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Taming Unruly Wind Power

By **MATTHEW L. WALD**

For decades, electric companies have swung into emergency mode when demand soars on blistering hot days, appealing to households to use less power. But with the rise of [wind energy](#), utilities in the [Pacific Northwest](#) are sometimes dealing with the opposite: moments when there is too much electricity for the grid to soak up.

So in a novel pilot project, they have recruited consumers to draw in excess electricity when that happens, storing it in a basement water heater or a space heater outfitted by the utility. The effort is rooted in some brushes with danger.

In June 2010, for example, a violent storm in the Northwest caused a simultaneous surge in wind power and in traditional hydropower, creating an oversupply that threatened to overwhelm the grid and cause a blackout.

As a result, the [Bonneville Power Administration](#), the wholesale supplier to a broad swath of the region, turned this year to a strategy common to regions with hot summers: adjusting volunteers' home appliances by remote control to balance supply and demand.

When excess supply threatens Bonneville's grid, an operator in a control room hundreds of miles away will now dial up a volunteer's water heater, raising the thermostat by 60 more degrees. Ceramic bricks in a nearby electric space heater can be warmed to hundreds of degrees.

The devices then function as thermal batteries, capable of giving back the energy when it is needed. Microchips run both systems, ensuring that tap-water and room temperatures in the home hardly vary.

"It's a little bit of that Big Brother control, almost," said Theresa Rothweiler, a teacher's aide in the Port Angeles, Wash., school system who nonetheless signed up for the program with her husband, Bruce, a teacher.

She said she had been intrigued by an ad that Bonneville placed in the local paper that asked

consumers to help enable the grid to absorb more renewable energy, especially wind.

“We’re always looking at ways to save energy, or be more efficient or green, however you want to put it,” said Ms. Rothweiler, who worries about leaving the planet a livable place for her 21-year-old daughter, Gretchen. Bonneville paid for the special technology, which runs around \$1,000 per home.

The initial goal of Bonneville’s pilot program is to gain experience in charging and “discharging” the water heaters and space heaters to see how much response operators can count on as the use of these thermal batteries expands.

Mark K. Lauby, director of reliability assessment at the [North American Electric Reliability Corporation](#), which enforces standards on the grid, said that such storage innovations would be “the holy grail” as the nation shifts to greater reliance on renewable energy.

While the threat of excess supply is most severe in the Pacific Northwest, other regions may land in the same situation in coming years because a surplus would threaten to destabilize the electric system as much as a shortage.

California, for example, is committed to [getting a third of its electricity](#) from renewable sources by 2020.

That would be harder if it had to turn off the wind machines on their best generating days to prevent the grid from being overwhelmed.

For decades, the Bonneville Power Administration rarely had a problem with excess supply. Its backbone is [hydroelectric](#) dams on the Columbia River, and while the operators must often run all of the falling water through its power-producing turbines for environmental reasons, the grid could adjust the supply by turning off fossil fuel plants.

That balance began to shift over the last few years as entrepreneurs built hundreds of wind machines nearby in the Columbia River Gorge, an area that utility executives now call a “wind ghetto.” While the wind turbines produce electricity far below their capacity most hours of the year, they get busy when a storm rolls through, which is when river flows are highest, too.

The agency can simply shut down the wind machines, and it did so intermittently this summer when excess power threatened the grid. But that angered the wind operators, who earn money from the electricity they sell and from tax and other credits based on their production.

This June, several wind companies appealed Bonneville’s policy to the Federal Energy

Regulatory Commission, calling it discriminatory, and in August they filed a federal court challenge that is still pending.

For Bonneville, the full dangers of excess supply first hit home during the June 2010 emergency, when a severe storm whipped through the region. The transmission network **had so much power** that the agency turned off all its fossil fuel generation, gave electricity away to neighboring networks and even told the system's only nuclear plant to slash its production by 78 percent, a highly unusual step.

The region squeaked through, but the agency was stretching its resources "to their limits," said Doug Johnson, a spokesman for Bonneville. At one point the system was running almost entirely on renewable energy.

"This is probably about the only place in the country where that could happen," said Michael Milstein, another spokesman with the agency.

The problem was complicated by environmental rules involving the hydroelectric dams.

The dams were built with spillways, or paths where operators can divert water without passing it through the power-producing turbines. But when the water goes through the spillways, it picks up nitrogen bubbles that can kill juvenile fish, so there are strict limits on their use.

Operators can usually keep the system in balance without excessive use of spillways, but in the June 2010 case, they were coping with as many as 2,000 megawatts of wind power, roughly double Seattle's power use or what two nuclear plants can deliver.

Wind installations have grown since then. So Bonneville began advertising for volunteers to accept extra electricity, mainly homeowners with electric heat and with water heaters of recent vintage.

Plumbers install a mixing valve on the water heaters to keep the faucet temperature safe, and new wiring and a small computer keep track of energy flows.

The agency says that some 200 homes will soon have the adapted water heaters, space heaters or both. In hundreds more, it is installing more traditional controls that will allow it to turn water heaters off. Another utility in the region, **Portland General Electric**, is about to begin a similar program paid for by the federal Energy Department.

For the time being, the storage devices collectively can absorb the output of only a handful of

wind turbines.

A 100-gallon home water heater can store about 26 kilowatt-hours, or about a day's worth of electricity for a typical house, or less if the house relies on electricity for heat.

The ceramic bricks in the space heater can store 40 kilowatt-hours, or more in some larger configurations. The heat can be drawn off by passing air and delivered to living spaces by a fan, with the bricks also functioning as a thermal battery.

Some of this equipment dates from the late 1980s and was originally designed for offering "time of use" rates, so that a homeowner could buy electricity during hours when it was cheaper and store it. But coordination over a broad area by a utility to manage regional flows is new.

One nagging question is who will pay for the installations if they are carried out on a larger scale.

While Bonneville pays for them now, Philip D. Lusk, the power resources manager for [the utility department of the city of Port Angeles](#) — the Rothweilers' retail supplier — said the agency might have to find additional ways of compensating consumers to get the thousands of volunteers it will eventually need to make the system effective.

If the installations are judged to benefit everyone because they improve stability, the cost might be spread among all ratepayers. But if Bonneville decides that they mainly benefit the wind generators because they never have to unplug their turbines, the agency could try to charge that industry.

Either way, said Mr. Johnson, the Bonneville spokesman, the agency will have to come up with a solution to "the cranky nature of wind."