

# Storage, EV and PV: Are the HEMS of Today Ready for the DERS of Tomorrow?



## **Speakers**



- Matt Stevens, Fleet Carma
- Dave Wells, Blue Wave Solar
- Scott Averitt, Bosch
- Ed Brann, Sears/Kenmore
- Sarah Colvin, ecobee
- Vince Faherty, Nest
- Q&A for all speakers at the end—please type in your questions as they come

## **Prompt for Speakers**



- From where you sit, how can we best position ourselves today to take advantage of all that is coming for the homes of the future?
- What are you seeing or doing to help today's smart home be poised to ensure a smooth transition to tomorrow's distributed, low carbon, efficient home?



# **THANK YOU TO OUR SPONSORS**







# BREAK: 10 Minutes!! RESUME AT: 2:06 EST

(optional) Break To Do List:
✓ Use the restroom
✓ Grab a beverage (possibly caffeinated)
✓ Procure a snack
✓ Ten jumping jacks
✓ Two sun salutations
✓ Text your friends/family and let them know how much fun you are having at this workshop

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Source: Wall Street Journal

# Electric Vehicles & HEMS?

Matt Stevens, CEO

NEEP - Smart Energy Homes Virtual Workshop 13 Dec 2017

Does EV load need to be managed? How flexible/malleable is EV load? EVs and HEMS?



## **Congratulations!** You are now an EV owner.

You just got home with your battery at 5%.

What is a reasonably amount of time for you to get fully charged?







### 2012 Nissan LEAF 24 kWh 3.3 kW (L2 charging) 84 miles

2017 Chevrolet Bolt 60 kWh 7.7 kW (L2 charging) 238 miles



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#### **EV Outlook**

Increase in Charging Power for BEVs





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In your personal life:

# 40 is the new 30.

7kW is the new 3kW.

Said differently: besides electric heating, electric vehicles are largest load in the home.

Battery pack cost when I purchased the vehicle

\$16,000

Battery pack cost now

\$3,000

Matt's 2012 Volt

Does EV load need to be managed? Yes. It is the largest load in many homes, an EV sales are accelerating .

How flexible/malleable is EV load?

Pros & cons to HEMS integration?



#### Active Load Growth Options for Utilities



#### The main options are: price signal and/or active control.

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#### **Existing TOU**

At left is data from over 600 electric vehicles equipped with FleetCarma devices.

Shown is the difference between a flat rate structure (orange) and a TOU (blue) structure with off-peak starting at 7pm.

Driving times were similar between the two groups.



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#### Dynamic Rewards EV-S

#### **EV-Specific Price Signal**



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July 2017

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OFF-PEAK TIMES

Transingpt to 5 are at days, 'sear-model

627 ...

247 um

283 \*\*\*\*\*



Final report at: https://www.fleetcarma.com/ resources/chargeto/

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**Comparison of Throttled to Predicted Charging** 



Ø fleetcarma.



#### **Active Control**



#### Vehicle-Side Data Required for SmartCharge Adoption



Nearly three-quarters of participant would **not** have participated in Blind Smart-Charging.

State-of-Charge (SOC) and a guaranteed charge time were necessary for involvement.



Does EV load need to be managed? Yes. It is the largest load in many homes, an EV sales are accelerating.

### How flexible/malleable is EV load?

EVs are a highly flexible load, either through price signal or paired smart-charging (vehicle data included)

Pros & cons to HEMS integration?



#### Pro

- EVs are a major load. Integrating that load into the HEMS would be a natural step.
- There are notable benefits for synching solar generation with EV charging. Or pairing with stationary storage to mitigate load impacts.
- Leveraging the home connective and single system could lower system prices.

#### Con

- A major reason for controlling/managing load will be distribution assets. How will those needs be signaled to the HEMS?
- Multiple control paths are required (networked EVSE, direct-to-vehicle, smartbreaker, etc.). The complexity may be a challenge for the HEMS.
- Vehicles are mobile. Increasing system complexity.
- Automakers want to be part of the value chain, and the HEMS integration may conflict with that desire.

It is unclear if EV load should be integrated into HEMS or run as a stand-alone system.



# Thank you for your time!



Matt Stevens, Ph.D. mstevens@fleetcarma.com 519.342.7385



## ChargeTO report is available for download at:

https://www.fleetcarma.com/resources/chargeto/

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Source: Wall Street Journal

# BLUEWAVE

David Wells Senior Director of Business Development

# Solar for everyone, everywhere.

At BlueWave Solar we are on a mission to make solar energy available to everyone, everywhere so communities can take control of their energy production and consumers can choose local, low-cost power.



### BLUEWAVE

#### OUR MISSION IS DEEPLY ROOTED IN OUR SHARED VALUES

#### Based on our values and mission, as a business we promise to,





As a certified B Corp, do business for the greater good because people and places matter.

## BLUEWAVE

#### WHAT WE DO – PRODUCTS

#### **Solar Project Development**

#### 100MW Developed, Financed and Built to Date \$350 million in Gross Asset Value

#### Community Solar

Expanding access to solar energy for residents & small businesses

Our mission, our deep understanding of project development and government policy enables us to provide customers a choice to go solar with a nearby solar farm.



#### Solar Loans

Helping households invest in solar We truly understand the solar installation process and provide high quality support to our partner installers and solar loan customers. Our loan option enables homeowners to own the system on their roof.

#### **One Platform Servicing Two Products**

#### **Economic and Social Impact**

To date, BlueWave has delivered over **\$5 million** in annual savings for customers and **\$275 million** in savings over life of contracts

Reduced CO2 by 100,000 metric tons annually, equivalent to\*:

**20,000+** passenger vehicles driven for one year, or

**14,000+** homes annual energy use, or

11 million gallons of gasoline consumed, or

The amount of carbon sequestered by over **2.5 million** trees



\* Equivalencies from the EPA Greenhouse Gas Equivalencies Calculator, 2017. epa.gov/energy

### How the Smart Home Can Work with a Solar Home

#### Home Energy Management Systems (HEMS)

#### Helps Monitor and Optimize Solar Systems

- Presents solar in an easy to understand interface
- Offers real-time performance indicators
- Tracks consumption patterns
- Ability to track solar generation vs. consumption

#### For Community Solar Customers

• Help customers grasp usage in more relevant terms

#### Smart Inverter

- Provide grid-wide support services
- Helps lower levelized cost of energy (LCOE), facilitating higher energy production and reliability



**Community Solar** 



Solar Management Platform

BLUEWAVE

# BLUEWAVE

137 Newbury Street Boston, MA 02116 Tel: 844.786.4100 Fax: 617.830.8270 bluewavesolar.com



@BlueWaveSolar

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# Scott Averitt



## Home Energy Management System Project **Demand Response Balanced with Customer Comfort**

### Description

Cyber-secure Home Battery System (HBS) controls that deliver demand response (DR) while providing guaranteed comfort and improved energy savings for homeowners.

### **Technologies**

Scalable system capable of utilizing Energy storage, connected home appliances, HVAC,

rooftop PV, grid, etc. Designed to also work with EVs and wind.

### Impact

Delivery of highly available (over 90%) and reliable DR capacity (over 5 kW) from individual homes across multiple planning horizons utilizing optimal scheduling of home appliances based on user preferences and DR requests.

Partners

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BOSC

### Home Energy Management System Project foresee™ Home Energy Management System (HEMS) Schematic





# BPA Home Energy Management System Project Laboratory Hardware Integration



- Eguana battery pack
- 3 kW Fronius PV inverter (DC power from simulated PV)

TRABUSE TRANS

- AO Smith Water heater
- Bosch Dishwasher
- Bosch heat pump + ecobee4 thermostat
- Bosch refrigerator
- Bosch Laundry set (not pictured)



# Home Energy Management System Project **Forsee Control Architecture**



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### Home Energy Management System Project foresee<sup>™</sup> Demand Response Use Case

#### Comparison of whole home power consumption



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### Home Energy Management System Project

### Daily Energy Savings Breakdown by Source

	Seaso	n			Heating				Cooling	
EE vs.	RBS	A Home		Tenino	b Eugen	e Seatt	le Emmett	Tacoma	Tenino	Eugene
haseline	Daily Energy Savings (kWh)			5.28	6.90	8.01	3.57	5.44	1.01	1.71
basenne	Daily Cost Savings (\$)			0.58	0.76	0.88	0.39	0.60	0.11	0.19
	Daily	CO2 Redu	uction (lbs)	1.90	3.15	2.89	0.49	2.06	0.85	0.69
	n				Heat	ing		Co	oling	
DR vs.	RBSA	A Home		Tenino	Eugen	e Seatt	le Emmett	Tacoma	Tenino	Eugene
baseline <sup> </sup>	Daily Energy Savings (kWh)			3.58	5.79	6.37	1.96	4.12	0.01	0.28
	Daily	Daily Cost Savings (\$)			0.64	0.70	0.22	0.45	0.00	0.11
	Daily	CO2 Redu	ction (lbs)	0.82	2.09	0.55	-0.27	0.66	0.76	0.53
8.00 7.00 (m 6.00 5.00 5.00 4.00 3.00 2.00 1.00 0.00	5.28 1.70 3.58	6.90 1.11 5.79 Eugene - heating	8.01 1.64 6.37 Seattle - En heating	Daily e Daily e Energy 3.57 1.61 1.96	energy say takebad 5.44 1.31 4.12 Tacoma - heating	1.01 1.00 1.01 1.00 0.01 Tenino - cooling	n DR mode, when DR is (4-hour load- shed event) 1.71 0.73 0.98 Eugene - cooling	vs RBSA called 2.1 sa	kWh/da avings p ome (5.5 = 1 Qua annua	ay er 5%) ad Ily

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Source: X. Jin, K. Baker, D. Christensen and S. Isley, "Foresee: A User-Cer Home Energy Management System for Energy Efficiency and Demand Response" Applied Energy (in print), 2017.

https://doi.org/10.1016/j.apenergy.2017.08.1

### Home Energy Management System Project

### DR Load Reduction Breakdown by Source (DR vs. baseline)

Season	Heating					Cooling	
RBSA Home	Tenino	Eugene	Seattle	Emmett	Tacoma	Tenino	Eugene
DR Forecast Error	8.08%	10.01%	2.10%	10.68%	-4.23%	9.29%	7.69%
DR Grid Energy Reduction (kWh)	20.86	13.76	28.13	16.79	12.68	15.66	9.46
DR Average Power Reduction (kW)	5.22	3.44	7.03	4.20	3.17	3.91	2.37

shed event)



Batteries were fully utilized except one lowload home

> Significant contribution from reduction of controllable loads

> > ROSC

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### Home Energy Management System Project Cybersecurity Implementation

- ✓ Documented rigorous risk assessment.
- Created an implementation plan to address risks in software, hardware, and system.



- ✓ Developed the cybersecurity layer based on the North American Electric Reliability Corporation (NERC) reliability standard for Critical Infrastructure Protection (CIP) Cybersecurity standards.
- ✓ Developed a security test plan and CIP compliance document
- ✓ Assessed platform hardening & documented best practices

*Future Impact:* Developing a journal paper to document, for the first time, how NERC CIP Standard requirements apply to end-use loads and building energy management systems, when aggregated to provide bulk-grid services.



### Home Energy Management System Project

### Current project runs through Q1 of 2018

- ✓ HEMS software + model development complete
- ✓ Cybersecurity implementation complete
- $\checkmark\,$  Hardware plus software integration completed at NREL
- ✓ Full operational validation complete

### **Next Steps**

- Perform operational scenarios on test system (Grid, Climate, and Residence)
- Cybersecurity penetration testing
- Seeking options for larger scale field deployment and validation

### **Benefits**

- Reliable DR aggregation to utilities
- Lower operating cost to homeowner
- Reduced energy & CO2 footprint
- Helps achieve Net Zero Energy + LEED ratings
- Competitive advantage for developers/builders
- Supports national goals for energy security and lower energy consumption © 2017 Robert Bosch LLC and affiliates. All rights reserved.



Utility Bill





# Renmore. Be Amazing

### Over 100 years of performance trusted by more than 100 million Americans

Edward Brann Kenmore Connected Product Manager Sears Holdings Corporation What is Retail's place for making the Smart Home a reality for all?

- Offer interoperable systems that work seamlessly in the background
- "Appliance as a service" with installation and service packages built into a monthly price of product
- Performance monitoring and failure prevention

### KCD SMART BENEFITS



#### CONTROL ANYWHERE

Control your smart products anywhere in the world via your mobile device.



#### 24/7 MONITORING Check in whenever/wherever you want and get timely alerts.



#### SAVE ENERGY & MONEY

Run products only when you need to, spending less on utilities and more on living.



#### EASY SETUP

Connecting is easy. Simply download the app and follow step-by-step instructions.

# Kenmore.





## Kenmore Smart App History educates about Energy Consumption

- Every Kenmore Smart appliance is ENERGY STAR certified, and users are interested in the impact of their appliances on their energy use
- Energy consumption is measured by the appliance and displayed by the app
- For many appliances, frequency of usage impacts the magnitude of energy consumption
  - Smaller families typically do less laundry
- Time saving features like glass doors on fridge or a dryer's wrinkle guard setting reduces energy consumption



### HEY, ALEXA, **CAN I BUY A KENMORE APPLIANCE ON AMAZON?**

The brand you've trusted from Sears for over 100 years is now also available on Amazon. It's easier than ever to come home to Kenmore.

Click. Buy. Delivered. Installed. Beyond Amazing.

shop at Sears

shop at Amazon\*

\*in limited areas

Available now thru Amazon in LA and Chicagoland More regions will be added thru 2018



sears

Be Amazing

amazon



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"Alexa, turn on air conditioner" "Alexa, set air conditioner to 74 degrees"

amazon

### Wally Platform



Wally is a complete water, temperature and humidity platform, alerting you of indoor environmental risks, while providing the tools necessary to address the issue.

### wally

CONFIDENTIAL

### Thank you



Learn more at: www.kenmore.com/smart

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Source: Wall Street Journal



# **R**ecobee



# It is expected that there will be 500 billion connected things by 2030

### **R**ecobee

Imagine a home that listens and responds to your every command.

WHOLE HOME VOICE

房

No buttons. No clutter. No effort.







# Building for whole home voice.

# Voice Engagement



Although knowledge based questions are asked more often, music playback on the ecobee4 has been increasing over time.

# Voice Engagement



# Works with your smart home

Thanks to our open API, ecobee thermostats seamlessly integrate with other home automation devices you own.



# Make your thermostat do more



### TXU Energy

by TXU Energy Rated: Guidance Suggested

#### Free to Enable

"Alexa, ask TXU Energy for my account balance" "Alexa, ask TXU Energy to make a payment" "Alexa, ask TXU Energy for energy saving tips"

#### Description

Managing your TXU Energy account's never been easier. Get your account balance, make a payment, learn ways to use less energy and more. Want to chat? No problem – Alexa can give you our 24/7 phone number.

Enable the skill with your MyAccount user name and password. Don't have one? Go to txu.com to set one up. Once the skill's enabled and you're connected, you can start the conversation! Say "Alexa, ask TXU Energy..."

- "Account Balance"
- "Make a Payment"
- "Energy Saving Tips"
- "Phone Number"

Check out http://www.txu.com/alexa-faq for help and FAQ's.



### Sarah Colvin sarahc@ecobee.com

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### NEEP Smart Energy Homes

Virtual Workshop | December 13, 2017

### IoT has hit a tipping point



### But most smart devices aren't smart enough (yet)



Follow

This smart salt shaker has voice controls but can't grind salt theverge.com/circuitbreaker



139 AM - 3 Aug 2017

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Q 17 17 19 10 171

Our D.C. office building got a security robot. It drowned itself.

We were promised flying cars, instead we got suicidal robots.



Q 4.9K 1] 141K ♥ 313K

My TV just told me the remote control was no longer compatible. @internetofshit



3:07 PM - 25 Aug 2017



### In the meantime...how can utilities cut through the noise to deliver value today?

Internet of Things



"Smart thermostats are probably the best gateway to engage consumers . . . If you're going to pick one thing, the research points towards thermostats. It's something everyone is already aware of. Very high numbers of people want one."





- Patty Durand, President and CEO, Smart Grid Consumer Collaborative

http://www.utilitydive.com/news/for-utilities-hoping-to-unlock-smart-grid-opportunities-data-is-the-key/427604/

# Today more than half of North American homes can get a smart thermostat incentive



Utilities included here have live offer programs for which Nest is eligible. These include both BYOT Demand Response and/or Energy Efficiency rebate offerings. Nest Labs Confidential

Nest Labs Confidentia

# And the smart thermostat has become a program platform



Energy Efficiency Save kWh & therms Demand Response Shift kW Time of Use Shift kW to align DSM & Rates

### We've learned...

Consumers want to save energy

Some want a product that feels less tech-y

The people in the home, not the hardware, should be the focus

Many are sensitive to the up front cost of a product.



### So we made a new thermostat (at a lower price)

### E is for Easy.

#### Nest Thermostat

Up in the morning, down at night, With a simple schedule the Next Thermoutat E-makes it easy to save energy.

nest

### E is for Energy savings.

nes

#### Nest Thermostat

Alth proven energy married features, the front Thermostat ( one pay for itself at less their test years...

### E is for Everyone.

#### Nest Thermostat<sup>€</sup>

The seay-to-use, energy-saving, control-it-from-everywhere Next Thermostat E. It's for everyone.



We kept energy provider perspectives top of mind



Results: kW and kWh, cost effectively



Happy customers: engaging experiences, loved products



Access/equity: value for the widest possible set of customers



Opportunity: a jumping off point for the connected home



### Nest + Google: Shaping the Connected Home

Whirlpool C LG -chargepoin+ I N S T E O N' PHILIPS	79 70				
When products work with Nest, you don't have to tell them how to connect. Or what to do.	The thermostat that programs itself then pays for itself.	The security system that's tough on bad guys, easy on you.	The smoke alarm that tells you what's wrong, whether you're home or away.	The voice-activated speaker that provides hands-free help from the Google Assistant.	The home Wi-Fi system for fast signal in every room, on every device.
ECOSYSTEM	ENERGY	SECURITY	SAFETY	ASSISTANCE	CONNECTIVITY








## Vince Faherty Head of Northeast Energy Partnerships vfaherty@nestlabs.com

## We've traveled Full Circle

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-In Hybrid S draw energy oaming plug-in can store energy utility use.

Smart Applian Respond to grid disturbances and s consumption during demand period