

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460



OFFICE OF
AIR AND RADIATION

September 21, 2015

Dear ENERGY STAR® Connected Thermostat Stakeholders:

In June, the U.S. Environmental Protection Agency (EPA) released for comment, a [draft of the Version 1.0 ENERGY STAR specification for Connected Thermostats \(CTs\)](#). The draft specification included a placeholder, indicating EPA's intent to include basic Demand Response (DR) criteria using open standards. In this letter, EPA is releasing for stakeholder comment, draft criteria intended to enable tangible grid benefits and create economic savings for the consumer, with minimal impact on comfort.

In developing this proposal, EPA has engaged with key stakeholders including connected thermostat manufacturers and service providers, the Electric Power Research Institute (EPRI), California utilities (IOUs), and Lawrence Berkley National Laboratory. The proposed criteria are intended to be compatible with both the EPRI (DR Ready) Framing Functional Specifications¹, and CEC Title 24, Joint Appendix 5 (Occupant Controlled Smart Thermostats).²

The criteria, outlined below, include definitions that would be added to Section 1 of the draft specification and a new subsection that would be added to Section 3. They are intended to facilitate the following:

- Demand Response (DR)
 - Support for "schedulable" (Type 1) and "fast" (Type 2) DR
 - Feedback to load management entity
- Price Response (PR) – Energy price notification and response

EPA will host a webinar on September 30th at 1PM Eastern that will cover the proposed criteria, the associated rationale, and goals for the specification. Interested stakeholders are encouraged to [register for the September 30 webinar](#), to submit written comments on the proposed criteria and/or to contact EPA to discuss your feedback. After consideration of stakeholder input, EPA plans to include revised DR criteria in the next draft of Version 1.0 ENERGY STAR specification for Connected Thermostats.

EPA will consider comments on this proposal for connected criteria submitted by October 23, 2015 via email to ConnectedThermostats@energystar.gov. Please direct any specific questions to Abigail Daken, EPA, at daken.abigail@epa.gov and 202-343-9375, or Doug Frazee, ICF International, at dfraze@icfi.com and 443-333-9267. Thank you for your continued support of the ENERGY STAR program.

Sincerely,

A handwritten signature in cursive script, appearing to read "Abigail Daken".

Abigail Daken,
Product Manager
ENERGY STAR Connected Thermostats or ENERGY STAR HVAC
U.S. Environmental Protection Agency

¹ Currently in draft

² http://www.energy.ca.gov/title24/equipment_cert/ocst/

Proposed Grid Responsiveness Criteria for Connected Thermostats

1) Definitions

- I. Communication Link: The mechanism for bi-directional data transfers between the CT and one or more external applications, devices or systems.
- J. Grid Response: Demand Response and/or Price Response.
 - 1) Demand Response (DR): Reduction in electric use by demand-side resources in response to signals from a load management entity.
 - 2) Price Response (PR): System operation that beneficially combines functional goals for temperature with energy prices that vary over time.
- K. Load Management Entity: Utility or third party that implements Grid Response program(s), such as a utility, DR service provider or a home energy management system.
- L. Open Standards: Standards that are:
 - 1) Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards,³ and/or
 - 2) Included in the National Institute of Standards and Technology (NIST) Smart Grid framework Tables 4.1 and 4.2,⁴ and/or
 - 3) Adopted by the American National Standards Institute (ANSI) or another well-established international standards organization such as the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE), or Internet Engineering Task Force (IETF).
- M. Premises: Land and the improvements on it.

Note: EPA has included additional definitions relevant to the section 3B5 Grid Responsiveness Requirements. References are included to cite external sources, as applicable. The term Grid Responsiveness (GR) is used to cover the combination of traditional episodic Demand Response and continuous modulation of system operation taking into account dynamic pricing with Price Response. The Open Standards definition is consistent with optional ENERGY STAR connected criteria for appliances and pool pumps.

3) Eligibility Criteria:

B. Connected Thermostat Product Requirements

5) Grid Responsiveness Requirements:

- a. Grid Communications – The product shall include a communication link that uses open standards, as defined in this specification, for all communication layers to enable the functionality outlined in Sections 3B5c and 3B5d.
- b. Open Access – To enable interconnection with the product over the communication link, an interface specification, application programming interface (API) or similar documentation shall be made readily available that, at a minimum, enables access to the functionality outlined in Sections 3B5c and 3B5d.

Note: Products that enable direct, on-premises, open-standards based interconnection are preferred, but alternative approaches, where open-standards connectivity is enabled only with use of off-premise services, are also acceptable.

³ http://collaborate.nist.gov/twiki-sgrid/bin/view/SmartGrid/PMO#Catalog_of_Standards_Processes

⁴ http://www.nist.gov/smartgrid/upload/NIST_Framework_Release_2-0_corr.pdf

Note: ENERGY STAR connected thermostats must include bi-directional communications that use open standards and facilitate open access.

EPA encourages the use of open standards communications from the Connected Thermostat Device on the consumer's premises. Such CTs will enable support for local energy management, including intelligent management of on-site (local) energy storage and generation. These CTs may further enable consumers to choose among multiple service providers and/or enable the CT to provide some connected benefits in the absence of an Internet connection.

c. Demand Response – The product shall enable consumers to participate in DR programs. At a minimum, the CT shall include the following DR capabilities:

i. Type 1 – The product shall include a default response of reducing controlled HVAC electrical load during the response period via a setpoint adjustment of at least +4°F for cooling (-4° for heating). Other Type 1 responses may also be included, and response(s) may be configurable to enable support for multiple DR/load shed strategies. The product shall maintain Type 1 response:

1. Until the end of the requested response period, or
2. For a minimum of 4 hours

Exceptions:

- The product shall not respond if the setpoint and/or room temperature is <50°F or >85°F, and
- The product shall limit its response in order to maintain a setpoint and/or room temperature that is >50°F and <85°F, and
- The product may continue to call for operation of the system fan, circulating pump (for hydronic systems), and the like
- In heating mode, products that are controlling conventional heating sources (typically oil or gas) are not required to respond, and
- The product is not required to respond to more than one Type 1 signal per rolling 24 hour period

ii. Type 2 - The product shall suspend operation of controlled HVAC equipment:

1. Until the end of the requested response period, or
2. For a minimum of 10 minutes

Exceptions:

- The product shall not respond if the setpoint and/or room temperature is <50°F or >85°F, and
- The product may continue to call for operation of the system fan, circulating pump (for hydronic systems), and the like
- In heating mode, products that are controlling conventional heating sources (typically oil or gas) are not required to respond, and
- The product is not required to respond to more than three Type 2 signals per rolling 24 hour period or to more than one Type 2 signal per hour.

- iii. Signals from the CT – At a minimum the product shall be capable of sending the following signals to the utility or load management entity:

Table 3-1. CT Signaling Requirements

DR	Signal Type	Signal Timing	Signal contents
Type 1	ACK	< 5m after receipt of signal	Current status (e.g. stage 1 heat on, stage 2 heat off, fan on)
Type 2		< 10s after receipt of signal	Load reduction - scheduled start time & duration
All	RT _{pre}	< 5m after start of response period	HVAC run time (seconds) in the 60m period immediately preceding the response period
	RT _{shed}	< 5m after the end of the response period	Hourly HVAC run time (seconds) during the response period
	RT _{post}	< 1 hour, 5m after the end of the response period	HVAC run time (seconds) in the 60m period immediately following the response period
	Override	< 10s after override occurs	Time of customer override

- iv. Conflict resolution – In cases where multiple response requests with overlapping response periods are received, Type 2 responses shall take precedence over Type 1. In the case of such conflict, the CT may terminate, limit or forego its Type 1 response.
- v. Consumer Override – Consumers shall be able to override their product's response to DR signals. Additionally:
1. When a consumer elects to override a Type 1 response, the product does not need to respond to subsequent Type 1 signals in the 24 hour period following the override, nor to Type 2 signals in the one hour period following the override.
 2. When a consumer elects to override a Type 2 response, the product does not need to respond to subsequent Type 1 or Type 2 signals in the 1 hour period following the override.

Note: EPA has proposed DR criteria that include two response types. Type 1 is intended for schedulable (e.g. day ahead) longer response periods that provides grid benefits without undue impacts to consumer comfort. Type 2 is intended for shorter response periods and deeper load reductions (e.g. spinning reserves/fast load reduction). While EPA has elected defined minimum default responses for both Type 1 and Type 2 signals, EPA encourages CT service providers to allow configurability of Type 1 responses, or include additional responses, to enable alignment with existing and future DR programs. As such, EPA encourages ENERGY STAR CT partners to work with utilities to align ENERGY STAR CT capabilities and utility load shed strategies, so as to enable grid benefits while limiting consumer impacts.

Proposed Type 2 criteria include minimum response (turn off controlled electrical HVAC equipment) and duration (at least 10 minutes). As with Type 1, EPA encourages CT manufacturers to work with utilities to ensure alignment between utility strategies and CT capabilities. For example, manufacturers may elect to develop CTs that can exceed the minimum response duration, or utilities may devise signaling strategies to enable longer load reduction periods by sending staggered Type 2 signals to multiple pools of CTs.

Both Type 1 and 2 response criteria include exceptions for extreme room temperatures (>85°F or <50°F). Similarly, response frequency limits prevent excessive DR burden on customers. As the specific provisions here are meant to address the needs of the electric grid, CTs that are controlling conventional heating (non-heat pump, typically gas/oil) sources are not required to respond. This does not preclude EPA from developing criteria

Note (cont):

appropriate to natural gas peak use reduction at a later date.

EPA has proposed that ENERGY STAR CTs must send signals to load management entities that:

1. Acknowledge receipt of a DR signal,
2. Report current operational status,
3. Provide data to inform measurement and verification of load shed, and
4. Provide notification when the consumer elects to override.

EPA has crafted these requirements to enable better grid interoperability while protecting consumer privacy by minimizing the type and frequency of data transfers. For example, while the capability to send limited run time data is required; sending temperature data, that might inform occupancy, is not.

As Type 2 responses are intended for fast-response shed scenarios, EPA proposes that Type 2 responses shall take precedence over Type 1 responses.

In order to enable consumers to remain in control of their thermostat, EPA proposes that ENERGY STAR connected thermostats empower consumers to override their CT's demand responses at any time. As such, there is no provision for non-override-able "emergency" DR for ENERGY STAR CTs.

d. Price Response

- i. The product shall include the capability to notify consumers of changing energy price conditions, for example upon significant changes in current or forecast price. Notification may be via CT device, and/or on remote user interfaces (e.g. web or smart phone).
- ii. The product shall include the capability to intelligently manage controlled HVAC load under varying energy price conditions. At a minimum, the CT shall allow the consumer to configure the CT to respond by pre-conditioning in advance of, shedding load during, and recovering comfort after, high price periods.

Note: EPA has included price responsiveness criteria to help ensure that ENERGY STAR connected thermostats can notify consumers of changing energy prices and enable automated management of HVAC energy consumption in response to price signals. A key goal of the ENERGY STAR CT program is to enable consumers to save money on energy bills through participation in DR programs or effective use of dynamic prices.

EPA notes that for consumers with on-site (local) energy storage and/or generation, there may be additional drivers to a *their* energy cost, including differential utility buy and sell prices, availability of on-site generation, ability to store or dispatch energy, and operation when the grid is down. One way to allow management of on-site resources is through a locally generated energy price, to which individual equipment can react. CT service providers are encouraged to develop CTs that are capable of effectively and intelligently managing HVAC energy consumption under a variety of use cases.

5) Information to Consumers

If additional modules, devices, services and/or infrastructure are part of the configuration required to activate the product's communications capabilities, prominent labels or other forms of consumer notifications with instructions shall be displayed on retail packaging and in product descriptions for on line sales, as well as in the product literature. These shall provide specific information on what consumers must do to activate these capabilities (e.g. "*This product has Wi-Fi capability and requires Internet connectivity and a wireless router to enable interconnection with an Energy Management System, and/or with other external devices, systems or applications.*").

4) Test Requirements:

When submitting data for connected thermostats, the following methods shall be used to determine ENERGY STAR qualification:

Table 4-1: Test Methods for ENERGY STAR Qualification

ENERGY STAR Requirement	Test Method Reference	Applicable Products
Grid Responsiveness	ENERGY STAR Test Method for Connected Thermostats, V1.0	All

Note: The ENERGY STAR Test Method for Connected Thermostats is under development. EPA intends for the test method to include methodology for:

1. Calculation of field energy savings, referencing a particular revision of open source code for metric calculation,
2. Measurement of standby power, based on IEC 62301, Ed. 2.0, 2011-01, "Measurement of Household Appliance Standby Power", and
3. Confirmation of grid responsiveness capabilities.