



## Codes & Standards Program

John Taylor

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Dear Mr. Taylor,

The Codes & Standards programs for San Diego Gas and Electric Company and Southern California Gas Company is pleased to offer comments on the proposed ENERGY STAR thermostat specification (Draft 1 Version 2.0). Together the utilities serve 6.2 million natural gas customers and 1.3 million electricity customers in California. Since 1990, our customers have saved more than 435 million therms of natural gas and 3.7 million megawatt-hours of electricity through SDG&E and SCG managed energy-efficiency programs. This letter summarizes our comments. The appendix to this letter contains detailed comments.

As you probably know the California IOUs have stopped providing incentives for residential Energy Star thermostats because the *EM&V studies showed that the expected* energy savings were not realized. Many customers treat their thermostat like a light switch, turning on the heating or cooling when they are actively using their home, and turning off the heating or cooling when they are away or have gone to bed. These customers have periods of discomfort just after they have turned on the thermostat but they are also saving more energy than the customer who wakes up or comes home to a warm or cooled house.

We are very supportive of the ENERGY STAR branding and have included ENERGY STAR in many of our programs. Thus we are very supportive of a new ENERGY STAR Thermostat specification that has the opportunity of saving energy as compared to a standard thermostat or a standard programmable thermostat.

Our comments in the remainder of this letter are focused on the following topics:

- Separate labeling and specification requirements for residential versus nonresidential thermostats.
- Minimum capabilities for commercial ENERGY STAR thermostats
- Desirability of Demand Response communication upgradeability
- The specification of HAN (home area network) capabilities
- Detailed comments on the Draft 1 Version 2 Thermostat Specification.(in appendix)

### **Separate Residential and Commercial ENERGY STAR Thermostats**

The current California Title 24 building energy code requirements have different requirements for commercial and residential thermostats. Commercial thermostats must have an occupied and unoccupied schedule with not only different setpoints but also different fan

operation. During occupied periods, the supply air fan must run continuously even when there is no call for heating or cooling whereas during the unoccupied period, the fan cycles on and off with the calls for cooling and heating. The thermostat must also have the capability for a timed (up to 4 hours) override of the normal settings. If there is an automatic switchover between heating and cooling mode, then the deadband between heating and cooling setpoints is required to be at least 5 degrees.

These requirements are different from those for residential thermostats. The fan system is supposed to cycle on and off with the call for cooling in residences as these systems are not providing any ventilation air. Residential thermostats are also required to be programmable and have the capability to set different setpoints for different time periods. Almost all residential thermostats require manual switchover between heating and cooling.

Because of their lower price and similar appearance, the use of residential thermostats in commercial buildings has been an ongoing problem. In addition, some manufacturers label their residential thermostats “compatible with Title 24” but do not specify whether their thermostat is compatible with the residential or nonresidential thermostat requirements. A single ENERGY STAR specification and labeling requirement that does not clearly specify “Residential Thermostat” as different from a “Nonresidential Thermostat” aggravates this problem.

A universal thermostat specification is not a good outcome as that would result in thermostats that need more user programming or adjustment for a given residential or non-residential application. In addition to the issues associated with fan operation, the default schedules for residences (setback during the day) are just the opposite of the default schedules appropriate for nonresidential spaces.

Thus it would be desirable to have an ENERGY STAR RESIDENTIAL Thermostat labeling program and an ENERGY STAR NONRESIDENTIAL Thermostat labeling program. This would help to differentiate these two very different types of thermostats and expand the scope of programmable thermostats to that market (nonresidential buildings) which can benefit the most from programmable schedules.

We would also be open to a product that is compatible with both specifications if it has a very simple mode (residential versus nonresidential) selection capability.

## **Desirable Features in ENERGY STAR Qualified NONRESIDENTIAL Thermostats**

An ENERGY STAR qualified NONRESIDENTIAL Thermostat would have the following features:

- Labeled as a NONRESIDENTIAL thermostat with written material indicating that this is the correct thermostat for nonresidential applications but inappropriate for residential dwelling units which are better served by an ENERGY STAR residential thermostat.
- Appropriate fan control for occupied and unoccupied periods during different modes of heating or cooling.

- Default schedule of 7 am to 5 pm Monday through Friday and unoccupied on Saturday and Sunday.
- Programming schedule at least 5-1-1 mode (separate program for three types of days: M-F, Sat and Sunday).
- Have program backup capabilities that prevent the loss of the thermostat's schedules for at least 7 days, and the time and date setting for at least 72 hours if power is interrupted.
- Thermostat timed override up to 4 hours.
- "Vacation mode" override up to three days places building in continuous unoccupied mode until timing out or being manually placed back in normal operation.
- Thermostat is two-stage or electronic so that it is compatible with small air conditioning systems that have a non-integrated economizer. For these systems a first stage that relies on the economizer only is necessary so the HVAC system can cycle back and forth between economizing and compressor operation when the economizer cannot serve the entire cooling load. Single stage thermostats results in the economizer high limit being set to extremely low settings and effectively disabling economizer operation for many of the possible hours of operation.
- Thermostat includes a "trouble light" or warning message that indicates a problem identified by fault detection and diagnostics (FDD) systems on-board the air conditioner.
- Thermostat include a "replace filter" light or message that indicates high pressure drop across the filter assembly.
- Intuitive programming menu that limits the number of layers required to access the most common programming features.
- Thermostat has an on-board communications capability or an expansion port that allows the thermostat to communicate with a Demand Response system through an industry standard port (e.g. RJ 47, USB Micro B, MicroSD slot, etc.) or standard chip socket [i.e. Dual In-line Package]. Those systems with an expansion port provide an interface control document that describes signals required to provide basic demand response functions. These minimum functions include:
  - Demand response state
  - Set thermostat up by 4 degrees
  - Duration of setup
  - Release from set up
  - Send state (cooling, heating, resistance heating, off)
- We do not think that the thermostat itself necessarily has to be the device where demand response settings need to be entered. This could just as likely be entered through a home area network, on-line through the utility demand response customer interface or potentially the expansion device may be compatible with the customer's

or installers computer output device. The market is too immature to over-specify this feature. The main issue is that the device should work with the delivery mechanism of at least one utility demand response program.

- Thermostat should also have some method of signaling a demand response state and/or the real time price of electricity.

## Overview of concerns regarding current specification

We appreciate the difficulty inherent in ENERGY STAR's decision to maintain the integrity of the program by rescinding a specification that did not achieve its goals. Our overarching request for the current specification is that the new requirements have a proven record of energy savings. As currently written, the specification is missing evidence for the effectiveness of the proposed requirements. References to studies showing statistically significant savings as a result of the proposed requirements would help to assure stakeholders that the new specification would not suffer the fate of its predecessor.

The current specification suggests that ENERGY STAR is promoting peak load reduction in addition to energy reduction. If so, a short explanation of the benefits of this policy is warranted.

There are 5 requirements listed in Section 2, and 27 requirements listed in Section 3 of the draft specification. Detailed comments on many of these requirements can be found in the appendix to this letter. Here, we discuss the requirements for communications and logging that we believe warrant special attention.

- There are at least four potential communications pathways to and from a thermostat: to local devices, from local devices, to remote entities (e.g. the utility), and from remote entities. The specification should state which of these pathways are required, and how the addition of each communications pathway is expected to reduce energy use (or peak demand).
- Section 2 of the specification requires that ENERGY STAR thermostats “be upgradeable to a PCT by installation of a HAN communication module” (Line 328). Overall, we agree with the spirit of the requirement for an expansion port, which would allow customers to add valued features to their thermostat. As written, however, this requirement (1) assumes that the thermostat does not have communications ability on-board, and (2) over specifies the type of module that the customer can choose; a communication module need not be HAN-compatible for the desired capabilities to exist. Note that the PCT definition (starting on Line 197) does not require HAN communication, and most existing PCTs use paging, FM radio, or direct Internet connection for communications, not local area networks. The phrasing “must be a PCT or be upgradeable to a PCT by installation of a communication module” would resolve both of these issues.
- The summary bullet list at the beginning of Section 3 (Lines 335-336) states that qualifying thermostats must have “the capability of communicating with other devices within the HAN and utility load control programs.” To maintain technical neutrality, the specification should avoid the HAN requirement.

Also, any reference to “utility load programs” must be in the context of an enabling technology that provides consumers with the choice to save on utility bill by programming their thermostat to respond to real time utility prices or demand response signals. The current language does not state that thermostat communication and control by a utility load control program is always based on consumer selected choices, and this specification could be misinterpreted to mean that ENERGY STAR is promoting unfettered utility or government control of consumer’s thermostats. The State of California ran into widespread opposition to their proposed requirements for PCTs because the specification did not specify that the PCT was to respond *only* to customer instructions. See, for example, the San Francisco Chronicle’s 1.12.08 article *Critics cool to 'smart thermostat' proposal*. A possible revision might be as follows.

“Have the capability of communicating with other devices in the building and with an outside source, such as the energy provider. Based upon local settings chosen by the consumer, the thermostat can initiate automated changes in setpoints in response to information received from local or remote signals.”

This wording clearly indicates that the PCT enables consumers to choose whether they wish to participate in utility load control or dynamic pricing programs based on consumer decisions regarding modules and settings.

- Requirement 18 requires that thermostats “use HAN communication modules featuring standardized, low-power, low bandwidth HAN communication protocols.” Removal of the term HAN from this statement requires the same functionality without limiting the technology options.
- Requirement 19 states that the thermostat shall “log and retain usage data.” This wording appears to require that the thermostat system meter energy usage. If this is the case, this is a major change to the functionality of a thermostat and should be added to Section 2 and the summary bullet list at the beginning of Section 3. If metering of energy usage is not intended, the wording should be clarified.

## **San Diego Gas and Electric and Southern California Gas’s continued interest**

We are hopeful that these new specifications will be compatible with the demand response system developed by the California IOU’s. These utilities are serving approximately 10% of the US population and would be a likely user of a specification that meets our needs.

Please keep us informed on developments to this new specification.

Sincerely,

Ron Gorman

Program Manager, Energy Efficiency Codes & Standards

San Diego Gas and Electric Company and Southern California Gas Company

## Appendix with Detailed Comments

The following recommendations are intended to improve the readability and intelligibility of the document.

### Commitment

Line 28 – Remove bullet character.

Lines 32-34 – Revise to read as follows.

- comply with current ENERGY STAR Eligibility Criteria, which specify the testing criteria for programmable thermostats and define the performance criteria that must be met for use of the ENERGY STAR certification mark on programmable thermostats

Line 49 – Define “co-op.”

Line 50 – Define “POP.”

Lines 52, 65 – Define, link to, or provide a Figure for, “the ENERGY STAR education graphic”

Line 55, 68 – Define or provide a link to guidelines regarding “approved messaging”

Line 77 – Define, link to, or provide a Figure for, “the ENERGY STAR mark.” State whether this is the same or different from “the ENERGY STAR education graphic.”

### Section 1: Definitions

Consider reordering definitions so that defined terms appear before they are used to define another term.

#### ***Programmable Thermostat***

(Lines 190-195) The definition of a PT should include reference to the fact that it controls the HVAC system.

(Lines 192-194) The explanation for how the PT enables the user to save money is exceedingly unclear. Consider revising to read as follows. “A PT can save HVAC energy use by enabling the customer to schedule energy-saving periods—for example, when the occupant is away or asleep—during which an Energy-Saving Setpoint Temperature is automatically initiated.” Even this revised statement might not be appropriate given the studies that provide evidence that this assumption is untrue.

### ***Programmable Communicating Thermostat***

(Lines 197-201) A PCT is defined to be a PT that can “communicate with external devices.” The definition, appropriately, does not say *how* it should communicate. The integration into a local network is implicitly optional at this point, based on the phrase “When integrated into a Home Energy Management System...” at line 198.

(Line 197) Define “external device”—i.e. external to what? If external to the PT itself, then all PTs are PCTs because they communicate with the HVAC components. Suggest “...to communication with devices external to the HVAC system.”

(Line 199) Revise to read “a PCT may control or be controlled by devices other than those associated with the HVAC system.”

(Line 200) Delete the term “(web)” as being redundant and technically inferior to the already supplied term “Internet.” Suggest revision to: “Internet-enabled scheduling”

### ***Home Area Network***

(Lines 203-204) The inclusion of this term seems unnecessary. “Local Area Network” could be used where needed, and is standard terminology that need not be defined in the spec. If the HAN term and definition remains, however, please provide clearer boundaries and an example or two. For example, both a home entertainment system and a doorbell fit the current definition of HAN.

(Line 227) Broadening the scope of the PT definition “to include HANs” is opening a can of worms that the EPA is unlikely to come out on top of. HAN specification itself is still in its infancy, and jumping on the HAN bandwagon is more likely to harm than improve the EPA’s reputation. For now, it might be prudent to watch HAN progress and save any specific inclusion of HAN for a Phase 2.

## ***Home Energy Management System***

(Line 206) Remove the word “Home” from this term, to read “Energy Management System,” allowing the use of this specification for small commercial buildings.

(Lines 206-213) Revise opening sentence; remove the confusing and unnecessary sentence beginning with the phrase, “A typical system may be comprised of...”; and remove references to the “HAN,” which are more confusing than clarifying in the definition of an EMS. The term “embedded” has been misspelled. The word “may” is overused (given that this is a specification, not a suggestion or list of permissions). Introduction of new terms should be limited. If used, the terms “controller” and “gateway” should be defined and distinguished from each other—unless they are the same, in which case only one of the terms should consistently be used.

Revise to read as follows.

“For the purpose of this specification, an Energy Management System consists of one or more interconnected devices that are monitored, scheduled and controlled by a controller (or gateway). Examples of interconnected devices include appliances, meters, energy displays, PCTs, addressable light switches, and direct load control relays.”

(Line 216) Revise to read “end-use control.” Utilities control load; customers control end-uses.

(Line 217) Not clear what is being measured. Perhaps “Energy use measurement”? Or “System monitoring”?

## ***Other Definitions***

(Lines 232-233) Note that the current definition implies that swamp coolers are conventional. If this is intended, then this is fine.

(Lines 235-236) As written, the definition of Heat Pump includes conventional AC systems—which means that the definition of conventional AC (non Heat Pumps) does not include conventional AC. Note that a conventional AC unit is simply a heat pump that does not work in reverse.

(Line 238) Remove the word “typically.”

(Line 239) Remove the terms “high-efficiency” and “high efficiency.” An inefficient unit with two fuel sources is still dual fuel.

(Line 266) Define duty cycle and how it is different from cycle rate.

(Lines 273-286) Consider using more meaningful terms, such as “Instant Recovery” and “Gradual Recovery,” in which case only two fairly self-explanatory terms are needed.

(Line 296) Remove “timed hold” and “scheduled hold” from the examples, since they are not defined and not self-explanatory. Vacation hold is a good enough example, and self-explanatory.

(Line 279) Consider changing “on-time” to “run-time”

## **Section 2: Qualifying Products**

(Line 304) Provide a reference to evidence that a 5-2 schedule meets the needs of the “majority” of residential users. Alternatively, soften or delete the claim.

(Line 310) “Low-voltage thermostat” has been defined, but not “low-voltage room thermostat.” This device sounds like something that maintains setpoint temperatures in a single room. If this is the case, define elsewhere. If not, remove the word “room.”

(Line 313-314) Revise to read as follows.

“The product must provide, by default, a pre-programmed weeklong setpoint schedule of five weekdays and two weekend days (5-2). Each daily schedule shall have a minimum of four possible schedule periods...”

(Line 314) Consider changing the terms “wake”, “day”, “evening” and “sleep”, since the schedules can be modified by the user in such a way that they are not consistent with the meanings of these words. Any consumer that does not follow this “normal” pattern will have a thermostat with confusing settings. Period 1, period 2, period 3 and period 4 would suffice.

(Line 325) Recommend moving requirement for compatibility with Dual Fuel Heat Pump systems to section C. The requirement for an “interface with external temperature sensors” should stand on its own or be deleted.

(Line 328) Overall, we agree with the spirit of the requirement for an expansion port, which would allow customers to add valued features to their thermostat. As written, however, this requirement (1) assumes that the thermostat does not have communications ability on-board, (2) overspecifies the type of module that the customer can choose; a communication module need not be HAN-compatible for the desired capabilities to exist. Note that the PCT definition starting on Line 197 does not require HAN communication, and most existing PCTs use paging, FM radio, or direct Internet connection for communications, not local area networks.

The phrasing “must be a PCT or be upgradeable to a PCT by installation of a communication module” would resolve both of these issues.

### **Section 3. Specifications for Qualifying Products**

(Line 333) Consider revising to read: “Enable and encourage energy savings.” Taken literally, only a thermostat that does not allow the AC to come on (ever) would “Maximize energy savings.”

(Line 335-336) Strongly recommend rewording or deleting the load control requirement, as it could be misinterpreted to mean that ENERGY STAR is promoting unfettered control of consumer’s thermostats. The State of California ran into a lot of opposition with their proposed requirements for Programmable Communicating Thermostats (PCTs) because the specification was not clear that the PCT was to respond *only* to consumer instructions. See, for example, the San Francisco Chronicle’s 1.12.08 article *Critics cool to 'smart thermostat' proposal*.

A possible revision might be as follows:

“Have the capability of communicating with other devices in the building and with an outside source, such as the energy provider. Based upon local settings chosen by the consumer, the thermostat can initiate automated change in setpoints in response to information received from local or remote signals.”

This wording allows customers to choose to participate in utility load control programs or dynamic pricing programs based on customer decisions regarding modules and settings.

(338) Unclear. Revise to read: “Reduce toxic material content”.

(339-345) Much of the text in this note would be a good introduction to insert at line 330.

(351) There is more than one “section 2” (e.g. at lines 299 and 368). For clarity, subsections should include meta-section designation; i.e. Section 1 → Section 1.A → Section 1.A.1

(433) Revise to read “communicating and non-communicating products.”

(443-447) The monitoring and displaying of energy usage data seems well beyond the functionality of a thermostat, which is defined as “a piece of equipment that controls the temperature in a building, machine, or engine” (MacMillan dictionary). It is already a major change for a thermostat manufacturer to add communications so the thermostat can receive signals from outside the building, either directly or through a local area network, to influence the functioning of the HVAC system. The requirements to “support downloading and processing of usage data” and “provide increased insight into energy usage to encourage voluntary reduction of energy consumption and increase energy efficiency” are well beyond what is expected from a thermostat, and beyond the experience of most thermostat manufacturers. It would be instructive to show an example of what is expected and provide a discussion of evidence supporting the idea that it will contribute to energy efficiency.

(451-452) Requiring communication with a HAN is not technology neutral. ENERGY STAR should specify WHAT they want to happen, not how to do it. Under the current spec, a thermostat connected to the Internet could respond to DR signals and provide energy usage data, but would not meet the ENERGY STAR spec because there is no HAN involved.

(454-455) Define “usage data.” If energy usage data is intended here, this requirement is more than just a communications requirement, and should be added to the summary list of requirements in Section 2 and at Lines 333-338. Also, no evidence is provided to indicate that providing this data to customers will improve efficiency. If such evidence exists, it should be provided in a footnote or appendix.

A thermostat typically monitors compressor status and indoor temperature, but not energy usage. Adding the ability to measure and log energy usage could be done at substantial effort and cost. Estimating energy usage from run-time data would be significantly easier, but only accurate if power draw in various modes were well known for each unit.