



# RETAIL CLIENT IMPACTS 2016 California Title 24 Building Energy Efficiency Standards

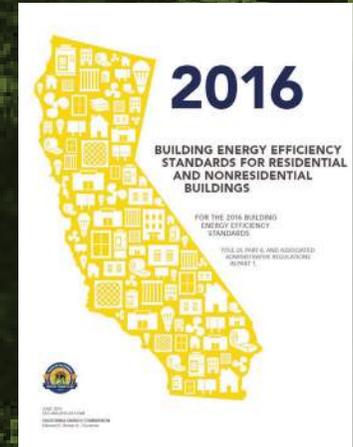
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# INTRODUCTION

## Background

On January 1st, 2017, the California 2016 Building Energy Efficiency Standards (BEES) becomes effective, replacing the 2013 version of the standard. California is striving for all newly constructed commercial buildings to be zero net energy (ZNE) by 2030. Several changes will have a substantial impact on remodel and new-construction retail projects. These changes impact building envelope, HVAC systems, indoor lighting levels, lighting controls, and exterior lighting. The purpose of this document is to identify those changes in the BEES that have the largest impact on retail construction.



## How to use this document

This document is not a comprehensive analysis of all of the changes to the BEES. Rather, it is meant to serve as a guide to identify those items that we believe may cause the highest cost and/or largest fundamental changes to national, retail client prototypes and standards. When appropriate, commentary on the impact for retailers is included.



## BUILDING ENVELOPE

### Fenestration

Glass requirements have not changed compared to the 2013 standard. Fixed windows require maximum U-factor of 0.36, maximum relative solar heat gain coefficient of 0.25, and minimum visible transmittance (VT) of 0.42.

### Demising Wall Insulation

Demising walls must be insulated to meet maximum U-factor of 0.099 for wood framed walls, and maximum U-factor of 0.151 for metal framed walls. Demising walls constructed of brick, masonry units, or solid concrete are not required to be insulated.

### Low-Slope Cool Roof

Minimum aged solar reflectance remained unchanged from the 2013 standard, at 0.63 for new construction and alterations, or solar reflectance index (SRI) of 75 in all climate zones. The following Cool Roof Rating Council (CRRC) website can be used to identify manufacturers who have complying products.

<http://coolroofs.org/products/results>



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# HVAC

## Prescriptive Threshold for Economizers

The 2016 standard continues to require economizers on all units sized for 54,000 Btu/h (4.5 tons) and larger.

## Economizer Fault Detection

Economizer fault detection and diagnostics (FDD) continue to be mandatory for all newly installed, air-cooled, direct expansion HVAC units equipped with economizers that have a capacity of 4.5 tons or greater. Controllers shall be capable of displaying the value of each sensor, and indicating status as follows: (a) Free cooling available, (b) Economizer enabled, (c) Compressor enabled, (d) Heating enabled (if system is capable of heating), and (e) Mixed air low limit cycle active. The FDD system shall detect the following faults: (a) Air temperature sensor failure/fault, (b) Not economizing when it should, (c) Economizing when it should not, (d) Damper not modulating, and (e) Excess outdoor air. The FDD systems are required to be certified by the Energy Commission.

## Modulating Cooling Capacity for HVAC Systems with Economizers

Direct expansion (DX) HVAC equipment must now have the capability to stage or modulate cooling capacity. Requirements vary depending on equipment capacity, but a minimum of two (2) stages are required. Fortunately, most of the major packaged rooftop unit manufacturers currently have equipment available that meet this requirement.

## HVAC Equipment Efficiency

Effective January 1, 2017, packaged air-cooled HVAC equipment from 5.4 to 11.1 ton capacities must have a minimum energy efficiency rating (EER) of 11.2, and minimum integrated energy efficiency rating (IEER) of 12.9. Packaged air-cooled HVAC equipment from 11.2 to 19.9 ton capacities must have a minimum EER of 11.0, and minimum IEER of 12.4. Packaged air cooled HVAC equipment from 20 to 63 ton capacities must have a minimum EER of 10.0, and minimum IEER of 11.6.



## INDOOR LIGHTING

### **Variable Airflow Fan Control**

All direct expansion (DX) HVAC equipment must have variable supply fan air flow for units with a capacity of 5 tons and greater. Either two-speed or variable speed fans are allowed.

### **Occupancy Sensors for Demand Controlled Ventilation**

Occupancy sensors may be used to control demand controlled ventilation and to allow the ventilation rate to be reduced to zero. The BEES now requires a minimum of one sensor per room and a one-hour, pre-purge prior to occupancy. Additionally, the BEES also requires fan cycle control to maintain the average outdoor air rate over a two-hour period. The controls must also shut off outside air within 30 minutes of vacancy. If a single zone system is used, the controls must cycle off the supply fan. A new requirement in the 2016 standard is that any directly conditioned space with operable wall or roof openings to the outdoors must be provided with interlock controls to disable or reset cooling/heating temperature setpoints to 55°F/90°F, respectively when any such opening is open for more than five (5) minutes.

### **Mandatory Measures**

Track lighting current limiters are required to be certified and labeled. Line voltage over-current panels are recognized for track lighting. Recessed fixtures with medium screw base sockets will be counted as minimum 50 W regardless of lamp type. Permanent screw base adapters are not recognized. Field modifications (even LED conversions) are not recognized, and linear LED conversions on fluorescent are not recognized. These mandatory measures will undoubtedly change the design of many retail lighting systems, as current design practices may not comply. The 2016 standard now requires occupancy sensors to be programmed to turn off lighting after 20 minutes of no sensed activity.

### **Lighting Power Density**

The BEES allows for three (3) different calculation methods for building and spaces: Complete Building, Tailored, and Area Category Method. Commercial/retail applications will most likely utilize either the Tailored or the Area Category Method. Within commercial/retail applications, typically the Tailored Method is better suited for smaller retailers, while the Area Category Method tends to produce more desirable results for big box retailers. The 2016 standard made minor adjustments to the Lighting Power Density (LPD) allowed for each space type, but the retail LPD did not change.

## Daylighting

Daylighting requirements apply to all buildings located within California Climate Zones 2 through 15 with enclosed spaces greater than 5,000 ft<sup>2</sup>, and ceiling heights greater than 15 ft. This requirement does not apply to spaces with a Lighting Power Density of less than 0.5 W/ft<sup>2</sup>. This requirement could have enormous implications to retail store design. The requirements will need to be evaluated for each retail prototype design, but this change in the BEES could require sky-lighting and side-lighting for many retail spaces that currently do not utilize daylighting.

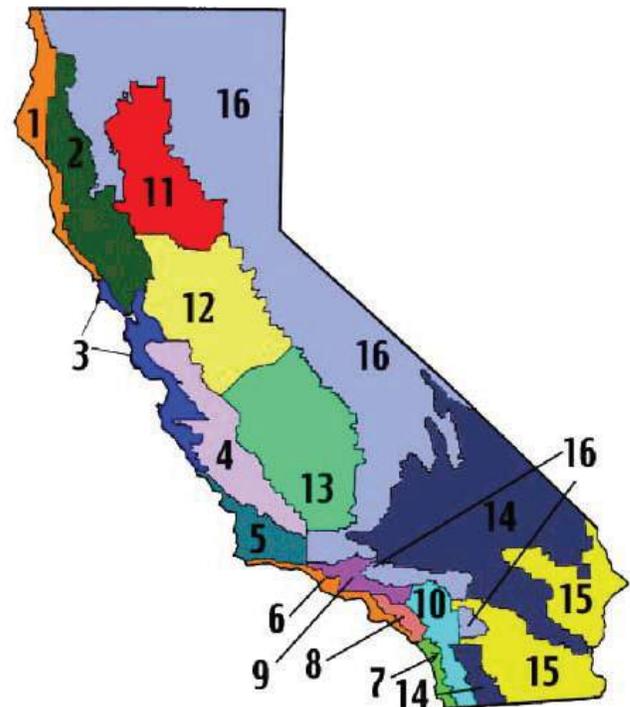
## Multi-Level Controls

Multi-level controls are required in areas 100 ft<sup>2</sup> or larger, or have a lighting power density greater than 0.5 W/ft<sup>2</sup>. The number of lighting control steps varies depending on the type of lighting used, but can be found in Table 130.1-A of the BEES. In addition, each light fixture shall be controlled by at least one of the following methods: manual dimming, lumen maintenance, tuning, automatic daylighting controls, or demand responsive lighting controls.

Retailers who use fluorescent lighting for general sales floor lighting will need to use stepped dimming, continuous dimming, or alternate lamp switching to achieve at least four levels of lighting that fall under specified ranges. This will impact the circuiting design and likely increase the installed cost of the general lighting system. Retailers who use track lighting for general sales floor lighting will need at least one step between 30-70%. Retailers using LED lighting for general sales floor lighting will need to have continuous dimming from 10-100%.

Retailers using fluorescent lighting which now requires dimming should evaluate the total cost of dimming fluorescent fixtures and the

## California Climate Zones



associated control system, versus the total cost of dimming LED fixtures and the associated control system. Though the cost of an LED fixture may be more than that of a fluorescent fixture, many LED fixtures come with dimming capabilities standard, whereas with fluorescent fixtures this can be an expensive non-standard option. For this reason, the LED fixtures may now provide a less expensive total system cost.

These multi-level lighting control changes will substantially impact prototypical lighting control, and will likely require a dimming system to be incorporated into the design.

The 2016 standards have excluded multi-level lighting control in some areas where lighting reduction is achieved through occupancy sensing means, such as corridors and stairwells.

### **Shut-Off & Automatic Shut-Off**

In addition to multi-level and manual ON-OFF controls, the BEES also requires automatic shut-off controls for when spaces are unoccupied. This can be accomplished in a variety of ways including occupant sensing control, automatic time-switch control, a signal from another building system, or some other control capable of shutting off all of the lights. The BEES also requires separate controls for the lighting on each floor, and separate controls for lighting in each room, with each control controlling a maximum of 5,000 ft<sup>2</sup> of lighting. Larger spaces will require separate 5,000 ft<sup>2</sup> control zones, except single-tenant retail spaces can increase the control zone size to a maximum of 20,000 ft<sup>2</sup>. Separate controls are also required for general, display, ornamental, and display case lighting.

Large retail spaces will need to have lighting zoned to control maximum 20,000 ft<sup>2</sup>. Separate controls are required for general and display lighting. Because of the manual ON-OFF control requirement, the general lighting zones must also have manual control switches installed. Retail sales floors are exempt from the requirement for the switches to be readily accessible and located in the same room, but the control is required to be located so that a person using the lighting control can see the lights or area controlled. Otherwise, the lighting control must be indicated with a visual signaling device showing the ON-OFF status of the lights.

The 2016 changes to this section revised requirements related to night lighting in the space. Instead of limiting continuously illuminated areas to 0.05 W/ft<sup>2</sup> in offices only, the wattage has been increased to 0.1 W/ft<sup>2</sup> for all buildings and spaces, provided the areas are designated as a means of egress.



Areas that are required to have multi-level controls shall be controlled by “partial-on” occupancy sensors (only 50-70% of the lights shall turn on) or vacancy sensors (manual-on only).

### **Demand Responsive Lighting Control**

This requirement applies to all buildings larger than 10,000 ft<sup>2</sup>, with lighting power density greater than 0.5 W/ft<sup>2</sup>. Upon receiving a demand response signal from the utility company, the system must automatically provide a 15% reduction in lighting power via dimming, or a reduction in lighting by one level below full on via stepped dimming or switching. This requirement will impact prototypical lighting control schemes, and will likely require a dimming system to be incorporated into the design.

### **Summary of Mandatory Lighting Controls for Retail Spaces**

The 2013 BEES summarized retail space lighting controls: “Retail spaces typically will have the area switches in a location that is not accessible to the general public. General lighting, display lighting, and ornamental lighting are required to be separately switched. Automatic shut-off

controls will typically be time-switch-based with local, timed override switches. With the prescriptive daylighting requirements applying to large open spaces with floor areas greater than 5,000 ft<sup>2</sup> and ceiling heights greater than 15 feet, many retail spaces are prescriptively required to daylight at least 75% of the space. Only the general lighting is required to be controlled with automatic daylighting controls; display lighting and ornamental lighting are allowed to be fully on regardless of how much daylight is entering the space.”

The 2016 BEES added parking areas, stairwells, and corridors to areas that may use manual controls not accessible by the public.

### **Threshold for Lighting Alterations**

The 2013 standard had a big impact on retailers, reducing the threshold that triggers compliance with the new BEES. Now, virtually all lighting alteration projects will trigger the new lighting power density and control requirements of the BEES.

Before 2013, the BEES only applied to lighting alteration projects where 50% or more of the lighting was impacted by the alteration. The threshold has now been reduced to 10% or more of the lighting.

For projects where less than 10% of the lighting is altered, the existing lighting power and lighting controls are permitted to be maintained.

For projects where more than 10% of the lighting is altered AND the resulting, installed lighting power density is less than or equal to 85% of the allowed lighting power (using the Area Category Method), then Manual Area Controls, Limited Multi-Level Controls, AND Automatic Shut-Off Controls are required.



For projects where more than 10% of the lighting is altered AND the resulting installed lighting power density is greater than 85% of the allowed lighting power (using the Area Category Method), then Manual Area Controls, Multi-Level Controls, Automatic Shut-Off Controls, AND Daylight Controls are required.

For lighting alterations where there has been a change in the area of the enclosed space, a change in space type, OR an increase in lighting power density in the enclosed space, the resulting installed lighting power shall not exceed the allowance (using the Area Category Method). When there is a lighting alteration in the changed space, or its changed space type, lighting controls require upgrade to Manual Area Controls, Multi-Level Lighting Controls, Automatic Shut-Of Controls, and Daylight Controls. If the space is larger than 10,000 ft<sup>2</sup>, Demand Response Control is also required.

## OUTDOOR LIGHTING

### Mounting Specific Controls

For lighting fixtures mounted less than 24 feet above the ground, the fixtures must have a motion sensor or other controls that automatically control the lighting in response to the area being vacated by occupants. These controls must be capable of reducing the lighting power of each light fixture by at least 40% but not exceeding 90%, or providing continuous dimming through a range that includes 40% through 90%. The lighting must also automatically turn on when the area once again becomes occupied. No more than 1,500 W of lighting is allowed to be controlled together.

The “wall-pack” lights that many retailers place around the perimeter of their buildings serve as a perfect example of how this new requirement applies. These light fixtures must be controlled by a motion sensor causing the fixture to dim 40% to 90% of the load.

The 2016 standard removed automatic light reduction exemption for Outdoor Sales Canopies.

### Outdoor Lighting Control

This section is intended to ensure outdoor lighting is turned off during daylight hours. All outdoor lighting must now be controlled by both a photocell device and an automatic scheduling control. Alternatively, an astronomical time-switch may be used in place of a photocell. All outdoor lighting is required to be independently controlled from other loads. The 2016 standard also added BUG (backlight, uplight, and glare) requirements for outdoor lighting fixtures.



## SIGN LIGHTING

### Indoor Sign Lighting Control Requirements

All indoor signs must be controlled by an automatic time-switch control or astronomical time-switch control.

### Outdoor Sign Lighting Control Requirements

Outdoor signs are required to have photocell and automatic time-switch control, OR an astronomical time-switch control. Sign lighting that is on both day and night shall be controlled with a dimmer that automatically reduces sign lighting power by a minimum of 65% during nighttime hours. Signs that are illuminated at night and for more than one-hour during daylight hours shall be considered to be on both day and night.

Signs that are illuminated only at night are exempt, but retailers will need to be sensitive to the rule that considers lighting to be on both day and night even when they are on for only one-hour during daylight hours. Most retailers using building automation or astronomical time-clocks should be able to comply with minimal changes.

### **Outdoor Sign Lighting Energy Requirements**

For internally illuminated signs, the maximum allowed lighting power is 12 W/ft<sup>2</sup> of illuminated sign area. For double-faced signs, only the area of a single face shall be used to determine the allowed lighting power. For externally illuminated signs, the maximum allowed lighting power is 2.3 W/ft<sup>2</sup> of the illuminated sign area. Only areas of an externally lighted sign that are illuminated without obstruction or interference, by one or more light fixtures, shall be used. Moving forward, retailers will need to work with their signage vendors to ensure that all new signage complies with these new sign lighting power requirements.

## **ELECTRICAL POWER DISTRIBUTION**

### **Service Metering**

The following is from the new chapter of the BEES: "Each electrical service shall have metering that will allow the building Owner to get useful information for managing the use of electric power. The requirements increase as the service size increases. For smaller services the building owner must be able to manually read the energy use (kWh) meter and to reset the readout to allow for period measurements, without affecting revenue measurements. As service size increases, the meter must also allow for demand measurements so that the building owner or operator can gain a better understanding of how and when the building uses electrical power. If the building is equipped with an Energy Management and Control System (EMCS) that provides these measurements, then the manual system is not required."

### **Disaggregation of Electric Circuiting**

Above a minimum threshold that varies by load type, electrical power systems must be designed and constructed so that specific building load types can be measured. This impacts wiring only, and does not yet require sub-meters to be installed. But it does require HVAC, lighting, and receptacle loads to be separated such that they can be measured independently. This could impact the number of panels and the organization of the electrical system such that a building operator could place a meter on a specific feeder to report energy use by a certain load type. The requirement is triggered at a service size of 60 A, but the requirements become more stringent as service size goes up. For larger buildings this mandatory requirement will require separate risers for lighting, receptacles/equipment, and HVAC.

The 2016 standard added an exception for up to 10% of the connected load to be of any type.

### **Circuit Controls for 120V Receptacles**

This requirement is applicable to offices, and requires both controlled and uncontrolled 120-volt receptacles be provided in office areas, lobbies, conference rooms, kitchen areas in office spaces, and copy rooms. The controlled outlets must be clearly differentiated from the uncontrolled outlets. The controlled outlets must be automatically switched off when the space is unoccupied, either at the receptacle or circuit level. If automatic time switch control is installed, it must have an override control that allows the controlled receptacle to remain ON for no more than two-hours, and an automatic "holiday shut-OFF" feature that turns off all loads for at least 24 hours and then resumes the normally

scheduled operation. Countdown timer switches are not allowed to be used to comply with the automatic time switch control requirement. At least one controlled outlet must be installed within six (6) feet of each uncontrolled receptacle, or split-wired receptacles can be used with one controlled and one uncontrolled receptacle. Where receptacles are installed in modular furniture in open office areas, at least one controlled receptacle is required at each workstation.

## OTHER RELEVANT CHANGES

### **Solar Readiness**

The 2016 BEES addresses the requirements for Solar Zones for new non-residential buildings, and requires all nonresidential buildings with three habitable stories or fewer to be “solar ready”. The solar zone is defined as “an allocated space that is unshaded and free of obstructions.” The solar zone can be located on the roof, overhang, roof of another structure located within 250 feet of the primary building, or above covered parking installed with the building project. The solar zone must be at least 15% of the total roof area after subtracting any area of the roof that is covered by a skylight.

### **Commissioning Requirements**

The commissioning requirement that was formerly part of the CALGreen code was moved to the BEES in 2013. All non-residential buildings equal to or greater than 10,000 ft<sup>2</sup> will require full commissioning. Commissioning includes the development of Owner’s Project Requirements, Basis of Design, Design Review, Commissioning Plan, Functional Performance Testing, Documentation and Training, and the final Commissioning Report. In addition, the commissioning measures are required to be shown in the construction documents.

Commissioning has been required for all projects in California since the adoption of the CALGreen code. However, retailers who have not built in California recently may be quite surprised by the extent of the required commissioning and the associated expense. The costs of commissioning will vary depending on the size and complexity of the project. These costs can potentially be substantial, especially since field work is a required part of the commissioning process.

## CONCLUSIONS

The 2013 California Building Energy Efficiency Standards made a substantial impact on how retailers design and construct their stores, and the 2016 standard made additional adjustments, but no drastic changes. Energy codes continue to transition from life safety to sustainability. In addition to the 2016 California BEES, the International Green Construction Code (IGCC) and ASHRAE Standard 90.1 are also driving a powerful transformation as they are adopted more widely by state, county, city, and local governments.

In the coming years expect higher construction and design costs to be the norm. In the long term, these code changes will benefit retailers in the form of reduced operating and maintenance costs. However, for those who are used to the previous way of doing business, the impacts of these changes could be shocking.

We encourage our retail clients to prepare for these code changes and start planning prototype changes as soon as possible if you have not already done so.

