Better Buildings Residential Network Peer Exchange Call Series:

Getting Smarter Every Day: Leveraging Smart Home Technologies to Advance Home Performance Projects

April 25, 2019

Agenda and Ground Rules

- Agenda Review and Ground Rules
- Opening Poll
- Residential Network Overview and Upcoming Call Schedule
- Featured Speakers:
  - **Beth Karlin,** See Change Institute
  - **Emily Kemper,** CLEAResult
  - **Lieko Earle**, National Renewable Energy Laboratory
- Open Discussion
- Closing Poll and Announcements

Ground Rules:

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.

Better Buildings Residential Network

Join the Network

Member Benefits:

- Recognition in media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

Commitment:

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

Upcoming Calls (2nd & 4th Thursdays):

- May 9th: Residential Energy Efficiency in a World of Funding Constraints
- May 23rd: Finding the Balance Between Solar and Energy Efficiency
- Jun 13th: Modular Housing, Tiny Homes and What the Future of Homeownership Means for Energy Efficiency

Peer Exchange Call summaries are posted on the Better Buildings website a few weeks after the call

For more information or to join, for no cost, email bbresidentialnetwork@ee.doe.gov, or go to energy.gov/eere/bbrn & click Join

Beth Karlin
See Change Institute

U.S. DEPARTMENT OF ENERGY

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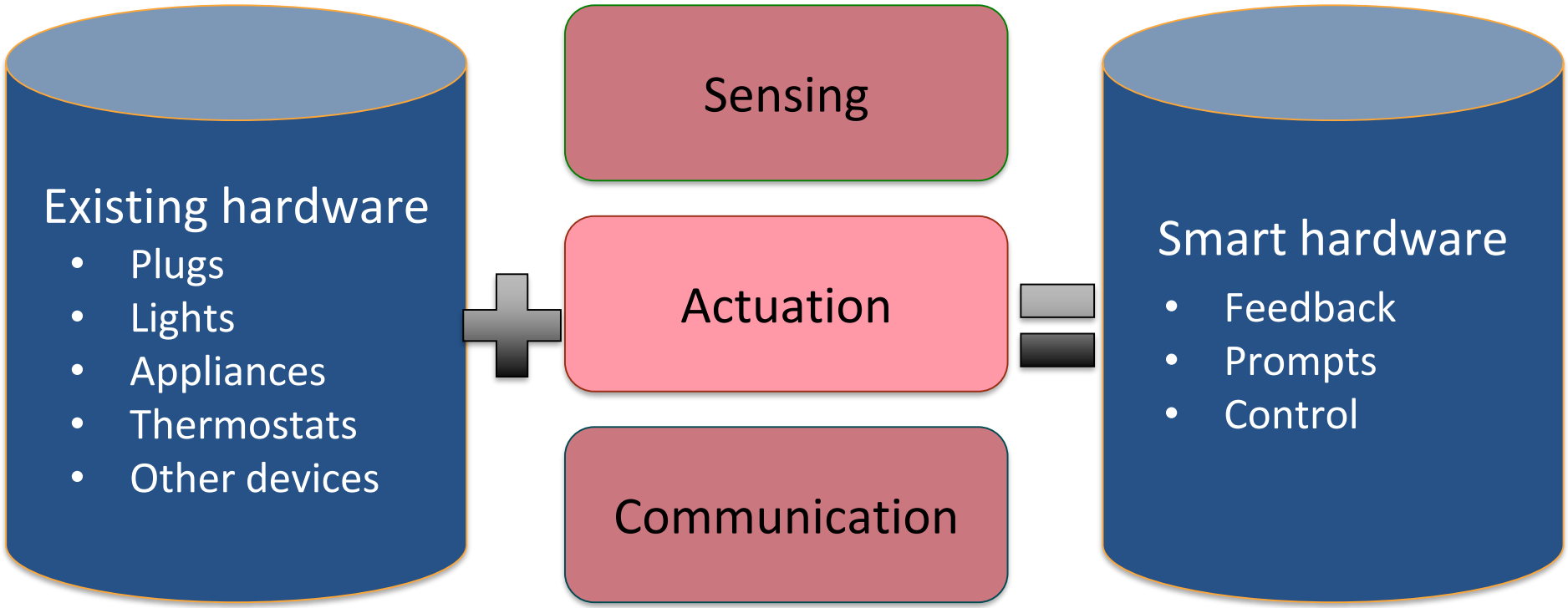
Getting Smarter Every Day:
Leveraging Smart Home Technologies to Advance Home Performance Projects

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

What does SMART mean?



Smart Home Product Categories

User Interfaces

Energy Portal

In Home Display

Load Monitor

Smart Hardware

Smart Appliance

Smart Light

Smart Thermostat

Smart Plug

Smart Switch

Hubs

Platforms

Smart Home/ Web Services Platform

Utility Facing Web Services

OPOWER 5.5 FLEX

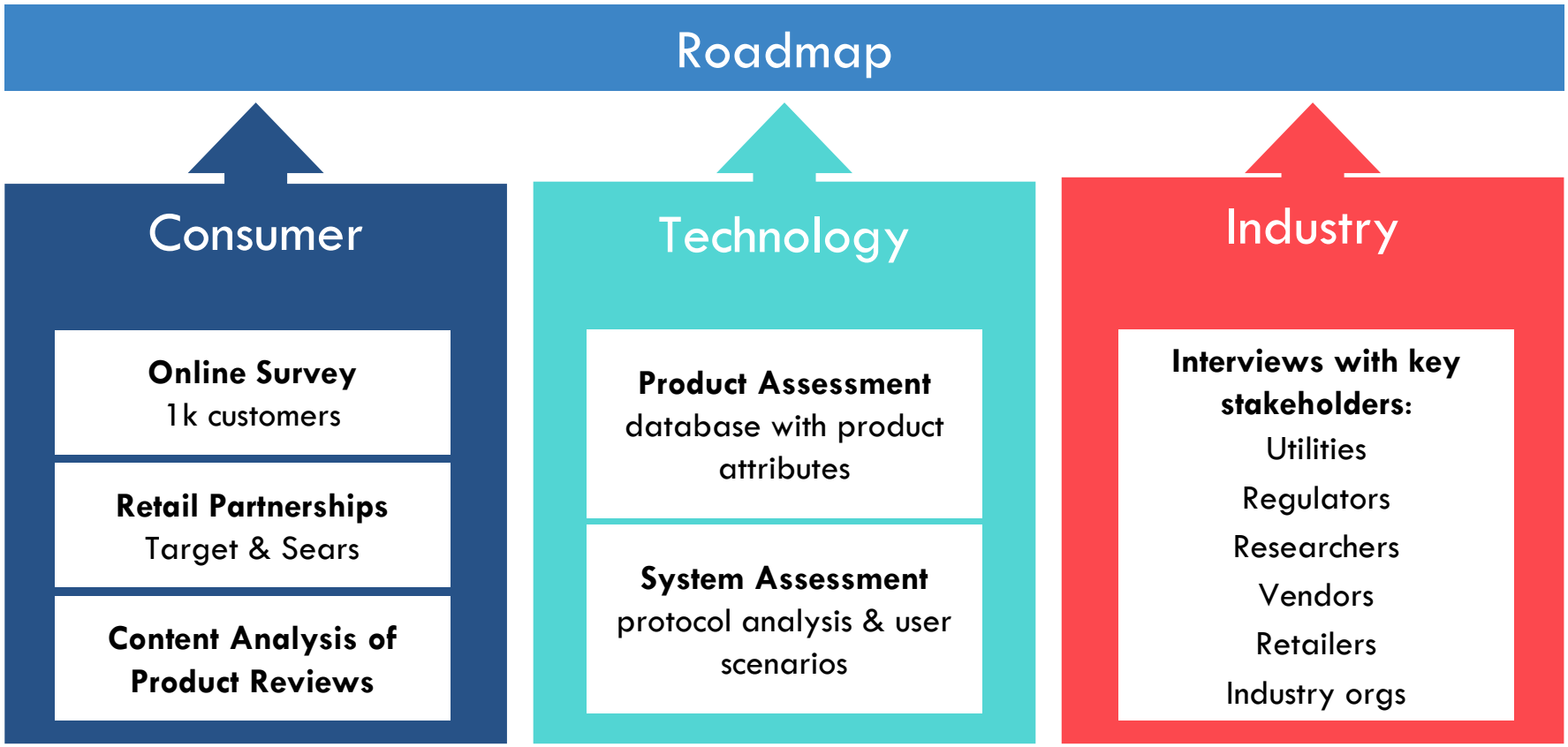
If you build it,

…will they come?

If you build it,

…will they come?

Pacific Gas and Electric Company® HEMS Research



Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

Methods

- 10-15 minute online survey sent to 15,000 utility customers
- 1,414 (28%) responses; 300 reported using HEM products
- Questions about 4 product categories (below)
  - **Adoption** – Do you have any? Where did you get them?
  - **Experience** – What do you like? Dislike?
  - **Outcome** – Did you save energy? Do you still use it?

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

Adoption

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

How much does _____ appeal to you?

"Somewhat" or *"Very much"*

70%

61%

61%

58%

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

Do you own a _____?

14% yes
4% not sure

12% yes
7% not sure

5% yes
2% not sure

7% yes
3% not sure

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

Mind the Gap

"*Somewhat*" and "*Very much*" appeal

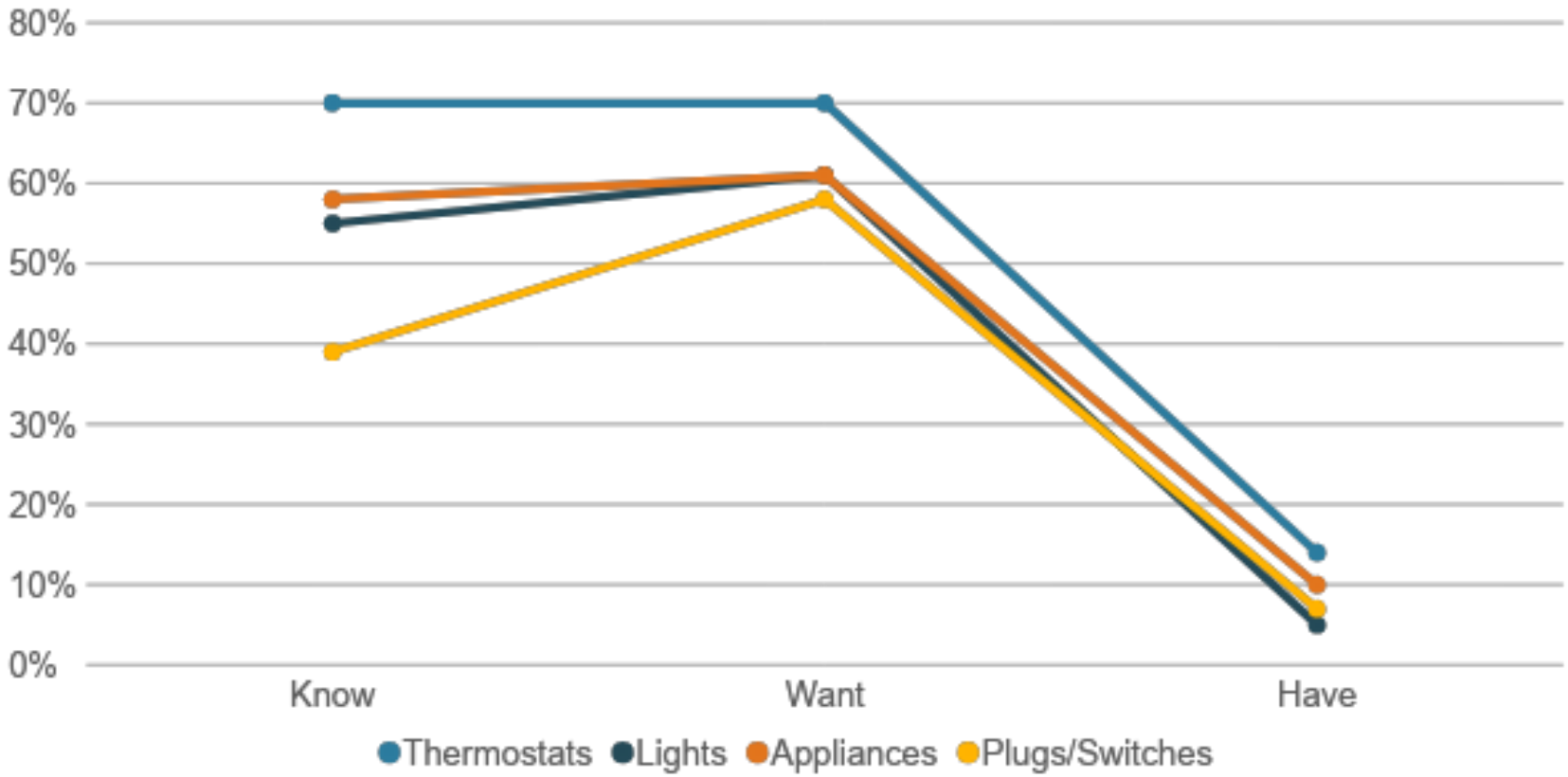
70%	61%	58%	61%

Own the product

14%	12%	7%	5%

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

Mind the Gap



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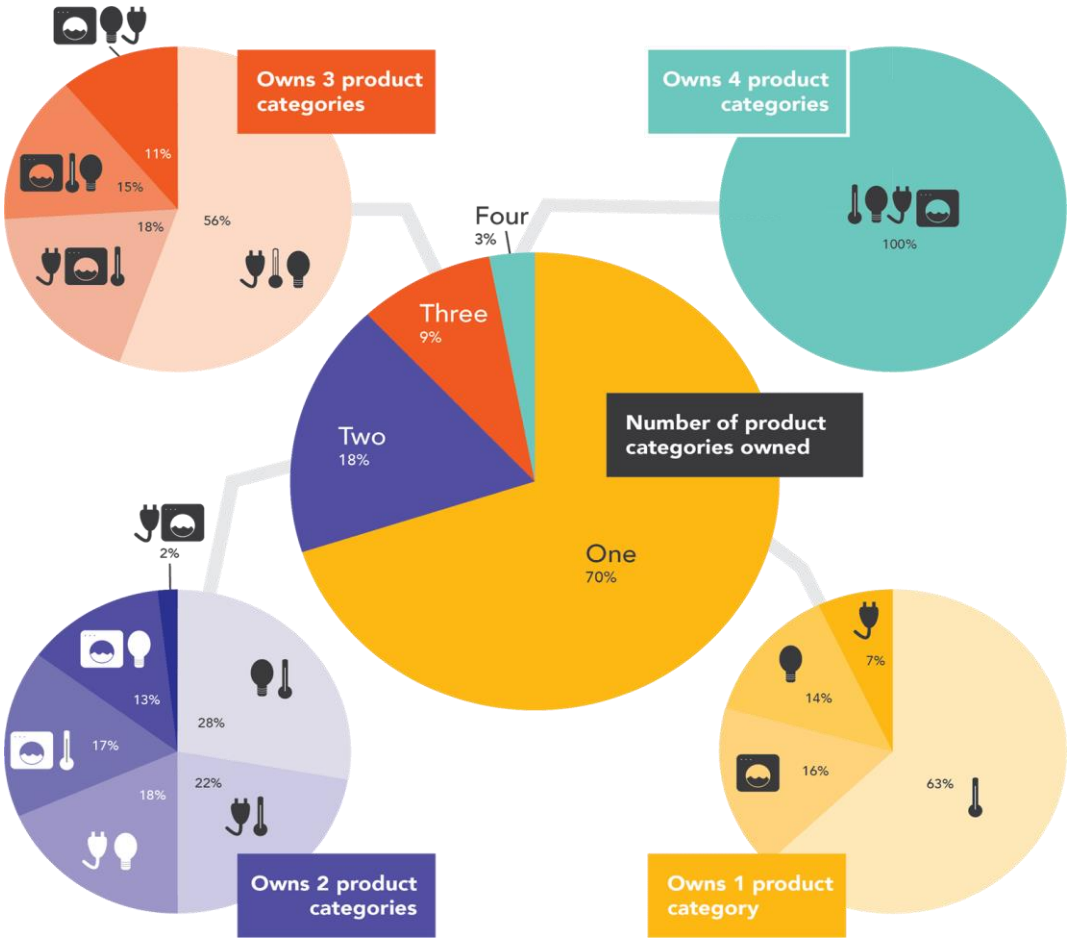
Adding it up



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Experience

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

What do you like about _____?

Remote access
Automation
Scheduling

Remote access
Savings/efficiency
Ease of use

Remote access
Scheduling
Aesthetics

Remote access
Scheduling
Integration

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

What do you dislike about _____?

Poor predictor of behavior
Connectivity issues
Ease of use

Ease of use
Performance/Reliability
Security

Cost
Performance/Reliability
Flexibility of controls

Ease of use
Cost
Performance/Reliability

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

Outcome

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

Has your energy changed as a result?

51% decreased
20% no change
6% increased

37% decreased
32% no change
7% increased

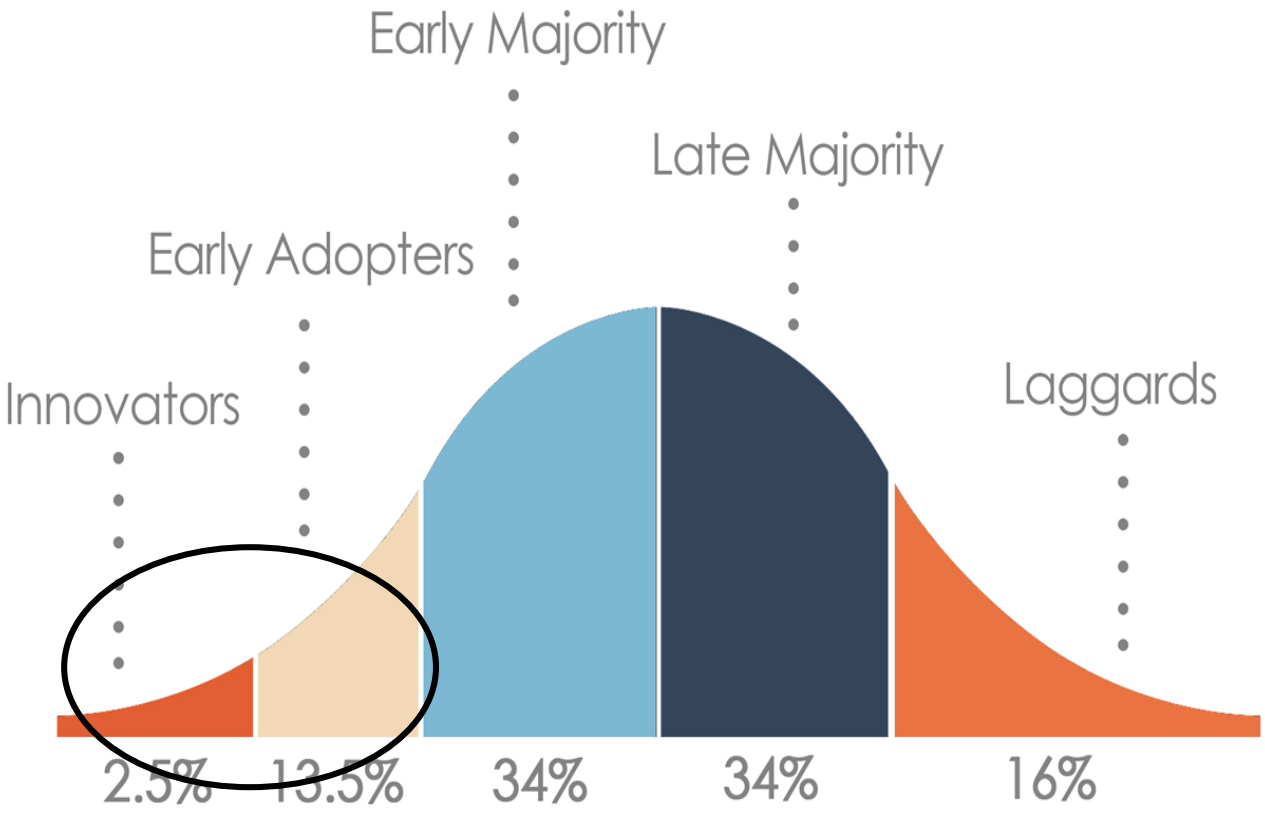
35% decreased
40% no change
3% increased

35% decreased
44% no change
4% increased

Survey findings at: http://bit.ly/ACEEE2018Karlin
Full report at: https://www.etcc-ca.com/reports/assessing-players-products-and-perceptions-home-energy-managment

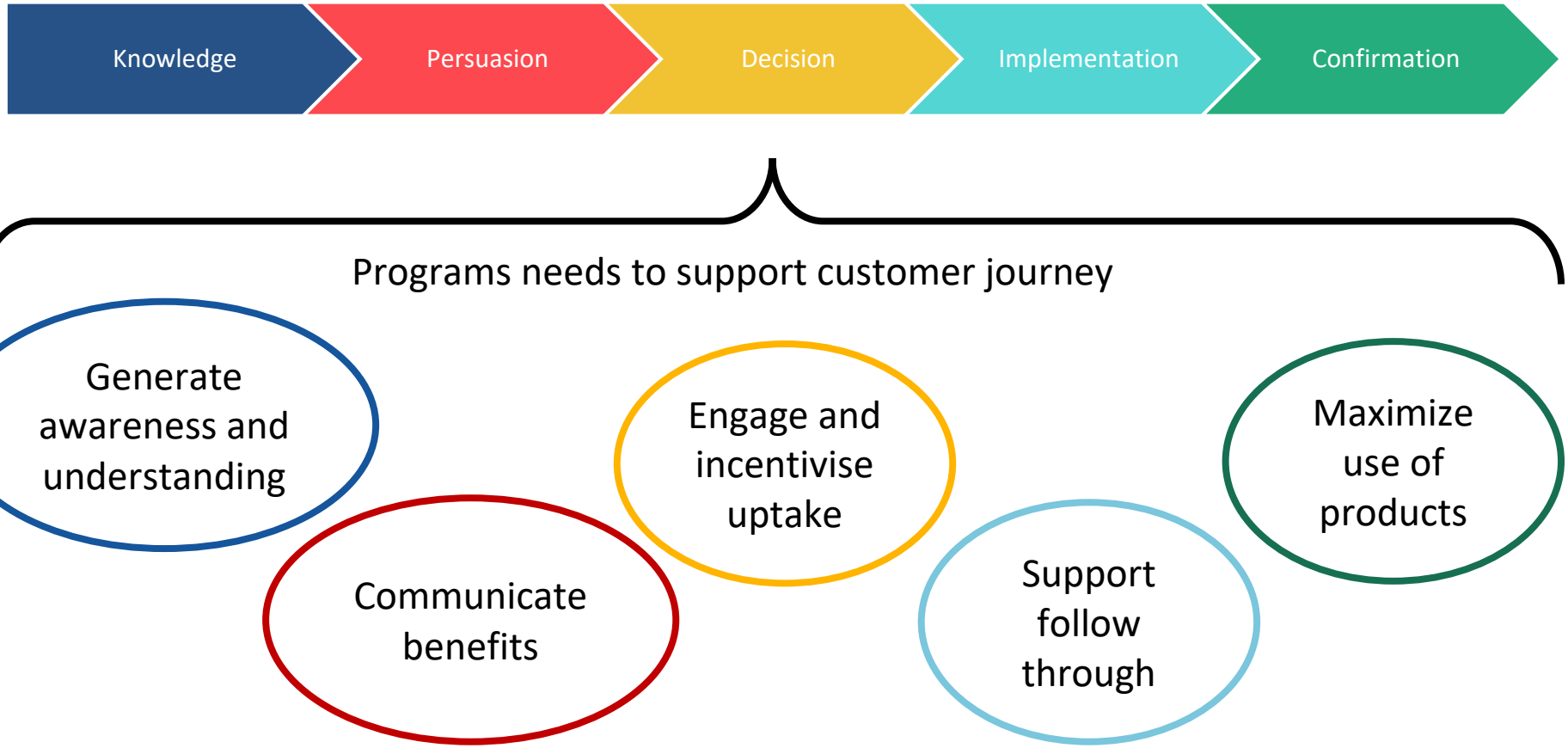
So What?

The How of the Customer



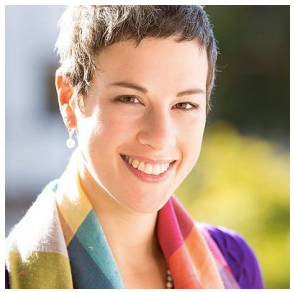
Rogers, 1986

The How of the Customer



Want to learn more?

Dr. Beth Karlin
See Change Institute



Dr. Rebecca Ford
Oxford University

Dr. Angela Sanguinetti
UC Davis

Dr. Marco Pritoni
LBNL

Our amazing team (pictured above) likes to publish our work whenever possible. Here's a list of titles and links to our technical reports, conference papers, and journal articles on Smart Home and Energy Management:

1. Characterization and Potential of Home Energy Management (HEM) Technology, 2015
2. Assessing Players, Products, and Perceptions of Home Energy Management, 2016 ***
3. Categories and Functionality of Smart Home Technology for Energy Management, 2017
4. Smart home consumers: Comparing self-reported and observed attitudes, 2017
5. Smarter Together? A Stakeholder Analysis of Perspectives on Home Energy Management, 2017
6. Smart Home Energy Management: Use Cases and Savings Opportunities, 2018
7. Home Energy Management (HEM) database: a list with coded attributes of 308 devices, 2018
8. Smart Home Energy Management Products: Characterizing and Comparing Adoption, Experiences, and Outcomes, 2018 ***
9. Understanding the path to smart home adoption: Describing consumers across the innovation-decision process, 2018
10. What's energy management got to do with it? Exploring energy management in the smart home adoption process, 2018

*** Reports on the survey data presented in this talk

seechange INSTITUTE

Thank you!

Questions? Comments? Suggestions?

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

Key Points

- There is a significant gap between the appeal of smart home products and their actual adoption by homeowners
- In many instances, homeowners are driven to buy these products for reasons other than energy efficiency
- With awareness firmly established, incentivizing uptake and adoption becomes a priority

Emily Kemper
CLEAResult

U.S. DEPARTMENT OF ENERGY

CLEAResult®

Getting Smarter Every Day: Leveraging Smart Home Technologies to Advance Home Performance Projects

April 25, 2019

Emily Kemper, Director, Residential Solutions

We change the way people use energy™

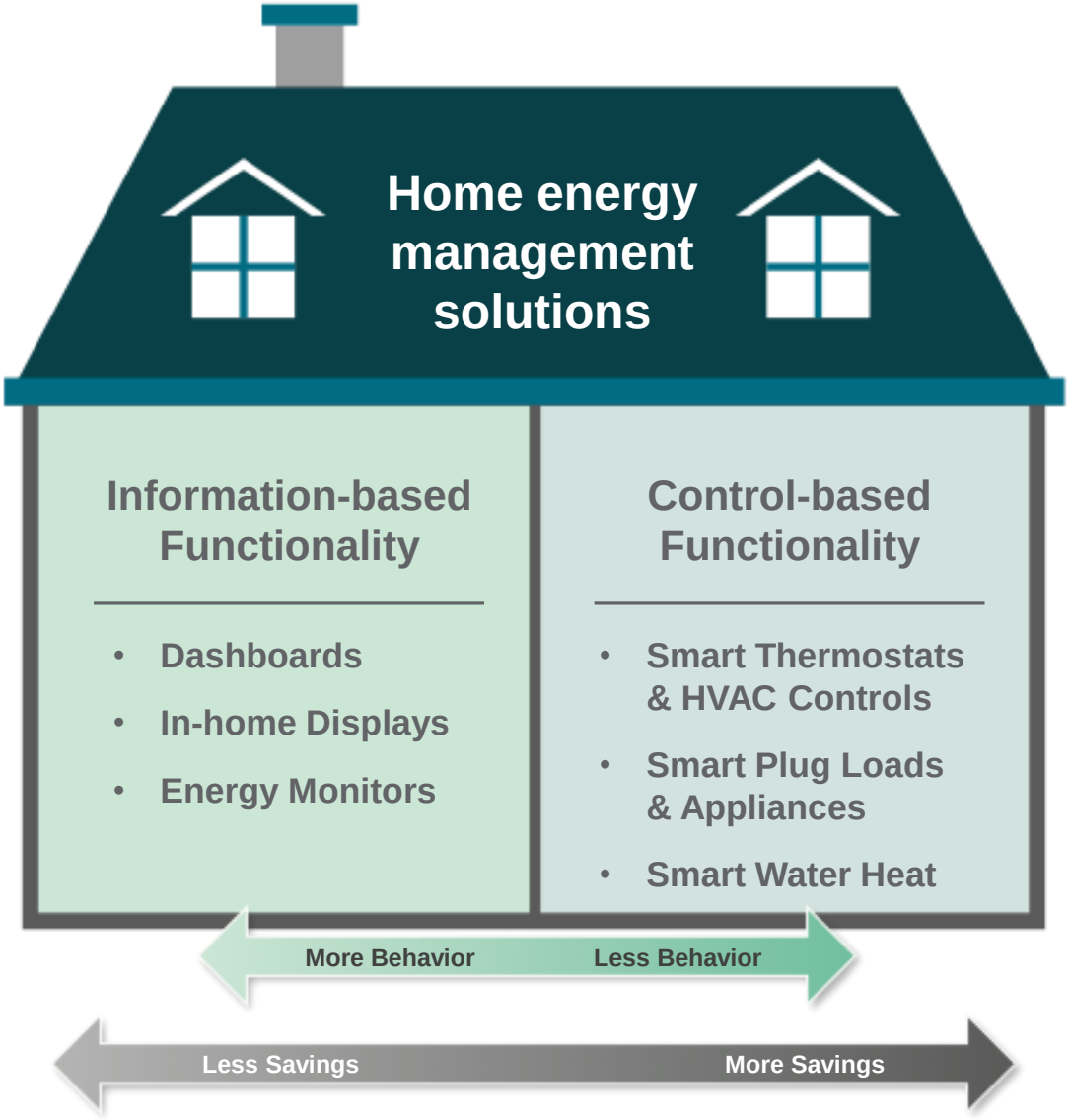
Growth in Connected Devices

Why are we talking about these devices?

- ***Consumers want smart home products***
- **32%** of households now own at least **one product that can be controlled with their smart phone**
- **18%** of households own a **home automation device**
- **The six most popular smart home devices** are found in 22% of U.S. broadband households:
  - **Smart thermostats (in 11% of households)**
  - Networked cameras
  - Smart lightbulbs
  - Video doorbells
  - Smart garage door openers
  - Smart door locks
- **82% of those with smart home technology** report that they're satisfied with it

(sources: Parks Associates, The Shelton Group)

Smart Home Energy Management and the promise of more savings



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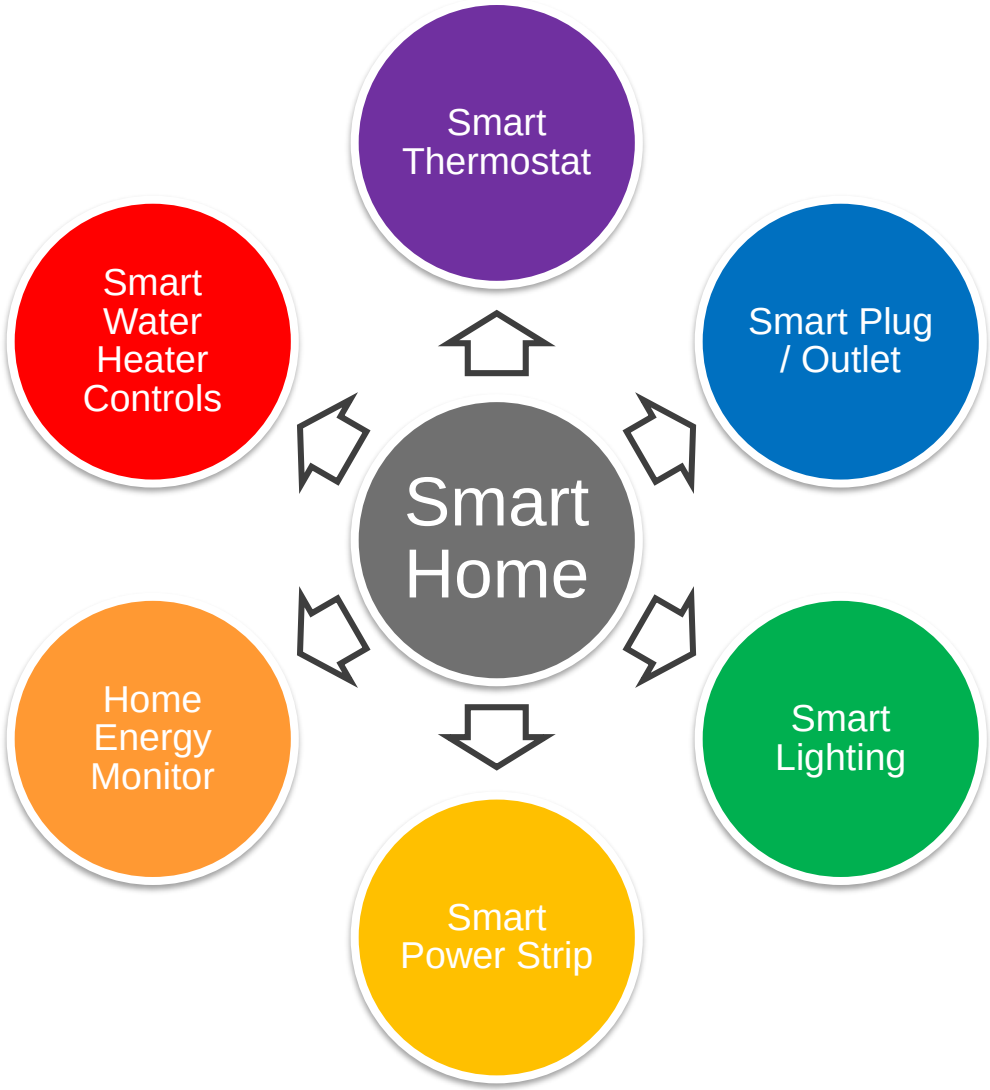
What Products can save energy?

- These product categories are “ready for prime time” and *most likely* to save energy →
- However, the only category which has shown energy savings *thus far* is **smart thermostats**
- Smart hubs themselves do not save energy



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Breaking News: ENERGY STAR SHEMS Package Requirements are out

EPA's ENERGY STAR Smart Home Strategy: Bring Energy Savings Along for the Ride

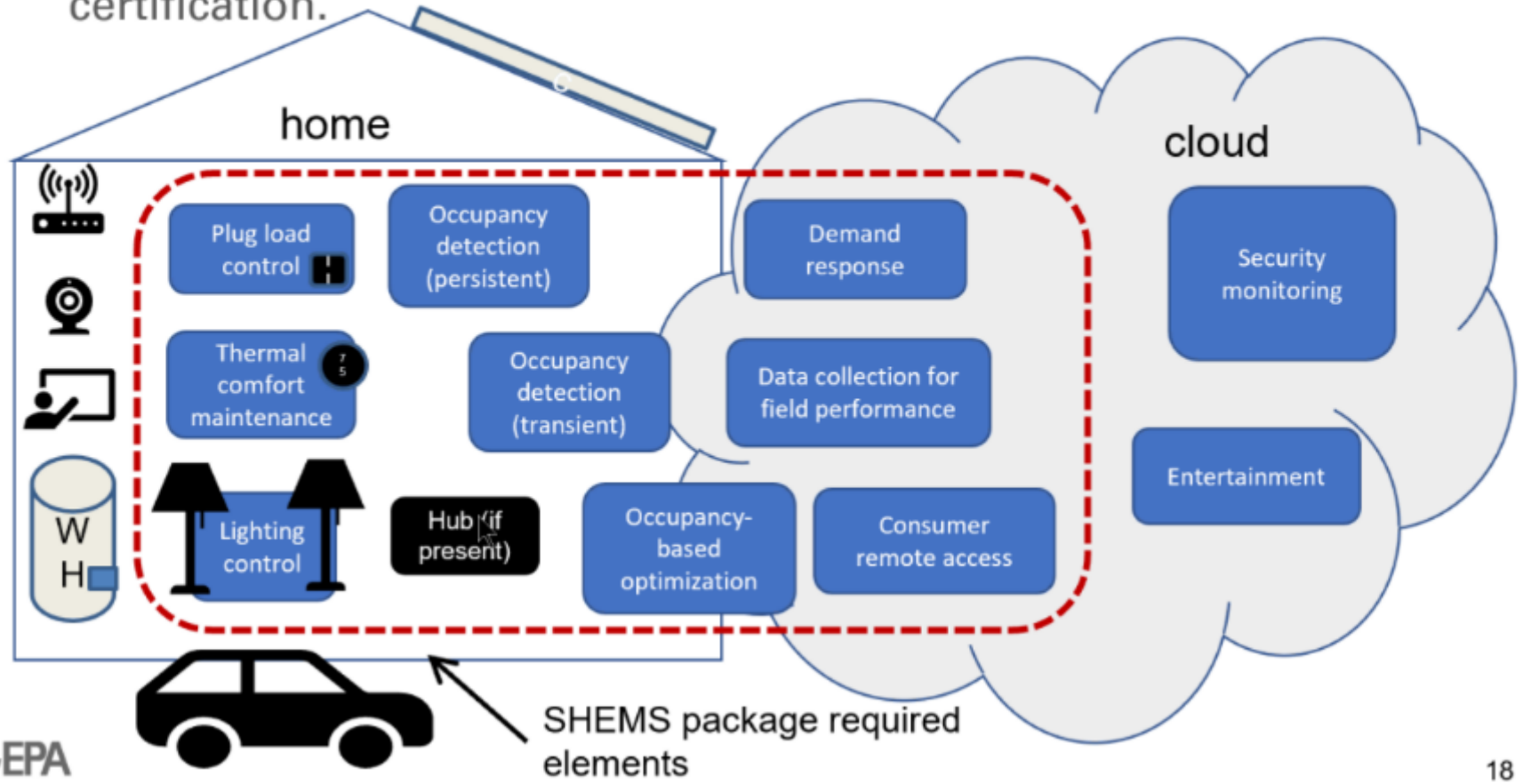
As the market for "smart" products and systems grows, EPA aims to help drive and optimize energy savings through their use.

- Guide energy characteristics of smart products and systems
- Explore system models and ways to work with Service Providers
- Leverage the ENERGY STAR brand and position to push energy efficient behaviors and practices into the connected and smart home market

Devices + Occupancy Info + Automated Services = Energy Savings

ENERGY STAR SHEMS: What's in it?

Included Products: Only packages that meet the definition of a SHEMS, as specified herein, are eligible for ENERGY STAR certification.



EPA

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ENERGY STAR SHEMS: What's in it?

Thermostat	Connected lighting and Lighting Control Devices	Load Measurement Device
		

EPA

Note: EPA has included the products above as examples and is not specifically highlighting any of the brands shown.

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The Path Forward for Programs

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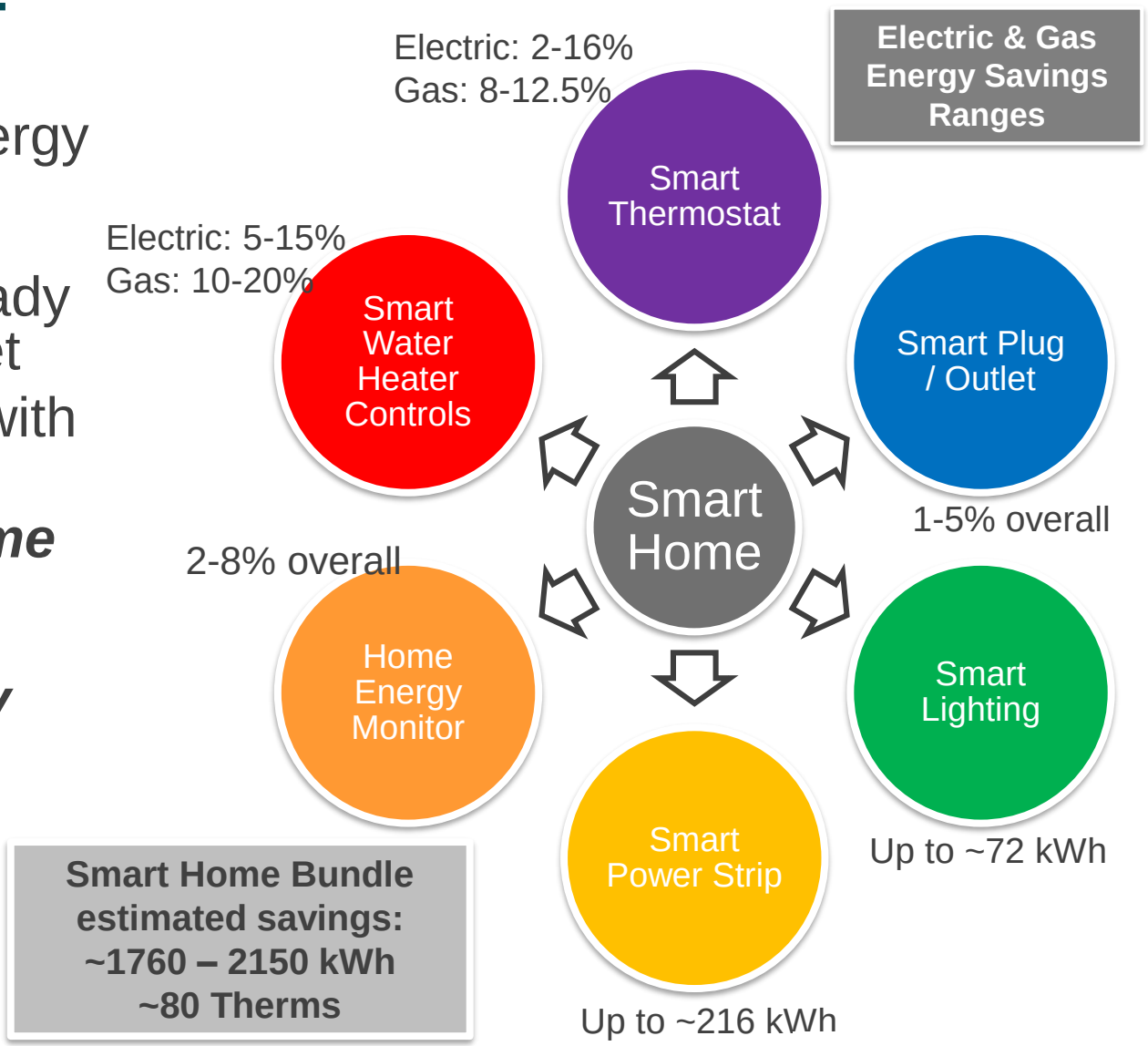
What would an ideal smart home solution look like now?

- Save as much energy as possible with known, vetted products that already exist on the market
- SHEMS will help with this
- ***A truly smart home will help make decisions about managing energy effortless for customers***



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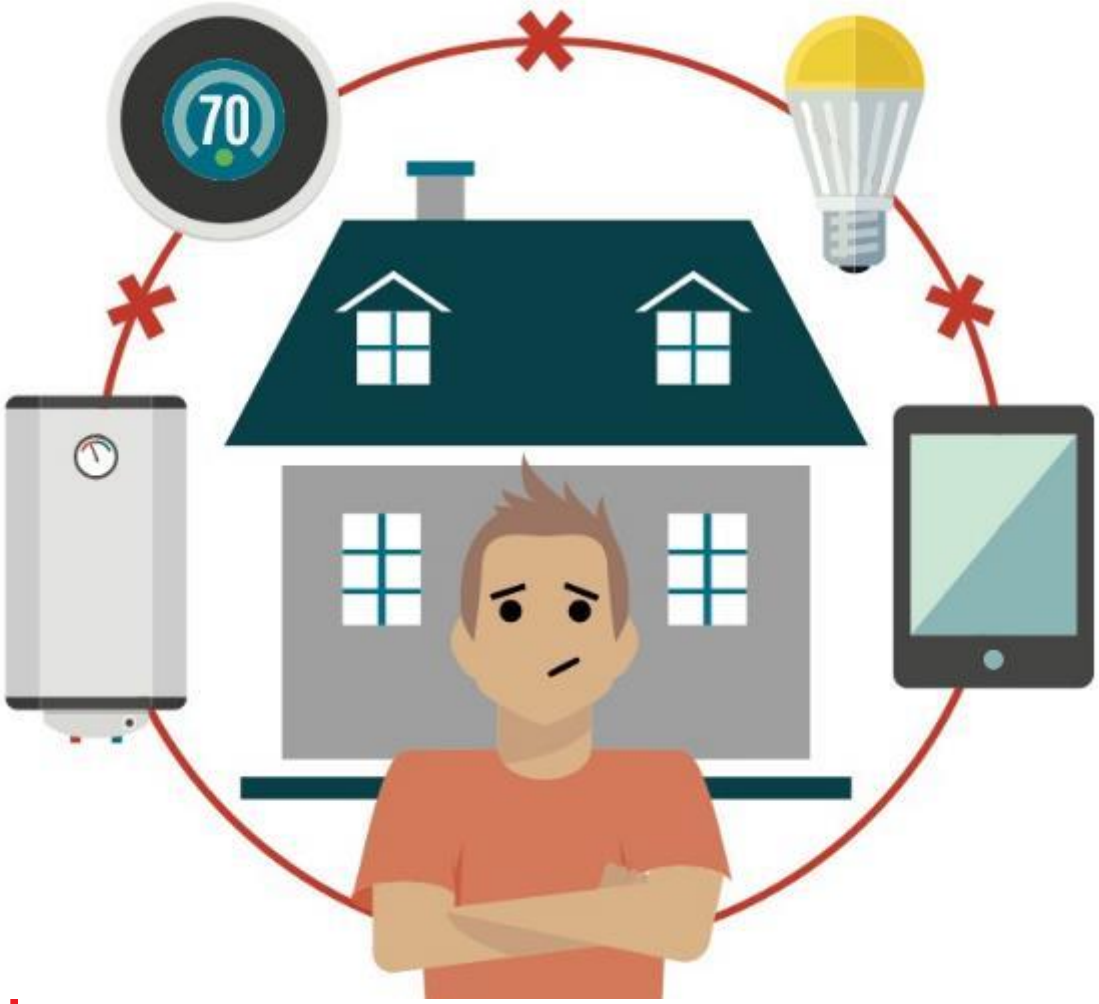
Opportunities for the smart home in programs from the consultant's perspective



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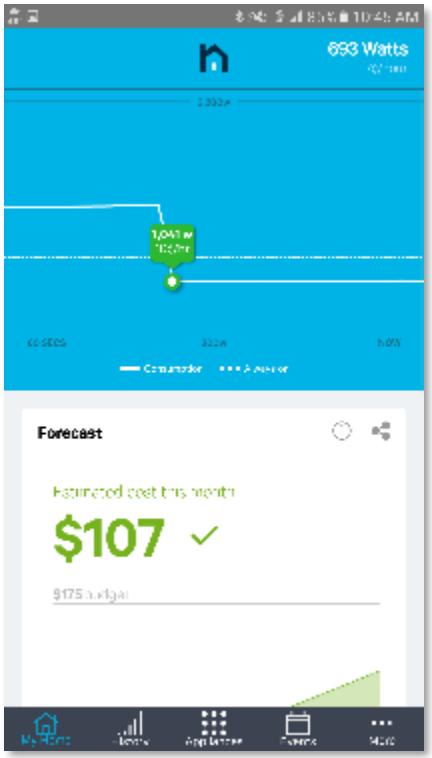
Remember to focus on the Consumer Benefits!

- Convenience
- Comfort & Health
- Control
- Security & Safety
- Energy Savings



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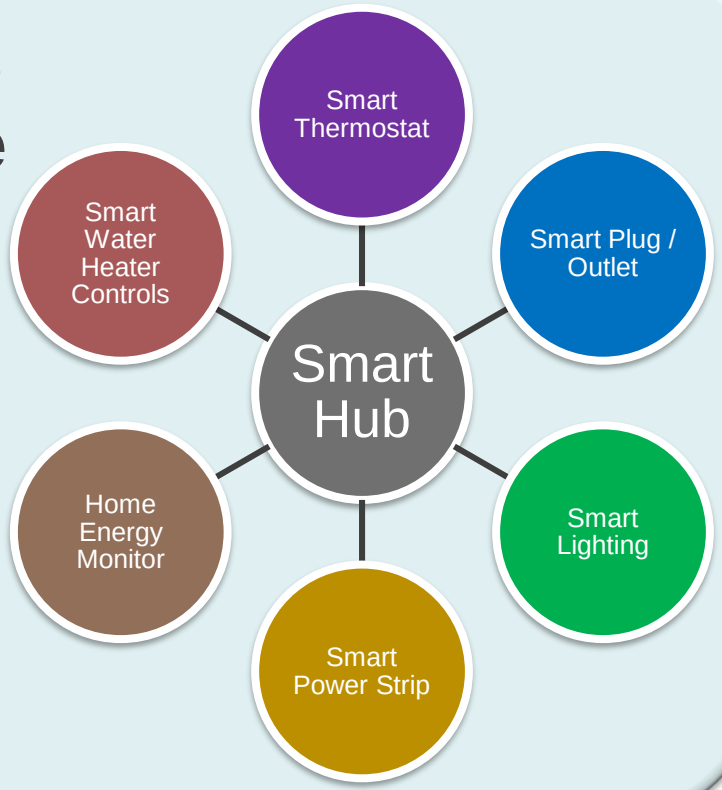
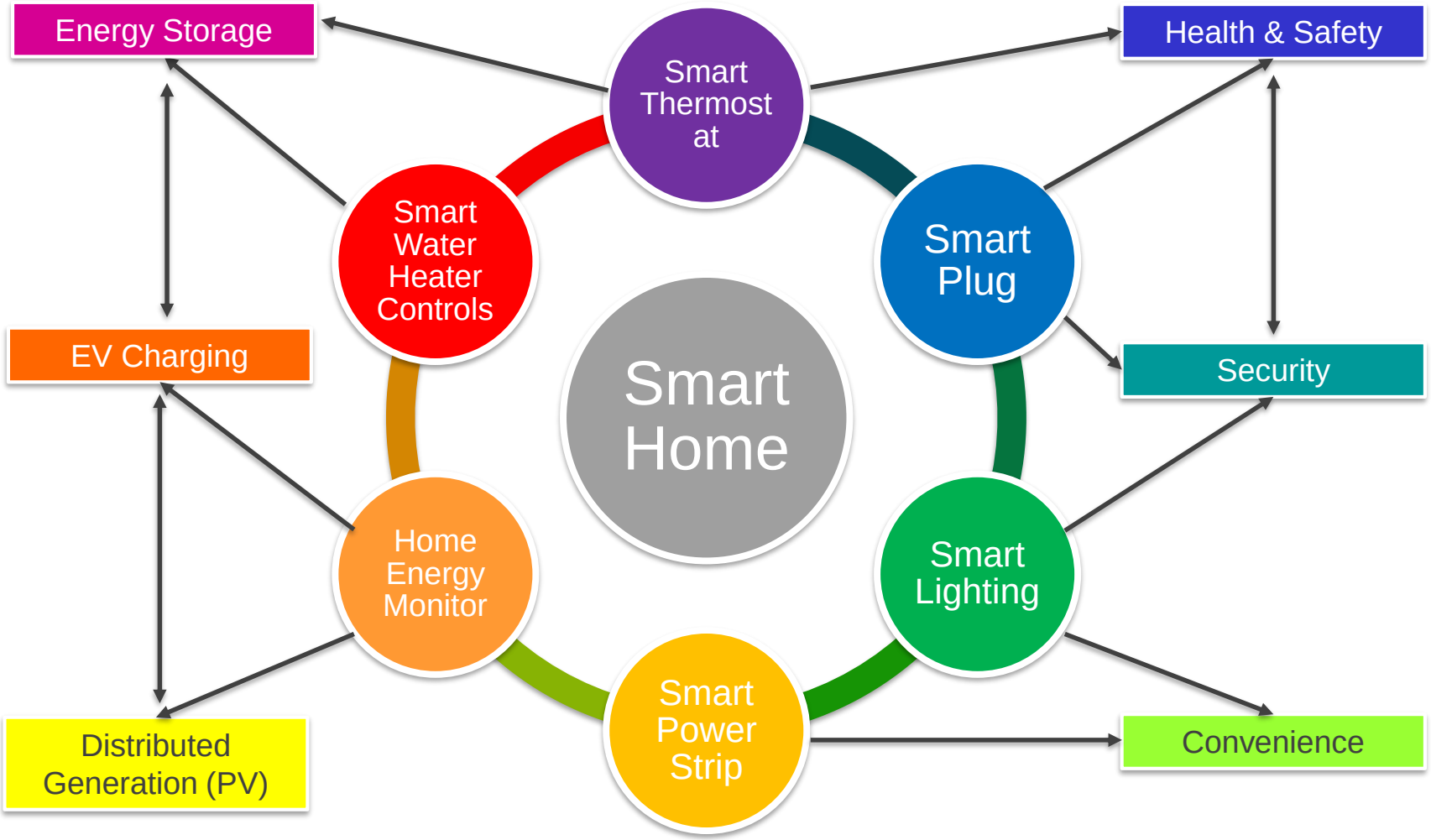
Smart home package for existing homes

Existing Home retrofits and home performance

- Incremental costs higher
- Products are often added as plug loads
- System often relies on hubs or 3rd party platforms (aka smart speakers) for harmony, if it exists



What does the future look like?



The home is the energy management system

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- Emily Kemper, AIA
- Director, Residential Solutions
- Emily.kemper@clearesult.com

Thank you!

CLEAResult®

Key Points

- Smart thermostats are the only smart home product to have demonstrated consistent energy savings delivery
- The ideal smart home solution should include a smart home energy management system (SHEMS) to integrate and manage all smart devices
- A truly smart home will make energy management decisions effortless for consumers

Lieko Earle
National Renewable Energy Laboratory

U.S. DEPARTMENT OF ENERGY

Smart Homes: Some Lessons Learned and Thoughts on the Road Ahead

Lieko Earle, Senior Researcher
National Renewable Energy Laboratory
BBRN Peer Exchange Call
2019-04-25

Agenda

- Notable lessons learned from recent field deployments
- Today vs. tomorrow’s smart home: Where are we headed?

Notable Lessons Learned from Recent Field Deployments

Why haven't you purchased smart home products in the past?

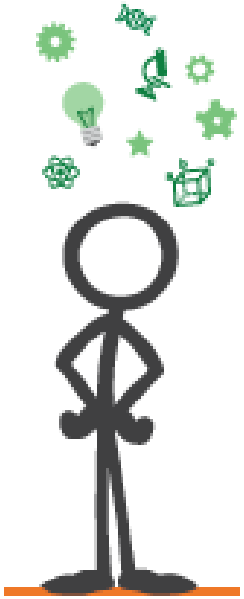
"I've read a little about smart home products and found them interesting, but considered the task too complicated to do myself."

"Not sure which products to get."

"Tech challenged"

"Didn't know enough of what to buy."

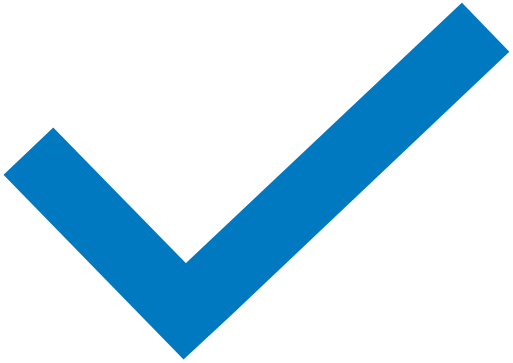
"Lack of time and lack of knowledge about these products."



Convenience

… is a key driver and lack of it is a major turnoff

- Many people are willing to purchase a product and learn how to use it if they believe it will make their lives easier.
- Conversely, if the learning or commissioning process is perceived to be too cumbersome the audience may be lost forever.
- Across the board small differences in installation time made big differences in perception



Voice Assistants

… appear to be here to stay

- While not an energy-saving device itself, a smart speaker can be a powerful hook to get people to embrace smart controls:
    - “We've been using our smart speaker to control the lights more than we thought we would.”
    - “We do enjoy the voice connection, which of course is convenient and fun.”
- Although most participants reported initially that they were motivated primarily by smart thermostat, during the site visits it often became clear that the smart speaker was in fact the upgrade that excited people the most.
- Popular with the kids!

Smart Lighting

… save significant energy if replacing non-LED bulbs with LED, but otherwise the savings depends on how they are operated (schedules, dimming, etc.)

- Smart bulbs or smart switches? Different benefits and drawbacks for different applications.
- Controllability of the smart lighting appeals to many people. Is the enthusiasm worth the cost and potentially increased usage? Maybe. But maybe we can help to ensure savings.

Schedules

… almost always improve convenience, but could increase or reduce energy use depending on the implementation.

- Schedules with setbacks when residents are not home are the main way for many smart home devices to provide savings.
- Sometimes energy use can go up – but improved comfort is an important benefit to consumers even with an energy penalty.
- Providing homeowners with a simple way to interact with their devices remotely (e.g., from a smartphone app) can go hand-in-hand with suggestions for how to use that capability to achieve savings.

The Smart Home

… features and functionalities are still very new to people and the importance of homeowner interactions cannot be overstated.

- It is very easy for residents to feel overwhelmed by even the basic functions of new Smart Home technology, not to mention the confusing array of features and app functions.
- It matters who is at home during these installations. Best to have family members who are most likely to be directly engaged with using the smart/connected features.
- The participants in our recent demonstration largely reported positive experiences with the smart home devices, **but to obtain their buy-in required lots of support and continued engagement.**
- **Good experiences can lead to enthusiastic participation**. Several people reported buying additional smart bulbs or other things that work with their smart speakers.

... So where are we headed? Today vs. Tomorrow's Smart Home

2019 "Smart" Home

- 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>

OK that's great. But really, why should we bother?

Smart Home of the Future

- Automated and dynamic coordination between end-use equipment, renewable generation, and energy storage

Success metrics focus around managing loads to ensure grid reliability and resilience, energy affordability, and end user satisfaction

So how do we get from today to tomorrow?

?

What are the yet unresolved problems?

Research Questions for Tomorrow's Smart Home

- **How can smart home technologies accommodate load flexibility through coordination of end-use equipment, renewable generation, and storage?**
- **How can smart home Solutions become more cost effective?**
- **How can more or better data be used for automated fault detection and repair for the benefit of both equipment longevity and occupant comfort?**
- **What must be done to ensure data security and privacy?**
- **What features provide key non-energy benefits?**

The Smart Home is evolving.

In addition to the rapid technology development

in the Smart Home space, many aspects of our energy infrastructure are changing.

These changes are shaping the requirements for Smart Home technologies moving forward.

There are many technical challenges.

But there are countless opportunities.

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Senior Researcher

Residential Buildings Research Group
Buildings & Thermal Sciences Center

Thank-you!

www.nrel.gov

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NREL
Transforming ENERGY

Key Points

- Convenience is a key driver of smart home product adoption (or lack thereof)
- Smart home features are still very new, and the importance of homeowner interaction cannot be overstated
- The smart home of the future will be characterized by automated and dynamic coordination between end-use equipment, renewable generation, and energy storage

Register for the Better Buildings Summit

- **WHEN**: July 10-11, 2019
- **WHO**: Better Buildings partners & stakeholders, & ~200 speakers with proven solutions
- **WHAT**: 2 days of sessions, networking, & sharing the most successful energy efficiency strategies
- **WHERE**: Arlington, VA across from Washington D.C.
- **INFO**: **energy.gov/betterbuildings/summit**

It only happens once a year

Explore the Residential Program Solution Center

Resources to help improve your program and reach energy efficiency targets:

- Handbooks - explain *why* and *how* to implement specific stages of a program.
- Quick Answers - provide answers and resources for common questions.
- Proven Practices posts - include lessons learned, examples, and helpful tips from successful programs.
- Technology Solutions NEW! - present resources on advanced technologies, **HVAC** & **Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.

https://rpsc.energy.gov

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