Electric Thermal Storage Water Heating

The Battery in Your Basement

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Great River Energy

- Not-for-profit electric cooperative providing wholesale power to 28 distribution cooperatives
- Our member cooperatives distribute electricity to about 1.7 million people in Minnesota and Wisconsin.
Electric Thermal Storage (ETS) Basics

- ETS Requires a large capacity water heater, typically 85 to 105 gallons.
- Heat water between 11 pm and 7 am.
- Tank temperature can be increased with the use of a mixing valve.
- GRE controls more than 65,000 ETS water heaters throughout its member service areas.
Hot Water “Chemical” Battery

- 26 kWh nightly storage capacity
- Average of 13 kWh
- Over 300 GWh/year!
Delivering Value and Utilizing Wind

MISO Wind Energy | Total MWh by Hour 2015 YTD

MISO Wind Energy | Total MWh by Hour 2014
Adding Grid-Interaction to ETS

- Adjusts the temperature in response to price or availability of renewable energy
- Varies the wattage to water heater electric elements
- Assures comfort is never compromised – \textit{home always has hot water}
Balancing the needs of the grid

Low Cost Storage | $110 - $300 per kW (http://www.esource.com/ES-WP-18/GIWHs)
## Wholesale Cost of an Electric Water Heater

<table>
<thead>
<tr>
<th>Type/Method</th>
<th>Energy Cost</th>
<th>Demand/Trans. Other Costs</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncontrolled</td>
<td>$256</td>
<td>$50 - $200</td>
<td>$306 - $456</td>
</tr>
<tr>
<td>Grid-Interactive LMP Optimized</td>
<td>$108</td>
<td>0</td>
<td>$108</td>
</tr>
<tr>
<td>Grid-Interactive with Regulation</td>
<td>($80)</td>
<td>0</td>
<td>($80)</td>
</tr>
</tbody>
</table>

- **Uncontrolled Water Heater**: No controls installed on water heater
- **Grid-Interactive Water Heater**: Consumes energy when LMP is low, but not doing regulation. Typically there is no additional transmission or demand cost during low demand hours when LMP is low
- **Grid-Interactive with Regulation**: Consumes energy when LMP is low and provides regulation. This option also provides a 70% reduction in CO₂ emissions, independent of the renewable integration value.

Note: PJM has a need for about 700MW of up and down regulation.
Thank You!

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