2024 INTERNATIONAL ENERGY CONSERVATION CODE (IECC) COMMERCIAL & RESIDENTIAL COMMITTEE FINAL BALLOTS – APPEALS

Staff Analysis Memo to ICC Appeals Board
Appeals Based on Subject Specific Issues

February 2024

Three appeals – filed by AHRI, NMHC/BOMA, and the Region VI Chapter of ICC (Region VI) – relate to certain technical issues with final actions taken by the 2024 International Energy Conservation Code (IECC) Commercial and Residential Committees. These appeals allege certain provisions of the codes are not cost-effective, do not increase efficiency, prioritize certain fuel sources over others, will not be feasible to implement, and/or are inconsistent with other I-Codes. More details regarding the allegations in the appeals, as well as ICC staff's response, are set forth below.

RELEVANT POLICIES

I. Relevant Policies

For purposes of the appeals at issue, two sections of CP-01 are of particular relevance:

- Section 6.3.7 provides: Review by the Appeals Board shall be limited to matters of process and procedure. The Board of Appeals shall not render decisions on the relative merits of technical matters.
- Section 6.3.8 provides: In order to sustain the appeal, or any part thereof, the Appeals Board must find that there was a material and significant irregularity of process or procedure.

IECC Committee Procedures

COST IMPACT AND EFFECTIVENESS ANALYSIS

In accordance with the Intent statement in both codes, the intent of the provisions is to provide "minimum efficiency requirements for buildings that result in the maximum level of energy efficiency that is safe, technologically feasible, and life cycle cost effective, considering economic feasibly, including potential costs and savings for consumers and building owners, and return on investment." The Intent statement further notes, "The code is updated on a three-year cycle with each subsequent edition providing increased energy savings over the prior edition".

In order to achieve this intent, all proposed changes shall include a statement on cost impacts consistent with the requirements of Council Policy 28 Section 3.3.5.6 and proponents are encouraged to include a cost effectiveness analysis. If a cost effectiveness analysis is not provided by the proponent, the committee may request the Department of Energy provide one to support their consideration. When offered by the code change proponent or requested by the committee, a cost effectiveness analysis shall be provided by the U.S. Department of Energy (DOE) national laboratories, if DOE provides such an analysis, and otherwise be conducted by an independent technical consultant in a transparent manner. Underlying assumptions should be clearly documented including compliance with any parameters set by the committees and approved by the Board. Such an analysis shall consider the change's cost effectiveness for the building owner, occupants and the energy system as a whole including both initial cost and life-cycle cost and savings. The Committee may develop a consistent set of parameters for use in a cost-effective analysis.

The Committees may use the results of a cost effectiveness analysis as a factor in determining acceptance of a change proposal, but other factors may also be considered including market-readiness.

II. Text of Relevant Code Sections

COMMERCIAL ENERGY PROVISIONS

C101.3 Intent
The International Energy Conservation Code-Commercial provides market-driven, enforceable requirements for the design and construction of commercial buildings, providing minimum efficiency requirements for buildings that result in the maximum level of energy efficiency that is safe, technologically feasible, and life cycle cost effective, considering economic feasibility, including potential costs and savings for consumers and building owners, and return on investment. Additionally, the code provides jurisdictions with supplemental requirements, including ASHRAE 90.1, and optional requirements that lead to achievement of zero energy buildings, presently, and through glidepaths that achieve zero energy buildings by 2030 and on additional timelines sought by governments, and achievement of additional policy goals as identified by the Energy and Carbon Advisory Council and approved by the Board of Directors. Requirements contained in the code will include, but not be limited to, prescriptive- and performance-based pathways. The code may include nonmandatory appendices incorporating additional energy efficiency and greenhouse gas reduction resources developed by the Code Council and others. The code will aim to simplify code requirements to facilitate the code's use and compliance rate. The code is updated on a three-year cycle with each subsequent edition providing increased energy savings over the prior edition. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this intent. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

RESIDENTIAL ENERGY PROVISIONS

R101.3 Intent
The International Energy Conservation Code-Residential provides market-driven, enforceable requirements for the design and construction of residential buildings, providing minimum efficiency requirements for buildings that result in the maximum level of energy efficiency that is safe, technologically feasible, and life cycle cost effective, considering economic feasibility, including potential costs and savings for consumers and building owners, and return on investment. Additionally, the code provides jurisdictions with optional supplemental requirements, including requirements that lead to achievement of zero energy buildings, presently, and, through glidepaths that achieve zero energy buildings by 2030 and on additional timelines sought by governments, and achievement of additional policy goals as identified by the Energy and Carbon Advisory Council and approved by the Board of Directors. The code may include non-mandatory appendices incorporating additional energy efficiency

and greenhouse gas reduction resources developed by the Code Council and others. Requirements contained in the code will include, but not be limited to, prescriptive- and performance-based pathways. The code will aim to simplify code requirements to facilitate the code's use and compliance rate. The code is updated on a three-year cycle with each subsequent edition providing increased energy savings over the prior edition. The IECC residential provisions shall include an update to Chapter 11 of the International Residential Code. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this intent. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

THE APPEALS

I. Cost Effectiveness

The intent statement of the IECC-C indicates the goal is to develop requirements for the design and construction of commercial building that are cost effective. Several appellants argue that certain provisions of the IECC codes violate the intent statement because they are not cost effective.

Specifically, AHRI argues that sections C406.1.1.1 and C502.3.7.2 of the IECC-C are not cost effective. AHRI contends that when the cost of a commercial heat pump water heater system is considered, the Ratio of Scalar Limit is 0.922 – below the 1.0 ratio required for the package to be cost effective for a healthcare building in climate zone 5B. AHRI states that the cost impact in CECD1-18-22, the proposal that introduced Sections C406.1.1.1 and C502.3.7.2, was misleading. It relied entirely on manipulating PNNL's Energy Credit cost effectiveness, stating, "further analysis using the outputs of PNNL's cost-effectiveness analysis and the U.S. Department of Energy (DOE) prototype models indicates that an additional 25% higher energy efficiency credits would have to cost an average of 12.2 times the upfront cost of the base credits to violate the cost-effectiveness criteria with a 9.3% nominal discount rate (16.6 times the base credits' upfront cost with a 5.3% nominal discount rate, as shown in Fig. 2)." The assumed "room" in the PNNL cost analysis to cost justify the 1.25x credit increase does not exist when representative commercial heat pump water heater systems are considered and applied to 100% of the load. For example, in the case of outpatient healthcare in 5B, the incremental cost becomes $8.27/ft2 or $338,687.63 – a 68,930% increase over the prototype gas system. The Ratio of Scalar Limit becomes 0.47, which is not cost effective.

NMHC/BOMA argue that the IECC-C's requirement to have electrical energy storage systems (ESS) or a reserved area for future installation of ESS is not cost effective. This requirement applies regardless of whether the building has, or is even capable of having, onsite renewable energy generation. They maintain that implementing this requirement because of a presupposed future use does not provide a return on investment and is not life cycle cost effective.

Region VI argues that a number of provisions require builders to install certain infrastructure and/or wiring regardless of whether it will actually be used by homeowners, which causes unnecessary expenses. For example, requiring houses to be wired as if the major appliances were electric, regardless of how the homeowners actually fuel their major appliances, creates an unreasonable extra expense. Similarly, Region VI argues that the requirement for new one and two-family dwellings and townhouses to install electrical infrastructure for electric vehicles regardless of whether the owners own an electric vehicle unnecessarily increases costs. Likewise, Region VI argues that the requirement to design and install a solar array system that the owner may not even want to install is an unjustifiable expense.

II. Increased Efficiency

NMHC/BOMA argues that certain provisions in the IECC codes run afoul of the IECC-R's intent statement, which focuses on developing requirements that provide "minimum efficiency requirements for buildings."

For example, requiring the support of EVs, which are “amenities and conveniences” does not constitute “minimum” efficiency requirements for buildings.

Additionally, NMHC/BOMA argue that the IECC-C’s requirement to have electrical energy storage systems (ESS) or a reserved area for future installation of ESS does not promote energy efficiency. These requirements apply regardless of whether the building has, or is even capable of having, onsite renewable energy generation. They argue that ESS do not provide any building energy efficiency – do not save energy – and are primarily intended to benefit electric grid operators’ management of the grid and to support Federal policies relative to the grid. Many 2024 IECC-C compliant buildings will not have onsite renewable energy generation systems and will utilize various offsite procurement methods as permitted by Section C405.15.2. In such buildings, an ESS can only store grid delivered electricity, which can support electric grid management and provide resiliency for a building, but does not save energy.

III. Prioritizing Fuel Sources

NMHC/BOMA argue that Sections C406.1.1.1 and C502.3.7.1 of the IECC-C give preferential treatment to a particular class of products – heat pumps – at the expense of combustion and electric resistance products that serve the same function in violation of the principle that the provisions should “not give preferential treatment to particular types or classes of materials, products or methods of construction.” The Section C406.1.1(2) formula reduces the credit available to buildings with any fossil fuel equipment by reducing the surplus renewable energy or load management credits value by 30 percent compared to an all-electric or all-renewable building. This reduction is presented as a method to account for the distinction in site energy savings for electric equipment versus combustion equipment instead of the more comprehensive source energy or energy cost metrics. Applying a penalty on equipment because of the nature of the equipment versus the performance of the product violates foundational principles of the IECC.

Region VI argues that, rather than allowing for flexibility within the code, it prioritizes a single industry. The electric readiness requirements are mandatory even if the homeowner wants to use gas, which goes against the idea of providing flexibility. Section R404.6’s renewable infrastructure provision, while not calling out solar in its title, focuses primarily on the installation of solar systems, which Region VI claims prioritizes one industry.

AHRI argues that sections C406.1.1.1 and C502.3.2.7 in the 2024 IECC-C disadvantage fossil fuel space and water heating equipment, electric resistance space and water heating equipment, and certain commercial heat pump water heater systems by imposing a “penalty” of requiring more credits to be achieved with their use.

IV. Feasibility of Implementation

NMHC/BOMA argue that the provisions of the IECC-R mandating demand responsive controls for certain service water heating equipment and the IEEC-C’s provisions mandating demand responsive controls for equipment for HVAC space conditioning, service water heating, and lighting cannot function as intended. They claim that nearly one-third of electric utilities do not offer demand responsive programs. In these jurisdictions, a requirement for DR controls for HVAC, lighting, or service water heating equipment is a requirement for a building owner to provide and install devices and equipment which cannot function as intended.

Region VI argues that proponents of the provisions requiring installation of EV infrastructure incorrectly argued that it would cost more to install electric vehicle infrastructure at a later point. If at some point, electric vehicles become mandatory, the demand will require an increase in supply, which will lead to a lowering of the cost as more materials and services are available. New products and services are more expensive being a niche market.

V. Consistency with Other Codes

NMHC/BOMA state that Energy Storage Systems provisions in the IECC-C conflict with requirements in the IBC, which violates the intent provision that states that the IECC-C is "not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances." NMHC/BOMA argue that 2024 International Building Code (IBC) (Sections 1008.3.1 and 1013.63) permits emergency power to be provided by on-site generators and that commercial buildings required by the IBC to have emergency and/or standby power systems frequently meet the requirement with onsite fuel powered generation. Given that the IBC governs requirements for the provision of emergency and standby power systems, the IECC-C cannot require ESS for resiliency purposes.

ICC STAFF RESPONSE

The intent statement identifies several guideposts for the committees to use as they consider code change proposals, namely providing the maximum level of energy efficiency that is cost-effective, technologically feasible, and safe. The development process for these codes included numerous safeguards to ensure that, as a whole, the code would achieve those goals. The committee's task was to evaluate code change proposals based on these principles using their technical expertise and reach consensus on a code that adheres to these principles to the greatest extent possible given the variety of viewpoints and interests represented.

Rather than evaluating the codes holistically, as the intent statement contemplates, Appellants point to specific provisions they claim fall short of these goals. These arguments ignore the fact that the committees must balance multiple factors when evaluating each proposal, and those factors may point in different directions.

For example, cost effectiveness of a proposal is just one factor the committee may consider. The IECC Committee Procedures state, "[t]he Committees may use the results of a cost effectiveness analysis as a factor in determining acceptance of a change proposal, but other factors may also be considered including market-readiness." Further, the cost-effectiveness of a provision is not measured in only one dimension. The IECC Committee Procedures further state that consideration of cost-effectiveness includes "the change's cost effectiveness for the building owner, occupants and the energy system as a whole including both initial cost and life-cycle cost and savings." (emphasis added). Thus, it was appropriate for the committee to consider the effect a proposal would have not only on a specific building but also on the costs for utilities and transportation related energy.

These arguments also raise largely technical issues, which are most appropriately resolved by the technical committees through the standard development process. CP-01 specifies that the Appeals Board's review "shall be limited to matters of process and procedure," and shall not relate to "the relative merits of technical matters."

For example, the committees actively considered the cost-effectiveness of the code as a whole. All proposals included a cost impact statement. See IECC code change monographs for relevant examples. Working groups for both IECC committees considered parameters for how to determine if code changes would be cost-effective, including discount rates, the time frame that should be considered, and the methodology for arriving at a cost estimate. The committees approved those parameters, and then utilized them when considering and voting on the proposals. Committee members and interested parties had numerous opportunities to comment on cost estimates they found misleading or false and attempt to persuade others that specific proposals were not cost effective.

Likewise, efficiency and feasibility issues were considered by the committees throughout the standard development process. Proponents of code changes regarding ESS programs presented information indicating that participants in those programs have cost and energy savings. See Appendix A. Proponents of demand response controls similarly presented information indicating these programs are available in two-thirds of the country and result in cost and energy savings. See Appendix B. PNNL performed an interim analysis on public draft number one to consider holistically if the drafts increased energy efficiency. That analysis was provided to the committees prior to their meetings to review the second round of comments and informed their consideration of all proposals.

With respect to arguments that certain code provisions treat fossil fuel space and water heating equipment, electric resistance space and water heating equipment, and certain commercial heat pump water heater systems less favorably than other fuel sources, as discussed in the staff analysis on scope and intent, the intent statements for these codes explicitly authorize the inclusion of provisions that reduce greenhouse gas emissions. The statement implies that it is acceptable to treat equipment differently based on their associated greenhouse gas emissions. Further, as outlined above, any consideration by the committees of the effects of proposals on the energy system as a whole would not have been problematic. Notably, PNNL, by way of the modeling subcommittee, provided a reason statement for the relevant proposals that indicated the proposed code language provided sufficient flexibility with respect to the fuel source based upon the site energy use.

Finally, there is no inconsistency between the International Building Code and section C405.16.2. Section C405.16.2 does not require the installation of Energy Storage Systems. Rather, it assists in paving the way for future installation of such systems.

Appendix A

Reason Statement from Proposal CEPI-7-21

Reason

Energy storage will soon become critical to achieving President Biden's goal of a carbon-free power sector by 2035. These systems could also bolster economy, present a cost savings opportunity for homeowners and increase resilience to power outages. In 2020, 21% of the United State's electricity is sourced from renewable energy, primarily wind, an intermittent source of energy. As the U.S. increases the amount of electricity generated from renewables, buildings must be prepared to aid in this transition by storing energy to match grid demands.

Policies to encourage energy storage will improve the U.S. economy. Energy storage is expected to grow by over 40% each year until 2025 and the U.S., because of its manufacturing background and experience in battery-storage technology for cars is becoming a clear leader in this market.

Energy storage will also present a cost-saving opportunity. Battery prices have and will likely continue to fall in the United States, meaning that behind-the-meter storage will likely become more accessible and affordable in the short-term. More and more utilities are moving beyond voluntary programs and are expanding use of time-of-use rates for electricity as a tool for shaping demand. Ensuring buildings are energy-storage ready now will allow them to cost effectively install storage systems in the future and take advantage of these programs.

Finally, energy storage will improve resilience to power outages. In 2020, DOE found that an average household in the United States goes without power for 8 hours in a year. Because of extreme weather events caused by climate change, those outages are increasing. These outages are estimated to cost the U.S. economy between $25 billion to $70 billion annually. Requiring buildings to be storage-ready will ensure communities are more resilient by allowing buildings to cost effectively install storage which can operate for a short-period of time without relying on the electricity grid.

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Cost Impact

The code change proposal will neither increase nor decrease the cost of construction.

Analysis completed by NBI using RSMeans showed no incremental costs for this measure.

Appendix B

Section R403.5.5 Introduced through proposal REPI-90-21. Proposal was approved as modified 31-3-2 at the 6/9/22 meeting. Proposal received more than ⅔ approval through balloting of Committee Action Report. Committee reason: This proposal adds Demand Response controls for tanked water heaters only. The proposal is for specific tanked water heaters with 3 exceptions listed in the proposal. The reason for the revision replaces a definition for "grid integrated controls".

Proposal REPI-90-21 Reason

Reason

With increasing penetrations of intermittent renewable energy, volatile wholesale power prices, and subsequent growth in dynamic rates/demand response programs, grid-interactive end uses present an opportunity to help homes manage their bills, participate in programs, and support efficient grid operations. Water heaters can provide many services to the grid, including generation, transmission, and distribution capacity, energy arbitrage, and ancillary services. In their assessment of the National Potential for Load Flexibility, Brattle estimated that across all measures these services could provide as much as $15 billion per year in value to the electric system.

As electricity systems transform to include more variable wind and solar energy, demand flexibility becomes increasingly critical to both grid operation and further transformation. Building systems that can use energy when it is abundant, clean, and low-cost not only help decarbonize the entire energy system, they also insulate their owners from future increases in demand charges and peak hour energy rates – a current and accelerating trend. Water heaters offer an unparalleled opportunity for load shifting: tanks full of hot water are inherently energy storage devices. Including the controls necessary to take advantage of this opportunity is relatively simple and affordable in new construction. Compared to other energy storage technologies such as batteries, smart, grid-integrated water heater controls can deliver substantial dispatchable (that is, reliable to the grid operator) energy flexibility. The controls specified by ANSI/CTA-2045-B ensure negligible risk of occupant disruption (that is, the hot water will not run out). Water heaters provide a particularly attractive option as they have inherent thermal storage that allows energy consumption to be shifted with little to no impact to the end user. This capability has been demonstrated in several contexts, most recently through regional demonstrations conducted by EPRI and BPA.

In their Grid-interactive and Efficient Buildings (GEBs) Roadmap, the US Department of Energy estimates that approximately 15 GW of additional load flexibility is expected to be added to the system under reference case assumptions. Combined with energy efficiency, this is expected to provide $13 billion/year of peak demand savings to the power system and its customers. Through a comprehensive literature review and interviewing dozens of national experts, the USDOE team found that one of the biggest barriers was the lack of interoperability. A key tool to solve this problem is building codes, which can help to ensure that interoperable devices and controls are installed at the time of construction. USDOE cited explicitly the use of codes and standards as one of its recommended pathways to enable greater adoption of GEBs technologies.

ANSI/CTA-2045-B standardizes the socket, and communications protocol, for electric water heaters so they can communicate with the grid, and with demand response signal providers. In addition, 2045-B adds control and communications requirements for mixing valves in water heaters, which enable them to provide greater storage capacity to support increased load shifting while eliminating scalding risk.

Versions of this standard are included in codes or other requirements in California, Oregon, and Washington and are referenced explicitly by ENERGY STAR.

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Cost Impact
The code change proposal will increase the cost of construction.

To enable grid-interactive controls, there are two sources of costs: the incremental cost to ensure that equipment is interoperable with CTA-2045-B and the cost of the control module installed in that device.
The incremental manufacturing cost is in the range of a few dollars, and negligible at higher volumes. The current incremental cost to include a CTA-2045-B compliant control module ranges from about $60 (direct current, hard-wired connection) to $160 (alternating current, wireless cellular connection); this is expected to decline as manufacturing lines are brought up to larger scale (source: Advanced Water Heating Initiative). The major determinant of cost if the chosen radio pathway as chipset costs vary considerably between different frequencies/standards.

In the BPA report, manufacturers stated a range of $2-$30 for regional deployment, but noted that there would be economies of scale for a national rollout. The main cost was development of firmware/hardware to accommodate the standard, but these costs have already been incurred to meet codes/standards in OR, WA, and CA.

Section C403.4.6 Introduced through proposal CEPI-99-21 which was approved as modified 29-0-1 at 6/15/22 meeting. Proposal received more than 2/3 approval through balloting of Committee Action Report. Committee reason: HVAC system control, often through thermostats, has been at the center of demand response (DR) programs for decades. DR programs continue to rely deeply on thermostat control strategies, but the need for such controls is fast growing.

Exception 5 added under CED1-161-22 approved as modified 33-0-1 at 4/12/23 meeting. Committee Reason: Standing on the reason statement with the proposal but with clearer language.

Exception 6 added under CEC2D-1-23 approved as modified 28-0-2 at 9/6/23 meeting. Committee Reason: Encourages the use of thermal energy storage by providing an additional technology option for reducing demand.

Reason Statement on CEPI-99-21

Reason

Grid-integrated controls for thermostats are added based on language from California Title 24 and ASHRAE Standard 189.1. Any thermostat listed as "Title 24 compliant" would meet this requirement. The controls allow for dialing back heating and cooling, as well as to accept additional heating or cooling when renewable energy generation is high or energy prices are low, and both ramp up and down requirements in relationship to the utility/grid operator/third party aggregator signal to prevent rebound issues on the grid after the signal is released.

In health care and assisted living facilities, thermostat setpoints can impact more than just thermal comfort, and temperature can be part of the health care being provided. To ensure that this requirement cannot have an adverse impact on those services, these facilities have been exempted from this requirement.

HVAC system control, often through thermostats, has been at the center of demand response (DR) programs for decades. DR programs continue to rely deeply on thermostat control strategies, but the need for such controls is fast growing. As electricity systems transform to include more variable wind and solar energy, demand flexibility becomes increasingly critical to both grid operation and further transformation. Building systems that can use energy when it is abundant, clean, and low-cost not only help decarbonize the entire energy system, they also insulate their owners from future increases in demand charges and peak hour energy rates – a current and accelerating trend.

Today's demand response programs typically set event (call) durations between 15 minutes and 4 hours. The preconditioning strategies (cooling set point reduction / heating set point increase) and temporary setback strategies (cooling set point increase / heating set point reduction) will enable substantial HVAC system energy savings over this time frame. In many cases, in a building compliant with this code, tenants are unlikely to even notice a change in their thermal comfort. The inclusion of preconditioning helps ensure that the building is able to reduce electrical demand by adjusting HVAC setpoints while minimizing the risk of tenant disruption: in many cases the event will end before the higher cooling (or lower heating) set point is reached in the space.

Based on modeling by LBNL (foundational modeling supporting the May 2021 DOE Grid-integrated Efficient Buildings Roadmap), thermostat controls configured to deliver preconditioning and/or space temperature adjustments can reduce building peak demand by roughly 10% in many cases.

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Cost Impact
The code change proposal will increase the cost of construction.

For larger commercial buildings with building management systems, it is not common to install a thermostat without demand response capabilities. Therefore, there is no incremental equipment cost associated with this measure for those building types. However, there could be soft costs to ensure those demand responsive controls function properly with the building management system. Conversations with industry experts indicate these soft costs can be around $0.25/s.f. for a medium office building. The primary cost drivers in thermostats are not the grid-integration controls but rather other features. Therefore, incremental costs vary. An entry-level grid-integrated thermostat currently available from a national retailer costs about $70, while the same retailer lists a similar non-grid-integrated programmable unit for just over $35, indicating an incremental cost of about $35. This cost has dropped in the last (X years) – A 2017 study out of Vermont cited incremental costs for smart thermostats in new construction at roughly $150 – a decrease in incremental costs of $115 over just 4 years.

However, smart thermostats (i.e., those with grid-integrated controls) are very common in new construction and represent a growing share of the retrofit market. All major smart thermostat brands already include grid-integration controls that comply with this requirement, so there is generally no incremental cost to include these controls assuming a smart thermostat is installed either based on customer preference or efficiency requirements.

Multifamily buildings and smaller commercial buildings that install direct-attached thermostats, demand responsive thermostats (which were estimated in a 2011 study to cost $68 more than a programmable thermostat) were found to be extremely cost effective. It was estimated that installing demand responsive thermostats in a 10,000 s.f. office building resulted in 83kWh to 274 kWh of electricity savings and between 0.19 to 1.97kW in demand savings in Climate Zones 2-4. Every dollar spent on demand responsive thermostats yielded between $1.20 to $7 in operating cost savings over a 15-year period for office buildings. In the 10 years since, equipment prices have decrease and incremental costs are estimated to be only $40 making this measure even more cost effective than estimated previously for buildings without building management systems. This measure will not only result in cost savings for consumers but will also result in other significant societal benefits. According to DOE's report, "A National Roadmap for Grid-Interactive Efficient Buildings," every watt in peak demand savings was found to create 17 cents in annual electric grid system value. This value included energy savings, capacity savings, transmission deferral and ancillary services. A 10,000 square foot office building with a demand responsive thermostat which is estimated to reduce peak demand savings between 0.26 to 1.09kW would result in $44 to $334 in annual electric grid system value. Demand responsive thermostats which allow grid operators to reduce demand on the grid during the times when the carbon intensity of the electric grid is high also results in reduced carbon emissions generating additional significant societal benefits.

Section C404.10 Introduced through proposal CEPI-125-21 was approved as modified 28-3-1 at the 6/8/22 meeting. Committee Reason: Grid-interactive end uses present an opportunity to help homes manage their bills, participate in programs, and support efficient grid operations. Water heaters can provide many services to the grid, including generation, transmission, and distribution capacity, energy arbitrage, and ancillary services.

Proponent reason and cost statement the same as REPI-90-21

Section C405.2.8 Introduced through proposal CEPI-176-21 was approved as modified 29-5-1. Committee Reason: Provides a means to effectively reduce lighting during demand response requests or other signals and improve the effective use of energy. Proposal was modified under CECD1-5-21 which passed 29-1 at the 4/5/23 meeting. Proposal CE2D-44-23 which added exceptions 4, 5 and 6 to address life safety concerns was approved as modified 26-1-4 at the 9/13/23 meeting.

Reason statement for CEPI-176-21

Reason

Demand responsive systems help projects savings on energy costs, especially peak demand charges, by helping to curtail/shift loads during times of peak electricity pricing or demand. Lighting is particularly well suited for demand response as lighting can often be adjusted without any disruption to the occupants (unlike cooling). Lights can gradually dim during a demand response event so that occupants don't notice the change in lighting (note that the first 20-25% of lighting dimming is undetectable by the human eye, yet that saves 20-25% in lighting energy). And after the DR event lighting can be brought back to previous levels quickly (unlike cooling loads which can take time for the space to be brought back to previous temperature).

What's more is that most networked lighting control (NLC) systems have native automated demand response capability. So, no new equipment is required.

Studies show that demand responsive lighting can save 30–50% of lighting power during peak periods (Newsham GR & Birt B. 2010. Demand-responsive lighting: a field study).

Lastly, demand responsive lighting has been in CA Title 24 since 2008 and in the ASHRAE 189.1 energy chapter since 2014. Plus, demand response is worth optional points in LEED v4 and demand response will be in the upcoming ASHRAE 90.1-2022 energy efficiency credits. Thus, the addition of demand responsive lighting will help bring the IECC inline with the other major building standards and rating systems.

Bibliography

Newsham GR & Birt B. 2010. Demand-responsive lighting: a field study. Leukos. 6(3) pg 203–225

Title 24 Stakeholders CASE report on demand response: https://title24stakeholders.com/wp-content/uploads/2020/08/NR-Grid-Integration_Final-CASE-Report_Statewide-CASE-Team.pdf

https://lightingcontrolsassociation.org/2014/05/20/lighting-control-and-demand-response/

https://www.energy.gov/sites/prod/files/2020/02/f71/ssl-rd2020-ghosh-market.pdf

Cost Impact

The code change proposal will increase the cost of construction.

The code change proposal may increase the cost of construction. However, savings from peak demand charges more than offsets any increased costs. Plus, most projects with over 4000 watts of lighting power will be using a networked lighting control system to comply with the mandatory lighting control provisions. And since most networked lighting control provisions have demand response built-in, no additional cost is incurred.

Reason statement for CECD1-5-22:

Reason

This proposal makes a number of important improvements to the code requirements for demand responsive lighting controls:

1. It limits the scope in base code to those occupancies (B, E, M, and S) where this can reasonably be achieved without excessive complexity and/or negative impact on building operations.
2. Changes the 4,000W exception to 10,000 square feet to significantly simplify compliance determination.
3. Specifies the capabilities of the required controls, so that it is clear to designers and building code officials what control systems would comply.
4. Modifies C406.3.2 to refer to the technical requirements in C405.2.9.1 so that the code can have one clear and consistent standard for how these controls operate.
5. Revises language to be clear that compliance with both base code and energy credits is determined occupancy by occupancy for mixed-use buildings.
6. Adds functional testing requirements for demand responsive lighting controls.

   To coordinate with C405.2.9 requirements, where a demand response signal is available and the building is not exempt, the credits are reduced by half.

Cost Impact

The code change proposal will decrease the cost of construction.

This code change proposal will decrease the cost of construction by limiting the requirement for demand responsive lighting controls in C405.2.9 to occupancy groups B, E, M, and S.