Residential Battery Pilot Project

Jo-Carroll Energy
mienergy
Oakdale Electric Cooperative
Richland Electric Cooperative
Co-op Vision For Residential Battery Storage Research Project

- Charge “off peak” from grid - Discharge “on peak” to household loads
- Incentive rate for participating members
- Develop control mechanisms for multiple control strategies
- Solar storage/avoided cost reduction
- Peak shaving for demand customers
# Financial Hurdles

## 4 kW Inverter

<table>
<thead>
<tr>
<th>ECO 4</th>
<th>ECO 6</th>
<th>ECO 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8,457.50</td>
<td>$10,174.16</td>
<td>$11,890.82</td>
</tr>
<tr>
<td>4 kWh</td>
<td>6 kWh</td>
<td>8 kWh</td>
</tr>
</tbody>
</table>

## 8 kW Inverter

<table>
<thead>
<tr>
<th>ECO 10</th>
<th>ECO 12</th>
<th>ECO 14</th>
<th>ECO 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>$14,522.25</td>
<td>$16,238.91</td>
<td>$17,955.57</td>
<td>$19,672.23</td>
</tr>
<tr>
<td>10 kWh</td>
<td>12 kWh</td>
<td>14 kWh</td>
<td>16 kWh</td>
</tr>
</tbody>
</table>
How the system works

TOU Schedule (if used):

**Mtr Pos 1/Reg 1**
- Rate A: Delivered On-Peak: 06:00-22:59
- Rate B: Delivered Off-Peak: 23:00-05:59

**Mtr Pos 1/Reg 2**
- Rate A: Received On-Peak: 06:00-22:59
- Rate B: Received Off-Peak: 23:00-05:59

Mtr Pos 1/Reg Set 1

- On/Off Peak
- Delivered KWH

Main Meter

Mtr Pos 2/Reg 1
- Delivered KWH On/Off Peak

Mtr Pos 2/Reg 2
- Received KWH On/Off Peak

**TOU can be used if desired**
Sonnen Specifications

**Batteries:**
Lithium Iron Phosphate (LiFePO4) - 51.2 v, 2 kWh modules

**Outback Inverters:**
- 120/240 v
- 16.67 amps (3-4 kW)
- 33.33 amps (7-8 kW)

**Automatic/integrated transfer switch**
Anti-Islanding Test

**Warranty:**
- 10 Year
- 10,000 Cycles

**Weight**
- 377 lbs. - 800 lbs.

**Dimensions:**
- 4/6/8 kWh = 26”x55”x14”
- 10/12/14/16 kWh models = 26”x75”x14”
System Operation

- Seamless discharge & charge
- System discharges minimum of 400 watts regardless of members subpanel usage
- Unit displays real-time discharge, charge, consumption, production
- SOC 6%
- Modes of operation - TOU, Backup, Self Consumption
MiEnergy Project

1. Purchased 4, Sonnen model “eco 16” (16 kWh / 8 kW) + 2 “eco 10” (10 kWh / 7 kW) batteries
2. Screened 25 prospects - selected 4 for site assessments.
3. Attended Sonnen’s initial training - electrician receive certification
4. Installation Process-Included PVs & a Generator
Screening Requirements

- Conditioned Space
- Broadband Internet
- Required to Install Sub-Panel
- Adequate Spacing
- Allow MiEnergy to Control
- Credit Score
- 2 Locations MN
- 4 Locations IA
- Yearly Inspections
- 5-10 Year Pilot Project
Not So Fast, Sonnen Certified Installers

STAR Energy Services LLC
• Tony Kassa, Master Electrician, Minnesota

Decorah Electric Inc.
• Joel Teslow, Master Electrician, Iowa
Site 1, Minnesota City, MN

- 1094 Average Monthly kWh
- 14.37 Peak kW
- 200 Amp Service
- Original Discharge 4 a.m. to 11 p.m.
- Charging at Midnight
Site 2, Winona, MN

- 950 Average Monthly kWh
- 7.19 Peak kW
- MiEnergy Employee
- 2 Parallel Service Panels
Site 3, Ridgeway, IA

- 743 Average Monthly kWh
- 7.5 Peak kW
- 200 Amp Service
- 14 kW Generator (never used, twice this year)
Site 4, Decorah, IA

- 691 Average Monthly kWh
- 15.1 Peak kW
- 7.8 kW DC PV System
- 200 Amp Service
- Discharge 5 p.m. - 10 a.m.
- Charge 11 a.m.
- Issues Shared Neutral
Site 5, Decorah, IA

- 554 Average kWh/Month
- 8.532 kW
- 6.6 kW DC PV System

- Entire House on Battery
  - Discharge 2 p.m. - 6 p.m.
  - Circuit Selection Education
Safety Is Responsibility

- E-Stop
- Placards
- 200 Amp Breaker
- Lithium Iron Phosphate
- Local Fire & Rescue Notified
Performance During Outage

95 Minute Outage
Does The Battery Really Cover The Entire Home?

Battery % of Total House

<table>
<thead>
<tr>
<th>Site</th>
<th>Battery % of Total House</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18.74%</td>
</tr>
<tr>
<td>2</td>
<td>19.03%</td>
</tr>
<tr>
<td>3</td>
<td>19.17%</td>
</tr>
<tr>
<td>4</td>
<td>21.59%</td>
</tr>
<tr>
<td>Average</td>
<td>20.03%</td>
</tr>
</tbody>
</table>

% of Home Usage Battery Covers
Battery Effect On Members Usage?

Pre vs Post Battery Install Usage

<table>
<thead>
<tr>
<th>Sites</th>
<th>2018 Usage</th>
<th>2019 Usage</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7826</td>
<td>8703</td>
<td>12.81%</td>
</tr>
<tr>
<td>2</td>
<td>5104</td>
<td>5242</td>
<td>2.75%</td>
</tr>
<tr>
<td>3</td>
<td>3577</td>
<td>3993</td>
<td>11.68%</td>
</tr>
<tr>
<td>4</td>
<td>3427</td>
<td>4564</td>
<td>33.31%</td>
</tr>
</tbody>
</table>

kWh

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

1 2 3 4

m1energy

Your Touchstone Energy Cooperative
AC/DC/AC Performance

Efficiency

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Total Discharge</th>
<th>Total Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>70.79%</td>
<td>875</td>
<td>1236</td>
</tr>
<tr>
<td>66.32%</td>
<td>759.7</td>
<td>1145.7</td>
</tr>
<tr>
<td>67.73%</td>
<td>1541.4</td>
<td>2275.7</td>
</tr>
<tr>
<td>71.53%</td>
<td>1631.1</td>
<td>2280.4</td>
</tr>
</tbody>
</table>

KWH
Solar Arrays Combined With Battery Unit

Store or Sell?

Net-Metering
- MN Co-ops & Utilities, 40 kW
- IL Co-ops & Utilities, 40 kW
- WI Utilities, 20 kW
- MiEnergy IA, kWh credits

Non-Net-Metering
- WI Co-ops (optional)
- IA
Battery Constraints

- **Cost** - an emerging market, too expensive for just emergency backup (21,000 after installation)
- **Capacity** - Limited capacity for load and kWh run time (332 kWh max per/month after efficiency loss)
- **Certified Installer** - Electricians need to get certified
- **Conditioned Space** - 41-113 degrees & accessible to main electric panel
- **Efficiency** - 69.1%
- **Broadband Internet** - Need to be hard lined to unit
What We’ve Learned & Takeaways For Others

- Simulate an outage
- Electricians needs to be Sonnen certified
- Members need to get quotes before purchasing - installations vary
- Whole house over sub panel
- Install bi-direction meters
- Informing/screening members
What Next?

- Discuss with Dairyland on control strategies for load MGMT
- Setup/test API system to remotely control each unit
- Sonnen designing a fixed discharge rate with TOU for next system update
- Implement energy storage rate - TOU rate
- Embrace the future
Thank You!