ENERGY STAR® Smart Home Energy Management Systems Discussion Guide

June 2018

Overview

The U.S. Environmental Protection Agency (EPA) is sharing this Smart Home Energy Management Systems Discussion Guide to invite stakeholder input. This Discussion Guide outlines a potential approach to recognizing energy management features of smart home systems based on criteria for a package of hardware and services that deliver integrated energy savings based on occupancy detection in the smart home. With smart products and integrated smart home services proliferating, EPA sees an opportunity to capitalize on the opportunity for energy savings by offering a uniform national platform to evaluate the energy management features of smart home systems. For more information on EPA's motivation and the market data that informs this move, please see the cover letter accompanying this Discussion Guide.

Included in this Guide are EPA's thoughts on terms and definitions, scope, evaluation method, and the structure of a potential ENERGY STAR specification, as well as specific questions EPA seeks feedback about. EPA developed this Discussion Guide document to generate conversation about the proposed approach and to further EPA's understanding of this market opportunity. Please note that this document is not intended to be a comprehensive review of the ENERGY STAR perspective on smart home energy management systems. Rather, this Discussion Guide serves as a starting point for EPA's specification development efforts.

Scope

In each product specification, EPA identifies specific product categories to be covered by the specification and, likewise, identifies product types that are ineligible for ENERGY STAR qualification or recognition.[1]

Approach:
EPA's intention is to define a subset of installations that have the capability to save energy based on occupancy and recognize the ones that demonstrate these savings. The most promising targets for energy savings based on occupancy, that apply to most homes, include control of HVAC, lighting, and major plug loads. Particular homes may have other opportunities. To that end, EPA proposes to include packages with a minimum set of devices and services that, together, enable such savings. EPA has also identified the need for installer education, whether the devices are professionally installed or by the end user. Recommendations for installing devices for maximum energy savings benefit will be a key part of this program. The basic package could include, at a minimum:

1) At least one ENERGY STAR certified smart thermostat,
2) At least three ENERGY STAR certified light bulbs or two highly-operated ENERGY STAR certified light fixtures,
3) Devices and/or capabilities that address energy used by miscellaneous electrical loads (MELs), potentially including smart plugs, power strips, etc.,

[1] In an effort to streamline this Discussion Guide, EPA has provided an Appendix which includes proposed definitions associated with the Scope and other sections of this document.

4) The ability to detect occupancy, which may be built into one or more of the devices included, provided by standalone devices, use systems-based sensing (e.g., geo-fencing), or any combination of the above,
5) A set of algorithms that modify the operation of the devices in the package to save energy based on occupancy information,
6) The ability to collect information about the optimization of devices within the home based on occupancy (see Qualification Criteria),
7) The ability to connect to a hot water heater controller or directly to a hot water heater, if such a device is present in the home, and
8) A set of installation instructions and recommendations to promote maximum energy savings.

Packages could be customized and expanded to include additional products that fit the qualification criteria (see Figure 1). Integration allows for systematic energy savings, including products for which an ENERGY STAR specification with connected criteria exists and products that are not covered by an ENERGY STAR specification such as lighting controls, automated window shades, or add-on parts such as hot water controllers and pool pump controllers.

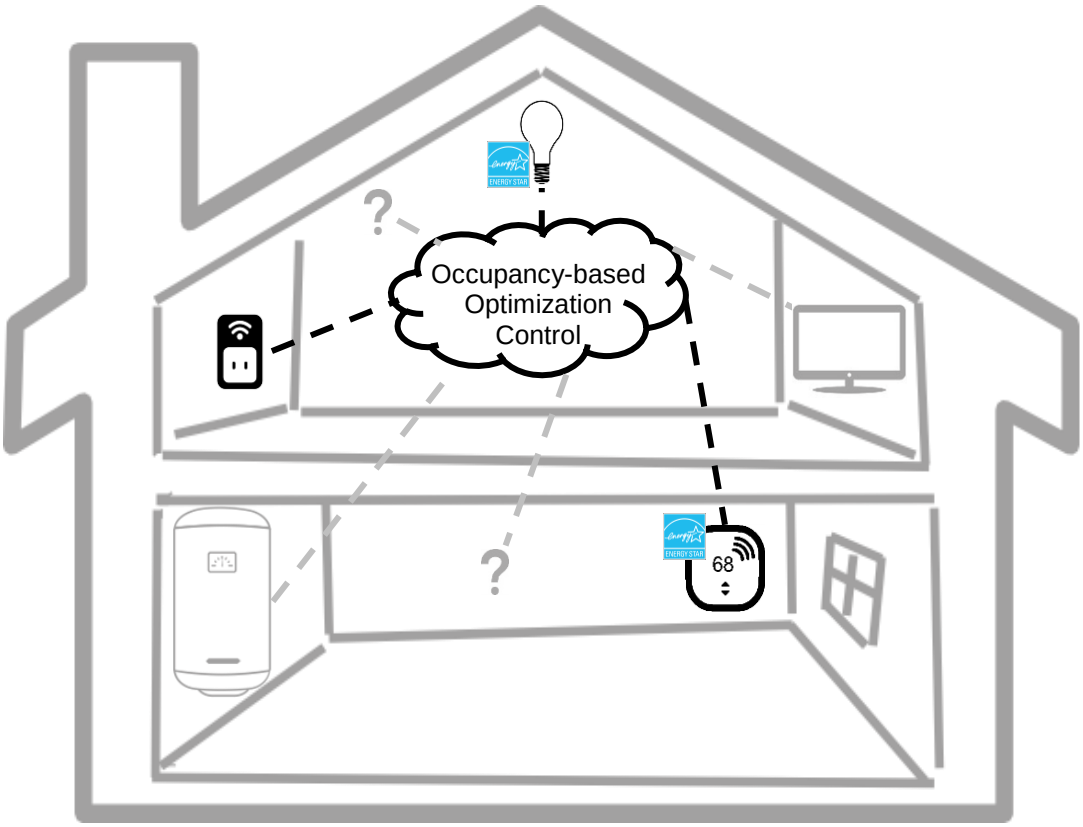

Figure 1 Example of a Smart Home Energy Management System Package

Feedback Request:
EPA seeks feedback on the approach to scope:

1) Which products or product capabilities should be included in the basic package?
2) What devices and/or capabilities should be included to address miscellaneous energy loads (MELs)?

3) Which products or capabilities should be expressly included in scope or encouraged beyond the basic package?
4) Are there any specific products or product capabilities that should be expressly **excluded** from scope?

Qualification Criteria

Along with determining eligibility, EPA will identify applicable metrics and propose criteria that recognize the packages in the marketplace that successfully optimize product/system performance using occupancy information to deliver energy savings without sacrifice to the end users' desired goals or comfort.

Approach:
EPA is proposing that service providers demonstrate their approach to occupancy-based automatic energy optimization, to include detailing how they define and control short term and long term away modes. EPA is also proposing that service providers briefly describe how their software integrates with the basic package hardware with initial validation methods (e.g., a bi-annual report summarizing customer metadata through statistical analysis to demonstrate optimized hours and opt out frequency). EPA's expectation is that devices are optimized based on occupancy within a reasonable range of performance to ensure energy savings without sacrifice to comfort or end users' goals. For instance, this would allow the option to operate smart lights minimally as a security feature for extended unoccupied periods or allow for pre-cooling or heating or adjusted temperatures to keep pets comfortable, but also for more extreme measures for prolonged unoccupied periods like in vacation properties.

Population of Installations to be Analyzed:
All of the service provider's customer homes that contain the hardware and capabilities of the package (e.g., ENERGY STAR smart thermostat, ENERGY STAR smart lights, smart plug, and a capability to control based on occupancy).

Metrics of the population to include:
1) Mean number ENERGY STAR smart thermostats per installation,
2) Mean number of ENERGY STAR certified lights with connected functionality per installation,
3) Mean number of MELs control devices per installation,
4) Mean number and characterization of other add-on hardware connected to the system beyond the basic package per installation,
5) Several statistical measures of hours subject to optimization (e.g., mean and decile bins) per installation, and
6) Average number of user override or opt out events per installation.

Feedback Request:
EPA is interested in what specific information would be needed to demonstrate an effective approach to occupancy-based optimization for a given system. Any data stakeholders could provide to estimate how much savings are available would be most helpful. One common concern about connected products is that the energy they save through automated energy savings is offset by additional energy they consume, compared to their unconnected alternatives. One example is a smart outlet. A conventional outlet draws no power when no power flows through it, and presents very little resistance when power does flow through it.

Products included in the package that are ENERGY STAR certified meet limits on standby or off power, which partially addresses this problem. Below are some initial questions to explore these topics:

1) Are there hallmarks of optimization strategies for short term, long term, and partially occupied spaces that have been used or piloted that could provide a general framework for this specification?
2) What strategies are effective to address MELs, using the devices and/or capabilities you mentioned in response to the Scope Feedback Request section, question 2?
3) What is the range of power use of smart switches when they are supplying power independent of what is plugged in?
4) What is the range of power use of smart plugs when they are not supplying power?
5) Are other measures needed to address this concern?
6) What other data and statistical measures would be helpful to analyze savings potentials realized by the population?

Potential Evaluation Methodology

For most ENERGY STAR product categories, the program leverages standardized test methods, to the extent they exist, to yield accurate and repeatable energy consumption values for establishing ENERGY STAR levels, to create a level playing field and fair comparison of products, and to verify labeled products are performing at the appropriate levels and delivering on ENERGY STAR's promise to consumers.

Typically, ENERGY STAR products are tested in a lab to fulfill the above. In this case, as with smart thermostats, behavioral interactions with users are critical to achieving savings. In addition, service providers maintain a relationship with users, allowing insight into these behavioral interactions.

Approach:
Similar to the method used for ENERGY STAR Smart Thermostats, EPA anticipates relying on field data to demonstrate systems/platforms are delivering the desired energy savings. EPA would define the population to analyze and the data that must be submitted for that population. Data would be submitted twice a year to demonstrate continuing product savings, consistent with the approach for smart thermostats.

Feedback Request:
1) Is it practical to report data from the entire population (defined in the Populations to be Analyzed section)? Alternately, EPA could define a procedure to produce a random sample and require analysis of that.
2) Is there a way to characterize energy savings from optimized unoccupied hours in terms of how deep the energy savings are (e.g., short term away optimization versus long term vacation modes, periods with pets at home, etc.)?
3) There are a wide range of ways to determine occupancy, some which require user interaction (e.g., geo-fencing, arming an alarm panel) and some which do not. Do data show a difference in frequency of use, depth of energy savings, or total time optimized based on the type of occupancy detection?

4) How would EPA determine, based on a description of product capability, whether a particular system can respond to occupancy?

Next Steps and Engagement Schedule

As EPA moves forward with developing potential ENERGY STAR recognition for smart home energy management systems, EPA will solicit input from all stakeholders on an ongoing basis via e-mail correspondence and stakeholder meetings.

Stakeholders are encouraged to submit written comments on this Discussion Guide by **July 27, 2018**. Please send all comments and supporting information to SmartHomeSystems@energystar.gov.

Prior to the comment deadline, EPA will host a stakeholder webinar on **July 11, 2018 at 1:00 p.m. EDT**. If you'd like to participate in this open discussion, please register prior to the webinar here. Also, an in-person discussion will be held in conjunction with the annual ENERGY STAR Products Partner Meeting being held September 5-7, 2018 in Phoenix, AZ.

Thank you for your interest and we look forward to working with you.

Sincerely,

Taylor Jantz-Sell & Abigail Daken

U.S. EPA ENERGY STAR Products

Appendix A: Definitions

EPA prefers to make use of existing, industry accepted definitions and aligns with DOE's definitions where they exist. Given that many of the terms EPA is introducing do not have established definitions, EPA invites stakeholder feedback on all definitions. What other definitions should EPA consider that it did not note here? Are there ways the definitions proposed here could be more helpful and/or specific?

Device or Hardware: A piece of physical equipment located in the home.

ENERGY STAR Certified Smart Light: A lamp, luminaire, or retrofit kit certified to the latest ENERGY STAR specification as meeting the optional connected criteria.

Miscellaneous Energy Loads (MELs)[2]: MELs is a catch-all category for loads that are not broken out as individual loads in end use analyses such as those published by the Energy Information Agency (EIA). These loads now constitute about 30% of energy used in typical homes, and the proportion is growing.

Occupancy-based Optimization: Using information on occupancy to serve consumers' desires with the least energy possible, for instance by reducing idle power or reducing the amount of time energy-using devices are on. Optimization algorithms also use predictive information about when occupancy is likely to change, based on learning.

Occupancy Sensing: A method (or methods) to detect whether a space has a person and/or animal in it, and potentially how many. Occupancy may be sensed on a room by room basis or for an entire dwelling, and may be sensed using dedicated sensors, sensors in a product with a different primary purpose (thermostat, light fixture), system-based techniques such as geo-fencing or the arming of an alarm panel, or a combination of these techniques. It may include information about how long the home has been or will be unoccupied which may affect optimization.

Package: A combination of hardware and service(s) defined by enabling a particular use case. For instance, a home security package might include a smart doorbell, window/door sensors, an alarm panel, and a monitoring service. A home automation package might include lighting control, window shades, and entertainment system control. Packages are defined by the company that offers them, to communicate with potential purchasers.

Platform: A computing platform or digital platform is the environment in which a piece of software is executed. It may be the hardware or the operating system (OS), even a web browser and associated application programming interfaces, or other underlying software, as long as the program code is executed with it.

Plug Load: The energy used by products that are powered by means of an ordinary AC plug (e.g., 100, 115, or 230 V). This term generally excludes building energy that is attributed to major end uses (HVAC, lighting, water heating, etc.)

[2] Navigant Consulting Inc. and Leidos - formerly SAIC. Analysis and Representation of Miscellaneous Electric Load in NEMS. Prepared for the U.S. Energy Information Administration. May 2013. Accessed from https://www.eia.gov/analysis/studies/demand/miscelectric/

Sensor: A device which detects or measures a physical property and records, indicates, or otherwise responds to it.

Smart Home Optimization Service: A set of user interfaces and software that provides for the interaction between users, hardware devices, occupancy, and energy optimization strategies.

Smart Home Service Provider: The company that owns the brand which consumers see when they interact with their smart home service. There may be additional brands associated with particular devices.