Residential Prescriptive and Performance Code Methodology for Crediting Smart Thermostats

Rationale

The prescriptive method of Florida Energy Code compliance requires, under section R403.1.2, that a programmable thermostat control the primary heating and cooling system. However, because achieving expected savings has been deemed unreliable due to the need for manual programming of schedules, a new class of "smart" thermostats are now available that learn occupant preferences and make adjustments automatically. There is a need to update the prescriptive code methodology to address new product offerings.

The performance method (R405) is the most popular compliance method in Florida. The method requires a software vendor to virtually create a baseline reference home the same size as the home to be permitted and insulate and equip it to a set of parameters spelled out in Table R405.5.2(1). This table includes the temperature that both the to-be-permitted home and the baseline must be maintained to simulate heating and cooling. The current performance code methodology does not credit thermostats capable of making adjustments to the standard heating/cooling set points, whether through manual programming or automatically through intelligent learning. Other rating systems, such as the Home Energy Rating System (HERS), have traditionally credited programmable thermostats, but are currently being updated to instead credit smart thermostats. There is a need to update the performance code methodology to appropriately represent expected savings from smart thermostats.

Overview

Programmable thermostats enable a user to manually program an hourly schedule of heating and cooling set points, enabling energy savings while a home is unoccupied, or overnight while occupants are sleeping. However, due to complexity with the manual programming involved, modeled energy savings are often not realized. As a result, the EPA suspended the EnergyStar designation program for programmable thermostats in 2009. As stated in Parker 2016, from 1999–2001, a large monitoring project in central Florida for Florida Power Corporation evaluated 150 sub-metered homes and found that homes with programmable thermostats actually used more space cooling than those with manual slide thermostats because homeowners were more likely to change the daily settings on the manual thermostats due to the nuisance of programming (Nevius 2000). Verifying this finding, the influence of thermostats and load controls was evaluated in Florida homes by utilities desiring to enhance load control. These findings from utilities also showed that programmable thermostats led to increased cooling consumption (Lopes and Agnew 2010).

Recently, an abundance of "smart" thermostats have become available that learn the occupancy habits and heating/cooling preferences of occupants, and automatically adjust the heating/cooling set points to achieve savings while maintaining occupant comfort. Several recent studies have been conducted to document the achievement of such savings, including one conducted in Florida that identified average heating and cooling energy savings of approximately 10% (Parker, 2016). Many utilities are utilizing smart thermostats as part of demand side management programs, and EnergyStar designation for thermostats has been updated and recently re-instated, focusing on smart thermostats with learning capability. Market research is showing a growing interest in smart thermostats from the general public, including that from Honeywell Intl. Inc: "Our research indicates more than half of the U.S. population already has an interest in connected thermostats. We tend to look at the world more through people's attitudes than demographics, so our biggest targets are families looking to make life a little simpler, and people who want to make sure their loved ones and homes are comfortable, safe, and secure."[1]

In order to reflect the shift away from programmable thermostats to smart thermostats, the prescriptive and performance code methodologies need to be updated to accurately reflect typical, achievable savings for Florida homes. In large part, savings are achieved through runtime reductions of heating/cooling systems as the smart thermostats automatically adjust set points to save energy. A synergistic effect to be investigated is the potential for elevated indoor relative humidity that may result from cooling system runtime reductions.

Scope of Work

Task 1a: Product review of available smart thermostats and applicable features and literature review of research documenting energy savings from smart thermostats. Literature review will at a minimum include searching reports from thermostat manufacturers and independent, peer reviewed studies such as those published in journals and conference proceedings.

Task 1b: Based on the literature search, develop draft rules. Draft rules will be of a form that can fit into the code document. For the performance method, the rules will describe how to treat the proposed home as well as the standard reference home.

Task 1c: Test draft rules in a simulation program. EnergyGauge USA will be used for this as it already has the rule set for programmable thermostats used for HERS ratings, and the ability to add a draft rule set for smart thermostats.

Task 1d. Write report to include the literature review, final recommendations for code changes, and expected impact for example homes.

[1] http://www.achrnews.com/articles/135162-homeowners-are-ready-for-smart-thermostats

Expected Outcome and Impact on the Code:

Prescriptive code credit and performance modeling rules for smart thermostats will be developed, and applicable heating/cooling energy savings will be able to be credited if the FBC adopts the changes developed.

Budget:

$20,000

References:

Lopes, Joseph S., and Patrick Agnew. 2010. “FPL Residential Thermostat Load Control Pilot Project Evaluation.” Proceedings of the 2010 ACEEE Summer Study on Energy Efficiency in Buildings 2:184–192.

Nevius, Monica. 2000. “An Unexpected Setback for Programmable Thermostats.” Energy Design Update 20 (November):1–4.

Parker, D., K. Sutherland, and D. Chasar. “Evaluation of the Space Heating and Cooling Energy Savings of Smart Thermostats in a Hot-Humid Climate using Long-term Data.” Proceedings of the 2016 ACEEE Summer Study on Efficiency in Buildings: 8-1 – 8-15.