

# Power Currents

Monthly Coverage of the Energy Technology Industry

## In this issue:

<i>GridWatch</i>	2
<i>Energy Techline</i>	6
<i>TapeTalk</i>	9
<i>Capital Markets Monitor</i>	15
<i>The (De-)Construction Site</i>	16
<i>DataWerks</i>	23
<i>Inductance &amp; Reactance</i>	27

## “Is It 2003 Yet?”

2002 seemed as if it would never end. Those who thought that, after 2000 and 2001, things couldn't get any worse were proven badly wrong. Consider the following “fun facts” about 2002:

- For the first time since World War II, major equity indexes were down for a third year in a row.
- The average energy tech stock fell 46%, and of the 50 stocks in our industry index, only 4 traded up.
- Telecom capex and tech hardware budgets continued to decline, and may

not recover until 2004.

- Spark spreads collapsed under the weight of excess generation capacity and a sluggish economy, dragging credit ratings across the utility industry down toward junk status.

However, there are reasons to believe that the energy tech industry will find 2003 to be a kinder, gentler year. The US economy is expected to grow about 3%; IT hardware orders appear to have stabilized; as debt has come due, utilities and their lenders have generally reached agree-

ment on refinancing terms; and technology manufacturing facility closures and power plant project cancellations have cleared away at least some of the capacity overhang that would otherwise weigh on prices and margins.

Of course, war in the Middle East would mean all bets are off. But should the US face a disruption in its oil supply for whatever reason, then the world of energy technology suddenly becomes very interesting indeed....

## Publication Information

*Power Currents* is written, edited and published by James LoGerfo of Vortex Energy. Please address questions and comments to:

[jlogerfo@vortexenergy.com](mailto:jlogerfo@vortexenergy.com)

Please see p. 30 for important disclosures and notices.

## Introducing the Inaugural Issue

Welcome to the first issue of *Power Currents*, covering the energy technology industry from the utility grid to the microchip. To help you stay informed about developments in energy tech, our newsletter will include a number of regular features. *GridWatch* tracks macro-level issues concerning energy markets, the transmission

network and utility regulations. *Energy TechLine* reports news about specific companies, both public and private, while *TapeTalk* follows share price and earnings performance of public companies. *Capital Markets Monitor* details energy tech company securities issuance; *The (De-)Construction Site* provides intelligence on M&A activ-

ity, corporate partnerships and other strategic moves; and *DataWerks* offers statistics on technology and energy product markets. Lastly, *Inductance & Reactance* is an occasional column on subjects we hope you find interesting. This month's piece takes on the question, “Whatever Happened to High Nines Power?”

---

## GridWatch

### Energy and Power Industry Announcements and Developments

**Overall Comment.** A key theme of the last few months has been control over the transmission network. The federal regulators have worked mightily to push transmission deregulation forward in the face of stiff resistance from many states. The going has been slow. Meanwhile, a KKR-led buyout of certain regional transmission assets could be an early move in a trend of financial investors putting money into the grid.

*January 3, 2003.* Early estimates of power plant completions in 2002 suggest that new capacity coming online tracked well ahead of demand growth, with the predictable result that power prices last year were down significantly. Energy Argus reports that 54,019 megawatts of new power generation were added last year, representing about three-quarters of the capacity expected to reach completion. The wave of power plant cancellations announced in 2001 as power companies hit the financial wall came too late to have much impact on planned capacity adds in 2002; the bigger cuts in power plant construction plans should come this year and next. Generation capacity grew 7% in 2001, versus an increase in demand of about 2.8%.

*December 18, 2002.* The FERC took another step forward in its plan to create large and liquid regional power markets by granting Regional Transmission Organization (RTO) status to PJM Interconnection LLC, which operates transmission assets for seven mid-Atlantic states and the District of Columbia. This makes RTO number 2. The first RTO, the Indiana-based Midwest Independent Transmission System Operator, covering 15 states and part of Canada, has plans with PJM to form a common market for power by October 2004.

*December 18.* The FERC gave the final nod to **Bank of America** and **UBS** to begin trading in wholesale electric power markets. Both banks had already secured FERC's initial approval, and a FERC decision to allow them to hold public utility stocks as part of their brokerage and investment banking operations while trading wholesale power through separate business units removed their last obstacle.

**Comment.** Liquidity in wholesale power markets has fallen precipitously as a growing financial crisis has forced merchant energy traders to scale back operations or exit altogether. Bank of America and UBS could become important sources of liquidity at a time when the "natural" market participants – the producers, distributors and users of power- are constrained by weak balance sheets. In fact, it could be argued that banks and insurance companies, with assets running into the hundreds of billions of dollars, are better suited to be market makers and intermediaries than those companies generating and distributing the physical commodity.

*December 17.* New Mexico's Public Regulation Commission approved a final rule requiring the state's electric utilities offer a voluntary renewable energy tariff to their customers, raise consumer awareness of the green power option and the benefits of renewable energy, and generate 10% of their power from renewable resources by 2011. Not all renewables are treated equally under the new regime – 1 kilowatt (kW) of solar power counts as 1.5 kW toward a utility's quota, while 1 kW of geothermal or biomass is scored as is at 1 kW, and 1 kW of wind counts as only 0.5 kW toward the total. The cost of the necessary investments will be rolled into the rate base.

---

## GridWatch

### Energy and Power Industry Announcements and Developments

**Comment.** This rule is but the latest example of a long-standing trend: leadership in promoting alternative energy is coming from the states, not the federal government. The Bush administration's proposed energy policy, which has yet to make it through Congress, is heavily weighted towards oil, gas and coal.

*December 10.* A combination of drought in the Pacific Northwest and the return of El Niño could lead to significant power price volatility in 2003. A research report published by the Banc of America Securities Diversified Energy research team noted that the Northwest is seeing exceptionally low seasonal snowpack, which might mean insufficient hydro power in the peak summer season this year. Low-cost hydroelectric power is a critical source of supply for the entire West Coast. At the same time, the El Niño weather pattern, which typically entails wetter conditions in Southern California and drier weather in the Pacific Northwest, could exacerbate the drought conditions and limit the availability of hydro power further. The result could be the kind of wide power price swings that afflicted California in 2000-01.

*December 6.* Germany, the key holdout in the European Union to an agreement on CO<sub>2</sub> emissions trading, changed course and signaled its willingness to comply. As Europe's largest producer of greenhouse gases, its participation was crucial, and came with the rise of the Green party after the September elections and a concession from the EU. German industry won from European Commission negotiators the ability to form collective pools for emission trading rather than placing the burden on individual companies. In 2005 a law will specify the amount of CO<sub>2</sub> a plant can emit, and excess emissions must be offset by the purchase of pollution rights from other EU companies operating below their limits. The scheme is a cornerstone of the EU's effort to achieve the greenhouse gas reductions required under the Kyoto Protocol.

*December 3.* **Kohlberg Kravis Roberts & Co. (KKR)** and **Trimaran Capital Partners** signed a definitive agreement to buy **International Transmission Co. (ITC)**, the transmission subsidiary of **DTE Energy**, for about \$610 million in cash. ITC owns close to 3,000 miles of high-voltage transmission lines. As part of the purchase agreement, ITC will petition the FERC to cap the transmission rates charged to DTE's electric utility customers through the end of 2005, with rates subject to FERC adjustment thereafter.

**Comment.** For the past ten years or so, investment in transmission and distribution has lagged investment in generation by a wide margin, leading to utility network bottlenecks that cost billions of dollars of losses annually. There are at least two key reasons for the underinvestment in transmission. First, the current system provides little incentive to spend on improvements that create "merchant" transmission opportunities. Second and more importantly, years of uncertainty about the rules governing transmission asset ownership and allowable rates of return have discouraged utilities from making the long-term commitment that a transmission investment entails – they have had no way of knowing whether they would see a return or not. Recent moves by the FERC to liberalize and restructure the transmission network are beginning to change all that, and the world has taken note. Several DC-power merchant transmission projects have been announced, and transmission assets have changed hands in other

---

## GridWatch

### Energy and Power Industry Announcements and Developments

service territories. What is notable about the DTE transaction is the participation of KKR, a purely financial investor. KKR's involvement suggests that the rules of the transmission game have materially changed. Most crucially, the fact that KKR and Trimaran intend to put more money into the DTE assets they will soon own, and to purchase additional transmission assets as the opportunities arise, could be a sign that the transmission network's long capital drought is ending and the monsoon rains are on the way. If the utility industry does begin to aggressively expand and upgrade the grid, it will be of significant interest to see whether at least some of the money will be spent on next-generation technologies such as high-speed power electronics switches, superconducting power cables, improved command and control systems and advanced energy storage.

*November 26.* After a lengthy French rear-guard action, European Union ministers reached an agreement to create a continent-wide market for electricity and gas. Commercial and industrial customers will gain access to competitive utility markets on July 1, 2004, and residential customers will be able to choose their power and gas providers beginning July 1, 2007. A change in government in France back in June to a center-right party cleared the way to the accord. The liberalization agreement still requires European Parliament approval, but given the Parliament's vocal support for more open markets, passage seems probable.

*November 20.* **Stanford University** unveiled its Global Climate and Energy Project, a 10-year \$225 million effort funded by some of the world's largest energy and power-related companies to develop ways to produce, distribute, store and consume energy that dramatically reduce greenhouse gas emissions. To date, **ExxonMobil** has pledged up to \$100 million over the next decade, while **General Electric** and **E.ON** have committed up to \$50 million each, and **Schlumberger** has spoken for up to \$25 million. These companies will collaborate with leading scientists and engineers from around the world to work on technologies such as advanced transportation systems, low-emission and renewable energy sources, hydrogen production and distribution, power transmission and storage and advanced nuclear processes. Stanford will hold the legal title to all intellectual property and patents emerging from the Project, and intends to make them widely available to the scientific community.

**Comment.** The formation of this Project is a clear plus for the energy technology industry. The involvement of large and influential corporations deeply involved in the commodities and the products creating the greenhouse gas problem in the first place is significant – it suggests how far the awareness has spread that there is a pressing need to reduce the environmental impact of energy consumption as the world's population continues to grow. In addition, the location of this program at Stanford University, the “mother ship” of Silicon Valley, could be the catalyst that sparks the Sand Hill Road crowd to provide some of the capital to energy technology companies that they have been bestowing upon the communication, computing, software and life sciences industries.

---

## GridWatch

### Energy and Power Industry Announcements and Developments

*November 12.* A *Reuters* news article reported that wholesale electricity market trading volumes may be down by as much as 50% since the Enron meltdown and the ensuing revelations of energy market manipulation and financial collapse of high-profile energy and power companies. Trading activity has been based mostly on physical rather than financial transactions, and liquidity has become especially thin for longer-dated contracts. The principal cause is the industry-wide sharp decline in credit ratings, which forces energy and power market participants to put more capital behind their trading operations.

*November 11.* **Puget Sound Energy** announced the end of its high-profile residential time-of-use program in which homeowners paid higher utility rates during peak daytime hours, and lower off-peak rates at night. The program was successful to the extent that participants managed to cut peak-hour power usage by 5%-6%, but was deemed a failure overall because those same customers ended up paying an average of \$0.80 more each month than under the standard flat-rate plan.

**Comment.** The termination of the Puget Sound Energy program is not an indictment of the principal (or the practice) of time-of-use pricing. When power market volatility is high and peak power is dear, the economic gains available from reducing peak load can be substantial. In addition, since the power plants that utilities fire up to meet peak demand tend to be the least efficient and most polluting, shaving the peak provides environmental benefits as well. A key reason cited by Puget Sound Energy for the failure of its program was the low cost and ready availability of power during peak hours over the past year or so. Other utilities are soldiering on with their own time-of-use programs, and it still appears that a properly structured set of incentives and prices can be a win for both the utility and its customers.

*November 7.* Utility regulators in the Southeast region released a study finding that the Federal Energy Regulatory Commission's (FERC) plan to create regional transmission organizations (RTOs) may not generate sufficient benefits to offset the estimated \$2 billion cost. The most optimistic scenario in the study projected that benefits to the Southeast from 2004-13 would only equal about \$1.1 billion.

**Comment:** The battle between the FERC and the Southeast points to a core utility industry issue – deregulation has losers as well as winners. One of the FERC's goals in pushing for the formation of RTOs is to create larger and more liquid markets for power, helping to ensure that power can flow to those areas needing it most and willing to pay. All this is well and good for high-cost states, but in the Southeast, where power is cheap, utility commissioners are concerned that their constituents will have to pay for improvements to the transmission network so that their low-cost power can be exported to other regions. A quick solution appears unlikely.

---

## Energy Techline

### Company News Releases

*December 23.* **General Motors** disclosed to the *New York Times* that it plans to roll out hybrid-electric power trains as an option on five of its major models over the next four production years. Hybrid-electric vehicles (HEVs) combine a slimmed-down internal combustion engine with electric power, usually stored in batteries. Unlike electric vehicles, they do not need to be plugged into an outlet to recharge – the internal combustion engine plus energy captured from braking keep the batteries topped off. GM will offer several hybrid-electric vehicle (HEV) configurations, with the most advanced scheduled for launch in the fall of 2005 for the 2006 model Saturn Vue.

**Comment.** Of the US and Japanese auto manufacturers, GM has been the most reluctant to develop and market an HEV, having made a strategic bet on fuel cell-powered cars several years ago. GM had concluded that HEVs would be a brief and temporary bridge to cleaner and more efficient fuel cell vehicles, and focused its R&D efforts on fuel cells. Meanwhile, **Toyota** and **Honda** began work on HEVs several years ago and already have several HEV models in the market. Toyota has sold over 100,000 of its Prius model HEV worldwide, and reportedly cannot make them fast enough to keep up with demand. Most other major auto makers also have plans to introduce HEVs over the next couple years. For GM to reverse course and get to work on HEVs of its own appears to be a tacit acknowledgement that the HEV bridge from the internal combustion engine of today to the fuel cell-powered car of the future is a fair bit longer than earlier believed.

*December 6 / November 12.* **Intermagnetics General** and **Southwire** each announced agreements to develop high-temperature superconducting (HTS) power cables. In November, Intermagnetics outlined the terms of collaboration with **Sumitomo Electric Industries** to build and install a 350-meter long superconducting power cable in Albany, New York, using first-generation HTS material. This project will be the world's first in-grid installation of a three-phase HTS cable. Following installation, expected in 2005, Intermagnetics and Sumitomo will then replace a 30-meter section of the cable with another using second-generation HTS materials. In addition, Intermagnetics has won the first right to supply second-generation wire for Sumitomo's HTS activities in North America.

In December, Southwire and **nkt cables** of Denmark announced the formation of **ULTERA**, a joint venture company that will develop and commercialize HTS cable systems. ULTERA's first project will be to design and manufacture a 300-meter HTS cable to be installed in **American Electric Power's** distribution system in Columbus, Ohio. Privately-held Southwire is the largest wire and cable producer in North America, and nkt cables and its parent company **NKT Holding** are a leading cable producer and long-time participant in the development of HTS materials and power cable technology.

**Comment.** Demonstration projects such as these are critical to utility industry acceptance of high-temperature superconducting products such as power cables, transformers and fault-current controllers. Utilities, charged with keeping the power flowing, are understandably reluctant to adopt new technologies when the traditional solutions still work. At this point, there are HTS power cable demonstration projects up and running or on the way in the US, Europe and Japan. The accumulation of field time on HTS cables produced by Intermagnetics and Sumitomo, Southwire and nkt cables, and others should go a long way toward winning the confidence of the utility industry in the viability of HTS technology.

## Energy Techline

### Company News Releases

*December 3.* In a long-awaited move, **Coleman Powermate** announced the introduction of the AirGen portable fuel cell power generator, a \$5,995 product targeting the industrial market. The AirGen is based on a Nexa fuel cell unit from **Ballard Power**, a power electronics system from **SoftSwitching Technologies**, and Coleman Powermate's systems integration expertise. Fuel will be provided by Praxair high-pressure hydrogen cylinders. A version of the AirGen for commercial and residential markets using small metal hydride canisters is on the way.

*December 3.* **Honda** and **Toyota** announced that they are shipping fuel-cell vehicle test fleets to California; the *Wall Street Journal* notes that this is the first time these cars will be operated by regular drivers. Honda delivered one FCX model fuel cell vehicle to the city of Los Angeles, and will send four more in 2003. For each vehicle, Honda will charge the city \$500 per month for two years, or a total of \$24,000 per car. Meanwhile, Toyota provided one fuel-cell version of its Highlander SUV each to the University of California, Irvine and the University of California, Davis. The two institutions will receive four more vehicles this year, and will pay \$10,000 per month for 30 months for each car, or a total of \$300,000 per car. Private-sector donations will cover the cost.

#### Meanwhile, in the world of "Stars and their Cars..."

*December 28.* The fight to reduce greenhouse gases and free the US from dependence on foreign oil has reached Hollywood, reports *New York Daily News*. Celebrities driving hybrid-electric or electric vehicles (in alphabetical order, not order of appearance) include Ed Begley, Blythe Danner, Larry David, Cameron Diaz, Leonardo DiCaprio, David Duchovny, Anthony Hopkins, Billy Joel, Bill Maher, Rob Reiner, Meryl Streep and Veronica Webb. Leonardo DiCaprio was reportedly so happy with his own that he bought three more for his family.

*November 13 and September 17.* **Kyocera** announced in September that it will increase solar panel manufacturing capacity over 33% from 72MW today to 100MW in 2003. The company cited growing demand in the domestic Japanese market as well as in Europe and the US as the driver of the roughly \$20 – 30 million investment. Meanwhile, in November the **Sharp Electronics Corp.** announced plans to open a PV module production facility in Memphis, Tennessee to take advantage of the rapidly growing US solar power market. The US Department of Energy is projecting a five-fold increase in domestic solar power generating capacity this decade, from just under 50MW currently to 250MW in 2010. With about 150MW of capacity in place, Sharp is already the largest PV manufacturer in the world by a wide margin, and intends to extend its lead further. By March 2003 the company expects to reach 200MW of capacity.

---

## Energy Techline

### Company News Releases

**Comment.** These Japanese PV producers no longer view their solar power efforts as pleasant diversions from their core mission with high public-relations value but no meaningful financial impact. They are treating solar power as a significant growth opportunity and signaling the seriousness of their commitment with substantial long-term capital investments. Also notable is Sharp's decision to establish production in the US, the world's largest energy consumer but only a minor player in solar markets. The State of California, largely single-handedly, has been pulling solar power from the fringes of the US power industry closer toward the mainstream, and major solar power producers are taking notice.

*November 12 / October 29.* **American Superconductor** and **Intermagnetics General** each announced the achievement of key milestones in the development of second-generation high-temperature superconducting (HTS) wire. In October, American Superconductor announced it has achieved reproducible results in electrical performance over 10-meter lengths of second-generation HTS wire that are significantly ahead of the goals set by the Department of Energy (DOE). The DOE had set a December 2003 target of 50 amps of electrical current per centimeter of width of second generation HTS wire in 10-meter lengths. American Superconductor's wire tested out at over 100 amps per centimeter of width, double the DOE's benchmark, and was produced over a year ahead of the suggested timetable.

Meanwhile, in November the SuperPower division of Intermagnetics General announced that it had exceeded its calendar year 2002 goal of producing second generation HTS wire longer than 1 meter using a continuous reel-to-reel process with performance of 100 amp-meter. The company achieved three-meter lengths of 315 amp-meter wire. The company's calendar 2003 goal is to produce tape consistently in greater than 10-meter lengths with performance exceeding the 1000 amp-meter level.

**Comment.** It is clear that first-generation HTS conductor will not reach cost levels below those of copper wire, and that the cost breakthrough that will enable the widespread use of superconductors in power equipment will have to come through second-generation materials. The challenge with Gen-2 is developing high-yield low-cost methods to produce wire in lengths of one kilometer and up. The progress reported by American Superconductor and Intermagnetics is encouraging. The two companies are using different methods to manufacture Gen-2 wire, and at present it is probably too early to reach any conclusions about which might reach commercial viability first.

# TapeTalk

## Energy Tech Company Share Price and Earnings Performance

Clearly, 2002 was a difficult year for distributed generation stocks. The only DG stock that closed up last year was H-Power, and the reason it managed to put in a gain was the announcement of a takeover bid from Plug Power. Performance year to date has been mixed. Clean fuel & combustion tech stocks held up well last year, buoyed by Headwaters and Methanex, whose shares reflected the companies' solid fundamental results. The more speculative names in this segment have done well thus far this year, reversing the trend of 2002.

Intergraph was the big winner among energy IT stocks in 2002, due in part to a victory in a major IP lawsuit against Intel. The group's showing this year has been positive. As for energy storage stocks, last year was punishing. Most of the companies in this group remain development stage, and the market in 2002 was not generous toward the shares of companies without the near-term prospect of commercial product or earnings.

Company	Price	Mkt Cap	Share Price % Change			Price/Earnings		Price/	Price/	Price/
	10-Jan-03	(\$MM)	2003 YTD	Dec-02	2002	FY 02	FY 03	Book	Cash	LTM Sales
<b>Distributed Generation</b>										
AstroPower	7.40	161	-7.4%	-8.2%	-70.4%	37.0	21.1	1.0	4.8	1.9
Ballard Power	11.70	1,226	5.7%	-26.3%	-62.6%	n/a	n/a	1.7	3.8	16.4
Capstone Turbine	1.02	83	13.3%	-25.0%	-83.4%	n/a	n/a	0.4	0.6	3.2
Energy Conversion Devices	11.61	254	18.5%	-19.4%	-48.3%	n/a	n/a	1.9	1.8	3.0
Evergreen Solar	1.21	14	-6.2%	-9.2%	-62.1%	n/a	n/a	0.4	1.0	2.6
FuelCell Energy	6.50	255	-0.8%	-27.6%	-63.9%	n/a	n/a	0.9	1.2	6.2
H Power	4.00	43	4.4%	-23.4%	22.8%	n/a	n/a	0.7	0.8	13.9
Millennium Cell	2.40	70	0.4%	-7.0%	-54.2%	n/a	n/a	7.7	8.3	139.4
Plug Power	5.01	255	11.6%	-35.9%	-48.6%	n/a	n/a	2.4	3.4	23.4
Proton Energy Systems	2.87	96	-4.3%	-6.5%	-63.6%	n/a	n/a	0.6	0.6	17.1
<b>Average</b>			<b>3.5%</b>	<b>-18.9%</b>	<b>-53.4%</b>			<b>1.8</b>	<b>2.6</b>	<b>22.7</b>
<b>Clean Fuel &amp; Combustion Technology</b>										
Catalytica Energy Systems	2.88	51	4.3%	-1.8%	-39.6%	n/a	n/a	0.7	0.7	13.0
Fuel-Tech N.V.	4.90	96	16.9%	-10.1%	-30.7%	21.3	14.0	6.1	11.7	3.6
Headwaters	16.38	449	5.6%	-3.2%	35.3%	12.6	10.1	4.1	61.4	3.8
Methanex Corporation	8.99	1,120	7.3%	-4.8%	51.3%	n/a	n/a	1.2	3.9	1.2
Quantum Fuel Systems Tech	2.70	48	14.9%	-35.8%	-59.5%	n/a	n/a	1.2	4.6	2.3
Syntroleum Corporation	2.20	72	27.2%	-6.0%	-75.6%	n/a	n/a	10.0	3.1	6.7
<b>Average</b>			<b>12.7%</b>	<b>-10.3%</b>	<b>-19.8%</b>			<b>3.9</b>	<b>14.2</b>	<b>5.1</b>
<b>Energy Information Technology</b>										
Caminus Corporation	2.55	44	9.0%	4.9%	-89.8%	n/a	n/a	0.4	1.1	0.5
Intergraph	18.44	851	3.8%	-1.9%	29.3%	68.3	41.0	1.6	2.3	1.7
Itron	20.41	412	6.5%	-24.2%	-36.7%	18.6	16.5	2.6	10.7	1.5
<b>Average</b>			<b>6.4%</b>	<b>-7.1%</b>	<b>-32.4%</b>			<b>1.5</b>	<b>4.7</b>	<b>1.2</b>
<b>Energy Storage</b>										
Active Power	1.78	74	0.0%	-12.7%	-73.8%	n/a	n/a	0.6	0.8	5.0
Beacon Power	0.25	11	19.0%	-36.4%	-83.8%	n/a	n/a	0.5	0.5	n/a
C&D Technologies	19.27	495	9.1%	-9.2%	-22.7%	26.4	20.3	2.0	59.0	1.4
Electric Fuel Corporation	0.53	18	-17.2%	-19.0%	-61.4%	n/a	n/a	1.5	5.1	3.4
Medis Technologies	5.06	107	1.2%	-4.4%	-32.0%	n/a	n/a	1.6	13.5	693.5
Ultralife Batteries	3.50	44	-5.4%	35.0%	-17.6%	n/a	n/a	2.4	49.2	1.4
Valence Technology	1.70	104	30.8%	-20.2%	-61.4%	n/a	n/a	(6.3)	17.9	45.2
<b>Average</b>			<b>5.4%</b>	<b>-9.6%</b>	<b>-50.4%</b>			<b>0.3</b>	<b>20.9</b>	<b>125.0</b>

Note: Data presented in TapeTalk are sourced from I/B/E/S, Market Guide and Vortex Energy LLC estimates

# TapeTalk

## Energy Tech Company Share Price and Earnings Performance

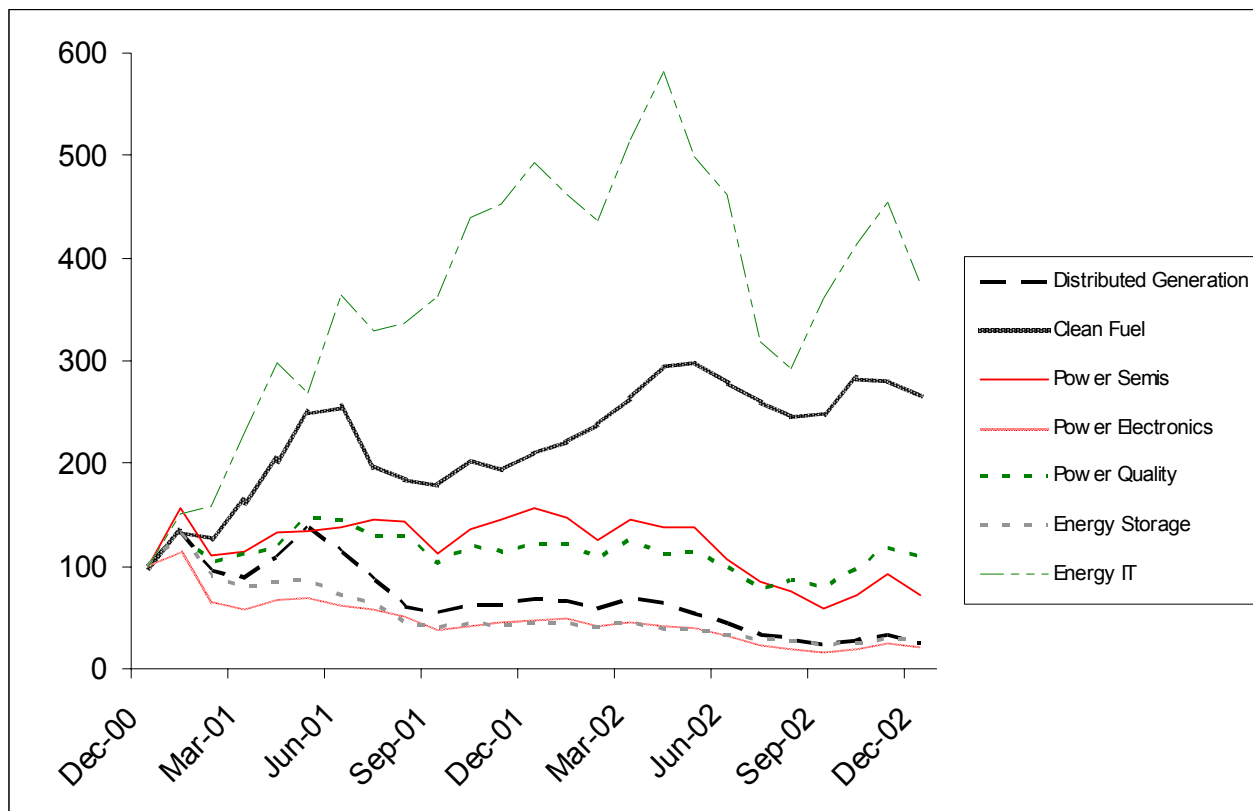
Weak demand for technology hardware of virtually any description weighed on shares of power semiconductor and power electronics companies—both of these groups underperformed the broader energy tech industry in 2002. Trading action thus far this year has been positive, with power semiconductor stocks showing particular strength. Lastly, companies developing or power quality systems could be divided into two categories—those with positive cash flow and earnings (American Power Conversion and Intermagnetics) and those that without (American Superconductor)—with the former group outperforming the latter by a wide margin.

Company	Price 10-Jan-03	Mkt Cap (\$MM)	Share Price % Change			Price/Earnings		Price/ Book	Price/ Cash	Price/ LTM Sales
			2003 YTD	Dec-02	2002	FY 02	FY 03			
<b>Power Semiconductors</b>										
Advanced Power Technology	4.28	45	32.1%	-29.6%	-72.1%	n/a	n/a	0.6	2.5	1.2
AVX Corporation	10.44	1,818	6.5%	-23.7%	-58.5%	522.0	52.2	1.2	2.5	1.6
Fairchild Semiconductor	11.70	1,368	9.2%	-30.0%	-62.0%	55.7	26.0	1.1	2.2	1.0
International Rectifier	22.37	1,428	21.2%	-26.0%	-47.1%	32.4	18.5	1.3	2.1	1.9
IXYS	7.11	227	0.7%	-1.5%	-12.7%	n/a	25.4	1.5	5.8	2.3
Kemet	9.03	778	3.3%	-29.0%	-50.8%	n/a	150.5	0.9	3.3	1.6
Maxwell Technologies	6.78	93	12.1%	-18.6%	-38.3%	n/a	33.9	1.8	11.2	1.6
Microsemi	7.77	225	27.6%	-4.1%	-79.5%	64.8	23.5	1.3	9.7	1.1
O2Micro International	11.50	438	18.1%	-26.2%	-59.5%	39.7	28.0	3.3	3.9	6.5
ON Semiconductor	1.84	324	34.3%	-37.4%	-33.8%	n/a	n/a	(0.5)	1.2	0.3
Power Integrations	18.95	540	11.5%	-16.9%	-25.6%	65.3	37.2	4.0	5.2	5.3
Semtech	12.78	934	16.8%	-27.5%	-69.3%	27.2	25.1	2.7	1.9	4.8
Siliconix	25.77	770	10.1%	-21.1%	-14.7%	n/a	n/a	2.1	3.9	2.2
<b>Average</b>			<b>15.7%</b>	<b>-22.4%</b>	<b>-48.0%</b>			<b>1.7</b>	<b>4.3</b>	<b>2.4</b>
<b>Power Electronics</b>										
Artesyn Technologies	3.81	146	-0.8%	-6.6%	-58.8%	n/a	n/a	0.9	1.6	0.4
Magnetek	5.10	120	14.9%	-23.6%	-50.7%	n/a	26.8	0.8	42.9	0.7
PECO II	0.74	16	15.6%	-32.6%	-89.3%	n/a	n/a	0.2	0.6	0.2
Power-One	6.17	493	8.8%	-28.2%	-45.5%	n/a	n/a	1.9	4.7	2.3
Powerwave Technologies	5.46	359	1.1%	-17.9%	-68.8%	54.6	78.0	1.1	2.3	0.9
SatCon Technology	1.32	22	-5.7%	-20.0%	-73.1%	n/a	n/a	0.7	7.7	0.5
UQM Technologies	2.80	53	10.7%	-12.8%	-53.4%	n/a	n/a	5.1	25.1	2.8
Vicor	8.41	356	1.9%	-1.0%	-49.1%	n/a	n/a	1.4	3.6	2.4
<b>Average</b>			<b>5.8%</b>	<b>-17.8%</b>	<b>-61.1%</b>			<b>1.5</b>	<b>11.1</b>	<b>1.3</b>
<b>Power Quality</b>										
American Power Conversion	15.23	2,987	0.5%	-5.9%	4.8%	22.7	20.3	2.3	4.7	2.3
American Superconductor	3.26	69	8.3%	-16.4%	-75.4%	n/a	n/a	0.4	2.0	4.9
Intermagnetics General	19.20	317	-2.2%	-9.5%	-24.2%	20.4	17.3	2.1	4.2	2.2
<b>Average</b>			<b>2.2%</b>	<b>-10.6%</b>	<b>-31.6%</b>			<b>1.6</b>	<b>3.6</b>	<b>3.1</b>

# TapeTalk

## Energy Tech Company Share Price and Earnings Performance

The graph below showing the share price performance of the various energy technology industry segments since the beginning of 2001 highlights the importance of stock selection. Energy IT and clean fuel & combustion technology shares outperformed by a wide margin, with a principal driver being the solid revenue and earnings growth posted by certain of the names in these groups, including Headwaters, Itron and Methanex.



# TapeTalk

## Energy Tech Company Share Price and Earnings Performance

Turning to technical stock indicators, several points stand out. Taken together, the signals seem neutral overall. First, insider trading activity over the last six months has been clearly positive, but concentrated at a few companies. Second, short insight in December declined slightly from November. And third, while 13-week relative strength (versus the S&P 500) has been fairly positive, it turned marginally negative in the past four weeks, basically in line with the direction of the broader market.

Company	Insider Trading		Short Interest - Dec		Short Interest - Nov		Average Volume		Beta	Relative Strength	
	Buys	Sells	Shares	% of Float	Shares	% of Float	Daily	Monthly		4-week	13-week
<b>Distributed Generation</b>											
AstroPower	6	-	5,236	29.6%	5,419	30.6%	116	5,043	2.2	-7	-1
Ballard Power	-	-	11,456	11.2%	11,770	11.5%	519	16,087	1.9	-6	27
Capstone Turbine	13	-	1,329	2.7%	953	2.0%	341	9,948	4.0	-3	31
Energy Conversion Devices	-	-	555	3.9%	575	4.1%	46	835	1.1	9	23
Evergreen Solar	-	-	116	1.4%	114	1.4%	19	718	2.7	-10	118
FuelCell Energy	-	-	3,102	9.3%	3,099	9.3%	208	7,176	1.6	-8	10
H Power	-	152	155	1.8%	-	0.0%	23	993	2.3	-11	29
Millennium Cell	-	356	977	4.8%	1,050	5.2%	86	2,356	1.3	-4	9
Plug Power	-	444	3,000	17.3%	3,011	17.4%	151	3,487	2.0	-13	7
Proton Energy Systems	2	-	378	3.3%	476	4.2%	41	1,242	3.4	-6	22
<b>Clean Fuel &amp; Combustion Technology</b>											
Catalytica Energy Systems	260	1	81	0.5%	89	0.5%	20	444	-0.7	5	-16
Fuel-Tech N.V.	-	-	180	1.2%	163	1.1%	38	619	-0.1	8	29
Headwaters	1	-	396	1.5%	821	3.2%	237	7,133	0.6	13	-2
Methanex Corporation	-	-	158	0.1%	93	0.1%	270	4,911	0.2	-3	7
Quantum Fuel Systems Tech	-	70	1,141	8.1%	1,290	9.2%	77	1,632	0.0	7	62
Syntroleum Corporation	482	14	43	0.2%	64	0.3%	99	2,495	0.3	40	30
<b>Power Semiconductors</b>											
Advanced Power Technology	18	-	91	1.5%	74	1.3%	34	1,280	2.8	17	26
AVX Corporation	-	-	748	1.4%	1,064	2.0%	338	6,848	1.6	-5	4
Fairchild Semiconductor	-	136	2,552	3.2%	3,298	4.1%	1,123	35,186	2.2	-4	30
International Rectifier	-	-	3,488	6.0%	3,708	6.4%	687	20,788	2.7	11	41
IXYS	2	-	396	2.2%	408	2.2%	31	663	2.3	-3	49
Kemet	-	28	3,239	3.8%	3,718	4.4%	394	13,140	1.5	-4	18
Maxwell Technologies	-	315	908	7.2%	945	7.5%	29	318	1.3	-4	5
Microsemi	4	-	1,512	5.6%	1,767	6.5%	278	7,224	1.9	17	19
O2Micro International	-	-	2,290	10.0%	2,316	10.1%	323	8,356	3.5	0	52
ON Semiconductor	51	20	90	0.1%	71	0.1%	142	2,794	3.2	-2	26
Power Integrations	6	60	2,048	7.3%	2,550	9.1%	412	10,539	1.8	-2	46
Semtech	3	-	5,207	7.5%	4,503	6.4%	1,138	40,506	1.6	7	4
Siliconix	-	-	38	0.7%	33	0.6%	12	481	1.5	2	19
<b>Power Electronics</b>											
Artesyn Technologies	41	5	70	0.2%	88	0.3%	157	3,777	2.5	21	145
Magnetek	168	-	213	0.9%	200	0.9%	73	1,126	1.1	-7	23
PECO II	-	-	23	0.2%	20	0.1%	37	1,422	0.9	-5	-39
Power-One	1,438	11	2,736	4.4%	2,312	3.7%	609	16,489	3.3	2	66
Powerwave Technologies	-	-	888	1.4%	787	1.2%	886	20,003	2.6	-1	54
SatCon Technology	-	-	169	1.5%	120	1.0%	90	1,506	1.2	-19	2
UQM Technologies	-	54	4	0.0%	4	0.0%	24	456	0.9	-9	-16
Vicor	-	10	180	0.9%	150	0.8%	40	1,738	1.8	-8	24
<b>Power Quality</b>											
American Power Conversion	-	-	2,038	1.2%	2,504	1.5%	1,908	40,233	1.8	-7	40
American Superconductor	-	-	1,342	6.5%	1,370	6.6%	93	2,051	2.1	-16	5
Intermagetics General	141	23	523	3.3%	609	3.8%	101	1,962	1.0	-10	1
<b>Energy Storage</b>											
Active Power	156	-	1,887	5.4%	1,895	5.4%	95	2,556	3.4	-11	-18
Beacon Power	-	-	7	0.0%	6	0.0%	69	2,089	2.1	-1	49
C&D Technologies	4	-	543	2.2%	615	2.5%	99	2,188	1.7	4	28
Electric Fuel Corporation	-	-	633	2.5%	654	2.6%	192	3,422	1.3	-33	-54
Medis Technologies	-	-	663	7.5%	579	6.6%	13	474	1.8	0	-5
Ultralife Batteries	61	33	217	2.2%	225	2.3%	10	870	0.4	11	40
Valence Technology	9,084	-	3,459	9.0%	3,619	9.4%	233	6,251	2.4	-18	128
<b>Energy Information Technology</b>											
Caminus Corporation	61	-	341	2.8%	369	3.0%	106	1,627	2.0	-8	22
Intergraph	1	39	381	0.9%	378	0.9%	217	8,016	0.7	5	-11
Itron	18	123	927	4.7%	1,028	5.2%	121	5,017	0.3	-18	9
<b>Total</b>	<b>12,003</b>	<b>1,771</b>	<b>67,227</b>	<b>4.2%</b>	<b>69,946</b>	<b>4.3%</b>					
<b>Average</b>							<b>266</b>	<b>7,142</b>	<b>1.8</b>	<b>-1.3</b>	<b>23.5</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

## Energy Tech Company Share Price and Earnings Performance

Underscoring the argument that a gradual recovery is underway, the historical data below shows that revenues in the most recent quarter were up both sequentially and year over year. EPS remain largely negative.

Company	Revenues			Last Q Revs - % Chg		Diluted Continuing EPS			Last Q EPS - % Chg	
	Last Q	2001	2000	Q/Q	Y/Y	Last Q	2001	2000	Q/Q	Y/Y
<b>Distributed Generation</b>										
AstroPower	23.0	69.5	49.8	12.7%	25.0%	0.04	0.16	0.18	100.0%	-33.3%
Ballard Power	28.0	60.7	55.3	45.8%	58.2%	(0.38)	(1.29)	(1.17)	n/a	n/a
Capstone Turbine	3.9	36.0	23.2	-47.3%	18.2%	(0.14)	(0.61)	(12.82)	n/a	n/a
Energy Conversion Devices	15.9	91.7	71.4	-11.7%	-29.3%	(0.26)	(0.96)	(0.27)	n/a	n/a
Evergreen Solar	2.1	2.5	2.2	61.5%	250.0%	(0.24)	(1.10)	(2.96)	n/a	n/a
FuelCell Energy	13.7	41.2	26.2	14.2%	104.5%	(0.53)	(1.25)	(0.45)	n/a	n/a
H Power	0.9	2.6	3.6	-18.2%	125.0%	(0.65)	(2.59)	(2.20)	n/a	n/a
Millennium Cell	0.1	-	-	n/a	n/a	(0.13)	(0.72)	(0.69)	n/a	n/a
Plug Power	3.0	5.7	8.4	20.0%	233.3%	(0.21)	(1.56)	(1.99)	n/a	n/a
Proton Energy Systems	1.6	3.0	0.7	23.1%	300.0%	(0.13)	(0.15)	(5.92)	n/a	n/a
<b>Clean Fuel &amp; Combustion Technology</b>										
Catalytica Energy Systems	1.5	5.5	5.5	36.4%	25.0%	(0.22)	(1.33)	(1.25)	n/a	n/a
Fuel-Tech N.V.	8.0	17.7	21.9	0.0%	90.5%	0.02	(0.09)	0.02	-60.0%	n/a
Headwaters	43.7	119.3	45.5	36.6%	244.1%	0.28	0.94	0.87	7.7%	7.7%
Methanex Corporation	296.5	1,149.0	1,061.3	32.6%	23.7%	0.46	0.53	0.83	283.3%	n/a
Quantum Fuel Systems Tech	5.6	23.4	23.4	21.7%	-3.4%	(0.30)	(2.46)	(1.71)	n/a	n/a
Syntroleum Corporation	3.9	6.7	8.0	-7.1%	30.0%	(0.29)	(0.91)	(0.84)	n/a	n/a
<b>Power Semiconductors</b>										
Advanced Power Technology	13.1	36.9	44.2	22.4%	92.6%	0.01	0.19	0.50	n/a	n/a
AVX Corporation	295.4	1,250.0	2,608.1	0.2%	-3.3%	0.01	(0.04)	3.22	0.0%	n/a
Fairchild Semiconductor	360.6	1,407.7	1,783.2	0.0%	10.8%	0.04	(0.42)	2.69	n/a	n/a
International Rectifier	212.2	720.2	978.6	5.6%	25.9%	0.17	0.75	1.35	-32.0%	13.3%
IXYS	35.3	82.8	111.4	28.8%	70.5%	(0.10)	0.07	0.49	n/a	n/a
Kemet	113.1	508.6	1,406.1	-8.8%	-6.2%	(0.13)	(0.32)	4.00	n/a	n/a
Maxwell Technologies	16.6	77.9	102.3	25.8%	10.7%	(1.53)	(0.82)	(1.66)	n/a	n/a
Microsemi	49.2	212.6	243.4	-4.5%	-14.0%	(0.25)	(0.16)	0.59	n/a	n/a
O2Micro International	18.0	45.8	40.4	1.7%	51.3%	0.07	0.16	0.21	-12.5%	75.0%
ON Semiconductor	272.0	1,214.6	2,073.9	-2.1%	-1.6%	(0.13)	(4.21)	0.48	n/a	n/a
Power Integrations	28.2	94.1	111.5	4.1%	22.6%	0.08	0.23	0.69	14.3%	166.7%
Semtech	47.2	191.2	256.7	-9.4%	8.0%	0.17	0.31	0.79	21.4%	41.7%
Siliconix	96.1	305.6	473.1	1.3%	42.4%	0.45	0.51	3.60	18.4%	n/a
<b>Power Electronics</b>										
Artesyn Technologies	86.0	494.0	690.1	-5.4%	-20.8%	(0.16)	(0.52)	1.10	n/a	n/a
Magnetek	42.8	188.2	298.3	-3.2%	-18.5%	(0.06)	0.06	0.39	n/a	n/a
PECO II	17.9	106.7	156.5	8.5%	-22.5%	(0.92)	(0.31)	0.68	n/a	n/a
Power-One	60.0	363.7	511.0	6.8%	13.0%	(2.46)	(2.36)	0.56	n/a	n/a
Powerwave Technologies	91.3	300.3	447.4	-19.5%	41.1%	0.02	(0.33)	0.71	-71.4%	n/a
SatCon Technology	11.2	41.6	41.7	-5.1%	12.0%	(0.32)	(1.25)	(1.51)	n/a	n/a
UQM Technologies	4.1	21.4	25.3	-14.6%	-21.2%	(0.05)	(0.36)	(0.12)	n/a	n/a
Vicor	39.5	195.9	257.6	7.3%	-23.4%	(0.06)	(0.01)	0.78	n/a	n/a
<b>Power Quality</b>										
American Power Conversion	337.1	1,433.3	1,483.6	9.4%	-5.1%	0.21	0.58	0.83	40.0%	90.9%
American Superconductor	4.5	11.7	16.8	55.2%	36.4%	(0.50)	(2.79)	(1.08)	n/a	n/a
Intermagetics General	36.7	153.3	138.2	4.3%	-5.9%	0.16	1.19	0.67	-23.8%	-73.3%
<b>Energy Storage</b>										
Active Power	3.2	22.6	4.9	3.2%	-48.4%	(0.16)	(0.70)	(1.92)	n/a	n/a
Beacon Power	-	-	0.1	n/a	n/a	(0.21)	(0.62)	(10.77)	n/a	n/a
C&D Technologies	87.6	471.6	615.7	3.9%	-14.5%	0.20	1.35	2.05	11.1%	185.7%
Electric Fuel Corporation	3.3	4.0	4.1	300.5%	450.0%	(0.03)	(0.71)	(0.62)	n/a	n/a
Medis Technologies	0.0	-	-	5.6%	n/a	(0.22)	(2.02)	(1.79)	n/a	n/a
Ultralife Batteries	6.8	32.5	24.2	-20.9%	-10.5%	(0.14)	(2.03)	(1.55)	n/a	n/a
Valence Technology	0.3	4.9	8.7	-40.0%	-40.0%	(0.19)	(1.53)	(1.14)	n/a	n/a
<b>Energy Information Technology</b>										
Caminus Corporation	19.7	74.7	51.7	4.8%	29.6%	(0.29)	(0.39)	(1.04)	n/a	n/a
Intergraph	133.5	532.1	690.5	8.9%	5.0%	0.06	0.39	0.20	-98.9%	200.0%
Itron	73.1	225.6	179.9	1.0%	20.0%	0.28	0.75	0.28	0.0%	33.3%

**Notes:**

All revenue data in millions

For companies with fiscal years that do not coincide with the calendar year, revenue and EPS data is for FY2002 and FY2001

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

# TapeTalk

## Energy Tech Company Share Price and Earnings Performance

While the latest EPS results have come in above consensus more often than below it, estimate revisions are taking near-term expectations down rather than up.

Latest Quarter Earnings Surprises		Total Estimate Revisions ↑ / ↓		
		Current Q	Next Q	Current Year
Upside	24	1 ↑	3 ↑	3 ↑
Downside	16	2 ↓	3 ↓	6 ↓

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>									
AstroPower	0.04	0.06	(0.02)	0.06	0.08	0.20	0.0%	0.0%	0.0%
Ballard Power	(0.35)	(0.38)	0.03	(0.34)	(0.27)	(1.30)	0.0%	0.0%	0.0%
Capstone Turbine	(0.14)	(0.17)	0.03	(0.14)	(0.14)	(0.62)	0.0%	0.0%	-1.6%
Energy Conversion Devices	(0.26)	(0.29)	0.03	n/a	n/a	(0.62)	0.0%	0.0%	0.0%
Evergreen Solar	(0.24)	(0.32)	0.08	(0.30)	n/a	(1.14)	0.0%	0.0%	0.0%
FuelCell Energy	(0.53)	(0.40)	(0.13)	(0.44)	(0.39)	(1.34)	-18.9%	-44.4%	-21.8%
H Power	(0.65)	(0.60)	(0.05)	(0.63)	(0.55)	(2.31)	0.0%	0.0%	0.0%
Millennium Cell	(0.09)	(0.10)	0.01	(0.10)	n/a	(0.44)	0.0%	0.0%	0.0%
Plug Power	(0.21)	(0.27)	0.06	(0.26)	(0.25)	(1.03)	0.0%	0.0%	0.0%
Proton Energy Systems	(0.13)	(0.13)	-	(0.10)	(0.10)	(0.39)	0.0%	0.0%	0.0%
<b>Clean Fuel &amp; Combustion Technology</b>									
Catalytica Energy Systems	(0.22)	n/a	n/a	n/a	n/a	n/a	0.0%	0.0%	0.0%
Fuel-Tech N.V.	0.05	0.04	0.01	0.02	0.16	0.23	0.0%	0.0%	0.0%
Headwaters	0.28	0.25	0.03	0.27	0.22	1.30	0.0%	0.0%	-0.8%
Methanex Corporation	0.46	0.35	0.11	0.25	0.20	0.70	0.0%	0.0%	0.0%
Quantum Fuel Systems Tech	(0.30)	(0.31)	0.01	(0.29)	(0.27)	(1.15)	0.0%	0.0%	0.0%
Syntroleum Corporation	(0.29)	(0.23)	(0.06)	-	-	(0.51)	0.0%	0.0%	0.0%
<b>Power Semiconductors</b>									
Advanced Power Technology	0.05	0.02	0.03	(0.05)	(0.04)	(0.04)	16.7%	20.0%	20.0%
AVX Corporation	0.01	0.01	-	(0.01)	0.01	0.02	0.0%	0.0%	0.0%
Fairchild Semiconductor	0.09	0.08	0.01	0.07	0.05	0.21	0.0%	0.0%	0.0%
International Rectifier	0.17	0.17	-	0.13	0.17	0.69	-7.1%	0.0%	0.0%
IXYS	(0.04)	(0.09)	(0.01)	(0.05)	n/a	(0.17)	0.0%	0.0%	0.0%
Kemet	0.00	0.03	(0.03)	(0.03)	(0.02)	-	0.0%	0.0%	0.0%
Maxwell Technologies	(0.37)	(0.22)	(0.15)	-	-	(1.54)	0.0%	0.0%	0.0%
Microsemi	0.03	0.03	-	0.01	0.02	0.12	0.0%	0.0%	0.0%
O2Micro International	0.07	0.08	(0.01)	0.07	0.08	0.29	0.0%	0.0%	3.6%
ON Semiconductor	(0.08)	(0.13)	0.05	(0.17)	(0.17)	(0.70)	0.0%	0.0%	0.0%
Power Integrations	0.08	0.08	-	0.08	0.09	0.29	0.0%	0.0%	0.0%
Semtech	0.11	0.14	(0.03)	0.10	0.10	0.47	0.0%	0.0%	0.0%
Siliconix	0.45	n/a	n/a	n/a	n/a	n/a	0.0%	0.0%	0.0%
<b>Power Electronics</b>									
Artesyn Technologies	(0.16)	(0.16)	-	(0.17)	(0.15)	(0.63)	0.0%	6.3%	0.0%
Magnetek	(0.06)	(0.03)	(0.03)	(0.05)	(0.04)	(0.15)	0.0%	0.0%	0.0%
PECO II	(0.27)	(0.22)	(0.05)	(0.21)	(0.20)	(0.95)	0.0%	0.0%	0.0%
Power-One	(0.06)	(0.07)	0.01	(0.04)	(0.02)	(0.24)	0.0%	0.0%	-4.3%
Powerwave Technologies	0.02	0.01	0.01	(0.02)	(0.01)	0.10	0.0%	-200.0%	-16.7%
SatCon Technology	(0.32)	-	-	(0.12)	(0.12)	(0.40)	0.0%	0.0%	0.0%
UQM Technologies	(0.05)	n/a	n/a	n/a	n/a	n/a	0.0%	0.0%	0.0%
Vicor	(0.06)	(0.09)	0.03	(0.07)	(0.04)	(0.36)	0.0%	0.0%	0.0%
<b>Power Quality</b>									
American Power Conversion	0.21	0.17	0.04	0.20	0.14	0.67	0.0%	0.0%	0.0%
American Superconductor	(0.50)	(0.50)	-	(0.49)	(0.50)	(1.99)	0.0%	0.0%	0.0%
Intermagetics General	0.22	0.22	-	0.25	0.27	0.94	0.0%	3.8%	0.0%
<b>Energy Storage</b>									
Active Power	(0.15)	(0.17)	0.02	(0.16)	(0.15)	(0.63)	0.0%	0.0%	0.0%
Beacon Power	(0.21)	(0.07)	(0.14)	(0.06)	n/a	(0.69)	0.0%	0.0%	0.0%
C&D Technologies	0.20	0.20	-	0.20	0.21	0.73	0.0%	0.0%	-1.4%
Electric Fuel Corporation	(0.03)	n/a	n/a	n/a	n/a	n/a	0.0%	0.0%	0.0%
Medis Technologies	(0.22)	(0.14)	(0.08)	(0.12)	(0.12)	(0.59)	0.0%	0.0%	0.0%
Ultralife Batteries	(0.14)	(0.10)	(0.04)	(0.06)	0.02	(0.09)	0.0%	0.0%	0.0%
Valence Technology	(0.19)	(0.18)	(0.01)	(0.16)	(0.15)	(0.68)	0.0%	0.0%	0.0%
<b>Energy Information Technology</b>									
Caminus Corporation	(0.11)	(0.14)	0.03	(0.07)	n/a	(0.26)	0.0%	0.0%	0.0%
Intergraph	0.05	0.06	(0.01)	0.06	n/a	0.27	0.0%	0.0%	0.0%
Itron	0.29	0.26	0.03	0.29	0.25	1.10	0.0%	-3.8%	0.9%

---

## Capital Markets Monitor

**Overall Comment.** What is notable about recent capital market activity and announcements is the out-sized participation of companies developing hydrogen and fuel cell technologies. Roughly half of the upcoming or completed transactions listed below involve hydrogen and fuel cell companies. Given that it could take as long as 10-15 years for some of these technologies to reach full commercial potential, there will undoubtedly be more rounds of hydrogen and fuel cell-related financings.

*December 30.* **Ballard Power Systems** successfully raised gross proceeds of US\$100 million (net proceeds were \$96 million) through a bought deal led by RBC Capital Markets. Ballard issued 7.7 million common shares at US\$13.016 per share. The underwriters did not exercise their “green shoe” option to purchase an additional 1.9 million shares.

*December 13.* **Quantum Fuel Systems Technologies Worldwide**, which makes hydrogen fuel tanks and other equipment for alternative fuels such as natural gas and propane, announced that it intends to raise \$10.2 million from the sale of 3.45 million shares. Use of proceeds would include product development, marketing and possible acquisitions. **General Motors** owns about 20% of Quantum, and is a major source of revenue (99% of fiscal 2002 sales). Quantum was spun off from **Impco** in July 2002.

*November 29.* Vancouver BC-based **Vanteck Technology** announced the completion of a non-brokered private placement grossing \$1.2 million. Proceeds will be used to finish a project with Pacific Corp and generate new business. Vanteck produces large-scale energy storage systems based on its patented Vanadium Redox Battery.

*November 27.* In a busy week in the capital markets for Canadian energy tech companies, another Vancouver BC-based outfit, **Azure Dynamics**, announced the completion of private placement financings grossing \$750,000. **Hydro-Quebec CapiTech** contributed about \$500,000 of the total. Azure Dynamics is developing hybrid-electric powertrains and energy management technology for light and medium-duty commercial vehicles.

*November 19.* **Fuel Cell Technologies** announced that it has engaged National Bank Financial and Acumen Capital Finance Partners to raise \$3.2 million to \$4.0 million in a private placement. Fuel Cell Technologies designs and produces aluminum/oxygen power systems for underwater vehicles, and is developing a solid oxide fuel cell.

---

## Capital Markets Monitor

*November 6.* Australian landfill gas-to-power company **Novera Energy** announced plans to raise A\$17.5 million (US\$9.5 million) in an initial public offering scheduled to close in the second week of December. **TXU** is reportedly planning to buy 10% of the company in the IPO. The use of proceeds is to finance landfill gas and wind power projects in Australia and the United Kingdom.

*October 22.* **Konarka Technologies** completed a Series B round of venture financing led by Draper Fisher. Other investors in the round included **Zero Stage Capital** (Round A leader), **Ardesta**, **NextGen Partners**, **ChevronTexaco** and **Eastman Chemical Company**. Konarka is developing a solar power technology based on dye-sensitized titanium dioxide nanoparticles.

---

## The (De-)Construction Site

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

**Overall Comment.** The level of strategic corporate activity in the last quarter of 2002 was particularly high. Surveying the action, several themes emerge. First, companies developing advanced distributed generation technologies showed signs of distress, with Ballard Power, Capstone and Global Thermoelectric announcing restructurings. Second, a long-awaited wave of consolidation in the crowded fuel cell & hydrogen sector may be underway, with two M&A deals announced. And lastly, a slowdown in the solar power industry's growth rate prompted several solar power systems producers to revise their strategies and reallocate assets (at the same time, however, several large Japanese players continue to aggressively expand capacity to take advantage of the solar industry's promising secular growth path.

### STRATEGIC DEALS

*December 18.* **Ballard Power** issued 2.5 million shares of common stock to **Alstom Canada** in return for Alstom's remaining interest in Ballard's stationary power subsidiary, **Ballard Generation Systems** (BGS). In addition, Alstom is relinquishing exclusive rights to manufacture Ballard's stationary fuel cell systems in Europe in exchange for non-exclusive worldwide rights (ex-Japan) to distribution rights for the same product. Following the closing of this transaction, and another similar deal, Ballard will own 100% of BGS, bringing the company's program to greatly simplify its organizational and capital structure much closer to the end.

*December 12.* **Astris Energi**, a developer of alkaline fuel cell technology, announced today the signing of a Memorandum of Agreement with **CareAction**, Inc., based in the Montreal suburb of Laval, Quebec. Astris will license its technology and CareAction will provide financing and management for a US\$15 million technology and consumer product development program, centered on the transportation sector. CareAction will receive shares and warrants in Astris in return for investing about \$2 million directly in Astris. In addition, a strategic alliance will be formed between Astris, CareAction and **Feel Good Cars** to develop a range of converted vans, passenger cars, as well as electric and hydrogen fuel cell low-speed vehicles, primarily for the burgeoning, under-served markets represented by seniors and disabled persons.

*November 27.* **Amerada Hess** increased its stake in **Nuvera Fuel Cells** to 53% by purchasing the ownership interest in Nuvera held by the successor entity to former Arthur D. Little. The balance of Nuvera shares is held by Italy's **Gruppo DeNora**.

*November 25.* **Solar Energy Limited** and its subsidiary Renewable Energy Limited (REL) announced that it will repossess the two subsidiaries it sold to **Sun Power Corp.** this time last year. With its shares on the decline and capital market conditions difficult, Sun Power has been unable to raise cash to provide sufficient working capital to the two subsidiaries, Sunspring and Renewable Energy Corp (RECO). Accordingly, Solar Energy Limited is exercising its right to take back Sunspring and RECO by returning the convertible Sunpower shares each division holds.

---

## The (De-)Construction Site

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

*November 19.* **Jenbacher AG** of Austria announced that majority stockholders owning 55.56% of shares out have signed a share purchase agreement with **General Electric**. As part of the agreement, General Electric obtains the right to submit a tender offer for the remaining 44.44% of the company's shares. Jenbacher is a high-quality producer of natural gas-powered gensets.

*November 12.* The vertical integration of the solar power industry continues with the announcement that **RWE Solar GmbH** and its subsidiary **ASE Americas** are coming together with **Schott Applied Power** to form **RWE Schott Solar**, a manufacturing and marketing joint venture. The deal brings together RWE's large and growing PV production base with the long market reach of Schott Applied Power. RWE Solar is rapidly expanding capacity and is on its way to the 100MW mark, while Schott Applied Power is one of the largest systems integrators and marketers of solar power in North America. With 2001 *pro forma* revenues of \$96 million, the combined entity becomes the sixth largest solar power company in the world.

**Comment:** There are at least two notable elements here. First, this deal is reminiscent of the acquisition last September of Atersa, a sizable European solar systems integrator and marketer, by Astro-Power, a leading solar cell and module manufacturer. Further vertical integration may be on the way. And second, the fact that RWE formed a JV with a US-based systems integrator rather than one located elsewhere suggests that the US is becoming an increasingly strategic market. Sharp, the world's largest PV manufacturer, announced earlier this year its intent to begin producing and selling in the US.

*October 28.* **Capstone Turbine Corp.** made a slew of announcements on this day. First, the company announced the formation of an alliance with **United Technologies** to develop, sell and service micro-turbine-based combined heat and power systems for commercial buildings. As part of the package, United Technologies agreed to purchase a 4.9% stake in Capstone. Second, CEO Ake Almgren stated his intention to retire, and resigned as Chairman of the Board. At the same time, the company announced a reorganization into five functional areas that is projected to yield several million dollars in annual savings. And lastly, Capstone lowered its 2002 unit sale guidance and revised its product mix forecast toward the lower-margin 30kW microturbine units and away from the more profitable 60kW system.

**Comment:** Taken as a whole these actions suggest a company doing what it can to manage through a difficult environment and find the right applications for its product. Initial expectations for Capstone's sales have proved much too optimistic – Wall Street analysts published reports in 2000 projecting sales of roughly 250MW – 300MW in 2002, coming primarily from the 60kW unit. With the company now guiding for 2002 sales of about 30MW (not 300MW), comprised more of the 30kW than the 60kW systems, clearly there have been disappointments. A key issue has been the microturbine's high price relative to the alternatives (due at least in part to low sales volumes). One answer is to find those applications where a microturbine's unique attributes overwhelm its premium price. Teaming up with United Technologies (UTC) to develop CHP systems that bring a Capstone microturbine with its substantial heat output together with UTC's Carrier brand heating, ventilation and cooling (HVAC) equipment is a savvy strategic move. Capstone gains a partner with a multi-billion dollar HVAC business, and the economic value of a key feature of its microturbine – high heat generation – is captured.

---

## The (De-)Construction Site

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

### M&A ACTIVITY

*December 23.* **Stuart Energy Systems** announced today that it has entered into an agreement to acquire **Vandenborre Technologies NV** for a consideration of about CDN \$9.9 million in cash and 7.3 million common shares of Stuart Energy. The total value of the transaction, currently estimated at CDN \$28 million, will be determined by Stuart Energy's share price on the transaction closing date. Both companies are developing technologies for onsite electrolysis-based hydrogen generation.

*December 6.* **SatCon Technology Corp.** announced that it has acquired the hybrid electronics customer base of **Sipex** through a royalty-based acquisition agreement. The product lines involved include high-reliability analog chips, thin film substrates and custom ASICs, and the principal customers are in the defense and aerospace industries. SatCon has a longstanding presence in specialty electronics, and the addition of the Sipex product offerings is intended to strengthen its position there.

*December 5.* **Lithium Technology Corp.** announced a share exchange agreement to take control of the remaining 40% of **GAIA Akkumulatorenwerke GmbH** that it does not currently own. Lithium Technology is developing lithium-based rechargeable batteries for automotive, stationary power and security applications.

*November 12.* **Plug Power** announced a definitive agreement to acquire competing PEM fuel cell developer **H Power**. The transaction, a stock-for-stock swap, values H Power at about \$51 million, or about \$4.70 per share. H Power shareholders will end up with 13%-16% of Plug after the deal closes.

**Comment.** Fuel cell industry observers have been predicting consolidation for some time now. There are scores of companies developing fuel cell technology, primarily PEM-based; estimates of the time and expense required to reach commercialization have been far too low; capital market conditions have been difficult for development-stage companies; and government funding may not be sufficient to keep so many fuel cell companies afloat. In acquiring H Power at roughly the value of the cash on the balance, Plug Power has issued shares in exchange for \$50 million of cash, and bought the rest of H Power virtually for free. Had Plug Power sought to raise \$50 million through a follow-on share offering to the public, it would have faced significant deal execution risk and an uncertain outcome. The acquisition of H Power neatly solves the problem of raising money while giving Plug Power access to physical and intellectual property assets that may create further value.

*November 1.* **American Superconductor** announced that it has acquired the assets of Nordic Superconductor Technologies (NST), a subsidiary of Denmark's NKT Holdings, in exchange for 546,000 shares of American Superconductor common stock valued at about \$2.1 million. Nordic Superconductor, a developer of high-temperature superconducting (HTS) wire, supplied the wire for successful HTS power cable demonstration projects in the US and Denmark. The transaction should expand American Superconductor's capacity and customer base, and enable NKT Holdings to focus on superconducting cable systems integration rather than bulk wire production.

---

## The (De-)Construction Site

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

*October 14.* **Siemens Power Generation** announced that it acquired NewEnergy Associates, an Atlanta-based energy software and consultancy company with 120 employees and \$17 million of sales last year. This deal follows on the heels of Siemens' acquisition of ICIS Technology Ltd., a UK energy software firm.

**Comment.** With power plant construction in the US slowing dramatically and numerous power producers canceling previous turbine orders, Siemens Power Generation appears to be turning to energy IT as a new source of growth. Historical utility industry investment in software solutions for physical asset management, energy trading, risk analysis, customer care and load control has been low, and the opportunity for Siemens and other energy IT providers is substantial. The catch here is that energy and power companies, at least in the US, may not be in a rush to spend in light of the disarray across the industry. At least from a valuation standpoint, for Siemens the timing of these acquisitions seems fortuitous – public software company valuations have fallen sharply since 1999-2000.

### RESTRUCTURINGS

*December 30.* **Sun Power Corp.** announced a surprising change of strategic direction. Concurrent with a restructuring program, the company will focus on the acquisition and management of mineral resource properties with a history of positive cash flow and profit, low-cost production and expandable reserves. To that end, Sun Power is purchasing an option to acquire 100% ownership of a silver mining operation in Mexico.

*December 9.* Faced with a significant cash burn rate and little prospect for near-term profits, **Ballard Power Systems** announced a broad restructuring program and a new development funding agreement. Under the restructuring, the company will cut its workforce by about 30%, from 1,400 to 1,000, and combine three of its four business divisions into a single unit. The 400-person headcount reduction will be achieved through layoffs, normal attrition and the transfer of about 100 employees over to **DaimlerChrysler**. All of the downsizing appears to be occurring in the three consolidating divisions – Transportation, Power Generation and Electric Drives & Power Conversion – while the Material Products Division will keep its workforce intact and continue operating as a stand-alone unit. Importantly, Ballard secured a preliminary agreement from key strategic partners DaimlerChrysler and **Ford** for US\$97 million of funding over the next five years; this is in addition to the current development programs already in place.

**Comment.** As it turns out, revolutionizing the automobile does not come cheaply. From 1999-2001, Ballard's operations consumed an average of roughly \$45 million of cash per year, and the company consumed an additional \$115 million in the first nine months of 2002 alone. Even after raising about \$330 million in 2000, Ballard's burn rate would have left it without cash by around late 2004. Furthermore, even the optimists do not expect widespread commercialization of fuel cell vehicles before 2010, leaving a wide gap between the end of Ballard's cash reserve and the beginning of high-volume sales of its core product. The restructuring program, together with the additional funding commitment from DaimlerChrysler and Ford and the company's successful \$100 million follow-on offering, should go a fair ways toward narrowing that gap.

---

## The (De-)Construction Site

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

*November 27.* **Global Thermoelectric**, reaching the conclusion that its current share price does not adequately reflect the value of either its solid-oxide fuel cell division or its financial strength, unveiled a three-point plan to increase shareholder value. First, the company will review strategic alternatives for its fuel cell arm, including partnerships or divestiture. Second, the work force at non-core divisions will be reduced by 30%. And third, the company will purchase up to 1.45 million common shares.

**Comment.** Fuel cell company valuations are depressed across the board; Global Thermoelectric is not suffering alone. However, a low stock price limits financing alternatives. The fact that Global Thermo would consider either bringing in a strategic partner for its solid-oxide fuel cell division or divest it altogether suggests that the cost of bringing a product to market may be more than the company can or will absorb.

*November 21.* **BP Solar**, among the world's largest solar power companies with annual revenues of \$300 million, announced that it will no longer manufacture thin film PV products. BP had been working with cadmium telluride and amorphous silicon thin film technologies. With thin film comprising 10%-15% of the company's total manufacturing capacity, BP will remain a major force in PV on the strength of its crystalline silicon production alone. Harry Shimp, BP Solar's CEO, cited "lack of material demand and present economics" of thin film PV, alongside technical and manufacturing cost improvements for crystalline silicon, as the key factors behind the decision.

**Comment.** The abandonment of cadmium telluride and amorphous silicon after many years of research and development work by a global PV industry leader naturally raises questions about the viability of these thin film approaches. Although thin film has received the lion's share of the PV industry R&D budget for many years, the goal of high-yield volume manufacturing at commercial prices has remained elusive. None of this means that thin film PV will never be economically viable. But BP's recent exit may be a signal that the time and cost required to make currently available thin film technology competitive against crystalline silicon remain substantial.

*November 7.* Following the news that its Japanese parent company is cutting its funding, Pittsburgh-based **Ebara Solar** has stated that it is seeking other sources of finances. Ebara Corp. posted a net loss at the parent level last year, with results pulled down in part by the solar power division. The company is reportedly discontinuing funding to Ebara Solar to avoid further net losses.

**Comment.** Ebara Corp. has invested about \$80 million in solar power since 1993, and the Pittsburgh plant was on its way to launch its flexible solar cell products in North America next year. For the parent company to pull back at this point suggests that the solar division may still be a ways away from generating a profit, and that the burden of funding further operating losses and capital equipment could be material enough to make walking away from an \$80 million investment more attractive than betting on eventual success.

---

## The (De-)Construction Site

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

*October 24.* Citing excess industry capacity and tepid market growth, **Shell Solar** announced its intention to restructure its manufacturing base. The company will consolidate production at four sites in the US and Europe, and shutter two facilities in Europe at a cost of about 170 jobs.

**Comment.** Growth in the PV industry in 2002 certainly has not matched the 30%-40% annual rates posted in 2000-01, but the exceptional growth of two years past prompted a number of solar power companies to begin adding substantial capacity. That capacity has started to come on line even as the industry's growth rate has slowed. While Shell's restructuring is a response to more challenging market conditions, it is probably something the company needed to do anyway to continue absorbing the solar power joint venture with Siemens it took over earlier this year.

### BANKRUPTCIES

*December 10.* Citing persistent cash flow shortfalls, **Ocean Power** filed for Chapter 11 bankruptcy with \$1.5 million of assets and \$24 million of liabilities. Ocean Power was formed in 1992 to develop modular power plants and seawater desalination units, the company went on to make acquisitions and form business agreements in technologies that included fuel cells, wind turbines, solar dish concentrators and Stirling engines.

*November 13.* After examining a range of strategic options, **Synergy Technologies Corp.** announced that it is filing for Chapter 11 bankruptcy protection. Synergy Technologies is developing processes to convert natural gas and other fossil fuels to hydrogen and carbon monoxide, and convert heavy oil and refinery bottoms into lighter, more usable crude. The company recently demonstrated that its technology is capable of turning high-sulfur, off-specification liquid fuels into hydrogen-rich synthesis gas (syngas) suitable for use in fuel cells and other applications.

### NEW COMPANY FORMATIONS

*November 12.* After years of operating as a small segment of a large enterprise, **Ericsson Power Modules** has stepped out from under parent company **Ericsson** of Sweden to become an independent entity. Ericsson recently closed the sale of its Microelectronics division to **Infineon**, freeing the way for Ericsson Power Modules to split off from the Microelectronics unit and strike out on its own. Ericsson Power Modules is a longtime leader in the design and manufacture of DC/DC power converters (DC bricks).

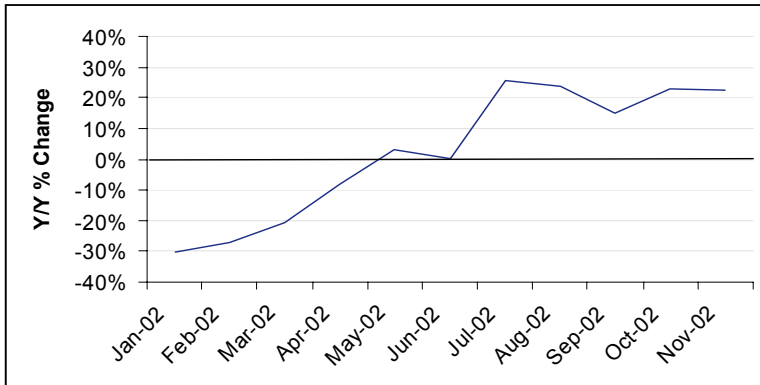
# The DataWerks

## A Statistical Look at Energy Tech Industry Trends

### Semiconductor Shipments

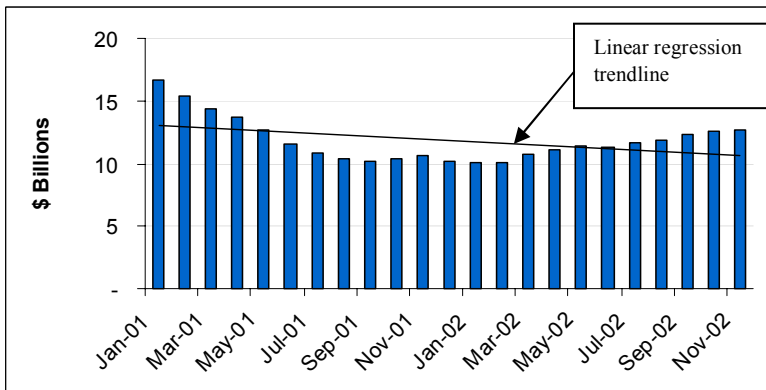
(Semiconductor Industry Association unadjusted monthly data)

Monthly Shipments—Y/Y % Change, Jan 2001 - Nov 2002



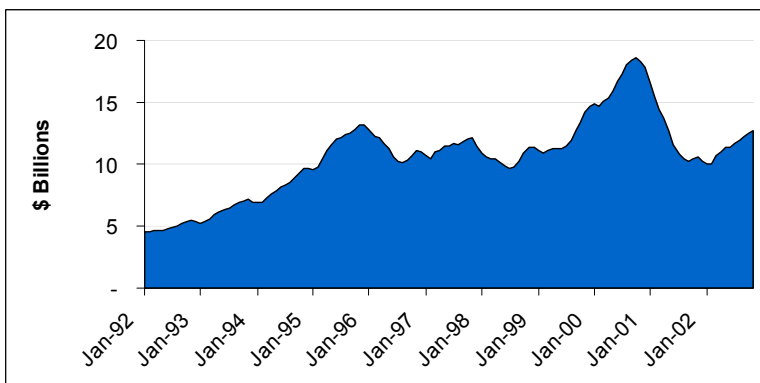
The year-over-year change in the value of semi shipments shows that a recovery may be unfolding. Semiconductor sales could be rebounding ahead of computer and communications gear because they are not dependent just on IT equipment sales; chips are also found in autos, industrial controls, medical devices, aerospace systems, etc.

Shipments—3-month moving average, Jan 2001 - Nov 2002



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, appears to confirm at least a modest recovery.

Monthly Shipments, Jan 1992 - Nov 2002



The 10-year data series shows the surge and subsequent collapse of demand from 1999-2001. Again, this is a graph that reflects an industry regaining a modicum of health. The long-term graphs of computer and communications equipment shipments shown on the next two pages do not look as favorable.

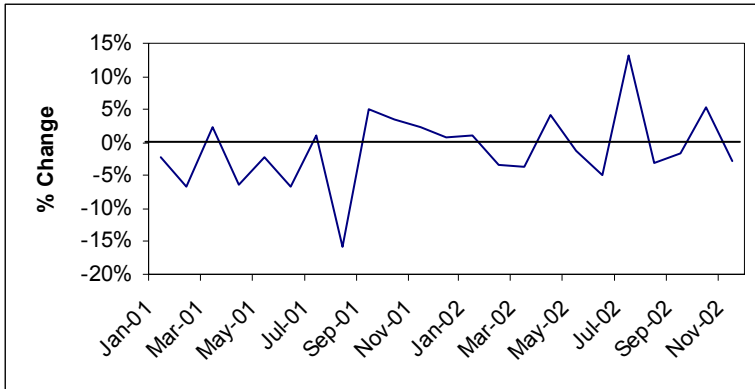
# The DataWerks

## A Statistical Look at Energy Tech Industry Trends

### Computers, Storage Devices & Peripherals

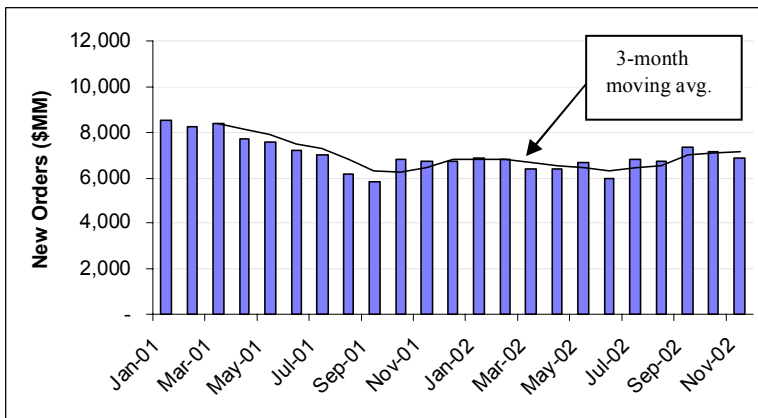
(US Census Bureau, seasonally adjusted monthly data)

Monthly Shipments—Sequential % Change, Jan 2001 - Nov 2002



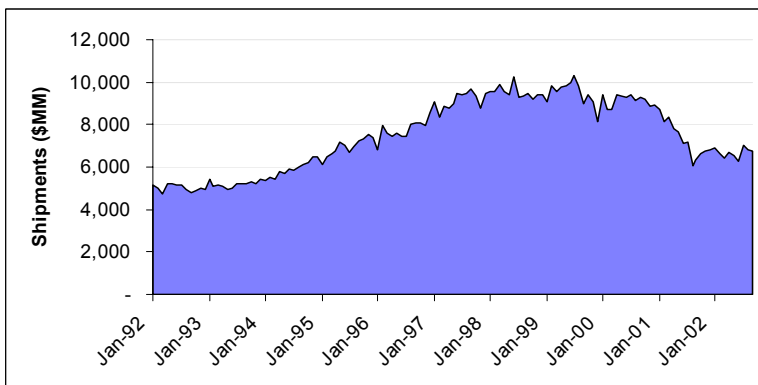
This first graph, showing the sequential change in shipments of computers and related devices, suggests a market that is basically stabilizing but not clearly growing.

Monthly New Orders, Jan 2001 - Nov 2002



As with recent trends in shipments, the data on new order activity, an important leading indicator, points to a stable but flattish market.

Monthly Shipments, Jan 1992 - Nov 2002



The 10-year data series shows that monthly shipments of computers, storage devices and peripherals have settled at 1995 levels, and have not yet decisively turned back up.

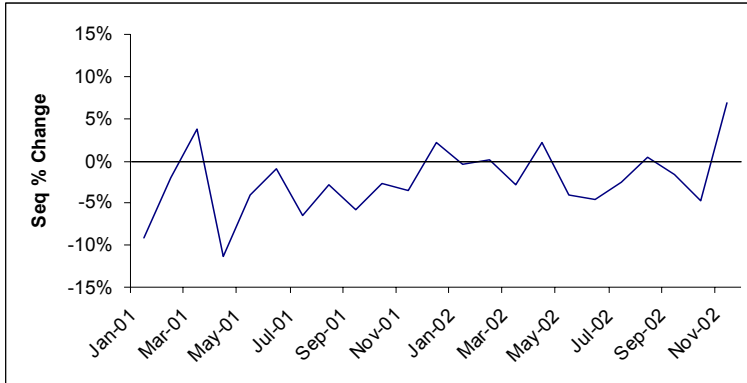
# The DataWerks

## A Statistical Look at Energy Tech Industry Trends

### Communications Equipment (non-defense)

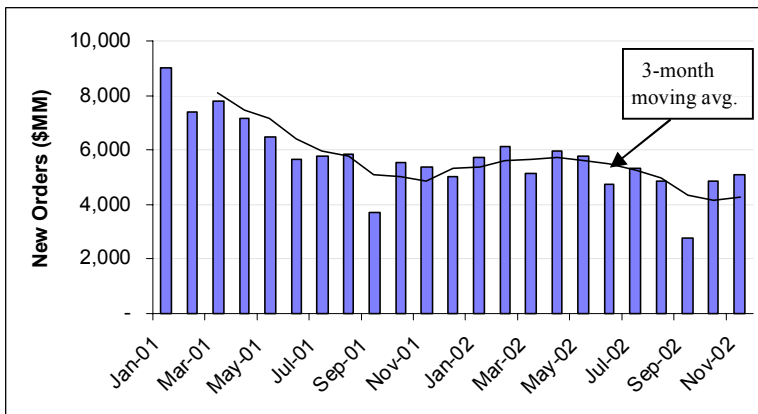
(US Census Bureau: seasonally adjusted monthly data)

Monthly Shipments—Sequential % Change, Jan 2001 - Nov 2002



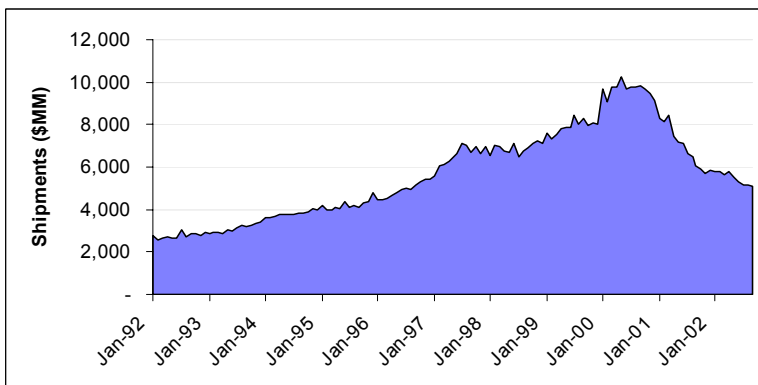
After an 18-month stretch in which communications equipment shipments declined sequentially much more often than not, signs of life appeared in November 2002. Judging from the data on new orders, however, the spike in November looks anomalous, and the trend remains flattish at best.

Monthly New Orders, Jan 2001 - Nov 2002



New order activity has been volatile but generally flat to down. It is not clear yet that communications equipment demand has truly stabilized.

Monthly Shipments, Jan 1992 - Nov 2002



The 10-year data series highlights both the run-up in shipments in 1999-2000 and the steep drop thereafter. Importantly, the recent direction of monthly shipments has been downward.

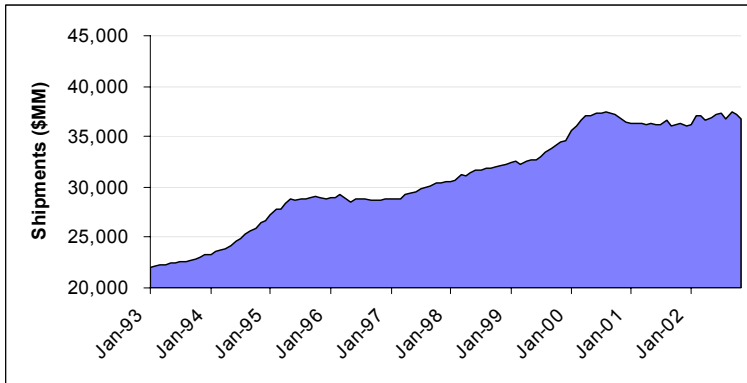
# The DataWerks

## A Statistical Look at Energy Tech Industry Trends

### Turbines, Generators & Other Power Transmission Equipment

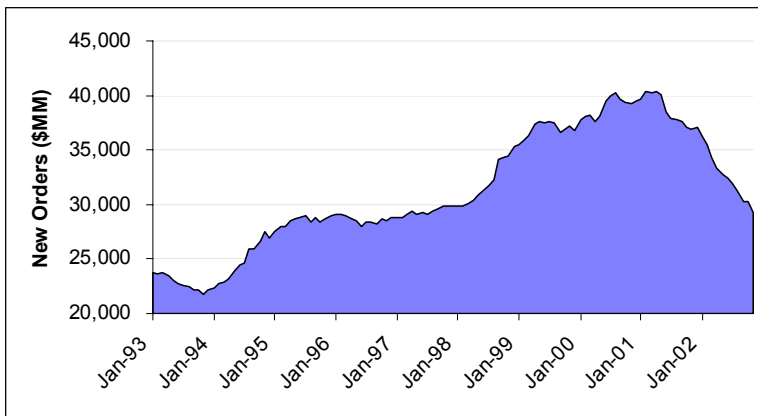
(US Census Bureau: seasonally adjusted monthly data)

Rolling 12-Month Shipments, Jan 1993 - Nov 2002



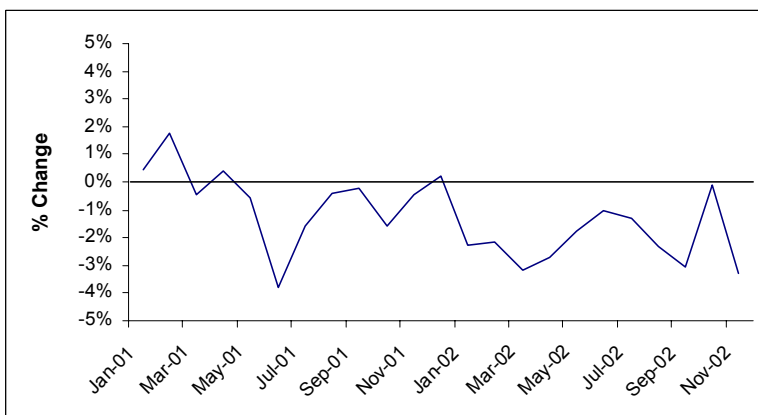
The long-term look at power equipment shipments seems to suggest that we have been witnessing a three-year plateau in the context of a strong secular growth industry.

Rolling 12-Month New Orders, Jan 1993 - Nov 2002



In contrast, the long-term data on new order activity is warning that the plateau ends with a cliff. 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.

Sequential Change, Rolling 12-Month New Orders, Jan 2001 - Nov 2002



Zooming in on new order activity within the last 2 years, we see that the trend has been clearly downward.

---

# Inductance & Reactance

## Occasional Comments and Random Observations

### Whatever Happened to “High Nines” Power?

A few years ago the idea of “high-nines” power – electric power flowing at extremely high levels of quality and reliability – held out the promise of supercharged unit growth for the power conditioning industry, and outsized revenue gains for producers of power semiconductors, power electronics systems, switchgear, UPS equipment, energy storage devices and backup gensets. Estimates of high-reliability “Internet Power” as a share of total current US electrical consumption ranged as high as 8-13%, and by 2010, up to 50% of power consumption was projected to be Internet-related in some way.

Now to the question – whatever happened to high-nines power? Did the sound and fury about Internet-quality digital power truly signify nothing? The answer is that nothing in fact “happened” to high-nines power. The need for reliable power was there before, is here today and will be here tomorrow. While in retrospect the sound about digital power may have been too furious, it nonetheless signified something very real. The equation is simple. Every silicon chip – logic, memory, digital signal processing, application-specific, etc., etc. – requires high-quality, high-reliability power. The utility network provides alternating current (AC) power at voltages of 110 - 240 volts, while digital processors run on direct current (DC) power typically at voltages of 12 volts and below. The “philosopher’s stones” of power that effect this transformation, turning raw utility-grid power (dross) into refined Internet-quality power (gold), include power semiconductors, power converters (power supplies), uninterruptible power supplies, switchgear, energy storage devices and backup power generators. Computers, servers, routers and other types of IT equipment all require power semiconductors and power converters, and their purchase may also create pull-through demand for uninterruptible power supplies, battery arrays and gensets to ensure that the flow of power is never compromised. Therefore, over the past two years, where hardware sales have gone, so too have the fortunes of the high-nines power industry.

The wild swings in computer and communications equipment shipments during the Internet boom and bust (see DataWerks, pp. 24-25) whipsawed the financials of the power conversion industry. The graph below illustrates the effect of end-market demand volatility on a basket of publicly traded power semiconductor, power electronics and power quality companies. While the year-to-year peak to trough declines in revenues and cash flow from were significant, the quarterly comparisons are particularly dramatic—peak-to-trough revenues decreased over 50%, while cash flow from operations fell a precipitous 90% (see charts on p. 29).

Of course, the corollary to all this is that a return to growth in IT equipment sales (and semiconductors more broadly) will drive demand for power conversion products. The outlook for 2003 appears muted. With 2003 estimates of corporate IT spending growth ranging from –5% to +5%, but estimates for semiconductor shipment growth coming in roughly around +10%, there is a disconnect that could be resolved one of several ways:

- corporate IT buyers are going to spend a lot more than currently expected (not likely, we think);
- semiconductor shipments to industries other than IT (which typically consumes about 60% of semiconductor output) will have to grow well above 10% (again not likely);
- semiconductor product mix will be rich enough to push ASPs higher this year (perhaps, but again not likely); or

---

# Inductance & Reactance

## Occasional Comments and Random Observations

- semiconductor shipment growth estimates of 10% may be optimistic (most likely the case).

Nonetheless, demand for the products that deliver “High Nines” power should see at least modest growth this year, and as long as one believes (like us) that next year there will be more chips in use and more data generated, communicated and stored than in this year, and yet more in the year after that, and so on, then the secular growth thesis for high-quality, high-reliability digital power remains intact.

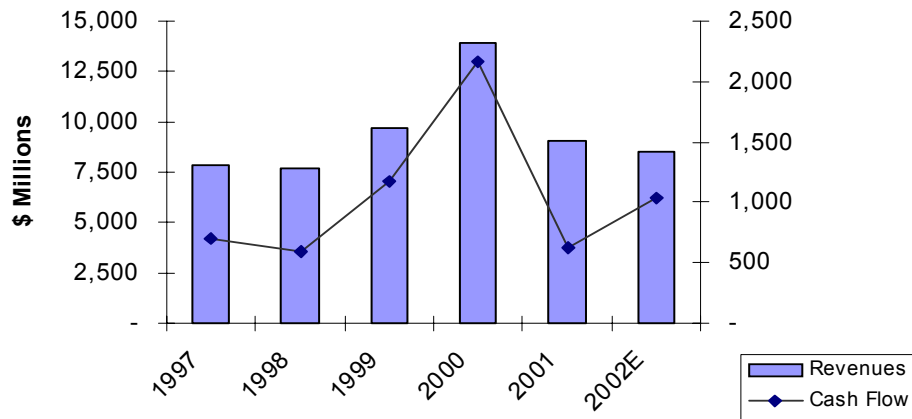
The following companies are included in the power conversion industry basket: Advanced Power Technology, American Power Conversion, Artesyn Technologies, AVX, Fairchild Semiconductor, International Rectifier, IXYS Corp., Kemet, Magnetek, Maxwell Technologies, Microsemi Corp., ON Semiconductor, Power Integrations, Power-One, Powerwave, Semtech, Siliconix, Vicor.

# Inductance & Reactance

Occasional Comments and Random Observations

## Power Conversion Industry Financial Performance, 1997-2002E

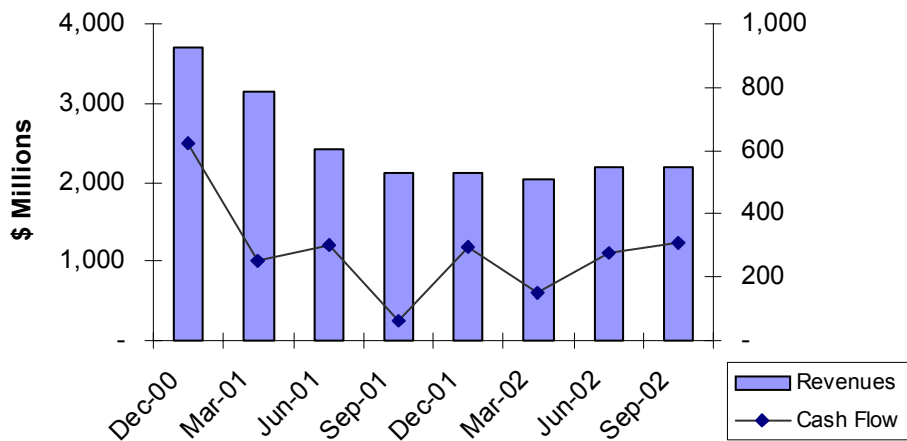
(\$ MM)



Left Axis - Revenues; Right Axis - Cash Flow

## Power Conversion Industry Financial Performance, Dec 2000-Sep 2002

(\$ MM)



Left Axis - Revenues; Right Axis - Cash Flow

Source: Market Guide, Vortex Energy LLC estimates.

---

## **IMPORTANT DISCLOSURES AND NOTICES**

This report has been prepared by Vortex Energy LLC (“Vortex Energy”) as part of its research activity and not in connection with any proposed offering of securities or as agent of the issuer of any securities. Vortex Energy provides this report solely for information purposes and is not an offer or solicitation for the purchase or sale of any financial instrument.

Vortex Energy and its principal(s) may at any time hold a position in securities of issuers mentioned herein, and may at any time be soliciting or executing investment banking or consulting engagements from or for the companies mentioned herein.

None of the companies mentioned herein are or have been clients of Vortex Energy in any capacity.

Please cite source when quoting from this report. All rights are reserved.

©2003 Vortex Energy LLC

## **VORTEX ENERGY LLC**

*Banking on the future of power*

10 East 29th Street, #37-D

New York, NY 10016

Phone: 212-252-1143 (starting February 1)

Cell Phone: 646-408-5495

Email: [info@vortexenergy.com](mailto:info@vortexenergy.com)