



## New Benefits from Old Appliances: An Applied Minnesota Case Study

Beneficial Electrification League

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In a new twist on an old idea, Minnesota's [Lake Region Electric Cooperative](#) (LREC) is piloting a program to store excess renewable energy in large volume water heaters in customers' homes. The Beneficial Electrification Community Storage Pilot is partially funded with a grant from the [Beneficial Electrification League](#) (BEL) as well as donations and technical support from [Steffes Corporation](#) and BEL.

Load management water heating programs and off-peak rates are not new to electric utilities or LREC,<sup>1</sup> but this small pilot is different. Instead of turning water heaters *off* to reduce peak, LREC's pilot uses intelligent algorithms to turn water heaters in strategic locations *on* when renewable generation exceeds demand.

### Background

In March of 2019, the 28,000-member distribution co-op began operation of a first-of-its kind 2 MW [Wind-Solar Hybrid Project](#)—a wind turbine and solar array integrated by a single inverter. The project is connected to LREC's distribution grid at their rural Erhard substation and the co-op purchases all of the project's generation through a power purchase agreement (PPA) with the project's developer and owner, [Juhl Energy](#).

To date, the pioneering project is highly successful and saves LREC more than \$200,000 a year by offsetting some of their wholesale power supply needs. But at times, the project is too successful, generating more energy than the 1,200 customers on the Erhard substation's feeders use. This means that the co-op pays for energy they aren't using. Furthermore, the excess energy can backfeed onto the transmission grid, which is not allowed by the co-op's contract with their wholesale power supplier and transmission grid operator, [Great River Energy](#).

So why not add a battery? During the project's planning phase, LREC and Juhl Energy considered this approach but ultimately decided against it because of upfront costs and potential regulatory hurdles.

### The Pilot

Instead of using a typical battery, LREC is testing a flexible community-based battery. Excess renewable energy is stored in customers' homes using [Steffes Corporation's Dynamic Dispatch™ technology](#), a cloud-based water heater control system that uses [grid-enabled thermal storage \(GETS\) controllers](#) installed on 80- to 100-gallon electric resistance water heaters. According to Steffes, this system "precisely controls a large fleet of water heaters and makes them appear to the system operator as a single flexible fast-ramp asset (a virtual generator or battery)."<sup>2</sup>



*Steffes GETS controller on a customer's water heater.  
Courtesy of Lake Region Electric Cooperative.*

"These are the Cadillacs of grid interactive system controllers," explained Steve Haiby, LREC's manager of energy services.

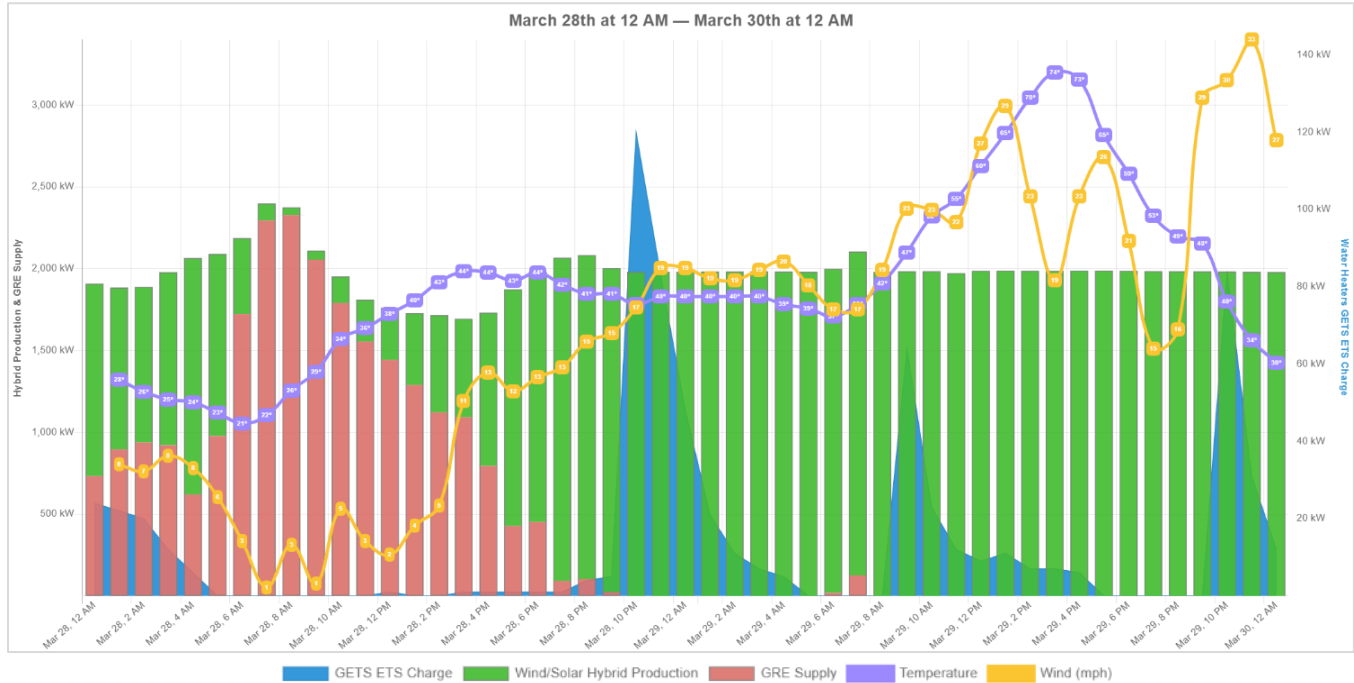
Far more advanced than standard radio-controlled or Wi-Fi-enabled one-way switches used to shed load on peak demand days, GETS controllers continually integrate real-time data on wind speed, outdoor temperature, wind-solar hybrid production, Erhard substation loading, and the percentage of BTUs available in each tank to

<sup>1</sup> <https://www.lrec.coop/products-service/off-peak-water-heating>

<sup>2</sup> <https://www.steffes.com/2017/01/01/what-is-gets/#:~:text=Steffes%20GETS%20is%20the%20most,creating%20equity%20for%20all%20stakeholders.>

determine when to heat water. “If a water heater is down to the threshold of 50% capacity, the controller allows that water heater to take a charge and heat up, day or night, when the substation load is low and the wind speed is high and the hybrid site is producing,” said Haiby. Temperature sensors ensure that hot water is available anytime and prevent overheating. The water heater tanks also have cold-water mixing valves to help regulate delivered water temperature.

The pilot’s dashboard is public (<https://hybrid.lrec.coop/>) so that customers can view how system inputs and outputs are coordinated on an hourly basis.



*Beneficial Electrification Community Storage Pilot dashboard screenshot, courtesy of Lake Region Electric Cooperative*

Currently, 40 LREC customers served by the hybrid project’s substation participate in the pilot. To qualify, a participant must have a large volume electric resistance water heater and full-time wireless connectivity so that the GETS controllers can communicate continuously with the rest of the system. In exchange, participants receive a discounted electricity rate for water heating.

### Conclusion and Next Steps

LREC plans to evaluate the impacts for a full year before releasing results. However, in March of 2021, several high wind and low substation load events had the potential to cause backfeed to transmission grid. The pilot’s large volume water heaters absorbed and utilized more than 2 MWh of excess renewable energy that otherwise would have contributed to backfeeding that month.

Going forward, the co-op is looking for ways to offer the program to more members since it fulfills many complimentary needs – flexible storage for renewable energy, community participation, cost-savings through utilization of existing assets, and importantly, hot showers. Because of these synergies, the pilot’s impact is likely to reach well beyond LREC’s territory by demonstrating how yesterday’s basic electric water heaters can be collectively transformed into sophisticated, data-driven assets for the grid of tomorrow.

### For More Information

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