

November 27, 2009

Ms. Katharine Kaplan
ENERGY STAR Program
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This letter presents the comments of the American Council for an Energy-Efficient Economy (ACEEE) on the ENERGY STAR® Programmable Thermostats Draft 1 Version 2.0 documents. ACEEE appreciates the opportunity to review and provide comments on programmable thermostats again.

The American Council for an Energy-Efficient Economy is a nonprofit, non-partisan, organization dedicated to advancing energy efficiency as a means of promoting economic prosperity, energy security, and environmental protection. ACEEE fulfills its mission by conducting in-depth technical and policy assessments; advising policymakers and program managers; working collaboratively with businesses, public interest groups, and other organizations; publishing books, conference proceedings, and reports; organizing conferences and workshops; and educating consumers and businesses.

ACEEE has reviewed the literature on energy savings associated with programmable thermostats, and commented on earlier ENERGY STAR actions in this area. In 2006, ACEEE supported suspending the program, because the field studies available at the time did not show energy savings associated with the presence of programmable thermostats (Attachment B). At the time, the most important issue to us was the user interface, and we urged EPA to suspend the program until "...robust field studies of sufficient size show that naïve users successfully use programmable thermostats to save energy, without instruction." This has not happened. In 2006, we also recommended "...that EPA and its partners evaluate a new feature, an interface to enable peak demand management and energy savings..." We are pleased that you have proposed a communicating capability requirement.

In this context, we are encouraged by the possibility that EPA might replace the troubled thermostat program with an EnergyStar "comfort control."¹ This would facilitate appropriate focus on usability and usefulness, the keys to customer satisfaction. In contrast, we find the proposed prescriptive requirements for the user interface so inadequate as to be counterproductive.² As pointed out by Mr. Antony Hilliard, University of Toronto (Attachment A), the current approach of low-level prescriptive requirements is likely to discourage better designs and newer technologies. As a small example, high-resolution OLED displays are self-illuminating active displays, and already available in some high-end consumer products. They should not require backlighting at all. The issue is interface usability, not backlighting. Other promising approaches that appear to be precluded by this specification include:

- Wi-Fi enabled, so the actual programming can be done from a computer (or new television). Large screens enable much richer interfaces that "map" into user experiences with computer mice, TV remotes, etc.
- Voice-based, along the lines of prescription-refill services today.

The appropriate approach to specifications, as noted by Mr. Hilliard, is to require usability performance metrics, as are commonly used in other industries and already codified (e.g., ISO/IEC 9126-2).

Mr. Hilliard elsewhere notes how common outstanding interface design is in consumer products like music players, and that it clearly begins with usability testing as part of the design process. To us, the programmable thermostat is less complicated, and has fewer user decision choices than many consumer devices that do not come with user manuals, or for which the user is not expected to ever open a manual. These include both digital

¹ ENERGY STAR® Programmable Thermostats Draft 1 Version 2.0 documents. Slide 13. http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/thermostats/Programmable_Thermostat_Online_Meeting_Presentation.pdf.

² ENERGY STAR Program Requirements for Programmable Thermostats – Tier 1 DRAFT 1 Version 2.0 5, Partner Commitments. http://www.energystar.gov/index.cfm?c=revisions.thermostats_spec

cameras and GPS navigation devices. Many of the former are in the same price class as programmable thermostats, and we should have no lower expectations for the usability of thermostats. This is why I suggested during the November 18 Conference Call, not entirely in jest, that the simplest interface requirement would be to prohibit including a user manual with an ENERGY STAR thermostat. Programming and use must be intuitive and/or self-guided, as for other consumer products today. Many on the call seemed to agree with the intent.

The draft specification has other issues, as well. For example, it manages to both overreach and miss an important target. We believe that requiring that any ENERGY STAR thermostat be able to control almost any equipment is unrealistic, and exponentially increases the challenges of design of the hardware (wiring pin outs), software, and interface. It seems to make much better sense to offer different devices, prominently marked, for different equipment. Conversely, as we read the specification, a thermostat/controller that uses a proprietary protocol for advanced, premium, ENERGY STAR furnaces and air conditioners (or heat pumps) would be prohibited from bearing the ENERGY STAR label on the thermostat, the only interface the consumer uses and sees daily. Please consider how a contractor is to explain that the best system available, the only one that has auto-diagnostics and air filter alarms, does not include an ENERGY STAR thermostat. The most likely work-around will be to try to install a third party thermostat that cannot use the premium capabilities that improve field performance, which is not the intended result.

Finally, the sense we have had is that the intended market for the ENERGY STAR programmable thermostat is the DIY home-owner, rather than the contractor. We appreciate the "straw man" on wiring in the draft specification, but it seems emblematic of a larger issue: intuitively, across a broad range of equipment, higher performance is associated with greater specificity, such as the trend toward regional furnace and air conditioner standards. We recommend that you listen carefully for considerations of what happens when homeowners try to install new thermostats on diverse older equipment. Would it be better to frame the target as the contractor, both when installing new equipment and as part of the scheduled maintenance that is recommended to assure peak performance?

At this point, ENERGY STAR has not shown savings associated with use of programmable thermostats. There is no reasonable basis for predicting that the current specification will lead to significant energy savings. We recommend that ENERGY STAR suspend the program for now, and work to develop a comfort control specification that will lead to energy savings.

Sincerely,

Harvey M. Sachs, Ph.D.
Senior Fellow.

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Attachments:

A Antony from Canada
BBB ACEEE letter of Feb 23, 2006

Attachment A
(Hilliard email, 11/19/2009, 2:36 am. Used with permission.)

Harvey,

I apologize for the piecemeal emails - I just read through the EPA draft programmable thermostat specification and found their mention of usability. I've integrated and revised my comments below.

It is encouraging that the draft 2.0 programmable thermostat specifications recognize the importance of usability and suggest evaluation criteria (lines 353-399). However, specifying usability requirements in terms of low-level physical and functional properties:

- * will not ensure intuitive interfaces
- * will entrench current thermostat design features thus discouraging innovation, and
- * will render the specification rapidly obsolete

For example, the optimal backlight inactivity time-out (line 379) will vary depending on many interface design choices, and what (if any) user interaction is in progress. Such issues are already addressed by requiring a maximum thermostat power consumption (line 428). If telephone usability requirements were specified in terms of minimum finger openings for rotary dials, mandatory key layouts, and mandatory speed-dial buttons, the Apple iPhone would be deemed non-compliant and un-usable.

Instead, specifications should be based on the performance-based summative usability test method as described in ISO standards (ISO/IEC 9126). Desired outcomes (effective, persistent consumer adoption and use) should inform specific task performance metrics to be achieved by live participants. To ensure fairness and accuracy, usability testing could be performed by an EPA-selected consultant, similarly to Underwriters Laboratories. By focusing on ultimate objectives, the Energy Star programmable specification could contain more universal, durable, and device-independent metrics such as:

- 1) The thermostat tasks that users will be asked to complete (which the Draft specification already includes: setting schedules, modifying schedules, setting energy-saving away mode)
- 2) The performance metrics to be met for Energy Star acceptance. These can be very specific, such as: "At least 75% of users shall complete programming the schedule and temperature settings in Table A in less than 3 minutes." "At least 90% of users shall complete setting an energy saving away mode in 30 seconds on their first trial, and in less than 5 seconds on their second trial". Metrics widely used by usability professionals include success rate, error rate, quitting rate, time taken, as in ISO/IEC 9126-2.

The specification would also specify standard test procedures, such as:

- 1) What demographic range of users shall be recruited for evaluations (age, education, prior use of programmable thermostats, other relevant demographics)
- 2) The standard testing protocol (Training time, scripts to be read by test administrators, etc.)

Such performance-based usability metrics are widely used throughout computing and device design practice. The Federal government already specifies usability evaluation methods and metrics

(http://www.usability.gov/methods/test_refine/learnusa/preparation.html). Notably, hospitals are now beginning to procure medical devices based on usability test outcomes

(http://www.usabilitynet.org/tools/r_international.htm#9126-1). This popularity shows no sign of abating.

The remainder of the technical Draft 2.0 specifications are excellent, particularly requirements for default energy-saving settings. I hope you will agree, however, that performance-based metrics should be used to specify usability requirements.

Regards,

-Antony Hilliard, M.ASc.
PhD Candidate, Industrial Engineering, University of Toronto

Attachment B

February 23, 2006

Mr. David Shiller
ENERGY STAR Marketing Manager
Environmental Protection Agency
C/o Gwen Duff, ICF Consulting
1725 Eye Street NW, Suite 1000
Washington, DC 20006

Dear David:

On behalf of the American Council for an Energy-Efficient Economy (ACEEE), thank you for the opportunity to comment on the recent *Programmable Thermostat Program Proposal*. The American Council for an Energy-Efficient Economy is a nonprofit, non-partisan, organization dedicated to advancing energy efficiency as a means of promoting both economic prosperity and environmental protection. ACEEE fulfills its mission by conducting in-depth technical and policy assessments; advising policymakers and program managers; working collaboratively with businesses, public interest groups, and other organizations; publishing books, conference proceedings, and reports; organizing conferences and workshops; and educating consumers and businesses.

ACEEE recently reviewed the savings potential of ENERGY STAR programmable thermostats; our results are summarized in the attachment. We find no evidence from the five field studies found that installation of programmable thermostats is associated with energy savings. We therefore conditionally support your proposal to "transition" the program from an ENERGY STAR thermostat specification to an educational program.

Our condition is that the term "transition" be taken to mean "suspend," in the sense that ENERGY STAR would review and reconsider its decision if robust field studies of sufficient size show that naïve users successfully use programmable thermostats to save energy, without instruction. We also recommend that EPA and its partners evaluate a new feature, an interface to enable peak demand management and energy savings. Public and utility program administrators may value programmable thermostats that will change consumer behavior to save energy without negatively impacting peak demand. At times of peak demand, line losses are highest, and in many situations the least efficient and "dirtiest" power plants may be brought online to meet demand. Both factors suggest that demand control can save energy and prevent pollution.

Because the engineering estimates of energy savings potential of programmable thermostats are large (5% - 15% of annual energy use), ACEEE remains optimistic that units that save energy and please users instead of frustrating them can make a difference. Until these are demonstrated, we support EPA's proposal to work with partners to develop an effective consumer education program.

Again, thank you for the opportunity to comment on the ENERGY STAR programmable thermostat program proposal.

Sincerely,

Harvey M. Sachs, Ph.D.
Buildings Program Director