

INNOVATION

ENORMOUS BATTERIES

to protect power grid



SINCE SUNLIGHT AND WIND CAN BE UNRELIABLE, RENEWABLE UTILITIES TEST BIG BACKUPS.

By **MARK CLAYTON**
STAFF WRITER

One evening in late February 2008, the famously steady winds of west Texas began to wane until, at last, hundreds of giant wind turbines were becalmed – their enormous blades slowed or stilled.

In just three hours, grid operators at the Electric Reliability Council of Texas watched wind power output fall by 1,400 megawatts – power needed to supply roughly 600,000 homes. Following emergency procedures, a blackout was avoided by quickly cutting power to several industrial customers.

But the incident highlighted renewable energy's Achilles' heel: Intermittent solar and wind power requires backups. It's not a big problem today with solar, wind, and other renewable energies supplying less than 3 percent of the energy needs in the United States. Yet it could be a big problem in the not-so-distant future.

If wind power supplies 20 percent or more of the nation's power by 2020, as a US Department of Energy study last year said

it could, storing backup electricity becomes critical to grid stability, experts say.

"Little attention has been given to massive electricity storage that is a key to making the use of renewable energy possible on a broad scale," wrote the authors of an American Institute of Chemical Engineers (AICE) report on mass power storage for the grid last year. "In America today, there is an almost total absence of public awareness of the need."

energy

While the Obama administration presses to expand renewable energy with emphasis on growing wind farms and utility-scale solar, these efforts could vastly increase the need to build new backup power plants – much of which today involves firing up natural-gas turbines when the winds die down. The only way to avoid using fossil fuels is to develop grid storage.

Without the ability to store massive amounts of energy, "renewable power can only be piggybacked onto the US grid to supply not more than 15 percent of the power at best," the AICE study says.

Yet the potential costs of building the storage necessary to allow renewable energy to expand to supply just 20 percent

See **BATTERIES** page 14



PHOTOS BY MARY KNOX MERRILL/STAFF

SCALING UP: David Bradwell (left), a graduate student at the Massachusetts Institute of Technology, researches new chemistries for prototype batteries, such as the one above, that could be used on a grid scale to store renewable power.

Waterless urinals: Green, cheap, and 'gross'?

By **VIJAYSREE VENKATRAMAN**
CORRESPONDENT

Sanitary fixtures in men's rooms don't make for polite conversation. Nor would many people want to read about them over a morning cup of coffee.

But it's Jan Aceti's job to encourage people to think about them.

As principal of consulting firm Aceti Associates, Ms. Aceti tries to spread the word about "waterless" urinals, an environmental innovation that she hopes can ease the world's water problems.

Fresh water is a dwindling resource worldwide. A waterless urinal saves one to three gallons of fresh water per flush, compared with a normal model, according to a 2008 report Aceti's firm prepared for the Massachusetts Executive Office of Energy and Environmental Affairs. In an office with 1,000 men, that adds up to 1.56 million gallons of water saved annually.

This waterless message has finally

started to catch on, says Aceti.

"Can you imagine a more scenic setting for a waterless urinal?" she asks, pointing to the picture of an installation at the Taj Mahal in India.

At American ballparks, airports, and tourist attractions, waterless urinals are becoming increasingly common.

Yet despite the message of efficacy and environmental stewardship, the 15-year fight to further introduce these unorthodox urinals is far from over.

Hygiene myths abound. Many hold

responsible tech

their noses when they hear of this no-flush system. Diverting streams of urine for use as fertilizer is another tough sell. But the industry is optimistic.

"By our estimates, less than 1 percent of the world's urinals use these waterless systems," says Randall Goble, vice president of marketing for Falcon Waterless Technologies in Grand Rapids, Mich.

He explains that the technology behind the setup is fairly simple. A biodegradable liquid sealant, such as oil or alcohol that is lighter than water, floats on top of

a conventional water-filled drain.

The barrier layer, a one-way seal, allows liquid waste to flow through but blocks sewer gases from coming back up and entering the restroom. (See page 16 for diagram.)

One of the first waterless urinals, patented in Austria more than 100 years ago, involved periodic cleaning of the waste sediment. But modern, water-fed plumbing put an end to this chore.

In the 1990s, sealant-filled cartridges for waterless urinals were introduced. "Those cartridges took the 'ugh' factor out of the maintenance," says Mr. Goble.

In 2006, kitchen- and bath-fixture giant Kohler Co. came up with an optimal funnel-shaped design for the bowl, eliminating the need for disposable cartridges.

"In traditional urinals, the surfaces on the inside are wet much of the time, and you get biofilms of growing organisms," says Prof. Charles Gerba, an Arizona

See **WATERLESS** page 16

INNOVATION

horizons

What's new in sci-tech

A call for blurring online maps to thwart terrorism

California Assemblyman Joel Anderson has proposed legislation that would require satellite-mapping companies, such as Google, to blur images of schools, hospitals, churches, and government buildings or face hefty fines.

"We heard from terrorists involved in the Mumbai attacks last year that they used Google Maps to select their targets and get knowledge about their targets. Hamas has said they were using Google Maps to target children's schools," Mr. Anderson, a Republican from the San Diego area, told Computerworld.

CNET asked Assemblyman Anderson if the motivation behind terrorist attacks ought to be what is addressed rather than the technology.

"I'm all for online mapping," he said. "But knowing where the air ducts are in an air shaft is not necessary for me to navigate in the city. Who wants to know that level of detail? Bad people do."

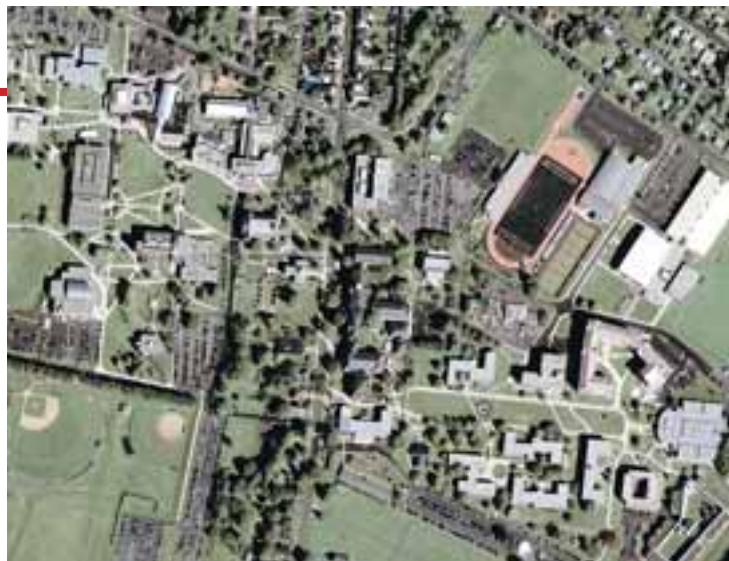
The bill would only affect California.

While not a terrorist, a South London man recently admitted to using Google Earth to look for the valuable tiles on roofs, filching them in the middle of the night and selling the metal to scrap shops. Total damage: £100,000.

Batteries that recharge in seconds

Researchers at the Massachusetts Institute of Technology have discovered a way to tweak batteries that allows them to recharge in seconds rather than hours.

The problem with current lithium-ion batteries, which are popular in cellphones and laptops, is that the energy flows into and out of the batteries rather slowly. To figure out why, professor Gerbrand Ceder developed computer models of how the ions cruise through the battery. His team found that the ions actually zip at incredible speeds, but they take really slow routes.



SPACE CAM: This photo of Kutztown (Pa.) University was the first image taken by the Google-sponsored GeoEye-1 Satellite. While fun to pursue, these maps could be used to plot attacks, says a California lawmaker.

"Lithium ions can indeed move very quickly into [lithium iron phosphate, one of the main battery materials] but only through tunnels accessed from the surface," says the MIT announcement. "If a lithium ion at the surface is directly in front of a tunnel entrance, there's no problem: It proceeds efficiently into the tunnel." But if it's not lined up perfectly, the ions need to navigate through a labyrinth of nanoscale twisty streets, looking for the nearest tunnel.

Mr. Ceder's team developed a new surface structure that uses microscopic "beltways" that lead directly to the tunnels.

To test out their new traffic flow, the team designed a small battery that would normally take six minutes to charge. The prototype fully charged and discharged in 10 to 20 seconds.

This significant reduction "may open up new technological applications and induce lifestyle changes," Ceder and graduate student Byoungwoo Kang write in their article in the journal *Nature*.

While current electric cars need to be plugged in overnight, these new MIT batteries could make filling up as easy as stopping for gas. More electronic devices could offer power-hungry features, such as video, because regaining the lost energy would no longer be a chore. Also, gadgets could potentially pack in new features that weren't practical before because they couldn't suck out energy fast enough.

— Andrew Heining and Chris Gaylord

Waterless: Cheap. Green. But many think 'gross.'

Continued from page 13

State University microbiologist who has researched surface contamination in public restrooms.

Flushing further creates a spray that lands on the rim and floor, creating a breeding ground for microorganisms.

"If easily-maintainable, water-free urinals had been developed first, no one would use conventional urinals because of all the contamination they cause," he adds.

While Mr. Gerba says that design innovations can now ensure that waterless urinals are both more efficient and more sanitary than their traditional counterparts, educating consumers and facility managers about the proper use and maintenance of waterless urinals is the key to wider acceptance, according to Shane Judd, senior manager at Kohler in Milwaukee.

"People have misgivings about water-free sanitaryware, but those who try it embrace it," he says. Because of the aesthetic of the sleek model, green designers have started installing it in clients' homes as well, he adds.

The financial argument

Most marketing for waterless urinals target organizations with environmental sustainability goals. Other groups gravitate to them for financial reasons. The waterless designs reduce operating costs and eliminate common plumbing emergencies, such as clogging and flooding, says Goble of Falcon Waterless Technologies.

"Students are known to flush anything from unwanted lunches to report cards in urinals," he says. Also there are no flush handles that can be tampered with.

In rural regions of the third-world where sani-

tary infrastructure is nearly nonexistent, these urinals present the option of leapfrogging past systems that use up precious water, says Jack Sim, an advocate of compost toilets. In 2002, he launched the World Toilet Organization, a nonprofit group based in Singapore and committed to improving toilet facilities worldwide.

"Human urine is also a good and cheap source of plant nutrients," says Mr. Sim. Farms in the developing world can use it to improve crops without buying expen-

sive fertilizers, he adds.

An environmental push

In parts of the United States, wastewater treatment plants discharge liquid waste into seacoasts, says Carol Steinfeld, author of "Liquid Gold: The Lore and Logic of Using Urine to Grow Plants."

The waste contains nitrogen that cause aquatic plants to thrive. These blooms eventually die and decompose, pulling oxygen out of the water and suffocating fish in the process.

"Much of that nitrogen is from the urine alone," she says. "Avoiding expensive denitrification could be as simple as diverting that stream. Waterless urinals point to a direct opportunity to harvest fertilizer. Urine is usually pathogen free — unlike the brown stuff."

As a resource recycling specialist, she designed a "Garden Urinal" for green-product company Ecovita in New Bedford, Mass. The urinal can be plumbed or directed to a self-contained planter. This waterless urinal — which can also be used by women — will be available for sale this summer. "Ornamental plants use up the nitrogen in urine, keeping it out of receiving waters," she says.

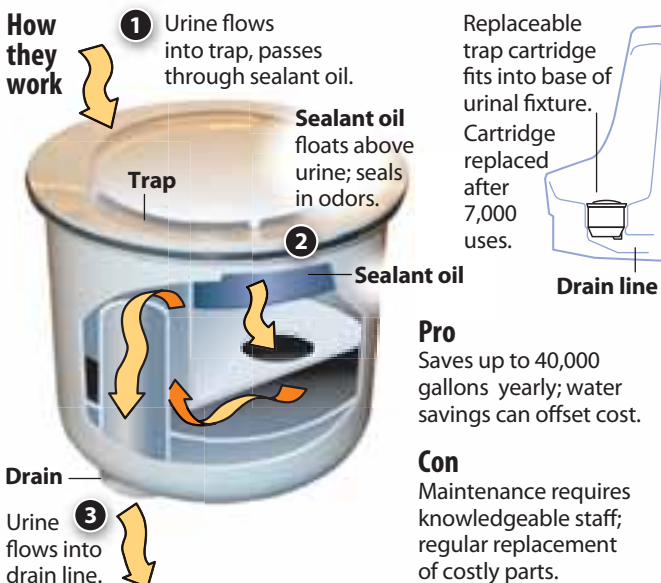
Diverting and using urine in backyards may seem gross now, but Ms. Steinfeld predicts that the environmental benefits will eventually outweigh the icky factor.

Meanwhile, water savings from waterless urinals could be the main draw for consumers. "Why do we flush [what could be] drinking water down the urinal every time?" asks Mr. Judd, of Kohler's Water Conservation division.

Because people have always done it that way, he says, answering his own question. "But now, with well-designed waterless urinals, there is a chance to change that."

No-flush urinals

Waterless urinals can save water but the specialized maintenance and costly replacement parts have frustrated some buyers.

How they work

Pro
Saves up to 40,000 gallons yearly; water savings can offset cost.

Con
Maintenance requires knowledgeable staff; regular replacement of costly parts.

SOURCES: Focal Water Free Technologies, Waterless Co.

© 2008 MCT