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CLEAN ENERGY TRENDS 2007

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MARCH 2007

CLEAN **EDGE**

THE CLEAN-TECH MARKET AUTHORITY

CLEAN ENERGY TRENDS 2007

Maybe it was the changing global climate, or perhaps the changing business climate, that fueled clean-energy markets in 2006. More than likely, it was both of these, among several other factors, that pushed markets for solar, wind, fuel cells, biofuels, and other energy technologies along their inexorable upward march.

We have reached the point where the steady and rapid growth of clean energy has become an old story. Each year, it seems, brings an ever-higher plateau of success. This appears to be the future of clean energy: a rolling series of technology breakthroughs, landmark corporate investments, industry consolidation, and the not-infrequent emergence of new and sometimes surprising players entering the field.

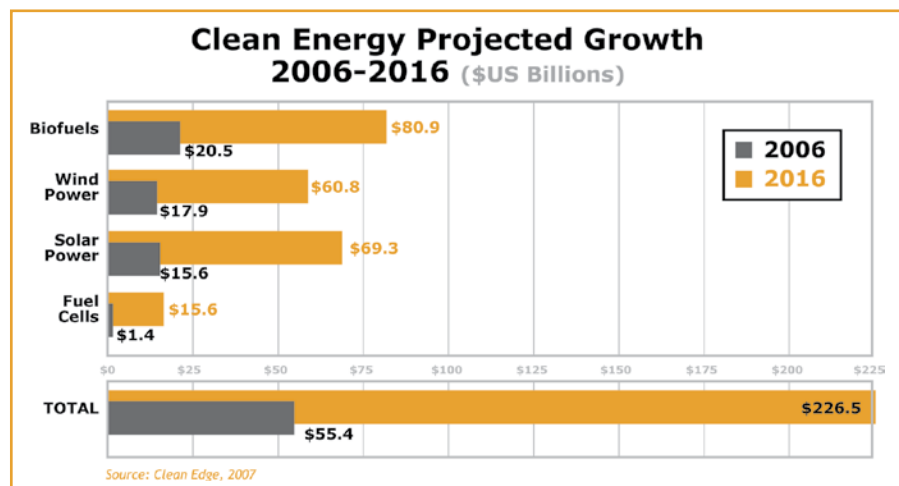
Since the publication of our first *Clean Energy Trends* report in 2002, we've provided an annual snapshot of both the global and U.S. clean-energy sectors. In this, our sixth edition, we find markets for our four benchmark technologies – solar photovoltaics, wind power, biofuels, and fuel cells – continuing their healthy climb. Annual revenue for these four technologies ramped up nearly 39% in one year – from \$40 billion in 2005 to \$55 billion in 2006. We forecast that they will continue on this trajectory to become a \$226 billion market by 2016.

A number of developments put clean energy definitively on the map over the past year. These include a near tripling in venture investments in energy technologies in the U.S. to more than \$2.4 billion; a new level of commitment by U.S. politicians at the regional, state, and federal levels; and significant corporate investments in clean-

energy acquisitions and expansion initiatives. One indicator: There are now a half-dozen stock indexes tracking the clean-energy sector in North America, including WilderHill's ECO, Ardour Capital's AGINA, and Clean Edge's own CELS and CLEN indexes. Clean-energy investing has now become accessible to the mainstream.

Two thousand and six also marked the year that even the most ardent naysayers about global climate change began to change their tune – and scientists, investors, business leaders, and politicians moved the conversation from whether climate change was occurring to what we are going to do about it. That acceptance of climate change as “real” helped to unlock latent interest in clean-energy technologies on the part of corporate and political leaders. In Washington and other capitals, clean energy is now a bipartisan issue. In corporate boardrooms, it is fast becoming an imperative.

We have reached the point where the steady and rapid growth of clean energy has become an old story.



As we highlight in our forthcoming book, *The Clean-Tech Revolution*, co-authored by Clean Edge's Ron Pernick and Clint Wilder (to be published by Collins in June 2007), six key forces are rapidly reshaping the global energy landscape. We refer to them as the "Six Cs": Cost, Capital, Competition, Consumers, China, and Climate.

These potent forces have moved clean energy from the fringes to the mainstream, and created dynamic new markets in some regions. Combined, they are accelerating the growth of technologies, companies, and markets faster than even many optimists might have imagined. At last, clean energy is having its day in the sun.

A \$226 Billion Market in 10 Years

According to Clean Edge research:

- global markets for biofuels (global manufacturing and wholesale pricing of ethanol and biodiesel) reached \$20.5 billion in 2006 and are projected to grow to \$80.9 billion by 2016;
- wind power (new installation capital costs) is projected to expand from \$17.9 billion in 2006 to \$60.8 billion in 2016;
- solar photovoltaics (including modules, system components, and installation) will grow from a \$15.6 billion industry in 2006 to \$69.3 billion by 2016; and
- the fuel cell and distributed hydrogen market will grow from a \$1.4 billion industry (primarily for research contracts and demonstration and test units) to \$15.6 billion over the next decade.

Together, we project these four clean-energy technologies, which totaled \$39.9 billion in 2005 and expanded 39 percent to \$55.4 billion in 2006, to quadruple to more than \$226.5 billion within a decade.

Select Corporate Clean-Energy Developments of 2006

- **Applied Materials** announced it was getting into the solar business in a big way. The company says it plans to have a \$500 million-a-year solar division by 2010. It acquired Applied Films, a publicly traded manufacturer of thin-film solar manufacturing equipment.
- **DuPont** set a target of generating \$6 billion in annual revenue from products meeting the definition of "sustainable" by 2015.
- **Honda** launched a second-generation Civic Hybrid (named *Motor Trend Car of the Year* for 2006), announced it was getting into the solar business, and established a wholly owned solar subsidiary.
- **Iberdrola**, one of the largest renewable energy operators in the world, unveiled its plan to acquire Scottish Power and its major wind power assets. It also purchased three U.S. wind-park developers.
- **Tyson Foods**, the world's largest chicken producer and meat processing company, formed Tyson Renewable Energy to turn its annual 2.3 billion pounds of animal fat into biofuels — enough feedstock for 300 million gallons of biofuels a year.

This level of growth is more akin to the PC, wireless, and Web industries during their heyday (PCs experienced more than two decades of 28.5 percent compounded annual growth) than the usually staid and slow-moving energy sector. And clean energy is attracting the interest and commitment of many of the same innovators and investors who created the info-tech revolution that preceded it. Take solar photovoltaics. Some of the largest manufacturers in the sector read like a *Who's Who* of consumer electronics: Kyocera, Mitsubishi, Sanyo, Sharp, and others.

Internet visionaries such as Google founders Sergey Brin and Larry Page are investing in clean-energy projects and initiatives. In 2006, Google began installing the largest announced rooftop solar PV system in the U.S.: 1.6 MW when completed in 2007.

As we briefly noted last year, one significant stumbling block along the path to a clean-energy future is the runup in production costs. While costs for clean energy have declined steadily over the past 30 years, recent years have seen price increases for solar PV modules, wind turbines, and biofuels. In 2004, the average cost to install a megawatt of wind power was around \$1 million; by last year, the cost had grown by about 20%. Similarly, solar PV costs have climbed, due mostly to the high cost of processed silicon. And profit margins for ethanol in the U.S. all but collapsed in 2006, as the price of corn nearly doubled in just two years. All of which pose a serious threat to the growth of the clean-energy sector.

But there is sunlight at the end of this tunnel. We believe solar prices will return to their downward trend as silicon costs stabilize and others, from multinationals to startups, begin deploying advanced manufacturing techniques that further cut costs. Prices for wind turbines also seem to be calming, and biofuels should gain traction as refiners apply next-generation refining techniques and find viable non-corn feedstocks.

And as we highlight in the following pages, we believe that a number of other developments will help turn the tide and bring lower costs back into the picture. These include everything from the advent of market-based global and regional climate trading schemes to the cost-cutting impact of Wal-Mart in building clean-energy markets.

U.S.-based venture capital investments in energy technologies nearly tripled from \$917 million in 2005 to \$2.4 billion in 2006. As a percent of total VC investments, energy tech increased from 4.2 percent in 2005 to 9.4 percent in 2006. Over the last seven years, venture investments in energy technologies have increased from less than 1 percent of total venture investments to nearly 10 percent.

Clean Energy Venture Capital Investments in U.S.-Based Companies as Percent of Total

Year	Total Venture Investments (US\$ Billions)	Energy Technology Investments (US\$ Millions)	Energy Technology Percentage of Venture Total
1999	\$59	\$468	0.8%
2000	\$103	\$1,329	1.3%
2001	\$41	\$932	2.3%
2002	\$21	\$566	2.7%
2003	\$18	\$547	3.0%
2004	\$20	\$716	3.3%
2005	\$22	\$917	4.2%
2006	\$25.5	\$2,425	9.4%

Source: Nth Power LLC and Clean Edge, Inc.

The Threat of Rising Costs

Venture Capital Investments

Although the number of companies that received VC investments grew from 84 to 140, the average deal size in 2006 took a more dramatic leap, to \$17 million, up from \$11 million a year earlier. The 2006 average was slightly higher than the 2000 record of \$16.8 million per deal.

Should investors be concerned about an energy-tech bubble? Probably not. Aside from a few known deals where valuation was played to the company's advantage or where some near-term liquidity could be reasonably expected, it appears that investors in the energy-tech category remained realistic about valuations. Our venture data shows that the median deal size grew only slightly from \$6.5 million in 2005 to \$8 million per deal in 2006. This is consistent with recent data from the overall venture capital markets showing that later-stage deals are showing some valuation inflation, but that early-stage deal valuations have remained flat.

Probably the most curious trend in 2006 was the willingness of early-stage investors to write checks to fund the build-out of ethanol, biodiesel and solar production. While some of these deals had elements of technology development, most were pure infrastructure. Investors poured more than \$1 billion into steel, cable, and concrete rather than into intellectual property.

The implication may be that returns for all but the earliest of investors in some of these deals (particularly biofuels) are not likely to be in line with typical early-stage venture investing. Large capital raises typically leave companies with high post-investment valuations that, in theory, come with a lower exit-value expectation, albeit with accompanying lower risk. This kind of risk/reward scenario is appropriate for some investors, but typically not venture capital.

Consistent with capacity deals in other energy-tech sectors, the largest dollars in energy-intelligence flowed to capital-intensive powerline communications deals. With the expected rollout of advanced metering initiatives, and the opportunity to create additional revenue streams from high-speed data communications over the electricity grid, investors became bullish on companies like Current Communications (investing \$130 million), BPL Global (\$30 million), and Intellon (\$18 million).

With energy efficiency and demand response high on the list of many utilities as a "new" source of power, energy-intelligence companies may be the new darlings of energy tech.

The unexpected surge of investment in capacity deals suggests the multi-year growth trajectory in energy-tech investments may be difficult to maintain. Energy-tech investors will have to meet or exceed the nearly \$1 billion in capacity investments made in 2006 to keep pace in 2007. This begs the rhetorical question: Will 2006 be a spike in an otherwise long-term upward trend, or will it be the peak before a downturn or flattening of venture capital dollars in energy-tech deals?

Should investors be concerned about an energy-tech bubble? Probably not.

Capacity Deals

'Intelligent' Energy

What to Watch for in 2007

FIVE TRENDS TO WATCH

How will clean-energy markets develop? Here is how we view the landscape.

1. CARBON FINALLY HAS A PRICE . . . AND A MARKET

After years of resisting carbon regs, many large U.S. corporations are now demanding it.

Since the market success of the U.S. sulfur dioxide emissions trading program in the early 1990s, climate-change activists have pushed for similar market-based approaches to reduce the greenhouse gas (GHG) emissions that fuel climate change. At last, carbon trading is now poised for significant growth and will be one of clean tech's biggest global markets in 2007.

Last year's enactment of GHG limits in California marked a milestone in climate regulation. That law, combined with the Regional Greenhouse Gas Initiative (RGGI) of nine Northeast states (plus Maryland, expected to join this year), has sent a strong signal to U.S. companies: get ready for mandatory carbon caps. "I believe nationwide cap-and-trade legislation will be passed by Congress in the next 12 months," said Michael Eckhart, president of the American Council on Renewable Energy, earlier this year.

After years of resisting carbon regs, many large U.S. corporations are now demanding it. Alcoa, Caterpillar, Duke Energy, FPL, General Electric, and PG&E are among the companies that joined with environmental nonprofits to form the U.S. Climate Action Partnership, calling for GHG legislation that would include a national carbon market. Duke CEO James Rogers told the *Wall Street Journal*, "If you're not at the table when these negotiations are going on, you're going to be on the menu."

Most climate policy analysts and virtually all corporations that favor carbon regulation support a market-based, cap-and-trade system rather than a government-imposed carbon tax. Such a

Profile:

Chicago Climate Exchange

Location

Chicago, Illinois
www.chicagoclimatex.com

Founded

2003 (start of trading)

Member Organizations

225

Technology

Its CCX Trading Platform allows members to trade carbon dioxide credits over the Internet.

The Buzz

The world's first voluntary carbon-trading exchange, CCX has pioneered the concept in the U.S. ahead of any government mandates, attracting many blue-chip companies as members. Trading volume jumped to 10.2 million tons of CO₂ in 2006 from 1.4 million tons the previous year.

Brain Trust

Founder and chair Richard Sandor pioneered the trading of interest-rate futures as an economics professor at UC Berkeley, then spent 10 years at the Chicago Board of Trade (CBOT) and eight years developing futures markets at Drexel Burnham Lambert. In the 1990s, he was instrumental in moving the EPA's annual auction of sulfur dioxide allowances to CBOT.

Bankrollers

CCX is owned by Climate Exchange plc, a public U.K. company that also owns the European Climate Exchange. Goldman Sachs bought a 10% stake last year for \$23 million.

Our Take

CCX's system is far from perfect, criticized by some for being unfairly weighted toward big utilities, and by others for being too weak to significantly cut GHG emissions. But with government-mandated cap-and-trade policies on the near horizon, CCX represents the best model to show both the benefits and flaws of carbon-trading markets.

system for RGGI states is scheduled to start in 2009. California's new law doesn't mandate a cap-and-trade system, but it is widely expected that one will eventually unfold in the Golden State. The four-year-old Chicago Climate Exchange, the first and biggest carbon trading system in the U.S., has experienced steady trading growth and now numbers 225 members.

Outside the U.S., the carbon-market horse has already left the stable. Global trading in carbon credits nearly doubled from \$11 billion in 2005 to \$21.5 billion in just the first nine months of 2006, according to the World Bank. Some 88 percent of that, \$19 billion, took place through the European Union's Emissions Trading Scheme, established in 2003 as part of the Kyoto Protocol implementation.

Companies' GHG strategies are getting Wall Street's attention: Some analysts, such as Innovest Strategic Value Advisors and Sanford C. Bernstein, now rate stocks in terms of carbon risk and are establishing funds of potential winners. Morgan Stanley plans to spend \$3 billion over the next five years to trade carbon credits.

That kind of financial firepower suggests that the emergence of carbon as a market force is more than just hot air.

Goldman Sachs Expects Big Returns from Going Green

Massachusetts Joins Regional Greenhouse Gas Initiative

EU to Propose 20% Emissions Cut by 2020

Morgan Stanley to Invest \$3 Billion in Emissions Reduction Credits

Carbon Trust Recommends 'Reformation' of UK Renewables Policy

California Bill Sends Clear Message that State Will Fight Global Warming

Ford Launches Customer Carbon Offset Program

Interface Purchases More than 33,000 Tons of Carbon Offsets

2006 Top Headlines

Carbon Disclosure Project

www.cdproject.net

The Carbon Trust

www.carbontrust.co.uk

Chicago Climate Exchange

www.chicagoclimatex.com

DuPont

www.dupont.com

EcoSecurities

www.ecosecurities.com

Select Organizations to Watch

2. BIOREFINERIES BEGIN TO CLOSE THE LOOP

Not only must we find alternatives to resource-intensive biomass crops such as corn, we must also reduce the fossil fuels needed in the refining process.

President Bush's 2007 State of the Union speech called for 35 billion gallons a year of biofuels by 2017. That's nearly a fivefold increase over earlier federal mandates of 7.5 billion gallons by 2012. To put that number in perspective, 35 billion gallons represents approximately 15 percent of anticipated U.S. gasoline consumption in 2017.

Reaching such ambitious targets with today's refining and processing technologies will be a tall task. Not only must we find alternatives to resource-intensive biomass crops such as corn, we must also reduce the fossil fuels needed in the refining process. Today, most biorefineries are powered by natural gas and some are turning to coal.

A number of forward-thinking companies are beginning to find a way forward, implementing closed-loop techniques – in which waste streams are turned into value-added resources and energy streams – to drive down costs, maintain competitive advantage, and help guarantee a sustainable supply of ethanol, biodiesel, and other biofuels.

VeraSun Energy, for example, says it has developed a process to produce biodiesel from distillers grain, the major byproduct of the ethanol refining process. If successful, the company will be able to produce two biofuels from one feedstock. VeraSun plans to launch a new refining facility in 2008 to help validate this two-for-one concept.

However promising, it's only a start.

A number of refiners are turning to cow manure from nearby feedlots as an energy source. In these facilities, manure is gasified to power ethanol refining facilities. Panda Ethanol has

Profile:

Panda Ethanol

Location

Dallas, Texas

www.pandaethanol.com

Founded

1982

Employees

44

Technology

Panda seems to have pieced together technologies to turn cow manure and other wastes into a gasified energy source for ethanol production. If successful, it will have some of the world's most efficient ethanol refineries, removing natural gas and other fossil fuels from the refining process.

The Buzz

For nearly 25 years, the firm (founded as Panda Energy) has developed and financed \$5 billion in energy projects totaling more than 9,000 megawatts of power. In 2005 it began to set its eyes on the growing ethanol and biofuels market, with a twist. It now claims it will use manure to power four of six planned refineries. In 2005, Newsweek named it one of the most eco-friendly American companies.

Brain Trust

Panda Energy was launched in 1982 by current chairman Robert Carter and Panda Ethanol is now run by his son, CEO Todd Carter.

Bankrollers

Panda raised roughly \$90 million in private-equity financing last June before going public late last year when it merged with an existing publicly-traded company, raising an additional \$8 million along the way. It now trades on the over-the-counter bulletin board.

Our Take

Panda's plan to develop 100 million-gallon a year ethanol plants, many powered by cow manure, is pushing the limits on closed-loop, low-cost, efficient ethanol refining. Its history as a developer and financier of more traditional energy plants in the U.S. and Asia could give it the experience and clout needed to deliver on its ambitious plans. But it will take ample amounts of capital, commitment, and specialized knowledge to make its closed-loop ethanol promise a reality.

announced plans to open up four such facilities, which collectively would use up to 4 billion pounds of cow manure a year. E3 Biofuels says it will have the first such plant up and running in the U.S. in early 2007, using manure as the facility's sole power source.

Other innovators envision something radically different. They are working to harness oil-rich algae to create biofuels. Deploying closed-loop techniques, several companies and research organizations are looking at how algae could utilize farm wastes and emissions from factory smokestacks to help speed algae growth as a biofuel feedstock. Talk about green energy!

Not all refiners are likely to deploy such closed-loop methods; producing ethanol from corn using fossil fuels will remain in the picture for some time. But the growth of these innovative technologies will help to fulfill the world's growing thirst for biofuels in ways that are both economically and environmentally viable, turning polluting wastes into resources along the way. That will have a significant impact on several fronts, saving refiners money, providing new revenue sources for farmers, providing cleaner fuel for drivers. And making environmentalists happy, too.

Methane from Manure Could be New Cash Crop

Panda Ethanol Completes \$188 Million Financing for Manure Powered Ethanol Plant

Algae May Be Cultivated for Biofuel

Pilot Plant to Turn Manure into Usable Energy

Closed-Loop Ethanol Plant to Start Production

Closed-Loop Biodiesel Production Among Winners at National Sustainable Design Expo

Cow Pies Power Ethanol Future

Glycerin as a Biogas Feedstock

2006 Top Headlines

Bion Environmental Technologies

www.biontech.com

E3 Biofuels

www.e3biofuels.com

LiveFuels

www.livefuels.com

Panda Ethanol

www.pandaenergy.com

VeraSun Energy

www.verasun.com

Select Companies to Watch

3. ADVANCED BATTERY MAKERS TAKE CHARGE

The robust growth of electric vehicles, plug-in hybrids, and gas-electric hybrids has helped to fuel global interest in batteries, creating huge needs for on-board solutions with ample storage and rapid recharge times.

The news that batteries are heating up can be worrisome – unless you're talking about breakthroughs in advanced batteries, blue-chip investor funding, and attention from big corporate players. That's exactly what's happening in the heretofore humdrum world of batteries, as the makers of everything from cars to cordless drills seek to take advantage of next-generation advancements in energy storage devices.

Basic rechargeable battery technology has advanced – from lead-acid to nickel-cadmium to nickel-metal hydride (NiMH) – but most rechargeable batteries still carry a lot of weight relative to their storage capacity and discharge time. Nanotechnology-based innovations in lithium-ion battery technology are changing that, while addressing the heating issues that have created vexing safety hazards.

The robust growth of electric vehicles, plug-in hybrids, and gas-electric hybrids has helped to fuel global interest in batteries, creating huge needs for on-board solutions with ample storage and rapid recharge times. Most hybrids today use NiMH batteries, but General Motors is working with lithium-ion pioneer A123 Systems and NiMH supplier Cobasys to power its Chevy Volt electric concept car. Tesla Motors' sporty \$92,000 electric Roadster hits the market this year powered by 7,000 small lithium-ion cells similar to those in cameras and cell phones. "Thirty to forty percent of our engineering work has gone into that battery pack," says Tesla CEO Martin Eberhard. Tesla has formed a new group to license its battery-pack technology to other companies, possibly including Norwegian electric car maker Think Global.

Investors see opportunity, too. The batteries sector saw more than \$100 million in venture

Profile:

A123 Systems

Location

Watertown, Massachusetts
www.a123systems.com

Founded

2001

Employees

250

Technology

High-powered lithium-ion batteries, based on nanoscale materials, for use in vehicles, power tools, consumer devices, and other products.

The Buzz

Fueling A123 is a promising combination of academia (spun out of research at MIT), commercial funding from top corporations and venture capital firms, and Pentagon interest through investor OnPoint Technologies, the U.S. Army's VC arm.

Brain Trust

President and CEO David Vieau has more than 30 years of high-tech and component industry management experience, most recently as VP of marketing at American Power Conversion. Founder and VP of business development and marketing Rick Fulop started A123 to commercialize tech advances that he worked on in the material sciences department at MIT.

Bankrollers

More than \$100 million from General Electric, Motorola, Procter & Gamble, and Qualcomm, and from venture firms, including FA Technology Ventures, North Bridge Venture Partners, OnPoint, and Sequoia Capital.

Our Take

A123's name seems to be everywhere. The company is supplying lithium-ion batteries for Black & Decker's DeWalt power tools, working with General Motors on its new Chevy Volt electric concept car, and recently brought on Procter & Gamble, the owner of Duracell batteries, as a strategic investor. Well-funded and growing, the company appears poised to ride the wave of advanced-battery momentum. The only question is whether the company is trying to address too many different markets too quickly, risking that it may run out of juice.

investments in 2006, taking its place at the VC table with biofuels, solar, efficiency and grid improvements, and fuel cells. A123 Systems, Boston-Power, Electro Energy, and Infinite Power Solutions are among those receiving recent VC infusions. Meanwhile, corporate powerhouses like 3M and Toshiba continue to compete aggressively in the battery sector.

One potential game-changing technology is that of ultracapacitors, which could alter the tradeoff between weight and storage capacity (traditional capacitors are light but store little energy). Ultracapacitor developer EESstor of Cedar Park, Tex., backed by venture capitalists Kleiner Perkins Caufield & Byers, recently announced its first customer: Toronto-based ZENN Motor Company will use EESstor's technology in electric cars it plans to launch late this year. That deal will be watched closely and could add to EESstor's – and advanced batteries' – already considerable buzz.

MIT Powers Up New Battery for Hybrid Cars

A123Systems Receives \$30 Million for Hybrid Battery Development

General Motors Selects Battery Supplier for Plug-Ins

Battery Developers are White-Hot Commodities in Detroit

EESstor Announces Two Key Production Milestones

Tesla Puts Tech in Economy Cars

Fuel Cells and Advanced Batteries Vie for Portable Power Market

Infinite Power Solutions Raises \$34.7 Million for Building Thin-Film Battery Manufacturing Facility

2006 Top Headlines

A123 Systems

www.a123systems.com

Altairnano

www.altairnano.com

Infinite Power Solutions

www.infinitepowersolutions.com

Nanoexa

www.nanoexa.com

Valence Technology

www.valence.com

Select Companies to Watch

4. WAL-MART BECOMES A CLEAN-ENERGY MARKET MAKER

The \$312-billion-a-year behemoth, which during 2006 launched a dizzying array of green initiatives, seems hellbent to be a clean-energy force.

There are signs that the road to a clean-energy future may pass through your local Wal-Mart. The \$312-billion-a-year behemoth, which during 2006 launched a dizzying array of green initiatives, seems hellbent to be a clean-energy force.

In recent months, the company has: committed to selling 100 million compact fluorescent light (CFL) bulbs in 2007; pledged to double the fuel efficiency of its trucks; sought proposals for a potentially massive solar PV rollout for its stores; opened the first in a series of “high-efficiency” superstores aimed at cutting energy use; and launched other energy-related initiatives.

It’s all part of the world’s largest retailer’s ambitious, even audacious, goals: to eliminate 30% of energy used in its stores, emit up to 30% fewer greenhouse gases, and operate its stores entirely on renewable energy.

There’s method to this madness. Energy is a billion-dollar line item for Wal-Mart, its second-biggest cost after labor. Efficiency stands to garner hundreds of millions in savings – \$52 million a year in fuel savings from truck improvements alone – while keeping prices low for customers (and, perhaps, high for its competitors).

The energy initiatives will enable the retailer to ramp up business with some of its largest suppliers – for example, GE, Philips, and Sylvania, which dominate the CFL market. But don’t discount the retailer’s potential to make (or break) the fortunes of other firms selling clean energy and efficiency.

Take trucks. In seeking hybrid-electric diesel vehicles used for medium-haul duties, Wal-Mart turned to established players like Cummins, Eaton, and International Truck – but also to lesser-known ArvinMeritor, which makes truck

Profile:

Cellex Power Products

Location

Richmond, British Columbia
www.cellexpower.com

Founded

1998

Employees

34

Technology

Makes hydrogen fuel-cell systems for companies operating large fleets of electric lift trucks in the distribution and logistics industries.

The Buzz

Early this year, Cellex successfully completed trials at two Ohio-based Wal-Mart distribution centers. The zero-emission pallet trucks met and exceeded uptime, fueling, environmental, and safety targets, logging more than 18,500 hours of continuous operation, refueling more than 2,100 times (in less than two minutes each time). It was a major milestone for Cellex, demonstrating that industrial lift trucks will be among the early adopters of hydrogen fuel cells.

Brain Trust

Chris Reid, President and CEO, was recruited by VC Ventures West to identify opportunities for fuel cells beyond the automobile market. He’s backed by a powerhouse team: Adrien Corless, VP of Technology, who came from Ballard; Tom Hoying, VP of Sales and Marketing, who logged 20+ years with Crown Equipment Corp., the largest lift-truck OEM in North America; and John Lee, COO, who came from the backup power sector.

Bankrollers

Three rounds of private financing, totaling just north of \$50 million, from a variety of VC and strategic investors, led by Ventures West.

Our Take

On the heels of its Wal-Mart success, Cellex is now taking on Sysco, the foodservice behemoth, and has been in discussions with more than a dozen other corporate giants. There are hurdles ahead — getting the costs down is still a challenge, for example, though the company says it is “getting there.” If it can lick that issue, there’s no limit to how high this lift-truck company can climb.

drivetrain systems and components. Novar, a division of Honeywell, provided controls for Wal-Mart's store in McKinney, Tex., the retailer's learning lab for energy-efficient technologies.

And then there's Wal-Mart's solar play, the winner(s) of which weren't known as of this writing. That contract, potentially worth hundreds of millions of dollars, could provide a surge to makers of modules, inverters, and related components – and to solar installers in the five states it has targeted.

There's more in the pipeline. The retailer reportedly is experimenting with a far-out "SuperMag" generator that manipulates magnetic fields to create electricity. And Wal-Mart's legendary cost-cutters are training their sights on conventional energy, too, setting up the company's own utility, Texas Retail Energy, to supply stores with cheap power bought at wholesale prices – and saving \$15 million a year in the process.

Could Wal-Mart do for renewables what it already has done for everything from laptops to lingerie: make them affordable by the masses? Wal-Mart could well become a powerhouse in the energy marketplace.

Wal-Mart Announces Goal of Selling 100 Million Energy Efficient Light Bulbs

Wal-Mart to Open First High-Efficiency Store

Wal-Mart Readies Large-Scale Move into Solar Power

Cleantech Industry Should Get Boost From Wal-Mart Initiative

Wal-Mart Grows Green with Energy-Saving Plan

Will Wal-Mart Sell Electricity One Day?

Wal-Mart Looks To SuperMag To Save Energy

Wal-Mart Seeks to Double Truck Fuel Economy by 2015

2006 Top Headlines

ArvinMeritor
www.arvinmeritor.com

Bergey Windpower
www.bergey.com

Cellex Power Products
www.cellexpower.com

Murphy Oil Corp.
www.murphyoilcorp.com

Novar Controls
www.novarcontrols.com

Select Companies to Watch

5. UTILITIES GET ENLIGHTENED

Energy utilities didn't, for the most part, find themselves in the clean-energy business willingly, but a growing number are discovering their "green gene." And while only a handful of utilities actively embrace solar, wind, and other clean technologies, there are signs the sector's longtime, monolithic resistance to clean energy is starting to lose power.

While only a handful of utilities actively embrace solar, wind, and other clean technologies, there are signs the sector's longtime, monolithic resistance to clean energy is starting to lose power.

For starters, the industry has finally recognized that climate change is a problem that requires action. This was inevitable. After all, top execs of some of the biggest U.S. utilities, such as Duke Energy's Jim Rogers and Pacific Gas & Electric's Peter Darbee, have expressed concern over the issue, even calling for mandatory emissions caps or – *gasp* – carbon taxes. But they're no longer alone. Early this year, the Electric Power Supply Association, representing about a third of U.S. power generation, called for federal caps on climate emissions. And the Edison Electric Institute, representing investor-owned utilities, called for (weaker) federal action to cut climate emissions.

For most utilities, however, such concern is only beginning to translate into products and services. In Texas, municipally owned Austin Energy, which already offers clean energy to its customers at the lowest premium in the nation, has created the first test-bed environment in the U.S. for clean-energy companies to prepare their technologies for commercialization. And other utilities are starting to post impressive numbers. In the U.S. Midwest, Xcel Energy generates 1.3 gigawatts of wind power, and has more coming; Florida-based FPL Energy lays claim to being "the leading producer of wind power in the world" as well as operating two of the world's largest solar fields; and AES says it plans to invest about \$1 billion over three years in clean-energy projects, specifically wind power and biomass. Such devel-

Profile:

Pacific Gas & Electric Company

Location

San Francisco, California
www.pge.com

Founded

1905

Employees

20,000

Technology

Provides natural gas and electric service to approximately 15 million people throughout a 70,000-square-mile service area in northern and central California.

The Buzz

PG&E has been on a clean-energy rampage of late, rolling out a breath-taking series of initiatives, from smart-metering millions of homes to considering a plan to charge fleets of battery-powered cars overnight with wind energy and let consumers sell back some of the stored energy during the day. With solid investments in solar, wind, hydro, and biomass, and no dirty coal plants to soil their image, California's largest utility is showing that efficiency and clean energy can power profits and shareholder value.

Brain Trust

Chairman and CEO Peter Darbee joined PG&E in 1999, after senior-management stints in the telecom industry. He has been an avid cheerleader for energy efficiency and renewables.

Bankrollers

PG&E's stock has performed well, rising 27.5% during 2006. The company posted solid year-end financials and raised its earnings guidance for 2007.

Our Take

It was only three years ago that PG&E emerged from bankruptcy, but now it seems rich with promise. With strong support from its CEO, and a push from California's governor and legislature, PG&E has become the leading investor-owned utility for clean energy. And there's more to come. For at least the remainder of this decade, Darbee and crew will roll out a series of technological and policy innovations that will help turn this once staid and barely solvent company into a lean, clean machine.

opments are creating new partnerships between utilities and clean-power companies, a status few could have claimed just a few years ago. Both entrepreneurs and behemoths like GE and Siemens are finding a more welcoming environment.

All good, of course, but it's only a start. Huge challenges remain. Large numbers of new coal and nuclear plants are still being proposed. Equally significant, precious few U.S. utilities outside of California have aggressively mined the potential for efficiency measures to eliminate the need to build new plants altogether – the victim, in many cases, of state and local policies perversely discouraging efficiency. And the grid needs fixing, if not rebuilding, harnessing “smart” technologies that improve its efficiency while making it more amenable to integrating distributed clean-power sources.

But all this, too, is destined to change. As voters, ratepayers, regulators, politicians, shareholders, activists, and others recognize that investments in efficiency and clean energy will yield dividends of reduced climate and public health risks, not to mention boosting jobs and economic development, the pressures on utilities to act will be an unstoppable force. And utilities already leading the clean-energy parade will find that they are positioned and empowered to reap the benefits.

PG&E Requests Additional 400 MW Renewable Power in New RFP
ACORE Announces Formation of Utility Committee for Renewable Energy
Energy Efficiency Council Report Finds Utility Policies Keep Efficiencies Off the Grid
Southern California Edison Signs 1500 MW Wind Energy Contract
Austin Energy to Support Plug-in Hybrid Development
AES Corporation Planning Billion-Dollar Alternative Energy Investment
California PUC Approves Landmark Solar Program - 3,000 MW in 11 Years
Concentrating Solar Power Ready to Replace Fossil Fuels, Say Colorado Ratepayers

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Select Companies to Watch

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Ron Pernick, co-founder and principal of Clean Edge, is an accomplished market research, publishing, and business development entrepreneur with two decades of high-tech experience. He oversees Clean Edge's strategic initiatives, including the co-production of the Clean-Tech Investor Summit and creation and management of the NASDAQ® Clean Edge® U.S. Index. He has been an instructor and adjunct faculty at UC Berkeley, New College's Green MBA program, and Portland State University. His forthcoming book, *The Clean Tech Revolution* (with co-author Clint Wilder), will be published by Collins in June 2007.

Clint Wilder, contributing editor for Clean Edge, is an award-winning technology and business journalist. His book, *The Clean Tech Revolution* (with co-author Ron Pernick), will be published by Collins in June 2007. Wilder is a frequent speaker at industry events, including United Nations World Environment Day and the Wharton Private Equity Conference. Before joining Clean Edge, he was editor-at-large and columnist for *Optimize* magazine, a monthly journal for high-level business technology executives, and won the 2002 American Society of Business Publication Editors award for best feature series for *Information Week*.

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