



Better Buildings Residential Network Peer Exchange Call Series: *The Future is Here – Smart Home Technology*

April 9, 2015

Call Slides and Discussion Summary

Agenda

- Call Logistics and Introductions
- Opening Poll
- Residential Network and Peer Exchange Call Overview
- Featured Speakers
 - **Matthew Harding**, Assistant Professor at Duke University, Co-Director Duke Energy Data Analytics Lab and Associate Director Information Initiative at Duke
 - **Jim Stewart**, Principal Economist and Statistical Analysis Group Co-Manager at Cadmus
 - **Marshall Runkel**, Director of Contractor Services and Policy at Clean Energy Works (CEW – *Network Member*)
- Discussion
 - What programs are currently using or considering smart home technologies?
 - How can residential energy efficiency programs best use smart home technology to drive customer demand?
 - Are there challenges to deploying smart home technologies and/or analyzing the data? What are strategies for overcoming those challenges?
 - Are there other questions related to smart home technology in the residential energy efficiency sector?
- Closing Poll

Call Participants

- Arlington County, VA
- Cadmus Group
- City of Chula Vista, CA
- City of Plano, TX
- Clean Energy Works
- CLEAResult
- Climate Solutions
- Center for Energy and Environment
- Community Office of Resource Efficiency (CORE)
- Duke University
- Elevate Energy
- EnergySmart Colorado
- Environmental Design / Build
- Greater Cincinnati Energy Alliance (GCEA)
- Holy Cross Energy
- Midwest Energy Efficiency Alliance (MEEA)
- Nexus Energy Center
- North Carolina Building Performance Association
- New York State Energy Research and Development Authority (NYSERDA)
- Southern Energy Management
- Sunnovations, Inc.
- The Oberlin Project
- Vermont Energy Investment Corporation (VEIC)

Call Participant Locations



Opening Poll

- Which of the following best describes your organization's experience with the call topic?
 - **Limited experience/familiarity—48%**
 - Some experience/familiarity—26%
 - Very experienced/familiar—13%
 - No experience/familiarity—13%
 - Not applicable—0%

Better Buildings Residential Network

- **Better Buildings Residential Network**: Connects energy efficiency programs and partners to share best practices to increase the number of American homes that are energy efficient.
 - Membership: Open to organizations committed to accelerating the pace of existing residential upgrades. Commit to providing DOE with annual number of residential upgrades, and information about benefits associated with them.
 - Benefits:
 - Peer Exchange Calls
 - Tools, templates, & resources
 - Newsletter updates on trends
 - Recognition: Media, materials
 - Optional benchmarking
 - Residential Solution Center

For more information & to join, email bbresidentialnetwork@ee.doe.gov.

- **Better Buildings Residential Network Group on Home Energy Pros**

Join to access:

- Peer exchange call summaries and calendar
- Discussion threads with energy efficiency programs and partners
- Resources and documents for energy efficiency programs and partners

<http://homeenergypros.lbl.gov/group/better-buildings-residential-network>

Better Buildings Residential Network Group on Home Energy Pros Website



Better Buildings Residential Network

Created by Better Buildings Support

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Information



The Better Buildings Residential Network connects energy efficiency programs and partners to share best practices and learn from one another to increase the number of American homes that are energy efficient.

Website: <http://betterbuildings.energy.gov/bbm>

Latest Activity: 8 hours ago

Join the conversation in the discussion forum below. You can use the "Follow" link at the bottom of the forum to receive an email whenever a new discussion is posted.

Open the table of contents below and follow the links to access topical materials and resources.

Helpful Links

- Table of Contents
- Better Buildings Residential Network
- Better Buildings Neighborhood Program Website
- Home Performance with ENERGY STAR
- Home Energy Score



Table of Contents



+New Discussion



Peer Exchange Call Archive



Better Buildings Network View



Tools



Related Events

Discussion Forum



Attend Today's Peer Exchange Calls on Program Sustainability and on Workforce

Don't miss today's calls. "Collaborating with Utilities on Residential Energy Efficiency" begins at 12:30 p.m. Eastern and "Engaging Efficiency First Chapters and Other Trade Associations in Energy Efficiency Programs" begins at 3:00 p.m. Eastern.

Continue

Tags: Peer Exchange Calls

Started by Better Buildings Support 8 hours ago.



Register for Upcoming DOE Webinar About On-Bill Financing

Sign up to attend the DOE State and Local Energy Efficiency Action Network (SEE Action) webinar, "Case Studies: Financing Energy Improvements on Utility Bills," taking place June 11, 2014, from 2:00 to 3:30 p.m. Eastern. To learn more on this topic, read

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Pages (15)

- Tools
- Better Buildings Network View
- Peer Exchange Call Schedule and Archive
- Peer Exchange Archive: Marketing and Outreach
- Peer Exchange Archive: Workforce Business Partners

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Home Energy Pros

Home Energy Pros was founded by the developers of Home Energy Saver Pro (sponsored by the U.S. Department of Energy,) and brought to you in partnership with Home Energy magazine.

Latest Activity

What brings you here?
[Share](#) 140

Tucker Henne commented on David Byrne's blog post Does Aereoseal work? An auditors review

"I would like to begin with a disclaimer that I am an Aereoseal contractor. One of the reasons I..."

16 minutes ago

T.J Alexander posted a blog post

So many homes have fiberglass insulation that is poorly installed in New Hampshire and elsewhere

Doing testing of existing homes it is typical to see mottled patterns of surface temperatures with...

See More
1 hour ago

0

CleanEdison updated an event



Entry Level Solar Photovoltaic at Cotuit, MA
September 30, 2012 to

Peer Exchange Call Series

- Calls are held the 2nd and 4th Thursday of every month at 12:30 and 3:00 ET
- Calls cover a range of topics, including financing & revenue, data & evaluation, business partners, multifamily housing, and marketing & outreach for all stages of program development and implementation
- Upcoming calls:
 - April 23, 12:30 ET : Community Organizing and Outreach
 - April 23, 3:00 ET : Developing State Energy Efficiency Alliances
 - May 14, 12:30 ET : Generating Demand for Multifamily Building Upgrades
 - May 14, 3:00 ET : Better Buildings Residential Network Orientation
- Send call topic ideas to peerexchange@rossstrategic.com.

Peer Exchange Call Summaries

Discussion: Challenges and Solutions

- Overcoming Challenges - Solutions:
 - Access trusted, local messengers
 - Engage your satisfied customers as champions to turn them into "lifetime customers"
 - Invite people to make a pledge with a few simple EE activities they can take
 - Connect with the right local partners (Connecticut conducted "community asset mapping")
 - Directly involve the homeowner through DIY work or as energy efficiency demonstration homes to help them feel engaged (San Diego demonstration homes)
 - Minimize paperwork to make it easier to participate

Poll Results

Participant Poll: Which of the following best describes your program's experience with energy efficiency behavior change efforts?

- Currently implementing: 31%
- Planning to implement: 31%
- Thinking about it: 19%
- Haven't thought about it: 0%
- Not applicable: 19%

The screenshot shows the Home Energy Pros website interface. At the top, the logo reads "HOME ENERGY PROS" with the tagline "Connecting home energy professionals". A navigation menu includes "Home", "Invite", "My Page", "Members", "Forum", "Blogs", "Groups", "Photos", "Videos", and "Events". Below the menu, there are links to "Back to Better Buildings Residential Network" and "All Better Buildings Residential Network Pages". The main content area is titled "Peer Exchange Archive: Program Sustainability" and lists several call summaries with their dates and PDF links:

- Incorporating Behavior Change Efforts into Energy Efficiency Programs**
July 10, 2014
[Presentation and Discussion Summary \(PDF\)](#)
- Collaborating with Utilities on Residential Energy Efficiency**
June 12, 2014
[Presentation and Discussion Summary \(PDF\)](#)
- BBRN Voluntary Initiative: Partnering to Enhance Program Capacity**
May 8, 2014
[Presentation and Discussion Summary \(PDF\)](#)
- Complementary Energy and Health Strategies**
April 10, 2014
[Presentation and Discussion Summary \(PDF\)](#)
- Mastermind: Jim Mikel, Spirit Foundation**
March 13, 2014
[Presentation and Discussion Summary \(PDF\)](#)

How do you eat an elephant? One bite at a time. A slight shift in perspective goes a long way.

Understanding how EE can solve a financial, public relation, or customer service problem for the utility is the right place to start.

Residential Program Solution Center

Web portal of residential EE upgrade program resources, & lessons learned to plan better, avoid reinventing the wheel.

- BB Neighborhood Program, Home Performance with ENERGY STAR Sponsors+
- Provides:
 - Step-by-step guidance
 - Examples
 - Tools
 - Templates
 - Lessons learned
 - Best practices
 - Tips
- Continually add content to support residential EE upgrade programs—member ideas wanted!



<https://bbnp.pnnl.gov/>

Market Research: Duke University

Smart Home Technology Opportunities and Unresolved Questions

Matthew Harding

Duke University

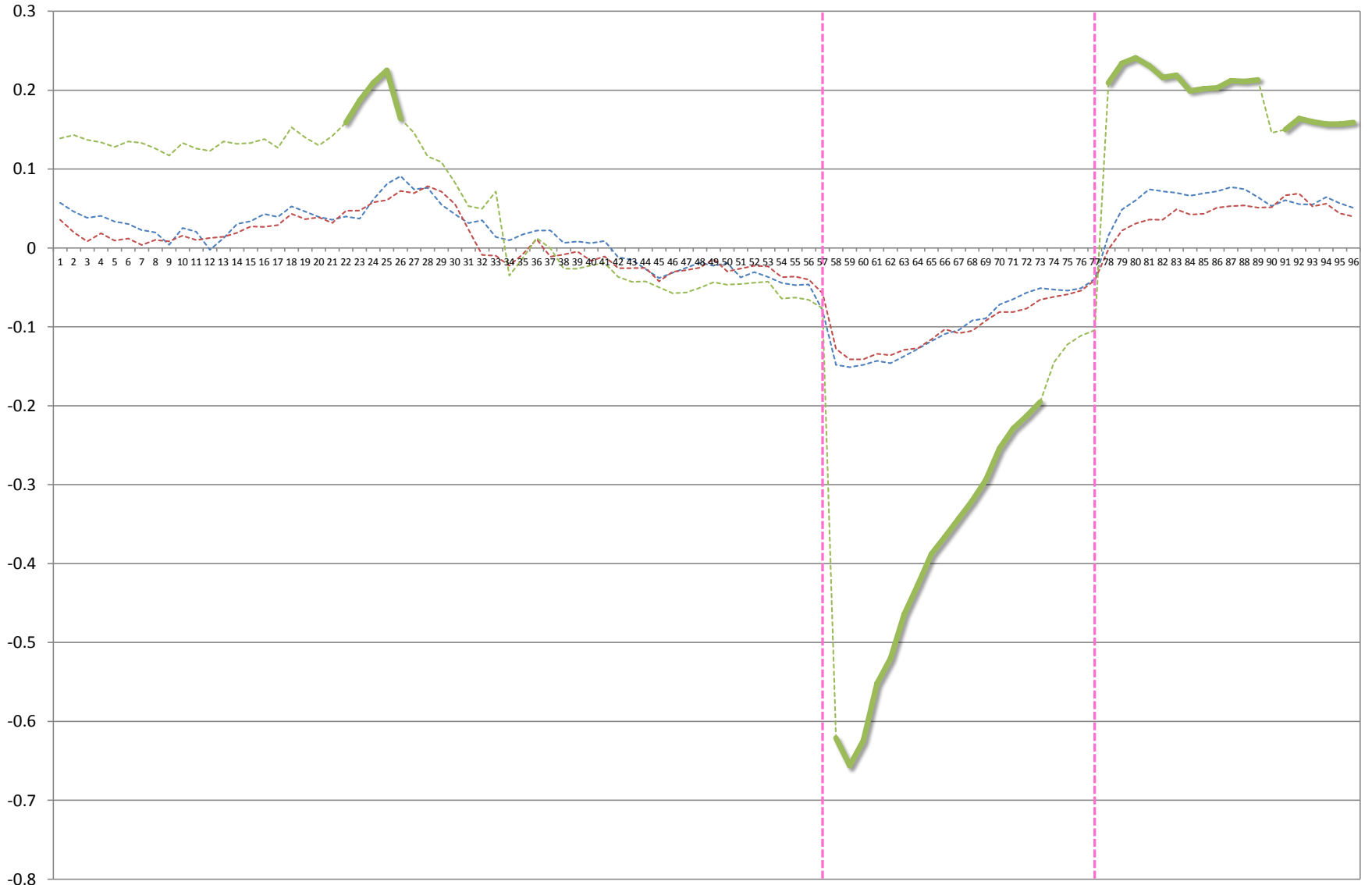
www.bigdataeconometrics.org

Motivating questions

- Smart grid promises large efficiency gains
- Cost savings, avoiding blackouts
- Opportunities for dynamic pricing

- Issues:
 - Impact of enabling technologies: information vs automation
 - Distributional impact: responsiveness across customer segments
 - Load shifting: magnitude and consequences

TOU, No Weekends



— Portal*

- - - Portal

— IHD*

- - - IHD

— PCT*

- - - PCT

Smart Thermostats @ EPRI – Some Research Questions

Pilot-specific research questions that may include:

- What is the EE potential?
- What is the DR potential?
- Impact of pre-cooling?
- Impact variation with customer and/or premise traits?
- Customer uptake/participation rates?
- How customers use the tstats?
- Customer opinions about them?
- How can smart tstat data be used for better evaluation, customer analytics, etc.?



Technologies and Platforms of Hosts

Pilot	Tstat/Platform
TVA/ Glasgow	ecobee tstats, Energy Hub DRMS (in development)
SRP	Energy Hub/ Radio Thermostat
BGE	(i) ecobee/Cooper (ii) Honeywell
KCP&L	(i) Opower/Honeywell & (ii) EcoFactor/Computime
LES	Honeywell (tstats + switches)
BPA	Various; tstat data analytics from existing pilots/programs

Smart Thermostats – EPRI Research Activities



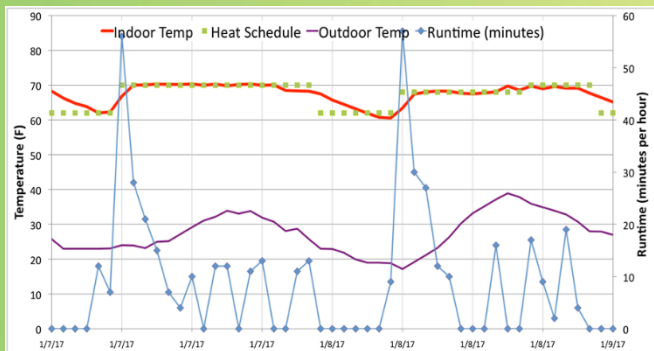
Pilot Design



Measurement & Verification



Technology Scouting



Thermostat Data Analytics

Considered Metrics

ENERGY STAR

- HVAC Run-Time
 - Furnace Run-Time as a Proxy for Energy Savings
 - Estimates energy savings by examining the elapsed time of furnace (or AC) operation

$$\text{fuel use} = RT \times \text{furnace capacity}$$

where,
 $RT = \text{furnace runtime}$

- Saving Degree-Hours
 - Identifies use of energy saving set temperatures
 - Takes into consideration thermal mass of building and outside temperature

$$\text{Savings degree-hours, SDH} = \sum_{\text{all heating hours}} (T_{ref} - T_{obs})$$

T_{ref} = reference thermostat setting
 T_{obs} = observed thermostat setting

EPA

EPA Collaboration



Stakeholder Meetings & Workshops

Duke University: Market Research Insights

- There's a link between smart home technology and increasing consumer awareness of and demand for energy efficiency.
 - Monetary savings aren't enough to motivate changes in consumer behavior.
 - Smart home technology allows consumers to be aware of their energy consumption and cost savings in real time.
 - The key question in developing smart home technology lies in determining the line between the consumer desiring control over their appliance and achieving greater efficiency through automation.
- Automated technology is more effective at reducing energy consumption than other energy tracking tools (i.e., websites, mobile applications).
 - In a randomized control trial, the Duke Energy Data Analytics lab found providing consumers a website to check energy consumption and costs did not result in statistically robust changes in consumption behavior, while significant changes in consumption were measured for consumers with programmable thermostats.
 - While consumers had access to information to track consumption through the website, they often did not do anything with that information.
 - The study concluded automation can be more effective at reducing energy consumption.

Pilot Study: Cadmus



CADMUS



Energy Savings from Honeywell Connected Thermostats

DOE Better Buildings Residential
Network Peer Exchange

April 7, 2015

Jim Stewart, Ph.D.



Study Background

- Study conducted for Honeywell
- Total Connect Comfort (TCC) thermostats
 - Wi-Fi and mobile capability
 - Reduces control costs
 - Sold through select retailers, home heating and cooling contractors, and utility programs
- Principal research question:
 - What are the energy and cost savings from TCC thermostats?



Study Requirements and Data Sources

- Requirements
 - National study
 - Annual space heating and cooling savings
 - Estimates by climate zone
- Data sources
 - Connected Thermostat User-Interface (UI) Data
 - 1,769 TCC thermostats
 - Date and time, location, display (interior) temperature, thermostat set point, mode
 - January 2012-December 2012
 - InfoGroup household demographic and housing data
 - No energy use meter data

Study Design

- Honeywell TCC thermostat UI data
 - Space heating and cooling behavior in homes with connected thermostats
- 2009 Residential Energy Consumption Survey (RECS)
 - Establishes baseline for TCC t-stat homes
 - Preceded widespread adoption of connected thermostats
- Coarsened Exact Matching (CEM) of TCC t-stat homes to RECS homes
 - Controls for observable differences between adopters and non-adopters
- Estimation of models of home heating and cooling energy use as a function of average thermostat set points
 - Yields estimate of energy savings per degree of temp setback

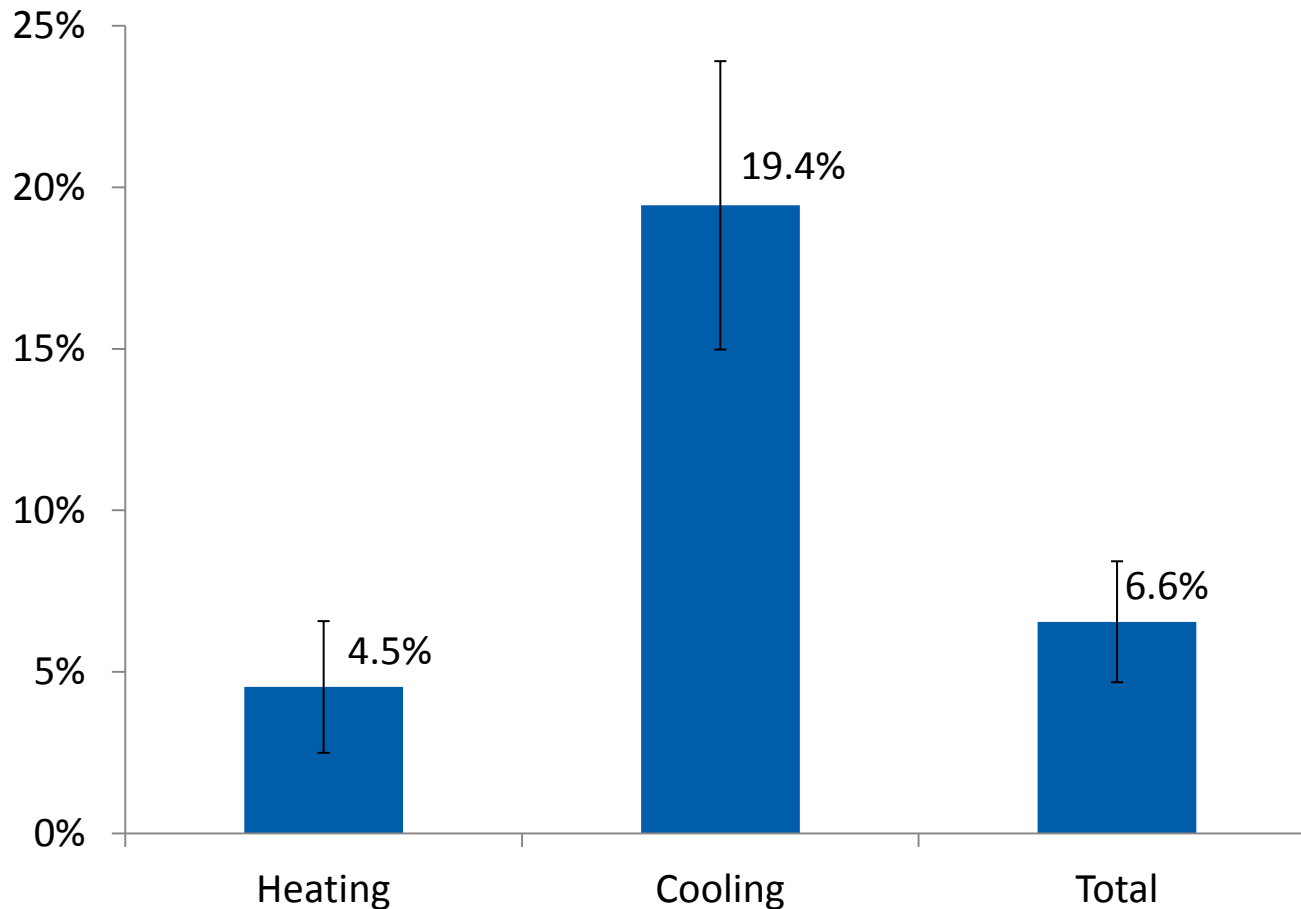
Analysis Steps

- Step 1: Develop models of energy use for home space heating and cooling
- Step 2: Match TCC homes to RECS homes
- Step 3: Estimate models of cooling and heating energy use models with matched RECS data
- Step 4: Determine average thermostat set points for TCC and RECS homes
- Step 5: Estimate energy savings as a function of difference in set points

RESULTS

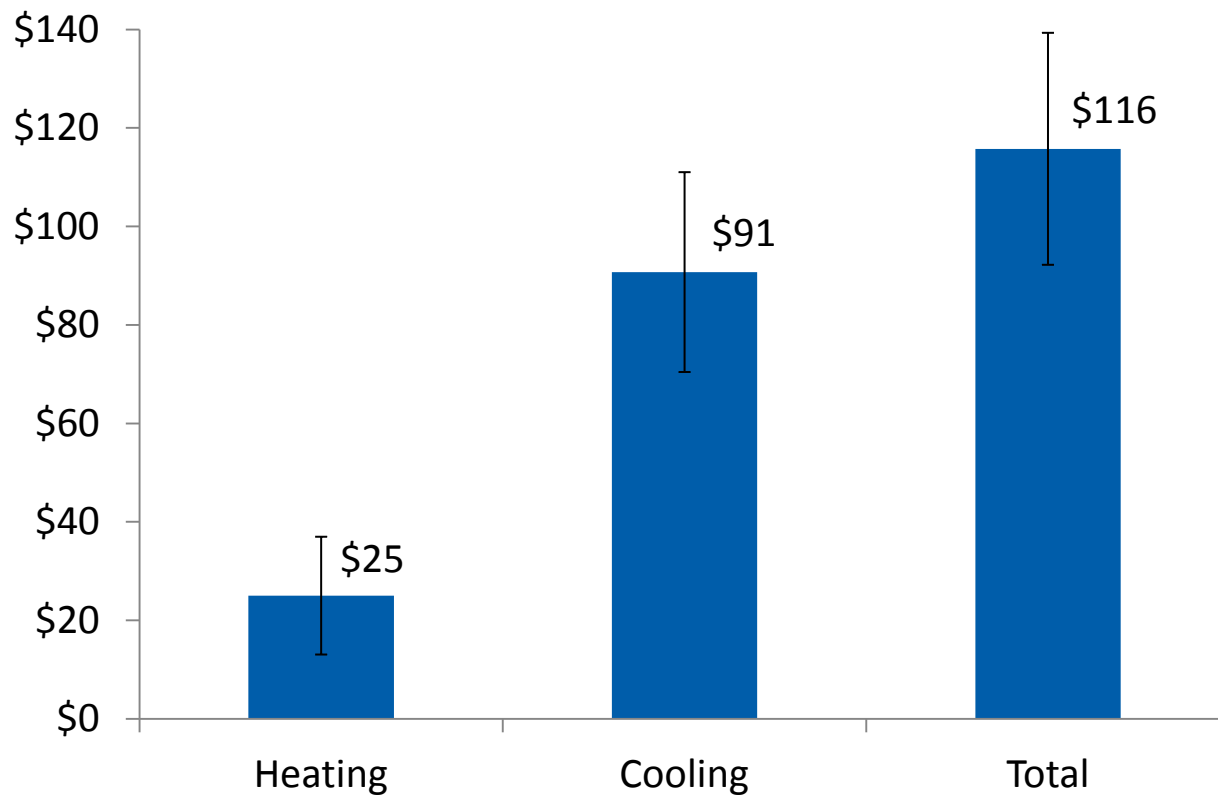
TCC Thermostat

Percent Space Conditioning Energy Savings for U.S. Normal Weather



TCC Thermostat

Annual Cost Savings per Home for U.S. Normal Weather



Heating Season TCC Thermostat Energy and Cost Savings by Climate Zone

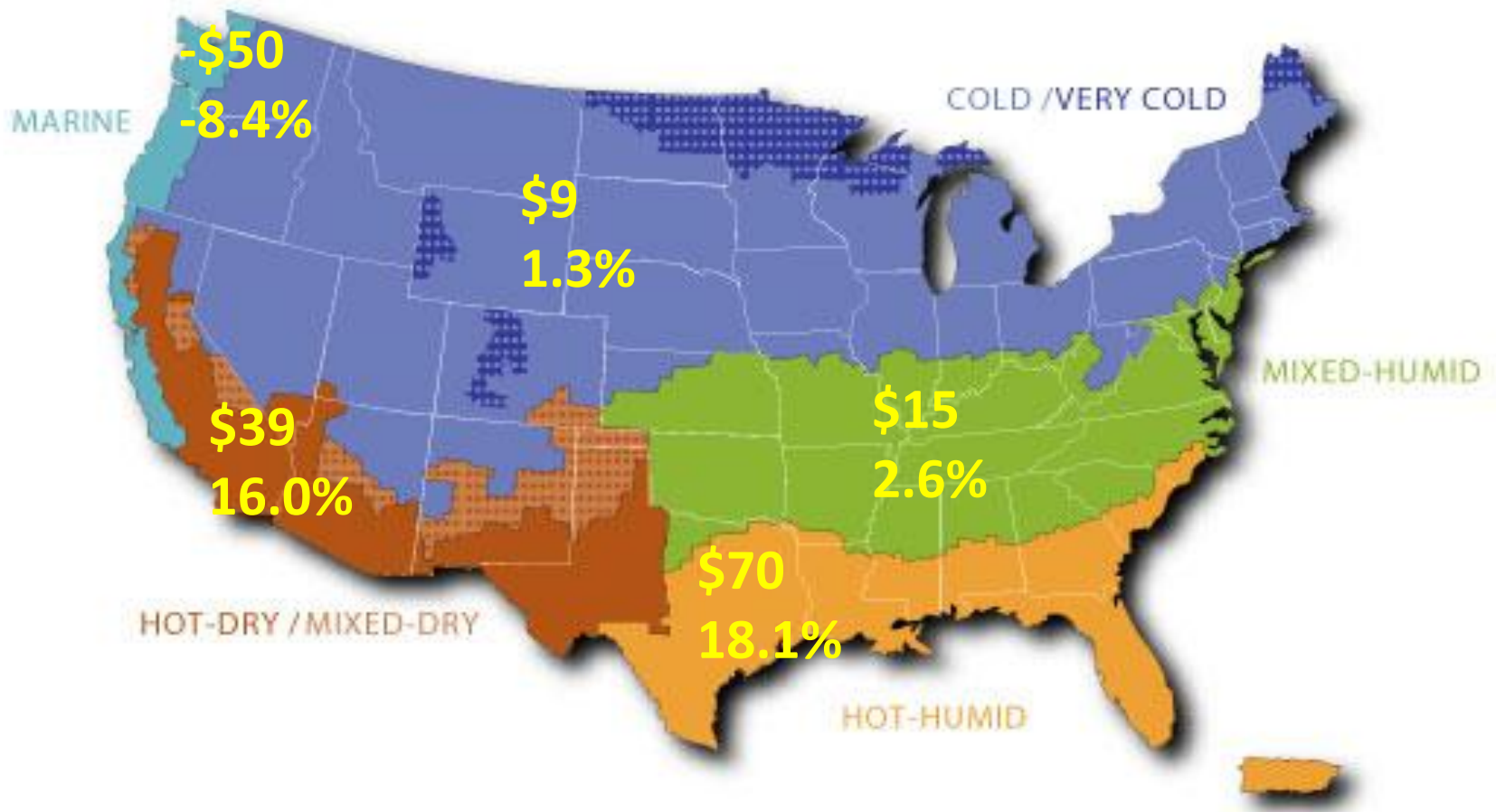


Figure shows the dollar and percent energy savings for each climate zone for normal weather and 2013 energy costs.

Cooling Season TCC Thermostat Energy and Cost Savings by Climate Zone

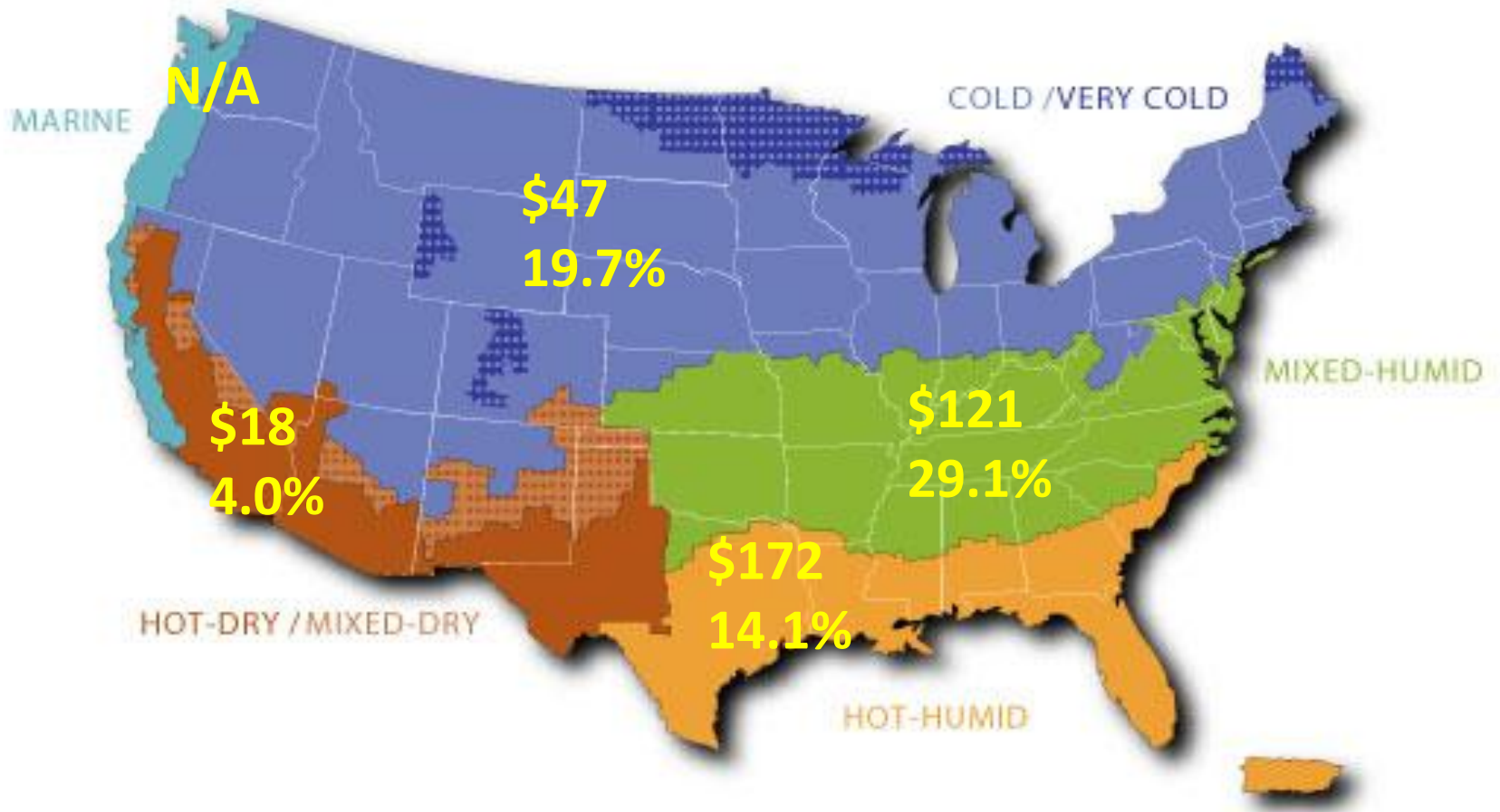


Figure shows the dollar and percent energy savings for each climate zone for normal weather and 2013 energy costs.

Summary of Key Findings

- TCC t-stats save about 6.6% in space conditioning energy use (2-3% of home energy use) and \$116 in energy costs per home with normal weather
- Energy and cost savings from connected thermostats vary by region
- Connected thermostat will be cost-effective for many utility customers

Cadmus: Honeywell Pilot Study Highlights

- Honeywell piloted Total Connect Comfort (TCC) thermostats in a study conducted Jan. 2012 - Dec. 2012 to assess the energy and cost savings from programmable thermostats.
 - Assessed user-interface (UI) data from 1800 TCC thermostats.
 - Compared TCC UI data to baseline data from the 2009 Residential Energy Consumption Survey.
 - The study made adjustments for population bias given assumptions that adopters of programmable thermostats could represent a different population (in terms of differences in energy behavior and values around EE) from households who did not adopt programmable thermostats.
 - The study did not observe the type of thermostat replaced by the installation of a programmable model. Installations did not include official training on how to program or use the thermostat.
- The study concluded that, for many utility customers, adoption of a programmable thermostat reduces energy use and is cost-effective. However, the reductions in energy use varied by climate regions.
 - Data on energy savings in the NW region was limited in this study due to a small sample size.
- A second study currently underway will assess data from 30,000 thermostats.

**Program Experience: Clean Energy Works
(CEW) – *Network Member***



Meet the next generation thermostat.

Most people leave the house at one temperature and forget to change it. So the Nest Learning Thermostat learns your schedule, programs itself and can be controlled from your phone. Nest Thermostat can lower your heating and cooling bills up to 20%. Complete home energy upgrades with Clean Energy Works and your nest is free.*

*Limited time offer. See letter for details. Apply at cewo.org/nest



Nest Pilot

NOVEMBER LEADS: 67

All CEW Markets:

Nov/Dec 'Apply By'

Jan/Feb – sign work proposal

Professionally installed Nest at no cost to customer (\$450 value)

Promotion driven by Direct Mail, Social Media, Local Newspaper outreach

14
comments

Smart thermostat from Clean Energy Works: Increased comfort, cut energy bills with low-cost to pricy upgrades



The Nest Learning Thermostat automatically adjusts heating and cooling in a home, lowering energy bills. Clean Energy Works



Public Relations

Nest Promotion

Winter Weather





Rebate Deadline Approaching!

***** 5-DIGIT 97227

[FULL_NAME]
[ADDRESS]
[CI_ST_ZIP]

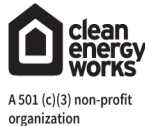
Dear [FULL_NAME],

The City of Portland wants to help you save energy and create a more comfortable, safer and healthier home.

Clean Energy Works (CEW) began in 2009 as a pilot partnership with the City of Portland. Today, CEW is the state's largest non-profit home performance provider, helping thousands of Oregon homeowners make their homes more comfortable, while reducing the energy wasted by leaky walls, old windows and outdated heating and cooling systems. The Bureau of Planning and Sustainability continues to partner with CEW to bring the benefits of home performance to as many Portland homeowners as possible.

You may be eligible for Instant Rebates up to [REBATE]* and no money down financing when you install home energy upgrades through Clean Energy Works. **Apply by October 31, 2014 and you will qualify for an extra \$250** bonus for a total of \$3,250 in savings. Visit www.cewo.org/bps and enter Instant Rebate Code: LGPDX17.** Once your application is processed, Clean Energy Works will:

- Match you with a Clean Energy Works Certified Contractor - specially trained in home performance and building science.
- Conduct a 100 Point Performance Check (worth \$250), to pinpoint essential upgrades to optimize your home.
- Offer no-money-down financing from Clean Energy Works' local lending partners, so you can upgrade your home with no upfront costs.
- Deliver one-stop convenience: Insulation, windows, heating and cooling systems, radon and seismic upgrades, solar and more bundled into one convenient project.
- Inspect the work: Once your upgrades are installed, Clean Energy Works will perform a FREE independent inspection (worth \$250) for peace of mind and complete 100% quality assurance.



Apply now at www.cewo.org/bps with Instant Rebate code LGPDX17 by October 31, 2014, to confirm that you qualify for savings up to \$3,250. Or, for more information call Clean Energy Works toll free at 1-855-870-0049.

Sincerely,

Andria Jacob
Program Manager

**Minimum investment per upgrade required. Rebates are available to qualified applicants that complete CEW upgrade projects on a first-come, first-served basis, are subject to availability, non-transferable and subject to change without prior notice. Energy Trust of Oregon cash incentives are available through Clean Energy Works to reduce the total project cost and help customers access energy savings on home upgrades. See cewo.org for additional restrictions. Clean Energy Works upgrades, rebates and promotions receive no funding from the City of Portland General Fund.

**Offer is available only to new applications received by CEW between October 1, 2014 and October 31, 2014.

Direct Mail

A/B Test: Standard offer vs. nest giveaway – **higher response rate**

Same promo \$250

All CEW Markets



Ongoing Facebook Campaign

- Nest Promotion
- Seasonal campaigns to drive online eValuations and applications
- Touches all markets
- Boosted posts
- 57 Applications in November



Clean Energy Works Oregon

Posted by Mike French [?] · Yesterday · Edited [?] 🌐

Make it toasty when you get home! With Nest, turn on your home's heating and cooling right from your smartphone or tablet. Get a Nest Learning Thermostat for yourself with your CEW home upgrade - for a limited time!
<http://goo.gl/mmcITS>



Energy Savings Results

Link to Nest White Paper on energy savings:

<https://nest.com/downloads/press/documents/energy-savings-white-paper.pdf>

Table 1. Gas and Electric Savings Results

Fuel	N	Pre-Nest Usage		Energy Savings	
		Total	HVAC	Total	% of HVAC
Natural Gas (therms/yr)	735	774	584	56 ±12	9.6% ±2.1%
Electricity (kWh/yr)	624	12,355	3,351	585 ±97	17.5% ±2.9%

CEW: Nest Pilot Program Highlights

- Lessons Learned from marketing Nest
 - CEW used traditional forms of marketing, including direct mail. The direct mail campaign that included the Nest offer had a higher rate of response than a direct mail campaign offering the CEW's standard upgrade track.
 - Social media/digital marketing had a much higher rate of response and return on investment than direct mail – for those looking to integrate smart home technologies into their existing home performance programs, this is the way to go.
 - Target audience: younger families that have lived in their homes for a short amount of time.
 - The partnership with Nest generated local media coverage; aptly timed with the start of heating season.
- Pilot Results
 - Users expressed that they liked the experience of tracking and controlling their appliances from a smart phone.
 - Users were attracted to the efficiency settings that were pre-programmed for the highest possible rate of return on their investment in the thermostat.
 - Nest mimics the classic circular design making control relatively intuitive to consumers of all ages.
 - After the promotion ended, contractors continued to offer the Nest as an up-sell to homeowners.

Discussion Questions

- What programs are currently using or considering smart home technologies?
- How can residential energy efficiency programs best use smart home technology to drive customer demand?
- Are there challenges to deploying smart home technologies and/or analyzing the data? What are strategies for overcoming those challenges?
- Are there other questions related to smart home technology in the residential energy efficiency sector?

Discussion: Benefits and Challenges to Deploying Smart Home Technologies

Benefits:

- Smart home technology creates a new source for data on consumer behavior and energy consumption previously only available through utilities.
 - How best to use this data remains to be seen.
- Smart thermostat models offer a gateway to further engage customers.
 - Customers are attracted to smart products to enhance the comfort, control, convenience, and safety of their household. Energy and monetary savings are often not the strongest motivator for investment and installation, but taking a whole systems approach works.
 - The product fosters a new level of interaction between residents and their home environment.
- Contractors (with the exception of HVAC contractors) often start including the technology in every proposal after a pilot program ends.

Challenges:

- Some of the piloted programmable thermostat brands, like Nest, are not compatible with high-end HVAC systems.
- Customer education is critical.
 - Relying on customers to install pilot smart home technology products can have limited success. A pilot program in Austin, TX distributed the Nest to customers for free; however, the program observed an installation rate of only 50%.

Additional Notes and Resources on Smart Home Technology

- Smart thermostats are different than regular programmable thermostats due to new features and learning capabilities.
- Samsung recently released [Samsung Smart Home](#) technology with an open (public) platform; a different approach than the proprietary one taken by Nest/Google.
 - Related article: [Samsung's Smart-Home Master Plan: Leave the Door Open for Others](#)
- [Apple's HomeKit](#) “a framework in iOS 8 for communicating with and controlling connected accessories in a user’s home.” See related articles:
 - [How Apple HomeKit Is Already Changing The Smart Home Industry](#)
 - [Apple's HomeKit Rollout to Require Apple TV for Remote Siri Control](#)

Closing Poll

- After today's call, what will you do?
 - **Seek out additional information on one or more of the ideas—75%**
 - Consider implementing one or more of the ideas discussed—**19%**
 - Make no changes to your current approach—**6%**
 - Other (please explain)—**0%**

Please send any follow-up questions or future call topic ideas to:
peerexchange@rossstrategic.com

LET'S ALL MEET IN MAY!

REGISTER TODAY for the BETTER BUILDINGS SUMMIT

Washington, DC · May 27-29, 2015

SAVE YOUR SPOT NOW:

<http://www1.eere.energy.gov/buildings/betterbuildings/summit/>

This Summit will bring together Better Buildings partners and stakeholders to exchange best practices and discuss future opportunities for greater energy efficiency in America's homes and buildings.

There will be time set aside for a specific Residential Network discussion and meet-up!