18.6	1.8	6.6	1.7
KEMET Corporation	13.53	1,169	54.8%	58.2%	-29.0%	-50.8%	n/a	n/a	1.6	3.9	2.8
Maxwell Technologies	7.44	103	23.0%	5.1%	22.9%	-38.3%	n/a	n/a	2.5	17.7	2.2
Microsemi Corp.	23.21	673	281.1%	36.4%	6.8%	-79.5%	50.5	28.3	4.0	22.9	3.4
O2Micro International	20.94	803	115.0%	40.0%	-7.3%	-59.5%	67.5	38.8	5.5	6.7	9.8
ON Semiconductor	6.36	1,377	364.2%	117.8%	8.1%	-33.8%	n/a	n/a	(1.9)	7.5	1.3
Power Integrations	32.50	980	91.2%	13.9%	17.4%	-25.6%	56.0	41.7	5.5	7.5	8.0
Semtech Corp.	21.66	1,599	98.0%	31.3%	15.8%	-69.3%	46.1	32.8	4.4	6.1	8.8
Siliconix	43.80	1,309	87.2%	2.0%	18.9%	-14.7%	32.2	22.9	3.2	5.0	3.4
<b>Average</b>			<b>125.5%</b>	<b>40.2%</b>	<b>4.4%</b>	<b>-48.0%</b>			<b>2.7</b>	<b>7.8</b>	<b>4.0</b>
<b>Power Electronics</b>											
Artesyn Technologies	7.39	286	92.4%	2.9%	28.2%	-58.8%	n/a	52.8	2.6	3.0	0.8
Magnetek	6.65	189	49.8%	64.6%	59.1%	-50.7%	n/a	28.9	2.0	135.1	0.9
PECO II	1.18	25	84.4%	71.0%	11.3%	-89.3%	n/a	n/a	0.5	1.4	0.6
Power-One	10.14	844	78.8%	-4.2%	48.7%	-45.5%	n/a	n/a	3.0	8.6	3.3
Powerwave Technologies	7.59	479	40.6%	-1.4%	25.0%	-68.8%	n/a	n/a	1.8	1.9	2.0
SatCon Technology	2.32	45	65.7%	321.8%	-11.3%	-73.1%	n/a	n/a	6.1	34.2	1.5
UQM Technologies	2.91	57	15.0%	-15.7%	15.0%	-53.4%	n/a	n/a	7.9	28.5	4.9
Vicor Corp.	11.28	472	36.7%	11.9%	3.9%	-49.1%	n/a	n/a	2.1	4.2	3.1
<b>Average</b>			<b>57.9%</b>	<b>56.4%</b>	<b>22.5%</b>	<b>-61.1%</b>			<b>3.2</b>	<b>27.1</b>	<b>2.1</b>
<b>Power Quality</b>											
American Power Conversion	23.90	4,745	57.8%	37.6%	11.3%	4.8%	28.1	24.4	3.3	6.3	3.4
American Superconductor	12.25	333	307.0%	52.4%	31.2%	-75.4%	n/a	n/a	3.6	37.8	10.7
Intermagnetics General	22.37	374	13.9%	10.4%	2.2%	-24.2%	23.3	17.6	2.4	4.3	2.7
<b>Average</b>			<b>126.2%</b>	<b>33.5%</b>	<b>14.9%</b>	<b>-31.6%</b>			<b>3.1</b>	<b>16.1</b>	<b>5.6</b>
<b>ENERGY TECHNOLOGY INDUSTRY</b>											
Mean			<b>91.3%</b>	<b>20.0%</b>	<b>3.6%</b>	<b>-46.4%</b>			<b>2.7</b>	<b>16.3</b>	<b>9.9</b>
Median			<b>65.1%</b>	<b>3.9%</b>	<b>0.1%</b>	<b>-53.1%</b>			<b>2.4</b>	<b>6.2</b>	<b>3.3</b>
<b>SECTOR &amp; MARKET INDEX PERFORMANCE</b>											
Vortex Energy Technology Index			<b>51.3%</b>	<b>2.1%</b>	<b>12.0%</b>	<b>-33.5%</b>					
Nasdaq Composite Index			<b>46.8%</b>	<b>1.5%</b>	<b>8.1%</b>	<b>-31.5%</b>					
S&P 500			<b>20.3%</b>	<b>0.7%</b>	<b>5.5%</b>	<b>-24.0%</b>					

# TapeTalk (cont'd)

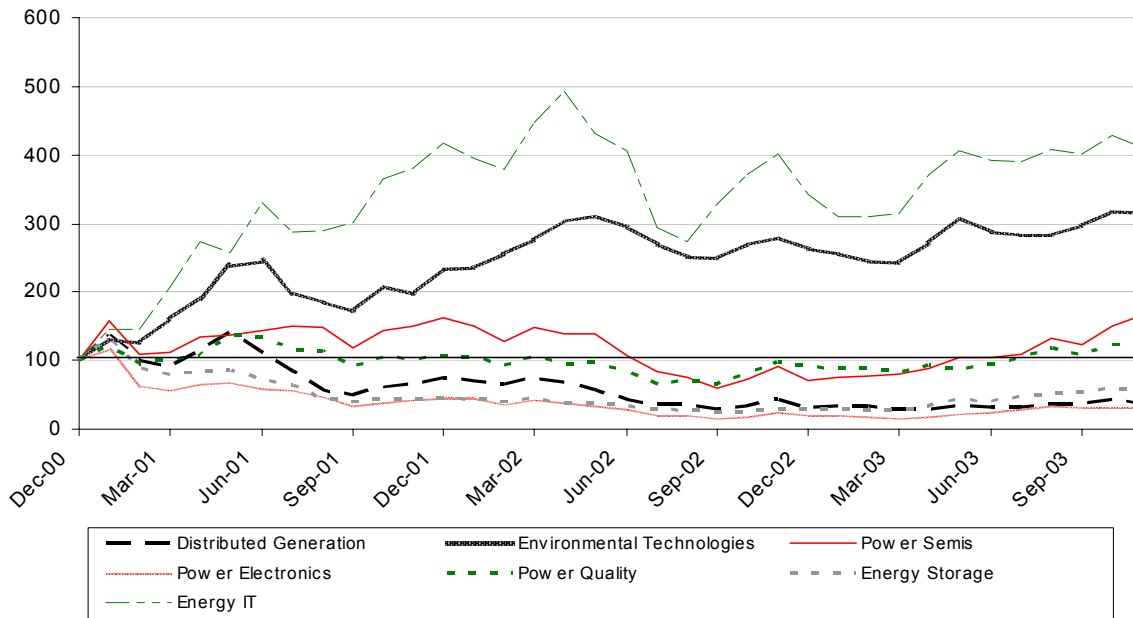
## Energy Tech Company Share Price and Earnings Performance

The first two graphs below, plotting the stock price performance of the overall energy tech industry versus the major indexes, show that energy tech shares held up relatively well over the course of two difficult years (2001-02), and have remained strong in 2003. The third graph below shows energy tech share price performance by segment, and underscores the importance of stock selection. Energy IT (topmost green dashed line) and clean fuel & combustion technology shares have outperformed the others by a wide margin.

VORTEX ENERGY TECH INDUSTRY INDEX



VORTEX ENERGY TECH SEGMENT INDEXES



# TapeTalk (cont'd)

## Energy Tech Company Share Price and Earnings Performance

Taken as a whole, technical stock indicators are weighted toward the negative. Insider selling overwhelmed insider buying. Short interest increased about 50 basis points since July, and short positions grew noticeably in Itron, Medis Technologies and Valence. Lastly, 4-week and 13-week relative strength versus the S&P 500 was modestly negative across most industry segments.

Company	Insider Trading		Short Interest - Nov		Short Interest - Oct		Average Volume		Beta	Relative Strength	
	Buys	Sells	Shares	% of Float	Shares	% of Float	Daily	Monthly		4-week	13-week
<b>Distributed Generation</b>											
Ballard Power Systems	-	-	7,261	6.4%	7,572	6.7%	363	9,733	1.5	-9	-19
Capstone Turbine	8	-	1,414	1.8%	1,412	1.8%	718	15,547	4.1	-18	-31
Distributed Energy System	1	-	345	3.0%	366	3.2%	101	7,082	3.1	-8	2
Energy Conversion Devices	1	-	1,063	5.1%	1,150	5.6%	80	3,803	1.1	-13	-49
Evergreen Solar	-	6	186	2.2%	190	2.3%	72	1,545	2.4	-20	-29
FuelCell Energy	-	4	4,865	11.9%	5,213	12.8%	660	20,258	1.8	-12	8
Hydrogenics	-	-	323	3.2%	304	3.0%	61	4,742	3.7	-5	8
Millennium Cell	-	100	406	1.6%	410	1.6%	154	5,557	1.2	-22	-44
Plug Power	20	1,069	4,031	15.4%	4,548	17.4%	555	18,652	1.8	22	16
<b>Clean Fuel &amp; Combustion Technology</b>											
Catalytica Energy Systems	-	-	162	0.9%	164	1.0%	23	468	0.0	-6	-3
Fuel Tech N.V.	-	100	14	0.1%	12	0.1%	148	1,336	0.5	-28	-50
Headwaters	-	34	1,513	5.7%	1,278	4.8%	672	9,831	0.7	0	29
Methanex Corp.	-	-	233	0.2%	302	0.3%	182	3,639	0.1	2	5
Quantum Fuel Systems Tech	-	-	336	2.2%	705	4.6%	291	9,068	0.0	-5	-4
Syntroleum Corp.	248	874	292	1.2%	278	1.2%	133	5,353	0.1	2	3
<b>Power Semiconductors</b>											
Advanced Power Technology	-	1	48	0.8%	44	0.8%	12	312	2.7	-5	-13
AVX Corp.	-	5	3,541	6.8%	3,564	6.9%	358	6,532	2.1	8	6
Fairchild Semiconductor	-	8,599	4,291	5.3%	4,174	5.1%	2,348	38,920	2.3	-3	25
International Rectifier	1	139	3,126	5.1%	3,905	6.4%	1,158	22,734	2.6	-6	9
IXYS Corporation	-	-	269	1.4%	286	1.5%	140	4,876	2.8	-12	-33
KEMET Corporation	-	365	3,370	3.9%	4,063	4.8%	982	15,889	1.8	-1	-3
Maxwell Technologies	467	132	409	3.1%	469	3.5%	22	389	1.1	-7	-22
Microsemi Corp.	-	57	1,682	6.1%	1,563	5.7%	362	7,439	2.2	2	23
O2Micro International	-	-	1,728	7.5%	2,558	11.1%	247	8,124	3.4	-16	21
ON Semiconductor	61	-	1,099	3.1%	505	1.4%	2,027	49,944	3.6	16	29
Power Integrations	-	452	2,232	7.5%	2,825	9.5%	627	12,434	1.8	-10	-17
Semtech Corp.	-	351	3,979	5.6%	4,764	6.8%	1,549	26,169	2.0	-16	6
Siliconix	-	-	88	1.5%	114	2.0%	28	555	1.9	-14	-22
<b>Power Electronics</b>											
Artesyn Technologies	-	115	1,989	6.5%	2,525	8.3%	251	5,899	3.2	-4	-19
Magnetek	-	-	871	3.3%	598	2.3%	203	2,937	1.4	-3	24
PECO II	-	-	23	0.2%	21	0.2%	16	827	1.6	-6	17
Power-One	-	-	1,077	1.7%	1,744	2.7%	511	14,702	4.3	18	-20
Powerwave Technologies	-	-	1,648	2.6%	3,283	5.2%	2,790	67,961	2.6	10	-25
SatCon Technology	50	-	1,207	8.5%	1,380	9.7%	169	12,816	0.9	-4	-37
UQM Technologies	-	5	7	0.0%	7	0.0%	74	921	0.8	-20	-24
Vicor Corp.	-	-	275	1.4%	219	1.1%	51	1,325	2.0	1	-4
<b>Power Quality</b>											
American Power Conversion	-	4,183	3,783	2.2%	2,739	1.6%	1,593	41,440	1.9	8	24
American Superconductor	-	-	2,694	10.2%	3,126	11.9%	186	6,885	2.0	12	0
Intermagnetics General	-	231	668	4.1%	704	4.3%	117	1,836	1.0	3	-12
<b>Energy Storage</b>											
Active Power	40	-	777	2.2%	810	2.3%	157	4,198	3.5	-6	-7
Arotech Corporation	-	341	2,340	6.3%	1,985	5.3%	1,436	41,373	1.5	-27	26
Beacon Power Corp.	-	7,331	277	0.9%	276	0.9%	1,873	101,258	2.8	-15	18
C&D Technologies	4	3	334	1.4%	471	1.9%	109	2,707	1.9	-15	-14
Medis Technologies	-	-	1,349	13.8%	1,186	12.1%	28	1,094	2.0	11	-19
Ultralife Batteries	-	159	430	3.4%	276	2.2%	106	5,252	0.8	-7	-2
Valence Technology	3,088	-	7,257	16.0%	6,513	14.3%	154	6,324	2.4	-1	-7
<b>Energy Information Technology</b>											
Intergraph Corp.	3	118	1,554	3.5%	1,543	3.4%	440	11,176	0.9	-12	-9
Itron	4	61	2,502	12.5%	2,567	12.8%	190	4,279	0.5	-11	-16
<b>TOTAL</b>	<b>3,992</b>	<b>24,774</b>	<b>76,866</b>	<b>4.6%</b>	<b>82,144</b>	<b>4.9%</b>	<b>24,337</b>	<b>641,862</b>			
<b>AVERAGE</b>							<b>518</b>	<b>13,657</b>	<b>1.9</b>	<b>-5</b>	<b>-5</b>

All share data in thousands

Insider trading data covers the last 6 months of activity

Daily trading volume based on 10-day average; monthly volume based on 3-month average

Relative strength indicates how well a stock has performed versus the S&P 500 over a specified time

# TapeTalk (cont'd)

## Energy Tech Company Share Price and Earnings Performance

EPS remain largely negative. Revenues at many companies are trending higher both sequentially and year over year. Median revenues in power semiconductors by far the largest sectors by revenue, are up 1%-5% sequentially and year/year, while power electronics sales continue to shrink. Revenues for power quality and energy storage companies are generally showing solid growth, while performance in other segments is mixed.

Company	Revenues			Last Q Revs - % Chg		Diluted Continuing EPS			Last Q EPS - % Chg	
	Last Q	2002	2001	Q/Q	Y/Y	Last Q	FY2002	FY2001	Q/Q	Y/Y
<b>Distributed Generation</b>										
Ballard Power Systems	28.2	90.9	36.2	-3.1%	0.7%	(0.28)	(1.29)	119.70	n/a	n/a
Capstone Turbine	2.3	19.5	36.0	-43.9%	-41.0%	(0.11)	(0.95)	(0.61)	n/a	n/a
Distributed Energy System	0.5	4.7	3.0	150.0%	-61.5%	(0.10)	(0.40)	(0.15)	n/a	n/a
Energy Conversion Devices	14.2	65.2	91.7	-17.9%	-10.7%	(0.65)	(1.75)	(0.96)	n/a	n/a
Evergreen Solar	3.1	6.7	2.5	-3.1%	47.6%	(0.35)	(1.16)	(1.10)	n/a	n/a
FuelCell Energy	7.3	41.2	26.2	-18.0%	-39.2%	(0.38)	(1.25)	(0.45)	n/a	n/a
Hydrogenics	5.5	15.8	7.4	-19.1%	25.0%	(0.13)	(0.44)	(0.11)	n/a	n/a
Millennium Cell	0.1	0.7	-	-50.0%	0.0%	(0.16)	(0.58)	(0.72)	n/a	n/a
Plug Power	3.5	11.8	5.7	12.9%	16.7%	(0.20)	(0.93)	(1.56)	n/a	n/a
<b>Clean Fuel &amp; Combustion Technology</b>										
Catalytica Energy Systems	1.1	4.8	5.5	10.0%	-26.7%	(0.18)	(1.02)	(1.33)	n/a	n/a
Fuel Tech N.V.	10.2	32.6	17.7	2.0%	27.5%	0.06	0.14	(0.09)	100.0%	200.0%
Headwaters	106.5	387.6	119.3	0.1%	143.7%	0.40	1.30	0.94	8.1%	42.9%
Methanex Corp.	334.7	1,041.8	1,195.5	-9.9%	12.9%	(0.07)	0.16	0.45	n/a	n/a
Quantum Fuel Systems Tech	7.9	23.6	23.4	6.8%	71.7%	(0.08)	(1.00)	(3.07)	n/a	n/a
Syntroleum Corp.	2.1	11.6	6.7	-84.7%	-40.0%	(0.22)	(1.98)	(0.91)	n/a	n/a
<b>Power Semiconductors</b>										
Advanced Power Technology	12.7	43.4	36.9	1.6%	-3.1%	(0.03)	(0.36)	0.19	n/a	n/a
AVX Corp.	267.3	1,134.1	1,250.0	4.1%	-9.5%	(0.44)	(0.07)	(0.04)	n/a	n/a
Fairchild Semiconductor	328.4	1,411.9	1,407.7	-5.4%	-8.9%	(0.05)	(0.02)	(0.42)	n/a	n/a
International Rectifier	234.1	864.4	720.2	2.5%	10.3%	0.25	(1.40)	0.75	19.0%	47.1%
IXYS Corporation	42.9	136.1	82.8	7.0%	21.5%	-	(0.39)	0.07	n/a	n/a
KEMET Corporation	100.1	447.3	508.6	-5.0%	-11.5%	(0.50)	(0.65)	(0.32)	n/a	n/a
Maxwell Technologies	11.0	58.0	77.9	2.8%	-33.7%	(0.16)	(2.88)	(0.82)	n/a	n/a
Microsemi Corp.	52.8	197.4	212.6	4.6%	7.3%	0.05	0.11	(0.16)	25.0%	n/a
O2Micro International	23.2	70.2	45.8	11.0%	28.9%	0.10	0.27	0.16	66.7%	42.9%
ON Semiconductor	264.8	1,084.5	1,214.6	3.4%	-3.2%	(0.10)	(0.82)	(4.21)	n/a	n/a
Power Integrations	34.5	108.2	94.1	15.8%	22.3%	0.15	0.33	0.23	15.4%	87.5%
Semtech Corp.	48.1	193.0	191.2	7.8%	1.9%	0.12	0.44	0.34	300.0%	-29.4%
Siliconix	97.4	372.9	305.6	10.4%	1.4%	0.32	1.55	0.51	3.2%	-28.9%
<b>Power Electronics</b>										
Artesyn Technologies	88.0	350.8	494.0	0.5%	2.3%	(0.11)	(2.84)	(0.83)	n/a	n/a
Magnetek	50.4	201.8	188.2	-7.5%	17.8%	(0.15)	(1.48)	0.06	n/a	n/a
PECO II	8.5	62.1	106.7	-14.1%	-52.5%	(0.19)	(1.85)	(0.31)	n/a	n/a
Power-One	63.7	230.7	363.7	-8.1%	6.2%	(0.04)	(2.63)	(2.36)	n/a	n/a
Powerwave Technologies	63.2	384.9	300.3	22.7%	-30.8%	(0.09)	0.06	(0.33)	n/a	n/a
SatCon Technology	6.4	41.6	41.7	16.4%	-45.8%	(0.36)	(1.25)	(1.51)	n/a	n/a
UQM Technologies	1.9	15.5	21.4	-40.6%	-53.7%	(0.05)	(0.18)	(0.36)	n/a	n/a
Vicor Corp.	35.9	152.6	195.9	-7.2%	-9.1%	(0.17)	(0.38)	(0.01)	n/a	n/a
<b>Power Quality</b>										
American Power Conversion	393.7	1,300.0	1,404.8	18.8%	16.8%	0.28	0.59	0.58	64.7%	33.3%
American Superconductor	9.6	21.0	11.7	23.1%	113.3%	(0.34)	(4.21)	(2.79)	n/a	n/a
Intermagetics General	22.3	147.4	153.3	-40.8%	-36.6%	0.02	0.88	1.19	-92.3%	-90.5%
<b>Energy Storage</b>										
Active Power	3.0	13.5	22.6	57.9%	-6.3%	(0.12)	(0.67)	(0.70)	n/a	n/a
Arotech Corporation	5.7	6.4	2.1	62.9%	72.7%	-	(0.15)	(0.22)	n/a	n/a
Beacon Power Corp.	-	-	-	n/a	n/a	(0.04)	(0.49)	(0.62)	n/a	n/a
C&D Technologies	81.4	335.7	471.6	5.2%	-3.4%	0.14	0.74	1.35	27.3%	-22.2%
Medis Technologies	-	0.2	-	n/a	n/a	(0.15)	(0.60)	(1.76)	n/a	n/a
Ultralife Batteries	19.9	15.6	32.5	-1.0%	192.6%	0.12	(0.24)	(2.11)	-25.0%	n/a
Valence Technology	2.3	2.6	4.9	43.8%	666.7%	(0.36)	(0.65)	(1.53)	n/a	n/a
<b>Energy Information Technology</b>										
Intergraph Corp.	133.6	501.2	532.1	4.9%	0.1%	0.27	7.48	0.39	1250.0%	350.0%
Itron	82.1	284.8	225.6	2.2%	12.3%	0.23	0.41	0.75	21.1%	-17.9%

All revenue data in millions

For companies with non-calendar fiscal years, revenue and EPS data is for FY2002 and FY2001

Diluted continuing EPS as reported in SEC filings; excludes extraordinary items but includes "above the line" gains and charges

# TapeTalk (cont'd)

## Energy Tech Company Share Price and Earnings Performance

The latest EPS results continue to surpass consensus, and the ratio of upside to downside surprises increased to about 3:1 from 1.5:1. Estimate revisions remain weighted to the downside, although less so than in July-August.

Latest Quarter Earnings Surprises		Total Estimate Revisions ↑/↓		
		Current Q	Next Q	Current Year
Upside	28	6↑	15↑	17↑
Downside	10	4↓	16↓	24↓

Company	Earnings Surprises - Latest Q			EPS Estimate			EPS Est. % Chg		
	Actual	Estimated	Variance	Current Q	Next Q	Current Year	Current Q	Next Q	Current Year
<b>Distributed Generation</b>									
Ballard Power Systems	(0.24)	(0.28)	0.04	(0.28)	(0.28)	(0.95)	3.4%	-0.3%	-1.0%
Capstone Turbine	(0.11)	(0.12)	0.01	(0.12)	-	(0.44)	-9.1%	--	-0.4%
Distributed Energy System	(0.13)	(0.08)	(0.05)	(0.09)	-	(0.44)	-12.5%	--	-0.4%
Energy Conversion Devices	(0.65)	n/a	n/a	-	-	-	--	--	--
Evergreen Solar	(0.28)	(0.36)	0.08	(0.36)	(0.29)	(1.24)	--	-0.3%	-1.2%
FuelCell Energy	(0.39)	(0.39)	-	(0.37)	(0.35)	(1.32)	-19.4%	-0.4%	-1.3%
Hydrogenics	(0.12)	(0.08)	(0.04)	(0.09)	-	(0.36)	--	--	-0.4%
Millennium Cell	(0.08)	(0.11)	0.03	(0.11)	-	(0.46)	--	--	-0.5%
Plug Power	(0.20)	(0.21)	0.01	(0.19)	(0.20)	(0.85)	--	-0.2%	-0.9%
<b>Clean Fuel &amp; Combustion Technology</b>									
Catalytica Energy Systems	(0.18)	n/a	n/a	-	-	-	--	--	--
Fuel Tech N.V.	0.06	0.04	0.02	(0.02)	(0.05)	0.04	--	-0.1%	0.0%
Headwaters	0.40	0.39	0.01	0.29	0.28	1.55	--	0.3%	1.6%
Methanex Corp.	0.27	n/a	n/a	-	-	0.69	--	--	0.7%
Quantum Fuel Systems Tech	(0.09)	(0.14)	0.05	(0.09)	(0.08)	(0.33)	--	-0.1%	-0.3%
Syntroleum Corp.	(0.22)	(0.10)	(0.12)	(0.11)	-	(0.81)	--	--	-0.8%
<b>Power Semiconductors</b>									
Advanced Power Technology	0.02	0.01	0.01	(0.03)	-	(0.06)	--	--	-0.1%
AVX Corp.	(0.08)	(0.06)	(0.02)	(0.04)	(0.02)	(0.22)	20.0%	0.0%	-0.2%
Fairchild Semiconductor	0.05	0.01	0.04	0.09	0.11	0.21	12.5%	0.1%	0.2%
International Rectifier	0.30	0.28	0.02	0.34	0.37	1.45	--	0.4%	1.5%
IXYS Corporation	-	0.04	(0.04)	0.02	0.06	0.09	--	0.1%	0.1%
KEMET Corporation	(0.15)	(0.12)	(0.03)	(0.11)	(0.08)	(0.38)	8.3%	-0.1%	-0.4%
Maxwell Technologies	(0.15)	n/a	n/a	-	-	-	--	--	--
Microsemi Corp.	0.07	0.06	0.01	0.09	0.10	0.46	28.6%	0.1%	0.5%
O2Micro International	0.10	0.08	0.02	0.11	0.11	0.31	--	0.1%	0.3%
ON Semiconductor	(0.12)	(0.12)	-	(0.07)	(0.05)	(0.50)	--	-0.1%	-0.5%
Power Integrations	0.15	0.15	-	0.17	0.16	0.58	--	0.2%	0.6%
Semtech Corp.	0.12	0.11	0.01	0.14	0.15	0.47	7.7%	0.2%	0.5%
Siliconix	0.32	0.39	(0.07)	0.40	0.40	1.36	--	0.4%	1.4%
<b>Power Electronics</b>									
Artesyn Technologies	(0.03)	(0.05)	0.02	(0.01)	-	(0.24)	--	--	-0.2%
Magnetek	(0.15)	(0.13)	(0.02)	(0.05)	(0.01)	(0.18)	--	0.0%	-0.2%
PECO II	-	-	-	-	-	(0.70)	--	--	-0.7%
Power-One	(0.04)	(0.04)	-	(0.06)	(0.04)	(0.16)	--	0.0%	-0.2%
Powerwave Technologies	(0.08)	(0.07)	(0.01)	(0.03)	(0.02)	(0.36)	--	0.0%	-0.4%
SatCon Technology	(0.37)	n/a	n/a	-	-	-	--	--	--
UQM Technologies	(0.05)	n/a	n/a	-	-	-	--	--	--
Vicor Corp.	(0.17)	(0.12)	(0.05)	(0.14)	(0.12)	(0.61)	--	-0.1%	-0.6%
<b>Power Quality</b>									
American Power Conversion	0.26	0.21	0.05	0.27	0.18	0.85	--	0.2%	0.9%
American Superconductor	(0.28)	(0.31)	0.03	(0.25)	(0.24)	(1.18)	--	-0.2%	-1.2%
Intermetics General	0.26	0.26	-	0.32	0.36	0.96	--	0.4%	1.0%
<b>Energy Storage</b>									
Active Power	(0.12)	(0.13)	0.01	(0.12)	(0.12)	(0.53)	--	-0.1%	-0.5%
Arotech Corporation	-	n/a	n/a	-	-	-	--	--	--
Beacon Power Corp.	(0.04)	(0.07)	0.03	(0.07)	-	(0.27)	--	--	-0.3%
C&D Technologies	0.16	0.16	-	0.17	0.19	0.58	--	0.2%	0.6%
Medis Technologies	(0.15)	n/a	n/a	-	-	-	--	--	--
Ultralife Batteries	0.12	-	-	0.13	0.14	0.43	--	0.1%	0.4%
Valence Technology	(0.13)	(0.13)	-	(0.12)	(0.11)	(0.48)	--	-0.1%	-0.5%
<b>Energy Information Technology</b>									
Intergraph Corp.	0.09	0.07	0.02	0.08	0.10	0.31	--	0.1%	0.3%
Itron	0.30	0.30	-	0.26	0.29	1.14	-18.8%	0.3%	1.1%

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## Capital Markets Monitor

**Overview.** In the aftermath of the blackout, share prices of anything even remotely perceived as a solution to the ills of the transmission network spiked sharply. A number of public companies seized upon the opportunity and turned darkness into dollars by issuing shares and raising debt. Importantly, these deals were filed, marketed and offered to the public. For the last year and a half, nearly every dollar raised by a distributed generation or transmission technology company came in through a bought deal, private placement or other “off-spec” transaction.

With the shift in the way that deals have been managed has come a shift in deal size. From private placements ranging from \$1-\$30 million, the capital market has moved to publicly managed underwritings sized from \$50-\$270 million. Deal activity continued into November and December, though at a more measured pace.

*October 24.* **Quanta Services**, a provider of specialized contracting services for electric power, gas, telecommunications and cable television industries, issued \$270 million principal amount of convertible subordinated notes. Quanta used the net proceeds to repay a portion of the senior secured notes, discussed below, and to cash collateralize the letters of credit under the credit facility as amended. The notes bear interest at 4.5% per year and are convertible into shares of Quanta's common stock at a price of \$11.14 per share. The offering was initially set at \$175 million, but was upsized to \$270 million due to demand.

*October 21.* **Quantum Fuel Systems Technologies Worldwide** announced that it has priced its public offering of 8.05 million shares of common stock, including an over-allotment option of 1.05 million shares, at \$8.00 per share, for gross proceeds of \$64.4 million. The shares were offered by Quantum pursuant to a registration statement that was declared effective by the SEC on October 21, 2003.

*October 21.* **Sustainable Energy Technologies** has exercised 2.5 million common shares to raise \$455,625 to fund the launch of its 5 kW grid-interactive solar inverter. Company officials claim a conversion efficiency of 94% at peak power. The company will target the North American solar market, particularly California.

*October 16.* **UQM Technologies, Inc.**, a developer of alternative energy technologies, announced that it has completed a follow-on offering of 720,000 shares of common stock to institutional investors in North America and Europe. The offering was initially sized at 600,000 shares, and was upsized to 720,000 to meet demand. Net cash proceeds to the Company, after deducting expenses of the offering, will be about \$2.2 million.

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## Capital Markets Monitor (cont'd)

*October 16.* **SAG Solarstrom AG** launched a new vehicle for investors to secure a low risk financial return from solar electricity generation. “SolarInvest” offers investors the ability to own a solar electricity generation system sited at a third party location. Income from the investment is secured by the sale of the electricity over a twenty-year term backed by the German Renewable Energy Law (EEG). SAG Solarstrom identifies suitable locations, then installs and maintains the PV installations. Rooftop systems would typically be in the range 25kW – 300 kW, and ground mounted systems up to the 600kW – 1MW range. The SolarInvest scheme runs in parallel with the company's **SolarStrom Park Oberrhein** initiative, in which pooled funds from multiple investors are used to finance large solar plants.

*October 16.* **Plug Power** announced that it has filed a shelf registration statement with the SEC for up to an aggregate of \$60 million of its common stock and preferred stock. From time to time after the registration statement becomes effective, the Company may complete one or more offerings of its common stock or preferred stock.

*(On November 13, Plug Power successfully completed a \$58.5 million follow-on offering).*

*October 15.* **Comverge, Inc.**, a supplier of power management solutions to power utility companies, announced the closing of its Series A round with the addition of \$5.6 million in investment from previous Series A investors, **Nth Power, EnerTech Capital Partners** and **Ridgewood Capital**, as well as company executives. The new investment brings the total for the Series A Preferred to \$18.6 million. Proceeds from the financing will be used to fund Comverge's internal growth opportunities, including the design and installation of additional Virtual Peaking Capacity systems and the advanced development of the company's Maingate and SuperSwitch product lines.

*October 9.* **Ener1, Inc.**, a developer of advanced lithium batteries and fuel cells, announced that it has arranged for expanded financing from **Ener1 Group, Inc.**, its majority investor. The additional funds will bring total Ener1 financing from Ener1 Group to more than \$6.5 million in 2003. Ener1 Group said that it plans to continue its financial support of Ener1's operations. The new funds will be used for working capital to support Ener1's product development and marketing activities, including work arising from Ener1's recently formed alliance with **ITOCHU Corp.**



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## Capital Markets Monitor (cont'd)

*October 9.* **Magnetek, Inc.**, a manufacturer of power electronics components and systems, announced that it sold 4.2 million shares of common stock in a private placement. The deal was priced at an 8% discount from the \$5.10 closing price of the stock on the New York Stock Exchange on October 8, 2003. Net proceeds to the company were about \$18.5 million. The company intends to use the proceeds to pay down debt.

*October 3.* **American Superconductor Corp.** priced a follow-on offering of 4,975,000 shares of common stock at \$9.50 per share, a 9% discount from the previous day's close. The \$44.5 million of net proceeds will be used primarily for working capital and for general corporate purposes, including the scale-up of pilot manufacturing for second-generation high-temperature superconductor wire.

*(On November 3, the underwriters exercised their over-allotment rights and purchased an additional 746,250 shares at \$9.50 per share, bringing total net proceeds to \$51.1 million)*

*September 30.* **Comverge**, a supplier of power management solutions to power utility companies, announced the addition of **Ridgewood Capital** and **Norsk Hydro Technology Ventures** to its Series A Preferred Share financing. The initial \$13 million round in April 2003 was led by **Nth Power**, and included **E.ON Venture Partners**, **EnerTech Capital**, **Shell Internet Ventures**, **Easton Hunt Capital Partners**, and **Data Systems & Software**, which remains Comverge's largest shareholder.

*September 29.* **Quantum Fuel Systems Technologies Worldwide** filed a registration statement with for a proposed public offering of 7 million shares of common stock, with an over-allotment of an additional 1.05 million shares. Quantum supplies integrated fuel systems to original equipment manufacturers for use in alternative fuel vehicles and fuel cell applications in the transportation, stationary power and hydrogen refueling markets.

*September 17.* A follow-on offering of 34.8 million shares from **ON Semiconductor** priced at \$4.50 per share, for gross proceeds of about \$157 million. The company plans to use the proceeds to prepay a portion of outstanding loans under its senior bank facilities.

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## Capital Markets Monitor (cont'd)

*September 17.* **Avista Labs**, a developer of fuel cell systems for backup power applications, has secured an additional \$5 million in equity financing from **Enterprise Partners Venture Capital** (EPVC). EPVC joins a syndicate consisting of **Avista Corp.**, **Buerk Craig Victor**, **Chrysalix Energy**, and **Wall Street Technology Partners**. Naser Partovi, Managing Director of EPVC, will join the Avista Labs Board of Directors.

*September 11.* **Enel SpA** announced that it intends to proceed with an initial public offering of its high-voltage power grid, **Terna**, in the first half of next year. Enel aims to sell about a 50% stake in the IPO. Analysts have estimated that 100% of the company should be worth about EUR 4 billion (\$4.5 billion). Enel's CEO said that an eventual merger with state-owned grid operator **Gestore della Rete di Trasmissione Nazionale** (GRTN) or other market players would follow an IPO.

Italy's Economics Ministry continues to own 68% of Enel. News reports have indicated the government could shortly proceed with a private placement with institutional investors of up to a further 10% stake as it seeks funds to cover budget shortfalls. A 10% stake in Enel at current market prices is worth about EUR 3.4 billion.

*September 10.* **Whistler Investments, Inc.** announced it has completed a private placement of one million Units at \$4.00 per Unit, for total gross proceeds of \$4 million. Each Unit comprises one share and a one-year warrant to purchase an additional share at \$6.00. The proceeds will apparently be used to fund a Whistler subsidiary, **NuPow'r, LLC**, an electric vehicle and electric products development company.

NuPow'r has demonstrated an electric vehicle power systems technology and patented battery recharger that it claims cuts the weight of battery packs by up to 75%, doubles or triples the range and speed of electrical vehicles, and cuts the recharge time by 75%.

*September 8.* **Konarka Technologies** announced that **Silicon Valley Bank**, a subsidiary of **Silicon Valley Bancshares**, will provide the company with a revolving line of credit of up to \$2 million. This follows Konarka's recent disclosure that the United States Army has also funded Konarka to develop a source of lightweight, flexible, scalable and renewable power in a variety of form factors for military applications. Konarka's technology converts sunlight as well as indoor, artificial light into direct current electrical power. The company uses proprietary low-temperature production methods to put photovoltaic cells onto flexible, lightweight plastics.

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## Capital Markets Monitor (cont'd)

*August 28.* A group of venture capitalists, led by Vancouver-based **Chrysalix Energy** and including **Wall Street Technology Partners** of New York and **Buerk Craig Victor** of Seattle, agreed to provide \$7.5 million to **AVLB Inc.**, the new private owner of **Avista Labs**. Avista Labs, founded in 1995, is a developer of a modular, cartridge-based PEM fuel cell technology. The new funding will be used to support Avista Labs' continuing development and commercialization of its fuel cell products. Former parent **Avista Corp.**, a Spokane-based electric utility, will own 19.9% of the new company, and has also committed to provide additional future funding of up to \$1.5 million under certain conditions.

*August 25.* **American Superconductor Corporation**, a provider of superconducting and power electronics solutions for the power infrastructure, announced that it plans to file a registration statement for a public follow-on offering of common shares. The planned offering replaces the company's previously announced secured debt financing plan to raise \$50 million in the form of a term loan, convertible subordinated notes and a working capital credit facility, which the company has decided not to pursue.

*August 13.* **Powerspan Corp.**, a clean energy technology company, announced the first closing of \$20 million in new financing from a group of investors including **The Beacon Group**, **FirstEnergy Corp.**, **Zero Stage Capital**, **NGEN Partners LLC**, **Aquilex Services Corp.**, and **Calvert World Values International Equity Fund**. The new funding will be used to complete commercial development of the Company's patented Electro-Catalytic Oxidation (ECO) technology, multi-pollutant control technology for existing and new coal-fired power plants. The ECO process reduces air pollution and produces a commercial fertilizer co-product that avoids landfill disposal of waste. Powerspan is now constructing a 50MW ECO commercial demonstration system at a FirstEnergy's plant in Ohio. In addition to Powerspan, FirstEnergy and the **Ohio Coal Development Office** are providing funding for the project.

*August 8.* **Advent Solar** announced the completion of a seed round of funding from its founders and Seattle-based angel investment fund, **Angels with Attitude**; and that James Gee, a former renewable energy scientist at **Sandia National Laboratories**, has joined Advent as the company's Chief Technology Officer. Advent's initial products will be based on the proprietary emitter-wrap-through (EWT) solar cell design patented by Gee, for which Advent has obtained an exclusive license from Sandia. Advent Solar believes EWT technology offers the potential for significantly lower cost and higher performance than conventional solar cells.

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## Capital Markets Monitor (cont'd)

*August 6.* **Origin Energy** of Australia will join to join **Woodside Petroleum** as an investor in **Geodynamics Ltd.** with a purchase of 10 million ordinary shares in Geodynamics at an issue price of \$0.50 per share. This will give Origin an interest of around 19% in Geodynamics. As part of the agreement, Origin has the right to appoint a non-executive director to the Board of Geodynamics, and the parties have agreed to negotiate a power purchase agreement (PPA) in which Origin Energy will have the right to purchase 50% of the power generated by Geodynamics from its geothermal projects, including Renewable Energy Certificates (REC's) and environmental credits, at a discount to the then market price.

*August 4.* **Artesyn Technologies, Inc.**, a provider of advanced power conversion systems for computing and communications equipment, announced it intends to offer \$75 million of convertible senior subordinated notes due 2010. The net proceeds from the offering will be used to repay Artesyn's existing subordinated convertible note in the principal amount of \$50 million and for working capital and general corporate purposes. Artesyn expects to grant the initial purchasers of this offering a 30-day option to purchase up to an additional \$22.5 million of the notes.

*August 4.* **Genscape Inc.**, a supplier of real-time power plant output and transmission information, announced that it has been acquired by an investor group led by **GFI Energy Ventures**. Founded in 1999 by former energy traders, Genscape is the originator of real-time power supply information to support decision-making for energy traders, power plant and line owners and operators, regulators, and other energy market participants. Genscape's customers include the majority of the top 50 US power generating, trading, and marketing companies as well as federal and state entities. The company's monitoring network currently contains real-time operating information on over 250 individual generating facilities and 20 strategic transmission lines.

Louisville-based **Chrysalis Ventures** led Genscape's first round of venture capital funding in November 2001, and was joined by **Prosperitas Investment Partners**, **Anchorage Angels** and **Vectren Enterprises**, an energy services company based in Evansville, Indiana.

## Capital Markets Monitor (cont'd)

Looking at both average and median returns for energy tech IPOs, certain of these stocks appear unlikely to trade above their deal price for a long, long time. On the other hand, valuations on a price/cash basis improved considerably over the past three months. The median price/cash ratio stood at 3.5 as of December 19, up from 3.1 in August and 2.0 in May.

### Energy Technology IPO Performance

Company	Ticker	Market Cap	Price / Cash	Price 19-Dec-03	Offering Price	Shares Issued	Gross Proceeds	% Change	Date of Pricing
<b>Initial Public Offerings</b>									
Beacon Power	BCON	47.3	3.5	1.10	6.00	9.2	55.2	-82%	16-Nov-00
Evergreen Solar	ESLR	18.5	0.8	1.59	14.00	3.0	42.0	-89%	1-Nov-00
Hydrogenics	HYGS	302.6	5.9	5.70	12.00	7.0	84.0	-53%	26-Oct-00
Proton Energy Systems	PRTN	88.9	0.8	2.83	17.00	8.1	136.9	-83%	28-Sep-00
02Micro International	OIIM	803.0	6.7	20.94	9.00	4.0	36.0	133%	22-Aug-00
Peco II	PIII	25.0	1.4	1.18	15.00	5.8	86.3	-92%	17-Aug-00
H Power	HPOW	44.6	1.0	4.14	16.00	7.0	112.0	-74%	8-Aug-00
Millennium Cell	MCEL	80.2	10.2	2.33	10.00	3.4	33.5	-77%	8-Aug-00
Active Power	ACPW	126.2	1.7	3.00	17.00	9.2	156.4	-82%	7-Aug-00
Advanced Power Technology	APTI	86.1	4.7	8.27	15.00	4.0	60.4	-45%	7-Aug-00
Capstone Turbine	CPST	123.0	1.0	1.48	16.00	10.5	167.3	-91%	28-Jun-00
Caminus	CAMZ	160.8	4.1	9.00	16.00	4.1	65.4	-44%	27-Jan-00
Plug Power	PLUG	392.7	6.0	6.44	15.00	10.5	156.8	-57%	28-Oct-99
<b>Avg. IPO Performance</b>			<b>3.7</b>					<b>-57%</b>	
<b>Median IPO Performance</b>			<b>3.5</b>					<b>-77%</b>	

Note: Caminus and H Power have both been acquired. The price shown for H Power is the stock's last trade; Caminus was taken over in an all-cash tender offer at \$9.00 per share.

# The (De-)Construction Site

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

**Overall Comment.** Power electronics and energy storage continued to see significant activity. Three power electronics acquisitions were announced, two of which occurred in Europe, and a strategic relationship was extended. Numerous strategic deals were struck in energy storage, the most significant of which was probably the MTI Micro Fuel Cells and Duracell agreement because of the legitimacy it confers on an emerging energy storage technology.

Distributed generation companies were also busy. Several solar power acquisitions and strategic agreements were announced, and FuelCell Energy bought part or all of two solid oxide fuel cell developers.

## STRATEGIC DEALS

*October 16.* **FuelCell Energy, Inc.**, a manufacturer of stationary fuel cell power plants, has entered into a Memorandum of Understanding with **Enbridge Inc.**, an energy transportation and distribution company, to develop a strategic distribution alliance agreement for its Direct FuelCell products in Canada. The alliance agreement is expected to include an initial term of three years, and incentive warrants issued to Enbridge which will vest based on order commitments for DFC power plants.

*September 30.* **SatCon Technology Corp.**, a producer of power electronics systems, announced that **General Atomics** has extended their strategic agreement to continue development of a DC power distribution system for the US Navy's next-generation "all-electric ship" program. The agreement now runs through March 2007 instead of March 2005. The DDX surface combat ship, based on an electric rather than mechanical propulsion system, represents a major reconfiguration of a basic Navy platform. After further testing, the Navy may include the modular power electronics system designed by SatCon and General Atomics in up to 48 DDX platforms over a number of years. Separately, SatCon is under contract to deliver a second set of the same basic system for installation on the RV Triton, a British research vessel, for at-sea testing.

*September 29.* **Konarka Technologies** has entered into an agreement with the **Easenergy** business unit of **Groupe Electricité de France (EDF)** to jointly develop and launch Konarka's polymer solar power products. Under the terms of their agreement, EDF will contribute expertise to accelerate the development and roll-out of Konarka's polymer PV products.

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## The (De-)Construction Site (cont'd)

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

*September 25.* **General Electric's** research division and **Energy Conversion Devices** (ECD) announced that they have been awarded a government grant to develop a low-cost, roll-to-roll process for the production of large-area organic electronic devices. The program goal is to create a cost-effective system for the mass production of products such as flexible electronic paper displays, portable TV screens the size of posters, embedded sensors, solar powered cells and high-efficiency lighting devices. GE will design and provide the organic electronic technology, while ECD will provide its roll-to-roll equipment-building expertise. The \$13 million cost of the four-year project will be shared among GE, ECD and a unit of the US Department of Commerce.

*September 22.* **Mechanical Technology** announced that its majority-owned **MTI Micro-Fuel Cells** unit has agreed to work with **Gillette's Duracell** battery products unit to develop and commercialize a low power direct methanol micro fuel cell power system and a compatible fuel refilling system. The companies will share and license intellectual property assets, and both parties will be able to earn royalties. As part of the agreement, Gillette made an initial investment of \$1 million in MTI MicroFuel common stock, and committed to investing a further \$4 million upon reaching certain milestones. Mechanical Technology will ensure funding for MTI MicroFuel during the first two years of the deal.

**Comment.** Of the three basic fuel cell applications – portable power, stationary power generation and automotive – we expect portable power will achieve commercialization first. The reason is simple—the competitive bar is set much lower. Fuel cells for portable applications are intended to supplement or replace batteries, and batteries are a less daunting target than the vast electric power grid or the highly engineered and cost-effective internal combustion engine. While we believe portable (and micro) fuel cells could be commercially available in 2-3 years, the widespread adoption of fuel cells for stationary power generation appears to be roughly 4-5 years out, and automotive fuel cells will not hit the road in volume for 15 years or more.

Fuel cells of all types must face the fuel infrastructure issue. In the case of fuel cells for portable applications, a company like Gillette / Duracell represents an ideal solution, and Duracell's relationship with MTI MicroFuel Cell can be seen as a win for micro and portable fuel cell developers of all descriptions. Makers of small batteries already have extremely broad distribution through the same channels that the makers of micro and portable fuel cells would want to use – consumer electronics retailers, convenience stores, toy stores, gas stations, and so on. The missionary work that Duracell does with MTI MicroFuel Cells to prepare these channels to act as a fuel refill distribution network for their own products should benefit the micro fuel cell industry more broadly.



## The (De-)Construction Site (cont'd)

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

### Energy Storage — Getting Energized by Strategic Relationships

*September 25.* **Electrovaya**, a manufacturer of lithium ion batteries, and **Exide Technologies**, a leading battery provider, have signed a non-binding Memorandum of Understanding (MOU) to jointly develop products and application solutions incorporating Electrovaya's lithium ion battery technology.

The two companies will explore and identify new market opportunities for Electrovaya's battery technology, initially in specific applications in telecom network power. Exide will determine market needs, define the product offerings, assist in product packaging and systems integration and market and distribute the products, while Electrovaya will determine technical and manufacturing feasibility, and develop and produce battery cells.

*September 24.* **Ener1, Inc.**, a developer of advanced lithium batteries and fuel cells, and its investor, **ITOCHU Corporation**, have formed a new company called **ENERSTRUCT**, and granted it exclusive rights to commercialize Ener1's and ITOCHU's high-rate lithium battery technologies in Japan. ITOCHU will own 51% of ENERSTRUCT, and Ener1 will own 49%.

ENERSTRUCT will use a specialized "Nano Structure" process to achieve electrode thickness and density that would not be possible with standard lithium ion coating techniques. The reported result is a significant increase in discharge rates and cycle life.

*September 22.* **Active Power**, a developer of flywheel-based power quality products, announced the signing of a distribution agreement with **Fuji Electric** in which Fuji will market and sell Active Power's DC energy storage products in Japan. An initial order for two units (250kW and 500kW) was received upon completion of the agreement.

**Comment.** The flurry of strategic activity among energy storage companies continues unabated. These three latest tie-ups reflect a common theme – a small company with a promising energy storage technology partners with an established enterprise to gain product development and distribution capabilities.

The reason for all this activity is simple. Stored energy has many uses and much value. However, energy storage is difficult and expensive. Conventional batteries deliver performance that is generally satisfactory at best and aggravating at worst (cell phone batteries being one of the biggest offenders), and their cost per unit of energy stored is dear. The strategic relationships detailed above reflect the growing recognition of the rewards available for building a better battery.

## The (De-)Construction Site (cont'd)

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

*September 9.* **Caterpillar** and **Eaton Corp.** announced a joint venture to provide integrated, high-reliability electric power systems. The new entity, **Intelligent Switchgear Organization LLC**, will be owned 51% by Eaton and 49% by Caterpillar. Product lines will include paralleling switchgear and automatic transfer switches used for emergency or prime power applications for a wide variety of facilities. The product line will carry the Cat brand. The joint venture will sell its products exclusively through the global Caterpillar dealer network.

*September 8.* **Landis+Gyr**, a meter manufacturer, and **Comverge, Inc.**, a provider of energy intelligence solutions, whose largest shareholder is **Data Systems & Software, Inc.**, announced that they have signed a five-year agreement to jointly market and develop commercial and industrial metering solutions. The companies will integrate Landis+Gyr's metering, two-way paging, and telephone technologies with various public network cellular communication technologies, along with the meter data acquisition and analysis capabilities of Comverge's PowerCAMP software. The companies will offer both external and under-the-glass solutions.

### Co-generation Co-operation

*August 19.* **Chapeau, Inc. dba BluePoint Energy** has entered into a \$35 million joint-venture agreement with **Calim Private Equity** to fund energy purchase agreements originated by BluePoint Energy. The partnership of **Calim-BluePoint I** will install, own and operate 100 BluePoint cogeneration systems on a first-right-of-refusal basis. Calim-BluePoint I has placed its initial purchase order for 10 BluePoint systems, yielding revenues of about \$2 million for BluePoint Energy. The agreement also allows for Calim-BluePoint I to convert its interests into common shares of Chapeau, Inc. at a rate of \$3.00 per share.

*August 7.* **Chapeau Inc. dba BluePoint Energy Inc.** has entered into an agreement with **Sempra Energy Solutions**, a subsidiary of **Sempra Energy Global Enterprises**, to jointly design, build, own and operate energy-conservation projects using BluePoint's cogeneration systems. The agreement covers the US market with initial efforts in the western states. Terms were not disclosed.

**Comment.** The deals struck by BluePoint Energy, a manufacturer of cogeneration systems, represents just the kind of activity we would expect in a high natural gas price environment. As we discussed on pages 8-9, cogeneration, or the combined production of heat and power (CHP), is extremely energy efficient. At a time when natural gas is dear and likely to remain so for some years to come, cogeneration offers energy users, and large commercial and industrial customers in particular, a way to reduce energy consumption and lower their energy bills.

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## The (De-)Construction Site (cont'd)

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

*August 14.* **Energy Intellect Ltd** (EIL) has entered into a ten-year service alliance agreement with **NGC** enabling NGC to offer EIL's energy information platform to energy retailers and large end-users in New Zealand and Australia. There are more than 6,000 advanced metering devices in New Zealand and Australia now linked to EIL's platform, and the arrangement with NGC could push that to over 10,000 within the next 12 months. NGC will also take a 25% equity stake in EIL and purchase EIL's energy data services business. The combination of these transactions will inject substantial new capital into EIL.

EIL's software enables utilities, energy service companies, and commercial and industrial end-users to manage complex energy supply, metering and consumption information along the entire value chain. The company also maintains an internationally certified advanced metering calibration facility, and designs and produces a host of electronic measurement and communications devices. NGC currently provides independent electricity metering services to 800,000 homes and businesses throughout New Zealand. NGC holds a 45 percent share of the mass-market metering installations and approximately 25% of the interval metering installations.

*August 5.* **Alternate Energy Corp.**, a producer of low-cost hydrogen gas, announced that it has signed a Letter of Intent with **Astris Energi**, a producer of alkaline fuel cells, for a proposed joint venture to produce hydrogen-powered stationary power systems for residential and commercial markets. AEC and Astris will enter into a final Joint Venture agreement after undergoing the completion of hydrogen quality and volume testing with the new AEC process.

*August 1.* The Commercial Power Division of **EaglePicher Technologies** has signed a long-term agreement with **NanoGram Devices Corp.** to develop and manufacture batteries based on NanoGram's patented nanomaterial technology. The initial application of the technology will be for batteries in implantable medical devices, with potential applications in other markets as well, including aerospace and defense. As part of the new venture, EaglePicher is establishing a dedicated manufacturing operation for medical batteries.

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## The (De-)Construction Site (cont'd)

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

### M&A ACTIVITY

*October 20.* **Doughty Hanson**, a UK-based buyout fund, agreed to acquire **SAFT**, a subsidiary of **Alcatel** specialized in batteries, for 390 million euros. The transaction requires the approval of several different authorities. For Alcatel, the agreement is an additional step in focusing on its core telecom equipment and services business. SAFT, a manufacturer of industrial and specialty batteries, employs about 4,000 people at 14 sites in eight countries. SAFT revenues in 2002 were 550 million euros.

*October 3.* **Xicor Inc.**, a supplier of high-performance, mixed-signal integrated circuits, has signed a definitive agreement to acquire **Poweready Inc.** The negotiated price of \$15 million is comprised of stock, cash and contingent consideration if certain performance milestones are met in 2004 through 2006. Poweready, a private company, designs and manufactures charging systems for SMBus battery management applications.

*September 26.* **Schneider Electric** announced that it has acquired **Ilevo** (Karlstad, Sweden), a former spin-off from **Ericsson**. Schneider placed Ilevo into a newly created entity, **Schneider Electric Powerline Communications**. Ilevo is developing the network hardware, modems and other equipment necessary for broadband communication over power lines.

*September 23.* **Alliance Data Systems Corp.**, a provider of transaction, marketing and credit services, announced that it has acquired **Conservation Billing Services, Inc.** (CBSI), a large Florida-based submetering service provider, for about \$15 million. The acquisition enables Alliance Data to offer submetering services that include automated meter reading, billing and collecting for clients that manage multi-tenant commercial properties, providing large utility customers a means of monitoring and tracking usage by individual unit for more accurate billing. Alliance Data currently has more than 20 utility clients, and recently announced that it is providing outsourced solutions to municipal utilities.

*September 18.* **Eltek ASA** (Drammen, Norway) agreed to acquire the **Voigt and Haeffner** telecom power system subsidiary of the **Röchling Group** (Frankfurt, Germany). With the acquisition of Voigt and Haeffner, Eltek becomes one of the largest telecom power suppliers in Germany. Eltek will acquire 100% of the shares in Voigt and Haeffner from Röchling for a total price of 3.5 million euros.

## The (De-)Construction Site (cont'd)

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

*September 17.* **Universal Communication Systems, Inc.** entered into a Letter Of Intent to acquire an initial 51% ownership position in **GiraSOLAR BV**, a Dutch solar power systems producer and integrator. GiraSOLAR holds interests in several Dutch solar power companies, which together are expected to have combined revenue of approximately \$14.5 million and profits of \$850,000 in the current financial year.

### Solid Oxide Fuel Cell Technology Solidifies Its Position

*August 7.* **ECN**, the Dutch energy research centre, announced its intent to sell its portfolio of patents relating to molten carbonate fuel cells. ECN first started work on molten carbonate technology in 1986, and since then, has also become involved in work on solid oxide and proton exchange membrane fuel cells as well as the processing of fuels to produce hydrogen.

The specific patents on offer have allowed ECN to build molten carbonate systems with good performance and low degradation for over 5,000 hours of operation. ECN believes those systems are capable of tripling that 5,000-hour operation figure. ECN will continue its work on solid oxide and proton exchange membrane fuel cell technology.

*August 4.* **FuelCell Energy**, a molten carbonate fuel cell developer, announced the signing of a definitive agreement to acquire **Global Thermoelectric (Global)**, a developer of solid oxide fuel cell (SOFC) technology, in an all-stock transaction valued at about US\$80 million (CDN\$112 million). Following the close of the transaction, Global shareholders will own 17% - 20% of the combined entity. The transaction is expected to close in the fourth quarter of 2003. As a result of the proposed combination with FuelCell, Global has paid a US\$2 million break-up fee to terminate its Combination Agreement dated as of April 8, 2003 with **Quantum Fuel System Technologies Worldwide**.

*August 4.* **FuelCell Energy**, a molten carbonate fuel cell developer, has invested \$2 million for 15.8% of **Versa Power Systems**. Founded in 2001, Versa is developing planar low-temperature solid oxide fuel cells. Versa is a joint venture of the **Gas Technology Institute, Electric Power Research Institute, Materials and Systems Research, the University of Utah** and FuelCell Energy.

The investment strengthens FuelCell Energy's ability to influence the solid oxide fuel cell technology developed for the DOE's Solid State Energy Conversion Alliance (SECA) program. FuelCell Energy is placing Versa at the head of its SECA subcontractor team's development efforts.

**Comment.** In these three news items, one molten carbonate fuel cell developer is investing or acquiring outright two companies working on solid oxide fuel cell systems, and a second fuel cell technology developer is abandoning its molten carbonate program altogether in order to focus on solid oxide and proton exchange membrane fuel cell systems. It is possible that these events are unrelated and indicative of nothing in particular. It also leads us to speculate about what they might imply for the future of molten carbonate versus solid oxide as viable high-temperature fuel cell technologies.

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## The (De-)Construction Site (cont'd)

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

Neither fuel cell type is economic as of yet, and both face technical barriers that must be cleared to win commercial acceptance. In the case of solid oxide, perhaps the key issue is the development of durable seals. As a solid oxide fuel cell heats up from ambient conditions to operating temperatures as high as 1,000° Celsius, the various materials used to construct the fuel cell stack tend to expand at different rates (i.e., they have different thermal coefficients), and maintaining a seal around the stack as they do so is a significant (but probably not insuperable) challenge.

As for molten carbonate, stack sealing is also an issue, but the bigger problem is the tendency of the fuel cell to basically dissolve itself. At the core of the fuel cell stack is a hot, corrosive liquid—the molten carbonate that gives the fuel cell its name—and this unfriendly substance has a way of leaking into other parts of the system, eating them away and potentially causing catastrophic failure.

Another trend with possible implications for molten carbonate and solid oxide is new fuel cell company formation. There have been precious few molten carbonate startups launched in recent years. Meanwhile, the ranks of solid oxide technology developers continue to grow, with new fuel cell entrants including **CellTech**, **Ion America** and of course **Versa Power**, while companies such as **Air Products**, **Ceramatec** and **H2Onsite** are working on hydrogen generators using similar core solid oxide technology. The result—bets on solid oxide as the leading high-temperature fuel cell architecture continue to mount, while molten carbonate players are standing pat or even folding.

*August 25.* Following its August 22 announcement of the signing of a definitive agreement to acquire 100% of **Millennium Electric T.O.U. Inc.**, **Universal Communication Systems Inc.** announced the formation of a new corporate subsidiary called “Solar One Corporation.” The move is part of Universal’s strategy of forming operating divisions, each concentrating on a particular aspect of the solar power industry. Solar One will concentrate on offering and marketing solar-powered consumer products in North America. The Solar One product line is projected to produce revenues of \$7.5 million in year one, \$16.5 million in year two, and \$37.5 million in year three.

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## The (De-)Construction Site (cont'd)

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

### RESTRUCTURINGS

*August 26.* **Japan Metals and Chemicals USA** (JMC), a metal and materials company, announced plans to sell its plant in North Carolina, which was initially set up in 1997 to supply metal-hydride in powder form to a locally based, secondary battery manufacturer, which has since closed. JMC is selling the building complete with equipment capable of producing up to 1,000 metric tons annually of metal-hydride powder, which is used to store hydrogen for fuel cells, particularly in the portable and automotive sectors. JMC is continuing to manufacture the metal-hydride materials in Japan and research new potential metal-hydride mixtures for the reversible storage of hydrogen to enable the introduction of fuel cell technology.

*August 18.* **Magnetek** announced that it has sold its Greenville, Ohio-based telecom services business to its locally based management team. While terms of the transaction were not announced, the impact of the divestiture on Magnetek's balance sheet will be negligible. Magnetek manufactures digital power supplies and systems used in many industrial, commercial and consumer applications requiring highly reliable, precise, energy-efficient power.



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## The (De-)Construction Site (cont'd)

Strategic Deals, M&A, Restructurings, Bankruptcies and the Birth & Death of Companies

### NEW COMPANIES

*September 23.* **Sun River Mining** announced that it will change its name to **XsunX, Inc.** and has acquired the patents for a technology to apply a transparent and photovoltaic glazing to glass. When XsunX glazing is exposed to light, the light energy is converted into electrical energy for use as a power source. The company will issue 70,000,000 shares of common stock (on a post reverse split-1 for 20-basis) in exchange for the solar electric glass patents held by **Xoptix, Inc.**, a private technology development company.

*September 22.* After trying and failing for three years to raise capital to exploit its flywheel energy storage intellectual property, **Indigo Energy** agreed to sell that intellectual property to **Cobalt Energy LLC** for the assumption of about \$100,000 of debt plus a royalty agreement. The board of Indigo Energy determined that the opportunity to eliminate the company's indebtedness and to possibly participate in future revenues derived from the exploitation of the company's intellectual property was adequate consideration for the sale of the intellectual property to Cobalt Energy.

A few days prior, the company announced that it had changed its name from Indigo Energy. to **Global Wireless Satellite Networks (USA) Inc.**, in connection with its proposed entry into the satellite telecommunications industry. The company has identified an opportunity to acquire Global Wireless Satellite Networks Inc. (Global), a satellite-based telecom service provider targeting isolated communities in the far northern regions of Canada. No agreement to acquire Global has yet been negotiated or completed.

### BANKRUPTCIES

*October 1.* **Advanced Vehicle Systems Inc.** (Chattanooga, TN) announced that it is closing its doors after 11 years. AVS filed for bankruptcy protection in April, but the costs to maintain the company became too great. AVS had contracted with **CARTA**, Chattanooga's bus system, to provide 11 hybrid buses, but had only delivered six.

# The DataWerks

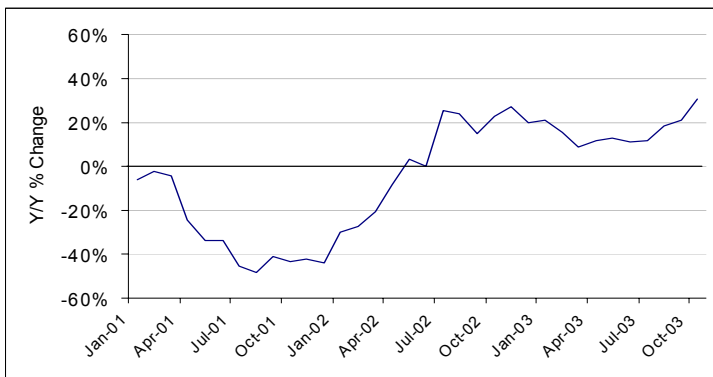
## A Statistical Look at Energy Tech Industry Trends

### Semiconductor Shipments

(Semiconductor Industry Association unadjusted monthly data)

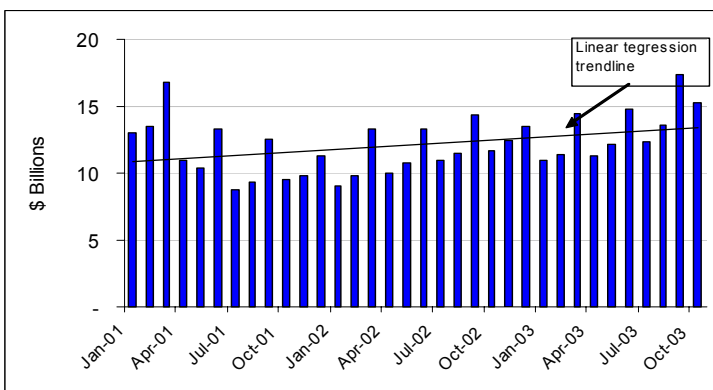
Another broad measure of technology industry health. Given that virtually every information processor—logic chip, DRAM, DSP, integrated circuit (IC), etc.—requires a power conversion device—a power semiconductor, embedded power supply, rectifier, and so on, and possibly power quality protection as well—semiconductor shipments also reflect demand for a range of power technologies.

Monthly Shipments—Y/Y % Change, Jan 2001 - Oct 2003



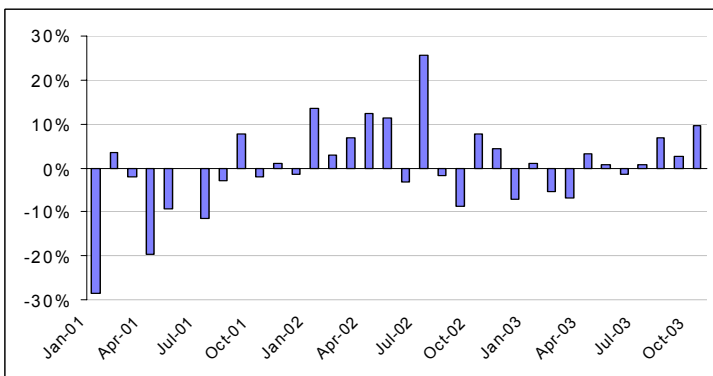
Year-over-year growth in semiconductor shipments began in July 2002. After a modest performance in the first half of 2003, shipments began to accelerate in August, corresponding with the broader economic improvement driven by recent federal tax cuts.

Shipments—3-month moving average, Jan 2001 - Oct 2003



The semi industry often looks at data on monthly shipment values by using a 3-month moving average to smooth out the characteristic spike in shipments in the third month of the quarter. The data shown here, fitted with a linear regression line to establish a rough trend, also suggests a surge in activity during the last few months.

Shipments—Change in Y/Y % Growth, Jan 2001 - Oct 2003



This graph, showing the change in the rate of semi shipment change, is a simple momentum indicator — is the rate of growth or decline accelerating or decelerating? As we see from this graph, semi shipment momentum improved in late 2001-early 2002, flattened in late 2002-early 2003, and turned back up in recent months.

# The DataWerks (cont'd)

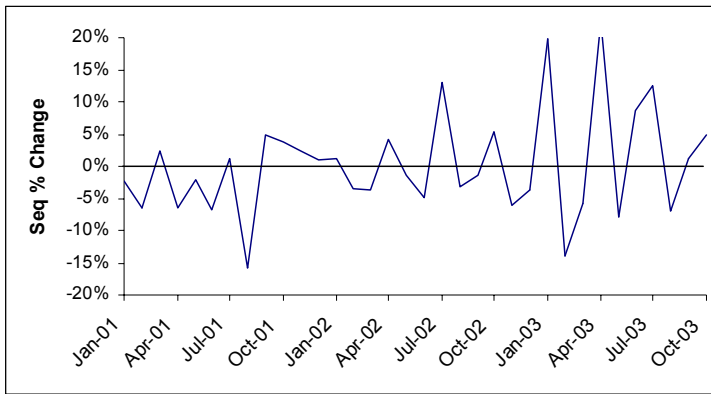
## A Statistical Look at Energy Tech Industry Trends

### Computers, Storage Devices & Peripherals

(US Census Bureau, seasonally adjusted monthly data)

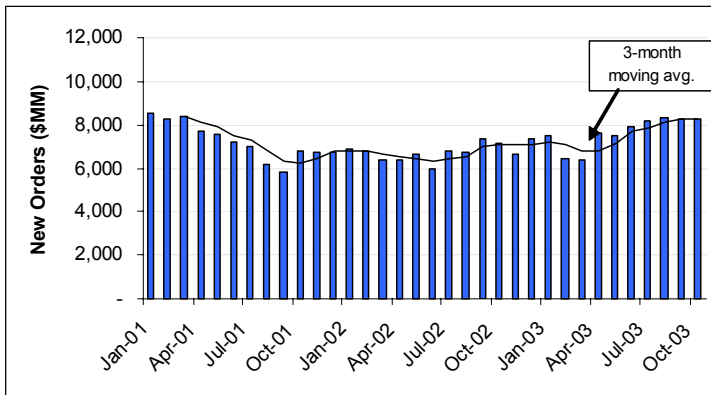
Computer, server, storage device and peripherals sales create pull-through demand for certain types of power conversion systems, such as ac/dc power supplies, voltage regulation modules, point-of-load converters and uninterruptible power supplies.

Monthly Shipments—Sequential % Change, Jan 2001 - Oct 2003



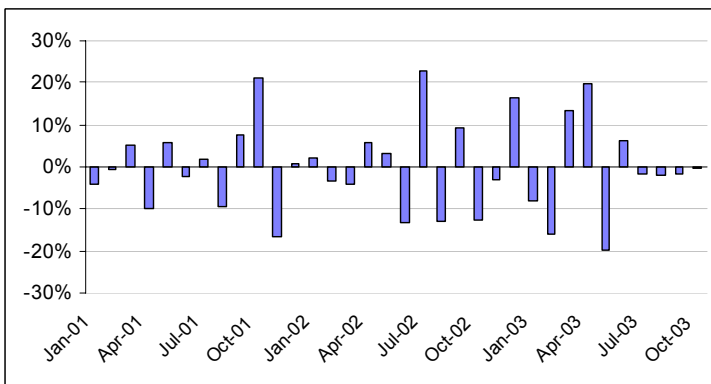
This first graph, showing the sequential change in shipments of computers and related devices, shows considerable volatility in recent months. The underlying trend has been modestly positive, with the swings in growth remaining wider than the swings back down.

Monthly New Orders, Jan 2001 - Oct 2003



In April-June 2003, order activity broke out of a long stretch of weakness. June orders finally topped the level set in April 2001, the point at which the real breakdown of computer-related spending began. In the last few months, orders have stabilized rather than continued to grow.

New Orders—Change in Seq. % Growth, Jan 2001 - Oct 2003



This graph, showing the change in the rate of monthly orders change, is a simple momentum indicator. The positive momentum of the first couple months of the year has faded, suggesting for now at least that further growth will be more steady-state than spectacular.

# The DataWerks (cont'd)

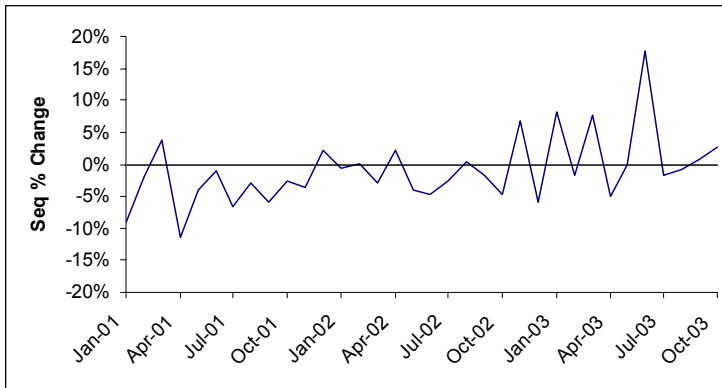
## A Statistical Look at Energy Tech Industry Trends

### Communications Equipment (non-defense)

(US Census Bureau, seasonally adjusted monthly data)

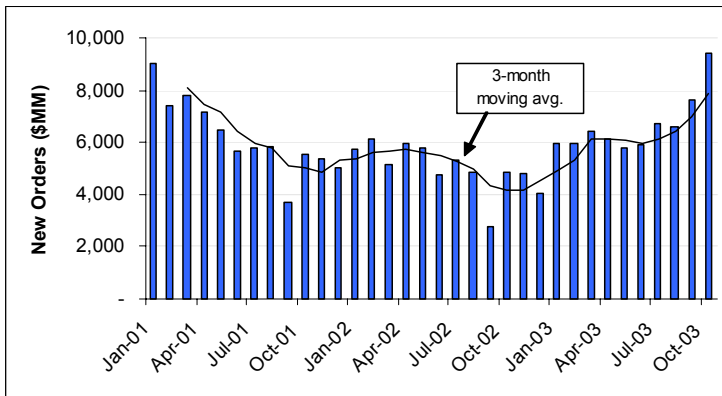
*Sales of communications hardware such as switches, routers, wireless base stations and repeaters, generate demand power conversion systems such as power semiconductors, ac/dc front ends, board-mounted dc/dc bricks, and dc power plants.*

Monthly Shipments—Sequential % Change, Jan 2001 - Oct 2003



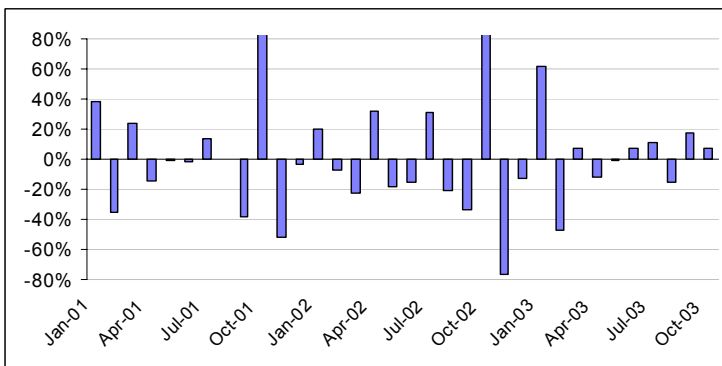
After nearly two years in which sequential changes in communications equipment shipments were overwhelmingly negative, early signs of life appeared in November 2002. Although shipment growth remains uneven, the overall trend has been biased toward the positive.

Monthly New Orders, Jan 2001 - Oct 2003



New order activity bounced off its lows in late 2002, then drifted sideways over the first half of this year. The huge spike in orders in September-October promises imminent growth in shipments. It remains to be seen whether the improvement in the order book will be temporary or enduring.

New Orders—Change in Seq. % Growth, Jan 2001 - Oct 2003



This graph, showing the change in the rate of monthly orders change, is a simple momentum indicator. The readings here show that order momentum has been generally positive since May, although the near-term peak may have passed.

# The DataWerks (cont'd)

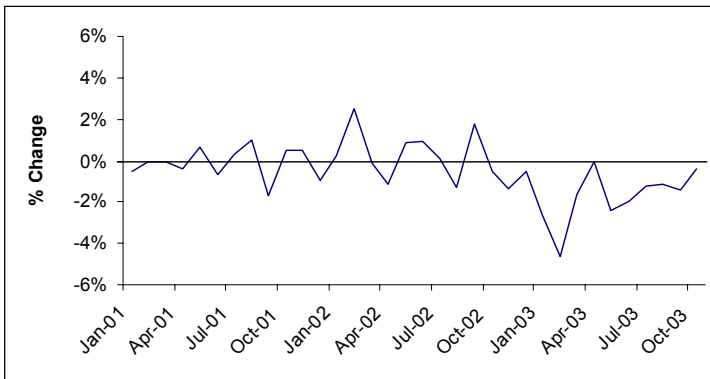
## A Statistical Look at Energy Tech Industry Trends

### Turbines, Generators & Other Power Transmission Equipment

(US Census Bureau: seasonally adjusted monthly data)

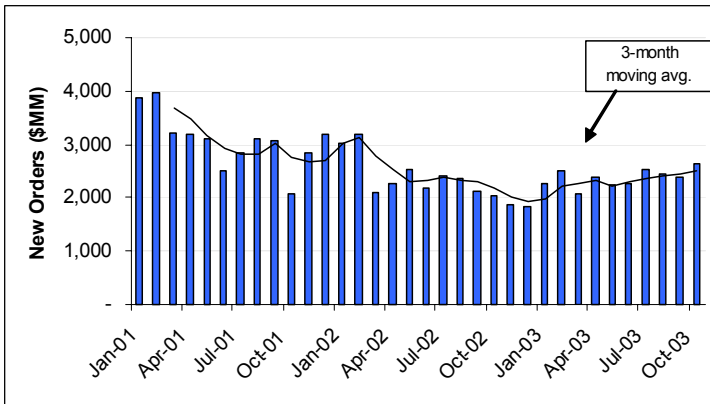
*A measure of utility industry investment in large capital equipment. Reflects the spending required to maintain the installed power infrastructure and build the new capacity needed to meet demand for electricity.*

Sequential Change, Rolling 12-Month Shipments, Jan 2001 - Oct 2003



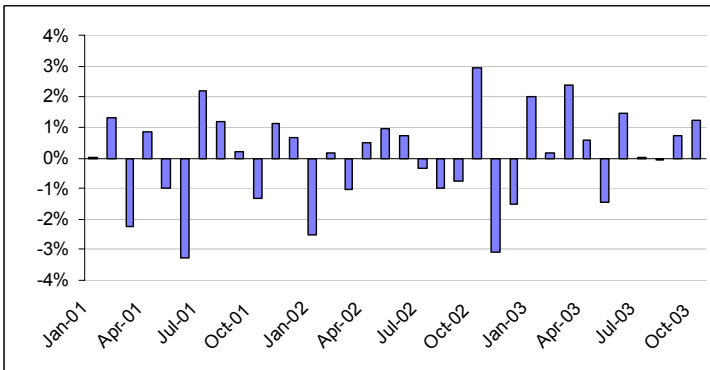
Sequential change in power generation and transmission equipment shipments went through a long sideways stretch for most of 2001-2002. The trend has been solidly negative for much of this year, although data from recent months suggests the worst may be over.

Monthly New Orders, Jan 2001 - Oct 2003



Since orders for power equipment are placed as long as 2-3 years before shipment is expected, new orders data is a key leading indicator of future shipment value. Order activity in 2002 was weak. However, the 3-month moving average shows that orders have recently been trending slightly higher.

Rolling 12-Mo. New Orders—Change in Seq. % Growth, Jan 2002 - Oct 2003



This graph, showing the change in the rate of rolling 12-month orders change, is a simple momentum indicator. The readings here show that order momentum has been generally positive since May.

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## VORTEX ENERGY LLC

*Banking on the Power of the Future*

The mission of Vortex Energy is to provide financial & strategic advisory services to the energy technology industry. We assist our clients, the companies that are changing the face of energy and power, with services that include crafting business plans, raising capital, finding strategic partners and facilitating mergers & acquisitions.

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