

SMART THERMOSTATS: Assessing Their Value In Low-Income Weatherization Programs



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Roadmap

- ▶ Smart thermostats - Potential
- ▶ Promoted across the county – rebates, DR
- ▶ How they function matters
- ▶ Demographics of weatherization clients and why that's important
- ▶ Studies: Client behavior matters
- ▶ Thoughts from weatherization experts
- ▶ Conclusions

Smart thermostats

- ▶ Smart thermostats are promoted as a measure that can produce significant household energy savings, and increased comfort and convenience for residential customers, over and above less costly, manual programmable and non-programmable thermostats.



Smart thermostats

- ▶ With lighting energy savings diminishing in the near term (due to market penetration and the evolution of federal efficiency standards), EE Program Administrators across the country are understandably looking for measures/programs to replace the lost energy savings. Utilities, too, are incorporating them in demand response programs.
- ▶ The savings *potential* of smart thermostats is well-documented.

Smart thermostats' Potential

- ▶ “Efficiency programs, pilots, evaluations, and whitepapers throughout the country have documented the savings *potential* of smart thermostats, ranging from lows of zero or even negative savings to upwards of 20 percent savings....

- ▶ While as a category, smart thermostats has shown a yield of significant savings in many cases, the expected savings of an individual home depends on individual factors, such as:
 - type, age, and configuration of the HVAC system;
 - details of the specific house, such as floor plan and envelope thermal efficiency;
 - climate and seasonal impacts; and/or
 - occupant behavior and preferences, including occupancy schedule.”

▶ *Claiming Savings from Smart Thermostats: Guidance Document*, Northeast Energy Efficiency Partnerships, Claire Miziolek (April 2017) (emphasis in original).

Evaluated energy savings are varied.

- ▶ “Different baseline scenarios, especially, can greatly influence the results of a study, making direct comparisons difficult or impossible. Results may also pertain only to specific climate regions, demographics, thermostat products, or have other restrictions, limiting how the results can be interpreted or generalized.
- ▶ Because not every home has the same kind of thermostat or the same setpoints to begin with, replacing an existing thermostat with a connected (smart) thermostat could yield appreciably different changes in performance from one home to the next.”
- ▶ Source: Fraunhofer USA Center for Sustainable Energy Systems, *Energy Savings from Five Home Automation Technologies: A Scoping Study of Technical Potential, Final Report to the Consumer Technology Association*, Bryan Urban, Kurt Roth, and Chimere (David) Harbor, April 2016, p. 18.

Understanding how a smart thermostat works matters when deciding whether to install one.

- ▶ Smart thermostats' algorithm-based function, for example, “learns” when the customer is home or away by how often the temperature is adjusted or whether the thermostat detects activity (customer walks in front of the thermostat).

How a smart thermostat works matters...

- ▶ Nest emphasizes that wifi connection is not needed for a home to experience heating or cooling energy savings. But Nest notes that “you won’t have access to all your thermostat’s features, and some of the energy saving features on your thermostat won’t work as well.” It includes in the list of examples of features that require wifi as
 - ▶ (1) the ability to get local weather data;
 - ▶ (2) the download of thermostat software updates; and
 - ▶ **(3) the ability to control the thermostat with a phone or tablet.**

How a Smart Thermostat “Learns” Matters

- ▶ Nest: the Home/Away function is also activated depending on where people’s phones are.
- ▶ Knowing when the thermostat will automatically switch to Home or Away depends on:
 - ▶ where the smart thermostat is installed in the home so it can sense motion.
 - ▶ the location of everyone who shares access to the home, factors like a customer’s phone’s cell signal strength, nearby wifi signals, the phone’s hardware and software versions

Given this functionality, **Client Demographics Matter.**

- ▶ **Internet/Broadband Access by Income:**
- ▶ American Community Survey: Among those households with an annual income below \$20,000, a full 40% have no internet subscription through any mechanism.
 - ▶ In comparison, only 5% of families earning more than \$75,000 are without internet subscriptions.
- ▶ Pew study: Similar double-digit gaps between broadband wifi access based on income level.
 - ▶ 92% of adults from households earning \$75,000 or more a year say they have broadband internet at home, but that share falls to 56% among those whose annual household income falls below \$30,000.

Client Demographics Matter

▶ **Internet/Broadband Access by Geography:**

▶ Re: Broadband Internet coverage, Federal Communications Commission (FCC) reported in 2019:

▶ “the gap in rural and Tribal America remains notable”

▶ Over 26% of Americans in rural areas and 32% of Americans in Tribal lands lacking broadband internet coverage, as compared to only 1.7% of Americans in urban areas.

▶ Federal Communications Commission, 2018 BROADBAND DEPLOYMENT REPORT, p. 23; *See <https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2018-broadband-deployment-report>*

Client Demographics Matter

▶ Internet/Broadband Access by Age:

- ▶ Older consumers and people of color are also more likely to have limited or no internet access.
 - ▶ Eight and a half million people over age 65 – **almost 18% of all elders – have no computer in their households, compared with only 4% of working people (age 18-64).**
 - ▶ Almost 4 million older consumers (8%) have a computer without an internet subscription.
 - ▶ This means that 12.4 million older consumers, **more than 25% of all seniors, are without internet access.**
 - ▶ About 10% each of Black and Hispanic Americans, more than 10 million people, have no internet subscription. Among white families, only 6% lack internet.

Client Demographics matter...

- ▶ **In Illinois, and about 54% of units served are occupied by elderly persons.****
- ▶ **In Illinois, about 27.5% of the Illinois units served are occupied by disabled persons.****

- ▶ **Illinois state weatherization manager: “If clients are remaining at home during the day, the installation of a smart or even a manual programmable thermostat makes little sense.”****

- ▶ ****Mick Prince, Manager of the State of Illinois Weatherization Assistance Program**

Client behavior matters...

- ▶ 2012 Massachusetts study: electric savings associated with wifi-enabled thermostats vary significantly from one house to another, with the occurrence of energy savings “very dependent on occupant behavior and baseline set point information.”
- ▶ Evaluators: For some participants, the energy savings benefits of a wifi-enabled thermostat are similar to those of a standard programmable thermostat. Cadmus found that “Whether a participant saves more energy with a wifi thermostat than they would with a programmable thermostat is difficult to quantitatively predict as the savings are reliant on participant behavior.”

Newer Massachusetts study results coming

- ▶ More information will be forthcoming about actual energy savings achieved in residential smart thermostat installations through a two-year Massachusetts statewide evaluation, projected to be completed in 2021.

2021

January	February	March	April
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<https://www.vertex42.com/calendars/printable-calendars.html>

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Are they the right measure for everyone, particularly, income qualified weatherization customers?

- ▶ LEAN member agencies report that they have yet to see significant interest in smart thermostats from their clients. John Wells, Vice President for Property and Energy Services at Action for Boston Community Development, Inc. (ABCD):
 - ▶ The cost of smart thermostats and the particular demographics of LEAN clients do not support the widespread installation of smart thermostats in programs LEAN administers.

Evaluated savings estimates are literally all over the map...

- ▶ A 2015 Energy Trust of Oregon evaluation involving smart thermostats and air source heat pumps found 12% average electric heating savings tied to smart thermostats both in the initial study and in the follow-up evaluation a year later. But another evaluation of an Energy Trust of Oregon Pilot comparing two smart thermostat brands involving gas furnaces reported about 6% heating load savings, on average, in gas-heated homes with one brand and about 5% *increases* in energy use with another brand.
- ▶ See Energytrust.org/wp-content/uploads/2016/12/nest_heat_pump_control_pilot_follow-up_billing_analysis.pdf

Illinois

- ▶ Navigant evaluators found 2% cooling savings for advanced thermostat participants who did not receive Home Energy Reports, “and about 0, or even perhaps slightly negative cooling savings for participants who did receive HERs (internal citation omitted).” The Navigant evaluation recommended that the Illinois TRM administrator and the Illinois TAC consider updating the cooling reduction factor in the next version of the Illinois TRM, to revise the assumed 8% electric savings to 2%. When consensus could not be reached among TAC participants, participants agreed that the electric savings figure would remain at 8% pending new evaluation results expected in 2020.
- ▶ *ComEd Advanced Thermostat Evaluation Research Report*, Navigant Consulting, Inc., Pace Goodman, Will Sierzchula, Carly Olig, p. 6.

Closing Thoughts from Other Weatherization Experts

- ▶ Art Wilcox, technical consultant for the Massachusetts LEAN program:
- ▶ As long as there are clear protocols as to when a smart thermostat should be installed, it should be on the list as an available measure in weatherization programs. “But, there’s going to be a lot of properties where it’s not going to be wise to do it.”

Closing thoughts from Other Weatherization Experts

- ▶ Ohio Partnership for Affordable Energy (OPAЕ)
Executive Director Dave Rinebolt:

- ▶ limited applicability to income-qualified weatherization efforts due to clientele demographics;
- ▶ installed in weatherized low-income homes only on a very selective basis.

Mick Prince, Manager of the Illinois Weatherization Assistance Program:

- ▶ If clients are remaining at home during the day, the installation of even a manual programmable thermostat makes little sense.
- ▶ Client age, wifi demographics matter to the decision

Importance of Behavior on EE results:

- ▶ ACEEE:

“Understanding human behavior is critical for achieving the goals of energy efficiency. Whether we are purchasing goods, using energy to service our homes and workplaces, or responding to the constraints placed upon us by technology and systems that surround us, human behavior is the key.”

- ▶ ACEEE, Behavior and Human Dimensions, <https://aceee.org/portal/behavior>

Conclusion

- ▶ ***Widespread*** installation of smart thermostats will remain neither cost-efficient nor appropriate in low-income weatherization programs unless:
 - ▶ (1) broadband wifi exists in the home;
 - ▶ (2) clients demonstrate specific interest in advanced thermostat installation;
 - ▶ (3) clients spend regular blocks of time outside of the home;
 - ▶ (4) no technical issue arises that would significantly increase labor costs associated with thermostat installations as compared to less advanced thermostat models;
 - ▶ (5) the client is technology savvy; and
 - ▶ (6) access to critical product education information and trouble-shooting is promptly and readily available.

Conclusion

- ▶ Ultimately, the decision whether to install smart thermostats in low-income residences is best resolved by on-the-ground, weatherization field specialists, in consultation with the clients they serve.



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Footnotes – ACS, U.S. Census Bureau

- ▶ Computer and Internet Use in the United States: 2016, American Community Survey Reports, Camille Ryan, U.S. Census Bureau, (August, 2018), p. 8.
- ▶ U.S. Census Bureau American Community Survey, Types of Computers and Internet Subscriptions (2017).
- ▶ U.S. Census Bureau American Community Survey by Selected Characteristics (2017)
- ▶ “Mobile Technology and Home Broadband 2019” Pew Research Center (June 2019), p. 4