**REPI-70-21**

**IECC®: SECTION 202 (New), R403.1.1, R403.5.4 (New), CTA (New),**

**Proponents:**

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**2021 International Energy Conservation Code**

**SECTION R202**

**GENERAL DEFINITIONS**

*Add new definitions as follows:*

**DEMAND RESPONSE SIGNAL.** A signal that indicates a price or a request to modify electricity consumption for a limited time period.

**DEMAND RESPONSIVE CONTROL.** A control capable of receiving and automatically responding to a *demand* *response signal*.

**SECTION R403**

**SYSTEMS**

*Revise text as follows:*

**R403.1 Controls.** Not less than one thermostat shall be provided for each separate heating and cooling system. The primary heating or cooling system serving the dwelling unit shall comply with Sections R403.1.1 and R403.1.2.

**R403.1.1 Programmable thermostat.** The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature setpoints at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C).

**R403.1.2 Demand responsive thermostat.** The thermostat shall be provided with a *demand responsive control* capable of communicating with the Virtual End Node (VEN) using a wired or wireless bi-directional communication pathway that provides the homeowner the ability to voluntarily participate in utility demand response programs, where available. The thermostat shall be capable of executing the following actions in response to a *demand response signal*:

1. Automatically increasing the zone operating cooling set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).
2. Automatically decreasing the zone operating heating set point by the following values: 1°F (0.5°C), 2°F (1°C), 3°F (1.5°C), and 4°F (2°C).
3. ~~Increasing the cooling set point by a maximum of~~ *~~4°F (2.2°C)~~*
4. ~~Decreasing the heating set point by a maximum of~~ *~~4°F (2.2°C)~~*

Thermostats controlling single stage HVAC systems shall comply with Section R403.1.2.1. Thermostats controlling variable capacity ~~and two-stage HVAC~~ systems shall comply with Section R403.1.2.2. Thermostats controlling multi-stage HVAC systems shall comply with either Section R403.1.2.1 or R403.1.2.2. Where~~n~~ a *demand ~~responsive~~response signal* is not available the thermostat shall be capable of performing all other functions.

**Exception:** ~~Health care and a~~Assisted living facilities.

**R403.1.2.1 Single stage HVAC system controls.** Thermostats controlling single stage HVAC systems shall be provided with a *demand responsive control* that complies with one of the following:

* + - 1. Certified OpenADR 2.0a VEN, as specified under Clause 11, Conformance
  1. Certified OpenADR 2.0b VEN, as specified under Clause 11, Conformance
  2. Certified by the manufacturer as being capable of responding to a *demand response signal* from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls
  3. IEC 62746-10-1
  4. The communication protocol required by a controlling entity, such as a utility or service provider, to participate in an automated demand response program
  5. The physical configuration and communication protocol of CTA 2045-A or CTA-2045-B

**R403.1.2.2 Variable capacity and two stage HVAC system controls.** Thermostats controlling variable capacity and two stage HVAC systems shall be provided with a *demand responsive control* that complies with the communication and performance requirements of AHRI 1380.

**SECTION R407**

**TROPICAL CLIMATE REGION COMPLIANCE PATH**

*Revise text as follows:*

**R407.2 Tropical climate region.** Compliance with this section requires the following:

1. Not more than one-half of the *occupied* space is air conditioned and is controlled by a thermostat in accordance with Sections R403.1.1 and R403.1.2.

**Add new standard(s) as follows:**

Chapter 6 Referenced Standards New

AHRI

Air-Conditioning, Heating, & Refrigeration Institute

2111 Wilson Blvd, Suite 500

Arlington VA 22201

AHRI 1380-2019 Demand Response through Variable Capacity HVAC Systems in Residential and Small Commercial Applications

ANSI American National Standards Institute

25 West 43rd Street, 4th Floor

New York NY 10036

CTA

Consumer Technology Association Technology & Standards Department

1919 S Eads Street

Arlington, VA 22202

ANSI/CTA-2045-A – 2018 Modular Communications Interface for Energy Management

ANSI/CTA-2045-B – 2018: Modular Communications Interface for Energy Management

IEC

IEC Regional Centre for North America

446 Main Street 16th Floor

Worcester, MA 01608

IEC 62746-10-1 - 2018 Systems interface between customer energy management system and the power management system - Part 10-1: Open automated demand response

OpenADR

OpenADR Alliance

111 Deerwood Road

Suite 200

San Ramon, CA 94583

OpenADR 2.0a and 2.0b – 2019: Profile Specification Distributed Energy Resources

**Reason Statement:**

As buildings account for over 70% of U.S. electricity use, effectively managing their loads can greatly facilitate the transition towards a clean, reliable grid. Grid-interactive efficient buildings (GEBs) combine efficiency and demand flexibility with smart technologies and communication to provide occupant comfort and productivity while serving the grid as a distributed energy resource (DER). In turn, GEBs can play a key role in ensuring access to an affordable, reliable, sustainable and modern U.S. electric power system. Their national adoption could provide $100-200 billion in U.S. electric power system cost savings over the next two decades. The associated reduction in CO2 emissions is estimated at 6% per year by 2030.[1]

Building codes represent standard design practice in the construction industry and continually evolve to include advanced

technologies and innovative practices. Historically, national model energy codes establish minimum efficiency requirements for new construction.[2] Expanding codes to support GEB capabilities is a pivotal step towards realizing demand flexibility in support of a clean grid by addressing capabilities to improve interoperability between smart building systems, the grid, and renewable energy resources. Realizing GEBs requires buildings with automated demand response (DR) capabilities that enable standardized control, subject to explicit consumer consent, of energy smart appliances on an electricity network. This is achieved through communication between appliances and a controlling entity that is in communication with the consumer participants.

Energy codes can support DR communication standardization and advance the deployment of flexible load technologies such as smart home energy management systems, energy storage, behind-the-meter generation, and electric vehicles (EVs). Incorporating automated demand response capabilities in energy codes provides many benefits to consumers and society. Specifically, it matches intermittent renewable energy sources to building electric loads, decreases peak load on the electric grid, allows buildings to respond to utility price signals, supports electrical network reliability and market growth of products and processes aligned with clean economic growth.

The incorporation of DR into the model residential energy codes was considered for the 2021 International Energy Conservation Code (IECC) code development cycle. The scope of this proposal includes two strategies for DR in residential buildings: 1) smart thermostats with demand-responsive control and 2) electric water heating incorporating demand-responsive controls and communication.

**[1] DOE (U.S. Department of Energy). 2021. A National Roadmap for Grid-Interactive Efficient Buildings. Washington DC.**

**Accessed on June 9, 2021 at https://gebroadmap.lbl.gov/**

**[2] While advanced codes can be considered model codes, in this document, the term “model energy code” refers to the**

**current published version of the International Energy Conservation Code-Residential and ASHRAE Standard 90.1, as those**

**documents are referenced by Energy Conservation and Production Act as modified by the Energy Policy Act of 1992 as the**

**minimum requirements for states adopting energy codes. https://www.govinfo.gov/content/pkg/USCODE-2011-**

**title42/pdf/USCODE-2011-title42-chap81-subchapII.pdf.**

**[3]** [**https://www.iccsafe.org/building-safety-journal/bsj-technical/co**](https://www.iccsafe.org/building-safety-journal/bsj-technical/co)

**Cost Impact:**

After additional review of thermostat costs, we believe $200 to be a more accurate estimate of the maximum incremental cost for smart thermostats when compared to programmable thermostats. In addition, many utilities will provide a free thermostat or substantial rebate, to participate in a DR program.

The code change proposal will increase the cost of construction.

The costs associated with installing residential DR control strategies highlighted in this technical brief are discussed below. The

installed costs for smart thermostats and electric water heaters with DR control are modest and depend on the design of the home. The cost of a standard programmable thermostat required in the 2021 IECC ranges from $20 to $100 based on costs at local home improvement stores. A smart thermostat can range from $120 to $400 based on brand, model, and level of sophistication. The cost to install a programmable or smart thermostat ranges from $112 to $255, with the national average cost of $175. Thus, the incremental cost of upgrading from a standard programmable thermostat to a smart thermostat with DR controls is anywhere between $100 and $300.

Electric resistance water heaters supplied with CTA-2045 communication have been manufactured but are not widely available.

HPWHs have taken over the energy efficiency segment of the water heater market, and brands at local home improvement stores include the CTA-2045 communication ports. The average cost for a 50-gallon electric resistance heater is $400, while the average cost for a 50-gallon HPWH is $1,300 at local home improvement stores (Salcido et al. 2021). The incremental cost of $900 plus additional condensate removal equipment of $75 results in a total cost differential of $975. Therefore, for buildings already including HPWHs in the original design, the incremental increase in cost is $0. If the building specified an electric resistance water heater, the most straightforward way to implement the CTA-2045 communication for DR control is to switch to an HPWH with an incremental cost of $975.

While DR control functionality will reduce costs to utilities as well as electric costs to consumers, it is difficult to estimate or calculate the actual cost savings. DR will present cost-saving opportunities for buildings as more homeowners take advantage of time-of-use or realtime pricing controls as they become more widely available. Adding DR controls in model energy codes can help homeowners have the capability of participating in DR programs with alternative utility pricing structures whether they exist now or in the future. When DR requirements are part of the model energy code, it will not require homeowners or buildings.