Minnesota Power Systems Conference

Great River Energy’s Distributed Generation Pilot Program

Bob Sandberg
Manager of Corporate Services
Great River Energy

- 28 member cooperatives – 1.7 million people
- 4th largest G&T in the nation
  - $3.7 billion total assets
  - $2.7 billion total debt
  - $980.4 million revenue
- 880+ employees (MN and ND)
  - 3,619 MW generation
  - 468 MW wind
- 4,600+ miles transmission
21st century electric utility environment

Evolving & challenging

Traditional utility model
1.) Maintain assets
2.) Load growth planning
3.) Least cost supply

New technologies & mandates

Conservation initiatives

Federal & state legislation

Technology savvy consumers

Wholesale marketplace
Traditional generation assets

*The shift is on*

- **Central station power**
  - Coal
  - Natural gas
  - Nuclear

- **Grid distributed energy assets**
  - Utility scale wind
  - Community solar
  - Pumped hydro storage

- **On-Site DG**
  - kW scale solar
  - Micro CHP
  - Battery storage
  - Microgrids
### Market economics

*Blurred lines*

#### Present

<table>
<thead>
<tr>
<th>$/kWh</th>
<th>DG: Solar</th>
<th>Incentives</th>
<th>Retail Energy</th>
<th>Wholesale</th>
</tr>
</thead>
<tbody>
<tr>
<td>$.20-.30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$.11</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>$.35</td>
<td></td>
<td></td>
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<tr>
<td>$0.00</td>
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</tbody>
</table>

#### Future

Cost of DG vs. average retail electricity rate

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_GREAT RIVER ENERGY_ A Touchstone Energy Cooperative
What should utilities do?

Vicious Cycle from Disruptive Forces

- Technology Innovation (DER)
- Energy Efficiency (EE/DR)
- Lost Revenues
- Rate Increase Required
- Customer Assessment
- Behavior Change

VISION
NEXT EXIT

GREAT RIVER ENERGY
A Touchstone Energy™ Cooperative
GRE DG initiative

Focus on customer side of meter

Solar
- Community & residential

Distributed combined heat & power (CHP)
- Micro (1 to 500 kW)

Storage
- Battery
Phase 1

Solar initiatives

• Maple Grove project
  – Research and demonstration focus
  – Develop internal skills to execute solar projects

• Member cooperative projects
  – 20 kW projects owned by GRE
  – Focus:
    • Standardized approached
    • Regional/local visibility
Maple Grove solar project

Completed May 30, 2014
Maple Grove solar project
272.4 kW (DC) = 258 kW (AC)
Solar output – 15 minute interval data
Solar output – 15 minute interval data
Solar output – 1 second interval data
Significant power swings

Real Power (kW)

Power Swing Summary

- 99% output
- 36% output
- 98% output
- 51% output
- 98% output

12 seconds
34 seconds
12 seconds
31 seconds
Maple Grove solar project

Energy usage

June 2014 - kWh
- Grid: 77%
- Wind: 4%
- Solar: 19%

July 2014 - kWh
- Grid: 76%
- Wind: 3%
- Solar: 21%

August 2014 - kWh
- Grid: 80%
- Wind: 2%
- Solar: 18%

September 2014 - kWh
- Grid: 79%
- Wind: 3%
- Solar: 18%
Maple Grove solar project

*Lessons learned/being learned*

- Solar industry is very dynamic
  - Equipment availability, regulations, company staying power
  - Large pricing variances across suppliers and installers
- Many industry topics yet to be resolved
  - Reliability/battery storage, smart inverters, power quality / harmonics, design approaches / standards, and metering requirements
- Life cycle costs?
  - Ongoing O&M, panel life expectancy
- What are the seasonal impacts?
- Where do utilities participate?
  - Large projects (1 MW+) vs. small projects (<40 kW)
Membership projects
Membership projects

**Objective**

- Introduce solar throughout GRE membership
- Acquire small scale solar installation knowledge
  - How and where does the utility participate?
- Study regional system impact
- Maximize efficiency & economies of scale:
  - Template design, bulk equipment orders, & 3rd party financing
- Offer a community solar option
  - Members can bring on additional solar at incremental price
Completed installations to date

*Kandiyohi Power Cooperative*
Completed installations to date

Lake Country Power
## Financing options explored

**Goal: monetize incentives**

<table>
<thead>
<tr>
<th><strong>Lease</strong></th>
<th><strong>“Tax Equity Financing”</strong></th>
<th><strong>Self Financed</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Providers:</strong></td>
<td><strong>Providers:</strong></td>
<td><strong>Providers:</strong></td>
</tr>
<tr>
<td>- CoBank</td>
<td>- NRCO</td>
<td>- Financial Institutions</td>
</tr>
<tr>
<td>- Federated</td>
<td><strong>Structure:</strong></td>
<td><strong>Structure:</strong></td>
</tr>
<tr>
<td><strong>Structure:</strong></td>
<td>- LLC &amp; blocker corp. develop</td>
<td>- Financed – 20 year @ 90/10 (Debt/Equity)</td>
</tr>
<tr>
<td>- CoBank owns asset on day 1</td>
<td>- Assets held in Blocker corp.</td>
<td>- No Monetization of incentives</td>
</tr>
<tr>
<td>- 10 year operating lease is entered into</td>
<td>- Asset buyout in yr 6/7</td>
<td><strong>Investment Summary:</strong></td>
</tr>
<tr>
<td>- Buyout in yr 10 (20% initial cost)</td>
<td>- PPA from LLC to owner</td>
<td>- GRE: 100% of project costs</td>
</tr>
<tr>
<td><strong>Investment Summary:</strong></td>
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<td><strong>Investment summary:</strong></td>
</tr>
<tr>
<td>- Owner: No upfront capital</td>
<td>- T.E: 55% of project cost</td>
<td>- Owner: No upfront capital</td>
</tr>
<tr>
<td>- CoBank: Finances 100% cost</td>
<td>- Owner: 45% of project cost</td>
<td>- CoBank: Finances 100% cost</td>
</tr>
</tbody>
</table>

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GREAT RIVER ENERGY

- A Touchstone Energy® Cooperative
GRE micro CHP initiative

- Explore non intermittent DG technologies
  - Reciprocating engine, micro-turbine, fuel cells
- Evaluate business models
  - 3rd party ownership
  - Risk mitigation
    - Minimal integration cost
    - 10-15 year life expectancy
    - Minimal O&M

Residential, small commercial
CHP technology options

- **Micro turbine**
- **Honda fuel cell**
- **Ceramics fuel cell**
- **NRG Beacon 10**
Pursue partnerships

• EPRI R&D project participation
  – Define & analyze technical & economic case for DG
  – Understand technology options and associated requirements, performance and relative economics
  – Potential for future phases involving lab & pilot testing

• Pilot natural gas-fueled micro CHP technology
  – Market-ready technology
    • 1 kW to 100 kW
    • Requires minimal integration & engineering
    • 10+ year life, minimal O&M
Next steps

• Solar:
  – Complete membership projects
  – Install storage technology to compliment solar
  – Explore utility scale project for 2017/2018
    • 1 MW plus
    • Leverage NRECA SUNDAA initiative

• CHP
  – Leverage ERPI efforts
  – Seek partnership with vendors to pilot technology