Utility Innovation:
Residential TOU Rate Design Pilot

March 29, 2018
Beginnings

- Settlement in 2013 rate case led to Alternative Rate Design Docket for residential customers
- Preliminary TOU Pilot concept presented at April 2017 Commission Planning meeting
- Stakeholder Process Initiated
  - 8 Meetings:
    - 2 Large Group Forums
    - 6 Working Group Sessions
TOU Pilot Design Overview

Opt-out
- 10,000 treatment group + 7,500 control group
- Opt-out at anytime
- Bill protections for participants

Education
- Welcome packets and surveys
- Targeted communications

Tech couplings
- AMI rollout in two geographical areas
- Incorporate data presentation and other potential tools
Proposed Rate Design

5 Hour Peak with 6 Hour Off Peak

<table>
<thead>
<tr>
<th>Proposed Energy Rates with Fuel</th>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Peak 3 PM - 8 PM Weekdays</td>
<td>25.9</td>
<td>22.4</td>
</tr>
<tr>
<td>Mid-Peak 6 AM – 3 PM &amp; 8 PM – Midnight</td>
<td>12.1</td>
<td>10.4</td>
</tr>
<tr>
<td>Off-Peak Midnight – 6 AM</td>
<td>5.7</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Weekends and holidays are only mid-peak and off-peak
## Preliminary Scorecard

<table>
<thead>
<tr>
<th>Pilot Design Suggestions from Stakeholders</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>• Indemnify low-income customers</td>
<td>Check</td>
</tr>
<tr>
<td>• Use an opt-out approach</td>
<td>Check</td>
</tr>
<tr>
<td>• Provide rates that accurately reflect the costs of energy</td>
<td>Check</td>
</tr>
<tr>
<td>• Balance precision and practicality, both for the utility and for customers</td>
<td>Check</td>
</tr>
<tr>
<td>• Give customers adequate tools to access and understand their usage data</td>
<td>Check</td>
</tr>
</tbody>
</table>
## Preliminary Scorecard

<table>
<thead>
<tr>
<th>Suggested Goals for TOU Rate from Stakeholders</th>
<th>In Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduce peak demand-related system costs to mitigate need for future investments in the system</td>
<td></td>
</tr>
<tr>
<td>• Increase customer satisfaction</td>
<td></td>
</tr>
<tr>
<td>• Increase customer participation</td>
<td></td>
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<tr>
<td>• Shift customer energy use to overnight periods when wind generation is highest</td>
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</tr>
<tr>
<td>• Promote conservation to the maximum reasonable extent</td>
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</tbody>
</table>
Overview

- WH purchased a Nissan Leaf in November 2014
- Publish data on performance and ownership costs
- Deployed publicly-accessible EV charging stations in our serving area
  - Headquarters 2015
    - DC Fast Charger
  - Albertville Outlet Mall (I94 corridor) 2017
    - DC Fast Charger
    - Two Level 2 Chargers
Why make the investment?

- Strategic fit for long term energy sales related to EV
  - Research and development investment
  - Located in high visibility and high traffic areas
    - 55 corridor and 94 corridor

- EV saturation is poised to be upwards of 50% (?) of new car sales by 2030 (?)

- Over 80% of charging is done at home, 10% at work and 10% other means (public stations)

- Next step is deeper dive into EV technology related to our infrastructure
  - Slated for 2018
WH EV Rate Options

Option 1 – EV Storage Charge
- Metered by separate Off-Peak meter
- Charging 8 hours per night - 11:00 pm to 7:00 am
- Energy rate during that time is 5.4¢/KWH
- Energy rate is NOT subject to Power Cost Adjustment (PCA)
- Requires a separate meter socket and receiver
- $200 Rebate – 240 volt level 2 charger minimum of 4.5kW charger rating
- Additional CIP Rebate up to $500 available

Option 2 – EV Time-of-Use Rate
- Metered by separate meter
- Energy rate from Noon to 10:00 pm is $0.1715 kWh
- All other hours energy rate $0.0521 kWh
- Energy is subject to PCA
- No rebate available
### Minnesota EV data

**Plug-in hybrid electric vehicles (PHEVs)**
- 2010: 0
- 2011: 336
- 2012: 1095
- 2013: 608
- 2014: 345
- 2015: 249
- 2016: 532
- 2017*: 579

**Battery electric vehicles (BEVs)**
- 2010: 4
- 2011: 17
- 2012: 114
- 2013: 273
- 2014: 258
- 2015: 294
- 2016: 558
- 2017*: 684

**Hybrid electric vehicles (HEVs)**
- 2010: 4063
- 2011: 3605
- 2012: 5327
- 2013: 6677
- 2014: 5955
- 2015: 4399
- 2016: 4529
- 2017*: 4680

**Conventional vehicles (CVs) and other**
- 2010: 175403
- 2011: 215446
- 2012: 225617
- 2013: 238147
- 2014: 249250
- 2015: 248160
- 2016: 253864
- 2017*: 223426

*data for 2017 is incomplete*
21K EVs sold in 9/2017 bringing total U.S. sales to 704,233 (EPRI)
Next Steps

**EV Study**

- View WH service territory as ripe for future EV sales
- Not an engineering study but an anticipated pace-of-investment study
- Need to better understand adoption rates
- What is the demographic profile of an EV buyer?
- Develop a glidepath with milestones
  - 1-3 years, 3-7 years, 7-10 years
- Financial investments
- Prepare communications plan
- Objective: accommodate our member needs with just-in-time investments and support!
Lake Region Electric Cooperative

WIN-WIN STRATEGIES

DAN HUSTED, VP BUSINESS DEVELOPMENT
LREC Mission & Vision

It begins here.
Member-Customer Focus

Identify underserved market niche

Structure program that creates value for member and co-op
Distributed Energy for Demand Reduction

- **GoWEST Solar** is about optimizing solar production during summer utility peak
- Value of demand reduction benefits member & co-op
- Size to load design
- Beneficial electrification incentives
- EV pilot - Wind Solar Hybrid
Great River Energy
Grid Interactive Water Heating

Jeff Haase
Member Owned G&T Cooperative

- Generation & Transmission cooperative providing wholesale electricity to 28 distribution cooperatives in Minnesota and into Wisconsin.
- Second largest utility in Minnesota, our member cooperatives distribute electricity to families, farms and businesses servings almost 1.7 million people.
Electric Thermal Storage

Great River Energy System Load | July 11 - 12, 2015

~66,000 ETS Water Heaters on GRE’s Member Systems

ETS Control Period

~1 GWh of Off-Peak Energy Annually

ETS "Charge" Period

July 11, 2015

July 12, 2015
By utilizing a strategy that limits water heating to the hours of 11 pm to 7 am GRE is able to reduce costs as well as utilize a greater amount of wind generated electricity.
Grid Interactive Water Heating
Visibility into State of Charge

MW_{(electric)}

Charge Rate

Coupled to the real-time needs of grid

MW_{(thermal)}

Discharge

Delivery of hot water

MWh_{(thermal)}

State of Charge
Project Timeline

Now through 2018

- Building out development
- Developing communications with Steffes
  - LoRa Radio
  - Persistent WiFi
- Member engagement with Dakota

2018 – 2019

- Engagement with EPRI
- Load shape models
- Measured performance of LMP optimization
- Actual load shapes
- MISO frequency regulation performance
- Customer perception of new home performance.
Thank you!

Jeff Haase, P.E., C.E.M
jhaase@grenergy.com
Steffes Hydro Plus GETS Water Heater

The Steffes Hydro Plus™ Water Heater is a grid-interactive energy storage device. Unlike traditional water heaters, the Hydro Plus™ provides fast acting, flexible and affordable energy storage to serve the needs of consumers and provides “Smart” control for the electric grid. With the built in Dynamic Dispatch™ control and IoT technology, Hydro Plus™ devices can be aggregated to operate like a virtual power plant helping balance power supply and demand while also integrating variable renewable energy generation resources.

**FEATURES**

- 7 kWh - 15 kWh of daily solar energy
- 0 kW - 4.5 kW controllable load
- On-Board kWh Metering
- Low temperature override/comfort assurance
- ETL Safety Listed
- Laser welded, long life 316L marine grade stainless steel tank
- Lightweight and durable - 15% lighter than comparable steel
- Long life stainless steel elements

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Hydro Plus Model</th>
<th>Gals</th>
<th>Watts</th>
<th>Volts</th>
<th>Height (inches)</th>
<th>Diameter (inches)</th>
<th>Weight (lbs)</th>
<th>Energy Factor</th>
<th>First Hour Rating (Gallons)</th>
<th>Min/Max Delivered Temp (°F)</th>
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**CONTACT:**
- Email: GETS@steffes.com
- Tel: 701-483-5400

Hydro Plus™ energy storage system water heaters incorporate Steffes’ patented Dynamic Dispatch™ as its power based control strategy. Dynamic Dispatch™ leverages the Microsoft Azure Cloud to aggregate groups of Hydro Plus™ water heaters so they can be controlled as a virtual power plant by the grid operator.

Hydro Plus™ provides real-time reporting of their power and energy levels. Dynamic Dispatch™ uses this information to ensure each Hydro Plus™ water heater receives the precise amount of energy needed so hot water is always available when needed.
Long Range Radio Communications

LoRa Gateway (Cellular)
Use Cases | Ancillary Services

- Signal following
  - ACE
  - Renewable Generation

- MISO
  - Required capacity level
  - Communication requirements
  - Demonstration of impact
Capture the Earth

**Internal Equipment (i.e. Heat Pump, ductwork, etc.)**
- Customer owned

**External Equipment**
(i.e. ground loops, glycol, etc.)
- Utility owned
- 100 year life

**Demarcation Point**