Better Buildings
U.S. DEPARTMENT OF ENERGY

Better Buildings Residential Network
Peer Exchange Call Series

Automation: Where Is the Balance Between Humans and Machines to Save Energy?

April 8, 2021

U.S. DEPARTMENT OF ENERGY

Agenda and Ground Rules

- Agenda Review and Ground Rules
- Opening Poll
- Residential Network Overview and Upcoming Call Schedule
- Featured Speakers
  - **Giselle Procaccianti**, Northeast Energy Efficiency Partnership
  - **Lucas Phillips**, National Renewable Energy Laboratory
  - **Cory Fox**, Ecobee
- 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):

- Apr 22: *Earth Day Special: Electrification, Batteries, Storage & Residential Efficiency*
- May 13: *Low Income, Market Rate Residential Efficiency: Reaching the Hard to Reach*
- May 27: *Decarbonization and Residential Buildings*

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*

Giselle Procaccianti
Northeast Energy Efficiency Partnership

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BBRN Peer Exchange – Automation and the Smart Energy Home

Giselle Procaccianti, PMP
Technology and Market Solutions Manager, NEEP
4/8/21

About NEEP

A Regional Energy Efficiency Organization

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

Northeast Energy Efficiency Partnerships

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

"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)"

About today's presentation

- The connection between automation and NEEP's Smart Energy Homes and Buildings program
  - Defining the Smart Energy Home
  - The role of automation in the Smart Energy Home
- What is home automation and why we need it
- Home automation and energy efficiency
- The human factor in smart home automation
- Smart home automation challenges
- Smart home automation programs and policies
- The future of smart home automation
- NEEP's Smart Energy Homes and Buildings resources and events

NEEP's Smart Energy Buildings Homes and Buildings Program Market Transformation Goals

By 2025:

- 50 percent of Northeast homes and buildings are "energy smart" with either two "energy smart" systems or smart building management systems able to respond to grid service needs.

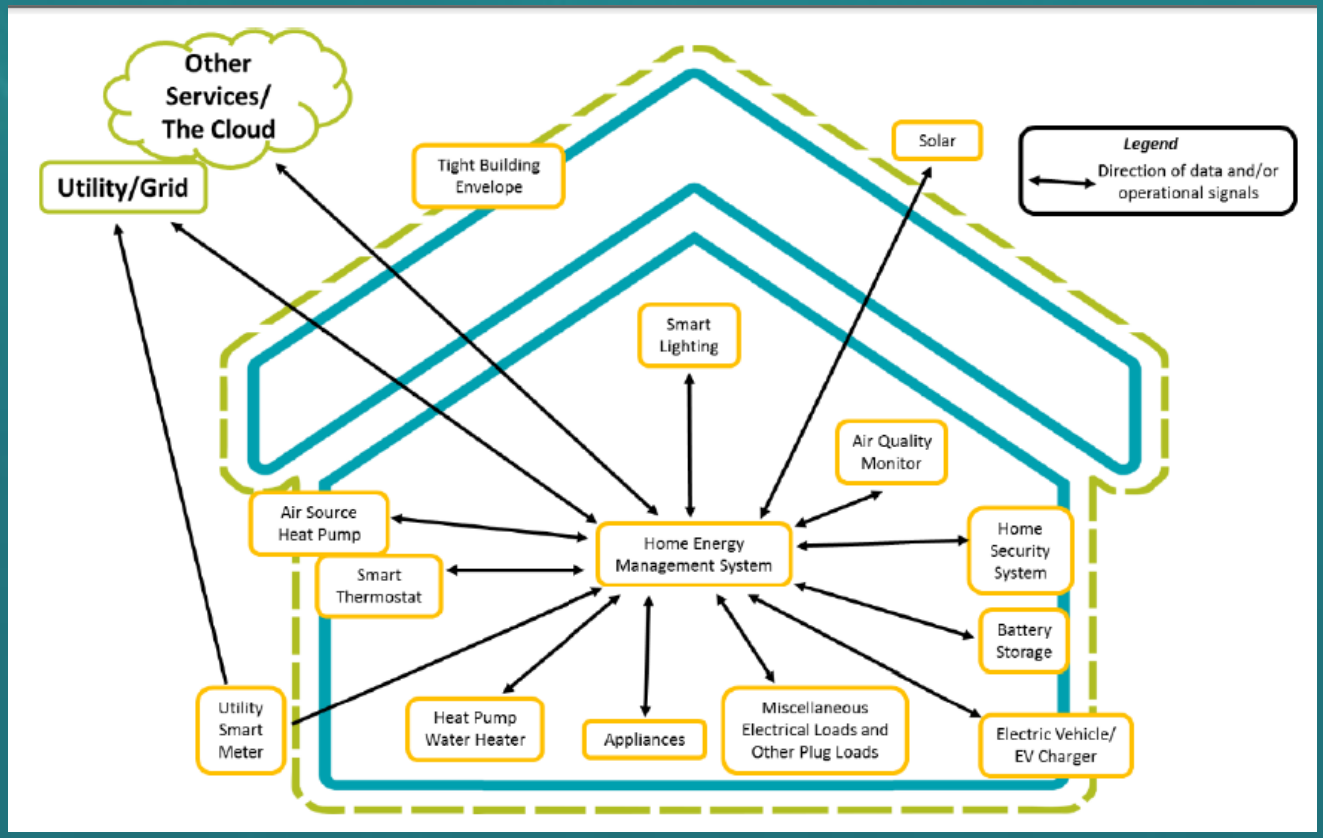
By 2030:

- 90 percent of Northeast homes and buildings are "energy smart" (as defined above).

NEEP's Smart Energy Homes and Buildings Program

- Transforming the smart energy homes and buildings market
- Bringing stakeholders together to discuss challenges and solutions
- Tracking policies, legislation, codes and standards
- Conducting research and analysis

The Ideal Smart Energy Home



Characteristics of a Smart Energy Home

The ideal smart energy building would:

- Include end uses that are smart and connected
- Include connected heating and cooling technologies
- Be highly efficient
- Be equipped with DERs
- Include some sort of energy management system

Similar characteristics to Grid-Interactive Efficient Buildings (GEBs):

- Efficient
- Connected
- Smart
- Flexible

The Role of Automation in the Smart Energy Home

- Automated processes – control the home's operations (including heating, air conditioning, lighting, smart appliances, building power generation and storage)
- Automated technologies respond individually and collectively to electric grid needs while meeting customer needs

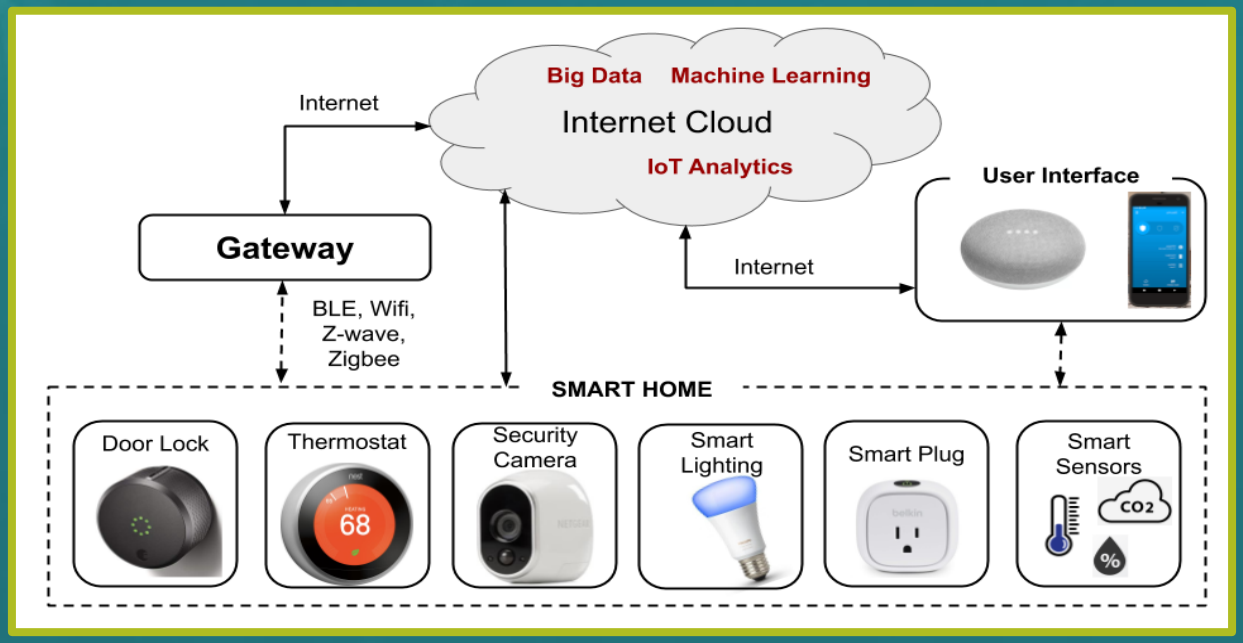
What is Automation?

When you schedule or program devices to turn on and off on their own.

Source: medium.com

What is Home Automation?

The integration of smart devices within a home, allowing for automatic or remote control of different devices and settings



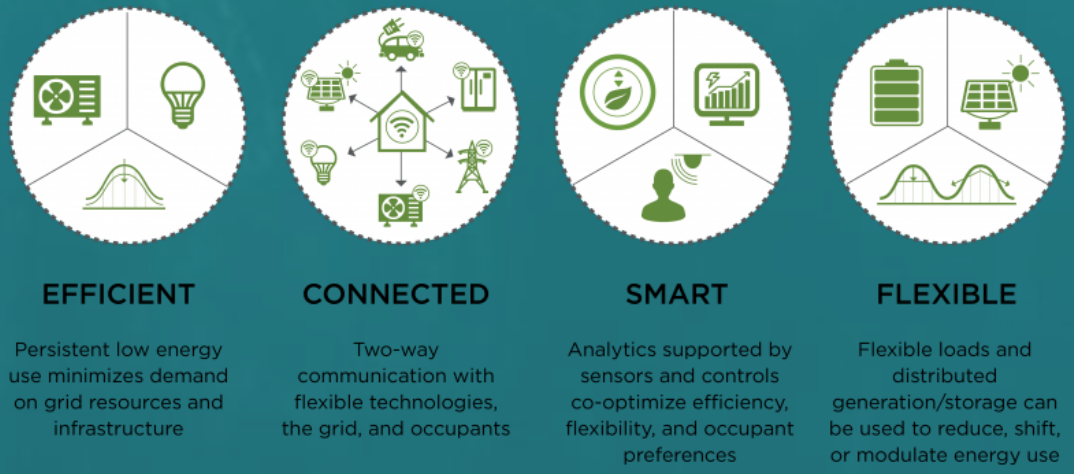
Source: smlease.com

What Drives Consumer Interest in Automation?

- Monitor and control smart home devices remotely
- Have smart devices make decisions of their own according to our user requirements
- Access real time data from anywhere
- Convenience and comfort

Benefits of Home Automation

- Energy efficiency
- Demand flexibility
- Enhanced security



Home automation and energy efficiency

Quantification of potential savings for home energy efficiency approaches

- Study by Consumer Technology Association (CTA)

Table 1: Annual technical energy savings potential estimates for selected home automation approaches.

	Primary Energy quads[1]		Household Savings Potential MMBtu[2]	kWh			
Approach	Usage[3]	Savings	Heating	Cooling	Lighting	Electric*	Relevant** Households
Connected Thermostat	7.5	0.7-1.1	6	400	-	-1 to -30	80-90%
HVAC Zoning[3]	7.5	0.3-0.6	4	210	-	-5 to -50	60-85%
Window Covering Control[3]	7.5	0.3-1.0	5	580	±50	-90	80%
Lighting Control, Occupancy	1.5	0.4-0.6	-	-	370 to 580	-50 to -235	100%
Circuit-level Control	2.5	0.8	-	-	-	630	100%

[1] One quad = 10^{15} British thermal units (Btus)

[2] MMBtu = one million Btus.

[3] Estimates based mainly on simulations and carry higher uncertainty.

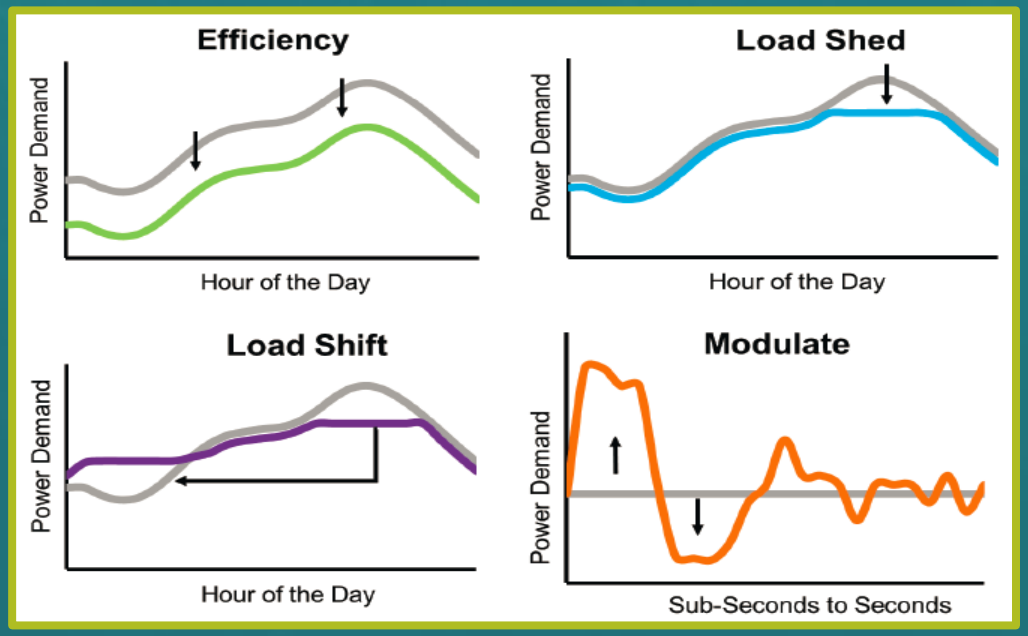
* Negative values indicate energy used during operation.

** Portion of households to which an approach is applicable.

Home Automation and Demand Flexibility

Automation enables demand flexibility

- Changing load to respond to grid signals



Smart Home Automation Technologies with Highest Efficiency Potential

- Smart HVAC systems
- Smart lighting
- Smart plug loads
- Smart window shading
- Distributed energy resources
- Building automation systems

The human factor in Smart Home Automation

- Final installation and commissioning
- Dealing with issues encountered during installation
- Field based inspections
- Ensuring accurate and current recording of energy savings data

Current smart home automation challenges

- Adoption
- Interoperability
- Communication effectiveness
- Smart network power consumption
- Signaling and bandwidth

Programs that Support Home Automation

- Prescriptive rebates
  - Offer cash incentives
- Custom incentives
  - Aim for systems-level efficiency improvements and savings
  - Include performance-based programs
- Demand response and distributed generation programs
  - Rely on smart meters
  - Customers can participate in demand response events

Policies/legislation/standards that support home automation

- Grid modernization
- Advanced metering infrastructure
- Demand response
- Non-wires alternatives
- Grid interactive codes and standards (connectivity standards, appliance standards etc.)

The Future of Smart Home Automation

- Greater Adoption of home automation devices, systems and applications
- Increased platforms for bi-directional communication
- Greater interoperability among smart devices, systems and applications
- More policies/legislation and programs that support smart home automation
- More research - the role of automation in optimizing smart homes and buildings

NEEP's Smart Energy Homes and Buildings Resources and Events

- Grid Interactive Efficient Buildings Tri-Region Status Report

  https://neep.org/grid-interactive-efficient-buildings-gebs-tri-region-status-report
- Emerging Codes and Standards for Grid-Interactive Buildings

  https://neep.org/emerging-codes-and-standards-grid-interactive-buildings
- Smart Energy Homes and Buildings Policy Tracker

  Coming soon!
- Smart Energy Homes and Buildings Workshop

  August 19th

  https://neep.org/events/smart-energy-homes-and-buildings-2021

THANK YOU!

For more information, contact:
gprocaccianti@neep.org

Lucas Phillips
National Renewable Energy Laboratory

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Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Automation: Where is the Balance Between Energy and Humans

Lucas Phillips, National Renewable Energy Laboratory

Building AMERICA
U.S. Department of Energy

What is "SMART"?

- Gimmicks Vs impactful technologies
- How does it make life easier
- Data
- How can it be leveraged?
- Can SMART=impact

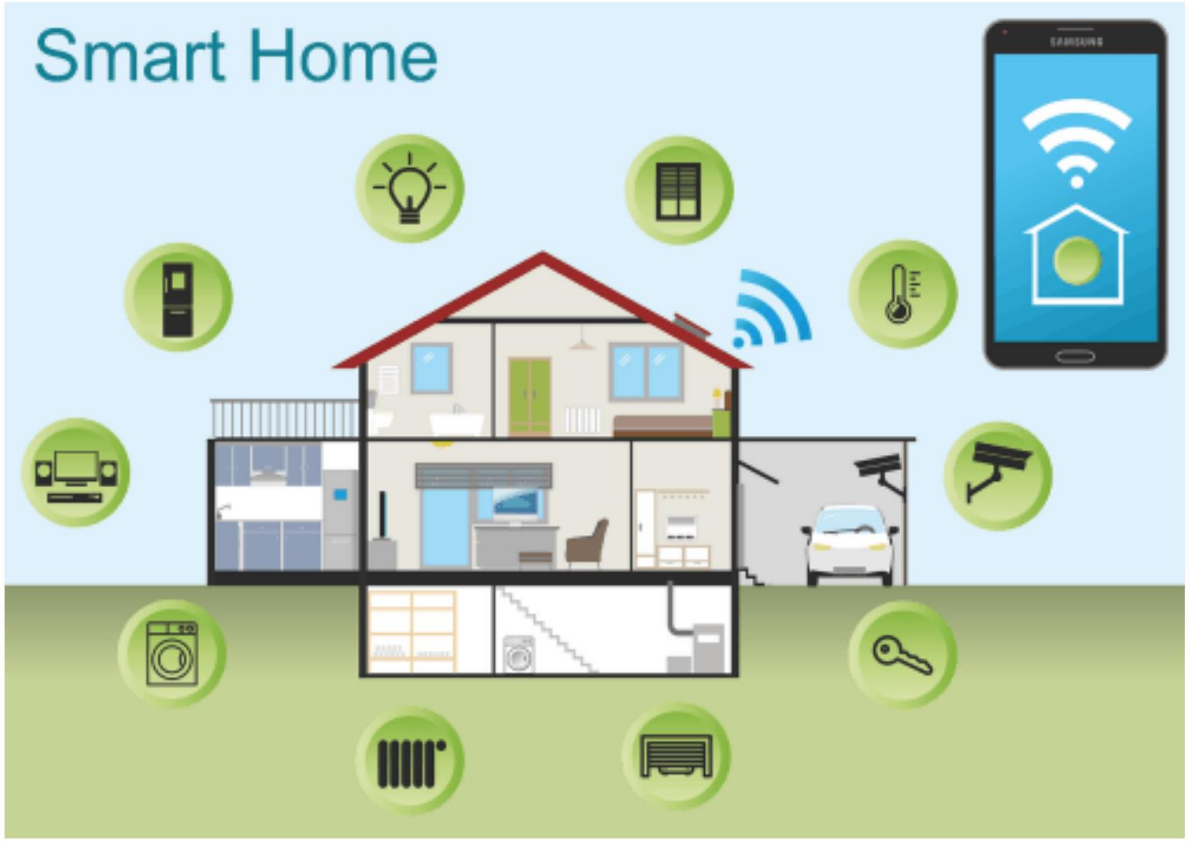
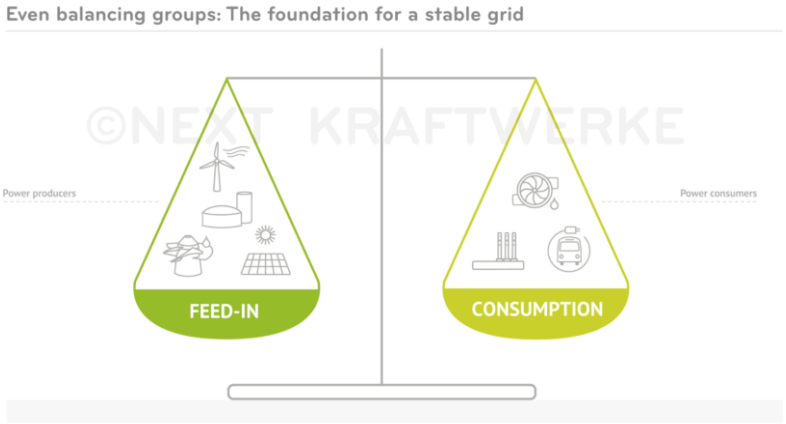
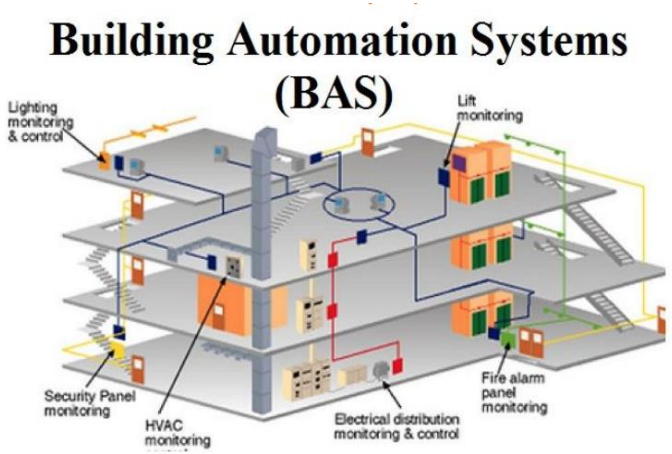


Image by Pixaline from Pixabay

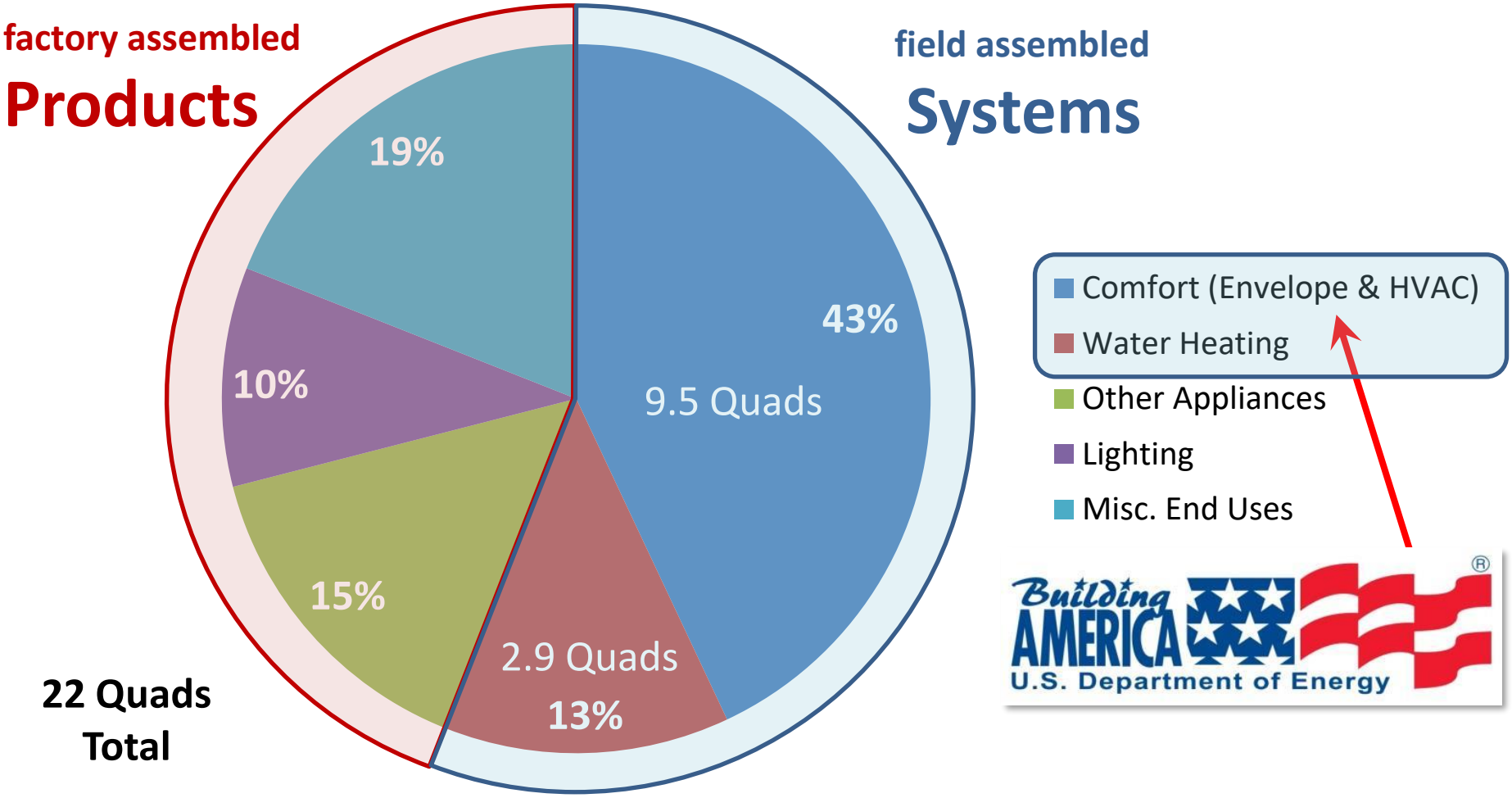
Commercial BAS/BMS





Building Automation Systems (BAS) Market

Building America Program Strategy



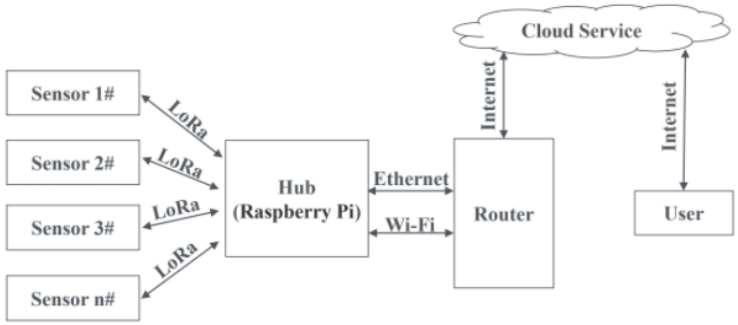
U.S. Residential Buildings Primary Energy Consumption

Research Questions

- Can an acccurate low cost wireless sensor pack be devleoped to interface with with IoT devices?
- Can an accurate whole home thermal model be developed with 15% error and 90% confidence?
- How do AFDD strategies utilize low-cost sensor network to accurately identfy faults and prescribe resolution measures?
- Can the optimization algorithm utilize the sensor network to optimize system operation and occupant comfort?
- How does accuracy compare with baseline testing in highly insturmented lab homes?

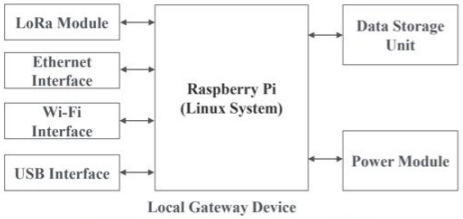
Texas A&M: IoT-based Comfort Control and Fault Diagnostics System for Energy-Efficient Homes

Partners: Clemson University and Drexel University

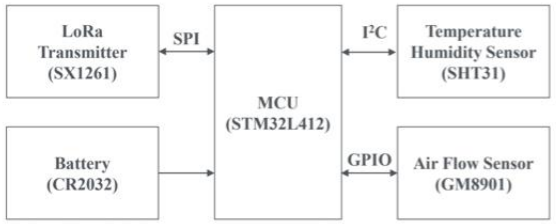


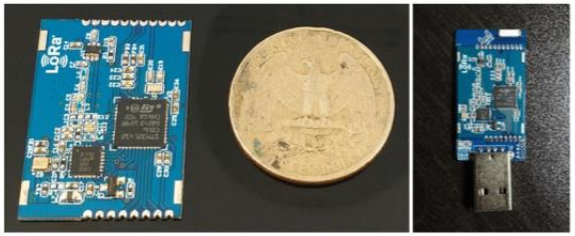
System Overview

- Development of low-cost and distributed sensor systems for comfort and energy measurements, as well as for system performance monitoring
- Development of cost-effective & computationally-efficient and accurate learning-based models for system monitoring, optimization, and AFDD
- Lack of an advanced control framework that integrates adaptive controls with AFDD, IoT enabled devices, and the human-in-the-loop for residential homes.

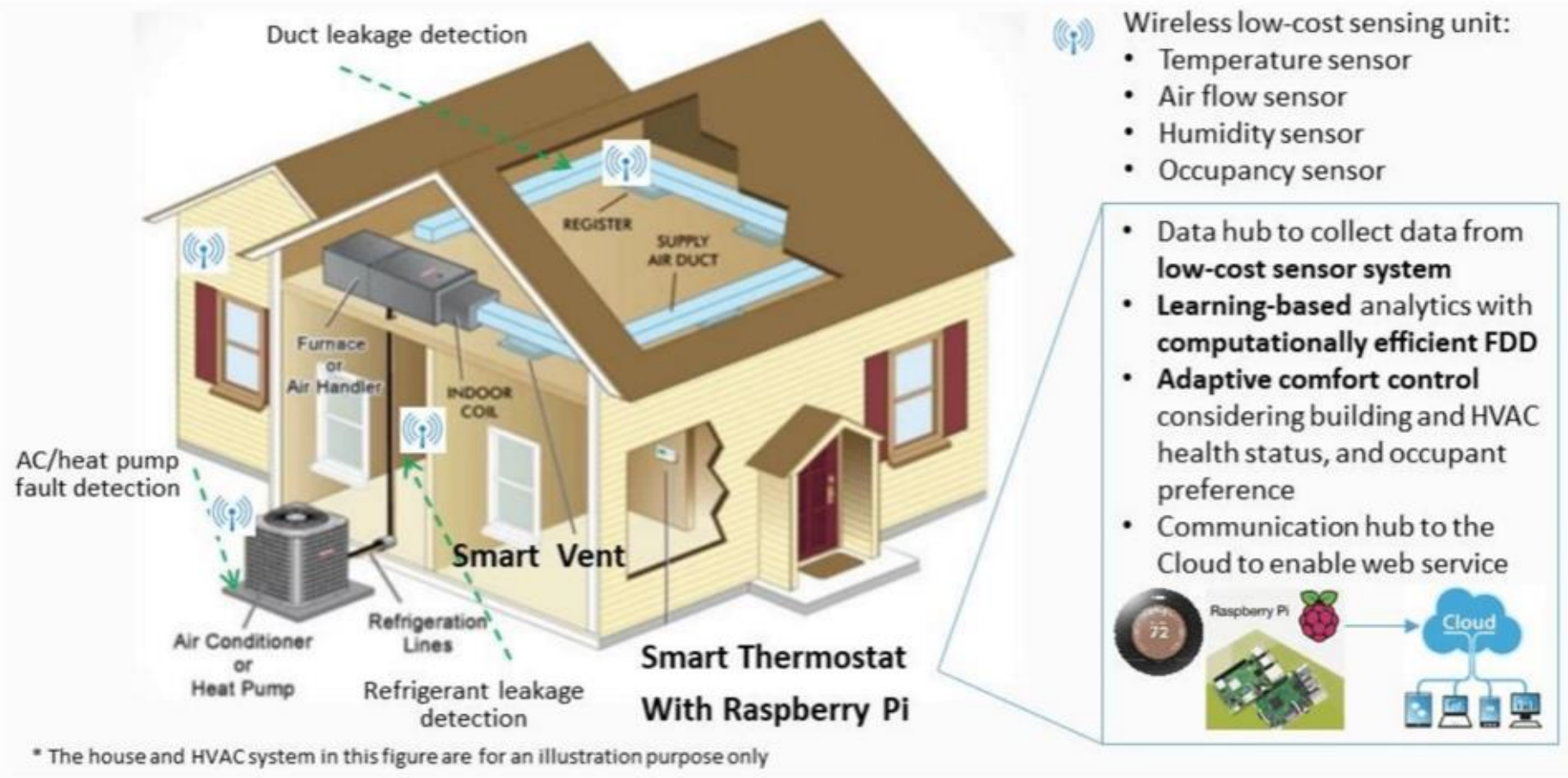


Local Gateway Device



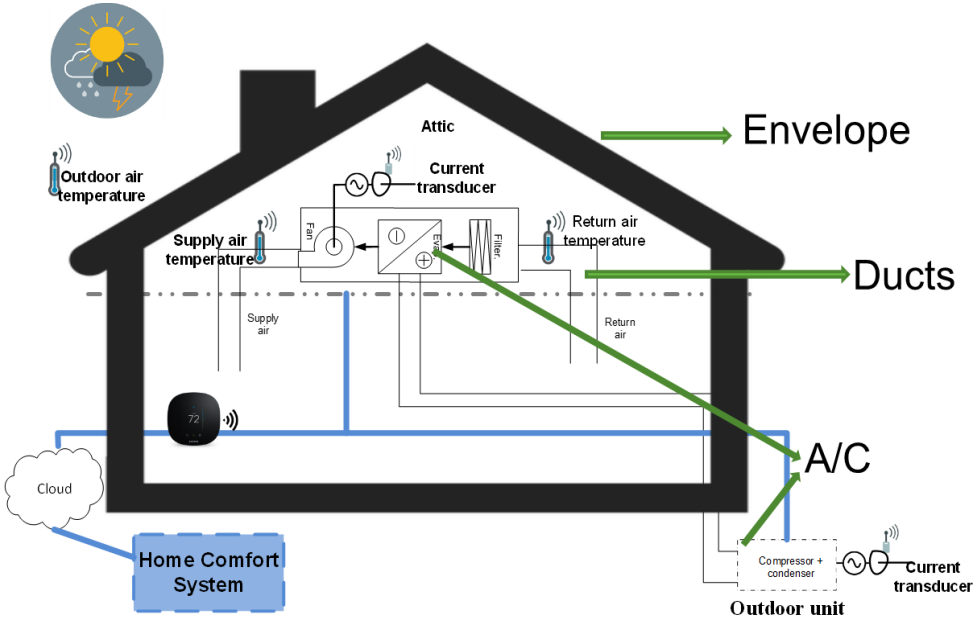


Texas A&M: IoT-based Comfort Control and Fault Diagnostics System for Energy-Efficient Homes



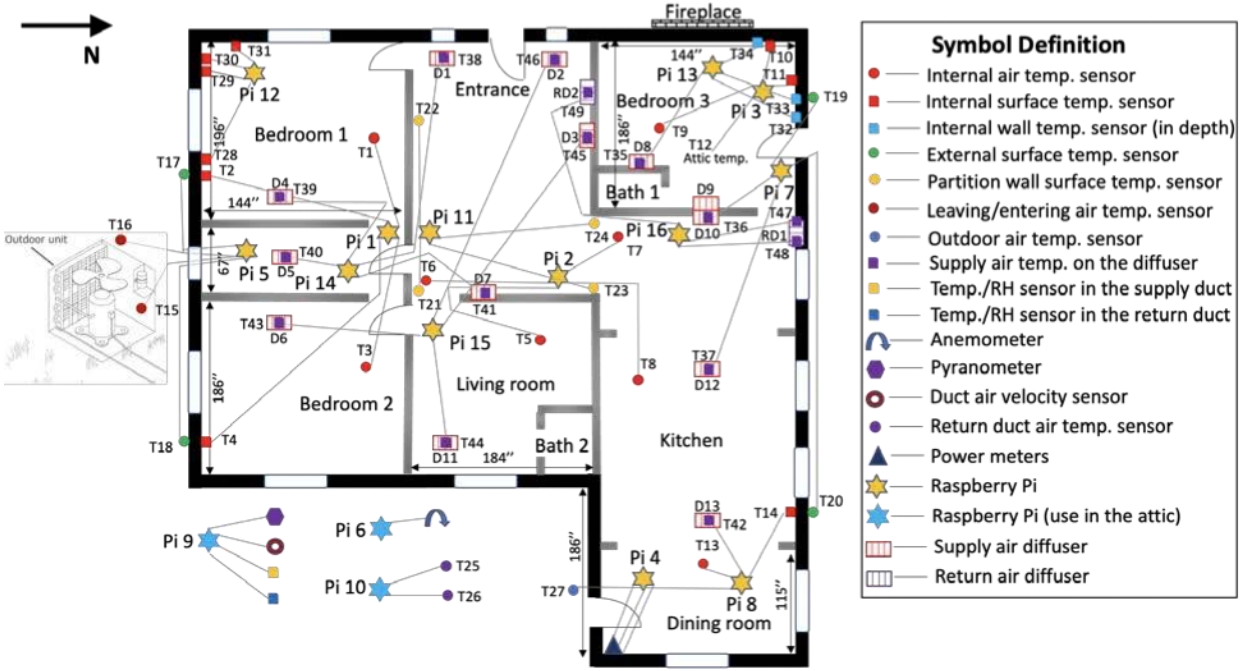
University of Oklahoma: Home Comfort System for Fault Detection & Optimal Comfort Control

Partners: University of Miami and Ecobee



- Ecobee smart thermostat
- Cloud computing
- VOLTTRON- open source with wider applicability

University of Oklahoma: Home Comfort System for Fault Detection & Optimal Comfort Control



- Equipment, distribution, envelope input
- Thermal loads, weather, internal gains
- Field validation in 10 test homes in Norman OK, Richland WA, and Miami, FL

Cory Fox
Ecobee

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April 8, 2021

Customers |Technology |Utilities |Programs

Automation: Where Is the Balance Between Humans and Machines to Save Energy?

ecobee

April 8, 2020

ecobee is about improving everyday life, while creating a more sustainable world.

How do we achieve balance when
customers have unique and personal drivers
for control, comfort, and convenience

ecobee

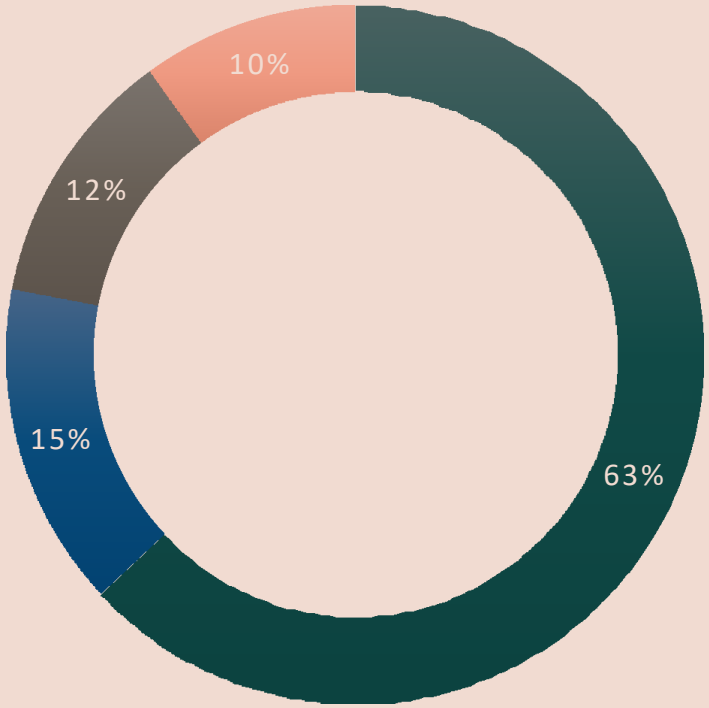
Consumer Purchase Drivers

Economist: To save on energy bills

Caretaker: To not have to worry about comfort for myself or other people in the home

Hobbyist: To have the coolest technology which makes life more convenient

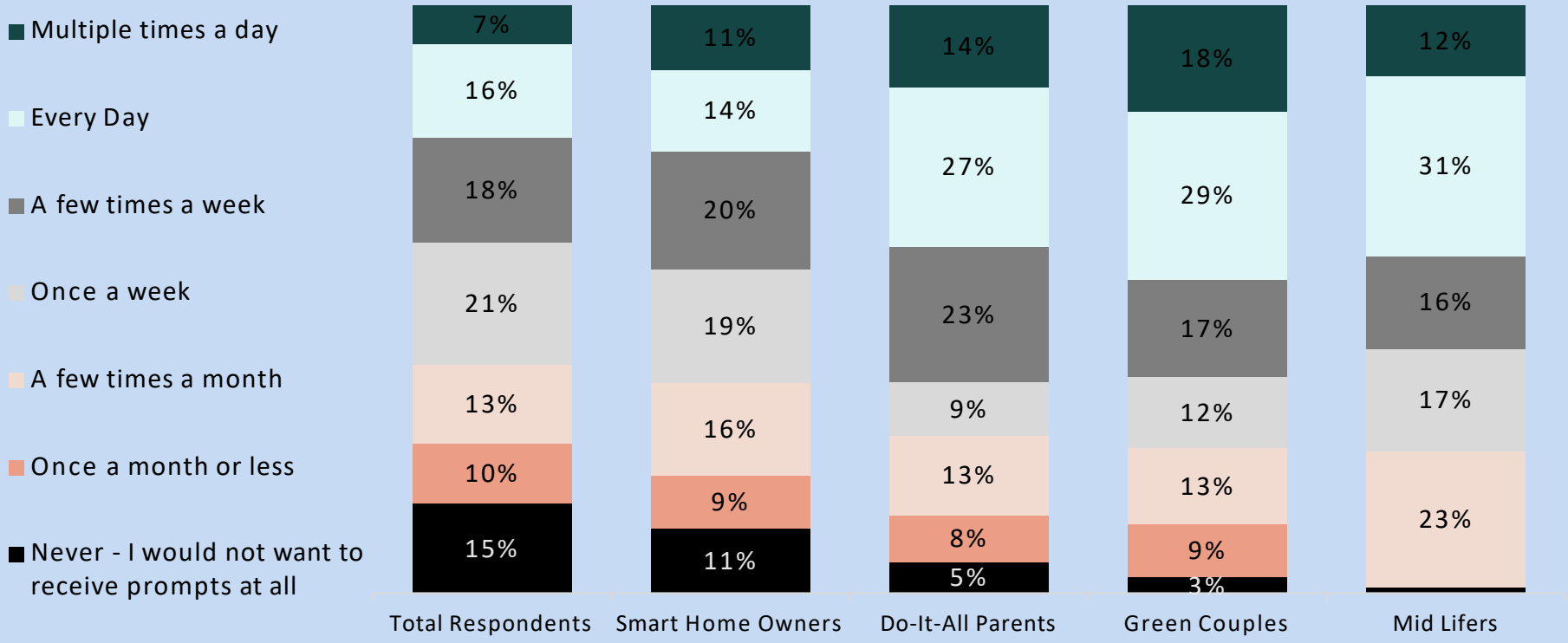
Environmentalist: To be environmentally-responsible



Recent ecobee Brandy Survey

Delivering Automated Features is Highly Personal

Ideal number of prompts



How do we balance the customer's desire for control, comfort and personalization with the utility's need for predictability, reliability and cost effectiveness

ecobee

April 8, 2021

Experience enhanced comfort and energy savings that are unique to your home with eco+ smart features

ecobee

COVID Impacts (Negligible)

Even with AC usage ~26% higher in 2020 than in 2019, the additive eco+ EE savings have remained consistent.

Third party eco+ EM&V study* showed an average of 6% and 5% additional energy efficiency savings in North America in summers 2019 and 2020, respectively.

* http://www.ecobee.com/ecoplusemv

How do we balance consumer and utility needs in the confines of Program Structures (WIP)

ecobee

April 8, 2021

Incorporate energy efficiency optimization savings.

VT and DC apply OEM opt-in rate and further blend by % OEM rebated market share

ecobee

April 8, 2021

On behalf of the ecobee energy team…

Thank You!

Cory Fox |Partnership Manager
cory.f@ecobee.com

ecobee

Upcoming Events

BPA National Home Performance Conference
April 12-16
events.building-performance.org/national/#austin

Winning Solar Home - The DOE Solar Decathlon Build Challenge Winners
April 28, 1–2 p.m. E.T.
solardecathlon.gov/virtual_sessions.html

DOE Better Buildings Summit
May 17-20
betterbuildingssolutioncenter.energy.gov/summit


STEM
RISING
U.S. DEPARTMENT OF ENERGY
ENERGY.GOV/STEMRISING

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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