Alphabet Soup: of HEMS, DR, & DER

2016 Home Energy Management Systems Workshop
Wednesday, September 21st, 2016
1:20pm-2:30pm
Speakers

- Background
  - Claire Miziolek, NEEP

- HEMS Examples in practice
  - Dennis Stewart, Weatherbug Home

- DER Possibilities
  - Brian “the Brain” Buckley
• **DR = Demand Response**
  
  − **Definition from PJM:**
    
    • DR is a voluntary [PJM] program that compensates end-use (retail) customers for reducing their electricity use (load), when requested by [PJM], during periods of high power prices or when the reliability of the grid is threatened.
    
    − Ex: Summer peak, winter peak

• **DER = Distributed Energy Resources**

  − **Definition from EPRI**
    
    • DERs are smaller power sources that can be aggregated to provide power necessary to meet regular demand. As the electricity grid continues to modernize, DER such as storage and advanced renewable technologies can help facilitate the transition to a smarter grid.
    
    − Ex: rooftop solar, battery storage, electric vehicles (EV)
## Regional Residential DR has 2 Flavors:

<table>
<thead>
<tr>
<th>Program</th>
<th>Sector</th>
<th>Details</th>
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<tbody>
<tr>
<td>Manual Curtailment</td>
<td>C&amp;I</td>
<td>• Based upon contractual commitments</td>
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<td>• 50-100kW usage reductions</td>
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<td>• Reservation v. voluntary enrollment</td>
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<td>• Opportunity for bonus payments</td>
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<td>Direct Load Control (DLC)</td>
<td>Res./Small C&amp;I</td>
<td>• Based upon direct communication between a program administrator</td>
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<td>• Smaller usage reductions (~1kW)</td>
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<td>Legacy DLC</td>
<td>Res./Small C&amp;I</td>
<td>• Switch based, one way signal</td>
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<td>• Cycling an A/C condensing unit, heat pump, pool pump, or hot water heater</td>
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<td>• Minimum verification required</td>
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<td>Two-Way Direct Load Control</td>
<td>Res./Small C&amp;I</td>
<td>• Behind the meter information and communication technologies (ICT) transit data over HAN/Broadband</td>
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<td>Behavioral Demand Response</td>
<td>Res.</td>
<td>• Based upon customer engagement</td>
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<td></td>
<td>• Can provide incentive or use behavioral triggers</td>
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<td>• AMI Required</td>
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Activity is Ramping Up

Moving beyond switches, toward a proliferation of connected devices

- Smart Phones, T-Stats, Hot Water Heaters, Heat Pumps, EMS, ARTUs, CALCs, PEVs, energy storage, etc.

Program Administrators Offering Demand Response

- NWA projects throughout the country
- Mass. 2016-18 Plan
- Conn. 2016-18 C&LM Plan
- Pennsylvania Act 129 Phase III
- NHEC Go Beyond the Peak
- Maryland BGE Smart Energy Rewards
- NY Dynamic Load Management Plans, Smart Home Rate in REV Track II Order

Why should utilities should get in the game? Survey Says...

- Those who are enthusiastic about smart tech identify as enthusiastic about EE; 52 percent, v. 27 percent of the general population
- Customers value connectivity almost as much as cost savings
- NGA report outlining opportunities
Dennis Stewart
dstewart@weatherbug.com
September 21, 2016

2016 HOME ENERGY MANAGEMENT SYSTEMS WORKSHOP

HEMS Integration with DR and DER
Weather is the Biggest Driver of Home Energy Use

- Sun
- High & Low Temperatures
- Humidity
- Shade
- Wind

50% of your energy use is driven by the weather
WeatherBug Home Intelligent Demand Side Management

*Patented methods and systems*

**DATA COLLECTION**

- WeatherBug Real-time Data
- Energy Usage Data
- Connected Thermostat
- Connected Devices

**ENERGY EFFICIENCY**

- Intelligent Device Optimization
- ScoreCards & Mobile App

**DEMAND RESPONSE**

- Average HVAC Savings per Home (National Grid, MA)
- Average Whole Home Energy Savings (ScoreCards)
- Average Capacity Per Home (CenterPoint, TX)
- WeatherBug App Page View Lift During Bad Weather (Charleston, SC)

16% 2% 1.76 kW 67%
HEMS Integrated with DR and DER
Why We Need Intelligence

- Load administrators want uniform load reduction
- Dispatching all resources at once will result in uneven reduction
- Need to intelligently control the level and timing of the setbacks
Evolution of Demand Response

Source – Adapted from Navigant/PLMA

• Pre 2000 – and continuing today
  • Interruptible tariffs for large C&I
  • 1 way DLC for residential A/C, water heaters, pool pumps
  • Capacity for planning and emergency needs

• 2005 – and continuing today and beyond
  • DR in wholesale markets, shave the peak
  • Behavioral/voluntary
  • Real time, customizable, mostly 2-way via HEMS (almost exclusively thermostats adjusting HVAC)
  • BYOT

• Today and Beyond
  • DR as a DER (one of many)
  • Targeted DR for localized distribution and congestion management – Direct install programs
  • DR response to load forecasts and price signals
Connected Devices into DRMS

Single platform to manage a variety of HEMS devices

Results .6 – 1.76kW/home
DRMS Functions – managing many devices all contributing to load curtailment

- Enrollment
  - Bulk and Individual
  - Enrollment Statistics
  - Marketing Campaign Tracking

- Device Summary
  - Offline, Online, Mode, by OEM

- Demand Response
  - Capacity Forecasting
  - Event Initiation
  - Event Recall
  - DR EM&V
  - Event Reporting
  - Historical Event Reports
  - Cumulative Event Reporting

- Energy Efficiency
  - Participation
  - TOU Optimization Reporting
  - Savings Report

- Reporting
  - Segment Customer Base by Home Performance Scores

- Data Presentment
  - Weather
  - Geo Mapping
  - Alerts/Badging
Evolution of Demand Response Analytics

Basic DR
Call Everything At Same Time
CNP 9.6.12

Better DR
Staggering Start Times
CNP 8.25.14

Advanced DR
Using Advanced Analytics
Oncor 6.9.15
Advancing DR via Home Data Analytics

- Forecast how homes respond to a DR event
- Bin into Groups for Optimized DR based on house size, propensity to opt out,
- Adjust set point profiles accordingly based upon scenario and home characteristics

Scenarios:
- Emergency: send maximum setpoint increase to all thermostats immediately
- Specific event duration: sustained load reduction for the specified time
- Other Specific strategy for a duration
  - Maximal load when event cancelation expected
  - Target load reduction

Setpoint Profile Techniques:
- Staggered
- Precooling
- Ramping
HEMS adding Value into DER

Improved DER management by directing PV generation to the grid, to a battery, or to appliances based upon cost.

Thermal capacity utilization of the hot water heater, and the home as a inexpensive “battery” for grid stabilization.

Avoided cost of distribution system upgrades

Enhanced customer engagement
HEMS – Foundation for Customer Engagement

Home Scoring

Disaggregate load based upon device

Offer tips for improvement

Program targeting

Provides the opportunity to truly understand energy consumption, program effectiveness and allows the supplier to become the “trusted advisor” to their customers.
Thermostat Based Residential DR

• Texas ERCOT-WSL program

• NY REV project – System wide as well as targeted DR (NWA), Central Hudson, Con Ed BQDM, Ngrid Kenmore

• CAL ISO – CPUC issued directives for DR in response to Aliso Canyon Shortfall – Demand Response Auction Mechanism (DRAM)

• PJM accepted forward capacity

• IOUs moving past the pilot stage
Thank You!
The Future of DER Possibilities

Brian Buckley
2016 Home Energy Management Systems Workshop
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Evolving Software Architecture
Multiple POCs, Integrating an Array of DERs

**DMS**
Existing, industry making incremental improvements
- Control and optimization of utility assets:
  - Switches
  - Reclosers
  - Capacitors
  - Voltage Regulators

**DERMS**
Net new and emerging
Building from concepts from DMS and DRMS
- Monitor, Optimize and Dispatch DERs to meet grid and market needs:
  - Energy storage
  - PV (with smart inverters)
  - Future Electric Vehicle charging

**DRMS**
Existing, industry making incremental improvements
- Program management and control of DR portfolio:
  - Smart AC
  - Aggregated DR

Source: PGE DERMS Workshop
NY-ISO Wholesale Market Redesign
Friendly to Aggregated, Price Responsive Load

Use Case 7 - Dispatchable Load, Storage and Generation

Source: Distributed Energy Resources Roadmap for New York’s Wholesale Electricity Markets
Questions and Discussion

• Where is the largest opportunity for DR integration within HEMS? For DER?
• How can a utility develop an appropriate DER HEMS strategy?
• What can lay the foundation for future DR? DER?
  – Thermostats?
  – Appliances?
  – Water heating?
  – Lighting?