NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

Grid-interactive Efficient Buildings – Case Examples
August 27, 2019  3:00 pm ET

Welcome

Rodney Sobin, NASEO, Senior Program Director

Xcel Energy

Eric Maurer, Product Developer
Neil Cowan, Regulatory Policy Specialist

Southern Company

Jim Leverette, Senior Research Engineer
Justin Hill, Senior Research Engineer

Q&A
Grid-interactive Efficient Buildings – Case Examples
August 27, 2019  3:00 pm ET

Logistics:

- All attendees are muted.
- Please use the GoToWebinar question box to ask questions or “raise hand” to be recognized and unmuted.
- Webinar recording and slides will be posted.
- Access via NASEO webpage (www.naseo.org); go to “EVENTS,” then “Past Webinars”
Advancing technologies open opportunities for more flexible building/facility load management:

- Reduce costs, enhance resilience, reduce emissions
- Reduce peaks, moderate ramp rates, provide grid services
- Enhance energy efficiency
- Integrate distributed and renewable resources

How can we optimize facility interactions with the grid?

How can states fashion policies, programs, and regulations to advance such optimization through GEB?

What are roles for states, facility operators, utilities, product and service providers, and others?
NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

- NASEO-NARUC GEB Working Group
  - Supported by U.S. DOE BTO
  - Inform states about GEB technologies and applications
  - Identify opportunities and impediments
    - Non-technical and technical
  - Identify and express state priorities, concerns, interests
  - Recognize temporal and locational value of EE and other DERs
  - Enhance energy system reliability, resilience, and affordability

- Inform state planning, policy, regulations, and programs
  - Webinars, briefing papers, calls
  - Advance potential roadmaps and pilots
  - National Lab technical assistance

Roundtable and Workshop at NASEO Annual Meeting
September 16, 2019
NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

- Working Group co-chairs:
  - Kaci Radcliffe, Oregon Dept. of Energy
  - Hanna Terwilliger, Minnesota PUC staff

- Working Group states:
  - Colorado
  - Connecticut
  - Florida
  - Hawaii
  - Massachusetts
  - Michigan
  - Minnesota
  - New Jersey
  - New York
  - Oregon
  - South Carolina
  - Tennessee
  - Virginia
  - Wisconsin
NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

https://naseo.org/issues/buildings/naseo-naruc-geb-working-group

Questions/inquiries:

Rodney Sobin rsobin@naseo.org and Maddie Koewler mkoewler@naseo.org

Danielle Sass Byrnett dbyrnett@naruc.org
Agenda

• Utility perspective on load flexibility
• Our evolution and path forward
• Initial experience
• Regulatory and policy issues
• Impending projects
Load flexibility—increasingly important, increasingly available

- Batteries
- EVs
- Control systems
- Smart devices
- Distributed solar
- Etc.
Our evolution and path forward

Conceptual illustration of load flexibility programs
Peña Station/Panasonic Project

3.376 kVA PV on feeder
Panasonic Project Use Cases

- Microgrid/Islanding of Panasonic building
- Peak Demand Reduction
- Energy Arbitrage
- Frequency Response
- Voltage Regulation
- PV Ramp Rate Limiting
### Panasonic Testing Results Summary

<table>
<thead>
<tr>
<th>Operation</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Regulation</td>
<td>Testing Stage – Medium priority</td>
</tr>
<tr>
<td>Peak Demand Reduction</td>
<td>Testing Stage – High priority</td>
</tr>
<tr>
<td>Energy Arbitrage</td>
<td>Testing Stage – Working out pricing mechanism</td>
</tr>
<tr>
<td>PV Ramp Rate Limiting</td>
<td>Reduced testing</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>Testing Stage – Medium priority</td>
</tr>
<tr>
<td>Microgrid</td>
<td>Testing Stage – In discussion with vendor</td>
</tr>
</tbody>
</table>

Detailed results can be found in the 2019 Semi-Annual Report to the Colorado Public Utilities Commission Regarding the Innovative Clean Technology Program.
Stapleton Utility Sited Project

Northern Reliability Modular Units:
- 2 x 18 kW/69 kWh
- 2 x 36 kW/138 kWh
- 2 x 54 kW/207 kWh

Objectives/Use Cases:
- Peak Demand Reduction
- Voltage Regulation
- Solar Time Shifting
- Energy Arbitrage

Stapleton feeder has ~18.5% PV penetration (2017)
Stapleton Behind-the-Meter Project

• Sunverge SIS units
  – 6 x 6 kW/15.5 kWh

• Objectives/Use Cases:
  – Providing Residential Backup Power
  – Peak Demand Reduction
  – Solar Time Shifting
  – Volt-Watt Operation

• Testing Results:
  – Testing Concluded
  – Units are capable of providing back-up power, performing efficient solar time shifting operation, and system peak demand reduction.
  – Units were not capable of performing voltage regulation as the vendor had no preexisting control algorithms for that operation.
## Stapleton Utility-Sited Testing Results

<table>
<thead>
<tr>
<th>Operation</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Time Shifting</td>
<td>Reduced Testing</td>
</tr>
<tr>
<td>System Peak Demand Reduction</td>
<td>Testing Stage – Working through firewall protocols</td>
</tr>
<tr>
<td>Feeder Peak Demand Reduction</td>
<td>Testing Stage – High Priority</td>
</tr>
<tr>
<td>Voltage Regulation</td>
<td>Testing Stage – Working with vendor to fix algorithm</td>
</tr>
<tr>
<td>Energy Arbitrage</td>
<td>Testing Stage – Working through firewall protocols</td>
</tr>
</tbody>
</table>

Detailed results can be found in the 2019 Annual Report to the Colorado Public Utilities Commission Regarding the Innovative Clean Technology Program
Operational & Planning Lessons Learned

• Communication
  – Firewall issues
  – Downtime alert system (potential)
  – Interoperability with cloud-based solutions

• Schedule Setbacks
  – Interdependencies on other infrastructure can (and will) delay the project
    • Installations of voltage meters at Stapleton Utility-Sited Project
    • Cybersecurity requirements is not static and could impact project implementation

• Weather Related Issues
  – Ventilation and cooling required for certain Li-Ion chemistries (potentially impact operation use)
Regulatory Issues and Policy

**ENABLERS**
- New and enhanced opportunities through legislation and regulatory applications
- Incentives
- Related investments and Integration:
  - Grid modernization
  - Convergence/Integration of Resource Planning Activities

**LIMITERS**
- Statutory/Rule Interpretation & Limitations
- Legacy Targets/Goals
- Limited R&D/Lengthy Approval Process
New projects

Grid Applications

Geo-targeting

Resilience

Load shifting

Ancillary Services

In market/approved
In development/@ PUC

999s

kWh

↑↑↑↑↓↓↓↓

New Technology

Batteries

Grid-interactive water heaters, thermal storage

Vehicles
Southern Company’s Smart Neighborhood® Initiatives

Jim Leverette, PE
Justin Hill, PhD, PE

Southern Company Research & Development
The Smart Neighborhoods

Objective
Design and build first-of-a-kind smart home communities to understand and prepare for evolving customer expectations and future grid needs.

Scope
Demonstrate distributed energy resource (DER) use cases optimizing cost, reliability, and environmental impact with a community-scale microgrid and in-home solar and batteries.

Demonstrate high-performance homes with connected home technologies providing an improved customer experience.

Demonstrate buildings-to-grid integration with real-time utility-to-customer interaction.
Monthly Energy Usage

AL Home

- Total (kWh): 1323

SN w/o EV

- Total (kWh): 789

SN w/ 2 EV

- Total (kWh): 1209

*SN home has been normalized to show equivalent sqft of AL home
January 2019 – Average Electric Demand (kW)
Two (potentially) Competing Objectives

Grid Side Optimization

Homeowner Optimization

CSEISMIC

VOLTTRON
1. CSEISMIC receives grid data

2. CSEISMIC attempts to influence Volttron to meet grid needs

3. VOLTTRON takes in customer preferences, weather and price to develop forecasts & schedules for all in-home devices

4. VOLTTRON sends aggregate forecasts to CSEISMIC
Capture as much data as possible
Why is Southern Company interested?

Solar + Storage Cost Reduction

Grid Resiliency
Comfort/Convenience
Energy Productivity

Customer Cost
Utility Cost

Understand Potential to:

It's Official. All New California Homes Must Incorporate Solar

"There are 100,000 customers annually that will see the acquisition of solar as a normal part of their home transaction."

JACOB JAFFEY  MAY 01, 2016

For an action image of solar energy.
<table>
<thead>
<tr>
<th>High Performance Homes</th>
<th>Manage Behind-the-Meter Assets</th>
<th>Potential Revenue &amp; Rate Design Impacts</th>
<th>Renewable Energy Grid Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load shifting</td>
<td>Energy Use Optimization</td>
<td>Informed Load Forecasting</td>
<td>Localized solar + storage</td>
</tr>
<tr>
<td>Tighter envelope</td>
<td>Buildings as a resource</td>
<td>New building codes &amp; standards</td>
<td>New infrastructure needs</td>
</tr>
<tr>
<td>Advanced Building Energy Systems</td>
<td>Create load shapes</td>
<td>How to price energy with tech options</td>
<td>Balance grid &amp; customer benefits</td>
</tr>
<tr>
<td>#</td>
<td>Gap</td>
<td>Lead Organization</td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Quantification of Device Level and Building Level Grid Service</td>
<td>R&amp;D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Seamless Device Installation/Onboarding and Ongoing</td>
<td>R&amp;D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Information &amp; Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Planning &amp; Operations Tools (may vary by application)</td>
<td>R&amp;D</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Data Management &amp; Cyber Security</td>
<td>TO (IT)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Appropriate Rate Design</td>
<td>Pricing &amp; Rates</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Customer Appetite</td>
<td>Marketing</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Regulatory</td>
<td>Regulatory Affairs</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Utility Business Case (including Grid Services Valuation)</td>
<td>System Planning / Marketing / New Ventures</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Legal (e.g. Data Privacy)</td>
<td>Legal / Regulatory Affairs</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Planner &amp; Operator Trust</td>
<td>System &amp; Dist. Planning</td>
<td></td>
</tr>
</tbody>
</table>
How States can Advance GEBs

• Focus on open standards for communications and control
• Encourage timing of energy usage as well as pure energy efficiency
• Keep customer as number one priority
• Allow utilities/other entities to capture full value of these resources
• Create incentives that make sense for your state and residents
• Take a system approach to efficiency that includes:
  – High Efficiency Construction
  – High Performance Equipment
  – Advanced Controls
• Encourage your utilities to do projects like these and innovate without regulations forcing their hand
What's next?

Future opportunities • Transition from Smart home to Smart Neighborhood to Smart Cities
Appendix
Buildings-to-Grid Control Integration

- Volttron
- CSEISMIC
- Pricing Signals
- Weather
- Solar forecasts
- Other relevant data

Southern Company’s RES

ecobee Cloud

Delta Cloud

Flair Cloud

SkyCentrics Cloud

Enel X Cloud

Relevant data from devices
Relevant settings or commands to device

EV Charger
Minisplit Controller

Battery & Solar
Altus at the Quarter

• Atlanta’s Upper Westside
  – 18 miles from Hartsfield Jackson Airport
  – 5.4 miles to Mercedes Benz Stadium
  – 7.3 miles to SunTrust Park

• The first 46 townhomes will be a part of the Georgia Power Smart Neighborhood
  – Part of larger build out of 227 townhomes
  – Pricing for Phase 1: $500k to $600k
  – 4 stories - 2,300 sq. feet

• Virtual Walkthrough
<table>
<thead>
<tr>
<th>Partners/Vendors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core Team</strong></td>
</tr>
<tr>
<td><img src="image" alt="Georgia Power" /></td>
</tr>
<tr>
<td><img src="image" alt="Southern Company" /></td>
</tr>
<tr>
<td><img src="image" alt="PulteGroup" /></td>
</tr>
<tr>
<td><strong>Partners</strong></td>
</tr>
<tr>
<td><img src="image" alt="Oak Ridge National Laboratory" /></td>
</tr>
<tr>
<td><img src="image" alt="EPRI - Electric Power Research Institute" /></td>
</tr>
<tr>
<td><img src="image" alt="ecobee" /></td>
</tr>
<tr>
<td><img src="image" alt="SkyCentrics" /></td>
</tr>
<tr>
<td><img src="image" alt="eMotorWerks" /></td>
</tr>
<tr>
<td><img src="image" alt="DEPARTMENT OF ENERGY" /></td>
</tr>
<tr>
<td><img src="image" alt="Delta" /></td>
</tr>
<tr>
<td><img src="image" alt="LG Chem" /></td>
</tr>
<tr>
<td><img src="image" alt="FLAIR" /></td>
</tr>
<tr>
<td><img src="image" alt="vivint." /></td>
</tr>
<tr>
<td><strong>Vendors</strong></td>
</tr>
<tr>
<td><img src="image" alt="AO Smith" /></td>
</tr>
<tr>
<td><img src="image" alt="SiteSage" /></td>
</tr>
<tr>
<td><img src="image" alt="Clean Power Research" /></td>
</tr>
<tr>
<td><img src="image" alt="Smart Neighborhood" /></td>
</tr>
<tr>
<td><img src="image" alt="Pulte Homes" /></td>
</tr>
</tbody>
</table>
Modeled Annual Energy Usage

Altus Home built to code

<table>
<thead>
<tr>
<th>Total (kWh)</th>
<th>15,911</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>18%</td>
</tr>
<tr>
<td>Cooling</td>
<td>7%</td>
</tr>
<tr>
<td>Hot Water</td>
<td>21%</td>
</tr>
<tr>
<td>Lights &amp; Appl.</td>
<td>54%</td>
</tr>
</tbody>
</table>

Smart Neighborhood Efficiency Update

<table>
<thead>
<tr>
<th>Total (kWh)</th>
<th>12,295</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>23%</td>
</tr>
<tr>
<td>Cooling</td>
<td>7%</td>
</tr>
<tr>
<td>Hot Water</td>
<td>5%</td>
</tr>
<tr>
<td>Lights &amp; Appl.</td>
<td>65%</td>
</tr>
</tbody>
</table>

Add in Solar Generation

<table>
<thead>
<tr>
<th>Total (kWh)</th>
<th>7,480</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>39%</td>
</tr>
<tr>
<td>Cooling</td>
<td>7%</td>
</tr>
<tr>
<td>Hot Water</td>
<td>5%</td>
</tr>
<tr>
<td>Lights &amp; Appl.</td>
<td>65%</td>
</tr>
</tbody>
</table>

Add in Solar Generation
Example Use Case – DERMs integration

• ACS DERMS platform is a layer on top of an existing self-healing network platform
  – Adds functionality to control Distributed Energy Resources (DERs)

• Implementing DERMS on this feeder means it will be a part of the self-healing network program

• Smart Neighborhood test site
  – ACS DERMS will communicate with the neighborhood energy controller

• Two other test sites for DERMS:
  – UGA Solar Plant
  – Georgia Tech Microgrid
Thank you!

https://naseo.org/issues/buildings/naseo-naruc-geb-working-group

Questions/inquiries:

Rodney Sobin rsobin@naseo.org and Maddie Koewler mkoewler@naseo.org

Danielle Sass Byrnett dbyrnett@naruc.org