Electric Thermal Storage Water Heating

The Battery in Your Basement

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Electric Thermal Storage (ETS) Water Heating

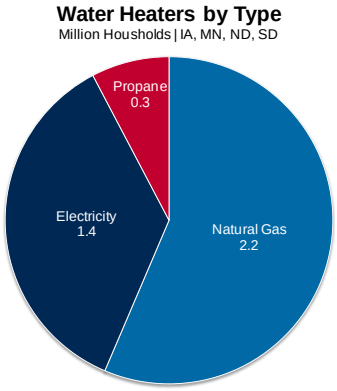
Electric Thermal Storage (ETS) water heating is a ***load control*** strategy that provides households with their daily hot water needs by charging their water heaters ***only*** during the lower-cost, off-peak hours. Members participating in the ETS program heat their water from the hours of 11:00 p.m. to 7:00 a.m. In exchange for this level of control Great River Energy provides discounted wholesale energy to its member cooperatives for energy sales associated with the ETS program. The strategy requires that a household install a "large capacity" storage water heater, which is typically between 85 and 105 gallons in size, with the larger water heaters provided to households that have more family members. In addition the size of the water heater can be extended by increasing the tank temperature and installing a mixing valve that regulates the temperature at the point of use to 120 °F.

Great River Energy's Electric Thermal Storage (ETS) Resource

Approximately 65,000 ETS water heaters, amounting to 11% of Residential End-Use Members, are participating in the ETS water heating program. Each ETS water heater has the ability to "store" 13 kWh a night, approximately 400 kWh a month, in the form of hot water. In aggregate this resource moves more than 300 GWh to low-priced, off-peak periods. One of GRE's member cooperatives, Redwood Electric Cooperative, has more than 45% of their residential membership participating in the ETS water heating program.

Household Water Heating

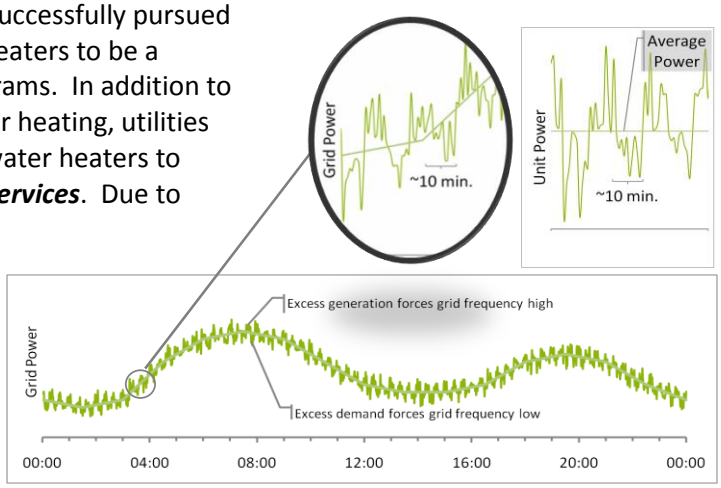
Household water heating is one of the more predictable energy consuming activities in a household. The primary variable that dictates hot water consumption is household size. According to the Energy Information Administration's (EIA) 2009 Residential End-Use Consumption Survey, water heating is responsible for approximately 15% of total household consumption. Nationally, average water heating consumption remained relatively unchanged for the period from 1993 to 2009.



Water heaters are often one of the more under-appreciated appliances in a home. Typically located in the basement, they tend to be ignored until there is an issue and you run out of hot water. At this point the unit will typically be repaired or replaced in an "emergency" situation. This makes proactive decisions associated with water heating difficult. ***The only thing a homeowner expects from a water heater is hot water.*** A utility can utilize hot water heaters as a resource, but only if this basic function is met.

Grid-Interactive Water Heating | *Can a water heater provide grid benefit?*

In response to the proposed water heating standards, which would effectively have eliminated the manufacture of electric resistance water heaters larger than 55 gallons, Great River Energy and the National Rural Electric Association (NRECA) successfully pursued legislation that allows large capacity water heaters to be a component of utility demand response programs. In addition to strategies such as ETS and interruptible water heating, utilities across the country are beginning to look at water heaters to interact with the grid and provide ***ancillary services***. Due to the variable nature of demand, which is now coupled with the variable nature of increased renewable generation, grid operators look at generators to provide ancillary service to the wholesale market. The generator is turned up or down to provide regulation services which keep generation matched to load and help to maintain voltage throughout the system. This same type of system regulation can occur through the variable control of water heaters. By turning a population of water heaters on or off, or by dynamically increasing or decreasing the current to those water heaters, the natural variations of supply and demand can be managed more effectively at the grid level. It is GRE's belief that as long as the hot water needs of a household are met, water heaters can effectively provide this type of service to the grid. Successful execution of this type of dynamic control strategy can reduce the wholesale cost of energy or cause it to be a revenue producer.



Type/Method	Energy Cost	Demand/Trans. Other Costs	Total Cost
Uncontrolled	$256	$50 - $200	$306 - $456
Grid-Interactive LMP Optimized	$108	0	$108
Grid-Interactive with Regulation	($80)	0	($80)

Integration with Renewable Energy

Steele-Waseca Cooperative Electric has packaged their 102.5 kW community solar project with ETS water heating. A member can purchase a 410 Watt solar panel for $170 when they join the ETS water heating program.

About Great River Energy

- Great River Energy is a not-for-profit electric cooperative providing wholesale power to 28 distribution cooperatives in Minnesota and into Wisconsin.
- Our member cooperatives distribute that electricity to families, farms and businesses serving almost 1.7 million people.
- With $3.7 billion in assets, GRE is the second largest electric utility in Minnesota and one of the largest generation and transmission cooperatives in the country.
- Based in Maple Grove, we own and operate 12 power plants and more than 4,600 miles of transmission line in Minnesota and North Dakota.