Energy Storage for Rural Affordable Housing: The McKnight Lane Redevelopment Project

September 27, 2017
Housekeeping

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ESTAP is a project of CESA

Clean Energy States Alliance (CESA) is a non-profit organization providing a forum for states to work together to implement effective clean energy policies & programs:

State & Federal Energy Storage Technology Advancement Partnership (ESTAP) is conducted under contract with Sandia National Laboratories, with funding from US DOE.

ESTAP Key Activities:

1. Disseminate information to stakeholders
   - ESTAP listserv >3,000 members
   - Webinars, conferences, information updates, surveys.

2. Facilitate public/private partnerships to support joint federal/state energy storage demonstration project deployment

3. Support state energy storage efforts with technical, policy and program assistance

ESTAP Project Locations
The Resilient Power Project

www.cleanegroup.org

www.resilient-power.org
Resilient Power Project

- Increase public/private investment in clean, resilient power systems
- Engage city officials to develop resilient power policies/programs
- Protect low-income and vulnerable communities
- Focus on affordable housing and critical public facilities
- Advocate for state and federal supportive policies and programs
- Technical assistance for pre-development costs to help agencies/project developers get deals done
- See www.resilient-power.org for reports, newsletters, webinar recordings
Today’s Speakers

- Peter Schneider, Vermont Energy Investment Corporation (VEIC)
- Craig Ferreira, Green Mountain Power
- Todd Olinsky-Paul, Clean Energy States Alliance (moderator)

Thank you to Imre Gyuk of US DOE-OE and Dan Borneo of Sandia National Laboratories
McKnight Lane: zero energy modular and solar+storage case study

peter schneider
partners

Cathedral Square

Addison County Community Trust

Vermont Housing & Conservation Board

U.S. Department of Energy

VERMONT Agency of Commerce & Community Development

Sandia National Laboratories

Clean Energy Group

Innovation in Finance, Technology & Policy

Efficiency Vermont

Clean Energy States Alliance

THE Vermont Community Foundation

HIGH MEADOWS FUND at the Vermont Community Foundation

pill-maharam architects

PMa

Vermont Energy Investment Corporation
zero energy modular redefines affordable housing

- Quality – craftsmanship and durability
- Healthy - fresh air ventilation and material selection
- Long Term Affordability – energy efficiency and asset value
Waltham, VT

HDD: ~7500

Design Temp: -4F

Solar Radiation: 3.7 kWh/m2/Day

Design Load: 7kBtu/hour

Climate Zone: 6a
how do we get there?
efficient mechanical and electrical systems

- conditioning energy recovery
- ventilation, heat pump, water heater, energy storage
- roof mounted photovoltaic panels (PV)
- cold climate heat pump and compressor

pill-maharam architects
PMa

Vermont Energy Investment Corporation
mcknight lane duplexes – waltham, vt
Average Monthly Customer Costs
Jan - Aug, 2017

Dollars

McKnight Ln # 1  McKnight Ln # 2  McKnight Ln # 3  McKnight Ln # 4  McKnight Ln # 5  McKnight Ln # 6  McKnight Ln # 7  McKnight Ln # 8  McKnight Ln # 9  McKnight Ln # 10  McKnight Ln # 11  McKnight Ln # 12  McKnight Ln # 13  McKnight Ln # 14

- Sum of Avg Net Cost
- Average Monthly Cost
Total Consumption by End Use Category

Total Gross kWh: 4,461
9/21/16-9/20/17

- HVAC: 69%
- Large Appliances: 12%
- Lights & Plug loads: 13%
- Water Heating: 6%
VOC Level in Master Bedroom
January, 2017

[Graph showing VOC levels and max throughout January, with peaks around certain dates]
Pollutant Exposure Time

This Week
09/15/17 - 09/22/17

- CERV Preferred Range (<24)
- ASHRAE 62.2 Range (<72)
- Poor IAQ Range (>72)

- 3.1 VOC Hours/Day
- 6.4 CO₂ Hours/Day
- 7.6 Pollutant Hours/Day
future developments
thank you.
• Energy Storage Benefits to McKnight Ln Customers
  • Reliability
  • Simulated Outage
• Energy Storage Benefits to GMP
  • Peak Reduction
  • Energy Arbitrage
  • T&D Deferral/Grid Congestion Relief
• System Performance Issues/Lessons Learned
• GMP Residential Energy Storage Pilot
Reliability at McKnight Lane

- Provides backup power to customers during a grid outage, effectively keeping the power on at all times.
- Integrated Automatic Transfer Switch senses when grid power goes down, and switches battery into backup mode until it senses grid power is restored.
- Usually, when the grid goes down, the PV array cannot generate electricity. The addition of the battery allows PV to continue generating, possibly extending the amount of backup time available to each customer.

<table>
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<th>Critical Loads</th>
<th>Average kW</th>
<th>3-hour Load (kWh)</th>
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<tbody>
<tr>
<td>Cold Climate Heat Pump</td>
<td>0.70</td>
<td>2.10</td>
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<tr>
<td>CERV Heat Pump</td>
<td>0.45</td>
<td>1.35</td>
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<tr>
<td>CERV Fans</td>
<td>0.09</td>
<td>0.27</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>0.08</td>
<td>0.24</td>
</tr>
<tr>
<td>Lights &amp; Plugs</td>
<td>0.33</td>
<td>0.98</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.65</strong></td>
<td><strong>4.94</strong></td>
</tr>
</tbody>
</table>

Sonnen ECO6
Provides over 3 hours of backup for customer and over 3 hours of peak shaving for GMP to lower costs for customers.

Sonnen ECO8
Provides almost 5 hours of backup for customer and almost 5 hours of peak shaving for GMP.

Average GMP outage is 2 hours.
### Event Schedule:

<table>
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<th>Time</th>
<th>Event</th>
<th>Duration</th>
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<tbody>
<tr>
<td>11:00 am</td>
<td>Grid Outage</td>
<td>2 hours</td>
</tr>
<tr>
<td>1:00 pm</td>
<td>Grid Connection</td>
<td>-</td>
</tr>
</tbody>
</table>

Battery output perfectly mirrors home consumption.
Peak Shaving

Distributed Energy Resources (DERs) provide an opportunity for GMP to reduce costs during peak events. This is currently GMP’s primary use of residential energy storage.

**Forward Capacity Market (FCM)**
- New England Peak
- 1 event per year

**Regional Network Service (RNS)**
- Vermont Peak
- 1 event per month

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Hour</th>
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<tbody>
<tr>
<td>2017</td>
<td>6/13/17</td>
<td>17</td>
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</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Hour</th>
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<tbody>
<tr>
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<td>8</td>
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<td>2017</td>
<td>7/19/17</td>
<td>21</td>
</tr>
<tr>
<td>2017</td>
<td>8/22/17</td>
<td>18</td>
</tr>
</tbody>
</table>
Value to GMP

Peak Reduction: 44.65 kW
Monthly Cost Reduction: ~$400
Energy Arbitrage

Energy Arbitrage is the process of charging or discharging the batteries based on market prices of energy. This represents a new value stream available to GMP.

GMP has partnered with Virtual Peaker to provide this functionality and is close to making arbitrage with these systems a reality.
Additional Benefits to GMP

Grid Congestion from PV

Store energy at time of high PV penetration to “Soak Up” excess solar in a certain area.

T&D Deferral

Small amounts of distributed energy storage may delay, or completely alleviate the need for wire or transformer upgrades that may be overkill for a small increase in capacity in a given area.
System Performance Issues

• Software
  • Communication
  • Response to commands

• Hardware
  • Modems/SmartFunctions
  • One bad inverter
  • One bad battery cell

Lessons Learned

• Expect the unexpected
• Communication is key
• Being on leading edge of technology has rewards as well as risks
GMP Residential Energy Storage Pilot: Tesla Powerwall

Available to all GMP Residential Customers

$15 per month for 10 years

-or-

$1,500 one-time up front charge

Performance

Usable Capacity
13.5 kW

Power
5.0 kW continuous, 7 kW peak

Operating Temp.
-4°F to 122°F

Enclosure
Rated for indoor and outdoor installation.
Thank you
Thank you for attending our webinar

Todd Olinsky-Paul
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Clean Energy States Alliance
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