



Northeast Energy Efficiency Partnerships

# Alphabet Soup: of HEMS, DR, & DER

2016 Home Energy Management  
Systems Workshop

Wednesday, September 21<sup>st</sup>, 2016

1:20pm-2:30pm

# Speakers

- Background
  - Claire Miziolek, NEEP
- HEMS Examples in practice
  - Dennis Stewart, Weatherbug Home
- DER Possibilities
  - Brian “the Brain” Buckley

# 101

- 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:

Program	Sector	Details
Manual Curtailment	C&I	<ul style="list-style-type: none"> <li>Based upon contractual commitments</li> <li>50-100kW usage reductions</li> <li>Reservation v. voluntary enrollment</li> <li>Opportunity for bonus payments</li> </ul>
Direct Load Control (DLC)	Res./ Small C&I	<ul style="list-style-type: none"> <li>Based upon direct communication between a program administrator</li> <li>Smaller usage reductions (~1kW)</li> </ul>
Legacy DLC	Res./ Small C&I	<ul style="list-style-type: none"> <li>Switch based, one way signal</li> <li>Cycling an A/C condensing unit, heat pump, pool pump, or hot water heater</li> <li>Minimum verification required</li> </ul>
Two-Way Direct Load Control	Res./ Small C&I	<ul style="list-style-type: none"> <li>Behind the meter information and communication technologies (ICT) transit data over HAN/Broadband</li> </ul>
Behavioral Demand Response	Res.	<ul style="list-style-type: none"> <li>Based upon customer engagement</li> <li>Can provide incentive or use behavioral triggers</li> <li>AMI Required</li> </ul>

# 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...

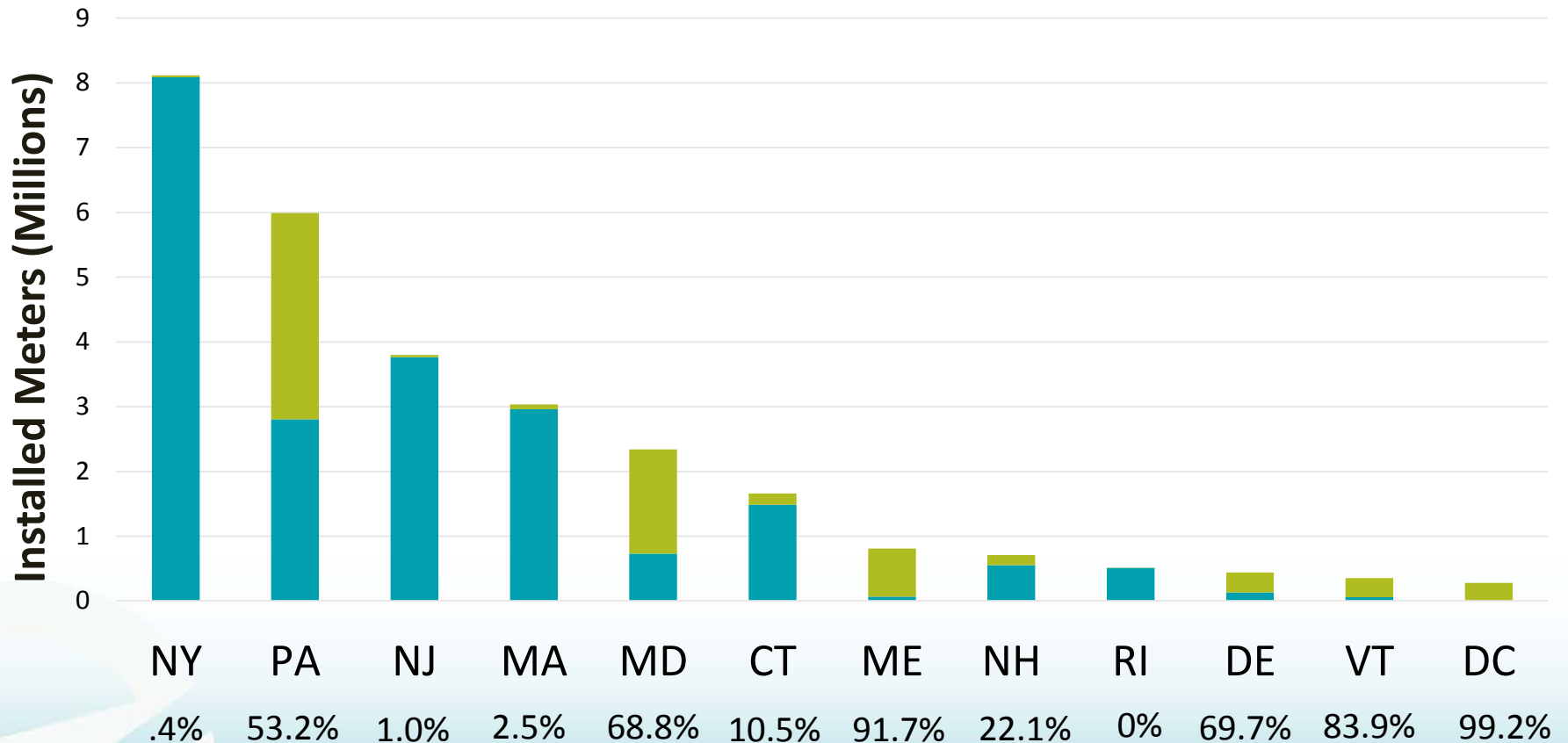
- Those who are enthusiastic about smart tech identify as enthusiastic about EE; 52 percent, v. 27 percent of the general population
- Customers value connectivity almost as much as cost savings
- NGA report outlining opportunities

# Northeast/Mid-Atlantic AMI Penetration



## Region's AMI Penetration (Electric 2014)

■ Non-AMI Meters ■ AMI Meters



*Dennis Stewart*

*dstewart@weatherbug.com*

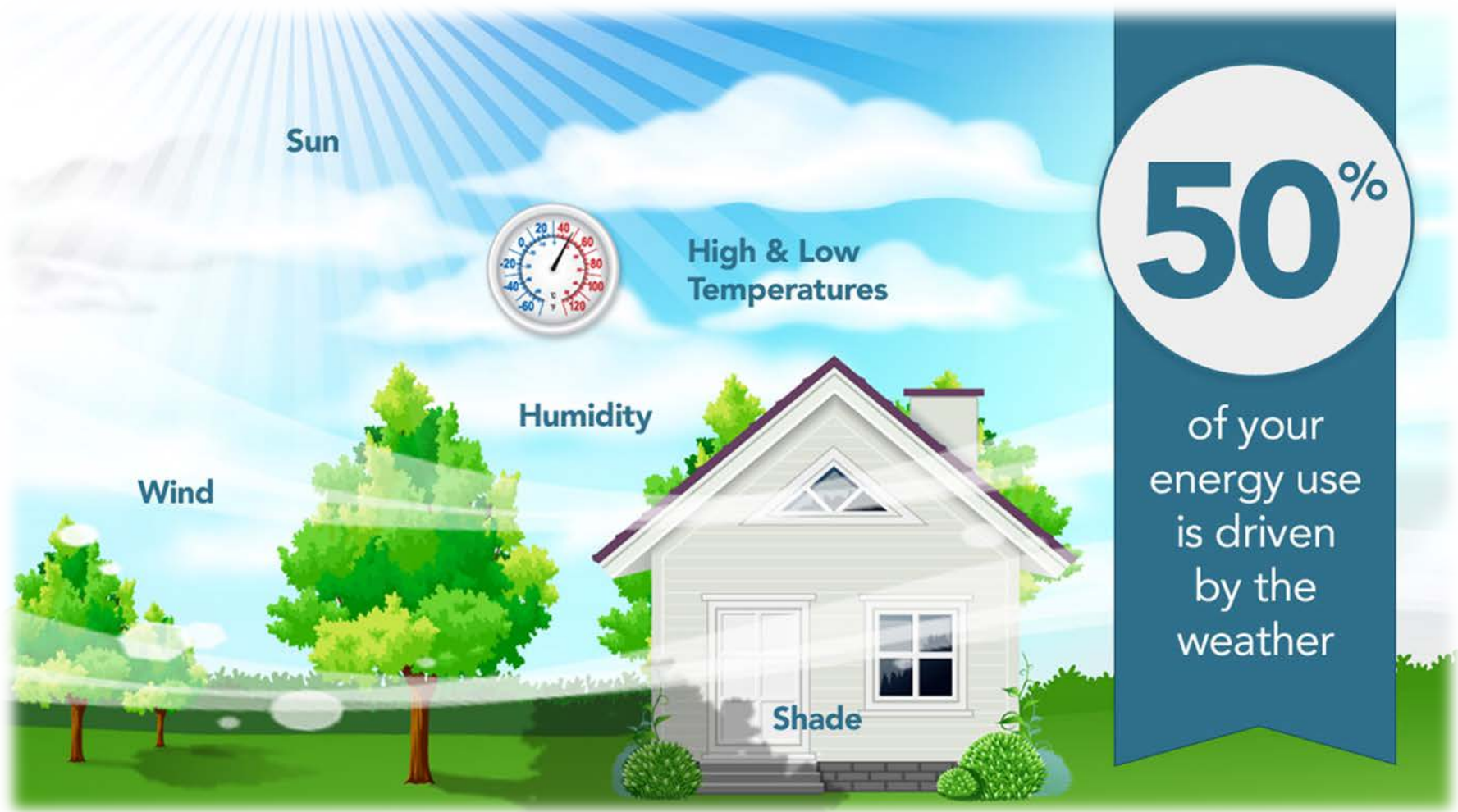
*September 21, 2016*



## 2016 HOME ENERGY MANAGEMENT SYSTEMS WORKSHOP

### HEMS Integration with DR and DER

# Weather is the Biggest Driver of Home Energy Use





# WeatherBug Home Intelligent Demand Side Management

*Patented methods and systems*

## DATA COLLECTION

WeatherBug  
Real-time Data



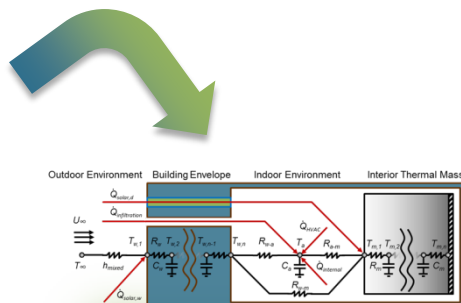
Energy Usage  
Data



Connected  
Thermostat



Connected  
Devices



## ENERGY EFFICIENCY

Intelligent Device  
Optimization



Automation

**16%**

Average HVAC  
Savings per  
Home  
(National Grid, MA)

ScoreCards &  
Mobile App



Consumer Engagement

Behavioral

**2%**

Average Whole Home  
Energy Savings  
(ScoreCards)

## DEMAND RESPONSE

Intelligent  
Demand Response



Automation

**1.76 kW**

Average Capacity  
Per Home  
(CenterPoint, TX)

WeatherBug  
Mobile App



Consumer Engagement

Behavioral

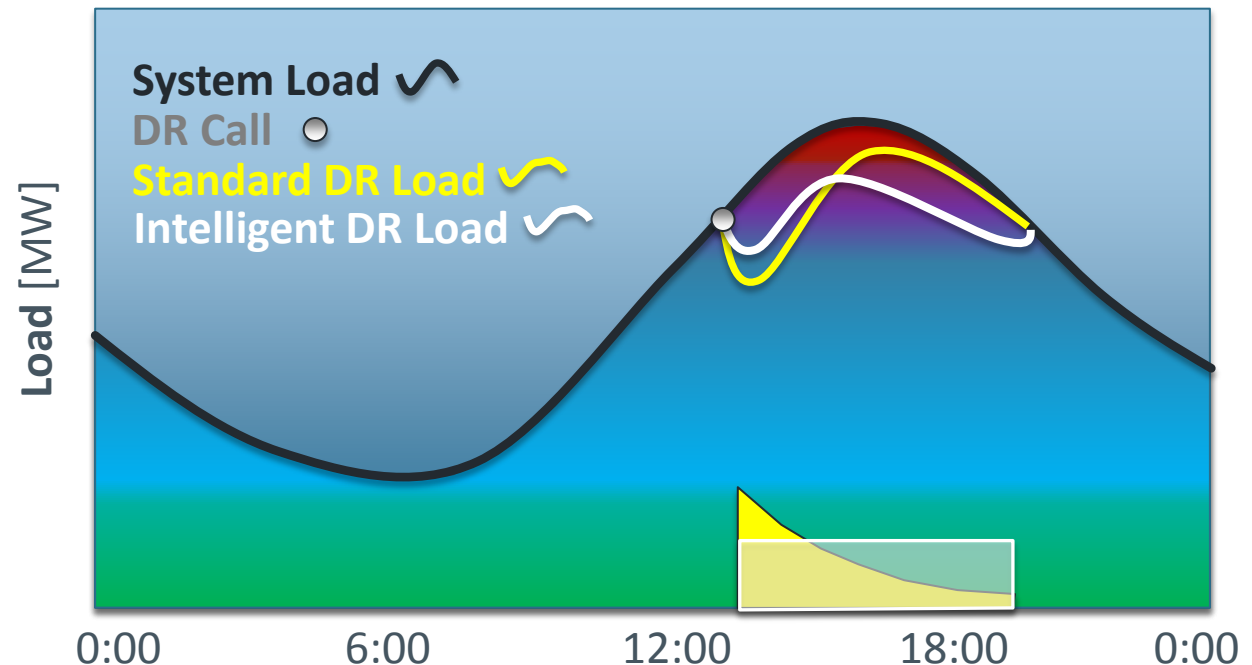
**67%**

WBH App Page  
View Lift During  
Bad Weather  
(Charleston, SC)

# 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

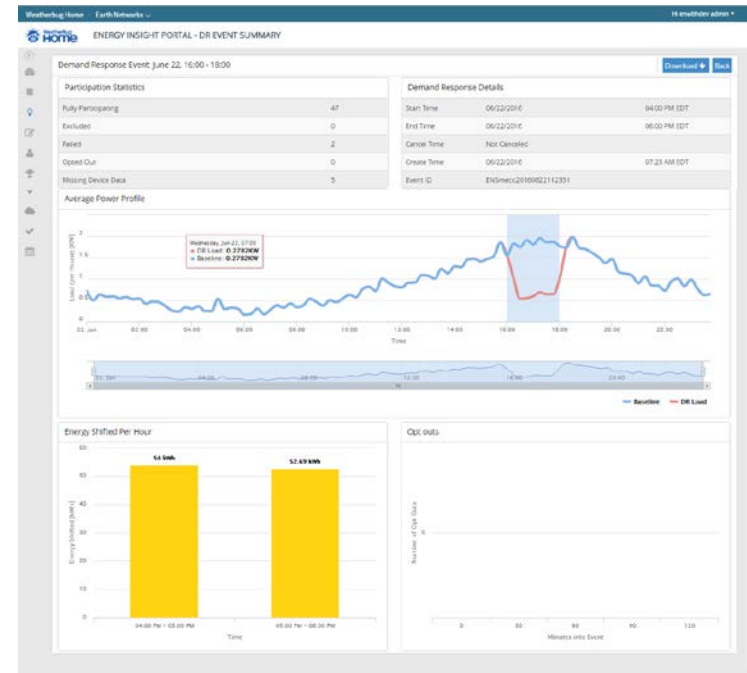
## Single platform to manage a variety of HEMS devices



## 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



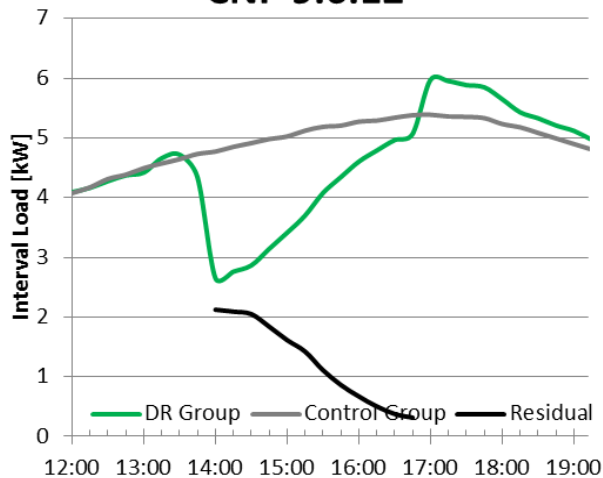
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# Evolution of Demand Response Analytics

## Basic DR

Call Everything At Same Time

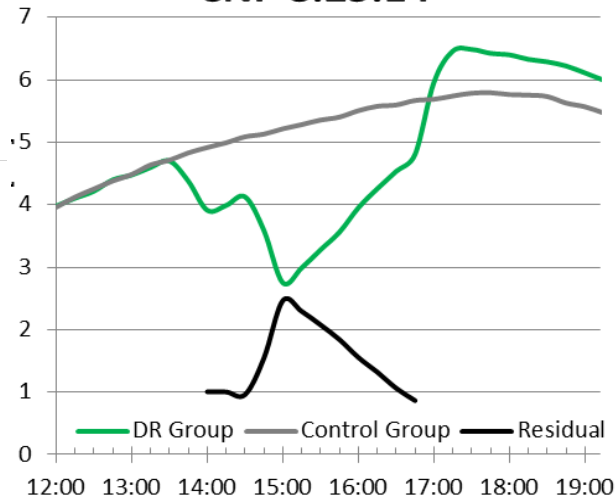
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## Better DR

Staggering Start Times

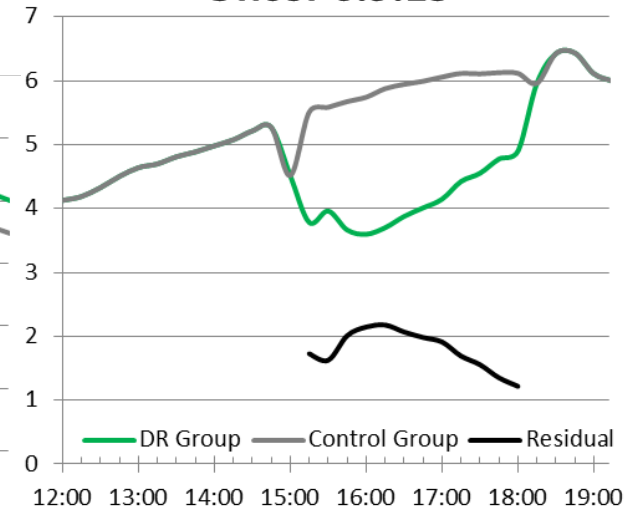
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## Advanced DR

Using Advanced Analytics

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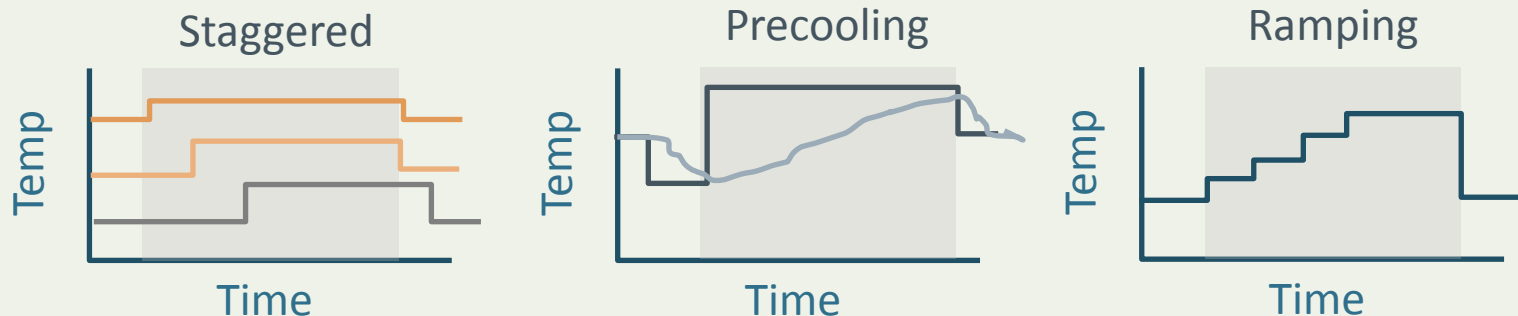
# Advancing DR via Home Data Analytics

- 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:

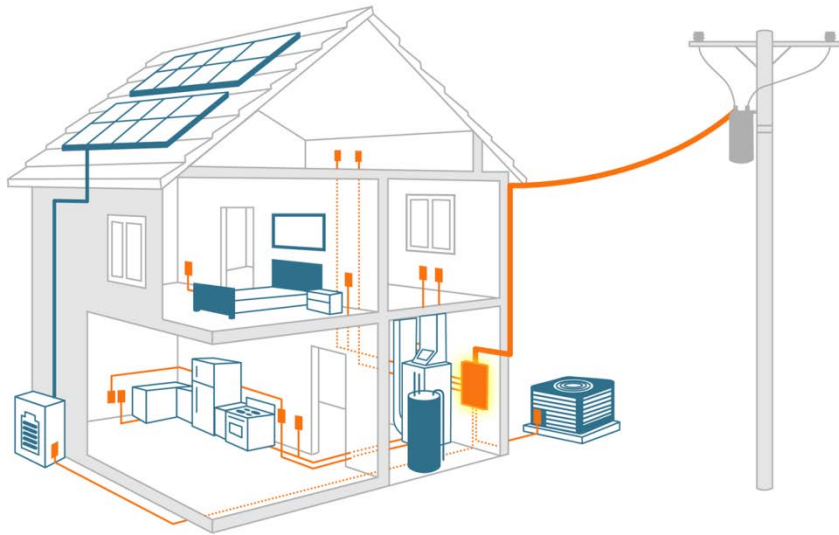
- Emergency: send maximum setpoint increase to all thermostats immediately
- Specific event duration: sustained load reduction for the specified time
- Other Specific strategy for a duration
  - Maximal load when event cancelation expected
  - Target load reduction

## Setpoint Profile Techniques:





# HEMS adding Value into DER



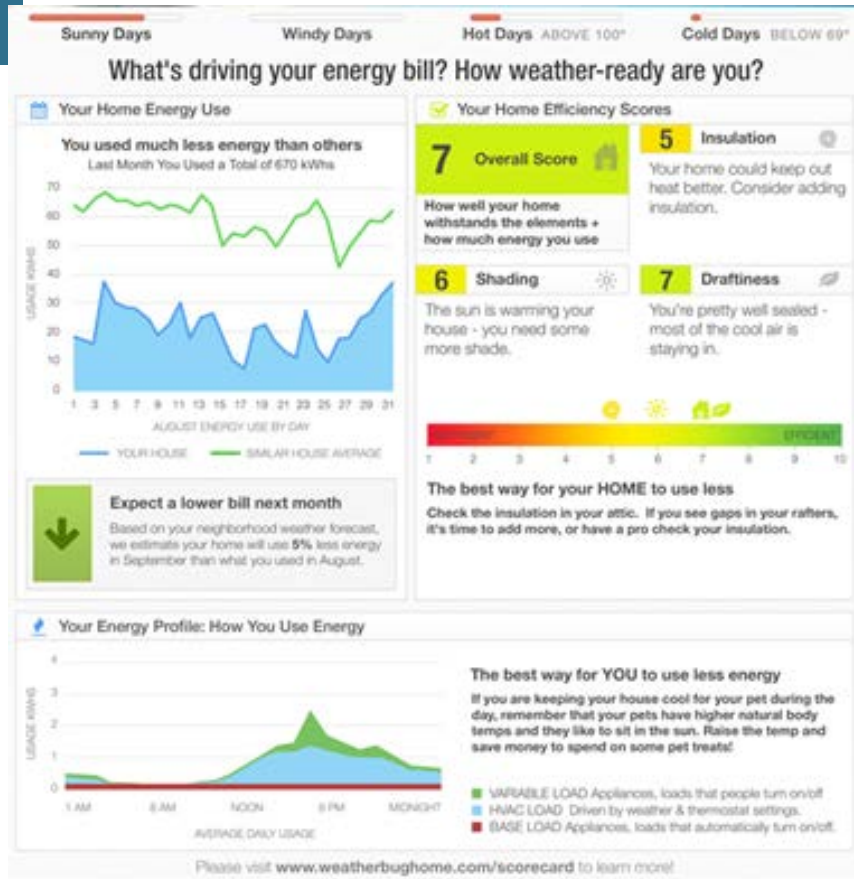
Improved DER management by directing PV generation to the grid, to a battery, or to appliances based upon cost.

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!



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# The Future of DER Possibilities

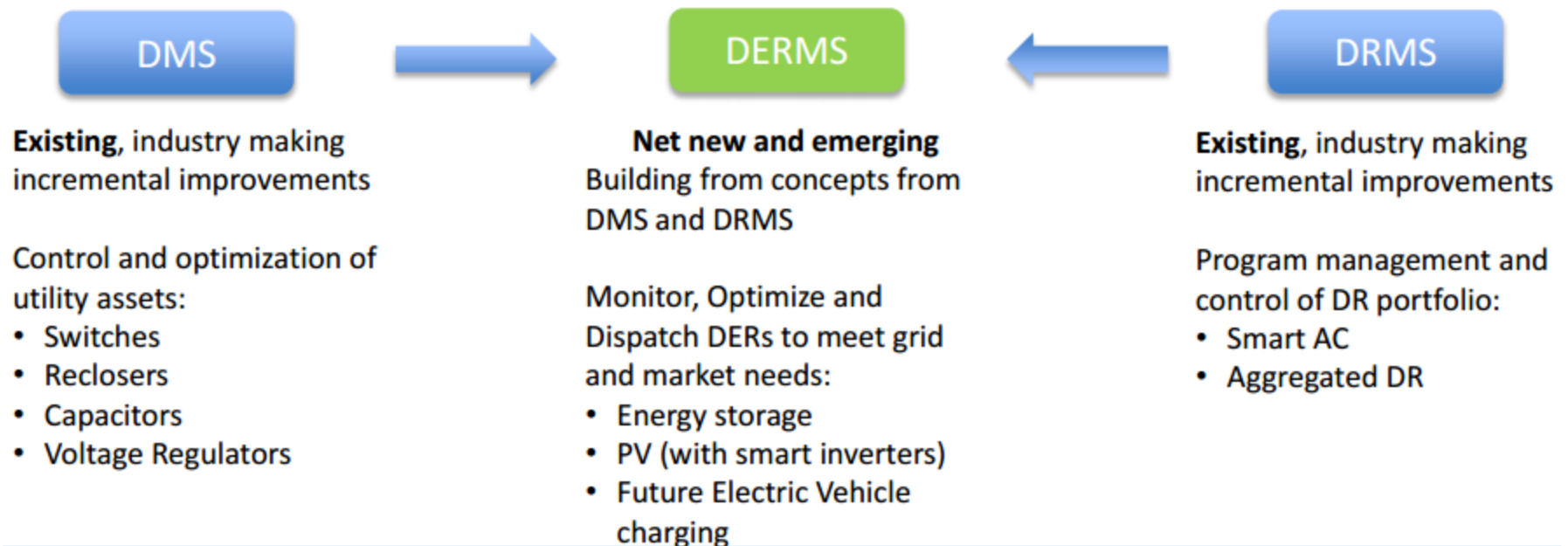
Brian Buckley

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# Evolving Software Architecture

## Multiple POCs, Integrating an Array of DERs



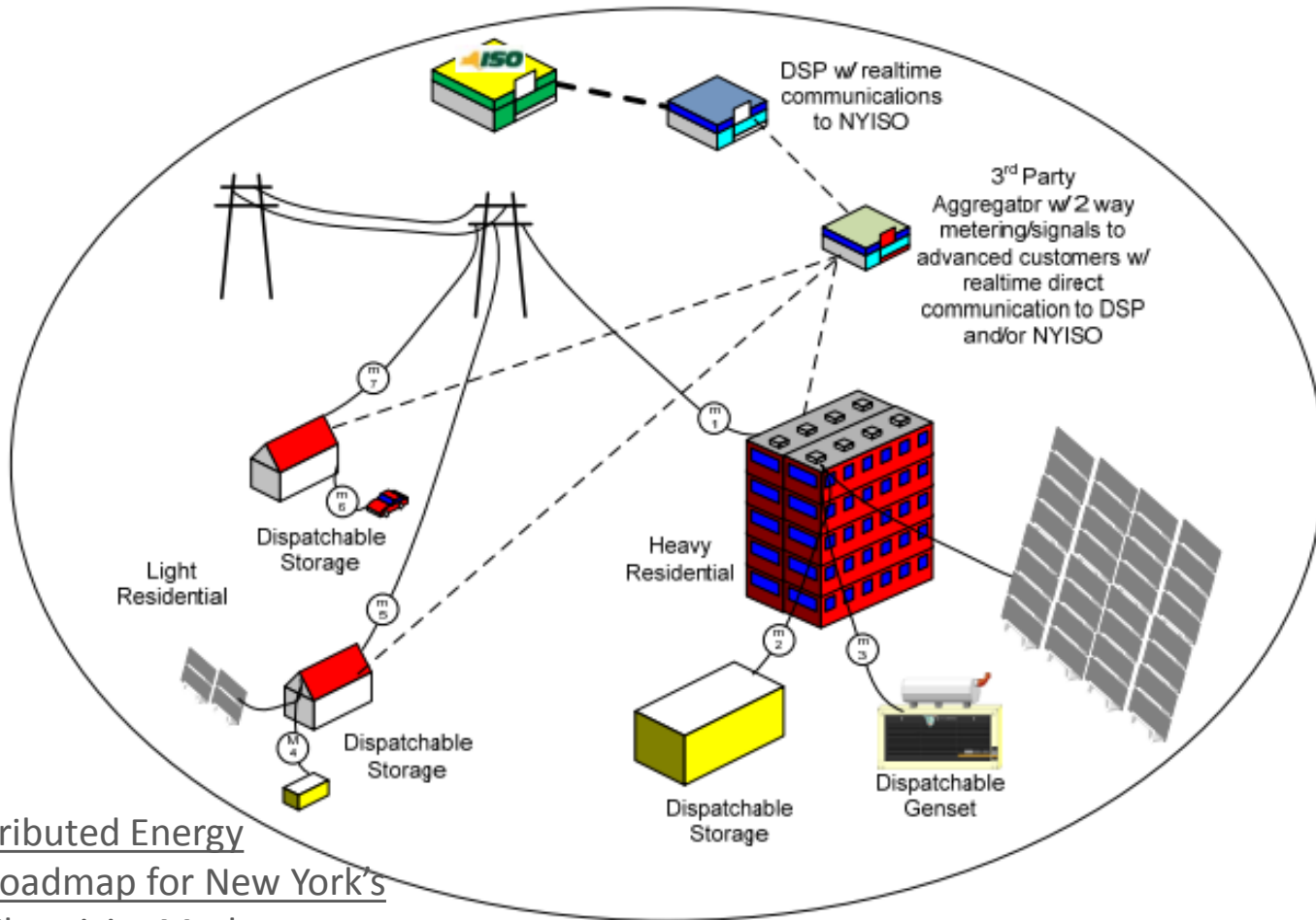
Source: PGE DERMS Workshop

# 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?

