




Welcome to the Residential Climate Controls Draft 2 Webinar.

I think most people who are going to join us are probably on the line. Rather than spend time on introductions, you can see who is on the line using the attendee list, accessible from an icon on the upper right of your screen.


Please keep your line muted as much as possible, in order to cut down on background noise and interference.

My name is Abigail Daken, and I am managing the development of the Climate Control specification at EPA. With me here is Doug Frazee from ICF international who is the other prime person working on the specification. We also have Dan Cronin from ICF taking notes and helping us out with some of the technology.


So lets get started.



## Agenda



- Context and Drivers
- Draft 2 Version 1.0 requirements
- Effect of enhanced testing requirements
- Next steps and development schedule
- Q&A

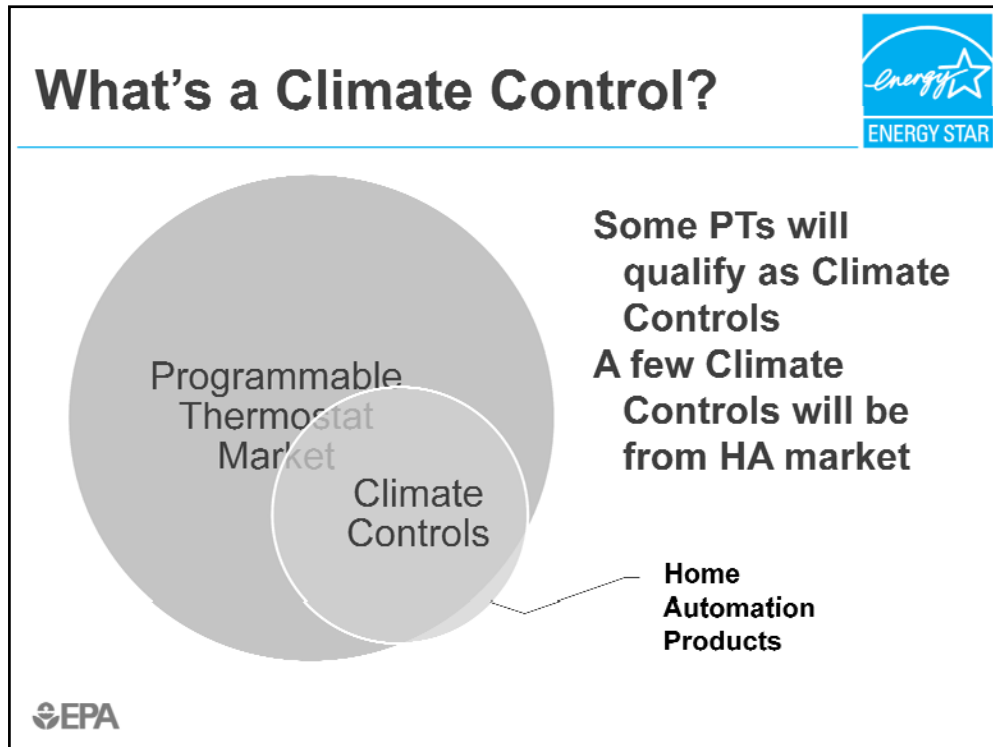


Here's the agenda for today's presentation. We will concentrate on the changes since Draft 1, but in case there are people on the line who are newly engaged in the process, we will review some of the information in the last webinar as well.

Throughout the presentation, we will pause at the end of major topics for questions.

If possible, please hold your questions or comments until these pauses.

In addition, depending on how long we take at each pause, we may have considerable time for discussion after the presentation.



Let's start with what a Climate Control is. As most of you know, ENERGY STAR sunsetted the programmable thermostat specification at the end of last year.

We did so because several studies had shown that programmable thermostats installed in homes were not generally saving people money. In other words, the well-understood potential savings from scheduling heating and cooling were not being realized. These studies revealed a number of barriers preventing that savings from being realized.

EPA did not feel that the specification we had in place at the time, or anything like it, effectively distinguished devices that really would be used correctly by homeowners who were not already turning their thermostats up or down when they left.

We believe that this Climate Controls specification does make that distinction. As those of you who have been following the process know, this is a very different specification than the previous one, which is why we are using a new name for it.

The graphic here shows our understanding of the relationship between the programmable thermostat market and qualified Climate Controls. Some units which are in the PT market will qualify, and most qualified Climate Controls will also be part of the programmable thermostat market. We expect that some, however, will come from the home automation market and may not be part of the traditional PT market.

## Going beyond PTs



- Differentiating features from historic programmable thermostat requirements:
  - enhanced usability, including “Away” mode
  - upgradeable to a communicating climate control, allowing access to a variety of energy-saving tools
  - outdoor temperature data access
  - display of humidity
- EPA will work with stakeholders to refine the current draft so that labeled products deliver user comfort and savings while providing increased energy savings.



Here is a brief overview of what distinguished Climate Controls from programmable thermostats. The features address several of the aforementioned barriers to the actual use of programmed modes, with the expectation that devices qualified under this specification will realize the potential for energy savings.

Specifically, we are addressing usability as well as communications. We expect communications to facilitate creative utility pricing schemes and other novel services, and to help customers understand what they are spending on energy and how they might spend less, saving both energy and money.

## Qualifying Products



- Low-Voltage and Line-Voltage Climate Controls may qualify
- Residential Climate Controls only
- Communicating Climate Control *or* end-user upgradeable to a Communicating Climate Control



As before, we keep the restriction to Residential Climate Controls. There are some key differences between residential and light commercial applications, including continuous ventilation requirements and different schedule requirements, which led us to believe that the specifications requirements would be significantly different. This was partially based on comments received on the Draft 1 Version 2.0 Programmable Thermostat specification.

We recognize the potential value these devices could bring to light commercial applications, and would consider expanding the specification at a later date.

The specification now clearly states our intention that Climate Controls may qualify and be labeled before the communication modules intended to work with them are available.

## Drivers and Context



- EPA recognizes that untapped potential remains for Heating/Cooling Scheduling to save energy and money.
- The Residential Climate Controls specification is designed to realize this potential through:
  - increased use of programmed and manual setbacks – usability is key
  - optimal control of HVAC equipment
  - improved customer visibility into how they are spending their energy dollars and how they can spend less
  - novel services and capabilities enabled by communication outside the HVAC system



## Consumer Cost



- \$250 retail cost (conservative estimate)

Product	Comm	HD screen	Cost	Notes
1	Y	Y	\$469	Retail qty 1, very high-end product produced in low volumes
2	Y	N	\$141	Zigbee SE, Wholesale @qty 25k
3	Y	Y	~\$150	Approx. high-volume wholesale price 2-piece design, WiFi and Zigbee SE, gateway betw. Zigbee & Wifi
4	Y	N	~\$250	Wholesale price @2k volume, Zigbee SE



On the last webinar, many of you asked about the anticipated cost of these devices. Based on your questions, we have done more research, and conservatively estimate \$250 retail price, though we do expect that most of these devices will continue to be distributed by utilities or HVAC and home automation contractors.

Since no products currently on the market have exactly the combination of features required by the Climate Controls Draft 2 specification, we surveyed products with similar features. Luckily, there are a lot of excellent products out there that are close.

There are two kinds of features that may be expensive:

First, most manufacturers anticipate using a high-definition color touch screen to meet the usability requirements in the specification. While it may not actually be needed, we include it as a worst-case cost scenario.

Second, communications external to the HVAC system. Many currently available thermostats have this feature, though few combine it with the usability features we seek.

The following existing products all include compliant communications features but may not comply with usability or power consumption requirements, as noted. However, they are useful for cost benchmarking. Note that non-communicating Climate Controls will be ENERGY STAR eligible and may be sold at reduced prices. In this model, utilities would provide the communication module free to consumers participating in demand response programs.

In addition to the above data, discussions with other Climate Controls stakeholders indicate that qualified Climate Controls will likely be available with retail price points starting at \$150 or lower.

PAUSE FOR QUESTIONS

## Key Elements



- Usability
- Communications
- Added Tier 2, June 2012
  - NIST SG Interoperability Std's Project
  - Digital Comm's internal to HVAC system
- Advanced HVAC control
- Ease of Installation



Now we're going to move to looking at the technical requirements of the specification. Again, we won't review each detail, but focus on key features and on changes from Draft 1.

I will be presenting most of the topics, but my colleague Doug Frazee from ICF International will present the Communication requirements. Before we go into requirements, let me review what qualifies under this specification.

The broad outlines of the specification haven't changed, except that we've added a tier 2, which refers specifically to communications. Doug will talk about that more when we get to that point.

So I'll start off with usability.



## Usability – mental models



- Consumers do not understand HVAC systems
- Use concepts they do understand



- Increase understanding where possible

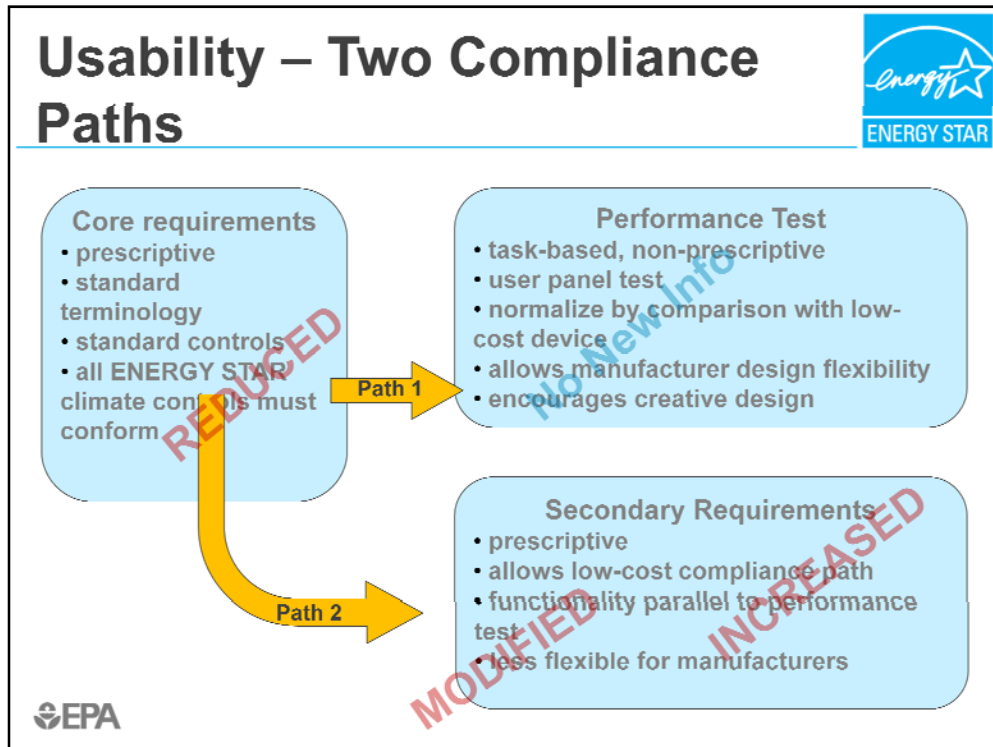


The broad outlines of the usability requirements remain largely the same, but in the interim between draft 1 and draft 2, we have learned more about what we can do to help consumers save energy. The primary thing we learned is that consumers don't understand their HVAC systems. Clearly this is not news to most of you – as I've spoken to some of you over the last week, that's struck a familiar cord. The usability research community talks about this as a problem with mental models. Users either have no idea what happens if they change their thermostat settings, or they have an incorrect idea. So we're trying to focus on communicating with them in terms they do understand.

As an example, we have modified the back up heat indicator requirement. The LED we previously required would only produce action in the small subset of users who know what that means. So in Draft 2 we require an indicator of high relative cost – now that's something everyone understands!

In addition, you will see that some of the requirements are designed to help people understand their systems better.

Research to be presented at ACEEE Summer Study, August 2010.



We maintain the two paths to comply

1. Meet core (prescriptive) usability requirements and pass usability metric.
2. Meet core and secondary (prescriptive) usability requirements .

We have reduced the number of core requirements. On the prescriptive path, we have increased the number of requirements, and modified them, where possible, to allow manufacturers more flexibility and creativity. We'll look at the prescriptive requirements in more detail, since they've been modified. We will only briefly touch on the performance test, as we have no new information about it.

## Usability – Core Requirements



- ~~Standardized “back up heat” indicator (modified secondary requirement)~~
- ~~Set date/time w/o user input~~
- Maintain date/time w/o user input
- Standardized default “Away” Heat & Cool set points with limited adjustability
- 62°F Heat / 85°F Cool
- Low Battery indicator



There are now only 3 core requirements. We have moved the back up heat indication to the secondary requirements, and modified it as mentioned.

In response to stakeholder comments that the requirement would be costly and would not provide a great deal of user benefit, we now allow Climate Controls to require that the time is initially set. We presume that will usually be done by an installer. Given this, we are now more specific about the need to maintain the time setting through a 1 week power failure, and also about implementation of daylight savings time.

The “Away” set points have not changed, nor has the low battery indicator.

And that’s now it for the core requirements.

## Usability – Secondary Requirements



- Operating mode indication
- Temperature display resolution (0.5°C, if shows in Celsius)
- TOU price tier indication (modified)
- Relative high price indicator for electric resistance back up heat.
- Single operations to activate “Away” mode, and for temperature adjustment
- Font size



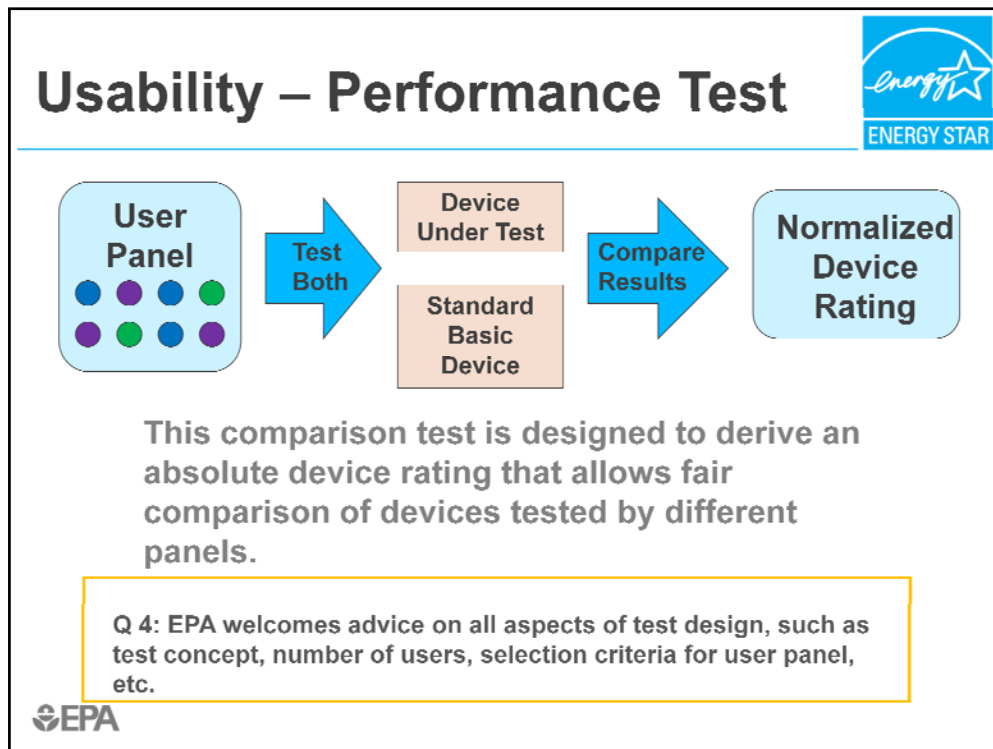
These are the prescriptive requirements that are only relevant for units that take path 2 to compliance and do not undergo performance-based usability testing.

There are now seven of them.

We have added a requirement that the device indicate it's operating mode (Following program schedule, Away, Long-Term Hold, Short Term Hold, etc.; HVAC mode; Fan mode; Program (configuration/setup) mode).

Many stakeholders commented both for and against requiring Celsius temperatures to be displayed in half-degree increments. In response, we have made Celsius display entirely optional, however if the Climate Control can display temperatures in C, it must show them, and allow adjustment, in half degree increments.

The TOU price tier indication has been modified to include a flashing red indicator for a four tier pricing scheme, and also to accommodate users with color vision deficiencies. We continue to consider this indication important. The location of most Climate Controls in high traffic areas of homes provides a unique opportunity to use ambient display principles to increase consumer response to pricing events. For those consumers participating in demand response programs, this is an important money saving opportunity.



- This slide will be familiar to those of you who were here for the first webinar – I just want to go over it quickly for anyone new.
- Only valid test = user panel performing common tasks. attempt to complete a series of six or seven common tasks using the Climate Control.
- how to compare results from different panels.
- specify panel size and composition
- not enough, thus panel performs the tasks on two devices: the Climate Control under test and a basic device which will be the same for all panels. DUT score based on the success rates on each task relative to success with the standard device.
- Success on each task = error-free completion and/or time to complete, depending on the task.
- Task scores on the tasks will be combined: min level or average or both
- Determining this, as well as determining a passing score, will require a great deal of thought and testing, which we will pursue in the coming months.

PAUSE FOR QUESTIONS

# Communications

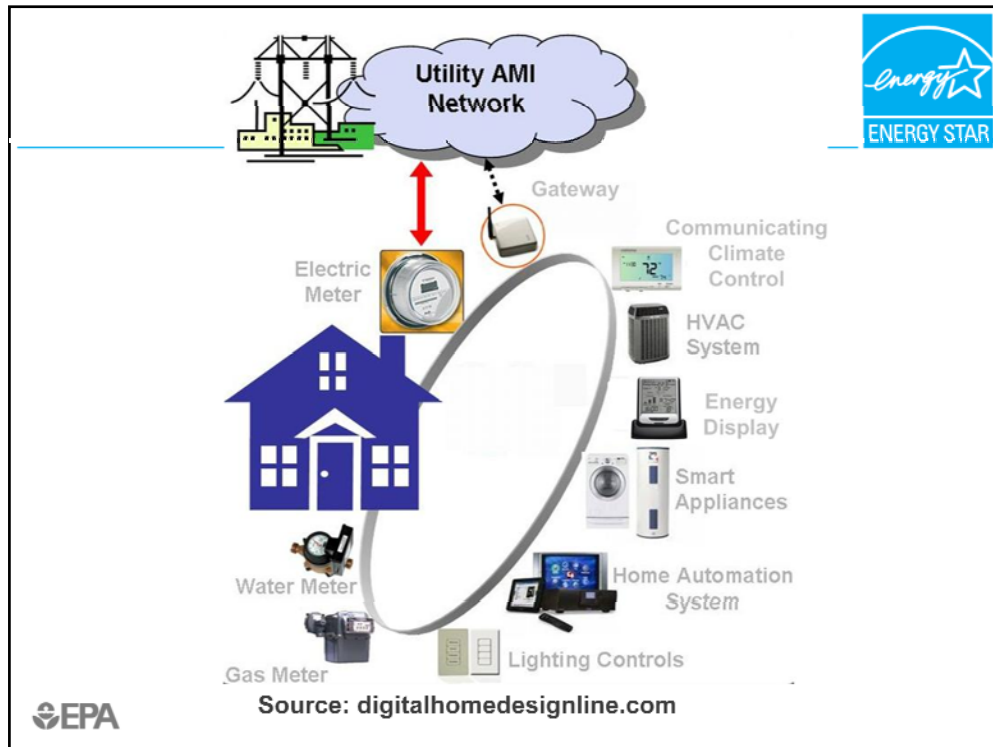


- Draft 2 Specification Changes
  - Definition of Open Standard has been removed
  - Requirement to use Open Communications Standards, where they exist has been removed
  - Data reporting and remote control requirements re-worded to clarify that they apply only to the Climate Control and do not extend to other elements of a larger system *that may include the Climate Control.*



This slide is a snapshot of changes to comm rqmts from Draft 1 to 2, additional detail is provided in the following slides

-Stakeholder comments were received that expressed concern over data storage and backhaul bandwidth requirements for the 1-minute data generated from Climate Controls. In response to these concerns, requirements 22 & 23 have been reworded to clarify that these communication requirements apply only to the Climate Control. EPA recognizes there may be other limiting factors in system level implementations that result in less frequent data collection or less responsive remote control. EPA has proposed these rqmts to ensure that the CCC is not the limiting factor.



- This Diagram presents a conceptual Smart Grid deployment.
- Other than the “cloud”, all devices are in or on the home
- With residential HVAC representing approx. 50% of residential energy consumption, the Communicating Climate Control is a key element for energy management. Utility Smart Grid deployments that include smart meters and CCC enable advanced energy management capabilities that help end users intelligently manage their energy consumption and expense, resulting in energy savings and reduction of carbon emissions from:
  - Enhanced energy awareness, via pricing indicators, energy dashboards and other tools
  - remote control & remote programming from PCs and smart devices
  - remote access to energy saving modes
  - innovative applications that take automatic action to reduce consumption

## Tier 1 Communication Requirements



- 3<sup>rd</sup> party open access (SDK or ICD required)
- Must use suitable open communications standards, when they exist
- Communication security
- 60-second Climate Control data availability
  - transmitted at least every 5-minutes
- Near-real time response to remote commands





## Tier 2 Communication Requirements

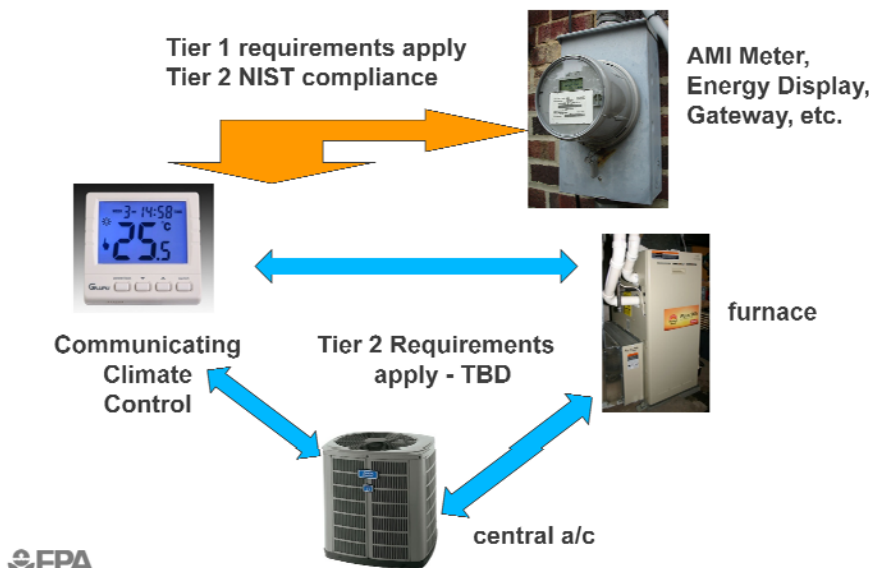


- Tier 1 requirements, plus
- Compliance with recommendations of NIST Smart Grid Interoperability Standards Project
- Digital communication with controlled HVAC equipment



- EPA is ramping up engagement with the NIST Smart Grid effort, additional information will be shared as we better understand the implications of the SGIP.
- Tier 2 development will, of course, be a stakeholder process webinars, commenting periods, etc.
- Last bullet refers to digital communication between the CC and the controlled HVAC devices incl heat pump, central ac, furnace etc. A number of tstat mfr currently market flagship systems that use proprietary thermostats with digital interfaces for HVAC control. There is also at least one open standard development effort for digital HVAC comms.
- Advantages to dig comms internal to the HVAC system include:
  - Auto-configuration, ensuring correct HVAC system configuration for optimal control and EE
  - Measurement and display at the CC of HVAC energy consumption & cost
  - Display of maintenance alerts on the CC, on smart devices or even automatic notification to the HVAC service contractor
- Proper installation and maintenance are strong drivers for achieving and maintaining max EE

## Communications (cont.)



Orange = Tier 1 – comms external to HVAC system

Blue = Tier 2 – digital comms internal to HVAC system

Note that it may be possible for both communication paths to share the same communication protocols and/or hardware.

## Advanced HVAC Control



- Recovery definitions harmonized with NEMA DC3-2008
- Recovery, adaptive as default
- For heat pump control default recovery must meet the requirements for recovery, adaptive AND recovery, heat pump with auxiliary heat



Many of the advanced HVAC control features have not been modified.

## Advanced HVAC Control (cont.)



- $\pm 1^{\circ}\text{F}$  operating differential
- Access to outside temp data
- Humidity sensing and display with minimum accuracy of  $\pm 3\%$ – $\pm 5\%$  (line voltage devices exempt)
- ~~0.5w maximum power consumption in any operational mode~~ (See next slide)
- Default schedule periods renamed to: Morning, Day, Evening, Night
- Default Night Cool setpoint relaxed to  $\geq 78^{\circ}\text{F}$



We have relaxed the required accuracy for humidity sensing to 5%. While we recognize important health and home care advantages to humidity control, we did not feel there was a strong energy efficiency case to be made for requiring Climate Controls to have this option. We hope that manufacturers will provide this option on some models for individuals who would like it.

The power consumption limit has changed; lets go to the next slide for the details.

# Power Consumption



- 2 W for Communicating Climate Controls, including active communication circuits (same device or separate)
- 1 W for Non-communicating Climate Controls
- If communication modules become available later, must report, and meet 2 W total limit.

Product	Communication options	Energy use (W)	Other parameters...
Anonymom	--	0.8	
SuperComfort 3	Zigbee	1.5	
	WiFi	1.82	
	Ethernet	1.48	



Intentionally left blank.

## Ease of Installation



- Written installation instructions are required; written user instructions are no longer required.
- Residential use, only – specific labeling required on packaging and instructions.
- Exemptions to NEMA DC3-2008 terminal markings for Line Voltage Climate Controls and Low Voltage Climate Controls that use serial data links for direct HVAC control
- *Minimum battery life 12 months as in Draft 1*



EPA recognizes benefits of thermostatic HVAC via serial data links, including

- Increased EE
- Diagnostic capability / fault detection
- Advanced control

PAUSE FOR QUESTIONS

## Enhanced Testing Requirements



- Enhanced qualification and verification testing requirements across ENERGY STAR program – not unique to Climate Controls.
- [www.energystar.gov/testingandverification](http://www.energystar.gov/testingandverification)
- Qualification: Test reports from EPA-approved, accredited labs will be reviewed prior to qualification
- Verification: third-party testing of products acquired from distribution channels



In this particular transition, Climate Controls partners have an advantage: By the time this specification is released, the ENERGY STAR program will be running in the new normal. Partners will send in test data from an EPA-approved, accredited lab, and products will be qualified (and partners given permission to use the ENERGY STAR label) after the test reports are reviewed.

We are likely to still be developing the verification testing program, which will assure that qualified products continue to meet ENERGY STAR specifications through third-party testing of products acquired from distribution channels. More information is available on the testing and verification web page, including news about the ongoing stakeholder process. We encourage Climate Controls stakeholders to remain involved in this stakeholder process, particularly considering that the usability test is a unique requirement with no similar test for any other ENERGY STAR product.

PAUSE FOR QUESTIONS

## Enhanced Testing Requirements



- Process continues on schedule
- Requirements finalized for laboratories and accreditation bodies; now accepting applications
- Climate Controls specification will be released with new requirements active
- Eventually, one or more certification body expected; at the beginning, perhaps not



Our intention has always been that the Climate Controls specification will be effective upon its release. However, we recognize that it may take some time for labs to be accredited against the new test requirements (even excluding usability). If this is the case, we will consider altering the effective date.



## Next steps



- Release to stakeholders of the draft usability metric, prior to final release
- Stakeholder webinar on test method and metric
- The ENERGY STAR Residential Climate Controls Specification Planned release date is November 1, 2010.
- Tier 1: Nov 1 2010; Tier 2: Jun 1, 2012

## Schedule



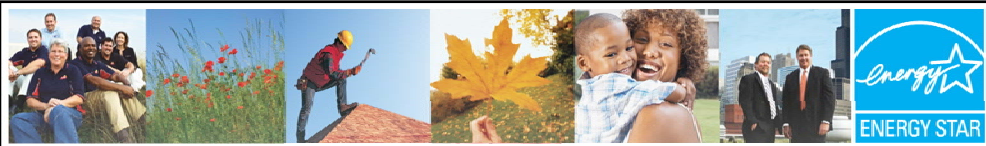
- March-April 2010 Draft 1 specification, webinar, comments
- 7-1-2010 Draft 2 specification
- 7-14-2010 Stakeholder webinar
- 7-30-2010 Comments due
- August 2010 Draft usability metric, webinar, comment period
- September 2010 Draft 3, with usability metric and enhanced testing
- October 2010 Final draft specification
- November 2010 Final Version 1.0 Residential Climate Controls specification



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# Thank you



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