

Grid Optimization, Load Flexibility, and AI, Oh My! April 3rd 2019

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Grid Optimization, Load Flexibility, and Al, Oh My!

Emily Kemper, CLEAResult



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CHALLENGES AND BENEFITS TO SMART HOME PRODUCTS

Challenges: Why have smart home products taken off in Best Buy, but not in energy programs?

Many utilities can't figure out the benefit to their businesses

- Utility perspective

Interoperability issues have made it challenging to develop a "turnkey" consumer experience

– Consultant perspective

Lack of nationally recognized standards for product categories

- Industry Advocate perspective

No clear leader in energy management platforms

- Technology company perspective

Opportunities: What are our objectives in getting more smart home products in homes?

Connecting the Smart Grid to the smart home, as **an extension of the AMI meter**

– Utility objective

Keep it simple and make it easy for the customer to choose products that will improve their lives while saving energy

- Consultant objective

Create a set of standards that address energy savings, so we can finally use smart home products in programs

– Industry Advocate objective

Getting the customer to adopt the **technology platform** and offer more convenience

- Technology company objective

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CONSUMER PERSPECTIVE

Consumers see the benefits – they crave new tech as much as they want a positive, **convenient** experience

Opportunities for the smart home in programs from an implementer perspective Convenience Comfort & Health Control 0 Ħ · · · . Security & Safety Energy Savings

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What does the home of the future look like?



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Thank you!





The Smart Energy Home: Driving Residential Building Decarbonization

Claire Miziolek, Technology and Market Solutions Senior Manager Northeast Energy Efficiency Partnerships (NEEP) HPC National, 4/3/2019

Who are we? The Regional Non-Profit Northeast Energy Efficiency Partnerships (NEEP)

"Assist the Northeast and Mid-Atlantic region to reduce building sector energy consumption 3% per year and **carbon** emissions 40% by 2030 (relative to 2001)"

Mission

We seek to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities.

Vision

We envision the region's homes, buildings, and communities transformed into efficient, affordable, low-carbon, resilient places to live, work, and play.

Approach

Drive market transformation regionally by fostering collaboration and innovation, developing tools, and disseminating knowledge



One of six REEOs funded in-part by U.S. DOE to support state and local efficiency policies and programs.

NEEP's background in the Smart Energy Home







We want to Reduce Carbon Emissions.

Are we on the path to 80% CO2 reductions?



• Not without strategic electrification, we aren't!

To get there, need a 3 pronged strategy:





Energy Efficiency





Renewable Electricity

Strategic Electrification

+ 11 = Pathway To Decarbonization

(80% Reduction in GHG emissions by 2050)

Use less energy

Have clean generation for electricity Strategically shift energy use towards electricity

Electrification sounds great, but... Shifting *seasonal* loads over the next 30 years





The Smart Energy Home: Driving Residential Building Decarbonization

....But How??

Home electric loads will grow in contrast to traditional load reduction goals of energy efficiency.

With electric space and water heat, we may face **new winter peaks** Thermal efficiency, energy storage, and strategic load shifting enabled by smart energy homes help **avoid large new** system peaks

In an electric home, many end-uses have loads that can be shifted to strategically beneficial times

In IoT, most end uses will be connected, but managing every end use individually isn't tenable for utilities and grid operator.

HEMS can play the "air traffic controller" to manage the signals between all the unique systems within the home and the grid. Simultaneously, **renewable generation** is growing, but renewables by their nature are variable.

While **low carbon**, more renewables means managing the stability of the grid is **more complex** Flexible end uses **absorb** the clean, low-carbon electricity when it is available, and can **shift** use away from system capacity peak times "Smart" technologies that send and receive signs, coupled with a HEMS, manage "generation-to-load" matching.

Batteries can offer power at times of need directly to the building or grid. HEMS can manage beneficial times to charge and discharge and ensure the electrical signals are **optimized**.



Areas of Focus to get it done:



1. Policy and Carbon:

Policies must evolve to recognize and value carbon reductions as a critical consideration and motivator for decision making so that a decarbonized residential building **4**. stock may be fully appreciated and incentivized.

2. Utility Regulatory Structure:

Utility programs of the future will serve as a "one-stopshop" for smart energy homes, including HEMS, DERs, and **5**. strategic electrification technologies. These programs will account for carbon reductions, promote lower-carbon strategic electrification activities, and have dynamic pricing.

3. Smart Energy Homes Drive Smart Home Performance:

As the grid decarbonizes and strategic electrification efforts increase, peak events will likely move towards the winter. Tight, low-load homes are critical to the success of strategic electrification and broader residential decarbonization. Low electric loads will be reinforced by smart energy home efforts that increase performance of existing homes.

Quality Assurance and Transparency in Technology:

Installed products in smart energy homes of the future are high quality, easy to find, and work well together to enable a low-carbon residential sector.

Focus on the Locational Value of Smart Energy Homes and Energy Efficiency:

A modernized grid that can account for a range of grid constraints when sending and receiving demand signals, particularly around location of savings, is critical.

6. New Construction and Smart Energy Home Integration with Building Codes:

New buildings are built to meet the future vision of flexible, low-load, electric homes.

THANK YOU!



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Read the report! <u>https://neep.org/smart-</u> <u>energy-home-driving-residential-</u> <u>decarbonization</u>

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Smart Homes for World Peace (or at least Grid-Home harmony)

Lieko Earle HPC National Home Performance Conference Chicago April 3, 2019



Located in Golden, Colorado

Owned by U.S. Department of Energy

Only national laboratory focused exclusively on renewable energy and energy efficiency research

1500+ scientists, engineers, & support staff

\$350 ~ \$400 million annual funding



2019 "Smart Home" Capabilities

- Appliances and equipment turn on/off based on occupancy detection, schedule, or remote control
- Security systems integrated with lights, camera
- Variety of user interfaces: phone, tablet, laptop, voice

Success metrics focus around <u>kWh saved, enhanced convenience</u>



We've figured out a few things

- ✓ Connectivity
- ✓ Occupancy detection
- \checkmark Integration
- ✓ Apps and other user-interfaces
- ✓ Remote control





Future Smart Home Capabilities

- Automated and dynamic coordination between enduse equipment, renewable generation, and energy storage
- Success metrics must focus on <u>managing loads to</u> <u>ensure grid reliability and</u> <u>end user satisfaction</u>

What's still missing?

- ✓ Connectivity
- ✓ Occupancy detection
- \checkmark Integration
- ✓ Apps and other user-interfaces
- ✓ Remote control
- + Features that accommodate load flexibility

Elegant coordination of end-use equipment, renewable generation, and storage for *whole-system efficiency*

Grid-Interactive Efficient Buildings (GEB)

What are labs doing?

Energy Systems Integration Facility at NREL: A user facility for megawatt-scale systems integration R&D





We can evaluate any portion of the **end-to-end energy ecosystem,** from generation to transmission to end uses.

Mock "homes" in our Systems Performance Laboratory (SPL)



foreseeTM: Customer- and Grid-Friendly Home Automation













Colorado Residential Retrofit Energy District (CoRRED)



COLORADO

Energy Office







Energy district demonstration in an existing residential neighborhood

Test new approaches to:

- DSM
- DR
- Renewable integration to ensure customer affordability, grid resiliency, and reliability

Goal: Replicable, collaborative model that can be used for future innovative energy districts
Thank you

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https://www.nrel.gov/buildings/index.html https://www.nrel.gov/esif/index.html





Redefining Home Performance in the 21st

Century:

How the Smart Home Could Revolutionize the Industry and Transform the Home-to-Grid Connection

<u>http://www.homeperformance.org/sites/default/files/HPC_Smart-</u> <u>Home-Report_201810.pdf</u>

Kara Saul Rinaldi

Vice President of Government Affairs, Home Performance Coalition

Combine smart home technologies and solutions with home performance retrofit programs to maximize home performance program efficiency.



Use Smart Home technology to reach low-income families with home performance and energy efficiency programs.





Image credit: 123RF, Shutterstock

Use Performance-based Policies and Incentives





Image credit: 123RF, Shutterstock

Incentivize Interoperability



Improve Data Access and Data Transfer Policies and Increase Data Sharing



Develop Replicable Best Practices for Privacy and Security



Focus on the Customer



Promote Contractor Certifications



ENERGY STAR



Implement Time of Use Pricing



Pay Attention to Appliances





Thank you!

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A Social Science Perspective on Grid Optimization, Load Flexibility, and AI, Oh My!

Beth Karlin, Ph.D. bkarlin@seechangeinstitute.com



But First...











The Big Picture



(CRED, 2009)







1. Technology and new media are changing how people interact with our natural, built, and social worlds.







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- 2. The essential **human experience** and our core social motives remain relatively unchanged over time.









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- 1. Technology and new media are changing how people interact with our natural, built, and social worlds.
- 2. The essential **human experience** and our core social motives remain relatively unchanged over time.
- 3. Technology in the digital age has great **potential to connect us** for pro-social / pro-environmental benefit.
- 4. A **social scientific approach** provides a theoretical base and <u>empirical methodology</u> to study this potential.







Does this work?









HOW Does this work?





Ingredients



Processes



Metrics



Ask the Right Questions





Ask the Right Questions

Nutrition Facts	AUDIENCE	CONTENT	EVALUATION
Tacts	Demographics	Message	Metrics
5 servings per program Serving size (1 city) kHw saved per serving: 80	Psychographics	Design	Methods
	Context	DELIVERY	Goal (Process,
	Culture	Timing	Outcome)
	BEHAVIOR	Duration	
	Туре	Frequency	
	Number	Medium	Buttetter Forts
	Frequency	Messenger	11



Follow a Systematic Process.



If you walk away with anything, let it be this...



There are benefits to simplicity...



Precision

Significance

But it's not always that easy...



Thank you!

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