Technology Innovation Project *Project Brief*

TIP 248: Residential Predictive Occupancy Zoned HVAC Demonstration, MountainLogic

Context

This project is unique in that it caters to user friendliness as its first order of business. It's well known by any user of central heating about the frustration and slow going of learning how to program the controller, such that many users simply don't do it, thereby losing much of the energy savings possible and having the system run inappropriately, burning energy at unnecessary times when the facility is not occupied. This technology will accurately sense occupancy and do the necessary programming automatically, removing the obstacle of the trying human-machine interface.

Description

There are 125 million homes in the US that generate 1281 million equivalent metric tons of CO2 (US DOE EIA 2007) and HVAC uses about 51% of residential energy consumption (US DOE EIA 2005). US homes alone generate about 4-1/2% of global greenhouse gases (US DOE EIA 2006) About 80% of US homes, or 100 million homes, have a central forced air HVAC plant. This project will demonstrate the effectiveness of retrofitting homes with a predictive occupancy zone system for central forced air HVAC control to reduce energy use. Here, 100 homes will be installed with the test system and 100 additional homes will be used as reference homes.

Why It Matters

This project will implement a residential predictive occupancy zone HVAC control system. Because of a complex user interface, existing EnergyStarR programmable thermostats have failed to produce broad energy savings in field use. The proposed MountainLogic system solves this by using occupancy sensors to record occupancy and then mine that data to predict occupancy patterns. With this solution users do not have to program any schedules. The system further increases energy efficiency with room-level zone controls to only condition zones when they are occupied. Even simple zone-based systems improve comfort and reduce energy usage. First-order analysis suggests that HVAC energy savings of 50% may be expected over a fixed manual thermostat. If used with a fossil fuel source a commensurate 50% reduction in carbon footprint is also expected. The system's ZigBee wireless network and innovative automated shape memory alloy-driven dampers allow for long battery life and eliminate the need to pull new wires in retrofit applications. The ZigBee network and smart controls lay the groundwork for future smart grid integration. This effort will result in completed technology engineering with 10 finished and field-installed prototypes. A field study will be conducted to measure basic technical performance, usability, user comfort and preliminary energy savings. The anticipated volume production cost of the system is projected to be less than one dollar per square foot, suggesting a uniquely efficient energy and environmental return on dollars invested.

Goals and Objectives

Demonstrate basic functionality, user acceptance and comfort with the technology; 2) Evaluate user interface effectiveness and acceptance; 3) Measure and demonstrate energy savings through field trials of homes with metered HVAC systems, half installed with MountainLogic's system and half without as a control group; 4) Measure energy savings when the system is provided with demand response cues; 5) Publish results.

Deliverables

Stage 1

1) Detailed project plan; 2) Recruitment and selection of 100 test and 100 reference homes; 3) 10 MountainLogic systems, installed and tested; 4) 10 power data loggers, installed and tested; 5)Preliminary field testing of the 10 systems; 6)Preliminary user survey; 7) Stage 1 report.

Stage 2

1) 90 additional MountainLogic systems, installed and tested; 2)10 additional power data loggers, installed and tested; 3) Stage 2 report.

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Stage 3

1) Field testing of system vs. reference homes; 2) Final user survey; 3) Final report:
a) Analysis of energy savings;
b) User survey results;
c) Conclusions and recommendations: Anonymized data sets from all 200 homes in the field tests in electronic readable CSV form. This data set will include occupancy by zone in 15-minute bins, HVAC furnace/HP and HVAC ventilation fan energy usage in 15-minute bins, outside air temperature data in 60-minute bins as available from the nearest NOAA NWS Quality Controlled Local Climatological Data (QCLCD) station, current and previous three-year power usage from utility billing records as available from the utility, and aggregate average residential power usage from current and previous three years for a large sampling of nearby residences.

Project Start Date: December 2011

Project End Date: September 2012

Funding

Total Project Cost:	$657,353
BPA Share:	$256,500
External Share:	$400,853
BPA FY2012 Budget:	$256,500

Participating Organizations

MountainLogic

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