

Special Advertising Section

MAINSTREAMING ALTERNATIVE ENERGY

By Joe Mullich

The Christmas tree at Rockefeller Center went solar last December, lighting up hundreds of colorful bulbs using panels that captured the power of the sun. The Oregon Institute of Technology has just graduated the country's first group of students in a four-year degree program in renewable-energy systems. More than half of power company executives have windmills on their minds; one of their key strategies over the next decade is to expand the use of wind power, according to a new study.

Given the huge interest in alternative energy, can it even be called "alternative" anymore?

The current focus on clean energy is not a bubble or passing phenomenon, says a new report from Cambridge Energy Research Associates (CERA), a consulting firm in Massachusetts. Clean energy is now moving from the fringes of the energy sector to the mainstream.

The growing view of global warming as a threat to the environment and political security will continue to drive alternative energy even if rising oil prices subside, the report contends. All around the world, efforts are underway to extract power from the sun and the wind as well as from surprising new sources, like ocean waves and pond scum.

Billions of dollars in venture capital are flowing to these new ideas and technologies. Each segment of alternative energy faces obstacles, such as finding ways to connect the sources of alternative energy to users. However, environmental concerns and government mandates requiring utilities to provide a growing share of their output from sources other than fossil fuel will continue to spur action. According to CERA, the most widespread drive for innovation that the energy industry has ever experienced is now underway.

BioMass Power Generation

The search for alternatives to fossil fuels has led people to some odd places — such as pond scum and turkey dung. First, let's wade into the pond: Algae were probably not the first thing that came to Thomas Edison's mind when he was looking for ways to power the electric light bulb. However, algae grow by photosynthesis, meaning the plants absorb carbon dioxide and can be processed into fuel oil just as soybeans and other crops can.

The U.S. Department of Energy says algae can provide 30 times more energy per acre than land crops, because of its cellular structure and rapid reproduction cycles. Half of its body weight is composed of oil, compared to just 20 percent of oil-palm trees. Another plus: Algae can be produced on land that isn't suitable for growing food.

The "oilgae" efforts to date have been relatively modest and face some technical challenges. However, a Texas algae farm that began operations on April 1 plans to produce 4.4 million gallons of algae oil a year. Consider that the next time your feet get tangled in seaweed, the most highly developed form of algae.

Algae is far from the only form of "biomass power generation" — materials from agriculture, food processing, forestry byproducts or even garbage that can be turned into a combustible gas, called biogas, or burned to produce steam for energy generation.

In Minnesota, for example, a power plant recently opened that creates energy from a combination of turkey dung and wood chips. What's more, Pacific Gas and Electric Co. recently unveiled a plan to collect methane from manure on a Fresno County dairy farm and turn it into biogas, which is almost identical to natural gas.

A report from the National Commission on Energy Policy said the contribution of biomass to overall energy production



Everyone from power company execs to consumers seek energy from the sun, wind, ocean waves — and even pond scum

will hinge on technology innovation, realizable feedstock sources and lower transportation costs. Questions have also been raised about whether growing crops for energy reduces food production and increases food prices.

Biofuels — primarily transportation fuels that are derived from biological sources, such as corn and sugar beet — are generally considered their own special class of biomass. Research from a Washington, D.C. law firm discovered that 2,796 biofuel-related patents were published in the U.S. from 2002 to 2007, with the number of patents increasing by 150 percent in each of the last two years of that period. The 1,045 biofuel patents in 2007 were almost double those for solar power and quadruple those for wind power.

Here Comes the Sun

Solar power dates back to ancient Greeks, Chinese and other early cultures that warmed buildings by orienting them to the sun. And now, 2,000 years later, solar power is hotter than ever.

Today, that glass of Merlot you had for dinner may be partly a result of solar power. Wineries throughout Napa and Sonoma County are among the heaviest users of solar power, with some operations installing thousands of solar panels to provide most of the electricity they use in their bottling plants.

Big box retailers — with their huge energy bills and large flat roofs — are quickly installing solar panels, as well. Some stores use enough solar modules to cover an entire football field. Wal-Mart, for example, has announced plans to begin a pilot program to use solar-powered generators in 22 stores in California and Hawaii. Best Buy, Safeway, Whole Foods, Costco and other large retailers have taken a shine to the sun, as well, announcing or beginning their own solar installations. Boston's Fenway Park is planning a new rooftop solar installation that will meet 37 percent of the stadium's water-heating load, according to the Boston Globe.

These examples represent half of the solar-power industry: The Wal-Mart stores, wineries and standalone operations use photovoltaic (PV) solar power, primarily composed of rooftop systems that rely on semi-conductors to turn sunlight into electricity. PV installations

in the United States grew by 45 percent last year, according to a report from the Solar Energy Industries Association. This segment of the solar market has been buoyed, in part, by technology advances like thin film and nanotechnology, which are engineering materials on an atomic scale.

The second, and newest, effort to harness the sun's power is "solar power plants." These operations go by the technical names of solar thermal technology or concentrating solar power (CSP). The plants use huge arrays of mirrors to concentrate the sun's rays, usually to boil water to generate steam to power turbine generators like those that run on coal or natural gas.

In 2007, a CSP plant came online in Nevada, the first commercial CSP plant to be constructed in the United States in 17 years, a testament in part to the zealous search for fossil fuel replacements. More solar plants are underway in California, Nevada, New Mexico and Arizona, leveraging the abundant sunlight offered in the southwestern United States year round.

According to Emerging Energy Research, a consulting firm in Cambridge, Mass., CSP plants could get the cost per kilowatt hour down from 15 to 20 cents to 10 cents, compared to 7 cents per hour for newly built coal-fire plants. Utilities are intrigued by solar power because it produces the most power on hot days when people are most likely to run their A.C., making them competitive with plants that use natural gas at some times now. Advocates point to several long-term pacts utilities have signed for CSP as the surest sign of the technology's viability.

Thar She Blows!

Most people believe at least part of the answer to cutting greenhouse gases is blowing in the wind. Wind power now provides 1 percent of the nation's energy, enough to power about 4.5 million homes. Last year, installed wind capacity grew by a whopping 45 percent. Experts believe that wind power could eventually provide at least 5 to 7 percent of the nation's total energy — the lower end represents the 2020 goal of the Department of Energy's "Wind Powering America" initiative.

In Denmark, where towering windmills are pointed out by tour guides and

featured on postcards — and the manufacturing of wind turbines is a major industry — wind power provides one-fifth of the country's energy. Emerging Energy Research projects that \$65 billion will be invested in wind power from 2007 to 2015.

The dramatic growth in worldwide wind capacity largely reflects advances in turbine technology and the low operating costs, according to a report from Goldman Sachs. The U.S. Department of Energy notes the cost of wind power has declined by 80 percent over the past three decades, down to 4 to 6 cents per kilowatt hour, making it one of the most economically viable sources of alternative power today.

The United States recently passed Spain to become the second biggest producer of wind power, trailing only Germany. Texas, which conjures images of towering oil derricks for some people, is the number-one state for wind power production. It's also the home to the world's largest wind farm, Horse Hollow Wind Energy Center, which sprawls across 47,000 acres in central Texas.

Modern windmills go far beyond anything Don Quixote could have imagined. Some stand twice as tall as the Statue of Liberty, with blades as long as a football field.

In the United States, "water-pumping windmills" were a major reason farming and ranching could be introduced to dry areas. Now wind farms are becoming a new cash crop for farmers in the Midwest, Great Plains and West, who are leasing their land to windmill developers or selling the power from windmills themselves. Food crops are being planted right up to the base of the large turbines.

Nothing more clearly indicates interest in wind power than the annual survey that PricewaterhouseCoopers, the global consulting firm, conducts with utility industry bigwigs around the world. In 2006, only 17 percent of those utility executives surveyed by PricewaterhouseCoopers thought wind power would provide an increasing share of their market's energy consumption over the next five years. When asked the same question a mere 12 months later, nearly half of the utility executives held that belief.

Instead of just buying wind power, utilities increasingly want to own the facilities that produce the energy. Southern California Edison has begun construction on the largest wind transmission project in the U.S., expecting it to be operational in 2009.

If you think sports stadiums are the only place corporations want to name, consider this: The cache of alternative

Illustration by Michael Austin

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energy has even caused Steelcase, the office furniture maker, to not only buy all the renewable energy credits from a new large Texas wind farm; Steelcase reportedly paid a premium for the rights to name the wind farm after the son of their company's founder.

Catch a Wave

Anyone who has swum against a strong current knows the raging power of the ocean. Numerous efforts are underway to turn waves or tidal flows into electricity. Last December, the first federal license was issued to build a wave plant in the U.S. off the coast of Washington state.

The project uses a series of buoys connected to long cylinders. As the buoys bounce up and down on the waves, they turn a shaft that powers a generator. The resulting electricity is carried to shore through an underwater cable. Other water-power projects use floating barges or submerged devices, which capture the power of underwater tidal currents rather than the breaking waves on the surface.

Ocean power is not as refined as wind or solar power, but the predictability of marine sources of energy intrigues advocates. Wave patterns can be accurately forecasted several days in advance, while sunlight or wind is less predictable, though those forecasting efforts are improving so companies can "schedule" wind and sun power with increasing accuracy.

In one presidential debate, Republican candidate John McCain even listed tidal power with more-established renewables such as solar and wind as a solution to the nation's energy needs. And in another industry first, Pacific Gas and Electric Co. committed to a 15-year-deal to purchase a small amount of energy from the Washington wave plant.

Thus far, Europe has taken the lead in marine power. The world's oceans can provide enough capacity to provide 10 times the power used in Britain, according to a research group funded by that country's government. Practically speaking, some analysts predict by 2020 Europe will have wave and tidal farms that produce the power of up to 10 coal-fired power plants.

Until then, advocates are pushing hard to prove the energy benefits of waterworks, some using a bit of PR razzle-dazzle: For example, a sailor, who made headlines six years ago by making a trans-Pacific trip in a boat made from recycled beer cans, set sail from Hawaii to Japan in a vessel powered solely by the power of waves.

The Quest:
Cheaper Energy

Unquestionably, the push for new energy sources will continue on many fronts, as the demand for cheaper, more reliable and ecologically friendly forms of energy mounts. Nuclear, solar, wind and other sources of energy will take an increasing role in powering the world.

New ideas for alternative energy — of varying degrees of practicality and stages of development — are constantly being advocated and tested.

Joe Mullich's articles on technology, business and other topics have appeared in *Information Week*, *eWeek*, *Salon* and more than 100 other publications. His writing has earned over two dozen awards from press organizations.

Here's a small sample of alternative energy initiatives around the world:

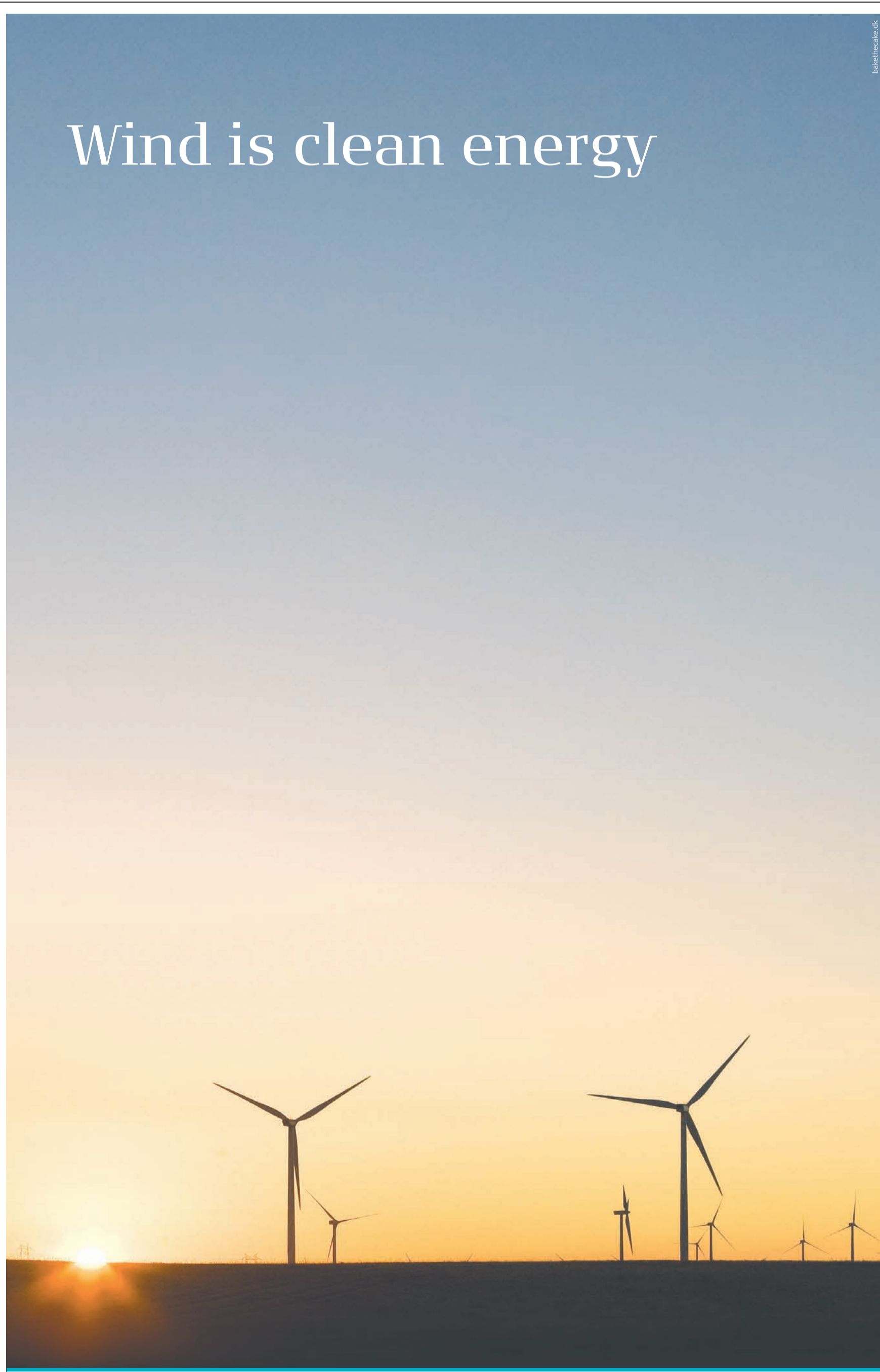
- * **Waste Not Wastewater.** A pilot program is underway in one city to use highly treated waste water pumped from a nearby plant to heat and cool buildings and then use the piped water to irrigate vineyards and landscaping.
- * **Heat the Road, Jack.** If you've ever gone barefoot on a summer day, you know the heat that hot asphalt can trap. A Dutch company is unlocking that power to warm apartment buildings and industrial parks.
- **Hold the Fries, Take the Grease.** An owner of a fast-food chain takes the French fry grease he used to throw out and recycles it into fuel for the two cars his business uses.
- **What a Whirlwind.** While it may sound like a plot for a superhero movie, an inventor has patented an idea to create electricity out of manmade tornadoes that would turn turbines.

Perhaps the surest sign of the future of alternative energy is that no less an industry titan than Google, the search engine giant, announced in November a new strategic initiative to generate 1 gigawatt of energy from renewable sources — about as much energy as a fair-size nuclear power plant can provide. Google announced it expected to spend tens of millions of dollars on research and development in 2008 in its quest for renewable energy sources that are cheaper than coal.

As the public appetite for alternative energy grows, new homebuilders are offering houses with reduced carbon footprints, trying to tempt aging baby boomers who want to make an environmental difference. Televisions, computers and other gadgets that use energy more efficiently are coming out, as well.

The public at large appears to be on board with renewable energy, at least the more proven sources like wind and solar (manmade tornadoes might raise some eyebrows). More than half of the people questioned by Deloitte & Touche, the global consulting firm based in New York, said they would pay more for alternative energy sources. These consumers also would have no problem with alternative energy facilities being built within "sight of home."

Wind is clean energy



Our environment depends on our ability to find new ways of creating clean energy. Energy that does not pollute, create waste or produce greenhouse gasses. Modern energy.

Wind is modern energy.

The United States has some of the best wind resources in the world and it is time to let modern energy power us. The best day to start is today.

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