EPRI Comments on EPA ENERGY STAR® Specifications for Climate Controls (Eligibility Criteria, Draft 3, Version 1.0)

The following comments are provided to the Environmental Protection Agency (EPA) by the Electric Power Research Institute (EPRI) in response to the EPA's solicitation of stakeholder feedback regarding the draft "*ENERGY STAR® Program Requirements for Residential Climate Controls, Eligibility Criteria Draft 3 Version 1.0*". EPRI appreciates the opportunity to be involved in this important body of work and to provide comments.

At the outset, EPRI would like to commend and thank the EPA for significantly advancing the most used consumer energy interface in the home. We believe that enhanced user interface designs and/or autonomous self-learning behaviors that make climate controls easier to use are critical to advancing the goals of energy efficiency (EE) and demand response (DR) of HVAC systems. EPRI's comments reflect the belief that establishing interoperability of systems and devices and enabling open standards is critical to achieving mass market DR. EPRI would like to ensure that future climate controls are capable of receiving utility signals for demand management, and to feed back data on the operation of the air conditioning systems as an element of participation in DR programs. The EPA's approach may encorage innovation in air conditioner design and by extension in other home devices. This approach to climate controls may also have secondary benefits such as furthering the utilization of building passive energy storage capability and helping to realize the full EE and DR potential of variable speed systems. Some of the comments provided herein are also informed by our work in regards to "Connected" Refrigerators and Window air conditioners.

There are two areas of concern related to changes in Draft 3 compared to Draft 2:

1. The EPA has removed entire sections in Draft 2 that dealt with the Energy Management Systems, AMI, ESI, DR and TOU. These are all areas of high impact to the utility, and Draft 3 as a result does not lay the foundation for providing utility services to the same extent as Draft 2.
2. With the removal of the requirement for LED lights, there is no requirement to provide consumers any feedback on pricing and utility signals. The climate control is the primary consumer energy interface in the home, and can be important for alerting customers to DR events. We request consideration of an alerting mechanism such as a red LED light or a beeping noise to indicate utility emergency events.

EPRI's viewpoint is that climate controls products that are installed today might be in service for another 20 years. Consequently, they will need to be highly reliable, upgradeable and provide services required by an electric grid that is rapidly getting smarter. The comments herein are presented topically, with references to locations in the draft proposal noted as needed.

Comments Regarding Definitions

In the area of communicating climate controls (lines 160-167), we agree with the requirement for the climate control to communicate with sources external to the HVAC system. However, we would like more specificity on the term "external sources" to better define out-of-the box energy efficiency and demand response capability. We would like to incorporate the following set of minimum requirements with regards to communication with external sources:

"The climate control should be capable of receiving demand response signals either directly from the utility (or 3rd party) or indirectly through sources such as a home computer, mobile device, or home energy management devices.

The climate control should report state of the HVAC system or the total power usage including indoor blower to an external source (extension of data reporting requirements) that can verify response to a utility signal. Example states include 1st stage cool, 2nd stage cool, 1st stage heat, 2nd stage heat, %heat or cool if variable speed, auxiliary heat, and fan (low speed/ high speed).

In regards to line 167, EPRI encourages reinsertion of language requiring usage of open standards, where they exist, similar to Draft 2.

With regards to Adaptive Recovery as set in lines 179 - 181, EPRI would like to include mitigation of the impact on energy demand when implementing adaptive recovery techniques. Adaptive recovery could trigger HVAC systems to turn on at peak demand times based on setback strategy and home tightness. An example language would be "the climate control will not trigger 2nd stage heating or cooling or auxiliary heat for recovery during times of high electric price or system emergency". One exception would be variable speed systems that can vastly mitigate demand impacts while still providing smart adaptive recovery.

We thank the EPA for advising mitigation of auxiliary heat during recovery of heat pump systems in lines 182-183. For long term hold mode as defined in lines 186-187, EPRI recommends the modification of the language such that consumer programmed demand response settings (such as pre-programmed response to price signals) are not suspended.

We would very much encourage the EPA to restore sections related to Energy Services Interface, Demand Response and TOU, in particular Demand Response, which is a key feature that will be enabled by the new climate control specification. Without these sections, the relevance of the climate control to utility needs is reduced significantly.

Comments Regarding Qualifying Products

EPRI requests the EPA to incorporate requirements to use standard hardware interfaces (e.g. a standard modular interface or connector such as CEA 2045) for Field Upgradable Communicating Controls. We would like to ensure that the hardware connection mechanism does not serve to lock climate controls into manufacturer proprietary standards. This can lead a multiplicity of legacy climate controls that lack connectivity. Open hardware architectures that enable interoperability with different communications

protocols are already available for various end-use categories. Open architectures help ensure that these controls can be upgraded at the earliest time possible, and prevent a lockout because a manufacturer does not see a market from their perspective or a manufacturer exits the climate control business. It will also enable utilities to easily provide hardware for demand response and energy management services, similar to currently available programs.

Comments Regarding Energy Efficiency Criteria

EPRI commends the EPA on the very thoughtful structure of the usability requirement, which can advance both standardization and innovation.

Section A: Technical Criteria:

EPRI agrees with the removal of default nomenclature for the time periods within a day. We believe it is more intuitive to the consumer to associate time periods with their activity (e.g, home, sleep, away, vacation) since indoor temperature is more closely related to human activity vs. time of day. As an example, both a normal day and a night shift worker would want their home to be at 76 F when they "home" and 82F when they are "away" in the cooling season.

In lines 257 – 265, EPRI would like to reiterate the requirement for the selectable recovery algorithms to accommodate for utility demand signals and peak requirements. We would encourage mandatory measures such as no auxiliary heat operation for recovery during utility peak periods, ensuring compressors do not come back on full power during DR periods and override of comfort based adaptive algorithms during these high demand periods.

Section B: Communication Criteria

We commend the EPA requiring open access to devices through published APIs. EPRI would like to ensure that open APIs do not adversely impact the consumer experience, which will adversely impact adoption of climate controls. EPRI would prefer that the use of published APIs be mainly to support those functions that are in addition to common utility demand response signals. No API should be required, but rather open standards, for the communication of common price, event, monitoring, and verification messages.

With regards to connectivity standards in lines 299 – 313, EPRI suggests that the physical communication means (lower layers) and a core set of DR related messages (upper layers) be required to be supported in an open standard way, rather than just recommended. In addition to software standards, EPRI would suggest the addition of additional requirements for hardware compatibility. This is especially important for future upgrades of communication capability. Existing standards such as CEA-2045 ensure interoperability and prevent "competition lockout". EPRI suggests that upgradeable communicating climate controls are provided using widely available and acceptable hardware connections.

EPRI views the requirement to transmit data every 5 minutes (line 339) as useful in some cases. This would not necessarily be sufficient for all demand-side response purposes. If in the future, buildings are

utilized for providing ancillary services such as frequency response, a higher data transmission frequency may be required. This can however, be addressed with advancing iterations of ENERGY STAR criteria rather than burdening the entire industry at this time.

We would like the EPA to revisit the minimum data storage period. A 1 month timeframe will provide consumers' with their monthly billed HVAC energy consumption.

We noticed that the humidity reading and control mode is required in the reported data (line 351) though humidity measurement is no longer required.

EPRI supports the requirement for real-time response to remote commands. Wording, however, in lines 352 to 354, should be modified to make no reference to communication delays outside the climate control, as it can have no influence over this. If the intent of the language currently used is that the total delay be 5 seconds, with one second of that being outside the climate control, then the specification could be better worded to just respond in 4 seconds, after receipt of the command.

Section C, Ease of Installation Criteria:

EPRI generally agrees with the installation requirements. We would encourage delivery of installation instructions through computers and smartphones to enable enhanced graphic illustration.

One area of concern is the reliability of communication networks. As anyone who manages their home wireless network knows, failures requiring manual restart of routers and devices are common. While a reboot every 6 months can be acceptable for home internet connectivity, it is unacceptable for a climate control solution whose life expectancy is 20 years. To this end, we would encourage the EPA to require measures such as:

Installers should be provided tools and instructions to correctly set up both the in-home wall interface and the remote interface (if present), ensuring no conflicts between the operation of the two interfaces.

- For climate controls that rely on wireless networks as an essential part of their operation, the control interface (wall interface) should provide indication of signal strength.
- Climate controls should possess the ability to run in a fail-safe mode when remote connectivity is lost.
- Provide diagnostics messages on the control interface when connectivity is lost.
- Provide assistance in reconfiguring the network when the network goes down.

Subsection D, Residential Climate Control Ease of Use Criteria:

Subsection D1: Core Prescriptive Ease of Use criteria:

EPRI would suggest language pertaining to preservation of settings in climate control devices at times of power and communication failure. Given the power required for communications, most climate control systems will utilize on-board HVAC 24 VAC power to operate the device. The language in lines 420 – 422 should cover power interruptions from building power failure, HVAC maintenance or if a fuse trips on the HVAC unit.

On core usability requirement c, EPRI would suggest increasing the maximum for AWAY heat setpoint to be 68 F and the minimum AWAY cool setpoint to be 78 F. Extreme defaults could reduce consumer acceptance because of extended recovery times and/or trigger high stage operation (e.g., strip heat in heat pumps). This could have unintended consequences during summer peak periods (example, ac kicks on at 5 PM on high stage).

Subsection D2: Additional Prescriptive Ease of Use Criteria:

On lines 447 – 449, EPRI would like to consider the use of Away mode as a default response to utility emergency events. It could also be a default consumer response when the consumer is informed of utility emergencies. An example sequence of events would be: Red LED blinks on the interface indicating emergency event → Consumer notices and presses a single hardware button → the climate control responds by defaulting to AWAY mode for a fixed number of hours.

EPRI commends the EPA for paying special attention to the auxiliary heat requirement which drives winter peaking in southern climates. We would like to see climate control systems avoid turning on auxiliary heating using internal timing delays on auxiliary heat as well as algorithms that adapt to the ramp rate of indoor temperature. We would also like to keep off auxiliary heat when the climate control is in AWAY mode.

EPRI would like the EPA to consider the term "Vacation" or one with similar meaning to indicate a long term hold setting. This will avoid confusion with the "Away" terminology traditionally used in thermostats as part of the daily programming.

Subsection D4: Performance Based Ease of Use with Remote Interface:

For systems that derive their usability from remote interfaces, we think it is critical to protect against loss of wireless connectivity. Since home configurations change during operation (especially for new homes), climate controls MUST have an indication of wireless connectivity/ signal strength. A derivative requirement would be reversion to default settings or current user settings on the climate control in case of wireless communications failure.

We also need to ensure coordination of remote interfaces with the climate control device. We would like to require the 5 second remote command requirement to apply in both directions, i.e., changes made to the climate control should be registered on the remote interface within 5 seconds. If this does not happen, the remote interface and the climate control would show different values and status, resulting in user confusion. Addressing these issues would be a pre-requisite for developing 3rd party APIs or apps, as 3rd developers might not be as aware of usability experiences as the manufacturers.

Additional Comments on enabling Mass Market Demand Response

Air conditioners are the largest load in homes and the best target to enable demand response. Currently, demand response is mainly accomplished through Direct Load Control (DLC). DLC is accomplished by inserting a relay in series with the air conditioner. The relay is controlled through a broadcast signal from the utility and is used to turn the air conditioning compressor ON and OFF at

regular intervals (e.g., 7 minutes). Manufacturers have expressed a preference towards a more sophisticated control that would be amenable to both the utility and the air conditioning system.

We believe that sophisticated climate controls can provide better peak load management while also providing a more comfortable consumer experience. We are of the opinion that the previous draft of was much attuned to providing these services. To this end, we would like to restore the requirement to provide indication to the consumer of utility emergency events. As an example, the indicator can alert customers during the "Flex your Power" alert from the California ISO, triggering savings from millions on non-TOU residential customers.

Providing consumers an indication of utility emergency events can also initiate consumer response on other high energy end use devices such as water heaters, plug loads like hair dryers and space heaters, etc. Hence, it would be very supportive of DR needs to restore a method of indicating utility emergency events on the climate control interface, given that climate controls are in many cases the only energy interface to the consumer.

We thank the EPA for the opportunity to provide our comments. We will be happy to further inform the criteria development process through discussion, providing clarification on submitted comments and collaborating on testing and education efforts with regards to climate control devices.