Better Buildings Residential Network Peer Exchange Call Series:

Wicked Smart: Optimizing Diagnostics through Home Energy Monitoring

November 16, 2017

Call Slides and Discussion Summary

Agenda and Ground Rules

- Agenda Review and Ground Rules
- Opening Polls
- Residential Network Overview and Upcoming Call Schedule
- Featured Speakers:
  - **Cory Fox**, Sr. Building Energy Efficiency Analyst, CSRA International
  - **Sarah Colvin**, Director, Business Development & **Sina Shahandeh**, Director, Data and Analytics, ecobee
  - **Keith Canfield**, Senior Program Manager, Residential, CLEAResult
- 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.

Better Buildings Residential Network

Join the Network

Member Benefits:

- Recognition in media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- Solution Center guided tours

Commitment:

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

Upcoming calls:

- November 30: Solar Decathlon Peer Exchange Call
- December 7: DOE Toolkit Launch: A New Approach to Evaluate as You Go
- December 14: The Amazing Race: City Winners of the National Georgetown University Energy Prize (GUEP)

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

Best Practices: CSRA International

Cory Fox, Sr. Building Energy Efficiency Analyst

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Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Wicked Smart: Optimizing Diagnostics through Home Energy Monitoring (HEM)

November 16, 2017

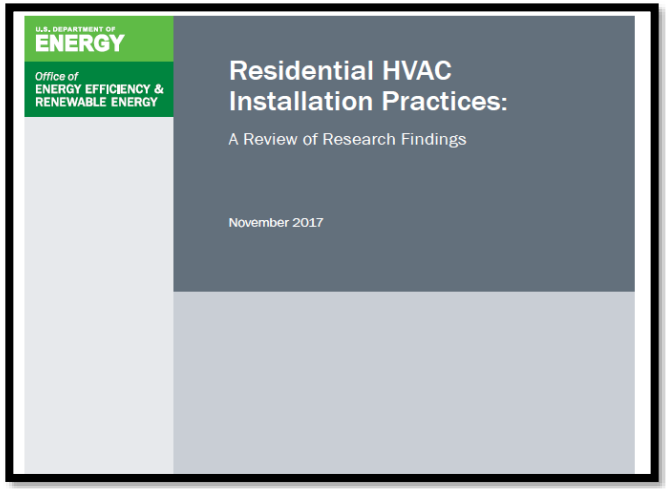
Home Energy Monitoring: Market Trends

- Market opportunity: current status, technology trends
  - Consumer uptake is strongest with smart thermostats, security devices and lighting (LEDs)
  - Greatest energy efficiency benefits are within HVAC, water heating and plug load devices and products.
  - Slower adoption than predicted (*Why* is complicated)
  - Voice enabled devices are exploding (and is emerging as a solution to interoperability issues as some products are built to integrate with 3rd parties)

- Market opportunity: looking ahead
  - HEMs holds a larger promise of deeper delivered energy savings through demand response capabilities, load shifting and leverage/integration with distributed energy resources
  - Leveraging trades and utility programs can increase market adoption, enable better system diagnostics, and optimize system performance
  - HEMs can play a role in managing household energy consumption patterns and improving the energy efficiency of homes

DOE Review Confirms Quality Installation Opportunities

- DOE conducted an extensive **systematic literature review,** gathering and analyzing 44+ reports and results on the impacts to performance from improper HVAC installation in the existing homes HVAC replacement market



- **Report forthcoming**: *Residential HVAC Installation Practices*
- **Key Findings:**
  - Proper installation (and system maintenance) is critical to optimizing HVAC system efficiency and performance
  - Trades, in-field experts, and EE programs should **utilize field verification** tools to **diagnose and correct** problems

Quality Installation Available Resources

High level **Market Snapshot** to understand the variety of tools available for use in the support of verified HVAC installation and performance measurement

Selection and Comparison Matrix to assist in identifying verification tools for use in specific applications

Find Selection Guide Here:
https://rpsc.energy.gov/tech-solutions/hvac

Performance Verification with HEMs

Advanced Fault Detection

Equipment level detection and perhaps component level detection

Continuous HVAC Optimization

Improving equipment and system quality through evolving diagnostics and algorithms

Improved modeling

Informing HVAC equipment system selection and design procedures

Continuation of Work: Installation Tools KPIs

Key Performance Indicators Development: (KPIs) provide the foundation to establish performance criteria for field verification tools.

KPI Criteria

- List of performance metrics and measurements used when installing HVAC systems
- Follows industry standards (ACCA 5 and OEM specs)
- NOT intended as an installation checklist or process

Performance Criteria

- Establishes the key measurement capabilities, tolerances, analytical capacity, etc. for diagnostic and monitoring tools

Resources

DOE Resources

- Download the 2016 report on Use Cases for Connected Thermostats
- Visit smartgrid.gov for more information on how the HEMs market can fit into a broader smart home and grid modernization effort
- Explore the New Technology Solutions website at DOE's Better Buildings Residential Program Solution Center, including the 2017 market snapshot of HVAC verification tools and selection guide

Additional Resources

- HEMs and Smart Homes report series, including a Contractors Guide to the Smart Home (Northeast Energy Efficiency Partnerships, forthcoming).
- Detailed report on how behavioral techniques can enhance the energy savings opportunities of connected technologies (Consortium for Energy Efficiency).

Thank You

- **Cory Fox, CSRA International**

- **Steve Dunn, Project Manager**
  DOE Building Technologies Office

Presentation Highlights: CSRA International

- **The market is rapidly developing, though with slower uptake than predicted, possibly because of price**
  - Voice enabled devices are booming
  - We all have a role to play in market development

- **U.S. DOE resources can support improvements to verified HVAC installation and performance measurement**
  - Market snapshot and selection guide identify HVAC verification tools, including performance monitoring tools
  - Key Performance Indicators (forthcoming in the first half of 2018) will establish performance criteria for field verification tools

Best Practices: ecobee

Sarah Colvin, Director, Business Development
Sina Shahandeh, Director, Data and Analytics

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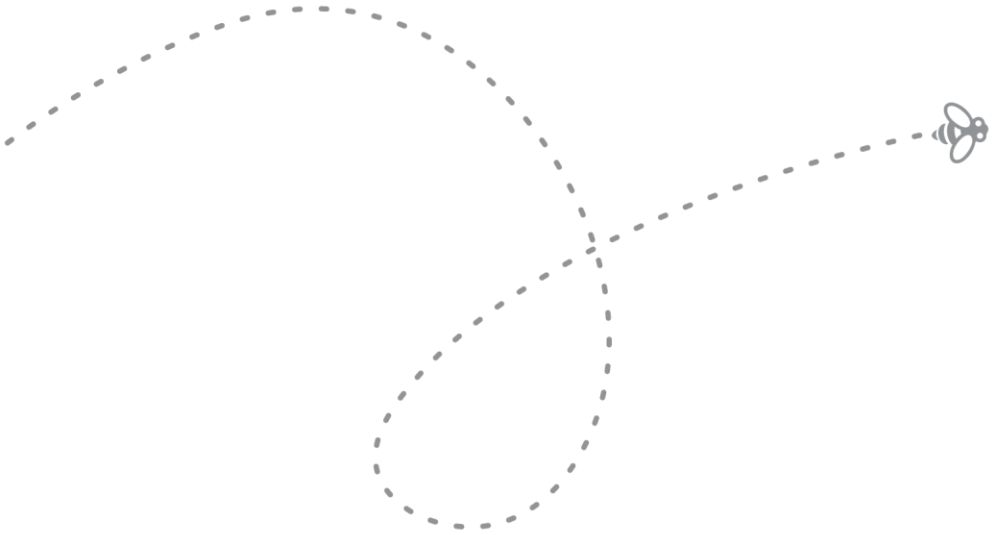
ecobee



ecobee4 smart thermostat

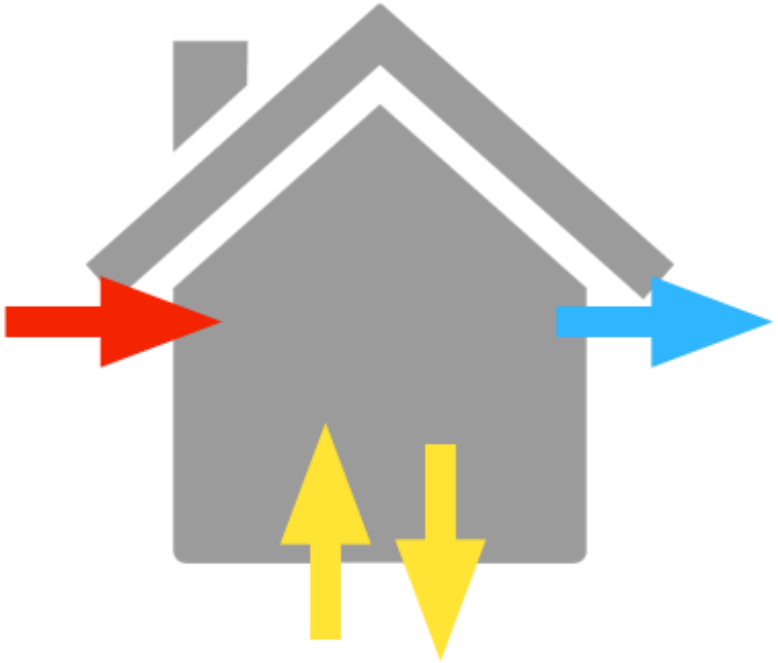
Automates your comfort with a
room sensor, and lets you
do more with your day with
built-in Alexa Voice Service.

The home energy balance

In *heating* season..

Energy In

- HVAC
- Internal Gains
- Solar Gains

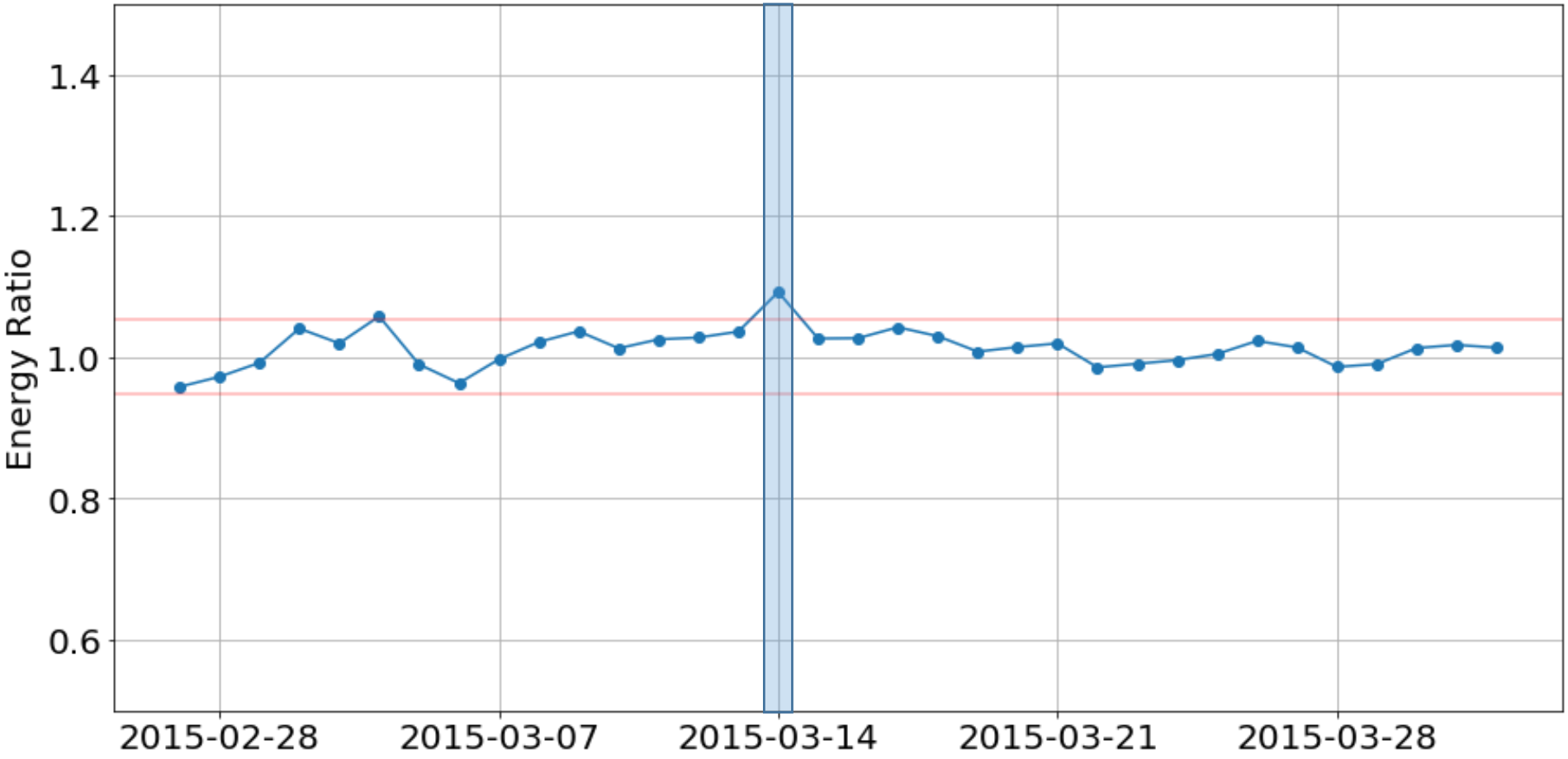


Energy Out

- Conduction
- Infiltration

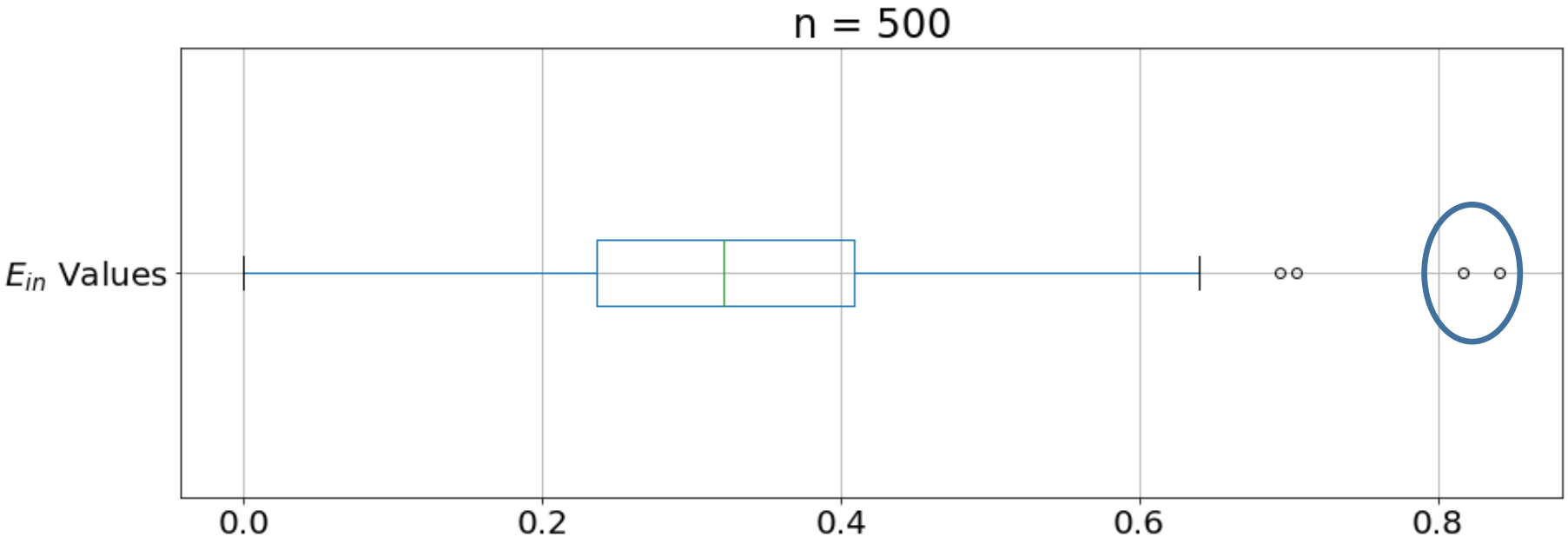
Energy Stored

Analysis – Individual Home Diagnostics



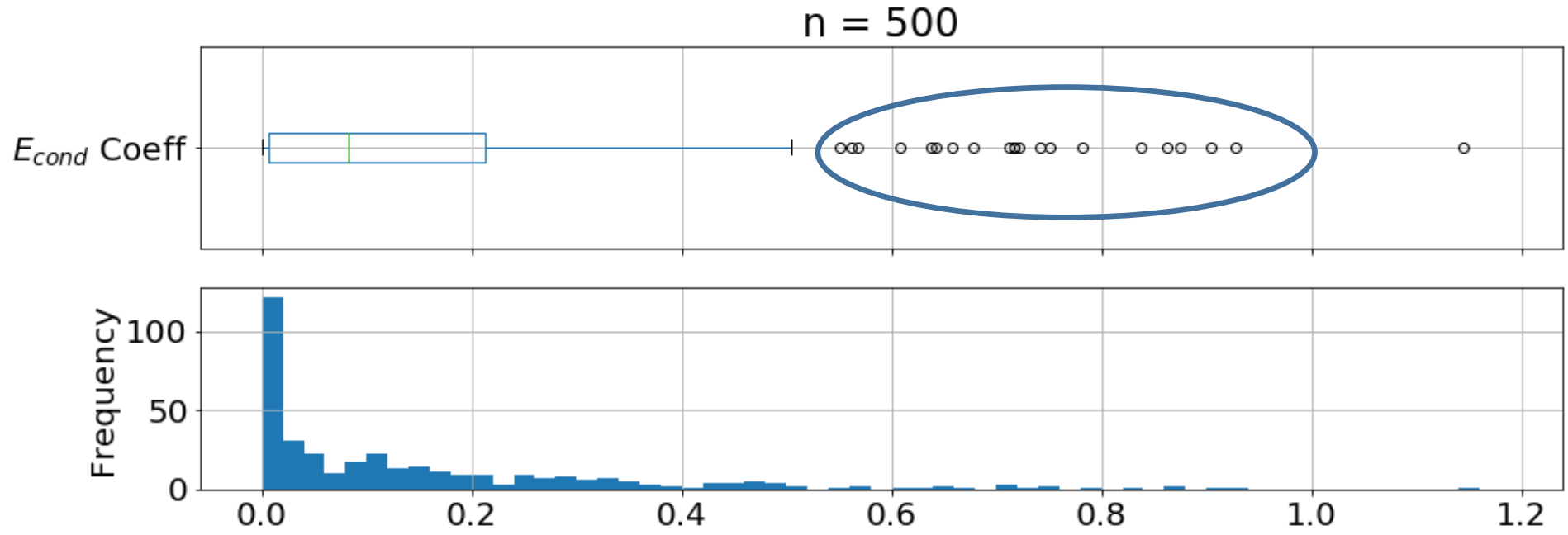
Analysis – Individual Home Diagnostics

Systems are shown to be running at near runtime capacity each night on average.



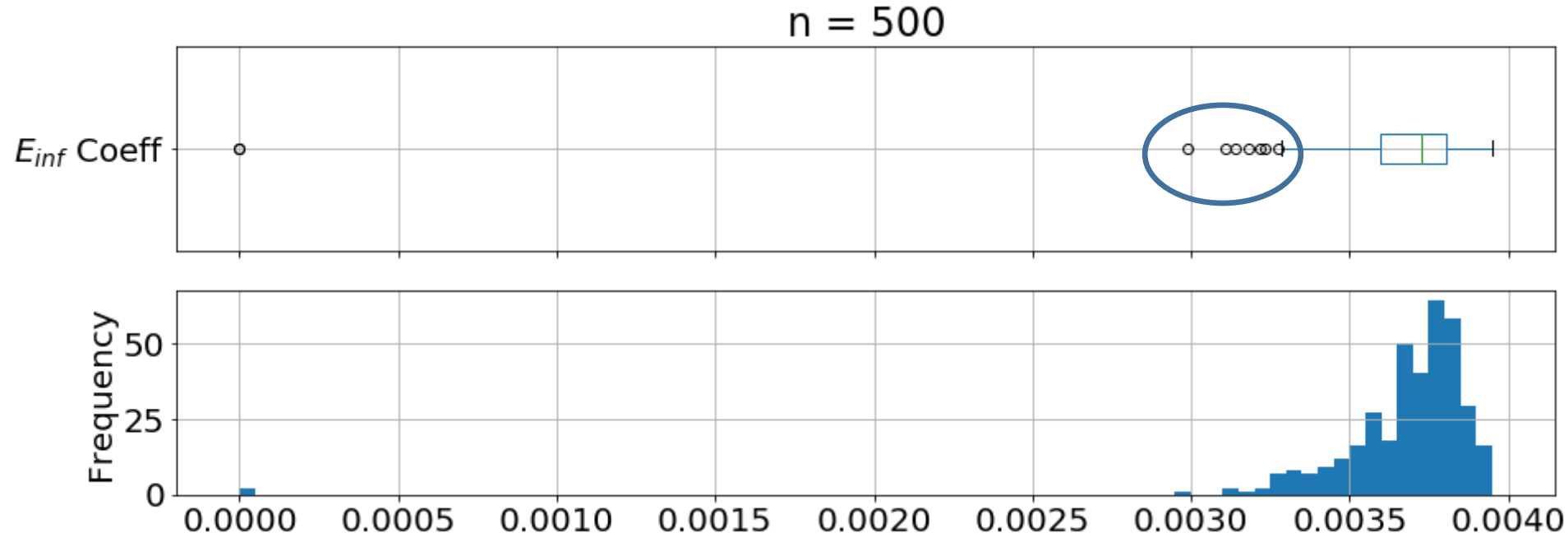
Analysis – Community Comparison

Homes that would appear to have a lower thermal resistance.



Analysis – Community Comparison

The outliers here would be those individuals who have a larger infiltration term.



Presentation Highlights: ecobee

- **Smart thermostats provide data to build a home profile and identify opportunities to improve efficiency**
  - Data come from weather, occupancy, and the thermostat
  - Individuals can track home performance through an online portal

- In the future, **utilities may be able to use these data to improve the efficiency of homes** in their portfolios to meaningfully impact the use of their services

- **Homeowners want messages that are specific to them, and that reflect their needs**
  - In marketing technologies, take customers through a journey with curated messages and services

Best Practices: CLEAResult

Keith Canfield, Senior Program Manager, Residential

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Using Smart Thermostats as Diagnostic Tools

ComEd	KCP&L	Entergy
>56,000 smart thermostats installed within 15 months of launch	23,000 smart thermostats installed over 36 months	3.3 Billion data points analyzed in first program year

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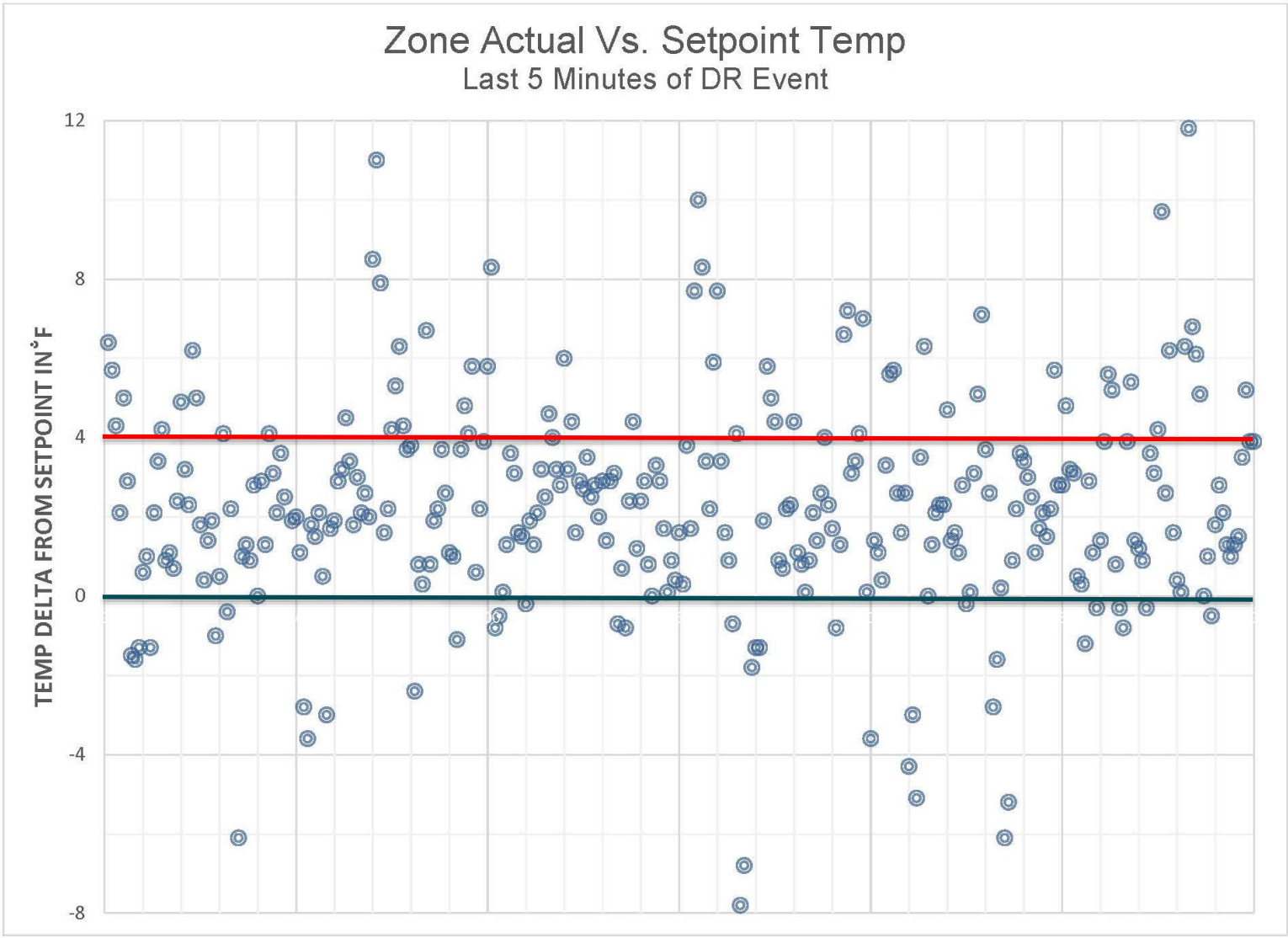
When does warm become hot?



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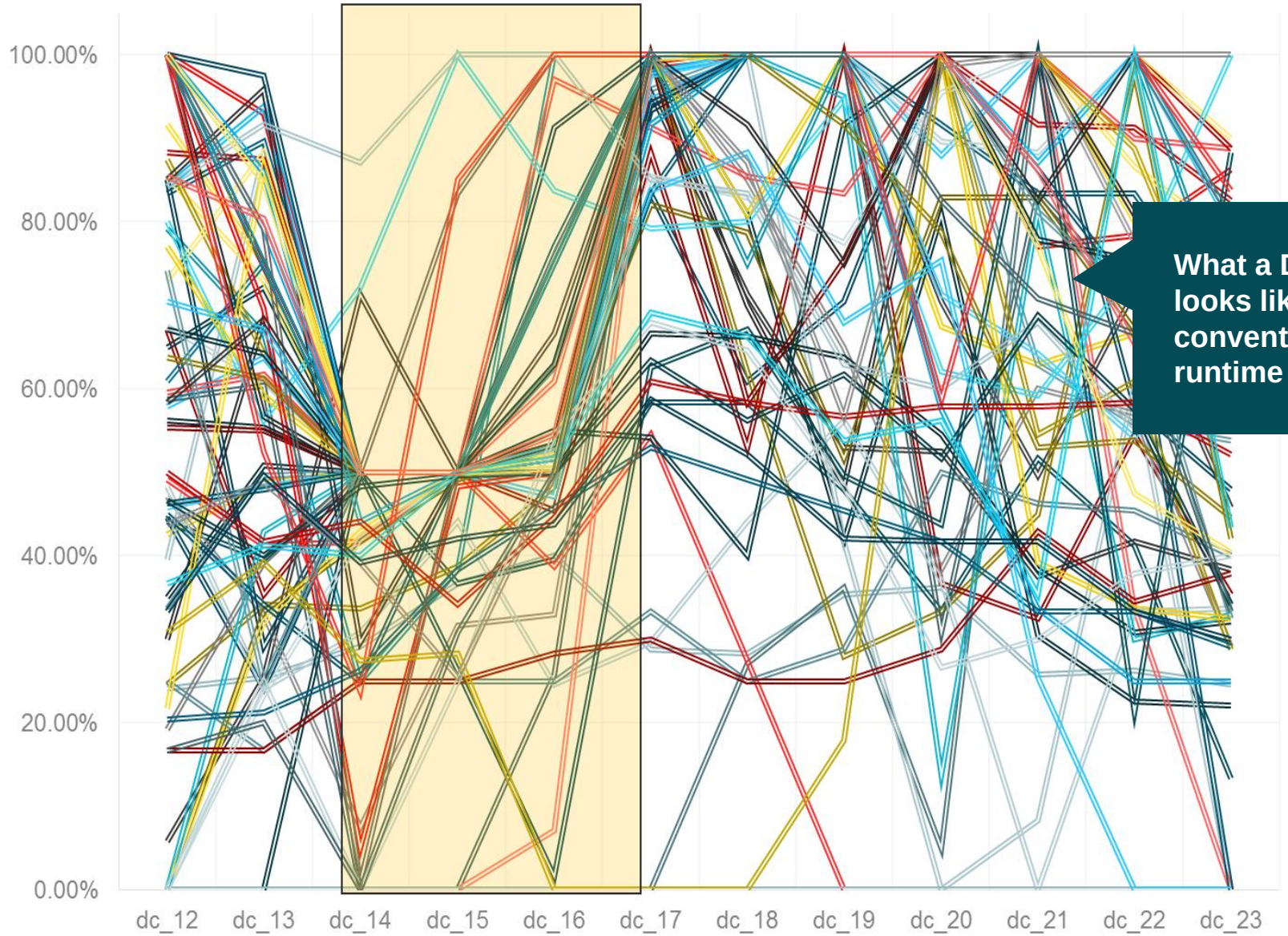
RUNTIME PERCENTAGE BY HOUR



What a DR event looks like using conventional runtime analysis

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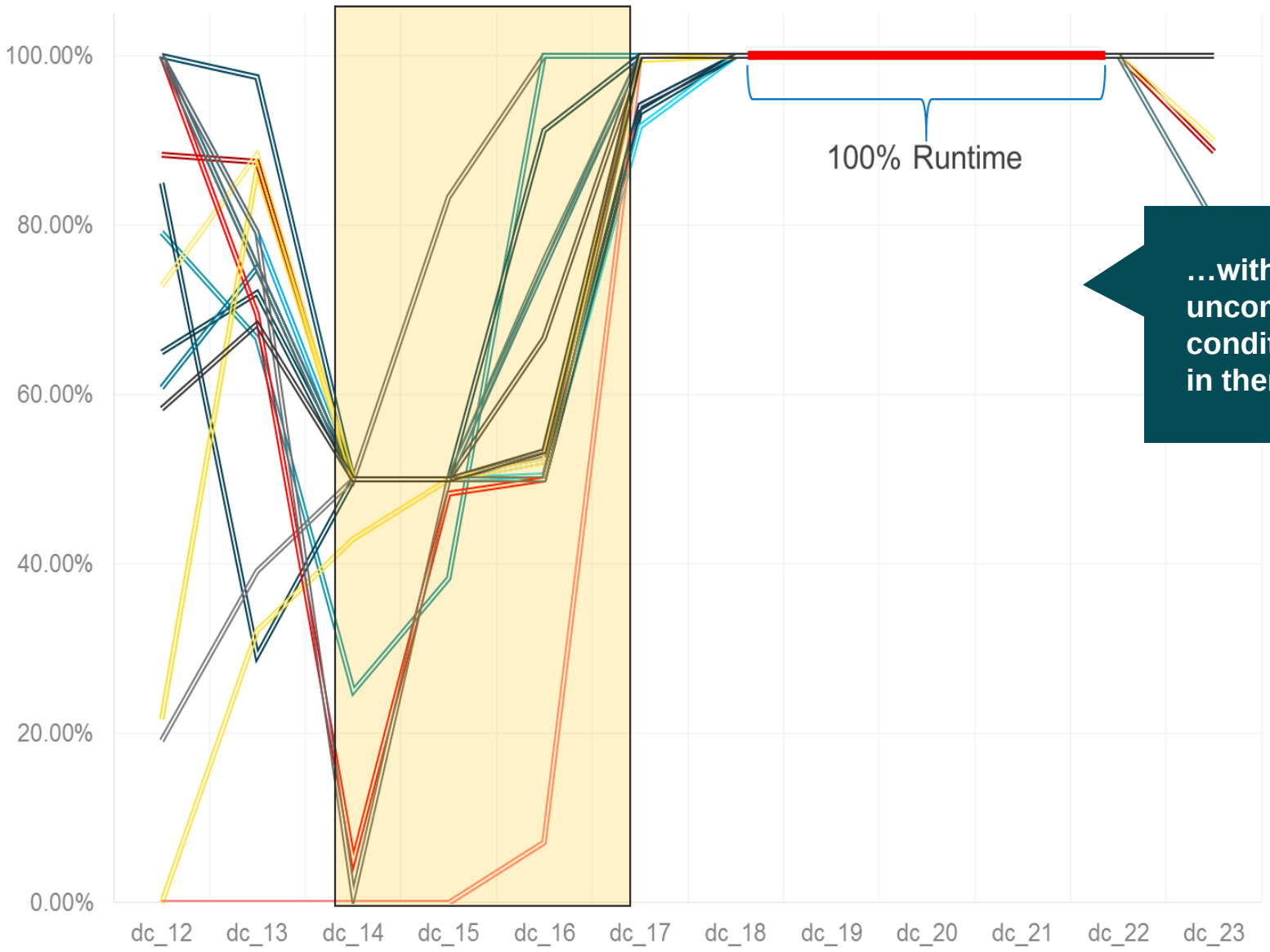
ISOLATION OF LONG RECOVERY TIMES



…with some uncomfortable conditions hiding in there.

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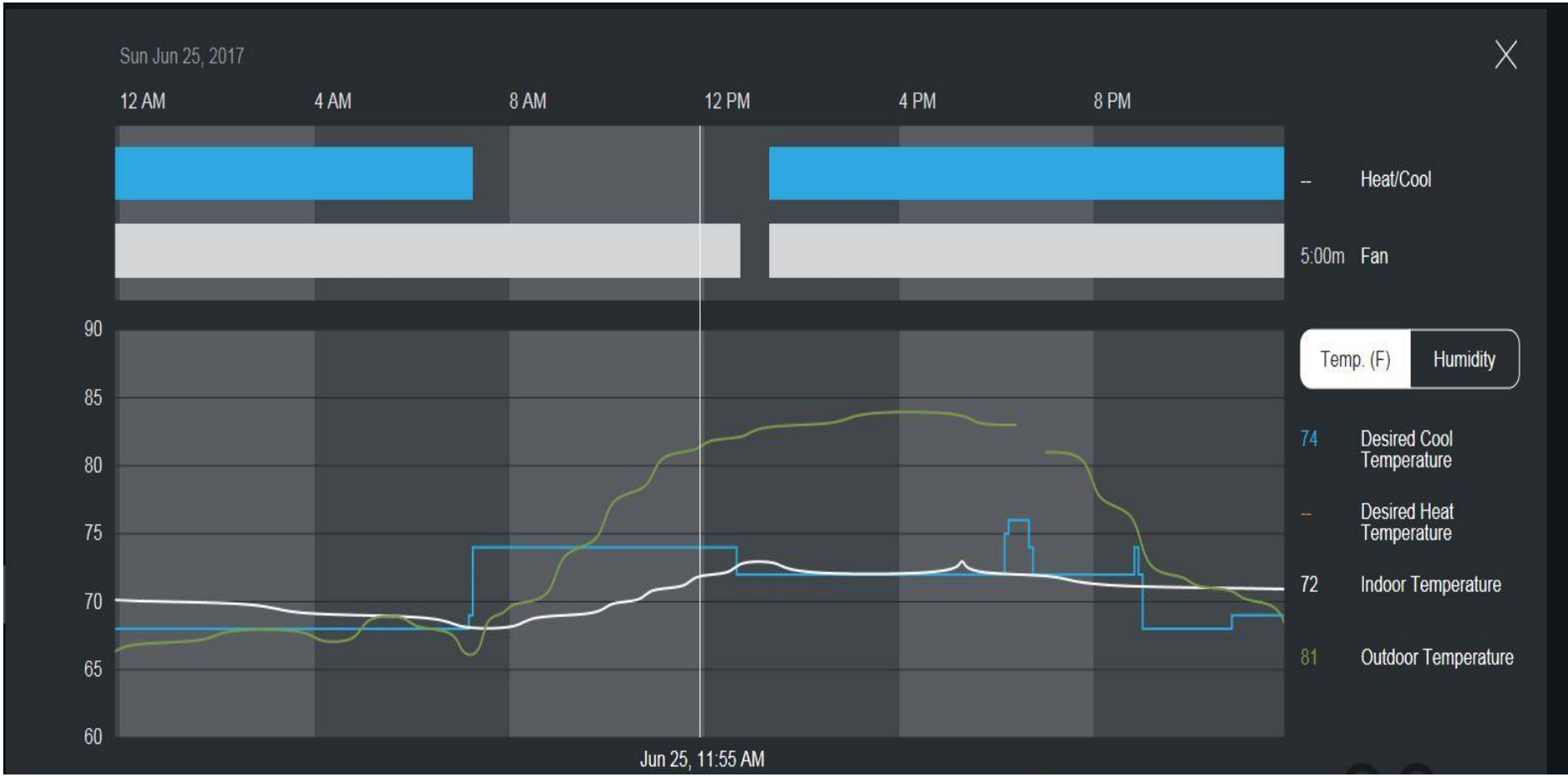
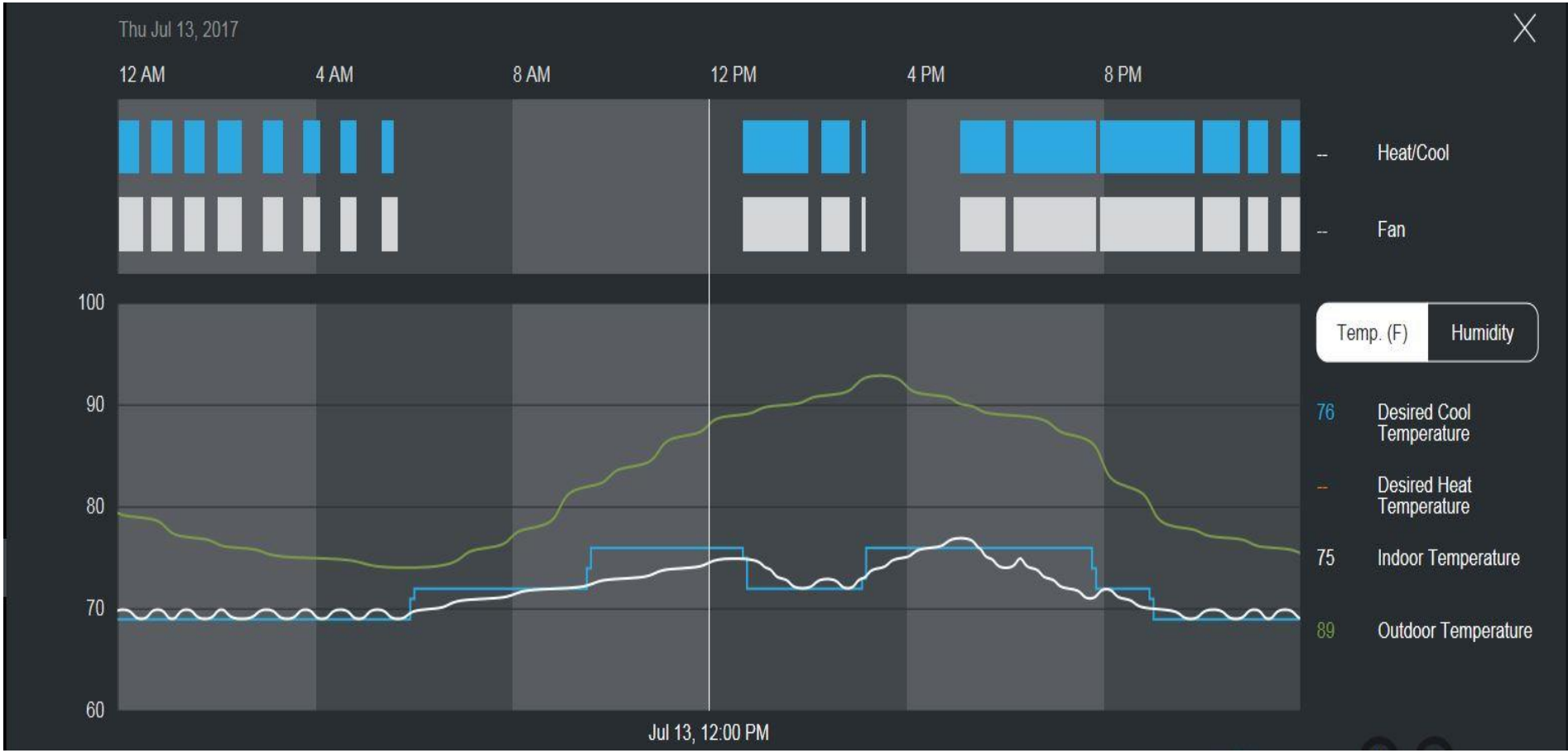
What does discomfort look like?



What does comfort look like?



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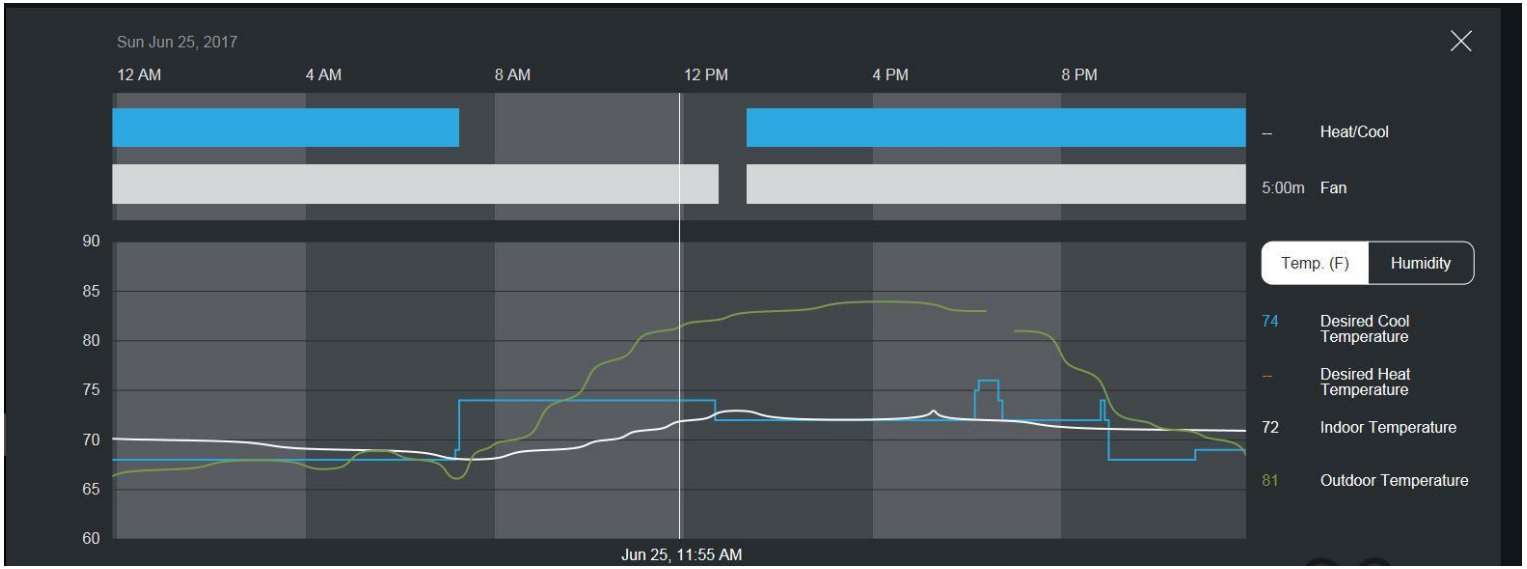
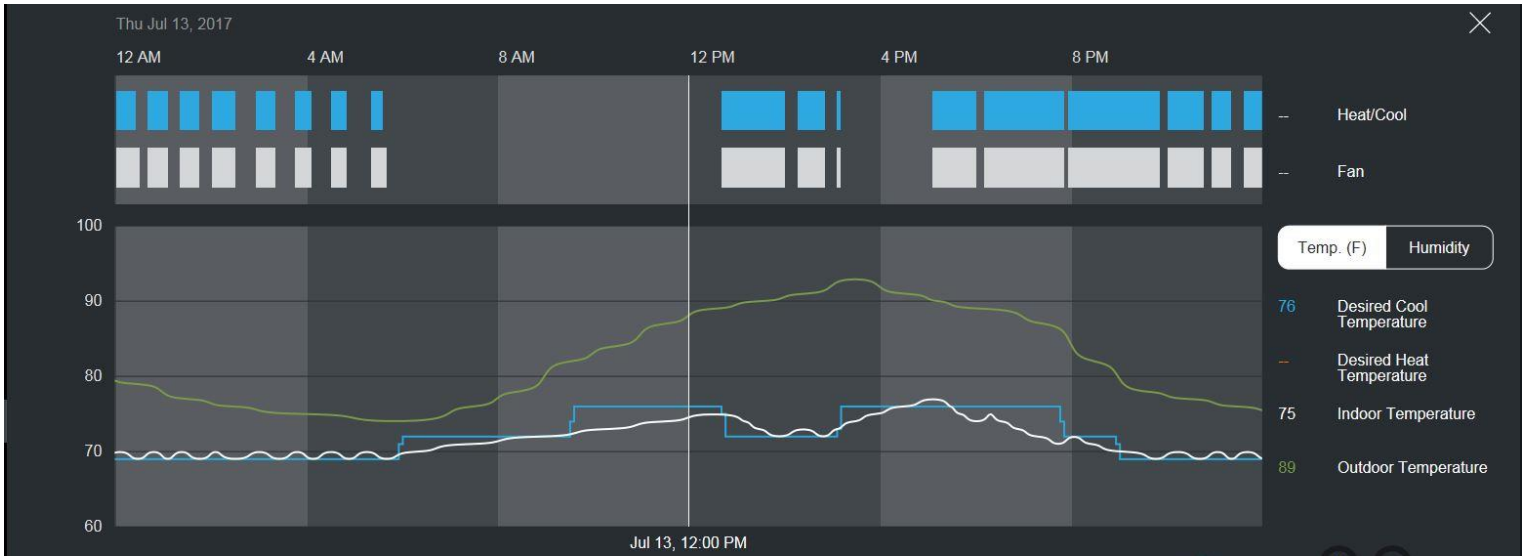
Conclusions?





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Example Home Pre and Post CoolSaver

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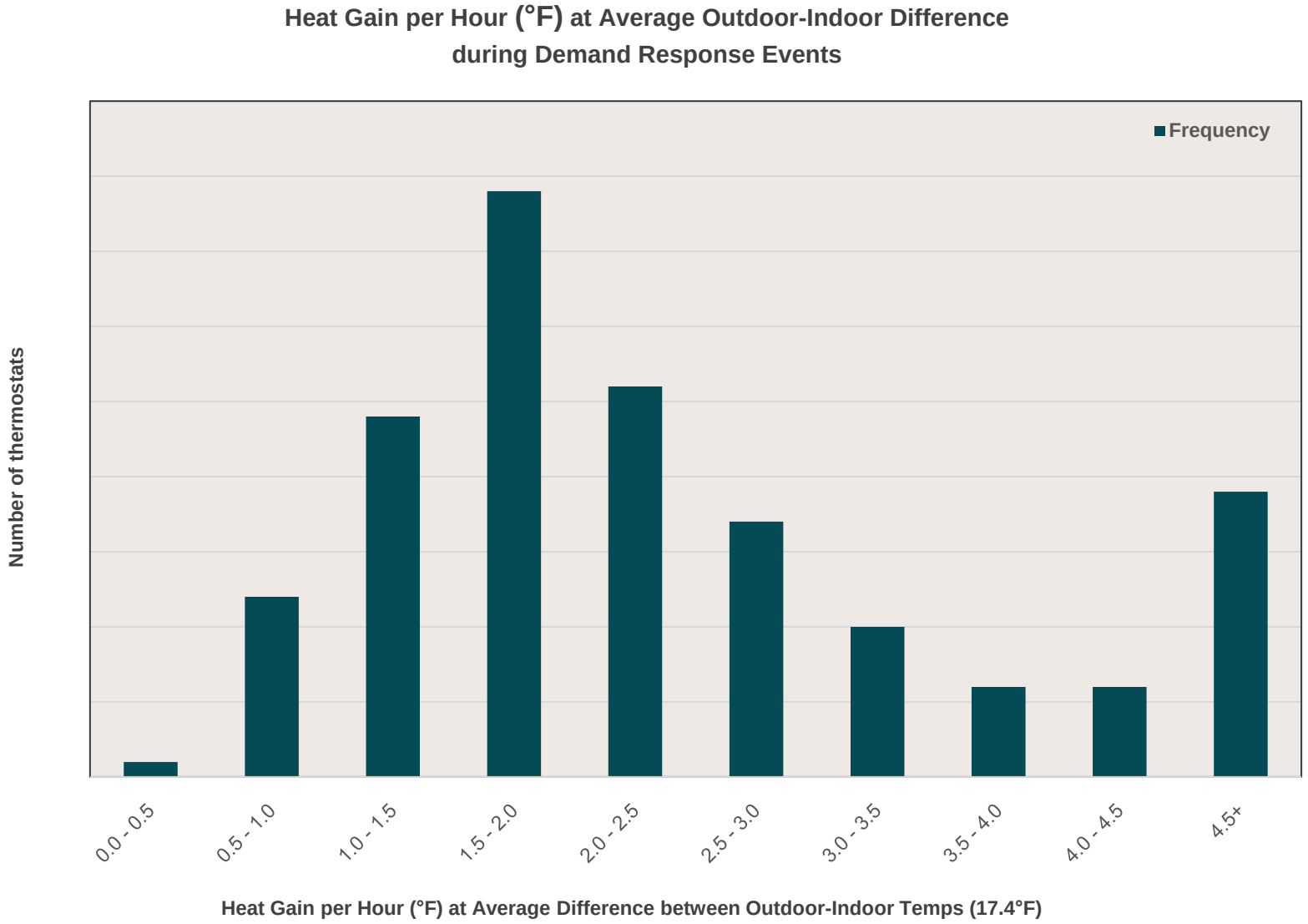
Your house is here:



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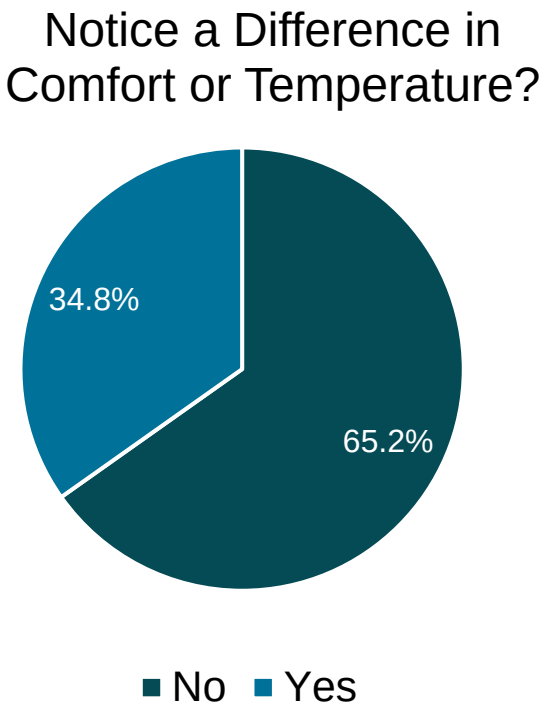
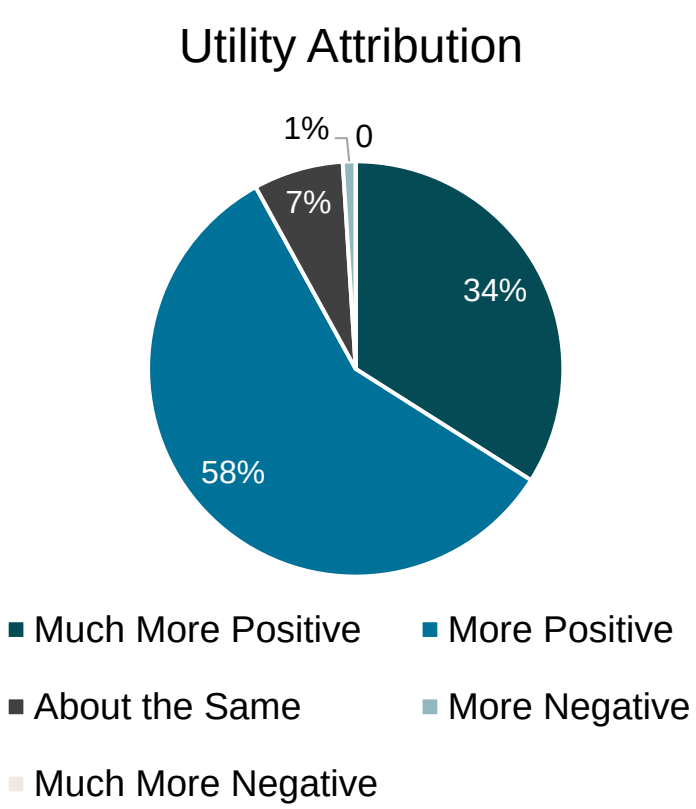
What is the customer impact of a data-centric approach?





Thank you. Gracias. Merci. Grazie.

Keith Canfield

Presentation Highlights: CLEAResult

- **High resolution smart thermostat data can be used to improve home performance and customer experience**
  - With a smart thermostat, utilities can see how home temperature deviates from the set point or occupant comfort specifications
  - These data can be used to identify customers that are not having a good experience and make the case for energy upgrades

- Utilities can **use smart thermostat data to track the positive impact of energy upgrades**, such as an HVAC tune-up or tightening the building envelope

- The future is **enhancing smart thermostats by combining them with other home devices**
  - For example, incorporating data about electric vehicles and cloud-based voice services
  - Customer experience will need to be part of the business case

Additional Resources

- U.S. DOE, Overview of Existing and Future Residential Use Cases for Connected Thermostats
- U.S. DOE, thermostats website
- Northeast Energy Efficiency Partnerships (NEEP), Home Energy Management Systems website

Upcoming Seasonal Messaging Opportunities

Now is the time to start planning energy efficiency messaging!

February 2, 2018

Groundhog Day

February 14

Valentine's Day

February

Super Bowl

Mass Save

Article: Avoid the Shadow this Groundhog Day

American Home Shield

Article & Card: Valentine's Cards for our Appliances

Energize Delaware

Facebook Post: Don't let energy leaks sack your next game day. A **#HPwES** home energy audit is the winning play.

Addenda: Attendee Information and Poll Results

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Call Attendee Locations

Network members

- American Council for an Energy-Efficient Economy (ACEEE)
- Boulder County
- Build It Green
- Center for Sustainable Energy
- CLEAResult
- Davis Energy Group
- ecobee
- Efficiency Main
- Home Energy Analytics, Inc.
- Inspection Perfection
- Johnson Environmental
- Resispeak
- TRC Energy Services
- Wisconsin Energy Conservation Corporation

Non-members (1 of 3)

- Alliant Energy
- ASK Efficiency LLC
- Association for Energy Affordability
- Bay City Electric Light & Power
- Bidgely
- Borough of Columbia
- Consortium for Energy Efficiency, Inc.
- City of Boulder
- City of Duluth Public Works & Utilities
- Clark County
- Columbia University
- Coolearth Architecture Inc.
- Delaware Division of Energy & Climate
- Emerson Automation Solutions
- Enbridge Gas Distribution

Non-members (2 of 3)

- Energy Smart Home Performance Ohio
- Environmental Design / Build
- EverReady Adjusters, LLC.
- FDACS Office of Energy
- FSG
- Green Compass Sustainability
- HDR Consulting
- Home Inspection and More LLC
- Home Office Training & Technology
- Home Performance Guild
- International Center for Appropriate and Sustainable Technology (ICAST)
- ICF
- IFA-DFI
- Johnson Controls
- Kriegh Architectural Studios
- LEENA Labs
- Local Government Commission
- Lockheed Martin
- Minnick's

Non-members (3 of 3)

- National Research Council Canada
- Navitas Partners, Inc.
- Nest
- Proctor Engineering
- PV Blue
- Quadlogic Controls Corp
- Rational Energy Solutions
- Salcido Solutions
- Smart Energy Design Assistance Center
- Solar Habitats, LLC.
- Southwest Energy Efficiency Project
- Sun Electric
- Temple University
- U.S. Department of State
- U.S. Energy Information Administration (EIA)
- University of Minnesota
- WegoWise
- Whisker Labs
- Yukon government Energy Branch

Opening Poll #1

- Which best describes your organization's experience with home energy monitoring?
  - Some experience/familiarity – ***42%***
  - Limited experience/familiarity – ***30%***
  - Very experienced/familiar – ***25%***
  - No experience/familiarity – ***2%***
  - Not applicable – ***2%***

Closing Poll

- After today's call, what will you do?
  - Seek out additional information on one or more of the ideas – ***73%***
  - Make no changes to your current approach – ***15%***
  - Consider implementing one or more of the ideas discussed – ***12%***
  - Other (please explain) – **0%**